

Aquatic Plant Management Plan

Okee Bay Mill Pond- Lake Wisconsin

Columbia County, Wisconsin
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Executive Summary

This document, Okee Bay Aquatic Plant Management Plan (OBAPMP) will cover the years 2025 through 2028. The plan includes data about the plant community, watershed and water quality of the lake.

This will be the first Aquatic Plant Management Plan (APMP) for the Okee Bay, although the currently have a 1 year cutting permit they are looking to upgrade to a 5-year permit.

Native plants provide fish and wildlife habitat, stabilize bottom sediments, reduce the impact of waves against the shoreline, and prevent the spread of non-native invasive plants all critical functions for the lake.

A special thank you is extended to the Okee Bay (Mill Pond) Lake Association (OBLA) for the assistance with OBAPMP update.

Plan Goals

- 1. Provide recreation opportunities while protecting the ecological integrity of Okee Bay,***
- 2. Maintain boating navigation opportunities through Okee Bay,***
- 3. Protect Okee Bay ecosystem,***
- 4. Protect Okee Bay fish community,***
- 5. Maintain 2024 Aquatic Plant Management Program with annual adjustments based on monitoring,***
- 6. Promote Native Plant Community and Reduce Aquatic Invasives Species.***

Introduction

The Aquatic Plant Management Plan for Okee Bay is sponsored by the Columbia County Land and Water Conservation Department (CCLWCD). The in-lake aquatic plant PI survey was conducted by WDNR. The plan includes data about the plant community, fish community, watershed, and water quality of the lake. A fish study was conducted in 2024, as such the fish section will be updated with current data upon its completion. The updated plan will guide the OBLA and the Wisconsin Department of Natural Resources in aquatic plant management for Okee Bay over the remaining four years (from 2025 through 2028) of a 5 year permit

Okee Bay - Lake Wisconsin Lake Information

Lake Wisconsin (WBIC- 1260600) is a eutrophic, impoundment of the Wisconsin River system in Columbia and Sauk Counties in Wisconsin located at 43.3710228, -89.6030917. The Water Body Identification Code is 1260600. It has a maximum depth of 24 feet. There are 15 boat launches on the water body. Walleye, Largemouth Bass, Smallmouth Bass, and Northern Pike are fish species considered common, while Trout, Panfish, and Catfish are listed as present. Curly-Leaf Pondweed, Eurasian Water-Milfoil, Zebra Mussel are the invasives on in the waterbody. Okee Bay is a Mill Pond creating a subset of Lake Wisconsin. Okee Bay is a shallow eutrophic mill pond off of Lake Wisconsin roughly 222 acres in size.

Lake Wisconsin (WBIC- 1260600)	
Size (Acres)	7197
Maximum depth (feet)	24
Littoral zone depth (feet)	8'

Table 1 Lake Wisconsin Lake Information

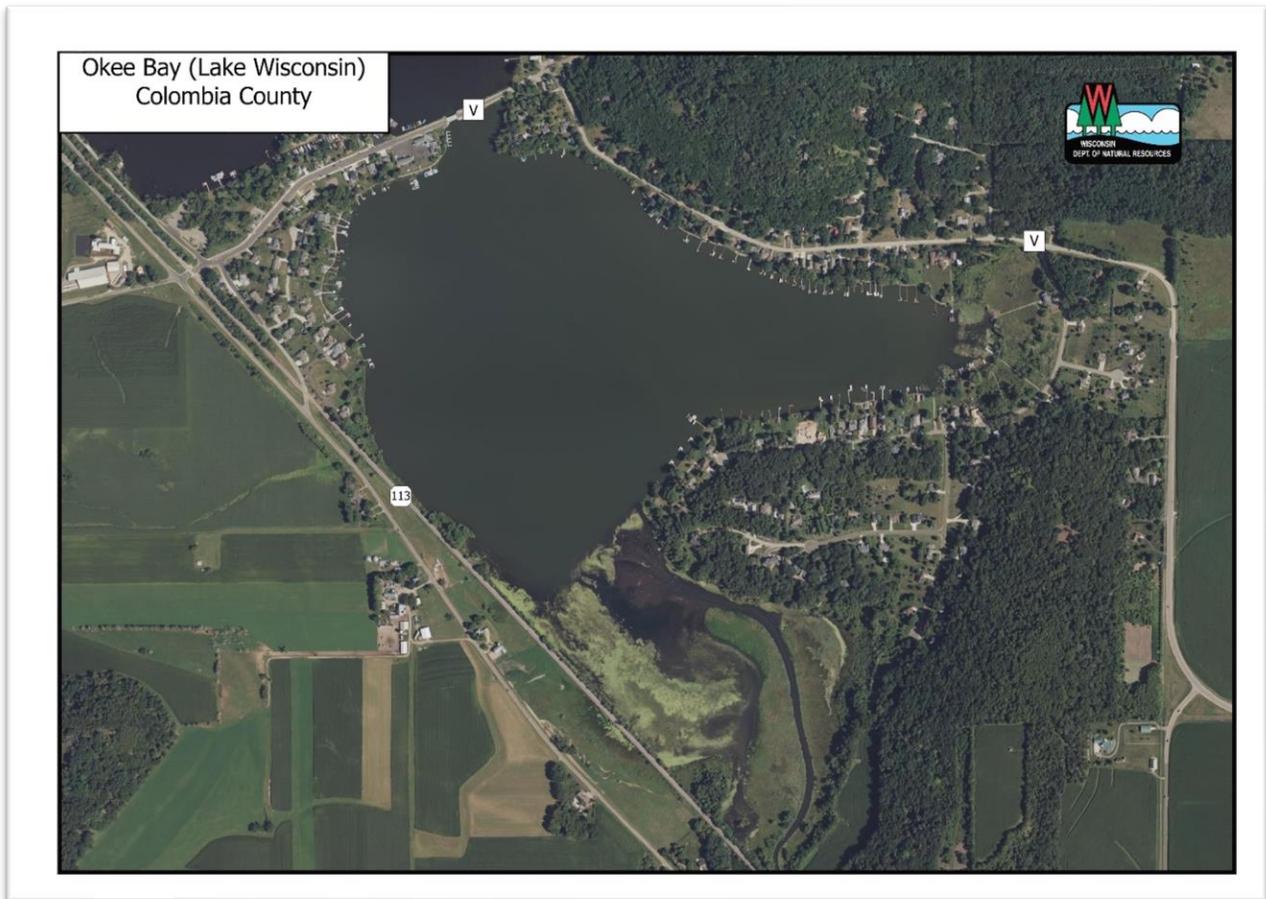


Figure 1 Okee Bay Lake Map

Watershed Description

Okee Bay Watershed is in south central Wisconsin on the border of Columbia County and Dane County. It flows northwest through the Lodi Marsh State Wildlife Area, into the City of Lodi, and empties into Lake Wisconsin. Spring Creek's headwaters and tributaries lie in an area with mixed land uses including forests, wetlands, and agriculture. Just below the confluence of the south and west branches of Spring Creek, Spring Creek flows through the City of Lodi and receives the effluent from its wastewater treatment plant before in drains into Lake Wisconsin. The watershed draining to Okee Bay Watershed is approximately 28,813 acres.

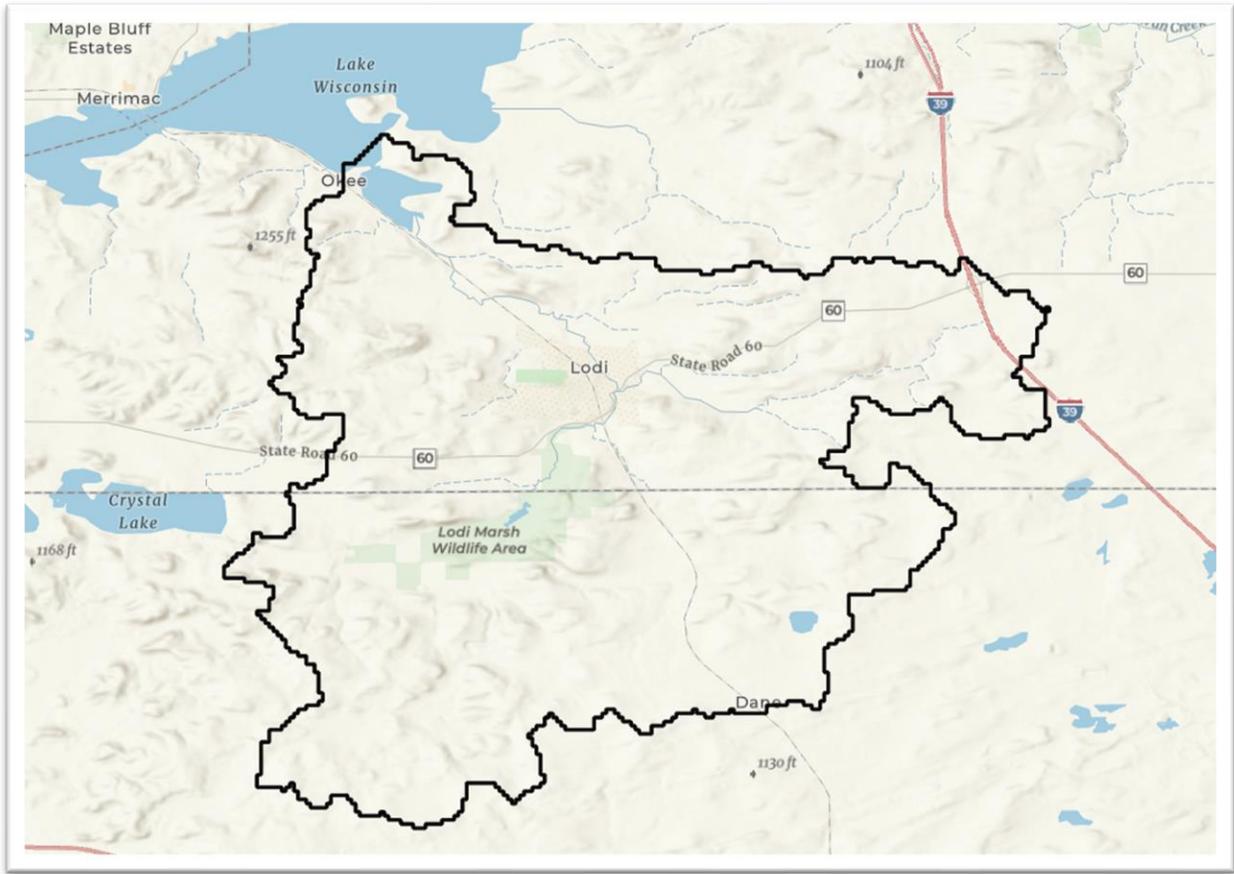


Figure 2 Okee Bay Watershed Map

Summary History

Water Quality

In Lake Water Quality

Water Quality data obtained in Okee Bay is limited. Plans are currently being implemented to train Citizen Lake Monitors for 2025 sampling season in Okee Bay

Year	2017	2018	2019	2020	2021	2022	2023
Secchi Disc (Ft.)	2.38	2.84	2.57	3.02	2.67	2.71	2.65

Table 2 Okee Bay Average Secchi Disc

Watershed Water Quality

During 2012, water quality samples were collected by grab method on a bi-weekly schedule at each of five monitoring sites beginning in March and ending in November. Samples were collected by staff from Columbia County LWCD and brought to UWSP's state certified Water and Environmental Analysis Lab (WEAL). Each water sample was analyzed for total suspended solids (TSS), total phosphorus (TP), soluble reactive phosphorus (SRP), total Kjeldahl nitrogen (TKN), nitrate (NO₂+NO₃-N), ammonium (NH₄), and chloride (Cl). Field parameters were also measured by Columbia County LWCD professionals at the time of sample collection including pH, specific conductance, dissolved oxygen, and temperature using an YSI multi-meter. Stream discharge was measured at each site with a Swiffer current velocity meter and corresponding staff gauge readings were recorded on the same date. During the sampling period, continuous flow and temperature were recorded with Solinst Level loggers at each site.

Total phosphorus (TP) was the primary focus of this study because of its role in the eutrophication in Spring Creek and Lake Wisconsin. Wisconsin's TP criteria for a wadable stream or river is a median concentration of 75 µg/L, in samples collected between May 1 and October 31 of each year (WI Administrative Code NR102.06). Median concentrations greater than 75 µg/L can contribute to changes in the aquatic ecosystem related to increases in algae and aquatic plant growth. In 2012, median TP concentrations at sites LS01, LS02, and LS05 were below 75 µg/L, LS04 was exactly 75 µg/L, and LS03 had a median TP concentration of 103 µg/L (Figure 3).

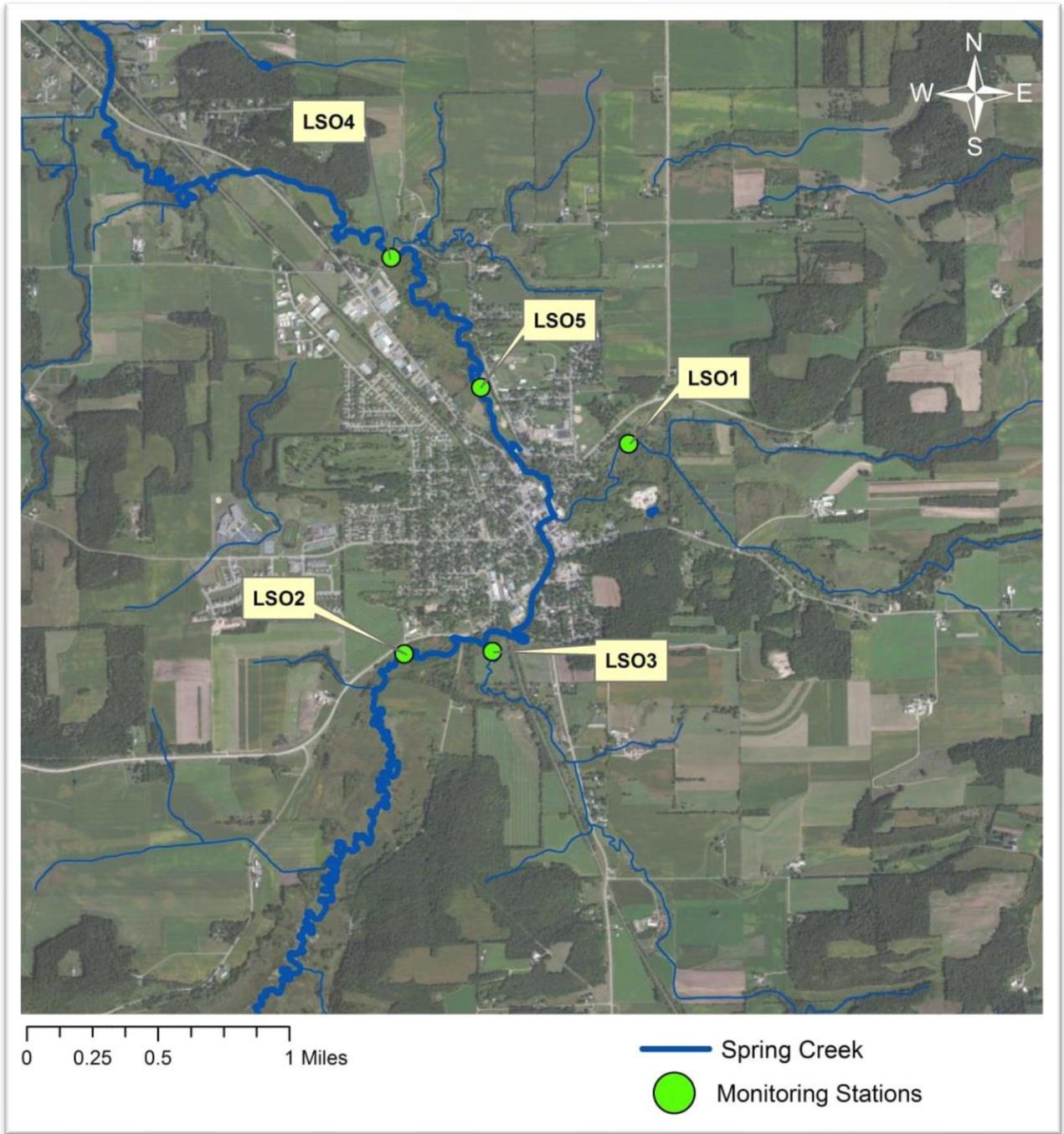


Figure 3. 2012 Spring Creek Monitoring Stations

Nitrate (NO₂+NO₃-N) comprised the greatest form of nitrogen in the stream samples. Inorganic forms of nitrogen exceeding 0.3 mg/L can result in increases in algae in lakes; however, criteria does not exist for flowing water. During 2012, median nitrate concentrations ranged from 2.6 mg/L to 7.9 mg/L. LS03 had the greatest nitrate concentrations, ranging from 6.8 mg/L to 7.9 mg/L. Concentrations at LS02 demonstrate expected background concentrations for this part of the state.

During low flow (baseflow) conditions, stream water generally represents an average concentration of the groundwater in the sub-watershed discharging to that site. With this in mind, there is concern that some of the private drinking water wells may have concentrations that exceed state and federal drinking water standard of 10mg/L. Therefore, we encourage landowners in the LS01 and LS03 sub-watersheds to have their drinking water tested for NO₂+NO₃-N.

Total suspended solids (TSS) is a measure of sediment in suspension in water. Soil erosion and other particles moving to the stream from the landscape or re- suspension of in-stream sediment can result in elevated TSS within Spring Creek, especially following snowmelt or storms. Samples collected from sites LS02 and LS05 exhibited increased median TSS concentrations during 2012 compared to those measured during 2011. Samples collected from site LS03 consistently had higher concentrations of TSS than the other sites.

In surface water, chloride (Cl) can be an indicator for human influence from land use practices in the watershed. In Wisconsin, background Cl concentrations are approximately 2mg/L. At sites LS01 and LS05, concentrations of Cl were greater during baseflow, suggesting that Cl is entering the streams via groundwater.

Bathymetric Mapping

In conjunction with the Aquatic Plant Data Collection, new depths were measured at every sampling interval. These depths were used to update the August 1955 WDNR Lake Wisconsin Bathymetric as seen below (Figure 4).

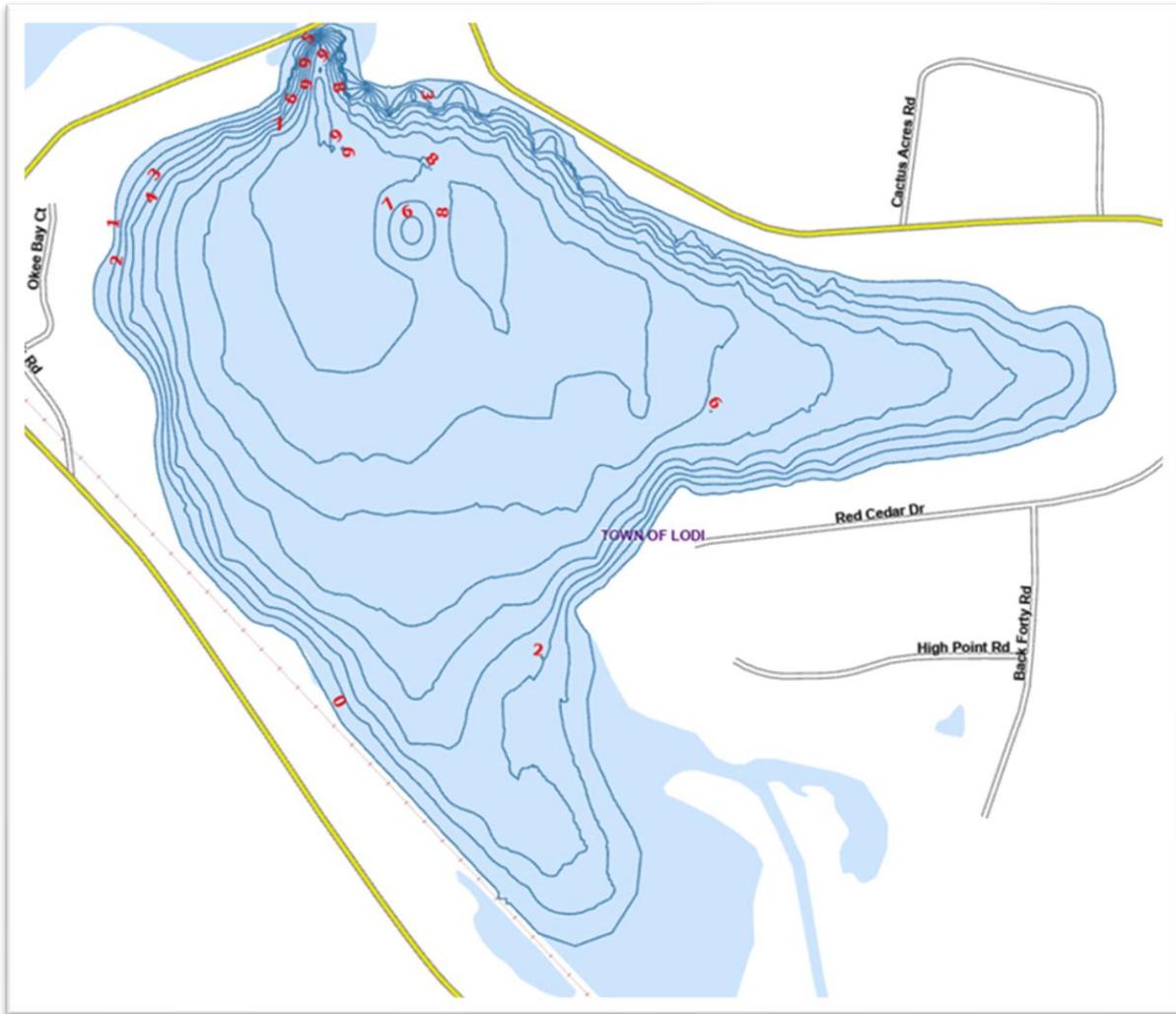


Figure 4 Okee Bay Bathymetric Map

Fishery

The tannin-rich waters of Lake Wisconsin have a stained appearance that limits light penetration in the water column. This inhibits aquatic macrophyte growth in much of the lake's main basin where shorelines quickly slope away into waters too deep to allow enough light penetration to facilitate plant growth. By contrast, the many bays found around the perimeter Lake Wisconsin are shallow enough to facilitate light penetration and plant growth, and they provide the vegetated littoral (near-shore) habitat that supports the healthy and thriving native fish community in the lake. Okee Bay is home to vast areas of aquatic macrophyte growth and serves as critical habitat for several fish species in Lake Wisconsin, including panfish (bluegills, crappies, pumpkinseeds and perch) as well as sportfish species including largemouth and smallmouth bass, walleye, sauger and northern pike. Depending on the species, these fish utilize habitat found in Okee Bay either seasonally or year-round, and for part or all their life cycle including spawning, hatching, rearing of early life stages and general feeding and living areas for adult fish. For this reason, extensive areas along the shoreline of Okee Bay are designated as Areas of Special Natural Resource Interest (ASNRI) by DNR as a measure of protection for the critical habitat they provide. Aquatic plant management efforts in Okee Bay must strike a delicate balance between serving recreational interests while also protecting the integrity of littoral habitat for fish.

Functions and Values of Native Aquatic Plants

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

Water Quality

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

Shallow lakes typically have two alternative stable states—phytoplankton (algae)-dominated or macrophyte (plant)-dominated. In moderate densities, macrophytes are beneficial in these lakes. Macrophytes keep sediment from being resuspended by the wind and, therefore, help keep the water less turbid.

Macrophytes also provide a place for attached algae to grow and remove phosphorus from the water column. If the macrophytes are removed or if external phosphorus inputs increase, the lake can shift from a macrophyte-dominated state to an algal-dominated state. Once a lake is in the algal-dominated state, macrophytes have a difficult time reestablishing themselves because algae reduce the penetration of light. Of these two conditions, it is commonly believed that the macrophyte-dominated state, which is present in Okee Bay, is more desirable for human and biological use than the algal-dominated state.

Fishing

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

Waterfowl

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

Protection against Invasive Species

Non-native invasive aquatic species threaten native plants in Wisconsin. The most common are Eurasian water milfoil (EWM) and curly leaf pondweed (CLP). These species are described as opportunistic invaders. This means that they take over openings in the lake bottom where native plants have been removed. Without competition from other plants, these invasive species may successfully become established and spread in the lake. This concept of opportunistic invasion can also be observed on land, in areas where bare soil is quickly taken over by weeds.

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

Plant Community

Aquatic Plant Survey Results

In April and August of 2023 full lake point intercept (PI) surveys were completed. In April a *Potamogeton crispus* (*Curly Leaf Pondweed*) survey was completed with a full lake survey of all species completed later in the growing season in August. This survey involved the

sampling of 170 predetermined points on Okee Bay. Figure 4 shows the sample location grid. At each sample point, a 14 tined rake was towed 1 meter and retrieved. Each plant species on the rake or that fell off the rake was identified and recorded at a density (1-3). Each sample point was given a combined full rake density (due to all plants on the rake), ranging from 1-3. Figures 5 and 6, shows the rake density of plants at each sample point. Okee Bay has plants at 56% of the lake bottom and 61 % of the littoral zone. Any location with a green, yellow or red dot has plants present. The blank area represent areas where no plants were sampled.

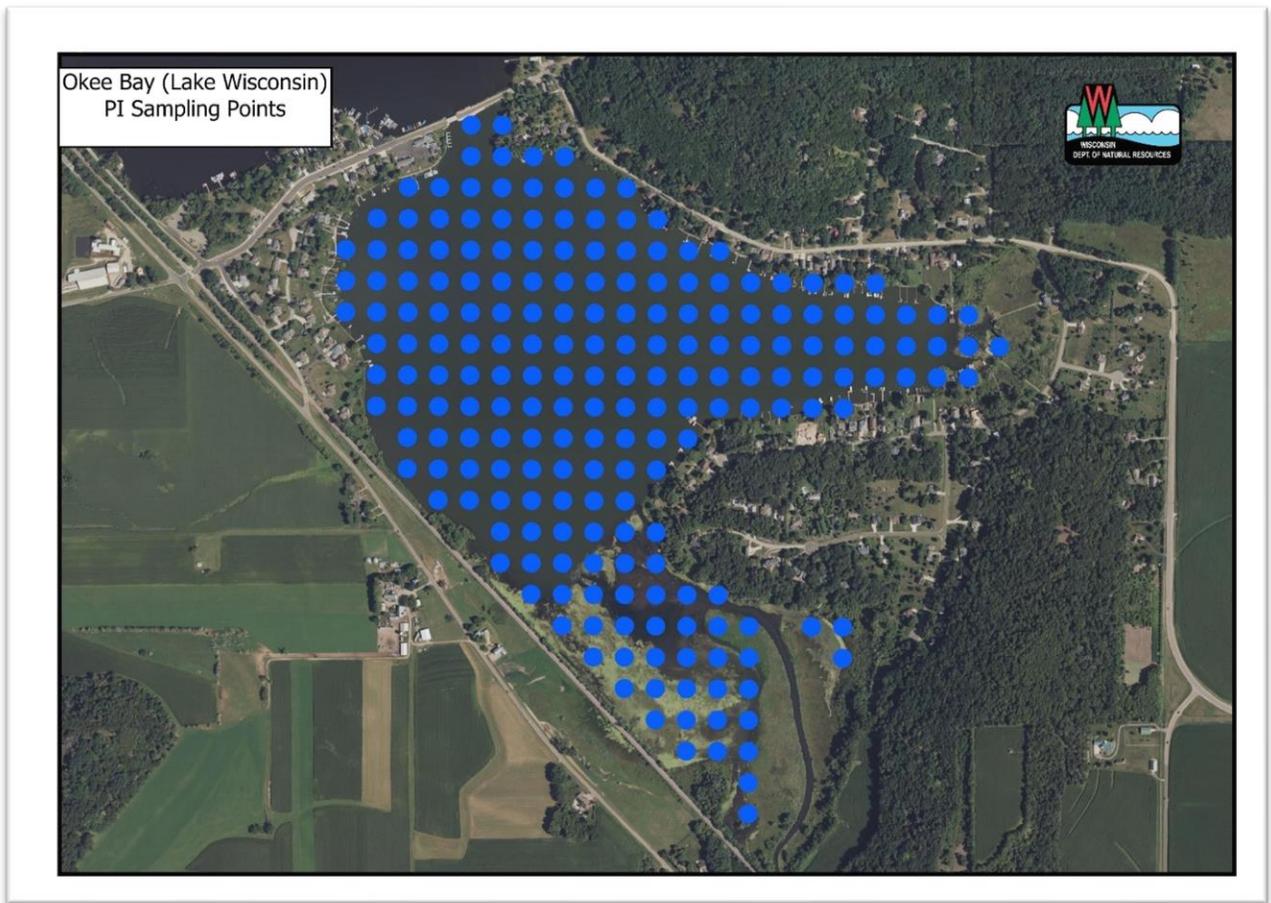


Figure 5 Okee Bay PI Map

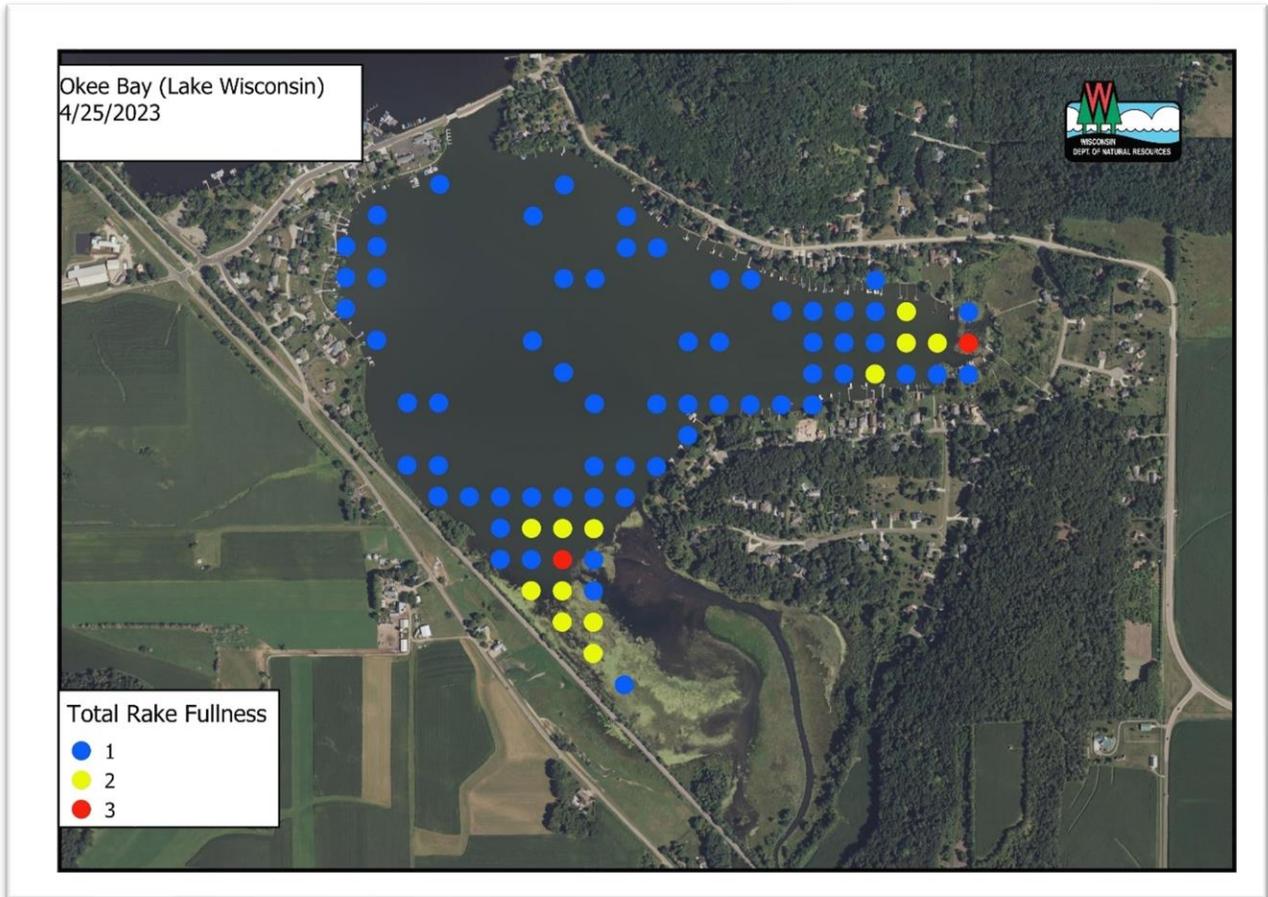


Figure 6 Total Rake Fullness 4/25/2023

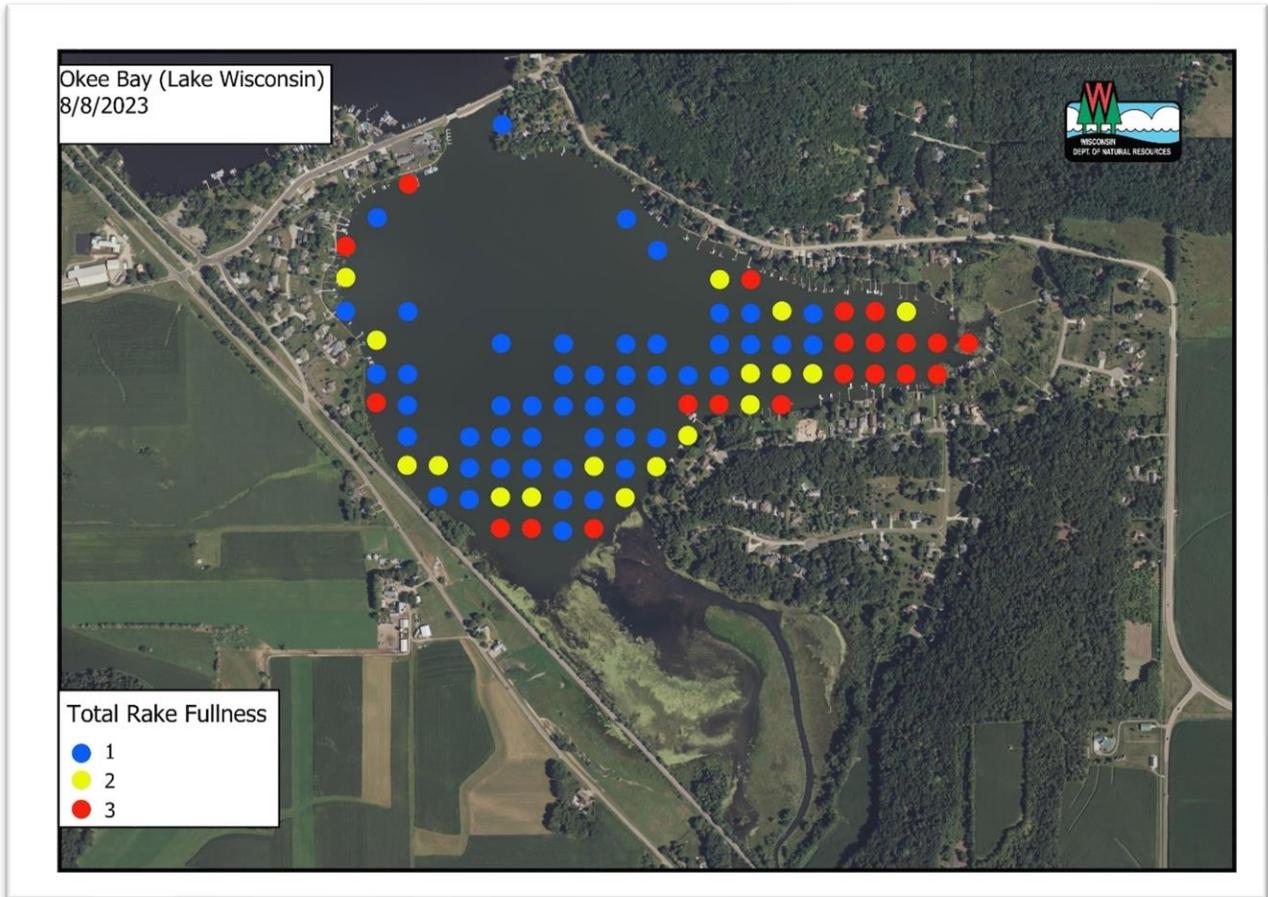


Figure 7 Total Rake Fullness 8/8/2023

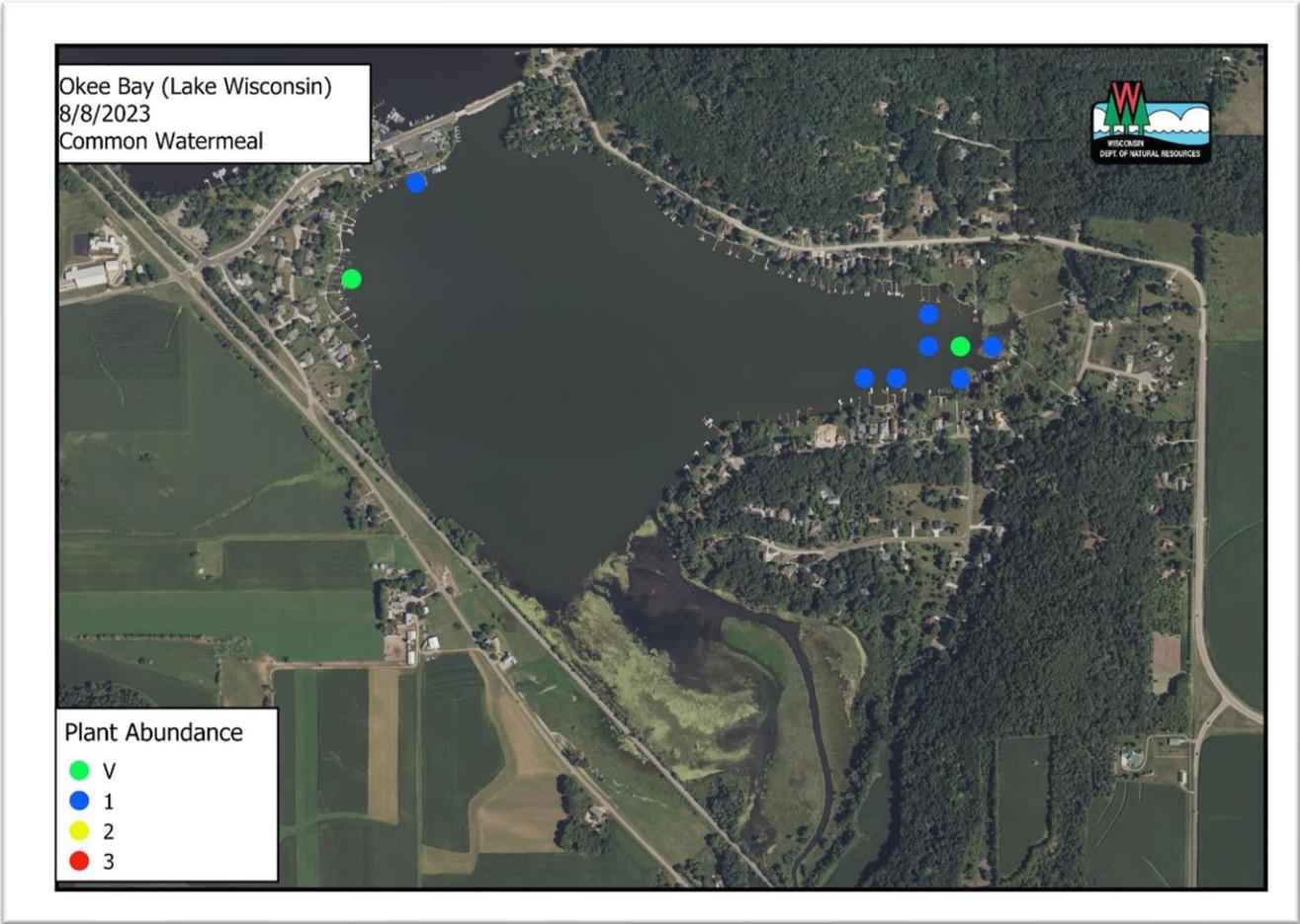


Figure 8 Common Watermeal

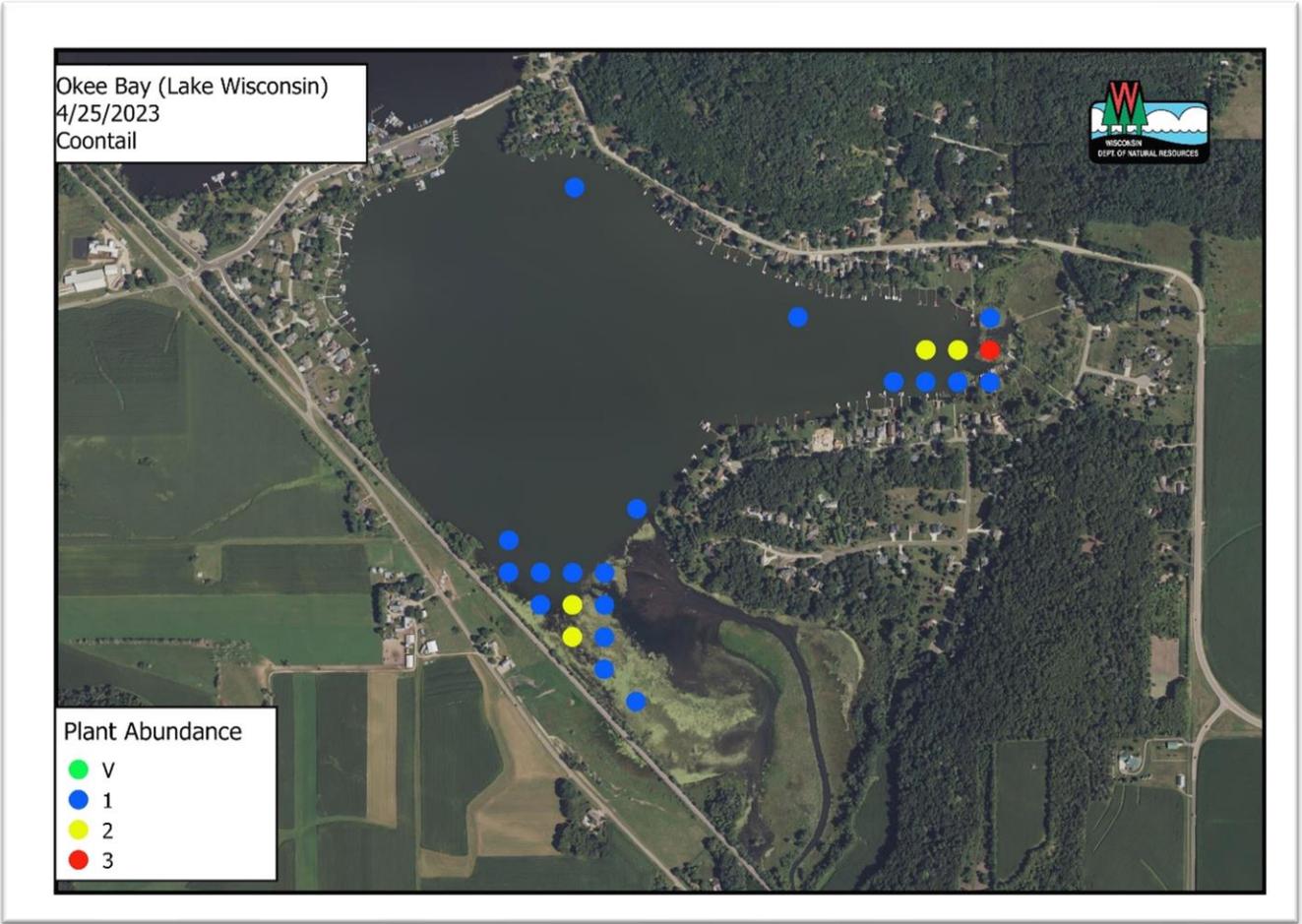


Figure 9 Coontail 4/25/2023

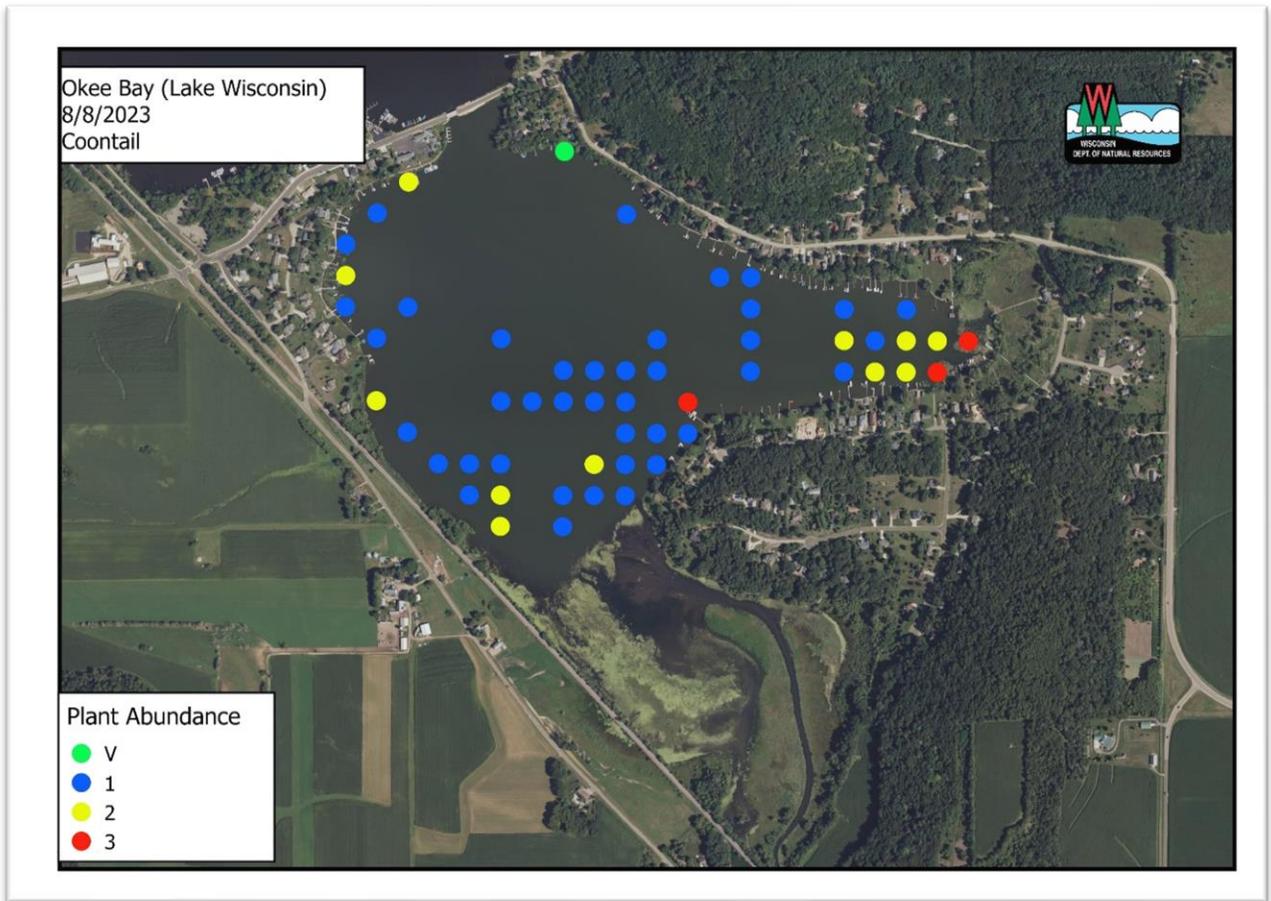


Figure 10 Coontail 8/8/2023

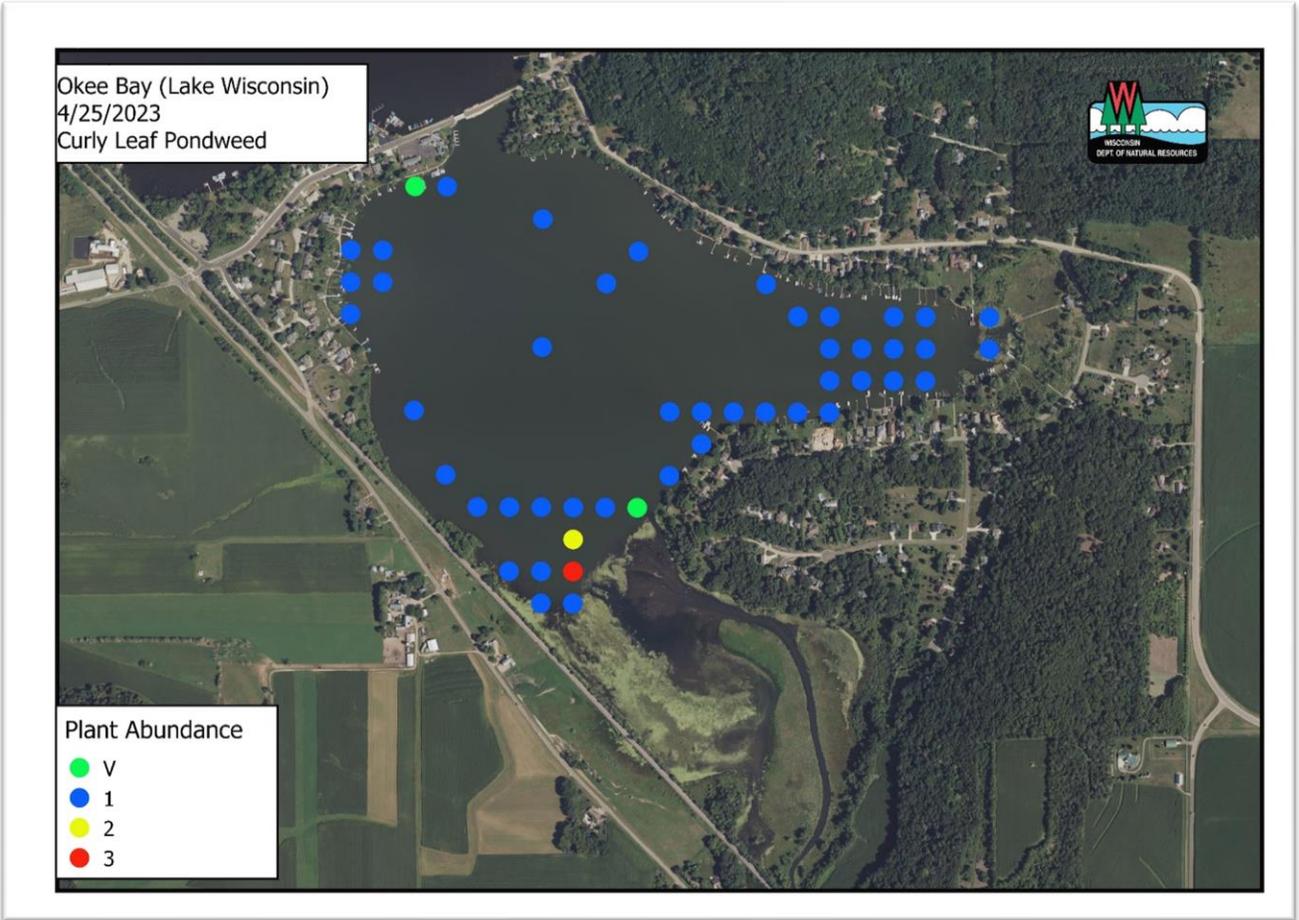


Figure 11 Curly Leaf Pondweed



Figure 12 Curly Leaf Pondweed 8/8/2023

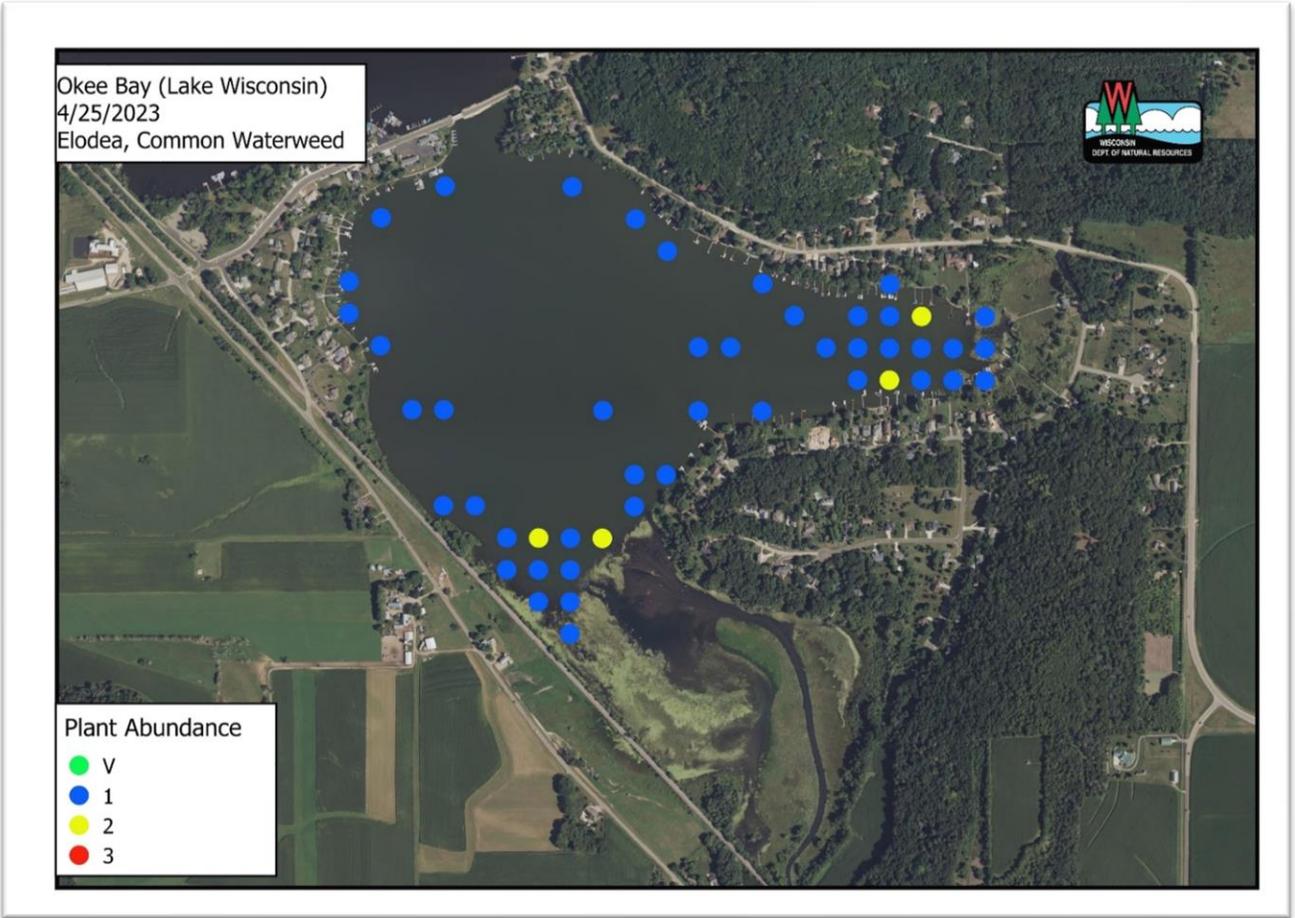


Figure 13 Elodea 4/25/2023

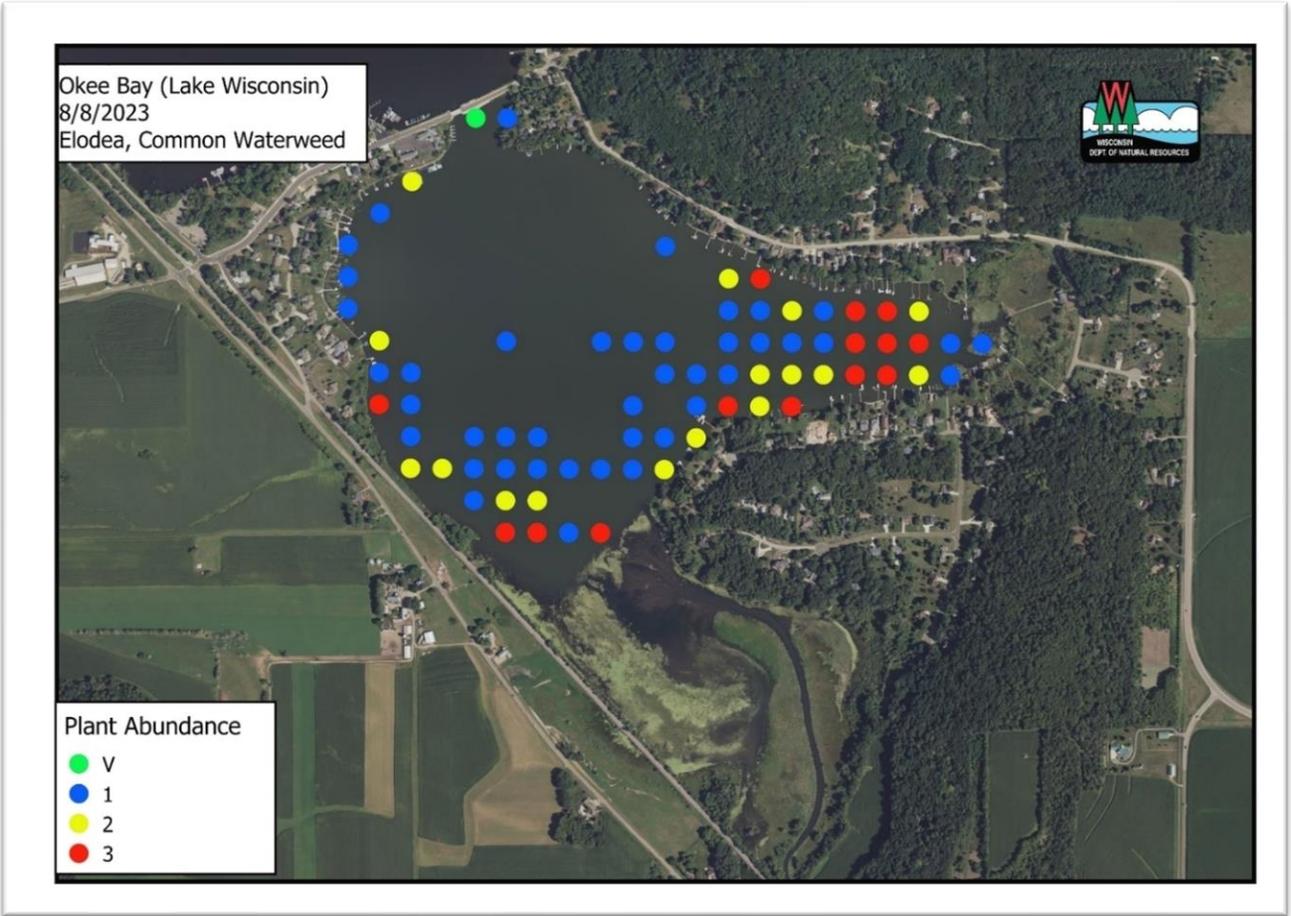


Figure 14 Elodea 8/8/2023



Figure 15 Eurasian Water-Milfoil 4/25/2023

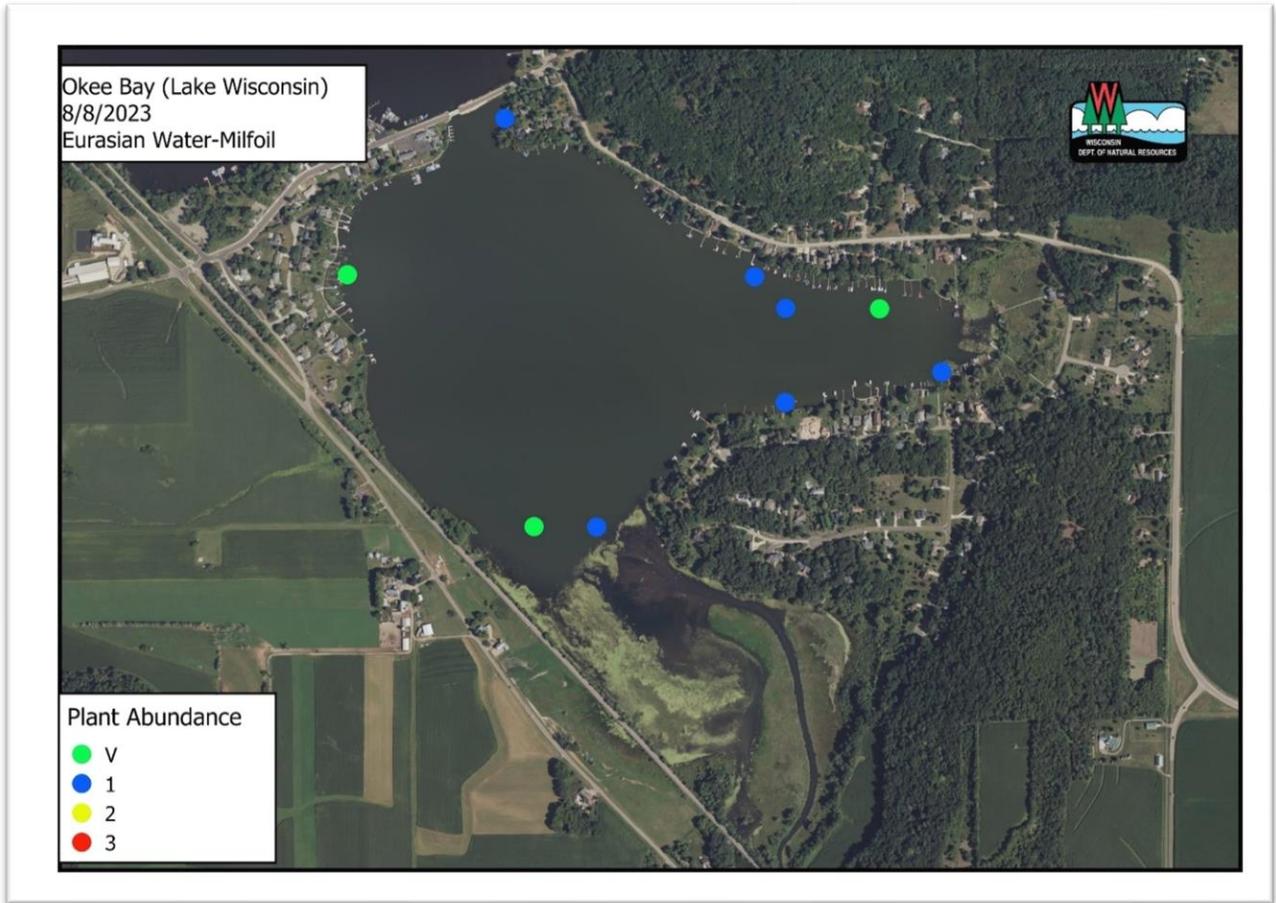


Figure 16 Eurasian Water-Milfoil 8/8/2023

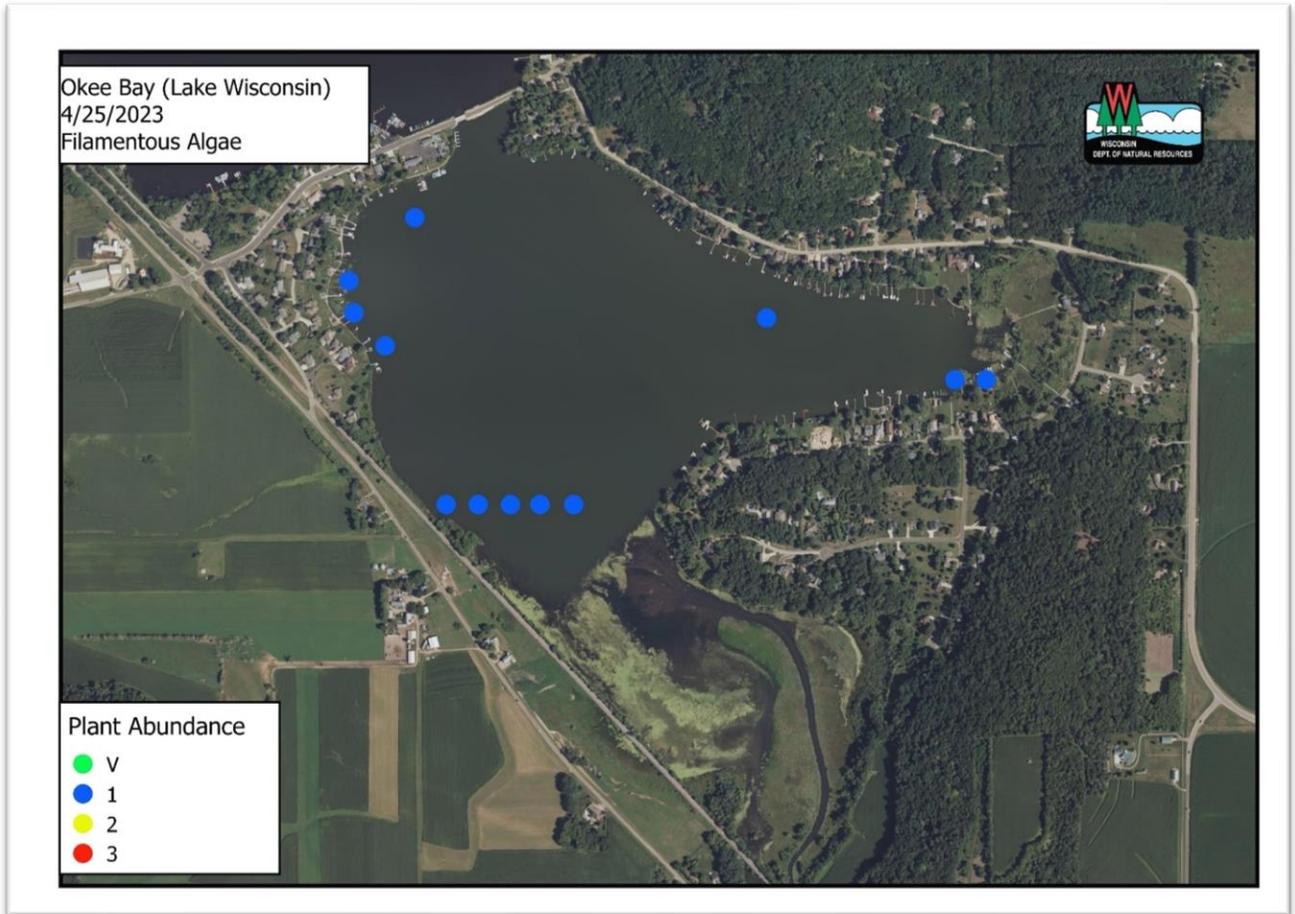


Figure 17 Filamentous Algae 4/25/2023

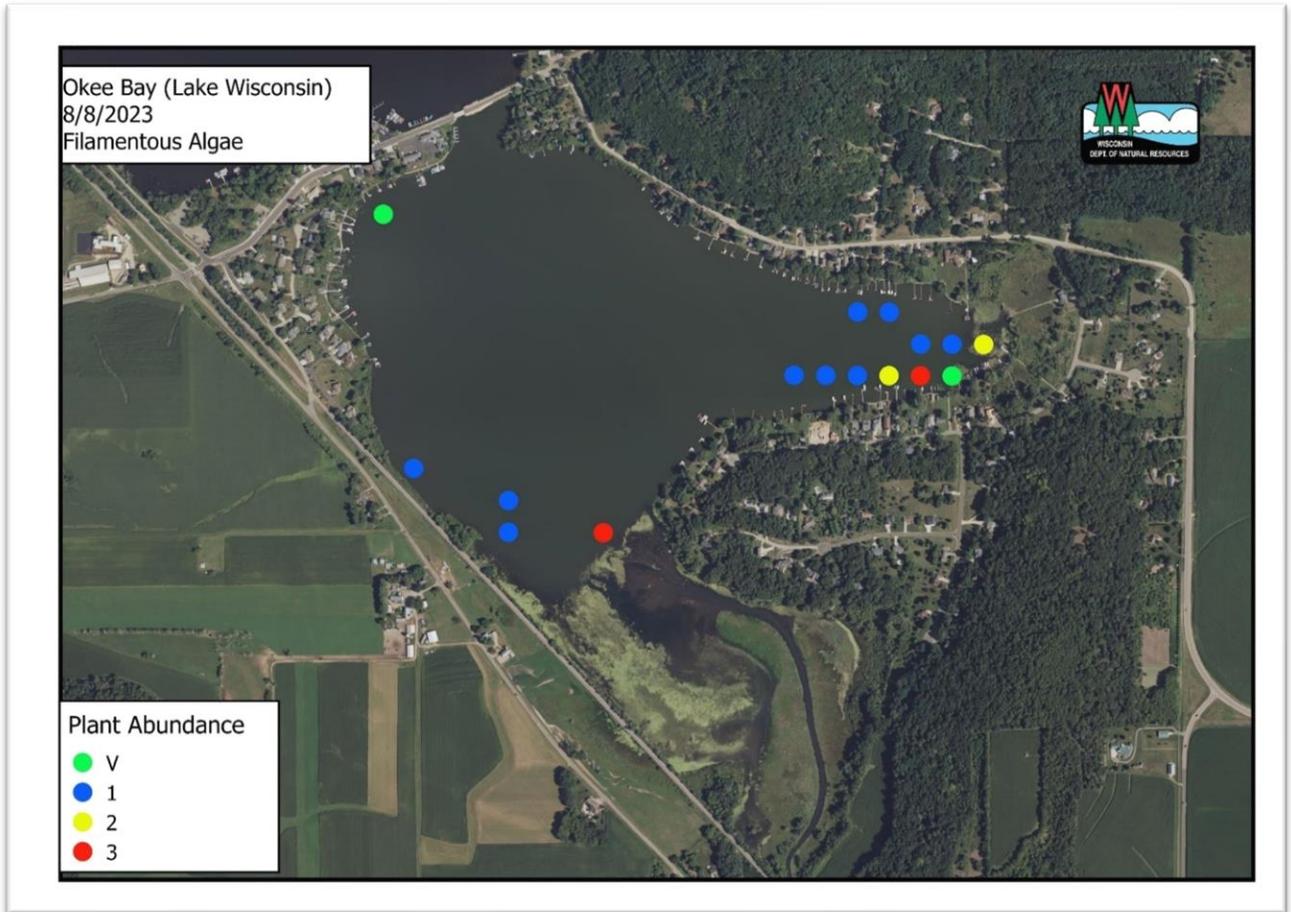


Figure 18 Filamentous Algae 8/8/2023



Figure 19 Water Stargrass 4/25/2023

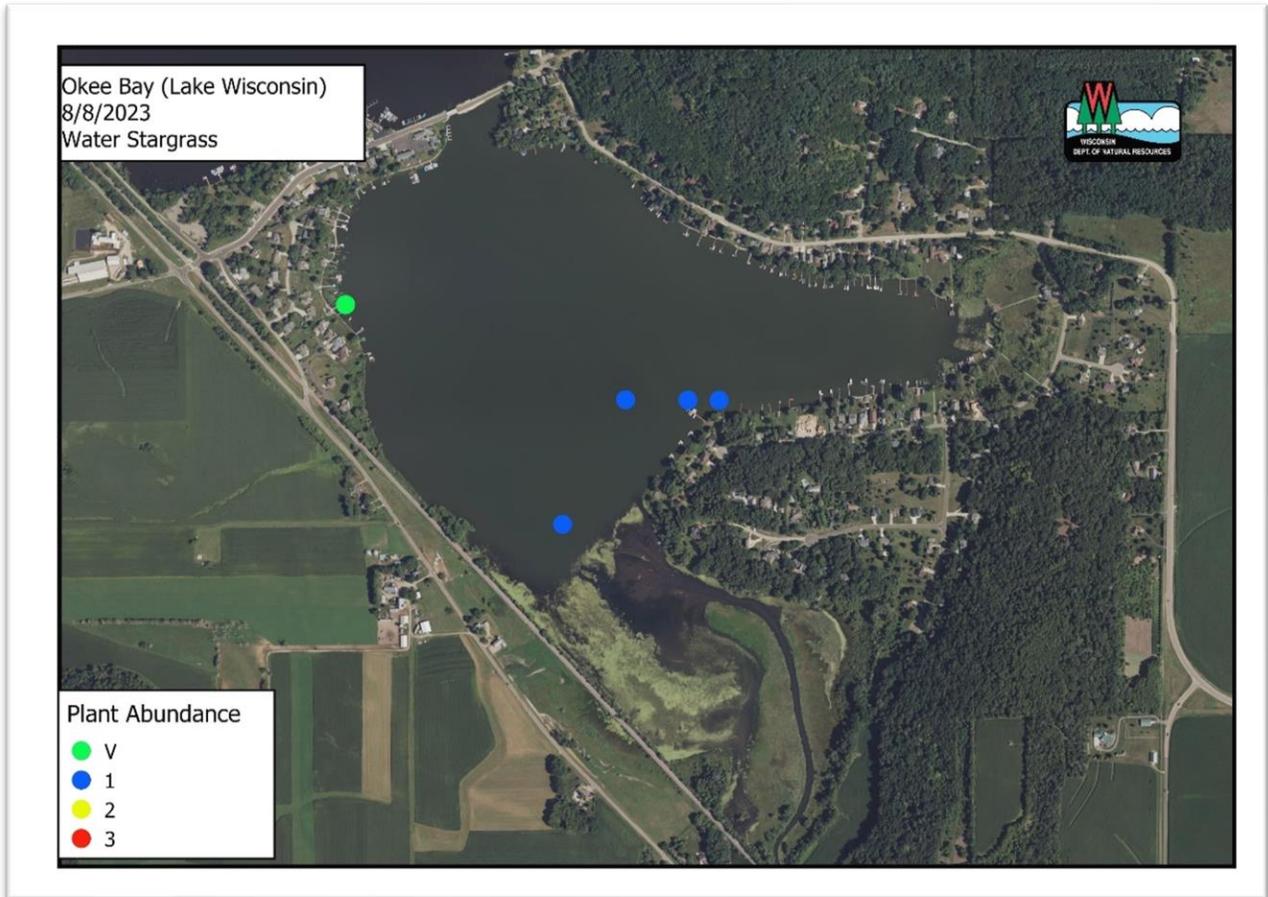


Figure 20 Water Stargrass 8/8/2023

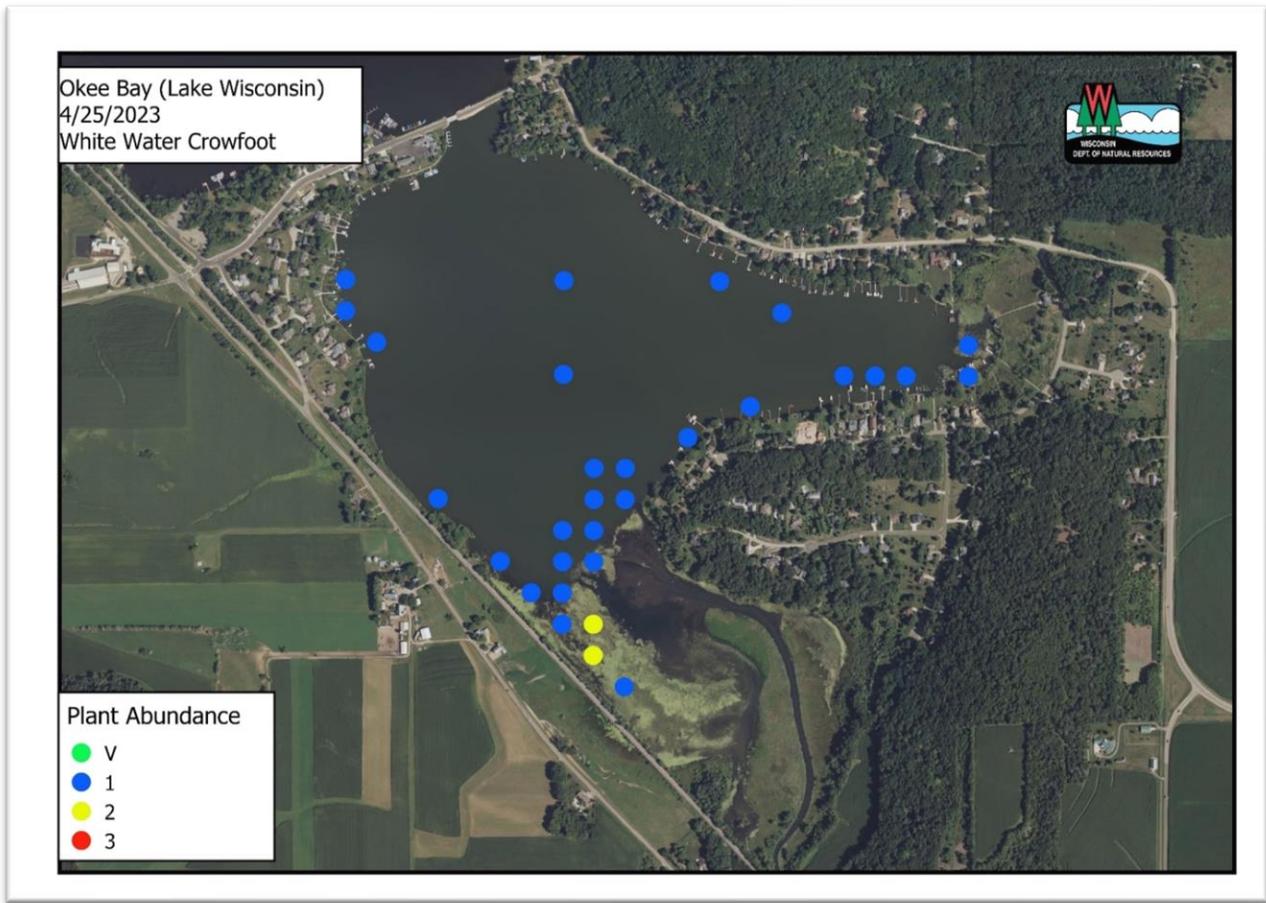


Figure 21 White Water Crowfeet 4/25/2023



Figure 22 White Water Crowfeet 8/8/2023



Figure 23 White Water Lily 4/25/2023

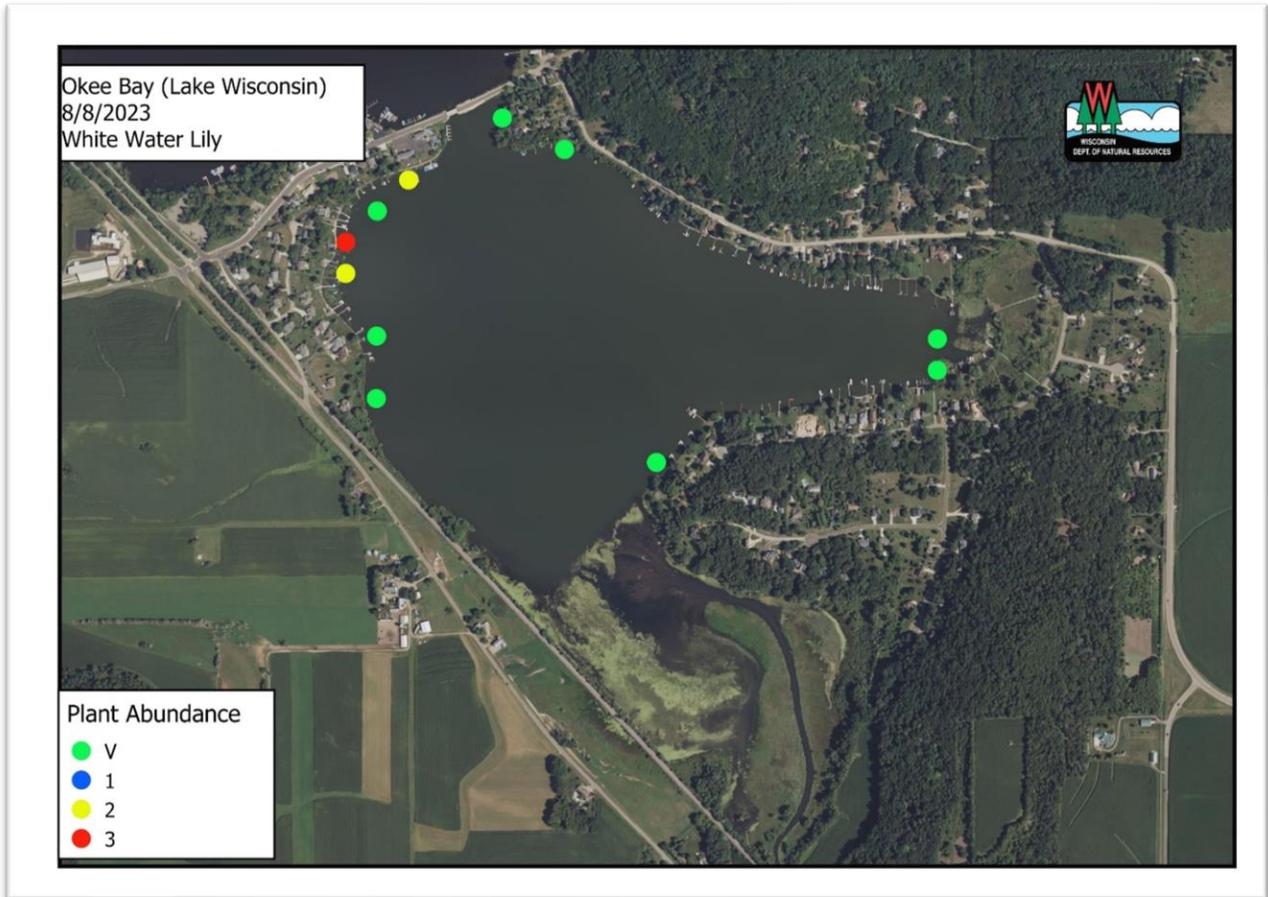


Figure 24 White Water Lilly 8/8/2023



Figure 25 Wild Celery 4/25/2023



Figure 26 Large Duckweed 8/8/2023

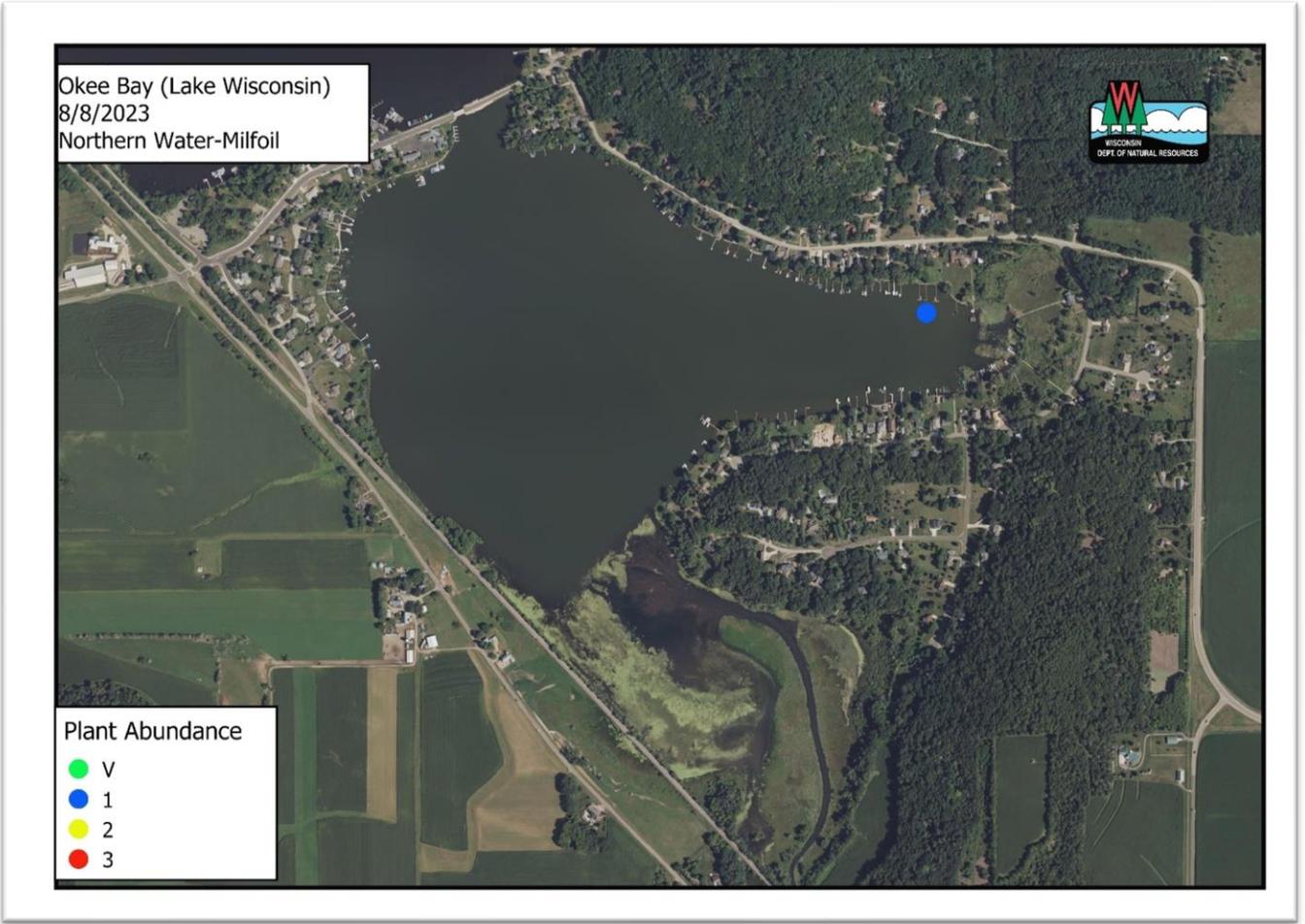


Figure 27 Northern Water-Milfoil 8/8/2023

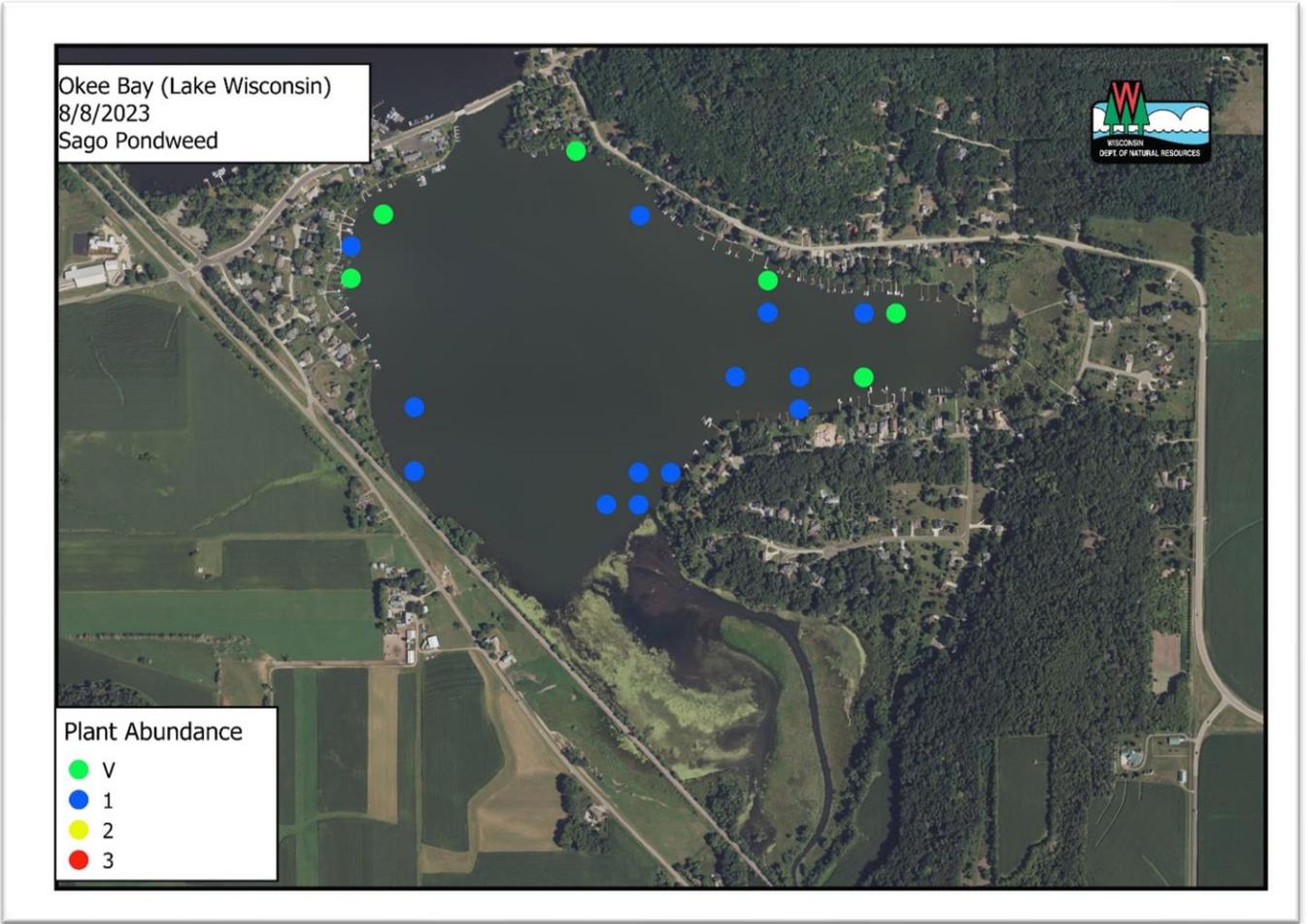


Figure 28 Sago pondweed 8/8/2023



Figure 29 Small Pondweed 8/8/2023

Table 3 Point Intercept Survey Statistics

	April 23	July 23
Total number of sites visited	170	147
Total number of sites with vegetation	76	83
Total number of sites shallower than maximum depth of plants	159	136
Frequency of occurrence at sites shallower than maximum depth of plants	47.80	61.03
Simpson Diversity Index	0.74	0.71
Maximum depth of plants (ft)**	8.00	7.50
Number of sites sampled using rake on Rope (R)	0	0
Number of sites sampled using rake on Pole (P)	170	147
Average number of all species per site (shallower than max depth)	0.93	1.23
Average number of all species per site (veg. sites only)	1.95	2.01
Average number of native species per site (shallower than max depth)	0.64	1.15
Average number of native species per site (veg. sites only)	1.72	1.89
Species Richness	7	12
Species Richness (including visuals)	8	13

The Simpson’s diversity index is a calculation that gives the probability that two species randomly sampled will be different. The Simpson’s diversity index for Okee Bay is 0.71 (0.71% probability two species will differ), which is low and supports a lower diversity of the plant community in the lake. There were just under 2 species (1.89) sampled on average at each sample point.

Vegetation Summary Statistics Species found April and August 2023

Table 4 Vegetation Summary Statistics (April & August 2023)

Species	Relative Frequency	# of sites Species Found	Average Rake Fullness	# viewed
Ceratophyllum demersum, Coontail - April	15.2	23	1.26	0
Ceratophyllum demersum, Coontail - August	32	54	1.31	1
Elodea canadensis, Common Waterweed - April	31.8	48	1.08	0
Elodea canadensis, Common Waterweed - August	42.6	72	1.61	1
Filamentous algae - April		13	1	0
Filamentous algae - August		14	1.43	2
Heteranthera dubia, Water star-grass - April	0.7	1	1	0
Heteranthera dubia, Water star-grass - August	2.4	4	1	1
Myriophyllum spicatum, Eurasian watermilfoil - April	1.3	2	1.00	0
Myriophyllum spicatum, Eurasian watermilfoil - August	3.6	6	1	3
Potamogeton crispus, Curly leaf pondweed - April	30.85	46	1.07	2
Potamogeton crispus, Curly leaf pondweed - August	2.4	4	1	1
Ranunculus aquatilis, White water crowfoot - April	19.9	30	1.07	0
Ranunculus aquatilis, White water crowfoot - August	1.2	2	1	0
Vallisneria americana- August	0.7	0	1	1
Myriophyllum sibiricum - August	1.8	3	2.33	8
Potamogeton pusillus -August	0.6	1	1	0
Ranunculus aquatilis- August	1.2	2	1	0
Spirodela polyrhiza - August	1.2	2	1	2
Stuckenia pectinata- August	7.7	13	1	6
Myriophyllum sibiricum - August	0.6	1	1	0
Wolffia Columbiana - August	4.1	7	1	2

Aquatic Plant Management

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

Discussion of Management Methods

Permitting Requirements

The Department of Natural Resources regulates the removal of aquatic plants when chemicals are used, when plants are removed mechanically, and when plants are removed manually from an area greater than thirty feet in width along the shore. The requirements for chemical plant removal are described in Administrative Rule NR 107 – Aquatic Plant Management. **A permit is required for any aquatic chemical application in Wisconsin.** The requirements for manual and mechanical plant removal are described in *NR 109 – Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations*. A permit is required for manual and mechanical removal except for when a riparian (waterfront) landowner manually removes or gives permission to someone to manually remove plants, (with the exception of wild rice) from his/her shoreline up to a 30-foot corridor. A riparian landowner may also manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit, provided there is no damage to native plant species. Manual removal refers to the control of aquatic plants by hand or hand-held devices without the use or aid of external or auxiliary power.

Impaired navigation or nuisance conditions usually need to be documented before native plants can be permitted to be managed with herbicides. Severe impairment or nuisance will generally mean that vegetation grows thickly and forms mats on the water surface. Techniques to control the growth and distribution of aquatic plants are discussed in the following text. The application, location, timing, and combination of techniques must be considered carefully.

Manual Removal

Manual removal—hand pulling, cutting, or raking—will effectively remove plants from small areas. It is likely that plant removal will need to be repeated more than once during the growing season. Hand pulling is a strategy recommended for rapid response to a Eurasian water milfoil establishment and for private landowners who wish to remove small areas of curly leaf pondweed growth. Raking is recommended to clear nuisance growth in riparian area corridors up to thirty feet wide. In lakes where EWM is a new invasive, or where management goals include keeping the population small, SCUBA divers may engage in manual removal for invasive species like Eurasian water milfoil. Care must be taken to ensure that all plant fragments are removed from the lake.

Mechanical Control

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

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

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

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

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results—open water and accessible boat lanes—are immediate and can be enjoyed without the restrictions on lake use which follow herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish by eliminating the upper canopy, harvesting reduces the shading caused by aquatic plants. The nutrients stored in the plants are also removed from the lake, and the sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

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

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

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

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

If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since these machines travel from lake to lake, they may carry plant fragments with them, and facilitate the spread of aquatic invasive species from one body of water to another.

Suction Harvesting operations use pump systems to collect plant and root biomass. The pumps are mounted on a barge or pontoon boat. The dredge hoses are from 3 to 5 inches in diameter and are handled by one diver. The hoses normally extend about 50 feet in front of the vessel. Suction harvesting is especially effective against the pioneering establishment of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology can be considered. To be effective, the entire plant, including the subsurface portions, should be removed.

Plant fragments can result from suction harvesting, but fragmentation is not as great a problem when infestations are small. Suction harvesting operations may need to be repeated more than once to be effective. When applied to a pioneering infestation, control can be complete.

Lake substrates play an important role in the effectiveness of a suction harvesting operation.

Soft substrates are very easy to work in. Divers can remove the plant and root crowns with little difficulty. Hard substrates, however, pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment.

Biological Control

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

The effectiveness of bio-control efforts varies widely (Madsen, 2000). Beetles are commonly and successfully used to control purple loosestrife populations in Wisconsin. Weevils are used as an experimental control for Eurasian water milfoil once the plant is established. Grass carp, an herbivorous fish, is sometimes used to feed on pest plant populations, but grass carp introduction is illegal in Wisconsin and as a result, grass carp is not a viable bio-control in Wisconsin lakes and won't be utilized.

Weevils have potential for use as a biological control agent against Eurasian water milfoil. There are several documented "natural" declines of EWM infestations with weevil present. In these cases, EWM was not eliminated but its abundance was reduced enough so that it did not maintain dominance.

There are advantages and disadvantages to the use of biological control as part of an overall aquatic plant management program. Advantages include longer-term control relative to other technologies, lower overall costs, and plant-specific control. On the other hand there are several disadvantages to consider, including very long control times (years instead of weeks), a lack of available biological control agents for particular target species, and relatively specific environmental conditions necessary for success. Biological control is not without risks. A new non-native species introduced to control a pest population may cause problems of its own.

Milfoil weevils are native to Wisconsin lakes, however. They could help reduce abundance of EWM if harvesting was not being done. Their use is currently being investigated on other lakes to learn more about when they do or do not work well for control.

Re-vegetation with Native Plants

Another aspect to biological control is native aquatic plant restoration. The rationale for re-vegetation is that restoring a native plant community should be the end goal of most

aquatic plant management programs (Nichols 1991; Smart and Doyle 1995). However, in communities that have only recently been invaded by nonnative species, a propagule (seed) bank probably exists that will restore the community after nonnative plants are controlled (Madsen, Getsinger, and Turner, 1994).

Physical Control

In physical management, the environment of the plants is manipulated, which in turn acts upon the plants. Several physical techniques are commonly used: dredging, drawdown, benthic (lake bottom) barriers, and shading or light attenuation.

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

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

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

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

The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984).

Benthic barriers will typically kill the plants under them within 1 to 2 months, after which time they may be removed (Engel 1984). Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively (Carter et al. 1994). Sites from which barriers are removed will be rapidly re-colonized. (Eichler et al. 1995). Synthetic barriers, if left in place for multi-year control, will eventually become sediment-covered and will allow colonization by plants. Benthic barriers may be best suited to small, high-intensity use areas such as docks, boat launch areas, and swimming areas. However, they are too expensive to use over widespread areas, and heavily affect benthic communities by removing fish and invertebrate habitat. Because they involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 WDNR permit would be required. Such permits are rarely granted because of the drawbacks to this method.

Shading or light attenuation reduces the amount of light plants have available for growth. Shading has been achieved by fertilization to produce algal growth, application of natural or synthetic dyes, shading fabric, or covers, and establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974). During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general these techniques are only of limited applicability. Physical control is not currently proposed for management of aquatic plants in Okee Bay.

Herbicide and Algaecide Treatments

Herbicides are chemicals used to kill plant tissue. Currently, products are only labeled for aquatic use if it benefits exceed the risks when used as directed. In addition, it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Joyce,1991). Thus, there are a limited number of active ingredients that are registered for aquatic use (Madsen, 2000).

The U.S. Environmental Protection Agency (EPA)-approved label gives guidelines protecting the health of the environment, the humans using that environment, and the applicators of the herbicide. WDNR permits under Chapter NR 107 are required for herbicide application.

General descriptions of herbicide classes are included below.

Contact herbicides

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

Systemic herbicides

Systemic herbicides are absorbed into the living portion of the plant and move within the plant. Different systemic herbicides are absorbed to varying degrees by different plant parts. Systemic herbicides that are absorbed by plant roots are referred to as soil active herbicides and those that are absorbed by leaves are referred to as foliar active herbicides.

2,4-D, dichlobenil, ProcellaCOR, fluridone, Florpyrauxifen-benzyl and glyphosate are systemic aquatic herbicides. When applied correctly, systemic herbicides act slowly in comparison to contact herbicides. They must move to the part of the plant where their site of action is. Systemic herbicides are generally more effective for controlling perennial and woody plants than contact herbicides.

Broad spectrum herbicides

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

Selective herbicides

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

Environmental considerations

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

General descriptions of the breakdown of commonly used aquatic herbicides are included below.

Copper

Copper is a naturally occurring element that is essential at low concentrations for plant growth. It does not break down in the environment, but it forms insoluble compounds with other elements and is bound to charged particles in the water. It rapidly disappears from water after application as an herbicide. Because it is not broken down, it can accumulate in bottom sediments after repeated or high rates of application. As time passes and copper accumulates with permitted use, it can reach levels that are toxic to clams and other benthic organisms.

2,4-D

2,4-D is broken down by microbial degradation in water and in sediments. Complete decomposition usually takes about 3 weeks in water but can be as short as 1 week. 2,4-D breaks down into naturally occurring compounds.

A study in Tomahawk Lake in Bayfield County, Wisconsin illustrated a much slower breakdown time of 2,4-D than described above. Following a whole lake treatment of .5 mg/L 2,4-D, the chemical was still present 160 days after treatment. While there was successful removal of the target plant, Eurasian water milfoil, there were also significant declines in native plant biomass. A potential explanation was the low nutrient conditions in Lake Tomahawk which was described as an oligo-mesotrophic lake. (Nault 2010, Toshner 2010)

Diquat

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

Endothall

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

Fluridone

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

Glyphosate

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

ProcellaCOR

A selective systemic herbicide for management of freshwater aquatic vegetation in slow-moving/quiescent waters with little or no continuous outflow: ponds, lakes, reservoirs, freshwater marshes, wetlands, bayous, drainage ditches, and non-irrigation canals, including shoreline and riparian areas in or adjacent to these sites. Also for management of invasive freshwater aquatic vegetation in slow-moving/quiescent areas of rivers (coves, oxbows or similar sites).

Herbicide Used to Manage Invasive Species

Eurasian Water Milfoil

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

Curly Leaf Pondweed

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies three herbicides for control of curly leaf pondweed: diquat, endothall, and fluoridone. Fluoridone requires exposure of 30 to 60 days making it infeasible to target a discrete area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction following treatment.

Studies have demonstrated that curly leaf pondweed can be controlled with Aquathol K (a formulation of endothall) in 50 to 60 degree F water, and that treatments of CLP this early in its life cycle may prevent turion formation. Since curly leaf pondweed is actively growing at these low water temperatures and many native aquatic plants are still dormant, early season treatment can somewhat selectively target curly leaf pondweed.

AIS Rapid Response Protocol

Lake residents and visitors are encouraged to be observant of water quality, plants and animals. If something unusual is found that could be a new exotic species, follow the protocol from the DNR's "Report Invasive Species" page.

If it is a plant

- Be sure the suspected [invasive species](#) has not been [previously found on the waterbody](#)
- Take a digital photo of the plant in the setting where it was found (if possible). Then collect 5 – 10 intact specimens. Try to get the root system, all leaves as well as seed heads and flowers when present. Place in a ziplock bag with no water. Place on ice and transport to refrigerator.
- Fill out form [3200-153 - Aquatic Invasive Plant Incident Report](#)

Deliver the specimen(s). Contact your local DNR Aquatic Invasive Species contact Shelby Adler, 608-712-4306, Shelby.Adler@wi.gov and deliver the specimens, report and digital photo (if available). Please do this as soon as possible – no later than 4 days after you discover the plant. If it is an animal, collect one, if possible, and put it on ice, or take a few clear photos. See the DNR website for additional steps.

Plans and Strategies

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

Goals are broad statements of direction.
Objectives are measurable steps toward the goal.
Actions are actions to take to accomplish objectives.
The **Implementation Plan** outlines timeline, resources needed, partners, and funding sources for each action item.

Okee Bay Aquatic Plant Management Plan Goals

- 1. Provide recreation opportunities while protecting the ecological integrity of Okee Bay,*
- 2. Maintain boating navigation opportunities through Okee Bay,*
- 3. Protect Okee Bay ecosystem,*
- 4. Protect Okee Bay fish community,*
- 5. Maintain 2024 Aquatic Plant Management Program with annual adjustments based on monitoring,*
- 6. Promote Native Plant Community and Reduce Aquatic Invasives Species.*

Goal 1 - Provide recreation, swimming and fishing opportunities while protecting the ecological integrity of Okee Bay

Objective 1. Mechanical aquatic plant harvesting will occur to provide boating access through roughly 12.5 acres of Okee Bay

Action Item -

1. Conduct Aquatic Plant Harvesting as seen in Figure 29

Objective 2. Herbicide treatments will occur to provide navigation opportunities

Action Item

1. Conduct Diquat treatments in Lane 1 and 2 as seen in Figure 29 and 30

Goal 2- Maintain Navigation through Okee Bay

Objective – Mechanically harvest aquatic plant community to allow for boating

Action Items –

1. Aquatic plant harvesting will be done to cut a 40’ -50” channel. Aquatic Plant Harvesting will be done to cut a 150’ main channel for access throughout the lake

Goal 3– Protect Okee Bay ecosystem

Objective - Provide aquatic plant harvesting opportunity while reducing risk of Okee Bay switching to an algal, turbid dominated state

Action items-

1. Aquatic plant harvesting will occur on <18% of the established plant community assuming 140acres or less established plants
2. Aquatic plant harvesting will occur in water equal to or greater than 3 feet.
3. Aquatic plant harvesting will work to reduce Curly Leaf pondweed to target pre-turion development
4. OBLA will use AIS Population control Grants in their effort to manage aquatic invasives.

2025 Treatment Plan

Mechanical harvesting is the primary preferred APM method for Okee Bay with 2 small Diquat treatments. The mechanical and chemical treatments will occur as one preliminary treatment the possibility of two follow up mechanical treatments and 1 chemical treatment based on the post treatment site conditions found in the treatment areas.

The planned treatment areas are broken up into four geographical areas with possibility of a western expansion of the Northwestern lobe of 1A shown be the red area as seen in Figure 30. The four areas are planned for 3 receiving mechanical and 1 receiving chemical treatments.

Area 1.a will be cut to create a 50' width in the May harvest and 40' widths in the follow up harvests in June/July.

Area1.b will be cut to create a 40' width area though out the season.

Area 2 will be harvested in its entirety

Small scale, manual removal using rakes can supplement plant control for swimming near piers.

Label	Area	Treatment	Targeted Species	Planned Treatment	Follow Up Treatments
1a.	7.5 ac	Mechanical	CLP	May	
1a.	7 ac	Mechanical			June
1a.	7 ac	Mechanical			July
1b.	2.1 ac	Mechanical	CLP	May	
1b.	2.1 ac	Mechanical			June
1b.	1.8 ac	Mechanical			July
2.	10.7 ac	Mechanical	CLP	May	
Lane 1	.34 ac	Herbicide-Diquat	Non - selective	May	As Needed
Lane 2	.46 ac	Herbicide-Diquat	Non - selective	May	As Needed

Table 5 2025 Harvesting Plan

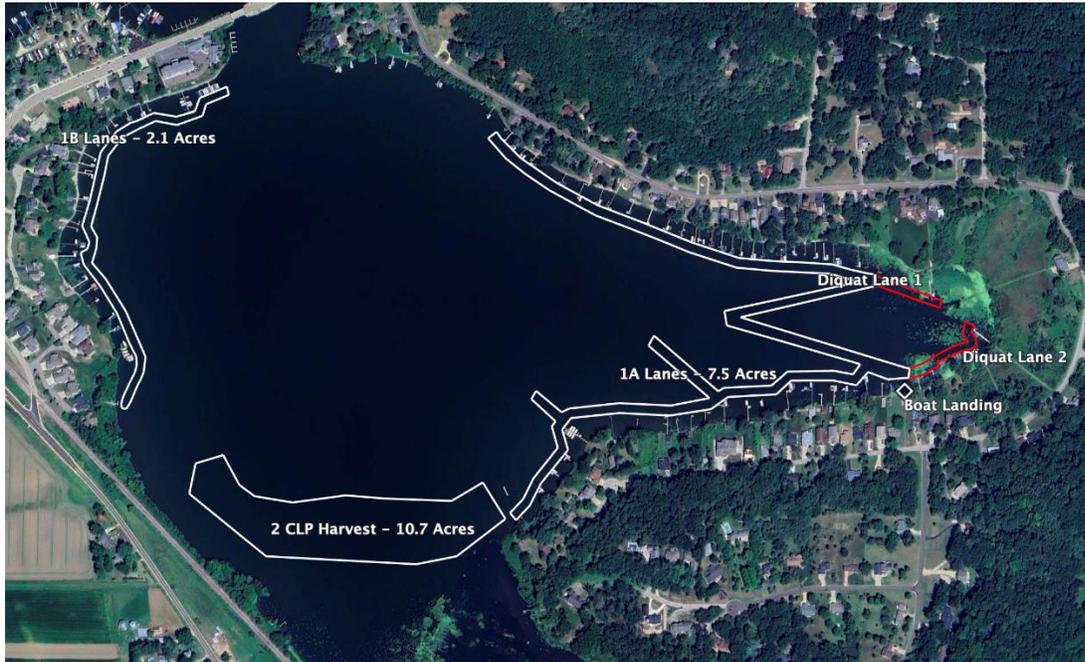


Figure 30 Full Harvesting Map

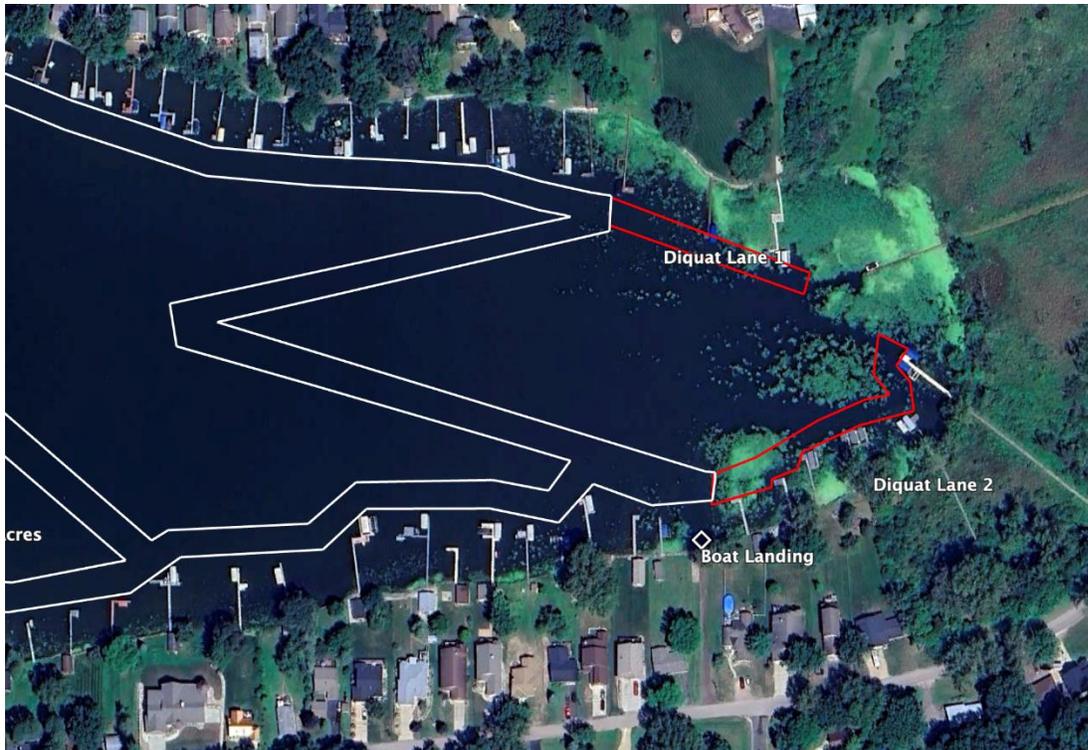


Figure 31 Lanes 1 and 2 Herbicide Treatment

Okee Bay Mill Pond Lake Association Future Steps		
When	Action Item	Responsible Party
April 3, 2025	Submit APMP to WDNR For Approval	CCLWCD
	Mechanical Permit for 4 remaining years of 5 year permit	OBLA
	Submit APMP Herbicide Permit for 1 year of treatment	OBLA
Sept 15, 2025	Submit pre-application Aquatic Invasive Species Control Grant to WDNR	OBLA
Nov 15, 2025	Submit Application Aquatic Invasive Species Control Grant	OBLA
Spring 2026	Submit APMP Herbicide Permit for 1 year of treatment	OBLA
Spring 2027	Submit APMP Herbicide Permit for 1 year of treatment	OBLA
2027	Apply for WDNR Grant for 2028 PI Study	OBLA /CCLWCD
Spring 2028	Submit APMP Herbicide Permit for 1 year of treatment	OBLA
2028	Conduct PI Study/ Update Okee Bay APMP	OBLA
Winter 2029	Submit APMP Mechanical Permit for 5-year Permit	OBLA

Table 6 Okee Bay Lake Association Future Steps

