

# Aquatic Plant Management Plan Church Pine, Round and Big Lakes

Polk County, Wisconsin

August 2015



## Sponsored By

Church Pine, Round and Big Lakes Protection and Rehabilitation District

## Prepared By

Harmony Environmental  
Ecological Integrity Services

Plan Writing and Facilitation  
Aquatic Plant Survey and Mapping

## Funded By

Church Pine, Round and Big Lake Protection and Rehabilitation District

A Wisconsin Department of Natural Resources Grant



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# Table of Contents

Executive Summary .....	1
Introduction.....	2
Public Input for Plan Development.....	2
Lake Information .....	4
The Lakes.....	4
Water Quality.....	7
Shorelines.....	12
Lake Watersheds.....	13
Curly Leaf Pondweed Dieback.....	17
Aquatic Habitats.....	18
Primary Human Use Areas .....	18
Functions and Values of Native Aquatic Plants .....	18
Aquatic Invasive Species Status .....	19
Sensitive Areas.....	20
Rare and Endangered Species Habitat .....	22
Lakes Fishery .....	23
Plant Community .....	24
Aquatic Plant Survey Results .....	24
Aquatic Invasive Species .....	37
Aquatic Plant Management.....	42
Discussion of Management Methods.....	42
Previous Aquatic Plant Management Plans .....	54
Past Aquatic Plant Management .....	55
Current Aquatic Plant Management.....	56
Plan Goals and Strategies.....	63
Monitoring and Assessment.....	70

# Tables

Table 1. Lake Information .....	4
Table 2. Citizen Lake Monitoring Results, July and August 2014.....	7
Table 3. Church Pine Lake Watershed Land Use and Nutrient Loading.....	14
Table 4. Round Lake Watershed Land Use and Nutrient Loading.....	15
Table 5. Big Lake Watershed Land Use and Nutrient Loading.....	15
Table 6. Spawning Temperatures and Substrate Needs.....	23
Table 7. Fish Species of Project Lakes .....	23
Table 8. Church Pine Lake Aquatic Plant Survey Summary.....	26
Table 9. Aquatic Plant Species of Church Pine Lake .....	27
Table 10. Round Lake Aquatic Plant Survey Summary .....	29
Table 11. Aquatic Plant Species of Round Lake .....	29
Table 12. Boat Survey Shoreline Species Observed Round Lake 2014.....	31
Table 13. Big Lake Plant Summary Data .....	32
Table 14. Aquatic Plant Species of Big Lake .....	35
Table 15. Boat Survey Shoreline Species Observed Big Lake 2014.....	36
Table 16. FQI Comparison of Project Lakes to Ecoregion.....	37
Table 17. Herbicides Used for the Management of Aquatic Plants in Project Lakes.....	50
Table 18. Past Waterfront Herbicide Treatments on Church Pine Lake.....	55
Table 19. Past Waterfront Herbicide Treatments on Big Lake .....	56
Table 20. CLP Treatment Summary (2011 – 2014) .....	57
Table 21. Mean Turion Density by Bed (turions/m <sup>2</sup> ) .....	59
Table 22. Clean Boats Clean Waters Boat Landing Inspections .....	62
Table 23. WDNR Aquatic Invasive Species Grants to BRCP PRD.....	71

# Figures

Figure 1. Big Lake and Church Pine Lake Contour Maps.....	5
Figure 2. Project Lakes Boat Access Sites.....	6
Figure 3. Church Pine Summer Average Secchi Depths 1986-2012.....	8
Figure 4. Church Pine Trophic State Index 1986-2014.....	8
Figure 5. Round (Wind) Summer Average Secchi Depths 1986-2012.....	9
Figure 6. Round (Wind) Trophic State Index 1986-2014.....	9
Figure 7. Big Lake Summer Average Secchi Depths 1986-2012.....	10
Figure 8. Big Lake Trophic State Index 1986-2014.....	10
Figure 9. Watershed Land Use.....	13
Figure 10. Sensitive Area/Critical Habitat Area Designations.....	21
Figure 11. Church Pine Lake Sampling Point Grid.....	24
Figure 12. Church Pine Lake Littoral Zone.....	25
Figure 13. Church Pine Rake Densities for Most Common Plants.....	26
Figure 14. Round Lake Littoral Zone.....	28
Figure 15. Rake Density for all Species Sampled on Round Lake.....	29
Figure 16. Round Lake Most Common Species Sampled.....	31
Figure 17. Big Lake Littoral Zone and Plant Density.....	32
Figure 18. Big Lake Most Abundant Plant Species.....	34
Figure 19. Narrow Leaf Cattail Beds Church Pine Lake.....	37
Figure 20. Round Lake Purple Loosestrife Locations 2009 and 2014.....	38
Figure 21. Curly Leaf Pondweed (CLP) Beds on Big Lake - 2009.....	39
Figure 22. Big Lake Purple Loosestrife Locations 2009 and 2014.....	40
Figure 23. Giant and Japanese Knotweed Locations near Big Lake.....	40
Figure 24. CLP Treatment Beds 2011 and 2014.....	57
Figure 25. Big Lake Endothall Concentrations 2013.....	58
Figure 26. Germinating CLP Turion.....	59
Figure 27. Turion Density 2014.....	59
Figure 28. Landing Signs and Kiosk Displays.....	62

# Appendices

Appendix A. Aquatic Invasive Species Information .....	A -1
Appendix B. Aquatic Plant Management Strategy Northern Region WDNR .....	B -1
Appendix C. References.....	C -1
Appendix D. Rapid Response for Early Detection of Eurasian Water Milfoil .....	D -1
Appendix E. Management Options for Aquatic Plants.....	E -1
Appendix F. Implementation Plan Chart .....	F -1

# Executive Summary

This Aquatic Plant Management Plan for Church Pine, Round, and Big Lakes presents a strategy for managing aquatic plants through the year 2020 by protecting native plant populations, controlling curly leaf pondweed, and preventing establishment of aquatic invasive species. The plan includes data about the plant community, watershed, and water quality of the lakes. It also reviews a history of aquatic plant management. This plan is an update of a plan first developed by the Lake District and an advisory committee in 2010. The Lake District also has a lake management plan which was completed in 2013.

An aquatic plant point intercept survey and curly leaf pondweed bed mapping were completed for the lakes in 2014. The aquatic plant surveys found that the lakes have healthy, abundant, and diverse plant communities. Native plants provide fish and wildlife habitat, stabilize bottom sediments, reduce the impact of waves against the shoreline, and prevent the spread of non-native invasive plants – all critical functions for the lake.

Plants grow at greater depths as water clarity increases from Big to Round to Church Pine Lake. Plant diversity also increases in the lakes in the same order. Aquatic invasive plants found on project lakes include curly leaf pondweed, purple loosestrife, narrow-leaf cattail, and giant knotweed. Control efforts are recommended for curly leaf pondweed, purple loosestrife and giant knotweed. Previous control efforts have greatly reduced curly leaf pondweed growth. Continued prevention efforts against establishment of Eurasian water milfoil and other aquatic invasive species are also important.

This aquatic plant management plan, developed with input from an advisory committee including lake property owners, will help the Church Pine, Round, and Big Lake Protection and Rehabilitation District implement methods to meet plan aquatic plant management goals. The implementation plan describes the actions that will be taken toward achieving these goals.

A special thank you is extended to the Aquatic Plant Management Advisory Committee for assistance with plan development. The Lake District's Lake Management Committee will provide assistance with plan implementation.

## Plan Goals

1. Prevent introduction of aquatic invasive species and pursue any new introductions aggressively.
2. Substantially reduce the population and spread of curly leaf pondweed, purple loosestrife, and other invasive aquatic plants.
3. Maintain navigable routes for boating.
4. Preserve our diverse native aquatic plant community.
5. Educate and engage the public regarding aquatic plant management.

## Introduction

This aquatic plant management plan is sponsored by the Church Pine, Round, and Big Lake Protection and Rehabilitation District (Lake District). It is an update of a plan first developed by the Lake District and an advisory committee in 2010. The planning project is funded by a Wisconsin Department of Natural Resources Aquatic Invasive Species grant and the Lake District.

The plan presents a strategy for managing aquatic plants by protecting native plant populations, controlling curly leaf pondweed, and preventing the establishment of additional invasive species. The plan includes data about the plant community, watershed, and water quality of the lakes. Based on this data and public input, goals and strategies for the sound management of aquatic plants in the lakes and river are presented. This plan will guide the Lake District and the Wisconsin Department of Natural Resources in aquatic plant management for project lakes over the next five years (from 2016 through 2020).

A separate lake management plan, developed in 2012 and 2013, includes the results of a water quality study and sociological survey. The lake management plan outlines the following goals and selects actions to implement the goals:

1. Reduce algae and phosphorus in the three lake system by reducing watershed runoff
2. Evaluate the progress of lake management efforts
3. Protect, maintain, and enhance fish habitat
4. Increase knowledge and participation

## Public Input for Plan Development

The Aquatic Plant Management (APM) Advisory Committee provided input for the development of this plan. The APM Advisory Committee met twice. At the first meeting March 26, 2015, the committee reviewed plan goals, identified plant management concerns, and reviewed the aquatic plant survey and curly leaf pondweed management. At a second meeting April 16, 2015, the committee finalized the curly leaf pondweed management program and discussed aquatic invasive species prevention, navigation, and education. The APM Advisory Committee concerns are reflected in the goals and objectives for aquatic plant management in this plan.

The Lake District board announced the availability of the draft Aquatic Plant Management Plan for review with a mailing to all lake residents and a public notice in the Osceola Sun in early July 2015. Copies of the plan were available to the public on the Lake District web site: [bigroundpine.com](http://bigroundpine.com). Hard copies of the draft plan were available at Osceola Public Library during regular business hours. Comments were accepted through July 31. The plan was summarized at the August 29 Lake District meeting where lake district members approved the plan budget.



## Resident Concerns

The APM Advisory Committee expressed a variety of concerns that are reflected in objectives for plan development and in the goals for aquatic plant management in this plan. Management concerns ranged from being able to respond to aquatic invasive species introduction to understanding the ability to remove curly leaf pondweed, best methods for monitoring and managing invasive species, and issues related to navigation and critical habitat areas. Water quality concerns were defined as outside the scope of this plan and deferred to the lake management plan implementation.

# Lake Information

## The Lakes

The project area is in southwestern Polk County, Wisconsin in the towns of Alden and Garfield. Project lakes include Church Pine Lake (WBIC: 2616100), Round Lake (sometimes mapped and referred to as Wind Lake) (WBIC: 2616000), and Big Lake (WBIC: 2615900). Church Pine Lake is a 107-acre lake with a maximum depth of 45 feet. Round Lake is a 38-acre lake with a maximum depth of over 24 feet<sup>2</sup>. Big Lake is a 259-acre lake with a maximum depth of 24 feet. Development around the lakes is moderate to heavy with much of the lakeshore developed for residential use.

Water flows from Church Pine, to Round, and then to Big Lake. North Creek flows into the north end of Big Lake, and Forest Creek flows from Big Lake on its west side. A dam on Forest Creek regulates the water levels in Big Lake at an established legal level between 96.5 and 95.5 feet. A timber dam was first constructed ¼ mile from the Big Lake outlet on this tributary in 1883.<sup>3</sup>

The maximum depth to which plants grow (the littoral zone) varies in project lakes. The littoral zone reached a depth of almost 26 feet in Church Pine Lake, 21 feet in Round Lake, and 18 feet in Big Lake in 2014. Table 1 summarizes information about project lakes.

*Table 1. Lake Information*

	Church Pine	Round (Wind)	Big
Size (acres)	107	38	259
Mean depth (feet)	23		17
Maximum depth (feet)	45	24+	24
Littoral zone depth (feet)	25.6	20.96	18.3
Average summer secchi depth 2012 (feet)	18	11	9

A lake depth map is found on the following page as Figure 1. Boat landings are indicated with dots on the lake map in Figure 2.

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<sup>2</sup> Although listed on Wisconsin DNR Lake Maps as 7 feet deep, the maximum depth recorded during the plant survey was in excess of 24 feet.

<sup>3</sup> [Bigroundpine.com/history](http://Bigroundpine.com/history)

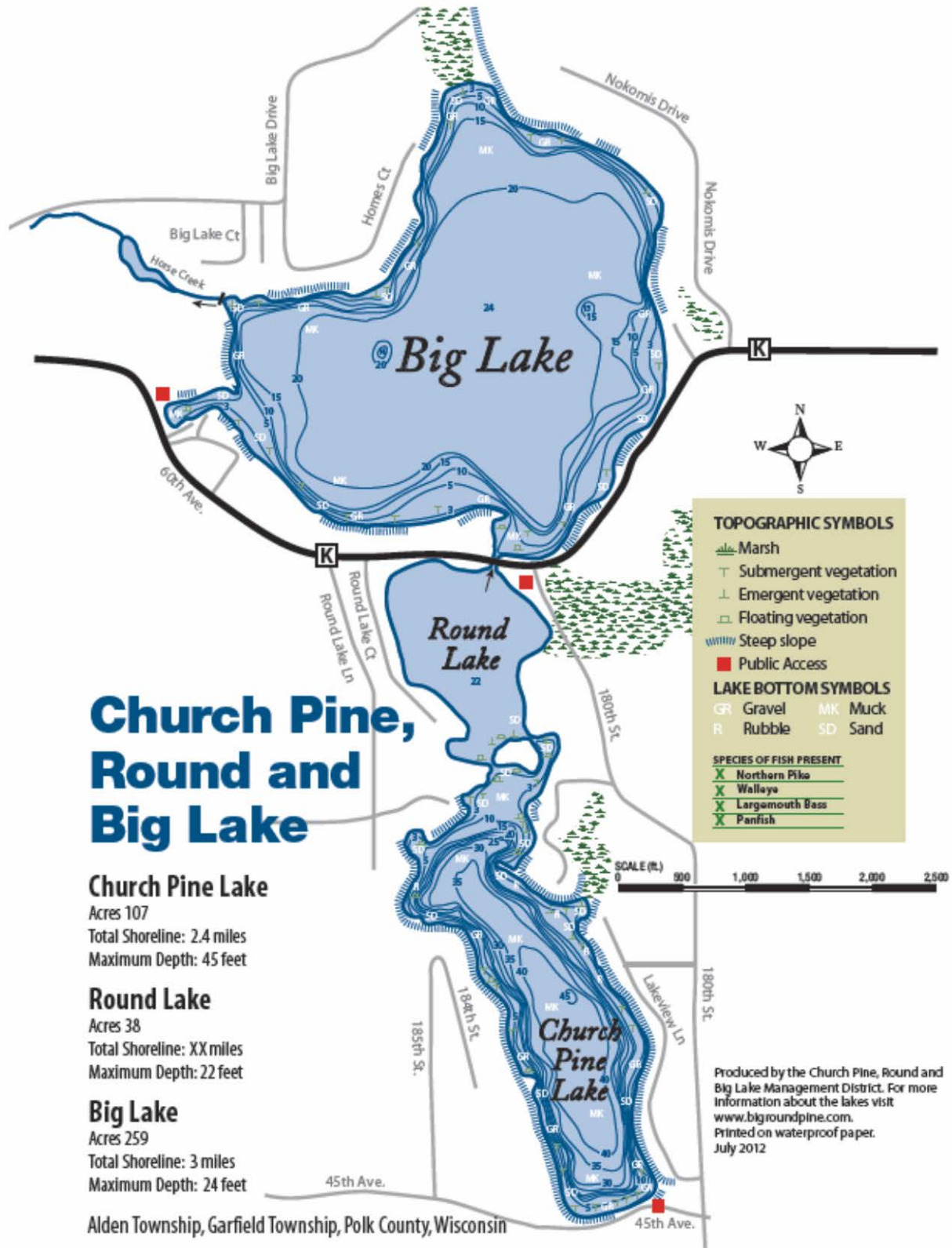
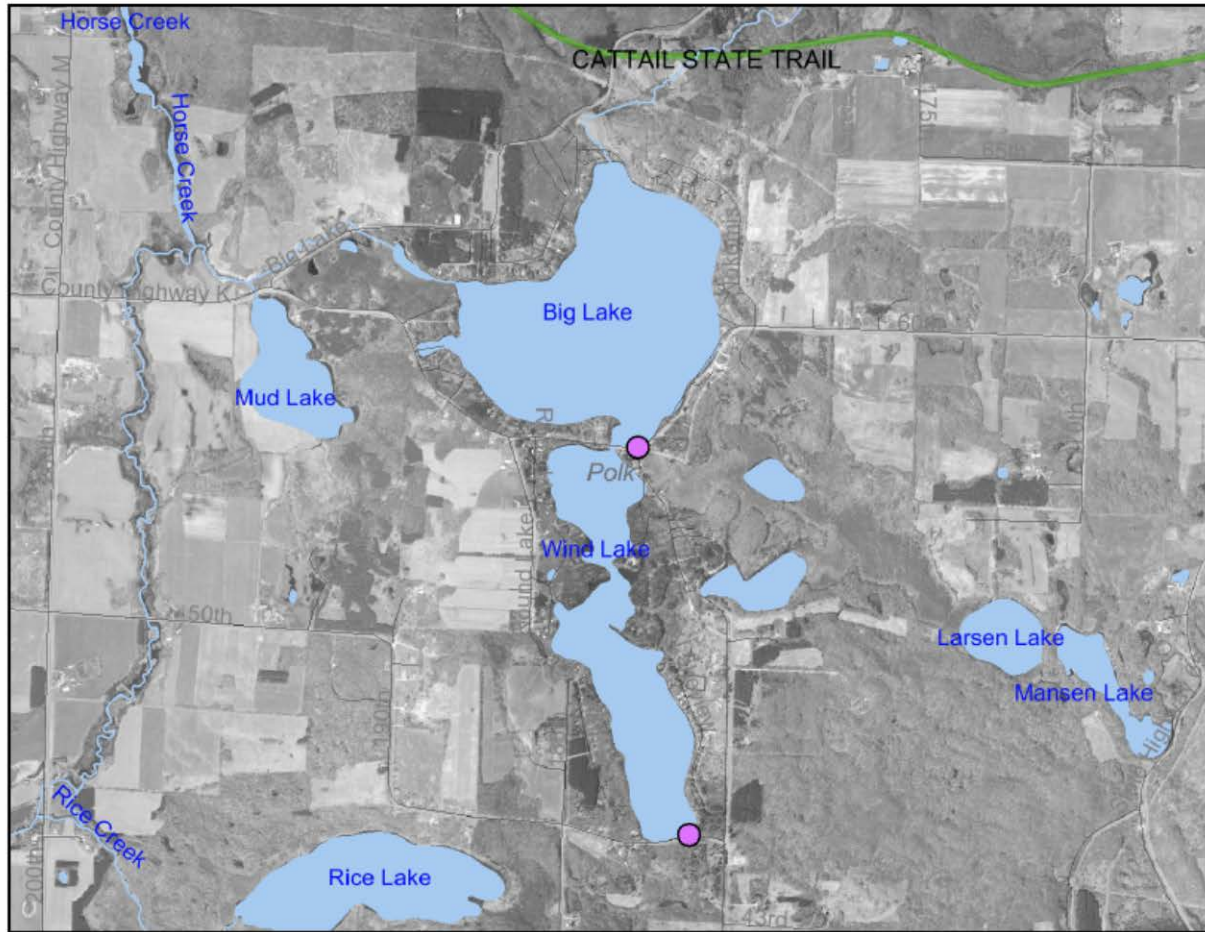


Figure 1. Big Lake and Church Pine Lake Contour Maps



## Public Boat Access Sites



### Legend

- Verified Boat Access Sites
  - RAMP (Pink circle)
  - CARRY-IN (Yellow triangle)
  - UNKNOWN (Green square)
- Un-Verified Boat Access Sites
  - Not Verified (White circle)
- Local Roads (Grey line)
- Rivers and Streams (Blue line)
- County Boundary (Black line)
- 24K Open Water (Blue area)
- Municipalities
  - Village (Light green area)
  - City (Light yellow area)
- DNR Managed Lands
  - Fee (Green area)
  - Easement (Red area)
  - Lease (Orange area)

0 3000 6000 9000 ft.



Scale: 1:30,159

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Figure 2. Project Lakes Boat Access Sites

## Water Quality

Water quality is frequently reported by the trophic state or nutrient level of a lake. Nutrient-rich lakes are classified as eutrophic. These lakes tend to have abundant aquatic plant growth and low water clarity due to algae blooms. Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms. Oligotrophic lakes are nutrient-poor with little growth of plants and algae.

Secchi depth readings are one way to assess the trophic state of a lake. The Secchi depth is the depth at which the black and white Secchi disk is no longer visible when it is lowered into the water. Greater Secchi depths occur with greater water clarity. Secchi depth readings, phosphorus concentrations, and chlorophyll measurements can each be used to calculate a Trophic State Index (TSI) for lakes.<sup>3</sup> TSI values range from 0 – to 110. Lakes with TSI values greater than 50 are considered eutrophic. Those with values in the 40 to 50 range are mesotrophic. Lakes with TSI values below 40 are considered oligotrophic. Church Pine is classified as oligotrophic, Round Lake as mesotrophic, and Big Lake as eutrophic based on 2014 chlorophyll data.

Citizen lake monitoring volunteers have collected data from the lakes almost annually since 1986. There is a data collection location established for each lake.

Results from 2014 are available from the WDNR website. July and August results are reported in Table 2 below. The parameters sampled included dissolved oxygen, total phosphorus, and chlorophyll. Secchi depth (a measure of water clarity) was not collected in 2013 and 2014. Trophic State Index classifications were determined based on the chlorophyll values. Lakes that have more than 20 µg/l of total phosphorus may experience noticeable algae blooms.

*Table 2. Citizen Lake Monitoring Results, July and August 2014<sup>4</sup>*

	<b>Church Pine</b>	<b>Round (Wind)</b>	<b>Big</b>
<b>Number of samples</b>	2	1-2	2
<b>Total Phosphorus (µg/l)</b>	11.4	17.8 (2 samples)	23.9
<b>Chlorophyll (µg/l)</b>	1.7	2.7 (1 sample)	14.7
<b>Trophic State Index (TSI)</b>	39	42	55
<b>TSI Classification (based on Chl.)</b>	Oligotrophic	Mesotrophic	Eutrophic

<sup>3</sup> TSI = 60 – 14.41 (ln \* Secchi depth in meters) and TSI = (9.81) (ln Chl a + 30.6).

<sup>4</sup> *Reports and Data: Polk County.* WDNR website. March 2014. <http://www.dnr.wi.gov/lakes/CBCW/>

Figure 3 illustrates the Secchi depth averages for Church Pine Lake. Figure 4 graphs the Trophic State Index for Church Pine Lake based upon Secchi depth, chlorophyll, and total phosphorus results from 1986 to 2014. Figures 5 and 6 depict Round Lake's Secchi depth and Trophic State Index, respectively. Figures 7 and 8 show results for Big Lake.

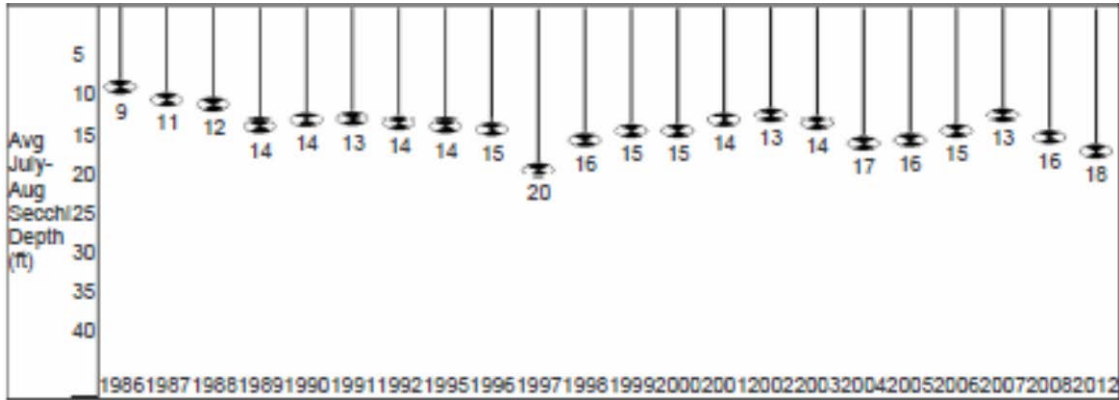


Figure 3. Church Pine Summer Average Secchi Depths 1986-2012

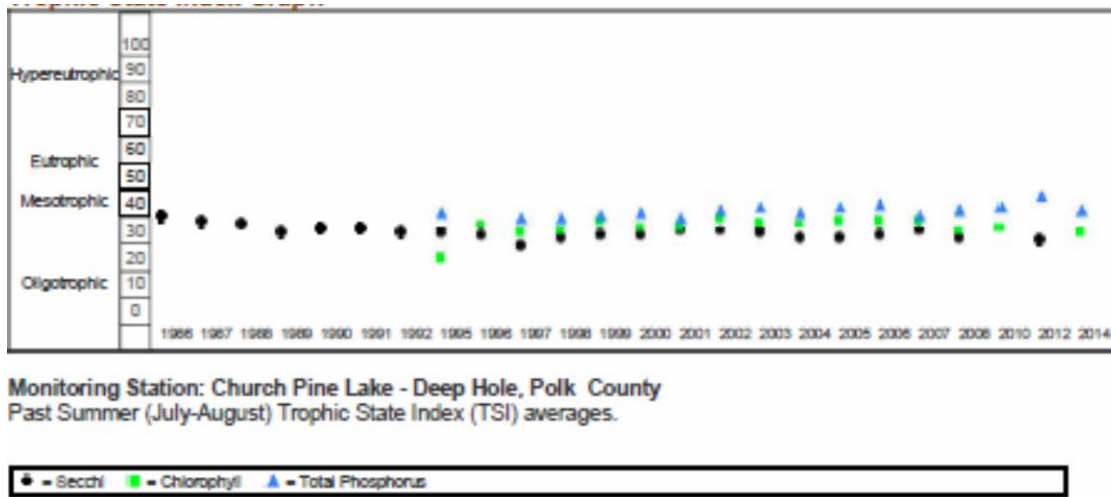


Figure 4. Church Pine Trophic State Index 1986-2014



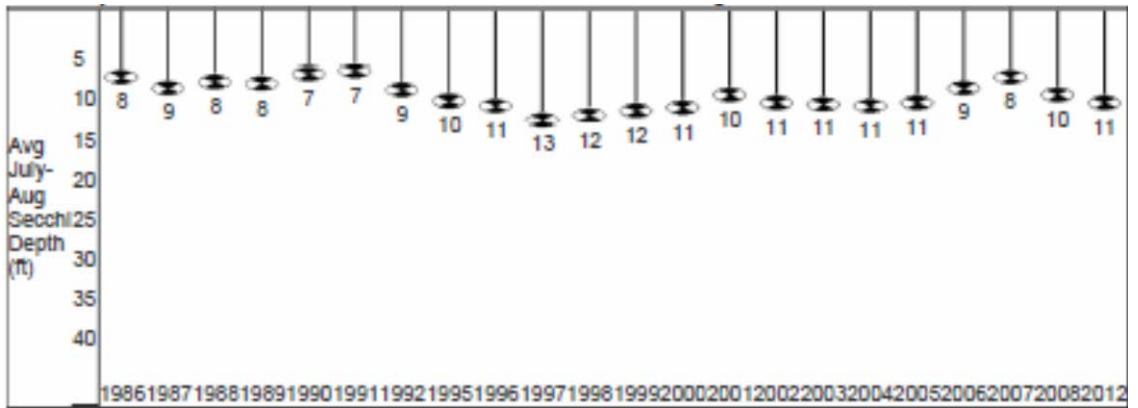


Figure 5. Round (Wind) Summer Average Secchi Depths 1986-2012

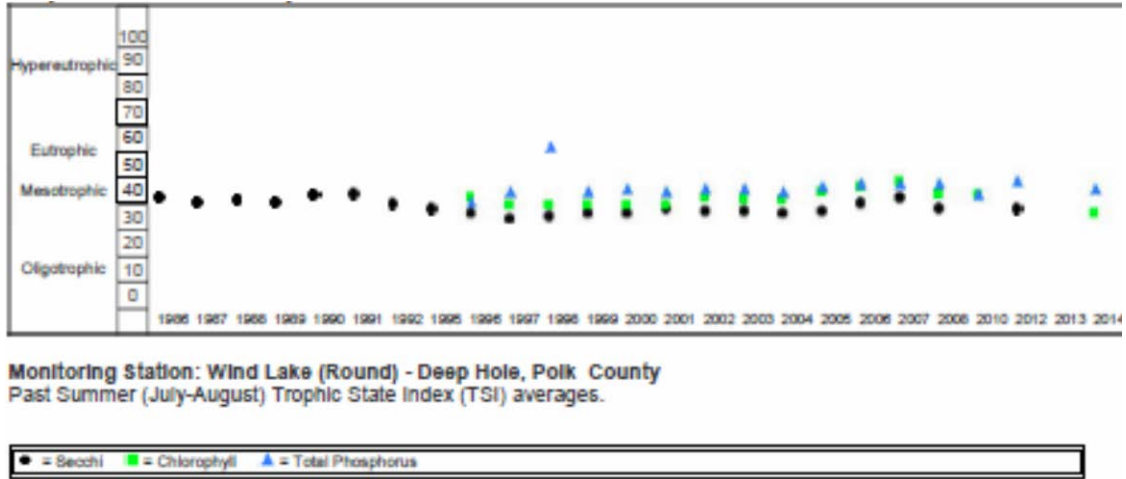


Figure 6. Round (Wind) Trophic State Index 1986-2014

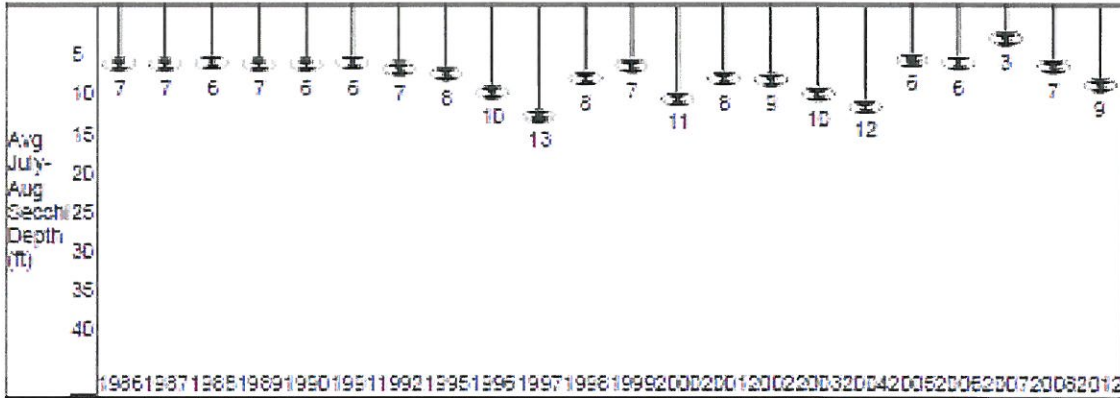


Figure 7. Big Lake Summer Average Secchi Depths 1986-2012

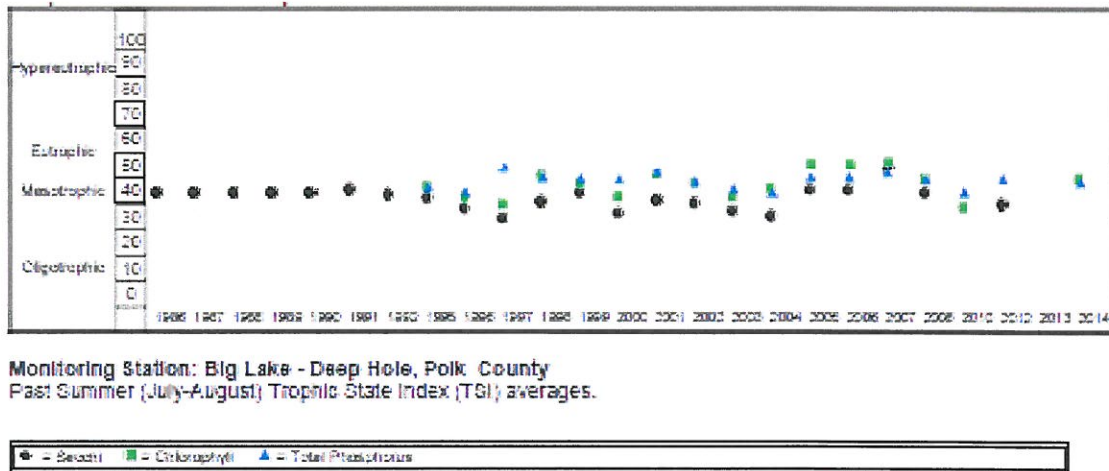


Figure 8. Big Lake Trophic State Index 1986-2014

### Impaired Waters

Every two years, Section 303(d) of the Clean Water Act requires states to publish a list of all waters that *do not meet* water quality standards. The list, also known as the Impaired Waters List, is updated to reflect waters that are newly added or removed based on new information or changes in water quality status.

In the 2014 draft list update, DNR proposed to add 192 new waters. A majority of the listing additions are waters that exceed total phosphorus criteria. A significant number of new listings are also based on poor biological condition. Big Lake is proposed for addition to the 2014 list for excess algae growth. The pollutant causing algae growth is not identified in the listing.<sup>5</sup>

<sup>5</sup> <http://dnr.wi.gov/topic/ImpairedWaters/> February 2015.



### Previous Water Quality Studies

Water and total-phosphorus budgets assist in understanding nutrient and water dynamics that influence algae and aquatic plant growth. Water and total-phosphorus budgets were assessed in 1987. The 1987 study concluded that water quality problems in Big Lake primarily came from excessive phosphorus loading from North Creek. The study concludes that the water quality of Church Pine and Round Lakes was not negatively influenced by their watersheds. The study estimated water retention times as follows: Church Pine Lake: 7.8 years, Round Lake: 2.9 years and Big Lake: 1.9 years. Declines in late summer water quality on Round and Big Lakes in 1985 were attributed to previous herbicide applications.

Water quality of the lakes was also analyzed in 1999 in the *Horse Creek Priority Watershed Water Resources Appraisal Report*. The Department of Natural Resources completed this report in preparation for the priority watershed project discussed later in this plan. The water quality appraisal used land cover and lake data to estimate the contributions of phosphorus and resulting water clarity impacts to the lakes. This region of Polk County has high levels of phosphorus in groundwater, and lakeshore wells were tested to assess the significance of phosphorus in groundwater. Groundwater was estimated to contribute a significant percentage (34%) of the phosphorus load to Big Lake in this study.

### 2012 Water Quality Study<sup>6</sup>

The Polk County Land and Water Resources Department completed a study of the lakes' water quality and watersheds in 2012. The study results and implementation plan are contained in *Church Pine, Round, and Big Lake Management Plan Polk County, WI* June 2013. There is a wealth of information regarding the water chemistry and quality of the lakes in this study. Water quality measurements reported previously include the study results in 2012 data.

The study found that all of the lakes are phosphorus limited. Church Pine stratified based on temperature profiles, Round Lake weakly stratified, and Big Lake very weakly stratified. Weakly stratified lakes may release phosphorus to the water column from lake sediments during the growing season. Phosphorus released from lake sediments is called internal loading. The Lake District was recently awarded a lake planning grant to better understand this source of internal loading of phosphorus in Big Lake.

### Phosphorus from Watershed Runoff

Phosphorus is a primary nutrient essential for healthy plant and algae growth. However, increased phosphorus levels speed up the process of eutrophication - where excess nutrients stimulate plant growth and cause extensive algae blooms. Prolific plant growth may lower dissolved oxygen levels when plants decay and consume oxygen.

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<sup>6</sup> Polk County Land and Water Resources Department. *Church Pine, Round, and Big Lake Management Plan Polk County, WI* June 2013.

Phosphorus loading in project lakes is, at least in part, the result of non-point sources. Non-point sources include rain falling on the lake and runoff from within the watershed. Phosphorus can be dissolved in the runoff water as well as carried in soil particles that erode from bare soil.

The amount of phosphorus in runoff from the watershed is determined by land use in the lake's watershed along with watershed soils and topography. Shoreland areas are particularly important areas of a lake's watershed. Agricultural and residential development tends to increase runoff and the amount of phosphorus that makes its way to the lake as a result. Land maintained in a natural, vegetated state, on the other hand, is beneficial to soil and water quality. Runoff from agricultural land is more likely to carry high levels of phosphorus to the lake because of lack of ground cover and fertilizer use. With natural vegetation, soil erosion is reduced and fewer pollutants are able to enter and impact the lake via runoff. Tall vegetation slows the flow of water, while forest groundcover and fallen leaves allow runoff water to soak into the soil.

Natural areas, such as forests and wetlands, allow for more infiltration of precipitation when compared with row cropped fields and developed residential sites containing lawns, rooftops, sidewalks, and driveways. This occurs because dense vegetation lessens the impact of raindrops on the soil surface, thereby reducing erosion and allowing for greater infiltration of water. Additionally, wetlands provide extensive benefits through their ability to filter nutrients and allow sediments to settle out before reaching lakes and rivers.

## Shorelines

The water quality appraisal emphasized the importance of preserving and restoring buffers of native shoreline plants and aquatic plants to preserve or improve water quality. It also cautioned that development of the watershed open space could lead to increased nutrient loading to the lakes.

### Shoreline Inventory

Volunteers completed a shoreline inventory as part of the 2012 water quality study. They reported characteristics at the ordinary high water mark (OHWM) and within a shoreline buffer zone from the OHWM to 35 feet inland.

The shoreline (linear feet) was categorized as:

- ✓ Rip rap
- ✓ Structure
- ✓ Lawn
- ✓ Sand
- ✓ Natural

The shoreline buffer area (square feet) was categorized as:

- ✓ Hard surface
- ✓ Landscaping

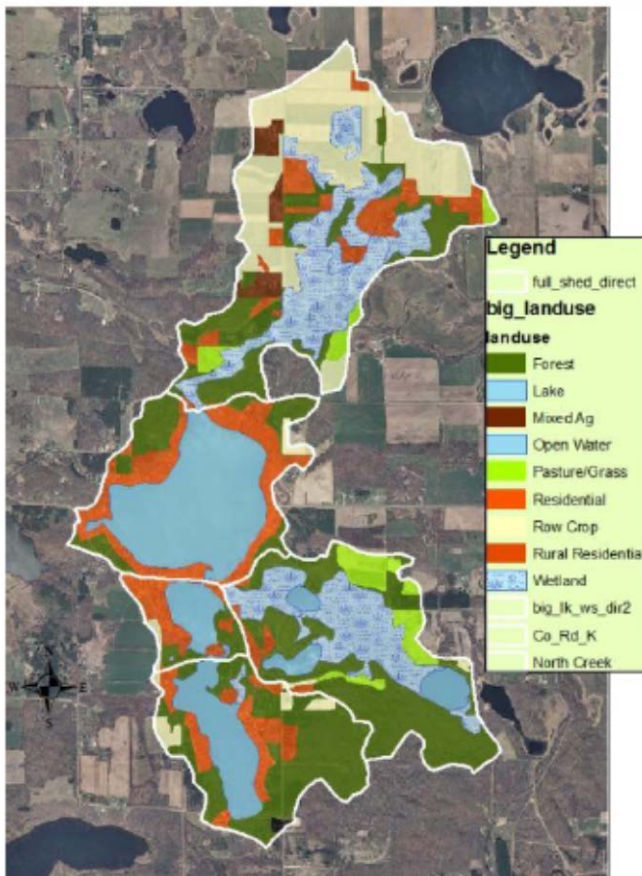
- ✓ Lawn
- ✓ Bare soil
- ✓ Natural

In total, 2.52 miles of shoreline were inventoried on Church Pine Lake, 1.17 miles on Round Lake, and 3.08 miles on Big Lake.

A characterization of the entire three lake system shoreline inventory shows that the greatest land use at the ordinary high water mark is natural (60%), followed by rip rap (30%), lawn (7%), sand (2%), and structure (1%). A characterization of the entire three lake system shoreline buffer composition inventory shows that the greatest land use is natural (64%), followed by lawn (23%), hard surface (6%), landscaping (5%), and bare soil (2%). Big Lake had the highest percentage of lawn in the shoreline buffer area (31%), followed by Round (20%), and Church Pine (16%). Coarse woody habitat was present at 22 sites: 11 on Church Pine Lake, 6 on Round Lake, and 5 on Big Lake.

## Lake Watersheds

The most recent watershed analysis is within the 2012 study, and the information below is taken directly from that source.



The area of land that drains towards a lake is called a watershed. The watershed area of Church Pine Lake, including the lake, is 337.5 acres. The lake itself is 91 acres and represents 24% of the total land use in the Church Pine Lake watershed.

The watershed area of Round Lake, including the lake, is 106.6 acres. The lake itself is 38 acres and represents 36% of the total land use in the Round Lake watershed.

The watershed area of Big Lake, including the lake, is 1,765.8 acres in size. The lake itself is 243 acres and represents 14% of the total land use in the Big Lake watershed.

Figure 9. Watershed Land Use

The Wisconsin Lakes Modeling Suite (WiLMS) was used to model current conditions for Church Pine, Round, and Big Lakes, verify monitoring, and estimate land use nutrient loading for the watershed. Phosphorus is the key parameter in the modeling scenarios used in WiLMS because it is the limiting nutrient for algal growth in project lakes.

### Church Pine Lake Watershed

Forest makes up over half (52%) of the land use in the Church Pine Lake watershed. Other land uses include the lake surface (24%), medium density urban (11%), rural residential (6%), row crop (5%), high density urban (1%), and wetlands (1%).

The largest contributor of phosphorus to Church Pine Lake is the lake surface (26%), followed by medium density urban (20%), forest and row crop (each 17%), high density urban (5%), rural residential (2%), and wetlands (less than 1%). The model estimates that septic systems are contributing 13% of the phosphorus load to Church Pine Lake.

*Table 3. Church Pine Lake Watershed Land Use and Nutrient Loading*

	<b>Total Acres</b>	<b>Percent Acres</b>	<b>Total Loading (lb P /year)</b>	<b>Percent Loading</b>
Row crop	17.5	5%	15.6	16.6%
Parking lot	3.8	1%	5.1	5.4%
Residential	41.9	11%	18.7	19.9%
Rural residential	23.1	6%	2.1	2.2%
Wetlands	4.4	1%	0.4	0.4%
Forest	195.8	52%	15.8	16.8%
Lake surface	91	24%	24.4	26.0%
Septic			11.9	12.7%

### Round Lake Watershed

The largest land use in the Round Lake watershed is the lake itself (36%), followed by medium density urban (24%), forest (21%), rural residential (14%), row crop (4%), and wetlands (1%). The largest contributor of phosphorus is medium density urban (33%), the lake surface (29%), row crop (11%), forest (5%), rural residential (4%), and wetlands (less than 1%). Additionally, the model predicts that septic systems are contributing 18% to the phosphorus load to Round Lake.

*Table 4. Round Lake Watershed Land Use and Nutrient Loading*

	<b>Total Acres</b>	<b>Percent Acres</b>	<b>Total Loading (lb P/year)</b>	<b>Percent Loading</b>
Row crop	4.3	4%	3.8	11.0%
Residential	25.4	24%	11.3	32.5%
Rural residential	15.4	14%	1.4	3.9%
Wetlands	0.8	1%	0.1	0.2%
Forest	22.7	21%	1.8	5.2%
Lake surface	38	36%	10.2	29.1%
Septic			6.3	18.0%

### Big Lake Watershed

The largest land uses in the Big Lake watershed are forest (26%) and wetlands (24%). Other land uses include row crop (16%), the lake itself (14%), rural residential (8%), medium density urban (6%), pasture/grass (5%), and mixed agriculture (2%). The largest contributor of phosphorus is row crop (50%), followed by the lake surface (13%), medium density urban (9%), wetlands and forest (each 7%), mixed agriculture (5%), pasture/grass (4%), and rural residential (2%). Additionally, the model predicts that septic systems are contributing 3% of the phosphorus load to Big Lake.

*Table 5. Big Lake Watershed Land Use and Nutrient Loading*

	<b>Total Acres</b>	<b>Percent Acres</b>	<b>Total Loading (lb P/year)</b>	<b>Percent Loading</b>
Row crop	288.6	16%	257.6	49.8%
Mixed agriculture	34	2%	24.3	4.7%
Pasture/grass	80.7	5%	21.7	4.2%
Residential	99.9	6%	44.5	8.6%
Rural residential	134.6	8%	11.9	2.3%
Wetlands	417.513	24%	37.2	7.2%
Forest	467.5	26%	37.8	7.3%
Lake surface	243	14%	65.2	12.6%
Septic			17.6	3.4%

## Lake Management Plan Implementation

Goals for lake plan implementation are as follows:

- Reduce algae and phosphorus in the three lake system by reducing watershed runoff
- Evaluate the progress of lake management efforts
- Protect, maintain, and enhance fish habitat
- Increase knowledge and participation
- Support the goals of the Aquatic Plant Management Plan

Watershed phosphorus reduction goals are as follows:

Church Pine: 5%

Round: 10-16%

Big: 16-25%

Phosphorus reduction is planned with the implementation of residential practices in all lake watersheds and agricultural practices in the Big Lake Watershed. Fish habitat enhancement through the installation of woody habitat or fish sticks and fish stocking are also actions in the plan.

## Groundwater Phosphorus

Groundwater testing was not part of the scope of the 2012 water quality study. Some tests of groundwater phosphorus were completed following the study, however. Well samples taken in August 2014 had average values of 0.021 mg/L reactive phosphorus and 0.121 mg/L total phosphorus. Water samples taken in February 2014 from North Creek showed baseline total phosphorus (likely from groundwater sources) of 0.063 mg/L at both sites. While the total phosphorus levels were higher in North Creek during the growing season when the watershed would influence phosphorus levels, these test results indicate that groundwater phosphorus likely contributes to Big Lake and North Creek phosphorus levels.

## Horse Creek Priority Watershed Project Results

The Horse Creek Priority Watershed Project was a project of the Polk County Land and Water Resources Department supported by Wisconsin Department of Natural Resources (WDNR) and Department of Agriculture, Trade, and Consumer Protection (DATCP) funding. Representatives from project lakes provided input as part of the citizen's advisory committee that assisted with plan development. Discussion of the watershed project is included here because of the importance of watershed management for lake water quality.

The following projects were completed within the project lakes watersheds as part of the priority watershed project through 2009. More information about these projects is available from the Polk County Land and Water Resources Department.

Nutrient/Pest Management	316 acres
High Residue Management	39 acres
Manure Storage Abandonment	2 facilities

Rain Gardens	5 gardens
Critical Area Stabilization	2 areas
Shoreline Habitat Restoration	3.5 acres

## Curly Leaf Pondweed Dieback

Curly leaf pondweed (*Potamogeton crispus*), a non-native, invasive plant managed in Big Lake, is another potential source of phosphorus that may fuel algae growth in the lake. This phosphorus source was not estimated as part of the 2012 lake management plan. By 2012, most of the CLP was greatly reduced through annual early season herbicide treatments.

Previous studies have pointed to dieback of curly leaf pondweed as a source of increasing lake phosphorus levels and therefore algae growth during the growing season in some lakes. The potential for significant in-lake phosphorus increases from curly leaf pondweed (CLP) in Big Lake was assessed for the 2010 APM plan using a range of data from the literature and maps of curly leaf pondweed growth. Literature values provided a range of density measurements of CLP and the phosphorus content of CLP tissue samples. In 2009 there were 23 acres of curly leaf pondweed in beds with a density of at least 50% in Big Lake. An estimate of the phosphorus content of CLP from the literature is 0.3%.<sup>7</sup> A density of 40 g/m<sup>2</sup> yields an estimate of 25 pounds of phosphorus, and a density of 120 g/m<sup>2</sup> yields an estimate of 74 pounds. CLP density in Bone Lake in Polk County was 294 g/m<sup>2</sup> in 2010. This density would yield an estimate of 180 pounds of phosphorus. This assumes that all of the phosphorus from decaying CLP reaches the water column to fuel algae growth, and this may not be the case. Lake sediments may capture a substantial amount of phosphorus released from CLP. On nearby Bone Lake, only 21% of the total phosphorus in CLP plant tissue was released to the water column.<sup>8</sup> If that percentage is applied to above calculations, phosphorus inputs might be in the range of 5 to 38 pounds annually if CLP growth was to return to 2009 levels.

The 2012 phosphorus load for Big Lake totaled 457 pounds, with 383 pounds coming from external sources including the watershed, tributaries, and Round Lake. Details of the phosphorus load estimates are shown in Table 5.

Only a few cases were found in the literature where CLP was managed with the goal of improving lake water quality. None of them provided any clear evidence that this could be or was accomplished. It was usually not possible to clearly separate the effects of CLP phosphorus release from other complicating factors such as changes in the fish/zooplankton community, drawdowns, or phosphorus inputs from stormwater inflow and sediment phosphorus release.<sup>9</sup>

<sup>7</sup> Study information compiled by Craig Roesler – Wisconsin DNR – Hayward.

<sup>8</sup> Schieffer, Steve. Bone Lake Curly Leaf Pondweed (CLP) Significance to Phosphorus Load and CLP Treatment Effectiveness. Unpublished report 2010.

<sup>9</sup> Study information compiled by Craig Roesler – Wisconsin DNR – Hayward.

# Aquatic Habitats

## Primary Human Use Areas

There are two boat landings in the project area. One is at the southern end of Big Lake along County Highway K. The second is at the southern end of Church Pine Lake. Many people use the Church Pine landing as a swimming area. There is additional parking within a block of the Church Pine boat landing at West Immanuel Lutheran Church. There are also two undeveloped town access points to the lakes. Needles Resort serves project lakes by renting cabins in a historic resort location.

Big Lake attracts around 250 anglers for an annual fishing tournament. Proceeds go toward walleye stocking.

Residential development is prevalent on the lake. Waterfront property owners and the general public utilize the lakes for a wide variety of activities including fishing, boating, swimming, and viewing wildlife.

## Functions and Values of Native Aquatic Plants

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

### Water Quality

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

### Fishing

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

### Waterfowl

Plants offer food, shelter, and nesting material for waterfowl. Birds eat both the invertebrates that live on plants and the plants themselves.<sup>10</sup>

### Protection against Invasive Species

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

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<sup>10</sup> Above paragraphs summarized from *Through the Looking Glass*. Borman et al. 1997.



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

Removal of native vegetation not only diminishes the natural qualities of a lake, but it increases the risk of non-native species invasion and establishment. The presence of invasive species can change many of the natural features of a lake and often leads to expensive annual control plans. Allowing native plants to grow may not guarantee protection against invasive plants, but it can discourage their establishment. Native plants may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.<sup>11</sup>

## **Aquatic Invasive Species Status**

Purple loosestrife (*Lythrum salicaria*) and curly leaf pondweed (*Potamogeton crispus*) have been observed on all of the project lakes. Information about invasive species identification and control is found in Appendix A.

### **Purple Loosestrife**

There are currently scattered locations of purple loosestrife around Big and Round Lake, and it was found in a single location on Church Pine Lake. Annual meeting reports in 2006 and 2007 confirmed that purple loosestrife occurred on Big Lake in several areas and was present in fewer areas on Round Lake. None was reported on Church Pine Lake. In 2010 beetles were raised by the Lake District and introduced in the large wetland area surrounding the North Creek inflow to Big Lake.

### **Giant and Japanese Knotweed**

A recent Polk County Land and Water Resources rapid response grant project found several locations of giant and Japanese Knotweed in Polk County. Three of the sites are on or near Big Lake and another is near Round and Church Pine. The Lake District budgets and contracts for knotweed control along with purple loosestrife control.

### **Curly Leaf Pondweed**

Curly leaf pondweed is currently found in just a few locations on project lakes. That, however, was following an intensive early season herbicide treatment on Big Lake over the past five years including in 2014.

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<sup>11</sup> *Aquatic Plant Management Strategy*. DNR Northern Region. Summer 2007.

### **Eurasian Water Milfoil**

There is a risk that Eurasian water milfoil and other aquatic invasive species may become established in project lakes. As described previously, there are two boat landings on the lake. The biggest threat of invasion by Eurasian water milfoil comes from anglers who travel from the Twin Cities, Minnesota metropolitan area, and access the lake at the boat landings. With Eurasian water milfoil present in many urban Twin Cities lakes, the danger of transporting plant fragments on boats and motors is very real.

Department of Natural Resource scientists have also found Eurasian water milfoil in the nearby Wisconsin counties of Burnett (Ham, Shallow, and Round Lakes), Barron (Beaver Dam, Horseshoe, Sand, Kidney, Shallow, Duck, and Echo Lakes), and St. Croix (Bass Lake, Goose Pond, Little Falls Lake, Lake Mallalieu, and Perch Lake). In Polk County EWM is found in Long Trade, Horseshoe, and Pike Lakes.

### **Sensitive Areas**

The Wisconsin Department of Natural Resources (DNR) has completed sensitive area surveys to designate areas within aquatic plant communities that provide important habitat for game fish, forage fish, macroinvertebrates, and wildlife as well as important shoreline stabilization functions. The DNR has transitioned to designations of *critical habitat areas* that include both *sensitive areas* and *public rights features*.

*Sensitive areas* offer critical or unique fish and wildlife habitat (including seasonal or life stage requirements) or offer water quality or erosion control benefits to the area (Administrative code 107.05(3)(1)(1)). The Wisconsin Department of Natural Resources is given the authority for the identification and protection of sensitive areas of the lakes. *Public rights features* are areas that fulfill the right of the public for navigation, quality and quantity of water, fishing, swimming, or natural scenic beauty.

The *critical habitat area* designation provides a holistic approach to ecosystem assessment and protection of those areas within a lake that are most important for preserving the very character and qualities of the lake. Protecting these *critical habitat areas* requires the protection of shoreline and in-lake habitat. The *critical habitat area* designation provides a framework for management decisions that impact the ecosystem of the lake.

### **Special Lake Designations**

The map titled *Critical Habitat Areas* shows Sensitive Areas for Big Lake and Church Pine Lake. It also indicates that Big Lake and Round Lake are also classified as Areas of Special Natural Resource Interest (ASNRI).

The Department of Natural Resources completed Sensitive Areas Designations in September of 1998. Purple loosestrife was identified in Big Lake sensitive areas A, C, and D. Curly leaf pondweed was found in Big Lake sensitive area C.

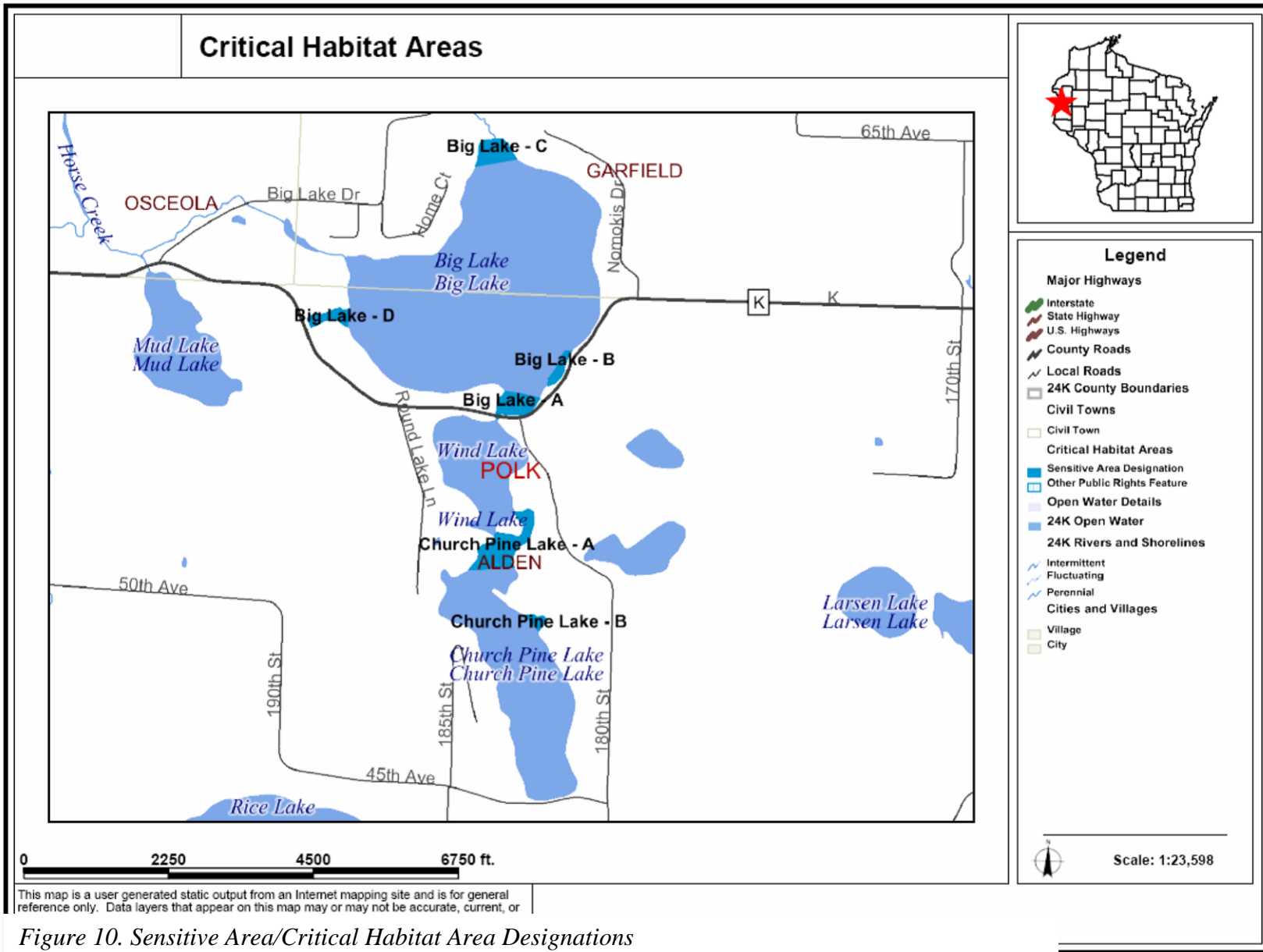


Figure 10. Sensitive Area/Critical Habitat Area Designations

## Sensitive/Critical Habitat Area Recommendations

### General

- Preserve/restore shoreline buffers at least 35 feet deep
- Limit aquatic vegetation removal to no more than 25 foot channels – hand pulling is the preferred method for management followed by harvesting and herbicide use
- Leave woody debris in place
- Prevent construction site erosion
- Limit rip rap for shoreline stabilization
- Strictly enforce zoning ordinances
- Control exotic species such as purple loosestrife

### Church Pine

- Use conservation easements, deed restrictions, or zoning to protect sensitive areas

Resource values of each lake sensitive area were described in the same way: provides bass, panfish, and forage species habitat; northern spawning and nursery areas; and wildlife habitat. All major types of plants: emergent, floating, and submergent were recorded in each sensitive area.

## Rare and Endangered Species Habitat

The Natural Heritage Inventory map of Polk County indicates occurrences of aquatic listed special concern species in the sections where project lakes are located. A species list is available to the public only by town and range. WDNR and federal regulations regarding special concern species range from full protection to no protection. The current categories and their respective level of protection are as follows: **SC/M** = fully protected under Migratory Bird Act, **SC/H** = take regulated by open closed seasons.

T32N R18W included the following species:

<i>Cyanus buccinator</i>	Trumpeter Swan	Special Concern/M
<i>Emydoidea blandingii</i>	Blandings Turtle	Special Concern/H
<i>Lanius ludovicianus</i>	Loggerhead Shrike	Endangered
<i>Senecio congestus</i>	Marsh Ragwort	Special Concern

T 33N R18W also has the Trumpeter Swan present.

## Lakes Fishery

The three lake chain is managed as a largemouth bass, panfish (bluegill, black crappie, pumpkinseed, and yellow perch), and northern pike fishery. Large fingerling walleye have been stocked for several years with lake district funding to create a stocked walleye fishery. Continued stocking will be necessary to maintain a walleye fishery.

*Table 6. Spawning Temperatures and Substrate Needs*

Fish species <sup>12</sup>	Spawning Temp in °F	Spawning substrates
Black crappie	Upper 50's to lower 60's	Build nests in 1-6 feet on hard bottom
Bluegill, Largemouth bass and Pumpkinseed	Mid 60's to lower 70's	Build nests in 1-6 feet on hard bottom
Northern Pike	Upper 30's to mid 40's soon after ice-out	Broadcast eggs onto vegetation (eggs attach)
Smallmouth Bass	Usually between 60 to 70	Nests in circular, clean gravel
Walleye	Low 40's to 50 degrees.	Gravel/rocky shoals with moving or windswept water 1-6 feet deep
Yellow perch	Mid 40's to lower 50's	Broadcast eggs in submergent vegetation or large woody debris

*Table 7. Fish Species of Project Lakes<sup>13</sup>*

Lake	Northern Pike	Walleye	Largemouth Bass	Panfish
Church Pine	P	P	C	C
Round	P	P	C	C
Big	P	P	C	P

A = Abundant, P = Present, C = Common

<sup>12</sup> Information from Aaron Cole. Wisconsin DNR Fisheries Biologist. 2015

<sup>13</sup> DNR Lakes Book. 2009.

# Plant Community

## Aquatic Plant Survey Results

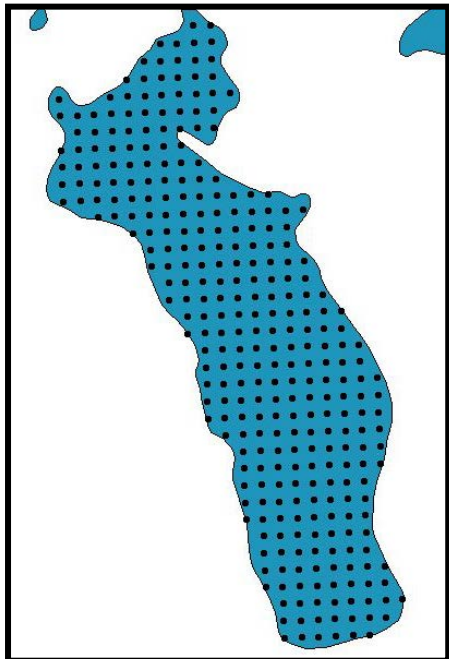
Ecological Integrity Service completed an aquatic plant inventory for project lakes in July 2014, according to the WDNR-specified point intercept method. A curly leaf pondweed (CLP) survey was conducted to identify the locations of this aquatic invasive species in late June. Since CLP typically dies in early July, CLP surveys are usually completed in late June while the CLP is robust.

The results discussed below are summarized or taken directly from the aquatic plant survey. The survey and data analysis methods for the aquatic plant survey are found in the following report: *Aquatic Macrophyte Survey Big Lake, Churchpine Lake, Wind Lake Polk County, Wisconsin 2014*. Round Lake is consistently referred to as Wind Lake in project results and maps.

Using a standard formula based on the lake's shoreline shape and length, islands, water clarity, depth, and size, the Wisconsin Department of Natural Resources (WDNR) generated the sampling point grid of 322 points for Church Pine Lake, 145 points for Round Lake, and 410 points for Big Lake. The results of the survey are discussed separately for each lake.

### Church Pine Lake

Figure 11 shows the distribution of sampling points for Church Pine Lake.



*Figure 11. Church Pine Lake Sampling Point Grid*

Vegetation was found at 122 of the 322 sampling points (about 38% of the lake). The greatest depth with plants – the limit of the littoral zone – was 25.6 feet. The littoral zone includes the depths at which plants can grow. About 84% of the lake littoral zone had plants present. This very deep littoral zone indicates that Church Pine Lake has very high water clarity throughout the summer which results in excellent light penetration for plant growth.

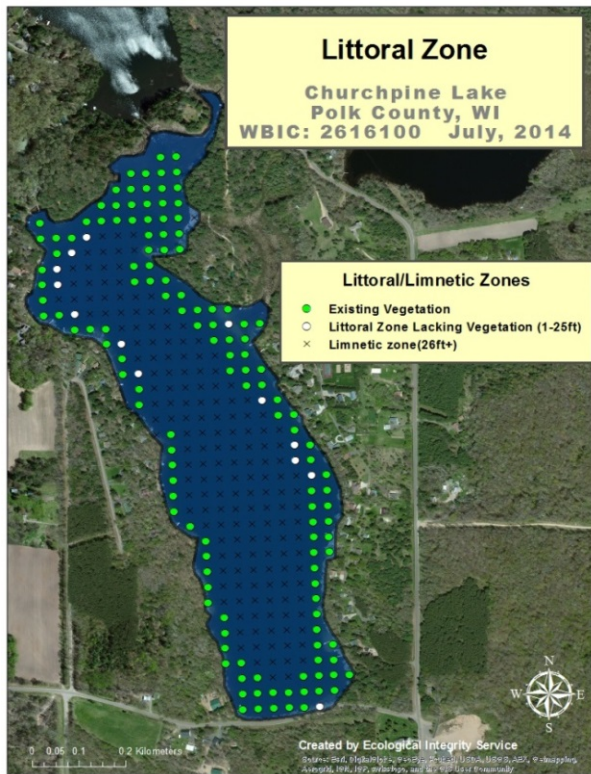


Figure 12. Church Pine Lake Littoral Zone

Some of the more shallow areas of the lake had fairly dense plant growth. However, most of the plant growth at sample points was moderate. The lake gets very deep quickly, and plant growth stops abruptly. Church Pine Lake has a very diverse plant community. There was a mean of 3.58 species of plants at each sample point. There were 33 species sampled at points and 37 species including visually observed plants. The Simpson's diversity index is 0.92. This demonstrates high diversity with a 92% chance that two plants sampled at a point will be different.

The most common plants sampled were fern pondweed (*Potamogeton robbinsii*), wild celery (*Vallisneria Americana*), and variable pondweed (*Potamogeton gramineus*). All of these are common native species found in Wisconsin lakes. Each of these plant species (as well as others sampled) is desirable and serves important roles or niches in the lake ecosystem. Maps of each species location are available in the full aquatic plant survey report.

Table 8. Church Pine Lake Aquatic Plant Survey Summary

	2014	2009
Total number of sample points in grid	322	322
Total number of sites with vegetation	122	138
Total number of sites shallower than maximum depth of plants	145	149
Frequency of occurrence at sites shallower than maximum depth of plants	84.14%	92.62%
Simpson Diversity Index	0.92	0.91
Maximum depth of plants (ft)	25.60	25.7
Average number of all species per site (shallower than max depth)	3.11	
Average number of all species per site (veg. sites only)	3.58	3.41
Average number of native species per site (shallower than max depth)	3.11	
Average number of native species per site (veg. sites only)	3.58	3.41
Species Richness	33	33
Species Richness (including visuals)	37	38

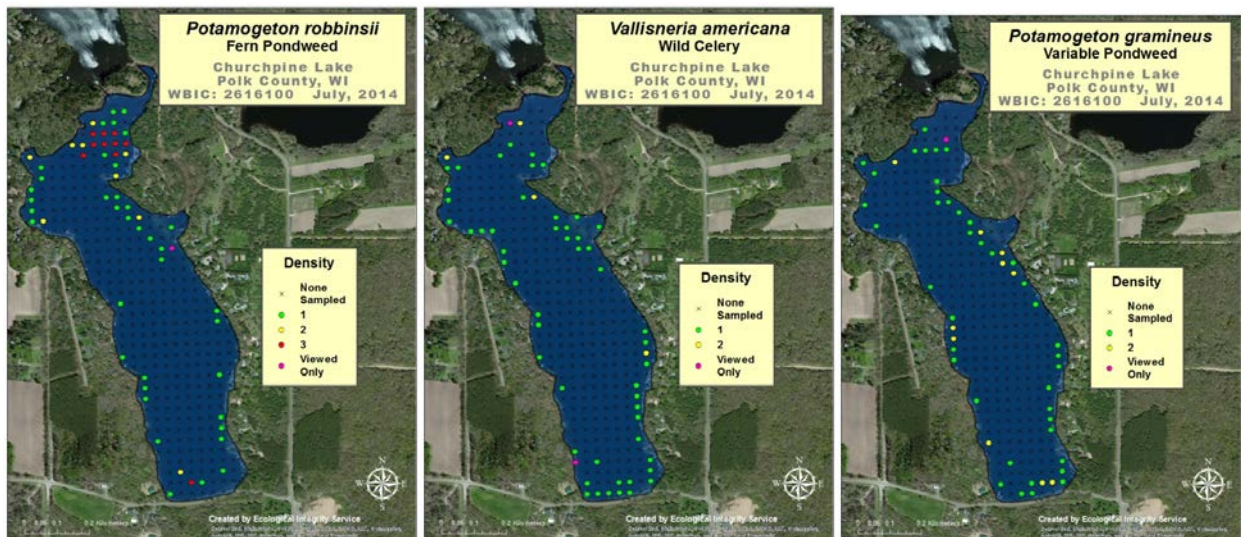


Figure 13. Church Pine Lake Densities for Most Common Plants



Table 9. Aquatic Plant Species of Church Pine Lake

Species	Vegetated Frequency	Littoral Frequency	Relative Frequency	# Sampled	Density
<i>Potamogeton robbinsii</i> , Fern pondweed	46.72	39.31	13.38	57	1.51
<i>Vallisneria americana</i> , Wild celery	45.90	38.62	13.14	56	1.07
<i>Potamogeton gramineus</i> , Variable pondweed	44.26	37.24	12.68	54	1.19
<i>Myriophyllum sibiricum</i> , Northern water-milfoil	38.52	32.41	11.03	47	1.13
<i>Najas flexilis</i> , Slender naiad	22.13	18.62	6.34	27	1.07
<i>Ceratophyllum demersum</i> , Coontail	21.31	17.93	6.10	26	1.13
<i>Potamogeton illinoensis</i> , Illinois pondweed	15.57	13.10	4.46	19	1.00
<i>Potamogeton zosteriformis</i> , Flat-stem pondweed	15.57	13.10	4.46	19	1.05
<i>Lemna trisulca</i> , Forked duckweed	9.84	8.28	2.82	12	1.00
<i>Nymphaea odorata</i> , White water lily	9.02	7.59	2.58	11	1.00
<i>Chara</i> sp., Muskgrasses	9.02	7.59	2.58	11	1.18
<i>Nitella</i> sp., Nitella	9.02	7.59	2.58	11	1.09
<i>Potamogeton friesii</i> , Fries' pondweed	8.20	6.90	2.30	10	1.30
<i>Potamogeton pusillus</i> , Small pondweed	8.20	6.90	2.30	10	1.11
<i>Heteranthera dubia</i> , Water star-grass	7.38	6.21	2.11	9	1.11
<i>Brasenia schreberi</i> , Watershield	5.74	4.83	1.64	7	1.00
<i>Potamogeton natans</i> , Floating-leaf pondweed	4.92	4.14	1.41	6	1.00
<i>Potamogeton foliosus</i> , Leafy pondweed	4.10	3.45	1.17	5	1.20
<i>Potamogeton praelongus</i> , White-stem pondweed	3.28	2.76	0.94	4	1.00
<i>Eleocharis acicularis</i> , Needle spikerush	2.46	2.07	0.70	3	1.00
<i>Elodea canadensis</i> , Common waterweed	2.46	2.07	0.70	3	1.00
<i>Bidens beckii</i> , Water marigold	1.64	1.38	0.47	2	1.00
<i>Juncus pelocarpus</i> f. <i>submersus</i> , Brown-fruited rush	1.64	1.38	0.47	2	1.00
<i>Pontederia cordata</i> , Pickerelweed	1.64	1.38	0.47	2	1.00
<i>Potamogeton amplifolius</i> , Large-leaf pondweed	1.64	1.38	0.47	2	1.00
<i>Typha augustifolia</i> , Narrow-leaved Cattail	1.64	1.38	0.47	2	1.00
<i>Eleocharis palustris</i> , Creeping spikerush	0.82	0.69	0.23	1	1.00
<i>Myriophyllum tenellum</i> , Dwarf water-milfoil	0.82	0.69	0.23	1	1.00
<i>Potamogeton richardsonii</i> , Claspingleaf pondweed	0.82	0.69	0.23	1	1.00
<i>Sagittaria cristata</i> , Crested arrowhead	0.82	0.69	0.23	1	1.00
<i>Schoenoplectus subterminalis</i> , Water bulrush	0.82	0.69	0.23	1	1.00
<i>Stuckenia pectinata</i> , Sago pondweed	0.82	0.69	0.23	1	1.00
<i>Utricularia intermedia</i> , Flat-leaf bladderwort	0.82	0.69	0.23	1	1.00
Aquatic moss	1.64	1.38	n/a	2	1.00
Freshwater sponge	0.82	0.69	n/a	1	1.00
Filamentous algae	18.85	15.86	n/a	23	1.04

Species	Vegetated Frequency	Littoral Frequency	Relative Frequency	# Sampled	Density
<i>Isoetes echinospora</i> , Spiny spored-quillwort	Viewed	only			
<i>Schoenoplectus acutus</i> , Hardstem bulrush	Viewed	only			
<i>Sparganium eurycarpum</i> , Common bur-reed	Viewed	only			
<i>Utricularia vulgaris</i> , Common bladderwort	Viewed	only			

### Round (Wind) Lake

Plant growth is widespread in Round Lake. Vegetation was found at 95 of the 145 sampling points (about 66% of the lake). The greatest depth with plants – the limit of the littoral zone – was 20.9 feet. Over 92% of the lake littoral zone had plants present. The sample grid is shown in the maps of the littoral zone below.

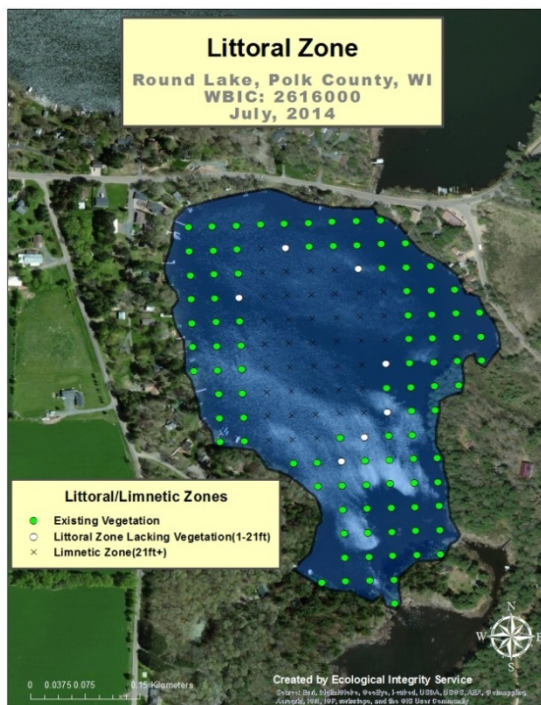


Figure 14. Round Lake Littoral Zone

Table 10. Round Lake Aquatic Plant Survey Summary

	2014	2009
Total number of sample points in grid	145	145
Total number of sites with vegetation	95	86
Total number of sites shallower than maximum depth of plants	103	108
Frequency of occurrence at sites shallower than maximum depth of plants	92.23%	79.63%
Simpson Diversity Index	0.94	0.91
Maximum depth of plants (ft)**	20.90	21.1
Average number of all species per site (shallower than max depth)	4.04	
Average number of all species per site (veg. sites only)	4.38	3.95
Average number of native species per site (shallower than max depth)	4.03	
Average number of native species per site (veg. sites only)	4.37	3.95
Species Richness	37	37
Species Richness (including visuals)	38	40

The plant community in Round Lake is diverse and healthy. There were 37 species of plants sampled on the rake and one more viewed. The most common plants sampled in Round Lake in 2014 were coontail (*Ceratophyllum demersum*), white water lily (*Nymphaea odorata*), and flat stem pondweed (*Potamogeton zosteriformis*). All of the native plants are balanced in frequency and are desirable to have in a lake ecosystem. Where plants were growing in Round Lake, the density was quite high. The map below shows the total rake density at sites with plants. Many of these sites have a rake density of three, which is the highest density rating.

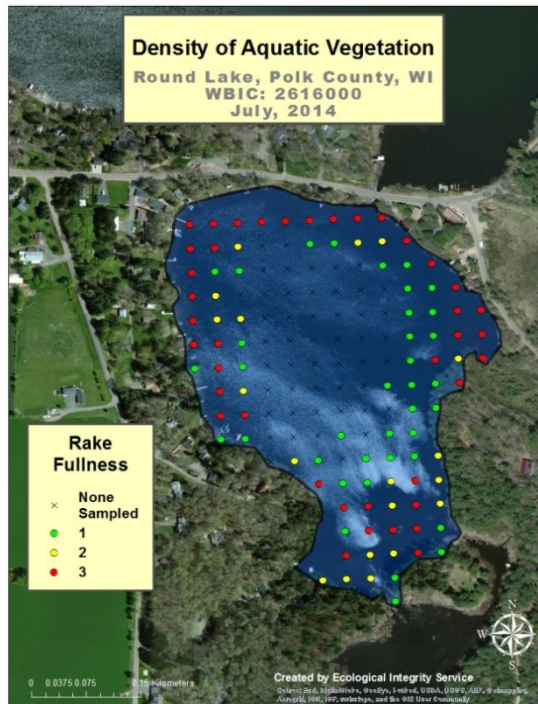


Figure 15. Rake Density for all Species Sampled on Round Lake

Table 11. Aquatic Plant Species of Round Lake

Species	Vegetated Freq.	Littoral Freq.	Rel Freq.	# Sampled	Density
<i>Ceratophyllum demersum</i> , Coontail	65.26	60.19	14.9	62	1.50
<i>Nymphaea odorata</i> , White water lily	34.74	32.04	7.9	33	1.00
<i>Potamogeton zosteriformis</i> , Flat-stem pondweed	30.53	28.16	7.0	29	1.00
<i>Najas flexilis</i> , Slender naiad	29.47	27.18	6.7	28	1.21
<i>Potamogeton robbinsii</i> , Fern pondweed	29.47	27.18	6.7	28	1.25
<i>Myriophyllum sibiricum</i> , Northern water-milfoil	22.11	20.39	5.0	21	1.00
<i>Elodea canadensis</i> , Common waterweed	18.95	17.48	4.3	18	1.00
<i>Heteranthera dubia</i> , Water star-grass	18.95	17.48	4.3	18	1.06
<i>Lemna minor</i> , Small duckweed	18.95	17.48	4.3	18	1.11
<i>Potamogeton illinoensis</i> , Illinois pondweed	17.89	16.50	4.1	17	1.06
<i>Potamogeton friesii</i> , Fries' pondweed	16.84	15.53	3.8	16	1.06
<i>Vallisneria americana</i> , Wild celery	15.79	14.56	3.6	15	1.00
<i>Brasenia schreberi</i> , Watershield	11.58	10.68	2.6	11	1.18
<i>Lemna trisulca</i> , Forked duckweed	11.58	10.68	2.6	11	1.00
<i>Nitella sp.</i> , Nitella	11.58	10.68	2.6	11	1.00
<i>Potamogeton pusillus</i> , Small pondweed	10.53	9.71	2.4	10	1.00
<i>Spirodela polyrhiza</i> , Large duckweed	8.42	7.77	1.9	8	1.00
<i>Potamogeton amplifolius</i> , Large-leaf pondweed	7.37	6.80	1.7	7	1.00
<i>Nuphar variegata</i> , Spatterdock	6.32	5.83	1.4	6	1.00
<i>Potamogeton richardsonii</i> , Clasp-leaf pondweed	6.32	5.83	1.4	6	1.00
<i>Potamogeton gramineus</i> , Variable pondweed	5.26	4.85	1.2	5	1.00
<i>Sagittaria sp.</i> , Arrowhead	5.26	4.85	1.2	5	1.00
<i>Bidens beckii</i> , Water marigold	4.21	3.88	1.0	4	1.00
<i>Chara sp.</i> , Muskgrasses	4.21	3.88	1.0	4	1.00
<i>Schoenoplectus acutus</i> , Hardstem bulrush	4.21	3.88	1.0	4	1.00
<i>Pontederia cordata</i> , Pickerelweed	3.16	2.91	0.7	3	1.00
<i>Sagittaria rigida</i> , Sessile-fruited arrowhead	3.16	2.91	0.7	3	1.00
<i>Wolffia columbiana</i> , Common watermeal	3.16	2.91	0.7	3	1.00
<i>Potamogeton natans</i> , Floating-leaf pondweed	2.11	1.94	0.5	2	1.00
<i>Potamogeton praelongus</i> , White-stem pondweed	2.11	1.94	0.5	2	1.00
<i>Utricularia intermedia</i> , Flat-leaf bladderwort	2.11	1.94	0.5	2	1.00
<i>Eleocharis acicularis</i> , Needle spikerush	1.05	0.97	0.2	1	1.00
<i>Isoetes echinospora</i> , Spiny spored-quillwort	1.05	0.97	0.2	1	1.00
<i>Potamogeton crispus</i> , Curly-leaf pondweed	1.05	0.97	0.2	1	1.00
<i>Potamogeton foliosus</i> , Leafy pondweed	1.05	0.97	0.2	1	1.00
<i>Stuckenia pectinata</i> , Sago pondweed	1.05	0.97	0.2	1	1.00



Species	Vegetated Freq.	Littoral Freq.	Rel Freq.	# Sampled	Density
<i>Utricularia vulgaris</i> , Common bladderwort	1.05	0.97	0.2	1	1.00
Aquatic moss			n/a		
Filamentous algae	13.68	12.62	n/a	13	1.00
<i>Sparganium eurycarpum</i> , Common bur-reed	Viewed	only			

Table 12. Boat Survey Shoreline Species Observed Round Lake 2014

<i>Polygonum amphibium</i> -Water smartweed
<i>Typha augustifolia</i> -Narrow leaf cattail

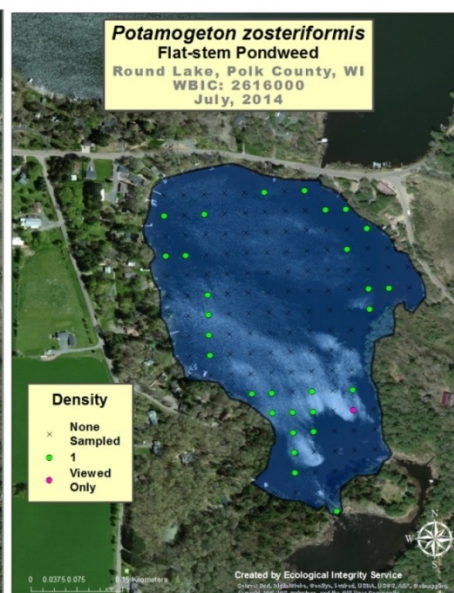
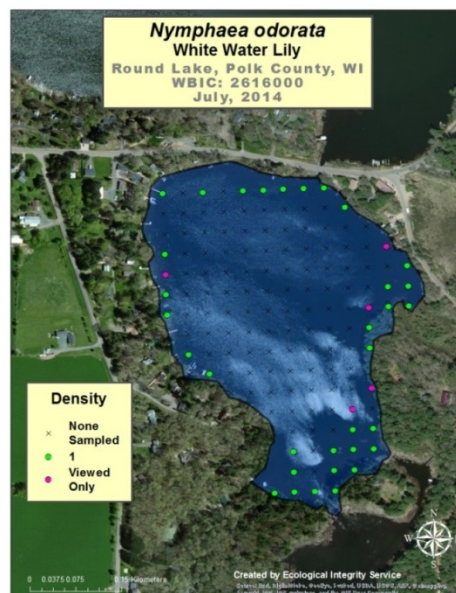
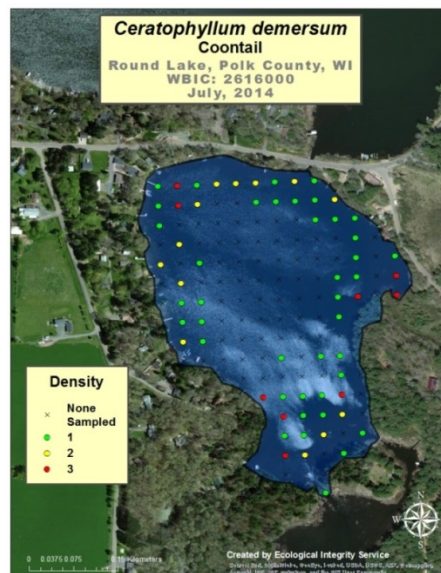


Figure 16. Round Lake Most Common Species Sampled

## Big Lake

There is rather low coverage of plants in Big Lake. Vegetation was found at 93 of the 410 sampling points (about 23% of the lake). The greatest depth with plants – the limit of the littoral zone – was 18.3 feet. The plant coverage in the littoral zone was about 64%. The sample grid is shown in the maps of the littoral zone below.

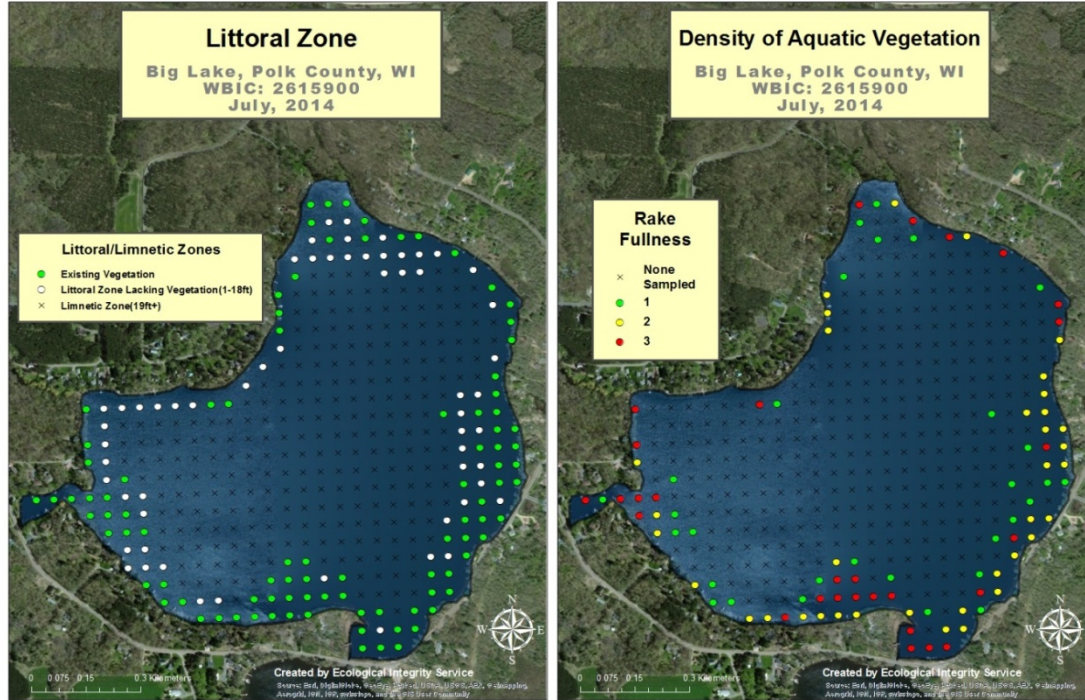


Figure 17. Big Lake Littoral Zone and Plant Density

Table 13. Big Lake Plant Summary Data

	2014	2009
Total number of sample points in grid	410	410
Total number of sites with vegetation	93	84
Total number of sites shallower than maximum depth of plants	144	114
Frequency of occurrence at sites shallower than maximum depth of plants	64.58%	73.68%
Simpson Diversity Index	0.87	0.91
Maximum depth of plants (ft)	18.30	16
Average number of all species per site (shallower than max depth)	1.87	
Average number of all species per site (veg. sites only)	2.89	3.64
Average number of native species per site (shallower than max depth)	1.86	
Average number of native species per site (veg. sites only)	2.88	3.52
Species Richness	28	27

Big Lake has a fairly diverse plant community. The species richness was 28 plants sampled. Another good measure of diversity is the Simpson's diversity index. The Simpson's diversity index from this survey was 0.87. Where there were plants growing, the coverage was quite dense.

The four most frequent plants sampled are coontail (*Ceratophyllum demersum*), wild celery (*Vallisneria Americana*), and forked duckweed (*Lemna trisulca*). All of these plants are native and common in Wisconsin lakes. They are desirable plants which serve very important roles in the lake ecosystem. Coontail has a relative frequency of 28.5%. This means more than one in every four plants sampled was coontail. The prevalence of coontail may indicate high nutrients in the lake and reduced water clarity, because coontail can live in lower light conditions and can absorb high amounts of nutrients directly from the water.







Table 14. Aquatic Plant Species of Big Lake

Species	Vegetated Freq	Littoral Freq	Rel Freq	# Sampled	Density	# Viewed
<i>Ceratophyllum demersum</i> , Coontail	82.80	53.47	28.50	77	1.60	
<i>Vallisneria americana</i> , Wild celery	39.78	25.69	13.75	37	1.08	
<i>Lemna trisulca</i> , Forked duckweed	27.96	18.06	9.60	26	1.08	
<i>Elodea canadensis</i> , Common waterweed	26.88	17.36	9.29	25	1.48	1
<i>Myriophyllum sibiricum</i> , Northern water-milfoil	18.28	11.81	6.32	17	1.00	7
<i>Potamogeton illinoensis</i> , Illinois pondweed	18.28	11.81	6.32	17	1.12	8
<i>Heteranthera dubia</i> , Water star-grass	13.98	9.03	4.83	13	1.08	1
<i>Nymphaea odorata</i> , White water lily	11.83	7.64	4.09	11	1.00	3
<i>Stuckenia pectinata</i> , Sago pondweed	10.75	6.94	3.72	10	1.00	2
<i>Potamogeton richardsonii</i> , Claspingleaf pondweed	7.53	4.86	2.60	7	1.00	7
<i>Lemna minor</i> , Small duckweed	4.30	2.78	1.49	4	1.00	
<i>Najas flexilis</i> , Slender naiad	4.30	2.78	1.49	4	1.25	
<i>Spirodela polyrhiza</i> , Large duckweed	4.30	2.78	1.49	4	1.00	
<i>Chara sp.</i> , Muskgrasses	2.15	1.39	0.74	2	1.00	
<i>Ranunculus aquatilis</i> , White water crowfoot	2.15	1.39	0.74	2	1.50	
<i>Wolffia columbiana</i> , Common watermeal	2.15	1.39	0.74	2	1.00	
<i>Bidens beckii</i> , Water marigold	1.08	0.69	0.37	1	1.00	
<i>Nuphar variegata</i> , Spatterdock	1.08	0.69	0.37	1	1.00	
<i>Potamogeton amplifolius</i> , Large-leaf pondweed	1.08	0.69	0.37	1		
<i>Potamogeton foliosus</i> , Leafy pondweed	1.08	0.69	0.37	1	1.00	
<i>Potamogeton friesii</i> , Fries' pondweed	1.08	0.69	0.37	1	1.00	
<i>Potamogeton gramineus</i> , Variable pondweed	1.08	0.69	0.37	1	1.00	
<i>Potamogeton praelongus</i> , White-stem pondweed	1.08	0.69	0.37	1	1.00	1
<i>Potamogeton robbinsii</i> , Fern pondweed	1.08	0.69	0.37	1	1.00	
<i>Potamogeton zosteriformis</i> , Flat-stem pondweed	1.08	0.69	0.37	1	1.00	
<i>Sagittaria sp.</i> , Arrowhead	1.08	0.69	0.37	1	1.00	1
<i>Schoenoplectus acutus</i> , Hardstem bulrush	1.08	0.69	0.37	1	1.00	
<i>Potamogeton crispus</i> , Curly-leaf pondweed	1.08	0.69	0.37	1	1.00	1
Filamentous algae	26.88	17.36		25	1.20	

Table 15. Boat Survey Shoreline Species Observed Big Lake 2014

<i>Lythrum salicaria</i> -Purple loosestrife
<i>Typha latifolia</i> -Broad leaf cattail
<i>Bolboschoenus fluviatilis</i> -River bulrush
<i>Typha angustifolia</i> -Narrow cattail
<i>Rumex orbiculatus</i> -Water dock
<i>Calla palustris</i> -Wild calla
<i>Cicuta bulbifera</i> -Bulb bearing rush
<i>Carex comosa</i> -Bottle brush sedge
<i>Iris versicolor</i> -Blue flag iris
<i>Potamogeton natans</i> -Floating pondweed
<i>Eleocharis palustris</i> -Creeping spikerush

### Floristic Quality Index

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

The FQI is calculated using the number of species present and each plant's species conservatism values. A higher FQI generally indicates a healthier aquatic plant community.

The Floristic Quality Index (FQI) was calculated for each lake. Only species sampled on the rake and listed in the Nichols FQI are used in determining the FQI. The list used for each lake FQI calculation is found in the plant survey results.

The FQI for each lake is higher than the median values for other lakes within the Northern Central Hardwoods ecoregion. In Big Lake, this is largely due to the higher number of species since the mean conservatism of the plants sampled is just slightly higher than the median within the ecoregion. In both Church Pine Lake and Round Lake all of the values (species, mean conservatism, and FQI) are substantially higher than the median within the ecoregion.

These values show the plant community is diverse with a large number of plants present that are intolerant to disturbance present. The habitat for plants is good and may show that human disturbance has had little impact on the plant community.

Table 16. FQI Comparison of Project Lakes to Ecoregion

Lake	Species used FQI	Mean Conservatism	FQI
Big Lake	26	5.96	30.4
Church Pine Lake	32	6.31	35.7
Round Lake	35	6.2	36.7
EcoRegion median	14	5.6	20.9

## Aquatic Invasive Species

### Church Pine Lake

There was one location where purple loosestrife was observed, but not sampled along the shore on Church Pine Lake. Purple loosestrife is an invasive wetland plant. Narrow leaf cattail, which is potentially invasive, was sampled and observed in a few different locations. The north end of Church Pine Lake, near the outlet to Round Lake, has two extensive cattail beds. These beds have a mixture of some broad leaf cattail, a large amount of narrow leaf cattail, and potentially a hybrid of the two species.



Figure 19. Narrow Leaf Cattail Beds Church Pine Lake

Narrow leaf cattail is an introduced species and, according to the Wisconsin DNR, is potentially invasive<sup>14</sup>. Some literature suggests the narrow leaf cattail does not act invasively when competing with broad leaf cattail. It can tend to be more common than broad leaf cattail, because narrow leaf cattail is more tolerant in deeper water. One study suggests that in more shallow water, which broad leaf cattail prefers, the narrow leaf cattail remained the same or declined slightly<sup>15</sup>. Narrow leaf cattail can also hybridize with broad leaf cattail, and this hybrid tends to spread more quickly than narrow leaf cattail.

No non-native aquatic invasive species were found in Church Pine Lake in the 2009 plant surveys. However, curly leaf pondweed was reported in low densities in the northeast corner of lake along two transects in 1997. APM Advisory Committee members also reported a floating fragment of curly leaf pondweed in late June 2010 in the southern portion of the lake.

### Round Lake

Two non-native species were found in and along Round Lake in 2009 and 2014.

#### **Curly Leaf Pondweed (*Potamogeton crispus*)**

While found in several single plants or small clumps and one 0.11 acre bed in 2009, there was only one observation of CLP in 2014.

#### **Purple Loosestrife (*Lythrum salicaria*)**

There were numerous locations where purple loosestrife (PL) was observed along the shoreline of Round Lake in 2009. All were single plants or very few plants in small clumps. Purple loosestrife can spread rapidly, and the shallow bays of Round Lake are suitable habitat for purple loosestrife. Just a few sites were observed in 2014.

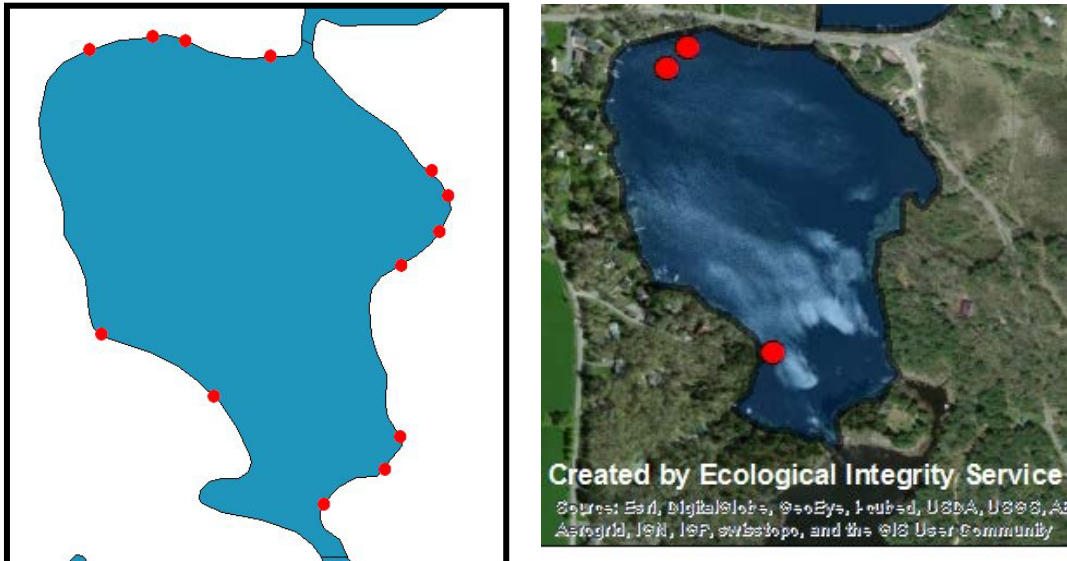


Figure 20. Round Lake Purple Loosestrife Locations 2009 and 2014

<sup>14</sup> Susan Knight, Wisconsin DNR personal communication, 2014.

<sup>15</sup> James B Gracea, Robert G Wetzels Long-term dynamics of *Typha* populations Aquatic Botany, Volume 61, Issue 2, 1 June 1998, Pages 137–146.

## Big Lake

Two non-native species were surveyed in or around Big Lake. Knotweed was also found previously by Polk County Land and Water Resources staff.

### Curly Leaf Pondweed (*Potamogeton crispus*)

Curly leaf pondweed (CLP) was surveyed and mapped in June 2014 and 2009. In 2014 it was sampled in only one location and not observed anywhere else on the lake (following herbicide treatment for CLP). In 2009, there was extensive CLP growth prior to an extensive, 5-year management effort.

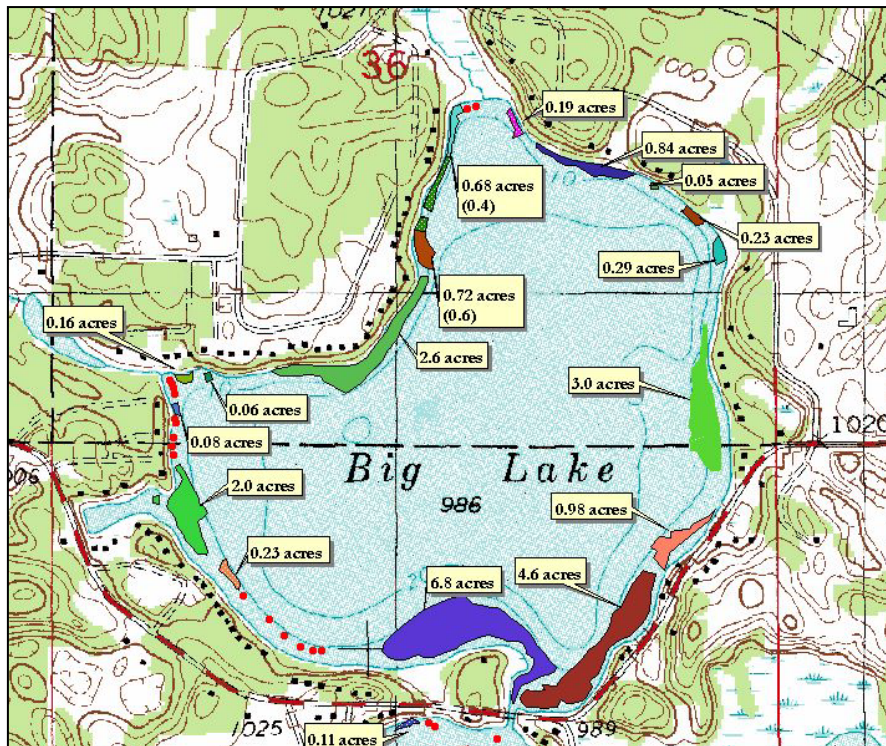


Figure 21. Curly Leaf Pondweed (CLP) Beds on Big Lake - 2009

### Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife was observed in a few locations on Big Lake in both 2009 and 2014. Two of these locations had growth that was large and quite dense. A bay near the landing has fairly extensive coverage and rather high density. Another large area of high density is across the road from Big Lake on the east shore. Committee members also described a large area of purple loosestrife growth along North Creek in 2009.



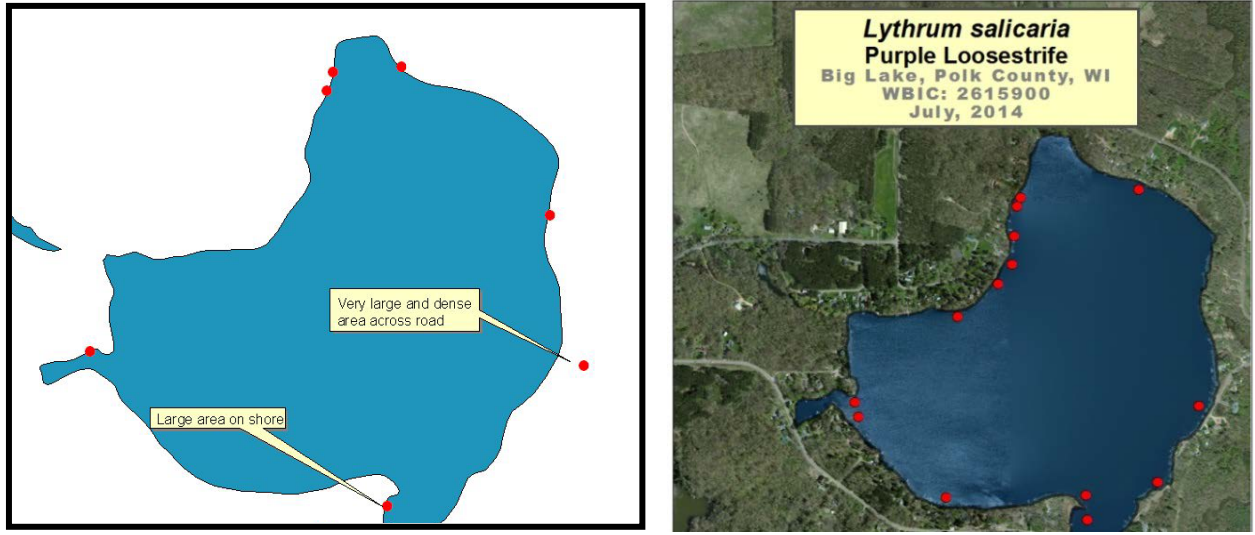


Figure 22. Big Lake Purple Loosestrife Locations 2009 and 2014

The other potentially invasive plant observed was narrow leaf cattail (*Typha augustifolia*). Narrow leaf cattail could be monitored if it is a concern for Big Lake. It is not known if the cattail in Big Lake has been changing over from broad leaf to narrow leaf cattail.

### Giant and Japanese Knotweed

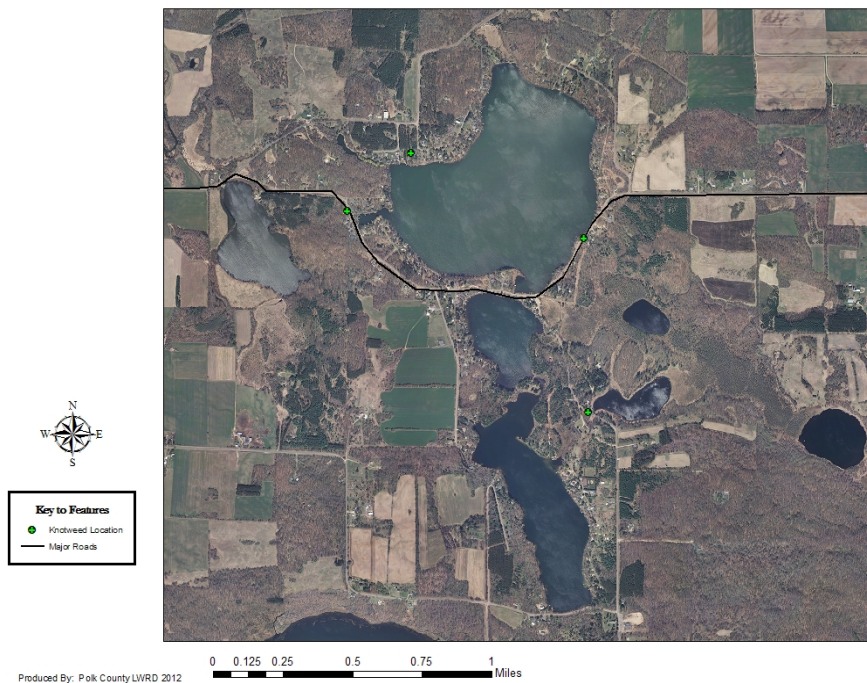


Figure 23. Giant and Japanese Knotweed Locations near Big Lake

## Plant Community Changes 2009-2014

Changes in the plant community from 2009 to 2014 are detailed in the point intercept survey results. There was very little change in plants for each lake between the two survey dates. In fact, there were more instances of significant increases in frequency of native plants than decreases. Decreases are more likely due to seasonal and sampling variation rather than impacts of human activity.

# Aquatic Plant Management

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

## Discussion of Management Methods

### Permitting Requirements

The Department of Natural Resources regulates the removal of aquatic plants when chemicals are used, when plants are removed mechanically, and when plants are removed manually from an area greater than 30 feet in width along the shore. The requirements for chemical plant removal are described in Administrative Rule NR 107 – *Aquatic Plant Management*. A permit is required for any aquatic chemical application in Wisconsin. Additional requirements exist when a lake is considered an ASNRI (Area of Special Natural Resource Interest) due, in the case of project lakes, to the designation of sensitive areas.

The requirements for manual and mechanical plant removal are described in NR 109 – *Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations*. A permit is required for manual and mechanical removal except for when a riparian (waterfront) landowner manually removes or gives permission to someone to manually remove plants, from his/her shoreline up to a 30-foot corridor. Wild rice may not be removed, even with hand methods. A riparian landowner may manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit. Manual removal refers to the control of aquatic plants by hand or hand-held devices without the use or aid of external or auxiliary power.<sup>17</sup>

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

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

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<sup>17</sup> More information regarding DNR permit requirements and aquatic plant management contacts is found on the DNR web site: <http://dnr.wi.gov/lakes/plants/>



## Manual Removal<sup>18</sup>

Manual removal—hand pulling, cutting, or raking—will effectively remove plants from small areas. It is likely that plant removal will need to be repeated more than once during the growing season. The best timing for hand removal of herbaceous plant species is after flowering but before seed head production. For plants with rhizomatous (underground stem) growth, pulling roots is not generally recommended since it may stimulate new shoot production. Hand pulling is a strategy recommended for rapid response to a Eurasian water milfoil establishment and for private landowners who wish to remove small areas of curly leaf pondweed growth. Raking is recommended to clear nuisance growth in riparian area corridors up to 30 feet wide.

SCUBA divers may engage in manual removal for invasive species like Eurasian water milfoil. Care must be taken to ensure that all plant fragments are removed from the lake. Manual removal with divers is recommended for shallow areas where sporadic EWM growth occurs.

## Mechanical Control

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

**Aquatic plant harvesters** are floating machines that cut and remove vegetation from the water. The cutter head uses sickles similar to those found on farm equipment, and generally cut to depths from 1 to 6 feet. A conveyor belt on the cutter head brings the clippings onboard the machine for storage. Once full, the harvester travels to shore to discharge the load of weeds off of the vessel.

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

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

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results—open water and accessible boat lanes—are immediate, and can be enjoyed without the restrictions on lake use which follow herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish. By eliminating the upper canopy, harvesting reduces the shading caused by aquatic

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<sup>18</sup> Information from *APIS (Aquatic Plant Information System)*. U.S. Army Corps of Engineers. 2005 and the *Wisconsin Aquatic Plant Management Guidelines*.

plants. The nutrients stored in the plants are also removed from the lake, and the sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

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

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

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

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

If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since these machines travel from lake to lake, they may carry plant fragments with them, facilitating the spread of aquatic invasive species from one body of water to another. Prevailing winds may also blow cut vegetation into open areas of the lake or along shorelines.

Harvesting may be an option worth considering for managing curly leaf pondweed on Big Lake if herbicide treatment is not effective.

**Diver dredging** operations use pump systems to collect plant and root biomass. The pumps are mounted on a barge or pontoon boat. The 3 to 5 inch diameter dredge hoses are handled by one diver. The hoses normally extend about 50 feet in front of the vessel. Diver dredging is especially effective against the pioneering establishment of submersed invasive plant species.

When a weed is discovered in a pioneering state, this methodology can be considered. To be effective, the entire plant, including the subsurface portions, should be removed.

Plant fragments can result from diver dredging, but fragmentation is not as great a problem when infestations are small. Diver dredging operations may need to be repeated more than once to be effective. When applied to a pioneering infestation, control can be complete. However, periodic inspections of the lake should be performed to ensure that all the plants have been found and collected.

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

**Rotovation** involves using large underwater rototillers to remove plant roots and other plant tissue. Rotovators can reach bottom sediments to depths of twenty feet. Rotovating may significantly affect non-target organisms and water quality as bottom sediments are disturbed. However, the suspended sediments and resulting turbidity produced by rotovation settles fairly rapidly once the tiller has passed. Tilling contaminated sediments could release toxins into the water column. If there is any potential of contaminated sediments in the area, further investigation should be performed to determine the potential impacts from this type of treatment. Tillers do not operate effectively in areas with many underwater obstructions such as trees and stumps. If operations are releasing large amounts of plant material, harvesting equipment should be on hand to collect this material and transport it to shore for disposal.

### Biological Control<sup>19</sup>

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

The effectiveness of biocontrol efforts varies widely (Madsen, 2000). Beetles are commonly and successfully used to control purple loosestrife populations in Wisconsin. Tilapia and carp are used to control the growth of filamentous algae in ponds. Grass carp, an herbivorous fish, is sometimes used to feed on pest plant populations, but grass carp introduction is not allowed in Wisconsin.

**Weevils**<sup>20</sup> have potential for use as a biological control agent against Eurasian water milfoil. There are several documented “natural” declines of EWM infestations. In these cases, EWM

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<sup>19</sup> Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

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

### **Purple Loosestrife Biocontrol<sup>21</sup>**

Biocontrol may be the most viable long term control method for purple loosestrife control. The DNR and University of Wisconsin-Extension (UWEX), along with hundreds of citizen cooperators, have been introducing natural insect enemies of purple loosestrife, from its home in Europe to infested wetlands in the state since 1994. Careful research has shown that these insects are dependent on purple loosestrife and are not a threat to other plants. Insect releases monitored in Wisconsin and elsewhere have shown that these insects can effectively decrease purple loosestrife's size and seed output, thus letting native plants reduce its numbers naturally through enhanced competition.

A suite of four different insect species has been released as biological control organisms for purple loosestrife in North America and Wisconsin. Two leaf beetle species called "Cella" beetles that feed primarily on shoots and leaves were the first control insects to be released in Wisconsin, and are the insects available from DNR for citizens to propagate and release into their local wetlands. A root-mining weevil species and a type of flower-eating weevil have also been released and are slowly spreading naturally. The Purple Loosestrife Biocontrol Program offers cooperative support, including free equipment and starter beetles from DNR and UWEX, to all state citizens who wish to use these insects to reduce their local purple loosestrife.

The length of time required for effective biological control of purple loosestrife in any particular wetland ranges from one to several years depending on such factors as site size and loosestrife densities. The process offers effective and environmentally sound control of the plant, not elimination, in most cases. It is also typically best done in some combination with occasional use of more traditional control methods such as digging and herbicide use. Biocontrol with beetles is recommended for large inaccessible patches of purple loosestrife growth in the project area.

There are advantages and disadvantages to the use of biological control as part of an overall aquatic plant management program. Advantages include longer-term control compared to other technologies, lower overall costs, and plant-specific control. On the other hand, there are several disadvantages to consider, including very long control times (years instead of weeks), a lack of available agents for particular target species, and relatively specific environmental conditions

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<sup>20</sup> *Control of Eurasian Water Milfoil & Large-scale Aquatic Herbicide Use*. Wisconsin Department of Natural Resources. July 2006.

<sup>21</sup> <http://dnr.wi.gov/topic/Invasives/loosestrife.html>

necessary for success. Biological control is not without risks; new non-native species introduced to control a pest population, may cause problems of its own.

### Re-vegetation with Native Plants

Another aspect to biological control is native aquatic plant restoration. The rationale for re-vegetation is that restoring a native plant community should be the end goal of most aquatic plant management programs (Nichols 1991; Smart and Doyle 1995). However, in communities that have only recently been invaded by nonnative species, a propagule (seed) bank probably exists that will restore the community after nonnative plants are controlled (Madsen, Getsinger, and Turner, 1994). Re-vegetation following plant removal is probably not necessary on project lakes because a healthy, diverse native plant population is present.

### Physical Control<sup>22</sup>

In physical management, the environment of the plants is manipulated. Several physical techniques are commonly used: dredging, drawdown, benthic (lake bottom) barriers, and shading or light attenuation. Because these methods involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 WDNR permit is required.

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

**Drawdown**, or significantly decreasing lake water levels, can be used to control nuisance plant populations. With drawdown, the water is removed to a given depth. It is best if this depth includes the entire depth range of the target species. Drawdowns need to be at least one month long to ensure thorough drying and effective removal of target plants (Cooke 1980a). In northern areas, a drawdown in the winter that will ensure freezing of sediments is also effective. Although drawdown may be effective for control of hydrilla for one to two years (Ludlow 1995), it is most commonly applied to Eurasian water milfoil (Geiger 1983; Siver et al. 1986) and other milfoils or submersed evergreen perennials (Tarver 1980). Drawdown requires a mechanism to lower water levels. Although Big Lake does have some control of water levels at the outflow, the ability to decrease water levels is minimal.

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<sup>22</sup> Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

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

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

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

**Shading or light attenuation** reduces the amount of light available for plant growth. Shading has been achieved by fertilization to produce algal growth; application of natural or synthetic dyes, shading fabric, or covers; and establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974). During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general, these techniques are of only limited applicability.

Physical control is not currently proposed for management of aquatic plants on project lakes.

#### Herbicide and Algaecide Treatments

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

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

General descriptions of herbicide classes are included below.<sup>23</sup>

### **Contact Herbicides**

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

### **Systemic Herbicides**

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

### **Broad Spectrum Herbicides**

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

### **Selective Herbicides**

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

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<sup>23</sup> This discussion is taken from: *Managing Lakes and Reservoirs*. North American Lake Management Society.

and rate of application. Biological factors that affect herbicide selectivity include physiological factors, morphological factors, and stage of plant growth.

**Environmental Considerations**

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

*Table 17. Herbicides Used for the Management of Aquatic Plants in Project Lakes.*

<b>Brand Name(s)</b>	<b>Chemical</b>	<b>Target Plants</b>
Cultrine Plus, K-Tea, Copper Sulfate (CuSO <sub>4</sub> ), PLL tablets	Copper compounds	Milfoils, pondweeds, elodea, cattails, coontail, and algae
Reward	Diquat	Milfoils, pondweeds, elodea, cattails, coontail, and algae
Aquathol, Aquathol-K, Hydrothol	Endothall	Milfoils, pondweeds, elodea, cattails, coontail, white water lily, wild celery, and algae
Navigate, Aqua Kleen	2, 4-D	Milfoils, yellow and white water lily, watershield
Lime Slurry*	Calcium Hydroxide	Curly-leaf pondweed

\*An experimental treatment was conducted to compare the selective control of curly-leaf pondweed using Reward (diquat) and a lime slurry treatment.



General descriptions of the breakdown of commonly used aquatic herbicides are included below.<sup>24</sup>

### **Copper**

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

### **2,4-D**

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

### **Diquat**

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

### **Endothall**

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

### **Fluridone**

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

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<sup>24</sup> These descriptions are taken from Hoyer/Canfield: *Aquatic Plant Management*. North American Lake Management Society, 1997.

## **Glyphosate**

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

## **Copper Compounds**

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

## Herbicide Used to Manage Invasive Species

### **Eurasian Water Milfoil**

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies the following herbicides for control of Eurasian water milfoil: 2,4-D, diquat, endothall, fluridone, and triclopyr.<sup>25</sup> All of these herbicides, with the exception of diquat, are available in both granular and liquid formulations. It is possible to target invasive species by using the appropriate herbicide and timing. Diquat is used infrequently in Wisconsin because it is nonspecific. The herbicide 2,4-D is most commonly used to treat EWM in Wisconsin. This herbicide kills dicots including native aquatic species such as northern water milfoil, coontail, water lilies, spatterdock, and watershield. Early season (April to May) treatment of Eurasian water milfoil is recommended to limit the impact on native aquatic plant populations because EWM tends to grow before native aquatic plants.

Granular herbicide formulations are more expensive than liquid formulations (per active ingredient). However, granular formulations are generally thought to release the active ingredient over a longer period of time. Granular formulations, therefore, may be more suited to situations where herbicide exposure time will likely be limited, as is the case of treatment areas in small bands or blocks. In large, shallow lakes with widespread EWM, a whole lake treatment with a low rate of liquid herbicide may be most cost effective, because exposure time is greater. Factors that affect exposure time are size and configuration of treatment area, water flow, and wind.

Application rates for liquid and granular formulations are not interchangeable. A rate of 1 to 1.5 mg/L 2,4-D applied as a liquid is a moderate rate that will require a contact time of 36 to 48 hours. Application rates recommended for Navigate (granular 2,4-D) are 100 pounds per acre for depths of 0 to 5 feet, 150 pounds per acre for 5 to 10 feet, and 200 pounds per acre for depths greater than 10 feet. Allowed and recommended application rates are found on herbicide labels.

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<sup>25</sup> Additional information provided by John Skogerboe, Army Corps of Engineers, personal communication. February 14, 2008.

### **Curly Leaf Pondweed**

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

Studies and in-lake CLP control programs have demonstrated that curly leaf pondweed can be controlled with Aquathol K (a formulation of endothall) in 50 to 60 degree F water, and that treatments of CLP this early in its life cycle can prevent turion (reproductive structure) formation.<sup>26</sup> Since curly leaf pondweed is actively growing at these low water temperatures and many native aquatic plants are still dormant, early season treatment selectively targets curly leaf pondweed. This method is commonly used to treat CLP in Wisconsin.

Because the dosage is at lower rates than the dosage recommended on the label, a greater herbicide residence time is necessary. To prevent drift of herbicide and allow greater contact time, application in shallow bays is likely to be most effective. Herbicide applied to a narrow band of vegetation along the shoreline is likely to drift, rapidly decrease in concentration, and be rendered ineffective.<sup>27</sup> Steep drop-off, high winds, and other factors may increase herbicide dilution and decrease contact time thereby decreasing treatment effectiveness. Early season treatment similar to that described above can be used to treat corridors for navigation purposes. Because of potential for drift, a higher concentration of endothall is generally used.

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<sup>26</sup> *Research in Minnesota on Control of Curly Leaf Pondweed*. Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.

<sup>27</sup> Personal communication, Frank Koshere. March 2005.

## Previous Aquatic Plant Management Plans

### **Plant Surveys and Aquatic Plant Management Plans**

The Lake District hired Barr Engineering to complete an aquatic plant survey in 1996 and a management plan in 1997 for Big Lake. Barr also completed plant surveys (1997) and an aquatic plant management plan (1998) for Church Pine and Round Lake. The Barr surveys followed transect survey protocols to assess the presence, frequency, and density of various plant species. The transect survey was an accepted aquatic plant survey method at the time. The Lake District applied for and received two DNR Lakes Planning Grants to support these projects. The initial grant application indicated that curly leaf pondweed (CLP) was present on project lakes in 1987 when a previous lake study was completed.

Problems identified for Big Lake included dense vegetation at the water surface and the presence of curly leaf pondweed. The plan proposed a phased, pilot approach whereby three CLP management methods would be tested prior to the development of a large scale control program. The pilot project used two, one acre treatment plots and two control plots to measure the effectiveness of each of the following methods to control CLP growth: the herbicide Reward, harvesting, and lime slurry. A program for preventing and monitoring Eurasian water milfoil introduction was also established.

The Round and Church Pine Lake surveys revealed much less extensive growth of CLP than found in Big Lake. The plan recommended navigation channels in two areas of dense vegetative growth in each lake. It also suggested using the results of the Big Lake pilot study to choose a control method for CLP.

The Lake District applied for grants to have Barr Engineering update the Big Lake plant survey and management plan in 2006. These projects were not funded or completed.

### **CLP Control Pilot Project**

A lake protection grant project (LPT-67) evaluated the previously mentioned methods to control CLP and overall aquatic plant growth. These methods included herbicide treatment with Reward, harvesting, and lime slurry treatment.

The effectiveness of each treatment method was assessed by measuring stem density and biovolume of each macrophyte species present prior to treatment in early June 1998 and following treatment in mid-June in both 1998 and 1999. Measurements were also made in mid-June 2000 when no treatment occurred. The density of turions in lake sediments was measured in late June of the years mentioned above. The Lake District contributed extensive volunteer time and cash to match the grant and cover unanticipated project costs.

A project report was issued in July 2001. The report summarized the results of the pilot treatment program. The report concluded that the total stem density goal of 111 stems per square meter was not achieved. Effectiveness of the tested methods varied from year to year. In 1998 harvesting was the most effective treatment method, but it was not found effective in 1999 or 2000.

Lime slurry and herbicide treatments were judged to be effective in the report. Lime slurry appeared to be more effective in 1998, and herbicide treatment appeared to be more effective in 1999 (even with a doubling of the lime slurry dose in 1999). Residual effects of both treatment methods were also evident in 2000. For herbicide treatment, it was noted that this was not necessarily a good thing because in 2000, CLP pondweed colonized areas where herbicide treatment previously occurred.

Large scale lime slurry treatment of the entire littoral area of Big Lake in an 80 foot wide band was recommended - except in sensitive areas where a 20 foot wide band was advised. Lime slurry treatment of selected navigation channels in Church Pine and Round Lake was also recommended. The Lake District applied for a permit to implement the lime slurry treatment in 2007, and the permit was denied.

### Past Aquatic Plant Management

The DNR Northern Region released an Aquatic Plant Management Strategy (Appendix B) in the summer of 2007 to protect the important functions aquatic plants provide in lakes. As part of this strategy, the DNR prohibited management of native aquatic plants in front of individual lake properties after 2008 unless management is designated in an approved aquatic plant management plan.<sup>28</sup> Because of the importance of the native plant population for habitat, protection against erosion, and as a guard against invasive species infestation, plant removal with herbicides as an option for individual property owners must be carefully reviewed before permits are issued. The DNR did not allow removal after January 1, 2009 unless the “impairment of navigation” and/or “nuisance” conditions are clearly documented.

#### Individual Corridors

Some homeowners contracted with herbicide applicators to remove aquatic plants in front of their properties until 2006. A summary of these treatments is included in Tables 18 and 19 below. Emergent, floating, and submerged water plants and algae were targeted. The stated purpose of these treatments was threefold: to maintain shoreline access for boating, swimming, fishing, and to reduce nuisance algae accumulation.

*Table 18. Past Waterfront Herbicide Treatments on Church Pine Lake*

Year	Individual Properties (#)	Acres Treated w/ Herbicide
1994	3	2.49
2000	6	0.57
2002	5	0.57
2003	2	0.34

<sup>28</sup> Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.

Table 19. Past Waterfront Herbicide Treatments on Big Lake

Year	Individual Properties (#)	Acres Treated w/ Herbicide
1985	24	4.26
1986	23	3.8
1987	24	3.98
1988	24	4.17
1990	15	2.87
1991	16	1.72
1992	16	1.72
1994	6	0.75
1995	28	1.29
1998	1	0.16
1999*		
2000	19	3.09
2001	9	1.34
2002	7	0.80
2003	2	0.34
2005	2	0.34
2006	4	0.68

\*An experimental comparison treatment was conducted in this year, but did not occur on individual properties.

## Current Aquatic Plant Management

### Purple Loosestrife

The Lake District hired Dale Dressel, with Northern Aquatic Services to chemically treat purple loosestrife from 2009 through 2014. Purple loosestrife costs have declined with successful herbicide treatments. They totaled \$3,126 in 2009 and have remained below \$1,000 through 2014. Dale cut stems and treated plants with glyphosate. In 2010 beetles were raised by the Lake District and introduced in the large wetland area surrounding the North Creek inflow to Big Lake. Both control methods will continue.

### Knotweed Control

The Polk County LWRD found and treated Giant/Japanese Knotweed on Big Lake. This treatment ended in 2013. The Lakes District plans to take over control efforts through contract.

## Curly Leaf Pondweed Control<sup>29</sup>

The Lake District successfully implemented an early season herbicide control program for curly leaf pondweed from 2011-2014. Herbicide treatment was almost entirely in Big Lake with one small bed treated in Round Lake. These treatments resulted in nearly complete removal of CLP during each treatment period, with treatment acres declining over the years.

Importantly, reductions in CLP likely occurred without significant impacts to native plants. While pre and post monitoring surveys showed some declines in native plants, these changes may have been due to natural variability in growth. One indication is that coontail did not decline. Coontail is a plant likely to be affected by an early season Endothall treatment because it also grows early in the year. Endothall is a broad spectrum herbicide.

Table 20. CLP Treatment Summary (2011 – 2014)<sup>30</sup>

Year	Acres	Target ppm	Temp. in F reported at treatment	Reported wind speed	Decline in CLP Frequency	Significant Declines in Native Plants	Notes
2011	25.6	1.25 to 2	54	3-6 mph	76% to 4% 95% decline	NA	Data not available
2012	20.7	1.25 to 2	50 to 51	2-5 mph	75 to 11% 85% decline	Some pondweeds	Coontail increased (grows early season)
2013	20.9	1.5 to 2.5	59.9	2-6 mph	81 to 9% 89% decline	Wild celery	Coontail not affected
2014	14.1	1.5 to 2.5	55	3 mpg	70% to 2% 97% decline	None	

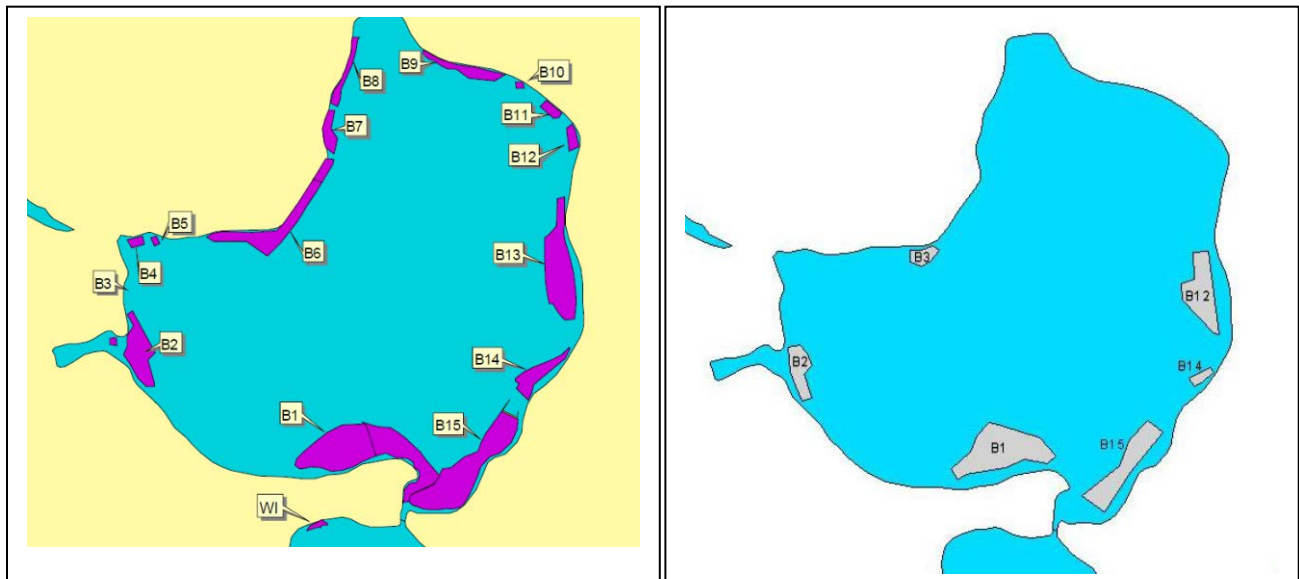


Figure 24. CLP Treatment Beds 2011 and 2014

<sup>29</sup> Schieffer, Steve. Ecological Integrity Service. *Herbicide Treatment Analysis for Potamogeton crispus (CLP) Big Lake Polk County, WI. 2011-2014*

<sup>30</sup> Schieffer, Steve. Email communication 3/10/15. Post treatment surveys occurred on 6/11/14 and 6/10/13.

### Herbicide Concentration Monitoring<sup>31</sup>

Herbicide concentration was monitored as part of a Department of Natural Resources study in 2013 and 2014. Results from both years show that herbicide concentrations are below the target amount and dissipate rapidly. The concentrations in the figure below show results from 2013. Sample site labels correspond to treatment bed numbers. Results from 2014 showed that herbicide concentrations began well below (50% or lower) target concentration and dropped below a baseline standard by 3 to 12 hours after treatment.

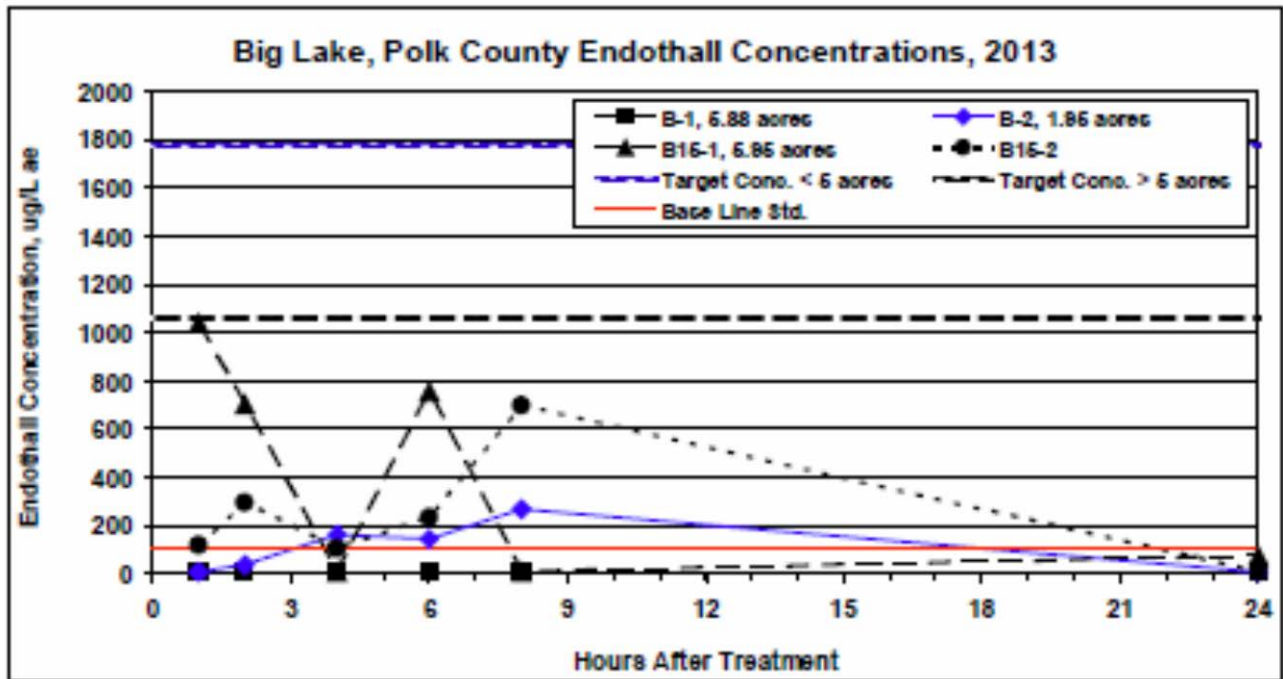


Figure 25. Big Lake Endothall Concentrations 2013

### CLP Turion Survey Results<sup>32</sup>

Ecological Integrity Service monitored curly leaf pondweed turions from 2011 through 2014. Most CLP reproduction occurs from turions which are small pinecone-like structures produced by plants prior to when they die back in early summer. CLP turions sprout through late fall or early winter in lake sediments, and the plants grow under the ice. The plants grow rapidly early in the spring following ice-out.

<sup>31</sup> Skogerboe, John. Draft: Big Lake, Polk County (WBIC 2615900), Dipotassium Salt of Endothall Herbicide Concentration Monitoring Summary, 2013 and 2014.

<sup>32</sup> Schieffer, Steve. Ecological Integrity Service. Herbicide Treatment Analysis for *Potamogeton crispus* (CLP) Big Lake Polk County, WI. 2011-2014





Figure 26. Germinating CLP Turion <sup>33</sup>

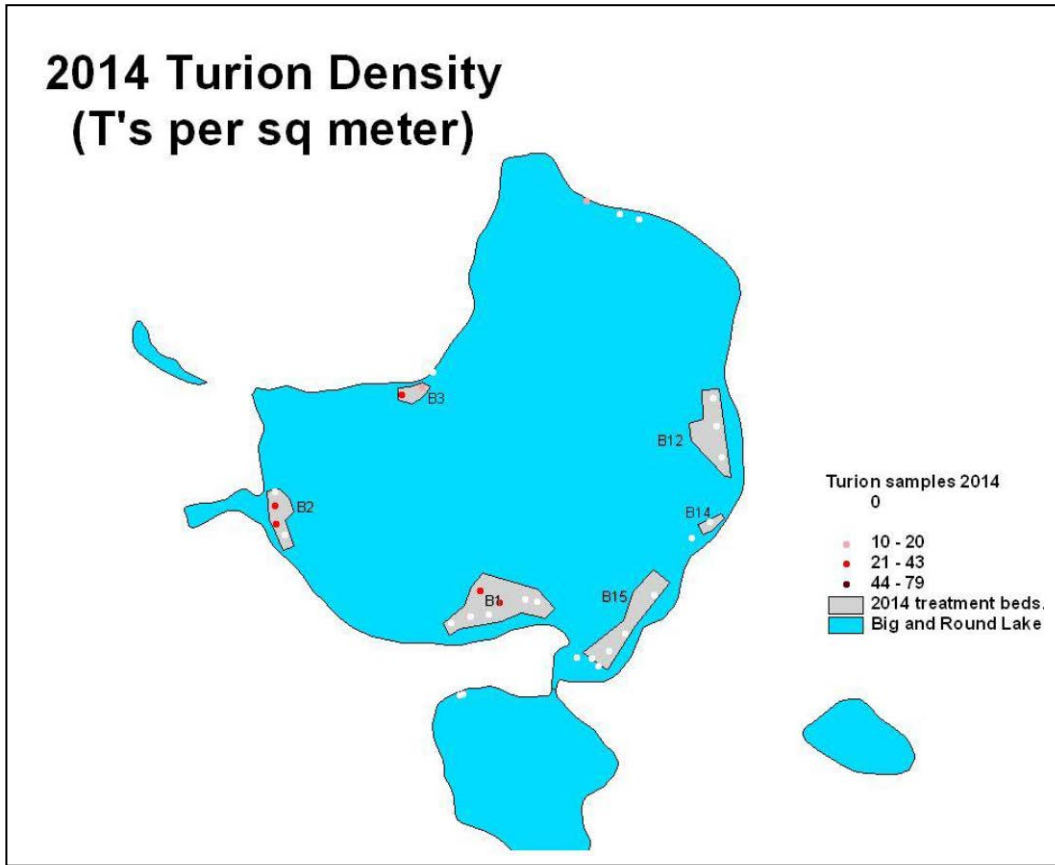
Research suggests that approximately 50% of turions germinate in a growing season while the rest remain dormant until the following growing season when another 50% will germinate (Johnson 2012). Depending on the level of turions at a given location, and knowing that latent turions may be able to survive for over 5 years in the sediment, it may take several years of control to exhaust the “turion bank” (R. Newman – U of M unpublished data).

Sediment turion analysis on Big Lake shows promising results with sediment turion density decreasing following four years of CLP herbicide treatments. Individual data for 2011 beds are not included in the table because the beds were not numbered consistently between 2011 and 2012. A map of the turion density at each sample point in 2014 is included as Figure 27.

Table 21. Mean Turion Density by Bed (turions/m<sup>2</sup>)

Bed	2011	2012	2013	2014
B1		30.7	27	12.4
B2		32.28	4	10.9
B3		7.1	15	21.7
B8		0	6.7	n/a
B12		28.7	39.7	0
B14		0	20	0
B15		30.7	16.7	0
R1		0	20	n/a
<b>All</b>	<b>44</b>	<b>12.8</b>	<b>13.6</b>	<b>6.4</b>

<sup>33</sup> Photo from Berg, Matthew. Curly-leaf pondweed (*Potamogeton crispus*) Post Herbicide Turion Survey Balsam Lake – WBIC: 2620600 Polk County, Wisconsin. November 2014.



*Figure 27. Big Lake Turion Density 2014*

## Lake District Education and AIS Prevention Activities

Education of lake homeowners occurs primarily through the Church Pine, Round, and Big Lakes web site ([www.bigroundpine.com](http://www.bigroundpine.com)) and spring and fall Lake District meetings. Lake District meeting topics have included water clarity, purple loosestrife, aquatic plant harvesting, and authorization for funds for aquatic plant management. Several educational handouts and brochures support educational efforts including a map with AIS messages developed specifically for the project lakes. The Lake District coordinates training and educational activities with the Polk County Land and Water Resources Department. County staff also provides plant identification assistance.

## **Clean Boats, Clean Waters**

The Clean Boats, Clean Waters (CBCW) program educates lake users regarding actions that prevent invasive species from entering lakes and records lake users' behavior. Because of the threat of introduction of invasive aquatic species, preparation for a CBCW project began in 2006. In that year, two lake residents attended DNR training. The Lake District also acquired inspector T shirts and hats to increase visibility of the program.

The CBCW inspections were launched in 2007. Residents who attended training in 2006 provided training for other volunteers. Coordinators were assigned for the Church Pine and Big Lake boat landings, and aquatic invasive species (AIS) signs were posted at these landings. Volunteers worked over 14 weekend days (57 hours) inspecting 57 boats with 2 potential AIS introductions avoided. Volunteers also looked for EWM at the boat landings in 2007. The program struggled in 2008 with fewer volunteers participating and deteriorating record keeping. Coverage at the boat landings went down to about four weekend days (22 hours) and 24 boat inspections.

In 2009, the Lake District hired 4 students working every weekend from 6 to 10 a.m. with two assigned per landing on Big Lake and Church Pine Lake. There were also ongoing "drop by" visits by the 16 volunteer adults. The Lake District funded the program without grant assistance in 2009.

Department of Natural Resources grants supported the Clean Boats Clean Waters program in from 2010 through 2014. Grant support has allowed expansion of the program. Inspectors staff the boat landings one weeknight, Saturdays, Sundays, and holidays beginning the weekend before Memorial Day and ending the weekend after Labor Day. Adults staff both the Church Pine and Big Lake Landings. They are paid \$10 to \$12 per hour. They enter data directly into the DNR SWIMS data base. The CBCW committee chair coordinates the program.

Table 22. Clean Boats Clean Waters Boat Landing Inspections

Landing	Boats 2009	Boats 2010	Boats 2011	Boats 2012	Boats 2013	Boats 2014
Big Lake	86	273	442	429	123	263
Church Pine	118	260	414	382	340	307

In 2012 inspectors worked 663 hours at the landings reaching 1,942 people.  
 In 2013 inspectors worked 408 hours at the landings reaching 1056 people.  
 In 2014 inspectors worked 459 hours at the landings reaching 858 people.

**Landing Signs and Kiosks**

AIS educational kiosks are maintained at both boat landings. These kiosks create an obvious display of AIS related material and serve as a presentation tool for CBCW inspectors. The signs and information at the kiosk provide reminders of the Polk County and State of Wisconsin Do Not Transport Ordinance and Regulation. It is illegal to transport aquatic vegetation on boats and equipment in Polk County.



Figure 28. Landing Signs and Kiosk Displays

**South Landing Camera**

The Lake District purchased and Environmental Sentry Protection, LLC (ESP) installed a video camera and signage at the Church Pine Boat Landing in August of 2011. The camera monitors boater landing use and behavior at the landings. It also serves as a reminder for boaters to clean boats and trailers upon entering and leaving the lake. While the aquatic plant management plan called for a second camera at the Big Lake Landing, the Polk County Highway Department would not allow camera installation in the right of way of County Road K.

**Boat Landing Monitoring**

Ecological Integrity Services surveyed the Big Lake and Church Pine boat landings in 2011, and the only aquatic invasive species found was mystery snail.<sup>34</sup> No additional aquatic invasive species were found with consultant boat landing inspections from 2012-2014.<sup>35</sup>

<sup>34</sup> Schieffer, Steve. *Big Lake and Churchpine Lake SCUBA Survey*. 2011

<sup>35</sup> Steve Schieffer. Personal Communication. March 10, 2015.

## Plan Goals and Strategies

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

An implementation plan chart, included as Appendix F, outlines how each action will be accomplished listing a timeline, resources needed, and responsible parties. The implementation plan chart will be updated each year. Actions may be modified as new information becomes available. The Water Quality Committee will review potential modifications and make recommended changes to the Lake District Board. The board will approve updated implementation plans including modified management actions.

**Goals** = broad statements of direction. Goals are listed in no particular order of priority.

**Objectives** = measurable steps toward the goal.

**Actions** = actions to take to accomplish objectives.

**Implementation Plan** outlines timeline, resources needed, and responsible parties for each action item.

### Plan Goals

1. Prevent introduction of aquatic invasive species and pursue any new introductions aggressively.
2. Substantially reduce the population and spread of curly leaf pondweed, purple loosestrife, and other invasive aquatic plants.
3. Maintain navigable routes for boating.
4. Preserve our diverse native aquatic plant community.
5. Educate and engage the public regarding aquatic plant management.

1. Prevent introduction of aquatic invasive species and pursue any new introductions aggressively.

### ***Objectives***

- A. Boaters inspect, clean, and drain boats, trailers and equipment.
- B. Identify new aquatic invasive species as soon as possible after introduction to the lakes.
- C. Rapidly and aggressively respond to new introductions of invasive species such as Eurasian water milfoil.

### ***Actions***

1. Continue a successful Clean Boats, Clean Waters program. (Objective A)
2. Monitor regularly for invasive species introduction at areas of high public use such as the boat landings using volunteers, consultants, divers, and/or other comprehensive, reliable methods. (Objective B)
3. Follow the Aquatic Invasive Species Rapid Response Strategy (Appendix D). (Objective C)
4. Investigate and pursue available monitoring and control measures for priority invasive species such as Eurasian water milfoil and zebra mussels. (Objective B, C)
5. Monitor surveillance cameras at the Church Pine boat landing. (Objective A)

2. Substantially reduce the population and spread of curly leaf pondweed, purple loosestrife, and other invasive aquatic plants.

### ***Objectives: Curly leaf pondweed***

#### Church Pine

- A. Eradicate curly leaf pondweed if found in Church Pine Lake.

#### Round

- B. Eliminate dense growth at the north end of Round Lake

#### Big Lake

- C. Substantially reduce CLP in Big Lake, pursuing aggressive treatment as long as treatment measures remain effective. (Monitor progress by measuring acreage, pretreatment CLP frequency, and sediment turion density in defined beds annually.)
- D. Understand the water quality impacts of phosphorus release from CLP in Big Lake.

### ***Actions***

1. Hand pull any curly leaf pondweed found growing in Church Pine or Round Lake. Use herbicide treatment only if hand pulling is not effective or practical. (Objectives A and B)

2. Control CLP growing in dense beds using low-dose, early season Endothall treatment or other accepted method. (Objectives C, D)
  - a. Select tentative beds for treatment in December of previous year
  - b. Select APM contractors (Herbicide Contractor, APM Monitor) in January
  - c. Apply for APM permits in January
3. Conduct DNR specified and required third-party pre and post treatment monitoring for CLP herbicide treatment. (Objective C)
4. Map beds of curly leaf pondweed annually. Look for curly leaf pondweed growth in Church Pine where reported in 1997 in transects 11 and 13 and where bed was previously present in Round Lake. (Objective A-D)
5. Monitor sediment turions. (Objective C, D)
6. Study CLP phosphorus content and release in Big Lake. As an initial step, add to lake modeling for the 2015 internal load study. (Objective D)

***Objectives: Purple Loosestrife and Giant and Japanese Knotweed***

- A. Eradicate individual plants
- B. Reduce populations in larger, established areas

***Actions***

1. Hire contractor to cut/apply herbicides to individual plants and patches. (Objective A and B)
2. Release beetles in large, inaccessible patches (purple loosestrife only). (Objective B)
3. Map purple loosestrife and knotweed growth annually to monitor progress toward objectives. (Objective A, B)

***Objective: Narrow Leaf Cattail***

- A. Ensure that the plant doesn't spread to additional areas of the lake.

***Actions***

1. Map beds of narrow leaf and broad leaf cattail annually (coincide with purple loosestrife mapping).
2. Consider control measures if narrow leaf cattail shows signs of spreading.



### 3. Define and maintain navigable routes for boating.

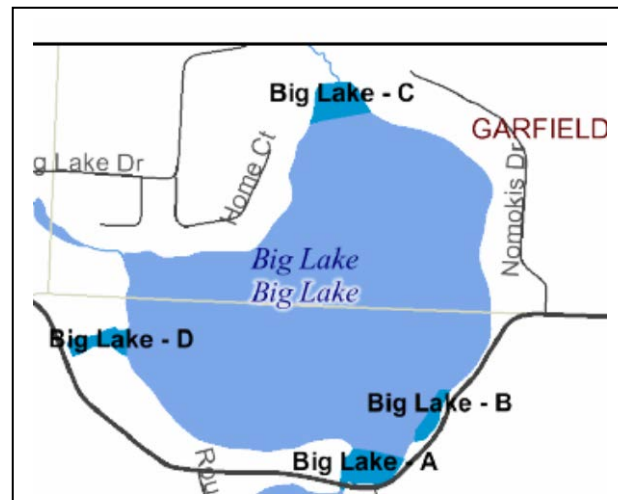
#### **Objectives:**

- A. Reduce nuisance conditions when native plant growth creates problems/nuisances in common boating routes. The common boating routes with potential navigation impairment currently identified are Sensitive Area D in Big Lake, the channel between Church Pine Lake and Round Lake, and under the bridge between Round Lake and Big Lake.
- B. Allow access through native and invasive aquatic plants to individual waterfront corridors.

#### **Actions**

- 1. Monitor to identify navigation impairment. (Objective A)
- 2. Seek permit and address confirmed navigation impairment using appropriate method. (Objective A)

*Herbicide application will generally be used to manage impaired navigation areas. The herbicide will target species present in problem area. Floating aquatic species such as water lilies may be addressed in subsequent years with preventative treatment measures (i.e., early June application).*



*Individual Access Corridors* are the openings from a waterfront property owner's shoreline out into the lake to the point where plants no longer inhibit navigation. These corridors may be a maximum of 30 feet wide (25 feet in a sensitive area) and must remain in the same location from year to year. Herbicide treatment or harvesting may be permitted for individual corridors in front of waterfront property to control invasive or native plants.

**Action**

3. Allow individual landowners to apply for permits and treat individual access corridors.

(Objective B)

*These treatments may focus on invasive or native plants. Landowners would bear the cost of these treatments. Hand removal methods are recommended as a first choice for navigation impairment created by native plants. Hand removal does generally not require a permit when limited to a 30-foot opening. Native plants provide an important shield against invasion by Eurasian water milfoil and other invasive aquatic plant species.*

Procedure for Individual Corridor Permitting and Monitoring

Document nuisance conditions (landowner/ herbicide contractor provide in permit application in February/March)

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

Verify/refute nuisance conditions and/or navigation impairment

- Landowner requests Lake District Lake Management Chair or designee review of their property prior to submitting a permit application to DNR.
- The Lake District Lake Management Chair or designee visits site, reviews documentation and provides a written opinion of navigation impairment i.e., is herbicide treatment or harvesting warranted?
- Standards for Lake District review: degree of navigation impairment, narrow corridors may be recommended in sensitive areas or for lots less than 100 feet in width.
- Landowner/applicator applies for permit to WDNR including photographic documentation, and identification of plants causing navigation problems.
- For curly leaf pondweed treatment, verification must occur the year before treatment in May or June. Once CLP nuisance is verified and a permit is approved, additional verification is not needed for three subsequent years (although permit applications must be completed each year). Treatment for CLP must occur with water temperatures from 50 - 58 degrees F.
- WDNR will contact herbicide contractor and owner with a notice to proceed with treatment or denial of permit application.

4. Preserve our diverse native aquatic plant community.

***Objectives***

- A. Maintain native plants to prevent AIS introduction.
- B. Protect native plant sensitive/critical habitat areas – especially areas with emergent vegetation like rushes and cattails.
- C. Increase residents’ understanding of the role and importance of aquatic plants and their impacts on them.

***Actions***

- 1. Limit native plant management in sensitive areas to narrow corridors (25 feet maximum width). (Objective B)
- 2. Implement strict adherence with treatment standards (early CLP treatment prior to native plant growth) and monitoring methods prior to and following herbicide treatment. (Objective A, B)
- 3. Limit removal of native plants to areas with severe navigation problems or nuisance conditions. (Objective A, B, C)
- 4. Use methods outlined in Goal 5 to deliver messages regarding native plant values. (Objective C)

5. Educate and engage the public regarding aquatic plant management.

***Audience***

Lake residents (full time and part time)  
Lake users/visitors

***Desired Behaviors***

Preserve native plants to protect the lake  
Look for aquatic invasive species and report potential AIS observed  
Clean sediment and plants from boats, trailers, and equipment (including docks, rafts, fishing buckets, etc.)  
Don't dump bait in the lakes  
Drain live wells  
Preserve native plants  
Don't use aquatic herbicides without a permit  
Share lake stewardship messages with others  
Look for zebra mussels on docks when you pull them from the water (and before they are put in)

***Messages***

Aquatic plant management plan

Why we are implementing the plan; who is doing it; when actions will be completed.  
Report progress toward plan goals and objectives.  
Inform landowners of the process for applying for individual corridor permits.

Invasive species prevention

Identify CLP, PL, and EWM with photos and descriptions.  
Explain methods to avoid spread of invasive species.  
Show maps of CLP and PL on the lakes.  
Clean aquatic vegetation from boats and trailers.  
Polk County and the state of Wisconsin prohibit transporting aquatic plants on boats and trailers.  
Fines may result if you don't obey the law.  
Recommend information to be included with DNR licenses – boat registration and operation.

Native plant values

Native plants prevent invasive species from getting established.  
Residents should understand the need for a balance and not attempt to eliminate all aquatic plants.

***Methods***

- Website (include pictures)
- Signs
- Clean Boats, Clean Waters inspectors
- Landing camera
- Lake District meetings: annual meeting, special meetings- use food to encourage attendance
- Talk to your neighbor campaign

- Plant identification workshops – pontoon classrooms
- Neighborhood/smaller group parties and picnics
- Mailing: information/reports to all lake property owners. Consider door to door contact.
- Personal visits to lake residents
- Flyers at Big Lake Store
- Pictures
- Handouts

## Monitoring and Assessment

Aquatic plant (macrophyte) surveys are the primary means for tracking achievement toward plan goals.

**Action.** Conduct whole lake aquatic plant surveys approximately once every five years to track plant species composition and distribution. The next survey is scheduled for 2019.

The whole lake surveys will be conducted in accordance with the guidelines established by the Wisconsin DNR. Any new species sampled will be saved, pressed, and mounted for voucher specimens.

### Aquatic Invasive Species Grants

Department of Natural Resources Aquatic Invasive Species (AIS) grants are available to assist in funding some of the action items in the implementation plan. Maintaining navigation channels to alleviate nuisance conditions are an exception. Grants provide up to 75 percent funding.

Applications for AIS control activities are accepted each year with postmark deadline of February 1. Applications for AIS prevention, education, and planning are accepted each year with a postmark deadline of December 10. This includes funding for the Clean Boats, Clean Waters programs.

Table 23 describes past and current Aquatic Invasive Species grants. The Lake District currently has two DNR grants: one to support the Clean Boats, Clean Waters program and a second for the development of this management plan and for curly leaf pondweed, purple loosestrife, and knotweed control and monitoring.

*Table 23. WDNR Aquatic Invasive Species Grants to BRCP PRD*

<b>Start Date</b>	<b>End Date</b>	<b>Grant Number</b>	<b>Amount</b>	<b>Tasks</b>
4/1996	6/1997	LPL-382	\$10,000	Church Pine, Big, & Round Lakes Macrophyte Management Plans
4/1997	6/1998	LPL-471	\$9,975	Church Pine and Round Lakes Macrophyte Survey
9/2007	12/2001	LPT-067	\$73,126.25	Big Lake Macrophyte Plan Implementation
4/2009	12/2009	SPL-208-09	\$3,000	Big and Church Pine Aquatic Plant Surveys
4/2009	6/2011	LPL-1299-09	\$10,000	Big, Round, Church Pine Aquatic Plant Management Plan
10/2009	12/2011	AEPP-212-10	\$15,660	Clean Boats, Clean Waters
04/2011	12/2014	ACEI-099-11	\$93,220.50	CLP Control and Monitoring
04/2014	12/2014	CBCW-052-14	\$6,000	Clean Boats, Clean Waters
10/2013	12/2016	ACEI-145-14	\$46,942.50	CLP, Purple Loosestrife, and Knotweed Control and Monitoring; Aquatic Plant Management Plan; AIS Prevention Monitoring
02/2015	12/2015	CBCW-129-15	\$6,000	Clean Boats, Clean Waters

#### Adaptive Management Approach

The treatment areas, standards, and methods will be reviewed each year to see if they are effective and cost efficient. Changes may be made to the treatment approach based upon project results, the experience of other lake groups, and/or recommendations from the Department of Natural Resources. Minor changes to these and other actions will be documented in the implementation chart each year. Significant changes will be documented as brief addendums to the aquatic plant management plan to be reviewed by the Lake District Board, the APM Advisory Committee, and the Department of Natural Resources.

## Appendix A. Aquatic Invasive Species Information

### Curly Leaf Pondweed

Curly leaf pondweed is specifically designated as an invasive aquatic plant (along with Eurasian water milfoil and purple loosestrife) to be the focus of a statewide program to control invasive species in Wisconsin. Invasive species are defined as a “non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (23.22(c)).”

The Wisconsin Comprehensive Management Plan for Aquatic Invasive Species describes curly leaf pondweed impacts as follows:

It is widely distributed throughout Wisconsin lakes, but the actual number of waters infested is not known. Curly-leaf pondweed is native to northern Europe and Asia where it is especially well adapted to surviving in low temperature waters. It can actively grow under the ice while most plants are dormant, giving it a competitive advantage over native aquatic plant species. By June, curly-leaf pondweed can form dense surface mats that interfere with aquatic recreation. By mid-summer, when other aquatic plants are just reaching their peak growth for the year, it dies off. Curly-leaf pondweed provides habitat for fish and invertebrates in the winter and spring when most other plants are reduced to rhizomes and buds, but the mid-summer decay creates a sudden loss of habitat. The die-off of curly-leaf pondweed also releases a surge of nutrients into the water column that can trigger algal blooms and create turbid water conditions. In lakes where curly-leaf pondweed is the dominant plant, the summer die-off can lead to habitat disturbance and degraded water quality. In other waters where there is a diversity of aquatic plants, the breakdown of curly-leaf may not cause a problem.<sup>36</sup>

The state of Minnesota DNR web site explains that curly leaf pondweed often causes problems due to excessive growth. At the same time, the plant provides some cover for fish, and some waterfowl species feed on the seeds and winter buds.<sup>37</sup>

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<sup>36</sup> *Wisconsin's Comprehensive Management Plan to Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species*. Prepared by Wisconsin DNR. September 2003.

<sup>37</sup> Information from Minnesota DNR ([www.dnr.state.mn.us/aquatic\\_plants](http://www.dnr.state.mn.us/aquatic_plants)).

The following description is taken from a Great Lakes Indian Fish and Wildlife Commission handout.

Curly Leaf Pondweed (*Potamogeton crispus*)<sup>38</sup>

### Identification

Curly leaf pondweed is an invasive aquatic species found in a variety of aquatic habitats, including permanently flooded ditches and pools, rivers, ponds, inland lakes, and even the Great Lakes. Curly leaf pondweed prefers alkaline or high nutrient waters one to three meters deep. Its leaves are strap-shaped with rounded tips and undulating and finely toothed edges. Leaves are not modified for floating, and are generally alternate on the stem. Stems are somewhat flattened and grow to as long as two meters. The stems are dark reddish-green to reddish-brown, with the mid-vein typically tinged with red. Curly leaf pondweed is native to Eurasia, Africa, and Australia and is now spread throughout most of the United States and southern Canada.



### Characteristics

New plants typically establish in the fall from freed turions (branch tips). The winter form is short, with narrow, flat, relatively limp, bluish-green leaves. This winter form can grow beneath the ice and is highly shade-tolerant. Rapid growth begins with warming water temperatures in early spring – well ahead of native aquatic plants.

### Reproduction and Dispersal

Curly leaf pondweed reproduces primarily vegetatively. Numerous turions are produced in the spring. These turions consist of modified, hardened, thorny leaf bases interspersed with a few to several dormant buds. The turions are typically 1.0 to 1.7 cm long and 0.8 to 1.4 cm in diameter. Turions separate from the plant by midsummer and may be carried in the water column supported by several leaves. Humans and waterfowl may also disperse turions. Stimulated by cooler water temperatures, turions germinate in the fall, over-wintering as a small plant. The next summer plants mature producing reproductive tips of their own. Curly leaf pondweed rarely produces flowers.

### Ecological Impacts

Rapid early season growth may form large, dense patches at the surface. This canopy overtops most native aquatic plants, shading them and significantly slowing their growth. The canopy lowers water temperature and restricts absorption of atmospheric oxygen into the water. The dense canopy formed often interferes with recreational activities such as swimming and boating.

In late spring, curly leaf pondweed dies back, releasing nutrients that may lead to algae blooms. Resulting high oxygen demand caused by decaying vegetation can adversely affect fish

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<sup>38</sup> Information from GLIFWC Plant Information Center (<http://www.glifwc.org/epicenter>).



populations. The foliage of curly leaf pondweed is relatively high in alkaloid compounds possibly making it unpalatable to insects and other herbivores.

### **Control**

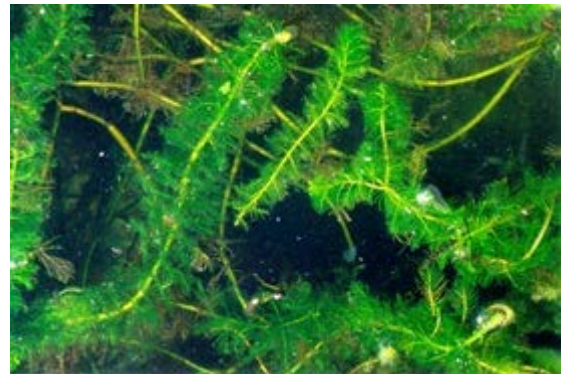
Small populations of curly leaf pondweed in otherwise un-infested water bodies should be attacked aggressively. Hand pulling, suction dredging, or spot treatments with contact herbicides are recommended. Cutting should be avoided because fragmentation of plants may encourage their re-establishment. In all cases, care should be taken to remove all roots and plant fragments, to keep them from re-establishing.

Control of large populations requires a long-term commitment that may not be successful. A prudent strategy includes a multi-year effort aimed at killing the plant before it produces turions, thereby depleting the seed bank over time. It is also important to maintain, and perhaps augment, native populations to retard the spread of curly leaf and other invasive plants. Invasive plants may aggressively infest disturbed areas of the lake, such as those where native plant nuisances have been controlled through chemical applications.

## Eurasian Water Milfoil (*Myriophyllum spicatum*)

### **Introduction**

Eurasian water milfoil is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-petaled or without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, Eurasian water milfoil is nearly impossible to distinguish from Northern water milfoil. Eurasian water milfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but does not have individual leaflets.



### **Distribution and Habitat**

Eurasian milfoil first arrived in Wisconsin in the 1960s. During the 1980s, it began to move from several counties in southern Wisconsin to lakes and waterways in the northern half of the state. As of 1993, Eurasian milfoil was common in 39 Wisconsin counties (54%) and at least 75 of its lakes, including shallow bays in Lakes Michigan and Superior and Mississippi River pools.

Eurasian water milfoil grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in

eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lake beds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

### **Life History and Effects of Invasion**

Unlike many other plants, Eurasian water milfoil 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. Milfoil is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist.

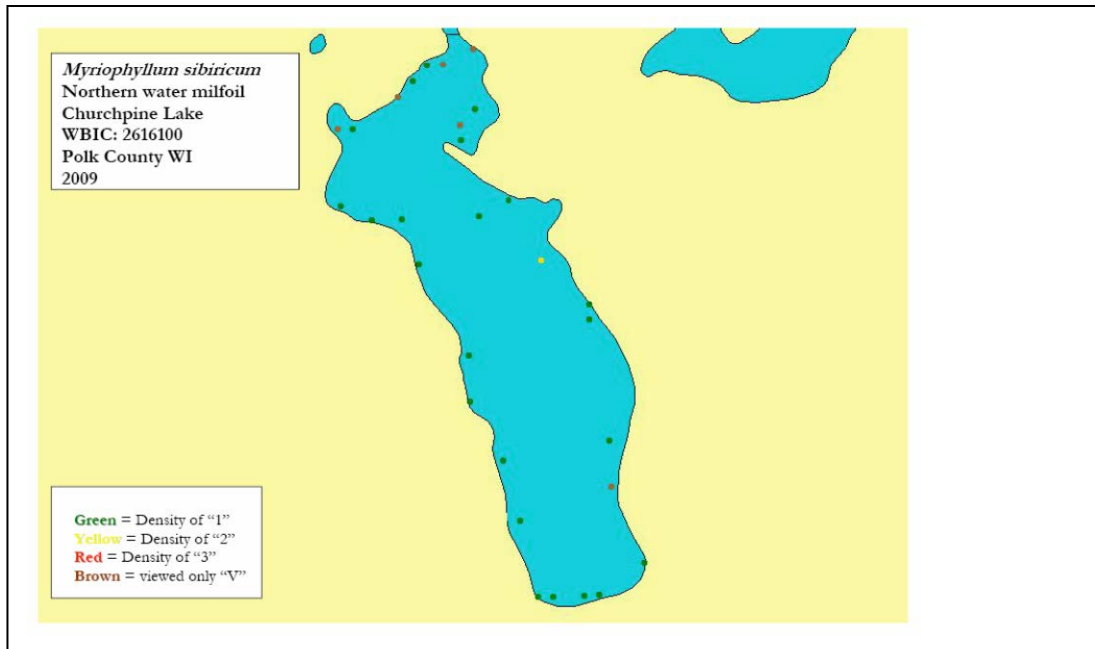
Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, Eurasian water milfoil is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates 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 Eurasian milfoil 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.

Dense stands of Eurasian water milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by Eurasian water milfoil may lead to deteriorating water quality and algae blooms of infested lakes.<sup>39</sup>

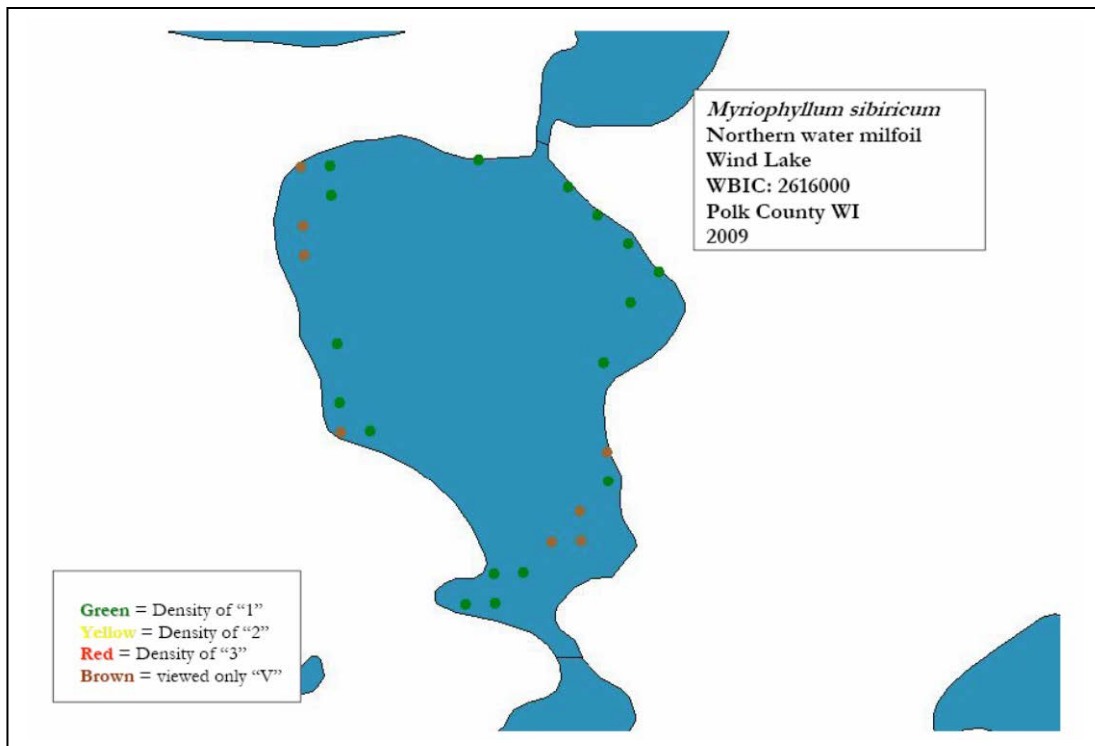
Eurasian water milfoil is likely to become established especially in areas where northern water milfoil grows. Maps on following pages indicated where northern water milfoil was found on project lakes.

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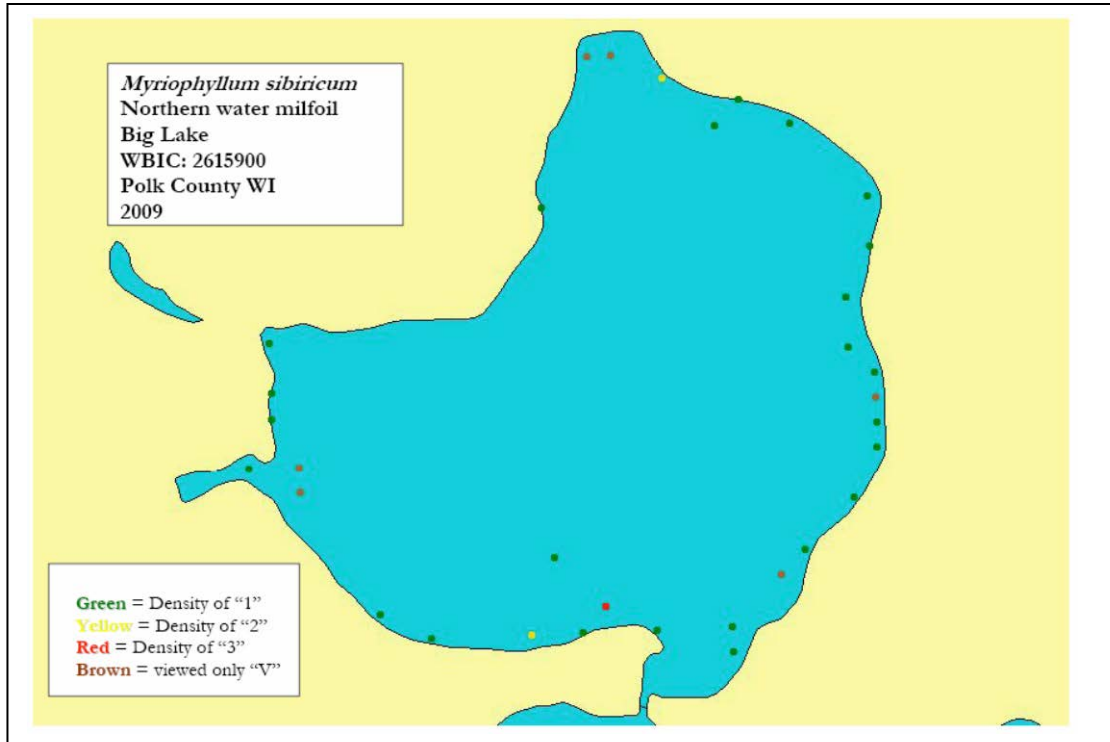
<sup>39</sup> Taken in its entirety from WDNR, 2008 <http://www.dnr.state.wi.us/invasives/fact/milfoil.htm>



*Northern water milfoil present on Church Pine Lake 2009.*



*Northern water milfoil present on Round (Wind) Lake 2009.*



*Northern water milfoil present on Big Lake 2009.*

## Reed Canary Grass (*Phalaris arundinacea*)

### Description

Reed canary grass is a large, coarse grass that reaches 2 to 9 feet in height. It has an erect, hairless stem with gradually tapering leaf blades 3 1/2 to 10 inches long and 1/4 to 3/4 inch in width. Blades are flat and have a rough texture on both surfaces. The leaf ligule is membranous and long. The compact panicles are erect or slightly spreading (depending on the plant's reproductive stage), and range from 3 to 16 inches long with branches 2 to 12 inches in length. Single flowers occur in dense clusters in May to mid-June. They are green to purple at first and change to beige over time. This grass is one of the first to sprout in spring, and forms a thick rhizome system that dominates the subsurface soil. Seeds are shiny brown in color.



Both Eurasian and native ecotypes of reed canary grass are thought to exist in the U.S. The Eurasian variety is considered more aggressive, but no reliable method exists to tell the ecotypes apart. It is believed that the vast majority of our reed canary grass is derived from the Eurasian ecotype. Agricultural cultivars of the grass are widely planted.

Reed canary grass also resembles non-native orchard grass (*Dactylis glomerata*) but can be distinguished by its wider blades, narrower, more pointed inflorescence, and the lack of hairs on glumes and lemmas (the spikelet scales). Additionally, bluejoint grass (*Calamagrostis canadensis*) may be mistaken for reed canary in areas where orchard grass is rare, especially in the spring. The highly transparent ligule on reed canary grass is helpful in distinguishing it from the others. Ensure positive identification before attempting control. The ligule is a transparent membrane found at the intersection of the leaf stem and leaf.

### Distribution and Habitat

Reed canary grass is a cool-season, sod-forming, perennial wetland grass native to temperate regions of Europe, Asia, and North America. The Eurasian ecotype has been selected for its vigor and has been planted throughout the U.S. since the 1800s for forage and erosion control. It has become naturalized in much of the northern half of the U.S. and is still being planted on steep slopes and banks of ponds and created wetlands.

Reed canary grass can grow on dry soils in upland habitats and in the partial shade of oak woodlands, but does best on fertile, moist organic soils in full sun. This species can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream banks, and seasonally wet areas; it also grows in disturbed areas.

### Life History and Effects of Invasion

Reed canary grass reproduces by seed or creeping rhizomes. It spreads aggressively. The plant produces leaves and flower stalks for 5 to 7 weeks after germination in early spring, then spreads laterally. Growth peaks in mid-June and declines in mid-July. A second growth spurt occurs in the fall. The shoots collapse in mid to late summer, forming a dense, impenetrable mat of stems

and leaves. The seeds ripen in late June and shatter when ripe. Seeds may be dispersed from one wetland to another by waterways, animals, humans, or machines.

This species prefers disturbed areas, but can easily move into native wetlands. Reed canary grass can invade a disturbed wetland in less than twelve years. Invasion is associated with disturbances including ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, and intentional planting. The difficulty of selective control makes reed canary grass invasion of particular concern. Over time, it forms large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites.<sup>40</sup>

Purple Loosestrife (*Lythrum salicaria*)<sup>41</sup>

### Description

Purple loosestrife is a non-native plant common in Wisconsin. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

Purple loosestrife is a perennial herb 3 to 7 feet tall with a dense bushy growth of 1 to 50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5 to 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 (underground stems) that form a dense mat.



### Characteristics

Purple loosestrife is a wetland herb that was introduced as a garden perennial from Europe during the 1800's. It is still promoted by some horticulturists for its beauty as a landscape plant, and by beekeepers for its nectar-producing capability. Currently, about 24 states have laws prohibiting its importation or distribution because of its aggressively invasive characteristics. It has since extended its range to include most temperate parts of the United States and Canada. The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators, like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

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<sup>40</sup> Taken from WDNR, 2008 [http://www.dnr.state.wi.us/invasives/fact/reed\\_canary.htm](http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm)

<sup>41</sup> Wisconsin DNR invasive species factsheets from <http://dnr.wi.gov/invasives>.



Purple loosestrife was first detected in Wisconsin in the early 1930s, but remained uncommon until the 1970s. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. This plant's optimal habitat includes marshes, stream margins, river 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.

### **Reproduction and Dispersal**

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 to 70%, resulting in an extensive seed bank. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Vegetative spread through local disturbance is also characteristic of loosestrife; clipped, trampled, or buried stems of established plants may produce shoots and roots. It is often very difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances, such as water drawdown, or exposed soil accelerate the process by providing ideal conditions for seed germination. When the right disturbance occurs, loosestrife can spread rapidly eventually taking over the entire wetland.

### **Ecological Impacts**

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways.

### **Mechanical Control**

Purple loosestrife (PL) can be controlled by cutting, pulling, digging, and drowning. Cutting is best done just before plants begin flowering. Cutting too early encourages more flower stems to grow than before. If done too late, seed may have already fallen. Since lower pods can drop seed while upper flowers are still blooming, check for seed. If none, simply bag all cuttings (to prevent them from rooting). If there is seed, cut off each top while carefully holding it upright, then bend it over into a bag to catch any dropping seeds. Dispose of plants/seeds in a capped landfill, or dry and burn them. Composting will not kill the seeds. Keep clothing and equipment seed-free to prevent its spread. Rinse all equipment used in infested areas before moving into uninfested areas, including boats, trailers, clothing, and footwear.

Pulling and digging can be effective but can also create disturbed bare spots, which are good sites for PL seeds to germinate or leave behind root fragments that grow into new plants. Use these methods primarily with small plants in loose soils, since they do not usually leave behind large gaps nor root tips, while large plants with multiple stems and brittle roots often do. Dispose of plants as described above.

Mowing has not been effective with loosestrife unless the plants can be mowed to a height where the remaining stems will be covered with water for a full twelve months. Burning has also proven largely ineffective. Mowing and flooding are not encouraged because they can contribute to further dispersal of the species by disseminating seeds and stems.

Follow-up treatments are recommended for at least three years after removal.

### **Chemical Control**

This is usually the best way to eliminate PL quickly, especially with mature plants. The chemicals used have a short soil life. Timing is important. Treat in late July or August but before flowering to prevent seed set. Always back away from sprayed areas as you go to prevent getting herbicide on your clothes. The best method is to cut stems and paint the stump tops with herbicide. The herbicide can be applied with a small drip bottle or spray bottle, which can be adjusted to release only a small amount. Try to cover the entire cut portion of the stem but not let the herbicide drip onto other plants since it is non-selective and can kill any plant it touches.

**Glyphosate herbicides:** Currently, glyphosate is the most commonly used chemical for killing loosestrife. Roundup and Glyphos are typically used, but if there is any open water in the area use Rodeo, a glyphosate formulated and listed for use over water. Glyphosate must be applied in late July or August to be most effective. Since you must treat at least some stems of each plant and they often grow together in a clump, all stems in the clump should be treated to be sure all plants are treated.

Another method is using very carefully targeted foliar applications of herbicide (NOT broadcast spraying). This may reduce costs for sites with very high densities of PL, since the work should be easier, and there will be few other plant species to hit accidentally. Use a glyphosate formulated for use over water. A weak solution of around 1% active ingredient can be used, and it is generally necessary to wet only 25% of the foliage to kill the plant.

You must obtain a permit from WDNR before applying any herbicide over water. The process has been streamlined for control of purple loosestrife, and there is no cost. Contact your regional Aquatic Plant Management Coordinator for permit information.

### **Biological Control**

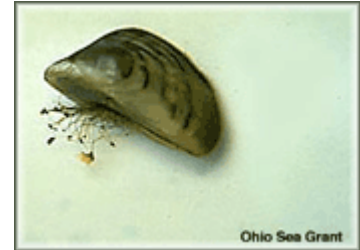
Conventional control methods like hand pulling, cutting, flooding, herbicides, and plant competition have only been moderately effective in controlling purple loosestrife. Biocontrol is now considered the most viable option for more complete control for heavy infestations. The WDNR, in cooperation with the U.S. Fish and Wildlife Service, is introducing several natural insect enemies of purple loosestrife from Europe. A species of weevil (*Hylobius transversovittatus*) has been identified that lays eggs in the stem and upper root system of the plant; as larvae develop, they feed on root tissue. In addition, two species of leaf-eating beetles (*Galerucella californiensis* and *G. pusilla*) are being raised and released in the state, and another weevil that feeds on flowers (*Nanophyes marmoratus*) is being used to stress the plant in multiple ways. Research has shown that most of these insects are almost exclusively dependent upon purple loosestrife and do not threaten native plants, although one species showed some



cross-over to native loosestrife. These insects will not eradicate loosestrife, but may significantly reduce the population so cohabitation with native species becomes a possibility.

### Zebra Mussels (*Dreissena polymorpha*)

The zebra mussel is a tiny (1/8-inch to 2-inch) bottom-dwelling clam native to Europe and Asia. Zebra mussels were introduced into the Great Lakes in 1985 or 1986 and have been spreading throughout them since that time. They were most likely brought to North America as larvae in ballast water of ships that traveled from fresh-water Eurasian ports to the Great Lakes. Zebra mussels look like small clams with a yellowish or brownish D-shaped shell, usually with alternating dark- and light-colored stripes. They can be up to two inches long, but most are under an inch. Zebra mussels usually grow in clusters containing numerous individuals.



Zebra mussels were first found in Wisconsin waters of Lake Michigan in 1990. They are now found in a number of inland Wisconsin waters. Zebra mussels are the only freshwater mollusks that can firmly attach themselves to solid objects. They are generally found in shallow (6 to 30 feet deep), algae-rich water.

Zebra mussels feed by drawing water into their bodies and filtering out most of the suspended microscopic plants, animals, and debris for food. This process can lead to increased water clarity and a depleted food supply for fish and other aquatic organisms. The higher light penetration fosters growth of rooted aquatic plants, which although creating more habitat for small fish, may inhibit the larger, predatory fish from finding their food. This thicker plant growth can also interfere with boaters, anglers, and swimmers. Zebra mussel infestations may also promote the growth of blue-green algae, since zebra mussels avoid consuming this type of algae but not others.

Once zebra mussels are established in a water body; very little can be done to control them. It is therefore crucial to take all possible measures to prevent their introduction in the first place. Be sure to follow the Clean Boats, Clean Waters procedure in preventing the spread of aquatic hitchhikers. In addition to these measures, boaters can take specific precautions in protecting their motors from zebra mussels.

No selective method has been developed that succeeds in controlling zebra mussels in the wild without also harming other aquatic organisms. To a certain extent, ducks and fish will eat small zebra mussels, but not to the point of effectively controlling their populations. As of yet, no practical and effective controls are known, again emphasizing the need for research and prevention.

## Giant Knotweed (*Polygonum sachalinense*)

Giant knotweed is a perennial that can reach up to 20 feet tall with erect, hollow stems that resemble bamboo. Plants die back each year; the dried stalks remain standing into winter. Stems are smooth and arching with swollen nodes and twigs that zigzag from node to node.



### Ecological Threat

Invades riparian areas where it prevents streamside tree regeneration

- Increases soils erosion along streambanks
- Often found in floodplain forests, disturbed areas, roadsides, and vacant lots
- Plants forms dense stands that crowd and shade out native vegetation
- Plants alter soil chemistry and may be allelopathic (exude chemical compounds toxic to native vegetation)
- Plant fragments as small as one inch have the potential to resprout
- Japanese and giant knotweed are known to hybridize

### Giant Knotweed is a prohibited species in Wisconsin.

#### Description

**Leaves:** Alternate, simple, dark green. Leaves are 6 to 14 inches long and have a heart-shaped base coming narrow to a point.

**Flowers:** Numerous small, greenish-white flowers appear in the leaf axils of the upper stems. Blooms are up to 4 inches long and occur during August to October. Giant knotweed blooms have both male and female parts in the same flower.

**Fruits & seeds:** Fruits are papery and broadly winged. Each fruit contains a 3-sided achene that is small, shiny, and brown. Small amounts of seed are viable and have no dormancy requirement.

**Roots:** Rhizomes that extend deeply into the soil creating a dense impenetrable mat.

**Similar species:** Japanese knotweed (*P. cuspidatum*) and Bohemian (hybrid) knotweed (*P. cuspidatum* x *P. sachalinense*) look very similar but can be distinguished by the type of hair on the veins on the undersides. Each species are equally as invasive. Japanese knotweed leaves are abruptly squared at base, and the flowers are dioecious. It has hollow stems with distinct raised nodes that give it the appearance of bamboo, though it is not related. Young plants are most commonly mistaken for rhubarb.

## **Control**

**Mechanical Control:** Hand pull, mow, or cut plants. Repeated cutting is needed to stimulate regrowth and exhaust root reserves. Digging up plants is difficult, because roots can extend so deeply into the soil. Discard plant debris cautiously as this plant aggressively reproduces vegetatively.

**Chemical Control:** Treat plants in the summer when there is a large amount of leaf surface to absorb and translocate systemic herbicides. Plants are more susceptible to herbicides if they are cut when 4 to 5 feet tall and the regrowth treated is around 3 feet tall. Foliar spray with 0.15% a.i. aminopyralid, 0.3 % a.i. Imazapyr, or either 2% a.i. glyphosate or triclopyr. Cut-stump treatment with 25% a.i. glyphosate or triclopyr.

Appendix B. Aquatic Plant Management Strategy WDNR

# **AQUATIC PLANT MANAGEMENT STRATEGY**

**Northern Region WDNR  
Summer, 2007**

# 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.

## Appendix C. References

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## Appendix D. Rapid Response for Early Detection of Aquatic Invasive Species

*Definition: Aquatic Invasive Species (AIS) are non-native plant species that can out-compete and overtake native plant species damaging native lake habitat and sometimes creating nuisance conditions. AIS currently in the Church Pine, Round, and Big Lake system include curly leaf pondweed (CLP), purple loosestrife (PL), narrow leaf cattail, and giant and Japanese knotweed. Additional AIS threaten the lakes and will be monitored by professional monitors or volunteers when species are added to the training program.*

1. Maintain a contingency fund for rapid response to EWM or other invasive species (Lake District Board).
2. Conduct volunteer (Clean Boats, Clean Waters Crew) and professional monitoring (APM Monitor) at designated public boat landings and other likely areas of AIS introduction. If a suspected plant is found, contact the AIS ID Volunteers.
3. Direct lake residents and visitors to contact the AIS ID Volunteers if they see a plant in the lakes they suspect might be an aquatic invasive species such as Eurasian water milfoil (EWM). Signs at the public boat landings, web pages, and handouts at annual meeting will provide plant photos and descriptions, contact information, and instructions.

If plant is likely AIS, AIS ID Volunteers will confirm identification with Polk County LWCD and the WDNR and inform the rest of the Lake District Board.

- a. Take a digital photo of the plant in the setting where it was found (if possible). Then collect 5 to 10 intact specimens. Try to get the root system, and all leaves as well as seed heads and flowers when present. Place in a zip lock bag with no water. Place on ice and transport to refrigerator.
  - b. Fill out plant incident form <http://dnr.wi.gov/lakes/forms/3200-125-plantincident.pdf>
  - c. Contact WDNR staff, then deliver collected plants to the WDNR (810 West Maple Street, Spooner, WI 54801) as soon as possible to the location they specify. WDNR may confirm identification with the herbarium at the University of Wisconsin – Stevens Point or the University of Wisconsin – Madison.
4. Mark the location of suspected AIS (AIS ID Volunteers). Use GPS points (in decimal degrees and WGS 84 datum), if available, or mark the location with a small float.
  5. If identification is positive:<sup>1</sup>

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<sup>1</sup> **If it is an animal other than a fish**

- Be sure the suspected [invasive species](#) has not been [previously found on the waterbody](#)
- Take a digital photo of the animal in the setting where it was found (if possible). Then collect up to five specimens. Place in a jar with water; put on ice and transport to refrigerator. Transfer specimen to a jar filled with rubbing alcohol (except for Jellyfish – leave in water).
- Fill out form [3200-126 – Aquatic Invasive Animal Incident Report](#)

- a. Inform the person who reported the AIS and the board (AIS ID Volunteers), who will then inform Polk County LWRD, herbicide contractor, and lake management consultant.
  - b. Mark the location of AIS with a more permanent marker. Special EWM buoys are available. (AIS ID Volunteers).
  - c. Post a notice at the public landing (DNR has these signs available) and include a notice on the website. Notices will inform residents and visitors of the approximate location of AIS and provide appropriate means to avoid its spread (Lake District Board).
6. Hire a consultant to determine the extent of the AIS introduction (Lake District Board). A diver may be used. If small amounts of AIS are found during this assessment, the consultant will be directed to identify locations with GPS points and hand pull plants found. All plant fragments will be removed from the lake when hand pulling.
  7. Select a control plan in cooperation with the WDNR (Lake District Board). The goal of the rapid response control plan will be eradication of the AIS. Additional guidance regarding EWM treatment is found in DNR's *Response for Early Detection of Eurasian Water Milfoil Field Protocol*.

Control methods may include hand pulling, use of divers to manually or mechanically remove the EWM from the lake bottom, application of herbicides, and/or other effective and approved control methods.

8. Implement the selected control plan including applying for the necessary permits. Regardless of the control plan selected, it will be implemented by persons who are qualified and experienced in the technique(s) selected.
9. Lake District funds may be used to pay for any reasonable expense incurred during the implementation of the selected control plan, and implementation will not be delayed by waiting for WDNR to approve or fund a grant application.
10. The Lake District Board will work with the WDNR to confirm, as soon as possible, a start date for an Early Detection and Rapid Response AIS Control Grant. Thereafter, the Lake District shall formally apply for the grant.
11. Frequently inspect the area of the AIS to determine the effectiveness of the treatment and whether additional treatment is necessary (Lake District Board, APM Monitor).
12. Review the procedures and responsibilities of this rapid response plan on an annual basis. Changes may be made with approval of the Lake District Board.

- 
- Contact DNR staff



EXHIBIT A<sup>2</sup>

CHURCH PINE, ROUND, AND BIG LAKE PROTECTION AND REHABILITATION DISTRICT

EWM ID Volunteers and Board Contacts	Gary Ovick: 715-294-3988 (home) Mike Reiter: 715-294-3950 (home)	715-417-1770 (mobile)
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POLK COUNTY LAND AND WATER RESOURCES DEPARTMENT

AIS Coordinator Director	Jeremy Williamson: 715-485-8639 Tim Ritten: 715-485-8631
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WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Grants and EWM Notice Permits EWM Identification and Notice	Alex Smith: 715-635-4124 Mark Sundeen: 715-635-4074 Spooner Lakes Team: 715-635-4124
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HERBICIDE APPLICATOR

Bid each December

APM MONITOR

Ecological Integrity Services	Steve Schieffer: 715-554-1168
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DIVERS

Ecological Integrity Services	Steve Schieffer: 715-554-1168
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<sup>2</sup> This list will be reviewed and updated each year.

## Appendix E. Management Options for Aquatic Plants

# Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
<b>No Management</b>	N	Do not actively manage plants	<p>Minimizing disturbance can protect native species that provide habitat for aquatic fauna; protecting natives may limit spread of invasive species; aquatic plants reduce shoreline erosion and may improve water clarity</p> <p>No immediate financial cost</p> <p>No system disturbance</p> <p>No unintended effects of chemicals</p> <p>Permit not required</p>	<p>May allow small population of invasive plants to become larger, more difficult to control later</p> <p>Excessive plant growth can hamper navigation and recreational lake use</p> <p>May require modification of lake users' behavior and perception</p>
<b>Mechanical Control</b>	May be required under NR 109	<p>Plants reduced by mechanical means</p> <p>Wide range of techniques, from manual to highly mechanized</p>	<p>Flexible control</p> <p>Can balance habitat and recreational needs</p>	<p>Must be repeated, often more than once per season</p> <p>Can suspend sediments and increase turbidity and nutrient release</p>
a. Handpulling/Manual raking	Y/N	<p>SCUBA divers or snorkelers remove plants by hand or plants are removed with a rake</p> <p>Works best in soft sediments</p>	<p>Little to no damage done to lake or to native plant species</p> <p>Can be highly selective</p> <p>Can be done by shoreline property owners without permits within an area &lt;30 ft wide OR where selectively removing exotics</p> <p>Can be very effective at removing problem plants, particularly following early detection of an invasive exotic species</p>	<p>Very labor intensive</p> <p>Needs to be carefully monitored</p> <p>Roots, runners, and even fragments of some species, particularly Eurasian watermilfoil (EWM) will start new plants, so all of plant must be removed</p> <p>Small-scale control only</p>

# Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
b. Harvesting	Y	Plants are "mowed" at depths of 2-5 ft, collected with a conveyor and off-loaded onto shore  Harvest invasives only if invasive is already present throughout the lake	Immediate results  EWM removed before it has the opportunity to autofragment, which may create more fragments than created by harvesting  Minimal impact to lake ecology  Harvested lanes through dense weed beds can increase growth and survival of some fish  Can remove some nutrients from lake	Not selective in species removed  Fragments of vegetation can re-root  Can remove some small fish and reptiles from lake  Initial cost of harvester expensive
<b>Biological Control</b>	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  Lowers density of problem plant to allow growth of natives	Effectiveness will vary as control agent's population fluctuates  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  Selective control of target species  Longer-term control with limited management	Need to stock large numbers, even if some already present  Need good habitat for overwintering on shore (leaf litter) associated with undeveloped shorelines  Bluegill populations decrease densities through predation

# Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
b. Pathogens	Y	Fungal/bacterial/viral pathogen introduced to target species to induce mortality	<p>May be species specific</p> <p>May provide long-term control</p> <p>Few dangers to humans or animals</p>	<p>Largely experimental; effectiveness and longevity unknown</p> <p>Possible side effects not understood</p>
c. Allelopathy	Y	Aquatic plants release chemical compounds that inhibit other plants from growing	<p>May provide long-term, maintenance-free control</p> <p>Spikerushes (<i>Eleocharis</i> spp.) appear to inhibit Eurasian watermilfoil growth</p>	<p>Initial transplanting slow and labor-intensive</p> <p>Spikerushes native to WI, and have not effectively limited EWM growth</p> <p>Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water</p>
d. Planting native plants	Y	Diverse native plant community established to repel invasive species	<p>Native plants provide food and habitat for aquatic fauna</p> <p>Diverse native community may be "resistant" to invasive species</p> <p>Supplements removal techniques</p>	<p>Initial transplanting slow and labor-intensive</p> <p>Nuisance invasive plants may outcompete plantings</p> <p>Largely experimental; few well-documented cases</p> <p>If transplants from external sources (another lake or nursery), may include additional invasive species or "hitchhikers"</p>

# Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
<b>Physical Control</b>	Required under Ch. 30 / NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a. Fabrics/ Bottom Barriers	Y	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
b. Drawdown	Y, May require Environmental Assessment	Lake water lowered with siphon or water level control device; plants killed when sediment dries, compacts or freezes  Season or duration of drawdown can change effects	Winter drawdown can be effective at restoration, provided drying and freezing occur. Sediment compaction is possible over winter  Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction  Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization, and increased water quality  Success demonstrated for reducing EWM, variable success for curly-leaf pondweed (CLP)  Restores natural water fluctuation important for all aquatic ecosystems	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling  May impact attached wetlands and shallow wells near shore  Species growing in deep water (e.g. EWM) that survive may increase, particularly if desirable native species are reduced  Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning  Winter drawdown must start in early fall or will kill hibernating reptiles and amphibians  Navigation and use of lake is limited during drawdown

# Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
c. Dredging	Y	<p>Plants are removed along with sediment</p> <p>Most effective when soft sediments overlay harder substrate</p> <p>For extremely impacted systems</p> <p>Extensive planning required</p>	<p>Increases water depth</p> <p>Removes nutrient rich sediments</p> <p>Removes soft bottom sediments that may have high oxygen demand</p>	<p>Severe impact on lake ecosystem</p> <p>Increases turbidity and releases nutrients</p> <p>Exposed sediments may be recolonized by invasive species</p> <p>Sediment testing may be necessary</p> <p>Removes benthic organisms</p> <p>Dredged materials must be disposed of</p>
d. Dyes	Y	<p>Colors water, reducing light and reducing plant and algal growth</p>	<p>Impairs plant growth without increasing turbidity</p> <p>Usually non-toxic, degrades naturally over a few weeks</p>	<p>Appropriate for very small water bodies</p> <p>Should not be used in pond or lake with outflow</p> <p>Impairs aesthetics</p> <p>Effects to microscopic organisms unknown</p>
e. Non-point source nutrient control	N	<p>Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use) thereby providing fewer nutrients available for plant growth</p>	<p>Attempts to correct source of problem, not treat symptoms</p> <p>Could improve water clarity and reduce occurrences of algal blooms</p> <p>Native plants may be able to better compete with invasive species in low-nutrient conditions</p>	<p>Results can take years to be evident due to internal recycling of already-present lake nutrients</p> <p>Requires landowner cooperation and regulation</p> <p>Improved water clarity may increase plant growth</p>

# Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
<b>Chemical Control</b>	Y, Required under NR 107	<p>Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae</p> <p>Results usually within 10 days of treatment, but repeat treatments usually needed</p> <p>Chemicals must be used in accordance with label guidelines and restrictions</p>	<p>Some flexibility for different situations</p> <p>Some can be selective if applied correctly</p> <p>Can be used for restoration activities</p>	<p>Possible toxicity to aquatic animals or humans, especially applicators</p> <p>May kill desirable plant species, e.g. native water-milfoil or native pondweeds; maintaining healthy native plants important for lake ecology and minimizing spread of invasives</p> <p>Treatment set-back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration</p> <p>May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape</p> <p>Often controversial</p>
a. 2,4-D	Y	<p>Systemic<sup>1</sup> herbicide selective to broadleaf<sup>2</sup> plants that inhibits cell division in new tissue</p> <p>Applied as liquid or granules during early growth phase</p>	<p>Moderately to highly effective, especially on EWM</p> <p>Monocots, such as pondweeds (e.g. CLP) and many other native species not affected</p> <p>Can be selective depending on concentration and seasonal timing</p> <p>Can be used in synergy with endothall for early season CLP and EWM treatments</p> <p>Widely used aquatic herbicide</p>	<p>May cause oxygen depletion after plants die and decompose</p> <p>May kill native dicots such as pond lilies and other submerged species (e.g. coontail)</p> <p>Cannot be used in combination with copper herbicides (used for algae)</p> <p>Toxic to fish</p>



# Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
b. Endothall	Y	Broad-spectrum <sup>3</sup> , contact <sup>4</sup> 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; heavy vegetation requires multiple treatments  Not to be used in water supplies; post-treatment restriction on irrigation  Toxic to aquatic fauna (to varying degrees)
c. Diquat	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  Must be reapplied several years in a row  Ineffective in muddy or cold water (<50°F)
d. Fluridone	Y; special permit and Environmental Assessment may be required	Broad-spectrum, systemic herbicide that inhibits photosynthesis  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  Applied at very low concentration at whole lake scale	Effective on EWM for 1 to 4 years with aggressive follow-up treatments  Some reduction in non-target effects can be achieved by lowering dosage  Slow decomposition of plants may limit decreases in dissolved oxygen  Low toxicity to aquatic animals	Affects non-target plants, particularly native milfoils, coontails, elodea, and naiads, even at low concentrations  Requires long contact time at low doses: 60-90 days  Demonstrated herbicide resistance in hydrilla subjected to repeat treatments  In shallow eutrophic systems, may result in decreased water clarity  Unknown effect of repeat whole-lake treatments on lake ecology

# Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
e. Glyphosate	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 loosestrife 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	RoundUp is often incorrectly substituted for Rodeo - Associated surfactants of RoundUp believed to be toxic to reptiles and amphibians  Cannot be used near potable water intakes  Ineffective in muddy water  No control of submerged plants
f. Triclopyr	Y	Systemic herbicide selective to broadleaf plants that disrupts enzyme function  Applied as liquid spray or liquid	Effective on many emergent and floating plants  More effective on dicots, such as purple loosestrife; may be more effective than glyphosate  Control of target plants occurs in 3-5 weeks  Low toxicity to aquatic animals  No recreational use restrictions following treatment	Impacts may occur to some native plants at higher doses (e.g. coontail)  May be toxic to sensitive invertebrates at higher concentrations  Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm)  Sensitive to UV light; sunlight can break herbicide down prematurely  Relatively new management option for aquatic plants (since 2003)
g. Copper compounds	Y	Broad-spectrum, systemic herbicide that prevents photosynthesis  Used to control planktonic and filamentous algae  Wisconsin allows small-scale control only	Reduces algal growth and increases water clarity  No recreational or agricultural restrictions on water use following treatment  Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin	Elemental copper accumulates and persists in sediments  Short-term results  Long-term effects of repeat treatments to benthic organisms unknown  Toxic to invertebrates, trout and other fish, depending on the hardness of the water  Clear water may increase plant growth

<sup>1</sup>Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.  
<sup>2</sup>Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.  
<sup>3</sup>Broad-spectrum herbicide - Affects both monocots and dicots.  
<sup>4</sup>Contact herbicide - Unable to move within the plant; kills only plant tissue it contacts directly.  
 Specific effects of herbicide treatments dependent on timing, dosage, duration of treatment, and location.  
 References to registered products are for your convenience and not intended as an endorsement or criticism of that product versus other similar products.  
**This document is intended to be a guide to available aquatic plant control techniques, and is not necessarily an exhaustive list.**  
**Please contact your local Aquatic Plant Management Specialist when considering a permit.**

## Appendix F. Implementation Plan

1. Prevent introduction of aquatic invasive species and pursue any new introductions aggressively.						
Actions <sup>42</sup>	Timeline	Cost 2015	Volunteer Hours 2015	Cost 2016	Volunteer Hours 2016	Responsible Parties
1. Clean Boats, Clean Waters (CBCW-129-15) <sup>43</sup>	Memorial Day through Labor Day	\$8,000	20	\$8,000	20	Clean Boats, Clean Waters Committee
2. Monitor areas of high public use for AIS (ACEI-145-14) <sup>44</sup>	July/August	\$400	10	\$400	10	Consultant/Diver
4. Zebra mussel monitoring (grant eligible)	July/August	\$350	5	\$350	5	Consultant/Diver
5. Maintain and monitor surveillance camera video from the Church Pine boat landing	May	\$2,300	10	\$2,300	10	Environmental Sentry Protection, LLC
<b>SUBTOTAL GOAL 1</b>		<b>\$11,050</b>	<b>45</b>	<b>\$11,050</b>	<b>45</b>	
Existing grant funding @ 75%		\$6,750		\$750		

<sup>42</sup> More detailed action item descriptions are found on pages 64-70.

<sup>43</sup> Grant CBCW-129-15 is funded through December 31, 2015 and is renewable annually

<sup>44</sup> Grant ACEI-145-14 is funded through December 31, 2016.

2. Substantially reduce the population and spread of curly leaf pondweed, purple loosestrife, and other invasive aquatic plants.						
Actions	Timeline	Cost 2015	Volunteer Hours 2015	Cost 2016	Volunteer Hours 2016	Responsible Parties
<b>Curly Leaf Pondweed Control (ACEI-145-14)</b>						
1. Hand pull curly leaf pondweed in Church Pine Lake	June		25		25	Board/Volunteers
2. Control CLP with low dose, early season Endothall						
a. select beds for treatment	December (prev. Year)		5		5	Lake Management Committee Chair Monitoring Consultant
b. select APM contractors	January	\$200	5	\$200	5	Lake District Board
c. apply for APM permits	January	\$435	5	\$435	5	Lake Management Committee Chair Herbicide Contractor
d. complete herbicide treatment	May	\$10,500	5	\$11,000	5	Lake Management Committee Chair Herbicide Contractor
3. Conduct pre and post monitoring	May and June	\$1,500		\$1,500		Monitoring Consultant
4. Map beds of curly leaf pondweed	June	\$500		\$500		Monitoring Consultant
3. Complete turion monitoring	October/Nov.	\$500		\$500		Monitoring Consultant

2. Substantially reduce the population and spread of curly leaf pondweed, purple loosestrife, and other invasive aquatic plants.						
Actions	Timeline	Cost 2015	Volunteer Hours 2015	Cost 2016	Volunteer Hours 2016	Responsible Parties
<b>Purple Loosestrife and Knotweed Control (ACEI-145-14)</b>						
1. Cut/treat plants	July/August	\$1,000		\$1,000		Herbicide Contractor
2. Grow and release beetles	May – July	0	40	0	40	Volunteer
3. Map purple loosestrife and knotweed locations and extent	September	\$250		\$250		Monitoring Consultant or Herbicide Contractor
<b>Narrow Leaf Cattail Monitoring</b>						
1. Map beds of narrow leaf and broadleaf cattail		\$0	5	If needed	5	Monitoring Consultant
<b>SUBTOTAL GOAL 2</b>		<b>\$0</b>	<b>80</b>	<b>\$0</b>	<b>80</b>	
Current grant funding @ 75%		\$15,319		\$15,319		

3. Maintain navigable routes for boating.						
Actions	Timeline	Cost 2015	Volunteer Hours 2015	Cost 2016	Volunteer Hours 2016	Responsible Parties
1. Monitor to identify navigation impairment <sup>45</sup>	July/August	\$200	10	\$200	10	Lake District Board Herbicide Contractor
2a. Seek permit if navigation problems identified		\$45	5	\$45	5	Lake District Board Herbicide Contractor
2b. Control nuisance plant growth with permitted method	Summer	\$955	5	\$955	5	Lake District Board Herbicide Contractor
3. Allow individuals to apply for permits to maintain access corridors	Summer	\$0	5	\$0	5	Lake Residents Herbicide Contractor
<b>SUBTOTAL GOAL 3</b> Activities are not grant eligible		<b>\$1,200</b>	<b>25</b>	<b>\$1,200</b>	<b>25</b>	

4. Preserve our diverse native aquatic plant community. (All actions carried out as components of other goals.)						
Actions	Timeline	Cost 2015	Volunteer Hours 2015	Cost 2016	Volunteer Hours 2016	Responsible Parties
1. Sensitive area management limited to 25 foot corridors	Ongoing	\$0	0	\$0	0	Lake District Board Herbicide Contractor
2. Follow treatment standards and monitoring protocol	Ongoing	\$0	0	\$0	0	Lake District Board Herbicide Contractor Monitoring Consultant
3. Limit removal of native plants	Ongoing	\$0	0	\$0	0	DNR Lake District Board
4. Deliver educational messages	Ongoing	\$0	0	\$0	0	Lake District Board

<sup>45</sup> Navigation route to be defined if impairment is identified.

5. Educate and engage the public regarding aquatic plant management.						
Actions	Timeline	Cost 2015	Volunteer Hours 2015	Cost 2016	Volunteer Hours 2016	Responsible Parties
1. Update web site	Ongoing	\$500	20	\$500	20	Lake District Board
2. Annual meeting/special meetings	Summer/Fall	\$20	20	\$20	20	Lake District Board
3. Workshops/small group meetings	Summer	\$200	20	\$200	20	Lake District Board Volunteers DNR Polk LWRD
4. Mailings/handouts	Ongoing	\$500	20	\$500	20	Lake District Board Volunteers
5. CBCW Brochures, Kiosk & Landing Signs	Ongoing	\$650	20	\$650	20	Lake District Board Volunteers
<b>SUBTOTAL GOAL 6</b> All activities are grant eligible		<b>\$1,870</b>	<b>80</b>	<b>\$1,870</b>	<b>80</b>	
Current grant funding @75%		<b>\$1,403</b>		<b>\$1,403</b>		