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Cedar Lake - Aquatic Plant Management Plan

Town of Schleswig Sanitary District #1

Prepared by:
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January 12, 2024

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Table of Contents Page

Executive Summary

Cedar Lake is the largest lake in Manitowoc County and provides numerous recreational opportunities for a wide spectrum of users. Being the largest inland lake in Manitowoc County and near the cities of Manitowoc and Sheboygan, Cedar Lake experiences the highest use of all lakes in Manitowoc County. Some use patterns may be detrimental to the overall health of the lake and bring a higher risk of the introduction of new aquatic invasive species (AIS).

The aquatic plant community in Cedar Lake is healthy and diverse, though it can grow dense in some locations. Dense aquatic plant growth can impact lake users and hamper navigation, which can be exacerbated by the presence of AIS. There is one AIS indicated to be present within Cedar Lake: Eurasian water-milfoil (*Myriophyllum spicatum* – EWM). Curly-leaf pondweed (*Potamogeton crispus* – CLP) had been previously noted by as being present in Cedar Lake. However, no voucher specimen exists and annual AIS surveys and 2016 and 2021 whole-lake point intercept surveys did not identify any presence of this species. Presence of CLP in Cedar Lake has been removed from DNR records.

Locally dense aquatic plant growth, AIS, and heavy recreational traffic are the main issues of concern for lake users and can hamper navigation throughout the lake, limit enjoyment, and cause increased expenditure on actions to alleviate them with past management focused on mechanical aquatic plant harvesting. This technique, though expensive to begin, provides temporary relief to navigation and is an accepted practice on Cedar Lake. However, it does not reduce the presence or spread of aquatic invasive species. An updated understanding and review of renewed data and current issues have caused the need for development of an updated aquatic plant management plan.

This management plan provides a multi-faceted approach to address issues and recommend management options based on best fit, cost, feasibility, and desires based on direct input from the lake user survey questions. Many aquatic plant management options are evaluated and, while there is not one silver bullet, it is likely a combination of techniques over a period of several years that will begin to yield positive results. The basic plan is based on exploration of new aquatic plant management techniques with expanded actions for AIS control, overall aquatic plant community control, and protection of the lake's value to all users. Some of these actions potentially include continued harvesting, herbicide applications, protection of ecologically sensitive areas, and AIS and boat landing monitoring. It would be recommended the group start with a specific project component or area of the lake to gain early and immediate success and build off that for future projects.

1.0 INTRODUCTION

Cedar Lake is a natural seepage lake located in the Town of Schleswig in the south western portion of Manitowoc County, and, at 154-acres, is the largest lake in the County. The lake has a maximum depth of 27 feet, mean depth of 10.3 feet, and 3.57 miles of shoreline. Water levels in Cedar Lake have historically fluctuated, up to four and a half feet below current levels. In 1972, a high capacity well was installed to fill the lake and help maintain water levels. Only sporadic use of the well has been required to maintain target levels. Occasional heavy rain events created excessively high levels, which were remedied by the installation of two culverts, one installed in 1986 and the other in 2009, to alleviate reoccurrences. An updated depth contour map to show current conditions was included in the last aquatic plant management plan (APMP).

Water quality of Cedar Lake rates as mesotrophic and mildly productive with excellent water clarity and provides numerous recreational opportunities. The Town of Schleswig Sanitary District #1 (TSSD) is the main organization responsible for management activities on Cedar Lake, with input and support from the Cedar Lake Improvement Association (CLIA). The CLIA is a group who supports the restoration and management of the lake with a strong tradition in conservation and resource management to protect and enhance these opportunities. Both entities have been active in several lake management activities on Cedar Lake including: aquatic plant management, water quality sampling and management, invasive species sampling, and fisheries management through stocking. The TSSD funded this APMP and contracted with Wisconsin Lake & Pond Resource, LLC (WLPR) to help develop an updated APMP for Cedar Lake.

2.0 LAKE USER INPUT AND PRIMARY CONCERNS

Any management plan can only be successful if accepted by the lake users it impacts the most. If options are laid out that are not needed or feasible, a plan is set to fail due to lack of support and this management plan is no different. Prior to and throughout the drafting of this plan, multiple meetings and presentations were complete. These direct engagements give us a unique look at all lake users and a better understanding of issues to guide development of a plan that will not only strive to improve current lake conditions, but be successfully implemented and supported by lake users through direct response actions by the people the lake impacts the most.

Project meetings and discussions to present results further refine the plan and goals were held during monthly District meetings. Review of the draft APM plan was submitted to the District and WDNR for comments prior to finalization. The APM plan that follows recommends specific management activities for Cedar Lake based on the top two management concerns indicated during the presentations and further discussions with lake users: management or control of nuisance aquatic plant growth hampering recreation, access, and navigation along with preventing the spread of AIS into and out of Cedar Lake. This plan will focus on these main contributing factors to lake user frustrations and concerns. Many options were discussed and it was clear that no action was not acceptable to lake users.

The Cedar Lake APM Plan includes a review of available lake information, an aquatic plant survey, and lake user input to determine the most appropriate management alternatives (physical, mechanical, biological, or chemical) for protection and health of the lake. Though not all activities desired for management by lake users may be viable or appropriate, their input above provides a strong base to form this plan.

3.0 LAKE HISTORY & PAST MANAGEMENT

Located in south western Manitowoc County in the Town of Schleswig, the lake has been an important fixture in the lives of residents and non-resident users. A public landing on the south shore provides excellent accessibility with two paved launch lanes. Additional lake access is provided by private properties. Camp Rokilio, the largest Cub Scout camp in the Midwest, is located on 213 acres adjacent to the southeast bay of Cedar Lake. The camp serves numerous Scouts annually with multiple activities relating directly to the lake.

Exceptional and numerous accesses to Cedar Lake and its proximity to the cities of Manitowoc and Sheboygan have led to a history of heavy recreational use. Over time, other local lakes have limited boating activities on Sundays, which caused an increase of weekend boating traffic on Cedar Lake. In turn, this led to increased user conflicts and implementation of slow-no-wake speeds during the following periods:

- Between the hours of 6:00 PM – 11:00 AM
- Sundays except from 11:00 AM – 2:00 PM
- Within areas of invasive plant growth at all times
- During periods of high water to limit shoreline erosion from waves

Cedar Lake is a productive lake with multiple locations of dense aquatic plant growth. Aquatic plants have created a nuisance to navigation in multiple locations which can be exacerbated by AIS, including EWM. Dense aquatic plant growth has been a concern throughout the history of Cedar Lake and has become the main issue for management. These have been dealt with in the past by various management plans and studies, including the following:

- **Cedar Lake Improvement Association – 1950:** CLIA officially founded to protect the lake, deal with management issues, and enhance the lake for future generations. All below activities, including this plan, would not have been possible without them.
- **Aquatic Plant Management – 1957**: Earliest methods of control were completed by individual landowners contracting for chemical treatments. In addition, the CLIA provided funds for several small mechanical harvesters for nuisance relief
- **Town of Schleswig Sanitary District #1 – 1967**: The District formed to further deal with lake management issues while being able to provide a stable financial situation for activities.
- **Aquatic Plant Survey – 1972**: The first documented aquatic plant survey of the lake was conducted on August 23. Many of the species noted in the 1972 survey are still present today and included: Millfoil species, pondweed species, large-leaf pondweed, muskgrass, white water lily, and others. Dense locations of growth requiring management were noted, especially along the north shore.
- **Sanitary District acquires its first mechanical harvester - 1972:** The District acquired its first mechanical harvester to deal with excessive aquatic plant growth. Harvesting continues today, averaging 131 tons of material annually.
- **Eurasian Water-milfoil Identified – 1993**: The first AIS was found growing in Cedar Lake – EWM. Though curly-leaf pondweed was also identified at this time, no official sample exists and surveys since 1993 have only turned up one location in 2005. Original samples of CLP may have been misidentified. Currently, the presence of CLP in Cedar Lake has been removed from official records. Since then, the following AIS have been identified in Cedar Lake: Zebra mussel – 2001, banded mystery snail – 2008, rusty crayfish – 2010, Chinese mystery snail – 2011, and yellow iris - 2014.

- **Cedar Lake Water Quality Study and Management Plan – 1997-2001:** A three phase approach for a lake management plan began in 1997 with a water quality study, continued in 1999 with a runoff and land use addendum, and culminated in 2001with a comprehensive lake management plan summarizing all phases. Each major phase was aided by WDNR grant funding in cooperation with the District.
- **Aquatic Plant Management Plan – 2005 & 2017:** Updated plans focused on targeted management of Cedar Lake's aquatic plants were created with financial assistance from the WDNR grant program and the District. These plans laid the groundwork for continued mechanical harvesting and were currently in use for the most recent harvesting permit, which expires in 2022.

Since the last management plan (2017), management of AIS has taken on various levels of control for EWM. Control for EWM has ranged from very small-scale spot treatments using fast-acting, non-selective applications (2020), to boarder, denser areas of EWM with a highly selective application (2021 and 2022). In addition to AIS control, a primary plant management focus for the TSSD has been on maintaining navigational access through aquatic plant mechanical harvesting. Wild celery, a mix of dense pondweeds (primarily Illinois pondweed), and EWM have been the primary species of concern for nuisance control.

Management actions carried out for aquatic plant growth within the lake have focused on a wide variety of approaches and actions. After several plans were created and actions enacted, Issues with dense plant growth persists in Cedar Lake, as evidenced by the concerns raised by users throughout the plan update process. Continued problems from denser aquatic plant growth drives the desire to continue plant management activities. Management activities require an updated plan approved by the Wisconsin Department of Natural Resources (WDNR) and led to creation of this APM plan.

3.1 WATER QUALITY SUMMARY

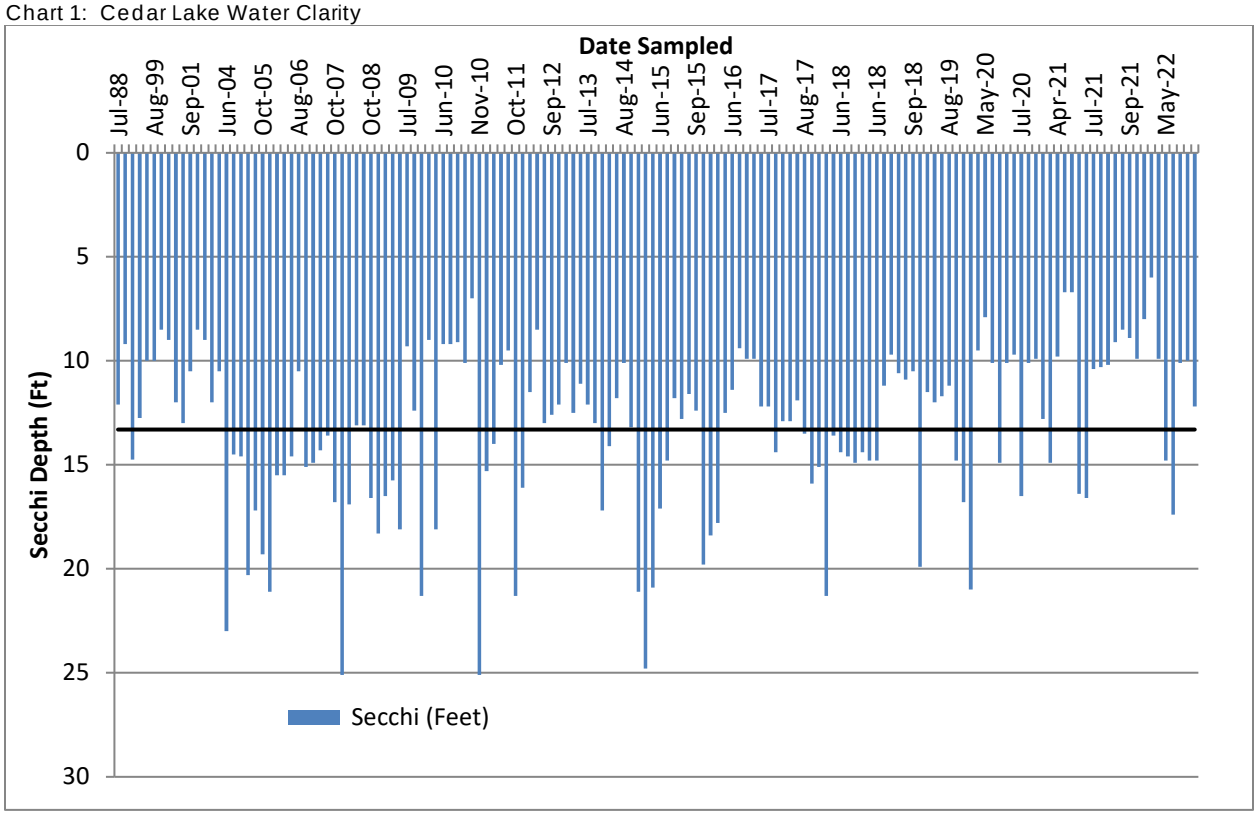
Cedar Lake is a natural seepage lake relying mainly on input from precipitation runoff and groundwater flowing into the system to maintain water levels. With a reliance on groundwater as the main source, water quality within the Lake remains stable over time, reflecting the quality of the ground water. In years of high rainfall, water quality may dip slightly due to increased runoff, but for only short periods of time.

Cedar Lake water quality data has been collected as part of various projects since 1988. Though data was collected from 1973-1975, results were atypical of the rest of the data pool and are excluded to represent current conditions. Samples since 1999 were collected by volunteers under the WDNR's Citizen Lake Monitoring program. Samples collected over time include:

- Water clarity (Secchi depth) – 1988, 1999-2022
- Total phosphorus – 1988, 1997-1998, 2006-2022
- Chlorophyll-*a* – 1988, 1997-1988, 2006-2022

Higher **secchi depth** (water clarity) readings indicate clearer water and deeper light penetration, allowing plants to grow in deeper areas of the lake. Historical water clarity for the lake is 13.3 feet (Chart 1), indicating excellent clarity when compared to the average for all lakes in Wisconsin (10ft). Seepage lakes like Cedar Lake tend to have better water clarity due to lessened impact from runoff, which increases nutrient and sediment loads within the water, when compared to drainage lakes and impoundments.

Chart 1: Cedar Lake Water Clarity



Nutrients within the water play an important part for the productivity of the water, leading to impacts on water quality. These include total phosphorus, nitrogen, and chlorophyll-*a*. **Phosphorus** is the key nutrient or food source influencing plant growth in waterbodies. Phosphorus promotes excessive aquatic plant growth and originates from a variety of sources, many of which are related to human activities. Major sources include human and animal wastes, soil erosion, wastewater treatment plants, detergents, septic systems and runoff from farmland or lawns. Soluble reactive phosphorus is the amount of phosphorus in solution that is available to plants. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form. For natural lakes, the average total phosphorus should be between 0.016 and 0.030 milligrams per liter (mg/L). The below table outlines average phosphorus readings and their respective water quality:

Water quality vs. Total Phosphorus

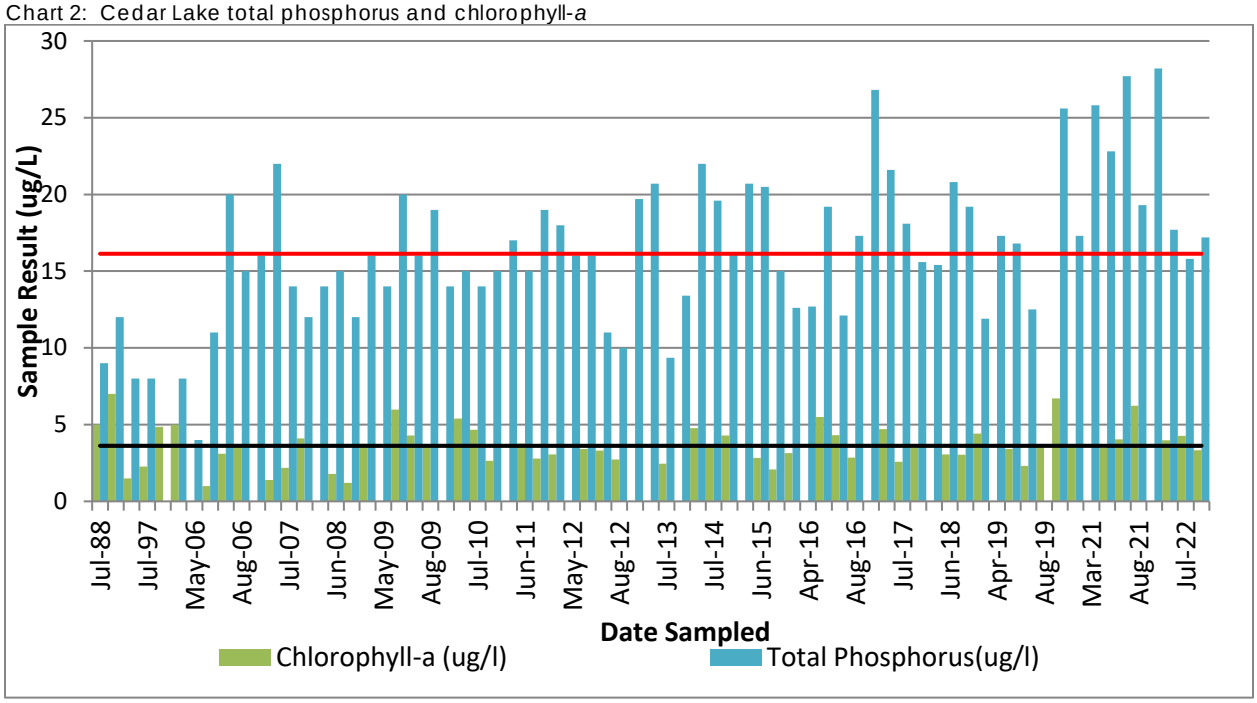
Water Quality Index	Total Phosphorus (mg/L)	
Very Poor	0.150+	
Poor	0.053 – 0.149	
Fair	0.031 – 0.052	
Good	0.016 – 0.030	← Cedar Lake
Very Good	0.002 – 0.015	
Excellent	0.001 or less	

All samples averaged 0.0161 mg/L (16.1 ug/L) for total phosphorus, indicating good quality, better than Wisconsin lakes on average, and lower availability of nutrients (Chart 2).

Chlorophyll-*a* is a green pigment present in all plant life and necessary for photosynthesis. The amount present in surface water depends on the amount of algae and is used as a common indicator of water quality. Higher chlorophyll-*a* values indicate lower water clarity. Values of 10 ug/L and higher are associated with algal blooms, while values between 5 and 10 ug/L indicate good water quality.

In natural lakes, these values cycle annually during the open water period. They begin low after ice out and increase throughout the year as the water warms and algae growth increases, sometimes spiking and creating a bloom condition (>10 ug/L). However, no readings over 10 ug/L were noted in Cedar Lake, indicating fairly stable planktonic algae populations. Though the amount of phosphorus present may fuel potential algae blooms, the algae is limited by other nutrients, such as nitrogen, or by zooplankton grazing in Cedar Lake. Zooplanktons are tiny, living organisms in the water column and are important food sources for small panfish and minnows.

Chart 2: Cedar Lake total phosphorus and chlorophyll-*a*



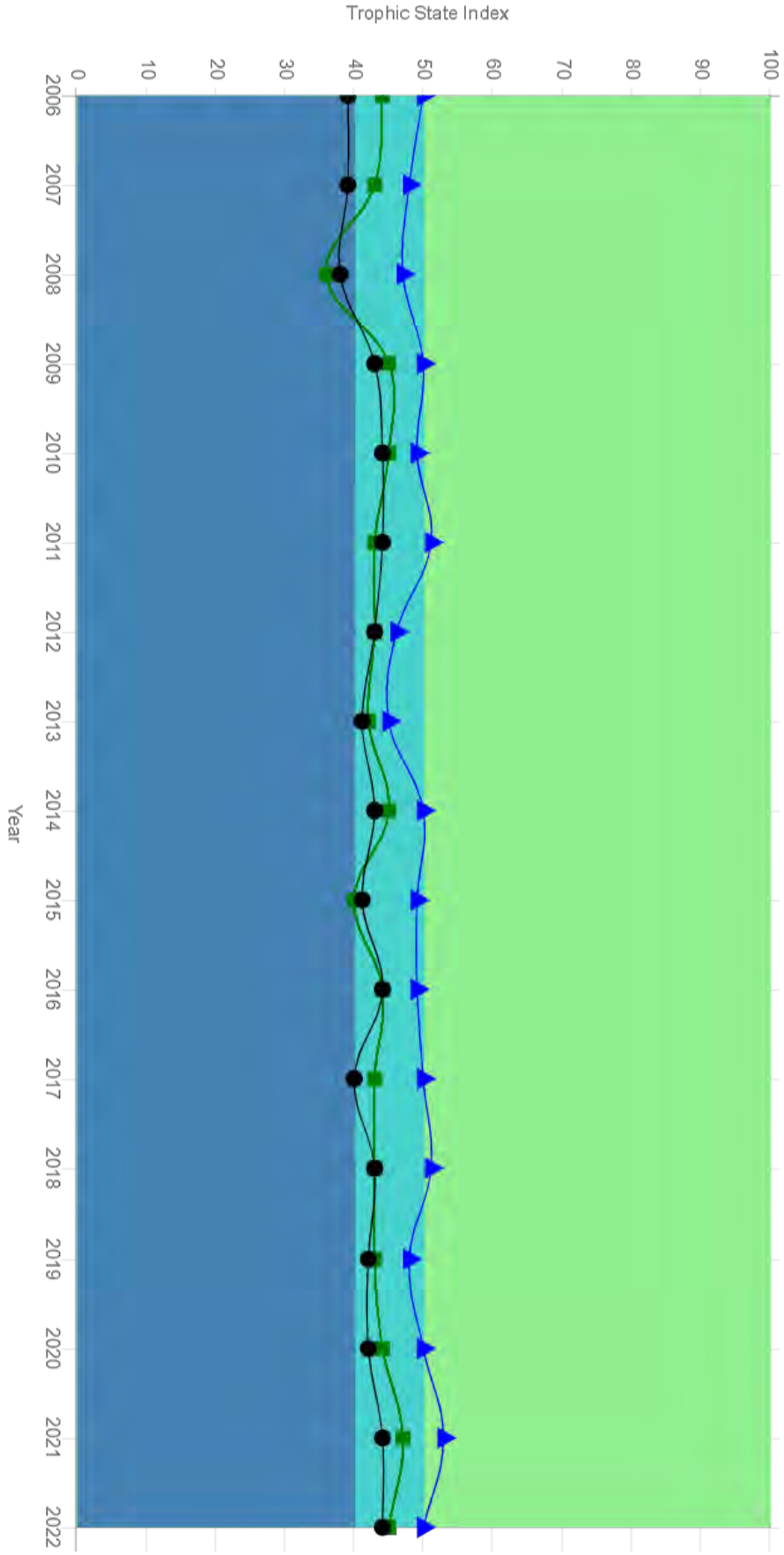
Water quality is a component of all three above factors: Water clarity (secchi), total phosphorus and chlorophyll-*a*. All factors are linked to each other, and as one changes so do the others. For example, if nutrient loads, such as phosphorus or nitrogen, increase, that increases available resources for algae (chlorophyll-*a*), which can cause an increase in this reading all while leading to a decrease in water clarity. Data is collected over time and averaged, allowing these factors to be used to assess the Trophic State Index (TSI) for a lake. TSI values are assigned to a lake based on all three values and are a measure of a lakes' biological productivity. Lakes with higher TSI values are more biologically productive, but have lower water clarity, increased nutrient input and the potential for frequent algae blooms. On the opposite end, lakes with low nutrient input and very clear water are typically less productive, having lower TSI values.

Historical water clarity, total phosphorus and chlorophyll-*a* data show a stable trend with minor annual variances of individual TSI averages for any of the three parameters. The overall average indicates that Cedar Lake is a mesotrophic lake with an average TSI rating of 44.5.

Category	TSI	Lake Characteristics	Total P *(ug/l)*	Chlorophyll a *(ug/l)*	Water Clarity *(feet)*
Oligotrophic	1-40	Clear water; oxygen rich at all depths, except if close to mesotrophic border; then may have low or no oxygen; cold-water fish likely in deeper lakes.	< 12	<2.6	>13
Mesotrophic	41-50	Moderately clear; increasing probability of low to no oxygen in bottom waters.	12 to 24	2.6 to 7.3	13 to 6.5
Eutrophic	51-70	Decreased water clarity; probably no oxygen in bottom waters during summer; warm-water fisheries only; blue-green algae likely in summer in upper range; plants also excessive.	> 24	>7.3	<6.5
Cedar Lake	**44.5**	**Mesotrophic**	**16.1**	**3.62**	**13.3**

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

The following chart displays the TSI of Cedar Lake over time and is adapted from WDNR data.


Trophic State Index
0
10
20
30
40
50
60
70
80
90
100
Year
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

4.0 AQUATIC PLANTS

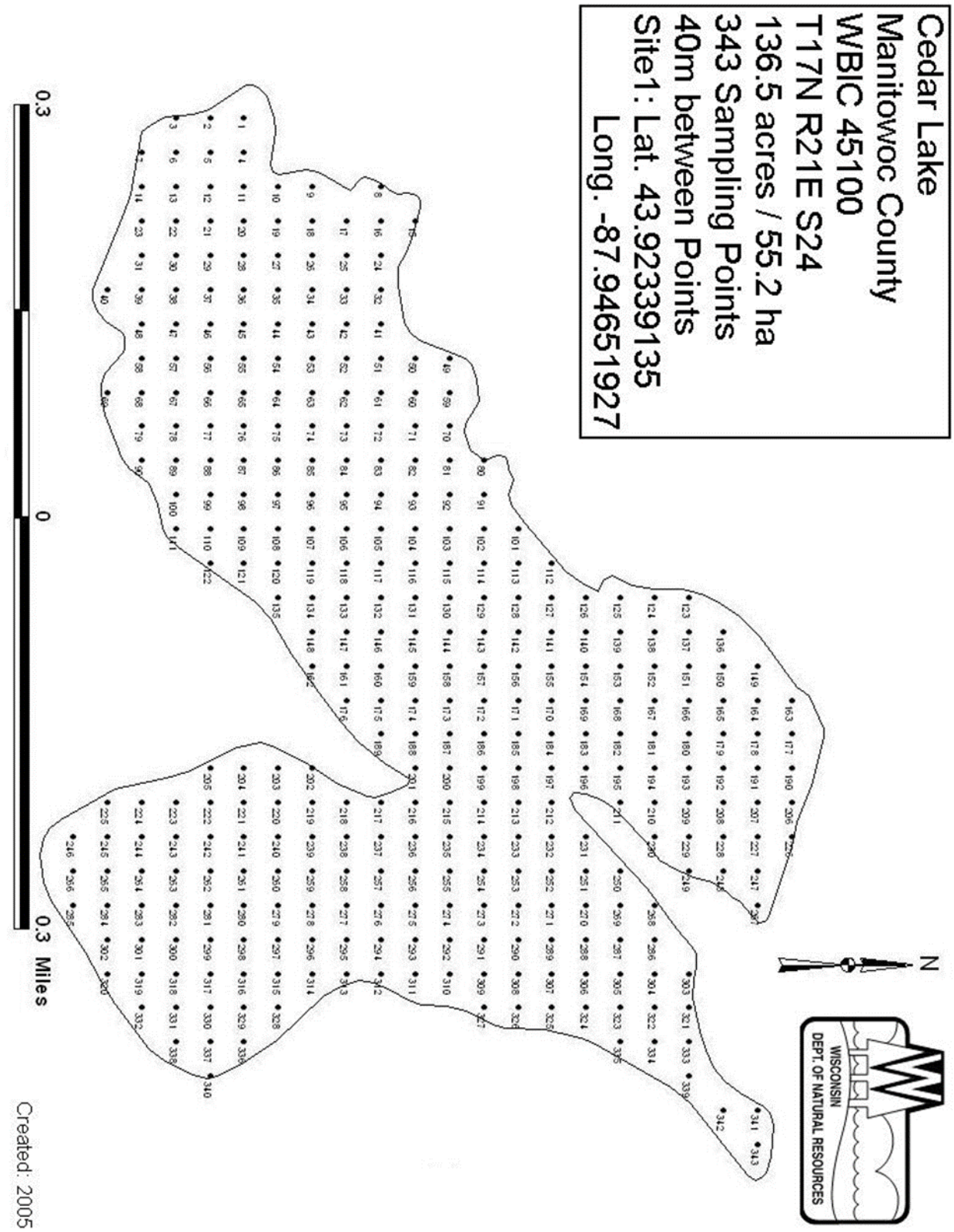
Aquatic plants are vital to the health of a water body. Unfortunately, they are often negatively referred to as "weeds." The misconceptions this type of attitude brings must be overcome in order to properly manage a lake ecosystem. Rooted aquatic plants are extremely important for the well-being of a lake community and possess many positive attributes. Despite their importance, they sometimes grow to nuisance levels that hamper recreational activities and are common in degraded ecosystems. The introduction of AIS, such as Eurasian water-milfoil, often can increase nuisance conditions, particularly when they successfully out-compete native vegetation and occupy large portions of a lake.

To assess the state of the current plant community, the last full point-intercept survey was completed on August 24-25, 2021 following all WDNR survey protocol. The survey included sampling at 343 pre-determined locations uniformly spaced 40 meters apart to document the following at each site:

- Individual species present and their density
- Water depth
- Bottom substrate

Each location was assigned coordinates and loaded into a GPS unit, which was used to navigate to each point (Figure 1). Data collected at each point was then entered into a WDNR spreadsheet, which outputs various aquatic plant community indexes and data, allowing for a comparison to past data to monitor changes over time. Information on methods and all referenced tables or charts is included in the attachments.

Since the 2021 survey, annual AIS surveys have been completed through pre-treatment AIS surveys in May/June and post-treatment AIS surveys in August/September. During these visits any location of AIS, primarily EWM, are recorded on GPS. Pre- and post-treatment monitoring in 2022 included a sub-set point intercept survey in two EWM control areas. Each location had 40 sample sites established and used to determine EWM control results and potential impacts to non-target species. At each season's end the locations are compiled, location and density maps created, and used for the following year's management planning. Native species presence is noted during each visit as well.


Cedar Lake
Manitowoc County
WBIC 45100
T17N R21E S24
136.5 acres / 55.2 ha
343 Sampling Points
40m between Points
Site1: Lat. 43.92339135
Long. -87.94651927
N
WISCONSIN
DEPT. OF NATURAL RESOURCES
0.3
0
0.3 Miles
Created: 2005

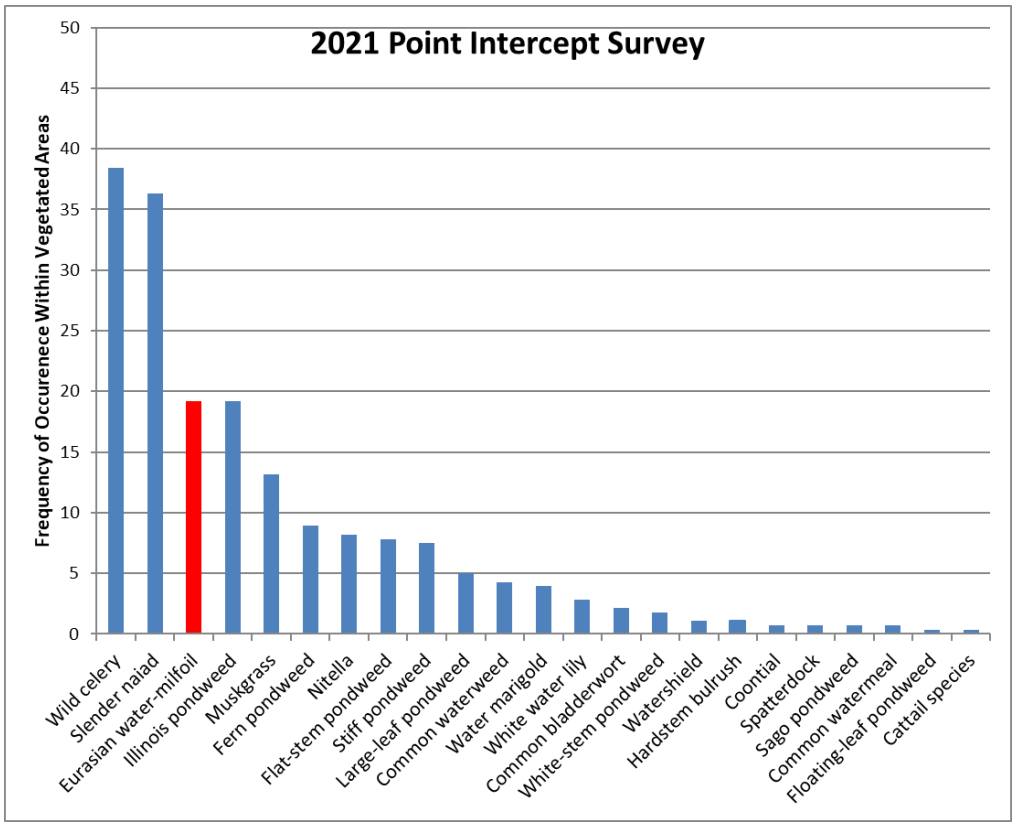
4.1 2021 POINT INTERCEPT SURVEY

In 2021, the aquatic plant survey identified continued very diversity community with scattered sections of dense submersed vegetation growth. In total, 23 species were identified; one of them being an AIS – Eurasian water-milfoil (Table 3). Remaining species identified are common of lakes in the region and included seven native pondweed species along with a mix of floating-leaf emergent, and submersed species. The diversity and mix of species and growth types are all vital to fisheries habitat and continue lake health.

Table 2: Aquatic Plant Community Statistics. Cedar Lake, Manitowoc Co., WI.

Community Statistics	2021
Number of sites sampled	340
Number of sites with vegetation	222
Number of sites shallower than maximum depth of plants	281
Frequency at sites shallower than maximum depth of plants	79.0%
Simpson Diversity Index	0.88
Maximum depth of plants (feet)	20.5
Species richness	23
Average number of all species per site	1.84
Average number of all species per vegetated site	2.33
Average number of native species per site	1.65
Average number of native species per vegetated site	2.09

Species sampled in Cedar Lake were present in four categories: floating-leaf species, which are rooted on the lake bottom but with leaves that float on the water's surface *(*white water lily – *Nymphaea odorata);* free-floating species, which are often small and do not root on the lake bottom, freely floating around the lake (small duckweed – *Lemna minor*); emergent, near shore species which are rooted below the water's surface with growth extending above the water (cattail - *Typha sp.);* and submersed species which root on the lake bottom and remain below the water's surface (sago pondweed – *Stuckenia pectinata*).



The photic zone, or area of the lake where light penetration can support plant growth, extends to 20.5-feet deep. Plant growth was locally dense with 79% of this area vegetated. Much of the sediment was compromised of sand, muck, or a mixture of the two. A mixture of sand and organic rich muck sediment provides ideal conditions for aquatic plant growth with an excellent nutrient source and solid footing for roots to establish in. In some areas of muck, the loose sediment allows plants to easily uproot due to wave or boat action and float to the surface, creating an additional nuisance to lake users.

Species richness was above average for area lakes at 23, exhibited good diversity per sample point with 2.09 native species per vegetated site, and continued be comparable to past surveys. A very good spread of species was noted throughout the system, as exhibited by a Simpson Diversity Index (SDI) of 0.88. An SDI value closer to 1.0 indicates a healthier, more evenly spread plant community. Wild celery (*Vallisneria americana*), slender naiad (*Najas flexilis*), and Illinois pondweed (*Potamogeton illinoensis*) were the most dominant native species present. Eurasian water-milfoil was tied for the third most dominant species present. Wild celery has consistently been one of the most dominant species during past surveys as well and causes much of the dense, nuisance growth and often uproots in large mats which float to the surface. Table 3, Appendix B displays frequency data by individual species. Figures 2-9 display the locations of the most common species and any AIS found during recent sampling.

Only one AIS was noted as being present in Cedar Lake (EWM) during the 2021 survey. Including visual observations, EWM was sampled at 54 locations (Figure 2). As an invasive species with aggressive growth tendencies, EWM spreads by growing from plant fragments, which can be hastened through mechanical harvesting. EWM has the potential to become an extreme nuisance and detriment to a lake's ecosystem, though in some lakes it can simply co-exist with native species. EWM has increased substantially from the 2016 whole-lake survey.

Curly-leaf pondweed was first noted in 1993, but no official sample exists in DNR records and was likely misidentified. During past surveys, it was only noted at one location in 2005 and not sampled in a 2007, 2016, or 2021 point-intercept surveys nor during any AIS monitoring surveys. Even so, it is possible CLP may be within Cedar Lake and, if so, has become part of the natural assemblage of plants and does not present nuisance conditions.

4.2 FLORISTIC QUALITY INDEX

To compare changes in the plant community over time within Cedar Lake and to similar lakes in Wisconsin, the floristic quality index (FQI) can be used. FQI provides the ability to compare aquatic plant communities based on species presence. This value varies throughout Wisconsin, ranging from 3.0 to 44.6, with a statewide average of 22.2. To achieve this, each plant species, except for AIS, is assigned a coefficient of conservatism value (C value). A plant's C value relates to a plant species' ability to tolerate disturbance. Low C values (0-3) indicate that a species is very tolerant of disturbance, while high C values (7-10) indicate species with a low tolerance of disturbance and are typically found in systems of higher water quality. Intermediate C values (4-6) indicate plant species that can tolerate moderate disturbance. The calculated FQI for Cedar Lake from the 2021 plant survey is 27.29 with an average C value of 5.82 (Table 4).

Not only does this track changes over time within the lake, but allows for comparison of the Lake to lakes with similar environmental conditions within a delineated area, called an eco-region, to be compared. Cedar Lake is located within the Southeastern Wisconsin Till Plains eco-region. Lakes within the Southeastern Till Plains region are typically natural lakes created by glaciation.

Cedar Lake is found near the eastern border of the ecoregion within the Kettle Moraine sub-regions. Lakes within this area are primarily seepage lakes that formed in low areas between the

hills and drumlins created by glaciation. Land use varies within the region from primarily forest to agricultural watersheds, with most lakes having at least moderate development along the shoreline.

Lakes within this eco-region have increased development around the lake and increased overall use leads to more disturbances from an expected natural condition, which leads to lower plant community metrics like FQI and coefficient of conservatism. Both are below the average for all Wisconsin lakes due to this

Even after years of mechanical harvesting, AIS impacts and management, and water level fluctuations, Cedar Lake displays a high quality, and above-average aquatic plant community within the eco-region. Its average C value (5.82), FQI (27.29), and total number of species (23) are all above the upper quartile of the eco-region (Table 5).

Table 5: FQI and Average Coefficient of Cedar Lake Compared to Wisconsin Southeastern Till Plains

	Average Coefficient of Conservatism			Floristic Quality			Number of Species		
Quartile*	Lower	Mean	Upper	Lower	Mean	Upper	Lower	Mean	Upper
Wisconsin Lakes	5.5	6	6.9	16.9	22.2	27.5	8	13	20
Southeastern Till Plains	5.2	5.6	5.8	17	20.9	24.4	10	14	19
2021	5.82			27.29			23		
2016	5.96			28.57			25		
2005	6.09			28.57			25		

Due to high shoreline development and recreation use for lakes within the region, many have a disturbed plant community. Mesotrophic lakes like Cedar Lake are moderately to very productive for both fisheries and aquatic plant growth, sometimes leading to dense nuisance growth, hampering navigation and use of the lake. This is true for Cedar Lake and though AIS are present, they do not pose an ecosystem threat within its very diverse native plant community. 22 native species were found during the 2021 survey with an average of 2.09 native species per sample point with vegetation present and many sample points having more than this. This native plant community is important should any AIS management be wanted. A healthy native plant population is already established and present to populate areas vacated by AIS due to potential management. Many lakes within the region with AIS growth lack a native community to do so.

4.3 HISTORICAL COMPARISON

The aquatic plant community of Cedar Lake has been sampled periodically throughout its recent history. Multiple surveys using similar sampling methods provide a unique opportunity to gauge changes over the years. Aquatic plant sampling protocol recommended by WDNR is completion of point-intercept surveys. These surveys are to be more repeatable between years. A full point-intercept survey was first completed in 2005 and repeated using the same sample sites in 2016 and 2021.

The relative plant community within the lake has fluctuated slightly over time in species composition while remaining stable and in diversity and density. Species diversity, average coefficient of conservatism, and FQI all display the overall stability trend over time and are shown below for all metrics over time when comparing historical survey data (Tables 1 & 3-7).

Table 6: Species sampled by year

	2005	2016	2021
Invasive Species			
Curly-leaf Pondweed	X		
Eurasian water-milfoil	X	X	X
Floating-leaf Species			
Spatterdock	X*	X	X
Watershield	X*	X	X
White water lily	X*	X	X
Free-floating Species			
Common watermeal			X
Emergent Species			
Arrowhead species		X	
Cattail species	X*		X
Hardstem bulrush	X	X	X
Narrow-leaved cattail	X*	X	
Submersed Species			
Aquatic moss		X	
Common waterweed	X	X	X
Coontial		X	X
Fern pondweed	X	X	X
Flat-stem pondweed	X	X	X
Floating-leaf pondweed	X	X	X
Frie's pondweed		X	
Illinois pondweed	X	X	X
Large-leaf pondweed	X	X	X
Muskgrass	X	X	X
Nitella	X	X	X
Northern water-milfoil	X	X	
Sago pondweed	X	X	X
Slender naiad	X	X	X
Small pondweed	X		
Stiff pondweed	X	X	X
Variable pondweed		X	
Water marigold	X	X	X
White water crowfoot	X		
White-stem pondweed	X	X	X
Wild celery	X	X	X

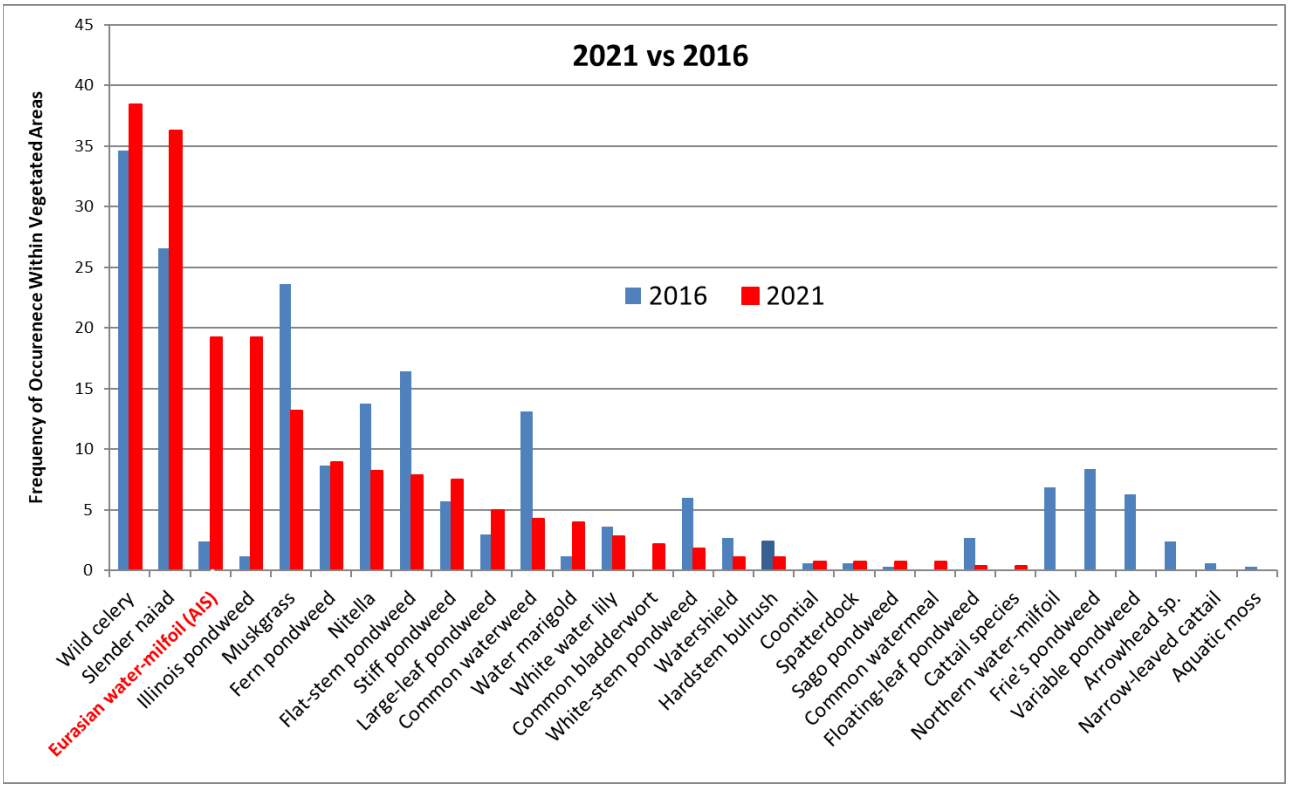
* - Species noted visualy only

Table 7: Historical Aquatic Plant Community Statistics

	2005	2016	2021
F.o.o. within photic zone	76.90%	80%	79%
Most Dominant Species	Muskgrass	Wild celery	Wild celery
	Wild celery	Slender naiad	Slender naiad
	Northern water-milfoil	Muskgrass	Illinois pondweed
	Small pondweed	Flat-stem pondweed	Eurasian water-milfoil
	White-stem pondweed	Nitella	Muskgrass
Maximum Depth of Plants	21.50	22	20.5
Species Richness	25	25	23
Community FQI	28.57	28.57	27.29
Average Coeffecient	6.06	5.96	5.82

Over the most recent surveys (2016 and 2021) as shown above, the aquatic plant community has seen changes in overall species composition while maintaining many community metrics. Species sampled in prior surveys, but not present in 2021 include northern water milfoil (2005 & 2016), Frie's pondweed (2016), variable pondweed (2016), small pondweed (2005), white water crowfoot (2005), and aquatic moss (2016).

Conversely, the 2021 survey had two species sampled that was not noted in the past survey; common bladderwort and common watermeal. Composition of the plant community changes by year and the lack of finding species in 2021 that were present in past surveys and vice versa is not concerning.



Data comparison between years shows that the lake continually exhibits a dynamic aquatic plant community. Dominant species will vary year to year depending on many factors including weather patterns, community composition in year's prior, water levels and more. Some conditions may be favorable for certain species during one growing year but not others and vice versa. This is common and indicative of a healthy lake. Variance is normal and that noted within the lake is currently not a cause for concern.

In many biologically productive lakes, some native species can grow to nuisance levels, hampering navigation and enjoyment of the waterbody. Past observations from the District's commissioner, Scott Otterson, indicate that most of the earlier harvested plant material was coontail. Up until the mid-1990's this was the case. However, now it is rare to see any coontail harvested with most of the nuisance control focused on harvesting a dense mix of native pondweed, primarily Illinois pondweed, and wild celery.

Throughout both surveys and current notes from the harvester operator, wild celery is now the bulk of the material harvested and has remained prevalent in Cedar Lake and continues to cause navigational nuisance within the system. Wild celery that is loosely rooted in soft sediments can easily break loose and float within the water column, causing an additional nuisance.

4.4 INVASIVE SPECIES MANAGEMENT

Prior to targeted AIS control each year, a survey was completed using a meander method around the entire perimeter and photic zone of the lake with rake throws and visual observations to verify the presence of AIS. All locations of AIS, primarily EWM, were recorded on a GPS. The surveys identified EWM growing at various densities and distribution throughout the lake. The following densities were used to describe the EWM populations:

1. **Spots** – small locations of individual plants or clumps that were not large enough to map around their perimeter.
2. **Scattered** – locations of EWM that had plants close enough to map as an area, but were still widely scattered. EWM is merely present and not a large component of the biomass.
3. **Low** – EWM identified in distinct beds. While individual plants or clumps may reach the surface, most are lower growing or not as dense. Often mixed with other vegetation.
4. **Moderate** – EWM occupies over half the water column with many plants or clumps at or just below the surface. Few other plant species found.
5. **High** – locations of EWM that were at or near the surface and occupied much of the water column. EWM may be the only plant found growing in these locations.

Targeted EWM control actions were taken in 2021 and 2022 with a newly developed, highly selective aquatic herbicide; ProcellaCOR EC (active ingredient florpyrauxifen benzyl). Prior to control, a complete AIS mapping was done to identify areas of EWM growth and their respective densities. In May, 2021 12.01 acres of EWM were noted throughout Cedar Lake (Figure 3a). A permit was applied for control through the DNR which approved control of only the largest area – Area G – in Cedar/North Bay. Control of EWM in Area G was completed on July 9, 2021. ProcellaCOR EC was applied at 4.5 PDU/ac-ft.

In 2022, an AIS mapping survey was completed on May 27 to assess 2021 results and identify 2022 EWM management areas (Figure 3b). Control of Area G in 2021 was noted as excellent, with only a handful of plants noted as spots or clumps and a small area of scattered density. Throughout the rest of the lake, 15.35 acres of EWM growth was noted, primarily as low to moderate density with two locations of high density.

Targeted EWM control was again completed in 2022 to the densest 7.0 acres of EWM (Figure 3c). To further assess treatment results sub-set point intercept surveys were completed in areas B and C. The pre-treatment sub-set survey was completed day of application on June 27, 2022 while the post-treatment sub-set survey was completed on September 23, 2022. Sub-set point intercept sampling is used to monitor treatment areas for not only results of EWM control but also for impact to non-target native species. Like whole-lake point intercept surveys, a grid or set of sample points is established within each area targeted for EWM control. These sample points are then sample before and after herbicide application to assess plant community response. Since many control areas are irregular shapes the sample points are often not set on a perfect grid to fit. Point intercept locations were established in for EWM control areas B and C in Cedar Lake (Figures 4a & 4b).

To assess changes between pre- and post-treatment surveys statistical analysis was completed using a Chi-square test with a 5% Type-I error rate. This error rate is standard in ecological studies and equals that there is a 5% chance of claiming statistically significant change when no real change occurred. Only those species that display a p-value of 0.05 or lower changed significantly population-wise between sampling events. To calculate these values, the total number of sample locations each species was found at is compared between surveys. Tables 8-10 display survey data and statistical changes, if any, for each species sampled with EWM control areas.

Target area B was located at near the central portion of the lake. Though some EWM remained post-treatment, control of EWM was excellent within B and a significant reduction noted. EWM was found at 70% of sample points in area B during the pre-treatment survey and often at rake density 2 or greater with an average rake density of 1.5. Only seven locations with a rake density of 1 were noted for EWM during the post-treatment survey. Within site B EWM occupied a broad, dense area of the control location. Control resulted in a statistically significant reduction of EWM across the entire site.

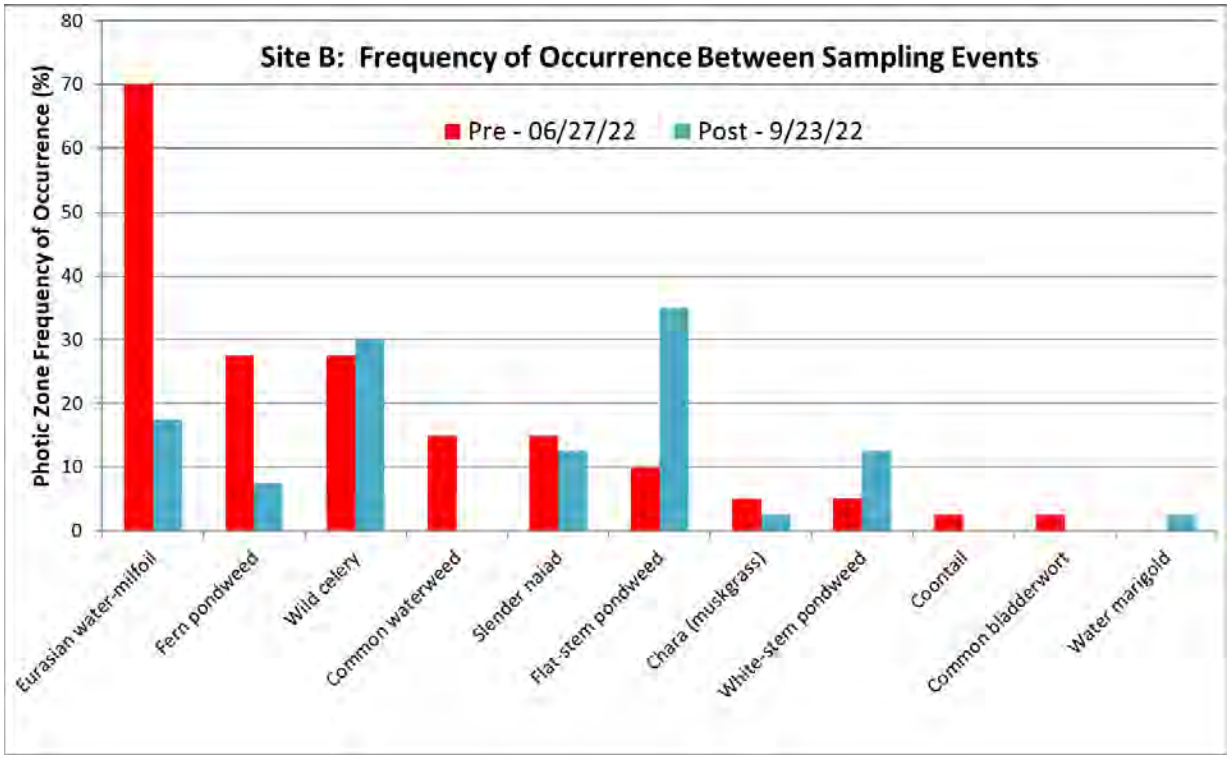
Within treatment area B, 10 species, including one non-native invasive, were identified pre-treatment while 8 species, only one non-native, were identified post-treatment. A slight change in overall species composition was noted between events. Overall diversity remained stable. Total native species found per sample site remained mainly stable at 1.1 per site pre-treatment and 1.03 post-treatment (Table 8).

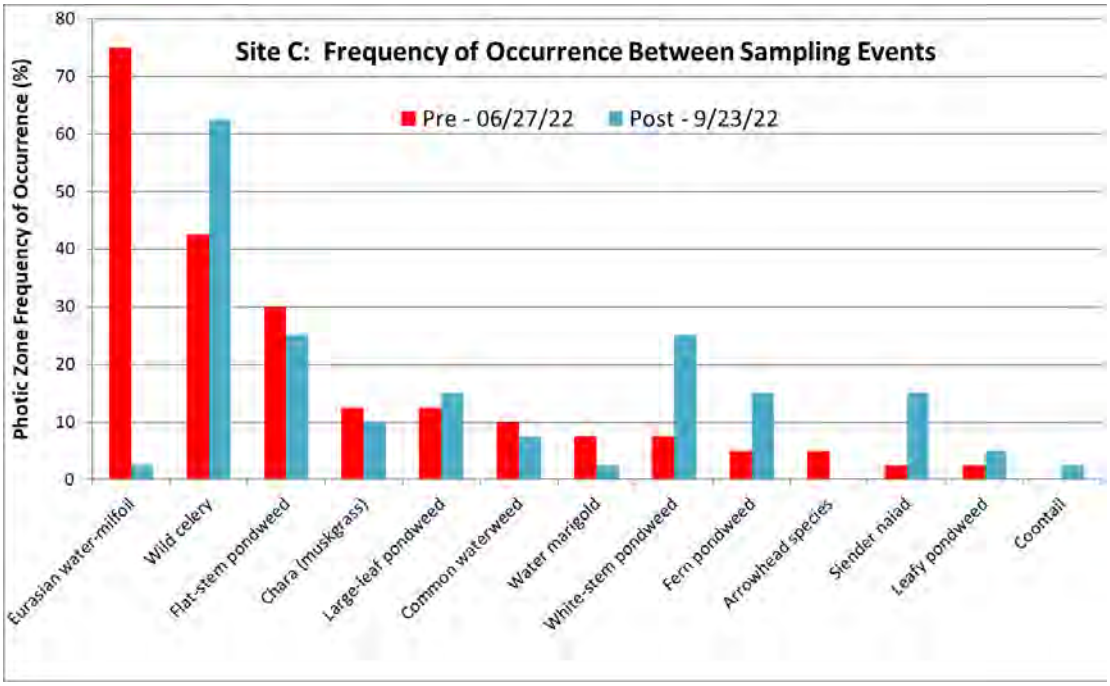
Target area C was in the southeast bay as a long, narrow target area. Though some EWM remained post-treatment, control of EWM was also excellent within Area C and a significant reduction noted. EWM was found at 75% of sample points in during the pre-treatment survey and often at rake density 2 or greater with an average rake density of 1.53. Only one location with a rake density of 1 were noted for EWM during the post-treatment survey. Within site C EWM occupied a dense strip through a majority area of the control location. Control resulted in a statistically significant reduction of EWM across the entire site.

Within treatment area C, 12 species, including one non-native invasive, were identified pre and post treatment. Like Area B, a slight change in overall species composition was noted between

events for Area C. Overall diversity increased per site between sampling events. Total native species found per sample site was 1.38 pre-treatment and increased to 1.85 post-treatment (Table 8).

Non-target impact from the ProcellaCOR EC application appears minimal, if any, for both control areas (Table 10). Within Area B, three species showed a statistically significant decline between sampling events: EWM (target species), common waterweed, and fern pondweed. One species, flat-stem pondweed, was noted to increase significantly between sampling events. Two of the species that saw a statistical decline are not listed as susceptible to ProcellaCOR EC on the product's label; fern pondweed and common waterweed. In similar studies on other lakes with ProcellaCOR EC treatment monitoring, pondweed species have been shown to be not susceptible to ProcellaCOR EC applications. In fact, in other 2022 study areas populations of fern pondweed were shown to increase slightly. Within Area C only EWM, the target species, saw a statistically significant reduction. Conversely, three native species saw a significant increase in population; slender naiad, large-leaf pondweed, and white-stem pondweed. Reduction of these species is likely from typical seasonal decline. Frequency of occurrence between sampling events for all species is included in Table 9 and shown below. Statistical changes of all species sampled is included in Table 10.





5.0 AQUATIC PLANT MAINTENANCE ALTERNATIVES

Based on the goals of the stakeholders outlined above, several management alternatives are available for this APM plan. Some general alternatives are discussed below. More information on management alternatives are included in Appendix B. The following management alternatives are based on historical, aquatic plant management approaches and incorporate needs established by the questionnaire and recommendations of Wisconsin Lake & Pond Resource.

AQUATIC PLANT MAINTENANCE ALTERNATIVES

A combination of management alternatives may be used on a lake with a healthy native aquatic plant community with invasive or non-native plant species present. Maintenance alternatives tend to be more protection-oriented because no significant plant problems exist or the issues are at levels that are generally acceptable to lake user groups with no active manipulation required. These alternatives can include an educational plan to inform lake shore owners of the value of a natural shoreline and encourage the protection of the lake water quality and the native aquatic plant community.

AQUATIC INVASIVE SPECIES MONITORING

One AIS was identified within the Project Area during the 2021 full point-intercept survey and follow-up 2020-2022 meander surveys. In order to monitor existing populations of current AIS and for new AIS in the future, a consistent and systematic monitoring program that conducts surveys for AIS is highly recommended. In some lake systems native aquatic plants "hold their own" and AIS never grow to nuisance levels; however, in others active management is required. The spread of AIS can be caused by several factors, including water quality.

It is recommended to complete pre and post treatment aquatic plant monitoring in any areas that are actively managed for AIS control to evaluate management effectiveness. Aquatic plant

communities may undergo changes for a variety of reasons, including varying water levels, water clarity, nutrient levels, and aquatic plant management actions. In general, lake-wide aquatic plant surveys are recommended every year to monitor changes in the overall aquatic plant community during large-scale treatments and then again, every 5 years once small scale, maintenance treatments take place to monitor the effects of the aquatic plant management activities.

In addition to invasive plants, excessive native plant growth combined with shallow water depths can cause navigational issues for lake users. These have historically been addressed through a harvesting program.

CLEAN BOATS/CLEAN WATERS CAMPAIGN

Prevention of the introduction of new AIS to the lake and spread of existing AIS from the lake was the top management priority indicated in the user survey responses. To prevent the spread of AIS from Cedar Lake, a monitoring program such as Clean Boats/Clean Waters (CB/CW) is a good choice. This program is carried out by trained volunteers who inspect incoming and outgoing boats at launches. Boat landing signage also accompanies the use of CB/CW to inform lake users of proper identification of AIS and boat inspection procedures. Education of District members about inspecting watercraft for AIS before launching a boat or leaving access sites on other lakes could help prevent new AIS infestations.

CB/CW use on Cedar Lake has been ongoing and used extensively, contacting the most people and boaters throughout Manitowoc County. Continued participation in this program is strongly encouraged, especially when considering the high amount of recreational use.

Scheduling volunteers for CB/CW landing inspection is often difficult due to time constraints for volunteers. The WDNR offers grant assistance through the Surface Waters program to pay for CB/CW landing inspectors. This establishes a set and known schedule for boat landing monitoring, offering added protection for the Lake. If acquiring CB/CW monitors becomes difficult for Cedar Lake and the District it is recommended they apply through this grant to program to hire a dedicated monitor. This is often done in conjunction with County-wide AIS monitoring efforts.

AQUATIC PLANT PROTECTION AND SHORELINE MANAGEMENT

Protection of the native aquatic plant community is needed to slow the spread of AIS from lake to lake and within a lake once established. Therefore, riparian landowners should refrain from removing native vegetation. Additionally, EWM and CLP can thrive in nutrient (phosphorus and nitrogen) enriched waters or where nutrient rich sediments occur. Two relatively simple actions can prevent excessive nutrients and sediments from reaching the lake.

The first activity is the restoration of natural shorelines, which act as a buffer for runoff containing nutrients and sediments. This can be a potential issue within the lake, as Cedar Lake has a large watershed with portions in agricultural use. Good candidates for shoreline restorations include areas that are mowed to the lake's edge, or that have structures directly adjacent to the lake edge. Establishing natural shoreline vegetation can sometimes be as easy as not mowing to the water's edge. Native plants can also be purchased from nurseries for restoration efforts. Shoreline restoration has the added benefits of providing wildlife habitat and erosion prevention. Or many times a simple "no mow" buffer strip 35'–50' back from the water's edge can provide effective and economical restoration for shoreline property owners. A vegetated buffer area can also prevent surface water runoff from roads, parking areas and lawns from carrying nutrients to the lake. Currently, much of the lake's north and south shorelines are developed, providing potential avenues for increased impacts from runoff.

The second easy nutrient prevention effort is to use lawn fertilizers only when a soil test shows a lack of nutrients. Importantly, fertilizers containing phosphorus, though readily available to the consumer, are illegal for use in Wisconsin, unless a soil test shows a deficiency in phosphorus. The fertilizers commonly used for lawns and gardens have three major plant macronutrients: Nitrogen, Phosphorus and Potassium. These are summarized on the fertilizer package by three numbers. The middle number represents the amount of phosphorus. Since most Wisconsin lakes are "Phosphorus limited," meaning additions of phosphorus can cause increased aquatic plant or algae growth, preventing phosphorus from reaching the lake is a good practice. Local retailers and lawn care companies can provide soil test kits to determine a lawn's nutrient needs. To help prevent fertilizer runoff into local lakes, the Town of Schleswig has restricted fertilization of private properties within 35' of the waterbody. Of course, properties with an intact natural buffer require very little maintenance, and no fertilizers.

The Manitowoc County Land and Water Conservation Department may be able to offer assistance with shoreline restoration projects, rain gardens and or additional shoreline protection. Interested landowners can contact the Land and Water Conservation Department at (715) 258-6245 to request additional information.

An additional option is the DNR Healthy Lakes grant program. This program provides initiative for lakeshore owners to improve their shoreline through simple and inexpensive best management practices. Deadline for pre- application is September 15th with funding of up to $25,000 per group or $1,000 per best management practice on a 75% DNR / 25% applicant cost sharing. Further information can be obtained at: http:// http://healthylakeswi.com

PUBLIC EDUCATION AND INVOLVEMENT

The TSSD should continue to keep abreast of current AIS issues throughout the County and State. The County Land and Water Conservation Department, WDNR Lakes Coordinator and the UW Extension are good sources of information. Many important materials can be found at the following website: http://www.uwsp.edu/cnr-ap/UWEXlakes

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

MANUAL (HAND) REMOVAL

Native plants may be found at nuisance levels in scattered locales throughout the waterway. Manual removal efforts, including hand raking or hand pulling unwanted native plants (except wild rice in the northern region), is allowed under Wisconsin law to a maximum width of 30 feet (recreational zone) per riparian property. The intent is to provide pier, boatlift, or swimming raft access in the recreation zone. A permit is not required for hand pulling or raking if the maximum width cleared does not exceed this 30-foot recreation zone (manual removal of any native aquatic vegetation beyond the 30-foot area would require a permit from the WDNR that satisfies the requirements of Chapter NR 109, Wisconsin Administrative Code, see Appendix C).

Manual removal of aquatic plants can be quite labor intensive and time consuming. This technique is well suited for small areas in shallow water. Hiring laborers to remove aquatic vegetation is an option, but also increases cost. SCUBA divers can be contracted to remove unwanted vegetation in deeper areas. Benefits of manual removal by property owners include low cost compared to chemical control methods, quick containment of pioneering (new) populations of invasive aquatic plants and the ability for a property owner to slowly and consistently work on active management. The drawback of this alternative is that pulling aquatic plants includes the challenge of working in the water, especially deep water, the threat of letting fragments escape and colonize a new area, and the fact that control of any significant sized

population is quite labor intensive, and therefore very costly; $1,500 - $2,000 or more, per acre depending on plant densities.

NUISANCE AQUATIC PLANT GROWTH CONTROL – MECHANICAL OR CHEMICAL

Aquatic plants may be mechanically harvested up to five feet below the water surface and leaving at least 12-inches of plant growth without disturbing or contacting the lake bed. Harvesting can be a practical and efficient means of controlling plant growth as it generally removes the plant biomass from the lake. It can also be effective in reducing nuisance caused by early-season curly-leaf pondweed growth if the plants are cut prior to the start of turion production. Harvesting can be an effective measure to control large-scale nuisance growth of aquatic plants.

The advantages of harvesting are that the harvester typically leaves enough plant material in the lake to provide shelter for fish and to stabilize the lake bottom. Navigation lanes cut by harvesting also allow predator fish, such as bass or pike, better ambush opportunities. Many times, prey like minnows or panfish can hide in thick vegetation lacking predation, potentially causing stunting to the population due to too many prey individuals and not being thinned out by predators.

Disadvantages of the harvesting are that it does cause fragmentation and may facilitate the spread of some plants, including EWM, and may disturb sediment in shallow water increasing water turbidity and suspended sediment issues. Another disadvantage is harvesters are limited in depths to which they can effectively operate; typically, it must be greater than 2' – 3' of water. Aquatic plant harvesting is subject to State permitting requirements under NR109which are renewable every 5 years. Mechanical harvesting requires significant infrastructure to complete, many times requiring the purchase of a harvester by the group and has significant startup costs.

The current harvesting permit expired in 2022 and is based on results from the 2017 plan that may not accurately portray current conditions. As an accepted practice already in place, mechanical harvesting is recommended to continue. An updated and renewed mechanical harvesting permit should be sought and use the Mechanical Harvesting Map attached (Figure 10). Harvesting should only be completed in the outlined areas to alleviate nuisance conditions for navigation and riparia, swimming, or boat access.

Contact herbicides can provide effective season long relief an alternative, some areas of excessive plant growth in shallow water areas that cannot be effectively managed by harvesting. Navigational channels 30' – 50' in width, as described in the section above, can be created using chemical herbicides. Since selectivity is not a concern for navigational treatment, contact herbicides such as diquat or more recently flumioxazin are used for submersed species. They are typically mixed with a copper-based algaecide for increased efficacy. For floating leaf species, an herbicide such as imazapyr is typically used with a surfactant or sticking agent. A combination of harvesting and treatment is sometimes a wise approach to compare length of control, costs, and season long performance. Please note, chemical control requires a separate NR107 permit.

6.0 INVASIVE PLANT MANAGEMENT ALTERNATIVES

6.1 AQUATIC INVASIVE SPECIES HERBICIDE TREATMENT

An aquatic herbicide treatment may be an appropriate way to treat larger areas of AIS and to conduct restoration of native plants. When using chemicals to control AIS, it is a good idea to reevaluate the lake's plant community and the extent of the AIS conditions before, during and after chemical treatment. The chosen herbicide may impact native plant communities including coontail, common waterweed, naiad species and others, especially during whole-lake

applications and/or extended periods of herbicide exposure. The WDNR may require another aquatic plant survey and may require an AIS survey prior to approving a permit for treatment. Surveys should be included for all aquatic plant treatments and is typically a WDNR requirement.

The science regarding what chemicals are most effective, dosages, timing and how they should be applied is constantly evolving and being updated. Current WDNR and Army Corps of Engineer research has shown that herbicide applied to water diffuses off-site due to a variety of environmental and physical conditions including wind, waves, water depth, and treatment area relative to lake volume. Due to these actions, as treatment areas decrease, herbicide retention time needed for impact is lessened due to diffusion off-site because of the small amount of area treated and herbicide applied relative to the entire water volume. To combat this, it is recommended to apply at higher rates when compared to a whole-lake rate and typically with a granular herbicide with a combination of active ingredients in hopes to extend contact time.

Chemical treatment is usually a long-term commitment and requires a specific plan with a goal set for "tolerable" levels of the relevant AIS. One such landmark might be 25% or less of the littoral area being occupied by aquatic invasive plants. WDNR recommends conducting a whole-lake point-intercept survey on a five-year bases (for Cedar Lake the next would be 2026). Such a survey may reveal new AIS and at the very least would provide good trend data to see how the aquatic plant community is evolving.

Herbicides provide the opportunity for broader control over a larger area than hand pulling, and unlike harvesters, allow for a true restoration effort. Disadvantages include negative public perception of chemicals in natural lakes, the potential to affect non-target plant species, and the fact that water use restrictions may be necessary after application.

6.1.1 Curly-leaf Pondweed

Curly-leaf pondweed is the second most prevalent aquatic invasive plant species targeted for chemical treatment in the State. At present, endothall, a systemic herbicide is the most common active ingredient in herbicides used for CLP management in Wisconsin. Imazamox has been used periodically in the last several years. Imazamox has shown promise in that it is a systemic herbicide for CLP control and can potentially have a much lower impact to the native plant community than a contact herbicide and appears to show increased year after treatment control than endothall. It is not entirely clear as to why this happens but it may be due to the systemic effect on turion production within the plants, resulting in fewer plants the following year. Penoxsulam is a newer active ingredient showing selective control of curly-leaf pondweed at very low rates. Continued research is ongoing on its longevity and selectiveness.

Granular based formulations are generally more costly and used for smaller spot type treatments, while liquid formulations are less costly and generally used for larger contiguous treatment areas or whole-lake type treatments. In order to decrease any potential impact to native plants and be as selective as possible for CLP, treatments are completed in the spring when native plant growth is minimal, typically prior to 60˚ water temperatures, but perhaps most importantly prior to the start of turion production. CLP seems to prefer and flourish in mucky or highly flocculent substrate, which is found in many areas of Cedar Lake's sediments. Given the inability to locate populations of CLP during the most recent surveys and large locations of appropriate substrate, its presence was expected to have been more prevalent. Monitoring may be the best option for management.

6.1.2 Eurasian Water-milfoil

EWM is the most managed AIS within Wisconsin lakes and the most prevalent within Cedar Lake. EWM is an extremely opportunistic plant and could easily expand within Cedar Lake. Should such an event take place, it is prudent to include potential management actions for EWM within this plan, to provide a quick and concise reference for management.

At present, 2,4-D has been the most common active ingredient for selective systemic herbicides used for EWM management in Wisconsin, although triclopyr use is increasing and has been commonly used in Minnesota for well over a decade. Granular based formulations are typically more costly and used for smaller spot type treatments, while liquid formulations tend to be less costly and used for larger contiguous treatment areas or whole-lake type treatments. In order to maximize effectiveness and decrease any potential impact to native plants to the greatest extent possible, treatments should be completed in the spring when native plant growth is minimal.

Current WDNR and Army Corps of Engineer research has shown that herbicide applied to water diffuses off-site due to a variety of environmental and physical conditions including wind, waves, water depth, and treatment area relative to lake volume. Due to these actions, as treatment areas decrease, herbicide retention time needed for impact is lessened due to diffusion off-site because of the small amount of area treated and herbicide applied relative to the entire water volume. To combat this, it is recommended to apply at higher rates when compared to a whole-lake rate and typically with a granular herbicide, a combination of active ingredients, or change of active ingredient in hopes to extend contact time. Recently, the active ingredient florpyrauxifen-benzyl has been approved for EWM control. This active ingredient requires very limited contact time and has shown to offer excellent control with reduced non-target impacts in comparison to previously used modes of action.

If EWM abundance and density increase and require active management within Cedar Lake and smaller treatment areas (< 2.0 ac) are mapped, it is recommended to use florpyrauxifen-benzyl, a fast-acting systemic herbicide, at appropriate rates of around 5-20 parts per billion (ppb). This approach has shown to be an effective management tool in various lakes throughout Wisconsin and is continuing to be researched for efficacy and long-term control.

The EWM within Cedar Lake has been identified as a hybrid. It is worth noting there are various hybrid strains of EWM being genetically confirmed throughout the State and many of these are showing resistance to typical systemic herbicides. Research projects are currently underway with the WDNR and herbicide manufacturers. For better control, combination herbicides (systemic, such as 2,4-D & contact, such as endothall) at 1:2 or 1:3 ratio as well other modes of action like pigment bleaching herbicides (fluridone) may be more effective on these strains of hybrid EWM. For fluridone applications are most successful on a whole-lake volume basis maintaining a 4-12 PPB residual for 90+ days.

Fluridone is also available in different pelletized slow-release formations that are designed to release off the carrier over extended periods of time; from several weeks to several months.

The size of the population tends to dictate the type of control. Small treatment areas or beds less than 5 acres are many times consider spot treatments and usually targeted with faster acting contact active ingredients. When there are multiple “spot” treatment areas within a lake, it most often makes more sense from economic and efficacy standpoints to target the “whole” lake for treatment. This typically entails calculating the entire volume of water within the lake, in acre/feet, and applying an herbicide at a low dose at a lake wide rate.

6.2 AQUATIC INVASIVE PLANT HARVESTING

MECHANICAL HARVESTING

Aquatic plants may be mechanically harvested up to five feet below the water surface and can be a practical and efficient means of controlling plant growth as it generally removes the plant biomass from the lake.

Harvesting can also be used to facilitate native aquatic plant growth by "top cutting" AIS growth that has canopied out. This is done by removing a canopy of AIS that shades out native, lower growing species, such as pondweed species. Use of a top cut only in areas of dense AIS growth, can provide additional sunlight for growth, increasing diversity and available fisheries habitat quality.

MANUAL (HAND) REMOVAL

If a small isolated stand of AIS is present, hand pulling may be a viable option. No permit is required to remove non-native invasive aquatic vegetation if the removal is conducted completely by hand with no mechanical assistance. All aquatic plant material must be removed from the water to minimize dispersion and re-germination of unwanted aquatic plants. Portions of the roots may remain in the sediments, so removal may need to be repeated periodically throughout the growing season. This can be a very effective control mechanism for EWM if the entire plant mass and root structure is completely removed. The drawback of this alternative is that pulling aquatic plants includes the challenge of working in the water, especially deep water, threat of letting fragments escape and colonize a new area, and control of any significant sized population is quite labor intensive and very costly. Hand harvesting costs using professionally contracted SCUBA divers are around $2,000 - $3,000 or more, per acre depending on plant densities.

7.0 OVERALL LAKE MANGEMENT GOALS

Cedar Lake is a natural drainage lake with good water quality, a very dense aquatic plant community, and moderately heavy recreational use. Management actions recommended below are based on the findings of this APM plan and chosen to protect and enhance the conditions present.

- Water quality is excellent, with clarity averaging 13.3 ft and low nutrients to fuel algae blooms (Section 3.1, pg 3.4)

- Good water clarity allows for aquatic plants to thrive, even in up to 20+ feet of water. Largely, the aquatic plant community of Cedar Lake is of high quality with great diversity and includes 22 native species (Section 4.1, pg 4.10, & Figures 1-9)

- Though of high quality, aquatic plants can and do grow to nuisance levels, requiring active management through mechanical harvesting since 1950 (Section 3.0, pg 3.2)

- AIS are a constant threat to the quality of the lake. After being found at primarily low, background levels, EWM had expanded significantly from 2017, requiring active management. Control of EWM in 2021 and 2022 was largely successful in reducing spread and density while limiting non-target impact to more desirable native species (Section 4.4, pg. 4.15, & Figures 2-5a). Currently, 19.8 acres of EWM are present (Figure 5b).

- Input was gathered to gauge the perception of the lake and formulate aquatic plant management options that are not only viable for Cedar Lake, but also desired by its users and able to be successful (Section 2.0, Pg. 2.1)

- Current management actions have shown to have no lasting negative impact to the native aquatic plant over time (Section 4.3, pg. 4.14-4.15) and are the most accepted and recommended by lake users to achieve results.

Even with EWM present, a potentially aggressive AIS, in Cedar Lake, its impact to the system has been reduced through highly selective, small to moderate scale, targeted management. Though the aquatic plant community in Cedar Lake is healthy, it consistently grows dense and impacts recreational use on the water. Dense aquatic plant growth in areas of the lake only worsens navigational issues throughout the lake and negatively impacted users, with many residents and users wanting management actions to reduce aquatic plant issues.

Only those options that will be supported by the users and TSSD and CLIA with high likelihood of approval from the WDNR will be selected to help accomplish management goals. However, not all desired management options are viable or feasible for each situation. All options are discussed further in Appendix B. Based on the above, the following recommended action plan includes a combination of management actions to achieve desired results.

A clear focus of the plan is to prevent the spread of AIS into or out of Cedar Lake while reducing the extent and density of AIS already established. In addition, continued maintenance of lanes to allow for navigation is recommended. Management planning will follow Integrated Pest Management (IPM) with an approach that provides a variety of control actions, active

ingredients, and monitoring to gauge results. Based on the above, the following recommended action plan includes a combination of management actions to achieve desired results.

The size of the population tends to dictate the type of the treatment. Small treatment areas or beds less than 2-5 acres are many times consider spot treatments and usually targeted with fast acting ingredients. When there are multiple "spot" treatment areas within a lake, it often makes more sense from economic and efficacy standpoints to target the "whole" lake for treatment.

This typically entails calculating the entire volume of water within the lake, in acre/feet, and applying a liquid herbicide, such as 2,4-D, at a low dose, lake-wide rate. Current WDNR and Army Corps of Engineer research has shown that herbicide applied to water diffuses off-site due to a variety of environmental and physical conditions including wind, waves, water depth, and treatment area relative to lake volume. Due to these actions, as treatment areas decrease, herbicide retention time needed for impact is lessened due to diffusion off-site because of the small amount of area treated and herbicide applied relative to the surrounding water volume. To combat this, it is recommended to apply at higher rates when compared to a whole-lake rate or with a combination of active ingredients in hopes to extend contact time.

Goal: Renew the mechanical harvesting permit

Primary Action: The current permit expired in 2022 and was issued using the 2017 APM plan. Use the contents of this plan, including Figure 10, to update the harvesting permit based on current conditions.

Goal: Reduce Nuisance Aquatic Plant Growth Hampering Navigation

Primary Action: Mechanically harvest common navigational areas up to depths of 5 feet below the surface while maintaining 12" or more of plant growth on the lake's bottom. Harvesting areas should focus creating lanes up to 100-ft wide for riparian and public boat access, maintain recreational areas, and maintain pier access. See Figure 10 for recommended harvest areas. The following guideline should be used for all mechanical plant harvesting activities:

- Only cut in depths of 5-ft or more
- Harvest areas using the outline as follows:
  - Maintain Riparian Navigational Access
    - Permitted areas of North/Cedar Bay
    - Permitted areas of the main lake
    - Nuisance typically caused by wild celery, Eurasian water-milfoil, Illinois pondweed, and smaller, dense pockets of various species
  - Navigation Lanes Throughout Cedar Lake
    - Primary target in these regions is to maintain safe navigation around the lake and central portion of North/Cedar Bay
    - Nuisance typically caused by dense Illinois pondweed, wild celery, and Eurasian water-milfoil
    - Harvesting in depths greater than 10-ft is not necessary as plant growth in these depths do not typically reach the surface
- Only cut to a maximum depth of 5-ft
- Do not cut within 12-in of the lake bed
- Do not disturb the lake bed during harvesting activity
- Avoid cutting in environmentally sensitive areas (Figure 11)
- Avoid cutting of high-value plant species except where a legitimate navigational impedance is present. Harvesting should be limited to lane creation or

maintenance only. Some high-value plant species present in Cedar Lake include: wild celery, chara, Illinois pondweed, White-stem pondweed, and others in lesser amounts

- Avoid cutting in areas recently treated for invasive species control for 30-days after chemical application.
- Avoid cutting in areas of active fish spawning. Timing of harvest should be planned to avoid impact and not begin until after June 1st.
- All cut material should be inspected for fish and animals. Any organisms found should be immediately returned to the water
- All cut materials should be collected and deposited at the designated disposal site as indicated on the permit
- Free floating plants, such as wild celery mats, or algae uprooted by wave and boating action may be surface skimmed without use of the cutting head if outside of designated harvest areas only if water depths are 5-ft or greater.

Goal: Obtain financial assistance for AIS management activities.

Primary Action: Upon advice of the District's consultant or biologist, apply for an AIS Established Population Control Grant through the WDNR's Surface Water Grant program to manual harvesting of EWM through hand and SCUBA control methods. The deadline for pre-application is September 15 and can fund up to 75% of eligible project costs.

Goal: Manage AIS to improve recreation, increase use opportunities, and maintain native plants by reducing AIS abundance and frequency within the littoral zone. For Cedar Lake, the littoral zone extends to an approximate depth of 20-ft and covers approximately 133.8 acres. Only the deepest portions of the basins are outside the littoral zone. If active AIS management is pursued, the goal should be to maintain the presence of the target species over a 3–5-year period.

Currently, EWM occupies the following coverage of the littoral zone at the listed densities (Figure 5b):

Density	Acres	% Littoral Zone
Scattered	4.4	3.3%
Low	8.03	6.0%
Moderate	6.59	4.9%
High	**0.78**	**0.6%**
TOTAL	**19.8**	**14.8%**

The following levels of AIS coverage and density within the littoral zone and can be used to trigger active management of the target species, primarily EWM:

- 2.5 – 15% coverage of the littoral zone for small scale, spot management of areas of moderate or high density

Or

- 15% or more littoral zone coverage for large-scale control at up to whole-lake approaches.

Primary Action: Continue monitoring for and mapping of AIS.

- Annual bed-mapping surveys to document spread and density of AIS already present
- Continually monitor for introduction of newly introduced AIS
- If a newly introduced AIS is found, follow the rapid response plan below:
  - Collect a sample and submit to WDNR for confirmation
  - Record spread, density, and location of species – preferably with GPS capable equipment
  - Initiate fast and targeted management, if necessary. This may include any of the following options:
    - Apply for appropriate WDNR permit, if necessary.
    - Hand pulling – does not require a permit if done without mechanical equipment
    - Targeted mechanical harvesting – either through conventional equipment or DASH (permit required)
    - Targeted chemical control – active ingredients, rates, and application methods may vary based on target species (permit required)
    - Pre- and post-treatment monitoring of any active control areas
    - Annual monitoring of any areas of pioneer infestation noted
    - Apply for a WDNR AIS Rapid Response Grant through the Surface Water program for financial assistance

Possible EWM Control Action: If populations of EWM exceed the above listed triggers pursue active management. If active management is chosen, the following density ratings should be used along with bed sizes listed in the below options. The following densities were used to describe the EWM populations:

1. **Spots** – small locations of individual plants or clumps that were not large enough to map around their perimeter.
2. **Scattered** – locations of EWM that had plants close enough to map as an area, but were still widely scattered. EWM is merely present and not a large component of the biomass.
3. **Low** – EWM identified in distinct beds. While individual plants or clumps may reach the surface, most are lower growing or not as dense. Often mixed with other vegetation.
4. **Moderate** – EWM occupies over half the water column with many plants or clumps at or just below the surface. Few other plant species found.
5. **High** – locations of EWM that were at or near the surface and occupied much of the water column. EWM may be the only plant found growing in these locations.

***Small-Scale control Action*:** Small-scale EWM control to maintain low populations may be a desired. This may include a variety approaches and control methods based on the dominance and size of small-scale EWM control areas.

- EWM areas less than 0.25 acres of **any density** and/or dominance
  - Monitoring only through annual surveys
  - Hand pulling by shoreline residents
  - Diver Assisted Suction Harvesting (DASH) stands of moderate or high density

- EWM areas 0.25 – 0.75 acres
  - Monitoring only through annual surveys
  - Hand pulling by shoreline residents
  - DASH for stands **up to moderate density**
  - Fast-acting, selective chemical control for stands of **moderate or high density** or more in protected bays.
    - The active ingredients florpyrauxifen-benzyl, diquat, endothall, and/or flumioxazin may be used at appropriate label rates

- EWM areas greater than 0.75 acres
  - Fast-acting, selective chemical control for stands of **moderate or high density**
    - The active ingredients florpyrauxifen-benzyl, diquat, endothall, and/or flumioxazin may be used at appropriate label rates

***Large Scale Control Action*:** Targeted, whole-lake based control efforts. This may include a variety of active ingredients and be dosed at up to whole-lake volume rates.

- If possible, control should be completed to time application to early/mid spring when plants are young

- Application may be completed using a variety of active ingredients and rates. Consideration should be given to expected longevity and selectivity of control. The following table displays a comparison of potential whole-lake application methods and expected longevity and selectivity:

Active Ingredient(s)	Product	Expected Control	Longevity of Control	Selectivity	Cost
fluridone	Sonar	X	X	O/X	$$$
florpyrauxifen-benzyl	ProcellaCOR EC	X	X	X	$$-$$$
2,4-D	Various	O	-/O	O	$
2,4-D & endothall	2,4-D/Aquathol K	O	O	O	$
X = good, O = OK, - = poor					

- Some recommended active ingredients and application rates are as follows:

  - Active ingredient 2,4-D at 0.25-0.40 PPM. Use of 2,4-D alone is likely a one-time application as EWM has shown to become tolerant of the active ingredient in repeated uses. 2,4-D alone is likely to see shorter-lasting results than options below.

  - Active ingredient 2,4-D at 0.25-0.40 PPM and active ingredient endothall at 0.6-0.80 PPM at whole-lake volume rates. This is likely a one-time Use of this method is likely to see shorter-lasting results than options below.

  - Active ingredient fluridone at 4-16 PPB whole-lake volume rates with follow-up "bump" applications to maintain 6 PPB in water for 120+ days. Target rates may be reduced by product uptake, loss through water flow out of the lake, and loss through natural degradation. Residual sampling of in-water concentrations should be completed approximately every 21 days after the initial application to properly dose and time "bump" applications.

- Active ingredient florpyrauxifen-benzyl dosed at 5 - 11 PPB within areas of direct application only. Due to the fast-acting nature of florpyrauxifen-benzyl, applications do not need to consider the entire lake's volume for dosing.

- An aquatic invasive species assessment survey should be completed 1-year prior to assess conditions and verify they exceed management triggers above. In addition, the survey should be repeated 1-year post control activities to gauge results. The assessment survey may be completed as a whole-lake point intercept survey or targeted AIS meander survey. Bed locations and dominance should be mapped to accurately assess conditions.

Goal: Continue comprehensive water quality monitoring within Cedar Lake through the WDNR Citizen Lake Monitoring Network and support CB/CW efforts.

Primary Action: Continue monitoring in 2023 and beyond for water quality through secchi readings, chlorophyll-a, and total phosphorus. Samples should be taken once monthly between May – September or at least 3 times a year spaced 30 days apart, or at a bare minimum once a year mid-summer.

Primary Action: Continue participation in the Clean Boats / Clean waters program and commit to a minimum of 50 hours of monitoring per year.

There are multiple resources and organizations able to help achieve plan goals and related actions. Contacts for those referenced in the plan and additional groups are included as follows.

Glacierland Resource Conservation and Development Council, Inc.
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University of Wisconsin – Extension Lakes
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uwexlakes@uwsp.edu

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APPENDIX A – SUPPORTING AQUATIC PLANT DOCUMENTATION

Appendix A – Supporting Aquatic Plant Documentation

The point intercept method was used to evaluate the existing emergent, submergent, floating-leaf and free-floating aquatic plants. If a species was not collected at a specific point, the space on the datasheet was left blank. For the survey, the data for each sample point was entered into the WDNR "Worksheets" (i.e., a data-processing spreadsheet) to calculate the following statistics:

Taxonomic richness (the total number of taxa detected)

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

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

APPENDIX B – ADDITIONAL MANAGEMENT OPTIONS

Management Options for Aquatic Plants

Option	Permit Needed	How it Works	Pros	Cons
No Management	No	No active plant management	Possible protects native species that can enhance water quality and provide habitat for aquatic fauna: • No financial cost • No system disturbance • No harmful effects of chemicals • Permit not required	May allow small populations of invasive plants to become larger and more difficult to control later • Requires intensive monitoring
Mechanical Control	Required under NR 109	Plants reduced by mechanical means	Flexible control	Must be repeated, often more than once per season, sometimes weekly
		Wide range of techniques from manual to mechanized	Can balance habitat and recreational needs	Can suspend sediments and increase highly turbidity and nutrient release
a. Handpulling/ Manual raking	Yes/No	Scuba divers or snorkelers remove plants are removed with a rake	Little to no damage done to lake or to native plant species	Very labor intensive and costly by hand or plants
		Works best in soft sediments	Can be highly selective Can be done by shoreline property owners within an area <30 ft wide or removing EWM or CLP Can be very effective at removing problems particularly following early detection of an invasive specie	Needs to be carefully monitored Roots, runners and even fragments of some without permits species (including EWM) will start new where selectively planted, so all of plant must be removed Small scale control only plants Can be very costly if subcontracted
b. Harvesting	Yes	Plants are “mowed” at depths of 2-5 ft., collected with a conveyor and off loaded onto shore	Immediate results	Not selective in species removed
		Harvest invasives only if invasive is already present throughout the lake	Good for CLP management if cut prior to turion production and is then cut to be kept in check through its growth cycle Usually minimal impact to the lake Harvested lanes through dense weed beds can increase growth and forage ability of some fish Can remove some nutrients from the lake	Fragments of EWM can re-root Difficulty in finding disposal sites Can remove some small fish and reptiles from lake Initial cost of harvester expensive High transport, maintenance and operational costs Liability if owned
Biological Control	Yes	Living organisms (e.g. insects or fungi) eat or infect plants	Self sustaining organism will over winter resume eating its host the next year Lowers density of problem plant to allow growth of natives	Effectiveness will vary as control agent’s population fluctuates Provides moderate control – complete control unlikely Control response may be slow. Must have enough control agent to be effective

Management Options for Aquatic Plants

a. Weevils on EWM	Yes	Native weevil prefers EWM to other native water milfoil	Native to Wisconsin: Weevil cannot "escape" and become a problem Selective control of target species Longer term control with limited management	Excessive cost need to stock large numbers, even if some already present and are costly **$1.00/each** Need good habitat for over wintering on shore (leaf litter) associated with undeveloped shorelines High Panfish populations decrease densities through predation
b. Pathogens	Yes	Fungal/bacterial/viral pathogen introduced to target species to induce mortality	May be species specific May provide long term control Few dangers to humans or animals	Largely experimental; effectiveness and longevity unknown Possible side effects not understood
c. Allelopathy	Yes	Aquatic plants release chemical compounds that inhibit other plants from growing	May provide long term, maintenance free control Spikerushes (*Eleocharis* spp.) appear to inhibit Eurasian watermill foil growth	Initial transplanting slow and labor intensive Spikerushes native to Wisconsin and have not effectively limited EWM growth Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water
d. Restoration of native plants	Possibly, strongly recommend plan and consultation with DNR	Diverse native plant community established to help repel invasive species	Native plants provide food and habitat for aquatic fauna Diverse native community more repellant to invasive species Supplements removal techniques	Initial transplanting slow and labor intensive Nuisance invasive plants may outcompete plantings Largely experimental; few well documented successful cases and very costly
Physical Control	Required under Ch. 30/NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a. Drawdown	Yes, may require Environmental Assessment	Lake water lowered; plants killed when sediment dries, compacts or freezes	Can be effective for EWM, especially when done over winter, provided drying and freezing occur. Sediment compaction is possible over winter.	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling
		Must have a water level control or device or siphon	Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction	Species growing in deep water (e.g. EWM) that survive may increase, particularly if desired native species are reduced
		Season or duration of drawdown can change effects	Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization and increased water quality Successful for EWM	May impact attached wetlands and shallow wells near shore Not a good control measure for CLP

Management Options for Aquatic Plants

			Low cost if not a hydroelectric dam Restores natural water fluctuation important for all aquatic ecosystems	Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning Winter drawdown must start in early fall or will kill hibernating reptiles and amphibians Controversial
b. Dredging	Yes	Plants are removed along with sediment	Increases water depth	Expensive
		Most effective when soft sediments overlay harder substrate	Removes nutrient rich sediments	Increases turbidity and releases nutrients
		For extremely impacted systems	Removes soft bottom sediments that may have high oxygen demand	Exposed sediments may be recolonized by invasive species
		Extensive planning and permitting required		Sediment testing is expensive Removes benthic organisms Dredged materials must be disposed if Severe impact on lake ecosystem
c. Dyes	Yes	Colors water, reducing light and reducing plant and algal growth	Impairs plant growth without increasing turbidity Usually non-toxic, degrades naturally over a few weeks	Appropriate for very slam water bodies Should not be used in pond or lake with outflow Impairs aesthetics Affects to microscopic organisms unknown
d. Mechanical circulation (Solarbees)	Yes	Water is circulated and oxygenated	Reduces blue green algae	Method is experimental; no published studies have been done
		Oxygenation of water decreases ammonium-nitrogen, which is a preferred nutrient source of EWM, theoretically limiting EWM growth (has not been demonstrated scientifically)	May reduce levels of ammonium-nitrogen in the water and at the sediment interface, which could reduce EWM growth Oxygenated water may reduce phosphorus release from sediments if mixing is complete Reduces chance of fish kills by aerating water	Although EWM prefers ammonium-nitrogen to nitrate, it will uptake nitrate efficiently, so EWM growth may not be affected Units are aesthetically unpleasing Units could be a navigational hazard
e. Non-point source nutrient control	No	Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use)	Attempts to correct source of problem, not treat symptoms Could improve water clarity and reduce occurrences of algal blooms	Results can take years to be evident due to internal recycling of already resent lake nutrients Expensive

Management Options for Aquatic Plants

			Native plants may be able to compete invasive species better in low nutrient conditions	Requires landowner cooperation and regulation Improved water clarity may increase plant growth
Chemical Control	Required under NR 107	Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae	Some flexibility for different situations	Possible toxicity to aquatic animals or humans, especially applicators
		Results usually within 10 days of treatment, but repeat treatments usually needed	Some can be selective if applied correctly Can be used for restoration activities	May kill desirable plant species, e.g. native water milfoil or native pondweeds Treatment set back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape Controversial
a. 2,4-D (DMA-4; Sculpin	Yes	Systemic[1] herbicide selective to broadleaf[2] plants that inhibit cell division in new tissue	Moderately to highly effective; especially on EWM	May cause oxygen depletion after plants die and decompose
		Applied as liquid or granules during early growth phase	Monocots, such as pondweeds (e.g. CLP) and many other native species not affected Can be used in synergy with endotholl for early season CLP and EWM treatments Widely used aquatic herbicides	Cannot be used in combination with copper herbicides (used for algae) Toxic to fish
b. Endothall (Aquathol)	Yes	Broad-spectrum[3], contact [4] herbicide that inhibits protein synthesis	Especially effective on CLP and also effective on EWM	Kills many native pondweeks
		Applied as liquid or granules	May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring Can be selective depending on concentration and seasonal timing Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds	Not as effective in dense plant beds Not to be used in water supplies Toxic to aquatic fauna (to varying degrees)
c. Diquat (Reward)	Yes	Broad-spectrum, contact herbicide that disrupts cellular functioning	Mostly used for water-milfoil and duckweed	May impact non-target plants, especially native pondweeds, coontail, elodea, naiads
		Applied as liquid, can be combined with copper treatment	Rapid action Limited direct toxicity on fish and other animals	Toxic to aquatic invertebrates Needs to be reapplied several years in a row

Management Options for Aquatic Plants

				Ineffective in muddy or cold water (<50°F)
d. Fluridone (Sonar)	Yes	Broad-spectrum, systemic pigment bleaching herbicide that inhibits photosynthesis, some reduction in non target effects can be achieved by lowering dosage	Effective on EWM for 2 to 4+ years Applied at very low concentration typically on lake wide basis of less than 8 PPB Specific granular formulation release over extended periods of time 30 – 60 days eliminating peaks and lessening impacts to non targets (natives)	Affects some non-target plants, particularly native milfoils, coontails, elodea and naiads, even at low concentrations. These plants are important to combat invasive species Requires long contact time: 60-90 + days Requires residual monitoring
			Slow decomposition of plants may limit decreases in dissolved oxygen Low toxicity to aquatic animals	Demonstrated herbicide resistance in hydrilla subjected to repeat treatments Unknown effect of repeat whole lake treatments on lake ecology
e. Glyphosate (Rodeo)	Yes	Broad spectrum, systemic herbicide that disrupts enzyme formation and function	Effective on floating and emergent plants such as purple loosestrife	Effective control for 1-5 years
		Usually used for purple loosestrife stems or cattails	Selective if carefully applied to individual plants	Ineffective in muddy water
		Applied as liquid spray or painted on loosestrife stems	Non-toxic to most aquatic animals at recommended dosages	Cannot be used near potable water intakes No control of submerged plants
f. Triclopyr (Renovate)	Yes	Systemic herbicide selective to broadleaf plants that disrupts enzyme function	Effective on many emergent and floating plants	Impacts may occur to some native plants at higher does (e.g. coontail)
		Applied as liquid spray or liquid	More effective on dicots, such as purple loosestrife; may be more effective than glyphosate Results in 3-5 weeks Low toxicity to aquatic animals No recreational use restrictions following treatment	May be toxic to sensitive invertebrates at higher concentrations Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm) Sensitive to UV light; sunlight can break herbicide down prematurely Relatively new management option for aquatic plants (since 2003)
g. Copper compounds (Cutrine, Captain)	Yes	Broad-spectrum, systemic herbicide that prevents photosynthesis	Reduces algal growth and increases water clarity	Elemental copper accumulates and persists in sediments
		Used to control planktonic and filamentous algae	No recreational or agricultural restrictions on water use following treatment Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin	Short term results Small-scale control only, because algae are easily windblown

Management Options for Aquatic Plants

					Toxic to invertebrates, trout and other fish, depending on the hardness of the water Long-term effects of repeat treatments to benthic organism unknown Clear water may increase plant growth
h.	**Lime slurry**	Yes	Applications of lime temporarily raise water pH, which limits the availability of inorganic carbon to plants, preventing growth	Appears to be particularly effective against EWM and CLP Prevents release of sediment phosphorus, which reduces algal growth Increases growth of native plants beneficial as fish habitat	Relatively new technique, so effective dosage levels and exposure requirements are not yet known Short-term increase in turbidity due to suspended lime particles High pH detrimental to aquatic invertebrates May restrict growth of some native plants
i.	**Alum (aluminum sulfate)**	Yes	Remove phosphorus from water column and creates barrier on sediment to prevent internal loading of phosphorus	Most often used against algal problems Lasts up to 5 years	Most not eat fish for 30 days from treatment area
			Dosage must consider pH, hardness and water volume	Improves water clarity	Minimal effect on aquatic plants, or increased light penetration may increase aquatic plants Potential ecosystem toxicity issues for aquatic animals, including fish at some concentrations
j.	**Phoslock**	yes	Remove/sequesters phosphorus from water column and creates barrier on sediment to prevent internal loading of phosphorus	Most often used against algal problems/blooms Improves water quality	Higher cost than Alum
			Dosing based on water quality parameters and volumes	Lasts up to 5 years Made from natural materials/carriers and tends to be more environmentally friendly than alum	

***EWM** - Eurasian water-milfoil
***CLP** - Curly-leaf pondweed

[1]**Systemic herbicide -** Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.

[2]**Broadleaf herbicide -** Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.

[3]**Broad-spectrum herbicide -** Affects both monocots and dicots.

[4]**Contact herbicide -** Unable to move within the plant; kills only plant tissue it contacts directly

Techniques for Aquatic Plant Control Not Allowed in Wisconsin

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

Techniques for Aquatic Plant Control Not Allowed in Wisconsin

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

APPENDIX C – WI ADMIN CODES NR 107 & NR 109

Chapter NR 107

AQUATIC PLANT MANAGEMENT

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

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

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

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

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

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

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

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

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

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

Note: The DNR district headquarters are located at:

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

(2) The application shall be accompanied by:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(d) Liquid chemicals are to be used.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(e) Conclusions and recommendations for future use.

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

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

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

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

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

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

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

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

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

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

(a) Water tanks used for potable water supplies;

(b) Swimming pools;

(c) Treatment of public or private wells;

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

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

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

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

Chapter NR 109

AQUATIC PLANTS: INTRODUCTION, MANUAL REMOVAL and MECHANICAL CONTROL REGULATIONS

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

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

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

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

NR 109.03 Definitions. In this chapter:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Note: Scientific collectors permit requirements are still applicable.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(c) The intensity of water use.

(d) The location of aquatic plant management activities.

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

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

(g) An education and information strategy.

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

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

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

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

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

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

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

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

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

TABLES

Table 1: Aquatic Plant Community Statistics. Cedar Lake, Manitowoc County, Wisconsin.

	2005	2016	2021
Number of sites sampled	277	361	340
Number of sites with vegetation	210	268	222
Number of sites shallower than maximum depth of plants	273	335	281
Frequency of occurrence at sites shallower than maximum depth of plants (%)	76.9%	80.0%	79.0%
Simpson Diversity Index	0.84	0.91	0.88
Maximum Depth of Plants (Feet)	21.5	22	20.5
Taxonomic Richness (Number Taxa - includes visuals)	25	25	23
Average Number of Species per Site (less than max depth of plant growth)	1.29	1.93	1.84
Average Number of Species per Site (sites with vegetation)	---	2.42	2.33
Average Number of Native Species per Site (less than max depth of plant growth)	1.29	1.91	1.65
Average Number of Native Species per Site (sites with vegetation)	---	2.39	2.09

Table 3: Frequency of Occurrence of Aquatic Plant Species by Year. Cedar Lake, Manitowoc Co., WI.

	Frequency of Occurrence (%)		
Species	2005	2016	2021
Eurasian water-milfoil	**0.37**	**2.39**	**19.22**
Curly-leaf pondweed* **	**0.37**	**---**	**---**
Water marigold	1.47	1.19	3.94
Watershield	0*	2.69	1.07
Coontial	---	0.60	0.71
Muskgrass	41.39	23.58	13.17
Common waterweed	3.30	13.13	4.27
Northern water-milfoil	13.92	6.87	---
Slender naiad	6.27	26.57	36.30
Nitella	1.10	13.73	8.19
Spatterdock	0*	0.60	0.71
White water lily	0*	3.58	2.85
Large-leaf pondweed	0.37	2.99	4.98
Frie's pondweed	---	8.36	---
Variable pondweed	---	6.27	---
Illinois pondweed	5.50	1.19	19.22
Floating-leaf pondweed	0.73	2.69	0.36
White-stem pondweed	8.79	5.97	1.78
Small pondweed	10.26	---	---
Fern pondweed	6.96	8.66	8.90
Stiff pondweed	0.37	5.67	7.47
Flat-stem pondweed	6.96	16.42	7.83
White water crowfoot	0.37	---	---
Arrowhead sp.	---	2.39	---
Hardstem bulrush	0.37	2.39	1.07
Sago pondweed	1.10	0.30	0.71
Narrow-leaved cattail	0*	0.60	---
Cattail species	0*	---	0.36
Common bladderwort	---	---	2.14
Wild celery	19.41	34.63	38.43
Common watermeal	---	---	0.71
Aquatic moss	---	0.30	---

* - recorded as visual only
--- - species not sampled
*** - likely mis-identified and no longer noted as present in Cedar Lake

Table 4: FQI Breakdown by species for Cedar Lake, Manitowoc County, Wisconsin

	C-Value
Common Name	**2021**
Water marigold	8
Watershield	6
Coontial	3
Muskgrass	7
Common waterweed	3
Slender naiad	6
Nitella	7
Spatterdock	6
White water lily	6
Large-leaf pondweed	7
Illinois pondweed	6
Floating-leaf pondweed	5
White-stem pondweed	8
Fern pondweed	8
Stiff pondweed	8
Flat-stem pondweed	6
Hardstem bulrush	6
Sago pondweed	3
Cattail species	1
Common bladderwort	7
Wild celery	6
Common watermeal	5
Total Species	22
Mean C	5.82
Floristic Quality Index (FQI)	**27.29**

Table 8: Treatment Area Aquatic Plant Community Statistics, Cedar Lake, Manitowoc Co., WI.

	B		C	
	Pre - 06/27/22	Post - 9/23/22	Pre - 06/27/22	Post - 9/23/22
Number of sites sampled	40	40	40	40
Number of sites with vegetation	38	31	39	39
Number of sites shallower than maximum depth of plants	40	40	40	40
Frequency of occurrence at sites shallower than maximum depth of plants (%)	95	77.5	97.5	97.5
Simpson Diversity Index	0.78	0.8	0.8	0.83
Maximum Depth of Plants (Feet)	16	16	15.5	15.5
Taxonomic Richness (Number Taxa - includes visuals)	10	8	12	12
Average Number of Species per Site (less than max depth of plant growth)	1.8	1.2	2.13	1.88
Average Number of Species per Site (sites with vegetation)	1.89	1.55	2.18	1.92
Average Number of Native Species per Site (less than max depth of plant growth)	1.1	1.03	1.38	1.85
Average Number of Native Species per Site (sites with vegetation)	1.16	1.32	1.41	1.9

Table 9: Frequency of Occurrence of Aquatic Plant Species by Event, Cedar Lake, Manitowoc Co., Wisconsin.

	Area B		Area C	
Species	Pre - 06/27/22	Post - 9/23/22	Pre - 06/27/22	Post - 9/23/22
Eurasian water-milfoil	**70.0**	**17.5**	**75.0**	**2.5**
Water marigold	---	2.5	7.5	2.5
Coontail	2.5	---	---	2.5
Chara (muskgrass)	5.0	2.5	12.5	10.0
Common waterweed	15.0	---	10.0	7.5
Slender naiad	15.0	12.5	2.5	15.0
Large-leaf pondweed	---	---	12.5	15.0
Leafy pondweed	---	---	2.5	5.0
White-stem pondweed	5.0	12.5	7.5	25.0
Fern pondweed	27.5	7.5	5.0	15.0
Flat-stem pondweed	10.0	35.0	30.0	25.0
Arrowhead species	---	---	5.0	---
Common bladderwort	2.5	---	---	---
Wild celery	27.5	30.0	42.5	62.5

--- - species not sampled

Table 10: Statistical Significance of Species between Sampling Events, Cedar Lake , Manitowoc Co., Wisconsin.

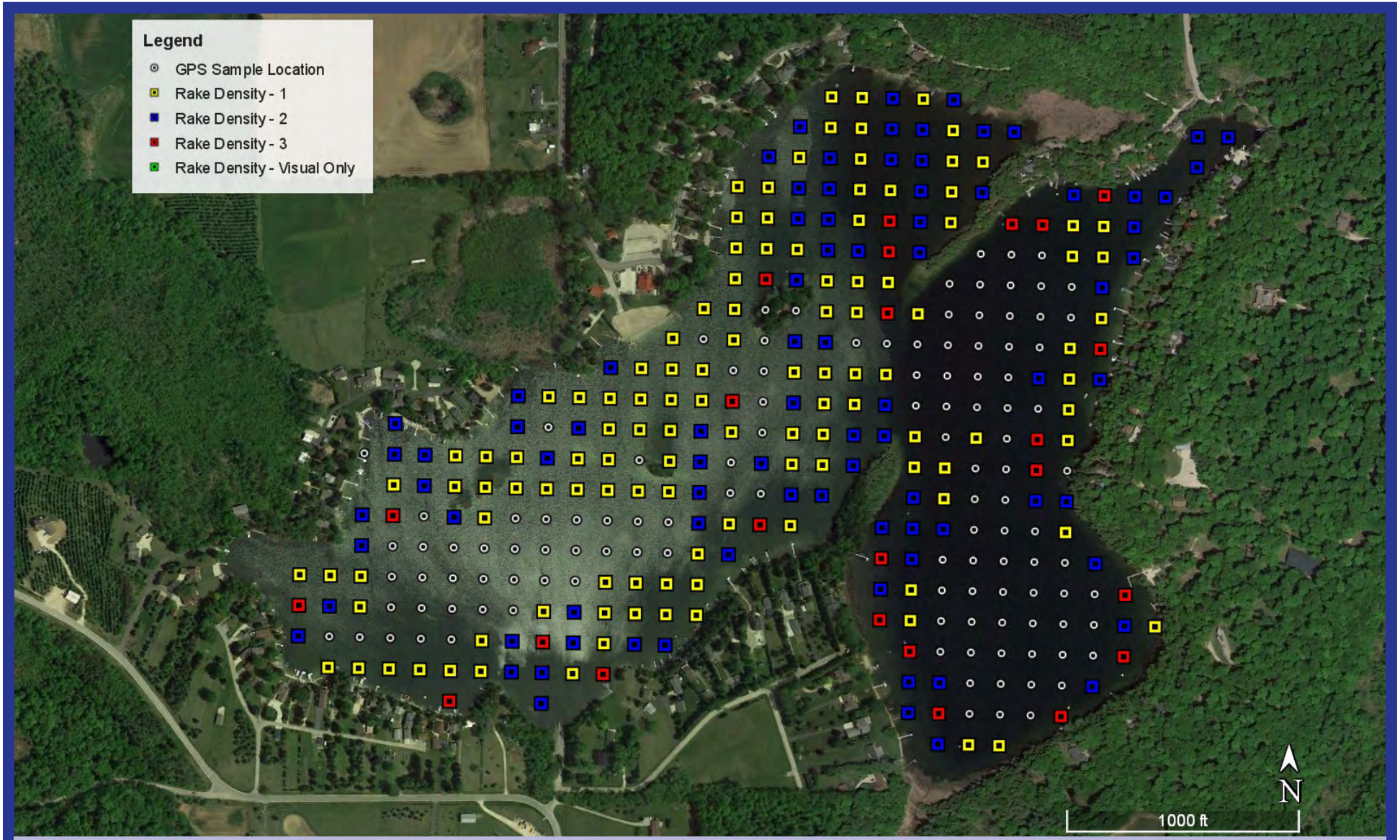
Species	Area B - 6/27/22 vs Post - 9/23/22			Area C - 6/27/22 vs Post - 9/23/22		
	P-value	Significance	+ / -	P-value	Significance	+ / -
Eurasian Water Milfoil	2.21374E-06	***	-	2.82827E-11	***	-
Water marigold	0.314266851	n.s.	+	0.304901788	n.s.	-
Coontail	0.314266851	n.s.	-	0.314266851	n.s.	+
Muskgrass	0.55620352	n.s.	-	0.723466343	n.s.	-
Common waterweed	0.01086976	*	-	0.45605654	n.s.	-
Slender naiad	0.745441059	n.s.	-	0.047888507	*	+
Large-leaf pondweed	---	---	---	0.01086976	*	+
Leafy pondweed	---	---	---	0.55620352	n.s.	+
White-stem pondweed	0.235222145	n.s.	+	0.033883477	*	+
Fern pondweed	0.018574632	*	-	0.136037128	n.s.	+
Flat-stem pondweed	0.007419649	**	+	0.616523791	n.s.	-
Arrowhead species	---	---	---	0.152078081	n.s.	-
Common bladderwort	0.314266851	n.s.	-	---	---	---
Wild celery	0.80488767	n.s.	+	0.073278107	n.s.	+

* - somewhat significant change, ** - moderatly significant change, *** - very significant change

n.s. - Change not significant

--- - Species was not sampled in both comparison surveys

FIGURES



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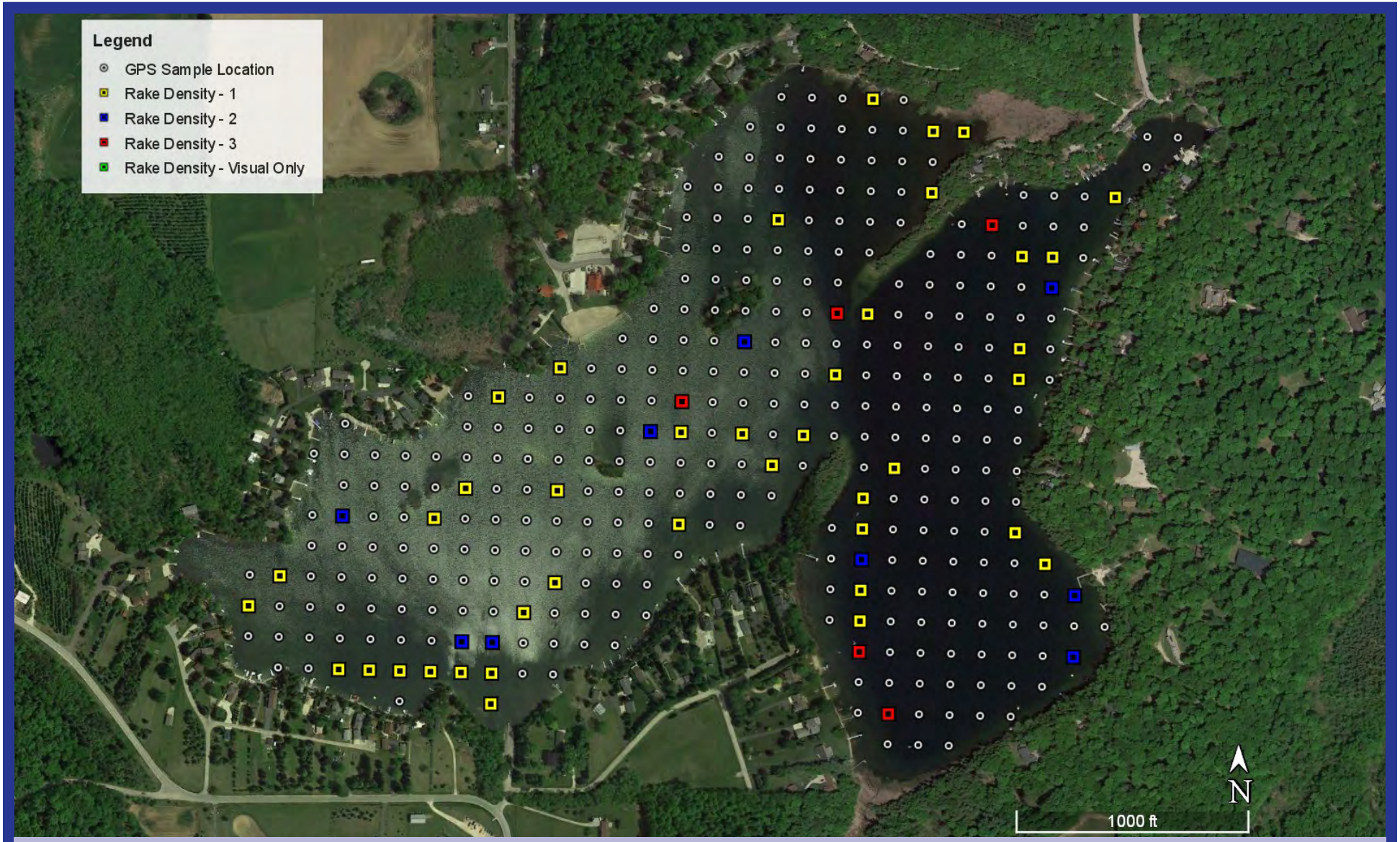
Total Rake Fullness

Surveyed: August 24-25, 2021

Figure 1
Cedar Lake
Manitowoc County



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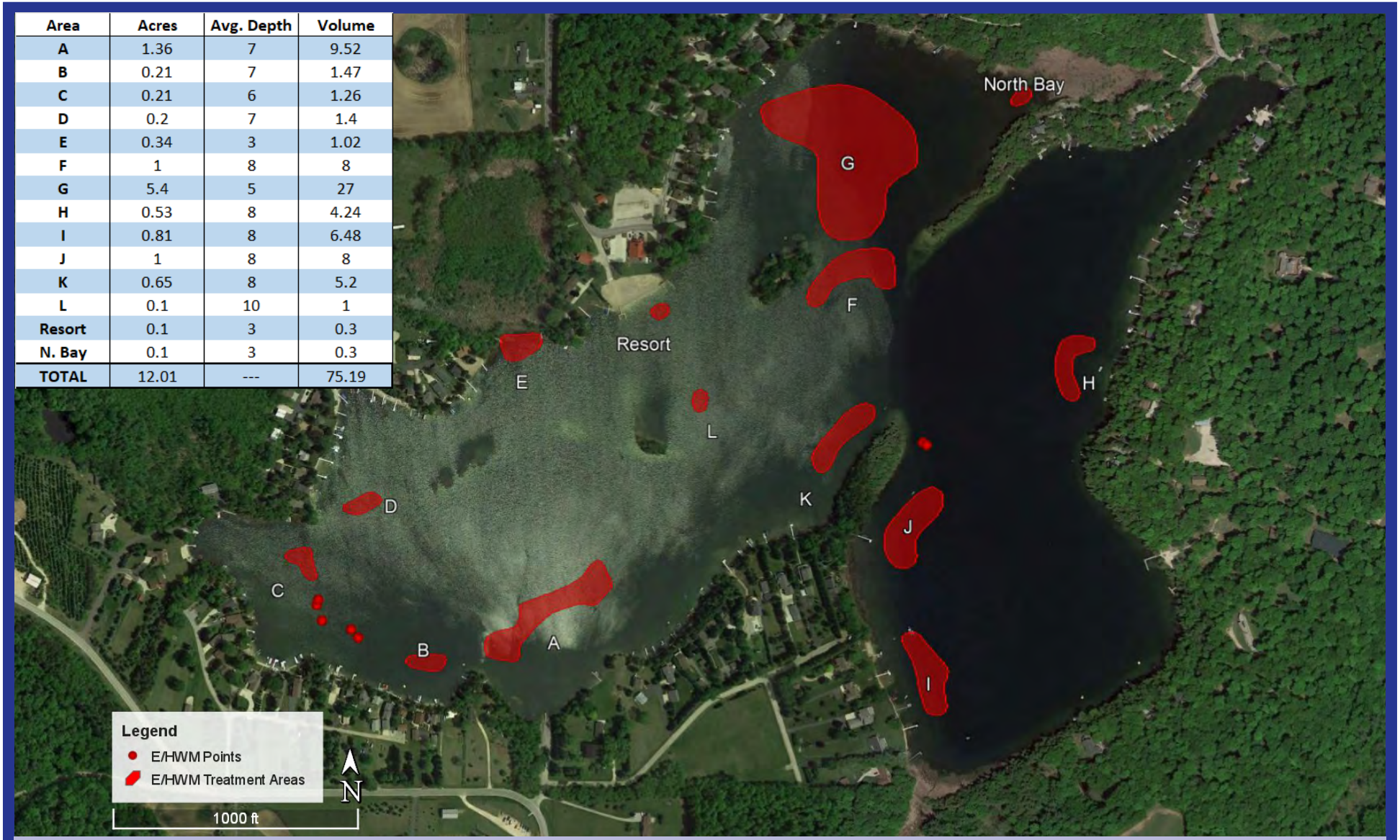
Eurasian Water-milfoil Locations

Surveyed: August 24-25, 2021

Figure 1
Cedar Lake
Manitowoc County

Area	Acres	Avg. Depth	Volume
A	1.36	7	9.52
B	0.21	7	1.47
C	0.21	6	1.26
D	0.2	7	1.4
E	0.34	3	1.02
F	1	8	8
G	5.4	5	27
H	0.53	8	4.24
I	0.81	8	6.48
J	1	8	8
K	0.65	8	5.2
L	0.1	10	1
Resort	0.1	3	0.3
N. Bay	0.1	3	0.3
TOTAL	12.01	---	75.19



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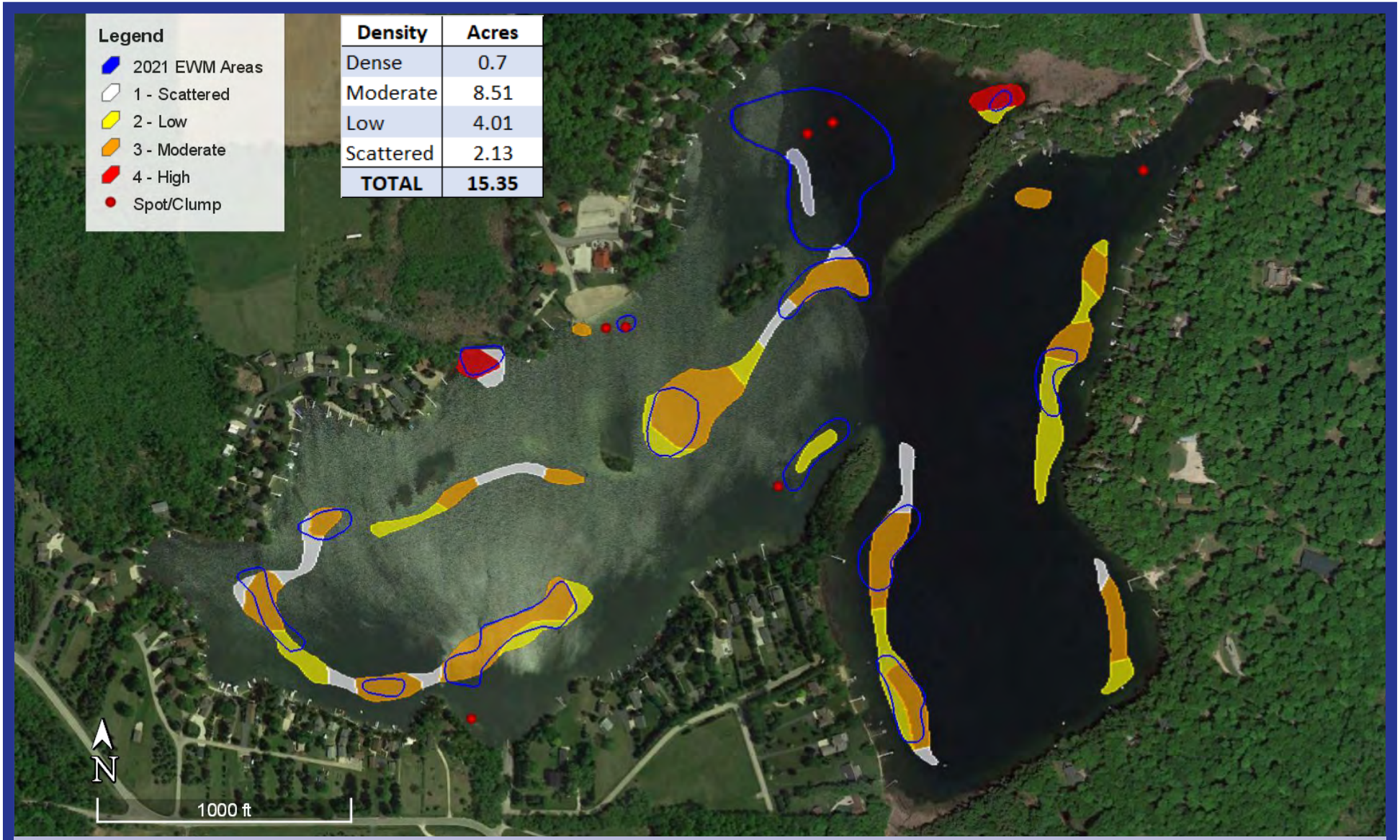
2021 Eurasian Water-milfoil Areas

Figure 3a
Cedar Lake, Manitowoc County
Surveyed: May 10, 2021



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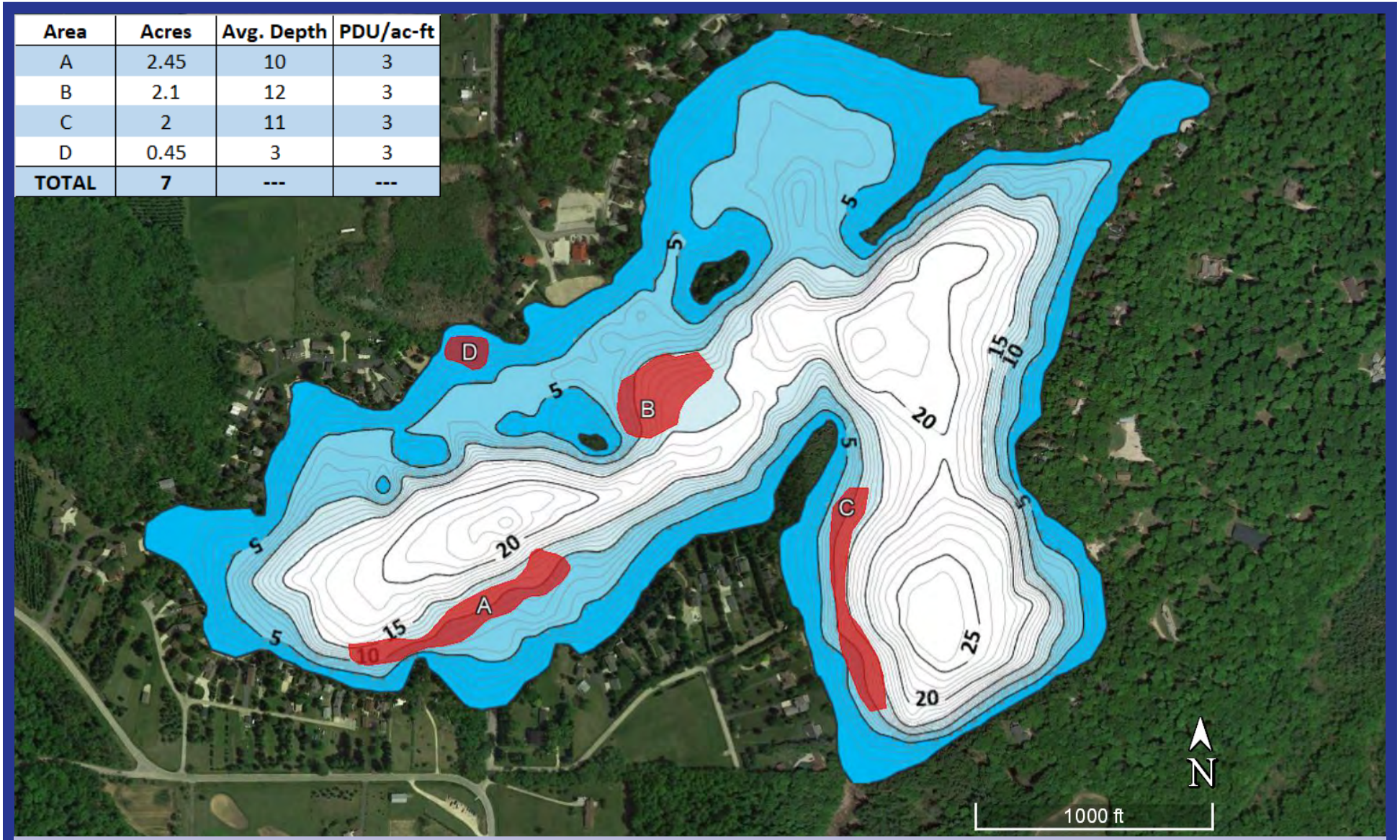
2022 Eurasian Water-milfoil Locations

Pre-Treatment - Surveyed: May 27, 2022

Figure 3b
Cedar Lake
Manitowoc County

Area	Acres	Avg. Depth	PDU/ac-ft
A	2.45	10	3
B	2.1	12	3
C	2	11	3
D	0.45	3	3
TOTAL	7	---	---



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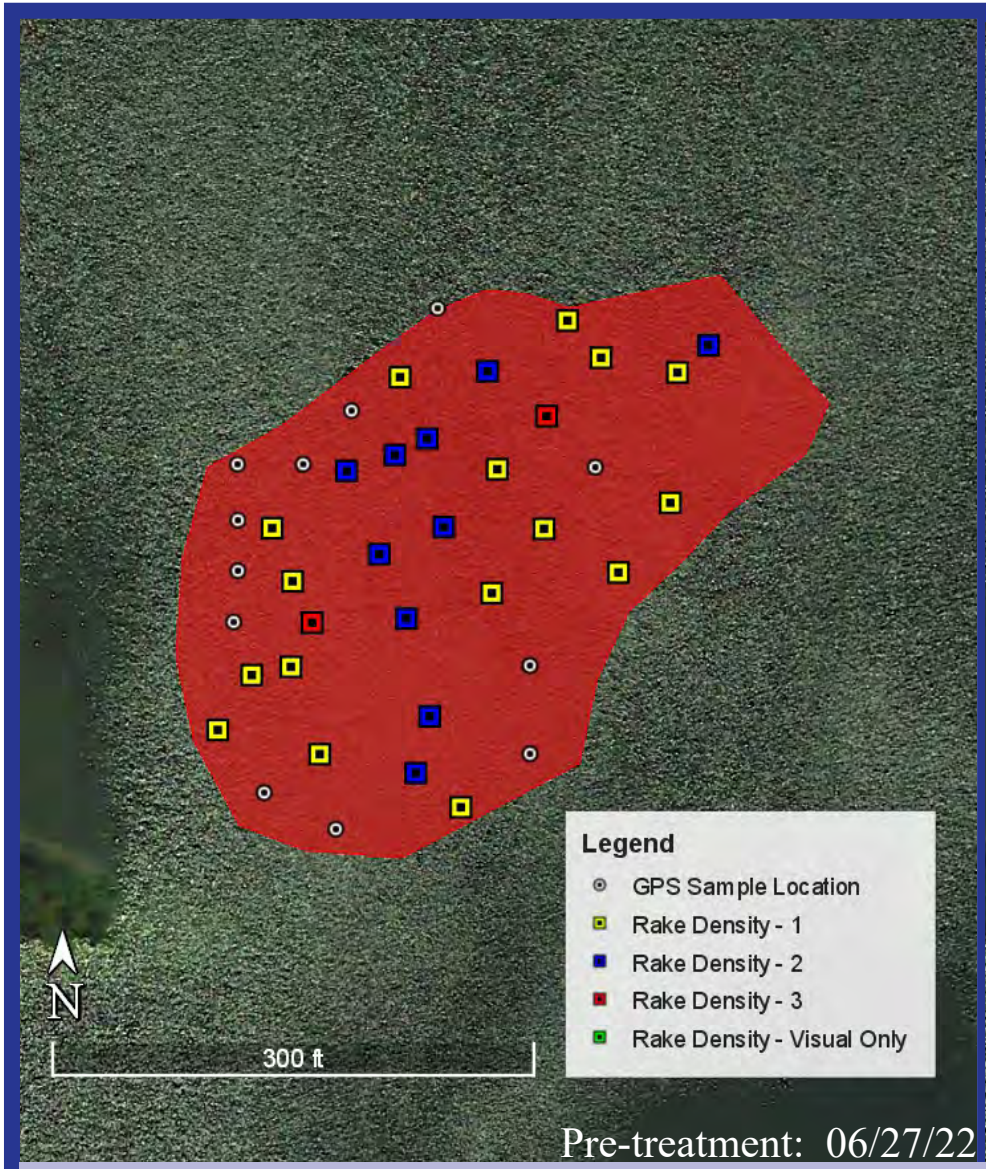
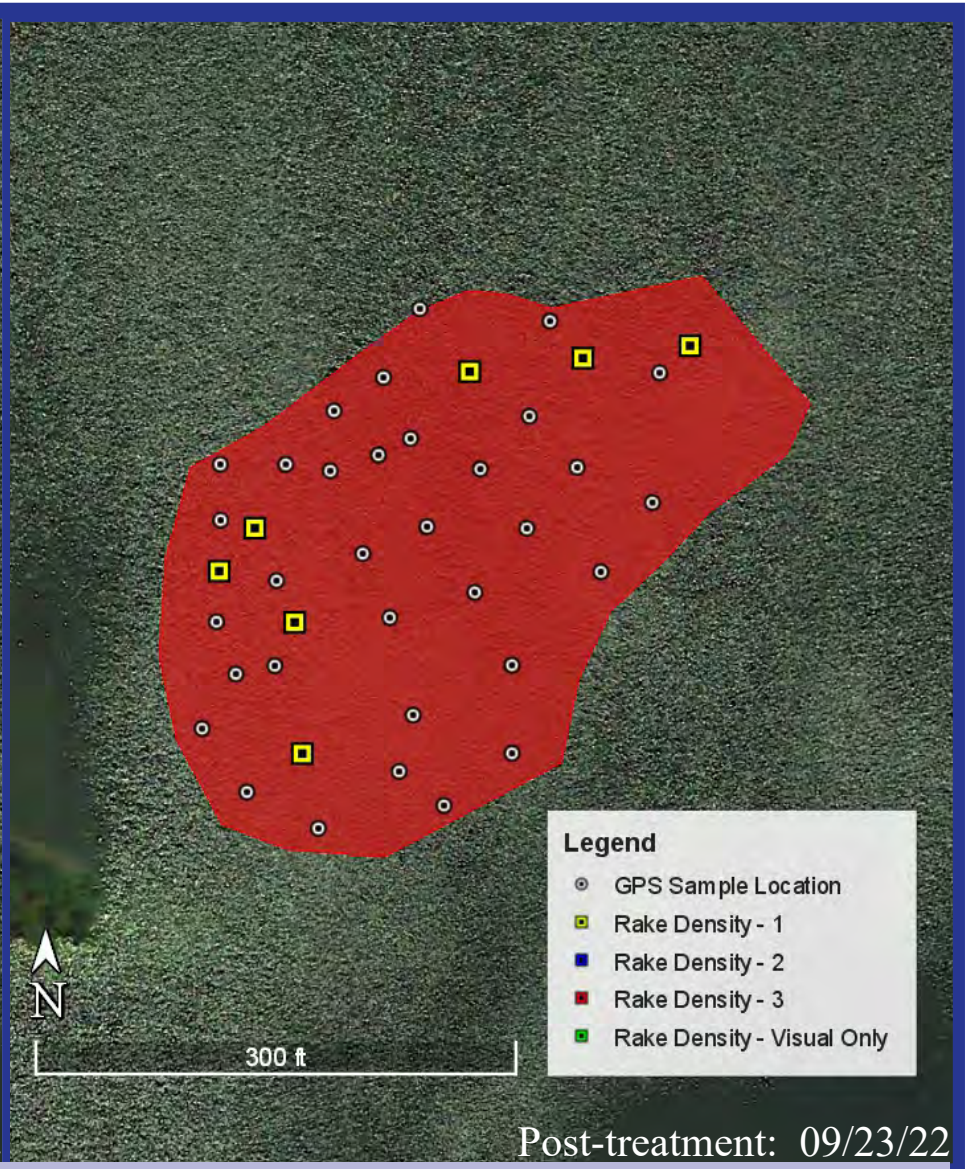
2022 Eurasian Water-milfoil Control Areas

Surveyed: May 27, 2022

Figure 3c
Cedar Lake
Manitowoc County



Pre-treatment: 06/27/22



Post-treatment: 09/23/22

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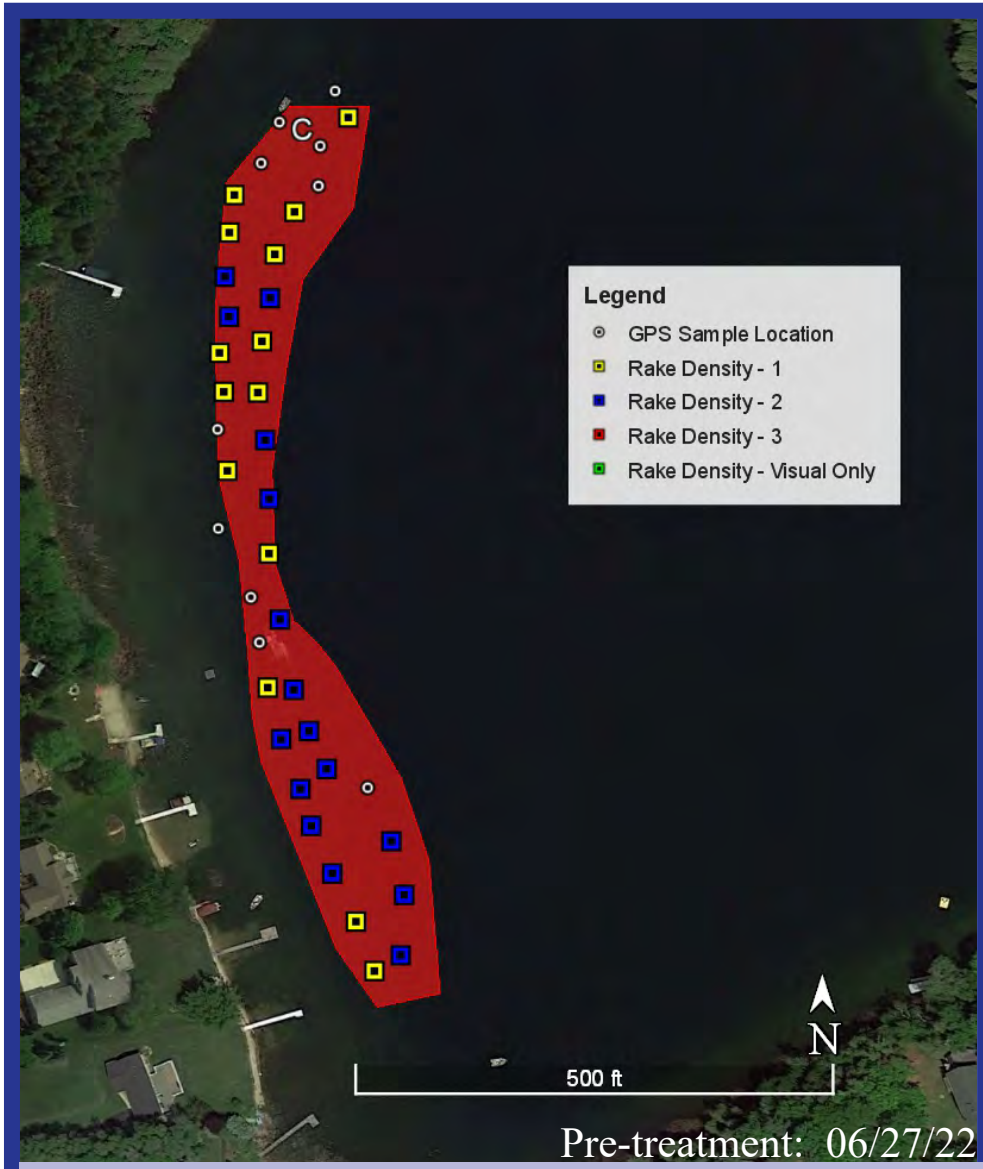
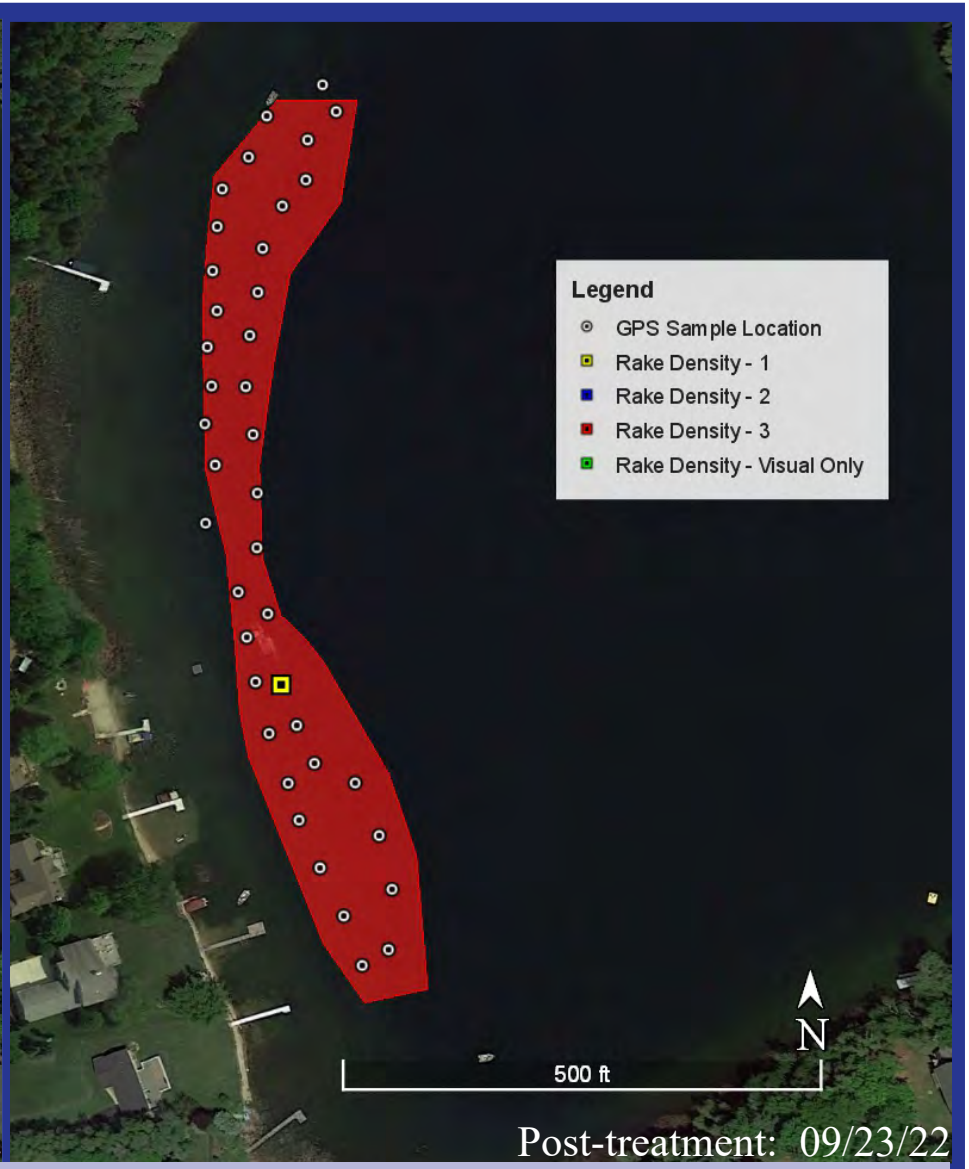
2022 EWM Treatment Results - Area B

Figure 4a
Cedar Lake
Manitowoc County





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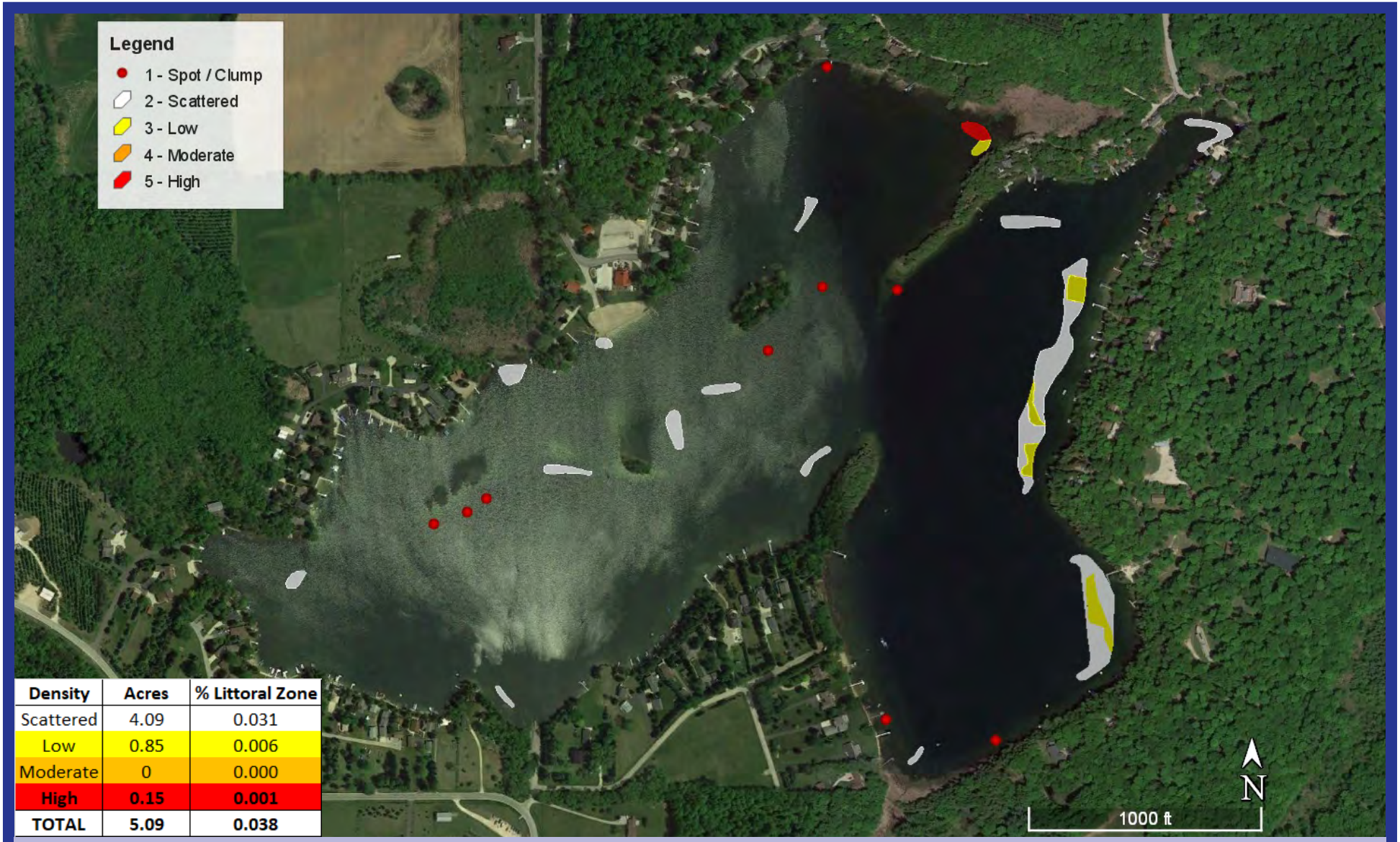
2022 EWM Treatment Results - Area C

Figure 4b
Cedar Lake
Manitowoc County



Density	Acres	% Littoral Zone
Scattered	4.09	0.031
Low	0.85	0.006
Moderate	0	0.000
High	**0.15**	**0.001**
TOTAL	**5.09**	**0.038**

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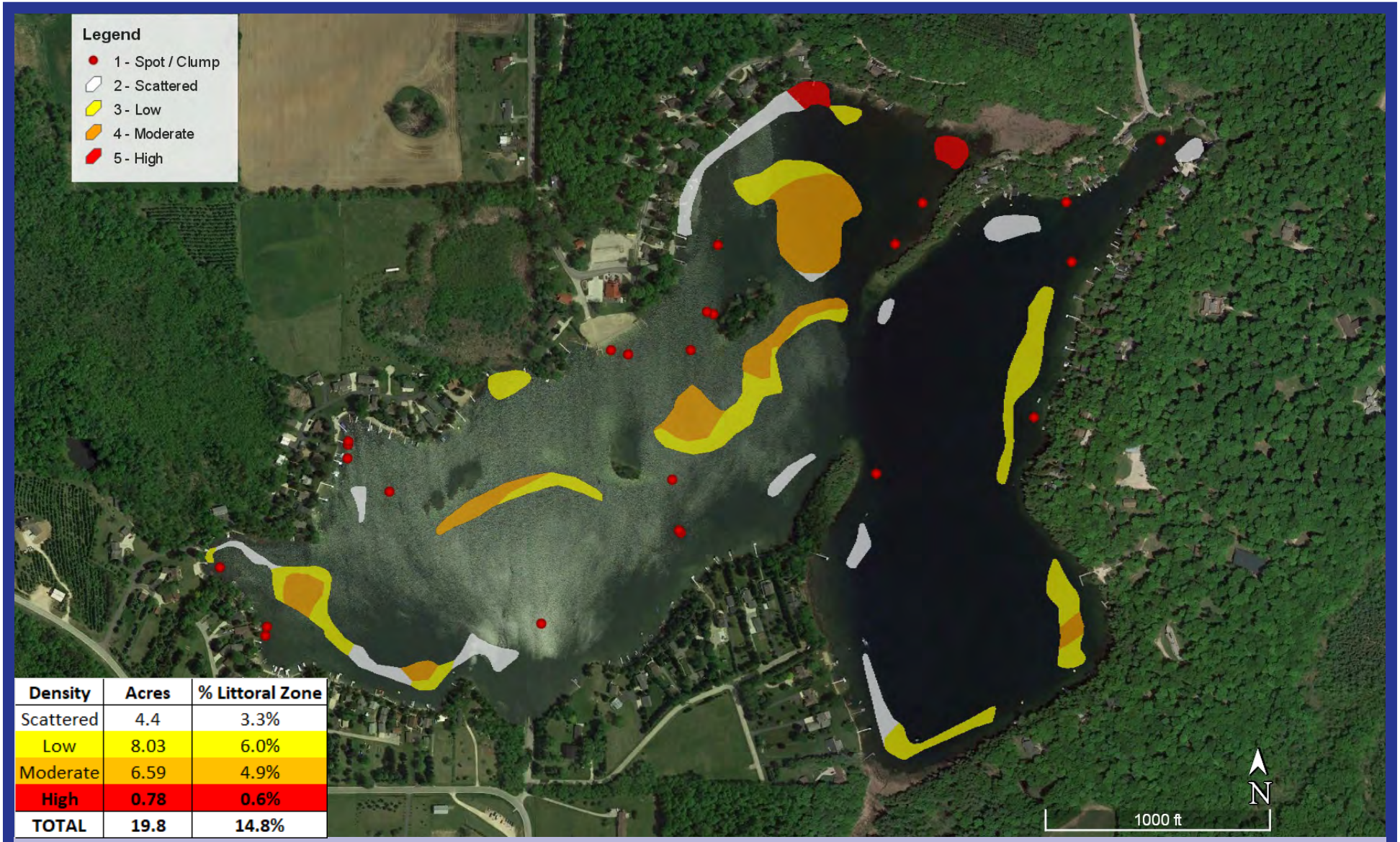
2022 Eurasian Water-milfoil Locations

Post-Treatment - Surveyed: September 23, 2022

Figure 5a
Cedar Lake
Manitowoc County



Density	Acres	% Littoral Zone
Scattered	4.4	3.3%
Low	8.03	6.0%
Moderate	6.59	4.9%
High	**0.78**	**0.6%**
TOTAL	**19.8**	**14.8%**

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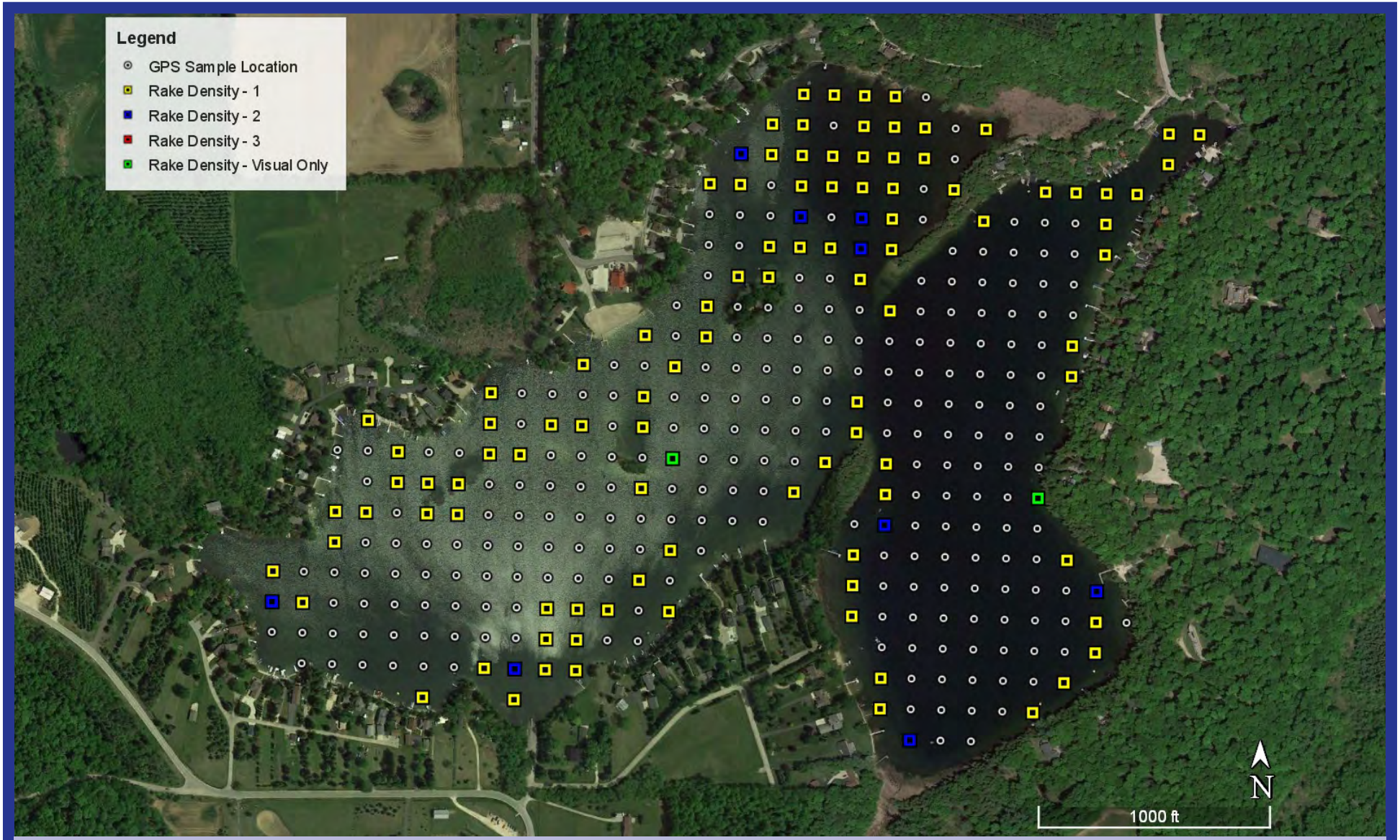
2023 Eurasian Water-milfoil Locations

Surveyed: September 22, 2023

Figure 5b
Cedar Lake
Manitowoc County



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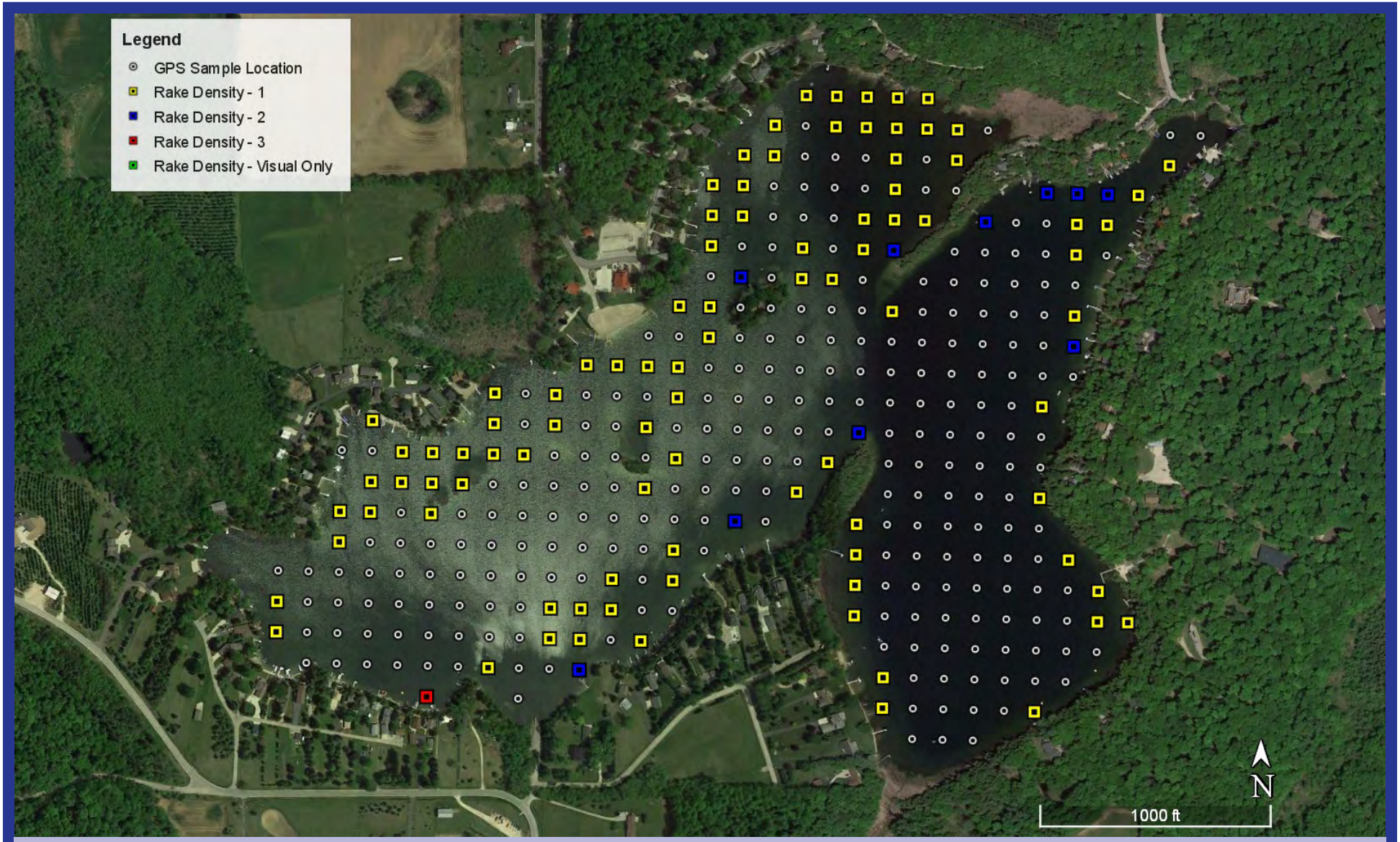
Wild Celery Locations

Surveyed: August 24-25, 2021

Figure 6
Cedar Lake
Manitowoc County



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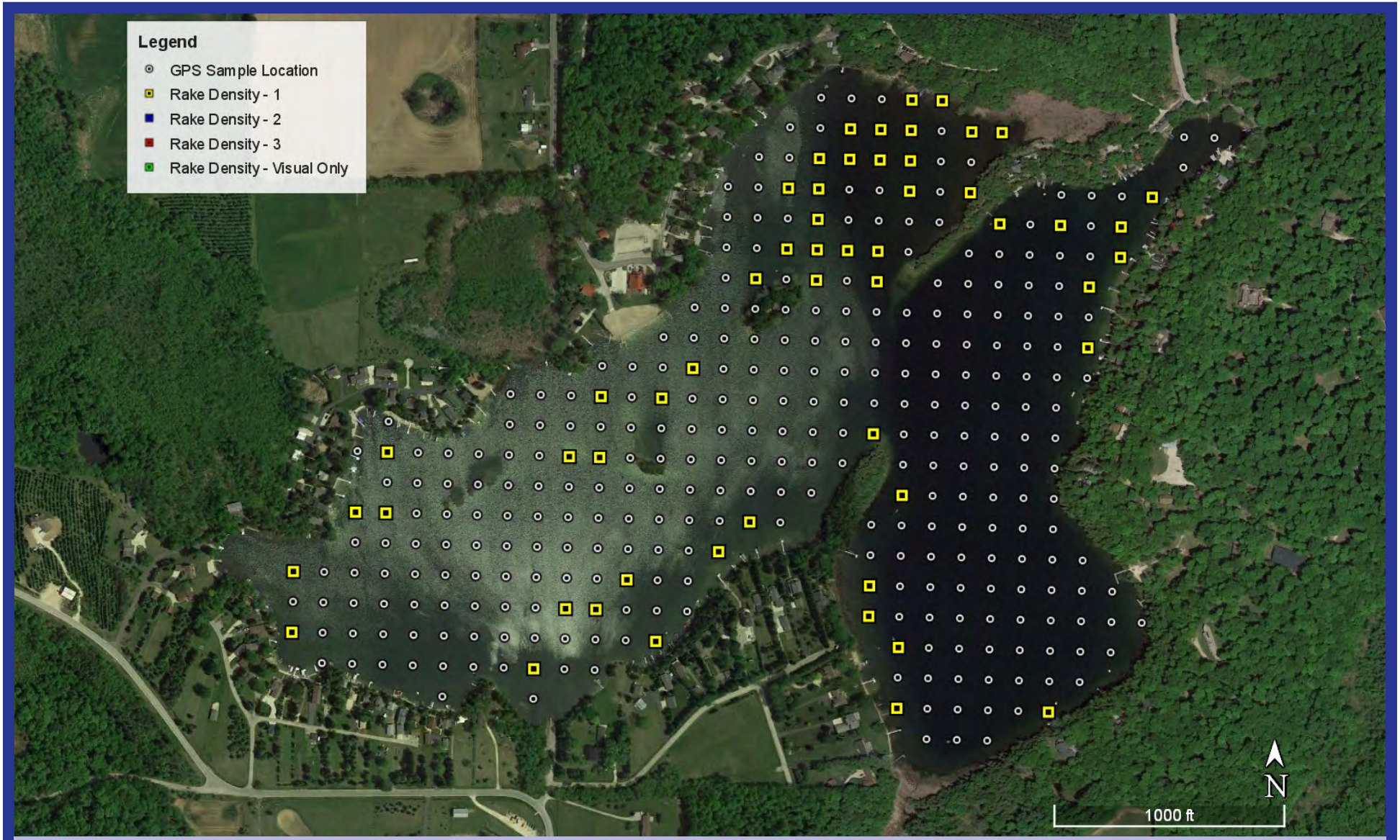
Slender Naiad Locations

Surveyed: August 24-25, 2021

Figure 7
Cedar Lake
Manitowoc County



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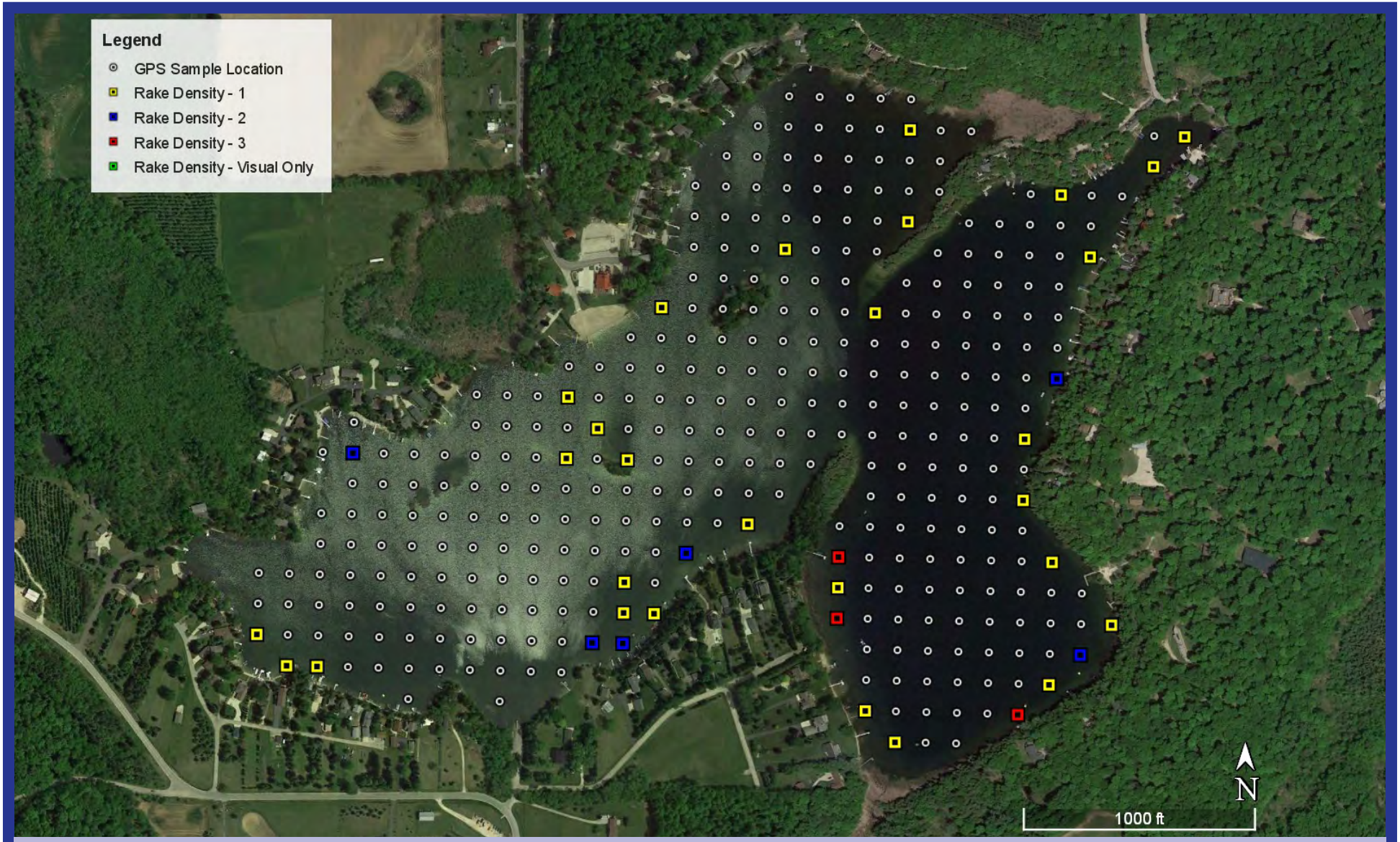
Illinois Pondweed Locations

Surveyed: August 24-25, 2021

Figure 8
Cedar Lake
Manitowoc County



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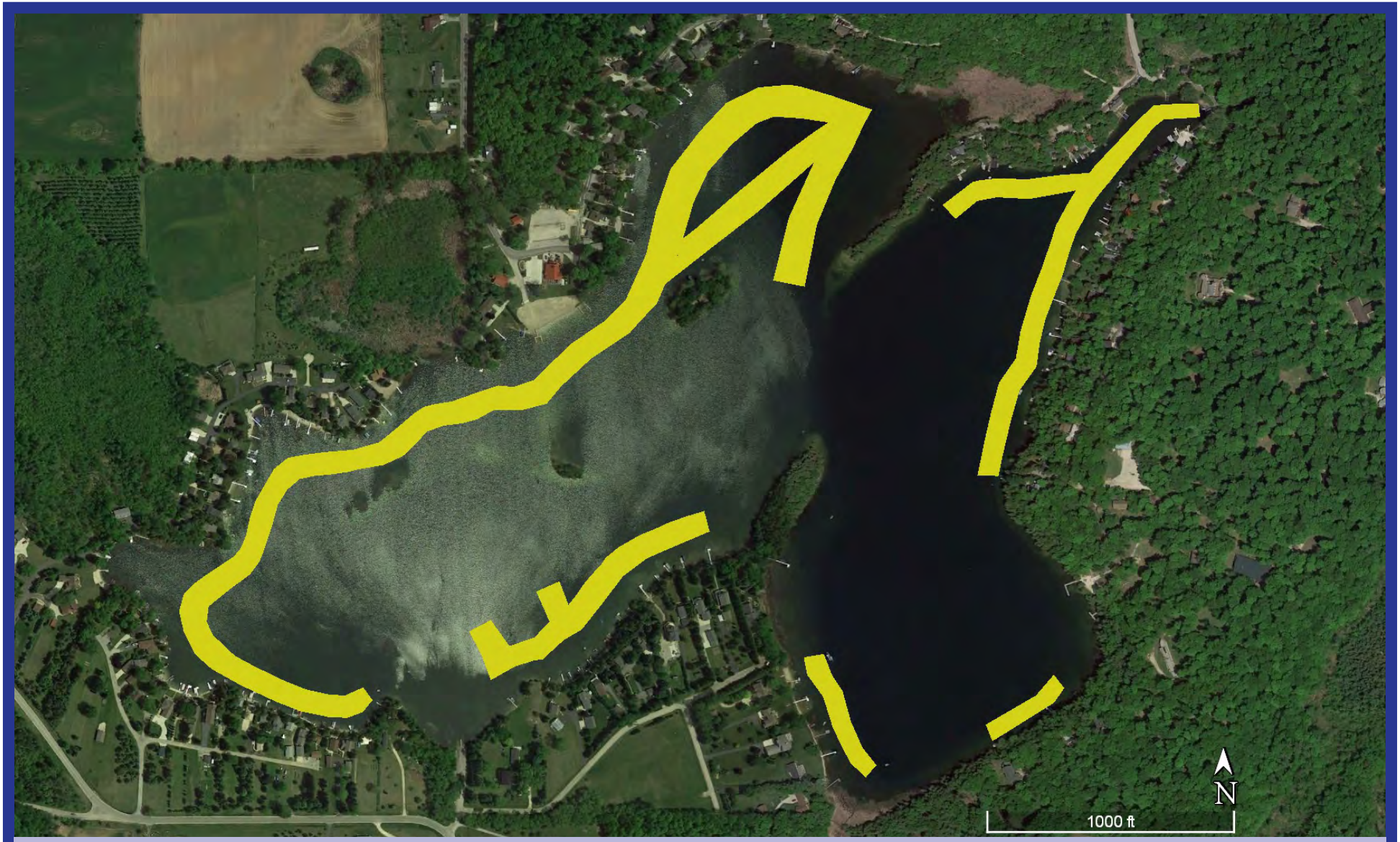
Chara / Muskgrass Locations

Surveyed: August 24-25, 2021

Figure 9
Cedar Lake
Manitowoc County



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Mechanical Harvesting Locations

- Harvesting only in depths of 5-ft or more
- Avoid harvest of high-value species except when navigation is impeded
- Total harvest area of 23.7 acres

Figure 10
Cedar Lake
Manitowoc County, WI

Hardstem bulrush: Area 4

White water lily: Areas 5 & 6

Watershield: Area 5

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Environmentally Sensitive Areas

Figure 11
Cedar Lake
Manitowoc County