Aquatic Plant Management Plan

White Ash and North White Ash Lakes

White Ash Lake Protection and Rehabilitation District

DECEMBER 2017

AQUATIC PLANT MANAGEMENT PLAN
WHITE ASH AND NORTH WHITE ASH LAKES

DECEMBER 2017

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1.0 Executive Summary

The White Ash Lake Protection and Rehabilitation District (The District) was formed in 1976 to address resource management concerns on White Ash and North White Ash Lakes. The District has been active in a number of lake management activities on White Ash and North White Ash Lakes including aquatic plant management, invasive species monitoring and control, habitat improvements, boat landing monitoring and community education activities. The District contracted Flambeau Engineering, LLC. to update the aquatic plant management (APM) plan for White Ash and North White Ash Lakes. The White Ash and North White Ash Lakes APM Plan includes a review of available lake information, aquatic plant surveys, fishery assessment, water quality evaluation and an evaluation of current management techniques. The APM plan recommends specific management activities for aquatic invasive species (AIS) in the lake systems, which are discussed below.

Flambeau Engineering completed aquatic plant surveys on White Ash and North White Ash Lakes in 2016. An early season survey was completed in May on each lake to accurately assess the curly-leaf pondweed (CLP) location and density. A second set of surveys was completed in August to assess the native vegetation. CLP was widespread in North White Ash and in isolated beds in White Ash. The density and area of coverage appears to have decreased in both lakes indicating the current management is effective.

RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN

One aquatic invasive plant was observed during the aquatic plant survey in 2016; curly-leaf pondweed (*Potamogeton crispus* – CLP). This species had been previously identified within the lake and actively managed since 1976. Management of the AIS has improved recreation on both lakes and may be improving water quality on both lakes. The following Recommended Action Plan focuses on AIS control and public education.

The following Active Goals form the structure of the White Ash and North White Ash Lakes Aquatic Plant Management Plan:

Active Goal: Effectively manage CLP to improve recreation, increase recreational opportunities and rehabilitate native plants.

Active Goal: Continue harvesting of CLP and native vegetation to improve navigation.

Active Goal: Control and manage existing aquatic invasive species in and around the two lakes.

Active Goal: Determine what impact aquatic plant management has on surface water quality.

Active Goal: Protect wild rice beds on both lakes.

Active Goal: Evaluate the success or failure of the activities included in this APM Plan.

2.0 Introduction

The White Ash Lake Protection and Rehabilitation District (The District) was formed in 1976 to address resource management concerns on White Ash and North White Ash Lakes. The District has been active in a number of lake management activities on White Ash and North White Ash Lakes including aquatic plant management, invasive species monitoring and control, habitat improvements, boat landing monitoring and community education activities.

White Ash and North White Ash (North) Lakes are located in Polk County. The lakes are connected by a channel; the Apple River enters this channel and flows through White Ash Lake. See Figure 1 for the layout of the lakes. The lakes are shallow with a maximum depth of 9 feet and average depth of 5-6 feet.

The shallow lakes are very rich in nutrients and are listed as hypereutrohpic (White Ash) and eutrophic (North). The water quality has shown signs of degradation over the years reflected in the reduced secchi readings. Both lakes have nuisance stands of curly leaf pondweed (CLP) that is managed by harvesting. The North White Ash also has nuisance stands of native vegetation that is management by harvesting. The lakes offer a wide variety of recreational activities and are very accessible to the public at multiple locations.

The lakes have been actively managed by the White Ash Lake Protection and Rehabilitation District (the District) since 1976 when the district was formed. The heavy plant growth has posed problems on the lakes since this time and was documented in a 1980 WDNR Lake Study which stated the dense aquatic plant growth was interfering with the riparian owners and lake users. The results of this study and feedback from the District indicated that large-scale plant harvesting was the best option to pursue for managing CLP and the native aquatic plants. At that time the plants were harvested by a contractor and in 1985 a harvester was purchased by the District. In 1996 the District contacted WDNR to obtain funds for purchasing a new, larger harvester; at that time the District was informed it needed an Aquatic Plant Management Plan to be eligible for the funds. In 1998 a new plan was completed and approved by WDNR and the new harvester was to implement the new plan.

The District sought matching funds (**66% State and 33% District shares**) from the Wisconsin Department of Natural Resources (WDNR) Large Scale Lake Planning Grant program to update the APM Plan to recommend treatment and control of CLP and to educate the public on AIS.

This document is the APM Plan for White Ash and North White Ash Lakes and discusses the following:

- Historical aquatic plant management activities
- Stakeholder's goals and objectives
- Aquatic plant ecology
- 2016 aquatic plant survey
- Feasible aquatic plant management alternatives

- Selected suite of aquatic plant management options

Two public meetings were held to discuss the APM Plan. The first was held on May 14, 2016 to kickoff the project and explain to the attendees the purpose of the project. A component of the presentation was AIS education. Attendees were given a refresher on both plant and animal AIS identification and impacts to lake resources. A second meeting was held in August 26, 2016 to present the APM Plan and to gather public input.

3.0 Baseline Information

3.1 Lake History and Morphology

White Ash and North White Ash Lakes are located in the Town of Apple River in Polk County as shown on the attached map. The Apple River flows through White Ash Lake. The watershed of North is very small (700 acres) when compared to the large watershed of White Ash (21,000 acres) which includes the Apple River upstream of the lakes. The land use in the White Ash watershed is mostly forest and wetland with a small amount of agriculture. The watershed of North contains significantly more agriculture. The land immediately surrounding both lakes is heavily populated with homes and cabins. The fishery is classified as warm water and consists of northern pike, bass and panfish. An NHI search of the area indicated two fish species (least darter and banded killifish), two bird species (eagles and osprey) and one community (Northern Dry Mesic).

The following summarizes the lake's physical attributes:

Table 1 – White Ash and North White Ash Physical Attributes

Lake Name	**White Ash**	**North White Ash**
Lake Type	Drainage	Drainage
Surface Area (acres)	147	116
Maximum depth (feet)	9	9
Mean depth (feet)	6	5
Volume (ac-ft)	924	600
Watershed:Lake Ratio	143:1	6:1
Shoreline Length (miles)	2.53	2.11
Public Landing	Yes	Yes

Source: Wisconsin Lakes, WDNR 2005 and WDNR Lake Survey map, 1969

There is ample opportunity for public access on the lakes: White Ash has three landings, North has one landing and three public access points; both lakes may be accessed from the Apple River. The lakes offer the following recreational opportunities and extended benefits for visitors and the local community:

- Recreational, pontoon boating
- Fishing, wildlife viewing
- Non-motorized watercraft use
- Aesthetic beauty
- Important habitat for fish and wildlife
- Swimming
- Snowmobiling
- Cross country skiing/snowshoeing
- Revenue for local and surrounding communities including real estate taxes and tourism dollars

Figures 2 and 3 (included in Figures Section) illustrates the lakes bathymetry.

3.2 Water Quality

The following data was used in creating the White Ash and North White Ash Lakes APM Plan. WDNR Lake Water Quality Database indicates that the following water quality information is available:

- Water clarity (Secchi depth)
- Total phosphorus
- Chlorophyll a

These parameters are commonly used to determine water quality. Higher Secchi depth readings indicate clearer water and deeper light penetration. Total phosphorus is a measure of nutrients available for plant growth. Chlorophyll a is green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae suspended in the water column of a lake, higher chlorophyll a values indicate lower water quality.

The above parameters are used to evaluate the trophic status of a lake. The trophic state index (TSI) ranges along a scale from 0-100 and is based upon relationships between secchi depth and surface water concentrations of chlorophyll a, and total phosphorus. The higher the TSI the lower the water quality of the lake. The TSI of White Ash and North White Ash Lakes indicate eutrophic conditions. All of the water quality parameters mentioned above are further discussed in subsequent sections of this report.

3.3 Summary of Lake Fishery

Both lakes have an excellent warm water fishery according to Aaron Cole, WDNR Fishery Biologist. Surveys were completed on the lakes in 1975, 1986, 1993 and again in 2015, data is available for the 1993 and 2015 surveys for a comparison. The results indicate moderate largemouth bass catch rates with excellent size structure. Catch rates of bluegill were high in both lakes and their size structure was good. Stocking of northern pike was done in 1987 and 1993, no further stocking has been completed and is not recommended based on the excellent fishery. Results of the surveys are included in the following sections of the report.

3.4 Lake Management History

Both lakes have been actively managed since 1976 to control CLP in both lakes and nuisance native vegetation in North White Ash. The following excerpt is from the 2010 APM Plan that details the history of management.

Large-scale harvesting of CLP and later season native plants has been occurring on the lake since 1980. The WALPRD owns its own harvester and the necessary equipment to transfer and dump the vegetation removed from the lake. In 1998, an APM Plan was implemented that set the following goals:

- *improve navigation through areas containing dense plant beds,*
- *improve recreational attributes of the lakes,*
- *remove or limit the growth of current exotic plants (CLP),*
- *preserve native species and prevent introduction of additional exotic species,*

- *preserve and/or improve fish and wildlife habitat*
- *protect and/or improve quality of the resources for all to enjoy*
- *minimize disturbance of sensitive areas*
- *reduce long-term sedimentation from decaying macrophytes (Barr Eng, 1998)*

The 1998 Plan (Barr Engineering, 1998) recommended a large-scale harvesting plan for both lakes. Harvesting activity on the South Lake was originally designed to provide 20-ft wide navigation channels for lake-users living adjacent to very dense areas of plant growth. Total native vegetation removed was around 5.3 acres. Harvesting on the North Lake was to provide a 20-ft wide navigation channel around the lake and additional channels throughout the lake to facilitate fishing and boating, and to provide a swimming area for interested lake users. The total acreage to be harvested on the North Lake was around 8.7 acres.

Later, around 2002 at the request of lake users, recommendations made in the 1998 plan were modified to include harvesting of several 200-ft wide navigation/recreational channels running side to side across the North Lake and a 400-ft wide recreational channel running end to end through the middle of the North Lake. Within these areas, the harvesters could run the cutting blade at its full depth of approximately 5-ft. The navigation channel around the lake was increased from 20 to 100-ft wide providing even more relief. In addition, the channel between the two lakes was to be kept open with harvesting up to a 20-ft width.

On the South Lake, navigation channels were extended to additional areas of the lake. These channels remained 20-ft wide. Harvesting records since 2003 for the two lakes combined show an interesting trend. Both the amount of time spent harvesting and the total number of acres covered by the harvesting is increasing, but the number of loads is actually decreasing. This suggests that the harvesting has been effective at reducing the amount of vegetation in the lakes, so much so that in recent years the harvester has put in more time and has covered more acres, and still the number of annual loads harvested is going down.

In 2004, the WALPRD installed a GPS tracking unit on their harvester. This unit allows harvesting to begin earlier in the season as the harvester does not have to visually see the results of the cutting swath in order to make the next cut. The GPS identifies where the last pass ended and the new pass begins. Because of this additional information, CLP harvesting in the current plan, which begins on the South Lake, can start much earlier. At this time, the harvester not only cuts what he can see, but also that which he can't see. A couple of weeks is generally spent on the South Lake in mid to late May taking out CLP in many areas of the lake before it reaches the surface of the lake where it can cause navigation and lake use issues. Then several weeks are spent in the North Lake before coming back to the South Lake to harvest new areas of CLP growth, and to re-cut much of the previously cut area. This change in the harvesting process very likely explains the increased amount of time and total acreage covered. Since much of the CLP cut in the South Lake has not reached its peak biomass in either the first or second cutting, total loads would be down, but time and acreage up.
The WALPRD currently off-loads harvested weeds at the 163rd Street public access on the South Lake, and at the public access off of 180th Ave on the north end of the North

Lake. Harvested plants from the South Lake are dumped by agreement onto the George Sumner (currently Dan Richter) *property off 163rd Street and in a lot in the White Ash Subdivision off 168th Street. Harvested plants from the North Lake are dumped by agreement on the Fred Norlund* (currently Jim Boch and Adam Majeski) *property off 180th Ave and Hwy E. These sites have been previously approved by the WDNR, and dumping will continue.*

At the present time, no chemical treatment of CLP or native plant species later in the season is completed. Riparian owners do participate in physical removal of vegetation by hand- pulling and raking. They also spend a fair amount of time raking up harvesting escapees that wash into shore.

3.5 Goals and Objectives

The objective of this project is to update the APMP and to collect data to determine if the current management techniques are reducing CLP, increasing native vegetation in White Ash and improving the water quality and recreational use of the lakes. Many of the tasks listed in the 2010 APMP have been implemented and the data collected will be analyzed to determine if the harvesting continues to have a positive effect on the lakes. The two lakes have very different vegetation characteristics and are managed accordingly. Both have nuisance stands of CLP that cause problems with navigation, recreational use and aesthetics. White Ash has little native vegetation; after dense stands of CLP die off there is little plant growth and algae dominates. It creates conditions that inhibit plant growth due to low water clarity. North has dense stands of CLP and native vegetation that cause navigation and recreation problems throughout the year. Navigation lanes are cleared and widespread skimming is used for access and aesthetics throughout the summer season.

The District identified the following goals for aquatic plant management on White Ash and North White Ash Lakes.

Active Goal: Effectively manage CLP to improve recreation, increase recreational opportunities and rehabilitate native plants.

Active Goal: Continue harvesting of CLP and native vegetation to improve navigation.

Active Goal: Control and manage existing aquatic invasive species in and around the two lakes

Active Goal: Determine what impact aquatic plant management has on surface water quality

Active Goal: Protect wild rice beds on both lakes

Active Goal: Evaluate the success or failure of the activities included in this APM Plan

4.0 Project Methods

To accomplish the project goals, the District needs to make informed decisions regarding APM on the lake. To make informed decisions, the following is proposed:

- 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 the data needed to evaluate aquatic plant management alternatives.

4.1 Aquatic Plant Survey and Analysis

The aquatic plant community of the lakes was surveyed twice; the first on May 27, 2016 and again on August 3, 2016 by Flambeau Engineering with assistance from the District. The first survey was to document the curly-leaf pondweed (CLP) and the second was to document all vegetation in the lakes. The surveys were completed according to the point intercept sampling method described by Madsen (1999) and as outlined 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 map showing these points is Figure 4 and 5 included in the Figures Section. Latitude and longitude coordinates and sample identifications were assigned to each intercept point on the grid. Geographic coordinates were uploaded into a global positioning system (GPS) receiver. The GPS unit was then used to navigate to intercept points. At intercept points plants were collected by a specialized rake on a pole. The rake was lowered to the bottom and twisted to collect the plants. All collected plants were identified to the lowest practicable taxonomic level (e.g., typically genus and 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.

The point intercept method was used to evaluate the existing emergent, submersed, floating-leaf, and free-floating aquatic plants. If a species was not collected at a specific point, the space on the datasheet 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 sites)
- **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. SDI = 1-(Σ(Relative Frequency^2) 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.
  FQI = mean C * sqrt N
  C= coefficient of conservatism
  N= number of native species
  This formula combines the conservatism of the species present with a measure of the species richness of the site.

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 possess 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 aquatic invasive species (AIS), such as CLP, 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. Appendix C includes a discussion about aquatic plant ecology, habitat types and relationships with water quality.

5.2 Aquatic Invasive Species

Aquatic Invasive Species (AIS) are aquatic plants and animals that have been introduced by human action to a location, area, or region where they did not previously exist. 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 a decline of a lake's ecology and interfere with recreational use of a lake. Common Wisconsin AIS include:

- Eurasian Watermilfoil
- Curly-leaf Pondweed
- Zebra Mussels
- Rusty Crayfish
- Spiny Water Flea
- Purple Loosestrife
- Phragmites
- Banded and Chinese Mystery Snails

White Ash and North White Ash contain the following AIS: curly-leaf pondweed, rusty crayfish, phragmites, purple loosestrife, Chinese and Banded mystery snail. The following link on the WDNR website has detailed information on AIS in Wisconsin http://dnr.wi.gov/lakes/invasives/BySpecies.aspx. Appendix C2 provides additional information on these AIS.

5.3 2016 Aquatic Plant Survey

The full vegetation survey was completed on August 3, 2016 on both lakes. On White Ash of the 273 sites 112 were visited and vegetation was documented at 60 of these points. The remaining points were deeper than vegetation grows on this lake or the vegetation was too thick to enter (north end). On North White Ash of the 240 mapped points, 224 were sampled and vegetation was documented at 215 of these points. The remaining points could not be accessed due to thick vegetation (north and south end). The aquatic macrophyte community of both lakes included submersed, floating-leaf and emergent communities.

The following data represents the conditions of the aquatic plant community at the time of the survey conducted in 2016. The following table lists the taxa identified during the 2016 aquatic plant survey.

Table 2 - White Ash - Taxa Identified in 2016 Aquatic Plant Survey

Plant Species	Frequency of Occurrence	Relative Frequency of Occurrence	No. Sites	Rake Fullness	No. of Visual Sitings
Ceratophyllum demersum, Coontail	45.54	39.32	46	1.5	4
Elodea canadensis, Common waterweed	23.76	20.51	24	1.1	
Vallisneria americana, Wild celery	11.88	10.26	12	1.3	2
Potamogeton crispus,Curly-leaf pondweed	9.90	8.55	10	1.1	2
Najas flexilis, Slender naiad	4.95	4.27	5	1.4	
Zizania sp., Wild rice	4.95	4.27	5	2.6	
Myriophyllum sibiricum, Northern water-milfoil	3.96	3.42	4	1.5	
Potamogeton zosteriformis, Flat-stem pondweed	3.96	3.42	4	1.0	1
Lemna trisulca, Forked duckweed	1.98	1.71	2	1.0	
Nuphar variegata, Spatterdock	1.98	1.71	2	1.0	4
Potamogeton richardsonii, Clasping-leaf pondweed	1.98	1.71	2	1.5	
Nymphaea odorata, White water lily	0.99	0.85	1	2.0	1
Filamentous algae	0.99		1	1.0	

The most abundant aquatic plant identified during the aquatic plant survey was coontail, followed by common waterweed and wild celery. These three species were by far the most dominant in the lake but did not cover a large area of the overall lake. Less than 25% of the lake supports vegetation.

Vegetation was identified to a maximum depth of 8 feet (photic zone). Aquatic vegetation was detected at 59% of photic zone intercept points. A diverse plant community inhabited the lake during 2016. The Simpson Diversity Index value of the community was 0.78, taxonomic richness was 12 species (including visuals), and there was an average of 1.07 species identified at points that were within the photic zone. There was an average of 1.95 species present at points with vegetation present. The following table summarizes these overall aquatic plant community statistics.

Table 3 - White Ash - Summary of Aquatic Plant Survey Statistics

Statistic	Total
Total number of points sampled	112
Total number of sites with vegetation	60
Total number of sites shallower than maximum depth of plants	101
Frequency of occurrence at sites shallower than maximum depth of plants	59.41
Simpson Diversity Index	0.8
Maximum depth of plants (ft)	8
Number of sites sampled using rake on Rope (R)	0
Number of sites sampled using rake on Pole (P)	234
Average number of all species per site (shallower than max depth)	1.07
Average number of all species per site (veg. sites only)	1.95
Average number of native species per site (shallower than max depth)	0.97
Average number of native species per site (veg. sites only)	1.91
Species Richness	12
Species Richness (including visuals)	12

The following table lists the species found in North White Ash in 2016.

Table 4 - North White Ash - Taxa Identified in 2016 Aquatic Plant Survey

Plant Species	Frequency of Occurrence	Relative Frequency of Occurrence	No. Sites	Rake Fullness	No. of Visual Sitings
Nymphaea odorata, White water lily	0	0	0	0	3
Elodea canadensis, Common waterweed	82.33	30.57	177	1.89	1
Ceratophyllum demersum, Coontail	81.40	30.22	175	1.78	1
Potamogeton amplifolius, Large-leaf pondweed	37.21	13.82	80	1.40	
Filamentous algae	20.93	7.77	45	1.36	
Lemna trisulca, Forked duckweed	16.74	6.22	36	1.17	
Potamogeton richardsonii, Clasping-leaf pondweed	16.74	6.22	36	1.06	
Potamogeton zosteriformis, Flat-stem pondweed	15.35	5.70	33	1.00	
Vallisneria americana, Wild celery	11.16	4.15	24	1.25	
Myriophyllum sibiricum, Northern water-milfoil	1.86	0.69	4	1.00	
Lemna minor, Small duckweed	0.93	0.35	2	1.00	
Najas flexilis, Slender naiad	0.93	0.35	2	2.00	
Nitella sp., Nitella	0.93	0.35	2	1.00	
Sparganium sp., Bur-reed	0.93	0.35	2	1.00	
Utricularia vulgaris, Common bladderwort	0.93	0.35	2	1.00	
Zizania sp., Wild rice	0.93	0.35	2	1.00	
Bidens beckii, Water marigold	0.47	0.17	1	1.00	
Lemna perpusilla, Least duckweed	0.47	0.17	1	1.00	

The most common species found was common waterweed followed by coontail and large-leaf pondweed. Both common waterweed and coontail were found at over 80% of the sites with vegetation making these highly dominant in the lake. This lake is heavily vegetated with dense stands of submersed vegetation throughout the entire lake. Curly-leaf pondweed was not found on the rake at the individual sample points but it was observed throughout the lake. Later in the season CLP dies back and is not typically found during the point-intercept plant surveys although it is still present in isolated locations.

Vegetation was identified to a maximum depth of 9 feet (photic zone). Aquatic vegetation was detected at 96% of photic zone intercept points. A diverse plant community inhabited the lake during 2016. The Simpson Diversity Index value of the community was 0.78, taxonomic richness was 16 species (17 including visuals), and there was an average of 2.58 species identified at points that were within the photic zone. There was an average of 2.69 species present at points with vegetation present. The following table summarizes these overall aquatic plant community statistics.

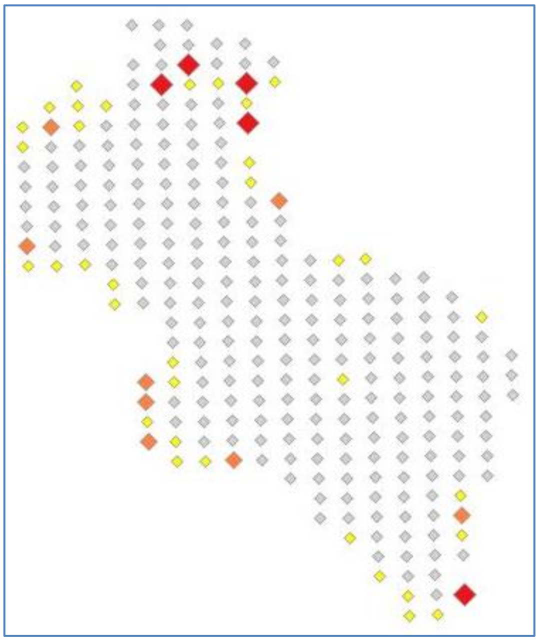
Table 5 - North White Ash -Summary of Aquatic Plant Survey Statistics

Statistic	Total
Total number of points sampled	224
Total number of sites with vegetation	215
Total number of sites shallower than maximum depth of plants	224
Frequency of occurrence at sites shallower than maximum depth of plants	96.0
Simpson Diversity Index	0.8
Maximum depth of plants (ft)	9
Number of sites sampled using rake on Rope (R)	0
Number of sites sampled using rake on Pole (P)	234
Average number of all species per site (shallower than max depth)	2.6
Average number of all species per site (veg. sites only)	2.7
Average number of native species per site (shallower than max depth)	2.6
Average number of native species per site (veg. sites only)	2.7
Species Richness	16
Species Richness (including visuals)	17

The following figures show the coverage and density of vegetation found during the 2016 surveys.

Figure 6 - Aquatic Plant Coverage and Density 2016

White Ash



North White Ash

The RED symbols indicate high density vegetation (3 rake fullness), ORANGE - medium density (2 rake fullness) and YELLOW - low density (1 rake fullness). White Ash has few stands that are very dense and the vegetation is scattered around the perimeter of the lake. North White Ash has very dense stands throughout the lake with nearly 100% coverage of the lake.

5.3.1 Floating-Leaf Plants

The following floating-leaf aquatic plant species were identified during the 2016 aquatic plant survey.

White Ash

- *Nuphar variegata* (spatterdock)
- *Nymphaea odorata* (white water lily)
- Lemna trisulca, Forked duckweed
- Vallisneria americana, Wild celery

North White Ash

- Lemna minor, Small duckweed

- Lemna perpusilla, Least duckweed
- Lemna trisulca, Forked duckweed
- Nymphaea odorata, White water lily
- Vallisneria americana, Wild celery

5.3.2 Submersed Plants

The following submersed aquatic plant species were identified during the 2016 aquatic plant survey.

White Ash

- Potamogeton crispus,Curly-leaf pondweed
- Ceratophyllum demersum, Coontail
- Elodea canadensis, Common waterweed
- Myriophyllum sibiricum, Northern water-milfoil
- Najas flexilis, Slender naiad
- Potamogeton richardsonii, Clasping-leaf pondweed
- Potamogeton zosteriformis, Flat-stem pondweed

North White Ash

- Bidens beckii, Water marigold
- Ceratophyllum demersum, Coontail
- Elodea canadensis, Common waterweed
- Myriophyllum sibiricum, Northern water-milfoil
- Najas flexilis, Slender naiad
- Nitella sp., Nitella
- Potamogeton amplifolius, Large-leaf pondweed
- Potamogeton richardsonii, Clasping-leaf pondweed
- Potamogeton zosteriformis, Flat-stem pondweed
- Utricularia vulgaris, Common bladderwort
- Filamentous algae

5.3.3 Emergent Plants

The following emergent plants were found in the 2016 surveys.

White Ash

- Zizania sp., Wild rice

North White Ash

- Sparganium sp., Bur-reed
- Zizania sp., Wild rice

5.3.4 Wild Rice

Wild rice is well established in both lakes. The south end of North White Ash, the north end of White Ash and the Apple River between the two lakes and exiting White Ash has extensive beds of wild rice. Wild rice is very beneficial to the lake ecosystem but can cause navigation problems. The following photos were taken from the GLIFWC website that show the wild rice beds on the lakes and the Apple River.

North White Ash and White Ash

Apple River exiting White Ash

Wild rice is a protected species and cannot be manually removed. Individual property owners may keep navigation lanes opens by continued travel with a motor boat.

The following text discusses the importance of wild rice. This excerpt is taken from WDNR website (http://dnr.wi.gov/topic/outdoorrecreation/activities/rice.html)

Though recognized as a prized food source for Native Americans, both historically and today, few people are aware of the importance of wild rice to many of Wisconsin's wildlife species. Capable of producing over 500 pounds of seed per acre, wild rice provides a nutrient-rich food source, offers refuge from predators and increases the overall vegetation structure on the landscape, in turn enhancing biodiversity.

Wild rice is most-often known for its importance to fall-migrating waterfowl. Mallard, blue-winged teal, ring-necked duck and wood duck consume wild rice, as do many other waterfowl species. In fact, a study conducted in wild rice country found the plant to be the most important food source for mallards during fall migration. In addition to a food source, wild rice provides several species of breeding ducks, Canada geese and trumpeter swans with a place to roost and loaf, and offers brood cover for their young. Because wild rice tends to occur in areas of gently flowing water, spring melt tends to expose these areas first, and the rice seed bank and associated invertebrate populations serve as a valuable food source for waterfowl during spring migration.

Common loons, red-necked grebes and muskrats commonly use wild rice for nesting materials. Muskrats forage heavily on the green shoots of wild rice during the spring. The presence of muskrats enhance the use of rice beds by some waterfowl species due to the small openings created amid dense cover. Additionally, muskrat houses are used as nesting sites by trumpeter swans and Canada geese, as perching sites for herons and eagles, and as sunning areas for turtles. Other species that forage on wild rice include beaver, white-tailed deer and moose.

A rich community of insects—both terrestrial and aquatic—is found among wild rice, providing a bountiful food source for blackbirds, bobolinks, rails and wrens. Wild rice is also a source of food for amphibian and fish populations, which in turn attract loons, herons and mink.

Wild rice beds exist as places of high biological diversity with numerous benefits that extend throughout the food chain. Protecting important areas where wild rice thrives will help ensure the persistence of many of Wisconsin's wildlife for all to enjoy.

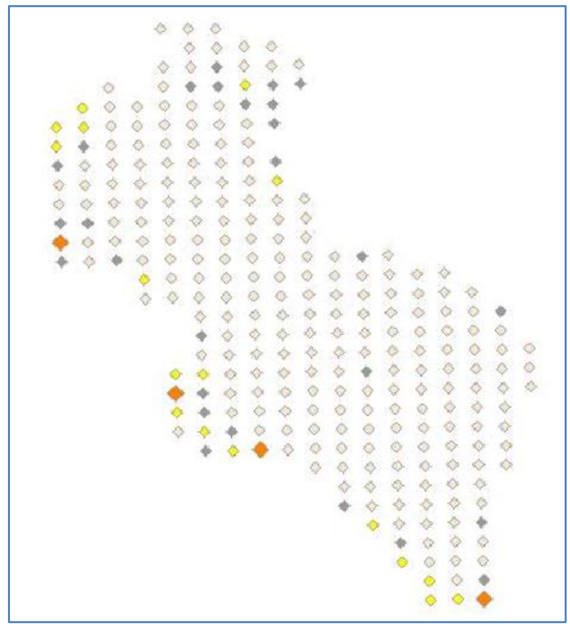
5.3.5 Curly-leaf Pondweed

CLP is an aquatic invasive species that can grow in thick beds and become a nuisance by hampering navigation, swimming and fishing. It is a submersed plant that grows in 3 to 10 feet of water and tolerates high turbidity and often invades disturbed areas. CLP begins growing very early in the spring and is one of the first plants to appear. It also dies quickly and by June or early July is not visible in the lake. If it grows in thick, large beds it can cause low dissolved oxygen when it dies due to the large influx of decaying plant material at the bottom of the lake and contributes high nutrient loading. CLP reproduces through rhizome spread and turions. Turions are hardened tips of plants, that fall to the sediment and produce a new plant in one to several years later; a single turion can lead to the production of several thousand turions in one season. To effectively control CLP it must be harvested before turion production to reduce new growth.

The CLP surveys were completed on both lakes on May 27, 2016. On White Ash Lake 105 points were visited of the 273 mapped points, CLP was documented at 21 sites with an additional 27 visual sitings. The average rake density was 1.4. The following figures show the locations of the beds and rake density.

Figure 7 White Ash - CLP Bed Locations

Location of CLP **Density of CLP**

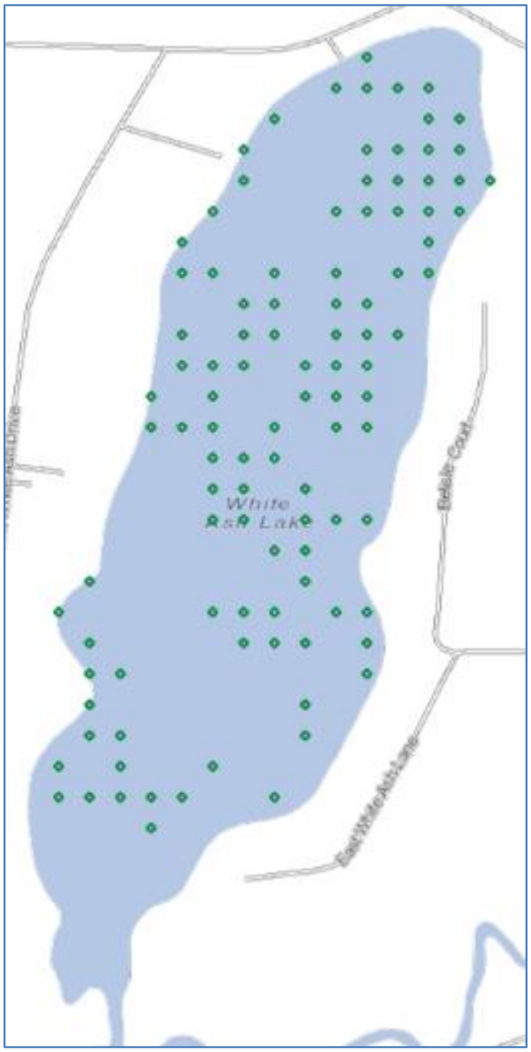


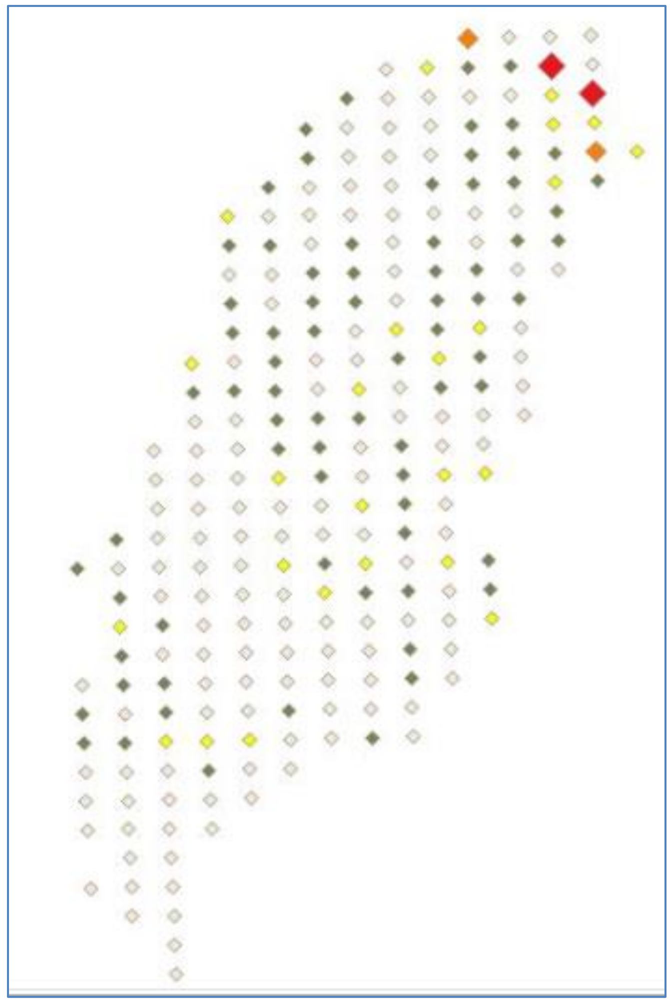
Symbols: gray – visual, yellow - low density, orange – medium density, red – high density

On North White Ash 215 points were visited of the 240 mapped points; CLP was documented at 29 sites with collected samples and an additional 75 visual sitings. The average rake density was 2.23. In North White Ash CLP was found scattered throughout the lake ranging from single plants to dense beds. The densest beds were located on the north end of the lake. The following map shows the locations of the CLP.

Figure 8 North White Ash - CLP Bed Locations

Location of CLP **Density of CLP**





Symbols: gray – visual, yellow - low density, orange – medium density, red – high density

5.3.6 Comparison of 2016 Survey to Historic Surveys

There have a been number of aquatic plant surveys completed on the two lakes beginning in 1980. Surveys in 1980 and 1997 were completed using the transect method; this is an older method that has been replaced by the point intercept method.

The results of these earlier surveys are hard to compare to the data collected in the 2016 survey. In 2008 and 2010 surveys using the point intercept method were completed. The August 2016 (full survey) data will be compared to these surveys to determine if the plant community is changing.

The following table lists the statistics of the surveys including the depth of water to which plants were found growing, number of species documented and aquatic plant density.

Table 6 - White Ash - Statistics of Surveys

Summary Stats: South White Ash Lake	2016	2010	1997	1980
# of sites visited	112	273	69	Unknown
# of sites with vegetation	60	75	69	
# sites shallower than max depth of plants	101	181	69	
Frequency of occurrence at sites < than max depth of plants	59.41	41.44	NA	NA
Simpson Diversity Index	0.8	0.92	0.91	0.91
Max depth of plants (ft)**	8	8	8.86	6.56
Number of sites sampled using rake on Rope (R)	0	0	0	0
Number of sites sampled using rake on Pole (P)	234	273	69	Unknown
Ave # of all species/site (< max depth)	1.07	1.67	NA	NA
Ave # of all species/site (veg. sites only)	1.95	4.04	7(transect)	
Ave # of native species/site (< max depth)	0.97	1.64	NA	NA
Ave # of native species/site (veg. sites only)	1.91	4	NA	NA
Species Richness	12	21	23	21
Species Richness (including visuals)	12	25	NA	NA
Median depth of plants (ft)	5	3.5	NA	NA
Ave rakeful all species (2010 1-3 Scale) (1997 1-5 Scale)	2.86	1.54	1.33	Unknown
FQI	18.39	26.4	26.4	NA

** Barr, ERS

A direct comparison to the 2010 survey indicates the areas where plants are growing may have increased based on the increased frequency of occurrence from 41 to 59. The number of species documented decreased; however, the species that were not documented in 2016 but were found in 2010 were found in very low numbers in 2010. These species may still be present but were not detected during the 2016 survey. The density of the vegetation has increased based on the average rake fullness.
The increase in vegetation in White Ash is a favorable change as a goal of the previous plan was to increase native vegetation in hopes of improving water quality.

Table 7 - North White Ash - Statistics of Surveys

Summary Stats: North White Ash Lake	2016	2010	1997	1980
# of sites visited	224	220	60	Unknown
# of sites with vegetation	215	215	60	
# sites shallower than max depth of plants	224	220	220	
Frequency of occurrence at sites < than max depth of plants	95.98	97.73	NA	NA
Simpson Diversity Index	0.8	0.84	0.88	0.86
Max depth of plants (ft)**	9	9	8.86	8.86
Number of sites sampled using rake on Pole (P)	234	220	60	Unknown
Ave # of all species/site (< max depth)	2.58	3.05	NA	NA
Ave # of all species/site (veg. sites only)	2.69	3.12	8 (transect)	
Ave # of native species/site (< max depth)	2.58	2.66	NA	NA
Ave # of native species/site (veg. sites only)	2.69	2.72	NA	NA
Species Richness	16	19	22	17
Species Richness (including visuals)	17	19	NA	NA
Median depth of plants (ft)	7	6	NA	NA
Ave rakeful all species (2010 1-3 Scale) (1997 1-5 Scale)	2.86	1.22	1.42	Unknown
FQI	23.8	22.3	25.2	NA

** Barr, ERS

The statistics on North White Ash appear to be very similar for 2010 and 2016. The only notable change is the density of plants which appears to have increased based on the average rake fullness increase.

A comparative statistical analysis of the data was completed. This indicated there were several species that had a measurable change in each lake as indicated below.

Table 8 - Change in Species Coverage 2010 to 2016

LAKE	CHANGE IN SPECIES COVERAGE 2010 TO 2016	
	INCREASE	DECREASE
WHITE ASH	Ceratophyllum demersum, Coontail	Lemna trisulca, Forked duckweed
	Vallisneria americana, Wild celery	Nymphaea odorata, White water lily
NORTH WHITE ASH	Elodea canadensis, Common waterweed	Ceratophyllum demersum, Coontail
	Potamogeton amplifolius, Large-leaf pondweed	Lemna trisulca, Forked duckweed
	Potamogeton richardsonii, Clasping-leaf pondweed	Myriophyllum sibiricum, Northern water-milfoil
	Vallisneria americana, Wild celery	Filamentous algae

In White Ash both coontail and wild celery have increased.

The vegetation in North White Ash exhibited a more notable change. Common waterweed, large-leaf pondweed, clasping leaf pondweed and wild celery have increased. This reflects the anecdotal evidence provided by the lake shore residents. The increase in wild celery has caused concern to the residents as it impedes navigation in some areas of the lake. The wild celery is uprooted by the paddle wheels on the harvester; it then forms floating mats that impede navigation. Skimming after August 1 in the southern part of the lake where wild celery is present may reduce/eliminate this problem.

5.4 CLP Comparison

The main goal of the harvesting plan is to reduce CLP. In 2010 early harvesting of CLP was recommended to remove the plants before turions are produced. In time this method will in theory reduce the turions present in the sediment and decrease overall CLP growth. Based on the aquatic plant survey data the coverage and density of CLP has been reduced in both lakes.

The following data compares CLP coverage for the years 1997, 2010 and 2016.

Table 9 - CLP Comparison 1997, 2010, 2016

	2016 Coverage			2010 Coverage			1997 Coverage		
Lake	# of points	% of Lake	Estimated Total Lake Acreage	# of points	% of Lake	Estimated Total Lake Acreage	# of points	% of Sampled Littoral Zone	Estimated Total Lake Acreage
White Ash	21 of 273	14	20.7	144 of 273	52.7	80.7	50 of 69	72.5	75
North White Ash	29 of 240	38	44.3	98 of 240	40.8	48.6	34 of 60	56.7	57

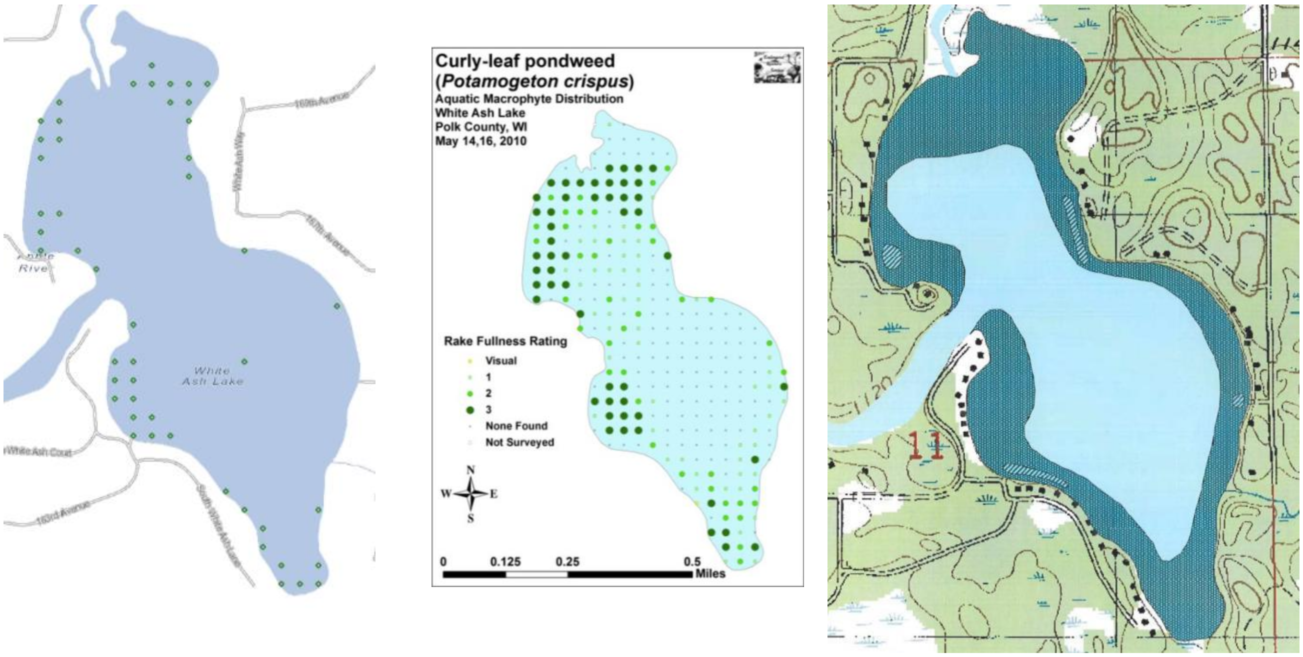
Based on the numbers in the above table the CLP in White Ash has decreased greatly. The coverage declined from 144 to 21 points and the area decreased from 53% to 14%.

North White Ash did not show a significant decrease in CLP coverage. The number of sites with documented CLP decreased from 98 to 29 but the acreage remained about the same. The acreage in 2016 was calculated using both the documented CLP and the visual sitings which gives a more accurate coverage area. Based on the above numbers it appears the density of CLP had decreased but the area it covers in the lake remains about the same.

The following maps shows the location of CLP in the 2016, 2010 and 1997 surveys respectively.

Figures 9 White Ash CLP Comparison

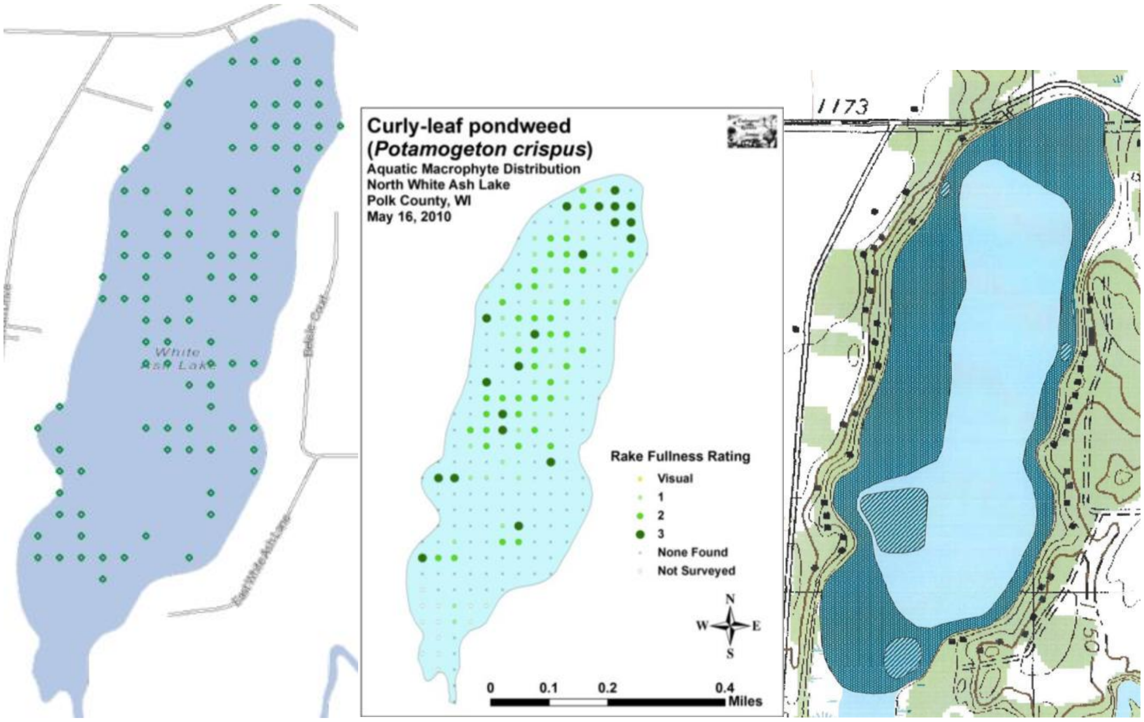
2016 **2010** **1998**



As shown above the most notable areas are in the north and south bays; the coverage and density of CLP has greatly decreased in these areas.

Figures 10 North White Ash CLP Comparison

2016 **2010** **1998**



As discussed above the area where CLP is found in North White Ash is about the same but the density has decreased indicating the harvesting program is effective.

5.5 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 2016 aquatic plant survey data was 18.39 for White Ash and 23.8 for North White Ash.

This FQI values are lower than Wisconsin's northern region mean of 24.3 and suggests that White Ash and North White Ash Lakes have a higher level of disturbance when using aquatic plants as an indicator. The FQI in White Ash decreased due to the rare species not being found in 2016. The FQI in North White Ash has stayed relatively steady over the years. The extensive harvesting on North White Ash does not appear to have negatively impacted the FQI.

5.6 Water Quality

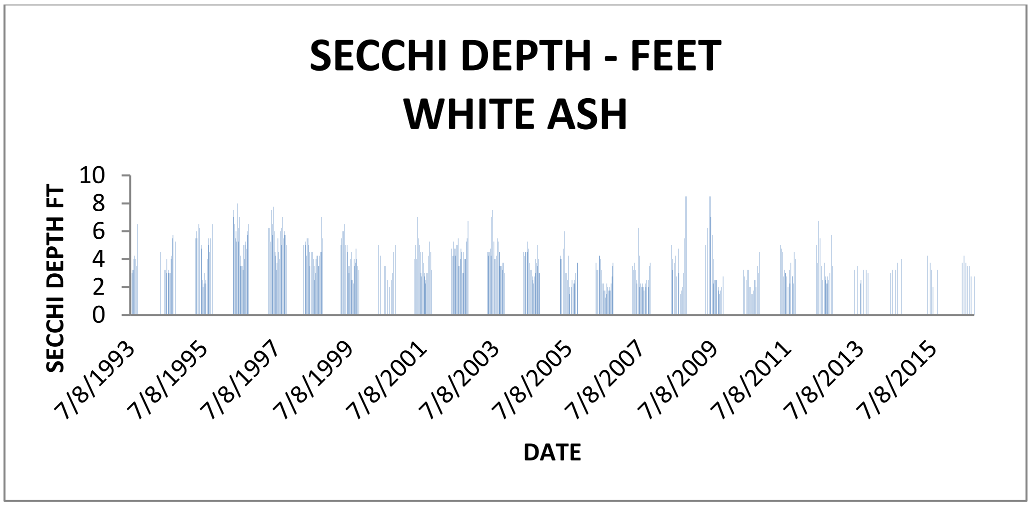
The water quality of the lake indicates eutrophic conditions with high nutrient levels, low water clarity and high productivity of aquatic plants and fish in both lakes. Both lakes remain in the eutrophic category but there were trends noticed in some of the water quality parameters. These are discussed below.

5.6.1 Water Clarity

The historical water clarity average based on Secchi Disk readings in White Ash is 3.9 feet and ranges from 1.25 to 8.5 feet indicating very poor to poor water clarity and eutrophic conditions. The Northeast Wisconsin average Secchi Disk reading in 2004 was 7.4 feet (WI Citizen Lake Monitoring Training Manual). The low water clarity may be in part due to the algae blooms that frequent this lake.

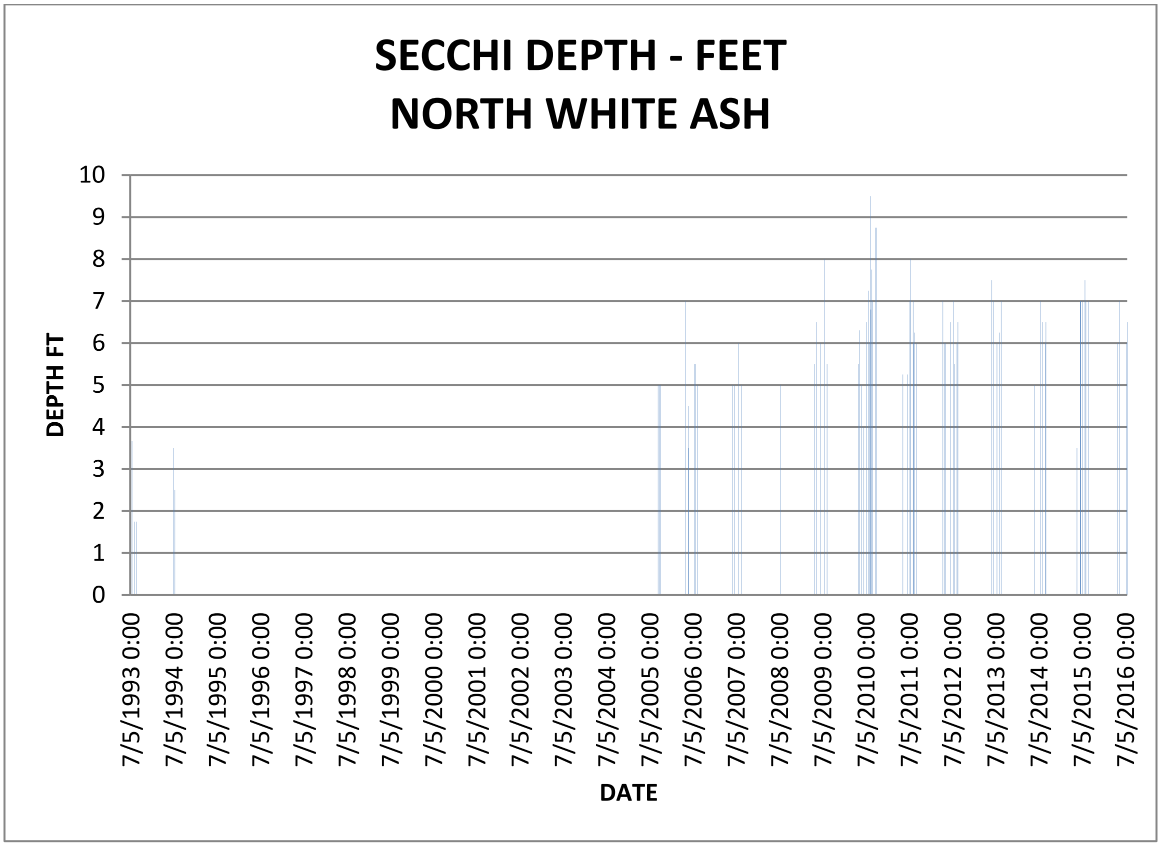
In North White Ash the average clarity is 6 feet, ranging from 1.75 to 9.5 feet indicating poor to fair water quality and mesotrophic conditions. The following graph illustrates the historical water clarity measurements on White Ash and North White Ash Lakes.

Figure 11 - White Ash - Secchi Depth



When the annual averages are graphed a trend of decreasing clarity can be seen on White Ash. In the late 1990’s the annual average was about 5.5 feet; since 2010 the annual average has been about 3.5 feet.

Figure 12 - North White Ash - Secchi Depth



The clarity on North White Ash has increased since the early 1990's from an annual average of 2.8 ft to 6.5 feet since 2010.

5.6.2 Total Phosphorus and Chlorophyll *a*

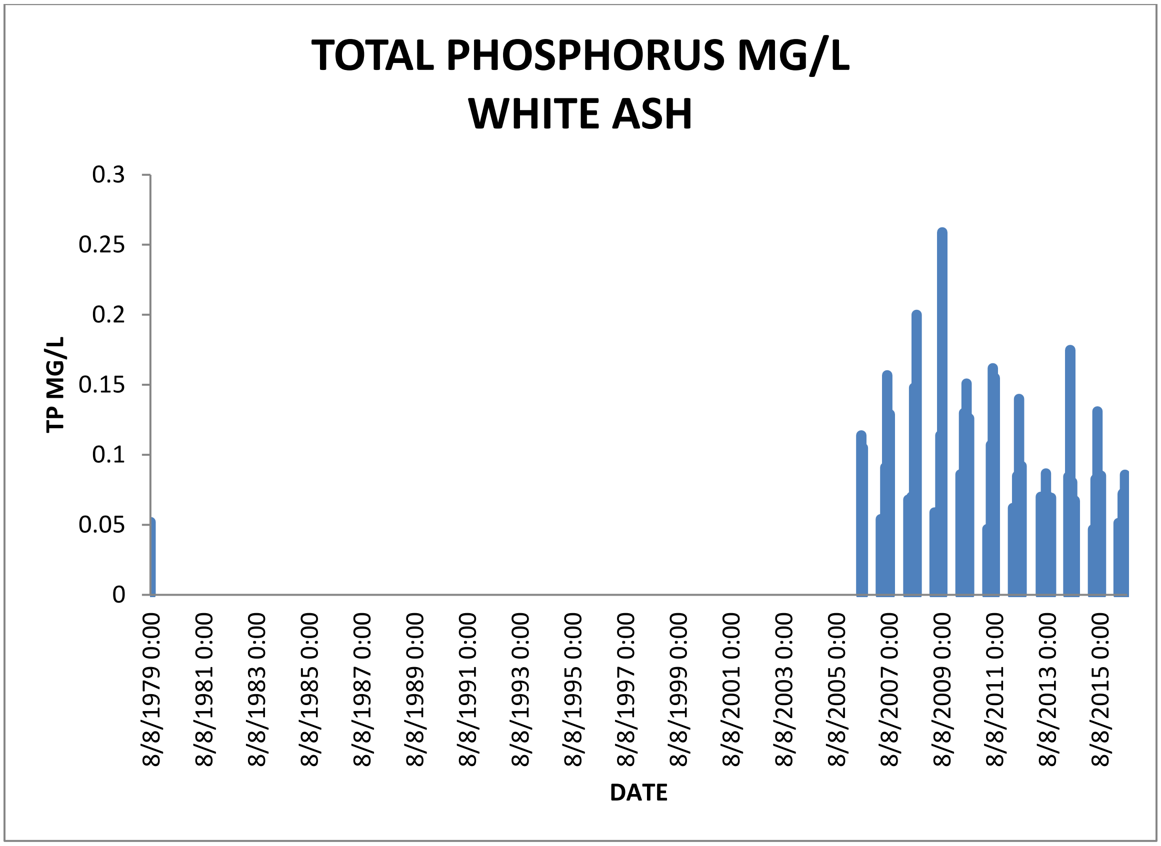
Total phosphorous (TP) and chlorophyll a are parameters that are frequently used to determine water quality in lakes. Following is an explanation of each.

Total Phosphorus (TP) - a measure of nutrients available for plant growth and high concentrations can promote excessive plant growth. In more than 80% of Wisconsin lakes phosphorous is the key nutrient affecting the amount of algae and plant growth. Phosphorous comes from a variety of sources, many of which are human related and include animal and human waste, soil erosion, detergents, septic systems and runoff from agricultural land and lawns. On lakes with high development in the near shore area fertilization of lawns and failing septic systems can contribute high amounts of phosphorous to the water.

Chlorophyll a - is green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae suspended in the water column of a lake. Chlorophyll a is used as a common indicator of water quality; higher chlorophyll a values indicate lower water quality.

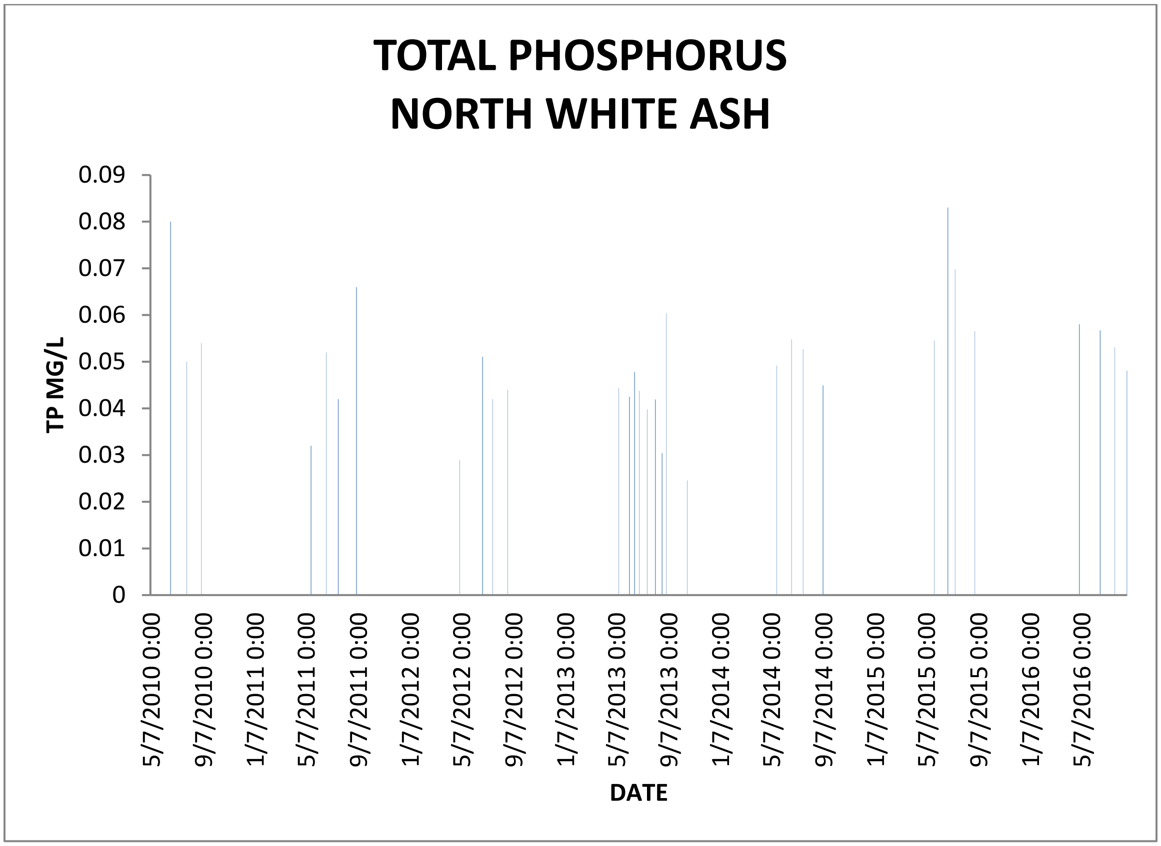
Following is a discussion of the total phosphorous and chlorophyll a concentrations in the lakes over the years of data. Historically, White Ash has had an average phosphorus reading of 100 micrograms per liter (ug/l - parts per billion). The total phosphorus has varied from 47 ug/l to 259 ug/l indicating poor water quality and eutrophic conditions. North White Ash has had an average phosphorus reading of 50 ug/l. The total phosphorus has varied from 25 ug/l to 83 ug/l indicating fair water quality and eutrophic conditions. The following graphs illustrate the historical phosphorus measurements on the lakes.

Figure 13 - White Ash – Total Phosphorous



The graph indicates the TP has been decreasing in recent years.

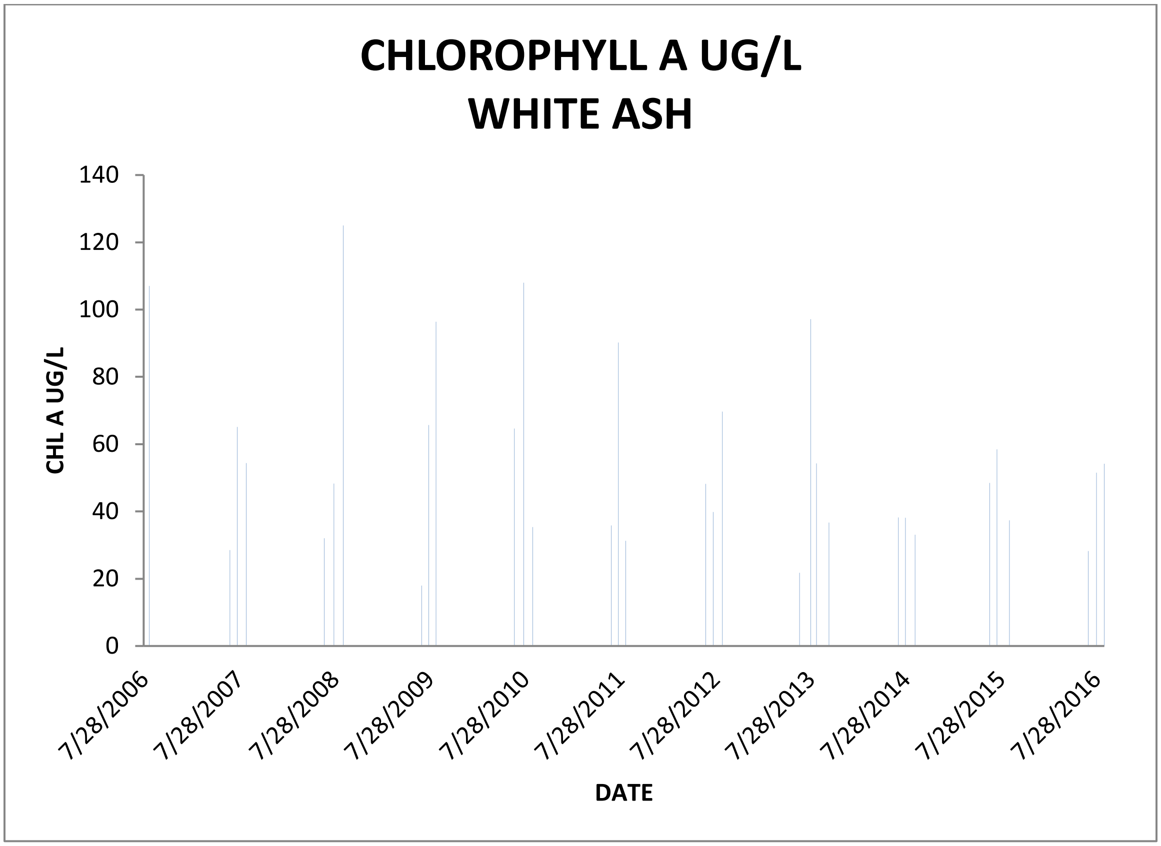
Figure 14 - North White Ash – Total Phosphorous



The TP in North White Ash has remained relativley steady.

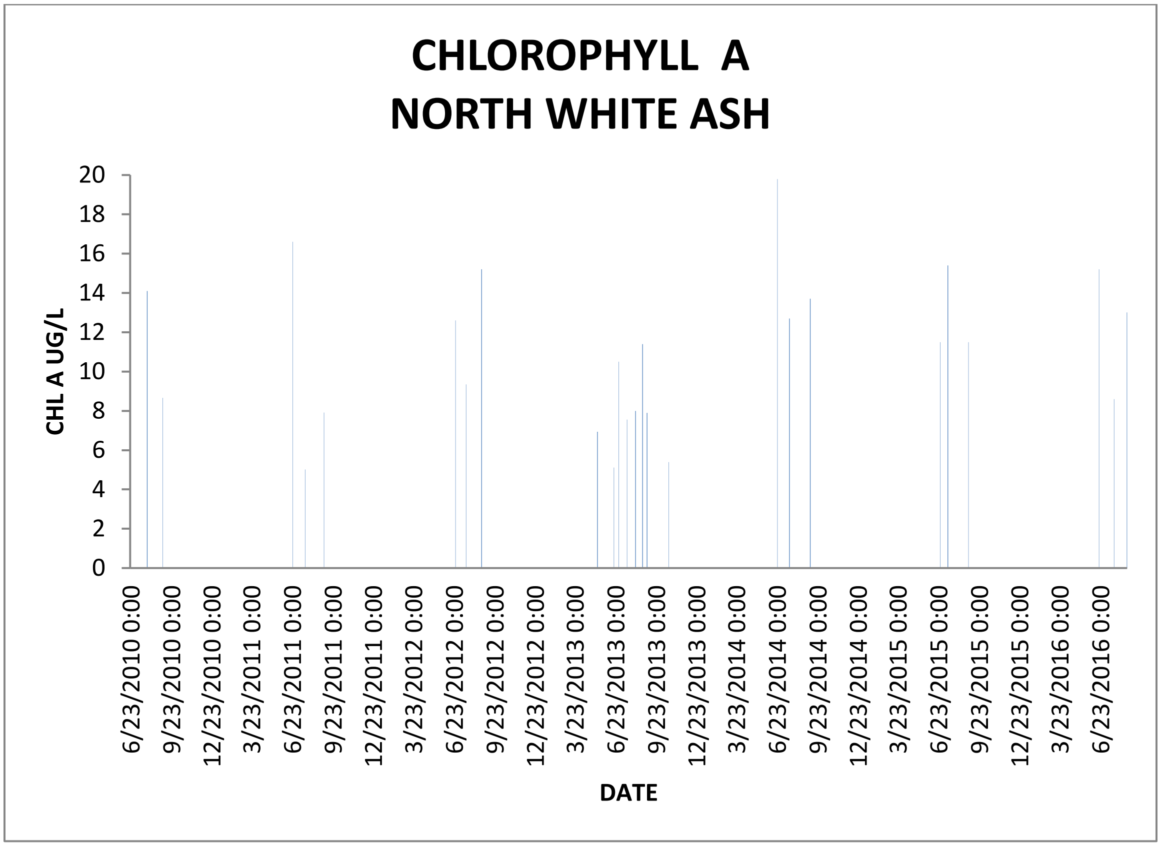
The chlorophyll *a* concentration in White Ash has an average of 55.3 ug/l indicating very poor water quality and eutrophic conditions. The average for Northwest WI lakes is 13 ug/l, values over 30 ug/l indicate very poor water quality. Data ranged from 18 ug/l to 125 ug/l. Chlorophyll a concentrations in North White Ash average 11.5 ug/l indicating eutrophic conditions. Data ranged from 5 ug/l to 26.2 ug/l. The following graphs show the Chlorophyll a concentrations for White Ash and North White Ash lakes.

Figure 15 - White Ash– Chlorophyll a



When the average annual values are graphed it is readily seen that the chl is decreasing in White Ash from about 70 ug/l prior to 2010 to about 50 ug/l in the last couple years. The decrease in chl a should have resulted in fewer algae blooms in the last several years.

Figure 16 - North White Ash– Chlorophyll a



The chl a on North White Ash has stayed relatively steady since 2010.

<u>Water Quality Summary</u>

The two lakes are very different systems based on water quality. White Ash is hyper eutrophic and North White Ash is on the lower end of the scale bordering on mesotrophic. The watershed of White Ash is very large and includes the area drained by the Apple River. This contributes to the high loading of nutrients and the eutrophic conditions of the lake. North White Ash has a very small watershed when compared to White Ash; this attributes to better water quality. The thick vegetation in North White Ash attributes to lower chl a concentrations since the plants take this up to use for growth. The harvesting of the thick vegetation helps to remove all of the nutrients that are stored in the plants so in the fall when the plants die the nutrients are not released back into the water column of sediment.

One of the goals of the 2010 plan was to improve water quality of White Ash and to protect the native vegetation in hopes it would aid in the improvement. The average annual values of Secchi, TP and Chl A were plotted for White Ash to determine if there were any trends in the data. The plots showed a decrease in Secchi depth from 1994 to 2015; indicating a decrease in water clarity. The average dropped from 5 feet in the early 1990's to 3.5 feet in 2015. TP was variable and a clear trend was not visible. Chl A also trended down with an average of 84 in 2006 to 44 in 2016; indicating increased water quality. This data shows mixed results; continued water quality sampling is highly recommended to collect data for future comparison. It appears that water quality is improving on White Ash but further data is needed.

5.6.3 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.

Figure 17 - TSI Description

Category	TSI	Lake Characteristics	Total P *(ug/l)*	Chlorophyll a *(ug/l)*	Water Clarity *(feet)*
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.	< 12	<2.6	>13
Mesotrophic	41-50	Moderately clear; increasing probability of low to no oxygen in bottom waters.	12 to 24	2.6 to 7.3	13 to 6.5
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.	> 24	>7	<6.5
White Ash	**66**	**EUTROPHIC**	**100**	**55.3**	**3.9**
North White Ash	**56**	**EUTROPHIC**	**50**	**11.5**	**6.0**

Adopted from Carlson 1977, Lillie and Mason, 1983, and Shaw 1994 et. al.

The data indicates that both lakes are eutrophic.

6.0 Management Alternatives and Recommendations

Based on the goals of the stakeholders as mentioned in section 3.6, several management alternatives are available for this APM plan. Some general alternatives are discussed below. More information on management alternatives is included in Appendix E. Currently, the Northern Region of the WDNR is working under an aquatic plant management strategy that is officially titiled Aquatic Plant Management Strategy, Northern Region WDNR, Summer, 2007 (working draft), or commonly referred to the NOR Region APM Strategy (Appendix H). This strategy lays out an approach for acceptable aquatic plant management in Northern Region lakes. The strategy protects native aquatic plant communities in northern Wisconsin and does not allow permits to control native plants unless documented circumstances of nuisance levels exist. The following management alternatives are based on the approaches described in the NOR Region APM Strategy, and incorporate recommendations of Flambeau Engineering.

6.1 Aquatic Plant Maintenance Alternatives

The maintenance alternative may be used at a lake in which a healthy aquatic plant community exists and invasive and non-native plant species are generally not present. The maintenance alternative is a protection-oriented management alternative because no significant plant problems exist or no active manipulation is required. This alternative can include an educational plan to inform lake shore owners of the value of a natural shoreline and encourage the protection of the lake water quality and the native aquatic plant community. **This is the management that is recommeded for the areas in White Ash that do not contain CLP**. The goal of the previous APM Plan and this current plan is to protect and improve the native vegetation in White Ash Lake. This will create more habitat for fish and wildlife and help to improve water quality. Based on a comparison of survey statistics from 2010 to 2016 it appears that both coverage and density of native vegatation has increased on White Ash. The frequency of occurrence increased along with the density (rakefullness) of native vegetation.

The folloiwng subsets are recommended for both lakes.

6.1.1 Aquatic Invasive Species Monitoring

Several AIS are present in the lakes; Chinese mystery snail, purple loosestrife and curly-leaf pondweed are present in both lakes. Banded mystery snail is present in North White Ash and a rusty crayfish was found in White Ash. In order to monitor existing spread of current AIS and for new AIS in the future a strong Citizen Lake Monitoring program that surveys for AIS is highly recommended. In some lake systems, native aquatic plants "hold their own" and AIS never grow to nuisance levels, in others however, vigilant and active management is required. This can be based on several things including water quality. White Ash and North White Ash Lakes residents should continue Citizen Lake Monitors for AIS.

The University of Wisconsin-Extension Lake's Program provides training and coordinates the Citizen Lake Monitoring Program. More information about the program is available by contacting Laura Herman, Citizen Lake Monitoring Network Education Specialist, (715) 346-3989, email: lherman@uwsp.edu, website: http://www.uwsp.edu/cnr/uwexlakes/clmn/.

Completing pre and post aquatic plant monitoring in any areas that are actively managed to evaluate management effectiveness is recommended. The protocol for these surveys was created by WDNR and must be followed if the management activities are grant funded. The protocol should be followed even if grant funds are not involved to assess management effectiveness. In general lake-wide aquatic plant surveys are recommended every 5 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.

6.1.2 Clean Boats/Clean Waters Campaign

Measures for the prevention of the introduction of new AIS to the lake and containment of existing AIS should be a priority. To prevent the spread of CLP and other AIS out of and other AIS into White Ash and North White Ash Lakes, a monitoring program such as Clean Boats/Clean Waters (CBCW) is an excellent choice. This program is carried out by trained volunteers who inspect the incoming boats at public launches. Signage also accompanies the use of CB/CW to inform lake users of proper identification of AIS and boat inspection procedures. Education of the public, along with private property owners, about inspecting watercraft for AIS before launching a boat or leaving access sites on other lakes could help prevent new AIS infestations. Contact with lake users at this time is a great way to distribute other educational materials. Lake residents participate in the Clean Boats/Clean Waters program. Continuation of this program is recommended and should be promoted by the CB/CW coordinator on the lakes. The busiest landings should be monitored during weekends and holidays to interact with the most lake users. Additional District members should be trained so there are plenty of people to staff the landings. More information and training schedule can be found at http://dnr.wi.gov/lakes/cbcw/.

6.1.3 Aquatic Plant Protection and Shoreline Management

Protection of the native aquatic plant community is needed to slow the spread of EWM, CLP and other AIS from lake to lake and within a lake once established. Therefore, riparian landowners should refrain from removing native vegetation. Additionally, EWM and CLP 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. Properties with seawalls, manicured lawn to waters edge and active erosion would be good candidates for shoreland restorations. 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, erosion prevention and it may deter geese from entering. A vegetated buffer area can also prevent surface water runoff from roads, parking areas and lawns from carrying nutrients to the lake.

The second easy nutrient prevention effort is to use lawn fertilizers only when a soil test shows a lack of nutrients. A relatively new Wisconsin law prohibits the application of turf fertilizer containing phosphorus except in certain circumstances. Phosphorous containing fertilizer may be used when planting a new lawn or when a soil test indicates the soil is low in phosphorous. Fertilizer may not be applied to impervious surfaces or frozen ground under the new law. More information can be found in Wisconsin Statute 94.643. The fertilizers that were 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. Local retailers and lawn care companies can provide soil test kits to determine a lawn's nutrient needs. Of course, properties with an intact natural buffer require very little maintenance, and no fertilizers.

Another possible source of nutrients to a lake is the septic systems surrounding the lake. Septic systems should be properly installed and maintained in order to prevent improperly treated wastewater, which carries substantial nutrients, from reaching the lake. Property owners who are not sure if their septic system is adding nutrients to the lake should contact a professional inspector and have their system assessed.

6.1.4 Public Education and Involvement

The DISTRICT should continue to keep abreast of current AIS issues throughout the County. The County Land Conservation Department and the WDNR Lakes Coordinator, and the UW Extension are good sources of information. Many important materials can be ordered at the following website:

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

Appendix G includes resources for further information about public education opportunities.

6.2 Aquatic Plant Manipulation Alternatives

This management alternative may be used when aquatic plants present some sort of problem that must be dealt with or manipulated by human action. **This is the recommended action for CLP in North White Ash and for the nuisance native vegetation and CLP in North White Ash.**

6.2.1 Harvesting

Harvesting is the current method of management for both CLP and native plants on North White Ash and CLP management on White Ash. Plants are "mowed" at depths of 2-5 ft, collected with a conveyor and off-loaded onto a transport and taken to the disposal site. Using this method, the CLP is harvested before the turions are produced, which in theory will reduce the density. Harvesting can be used to target specific beds of CLP as is the case in

White Ash and leave the native vegetation undisturbed. It can also be used on the entire lake as it is in North White Ash to remove CLP and the nuisance native vegetation. The widespread harvesting in North White Ash reduces the nutrient load in the lake by removing large amounts of vegetation. Continuing the current harvesting management plan is recommended for both White Ash and North White Ash. A detailed harvesting schedule and map are included in Section 7 below.

6.2.2 Manual Removal

This method may be used by individual property owners if vegetation is causing issues near the shoreline. This is a good alternative in the shallow area less than 3 feet deep where the harvester is not allowed.

Manual removal consists of physically removing plants using bodily force and hand tools. Manual removal efforts include hand raking, hand cutting and hand pulling unwanted plants. This method is most effective when plants are pulled or cut as near the sediment as possible and all plant material is removed from the lake. Manual removal of aquatic plants can be quite labor intensive and time consuming. This technique is well suited for small areas in shallow water where property owners can weed the aquatic garden. Hiring laborers to remove aquatic vegetation is an option, but also increases cost. Scuba divers can be contracted to remove unwanted vegetation in deeper areas. Benefits of manual removal by property owners include low cost compared to chemical control methods, quick containment of pioneering (new) populations of invasive aquatic plants, and the ability for a property owner to slowly and consistently work on active management. The drawback of this alternative is that pulling aquatic plants include the challenge of working in the water, especially deep water, the threat of letting fragments escape and colonize a new area, and the fact that control of any significant sized population is quite labor intensive. Again, hiring laborers to remove aquatic vegetation is an option, but also increases cost.

Curly-leaf Pondweed

No permit is required to remove non-native invasive aquatic vegetation, as long as the removal is conducted completely by hand with no mechanical assistance of any kind. All aquatic plant material must be removed from the water to minimize dispersion and re-germination of unwanted aquatic plants. Portions of the roots may remain in the sediments, so removal may need to be repeated periodically throughout the growing season.
CLP should be targeted for removal in the spring or early summer (May/June) before turion production begins. CLP plants should be removed as close to the sediment as possible. When using a rake or weed cutter be sure the head is near the lake bottom. If hand-pulling use even pressure to try and pull up the entire plant and in shallow water pull as close to the lake bottom as possible.

Native Vegetation

Native plants may be found at nuisance levels that inhibit navigation and recreational use in certain areas in the lake. Manual removal of these plants is allowed at individual properties. (**except wild rice in the northern region**), under Wisconsin law, to a maximum width of 30 feet (recreational zone). The intent is to provide pier, boatlift or swimming raft access in the recreation zone. A permit is not required for hand pulling or raking if the site is **not located in a Sensitive Area** and maximum width cleared does not exceed the 30-foot recreation zone (manual removal of any 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, see Appendix F). If the site of manual removal is located in a Sensitive Area a permit is required. Manual removal is **cautioned** because it could open a niche for non-native invasive aquatic plants to occupy. If a proposed management area is near a stand of CLP removal of native vegetation is **not recommended**. CLP is known for invading disturbed areas where native plants have been removed. Removal of native plants also destroys habitat for fish and wildlife.

Limited manual removal of native vegetation is recommended for individual property owners where nuisance conditions occur. The area of removal should be kept to a minimum and a width of less than 30 feet is recommended. A navigation lane just wide enough for watercraft used is recommended. If lanes for fishing from the dock are required an area a few feet wide could be cleared to provide casting opportunities.

6.2.3 Additional Options

The following subsets are options that may be considered but are not recommended at this time. The harvesting program is effective on managing the CLP and nuisance native vegetation. It is the most economical as the District already owns a harvester and has a program in place.

Aquatic Invasive Plant Species Chemical Herbicide Treatment

A chemical herbicide treatment may be an appropriate way to treat large areas of AIS to conduct restoration of native plants. Chemical treatments on small, isolated beds of AIS are generally not very effective. In order for herbicides to be effective concentration and contact time need to be maintained; this is difficult to achieve when treating small stands in moving water (such as a flowage). Herbicides are generally not recommended for use in Sensitive Areas; these are areas designated by WDNR that have vegetation offering critical or unique fish and wildlife habitat to the lake. Herbicide application permits may be denied by WDNR if they are for a Sensitive Area. The applicant must demonstrate that the herbicide treatment will not alter the ecological character or reduce ecological value of the area. **Chemical treatment is not recommended at this time for either lake**. White Ash has scattered beds of CLP that make it difficult to effectively treat and North White Ash would require a whole lake treatment that would be costly and difficult to obtain a permit due to wild rice. The current harvesting program appears to be effective at controlling CLP and the native nuisance vegetation. The aspects of chemical treatment are discussed below for informational purposes.

When using chemicals to control AIS it is a good idea to reevaluate the lake and the extent of the AIS conditions before, during and after chemical treatment. The WDNR may require another whole-lake plant survey and will certainly require a proposed treatment area survey. Along with the above mentioned survey, pre and post treatment monitoring should be included for all aquatic plant treatments and is typically a WDNR requirement in their Northern Region.

The science regarding what chemicals are most effective and how they can be used is constantly being updated. Recent studies have shown good to excellent control of CLP using formulations of diquat (Reward) and endothall (Aquathol K). These treatments are effective but only give control in the year applied. Some studies have shown endothall applied early in spring can control CLP and stop turion production. This experimental study has shown control using Aquathol K in 60 degree (F) water early in CLP lifecycle can prevent turion formation.

Chemical treatment is usually a long term commitment and requires a specific plan with a goal set for "tolerable" levels of the relevant AIS. One such landmark might be 10% or less of the littoral area being occupied by aquatic invasive plants. At this time the CLP beds are far less than 10% of the littoral area. WDNR recommends conducting a whole-lake point-intercept survey on a five year cycle. Such a survey may reveal new AIS and at the very least would provide good trend data to see how the aquatic plant community is evolving.

<u>Native Vegetation Management Chemical Herbicide Treatment</u>
Native vegetation is generally not managed in Wisconsin waters. In the case of North White Ash Lakes native vegetation has become so thick in many areas of the lake that it has reached nuisance levels by severely limiting navigation and recreational use. In order for herbicide to be effective a whole lake treatment would be needed to control the nuisance native vegetation and the CLP. This would be an expensive option and would provide short term relief at best. It is difficult to impossible to predict the effectiveness of chemical treatments on lakes and the vegetation will return after an unknown period of time. It would also be very hard to obtain a permit for a whole lake treatment due to the wild rice beds in the lake.

At this time the harvesting program is proven effective and chemical herbicide treatment is not recommended.

7.0 Conclusion and Recommended Action Plan

One aquatic invasive plant was found during the aquatic plant survey in 2016; curly-leaf pondweed, *Potamogeton crispus* (CLP). This species has been previously identified within the lake and has been actively monitored and managed since 1976. The harvesting plan that has been followed since 2010 is effectively managing the CLP in both lakes. It is also managing the native vegetation in North White Ash to provide open water for recreation. This harvesting plan has been modified to meet the current needs of the lakes and is presented below along with other Active Goals to improve the lakes.

7.1 Recommended Active Goals

The recommended action plan includes actions for White Ash and North White Ash Lakes based on the Maintenance Alternative and Aquatic Plant Manipulation Alternative listed above in Section 6. **The goals listed below are meant to be a guideline used to manage the lakes; these goals should to be evaluated and revised as needed to fit the changing needs of the lakes.** Lakes are dynamic systems and flexibility is needed when managing them; **the dates and timelines listed below are guidelines and may change based on conditions**. The District board has approved the following active goals. It will be up to residents of White Ash and North White Ash Lakes and the District to determine the actions, find the funding, and gather the individuals needed to implement the active goals.

Goal One: Continue CLP harvesting program

Objective One: Follow the harvesting schedule below to remove CLP in the lake system and minimize disturbance caused by the harvesting program. Harvest CLP early in the season to remove turions from the system and decrease overall CLP growth.

Action 1: Begin harvesting approximately the 3rd week of May in White Ash Lake (approx 5 days)

- Harvest only those areas with CLP growth visible at or near the surface. See Map 1.

Action 2: Approximately the last week of May, first week of June begin harvesting in North White Ash Lake (approx 20 days)

- Harvest those areas with CLP growth. See Map 2.

Action 3: Begin second harvest approximately second or third week of June in White Ash Lake (approx 5 days)

- Harvest all remaining CLP. See Map 1.

Action 4: Begin second harvest approximately the last week of June on North White Ash Lake (approx of 10 days)

- Harvest all remaining CLP. See Map 2.

Goal Two: Continue Harvesting to Improve Navigation and Recreation

Objective One: Continue harvesting of navigation channels in White Ash and North White Ash Lakes to provide for navigation and recreational use areas in both lakes.

Action 1: White Ash – Limit late season plant harvesting to provide only a 50-ft navigation channel around the periphery of the lake. See Map 3.

Action 2: North White Ash - Continue large-scale harvesting in designated navigational channels and recreational corridors.

- Begin harvesting native plant navigation channels around the periphery of lake; last week of June. See Map 4.
- A navigation channel of 100 ft wide will be maintained around the periphery of the lake for the season.
- A recreational use area of 360 ft wide by 3200 ft long will be maintained in the center of the lake for the season.

Action 3: North White Ash - Allow for surface skimming with harvester outside the designated navigational channels and recreational corridors.

- The area inside of the periphery navigation channel may be skimmed.
- Surface skimming is defined as harvesting to a depth of 18 to 36 inches below the water surface.
- Pick-up of matted vegetation or algae on the surface.
- Must remain outside previously designated sensitive areas.
- Skimming is not allowed in 3-ft of water or less.
- After August 1, skim southern part of the lake where wild celery is present.

Action 4: Maintain navigation between the two lakes.

- Maintain a 20-ft wide open navigation channel running south from North White Ash into the Apple River corridor. See Map 4.
- Maintain the Apple River corridor at 20-ft wide from where the Apple River enters White Ash to the open water on White Ash. See Map 3.
- It may be necessary to begin harvesting this channel in June as growth of wild rice could quickly fill in this channel.
- Maintain a 20-ft wide navigation channel on Apple River downstream of White Ash. Due to safety reasons, this may only be harvested during very low flows.

General Conditions:

- Navigation channels will be established and included in any permit applications each year, regardless of plant density to keep the option of harvesting if necessary open

- Position of navigation channels will vary with lake level, but will generally follow the 3-ft depth contour around the lake
- Harvesting is not allowed in 3-ft of water or less
- Cutting heads may be operated no deeper than 12 inches off the bottom

Goal Three: Control and manage existing aquatic invasive species in and around the two lakes

Objective One: Encourage physical removal of CLP and other aquatic plants according to NR 109 guidelines by land owners in waters 3-ft deep or less

- Does not include wild rice
- Must be in compliance with NR 109 physical removal guidelines

Objective Two: Monitor purple loosestrife and manage as needed. Actions may include:

- Beetle rearing stations
- Work with landowners to identify and train to physically remove pioneering or isolated purple loosestrife plants

Objective Three: Monitor giant reed grass and manage as needed. Actions may include:

- Monitor the spread of giant reed grass annually using GPS technology
- Chemically treat giant reed grass on an annual

Objective Four: Monitoring for Eurasian Water Milfoil

Action 1: implement early response and detection activities

Objective Five: Prevent the introduction of new AIS into the White Ash Lakes system

Action 1: Continue a Watercraft inspection program on both lakes

- Target busy times such as holidays and other high traffic days on the public landings on White Ash and North White Ash.

Action 2: Continue an AIS In-lake monitoring program

- Complete in-lake monitoring of AIS in both lakes following Citizen Lake Monitoring Network AIS monitoring protocols
- A successful AIS program will mean no new AIS in the White Ash Lakes, or at a minimum, an early detection of something new.

Objective Six: Complete AIS education aimed at riparian owners and other lake users

Action 1: Maintain AIS signage at all public accesses including illegal to launch and illegal to transport signage

Action 2: Provide AIS training in identification and monitoring for all interested parties on both lakes

Goal Four: Determine what impact aquatic plant management has on surface water quality

Objective One: Continue to support Citizen Lake Monitoring Network expanded water quality monitoring efforts on both lakes

Action 1: TP (Spring, June- August) and Chlorophyll a (June – August)

Action 2: Secchi, and temperature (every two weeks April – October)

Goal Five: Protect wild rice beds on both lakes

Objective One: Educate lake residents and users as to the value of wild rice is the system

Objective Two: Allow no intentional harvest of wild rice except immediately within the designated navigation channels and recreational corridors

Goal Six: Evaluate the success or failure of the activities included in this APM Plan

Objective One: Improve WALPRD aquatic plant harvesting record keeping

Action 1: Design and set-up a digital record keeping sheet to track harvesting data. Present at annual meeting in August. A hard copy of the hours, loads and area cut are kept for each cutting session.

Objective Two: Complete an assessment of the project activities annually

Action 1: To be completed by the WALPRD and their cooperating consultant

Objective Three: Complete a five-year end-of-project assessment

Action 1: To be completed by the WALPRD and their cooperating consultant

- Apply for grant to update APM Plan
- Due by December 10 of the year following the last year of implementation
- Redo early and mid-season point-intercept aquatic plant surveys on both lakes
- Evaluate water quality in both lakes to determine if trends established in 2010 have continued, were arrested, or were reversed

7.2 Pursue Grant Funding to Implement Actions

There are a number of grants available through WDNR to implement actions outlined in this plan and to complete further research and projects on White Ash and North White Ash Lakes. Following is a brief description of the grants available through WDNR.

Small Scale Lake Management Planning

Funding Amount: $3,000
Local Match: 33%
Purpose: funding to collect and analyze information needed to protect and restore lakes and watersheds.
Application Deadline: Feb 1 and Aug 1
Eligible Projects:

- Lake monitoring such as water quality and aquatic plants
- Lake education such as activities that will collect/disseminate information about lakes to educate public on lake use, lake ecosystem and lake management techniques
- Organization development such as assist management units in formation of goals/objectives for management of lake
- Studies/assessments to implement management goals and expanding monitoring.

Large Scale Lake Management Planning

Funding Amount: $25,000
Local Match: 33%
Purpose: funding to collect and analyze information needed to protect and restore lakes and watersheds.
Application Deadline: Feb 1 and Aug 1
Eligible Projects:

- Gathering and analysis of physical, chemical and biological information
- Describing present and potential land uses in watershed and on shoreline
- Reviewing jurisdictional boundaries and evaluating ordinances that relate to zoning, sanitation or pollution control or surface use
- Assessment of fish, aquatic life, wildlife and their habitats
- Gathering and analyzing information from lake property owners/users
- Developing, evaluation, publishing, distributing alternative courses of action and recommendations in a lake management plan

Lake Protection Grant

Funding Amount: $200,000
Local Match: 25%
Purpose: Funding for large, complex, technical projects for lake protection
Application Deadline: May 1
Eligible Projects:

- Purchase of land or conservation easements
- Restoration of wetlands and shorelands to protect water quality
- Development of local regulations to protect lakes and education activities necessary to implement them
- Lake management plan implementation project recommend in **WDNR approved plan**
    - Watershed management projects

- Lake restoration
- Diagnostic feasibility studies

Aquatic Invasive Species Education, Planning and Prevention Grant

Funding Amount: $150,000
Local Match: 25%
Purpose: Educate lake users on AIS
Application Deadline: Feb 1 and Aug 1
Eligible Projects:

- Educational programs including workshops, training or coordinating volunteer monitors.
- Develop prevention and control plans for AIS
- Monitor, map and assess waterbodies for AIS or studies that will aid in prevention AIS
- Watercraft inspection and education projects (CBCW). Inspectors must be trained and staff boat launch facilities a minimum of 200 hours between May 1 and October 30. Limited to $4,000 per boat launch facility.

Aquatic Invasive Species Established Population Control Project

Funding Amount: $200,000
Local Match: 25%
Purpose: Provide for eradication/substantial reduction and long term control of AIS with goal of restoring native species.
Application Deadline: Feb 1 and Aug 1
Eligible Projects:

- Department approved control activities recommended in control plan
- Experimental or demonstration project in WDNR approved plan
- Purple loosestrife bio-control project

Aquatic Invasive Species Early Detection and Response

Funding Amount: $20,000
Local Match: 25%
Purpose:
Application Deadline: As approved
Eligible Projects: Identification and removal by approved methods of small, pioneer population of AIS. Localized beds must be present less than 5 years and less than 5 acres in size or less than 5% of lake area. Control of recolonization following completion of an established population control project is eligible.

Aquatic Invasive Species Research and Demonstration

Funding Amount: $500,000
Local Match: 25%
Purpose: Funding for cooperative research or demonstration activity between sponsor and WDNR

Application Deadline: Feb 1 and Aug 1

Aquatic Invasive Species Maintenance and Containment

Funding Amount:	full cost of aquatic plant management permit
Local Match:	25%
Purpose:	Funding for department approved management at desired level of AIS where eradication is not possible. Monitoring and reporting are required.
Application Deadline:	continuous

7.3 Closing

This APM Plan was prepared in cooperation with the White Ash Lake Protection and Rehabilitation District. 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 CLP and nuisance native plant management activities for the lakes. This section outlines important monitoring and management activities. The greater APM Plan document and appendices provides a central source of information for the lake's aquatic plant community information, the overall lake ecology, and sources of additional information. If there are any questions about how to use this APM Plan or its contents, please contact Flambeau Engineering, Inc..

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

8.0 References

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

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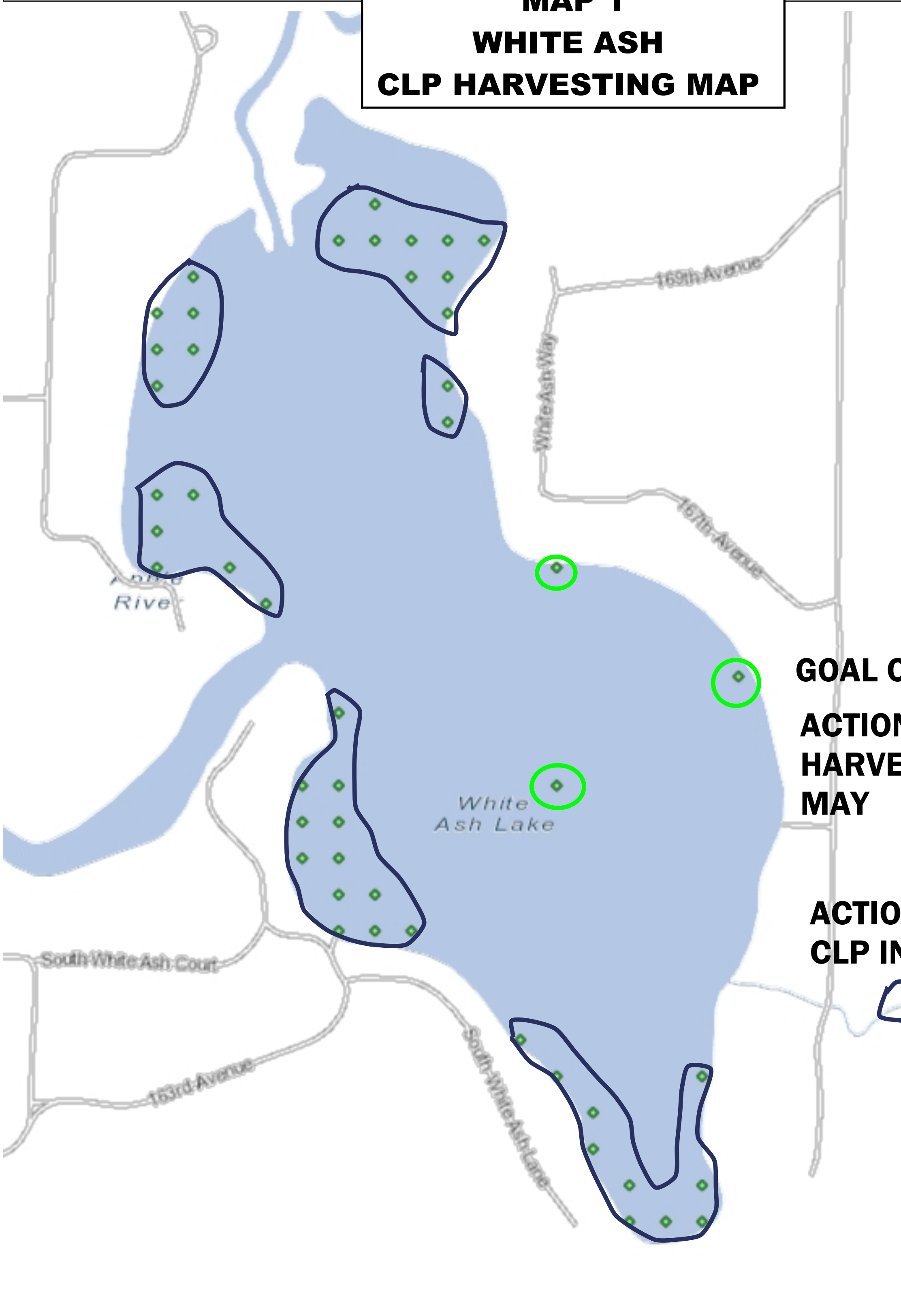
Harvest Maps

2016 CLP WHITE ASH

MAP 1
WHITE ASH
CLP HARVESTING MAP



Legend

- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Lakes and Open water

0.3 0 0.13 0.3 Miles

1: 7,920

NAD_1983_HARN_Wisconsin_TM

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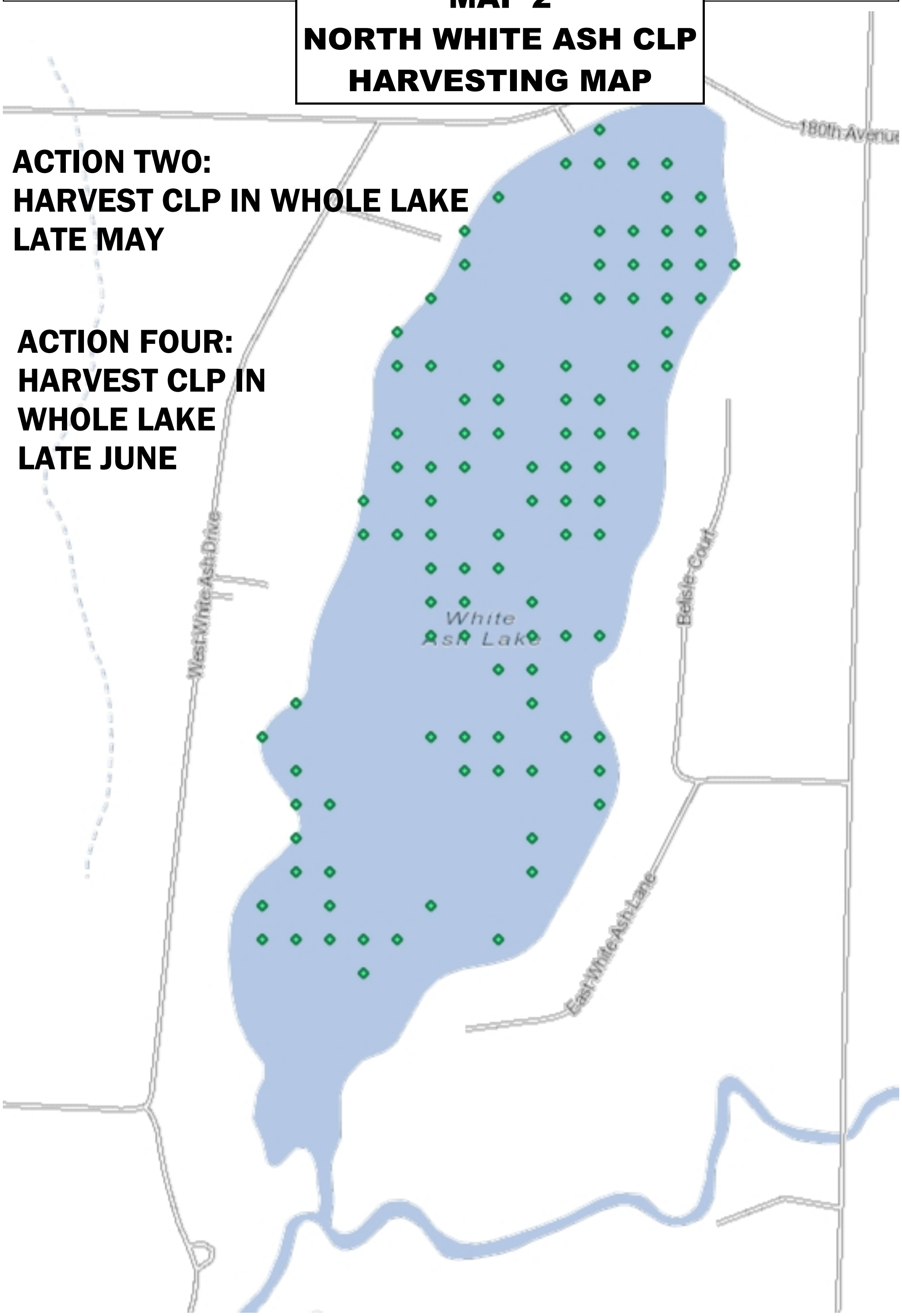
Notes

2016 CLP NORTH WHITE ASH

MAP 2
NORTH WHITE ASH CLP HARVESTING MAP

ACTION TWO:
HARVEST CLP IN WHOLE LAKE
LATE MAY

ACTION FOUR:
HARVEST CLP IN WHOLE LAKE
LATE JUNE



Legend

- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Lakes and Open water

0.3 0 0.13 0.3 Miles

1: 7,920

NAD_1983_HARN_Wisconsin_TM

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Notes

Legend

Rivers and Streams
Sections
Parcels
Railroad
Cities (Scale below 25000)
Villages (Scale below 25000)
Towns
TwpRgGrdweb
Surrounding Counties
Hospitals

Polk County, WI

N

0 200 400 600ft

DISCLAIMER: This map is not guaranteed to be accurate, correct, current, or complete and conclusions drawn are the responsibility of the user.

Author:
Date Printed: 11/29/17 4:5 PM
Sources:

COUNTY OF POLK Est. 1853 WISCONSIN

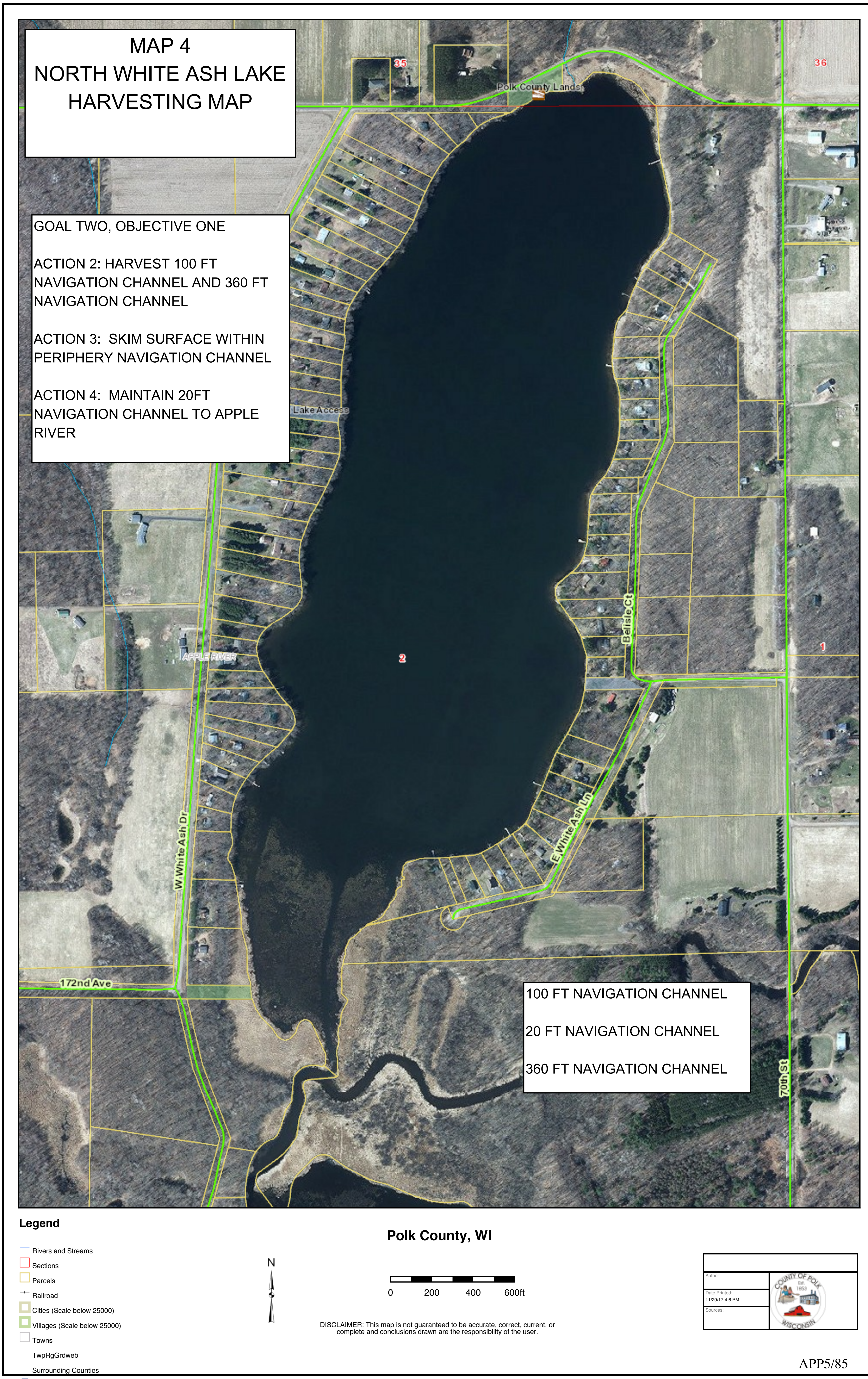
MAP 4
NORTH WHITE ASH LAKE HARVESTING MAP

GOAL TWO, OBJECTIVE ONE

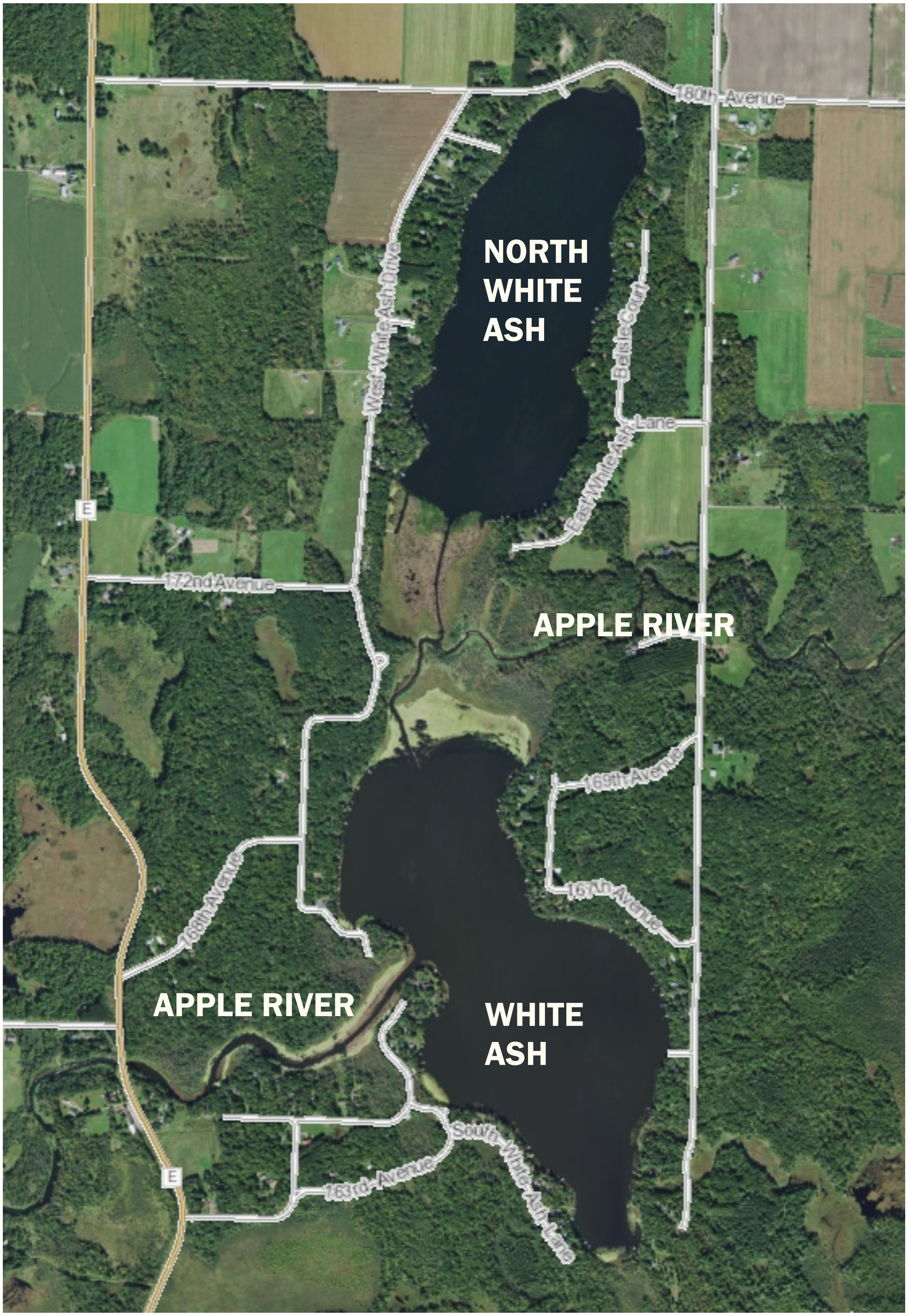
ACTION 2: HARVEST 100 FT NAVIGATION CHANNEL AND 360 FT NAVIGATION CHANNEL

ACTION 3: SKIM SURFACE WITHIN PERIPHERY NAVIGATION CHANNEL

ACTION 4: MAINTAIN 20FT NAVIGATION CHANNEL TO APPLE RIVER



WHITE ASH AND NORTH WHITE ASH LAKES



Legend

- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands

0.5 | 0 | 0.25 | 0.5 Miles

1: 15,840

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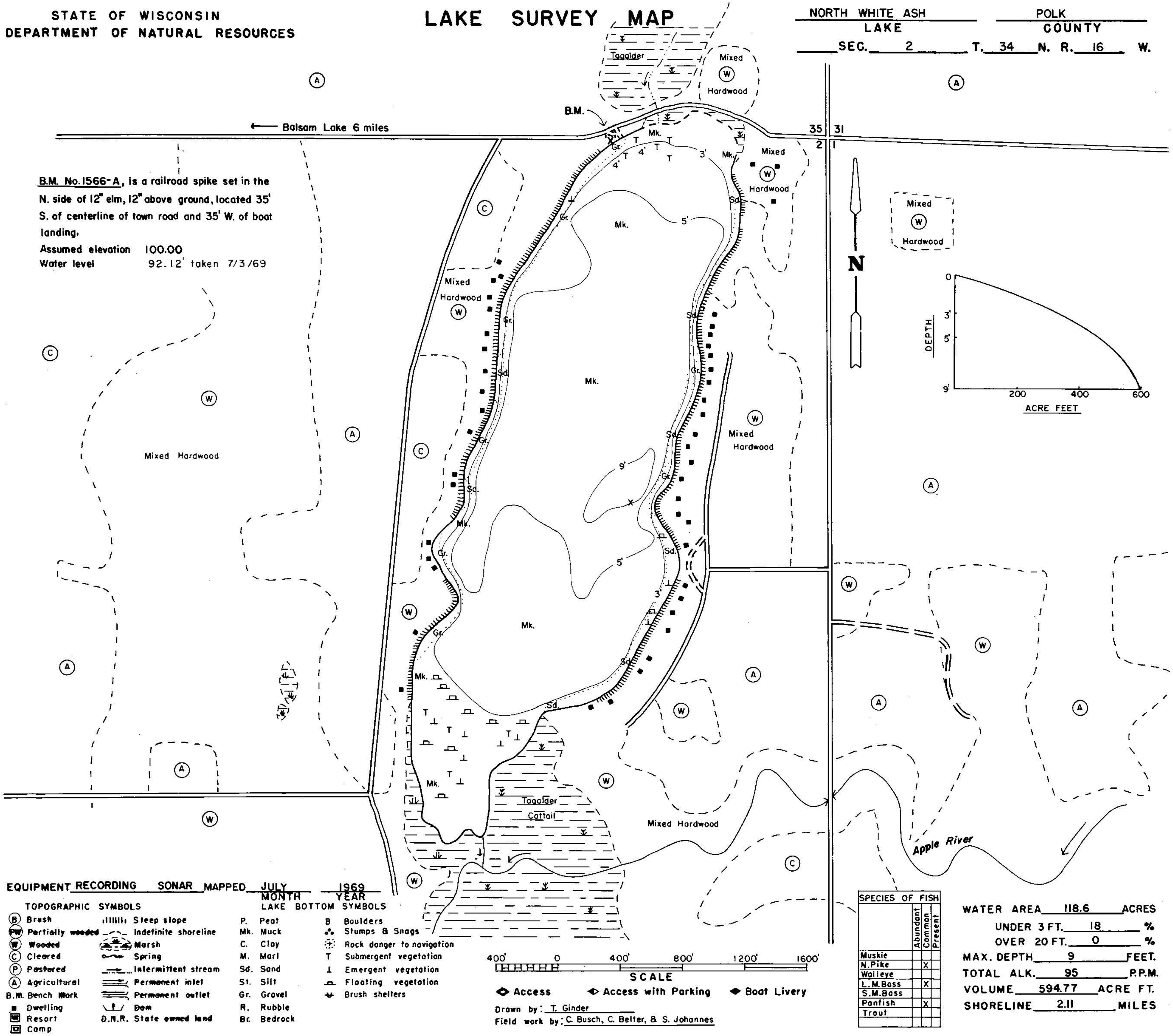
Notes

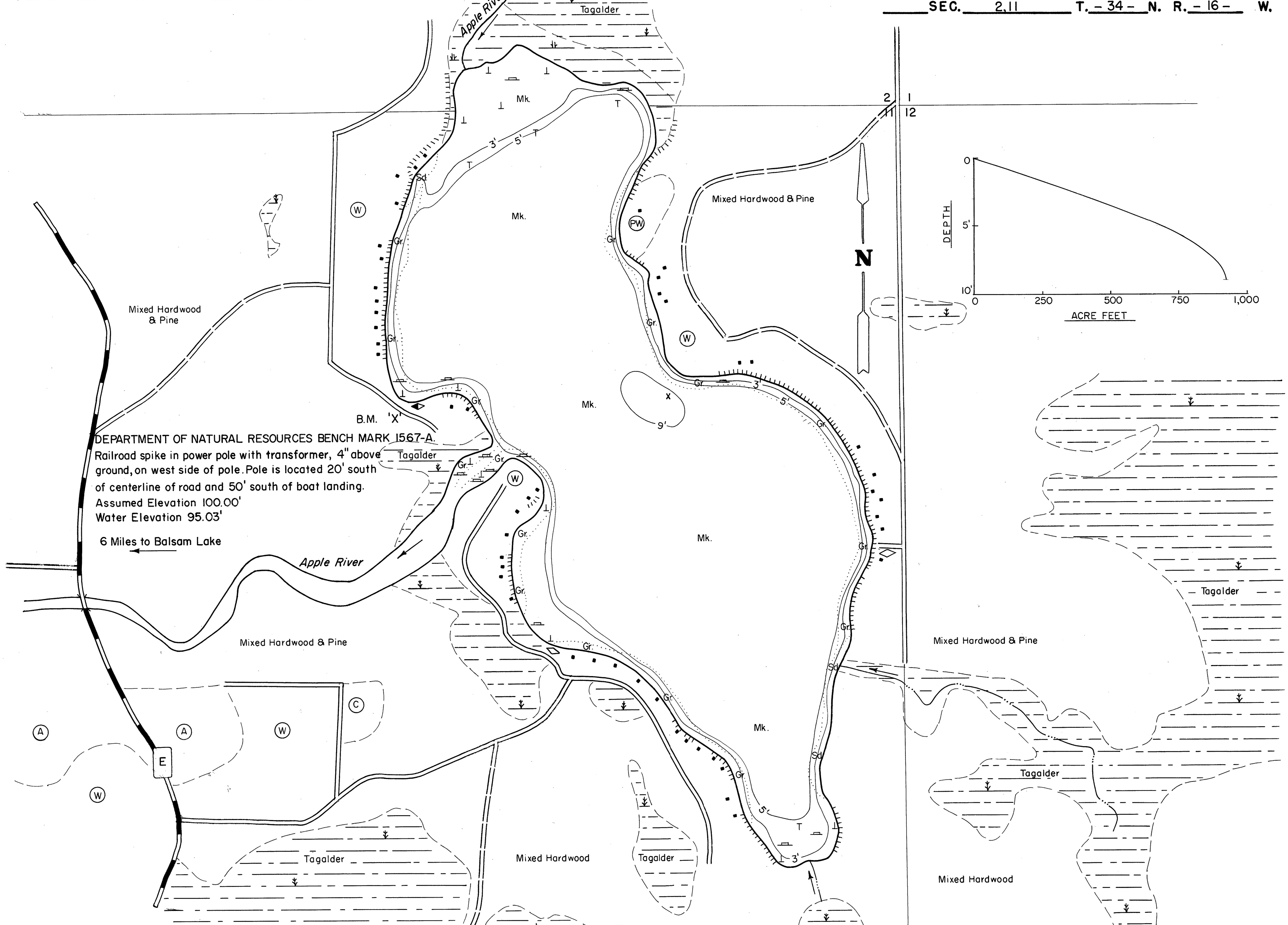
Figures


STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
LAKE SURVEY MAP
NORTH WHITE ASH LAKE
POLK COUNTY
SEC. 2 T. 34 N. R. 16 W.
Balsam Lake 6 miles
B.M.
B.M. No.1566-A, is a railroad spike set in the N. side of 12" elm, 12" above ground, located 35' S. of centerline of town road and 35' W. of boat landing.
Assumed elevation 100.00
Water level 92.12' taken 7/3/69
Tagalder
Mixed Hardwood
Mk.
Sd.
Gr.
5'
9'
3'
4'
Tagalder
Cattail
Apple River
N
DEPTH
ACRE FEET
0
3'
5'
9'
200
400
600
EQUIPMENT RECORDING SONAR MAPPED JULY 1969
MONTH YEAR
TOPOGRAPHIC SYMBOLS
Brush
Partially wooded
Wooded
Cleared
Pastured
Agricultural
B.M. Bench Mark
Dwelling
Resort
Camp
Steep slope
Indefinite shoreline
Marsh
Spring
Intermittent stream
Permanent inlet
Permanent outlet
Dam
D.N.R. State owned land
LAKE BOTTOM SYMBOLS
P. Peat
Mk. Muck
C. Clay
M. Marl
Sd. Sand
St. Silt
Gr. Gravel
R. Rubble
Br. Bedrock
B Boulders
Stumps & Snags
Rock danger to navigation
T Submergent vegetation
Emergent vegetation
Floating vegetation
Brush shelters
400' 0 400' 800' 1200' 1600'
SCALE
Access
Access with Parking
Boat Livery
Drawn by: T. Ginder
Field work by: C. Busch, C. Belter, & S. Johannes
SPECIES OF FISH
Abundant Common Present
Muskie
N. Pike X
Walleye
L.M.Bass X
S.M.Bass
Panfish X
Trout
WATER AREA 118.6 ACRES
UNDER 3 FT. 18 %
OVER 20 FT. 0 %
MAX. DEPTH 9 FEET.
TOTAL ALK. 95 P.P.M.
VOLUME 594.77 ACRE FT.
SHORELINE 2.11 MILES

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

LAKE SURVEY MAP

WHITE ASH LAKE — POLK COUNTY
SEC. 2,11 T. - 34 - N. R. - 16 - W.



EQUIPMENT RECORDING SONAR MAPPED JULY (MONTH) 1969 (YEAR)

TOPOGRAPHIC SYMBOLS
- (B) Brush
- (PW) Partially wooded
- (W) Wooded
- (C) Cleared
- (P) Pastured
- (A) Agricultural
- B.M. Bench Mark
- ■ Dwelling
- ▣ Resort
- ◘ Camp
- Steep slope
- Indefinite shoreline
- Marsh
- Spring
- Intermittent stream
- Permanent inlet
- Permanent outlet
- Dam
- D.N.R. State owned land

LAKE BOTTOM SYMBOLS
- P. Peat
- Mk. Muck
- C. Clay
- M. Marl
- Sd. Sand
- St. Silt
- Gr. Gravel
- R. Rubble
- Br. Bedrock
- B Boulders
- Stumps & Snags
- Rock danger to navigation
- T Submergent vegetation
- ⊥ Emergent vegetation
- Floating vegetation
- Brush shelters

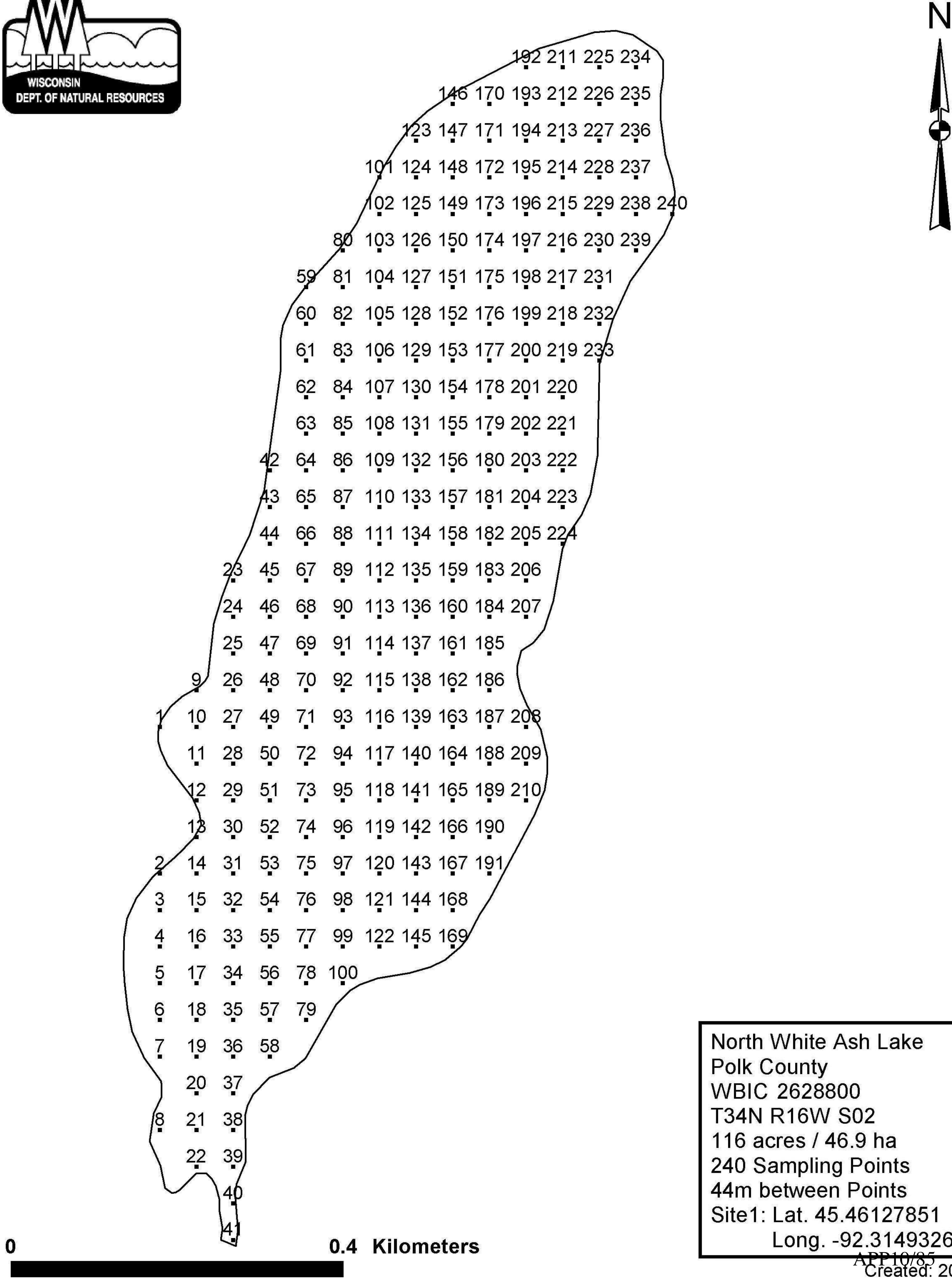
400' 0 400' 800' 1,200' 1,600'
SCALE

◇ Access ◇ Access with Parking ◆ Boat Livery

Drawn by: J. Roth
Field work by: C. Busch, C. Belter, S. Johannes

SPECIES OF FISH	Abundant	Common	Present
Muskie			
N. Pike		X	
Walleye			
L.M. Bass		X	
S.M. Bass			
Panfish		X	
Trout			

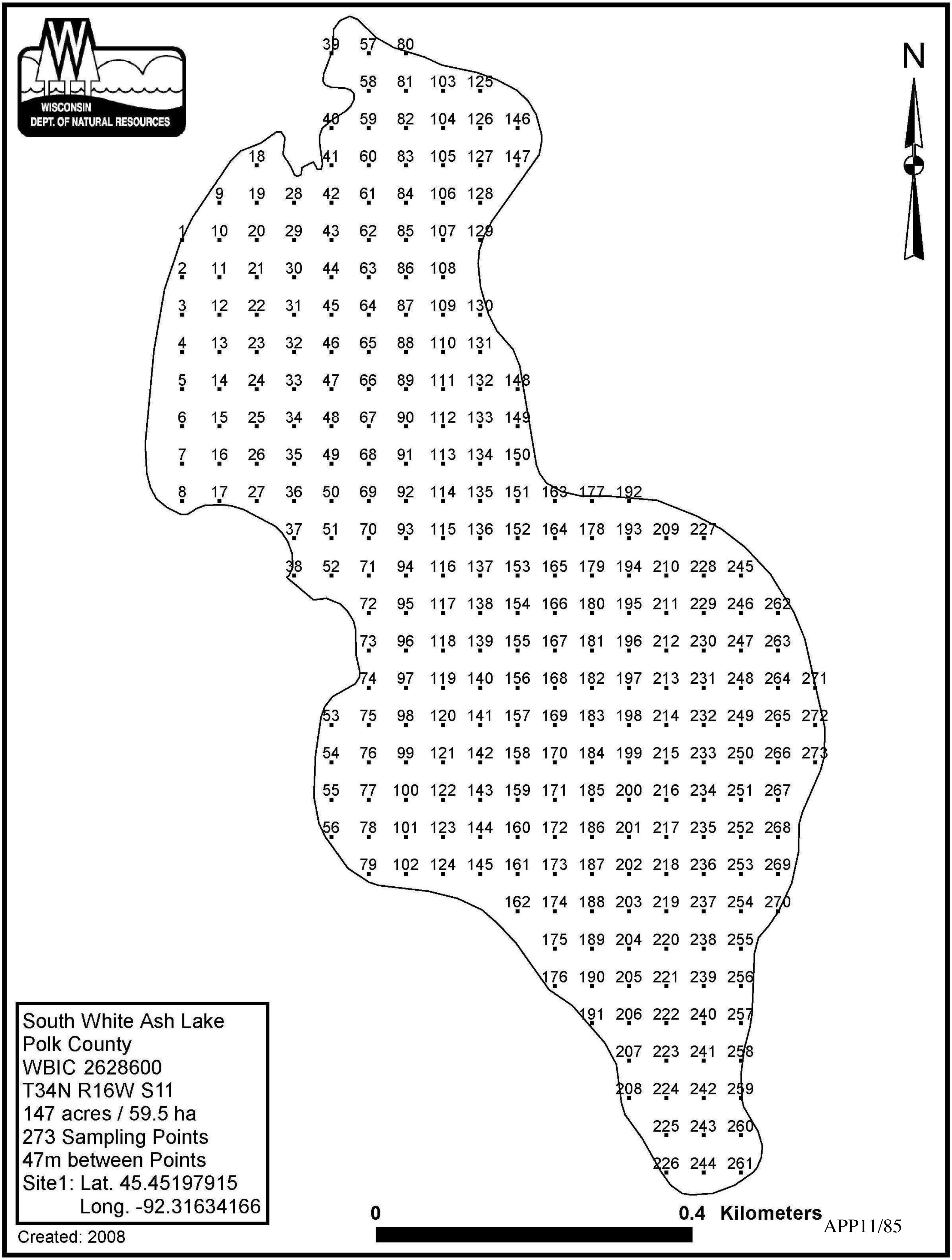
WATER AREA 153.1 ACRES
UNDER 3 FT. 14 %
OVER 20 FT. 0 %
MAX. DEPTH 9 FEET.
TOTAL ALK. 136 P.P.M.
VOLUME 924.0 ACRE FT.
SHORELINE 2.53 MILES



North White Ash Lake
Polk County
WBIC 2628800
T34N R16W S02
116 acres / 46.9 ha
240 Sampling Points
44m between Points
Site1: Lat. 45.46127851
Long. -92.31493264

APP10/85

Created: 2008



N
WISCONSIN
DEPT. OF NATURAL RESOURCES
South White Ash Lake
Polk County
WBIC 2628600
T34N R16W S11
147 acres / 59.5 ha
273 Sampling Points
47m between Points
Site1: Lat. 45.45197915
Long. -92.31634166
Created: 2008
0
0.4 Kilometers

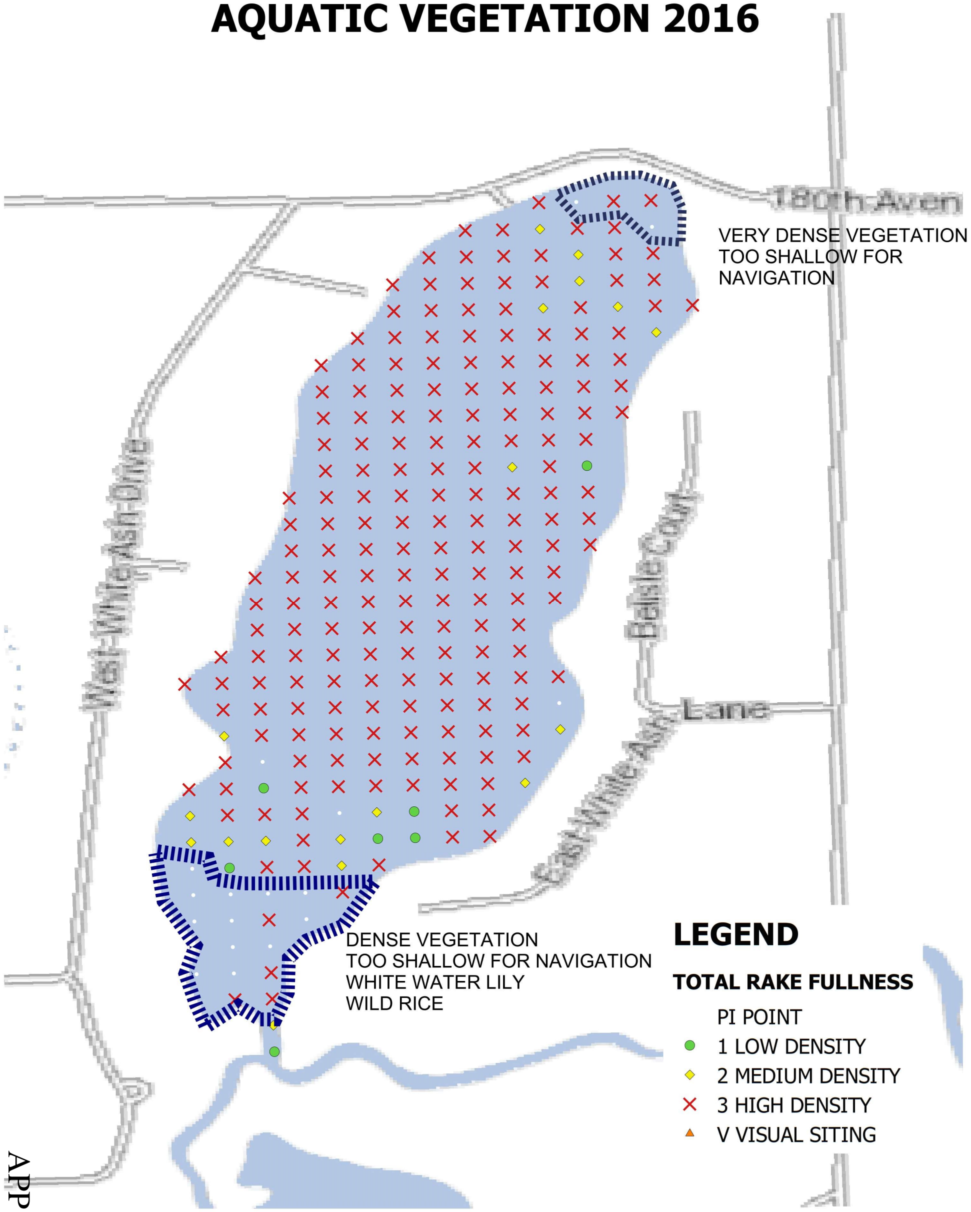
Appendix A –
POINT INTERCEPT TABLES

	A	B	C	E	Q	AC	AS	BA	BD	BM	BN	CL	CQ	EE	EK	EN	EZ	FA
1		**WHITE ASH PI STATS** **STATS**	Total vegetation	*Potamogeton crispus*, Curly-leaf pondweed	Ceratophyllum demersum, Coontail	Elodea canadensis, Common waterweed	Lemna trisulca, Forked duckweed	Myriophyllum sibiricum, Northern water-milfoil	Najas flexilis, Slender naiad	Nuphar variegata, Spatterdock	Nymphaea odorata, White water lily	Potamogeton richardsonii, Clasping-leaf pondweed	Potamogeton zosteriformis, Flat-stem pondweed	Vallisneria americana, Wild celery	Zizania sp., Wild rice	Filamentous algae		
2	**Lake**	SOUTH WHITE ASH																
3	**County**	POLK																
4	**WBIC**	2628600																
5	**Survey Date**	08/03/16																
6		**INDIVIDUAL SPECIES STATS:**																
7		**Frequency of occurrence within vegetated areas (%)**		16.67	76.67	40.00	3.33	6.67	8.33	3.33	1.67	3.33	6.67	20.00	8.33	1.67		
8		**Frequency of occurrence at sites shallower than maximum depth of plants**		9.90	45.54	23.76	1.98	3.96	4.95	1.98	0.99	1.98	3.96	11.88	4.95	0.99		
9		**Relative Frequency (%)**		8.5	39.3	20.5	1.7	3.4	4.3	1.7	0.9	1.7	3.4	10.3	4.3			
10		Relative Frequency (squared)	0.22	0.01	0.15	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00			
11		**Number of sites where species found**		10	46	24	2	4	5	2	1	2	4	12	5	1		
12		**Average Rake Fullness**	2.86	1.10	1.46	1.13	1.00	1.50	1.40	1.00	2.00	1.50	1.00	1.25	2.60	1.00		
13		**#visual sightings**		2	4					4	1		1	2				
14		**present (visual or collected)**		presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	present		
15																		
16		**SUMMARY STATS:**																
17		**Total number of sites visited**	**112**															
18		**Total number of sites with vegetation**	**60**															
19		**Total number of sites shallower than maximum depth of plants**	**101**															
20		**Frequency of occurrence at sites shallower than maximum depth of plants**	**59.41**															
21		**Simpson Diversity Index**	**0.78**															
22		**Maximum depth of plants (ft)****	**8.00**															
23		**Number of sites sampled using rake on Rope (R)**	**0**															
24		**Number of sites sampled using rake on Pole (P)**	**234**															
25		**Average number of all species per site (shallower than max depth)**	**1.07**															
26		**Average number of all species per site (veg. sites only)**	**1.95**															
27		**Average number of native species per site (shallower than max depth)**	**0.97**															
28		**Average number of native species per site (veg. sites only)**	**1.91**															
29		**Species Richness**	**12**															
30		**Species Richness (including visuals)**	**12**															
31																		
32		**SEE "MAX DEPTH GRAPH" WORKSHEET TO CONFIRM																

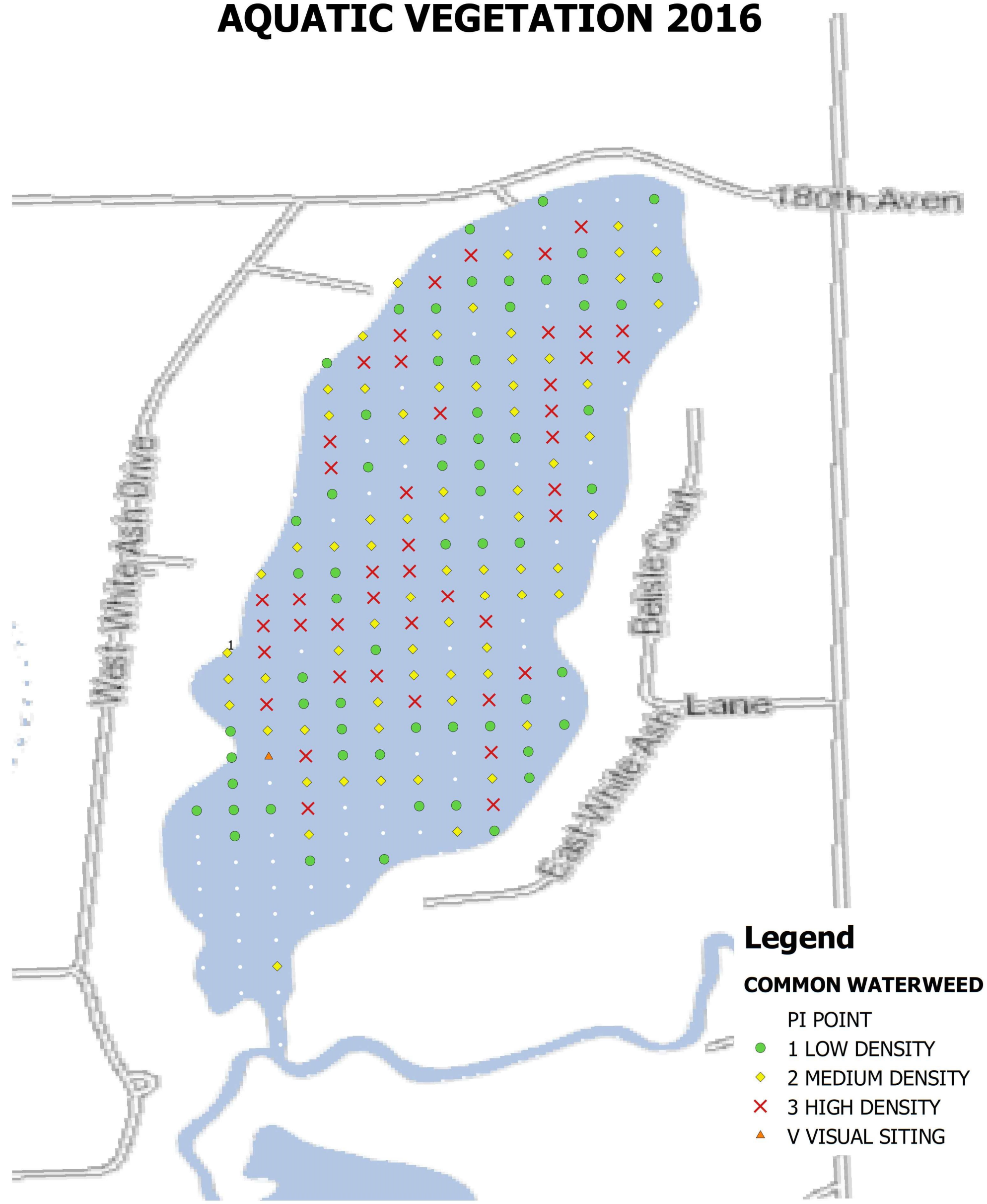
	A	B	C	H	Q	AC	AQ	AR	AS	BA	BD	BI	BN	BU	CL	CQ	DO	ED	EE	EK	EN	EZ
1		**NORTH WHITE ASH PI STATS** **STATS**	Total vegetation	Bidens beckii (formerly Megalodonta), Water marigold	Ceratophyllum demersum, Coontail	Elodea canadensis, Common waterweed	Lemna minor, Small duckweed	Lemna perpusilla, Least duckweed	Lemna trisulca, Forked duckweed	Myriophyllum sibiricum, Northern water-milfoil	Najas flexilis, Slender naiad	Nitella sp., Nitella	Nymphaea odorata, White water lily	Potamogeton amplifolius, Large-leaf pondweed	Potamogeton richardsonii, Clasping-leaf pondweed	Potamogeton zosteriformis, Flat-stem pondweed	Sparganium sp., Bur-reed	Utricularia vulgaris, Common bladderwort	Vallisneria americana, Wild celery	Zizania sp., Wild rice	Filamentous algae	
2	**Lake**	NORTH WHITE ASH																				
3	**County**	POLK																				
4	**WBIC**	2628800																				
5	**Survey Date**	08/03/16																				
6		**INDIVIDUAL SPECIES STATS:**																				
7		**Frequency of occurrence within vegetated areas (%)**		0.47	81.40	82.33	0.93	0.47	16.74	1.86	0.93	0.93		37.21	16.74	15.35	0.93	0.93	11.16	0.93	20.93	
8		**Frequency of occurrence at sites shallower than maximum depth of plants**		0.45	78.13	79.02	0.89	0.45	16.07	1.79	0.89	0.89		35.71	16.07	14.73	0.89	0.89	10.71	0.89	20.09	
9		**Relative Frequency (%)**		0.2	30.2	30.6	0.3	0.2	6.2	0.7	0.3	0.3		13.8	6.2	5.7	0.3	0.3	4.1	0.3	7.8	
10		Relative Frequency (squared)	0.22	0.00	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00		0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
11		**Number of sites where species found**		1	175	177	2	1	36	4	2	2		80	36	33	2	2	24	2	45	
12		**Average Rake Fullness**	2.86	1.00	1.78	1.89	1.00	1.00	1.17	1.00	2.00	1.00		1.40	1.06	1.00	1.00	1.00	1.25	1.00	1.36	
13		**#visual sightings**			1	1							3									
14		**present (visual or collected)**		presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	presen	present	
15																						
16		**SUMMARY STATS:**																				
17		**Total number of sites visited**	**224**																			
18		**Total number of sites with vegetation**	**215**																			
19		**Total number of sites shallower than maximum depth of plants**	**224**																			
20		**Frequency of occurrence at sites shallower than maximum depth of plants**	**95.98**																			
21		**Simpson Diversity Index**	**0.78**																			
22		**Maximum depth of plants (ft)****	**9.00**																			
23		**Number of sites sampled using rake on Rope (R)**	**0**																			
24		**Number of sites sampled using rake on Pole (P)**	**234**																			
25		**Average number of all species per site (shallower than max depth**	**2.58**																			
26		**Average number of all species per site (veg. sites only)**	**2.69**																			
27		**Average number of native species per site (shallower than max depth)**	**2.58**																			
28		**Average number of native species per site (veg. sites only)**	**2.69**																			
29		**Species Richness**	**16**																			
30		**Species Richness (including visuals)**	**17**																			
31																						
32		****SEE "MAX DEPTH GRAPH" WORKSHEET TO CONFIRM**																				

Appendix B -
POINT INTERCEPT MAPS

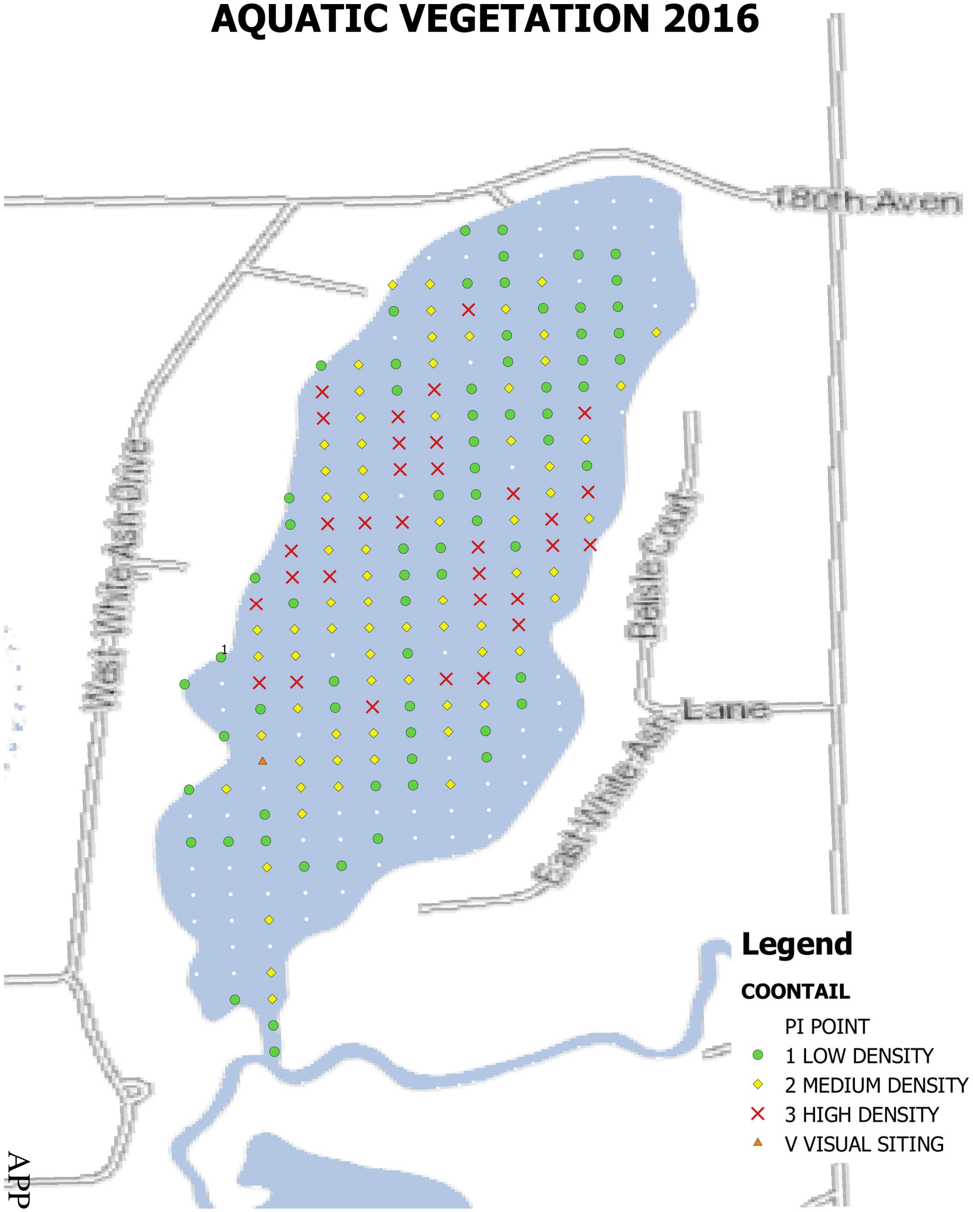
NORTH WHITE ASH LAKE AQUATIC VEGETATION 2016



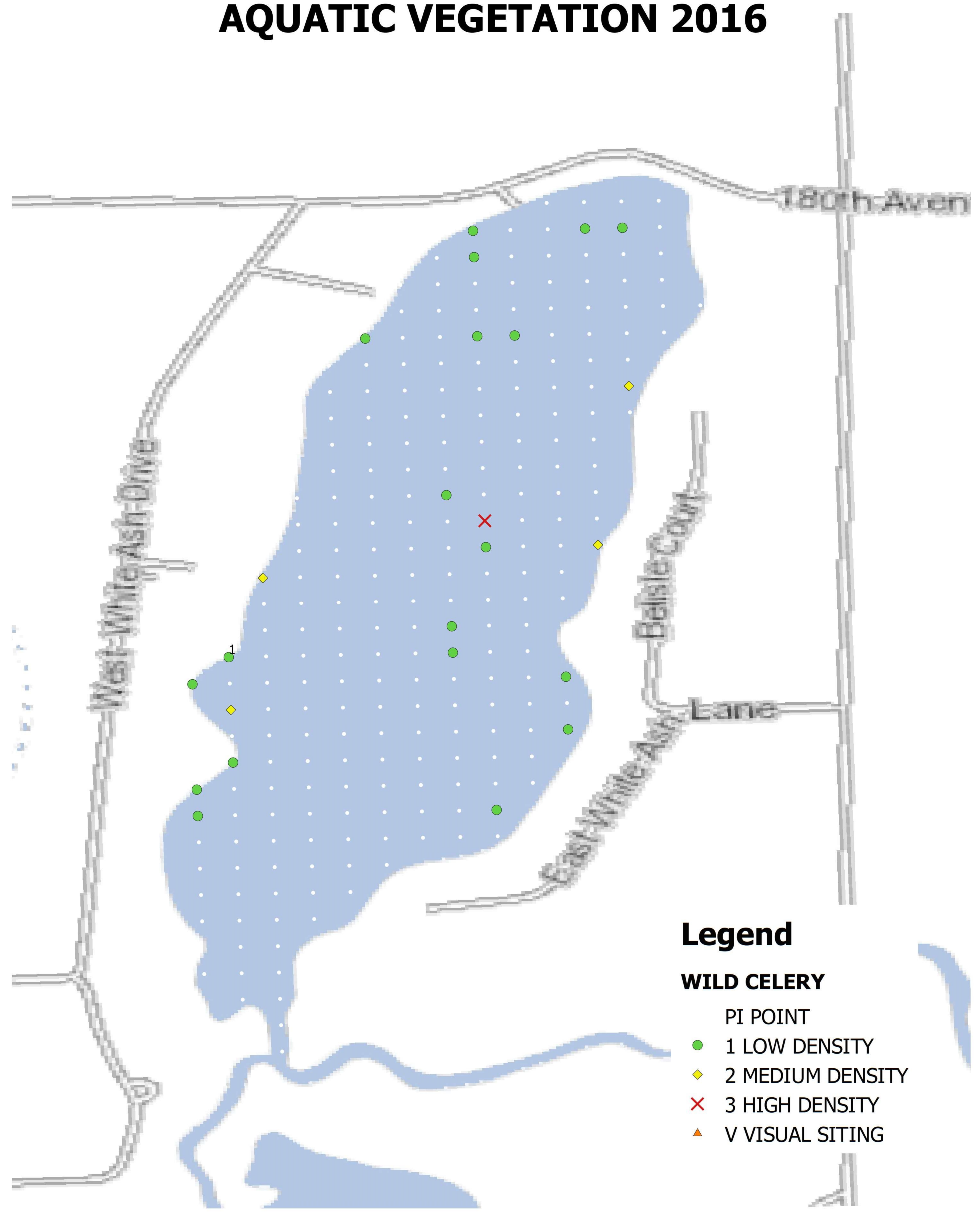
NORTH WHITE ASH LAKE AQUATIC VEGETATION 2016



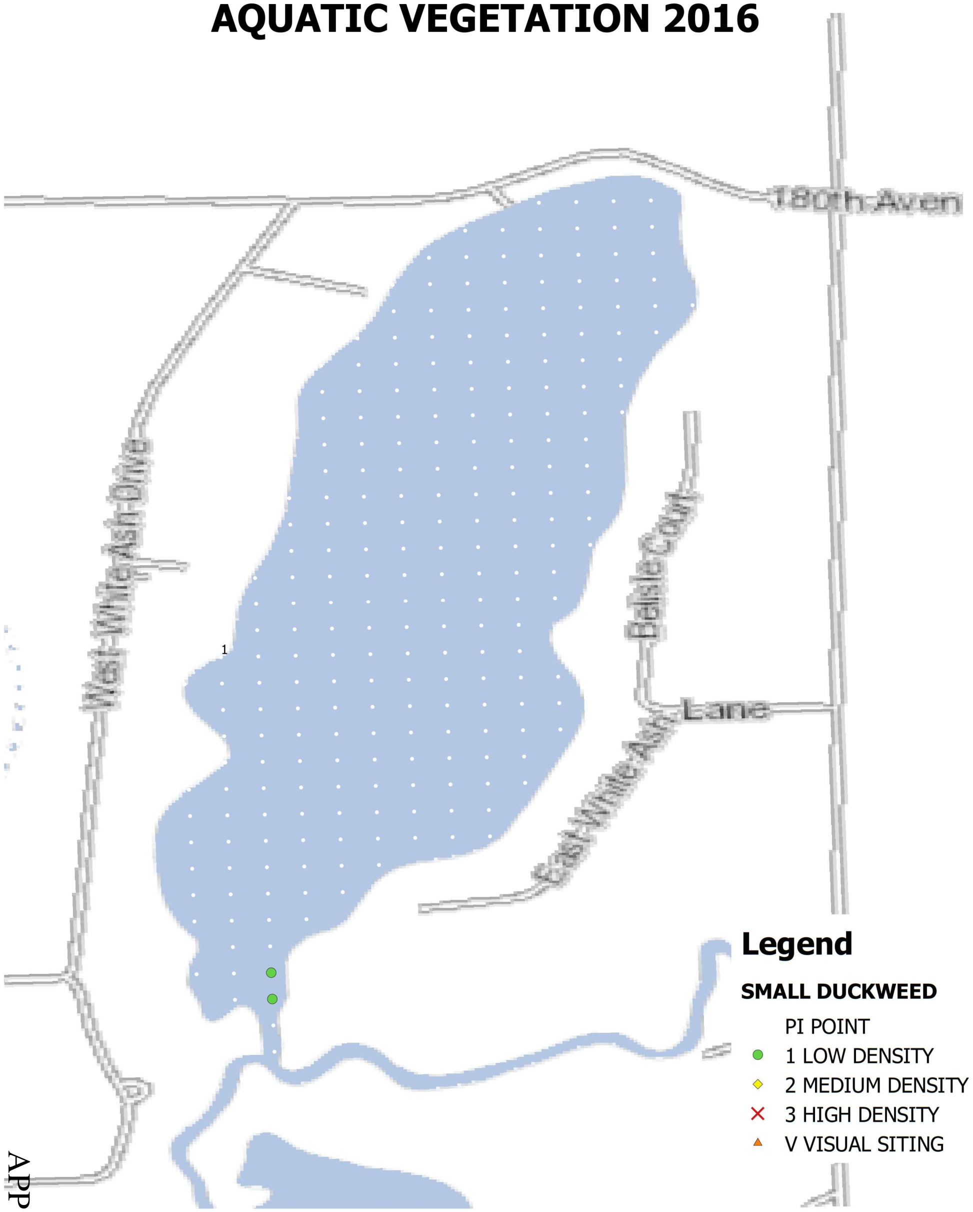
NORTH WHITE ASH LAKE AQUATIC VEGETATION 2016



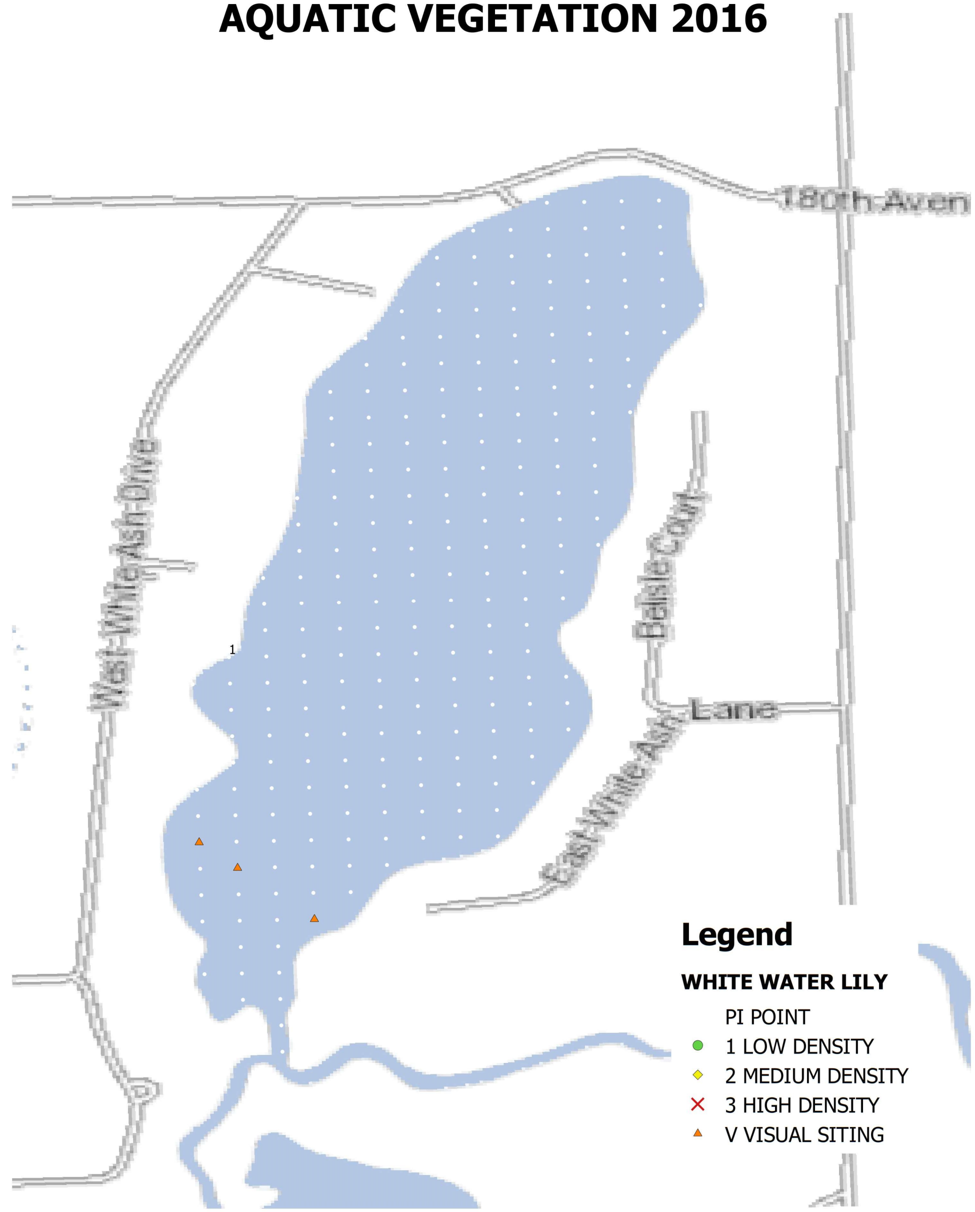
NORTH WHITE ASH LAKE AQUATIC VEGETATION 2016



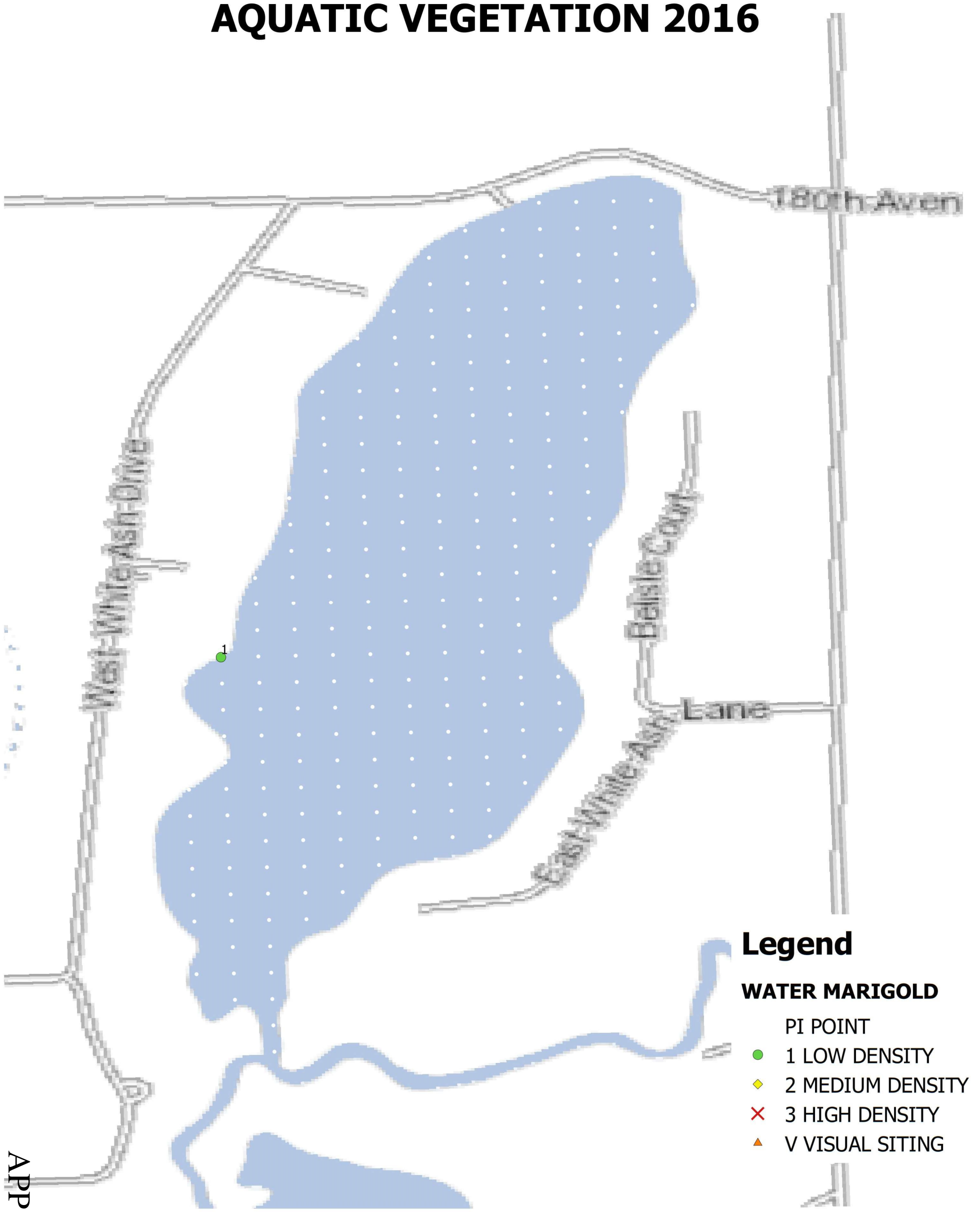
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



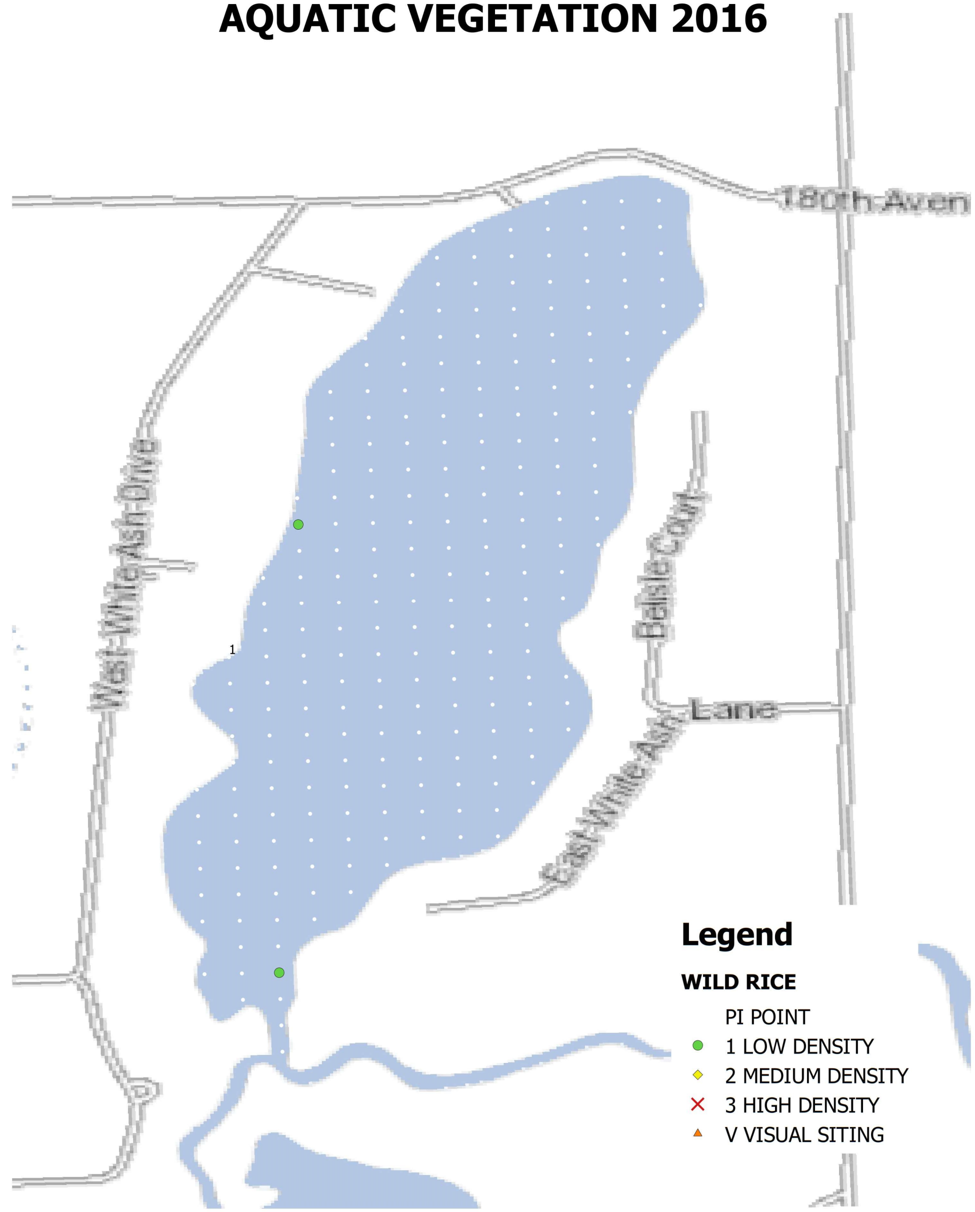
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



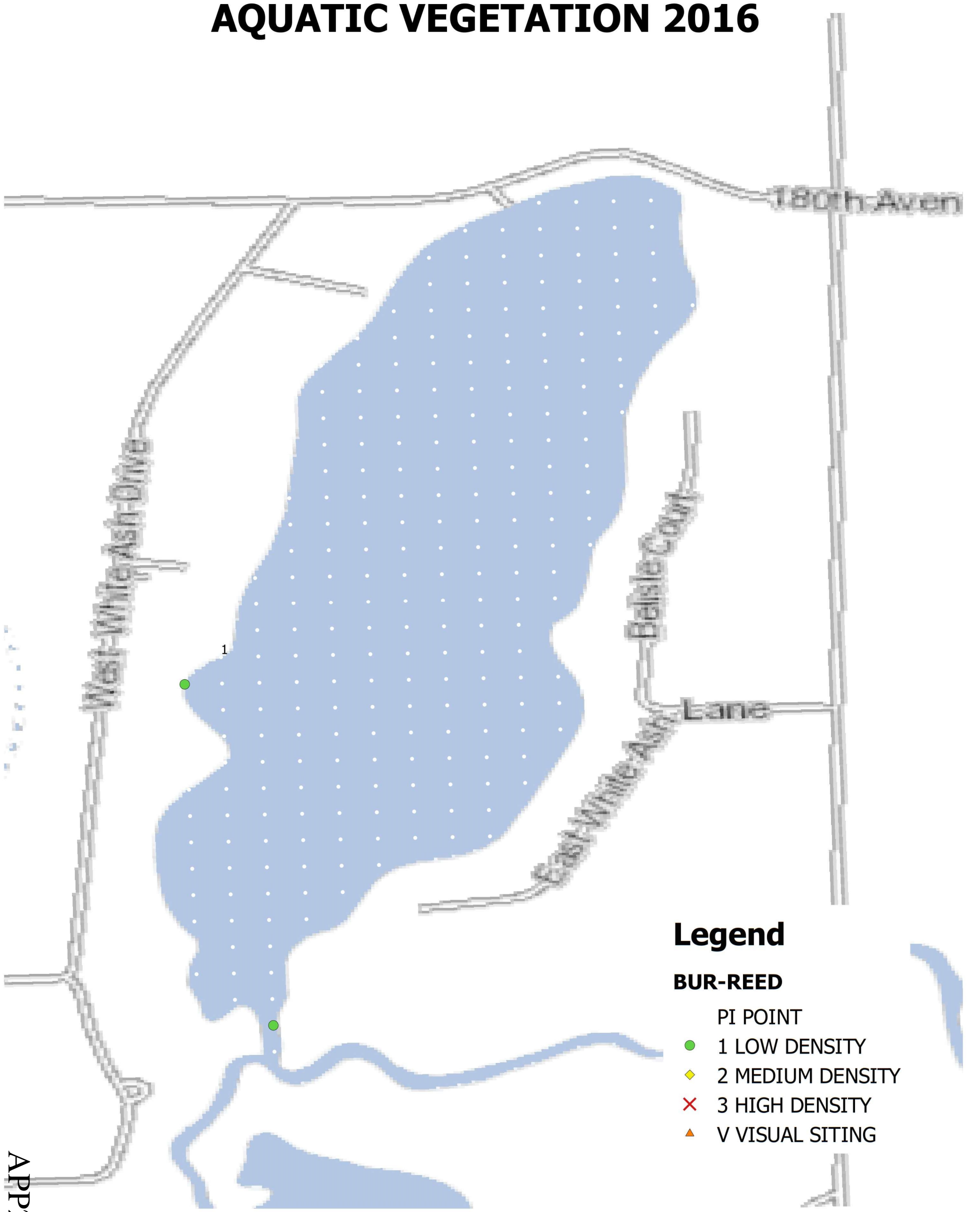
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



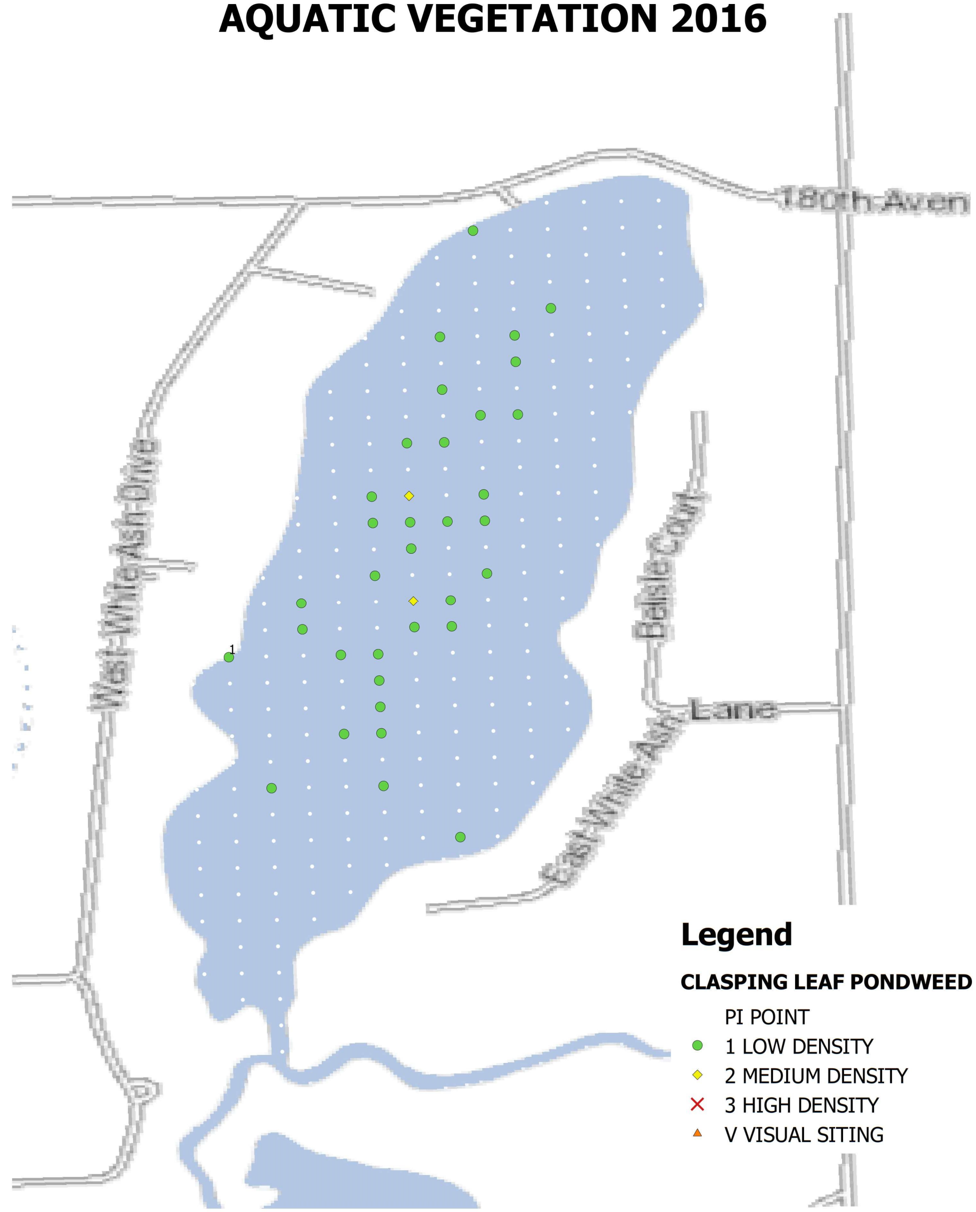
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



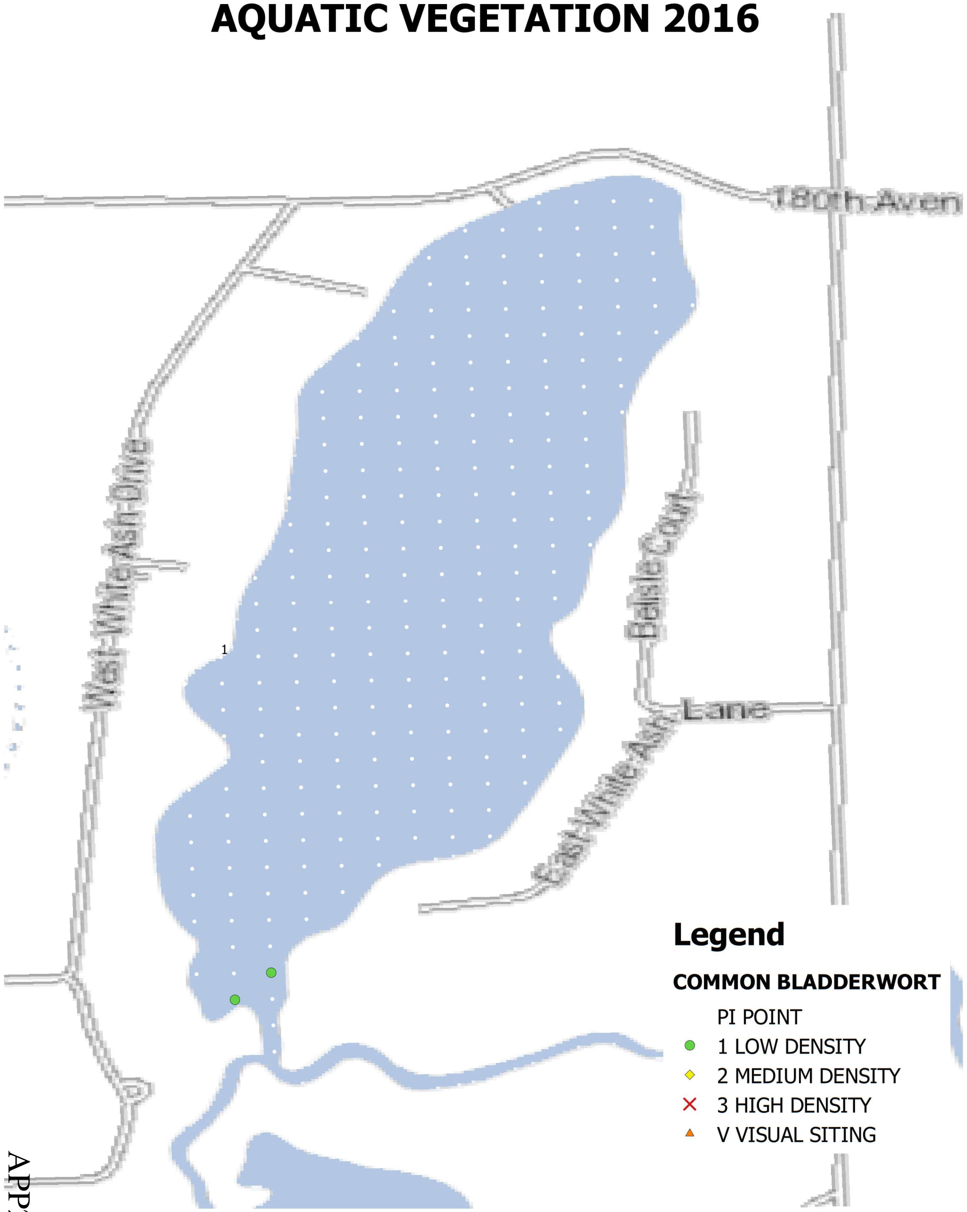
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



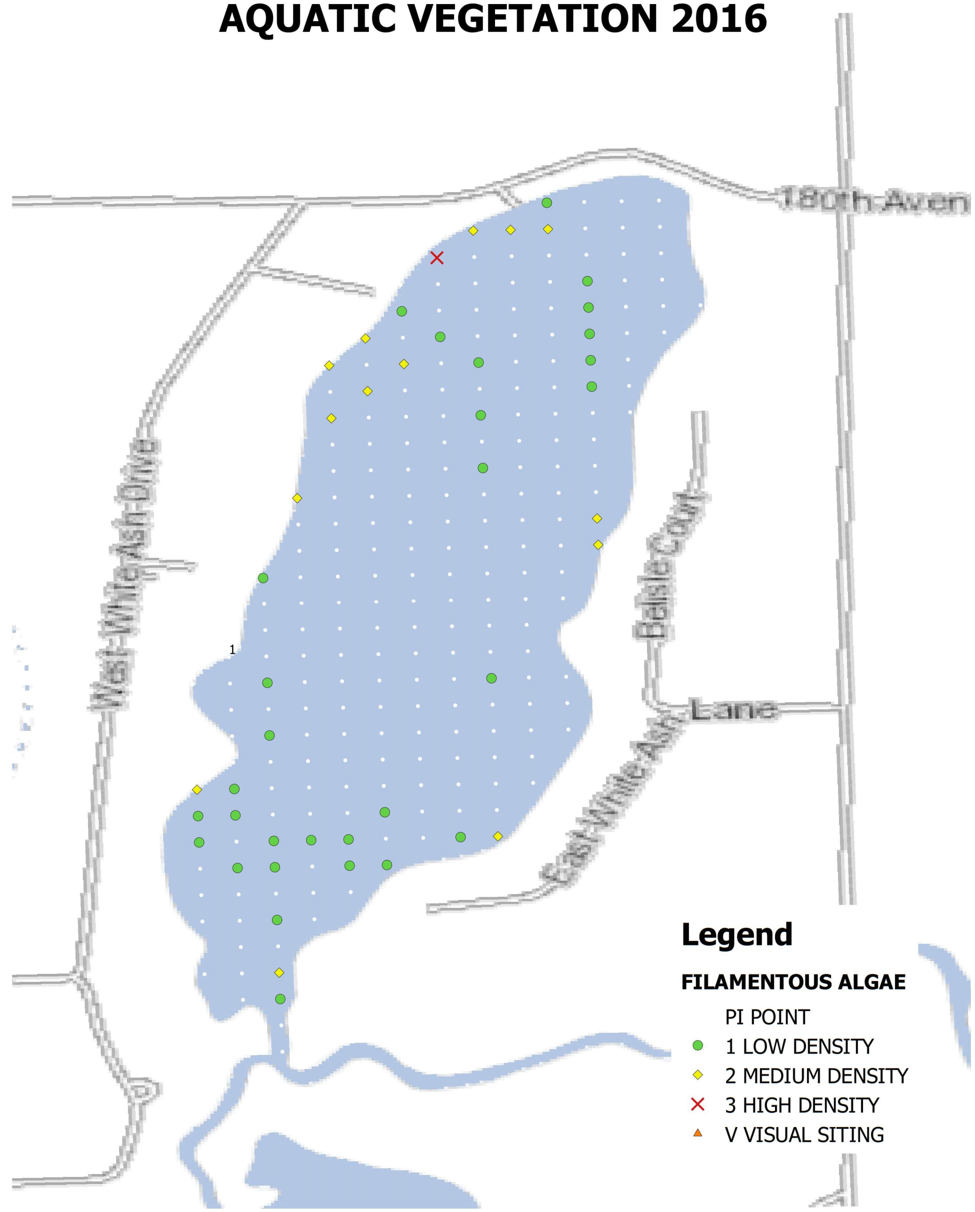
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



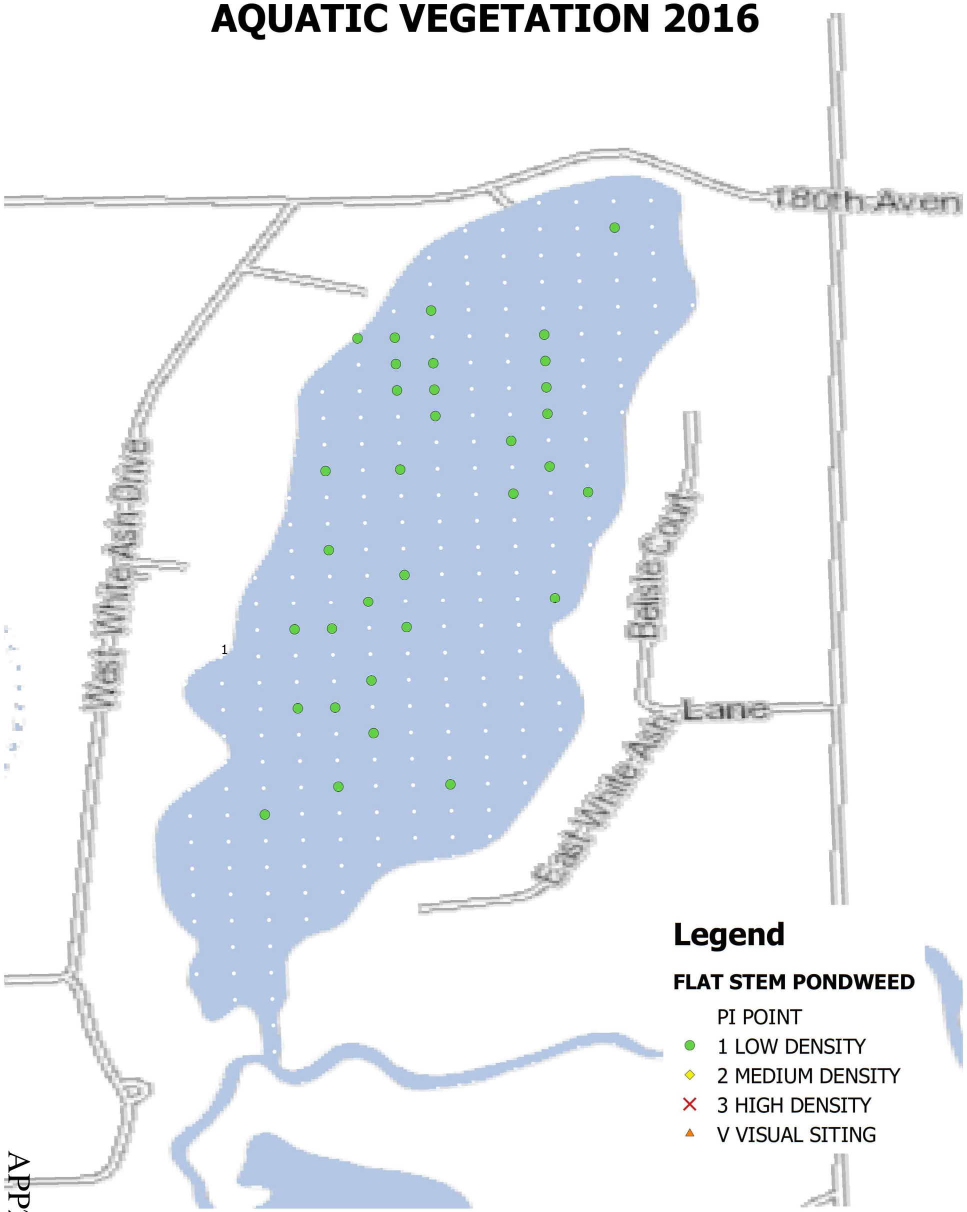
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



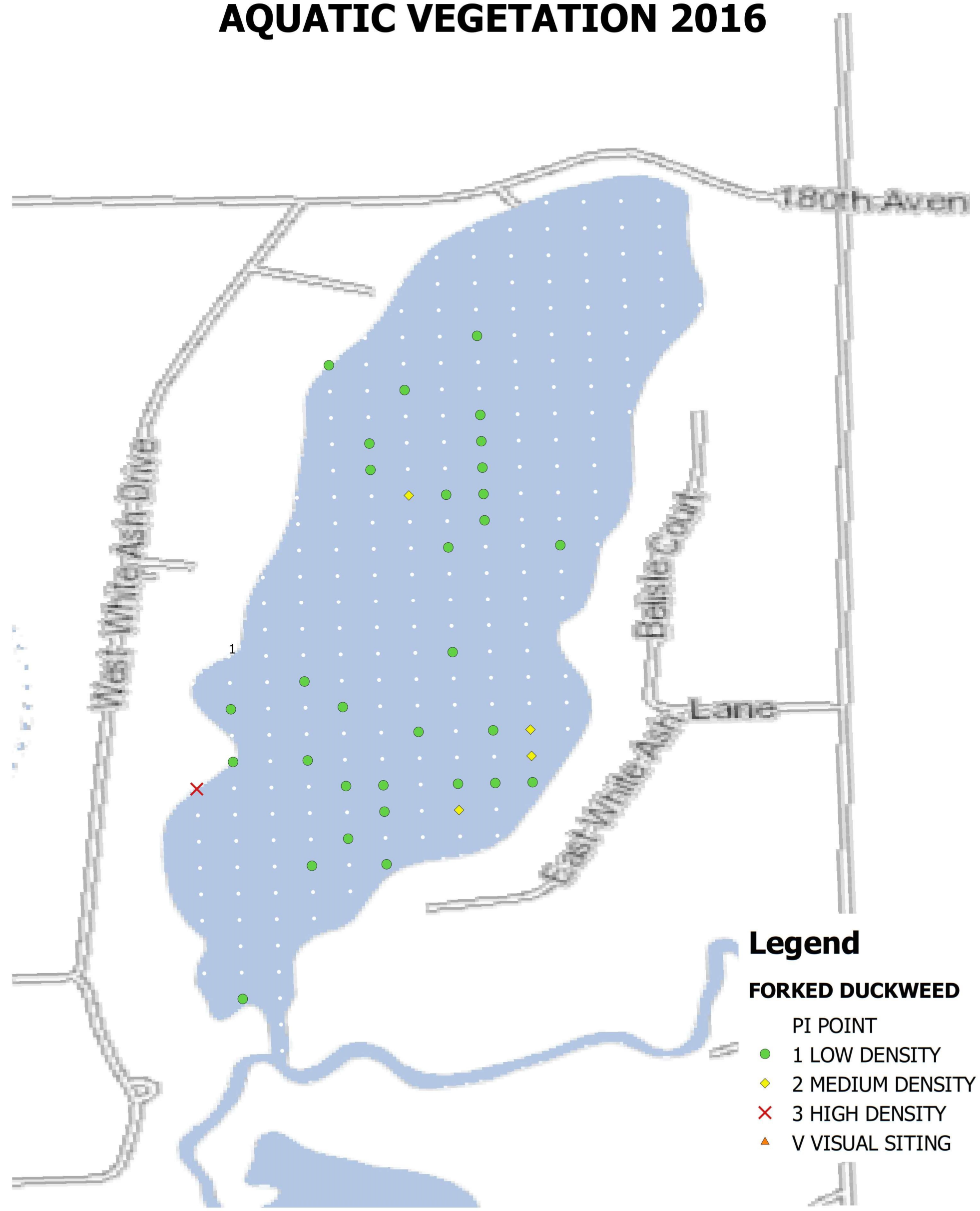
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



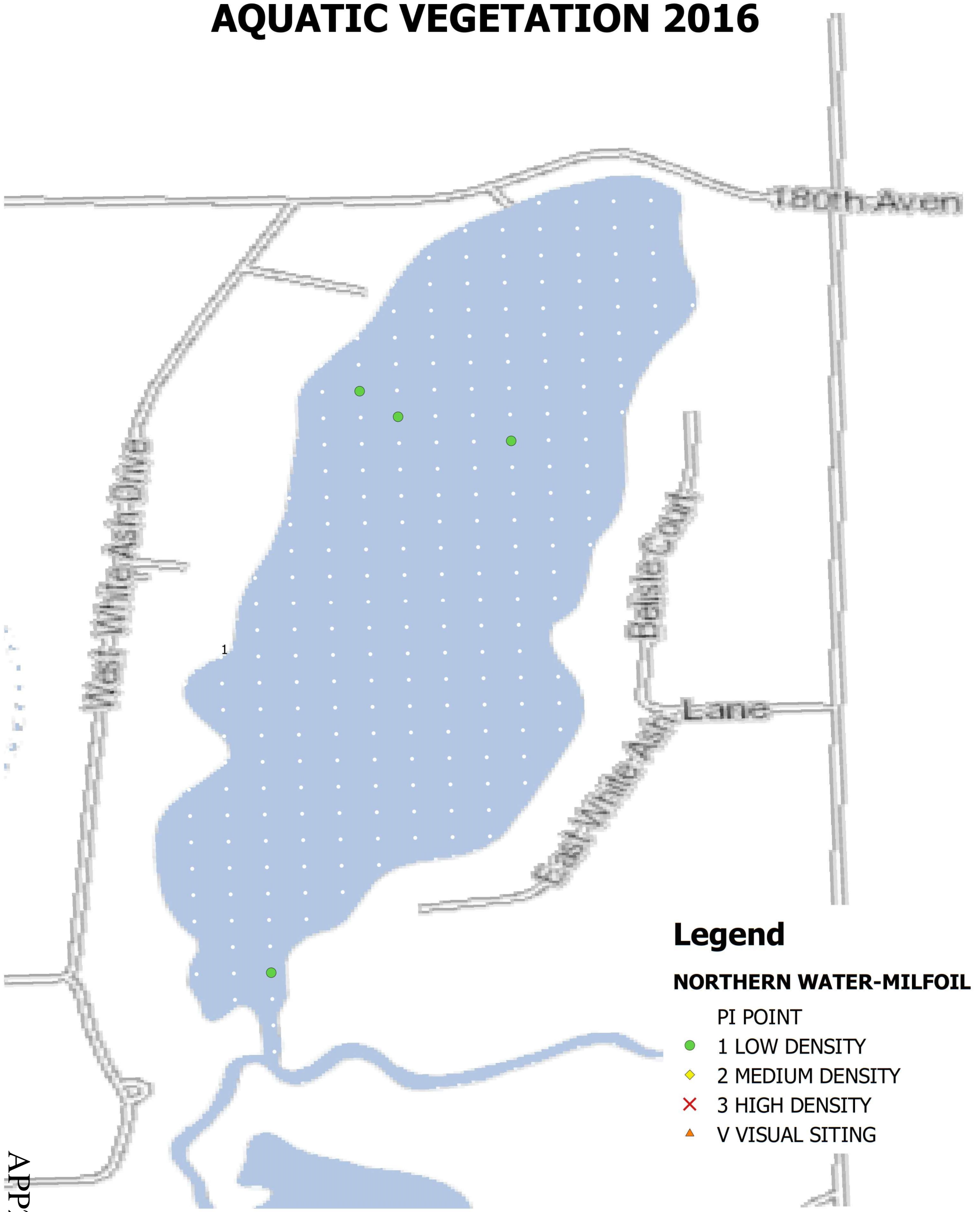
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



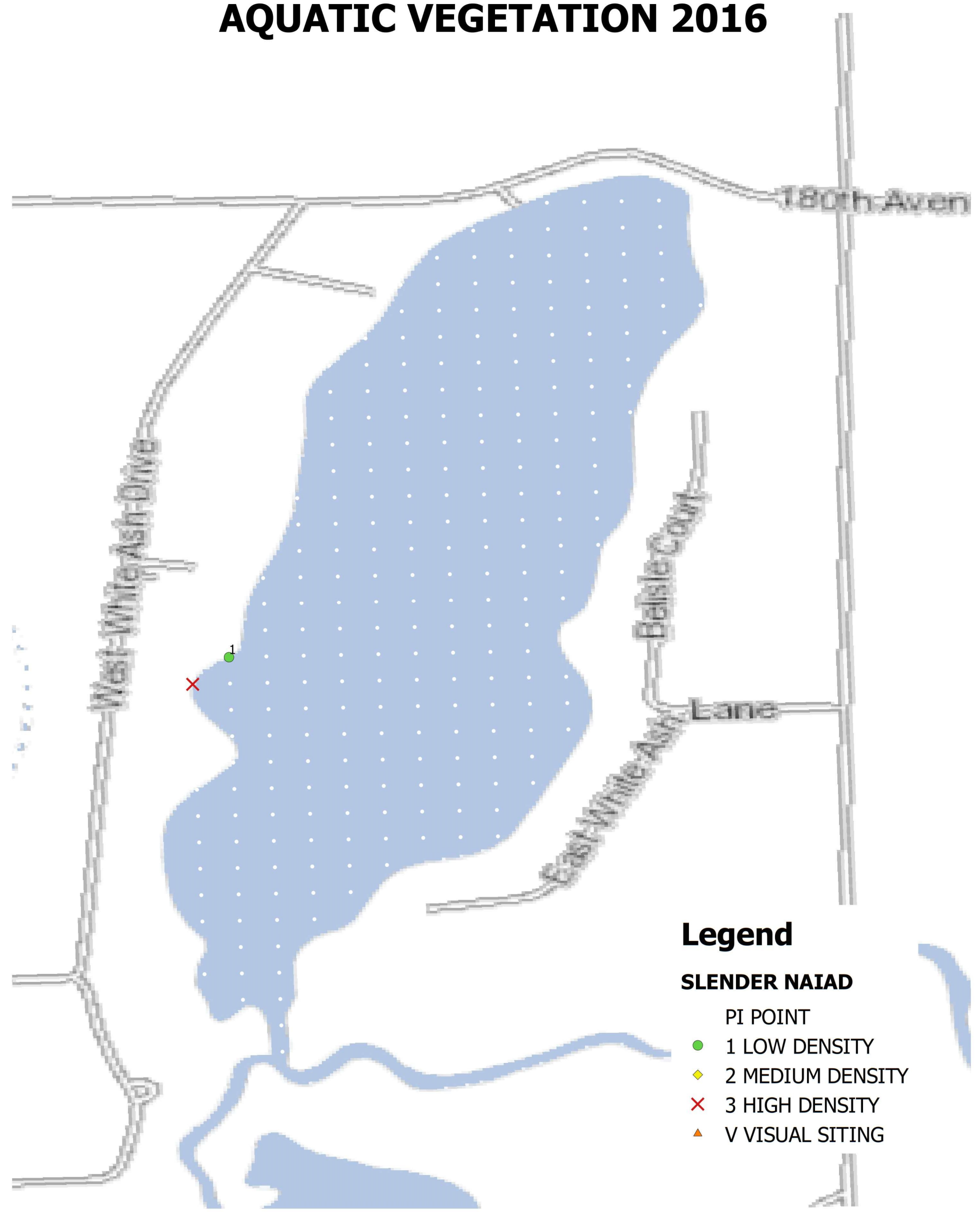
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



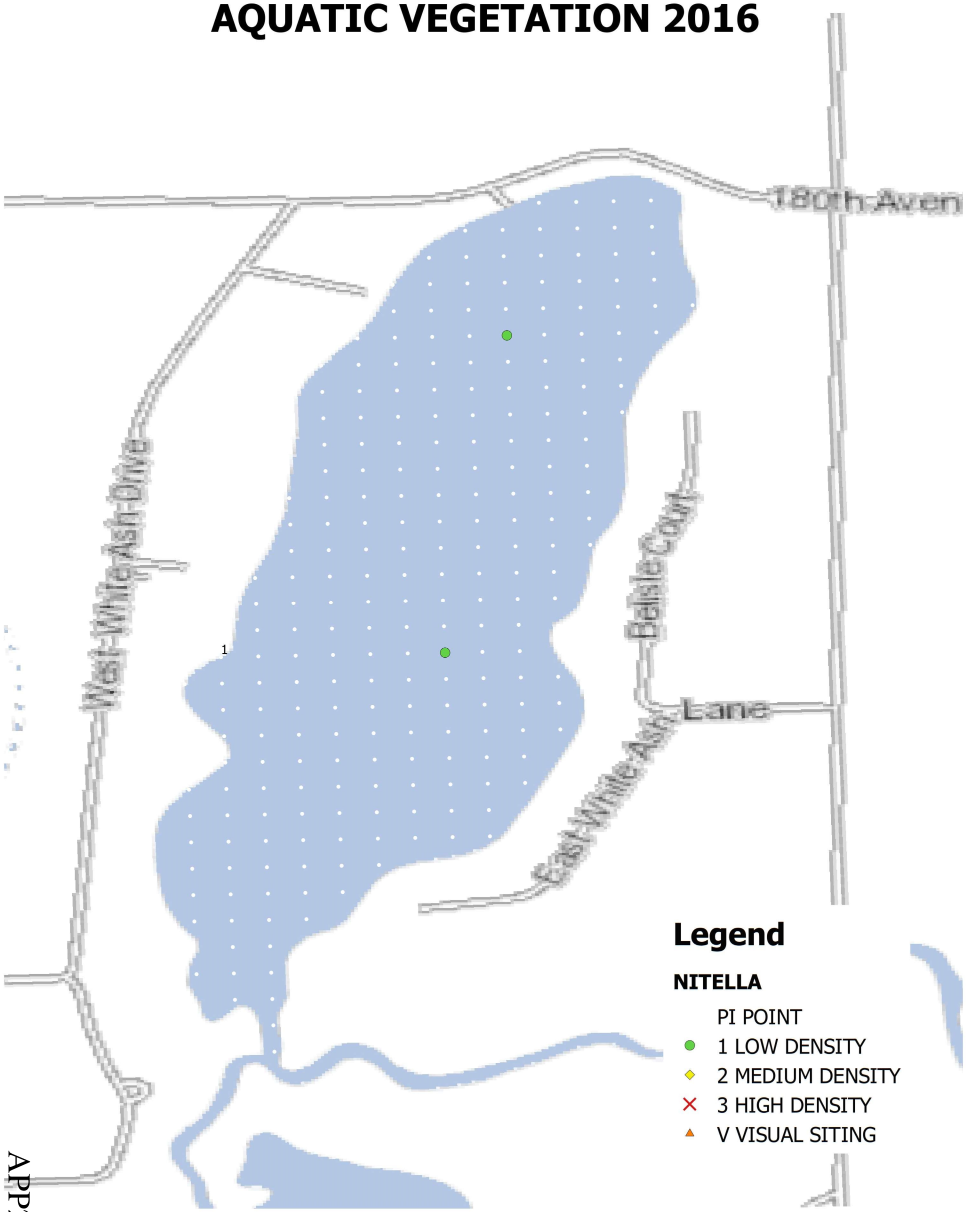
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



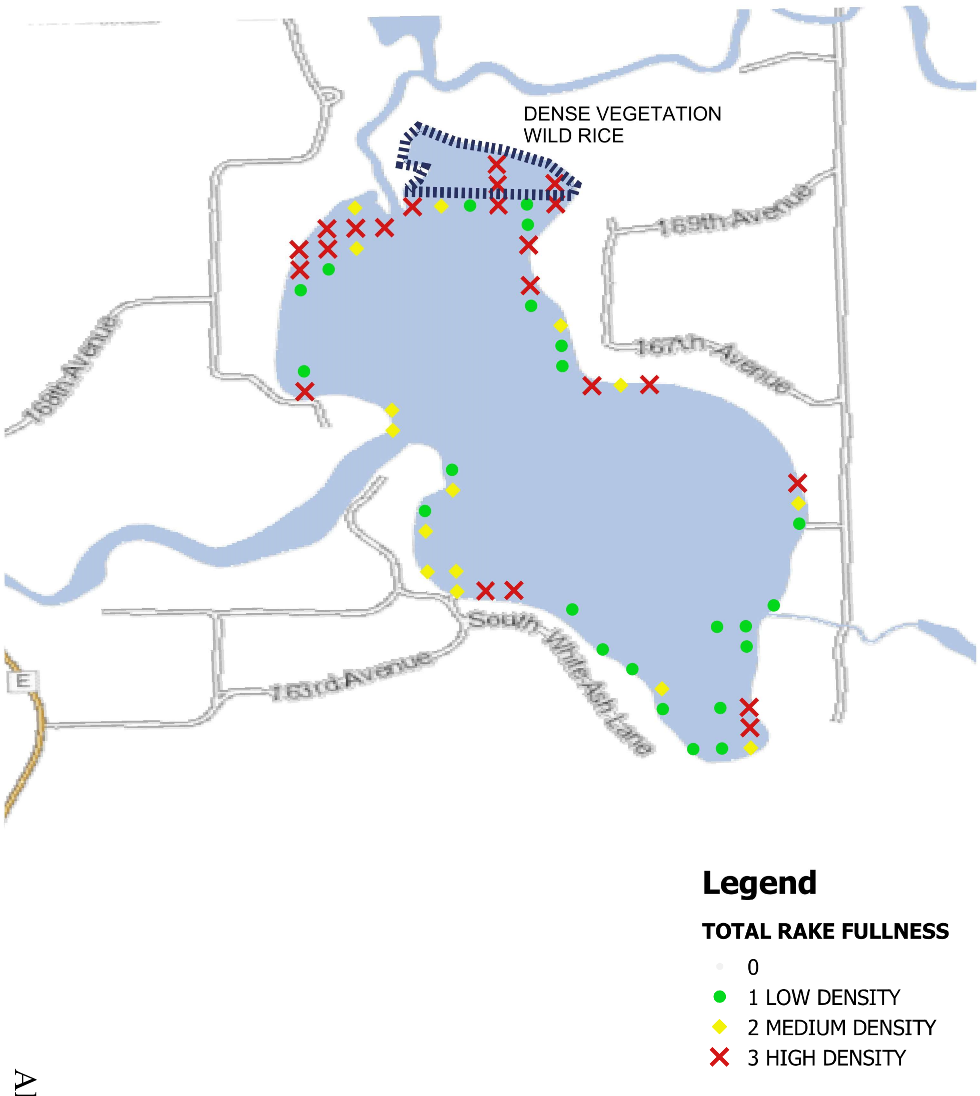
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



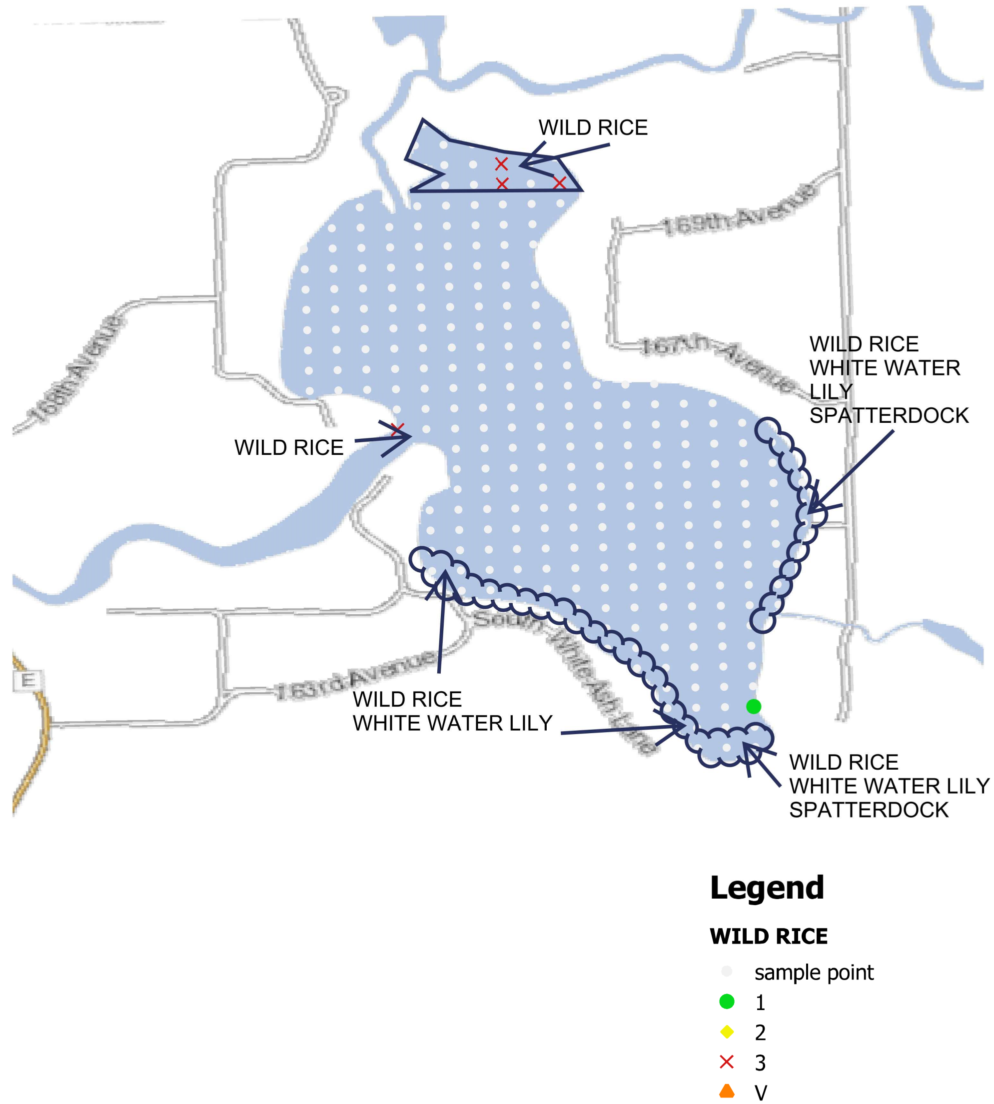
NORTH WHITE ASH LAKE
AQUATIC VEGETATION 2016



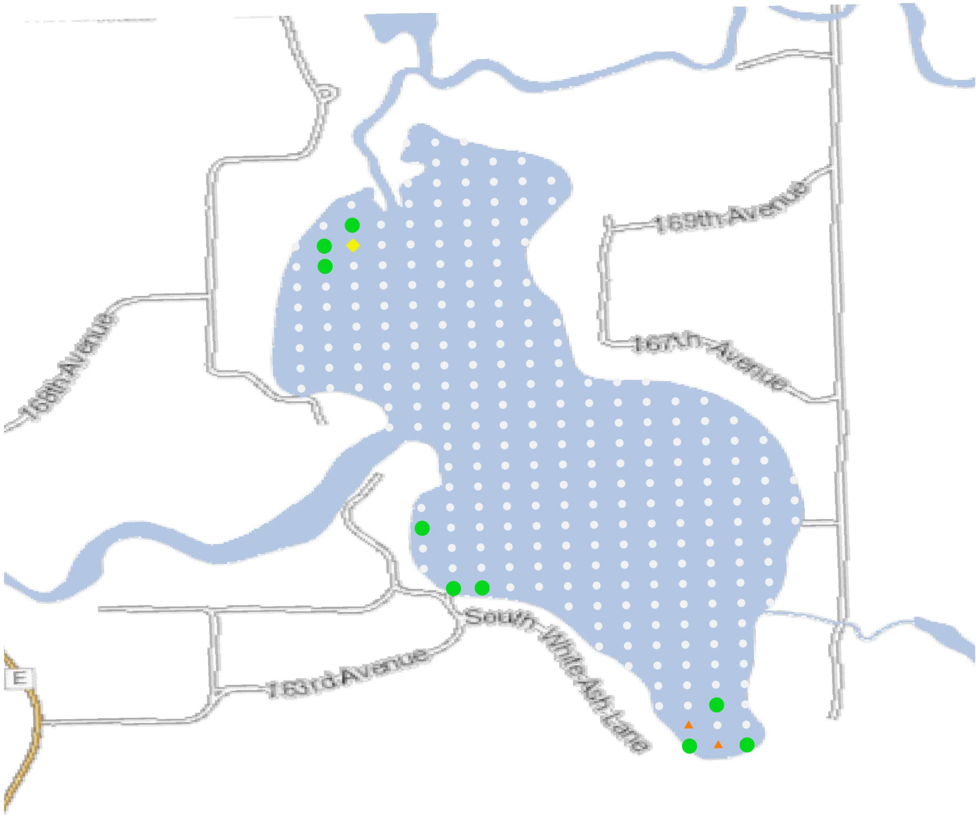
WHITE ASH LAKE
AQUATIC VEGETATION 2016



WHITE ASH LAKE
AQUATIC VEGETATION 2016
FLOATING LEAF AND EMERGENT VEGETATION



WHITE ASH LAKE
AQUATIC VEGETATION 2016

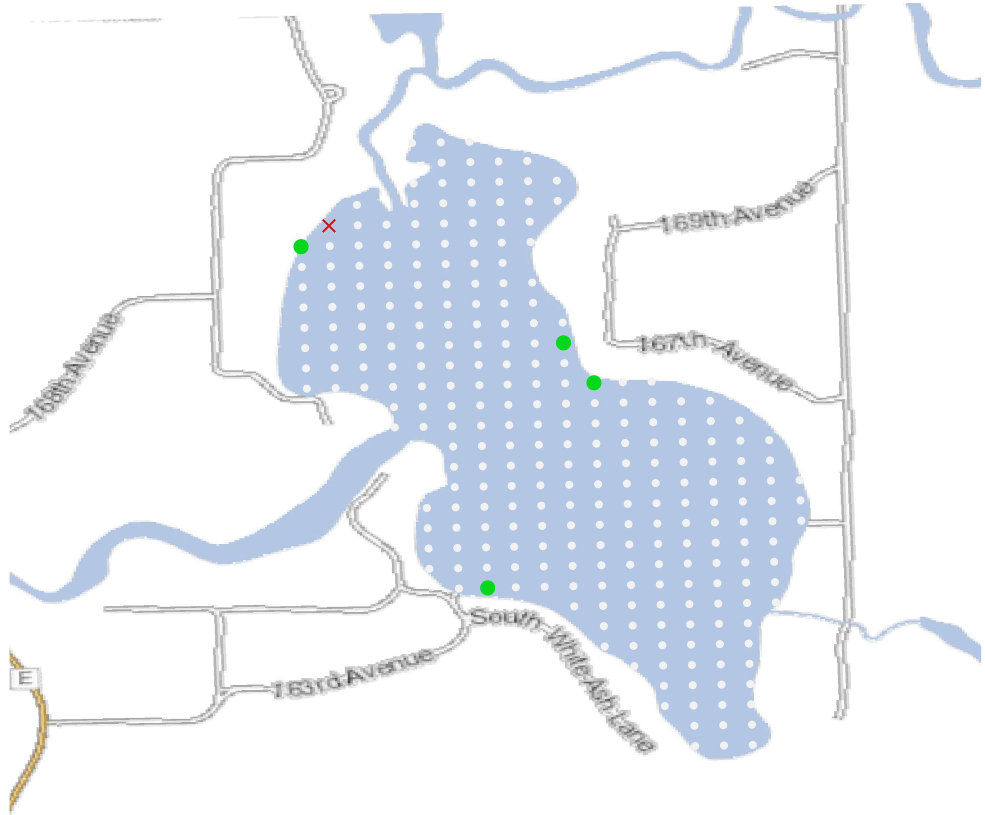


Legend

CURLY-LEAF PONDWEED

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

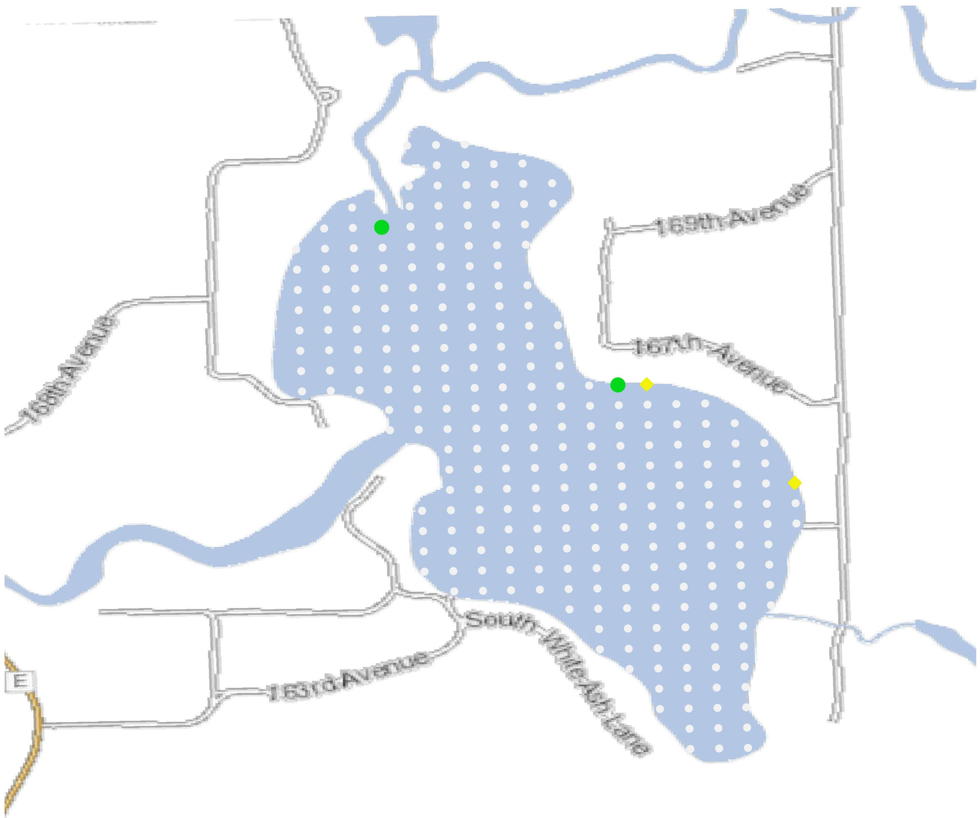


Legend

SLENDER NAIAD

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016



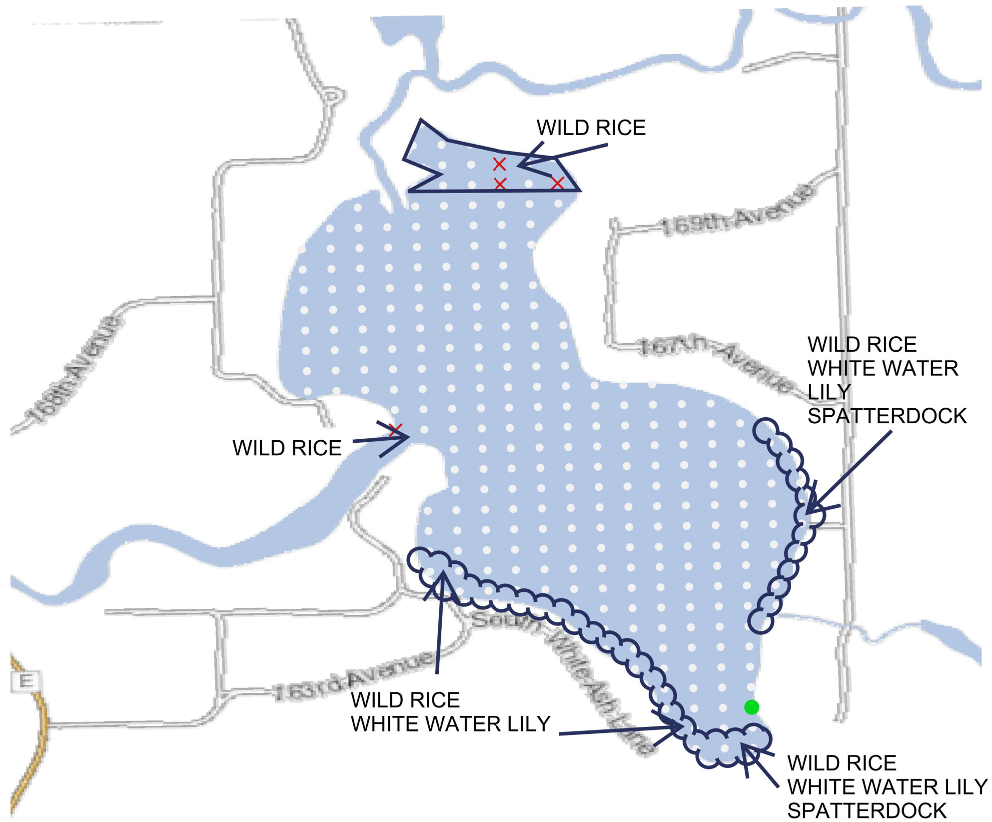
Legend

NORTHERN WATER MILFOIL

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

FLOATING LEAF AND EMERGENT VEGETATION

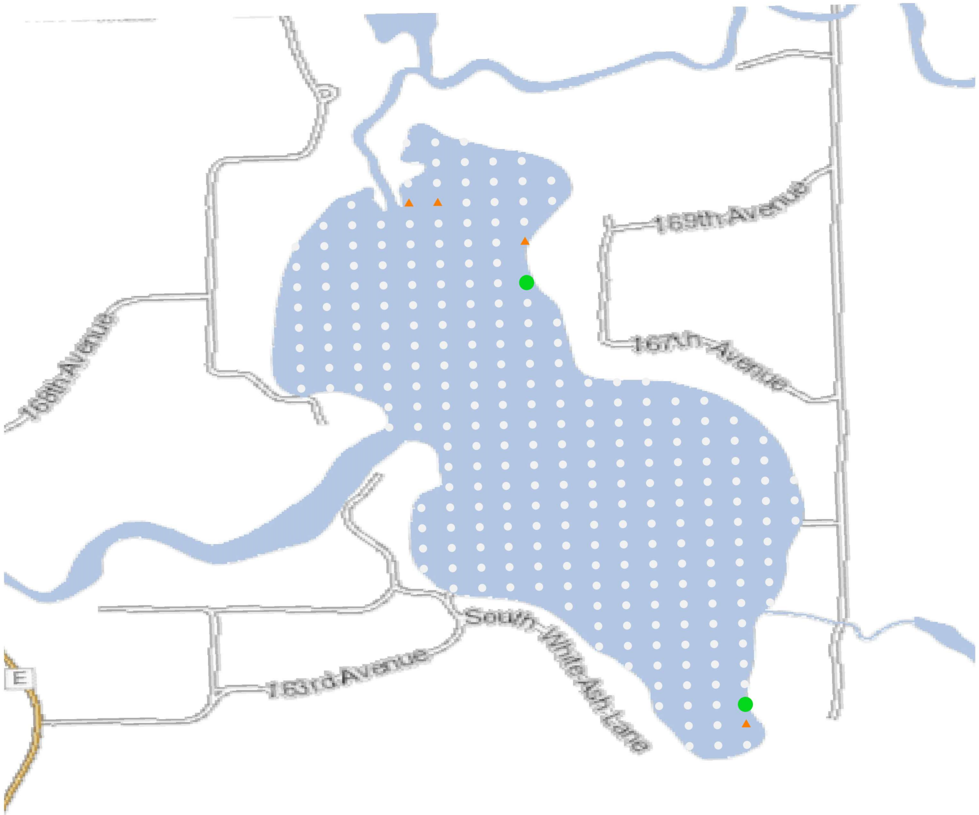


Legend

WILD RICE

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

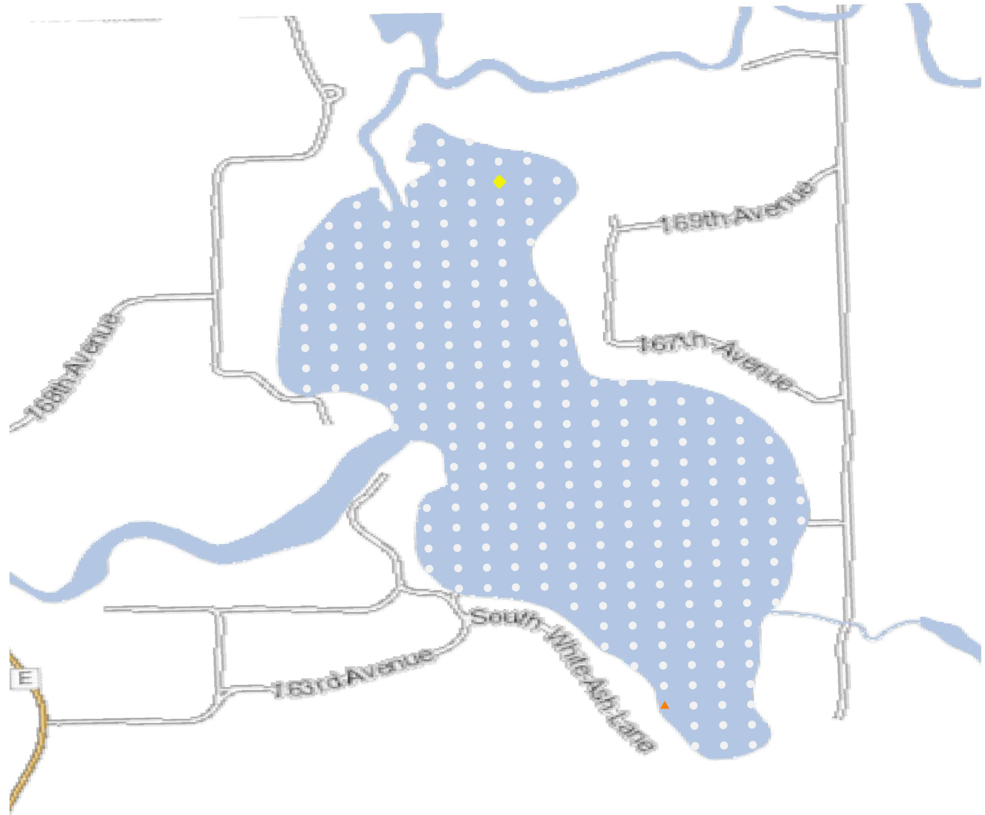


Legend

SPATTERDOCK

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

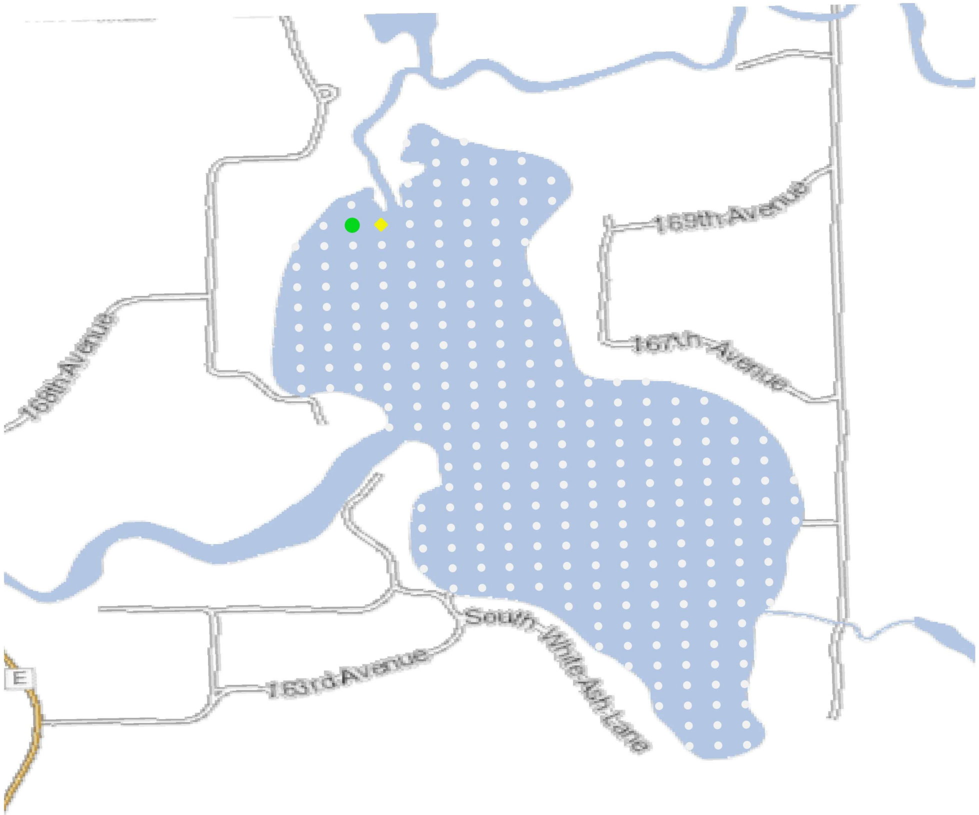


Legend

WHITE WATER LILY

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

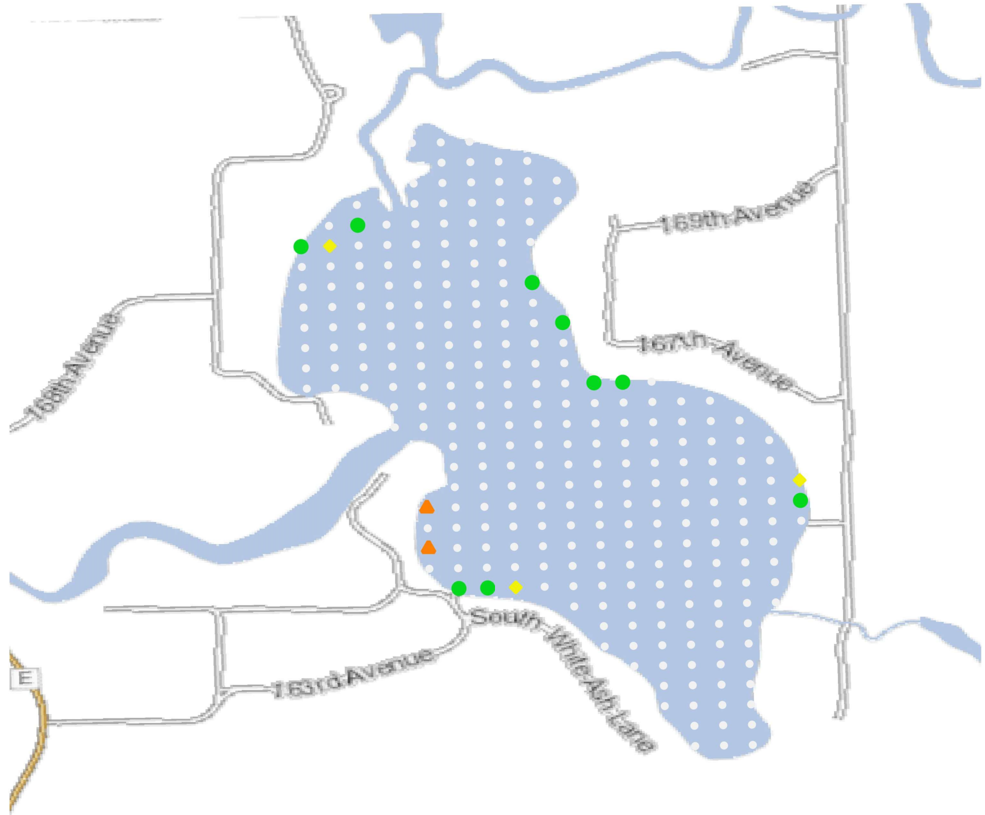


Legend

CLASPING LEAF PONDWEED

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

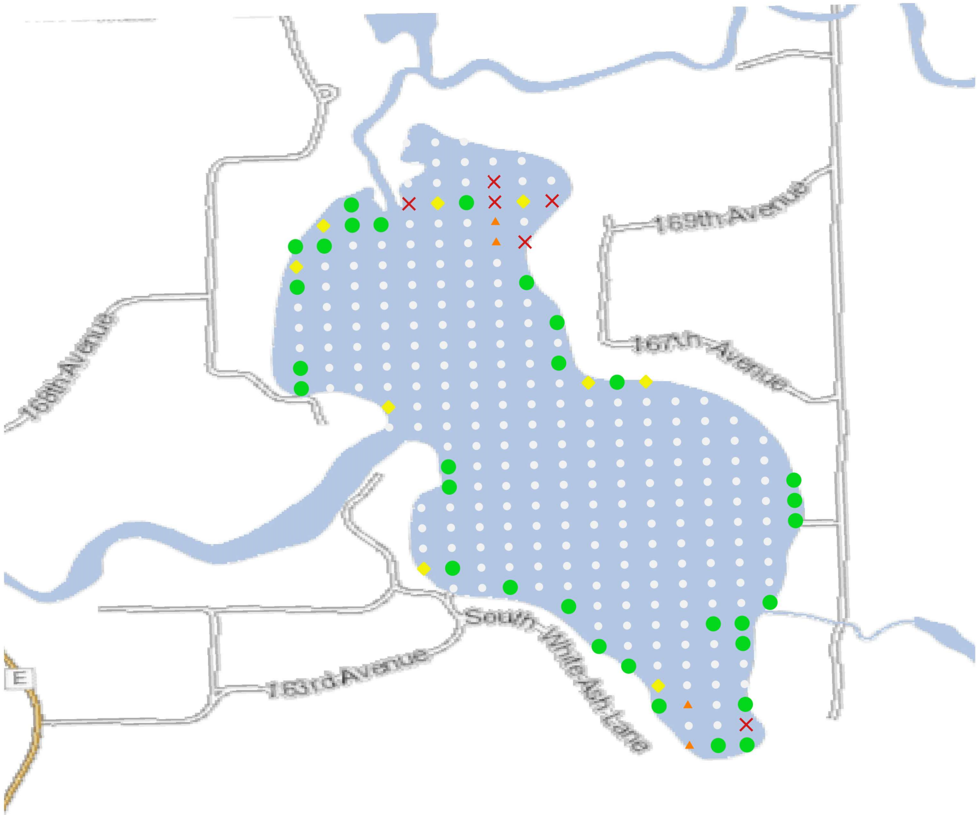


Legend

WILD CELERY

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

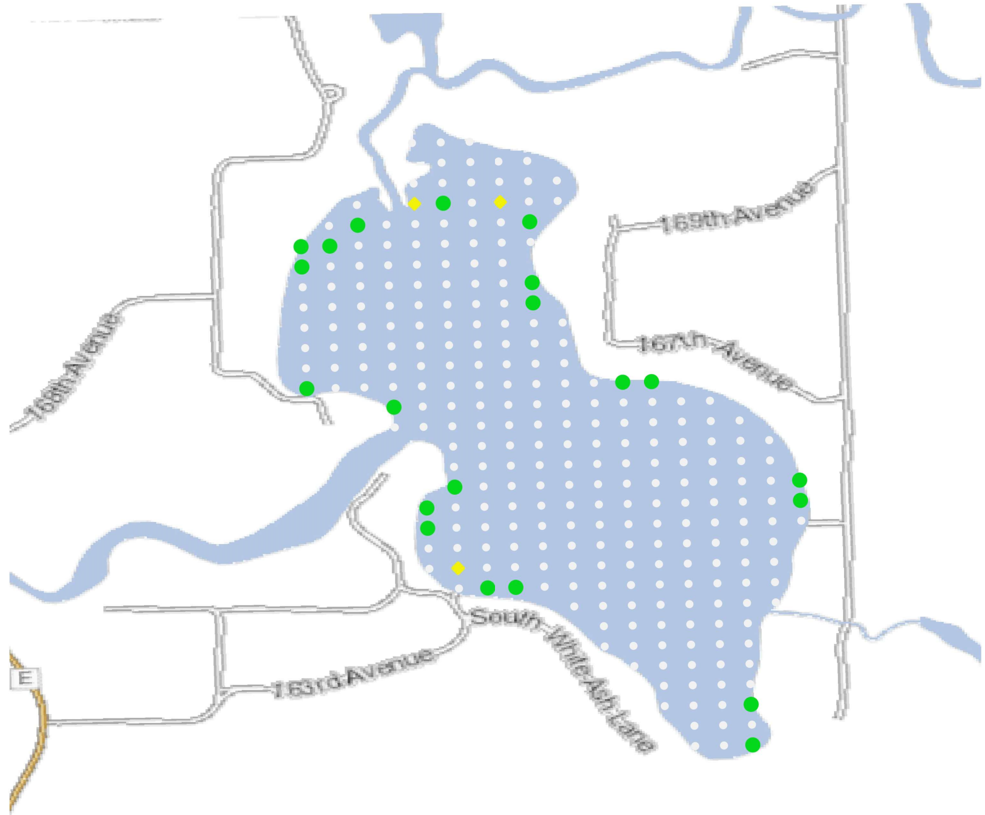


Legend

COONTAIL

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

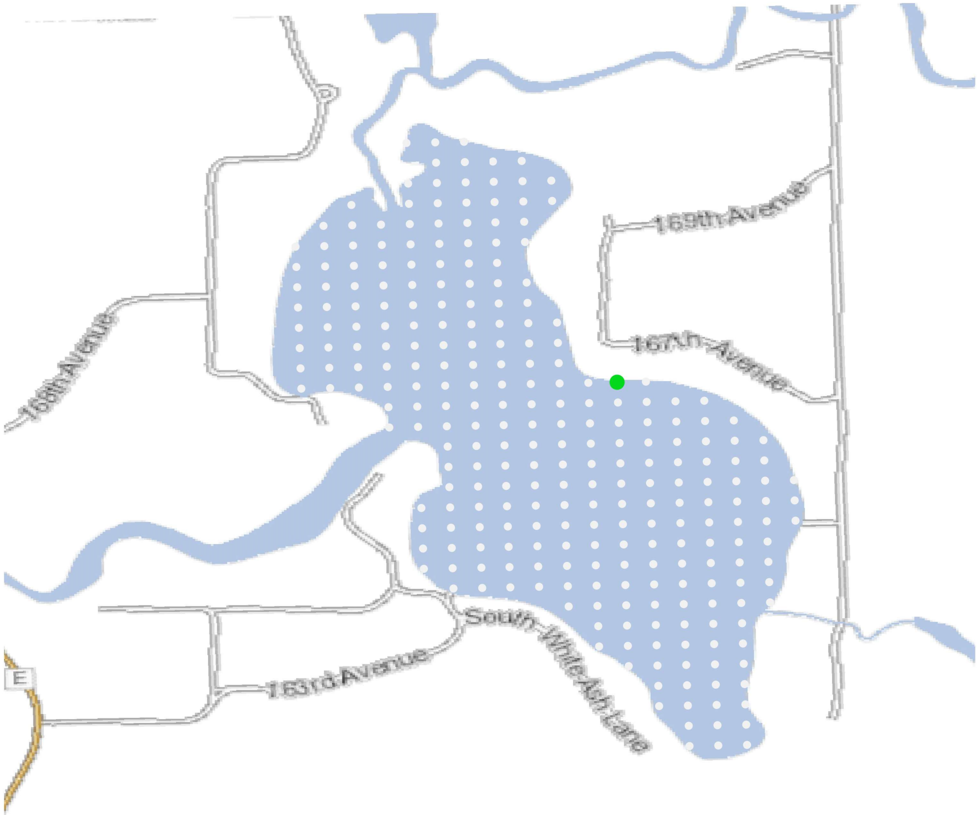


Legend

COMMON WATERWEED

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

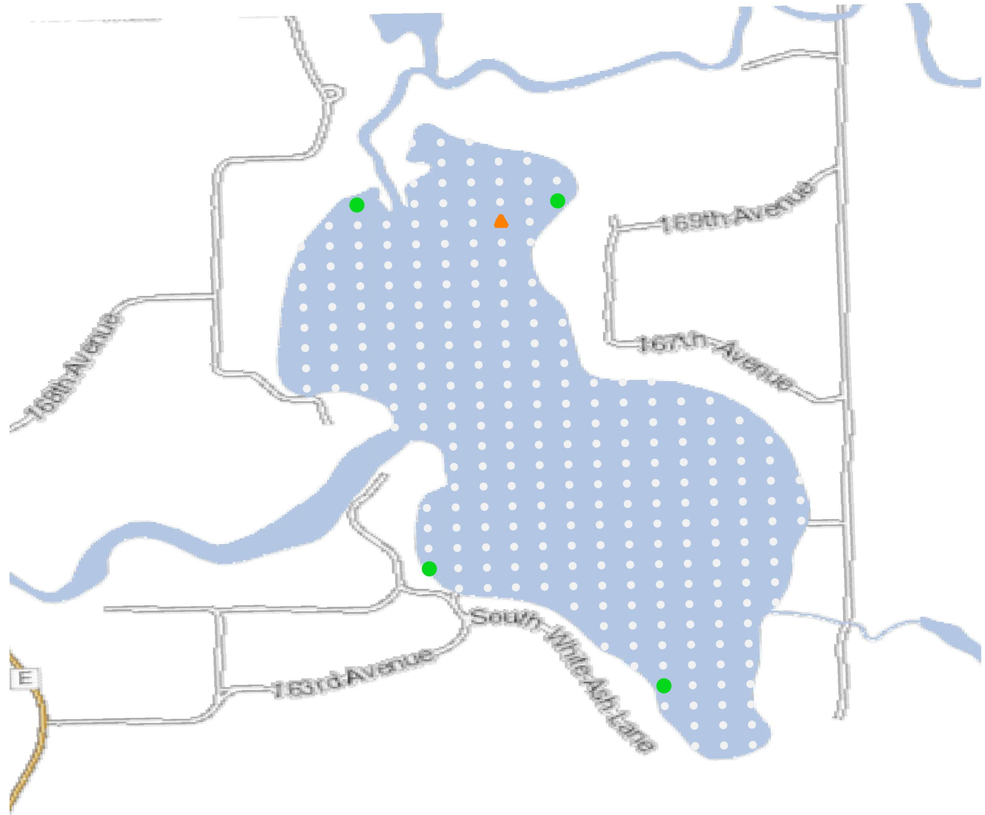


Legend

FILAMENTOUS ALGAE

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016

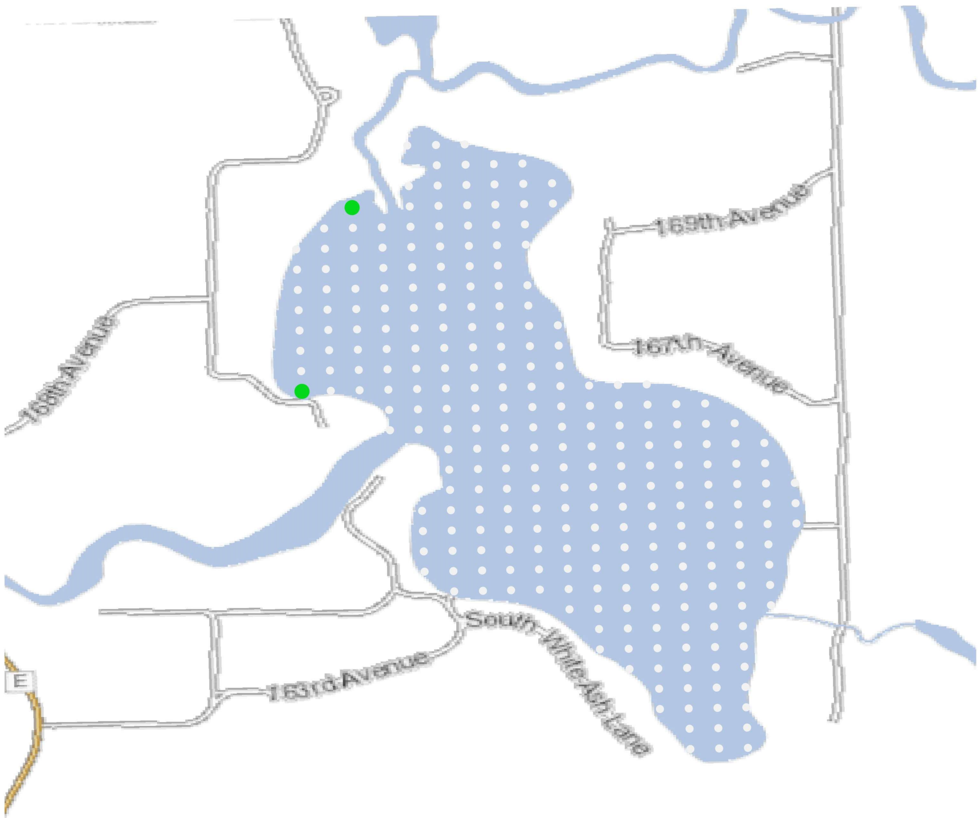


Legend

FLATSTEM PONDWEED

- sample point
- 1
- 2
- 3
- V

WHITE ASH LAKE
AQUATIC VEGETATION 2016



Legend

FORKED DUCKWEED

- sample point
- 1
- 2
- 3
- V

Appendix C1 – Importance of Aquatic Plants to Lake Ecosystem

AQUATIC PLANT TYPES AND HABITAT

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

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

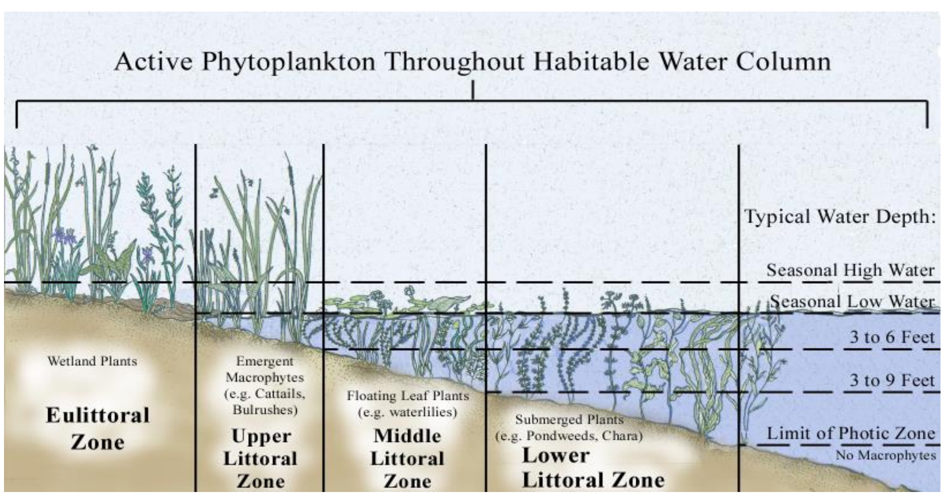
Eulittoral Zone: Includes the area between the highest and lowest seasonal water levels, and often contains many wetland plants.

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

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

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

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



Aquatic Plant Communities Schematic

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

AQUATIC PLANTS AND WATER QUALITY

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

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

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

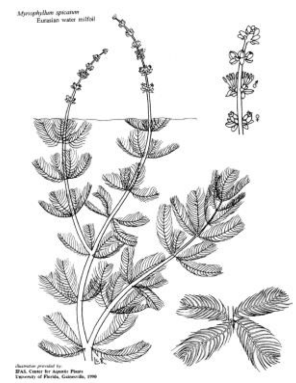
Aquatic plants also play a key role in the ecology of a lake system. Aquatic plants provide food and shelter for fish, wildlife and invertebrates. Plants also improve water quality by protecting shorelines and the lake bottom, improving water quality, adding to the aesthetic quality of the lake and impacting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

Appendix C2 – Aquatic Invasive Species

INVASIVE AQUATIC PLANTS

Invasive species have invaded our backyards, forests, prairies, wetlands, and waters. Invasive species are often transplanted from other regions, even from across the globe. "A species is regarded as invasive if it has been introduced by human action to a location, area, or region where it did not previously occur naturally (i.e., is not native), becomes capable of establishing a breeding population in the new location without further intervention by humans, and spreads widely throughout the new location " (Source: WDNR website, Invasive Species, 2007). 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 County.

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, 2007).

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, 2007).

Dense stands of EWM also inhibit recreational uses like swimming, boating, and fishing. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by EWM may lead to deteriorating water quality and algae blooms of infested lakes (WDNR website, 2007).

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. CLP forms surface mats that interfere with aquatic recreation in mid-summer, when most aquatic plants are growing, CLP plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches (WDNR website, 2007).

Purple Loosestrife (Lythrum salicaria)

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

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, 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, 2007).

OTHER AQUATIC INVASIVE SPECIES

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

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

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

http://dnr.wi.gov/invasives/fact/zebra.htm.

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

http://dnr.wi.gov/invasives/fact/spiny.htm.

Appendix D – Descriptions of Aquatic Plants

Description of Plants
WHITE ASH AND NORTH WHITE ASH 2016

Water marigold (Bidens beckii)

- Submersed
- Native; primarily in northern and eastern WI
- Found in soft sediment, clear water lakes from ankle deep to 3 meters deep
- Flowers attract insects, provide forage, shelter and shade to fish, shorebirds consume fruit.

Watershield (Braensia schreberi)

- Floating-leaf
- Native, common in northern WI
- Found in soft-water lakes with organic sediment in very shallow to water 2 m deep
- Consumed by waterfowl; provides habitat for fish and invertabrates

Coontail (Ceratophyllum demersum)

- Submersed
- Native and common in WI
- Tolerant of low light conditions and will grow in water several meters deep
- Offer prime habitat in winter due to stiff whorls and lack of other vegetation at this time of year

Common waterweed (Elodea Canadensis)

- Submersed plant up to 1 m long
- Native and common in WI
- Found in water depths from ankle to several meters deep, most abundant in fine sediments rich in organic matter
- Provide shelter and grazing opportunities for fish, food for muskrats and waterfowl.

Northern watermilfoil (Myriophyllum sibiricum)

- Submersed
- Native and common throughout WI
- Found in soft sediments in fairly clear water up to 4 meters deep; sensitive to reduced water clarity and declines in lakes that are becoming eutrophic
- Consumed by waterfowl; provide invertebrate habitat; provides shade, shelter and forage for fish.

Spatterdock (Nuphar variegate)

- Floating leaf

- Native and widely distributed in WI
- Found in sun or shade, prefers soft sediment in water 2 meters or less
- Anchors shallow water community; provides food for waterfowl, deer, muskrat, bever; provides shade and shelter for fish

White water lily (Nymphaea odorata)

- Floating leaf
- Native and widely distributed in WI
- Found in quiet water, variety of sediments in water 2 meters or less
- Provides food for waterfowl, deer, muskrat, beaver; provides shade and shelter for fish

Large-leaf pondweed (Potamogeton amplifolius)

- Submersed
- Native, throughout WI
- Found in one to several meters deep water , soft sediment; sensitive to increased turbidity and suffers when top-cut by motors
- Offers shade and foraging for fish, valuable waterfowl food

Clasping-leaf pondweed (Potamogeton richardsonii)

- Submersed
- Native; common throughout WI
- Grows in a variety of substrates up to 4 meters deep; tolerant of disturbance and often found with coontail and small pondweed
- Fruit locally important food for waterfowl, grazed by mammals; provides forage and cover for fish

Floating-leaf burreed (Sparganium fluctuans)

- Submersed
- Native and common in WI
- Found in quiet water, muddy sediment

Common bladderwort (Utricularia vulgaris)

- Submersed
- Native and common in WI
- Free-floating, occur in various depths; most successful in still water
- Provide fish habitat

Wild celery (Vallisneria Americana)

- Submersed

- Native, throughout WI
- Found in firm substrate in water from ankle to several meters deep; turbidity tolerant and survives wide range of water chemistries
- Premiere source of food for waterfowl, all portions of plant are consumed; grazed by muskrats, good fish habitat that provide shade, shelter and food

Filamentous algae

- Submersed
- Forms on bottom and floats to top in mats
- Stringy, like wet wool

Wild Rice

- Emergent
- Sprouts from seed, found in silt or muck, win water 10 cm to 1m deep, in moving water
- Valued by waterfowl, muskrats and humans

Nitella

- Submersed
- Algae that looks like a plant, found in soft sediments in deep zones
- Harbors invertebrates, grazed by waterfowl, foraging for fish

Naiad

- Submersed
- Fine branching stems that grow in sandy sediment in a variety of depths
- One of most important foods for waterfowl,

Appendix E – Summary of Aquatic Plant Management Alternatives

Management Options for Aquatic Plants

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

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

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

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

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

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

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

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

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

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

Techniques for Aquatic Plant Control Not Allowed in Wisconsin

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

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

Aquatic Plant Management

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

Physical Controls

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Dredging

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

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

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

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

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

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

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

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

Chemical Controls

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Biological Controls

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Aquatic Plant Prevention

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

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

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

Appendix F – NR 107 and NR 109 Wisconsin Administrative Code

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Chapter NR 107

AQUATIC PLANT MANAGEMENT

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

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

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

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

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

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

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

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

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

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

Note: The DNR district headquarters are located at:

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

(2) The application shall be accompanied by:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(d) Liquid chemicals are to be used.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(e) Conclusions and recommendations for future use.

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

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

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

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

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

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

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

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

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

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

(a) Water tanks used for potable water supplies;

(b) Swimming pools;

(c) Treatment of public or private wells;

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

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

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

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

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Chapter NR 109

AQUATIC PLANTS: INTRODUCTION, MANUAL REMOVAL and MECHANICAL CONTROL REGULATIONS

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

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

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

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

NR 109.03 Definitions. In this chapter:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Note: Scientific collectors permit requirements are still applicable.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(c) The intensity of water use.

(d) The location of aquatic plant management activities.

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

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

(g) An education and information strategy.

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

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

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

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

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

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

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

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

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

Appendix G – Resource for Additional Information

WISCONSIN DEPARTMENT OF NATURAL RESOURCES LAKES

http://dnr.wi.gov/lakes/

http://dnrmaps.wi.gov/H5/?viewer=Lakes_AIS_Viewer

Aquatic Plant Management
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Regional DNR AIS Coordinator
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Kris.Larsen@wisconsin.gov

County or Tribal Coordinator
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Report a New Finding
Kris Larsen
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Kris.Larsen@wisconsin.gov

Water Guard
Ashley Dooley
ashley.dooley@wisconsin.gov

Grants - Applying and Technical Assistance
Alex Smith
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Alex.Smith@Wisconsin.gov

Citizen Lake Monitoring - Getting Started

Kris Larsen
715-635-4072
Kris.Larsen@wisconsin.gov

Paul Skawinski
715-346-4853
Paul.Skawinski@uwsp.edu

UW-EXTENSION LAKES

https://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/default.aspx

https://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/programs/cbcw/default.aspx

Appendix H – Aquatic Plant Management Strategy

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR
Summer, 2007
(working draft)

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

ISSUES

- Protect desirable native aquatic plants.
- Reduce the risk that invasive species replace desirable native aquatic plants.
- Promote "whole lake" management plans
- Limit the number of permits to control native aquatic plants.

BACKGROUND

As a general rule, the Northern Region has historically taken a protective approach to allow removal of native aquatic plants by harvesting or by chemical herbicide treatment. This approach has prevented lakes in the Northern Wisconsin from large-scale loss of native aquatic plants that represent naturally occurring high quality vegetation. Naturally occurring native plants provide a *diversity of habitat* that *helps maintain water quality*, helps *sustain the fishing* quality known for Northern Wisconsin, supports common lakeshore wildlife from loons to frogs, and helps to provide the *aesthetics* that collectively create the "up-north" appeal of the northwoods lake resources.

In Northern Wisconsin lakes, an inventory of aquatic plants may often find 30 different species or more, whereas a similar survey of a Southern Wisconsin lake may often discover less than half that many species. Historically, similar species diversity was present in Southern Wisconsin, but has been lost gradually over time from stresses brought on by cultural land use changes (such as increased development, and intensive agriculture). Another point to note is that while there may be a greater variety of aquatic vegetation in Northern Wisconsin lakes, the vegetation itself is often *less dense*. This is because northern lakes have not suffered as greatly from nutrients and runoff as have many waters in Southern Wisconsin.

The newest threat to native plants in Northern Wisconsin is from invasive species of aquatic plants. The most common include Eurasian Water Milfoil (EWM) and CurlyLeaf Pondweed (CLP). These species are described as *opportunistic invaders*. This means that these "invaders" benefit where an opening occurs from removal of plants, and without competition from other plants may successfully become established in a lake. Removal of native vegetation not only diminishes the natural qualities of a lake, it *may increase the risk that an invasive species can successfully invade onto the site where native plants have been removed*. There it may more easily establish itself without the native plants to compete against. This concept is easily observed on land where bared soil is quickly taken over by replacement species (often weeds) that crowd in and establish themselves as new occupants of the site. While not a providing a certain guarantee against invasive plants, protecting and allowing the native plants to remain may reduce the success of an invasive species becoming established on a lake. Once established, the invasive species cause far more inconvenience for all lake users, riparian and others included; can change many of the natural features of a lake; and often lead to *expensive annual control plans*. Native vegetation may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.

To the extent we can maintain the normal growth of native vegetation, Northern Wisconsin lakes can continue to offer the water resource appeal and benefits they've historically provided. A regional position on removal of aquatic plants that carefully recognizes how native aquatic plants benefit lakes in Northern Region can help prevent a gradual decline in the overall quality and recreational benefits that make these lakes attractive to people and still provide abundant fish, wildlife, and northwoods appeal.

GOALS OF STRATEGY:

1. Preserve native species diversity which, in turn, fosters natural habitat for fish and other aquatic species, from frogs to birds.
2. Prevent openings for invasive species to become established in the absence of the native species.
3. Concentrate on a" whole-lake approach" for control of aquatic plants, thereby fostering systematic documentation of conditions and specific targeting of invasive species as they exist.
4. Prohibit removal of wild rice. WDNR – Northern Region will not issue permits to remove wild rice unless a request is subjected to the full consultation process via the Voigt Tribal Task Force. We intend to discourage applications for removal of this ecologically and culturally important native plant.
5. To be consistent with our WDNR Water Division Goals (work reduction/disinvestment), established in 2005, to "not issue permits for chemical or large scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities." This process is similar to work done in other WDNR Regions, although not formalized as such.

BASIS OF STRATEGY IN STATE STATUTE AND ADMINISTRATIVE CODE

State Statute 23.24 (2)(c) states:

"The requirements promulgated under par. (a) 4. may specify any of the following:

1. The **quantity** of aquatic plants that may be managed under an aquatic plant management permit.
2. The **species** of aquatic plants that may be managed under an aquatic plant management permit.
3. The **areas** in which aquatic plants may be managed under an aquatic plant management permit.
4. The **methods** that may be used to manage aquatic plants under an aquatic plant management permit.
5. The **times** during which aquatic plants may be managed under an aquatic plant management permit.
6. The **allowable methods** for disposing or using aquatic

plants that are removed or controlled under an aquatic plant management permit.

7. The requirements for plans that the department may require under sub. (3) (b). “

State Statute 23.24(3)(b) states:
“The department may require that an application for an aquatic plant management permit contain a plan for the department’s approval as to how the aquatic plants will be introduced, removed, or controlled.“

Wisconsin Administrative Code NR 109.04(3)(a) states:
“The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long-term sustainability of beneficial water use activities.”

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

APPROACH

1. After January 1, 2009* no individual permits for control of native aquatic plants will be issued. Treatment of native species may be allowed under the auspices of an approved lake management plan, and only if the plan clearly documents "impairment of navigation" and/or "nuisance conditions". Until January 1, 2009, individual permits will be issued to previous permit holders, only with adequate documentation of "impairment of navigation" and/or "nuisance conditions". No new individual permits will be issued during the interim.

2. Control of aquatic plants (if allowed) in documented sensitive areas will follow the conditions specified in the report.

3. Invasive species must be controlled under an approved lake management plan, with two exceptions (these exceptions are designed to allow sufficient time for lake associations to form and subsequently submit an approved lake management plan):
   a. Newly-discovered infestations. If found on a lake with an approved lake management plan, the invasive species can be controlled via an amendment to the approved plan. If found on a lake without an approved management plan, the invasive species can be controlled under the WDNR's Rapid Response protocol (see definition), and the lake owners will be encouraged to form a lake association and subsequently submit a lake management plan for WNDR review and approval.
   b. Individuals holding past permits for control of *invasive* aquatic plants and/or "mixed stands" of native and invasive species will be allowed to treat via individual permit until January 1, 2009 if "impairment of navigation" and/or "nuisance conditions" is adequately documented, unless there is an approved lake management plan for the lake in question.

4. Control of invasive species or "mixed stands" of invasive and native plants will follow current best management practices approved by the Department and contain an explanation of the strategy to be used. Established stands of invasive plants will generally use a control strategy based on Spring treatment. (typically, a water temperature of less than 60 degrees Fahrenheit, or approximately May 31st, annually).

5. Manual removal (see attached definition) is allowed (Admin. Code NR 109.06).

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* *Exceptions to the Jan. 1, 2009 deadline will be considered only on a very limited basis and will be intended to address unique situations that do not fall within the intent of this approach.*

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DOCUMENTATION OF IMPAIRED NAVIGATION AND/OR NUISANCE CONDITIONS

Navigation channels can be of two types:

- Common use navigation channel. This is a common navigation route for the general lake user. It often is off shore and connects areas that boaters commonly would navigate to or across, and should be of public benefit.

- Individual riparian access lane. This is an access lane to shore that normally is used by an individual riparian shore owner.

Severe impairment or nuisance will generally mean vegetation grows thickly and forms mats on the water surface. Before issuance of a permit to use a regulated control method, a riparian will be asked to document the problem and show what efforts or adaptations have been made to use the site. (This is currently required in NR 107 and on the application form, but the following helps provide a specific description of what impairments exist from native plants).

Documentation of *impairment of navigation* by native plants must include:

a. Specific locations of navigation routes (preferably with GPS coordinates)
b. Specific dimensions in length, width, and depth
c. Specific times when plants cause the problem and how long the problem persists
d. Adaptations or alternatives that have been considered by the lake shore user to avoid or lessen the problem
e. The species of plant or plants creating the nuisance (documented with samples or a from a Site inspection)

Documentation of the *nuisance* must include:

a. Specific periods of time when plants cause the problem, e.g. when does the problem start and when does it go away.
b. Photos of the nuisance are encouraged to help show what uses are limited and to show the severity of the problem.
c. Examples of specific activities that would normally be done where native plants occur naturally on a site but can not occur because native plants have become a nuisance.

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

DEFINITIONS

Manual removal:	Removal by hand or hand-held devices without the use or aid of external or auxiliary power. Manual removal cannot exceed 30 ft. in width and can only be done where the shore is being used for a dock or swim raft. The 30 ft. wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed. Wild rice may not be removed under this waiver.
Native aquatic plants:	Aquatic plants that are indigenous to the waters of this state.
Invasive aquatic plants:	Non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
Sensitive area:	Defined under s. NR 107.05(3)(i) (sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water).
Rapid Response protocol:	This is an internal WDNR document designed to provide guidance for grants awarded under NR 198.30 (Early Detection and Rapid Response Projects). These projects are intended to control pioneer infestations of aquatic invasive species before they become established.