Aquatic Plant Management Plan
Long Lake
Polk County, Wisconsin

July 2022

Sponsored By
Long Lake Protection and Rehabilitation District

Aquatic Plant Management Advisory Committee

Prepared By
Harmony Environmental — Plan Writing and Facilitation
Endangered Resource Services, LLC — Aquatic Plant Survey and Mapping

Funded By
Long Lake Protection and Rehabilitation District
A Wisconsin Department of Natural Resources Grant

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September 9, 2022

Patti Langer, Chair
Long Lake Protection and Rehabilitation District
P.O. Box 294
Centuria, WI 54824

Subject: Long Lake Aquatic Plant Management (APM) Plan Approval Request

Dear Ms. Langer,

Thank you for your efforts to understand, protect, and improve Long Lake! This letter is to notify you that the July 2022 Aquatic Plant Management (APM) Plan meets the criteria under Administrative Code NR 193 and thus the DNR has approved the APM Plan.

Approved management activities in the plan and outlined below are eligible for funding under the Surface Water Grants program subject to the application requirements of the program.

Approved management recommendations include the following:

1. AIS prevention and monitoring activities
2. Species-specific AIS monitoring and management activities provided they meet DNR guidelines and Administrative Code requirements
3. Educational activities involving AIS, lake stewardship, aquatic plants, shoreline health, etc.

Please note: Aquatic plant control for the purposes of nuisance relief or navigation are *not* eligible for grant funding. The Department reserves the right to inspect nuisance or navigation conditions prior to permitting aquatic plant management activities.

Thanks to you and the lake community for continuing your efforts to protect and improve Long Lake.

Sincerely,

Alex Smith
Lake Biologist

CC: Mark Hazuga, Tyler Mesalk – WDNR
Cheryl Clemens – Harmony Environmental

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Executive Summary

This Long Lake Aquatic Plant Management Plan updates a previous plan prepared in 2017. The updated plan will be implemented from 2023 - 2027. Strategies are included for controlling Curly-leaf pondweed, protecting native plant populations, preventing establishment of invasive species, and allowing navigation through aquatic plant beds. The plan includes data about the plant community, watershed, and water quality of the lake. It also reviews the history of aquatic plant management on Long Lake.

Results from aquatic plant point intercept surveys help to guide management of aquatic plants on Long Lake. Extensive data is available with surveys completed in 2010, 2011, 2012, 2016, 2019 and 2021. Aquatic vegetation has changed in the lake in response to early season herbicide treatment for Curly-leaf pondweed and improvements in water clarity following installation of watershed practices and subsequent alum treatments.

The 2021 aquatic plant surveys found that Long Lake has moderately high plant community diversity. Highest diversity is found in the shallow bays at either end of the lake. Native plants provide fish and wildlife habitat, stabilize bottom sediments, reduce the impact of waves against the shoreline, and prevent the spread of non-native invasive plants – all critical functions for the lake.

This Aquatic Plant Management Plan, updated with input from an advisory committee, will help the Long Lake Protection and Rehabilitation District carry out activities to meet 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.

Advisory Committee Members
Jerry Bentley
Coral Bruce
David Christianson
Karen Langer
Michael Langer
Patti Langer (Board, Chair)
Joe Murray (Board, Treasurer)
Sheri Murray
Marjean Sieberer (Board, Secretary)

Plan Goals

1) Maintain water quality and clarity.
2) Promote and protect a healthy, balanced native aquatic plant community. A balanced native plant community has a high diversity and distribution of species – one or two species do not dominate aquatic plant growth.
3) Balance recreation and waterfront owner needs with protection of native plants and the fishery.
4) Prevent the introduction of Eurasian water-milfoil, Zebra mussels, and other aquatic invasive species.
5) Rapidly respond to eliminate any newly introduced aquatic invasive species.
6) Increase lake residents' and visitors' understanding of lake ecology and aquatic plant management to encourage practice of proactive lake stewardship.

Introduction

The Long Lake Aquatic Plant Management Plan is sponsored by the Long Lake Protection and Rehabilitation District (LLPRD) with partial funding from a Wisconsin Department of Natural Resources Aquatic Invasive Species grant (ACEI20218).

This Long Lake Aquatic Plant Management Plan updates a previous plan prepared in 2017. Strategies are included for controlling Curly-leaf pondweed, protecting native plant populations, preventing establishment of invasive species, and allowing navigation through aquatic plant beds. The plan includes data about the plant community, watershed, and water quality of the lake. It also reviews the history of aquatic plant management on Long Lake. This plan will guide the Long Lake Protection and Rehabilitation District and the Wisconsin Department of Natural Resources in aquatic plant management for Long Lake over the next five years (from 2023 through 2027). A plan update will begin with an updated plant survey in 2026.

Public Input for Plan Development

The LLPRD Aquatic Plant Management (APM) Advisory Committee provided input for the development of this plan. The APM Advisory Committee met four times. At the first meeting March 24, 2022, the committee reviewed aquatic plant management planning requirements, existing plan goals, discussed aquatic plant management concerns, and reviewed progress since the 2017 plan. At the second meeting on April 13, 2022, the committee reviewed goals and objectives and discussed potential methods to maintain common access navigation channels. At the third meeting on May 4, 2022, the committee continued previous discussions and reviewed Curly-leaf pondweed control. Additional feedback was provided between meetings including related to outreach strategies. At the fourth meeting on May 18, 2022, the committee reviewed aquatic invasive species prevention options and discussed committees for plan implementation. The APM Advisory Committee concerns are reflected in the goals and objectives for aquatic plant management in this plan.

The LLPRD board announced the availability of the draft Aquatic Plant Management Plan for review with a public notice in the Inter-County Leader the week of June 6, 2022. Copies of the plan were made available to the public on the Long Lake web site: longlakepolk.com and on the Long Lake Facebook page. Comments were accepted through July 1, 2022. Four individuals including two board members and two advisory committee members submitted comments on the draft plan. Changes were made to the implementation section of the plan as a result.

Resident Concerns

The APM Committee expressed a variety of concerns that are reflected in the goals for aquatic plant management in this plan. Management concerns included addressing prevention of aquatic invasive species, and developing a response plan should they become introduced. Education was also very important to committee members. A newly emerging concern is maintaining the ability to swim, fish, and access areas around docks because of dense plant growth.

Property Owner Survey

The LLPRD distributed a public opinion survey to Long Lake property owners on April 1, 2012. Results of this survey were included in the 2017 APM plan and are not repeated here. A public opinion survey was not completed in preparation for the 2022 APM plan update.

The Lake

Long Lake is a 272-acre lake located in Polk County, Wisconsin in the Town of Balsam Lake (S6, S7, and S8, T34N, R17W). Its water body identification code is 2478200. The maximum depth of the lake is 18 feet, and the mean depth is 11 feet.[1] The watershed area of Long Lake, including the lake, is approximately 2,343 acres (LWRD, 2013). The lake is a seepage lake with no streams entering or leaving the lake. A ditch on the north end, and another on the south end, flow to the lake during and after storm events.

Long Lake water quality improved dramatically in recent years following alum treatments in 2018 and 2020 to reduce release of phosphorus from lake sediment. A third alum treatment is planned for June 2022. Prior to the alum treatments, Long Lake was classified as a eutrophic to hypereutropic lake with summer Secchi depths averaging 3.5 feet. The algae blooms that limited Secchi depth were also accompanied by cyanobacteria toxin formation – a threat to human and animal health (LWRD, 2013). As of 2021, the summer Secchi depth had increased to 6.3 feet, an 81 percent improvement (James, 2022).

The lake's substrate is 52.8 percent muck and sandy muck, 34.4 percent pure sand, and 12.8 percent rock as shown in Figure 1. When the lake was surveyed in 2016, nutrient-rich organic muck dominated the northwest, southeast, and southern mid-lake bays while the central basin was a combination of sandy muck on the lake's western half that trended toward pure sand on the eastern half. Sand also dominated the shoreline around the central basin with areas of cobble and gravel primarily located around points, and north and west of the lake's eastern island (Berg, 2016). A lake map is found as Figure 2.

Table 1. Long Lake Information

Size (acres)	272
Mean depth (feet)	11
Maximum depth (feet)	>18
Littoral zone depth (feet)	18
Summer Secchi depth (feet) 2021	6.3

[1] Although WDNR lake pages list the maximum depth of Long Lake as 17 feet, plants have been recorded at depths to 18 feet and deeper areas were measured.

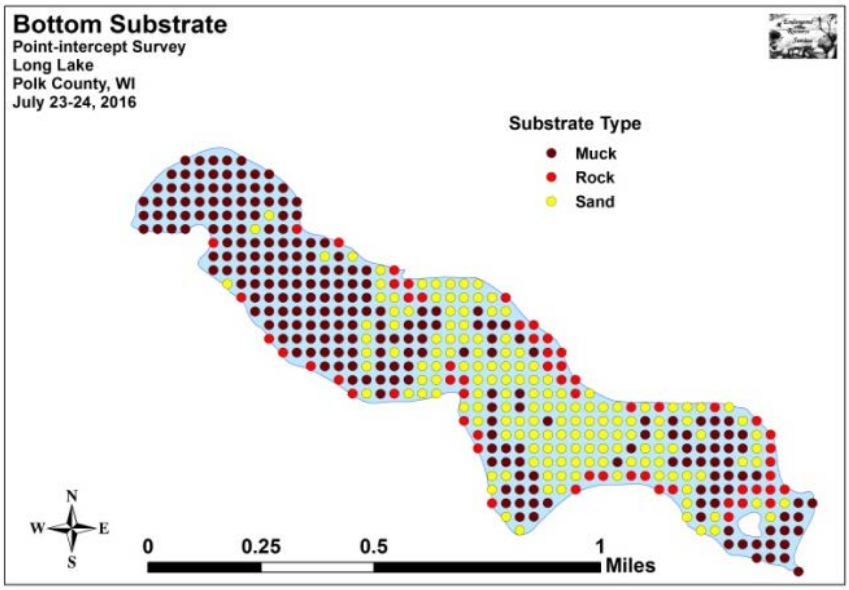

Figure 1. Sediment Type

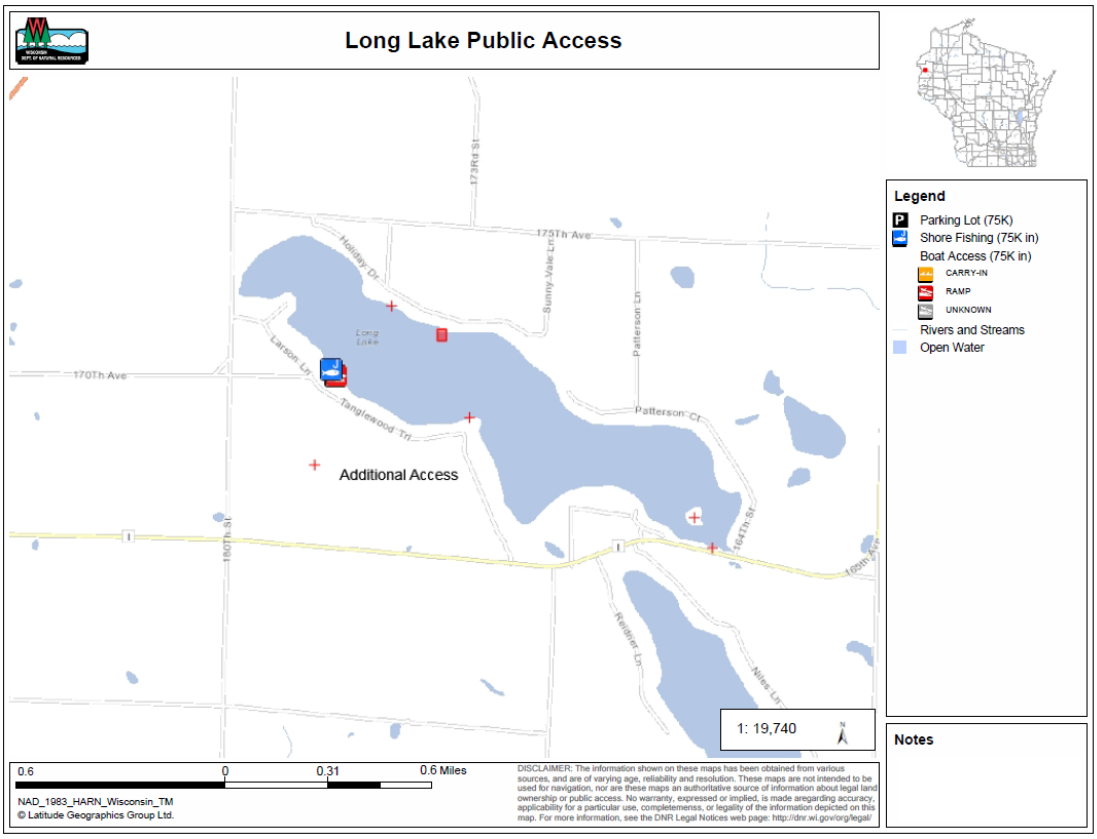

Figure 2. Long Lake Public Access

Water Quality

Water quality is frequently reported by the trophic state or nutrient level of the lake. Nutrient-rich lakes are classified as eutrophic. These lakes tend to have abundant aquatic plant growth and low water clarity due to algae blooms. At the high end of the eutrophic scale (hyper-eutrophic lakes) blue-green algae dominate and algae scums are present, sometimes throughout the summer. Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms. Oligotrophic lakes are nutrient-poor with little growth of plants and algae.

Secchi depth readings are one way to assess the trophic state of a lake. The Secchi depth is the depth at which the black and white Secchi disk is no longer visible when it is lowered into the water. Greater Secchi depths occur with greater water clarity. Secchi depth readings, phosphorus concentrations, and chlorophyll measurements can each be used to calculate a Trophic State Index (TSI) for lakes. TSI values range from 0 – 110. Lakes with TSI values greater than 50 are considered eutrophic. Those with values in the 40 to 50 range are mesotrophic. Lakes with TSI values below 40 are considered oligotrophic. Citizen monitoring results place Long Lake in the eutrophic TSI range.

Citizen lake monitoring volunteers have collected data from the lake annually at the deep hole of Long Lake since 1992. Results are available from the WDNR website.[2] Only July and August results are summarized and reported in the figures that follow.

Figure 3 illustrates the annual summer Secchi depth averages for the lake. Figure 4 graphs the Trophic State Index (TSI) for Long Lake, based upon Secchi depth, chlorophyll, dissolved oxygen, and total phosphorus results. The TSI based on chlorophyll was 72 in 2016, a hyper-eutrophic value. In 2021 the TSI based on chlorophyll was 51, barely in the eutrophic range.

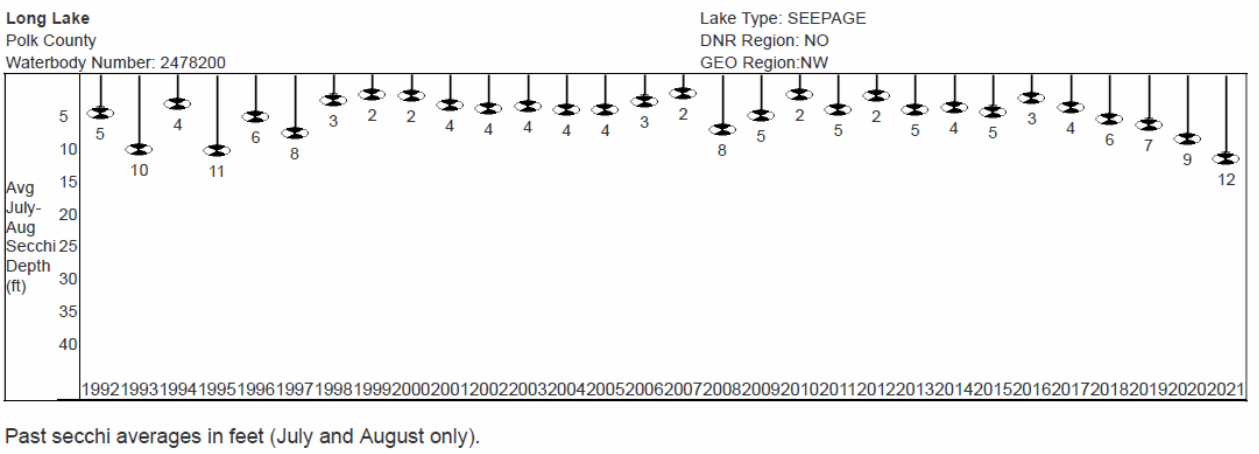

Figure 3. Long Lake Secchi Depths 1992-2021

[2] www.dnr.state.wi.us/lakes/clmn/

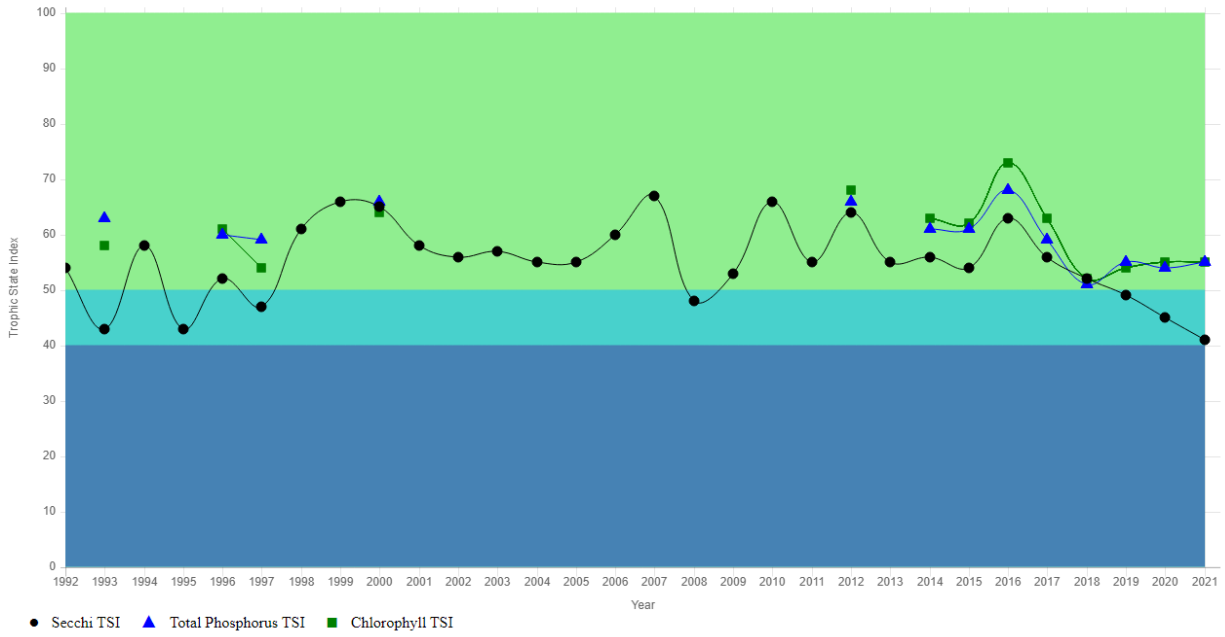

Figure 4. Average July/August Trophic State 1992-2021

Professional monitoring results provide additional detail and support citizen monitoring results. The Polk County Land and Water Resources Department identified lake sediments as a significant source of phosphorus leading to algae blooms as part of a 2012 lake study and 2013 lake management plan (LWRD, 2013). UW-Stout scientists studied the lake and its sediments to identify if alum treatment of sediments was appropriate, develop an appropriate alum dose (James, 2017), and monitor water and sediment results following alum treatments which occurred in 2018 and 2020 (James, 2020).

Results shown in Figure 5 illustrate dramatic improvements in lake water quality and reduced release of phosphorus from lake sediments. Results are reported for the summer period of July through September. When 2021 results are compared with average values prior to the alum treatment, there are improvements in all measured parameters.

- Surface Total Phosphorus 65% Reduction
- Bottom Total Phosphorus 67% Reduction
- Bottom Soluble Reactive Phosphorus 96% Reduction
- Mean Chlorophyll 60% Reduction
- Secchi Transparency 81% Increase
- Phosphorus Flux from Sediments 98% Reduction

The results follow alum treatments in 2018 of 60 g/m^2 and in 2020 of 25 g/m^2 applied to lake sediments where water depth is 15 feet and greater (James, 2022). Watershed sources of phosphorus were also controlled prior to the alum treatment (Clemens, 2017).

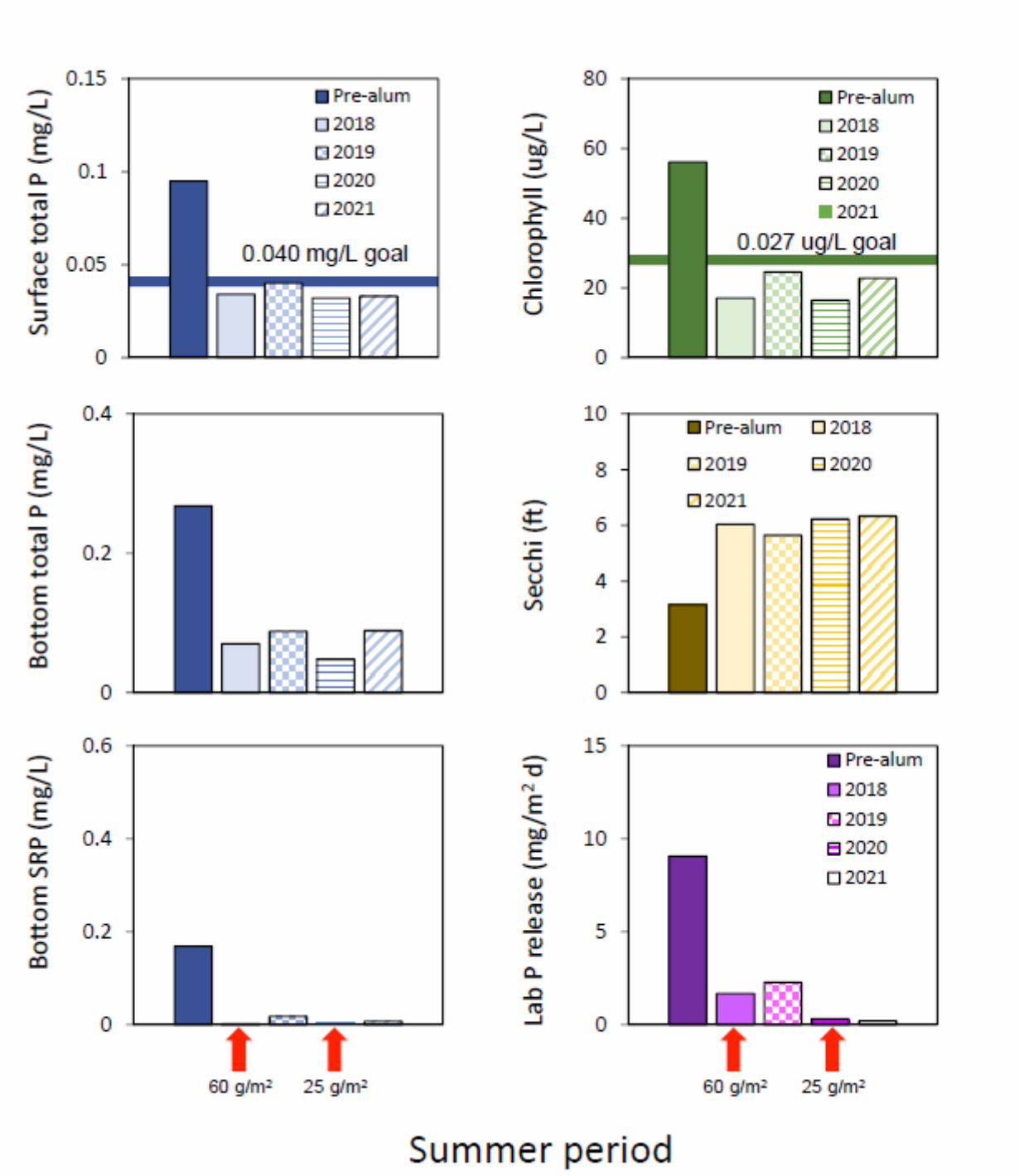

Figure 5. Water Quality Monitoring Results Pre-alum and Following Alum Treatments (2018-2021)

Watershed

A watershed map is included in Figure 6 below. The entire Long Lake watershed is over 2,000 acres. The area draining directed to the lake was reported to be about 1,279 acres in the Barr 2003 water quality study. The watershed is largely agricultural (57 percent) with significant amounts of residential land (13 percent) and open space (19 percent). The lake itself makes up 11 percent of the watershed (Figure 7) (LWRD, 2013).

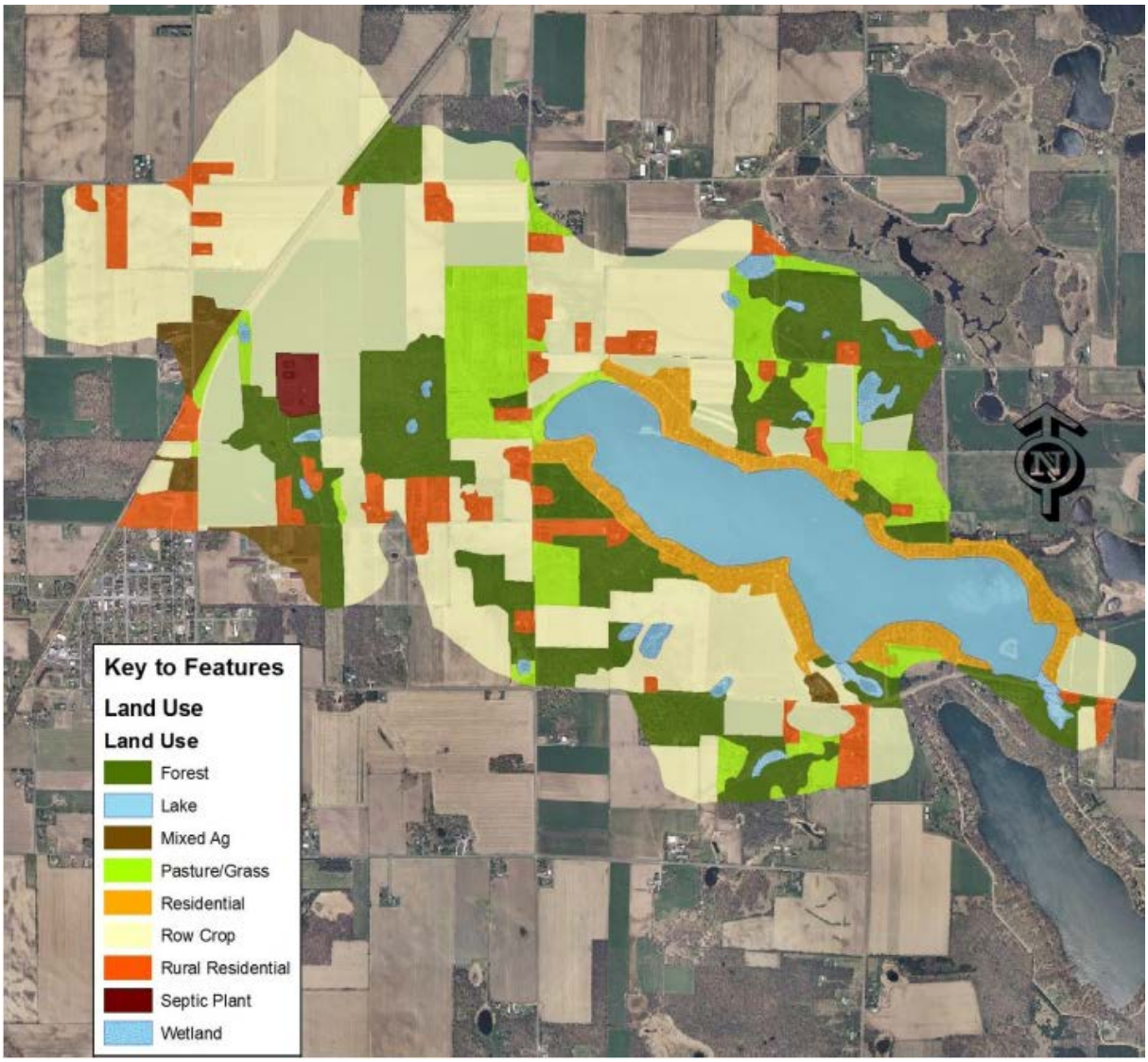

Figure 6. Long Lake Watershed Map

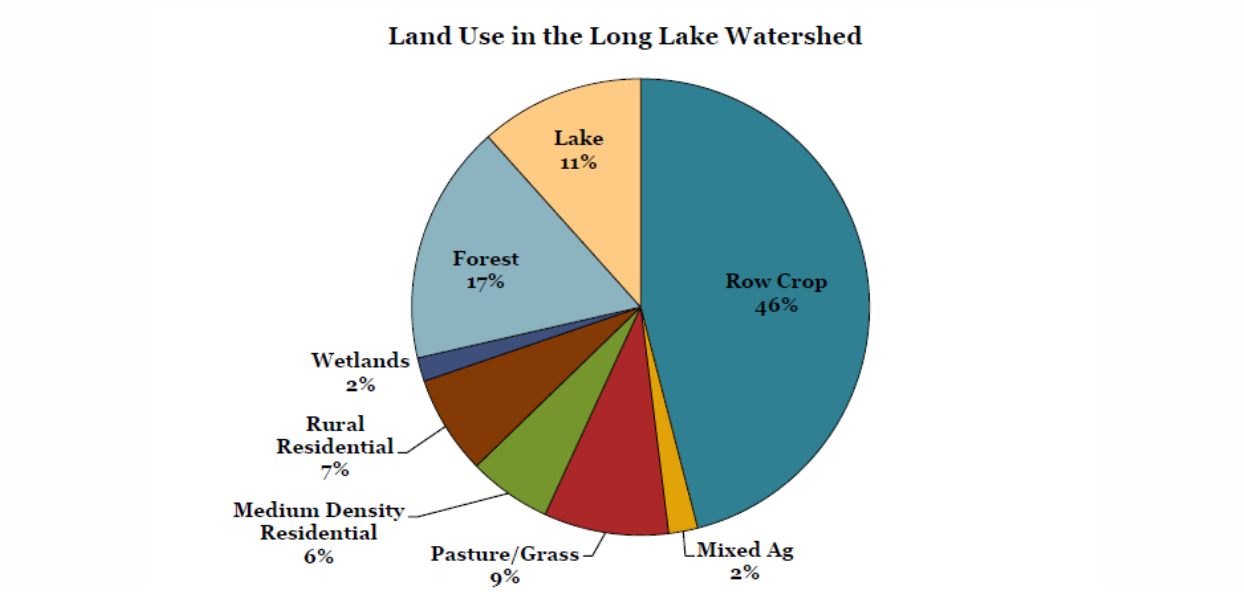

Figure 7. Watershed Land Use

Aquatic Habitats

Primary Human Use Areas

A public boat landing owned and operated by the Village of Centuria is located on the south side of the lake. The boat landing includes space for parking nine vehicles and trailers. The landing is used heavily in the summer. Anglers frequently park along the road when the boat landing parking area is full. There is another public landing on the north side of lake that is used less frequently. The landing is paved, but there are no parking spaces.

The shoreline of Long Lake is largely developed for residential use with about 169 residences. There are 182 parcels in the lake district.[3] Lake residents' use focuses around their docks placed in the relatively shallow, littoral zone of the lake.

Habitat Areas

The littoral, or plant supporting, zone of the lake provides critical habitat for fish, waterfowl, and other wildlife. While densest plant growth is in shallow water, the littoral zone extends to depths up to 18 feet (Berg, 2022). The littoral zone depth increased in recent years following increases in water clarity. In 2012, the littoral zone depth was only 10.5 feet. Extensive areas of plant growth are found in the northwest and southeast bays where the water is relatively shallow.

Sensitive Area Study

The Wisconsin Department of Natural Resources sensitive area study (1989) identified these two bays for special protection of aquatic habitat. "These areas of aquatic vegetation on Long Lake offer critical or unique fish and wildlife habitat. This habitat provides the necessary seasonal or life stage requirements of the associated fisheries while offering water quality or erosion control benefits to the body of water" (WDNR, 1989). In the designated sensitive areas, aquatic vegetation removal is limited to navigational channels no greater than 25 feet wide. Chemical treatments are discouraged and if navigational channels must be cleared, pulling by hand is preferable.

Resource Value of Area A

This area consists of the northwestern bay. It provides important habitat for bass and panfish and northern pike spawning and nursery areas. The area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

Resource Value of Area B

This area consists of the southeastern bay.

Values are the same as those described above for Area A.

[3] Personal email communication Joe Murray, LLPRD Treasurer. January 19, 2022.

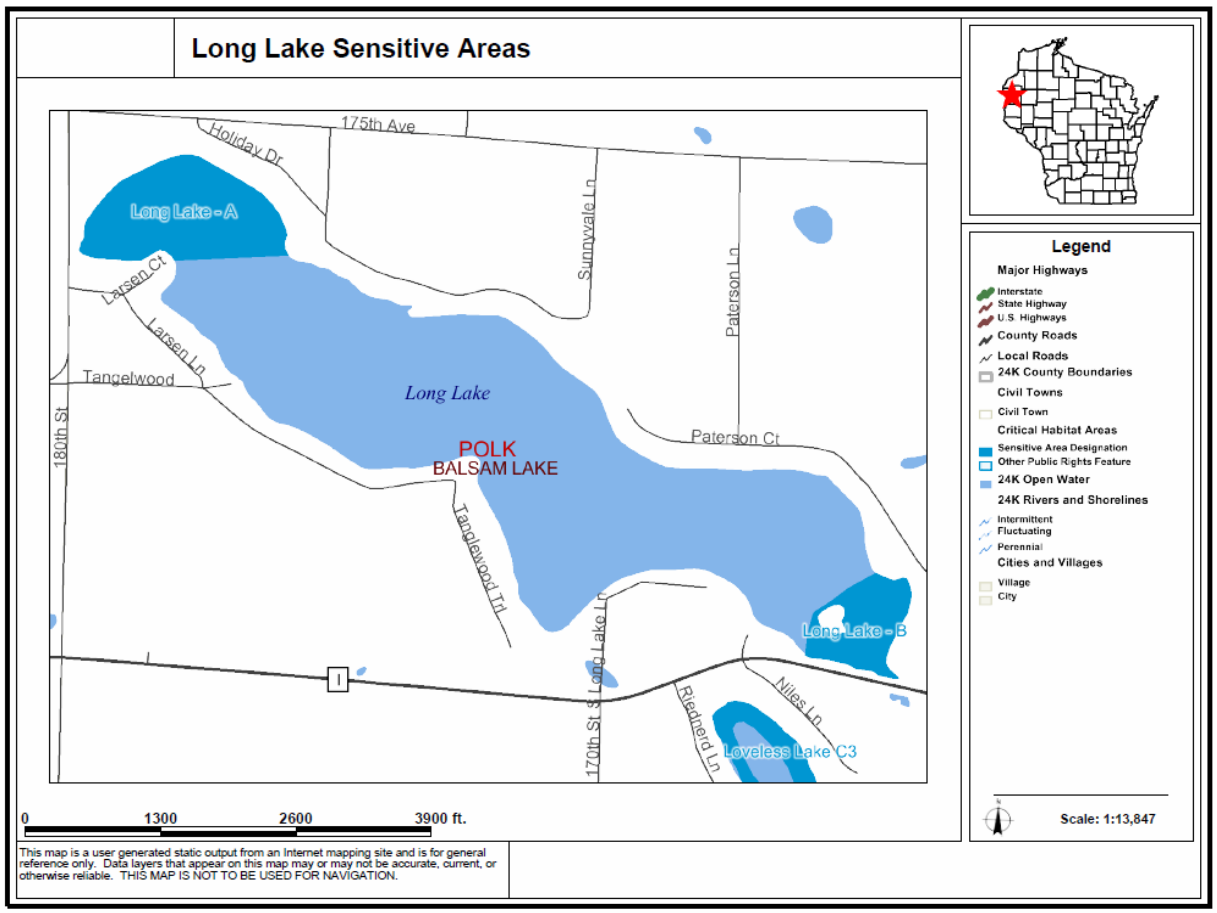

Figure 8. Long Lake Sensitive Areas

Long Lake Fishery

Long Lake's fish community consists of northern pike, largemouth bass, and panfish.[4] The Department of Natural Resources (DNR) stocked northern pike in the lake most years from 1980 through 2016. Northern pike stocking was discontinued after the 2017 fisheries survey because natural reproduction appeared to maintain the population.

The 2017 fisheries survey consisted of an early spring fyke netting survey for northern pike and a late spring night electrofishing survey for bass and panfish species. An abundant northern pike population was present with good size structure. There were 450 northern pike collected during the fyke netting survey, which resulted in a catch rate of 28.1 fish/net night. During the late spring electrofishing survey, the largemouth bass population was characterized as having low abundance (16.8 fish/mile). With the lower abundance, the size structure of the population was high and included fish over 19 inches. Bluegill, pumpkinseed, and black crappie had moderate abundance and moderate size structure.[5]

[4] Wisconsin Lakes Book

[5] Aaron Cole. DNR Fisheries Biologist. Email Communication 01/06/2022.

Fish spawning times are listed in Table 2 to consider for potential plant management activities.

Table 2. Fish Spawning Considerations

Fish Species	**Spawning Temp. (Degrees F)**	**Spawning Substrate / Location**	**Comments**
Northern Pike	Upper 30s to mid 40s (right after ice-out)	Emergent vegetation 6-10 inches of water	Eggs are broadcast
Black Crappie	Upper 50s to lower 60s	Nests are built in 1-6 feet of water	Nest builders
Largemouth Bass Bluegills	Mid 60s to lower 70s	Nests are built in water less than 3 feet deep	

Functions and Values of Native Aquatic Plants

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

Water Quality

Aquatic plants can improve water quality by absorbing phosphorus, nitrogen, and other nutrients from the water that could otherwise fuel nuisance algae 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. This is especially important in shallow areas with mucky bottoms such as found in Long Lake. Stands of emergent plants (with stems that protrude above the water surface) and floating plants help to blunt wave action and prevent erosion of the shoreline. Poor water clarity can limit aquatic plant growth by limiting light penetration.

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.[6]

[6] Above paragraphs summarized from *Through the Looking Glass*. Borman et al. 1997.

Invasive Species Protection

Non-native invasive aquatic species threaten native plants in Northern Wisconsin. The most common are Eurasian water-milfoil (EWM) and Curly-leaf pondweed (CLP). These species are described as opportunistic invaders. This means that they take over openings in 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 measures. 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. (WDNR 2007)

Plant Community

Aquatic Plant Survey Results

Endangered Resource Services completed warm water aquatic plant surveys for Long Lake in 2010, 2011, 2012, 2016, 2019, and 2021 according to the WDNR-specified point intercept method. The survey results presented here summarize the results of the most recent survey completed in July 2021 and compare results between 2016 and 2019 and 2021. Some comparisons are also included from 2010 to 2012.

The survey and data analysis methods for the aquatic macrophyte survey are found in the following report: *Curly-leaf pondweed (Potamogeton crispus) Point-Intercept and Bed Mapping Surveys, and Warm-water Macrophyte Point-intercept Survey Long Lake - WBIC: 2478200 Polk County, Wisconsin*, conducted and prepared by Matt Berg, Endangered Resource Services, LLC. Extensive additional data and maps are included in this report (Berg, 2021).

Using a standard formula based on a 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 453 points. Figure 9 shows the distribution of these sampling points. All 453 points were sampled in 2021.

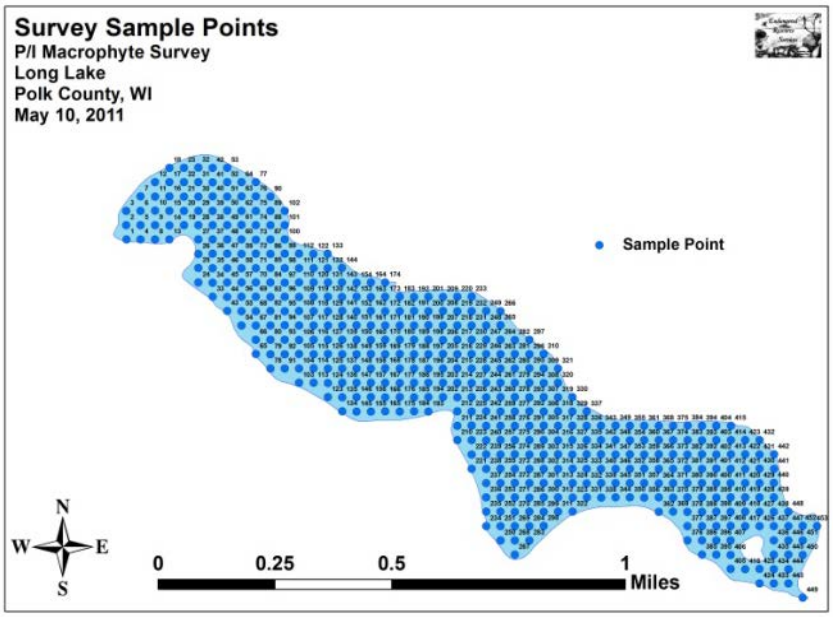

Figure 9. Sampling Point Grid

In July 2021 plants were found growing at 186 points. This is the highest number of points with plants of any of the July Long Lake plant surveys. It represents 41 percent of the lake bottom and 48 percent of the littoral zone (the depth at which plants can grow). Changes in plant growth correlate with increased water clarity following the alum treatments in 2018 and 2020.

The littoral zones for 2019 and 2021 are shown in Figure 10 below. The littoral zone has ranged from a low of 10.5 feet in 2012 to a maximum of 18 feet in 2021. Mean depth of plant growth has also increased dramatically since the alum treatment. Although plant growth is sparse over 12 feet, plants are growing in deeper water than in previous years. The northwest and southeast bays are the largest littoral zone areas and have the highest density of plant growth.

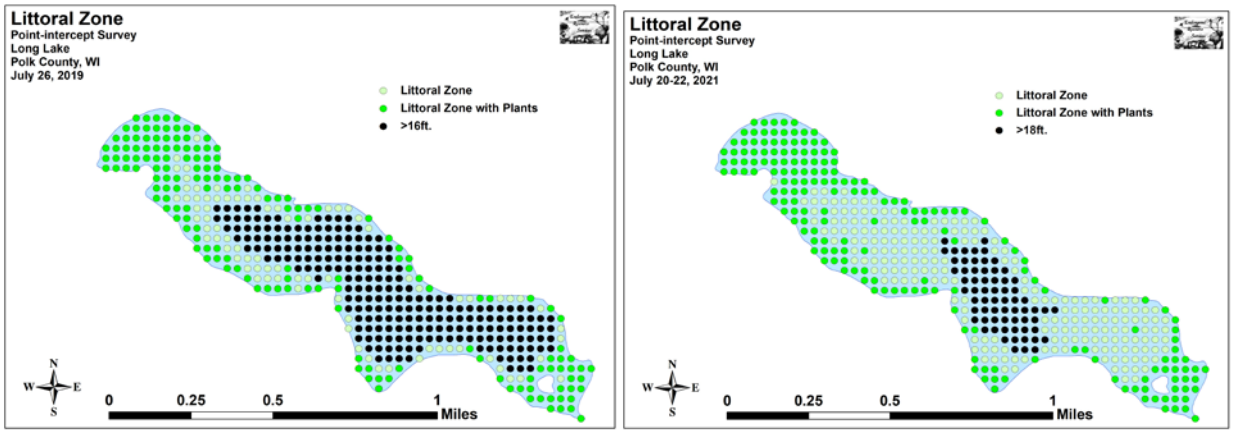

Figure 10. Long Lake Littoral Zone July 2019 and July 2020

Table 3 includes summary statistics from various plant surveys. Plant diversity was moderately high in 2021 with a Simpson Index value of 0.86 – down from 0.90 in 2019 and 0.87 in 2016. A total of 25 aquatic plant species were found on the lake in 2021 when including visuals and plants seen during the boat survey – identical to 2019, but down from 27 in 2016. Most of the species seen in 2016 that were absent in 2019 and 2021 were emergent plants (with stems above the water surface) that likely disappeared in response to higher water levels.

Declines in the number of species sampled on the rake (native species/site) between 2019 and 2021 were attributed to lower diversity found where plants had expanded into deeper water. In shallower areas, native species sampled per site appeared generally stable (Figure 11).

Table 3. Aquatic Plant Surveys Comparison

	2010	2011	2012	2016	2019	2021
Total # of points sampled	249	231	453	453	453	453
Total # of sites with vegetation	119	129	142	152	160	186
Total # of sites shallower than the max. depth of plants	237	176	181	250	240	387
Freq. of occur. at sites shallower than max. depth of plants	50.2	73.3	78.5	60.8	66.7	48.1
Simpson Diversity Index	0.85	0.89	0.88	0.87	0.90	0.86
Maximum depth of plants (ft)	14.0	11.5	10.5	15.0	16.0	18.0
Mean depth of plants (ft)	3.6	4.4	4.3	5.6	7.3	7.3
Median depth of plants (ft)	3.5	4.0	4.0	4.5	6.5	6.3
Ave. # of all species per site (shallower than max depth)	1.50	2.18	2.55	1.60	2.18	1.30
Ave. # of all species per site (veg. sites only)	2.99	2.98	3.25	2.63	3.27	2.72
Ave. # of native species/site (shallower than max depth)	1.47	2.06	2.55	1.58	2.10	1.30
Ave. # of native species/site (sites with native veg. only)	2.92	2.93	3.25	2.59	3.15	2.70
Species richness	17	18	17	23	20	19
Species richness (including visuals)	17	18	17	24	23	21
Species richness (including visuals and boat survey)	17	18	18	27	25	25
Mean total rake fullness (veg. sites only)	2.16	2.38	2.15	1.93	2.05	2.42

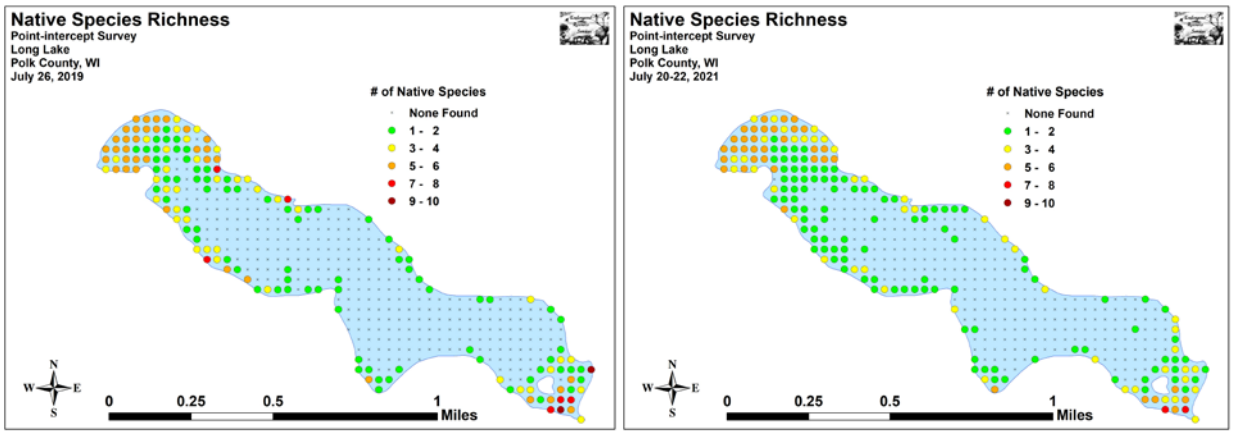

Figure 11. Native Species Richness July 2019 and 2021

Figure 12 illustrates plant density based on fullness of vegetation on the sample rake. The density rating of the rake sampled varied between 1 and 3 (from low to high density). Total rake fullness has increased in recent years from a moderate 1.93 in 2016 to 2.05 in 2019. This trend continued in 2021 with an increase to a moderately high 2.42. These increases were primarily due to expansion along the southwest and northwest shorelines and the southeast bay.

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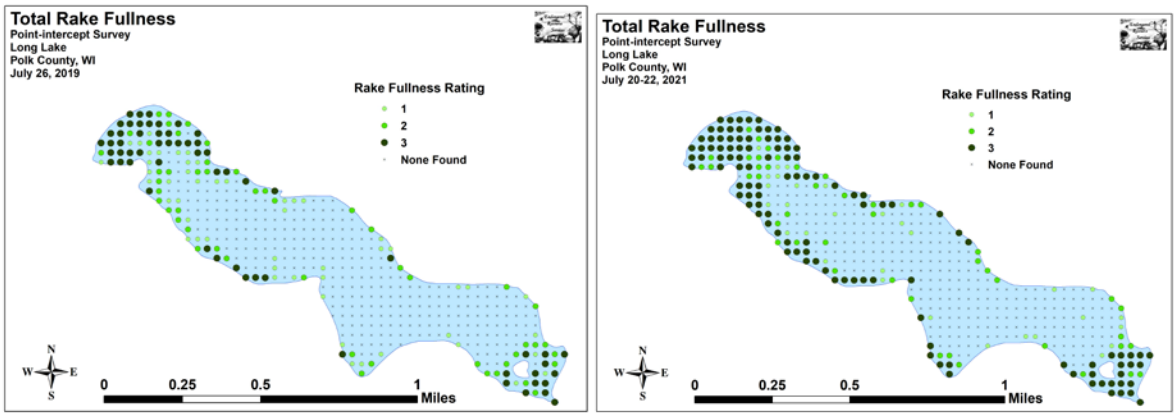

Figure 12. Total Rake Fullness July 2019 and 2021

Berg highlighted changes in growth of species from 2016 to 2021, and maps that illustrate some of these changes are included. Additional maps and more detailed statistics are available in the plant survey report.

Coontail was the most common species in 2016, 2019, and 2021 and showed no significant changes in distribution. However, mean rake fullness increased from 1.59 in 2016 to 1.82 in 2019, and to 2.18 in 2021. The majority of this expansion, both in 2019 and 2021, occurred in shallow areas of the northwest bay and along the southwestern shoreline.

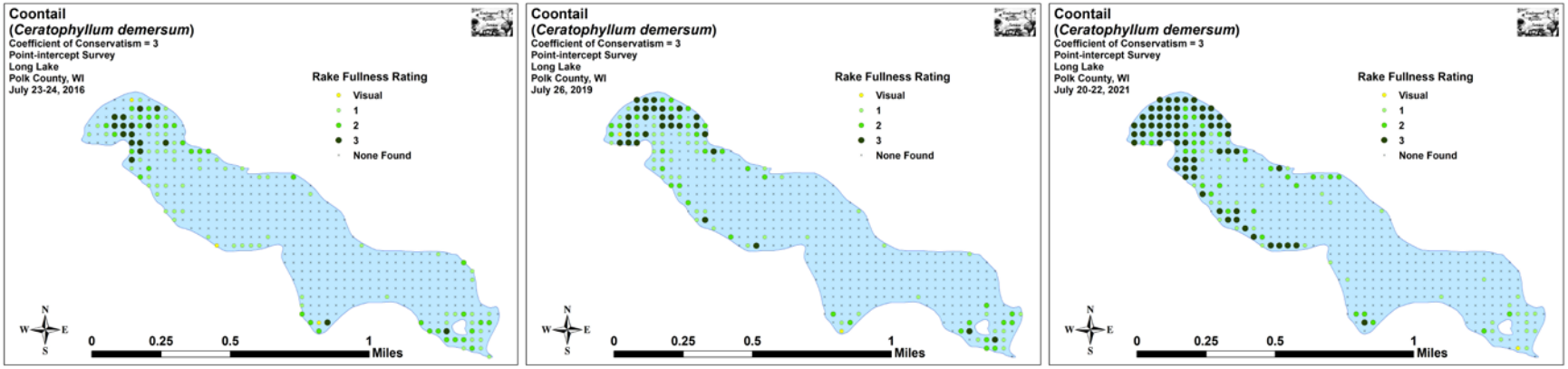

Figure 13. 2016, 2019, and 2021 Coontail Density and Distribution

Small pondweed was not detected in the plant surveys prior to 2016 when it was seen in the lake but not sampled on the rake. By 2019, this species had greatly increased in distribution and density to become the second most common species. It had expanded into deep water just outside the northwest bay in areas formerly dominated by Curly-leaf pondweed. By 2021 this new population collapsed with a decline in distribution and density. This species is highly sensitive to endothall (the chemical used to treat Curly-leaf pondweed), so it is possible the small treatment in May 2021 negatively impacted it. It is also possible that this decline is tied to the expansion of other species such as Coontail and Northern water-milfoil.

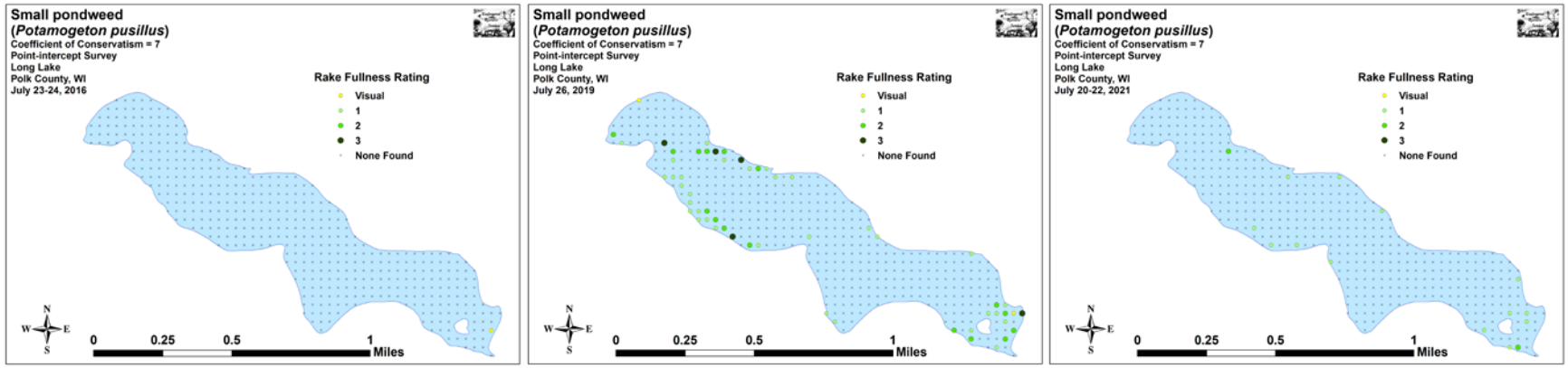

Figure 14. 2016, 2019, and 2021 Small Pondweed Density and Distribution

White water lily was the second most common species in 2016 but was growing in fewer locations in 2019 and 2021. This change was not statistically significant. However, declines in density from a mean rake fullness of 2.45 in 2016 to a mean rake fullness of 2.02 in 2019 then to 1.54 in 2021 were significant.

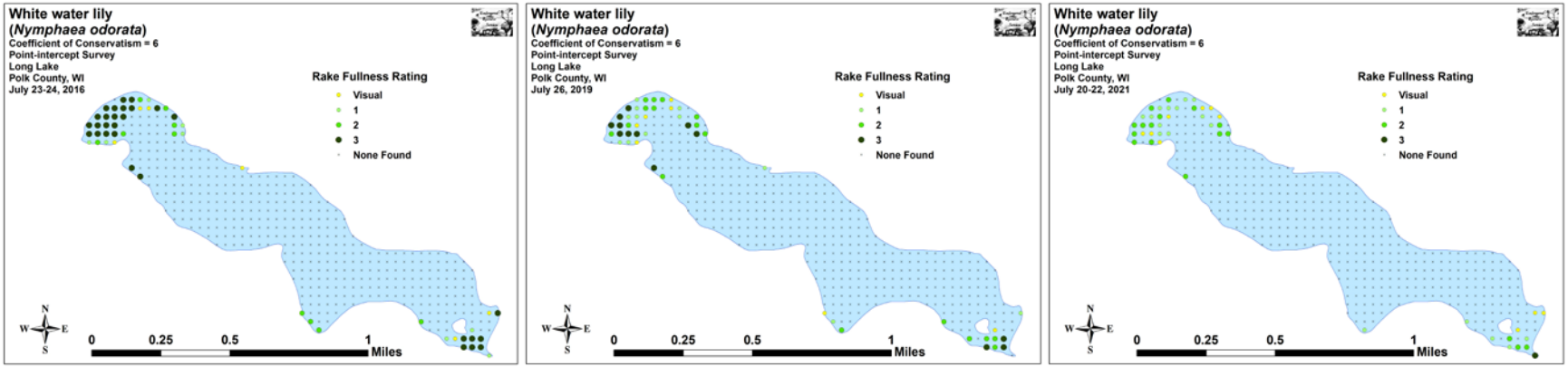

Figure 15. 2016, 2019, and 2021 White Water Lily Density and Distribution

Historically, Common waterweed has exploited posttreatment environments in nearshore areas of Long Lake. With declines in CLP treatment size and frequency, this species has generally declined in these areas as well.

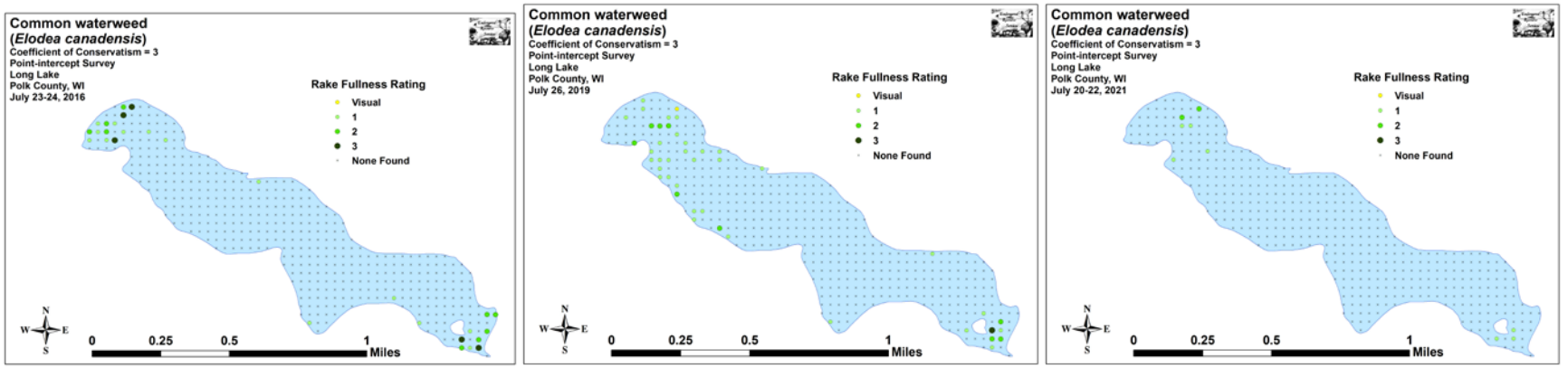

Figure 16. 2016, 2019, and 2021 Common Waterweed Density and Distribution

After Northern water-milfoil nearly disappeared from the lake in the early 2010s following large-scale chemical treatments, the 2019 and 2021 surveys documented highly significant increases in both distribution and density. An important habitat producing plant, it dominated much of the southeast bay in areas formerly occupied by dense Curly-leaf pondweed in the spring and Coontail, Common waterweed, and White water lily in the summer. By 2021, these dense and often canopied beds of Northern water-milfoil had expanded along the majority of the lake's shorelines as this species jumped from the eighth most common species in 2019 to the second most common in 2021.

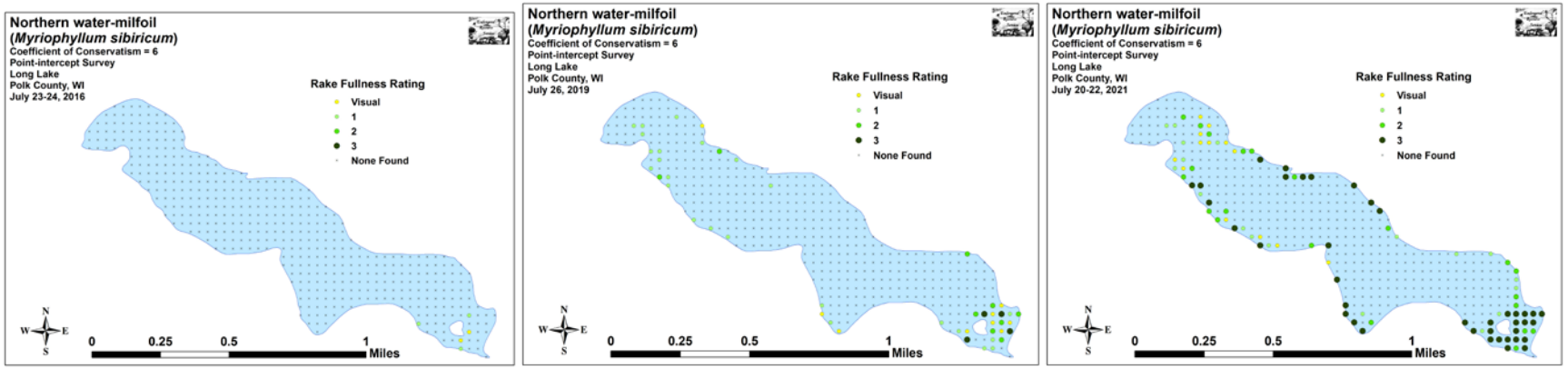

Figure 17. 2016, 2019, and 2021 Northern Water-milfoil Density and Distribution

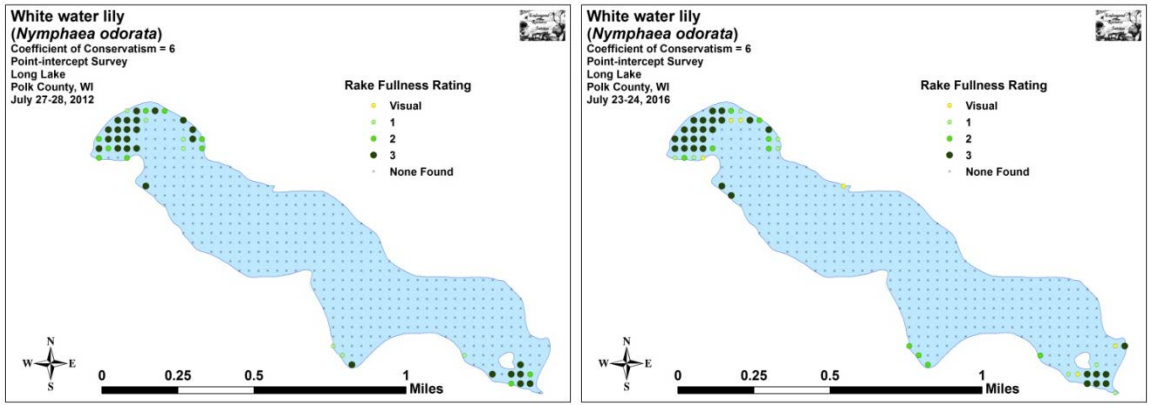

Figure 18. White Water Lily Density and Distribution (2012 and 2016)

Present at 106 sites in 2012, common waterweed was the most common macrophyte species in the lake. However, it declined significantly in distribution to just 28 sites in 2016. Although this overall decline might seem concerning, analysis of the maps for coontail show that these two species were essentially exchanged for one another. These two species seem to compete with each other to fill much of the void left by the elimination of Curly-leaf pondweed following the spring treatment.

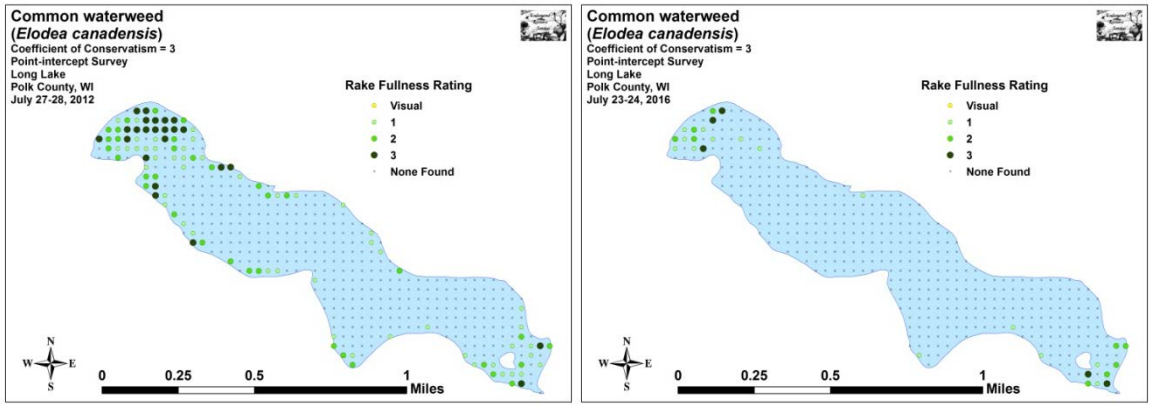

Figure 19. Common Waterweed Density and Distribution (2012 and 2016)

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 disturbance or changing conditions, and can therefore be found in a wider range of habitats. The FQI is calculated using the number of species present and these plants' species conservatism values. A higher FQI generally indicates a healthier aquatic plant community.

Table 4. Long Lake Floristic Quality Index 2012 - 2021

	FQI	Mean C
2012	19	4.8
2016	23.3	5.1
2019	24.4	5.5
2021	22.4	5.3
Ecoregion median	20.9	5.6

Nichols (1999) reported an average mean C for the North Central Hardwood Forests Region of 5.6 putting Long Lake just below average for this part of the state. The FQI was, however, above the median FQI of 20.9 for the North Central Hardwood Forests (Nichols 1999).

Comments from Matt Berg, Plant Surveyor (summarized)

Over the past twelve years, we've observed that fluctuations in water clarity and quality appear to be a significant driving factor in native plant growth as well as annual diversity. Specifically, in years where there were major algal blooms, we have found that more sensitive native species tend to have population crashes; conversely, in years with better water clarity, they often carpet the bottom. Unlike Curly-leaf pondweed, most rooted native species have a low growth profile that doesn't interfere with watercraft navigation, and they are photosynthetic late into the summer meaning they continue to pull nutrients out of the water column after CLP has completed its annual senescence. Unfortunately, when phosphorus and nitrogen levels exceed what the lake's macrophytes can utilize, it tends to promote the algae blooms which impact these sensitive species as well as general lake esthetics.

Increased water clarity has allowed native plants to continue to expand. *In this new lower-nutrient environment, Curly-leaf pondweed no longer has such a large competitive advantage over the lake's native species. The main benefactor of this changing environment has been Northern water-milfoil (NWM). Its population has exploded, and canopied mats of this species are likely causing significant navigation impairments for residents – especially in the southeast bay.*

Although potentially frustrating, these dense stands of NWM should be viewed as a steppingstone to restoration rather than what the "end product" will look like. NWM is a rooted plant, and, as such, it holds on to nutrients throughout the growing season. It also has some ability to overwinter. In areas where NWM is the densest, CLP has almost disappeared - it is, in effect, outcompeting CLP for space, nutrients and light.

Although it may sound counterintuitive, the next step in restoration is for more plant species to occur in greater numbers. In most systems we work on, there are several species that compete with NWM and help keep it in balance relative to the overall macrophyte community - Flat-stem pondweed, Clasping-leaf pondweed, and Wild celery. Collectively, these three species grow with NWM and create mixed beds that support fish, don't canopy and interfere with boat traffic, and tie up nutrients throughout the growing season which helps maintain water clarity. These species are already present in Long Lake, albeit at low numbers. Hopefully, with continued improvements in water quality, these species will soon grow in high enough numbers to compete with NWM.

Aquatic Invasive Species

Three species of aquatic invasive plants not native to Wisconsin lakes were observed in the aquatic plant surveys. They are Curly-leaf pondweed (*Potamogeton crispus*), Reed canary grass (*Phalaris arundinacea),* and Narrow-leaved cattail hybrid (*Typha angustifolia*). More information about several common aquatic invasive species is included in the aquatic plant management companion document (Clemens, 2021).

Curly-leaf pondweed (CLP) grows extensively throughout the littoral zone of Long Lake. Curly-leaf pondweed growth and recent management targeting CLP are summarized in subsequent pages.

Reed canary grass was observed in all of the aquatic plant surveys. It was also noted in the 1989 DNR sensitive area report. This plant is common and well-established adjacent to shorelines in northwest Wisconsin and is difficult to control.

Narrow-leaved cattail is native to southern but not northern Wisconsin. Narrow-leaved cattail (*Typha angustifolia*) and its hybrids with broad-leaved cattail are becoming increasingly common in northern Wisconsin where they also tend to be invasive. First noticed in 2011 in Long Lake, hybrid cattails have now crowded out most native cattails around the lake and in adjacent wetlands, and they are firmly and likely irrevocably established (Figure 20). Figure 20 illustrates hybrid cattail presence in 2016. It decreased with higher water levels in 2021.

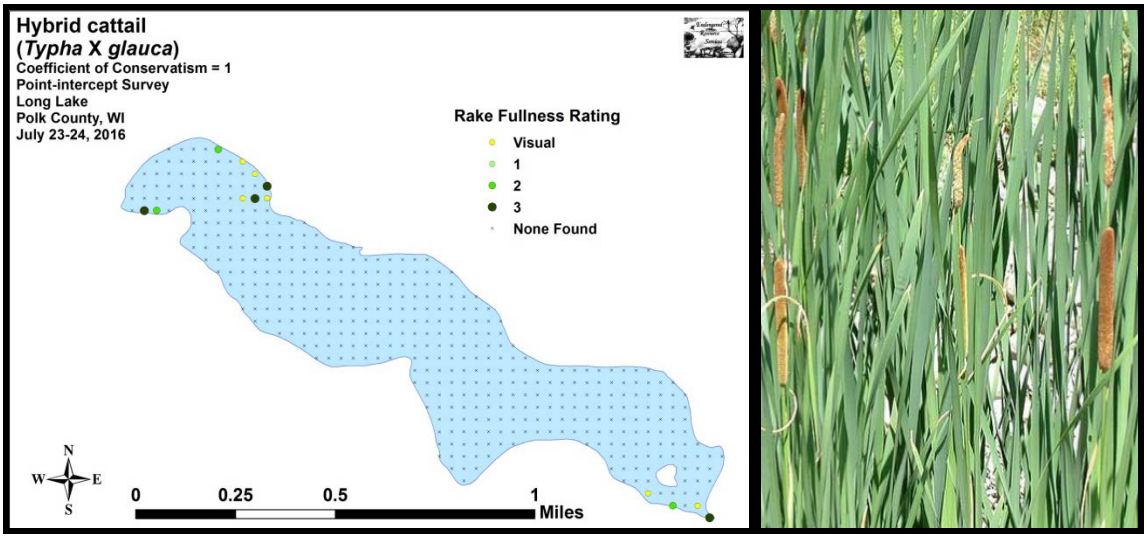

Figure 20. Hybrid Cattail Density and Distribution

Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*Polygonum sachalinense*) are potential concerns for riparian areas of Long Lake. The Polk County Land and Water Resources Department has documented several riparian locations of knotweed throughout Polk County.

There is a high risk that Eurasian water-milfoil and other aquatic invasive species may become established in Long Lake. With Eurasian water-milfoil present in many urban Twin Cities lakes, there is a danger of transporting plant fragments on boats and motors. Department of Natural Resource scientists have also found Eurasian water-milfoil in the nearby Wisconsin counties of

Burnett (Ham, Little Trade, Shallow, and Round Lakes), Barron (Beaver Dam, Horseshoe, Sand, Kidney, Shallow, Duck, Rice, and Echo Lakes), and St. Croix (Bass Lake, Cedar, Goose Pond, Little Falls Lake, Lake Mallalieu, Lake St. Croix, New Richmond Flowage, and Perch Lake). In Polk County, EWM is found in Cedar Lake, Half Moon Lake, Horseshoe Lake, Indianhead Flowage, Long Trade, North Twin, South Twin, and Pike Lakes.

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.[7]

[7] *Wisconsin's Comprehensive Management Plan to Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species.* Prepared by Wisconsin DNR. September 2003.

Aquatic Plant Management

This section reports recent management activities on the lake. Potential management methods and permitting requirements are included in a companion document to this plan.

Curly-leaf Pondweed Management

The LLPRD managed Curly-leaf pondweed (CLP) with early season herbicide treatments beginning in 2004 and continuing through 2021. Strategies for CLP control have changed over the years in response to monitoring results that provide information about impacts on CLP and native plants. Current efforts seek to allow recovery of native plants while reducing impacts from CLP growth.

Early season CLP endothall treatments began in 2004. In 2004 and 2005 a total of 17 acres of CLP was treated along shorelines of Long Lake. In 2008 and 2009, the northwest and southeast bays were treated.

Curly-leaf pondweed beds covered 97 acres or 75 percent of the littoral zone (the area at depths where plants grow) and 35 percent of the lake in 2007. This coverage was estimated to contribute 32 percent of the annual total phosphorus budget (Barr 2007). However, the lake management plan (Polk County LWRD 2013) suggested the 2007 contribution would have been closer to 5 percent because not all of the phosphorus was available for algae growth. In any case, CLP dieback contributed phosphorus to the lake at a time of the year when temperatures support algae growth.

The 2007 Long Lake Aquatic Plant Management Plan recommended a low-dose, early season endothall treatment for CLP throughout the littoral zone (Barr 2007). The ultimate goal was to reduce CLP coverage from 97 to less than 10 acres. The 2012 APM plan revised that goal to reduce CLP to less than 20 acres.

The CLP early season treatment program has been successful on Long Lake. A comprehensive CLP treatment program began in 2010. Treatment acreages and costs are shown in Table 5. Pre and post-treatment monitoring occurred each year within the treatment areas.
From 2010 – 2014, CLP beds were delineated and treated where "any significant CLP was present." **Based on this definition, CLP beds had declined from 65 acres in 2010 to 20 acres in 2014. The frequency of CLP within the beds had also declined. This nearly reached the objective established in the 2012 plan – to less than 20 acres of CLP in beds.**

As a result of previous treatment success (measured by declining CLP beds and frequency) and an indication that 2015 growth would be low (low turion density), CLP treatment was suspended in 2015. Lack of herbicide effectiveness in 2014 was also noted. A preliminary hypothesis was that previous spot treatments were large enough to effectively provide a whole-lake effect. This was evidenced by control of CLP beyond the treatment area which did not occur with the 2014 20-acre treatment.

Table 5. Long Lake CLP Treatment (2010-2021)

Year	Acres Treated	Cost	Cost/acre (permit and herb.)[8]	Monitoring (pre/post, turions)
2010	65.0	$38,500	$592	$1,200
2011	56.5	$38,304	$678	$3,855
2012	58.0	$39,905	$688	$5,555
2013	26.6	$29,711	$1,117	$4,275
2014	20.1	$24,466	$1,217	$3,800
2015	0	NA	NA	$1,950
2016	35	$33,925	$944	NA
2017	34	$33,917	$997	$4,100
2018	0	NA	NA	$4,100
2019	0	NA	NA	$4,100
2020	0	NA	NA	$4,100
2021	6.8	$7,837	$1,152	$4,100

Treatment resumed in 2016 using the guidelines established late in 2014 and affirmed in the 2017 APM plan update. With an established maximum of 35 acres, the board selected beds to be treated based on pre-treatment survey results. There was a 68% frequency of CLP in selected beds prior to treatment and a 1% frequency post treatment in 2016. A lakewide effect was observed with the same low frequency in untreated areas. CLP treatment was also completed in 2017, with 34 acres treated. Because CLP growth did not meet treatment standards, the LLPRD opted not to treat CLP in 2018, 2019, and 2020.

Curly-leaf Pondweed Treatment Thresholds (2017 APM Plan)

25 - acre minimum overall treatment area, minimum 5-acres/bed

>30% Frequency of Occurrence within treatment beds

Suspend treatment until CLP in beds reaches 25 acres

Use sediment turions to forecast following year treatment. Guideline (may be updated): Sediment Turion Density: >50 turions/yd^2 (per bed), >20 turions/yd^2 (mean over all beds)

*Adaptive management will be employed; treatment thresholds may be modified with experience.

[8] Note that cost increases may be due to increased concentration of chemical and depth of treatment area.

The LLPRD received aquatic invasive species control grants to pay for 50-65 percent of the cost of CLP treatments and associated permitting and monitoring expenses from 2013 through 2022. The current grant (ACEI20218) also covers the aquatic plant point intercept survey and the update of the aquatic plant management plan.

Curly-leaf Pondweed 2021 Treatment

The LLPRD completed an early season CLP treatment in 2021 with treatment areas established following an early season pre-treatment survey. Treatment areas for 2021 are shown in Figure 21. Of the 21.93 acres identified for potential treatment, only 8.6 were treated. The post treatment survey found no CLP within the treatment area in the northwest bay.

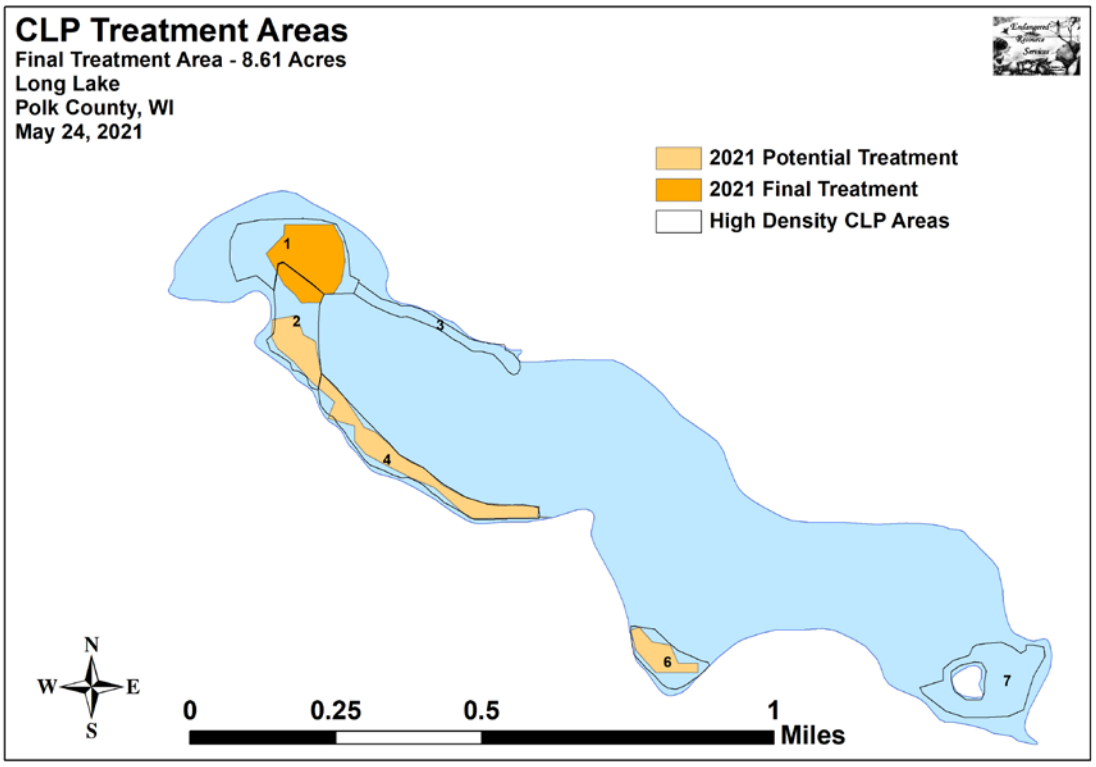

Figure 21. Curly-leaf Pondweed Potential and Final Treatment Areas 2021

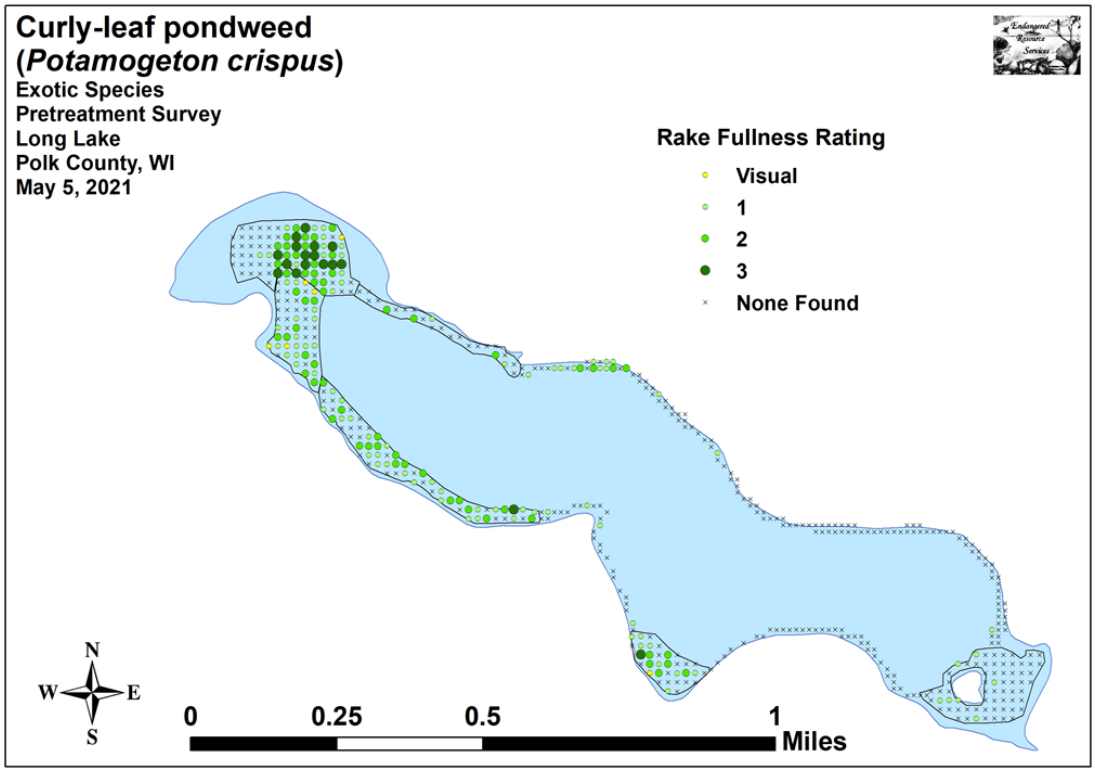

Figure 22. CLP 2021 Pre-treatment Survey

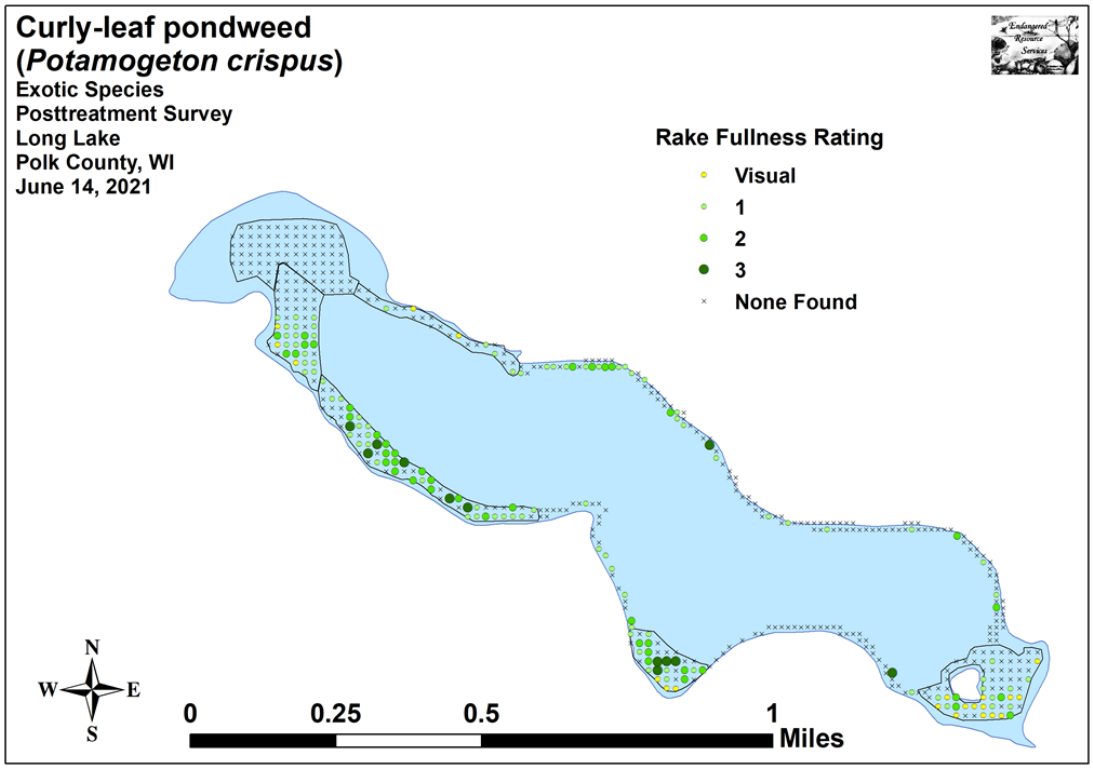

Figure 23. CLP 2021 Post-treatment Survey

Long Term CLP Results

Fall sediment turion monitoring began in 2012. Turion monitoring followed three years of successful treatments in 2010, 2011, and 2012. Turion concentrations in sediment prior to CLP herbicide treatment are unknown. Numbers of turions/m^2 in the sediment provides an indication of potential CLP growth in subsequent seasons. CLP turions surveyed following the 2021 treatment are shown in Figure 24 and Table 6.

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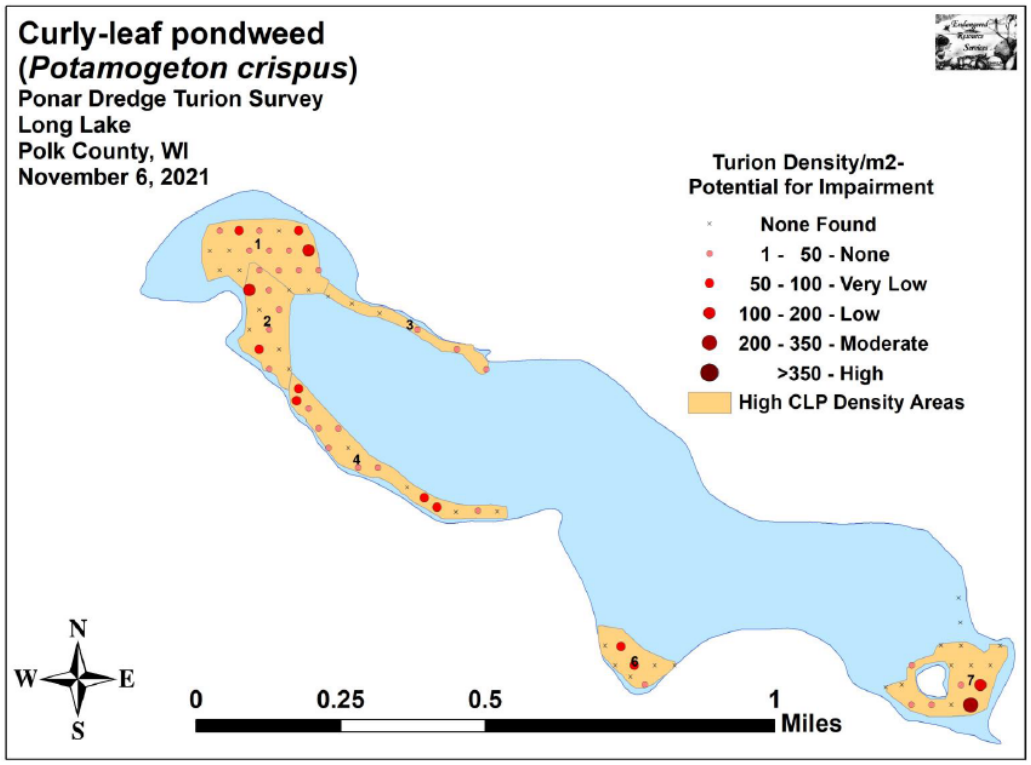

Figure 24. Sediment Turions in CLP Beds Fall 2021

Table 6. Sediment Turions in CLP Beds Fall 2021

Polygon Number	Points Surveyed	Points with Live Turions	Total Live Turions	Est. Mean Turions/m^2
1	17	11	25	31.66
2	12	7	14	25.12
3	6	3	4	14.35
4	15	11	26	37.31
6	8	3	9	24.22
7	17	6	20	25.33
Total	**75**	**41**	**98**	**28.13**

These relatively low values ranging from 14 to 37 are not expected to result in significant impairment of navigation in 2022. Research suggests that when the turion density is at or above 200/m^2, the following year's CLP growth has the potential to at least moderately impair navigation (Johnson 2012). Sediment turion means of all polygons measured from 2013 through 2021 are shown in Figure 26. Turions increased in years when CLP was not treated (2015, 2018, 2019, and 2020).

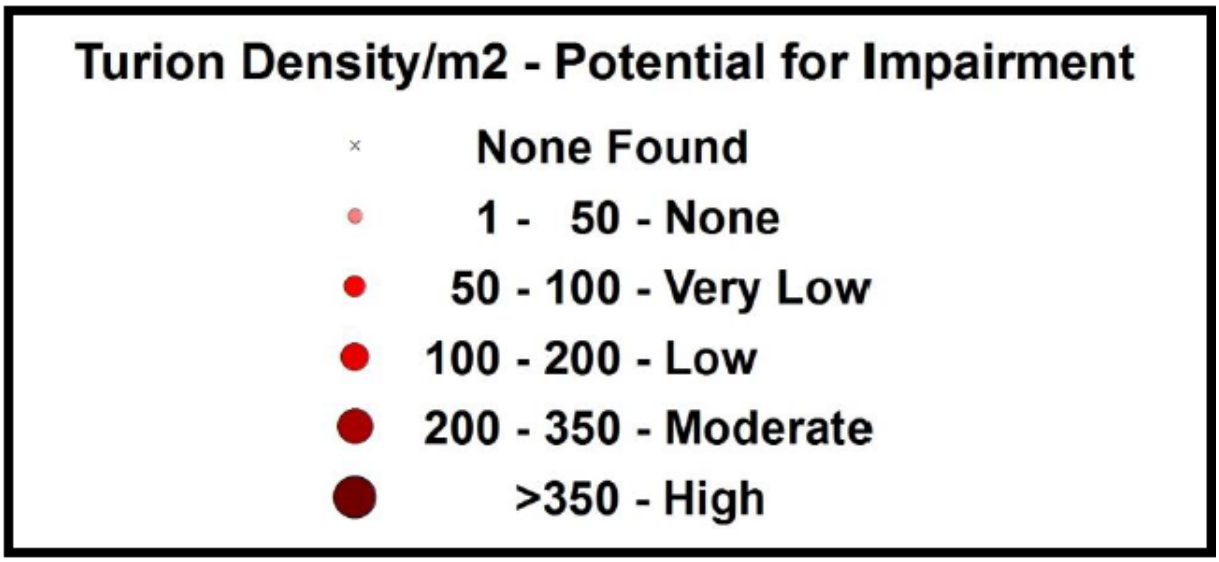

Figure 25. Predicted Navigation Impairment Based on Turion Density

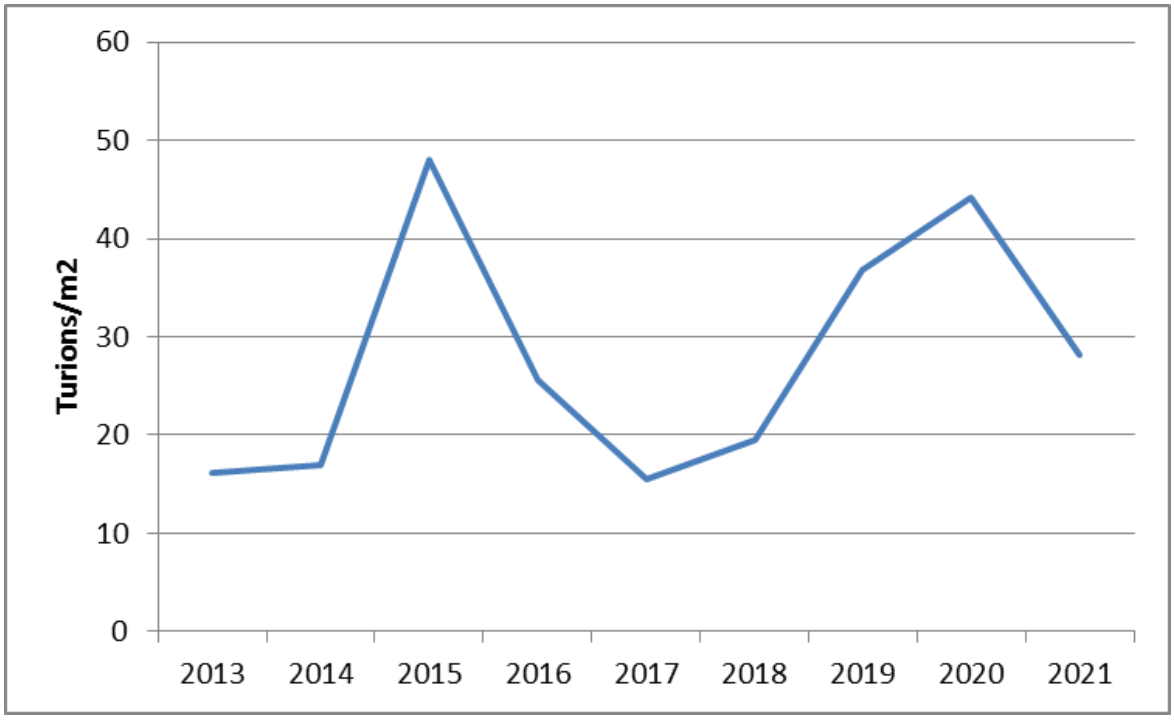

Figure 26. Long Lake Sediment CLP Turion Means 2013 to 2021

Another indication of long term results of the CLP control program is provided by examining CLP measured in beds. By definition, a “bed” is any area where CLP made up >50% of the area’s plants, was generally continuous with clearly defined borders, and was canopied or close enough to being canopied that it would likely interfere with boat traffic. CLP beds were measured in mid-June. No beds of CLP were observed in and year following early season treatment that exceeded 20 acres. Even with suspension of herbicide treatment in 2018 through 2020 and a relatively small treatment of 8.6 acres in 2021, CLP in beds decreased significantly since 2009. In 2021 there were six areas totaling 10.76 acres of CLP in beds, an 11.49-acre decline (-51.6%) from the 2019 survey and 74.75 acres less than (-87.4%) the 2009 survey (Berg, 2021).

Suspending CLP treatment in 2015, 2018, 2019, and 2020 resulted in recoveries of native plants in Long Lake. Between 2017 and 2021 there were significant recoveries in native species, especially those that are sensitive to endothall such as Coontail, Northern water-milfoil, and Small pondweed. The increases in Water star-grass, Northern water-milfoil, and Small pondweed at depths previously unseen also suggests plants are responding to improvements in water clarity. Ultimately, this strong regrowth and increasing richness and diversity of native species may mean that the lake is trending towards a more balanced plant community that will not require significant active management in the future (Berg, 2021).

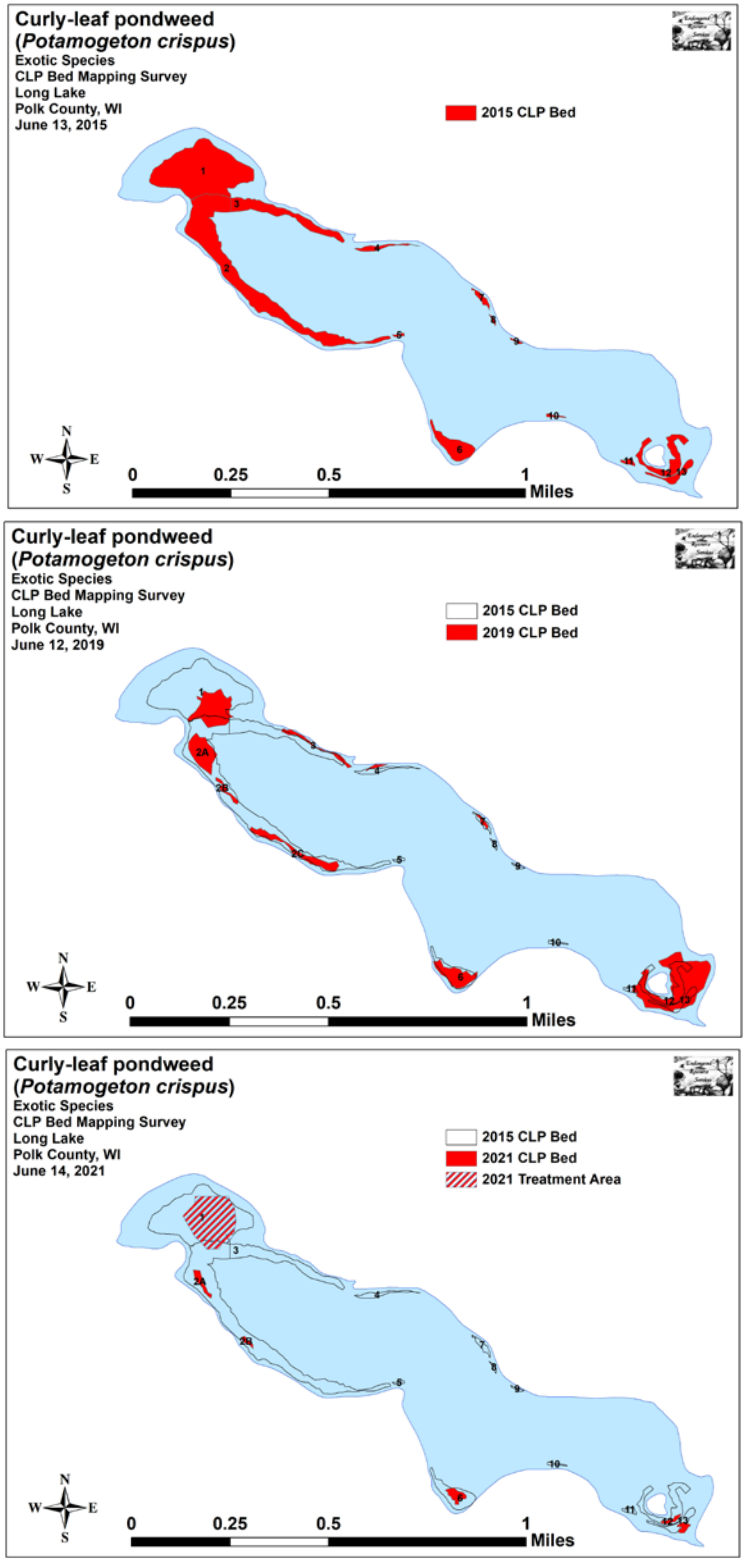

Figure 27. 2015, 2019, and 2021 Early-season Curly-leaf Pondweed Beds

Past Aquatic Plant Management[9]

The DNR reports that Long Lake has a history as one of the most chemically treated lakes in the state for aquatic plant management.[10] Algae and aquatic plant treatments occurred in channels from 50 to 150 feet wide along much of the lake shoreline. The northwest and southeast bays tended to have narrower, 25-foot wide channels. The overall acreage and frequency of algae treatments decreased over the years as shown in Table 8. From 1959 through 1981 chemical treatment for algae control included literally tons of sodium arsenite and copper sulfate generally used to treat about 80 acres of the lake. From 1983 to 2002 frequent algae treatments covered from 19 to 59 acres.

Herbicides were used to treat 5-13 acres of aquatic plants from 1959-1982. DNR treatment records reviewed from 1983-2002 also show regular herbicide treatments for aquatic plants (20-30 acres, 4 to 6 times per year). A wide variety of herbicides were used over the years including endothall, 2,4-D, glyphosate, and diquat (with various trade names).

Table 7. Algae Treatment along Lake Shoreline

Years	**Chemicals Used**	**Area Generally Treated/Permitted**	**Annual Frequency (when known)**
1959 - 1981	Sodium arsenite Copper sulfate	80 acres	Up to 9 times
1982 - 1987	Copper sulfate	53 – 58 acres	6 – 14 times
1988 - 2002	Copper sulfate	19 – 22 acres	5 – 10 times (8.6 ave.)
2003 - 2007	Copper sulfate Cutrine plus	3 – 9 acres	Up to 6 times

Table 8. Aquatic Plant Treatment in Navigation Channels

Year	**Total Area Permitted**	**Annual Frequency (when known)**
1959 - 1981	5-13 acres	2-6 times
1982 - 1984	29.7 acres	4 times
1985 - 1988	20.7 acres (6,000 ft. by 150 ft.)	4 -5 times
1989 - 1993	19.15 acres	3-8 times
1994 - 2003	22 acres	1-10 times (5.5 ave.)
2004 - 2007	17-20 acres	1-7 times (4.25 ave.)

[9] Information from Wisconsin Department of Natural Resources Files. Spooner Office.
[10] Nonpoint Source Control Plan for the Balsam Branch Priority Watershed Project. DNR. 1995.

Table 9. Aquatic Plant Contractors

Names	**Years (when known)**
The Lake Biologist, Inc.	1977-1978
Lindberg Aquatic Services	1979-1981, 1985-1987
Aquatic Nuisance Control	1989, 1993-1994
Lake Management, Inc.	1998-2003
Aquatic Engineering	2004-2005
Northern Aquatic Service	2005-2011

The DNR Northern Region released an Aquatic Plant Management Strategy in the summer of 2007 to protect the important functions of aquatic plants in lakes. As part of this strategy, the DNR prohibited management of native aquatic plants in front of individual lake properties after 2008 unless management is designated in an approved aquatic plant management plan.[11] Because of the importance of the native plant population for habitat, protection against erosion, and as a guard against invasive species infestation, plant removal with herbicides as an option for individual property owners must be carefully reviewed before permits are issued. The DNR will not allow removal after January 1, 2009 unless the "impairment of navigation" and/or "nuisance" conditions are clearly documented.

Common and Individual Corridor Management

The 2007 aquatic plant management plan (Barr Engineering, 2007) indicated that treatment of native species would be restricted to areas with impairment of navigation and nuisance conditions. It also indicates that owner requests for plant control would be coordinated with the district plan. No herbicide records for late season treatment of native plants for navigation channels were found after 2007.

The ability for the LLPRD to maintain common access navigation channels when there is severe navigation impairment was added in this management plan update. The plan for these limited channels keeps in mind that shallow areas of the lake with heavy plant growth (NW and SE bays) are designated sensitive areas. These sensitive areas are important spawning and nursery areas for fish. Plants hold sediments in place. The LLPRD does not want to encourage boating in shallow waters where sediments can be stirred up. Wisconsin Department of Natural Resources permits for harvesting do not allow harvest operations in depths of 3 feet or less. An alternatives evaluation matrix that supported committee direction is included as Appendix A.

The plan will allow for maintenance of individual corridors. This means that individuals will be able to pursue permits to maintain an opening of up to 30 feet around their docks (25 feet in sensitive areas). Aquatic herbicides can only be applied by licensed applicators, and a DNR permit is always required. Permits are issued only where navigation is severely impaired. The LLPRD will review navigation impairment to consider these permits on the lake. The LLPRD will not pay the cost of individual permits and herbicide applications. Instead, owners will cover

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

the cost. Owners (or someone they hire) are allowed to clear up to a 30 foot opening in front of their property using hand methods. In designated sensitive areas this opening is limited to 25 feet. A map of sensitive areas is shown in Figure 8. Hand methods do not include use of any mechanical means such as boats, ATVs, or mowers. Mechanical control requires a DNR permit.

Preventing Invasive Species

Methods the LLPRD and others can consider to prevent invasive species introduction and establishment include: education to lake users, Clean Boats Clean Waters program, landing surveillance cameras, lake monitoring, and a rapid response strategy for any new invasive species.

Education to Lake Users

Education efforts focus on identification and prevention of new invasive species. Activities might include aquatic invasive species (AIS) information presented at annual meetings and workshops, signage at the public landings, lake maps and brochures with AIS messages, and web site and newsletter information.

The LLPRD currently distributes information through a website shared with the Long Lake Homeowners Association: www.longlakepolk.com. A LLPRD newsletter is distributed occasionally via email.

Clean Boats Clean Waters (CBCW) Program

Clean Boats Clean Waters educators provide boaters with information on the threat posed by invasive species. They offer tips on how to keep boats, trailers, and equipment free of aquatic hitchhikers. They also collect information on boater behavior, concerns, and knowledge of existing local and state laws related to anti-AIS measures.

Long Lake has had a CBCW program since 2013. Hours of coverage at the main landing are shown in Figure 28. Polk County Land and Water Resources Department provides training for paid staff or volunteers to staff landings and educate boaters. A WDNR Clean Boats, Clean Waters grant can currently provide 75 percent funding up to $4,000 as long as a minimum of 200 hours are covered at a landing or pair of landings.

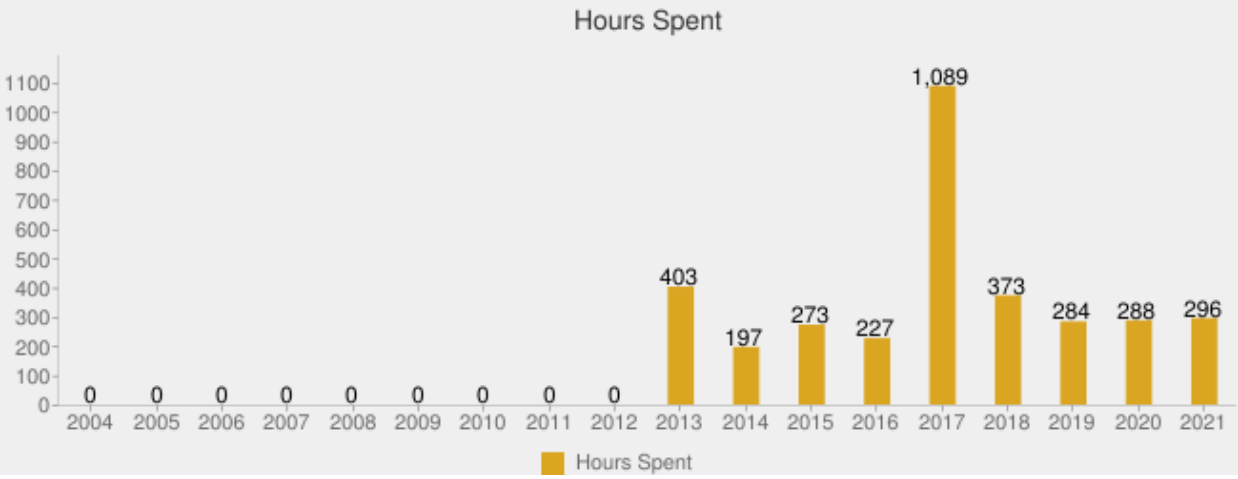

Figure 28. Clean Boats, Clean Waters Staffing on Long Lake 2013-2021

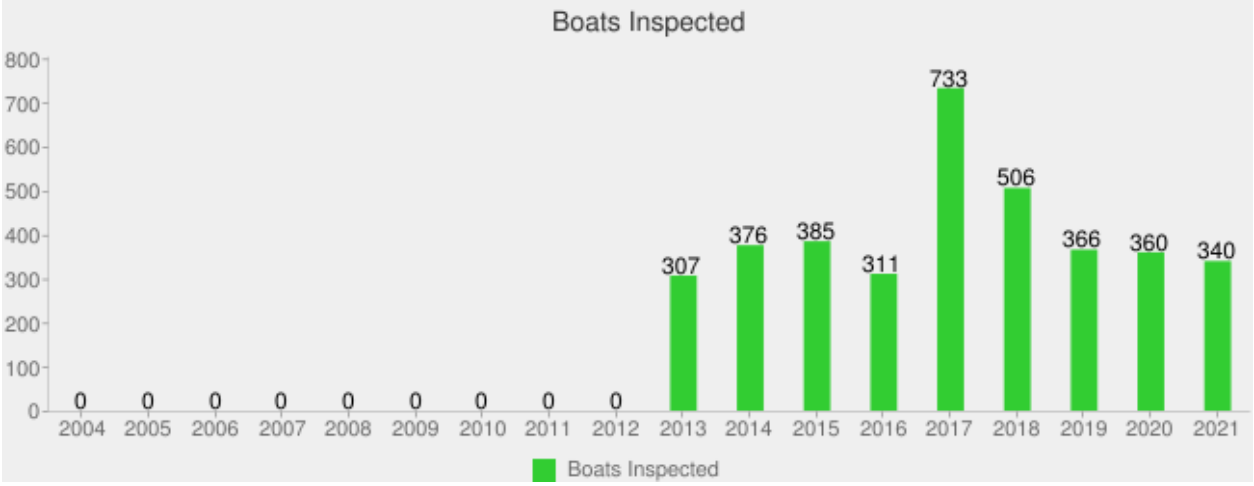

Figure 29. Clean Boats, Clean Waters Boats Inspected on Long Lake 2013 - 2021

Landing Surveillance Cameras

Some lake organizations use video cameras at public landings to record landing activity. Videos are reviewed, and if watercraft are launched with vegetation attached, enforcement action may be taken. Violations of the ordinance and state rule which prohibits transporting and launching boats and trailers with vegetation attached can be enforced by local law enforcement officers. The camera also serves as a reminder for boaters to check their equipment. Surveillance cameras are in place at Bone Lake and Church Pine Lake in Polk County. WDNR grants can be used to support camera installation. Maintenance and video/photo review are not grant-eligible expenses.

Boat Washing Stations

Boat washing stations use hot water and high pressure to remove potential aquatic invasive species from boats, trailers, and equipment. The hot water kills the AIS, and the high pressure removes them. There are no soaps, bleaches, or chemicals used or recommended at this time.

Chemicals are not as reliable as temperature for killing AIS. At 140°F, a hot water rinse for 10 seconds in each spot will kill all adult mussels. At 120°F, a contact time of two minutes is needed to destroy zebra mussels (MNDNR 2017). Use of boat washing stations is voluntary in Wisconsin unless there are local ordinances to require decontamination. Polk County recently passed an ordinance which requires decontamination if offered at a public or private water access.

Several lake organizations in Burnett and Washburn County, Wisconsin have installed boat washing stations which use a mild bleach solution to decontaminate boats. The solution of two tablespoons of household bleach/gallon of water is sprayed on boats and trailers. A contact time of ten minutes is required when using this solution. The bleach solution must be replaced regularly – daily replacement is preferred. Signage is installed to provide instructions for and to encourage use (NW WI ZM Team 2018).

Lake Monitoring

The objective of lake monitoring is to look for new invasive species. Monitoring for invasive species is generally focused around boat landings and other areas of high public use. Trained volunteers or consultants may complete the monitoring. Divers may be used. It is critical to complete aquatic invasive species visual surveys when algae growth is low and visibility is good.

Rapid Response for New Invasive Species

The activity is intended to control any new invasive species that are found in the lake. Rapid response protocols include the following:

- monitoring for invasive species
- education of lake residents and visitors
- contacts to confirm invasive species identification
- procedures for notification
- plans for removal and control
- funding contingencies and grants.

Invasive species information is available on the DNR website http:/dnr.wi.gov/topic/invasives.

A rapid response protocol is included as Appendix B.

Plan Goals and Strategies

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

Goals are broad statements of desired results.
Objectives are the measurable accomplishments toward achieving a goal.
Actions are the steps taken to accomplish objectives and ultimately goals.

An aquatic plant management action plan, included as Appendix C, outlines how each action will be accomplished listing a timeline, resources needed, and responsible parties. The action plan chart will be updated annually (or more frequently) by the LLPRD Board. Actions may be modified as new information becomes available.

Plan Goals

1) Maintain water quality and clarity.
2) Promote and protect a healthy, balanced native aquatic plant community. A balanced native plant community has a high diversity and distribution of species – one or two species do not dominate aquatic plant growth.
3) Balance recreation and waterfront owner needs with protection of native plants and the fishery.
4) Prevent the introduction of Eurasian water-milfoil, zebra mussels, and other aquatic invasive species.
5) Rapidly respond to eliminate any newly introduced aquatic invasive species.
6) Increase lake residents' and visitors' understanding of lake ecology and aquatic plant management to encourage practice of proactive lake stewardship.

Responsible Parties for APM Implementation and Monitoring

Long Lake Protection and Rehabilitation (LLPRD) Board – elected representatives responsible for oversight of the lake management district. Some actions, such as hiring a contractor or consultant, require a vote of the board.

Aquatic Plant Management (APM) Lead – directs contractors in herbicide treatments and related monitoring.

Harvesting Lead – coordinates feasibility study of harvesting for aquatic plant management and contracted harvesting.

Aquatic Invasive Species (AIS) Lead – leads and coordinates volunteer AIS education activities including Clean Boats, Clean Waters monitoring and education at the boat landings and lake monitoring.

Harvesting Contractor – the entity hired by the LLPRD Board to harvest on Long Lake. The Apple River Protection and Rehabilitation District is the only contract harvester under consideration because the Apple River Flowage has only one aquatic invasive species present (CLP), as we do, and the harvester will undergo decontamination prior to use in Long Lake.

Herbicide Contractor – the herbicide applicator hired by the LLPRD Board to complete herbicide treatment as permitted by the Wisconsin Department of Natural Resources.

Aquatic Plant Management (APM) Monitor– a consultant hired to complete monitoring under the direction of the APM Lead and the LLPRD Board.

Planning Consultant – facilitates discussion regarding aquatic plant management options and implementation and writes grants to assist with plan implementation.

WDNR – Aquatic Plant Management (APM) – staff who review aquatic plant management permit applications and enforce permit conditions.

Polk County Land and Water Resources Department (LWRD) – staff from Polk County who assist with education and plant identification.

Goal 1) Improve water quality and clarity.

Objective

A. Reduce phosphorus loading from Curly-leaf pondweed (CLP) by limiting total CLP growth in beds[12] to less than 20 acres and preventing CLP spread.

Discussion

Successful early season herbicide treatments of CLP over several years have resulted in decreased growth of CLP in beds, meeting objectives established in the 2017 aquatic plant management plan. Other lake management efforts to reduce phosphorus loading, including alum treatments to prevent phosphorus release from lake sediments and runoff mitigation projects, are addressed in the Long Lake Management Plan. Minimum CLP treatment areas are established based on experience, to ensure effectiveness of the herbicide treatments.

Actions

1. Continue early season CLP treatment using a low-dose endothall application according to the treatment thresholds outlined below:
    a. Apply for APM permit. (APM Lead with assistance from Planning Consultant and APM Monitor)
    b. Identify treatment areas with pre-monitoring in April or May. CLP treatment beds are delineated as any areas where CLP is present in frequency of occurrence >50%[13]. (APM Monitor, Planning Consultant, and APM Lead)
    c. Complete early season herbicide treatment. (Herbicide Contractor)
    d. EVALUATION: Complete CLP pre and post monitoring according to methods approved by the Department of Natural Resources. (APM Monitor)

Curly-leaf Pondweed Treatment Thresholds*

25 - acre minimum total treatment area, with a minimum of 5-acres in each bed before herbicide treatment will proceed

Exception to 25-acre minimum: treatment can occur in shallow bays only, with 5-acre minimum bed size

>50% Frequency of Occurrence within treatment beds

*Adaptive management will be employed; treatment thresholds may be modified with experience.

[12] By definition, a "bed" is any area where CLP makes up >50% of the area's plants (visually estimated), is generally continuous with clearly defined borders, and is canopied or close enough to being canopied that it would likely interfere with boat traffic. (Berg, 2021)

[13] This means that 50% or more of the designated sample points within the proposed treatment area have CLP present.

2. Consider removing late season (June – August) CLP growth by encouraging hand-pulling by residents or hiring SCUBA divers when water quality allows.

3. Consider harvesting as a CLP management tool if harvesting is pursued for maintenance of common access navigation channels. Harvesting could target any CLP bed when plants are high enough for cutter blade to reach and prior to turion formation.

4. EVALUATION: Conduct periodic fall monitoring of sediment CLP turions. Complete turion monitoring during the same year the aquatic plant point intercept survey is conducted, if feasible. (APM Monitor)

Goal 2) Promote and protect a healthy, balanced native aquatic plant community.

Objectives

A. Restore the lake's ecosystem by promoting the replacement of CLP with native aquatic plants.
B. Manage for a balanced native plant community. The plant community consists of many species, and one or two species do not dominate aquatic plant growth.
C. Maintain native aquatic plant functions which include: stabilizing sediments, reducing erosion, consuming nutrients, and providing habitat.

Discussion

Native plants play a critical role in the lake ecosystem, and removing native plants can lead to adverse effects on the lake. Rooted aquatic plants in the lake stabilize bottom sediments and prevent re-suspension of nutrients. This is especially important in mucky, shallow areas – characteristic of much of the area where plants grow in Long Lake. Emergent plants with stems reaching above the water level protect against shoreline erosion. All types of aquatic plants provide habitat for fish and other aquatic creatures. Healthy, native plant populations prevent colonization by invasive plants such as Eurasian water-milfoil and Curly-leaf pondweed. Erosion and runoff from waterfront property may alter sediment characteristics and encourage spread of invasive plants. Boating disturbance near the shoreline can remove aquatic plants and the valuable functions they provide.

Actions

1. EVALUATION: Assess impacts of early season CLP herbicide treatments to native plants through pre and post monitoring (covered in Goal 1). (APM Monitor) Modify treatment strategy as needed to limit impacts on native plants.

2. EVALUATION: Assess impacts of maintaining common navigation channels to native plants through a periodic point intercept survey. (APM Monitor) Modify treatment strategy as needed to limit impacts on native plants.

3. Educate lake residents about the values of native aquatic plants (more information in Goal 6 discussion).

Goal 3) Balance recreation and waterfront owner needs with protection of native plants and the fishery.

Objectives

A. Support the ability for boaters to navigate to the lake by way of identified common access navigation channels. This must be done within WDNR Aquatic Plant Management Permit requirements.

B. Allow owners to maintain individual access corridors to their properties (by manual or chemical means) as permitted by state regulations.

C. Minimize disturbance to shallow water habitat and sensitive areas while maintaining common access navigation channels or individual access corridors.

D. Minimize CLP growth to allow for navigation (actions covered in Goal 1).

Information from the DNR Northern Region Aquatic Plant Management Strategy

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.

Objective A. Support the ability for boaters to navigate to the lake by way of identified common access navigation channels. This must be done within WDNR Aquatic Plant Management Permit requirements.

Action A-1. **Select and map common navigation channels.**

Preliminary proposed common access navigation channels are indicated on the map in Figure 30.

Specific channel location and channel width will be selected by the LLPRD Board the summer before the treatment year in cooperation with DNR. This will occur for the first time in 2022.

Map navigation channels for the coming year. A common access navigation channel map is required for DNR aquatic plant management permits whether for harvesting or herbicide application. Channels are intended only to provide residents the ability to assist in reaching their docks, not to allow cruising around the entire lake perimeter.

Annual channel selection will be based upon:

- degree of navigation impairment (severe navigation impairment is required for permitting control efforts)
- provision of access to multiple resident docks
- minimum water depth of 3 feet, if possible
- width limited to no more than 25 feet to minimize disturbance to Sensitive Areas.

In subsequent years, proposed channels will be re-evaluated. Common access navigation channel location may change from year to year based on water depth, plant growth, effectiveness of previous implementation, and other factors.

Common access navigation channels may not need to be maintained each year as growing conditions vary and aquatic plants may not re-grow robustly a year or two following control measures.

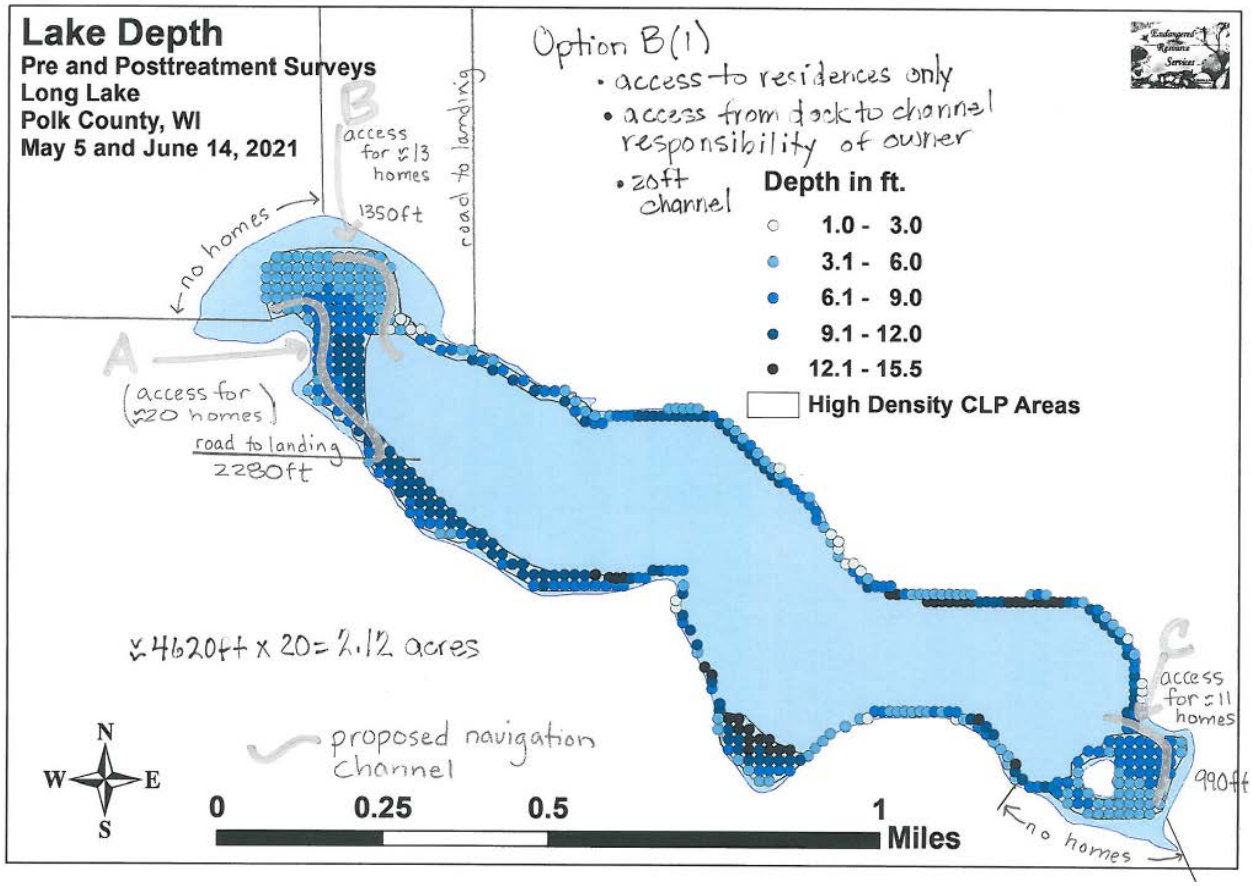

Figure 30. Preliminary Proposed Common Access Navigation Channels

Action A-2. – Option A. **Implement a trial to maintain common access navigation channels by encouraging navigation along specific routes.**

a. Work with the Town of Balsam Lake to obtain a DNR permit for navigation markers.
b. Encourage lake residents to boat along these common navigation routes.

Option A is currently the preferred alternative for 2023. Option B or C may be considered depending upon plant growth and navigability and the ability to secure a navigation channel marker permit.

Action A-2- Option B. **Take no action to maintain navigation channels in 2023.** Repeat the assessment of navigation impairment along navigation channels proposed in 2022 and record observations.

Action A-2- Option C. **Conduct a trial to maintain common navigation channels using herbicides.**

Selecting herbicide and concentration

Effective herbicides that target Northern water milfoil may be used initially. ProcellaCOR or 2,4-D is currently proposed for use for navigation channel treatment. If 2-4-D is selected, use granular 2,4-D at a rate of 200 lbs./acre – or as modified by best available information. Recommended ProcellaCOR application rates are available from the distributor.

The herbicide type and application rate will be modified considering the results of previous treatments and new available information.

Procedures for treatment

a. Select channels for treatment and record GPS points of channel locations as described in Action A-1.

b. Let out bids for channel treatment (January of treatment year). (LLPRD Board)

c. Apply for permits (February or March of the treatment year). (Chair, LLPRD Board or delegate to Applicator)

d. Confirm severe navigation impairment prior to herbicide treatment, and determine timing for treatment.

e. Notify general public of treatment, timing, and water use limitations as required by permit conditions. (Secretary or delegate to Applicator)

f. Post herbicide notices at boat landings. (Secretary, or delegate to Applicator)

g. Supervise and direct contracted applicator. (Chair, LLPRD Board)

h. Conduct treatment according to permit conditions – Applicator. Treatment will not occur if threshold of severe navigation impairment is not reached by early-July.

i. Monitor effectiveness of treatment. (Chair, LLPRD Board)

j. Notify all lake residents and volunteers to report any irregularities (fish or amphibian kills). (LLPRD Board)

Action A-3. Investigate the feasibility of harvesting to maintain common access navigation channels.

a. The feasibility study will be conducted by the LLPRD Board or a committee appointed by the board.
b. The study will include a cost/benefit and risk analysis of harvester ownership, leasing, and contracted service.
c. Various types of harvesting equipment will be investigated, particularly those applicable for use at small scales.
d. Results and recommendations will be presented to district members for budget approval.

If contracted harvesting is used, the following procedure will be followed:

i. Secure permit from WDNR for mechanical harvesting of common navigation channels (February or March of the harvesting year). (LLPRD)

ii. Develop an agreement for contracted harvesting including navigation impairment thresholds, approximate harvesting dates, cost, decontamination procedures, disposal of plant material, and other relevant terms. Harvesting should occur after July 4 to minimize potential dispersal of CLP turions. CLP generally dies back by this time. (LLPRD AND ARPRD)

iii. Confirm severe navigation impairment prior to initiating harvest and contact ARPRD Lead Harvester Operator.

iv. Complete harvesting according to permit conditions. (ARPRD) Harvesting will not occur if threshold of severe navigation impairment is not reached.

v. Monitor effectiveness of harvesting by recording observations. (LLPRD Board)

vi. Notify all lake residents and volunteers to report any irregularities (fish or amphibian kills, plant fragment nuisances). (LLPRD Board)

Action A-4. For years 2024 until the aquatic plant management plan is updated, methods to maintain common access navigation channels will generally follow the steps outlined for

harvesting and herbicide use above. Method(s) will be chosen based on cost and ability to meet all plan goals and objectives.

Potential resurgence of CLP in common access navigation channels will be visually monitored each year during late June. The LLPRD will modify actions if CLP takes over native plants in these maintained channels.

Adaptive management will be employed. Common access navigation channel methods and process may be modified based on lessons learned and options available. Significant changes will be documented in a brief plan amendment to be approved by the LLPRD board and submitted to the WDNR.

Objective B. Allow owners to maintain individual access corridors to their properties (by manual or chemical means) as permitted by state regulations.

Action B-1. Support individual corridor management through LLPRD verification of nuisance plant conditions and navigation impairment.

Discussion: Individual Access Corridors

The only time a permit is not required to control aquatic plants is when a waterfront property owner manually removes (i.e., hand-pulls or hand rakes), or gives permission to someone to manually remove, plants (except wild rice) from his/her shoreline in an area that is 30 feet or less in width and is not within a designated sensitive area. In sensitive areas the opening is limited to 25 feet. The corridors may begin at the shoreline and extend out into the lake to reach a point where navigation is not impaired by plant growth. The non-native invasive plants (Eurasian water-milfoil, Curly-leaf pondweed, and Purple loosestrife) may be manually removed beyond 30 feet without a permit, as long as native plants are not harmed. Wild rice removal always requires a permit. Raked plants must be removed from the lake.

Individual Access Corridors are the openings from a waterfront property owner's shoreline out into the lake. These corridors may be a maximum of 30 feet wide and must remain in the same location from year to year. Herbicide treatment or harvesting may be authorized only with a permit from the Wisconsin Department of Natural Resources for individual corridors in front of waterfront property to control invasive or native plants.

Invasive Plant Control for Individual Corridors

Currently, the only invasive aquatic plant prevalent in Long Lake is Curly-leaf pondweed. Curly-leaf pondweed grows early in the summer, then dies back by early July. Nuisance conditions must be verified for herbicide treatment. Curly-leaf pondweed beds in the lake are currently mapped and treated if certain thresholds are met. If lake-wide treatment is suspended for the year, the most recent CLP bed map (indicates >50% frequency of occurrence) may be used to verify nuisance conditions for the following year's treatment. An aquatic plant management permit is required each year.

Action B-2. The LLPRD will inform waterfront property owners of the process and limits of individual corridor access management options.

Procedure for Individual Corridor Permitting and Monitoring
A WDNR permit is required for any use of herbicides in the water.

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 CLP 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 in areas with wild rice will not be permitted. Wild rice is not known to be present in Long Lake.

Verify/refute nuisance conditions and/or navigation impairment

- Landowners will document conditions with photographs and submit request for review by the APM Lead or designee.
- Landowner requests LLPRD APM Lead review of their property prior to submitting a permit application to DNR. The LLPRD will not coordinate submittal of multiple permits to the DNR.
- The APM Lead or designee visits site, reviews documentation and provides a written opinion of navigation impairment i.e., is herbicide treatment potentially warranted?
- Landowner/applicator applies for permit to WDNR including photographic documentation, identification of plants causing navigation problems, and LLPRD evaluation.
- For CLP treatment, verification must occur the year before treatment in May or June. Treatment for CLP must occur with water temperatures from 50 - 58 degrees F.
- WDNR will contact herbicide contractor and owner with an approved permit with conditions or denial of permit application.

Objective C. Minimize disturbance to shallow water habitat and sensitive areas while maintaining common access navigation channels or individual access corridors.

This objective is attained through procedures described above including:

- Limiting common access navigation channel width to 25 feet.
- Limiting common access navigation channels to provide access to residences only, not for boating around the perimeter of the lake.
- Not treating with herbicides late in the season (beyond mid-August) because of limited benefit to navigation compared to the impact on sensitive areas.
- Navigation channels may not need to be treated each year as growing conditions vary, and aquatic plants may not re-grow robustly a year or two following herbicide treatment.
- The LLPRD will not coordinate homeowner applications for individual corridor permits. The cumulative impact of several individual corridor permits can damage native aquatic plants and remove the important functions they provide to the lake. Manual removal methods should be encouraged, if needed, wherever possible.

Goal 4) Prevent the introduction of Eurasian water-milfoil and other invasive, non-native aquatic species.

Objectives

A. Provide invasive species education and monitoring where visitors enter Long Lake.

B. Encourage compliance with Polk County's Do Not Transport and Decontamination Ordinance.[15]

C. Encourage lake residents and visiting boaters to complete AIS prevention and decontamination measures required by state regulations and local ordinance.

Objective A. Provide invasive species education and monitoring where visitors enter Long Lake.

Action A-1. Continue the Clean Boats, Clean Waters program and distribute materials at the boat landings with volunteers and/or paid staff.

Objective B. Encourage compliance with Polk County's Do Not Transport and Decontamination Ordinance.

Action B-1. Work with the Polk County Sheriff's Department to encourage enforcement of the Do Not Transport and Decontamination Ordinance.

Objective C. Encourage lake residents and visiting boaters to complete AIS prevention and decontamination measures required by state regulations and local ordinance.

Action C-1. Investigate the use of a surveillance camera for AIS prevention at the Village of Centuria boat landing.

Action C-2. Provide tools such as brushes, hooks, and/or a mild bleach solution sprayer to remove potential AIS. Install appropriate signage with instructions for their use.

Action C-3. Investigate additional options for AIS decontamination.

Action C-4. Inform lake residents and visiting boaters about invasive species prevention (See Goal 6).

[15] In August 2021 the Polk County Board of Supervisors unanimously voted to approve an amendment to the Illegal Transport of Aquatic Plants and Invasive Animals Ordinance which requires decontamination where it is available.

Goal 5) Rapidly respond to eliminate newly introduced invasive, non-native aquatic plant species.

Objectives

A. Monitor to detect newly introduced invasive species annually or more frequently.

B. Be prepared to respond to aquatic invasive threats which are discovered.

Actions

Follow the Rapid Response Protocol in Appendix A.

- Train and support lake resident volunteers to identify Eurasian water-milfoil and other aquatic invasive species.

- Provide consultant monitoring for aquatic invasive species at least on an annual basis.

- Establish a non-lapsing contingency fund of at least $15,000 for removal of invasive species.

- The LLPRD Board will review the Rapid Response Protocol including contacts and contact information at least annually.

Goal 6) Increase lake residents' and visitors' understanding of lake ecology and aquatic plant management to encourage practice of proactive lake stewardship.

Audiences
Lake residents
Visiting boaters

Messages/content targeting lake residents

- Water quality/clarity must be maintained, and thus, must continue to be our highest priority goal. It is an important aspect of a healthy lake, provides a healthy/pleasant environment for recreational activities, decreases toxin production from blue-green algae, is critical to our fisheries and wildlife, and helps maintain our property values.
- A healthy and balanced plant population is critical in maintaining water quality/clarity.
- Additional native plant benefits include stabilizing sediments, reducing erosion, and providing fish and wildlife habitat.
- Increased water clarity can increase native plant growth. Our aim is have a balanced native plant community where one or two species do not dominate plant growth and impair navigation.
- Aquatic plant and water quality changes can occur over extended periods of time, and we need to monitor and respond to conditions.
- Explain shallow lakes alternate states – no plants and algae dominated vs. native plants with clear water.
- CLP is an invasive species which will take over if given the chance. The LLPRD has successfully reduced the amount of CLP in Long Lake. To maintain this low level of CLP, we need to allow the native plants to regrow and take hold. The benefit is two-fold. 1. Less CLP means less phosphorous input into the lake. 2. More native plant life helps maintain our water clarity/quality.
- CLP herbicide treatments can negatively impact native plants.
- It is illegal for property owners to apply herbicides in the lake without a permit in Wisconsin. In addition, liquid aquatic herbicides can only be applied by a licensed applicator.
- Explain how property owners can legally maintain access to their docks if plant removal is needed for navigation: 1) rake up to a 30-foot wide opening around the dock or 2) work with a licensed herbicide applicator to obtain a WDNR permit for herbicide control. Navigation must be severely impaired to obtain a permit.
- Shoreline restoration can improve water quality and habitat.
- Treatment result maps and reports (post on website)
- Aquatic Plant Management Plan summary
- Eurasian water-milfoil, Zebra mussels, other invasive photos for identification

AIS Prevention and Monitoring:

- We must be diligent in monitoring for, and responding to, any new invasive species. Resident volunteers are critical in our ability to do both.
- Know how to identify Eurasian water-milfoil (EWM), CLP, and Zebra mussels (ZM) and others.
- Impacts of invasive plants and animals.
- Nearby lakes with EWM, ZM, and other AIS that threaten Long Lake.
- It is your duty to clean boats and trailers and drain live wells to prevent invasive plant and animal spread. Do not dump bait buckets in the lake. All may contain invasive species that are not visible to the naked eye.
- It is illegal to transport aquatic plants on boats, trailers, and equipment in WI.

<u>Methods</u>
Website
Email communications
Facebook
LLPRD newsletter (electronic) and Long Lake Association newsletter
Presentations (annual meeting)
Handouts/brochures
New resident packets of information
Support for volunteers
Promotion of conferences and training opportunities
Partner on projects with PCALR (Polk County Association of Lakes and Rivers)

<u>Messages targeting lake visitors</u>

- Impacts of invasive plants and animals.
- Nearby lakes with EWM, ZM, and other AIS that threaten Long Lake.
- It is your duty to clean boats and trailers and drain live wells to prevent invasive plant and animal spread. Do not dump bait buckets in the lake. All may contain invasive species that are not visible to the naked eye.
- It is illegal to transport aquatic plants on boats, trailers, and equipment in WI.
- Decontamination of boats and equipment is required if tools are provided at the landing.
- Avoid travel in sensitive areas (provide a map).
- Be respectful of loons.

<u>Methods targeting lake visitors</u>
Signs (update as needed)
Kiosk at the landing
Handouts
Pledge to sign to abide by AIS prevention rules

Committees for Volunteer Engagement

Volunteer engagement will be critical for plan implementation. The advisory committee recommended the following as a starting point for committee structure, tasks, and process.

Monitoring:

- Establish contacts for aquatic invasive species identification
- Provide contacts for lake residents through newsletter, website, etc.
- Organize training

Communication:

Use methods identified in Goal 6 to reach lake residents and visitors.

Aquatic Invasive Species Prevention:

- Clean Boats, Clean Waters program
- Investigate surveillance cameras for the boat landing
- Investigate decontamination at landing

Committee Process

1. Discuss how the committees will interact with the board
2. Appoint committee leaders
3. Describe the purpose of each committee
4. Recruit volunteers (describe tasks and time required, ask volunteers to identify their own talents, tasks of interest to them, and time available) recruit at annual meeting, in newsletter, and on web site
5. Committees each establish more specific plans using the Aquatic Plant Management Plan as a guide – set priorities and establish action steps with a schedule

Monitoring and Assessment

Aquatic Plant Surveys

Aquatic plant (macrophyte) surveys are the primary means for tracking achievement toward plan goals. The Long Lake Aquatic Plant Management Plan has used aquatic plant surveys to assess the impact of CLP treatment on native plants.

Action. Whole lake surveys are completed every five years in preparation for the aquatic plant management plan update. The next survey is planned for 2026.

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.

Funding Plan Implementation

Aquatic Plant Management is funded with a combination of LLPRD assessments and Wisconsin Department of Natural Resources grant funding. The budget for aquatic plant management plan activities must be approved by the district membership at an annual meeting.

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 and the newsletter are exceptions. Grants provide up to 75 percent funding. Applications are accepted each year with a digital deadline of November 1. Draft applications are due September 2.

Current LLPRD grants are shown in Table 10 below.

Table 10. Current LLPRD Grants

Grant Number	Dates Covered	Amount	% State Grant
CBCW 105322	2/15/22 – 12/31/22	$4,000	75
ACEI 20218	4/15/2018 – 12/31/2022	$64,143	50

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Appendix A. Alternatives Evaluation: Common Access Navigation Channels

Several members of the advisory committee expressed concerns regarding inability to navigate from their properties to the lake. Most of these own property along the shallow bays at either end of the lake. These bays are also designated as sensitive areas. The plan development discussion focused on enhancing the ability to navigate in these areas while keeping other objectives of the plan in mind. The following goals and objectives were considered in evaluation of alternatives for common access navigation channels. An alternatives evaluation matrix is presented as Table 11 with a rationale for rankings in narrative that follows the table.

Goal 2) Promote and protect a healthy, balanced native aquatic plant community.

Objective

B. Manage for a balanced native aquatic plant community. The plant community consists of many species, and one or two species do not dominate aquatic plant growth.

Goal 3) Balance recreation and waterfront owner needs with protection of native plants and the fishery.

Objectives

A. Support the ability for boaters to navigate to the lake by way of identified common access navigation channels. This must be done within WDNR Aquatic Plant Management Permit requirements.

B. Allow owners to maintain individual access corridors to their properties (by manual or chemical means) as permitted by state regulations.

C. Minimize disturbance to shallow water habitat and sensitive areas while maintaining common access navigation channels or individual access corridors.

D. Minimize CLP growth to allow for navigation (actions covered in Goal 1).

Table 11. Common Access Navigation Channels Alternatives Evaluation Matrix

	SUPPORT NAVIGATION	AVOID NATIVE PLANT IMPACTS	MINIMIZE CLP GROWTH	LOWER COST TO DISTRICT
No Action	X	XXX	X	XXX
Herbicide	XX	X	X	XX
Harvesting	XXX	XXX	XXX	X

X: minimally supports objective
XX: moderately supports objective
XXX: best support of objective

No Action – A wait-and-see approach would allow time for native plant growth to stabilize. Without use of herbicides, other plants would have a better chance to compete with northern water milfoil. The CLP treatment program would be continued according to program standards. A no action approach has the lowest cost to the lake district. However, it does not immediately address identified navigation problems.

Herbicide – Using herbicides to maintain channels is the least expensive approach for potential results in 2023. Treating 2 acres of channels is estimated to cost $1,000 to $6,500 (depending upon chemical used, with prices subject to change). However, there is no guarantee of results with chemical treatment of channels. Herbicides dissipate quickly in water, so treatments do not always have intended results. They may not kill plants where chemical is directed, and other plants outside of intended treatment area may be killed. From the applicator: *The only kind of trails I can confidently treat are emergent plants [like cattails or bulrushes] using contact herbicides.* However, he also expressed concerns about environmental impacts of the cheaper contact herbicide, Diquat, because it can persist in the environment. A DNR permit is required for herbicide applications.

Harvesting – Harvesting can effectively support navigation without impacting adjacent native plants and habitats. Repeat harvesting may be needed within a growing season. If harvesting equipment is available, it could also be used to remove CLP. Any plants must be harvested in depths greater than 3 feet and when plants have grown tall enough for harvester blade to reach them. According to the lead harvester operator for the Apple River Protection and Rehabilitation District, their harvester blade can reach down to harvest from depths of 3 feet of water to 7.5 feet below the surface.[16] CLP must be harvested prior to turion formation to avoid spread.

The biggest drawback of owning and operating a harvester is expense. We reviewed a range of capital and annual operation and maintenance costs from nearby lakes at our second meeting. Capital equipment costs ranged from $170,000 to $250,000, and annual operation and maintenance costs ranged from $6,000 to $35,000. While these are for harvesters with cutter blades from 6 to 10 feet, costs for harvesters alone with 4-foot cutter blades are in the $35,000 to $75,000 range. In addition, there are additional considerations including storage, staffing,

[16] Telephone conversation Cheryl Clemens with Dave Schleusner 05/05/2022

training, insurance, etc. Detailed analysis of options for harvester acquisition and operation would be required. According to one vendor, leasing a small harvester could be possible if a used harvester is available.

Contracted harvesting is an option, but there is potential to transfer of invasive species from lake to lake. **The Apple River Protection and Rehabilitation District is willing to transport its harvesting equipment to Long Lake and operate the harvestor at a rate of $250/hour to mobilize (est. $500) and $350 to operate.** Total cost estimate for 8 hours of operation = $2,800 + $500.[17],[18] A permit would be required to harvest. If completed in 2022 prior to APM plan completion, a feasibility study plan could be developed to support the permit application.[19] Permits fees also apply. The Apple River has the same invasive species as Long Lake (CLP), and operators sanitize equipment with a bleach solution when moving between lakes.

Funding common navigation channels

Wisconsin Department of Natural Resources Surface Water Grant Funding is not available for establishing and maintaining navigation channels. Further, while there is funding potentially available through WDNR Recreational Boating Facilities grants to purchase harvesting equipment, a 30-acre harvesting area minimum is required for grant eligibility. The area to be harvested on Long Lake is likely to be too small to qualify for these grants. It may be difficult to meet the 30-acre minimum even if CLP beds were harvested (11 acres of CLP was mapped in beds in 2021). Therefore, Long Lake homeowners must pay the full cost for maintenance of common navigation channels.

Funding decisions and authorization for the program would need to be approved at an annual meeting as part of the budgeting process. Any loans to pay for equipment must also be approved at an annual meeting.

Funding could be collected only from homeowners who are benefited by the navigational channels or from the LLPRD owners as a whole. If paid by individual owners, votes could be taken for approval by channel.

[17] Telephone conversation Cheryl Clemens with Dave Schleusner 5/02/2022

[18] Expenses $2,500 and greater must be approved at an annual meeting according to state regulations. It might be possible to limit operation to 5 hours or to have some costs paid directly by homeowners.

[19] According to telephone conversation with Tyler Mesalk, DNR 05/02/2022

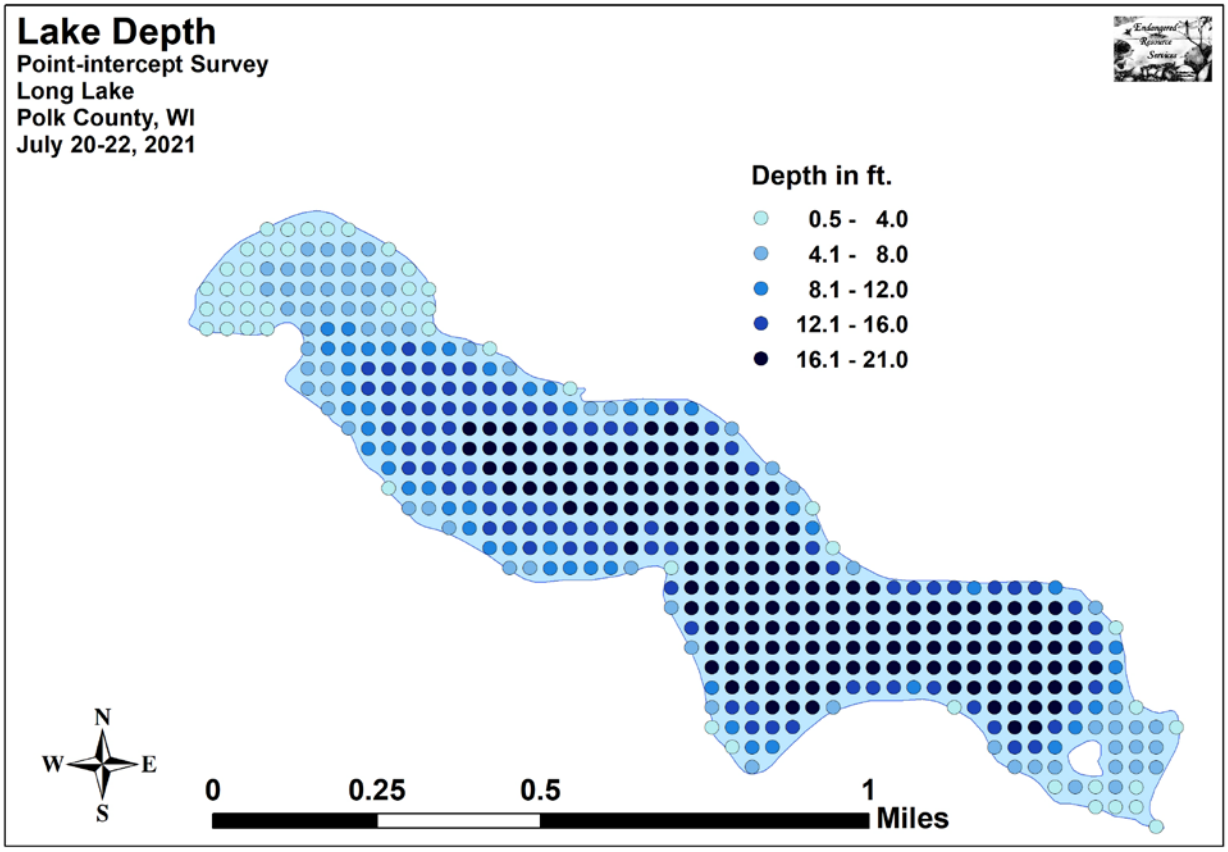

Figure 31. Long Lake Depth Map

Appendix B. Rapid Response for Early Detection of Aquatic Invasive Species

Definition: Aquatic Invasive Species (AIS) are non-native plant and animal species that can out-compete and overtake native species damaging native lake habitat and sometimes creating nuisance conditions. AIS currently in Long Lake include Curly-leaf pondweed (CLP), Hybrid cattail, and Chinese mystery snail. Additional AIS threaten the lake and will be monitored throughout the lake by volunteers and consultants.

1. Maintain a non-lapsable contingency fund for rapid response to EWM or other invasive species[20] (LLPRD Board).

2. Conduct volunteer and professional monitoring (APM Monitor) at the public landing and other likely areas of AIS introduction. If a suspected plant is found, contact the AIS Identification Volunteer(s).

3. Direct lake residents and visitors to contact the AIS Identification Volunteer(s) if they see a plant or animal in the lake they suspect might be an AIS. Signs at the public boat landings, web pages, handouts at annual meetings, and newsletter articles will provide photos and descriptions of AIS that have a high likelihood of threatening Long Lake, contact information, and instructions.

4. If a volunteer locates a likely AIS, instructions will request that the volunteer record the location of suspected AIS using GPS, if available, or mark the location with a small float. Note that cell phone applications are available to identify GPS points.

5. The AIS Identification Volunteer(s) will tentatively confirm identification of plant or animal AIS with the Polk County LWRD or lake management consultant then fill out an AIS Incident Report from the Wisconsin DNR. This form can be found at: https://dnr.wisconsin.gov/topic/Invasives/report.html. Contact Wisconsin DNR and deliver plant samples to Polk County LWRD or Wisconsin DNR, 810 West Maple St., Spooner, WI 54801.
    - If the sample is a plant, collect 3-5 intact specimens and attempt to keep all parts of the plant present (roots, leaves, fruits, and flowers if present). Place in a plastic, sealed bag(s) and refrigerate or put on ice.
    - If the sample is an animal, 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).

[20] A $15,000 contingency fund is currently maintained by the LLPRD. It is in place to cover costs related to aquatic invasive species rapid response and potential dam repair.

6. If identification is positive:
    a. Inform the person who reported the AIS and the board, who will then inform Polk County LWRD, and lake management consultant.

    b. Mark the location of AIS with a more permanent marker and GPS points. Special EWM buoys are available. (AIS Identification Volunteer(s)).

    c. Post a notice at the public landing (DNR has these signs available) and include a notice in the next newsletter. Notices will inform residents and visitors of the approximate location of AIS and provide appropriate means to avoid its spread (LLPRD Board).

7. Determine the extent of the AIS introduction (LLPRD in cooperation with Polk County LWRD and WDNR). Divers may be used. If small amounts of AIS are found during this assessment, divers may be directed to identify locations with GPS points and hand pull plants/remove animals found. All plant fragments will be removed from the lake when hand pulling.

8. Select a control plan in cooperation with the WDNR (LLPRD 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 AIS from the lake bottom, application of herbicides, and/or other effective and approved control methods.

9. 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.

10. The LLPRD will work with the WDNR to apply for an Early Detection and Rapid Response AIS Control Grant.

11. Frequently inspect the area of the AIS to determine the effectiveness of the treatment and whether additional treatment is necessary (APM monitor, WNDR, and/or other agency representatives).

12. Review the procedures and responsibilities of this rapid response plan on an annual basis. Changes may be made with approval of the LLPRD Board.

EXHIBIT A[21]

LONG LAKE PROTECTION AND REHABILITATION DISTRICT

Board Contacts:	Patti Langer: patti.langer23@yahoo.com Marjean Sieberer: MJRN53@msn.com Joe Murray: jmurray_87@msn.com
AIS Identification Volunteer:	John Suzukida: jsuzukida@gmail.com

POLK COUNTY LAND AND WATER RESOURCES DEPARTMENT

AIS Coordinator	Katelin Anderson: 715-485-8637 katelin.anderson@polkcountywi.gov
Director	Eric Wojchik: 715-485-8644

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Grants and EWM Notice	Alex Smith: 715-635-4124 Alex.smith@wisconsin.gov
Permits	Tyler Mesalk: 715-635-4227 Tyler.mesalk@wisconsin.gov
EWM Identification and Notice	Spooner Lakes Team: 715-635-4124

APM MONITOR

Endangered Resource Services	Matt Berg: 715-483-2847 saintcroixdfly@gmail.com

[21] This list is current as of 2022. Refer to the Long Lake web site www.longlakepolk.com for updated information.

Appendix C. Aquatic Plant Management Action Plan

GOAL	Objective	Action *(actions listed as "program guidance" are not included here)*	Priority	Cost	Volunteer Hours	Organization /Committee	Assigned Lead	Partners	Frequency	When	Funding Sources	% grant	Notes
1	1A	1A-1. Continue CLP early season Endothall treatment when treatment thresholds are reached.							Annually				Treatment occurs only when treatment thresholds are reached.
1	1A	1A-4. Complete turion monitoring							Every 5 years	2026	WDNR planning grant	67	
2	2ALL	1. EVALUATION: Pre and post CLP herbicide treatment monitoring and potential modification.							Annually				
2	2ALL	2. EVALUATION: Aquatic Plant Point Intercept Survey							Every 5 years	2026	WDNR planning grant	67	
3	3A	3A-1. Identify common access navigation channels				LLPRD Board			Annually	2022			
3	3A	3A-2. Present proposed trial of navigation channel maintenance (harvesting and/or herbicide, or no action) and budget to members								2022 Annual Meeting			
3	3A	3A-2. Conduct trial of navigation channel maintenance (harvesting and/or herbicide, or no action)								2023			
3	3A	3A - 3. Conduct a feasibility study of harvesting as long term method for navigation channel maintenance								2023			
3	3A	3A-4. Select mid-range method for navigation channel maintenance (2024 - 2027). Present recommendation at 2023 Annual Meeting.								2023			
3	3B	3B-1. Review nuisance conditions for proposed individual corridors											
3	3B	3B-1. Inform owners of options for individual corridor maintenance											
4	4A	4A-1. Continue Clean Boats, Clean Waters Program											
4	4B	4B-1. Communicate with Polk County Sherrif's Dept. re: potential violations											
4	4C	4C-1. Investigate use of surveillance camera for AIS prevention											
4	4C	4C-2. Provide simple tools for AIS decontamination.											
4	4C	4C-3. Investigate options for boat decontamination											
5	5A	5A-1. Conduct professional aquatic invasive species monitoring											
5	5A	5A-1. Recruit and train volunteers to conduct aquatic invasive species monitoring											
5	5B	5B-1. Follow the rapid response protocol and update annually.											
6	6A	Maintain and provide content for website											
6	6A	Maintain email list and develop email communication											
6	6A	Submit information to Facebook (who's account is it?)											
6	6A	Present information at annual meeting, provide handouts as needed											
6	6A	Update signs, install kiosk, provide handouts for visitors at landings											
ALL	AS SHOWN	Grant writing		$500 - $1000					Every 1 to 3 years	August - October			