Des Moines Lake
Aquatic Plant Management Plan

December 4, 2023

Sponsored by:
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Introduction

This Aquatic Plant Management Plan (APM) for Des Moines Lake, Burnett County, Wisconsin presents strategies for preventing aquatic invasive species (AIS) from entering the waterbody, protecting native aquatic plant populations, and providing information on maintaining pristine water clarity. This plan includes data about the plant community, watershed and water quality of Des Moines Lake. Based on the data provided and the public input survey, goals and strategies were formed to create an Aquatic Plant Management Plan for Des Moines Lake. This plan will guide the Des Moines Lake Association and the Burnett County Land Services Department in aquatic plant management and aquatic invasive species prevention over the next five years (2024-2029).

Plan Mission Statement

Des Moines Lake is one of the premier and sought after recreational lakes in the area. The overall goal of the aquatic plant management plan is to provide insight on the quality of the aquatic plants community and provide strategies on preventing aquatic invasive species from establishing in the waterbody. Aquatic plants offer habitat for fisheries, provide clean water, protection for shorelines and natural beauty for future generations.

This Aquatic Plant Management Plan (APM) is guided by public input, scientific data from lake surveys and requirements from the Wisconsin Department of Natural Resources (WDNR). This APM is required by the WDNR regulations for certain aquatic plant management activities and the ability to obtain grants that fund aquatic invasive species plant management.

This plan follows the WDNR's aquatic plant management planning guidelines and the Northern Region Aquatic Plant Management Strategy. DNR sampling protocol and plant survey methods were followed using the Point Intercept Survey method.

Des Moines Lake Information

Des Moines Lake Management plan guides the association members in preventing undesirable wildlife, providing educational opportunities and ways to manage water quality with the following goals:

- Goal 1. *Prevent the introduction and spread of aquatic invasive species.*
- Goal 2. *Reduce and control the spread of Purple Loosestrife, and Banded and Chinese Mystery Snails.*
- Goal 3. *Educate community regarding aquatic plant management, appropriate native plant management actions and erosion control practices.*
- Goal 4. *Maintain and improve water quality.*
- Goal 5. *Develop a Rapid Response Plan for aquatic invasive species.*

Several meetings were scheduled during the development of this plan between the Des Moines Lake Aquatic Plant Management (APM) committee and the Burnett County Land Services Water Resources Specialist/AIS Coordinator. Advisory meetings were scheduled on 1/20/2022, 10/17/2022, 1/25/2023 and the public input meeting was hosted on 5/27/2023. During the advisory meetings (1/20/2022, 10/17/2022, & 1/25/2023) the group met to learn about the importance of APM planning, to develop the goals and objectives and discuss the results of the public input survey. A public input meeting was hosted at the Cabaret on 5/27/2023 in Webb Lake, Burnett County, WI to discuss the Lake User survey results to the residents of Des Moines Lake and present the goals of the APM. The meeting was posted in the Burnett County Sentinel between May 9th to May 19th, 2023 inviting the public to make comments, suggestions and edits to the proposed APM goals.

Property Owner Survey

The Des Moines Lake User Survey was sent to 91 riparian property owners and of those, 34 households completed and returned the survey (Appendix C). Below outlines 4 questions that stood out from the responses:

Question 1: Type of Residency (Permanent, Seasonal or Weekend).

- Over 50% of the lakeshore owners answered the type of residency is seasonal.
- Under 10 lakeshore owners answered permanent or weekend for their residency.

Question 4.1: Issues you are concerned with that could impact Des Moines Lake? Can choose multiple answers.

- As shown in Figure 1 the three major concerns the lakeshore owners expressed were:
    - 1) Introduction of undesirable wildlife.
    - 2) Too much public use.
    - 3) Poor fishing quality.

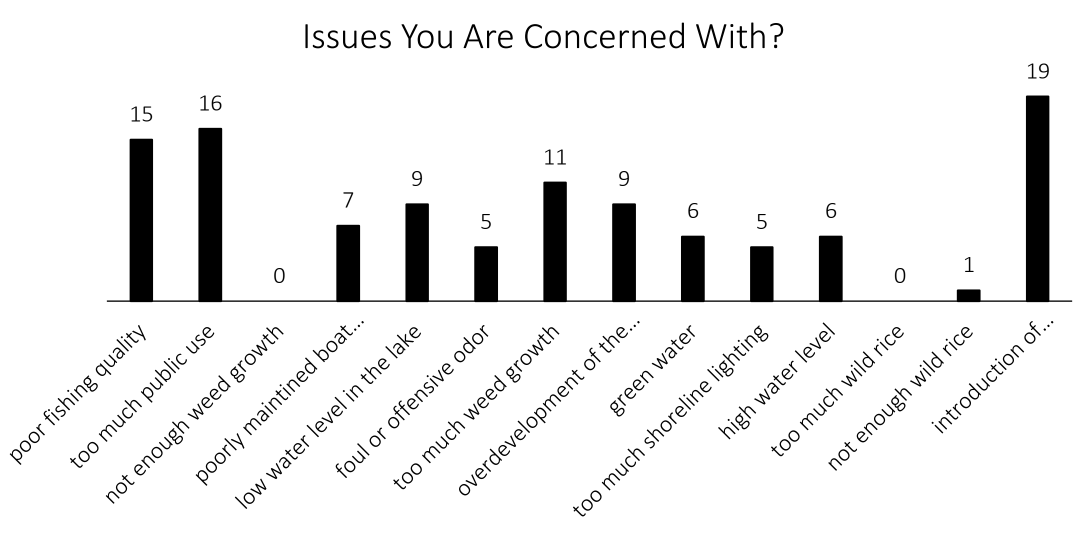


Figure 1. Question 4.1 from Lake User survey; Issues landowners are concerned with that could impact Des Moines Lake? Can choose multiple answers.

Section 5: Aquatic Invasive Species problems and identification. Species include curly leaf pondweed, Eurasian watermilfoil, purple loosestrife and others.

- Shown in Figure 2-4 below are responses to aquatic invasive species knowledge and identification for three common species. The majority of the participants that responded have very little knowledge of common invasive species present in Burnett County.

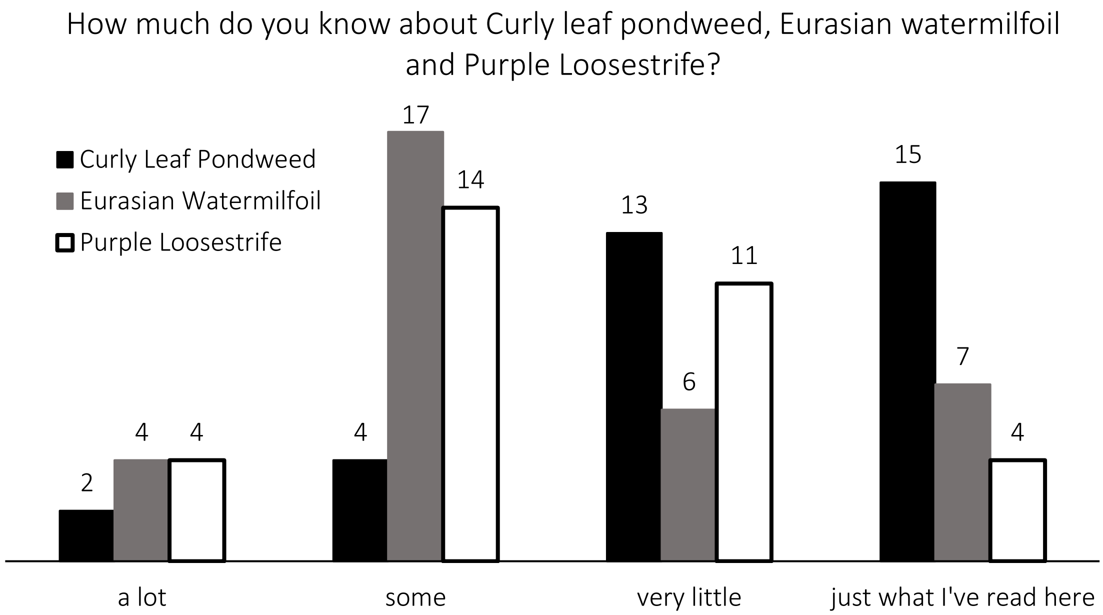


Figure 2. Section 5 responses from the lake user survey inquiring about participant knowledge of common invasive species. Each species is represented by a bar (Curly leaf pondweed – black; Eurasian watermilfoil – grey; Purple Loosestrife – white).

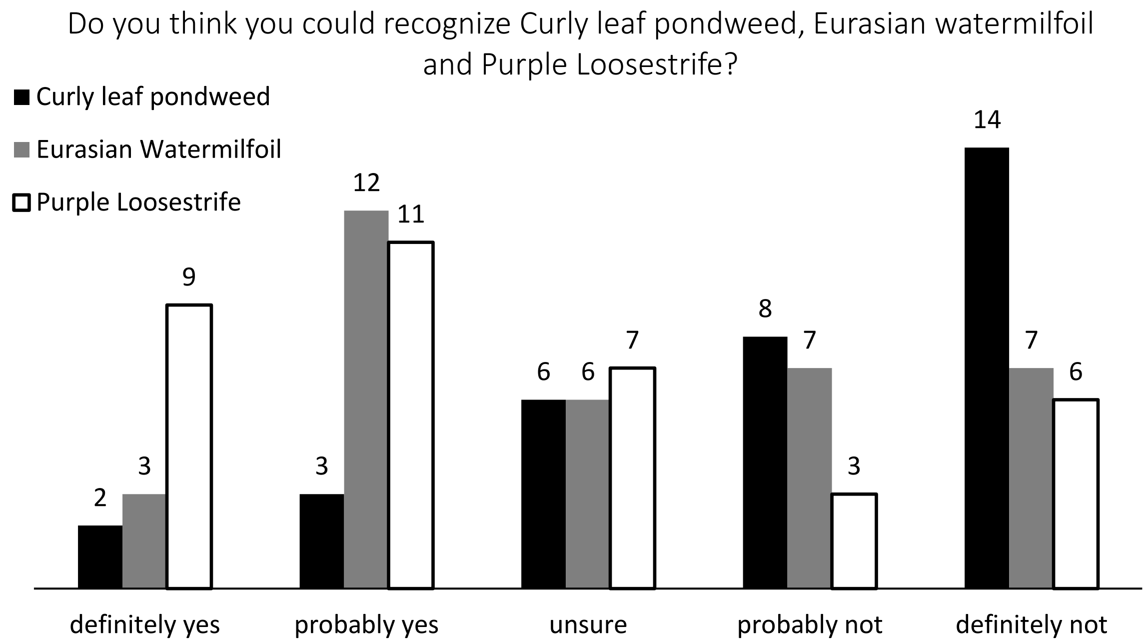


Figure 3. Section 5 responses from the lake user survey inquiring about participant identification skills of common invasive species. Each species is represented by a bar (Curly leaf pondweed – black; Eurasian watermilfoil – grey; Purple Loosestrife – white).

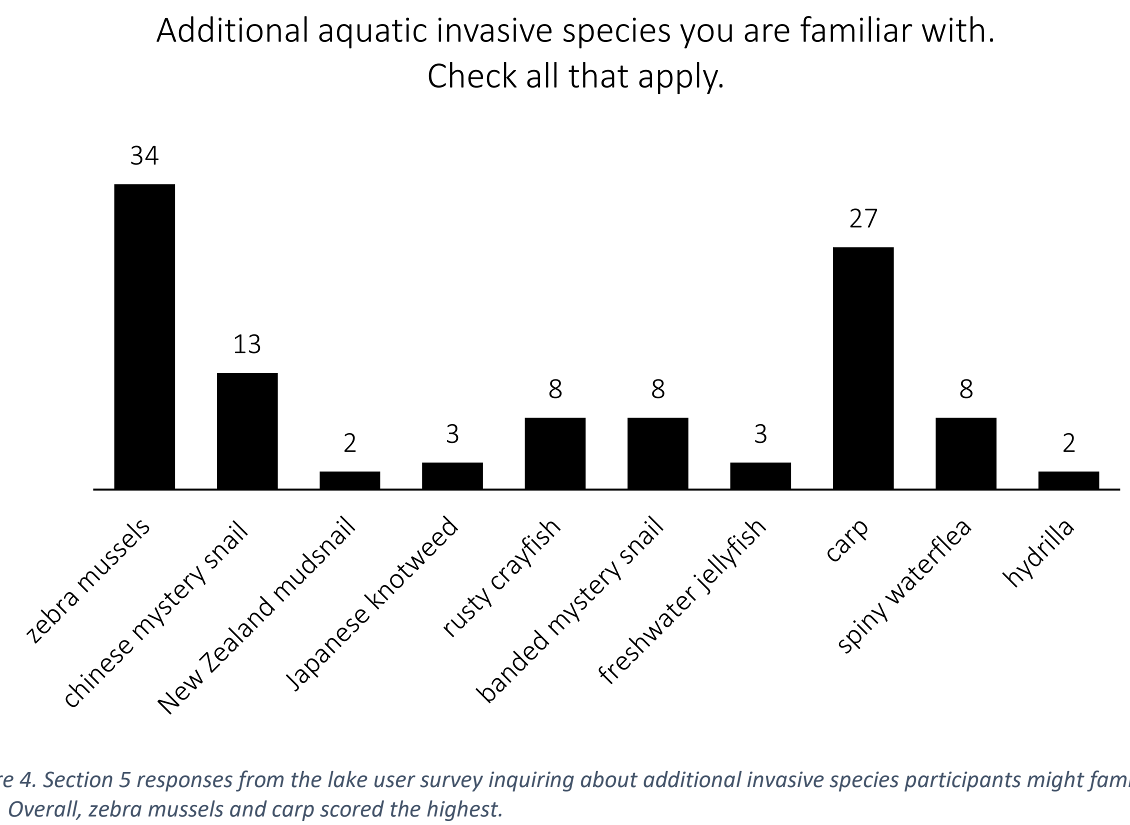


Figure 4. Section 5 responses from the lake user survey inquiring about additional invasive species participants might familiar with. Overall, zebra mussels and carp scored the highest.

Lake User Survey Discussion

Results from the survey indicated that participants are most concerned with introduction of undesirable wildlife, too much public use and poor fishing quality. Additionally when asked about their knowledge on common aquatic invasive species (AIS) and identification skills most participants were unfamiliar with these threats. Burnett County suggests that Des Moines Lake Association host a workshop with the Burnett County AIS Coordinator to teach interested lakeshore property owners on AIS threats and identification. These common invasive species loom in nearby lakes and other counties and with Des Moines Lake being a popular recreational waterbody it's important to have more boots on the ground capable of identifying AIS. As mentioned before, the lake user survey with all participant responses can be seen in Appendix C.

Information on how to enhance the fisheries on Des Moines Lake can be found in the fisheries section on page 16. In short, to support a better fisheries the waterbody must contain habitat for the fisheries to spawn and reproduce effectively. Habitats that support spawning for fish can be seen in Table 1.

Lake Information

Des Moines Lake is a 239.3 acre seepage lake located in the Lower Namekagon River Watershed in the Town of Webb Lake, Burnett County, Wisconsin.[2] The lake bottom is comprised of 99% sand with pristine water quality. The maximum water depth is 37 feet, with an average depth reaching 23 feet. A lake map is included in Figure 5.

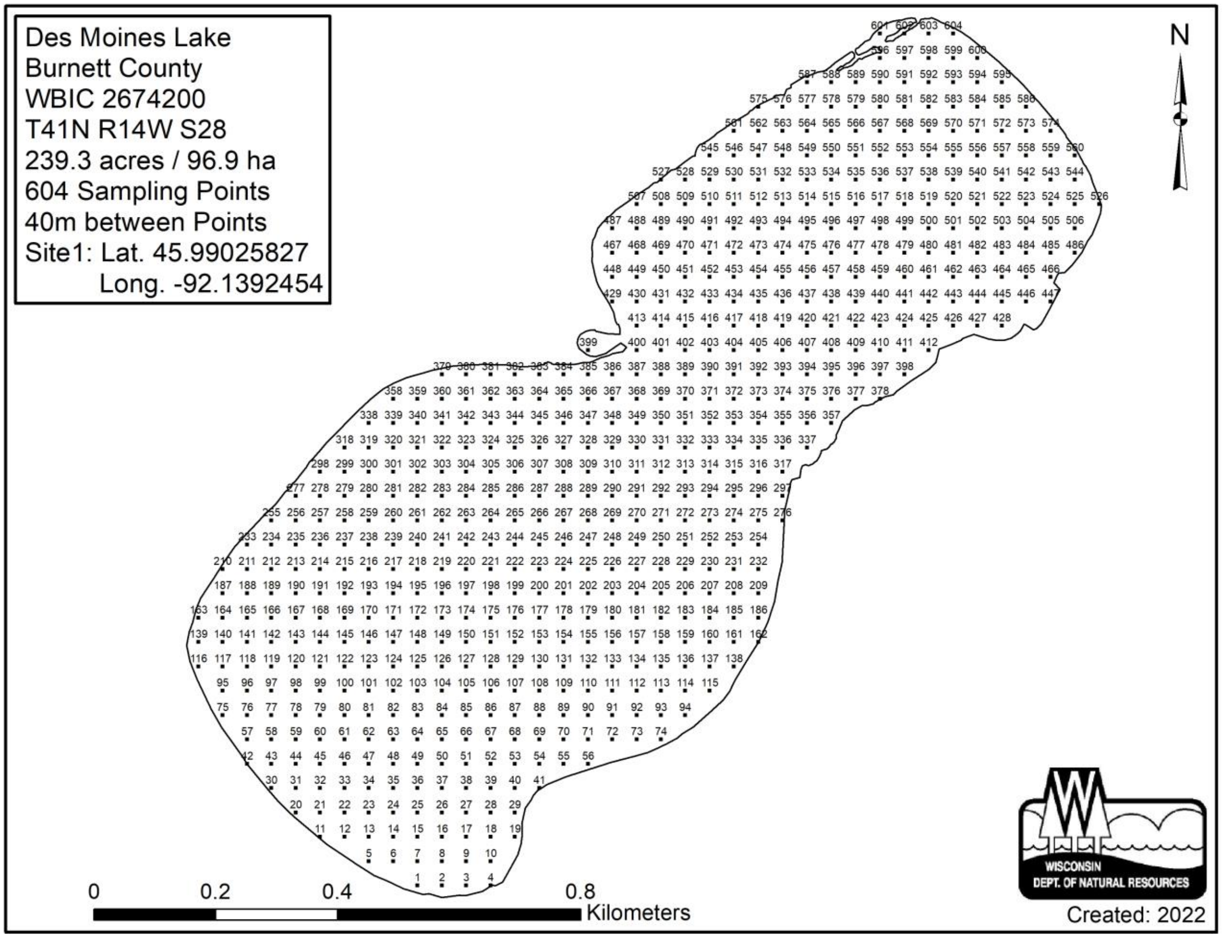


Figure 5. Des Moines Lake Point-Intercept Grid

Watershed

Des Moines Lake is located in the Lower Namekagon River Watershed (SC19). This watershed includes the Namekagon River drainage below the Trego Lake dam down to the confluence of the St. Croix River. This area includes the west central part of Washburn County and a part of northeastern Burnett County in northwest Wisconsin. The watershed is approximately 153,176 acres and has roughly 172 miles of streams and rivers, 12,590 acres of lakes and 21,781 acres of wetlands. The watershed is dominated by forest (62%) and wetlands (14%). The watershed is ranked low for nonpoint sources that can impact groundwater quality. Figure 6 shows the outline of the Lower Namekagon River Watershed and the location of Des Moines Lake indicated in the light blue outline.

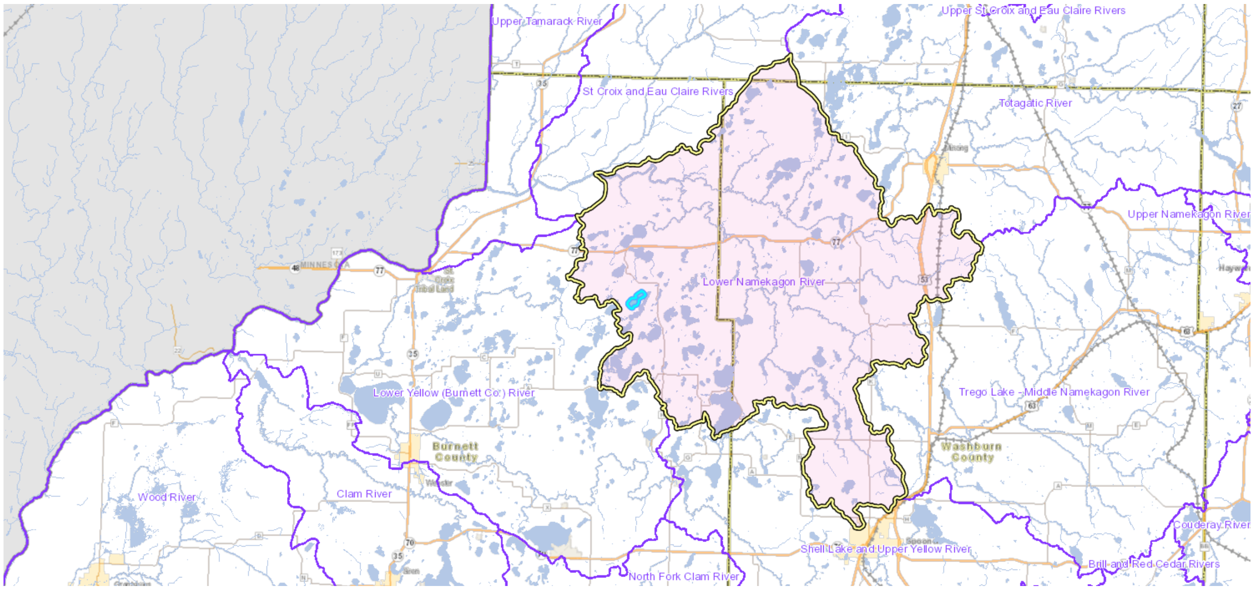


Figure 6. Watershed area for Des Moines Lake outlined in yellow.

Immediate Watershed

The immediate watershed of Des Moines Lake that would impact the water quality at the highest degree can be seen in Figure 7 below. The dominant landcover types that make up the 1 sq mi area include: Open Water (39.1%), Deciduous Forest (24.7%), Mixed Forest (14.8%), Developed/Open Space (9.6%), Grassland/Herbaceous (4.1%), Shrub (1.5%), Woody Wetlands (2.2%), and Evergreen Forest (1.3%). This data is outdated from the WI DNR, which only includes the NLCD 2011 data. Over 90% of the waterbody is developed, however, it is unclear the percentage of undeveloped areas along the shoreline frontage.

Sources of phosphorus and algae in Des Moines Lake would impact the waterbody the most from the immediate watershed. These sources include developed shoreline frontages, sedimentation from sand beaches and roads/driveways, faulty septic systems, fertilizer application, uprooted aquatic vegetation, inadequate stormwater management practices (absent gutters & downspouts, roof runoff, bare ground, lawns, etc) and more.

In order to understand the impacts that are currently occurring on Des Moines Lake it is recommended to conduct a shoreline survey to document the percent naturalness vs developed. This survey was completed in 2013, so it would be interesting to compare the results 10 years later. More information on the past shoreline survey can be found on page 15.

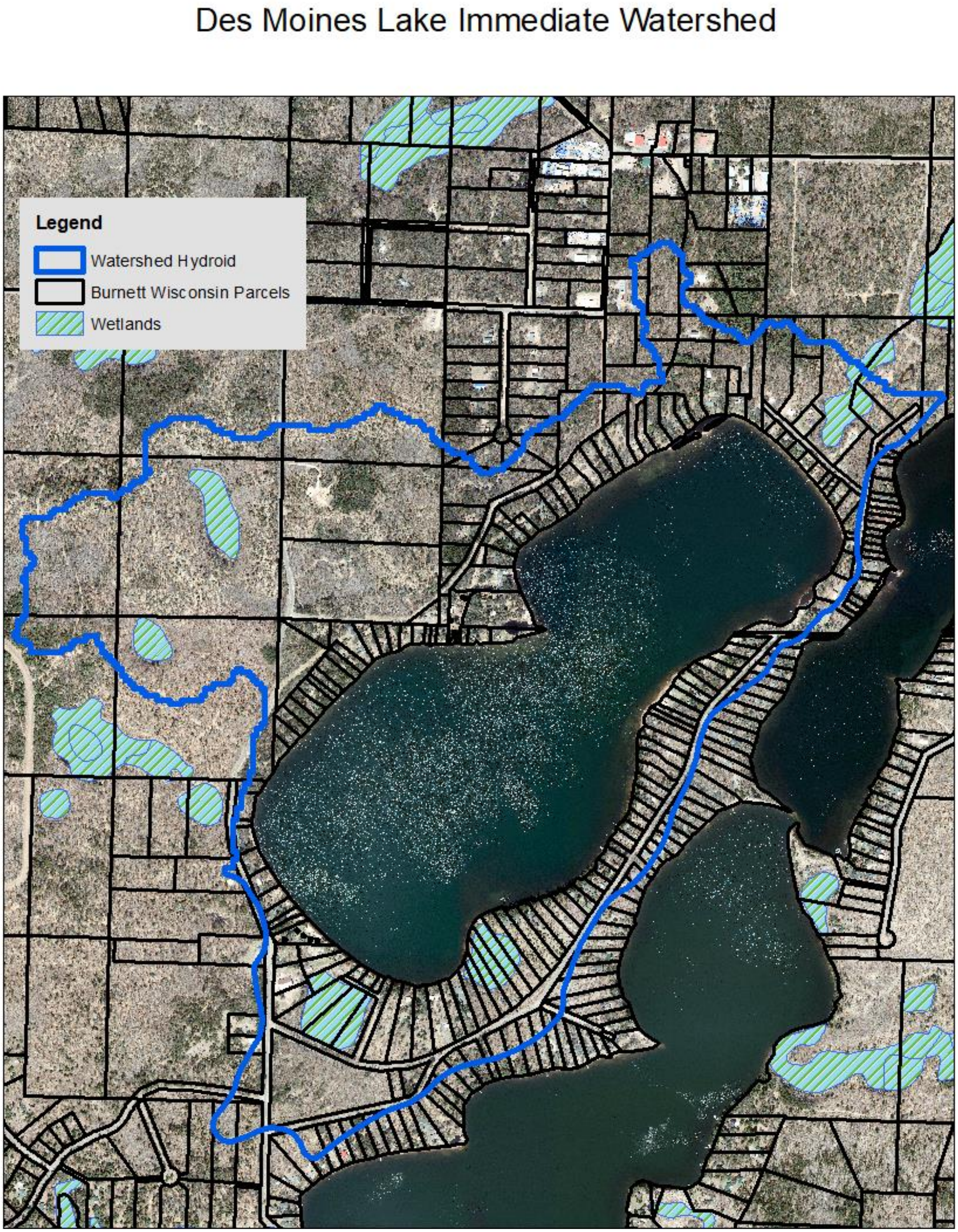


Figure 7. Des Moines Lake immediate watershed shown in blue

Des Moines Lake Characteristics

Area: 239.3 acres
Maximum depth: 37 feet
Mean depth: 23 feet
Bottom: 99% sand
Hydrologic lake type: Seepage
Invasive species present: Banded and Chinese Mystery Snails and Purple Loosestrife
Fisheries: Panfish, Largemouth Bass and Northern Pike

Water Quality

Des Moines Lake volunteers have been taking water chemistry data since 1991 and inputting the data into the Surface Water Integrated Monitoring System (SWIMS).[4] The following statistics were generated and subjected for review from the SWIMS database:

1. Trophic state
2. Secchi Disk
3. Total phosphorus
4. Chlorophyll-a

Trophic State

Trophic state describes the overall productivity of a lake. There are three common classifications that describe the trophic state of a waterbody. The most productive lakes are referred to as **eutrophic**. Eutrophic lakes tend to have a soft, mucky lake bottom and are high in nutrient content. Rooted plant growth tend to be abundant in eutrophic lakes and contain high amounts of algae growth. Water clarity is low in eutrophic lakes due to the high productivity of algae. If an eutrophic waterbody is deep enough to stratify, the lake bottom may be devoid of oxygen and capable of releasing phosphorus into the water column fueling algal blooms. **Oligotrophic** lakes are most commonly deep waterbodies with pristine clear water conditions. Oligotrophic lakes tend to have low productive levels and have sparse rooted plant growth. Oligotrophic lakes can experience stratification and maintain oxygen levels throughout the water column. **Mesotrophic** lakes have intermediate trophic states with characteristics of both eutrophic and oligotrophic waterbodies.

Figure 8. Schematic of Oligotrophic, Mesotrophic and Eutrophic Lakes.

Des Moines Lake straddles between oligotrophic and mesotrophic based off of the Citizen Lake Monitoring Network (CLMN) data (See Figure 8). The lake maintains clear water and oxygen levels throughout the season. From the aquatic macrophyte survey conducted in 2023, there is a sparse population of aquatic plant growth with low diversity present, which is consistent with the waterbody being Oligotrophic.

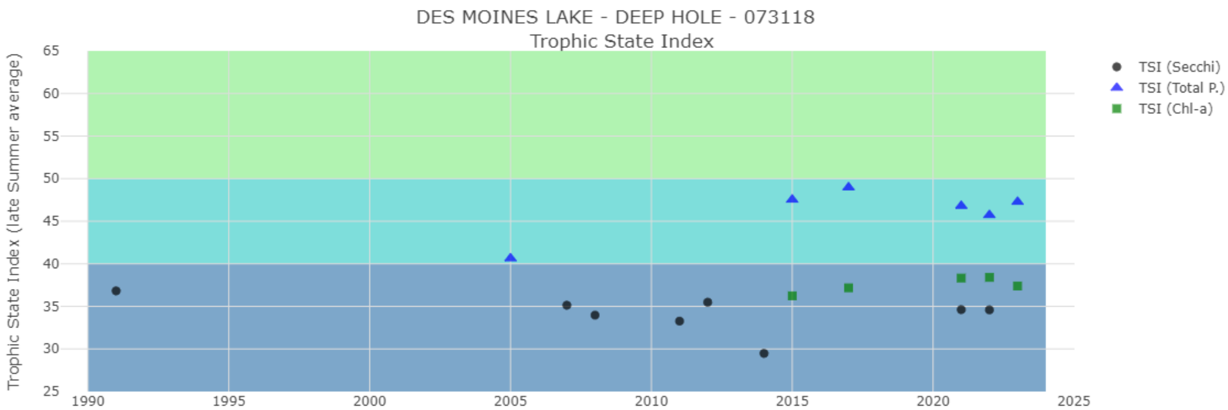


Figure 9. CLMN Trophic State Index data.

Table 1. Trophic State Index General Description.

Trophic State Index (TSI)	General Description
<30	**Oligotrophic** clear water, high dissolved oxygen throughout the year/lake
30-40	**Oligotrophic** clear water, possible periods of oxygen depletion in the lower depths of the lake
40-50	**Mesotrophic** moderately clear water, increasing chance of anoxia near the bottom of the lake in summer, fully acceptable for all recreation/aesthetic uses
50-60	**Mildly eutrophic** decreased water clarity, anoxic near the bottom, may have macrophyte problem, warm-water fisheries only
60-70	**Eutrophic** blue-green algae dominance, scums possible, prolific aquatic plant growth, full body recreation may be decreased
70-80	**Hypereutrophic** heavy algal blooms possible throughout the summer, dense algae and aquatic plants
>80	**Algal scums**, summer fish kills, few aquatic plants due to algal shading, rough fish dominate

Secchi Disk

Volunteers of Des Moines Lake have been collecting water chemistry data since 1991. Secchi Disk readings are the most common data collected in the CLMN program. A Secchi Disk is used to measure the transparency of the water. A Secchi Disk is an 8-inch disk with alternating black and white quadrants attached to a rope with 1 foot increments labeled on the rope. The disk is lowered into the water column until it can no longer be seen by the observer at which point that measurement is the transparency level. Water transparency can be affected by the color of the water, algae and suspended sediments. As the water color, algae and suspended sediments increase, the transparency will decrease. The transparency is often used as an indicator of human activity.

Figure 10 shows the Secchi Disk measurements taken between 1991 and 2023 by CLMN volunteers. Graph excludes CLMN years that only include 3 or less sampling events taken as data is meaningless (2009, 2011, 2012, and 2019). Overall, Des Moines Lake has relatively high water clarity over the years with an average reading staying between 15-20 feet, the lowest recorded in 2007 at 11 feet and the highest recorded in 2014 at 35 feet. Between September and October in 2007 and 2023 there is a noticeable drop in Secchi Disk readings which could be due to the lake experiencing fall turnover. This occurs when the cold winter front comes in, cooling the epilimnion surface water making the water heavy enough to sink and mix with the cooler water in the thermocline and below.

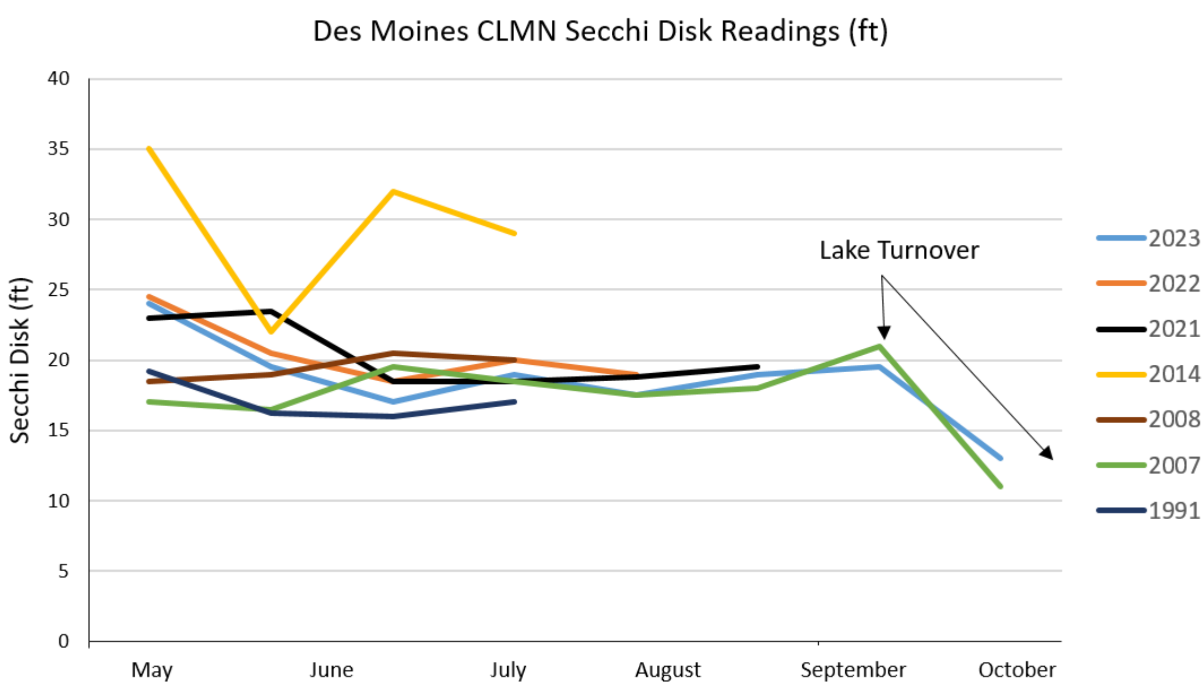


Figure 10. Graph of Des Moines Lake Secchi Disk (ft) measurements between 1991 to 2023 taken at the deep hole.

Total Phosphorus

Phosphorus is a naturally occurring element present in lakes which is necessary for plant and algae growth. Excessive amounts of phosphorus can lead to an overabundance of plants and algae blooms causing the transparency levels and water quality to decrease. Phosphorus is also naturally occurring in soils and rocks around lakes, which can make its way into waterbodies through groundwater and human disturbances such as soil erosion, sand beaches and manicured lawns. Other external sources of phosphorus inputs caused by human disturbances are fertilizer runoff, inadequate stormwater practices such as roof runoff, and urban and agricultural landscapes.

If these inputs are not properly managed and continually get into lakes, internal phosphorus loading and eutrophication can set in on the bottom of the lake. Phosphorus does not readily dissolve in water, instead it forms insoluble precipitates with other elements naturally occurring in lakes such as calcium and iron. If oxygen is available in the hypolimnion (lake bottom zone) then iron forms sediment particles that store phosphorus in the lake sediments. If oxygen is depleted during the winter or summer months, the hypolimnion becomes anoxic (devoid of oxygen) and these iron particles dissolve and phosphorus is able to be released and redistribute throughout the water column, which causes negative impacts to the aquatic ecosystem. Unfortunately, Des Moines Lake does not have dissolved oxygen measurements taken on the lake, so it is unclear if this happening. Dissolved oxygen measurements is a very important water quality measurement that should be taken on lakes to monitoring the hypolimnion.

Des Moines Lake is a deep seepage lake that experiences stratification, separating the lake into three distinct layers, the **epilimnion** (upper photic layer), **metalimnion** (middle layer that separates the warm photic layer from the cool lake bottom layer, and the **hypolimnion** (cool dense layer near lake bottom). These distinct layers can be shown in a temperature and dissolve oxygen graph by taking temperature and dissolved oxygen readings throughout the water column. Temperature and dissolved oxygen are important readings to take in lakes because both are essential in determining the survivability of aquatic organisms and whether or not the waterbody is experiencing **internal phosphorus loading** (accumulation of phosphorus in the lakebed that can be recycled between the lakebed and water column when low oxygen levels are present). These readings are typically taken at the deep hole in the waterbody.

Des Moines total phosphorus average is 0.012 mg/L or 12 µg/L.

The Wisconsin DNR sets levels for the amount of allowable phosphorus concentrations within lakes. The basis of these levels can be found within NR 107 or Wisconsin's Phosphorus Rule. The maximum level for stratified and drainage lakes at 30 µg/L. When comparing the maximum level to Des Moines Lake level, Des Moines Lake is well below the maximum level for Phosphorus.

Chlorophyll-a

Chlorophyll-a is used as an indicator of water quality in a lake. This indicator gives a general idea on the amount of algae in the water column as Chlorophyll-a is a pigment in algae and in plants. Chlorophyll-a is measured in µg/L (micrograms/L) where the greater the value of Chlorophyll-a, the greater the concentration of algae present in the water column.

Chlorophyll-a has the greatest impact on water clarity when measurements exceed 30 µg/L. The average Chlorophyll-a measurements taken on Des Moines Lake by volunteers is 1.4 µg/L.

Des Moines Lake average summer water quality statistics

Secchi Disk: 21.2 ft

Total phosphorus: 0.012 mg/L→ 12 µg/L

- WI-DNR Surface Water Phosphorus Rule for stratified and drainage lakes: 30 µg/L.
    - Phosphorus levels in Des Moines Lake is significantly lower than range of the allowable concentration per NR 102.
- WI-DNR Surface Water Phosphorus Rule was established in 2010 to set the maximum allowable phosphorus concentration in Wisconsin's waters.

Chlorophyll-a: 1.4 µg/L

- WI-DNR Algae Thresholds for Chlorophyll-a for stratified and drainage lakes: 20 µg/L (does not exceed 20 µg/L chlorophyll-a for more than 30% of days during summer sampling period – July 15 to Sept 15).
    - Chlorophyll-a levels in Des Moines Lake is significantly lower than the algae thresholds set for recreational use per NR 102.

Current and/or Previous Water Quality Lake Studies

Staff Gauge

Burnett County Land Services installed a staff gauge in 2017 at a location in Des Moines Lake to monitor the lake level elevation between May-November each season. The staff gauge is a graduated measuring instrument and is placed in the lake bed to show the elevation of the water surface. The elevation is calibrated by referencing the numbered height on the gauge to the surveyed elevation of a permanent reference mark on the lake at the time of installation and also when the gauge is taken out for the season (Harrelson et al. 1994).[9] From the date of installation until the end of 2022, Des Moines Lake has been trending downwards in water surface elevation, as shown from the dotted trend line in Figure 11 below. Being that Des Moines is characterized as a seepage lake, the water level fluctuations dramatically depend on the amount of precipitation that occurs over the season.

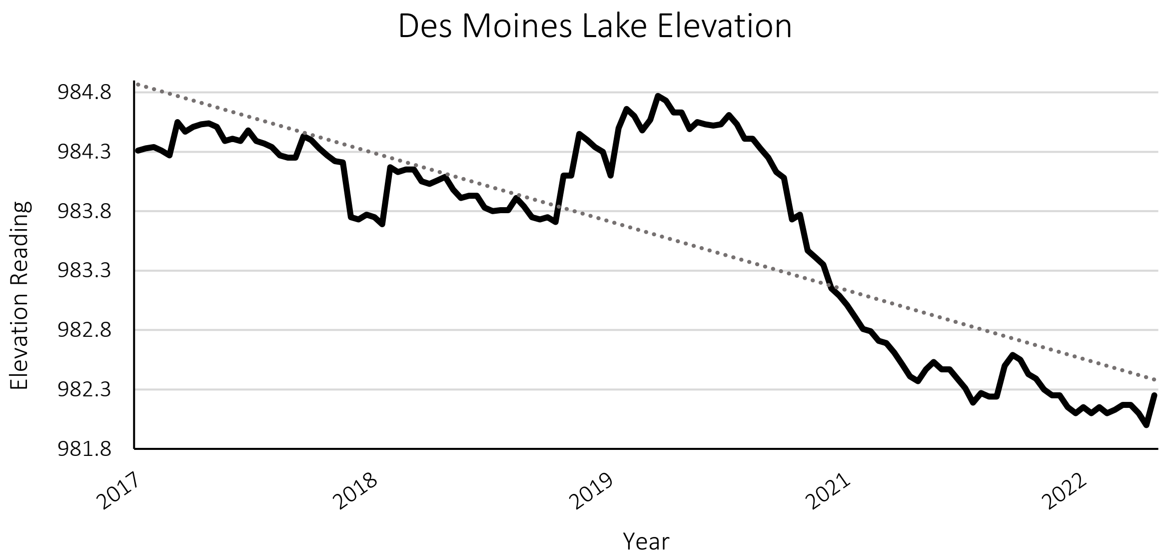


Figure 11. Des Moines Lake Elevation from Staff Gauge.

Shoreland Habitat Protection: Social Marketing Strategies

In 2013 Burnett County partnered with the University of Wisconsin-Extension to conduct research with lake property owners to get an idea on landowner knowledge of shoreland management practices that protect lakes (Amato et al. 2012).[1] The study explored how the phenomenon of self-landowner bias may cause an over-estimate on how natural the shoreland area is and how that may prevent remedial action. Des Moines Lake and Long Lake were chosen for this study. Surveys were mailed to 212 property owners on both lakes to determine landowner views on shoreland programs available to them and their input on how natural the shoreland was. Results revealed that landowners scored their shoreland areas more natural than biologists, which suggests that landowners do show bias when evaluating their personal shoreland area more than an observer.

During the study, two unbiased biologists surveyed the shoreland areas using the WDNR Shoreland and Shallows survey protocol to determine how natural the shoreline was. Secondly, the surveys were sent out to landowners to determine their views on their personal shoreland areas. Of the 212 households contacted, 163 surveys were returned yielding a response rate of 78%. There were some limitations from the study that may have impacted the results including:

- Potential differences between the set of categories used by the biologist and the scale used by the landowners.
- Timeframe of evaluation.
- Different ecological knowledge between biologists and landowners.

A more refined study could be implemented on both waterbodies in the future to fix the issues that were found during this study. Past data on shoreline health could be compared to what shorelines look like today to see how Des Moines has changed since 2013.

Des Moines Lake Aquatic Communities

Fish Community

Des Moines Lake has a simple fish community. The WDNR has sampled the waterbody in 2009, 2015 and completed for 2022, but data isn't available yet.[17] Sampling methods include early spring netting/electrofishing for walleye, pike and muskellunge and late spring electrofishing for bass and panfish. In 2009, the most dominant fish species caught was Largemouth Bass, followed by Bluegill. In 2015 during the sampling event the WDNR found 0 muskellunge, 18 northern pike (16 inch average) 2 walleye (20.5 & 21.5 inch) 33 largemouth bass (11.5 inch average) and observe fishes of white sucker, bluegill and black crappie. The WDNR have stocked muskellunge from 1977 to 2012 and Walleye from 1999 to 2001. Stocking stopped due to low catch between both species, potentially due to inadequate habitat for spawning recruitment. Table 2 shows the WDNR information on the spawning needs for common fish species. This table can guide the lake association and landowners on best practices to enhance fish spawning habitats along their shoreline.

When considering fish in a management plan, to better the community of the waterbody, the following should be considered:

1. There should be an increase in fisheries habitat including woody debris along the shoreline and an increase in natural shoreline buffers.
2. There should be minimal emergent aquatic plant management by landowners, as bulrushes, cattails, lily pads and submergent plants provide shelter, food and habitat for fisheries.
3. Reduction of sedimentation in the waterbody. Sand and other soils that runoff into a lake can impact spawning by covering and suffocating eggs.

Table 2. Fish Species and Spawning Needs.

Fish Species	**Spawning Temp ^{0}F**	**Spawning Habitat Needs**
Black Crappie	Upper-50s to lower-60s	Build nests in 1-6 feet of water on hard bottoms by sweeping an area on the lakebed
Bluegill, largemouth bass and Pumpkin seed	Mid-60s to lower-70s	Build nests in less than 3 feet of water on hard bottoms
Muskellunge	Mid-50s to near-60s	Broadcast eggs over organic sediment, woody debris and submergent vegetation. Eggs are deposited indiscriminately over several hundred yards of shoreline.
Northern Pike	Upper-30s to mid-40s soon after ice-out	Broadcast eggs onto vegetation (eggs attach)

Smallmouth Bass	62 and 64 degrees, but sometimes mid-50s	Nests in circular, clean gravel
Walleye	Low-40s to-50	Gravel/rocky shoals with moving or windswept water 1-6 feet
Yellow Perch	Mid-40s to lower-50s	Broadcast eggs in submergent vegetation or large woody debris

Aquatic Plant Community

Lake ecosystems rely heavily on the aquatic plant community. Aquatic plants can be found in the **littoral zones**, where light penetrates and allows aquatic plants to capture light in the waterbody. This area is found in nearshore areas in shallow water. There are 3 common plant community types that are found in lakes: Emergent, Floating-leaf and Submergent aquatic plants.

Emergent aquatic plants are rooted in the lake bottom, but their leaves, stems and flowers extend out of the water. These aquatic plants filter runoff that enters the lake from the watershed area and their root networks also stabilize the lake bottom to reduce turbidity. Emergent aquatic plants also protect the shoreline from erosion by reducing the impacts from waves. Emergent aquatic plants provide shelter and important spawning habitats for fisheries. Many birds, waterfowl and mammals rely on emergent aquatic plants for food, nesting material and habitat. Common emergent aquatic plants include: bulrushes, arrowhead, Wild Rice and lake sedges.

Floating-leaf plants are rooted in the lake bottom, but their leaves and flowers float on the water surface. The most common example of a floating-leaf aquatic plant is the water-lily. Floating-leaf aquatic plants also protect the shoreline from wave energy and provide shelter for other aquatic communities. Other examples of floating-leaf plants include watershield, spatterdock and duckweeds.

Submergent aquatic plants are rooted to the lake bottom and grow completely under the water surface. These aquatic plants produce oxygen byproduct from photosynthesis. They absorb nutrients that are present within the water column from their roots and leaves, which in turn decreases nutrients that would be available to algae. Like emergent and floating-leaf plants, submergent aquatic plants stabilize the lakebed and reduce re-suspended sediments caused by wind and boat activity that would cause turbidity in the water column.

Aquatic plants vary greatly from lake to lake and can take on many shapes and distributions within a waterbody. Lakes that have a high plant diversity tend to prevent the establishment of invasive aquatic plant species better than lakes with less plant diversity. However, some native aquatic plants can reach nuisance levels depending on the environmental characteristics present in a given growing season.

Non-native invasive species are opportunistic species, meaning they are capable of taking over and occupying open available space along the lake bottom where native species either were removed or not present to begin with. Without the competition of native species, non-native invasive plants flourish. Removal of native aquatic plants not only diminishes the natural qualities of a waterbody, but also increases the risk of non-native species invasion and establishment. Allowing native aquatic plants to grow may not guarantee complete protection over non-native invasive species, but it could lead to the discouragement of their establishment into introduced areas.

Aquatic Plant Survey Results for Des Moines Lake

This is Des Moines Lake's first Aquatic Plant Management Plan (APM) and first time the waterbody has been sampled for aquatic plants using the WDNR point-intercept survey protocol. Burnett County Land Services Department – AIS Coordinator completed two aquatic plant surveys, one early in the season to capture invasive aquatic plants and one survey later in the growing season to capture the native aquatic plant community. Plant survey methods can be found in Appendix B.

At each sampling point a depth finder was used to determine depth and a rake was used to sample the plant community at depths deeper than 5 feet. A pole grabber was used at depths 4 feet or shallower. All plants on the rake were identified to species and assigned a rake fullness value of 1 to 3 to estimate abundance [10]. Visual sightings of plants were also recorded in shallower waters where visibility was clear. The lake bottom substrate was assigned at each sampling point if it could be reliably determined using the rake.

During the survey, all 440 points were sampled and 131 sites had aquatic plants present. Of the 131 sites sampled, the rake was used at 68 sites and the pole was used at 78 sites.

Data collected was entered into a spreadsheet for analysis. The following statistics were generated and subjected for review:

1. Maximum depth of plants (in Feet)
2. Sample points with vegetation
3. Species richness
4. Number of sites where each species was found
5. Average rake fullness
6. Frequency of occurrence
7. Relative frequency
8. Simpson's Diversity Index
9. Floristic Quality Index

Explanations of the above statistics that were analyzed on Des Moines Lake are described below. Des Moines Lake values are also described and compared to the regional eco-region with applicable (Northern Lakes and Forests.) Table 3 presents the values associated with 1-7 on page 27.

Maximum depth plants

Aquatic plants have a maximum depth of which they can grow within a lake, typically dependent on the amount of light availability penetrating the water's surface. Lakes that have greater water clarity have aquatic plants that can grow in deeper depths, compared to lakes that have poor water clarity. The maximum depth aquatic plants were found in Des Moines Lake was 13 feet. Figure 12 shows the number of sites plants were found at which depth during.

The top three most common plants found in Des Moines Lake was *Potamogeton gramineus* (N = 72 sites), *Najas flexilis* (N = 66 sites) and *Chara sp* (N = 34 sites). *Potamogeton gramineus (*Variable-leaf pondweed) is a perennial native aquatic plant that grows from a creeping rhizome in the lakebed. This species can be found in many different habitats, including ponds, lakes, ditches and streams. It typically can be seen growing in oligotrophic lakes and tends to be intolerant to nutrient pollution. The second most common aquatic plant found was *Najas flexilis (*Nodding waternymph or Slender naiad*)*. This aquatic plant can be found in soft or hard water lakes, ponds, rivers and streams. It has a similar growing pattern as *Potamogeton gramineus*, where it can be found growing on creeping rhizomes, but also produces seeds. Lastly, the third most common species found was a *Chara sp*s or charophyte. This species was the only one not to be identified to species, as it can be difficult to distinguish between the other family members in this group. *Chara sp* are actually large aquatic macro-algae, not aquatic plants. The main difference between macro-algae and macrophytes (aquatic plants) is that the macro-algae do not have the same vascular system or specialized organs and tissues as macrophytes. Additionally, the major difference between algae and macro-algae is that algae species need to be identified in a microscope because they are considered "micro"-algae, whereas, "macro"-algae can be seen with the naked eye. Charophytes are large, complex green algae that blanket the lakebed like a green carpet. These species can be found in brackish (salt) and freshwater ecosystems and are typically indicators of pristine water clarity, such as Des Moines Lake. All three species are native and provide positive ecosystem services to the lake ecosystem.

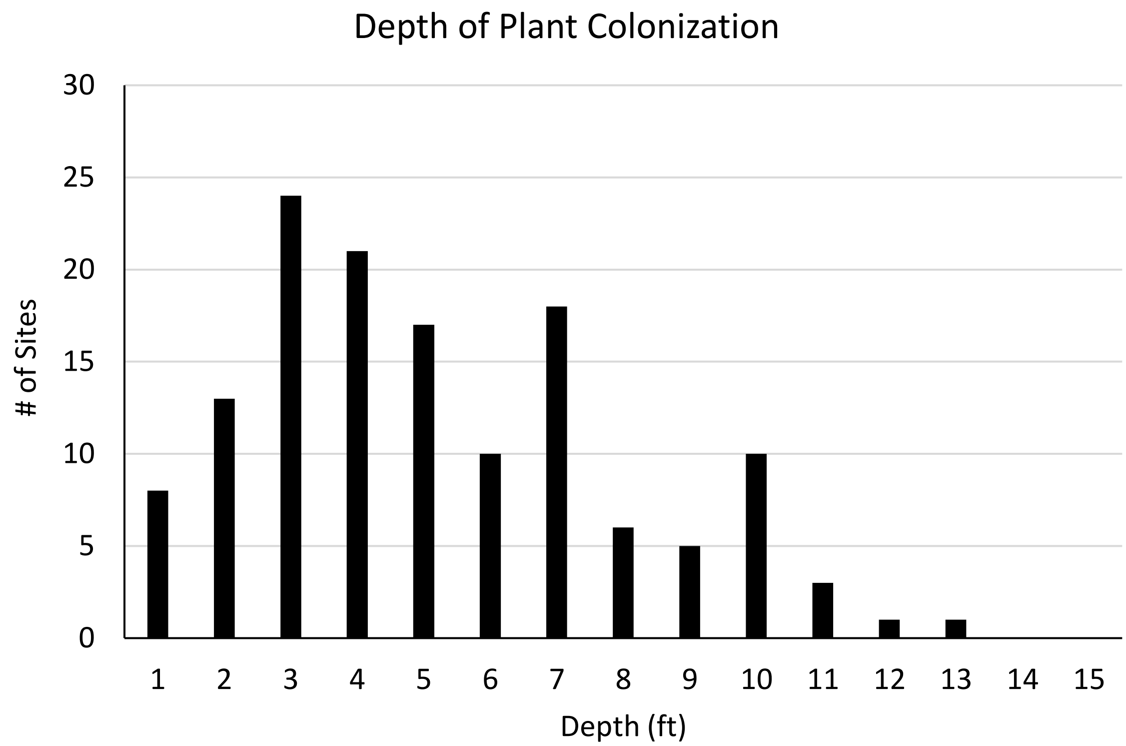


Figure 12. Depth of plant colonization at sample site.

Sample points with vegetation

This is the total number of sites where at least one plant was found during the survey. In total, plants were found at 137 sites of the 599 points sampled. That means that 23% of the lake bottom was covered with aquatic plants.

Species richness

Species richness is the number of different species found in a lake. The total number of aquatic plant species found in Des Moines Lake was 10, which is lower than the average number of species and upper quartile found in the Northern Lakes and Forests Eco-region with 13 and 20 species respectively.

Number of sites where each species was found

During the survey, a count is made on how many times a species was found at each site. Variable pondweed was found the most during the survey with a count of 72 times. All 9 species and the total number of sites each species was found can be seen in Figure 13. This excluded species that were only found visually.

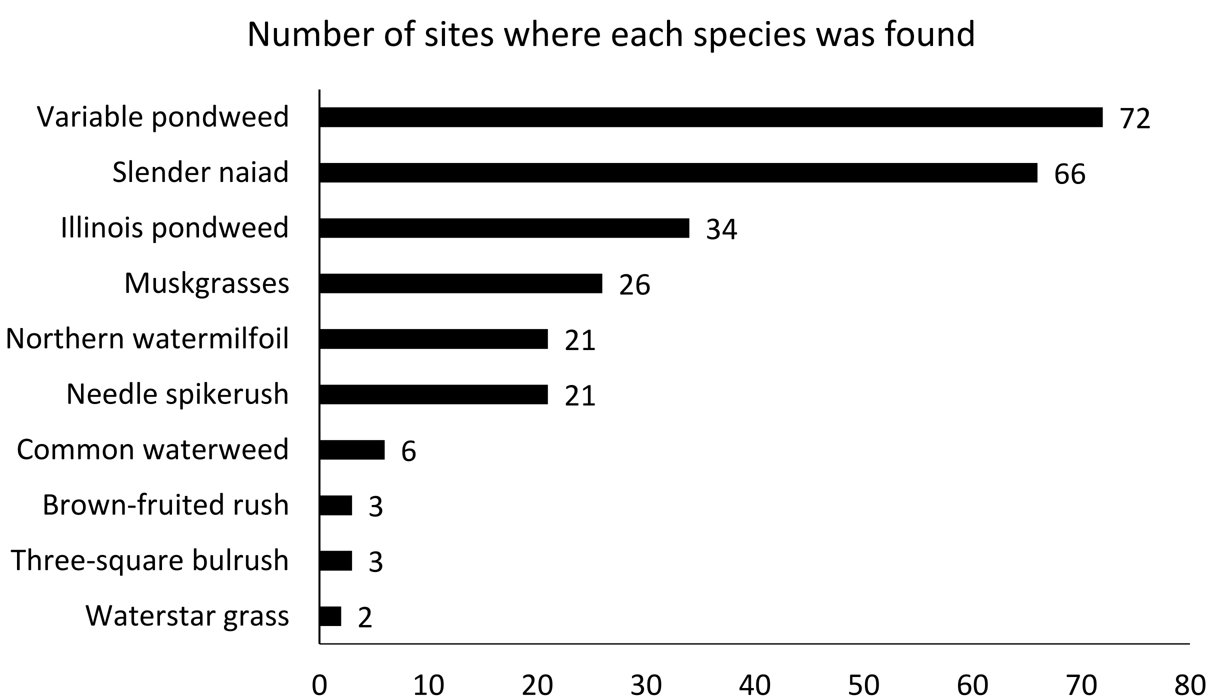


Figure 13. Number of sites where each species was found.

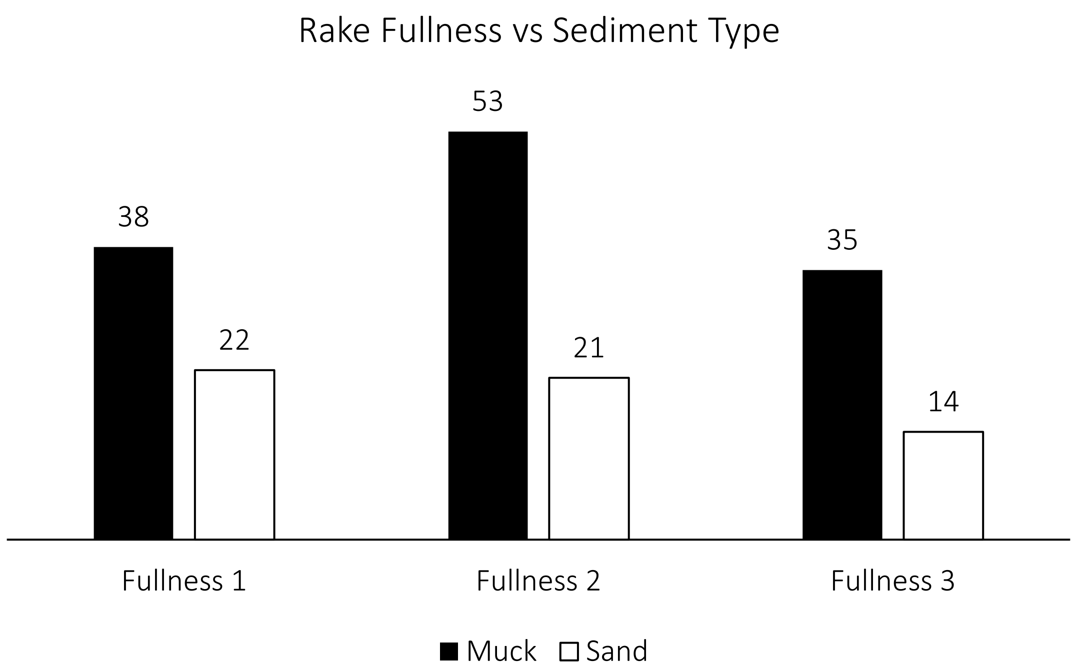


Figure 14. Rake Fullness vs Sediment Type.

Average rake fullness

During the survey, a rake fullness value is given for each species found ranging from 1 (sparse), 2 (medium), or 3 (full). Species that were not sampled on the rake, but were only found visually are not represented in Figure 14.

Frequency of occurrence

Two values are computed for frequency of occurrence during the aquatic macrophyte survey: frequency of occurrence within vegetated areas and frequency of occurrence at sites shallower than the maximum depth of plants. For both values, the greater the value computed, the more frequent the aquatic plant was found. Table 3 shows the values for both frequency of occurrence criteria, however, species that were found visually only will not be presented.

<u>Frequency of occurrence within vegetated areas</u> is defined as the number of times a species was sampled in a vegetated area divided by the total number of vegetated sites. This value will show how often an aquatic plant would be found everywhere vegetation was found within the waterbody.

<u>Frequency of occurrence at sites shallower than the maximum depth of plants</u> is defined as the number of times a species was sampled divided by the total number of sites shallower than the maximum depth of plants. This value will show how often a plant will be found within depths an aquatic plant would grow.

The most frequent species found in the survey was Variable pondweed occurring at 52% of the sites. Other frequently found species were Slender naiad (48%), Illinois pondweed (24%), and Muskgrass (18%).

Relative Frequency

The relative frequency is the frequency of a plant relative to other species found. This value shows which species is dominant amongst other species within a waterbody, where the higher the value, the more common the species is compared to others. The relative frequency will add up to 100%. If a species has a relative frequency of 10%, this species will then have occurred 10% of the time compared to all species sampled.

The most dominate aquatic plant found in Des Moines Lake during the survey as indicated by the relative frequency was Variable pondweed (27.9%), followed by Slender naiad (25.6%), Illinois pondweed (13.2%), and Muskgrass (10.10).

Table 3. Species found during aquatic macrophyte survey and their corresponding frequency statistics.

Species	FO vegetated (%)	FO < max depth (%)	Relative frequency	# of Sites	Average rake fullness
Variable pondweed	52.55	40.68	27.9	72	1.32
Slender naiad	48.18	37.29	25.6	66	1.47
Illinois pondweed	24.82	19.21	13.2	34	1.24
Muskgrass	18.98	14.69	10.10	26	1.46
Needle spikerush	15.33	11.86	8.1	21	1.71
Northern watermilfoil	15.33	11.86	8.1	21	1.38
Common waterweed	11.68	9.04	6.2	17	1.63
Three-square bulrush				3	Visual
Brown-fruited rush				3	Visual
Waterstar grass	1.46	1.13	0.8	2	1.5

Simpson's Diversity Index

The Simpson's Diversity Index is used to determine how diverse the aquatic plant community is within the lake by measuring the probability that two individuals randomly selected from a sample will belong to the same species. This value ranges from 0 to 1, with the greater or closer the value is to 1, the more diverse the plant community is. An Index of 1 means that the two plant species sampled will always be different or diverse versus an index of 0 means that the two plants sampled will never be different or more common/same.

The Simpson's Diversity Index for Des Moines Lake was 0.81.

Floristic Quality Index (FQI)

The Floristic Quality Index (FQI) evaluates the closeness of the flora in an area to that of an undisturbed condition. The FQI measures the aquatic plant species tolerances for changing water quality and habitat modifications and assigns each species with a coefficient of conservation (C) score between 1 to 10 (Table 4). A high value of C indicates a plant species is intolerant of change, whereas, a low value of C indicates a plant is tolerant to changes. Plants that score higher are likely to respond adversely to changes in water quality and habitat, like eutrophication. Invasive species have a C of 0. A higher FQI score indicates a healthy plant community.

Table 4. Floristic Quality Index Conservation C Scores.

Scientific Name	Common Name	C
Chara	Muskgrasses	7
Eleocharis acicularis	Needle spikerush	5
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Juncus pelocarpus f. submersus	Brown-fruited rush	8
Myriophyllum sibiricum	Northern water-milfoil	6
Najas flexilis	Slender naiad	6
Potamogeton gramineus	Variable pondweed	7
Potamogeton illinoensis	Illinois pondweed	6
Schoenoplectus pungens	Three-square bulrush	5
N (# of species)		10
Mean C		6
FQI		18.65

Summary of Northern Lakes and Forest (NLFL) values for FQI

A floristic Quality Assessment of Wisconsin's aquatic plant community was created to evaluate the closeness of the flora in undisturbed areas. Wisconsin was split into ecoregions in order to calibrate the community effectively (Figure 15). Des Moines Lake is within the Northern Lakes and Forest ecoregion. This region has the highest floristic quality and average coefficient values compared to all other ecoregions due to the lack of human developmental pressure (Nicols, 1999). This ecoregion was developed in 1999, which is fairly outdated and the values may have changed since then. Table 5 represents the mean FQI values compared to the values calculated for Des Moines Lake during the aquatic macrophyte survey.

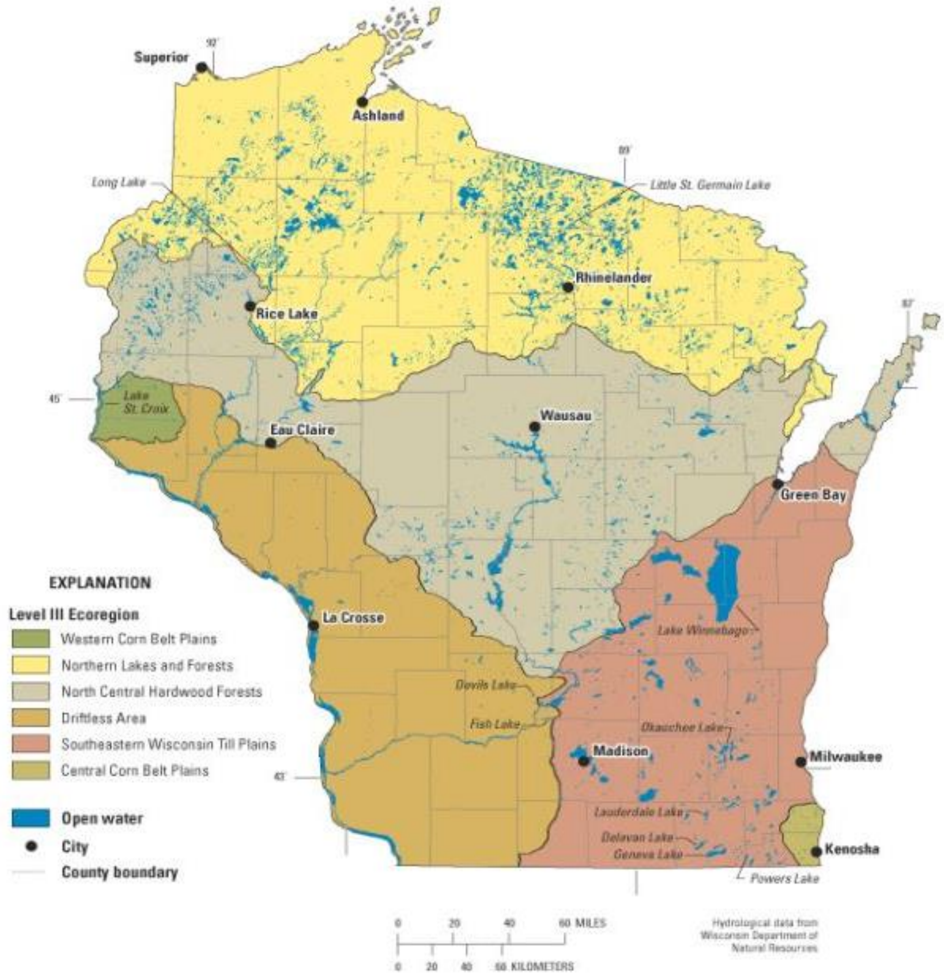


Figure 15. Map of ecoregions in Wisconsin.

Table 5. Ecoregion mean values compared to Des Moines Lake data.

	Ecoregion Mean Values	Des Moines Lake
Species richness	13	10
Conservatism	6	6.15
Floristic Quality	22.2	27.5

Aquatic Invasive Species (AIS) Survey

An aquatic invasive species survey was also conducted on Des Moines Lake early in the season. AIS surveys occur earlier than the aquatic macrophyte survey because AIS have shown to start growing earlier in the season, compared to native aquatic plants. This survey used the same methods as described above for the native aquatic plants. No aquatic invasive plants were detected during the survey. Chinese and Banded Mystery Snails are currently present on Des Moines Lake, but are very difficult to map the distribution accurately. We did find some of both species during the survey. Another invasive species detected on Des Moines Lake is Purple Loosestrife, a riparian invasive found along shorelines and wetland areas. Locations found during the survey can be found in Figure 16, indicated by the black dots. Please note, these locations are marked by the closest point-intercept grid point in the lake, but the Purple Loosestrife was seen along the shoreline area.

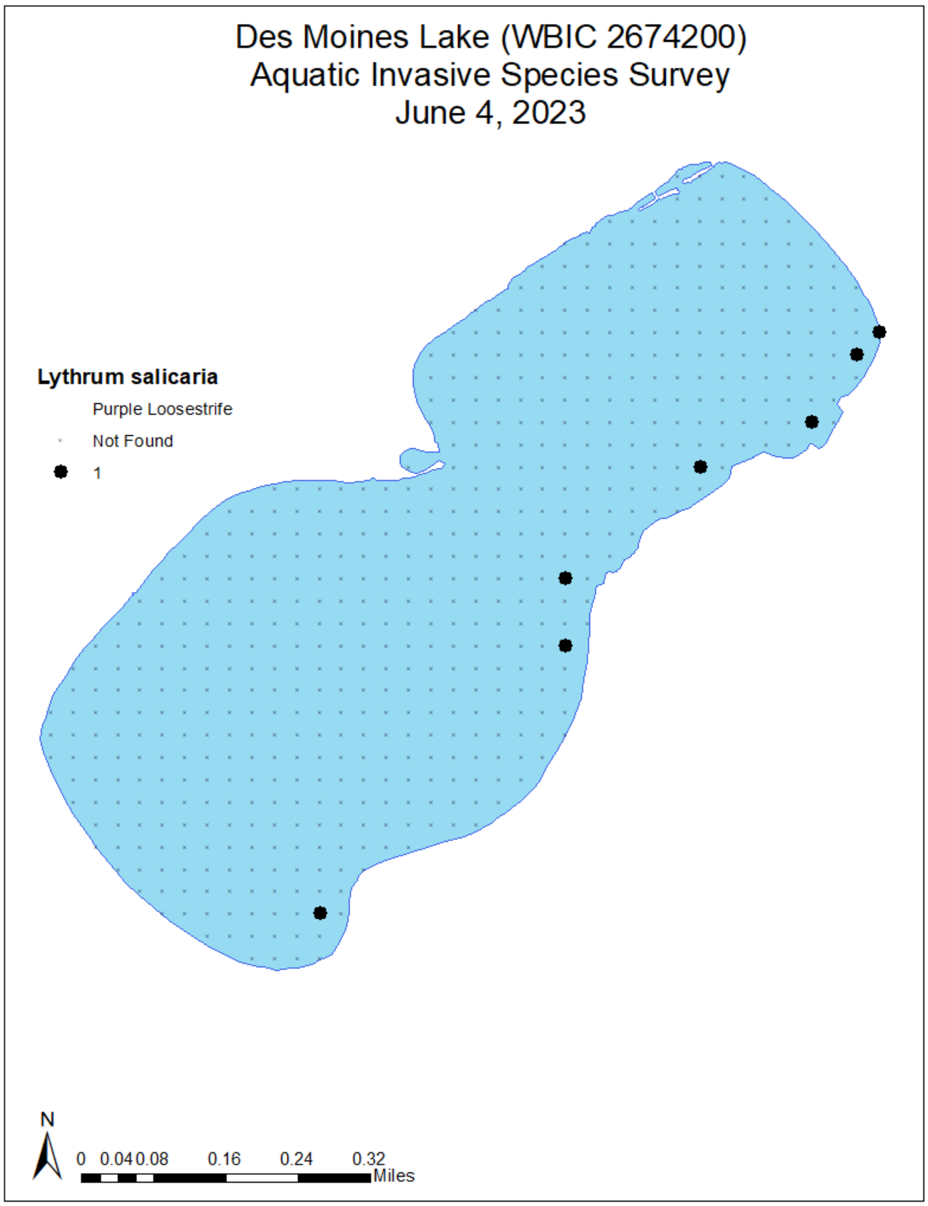


Figure 16. Distribution map of Lythrum salicaria (Purple Loosestrife).

Aquatic Plant Management - Current and Past Aquatic Plant Management Activities for Des Moines Lake

Education – The Des Moines Lake Association provides a newsletter with an educational component every other month to members. In August every year, the lake association shares Purple Loosestrife updates and awareness messages to all members through a content-specific email blast. Additionally, the lake association provides other educational messages to members including water quality, Septic System Smart Week information, and information on decontamination at the landings and updates on the Aquatic Plant Management plan.

CBCW **–** The Des Moines Lake Association partners every year with the Long Lake Association for CBCW inspections. The public boat launch is shared with Long Lake so volunteers can monitor both lakes and educate boaters on the State and Local Ordinances and impacts AIS have on the waterbodies. Typically Long Lake Association applies for a CBCW grant that covers both Long Lake and Des Moines Lake landings. According to the WDNR CBCW website, Des Moines Lake began inputting data for the program in 2015. Figure 17 shows the CBCW data that was provided on the WDNR CBCW website. Years 2015-2018 were not provided as some years had no data entered or below 5 data statistics.

Purple Loosestrife (PLS) – The Des Moines Lake Association has been active in managing Purple Loosestrife on the waterbody. PLS plants were grown in a mass rearing cage and beetles were reared at one point in time. Volunteers have also removed PLS from a low bog area by digging the rootstock up and disposing of it appropriately.

Lake Monitoring – The Des Moines Lake Association has been a part of the Citizen Lake Monitoring Network (CLMN) program for several years. Volunteers go out and collect monthly water chemistry data during June-August. More about the CLMN water quality results can be found in the water quality section on page 14.

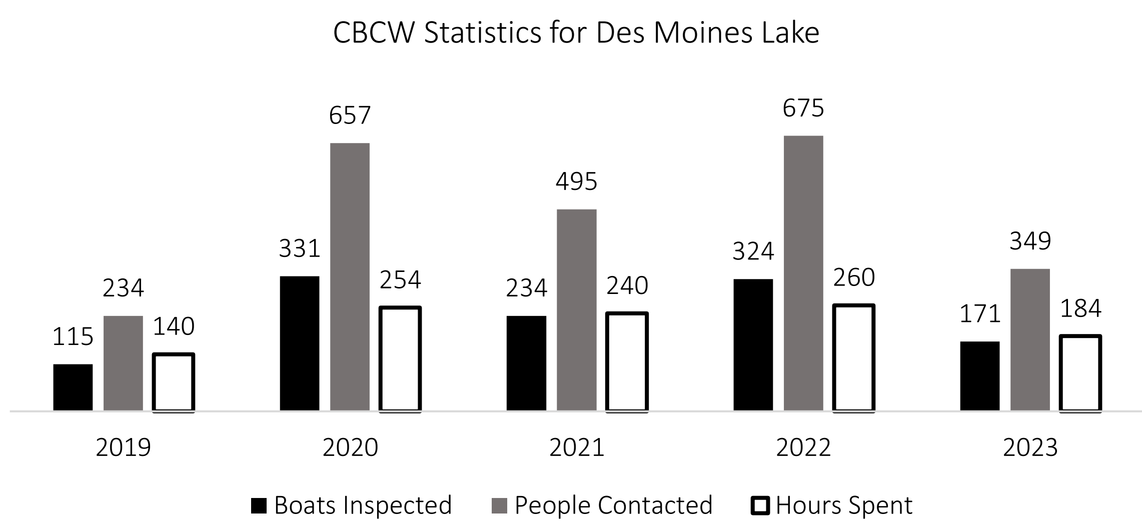


Figure 17. Des Moines CBCW Statistics.

Plan Goals and Strategies

Overall Purpose

This section of the plan lists the goals, objectives and actions for an Aquatic Plant Management Plan for Des Moines Lake. This plan was called for due to pressures from the lake association board regarding nearby threats of aquatic invasive species. It presents a detailed strategy on how Des Moines Lake Association plans to prevent, reduce and control populations of aquatic invasive species, provide education on aquatic plants, erosion concerns and areas to improve on water quality.

Plan Goals

1. Prevent the introduction and spread of aquatic invasive species.
2. Reduce and control the spread of Purple Loosestrife, and Banded and Chinese Mystery Snails.
3. Educate community regarding aquatic plant management, appropriate native plant management actions and erosion control practices.
4. Maintain and improve water quality.
5. Develop a Rapid Response Plan for aquatic invasive species.

Goal 1: Prevent the introduction and spread of aquatic invasive species.

Objectives

A. 100% of watercraft users will receive inspections, clean, drain and decontaminate boats, trailers and equipment.
B. 100% enforcement of Burnett County's Do Not Transport Ordinance.
C. Train Des Moines CBCW volunteers and the public on Burnett County's No Power Loading Ordinance and follow with 100% enforcement in 2024 and going forward.
D. Des Moines Lake residents will continue monitoring for aquatic invasive species.

Actions

- Continue to collaborate with Long Lake Association with their application for a Clean Boats Clean Waters (CBCW) grant to conduct CBCW monitoring and education at the boat landing using paid and/or volunteer staff. (OBJ A, B).
- Work with Burnett County Sheriff's Department to encourage increased enforcement and potentially increase fines for the Do Not Transport Ordinance and No Power Loading Ordinance (OBJ A, B, C).
- Install 'No Power Loading' signage at the Des Moines Lake boat landing.
- Attend Burnett County's CBCW trainings and workshop in April as needed (OBJ C).
- Provide information and trainings to Des Moines Lake community on identifying Purple Loosestrife (PLS), Curly-leaf Pondweed (CLP), Eurasian watermilfoil (EWM), Chinese and Banded Mystery Snails and Zebra Mussels and who to contact if they have a suspected AIS. (Burnett County LSD will provide volunteer training for AIS identification. Burnett County AIS Coordinator and lake association AIS representative will provide identification assistance.) (OBJ D).

- Conduct point intercept surveys every 2-3 years to monitor for CLP, EWM and other aquatic invasive species (OBJ D).

Goal 2: Reduce and control the spread of known AIS species such as Purple Loosestrife (PLS), and Banded and Chinese Mystery Snails (BMS, CMS).

Objectives

A. Educate Des Moines Lake community members how to identify PLS and Mystery Snails and the impacts of invasive species.
B. Recruit volunteers to control current populations of PLS, BMS and CMS.

Actions

- Monitor Des Moines Lake for PLS growth annually.
- Cut and spray individual PLS plants where identification is confirmed.
- Collaborate with Long Lake Association to raise and release Galerucella beetles to help reduce and control the spread of PLS.
- Note each area where PLS is sprayed and monitor subsequent years.
- Consider obtaining & planting native species in place of PLS.
- Design a manual removal event for BMS and CMS.

Goal 3: Educate community regarding aquatic plant management, appropriate plant management actions, erosion control practices, and identification and removal of other invasive species.

Audience: Des Moines Lake Community

A. All lake residents
B. Business owners
C. Lake users
D. Residents who treated waterfront with herbicides or hand pulling in the past.

Messages

1. Educate the next generation of lake users on the importance of water quality, AIS preventive measures and being a good lake steward.
2. Where to find summary of APM plan and when APM meeting(s) are being conducted.
3. List of APM do's and don'ts
4. Include Des Moines APM committee contact list on the lake association website.
5. Importance of native aquatic plants.
6. Limit impacts to native aquatic plants by traveling with no wake in shallow areas, using hand removal methods near docks, and swimming areas.
7. Explain procedures for individual corridor herbicide applications and describe conditions where herbicide treatments may be allowed.
8. Explain aquatic plant management techniques and permitting procedures.
9. Provide audience information on CLP, PLS, EWM and Zebra mussel identification and removal methods.

10. Provide the audience with information on lakes nearby with aquatic invasive species, especially Clean Boats Clean Waters inspectors.
11. Describe new potential invasive species and why they are a threat.
12. Native plant identification.
13. CBCW methods on proper inspections.
14. Updates on Burnett County Ordinances.

Methods

Summary of APM plan
AIS education workshops and webinars for all lake users
Improvements to signage at boat landings
Updates to AIS handouts
Newsletter articles
Mailings to lake residents
Develop and update website
Social media posts
Clean Boats Clean Waters monitoring and education
Annual meeting/special meetings
Door-to-door distribution of information
Plastic peel-off stickers for boats

Table 6. Methods of educational messages that correspond to the implementation table.

Method	Audience	Message #
Summary of APM plan	A – D	1
AIS education	A – D	4, 8-14
Signage	A – D	14
AIS handouts	A – D	4, 6-14
Newsletter articles	A – D	1 – 14
Mailings	A – C	1 – 14
Website	A	1 – 14
Clean Boats Clean Waters	A	8-11, 14
Annual meeting/special meetings	A – D	1 – 14
Door-to-door distribution	A	4-14
Plastic peel-off stickers	A – C	14

Goal 4: Maintain and enhance water quality conditions.

Objective

A. Continue to sample and record both water samples and Secchi readings.
B. Encourage lake residents to restore and preserve shoreline buffers with native vegetation.
C. Encourage lake residents to reduce hand pulling of aquatic plants near the immediate shoreline.
D. Reduce phosphorus and sediment loads from immediate watersheds.
E. Encourage riparian landowners to adopt and implement stormwater runoff controls for existing structures and all new construction.

Action

- Train and recruit Citizen Scientists on the proper protocols for sampling water clarity and water chemistry and submit data into SWIMS.
- Provide workshops and presentations to lake residents on best management practices for healthy shorelines.
- Introduce property owners to different cost share programs available for stormwater practices, including Healthy Lakes and Rivers and Burnett County Shoreline Incentives Program.
- Provide onsite visits for property owners having issues with erosion and runoff. (Provided by Burnett County Water Resources Specialist)
- Educate property owners on the benefits aquatic plants have at protecting the shoreline and reducing sediment suspension.
- Send messages out about the impacts pollution, littering, plastic, fireworks, balloons have on the water quality.
- Educate property owners on the do's and don'ts along the shoreline, including zoning regulations, setbacks and aquatic plant removal.
- Provide education on the impacts of leaky or old septic systems and plumbers to contact in the area to do regular maintenance.

Goal 5: Develop Rapid Response Plans for aquatic invasive species.

Objective

A. Lake association has recently obtained 501(c)(3) status, which makes association eligible to apply for grants. The board may consider revising association bylaws for additional grant eligibility purposes if necessary.
B. Develop plan for Curly-leaf pondweed, Eurasian water milfoil and Zebra mussels.

Action

- Lake association board discussed current bylaws and needs for grant eligibility and determined its 501(c)(3) status was adequate to qualify for grants and will consider further bylaw changes for additional grant eligibility should the need arise.
- Association board presents any recommendations (as needed) and schedules meetings to develop plans and address needs.

- Make response plans available online.

Implementation Plan Abbreviations:

AIS: Aquatic invasive species

APM: Aquatic plant management plan

BC: Burnett County

BCLSD: Burnett County Land Services Department

CBCW: Clean Boats Clean Waters

CLMN: Citizen Lake Monitoring Network

DMLA: Des Moines Lake Association

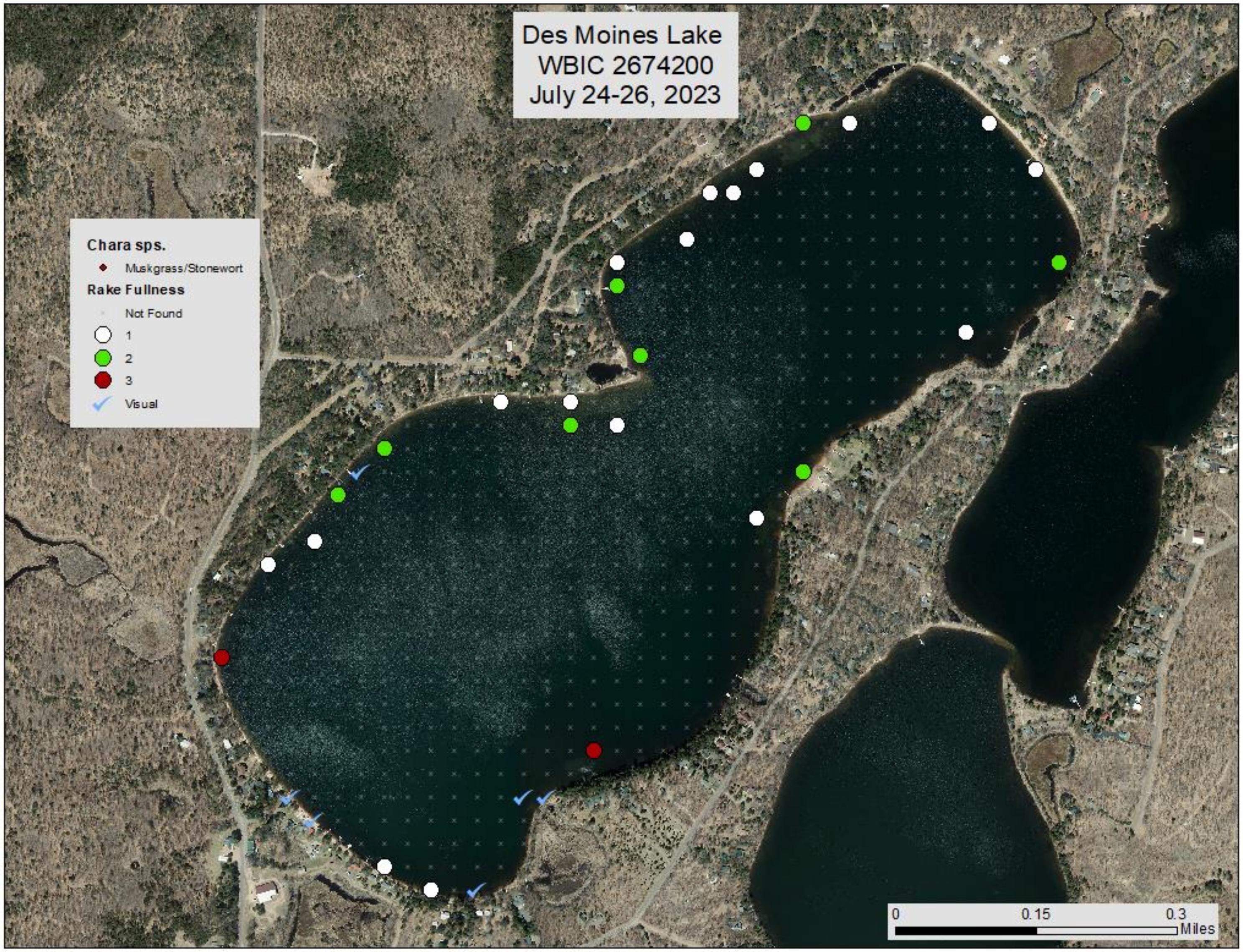
PLS: Purple Loosestrife

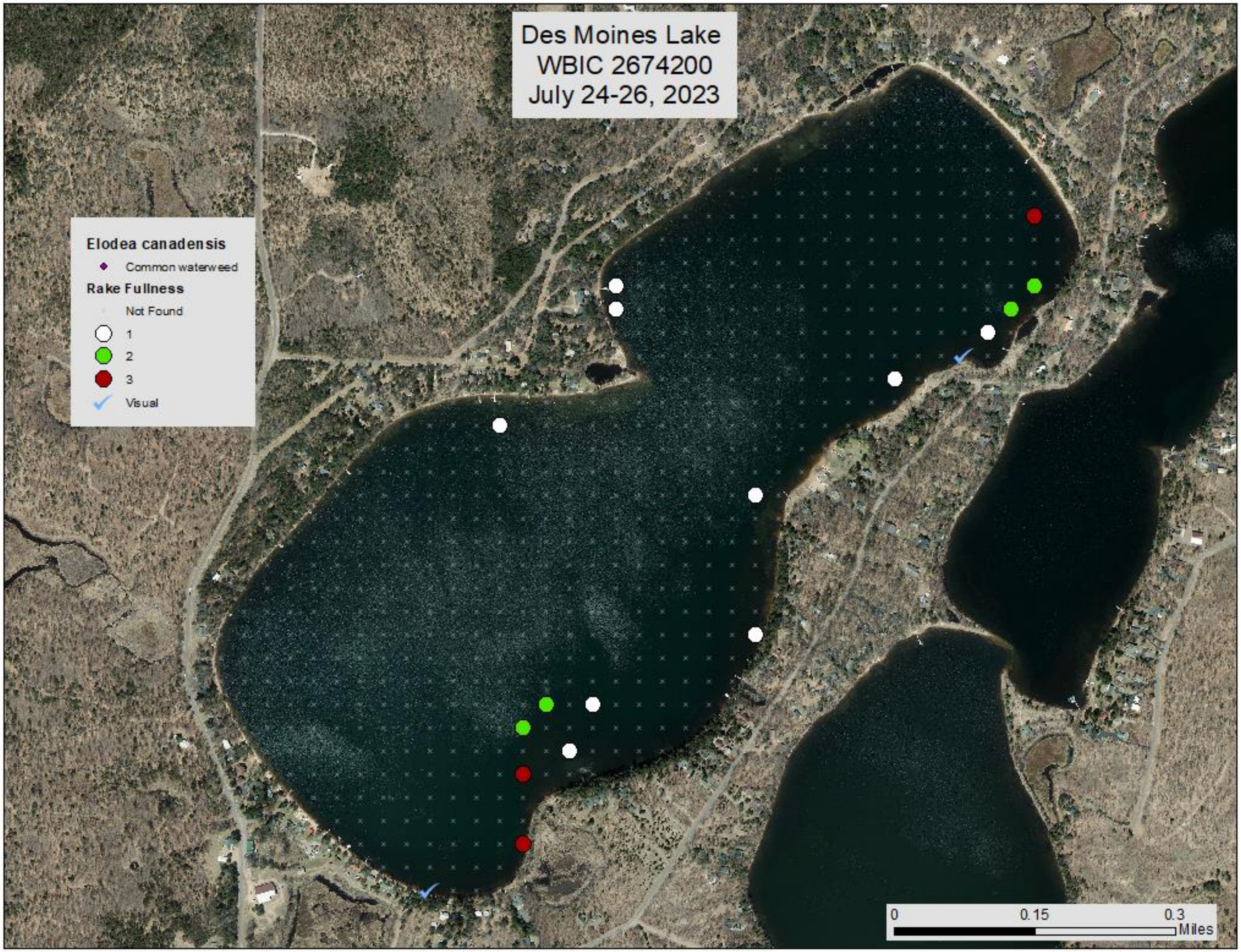
TBD: To be determined

Action Items	Timeline	Cost 2023	Cost 2024	Cost 2025	Responsible Parties
Goal 1: Prevent AIS Introduction					
Upgrade decontamination station at landing to Power washer	2023-2025		$23,000	$2,000	DMLA & DNR
Coordinate DMLA volunteers for CBCW program ~ liaise with Long Lake	Ongoing	10 hours	10 hours	10 hours	DMLA Board Member
Increase enforcement of BC Do Not Transport Ordinance & No Power Loading Ordinance	Ongoing	4 hours	4 hours	4 hours	DMLA, BC Sheriff Dept. & BCLSD
Monitor boat landings	Annually	$0	$0	$0	DMLA, BCLSD
Train Volunteer monitors in CLMN	As needed	$0	$0	$0	BCLSD
Rapid Response plan review	Ongoing	3 hours	3 hours	3 hours	DMLA, BCLSD
Provide AIS education/identification and encourage volunteer monitoring	May - August	20 hours	20 hours	20 hours	DMLA AIS Committee, BCLSD
Conduct AIS survey every 3-5 years	Ongoing		$1,700		DMLA, BCLSD
Goal 2: PLS, BMS, CMS Control					
Monitor Des Moines Lake for PLS growth each year	Ongoing	10 hours	10 hours	10 hours	DMLA, BCLSD
Apply for permit to cut and spray PLS	Ongoing	TBD	TBD	TBD	DMLA
Cut and spray individual PLS plants where identification is confirmed	Ongoing	$100	$100	$100	DMLA
Raise and release Galerucella beetles (in collaboration with Long Lake Assoc.)	Ongoing				DMLA
Monitor post treatment	Ongoing	3 hours	3 hours	3 hours	DMLA
Manual removal of BMS, CMS	May – August	10 hours	10 hours	10 hours	DMLA

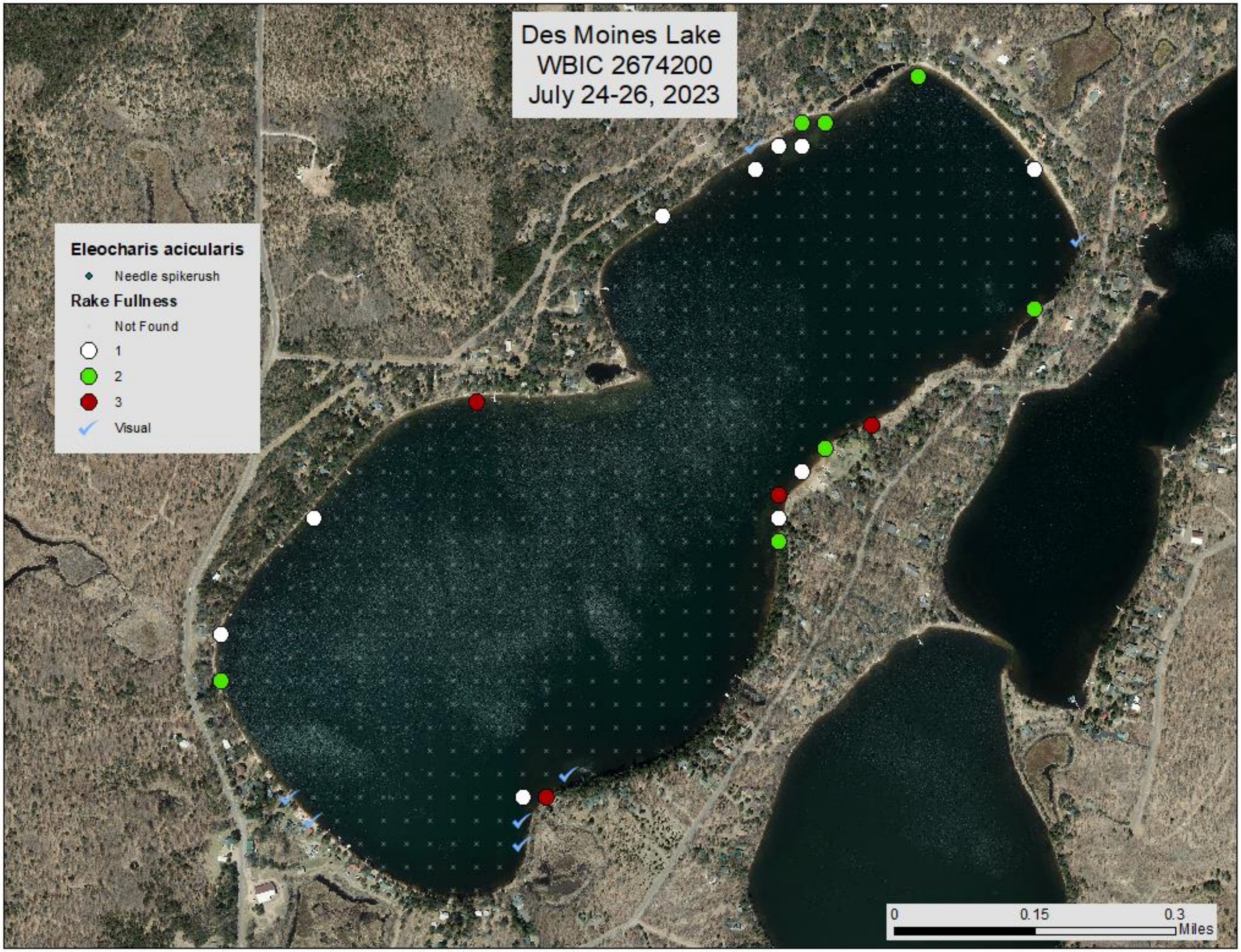
Goal 3: Educate Des Moines Lake Community					
AIS workshops	Ongoing	$0	$0	$0	BCLSD
AIS signage	As needed	$0	$0	$0	BCLSD
Handouts, mailings, door-to door distribution	Ongoing	$500	$350	$350	DMLA, BCLSD
DMLA e-newsletter articles	Ongoing	$0	$0	$0	DMLA
DMLA website updates	Ongoing	30 hours	20 hours	20 hours	DMLA
DMLA social media updates (Facebook & Instagram)	Ongoing	20 hours	20 hours	20 hours	DMLA
DMLA educational videos (YouTube)	Ongoing	10 hours	10 hours	10 hours	DMLA
Annual meeting	Ongoing	$200	$200	$200	DMLA
Goal 4: Maintain and Enhance Water Quality					
Water chemistry and Secchi sampling	Ongoing	20 hours	20 hours	20 hours	DMLA, CLMN Volunteer(s)
Reduce phosphorus and sediment loads from immediate watershed	Ongoing	TBD			DMLA, BCLSD
Educate and assist Des Moines Lake community members in the restoration and preservation of shoreland buffers and shoreland vegetation	Ongoing	TBD			DMLA, BCLSD
Continue implementation of shoreline owners' education program	Ongoing	TBD			LA, BCLSD
Explore grant opportunities to support shoreline restoration and/or water quality initiatives. (Ex.: Healthy Lakes & Rivers program)	Ongoing				LA

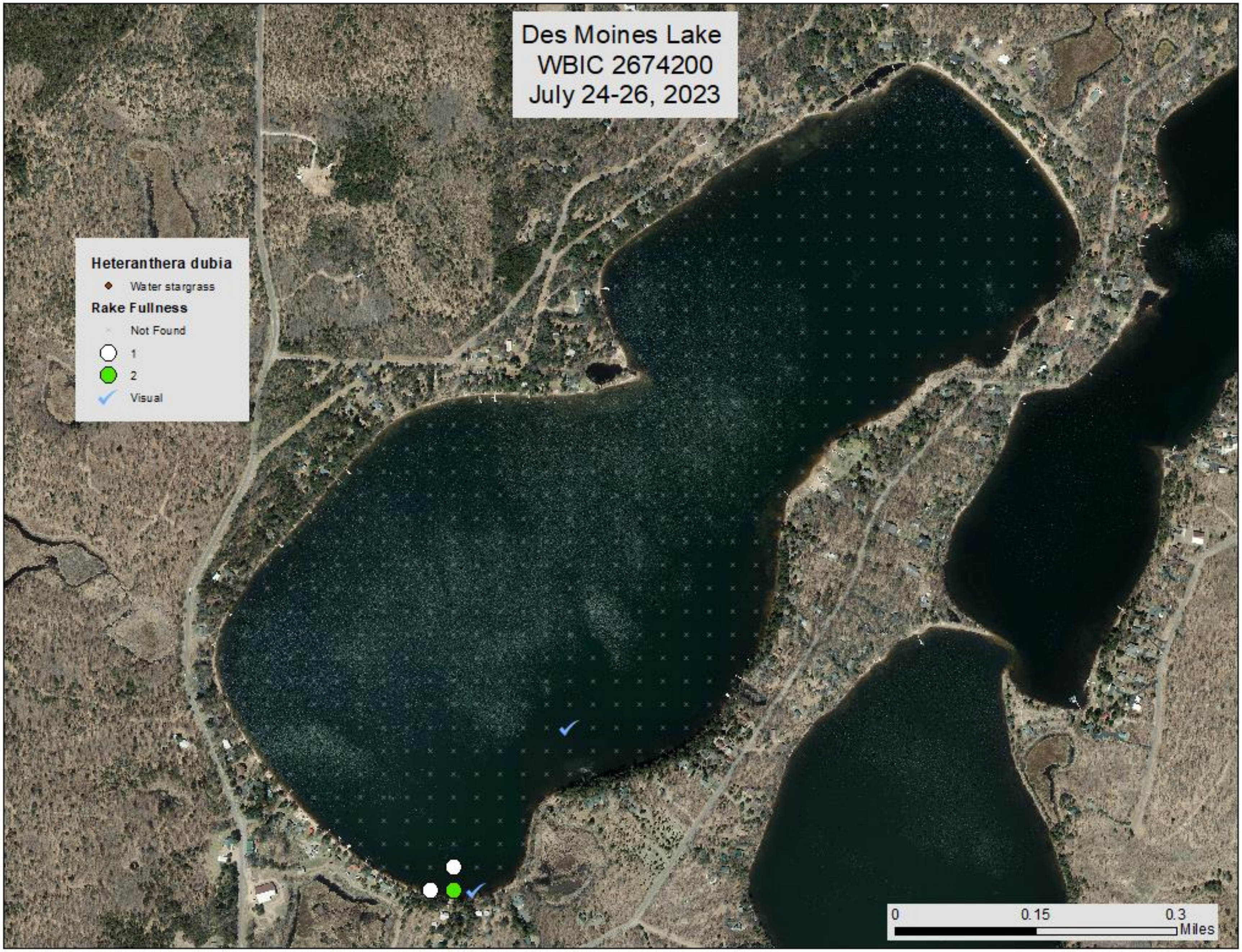
Appendix A: Aquatic Plant Maps

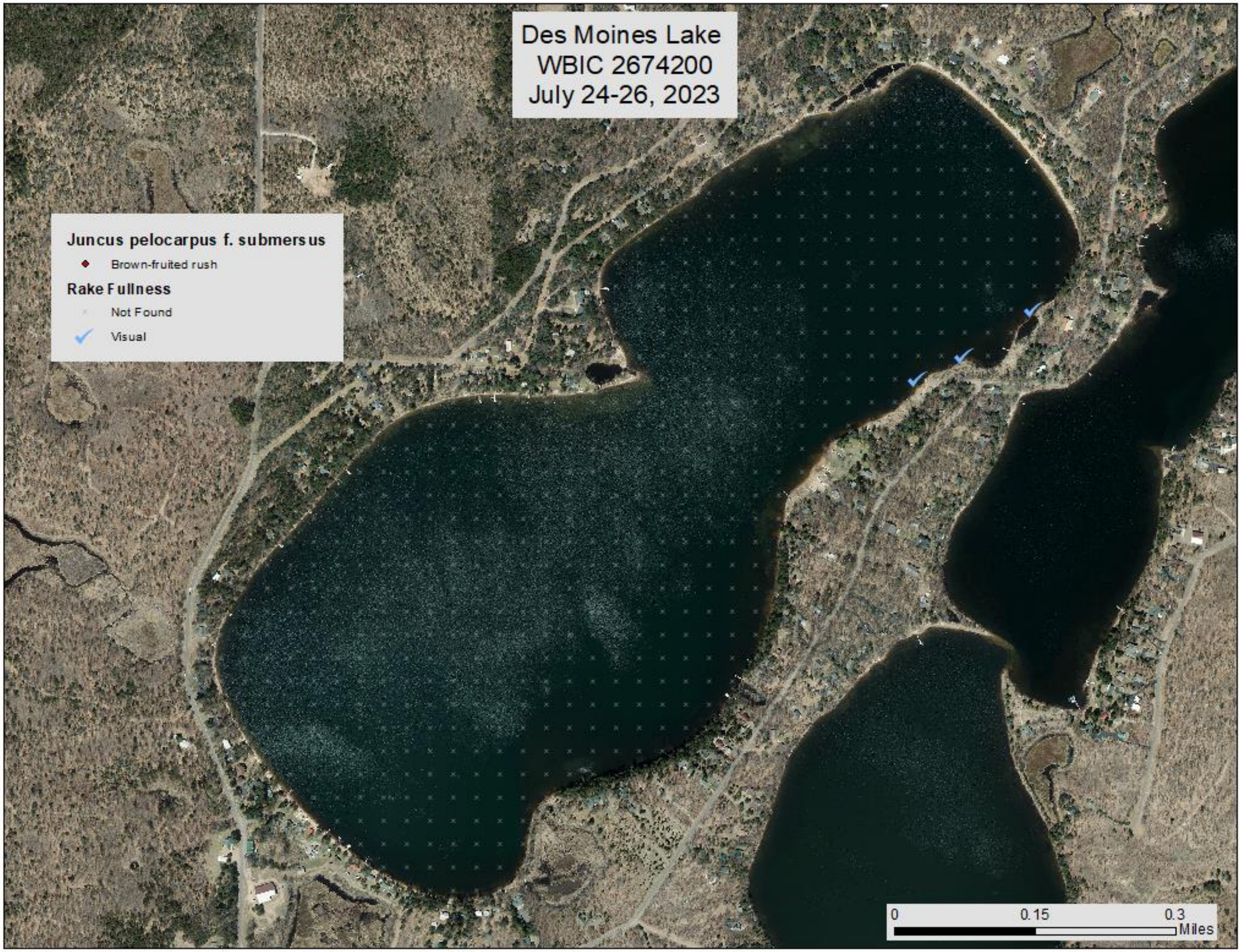


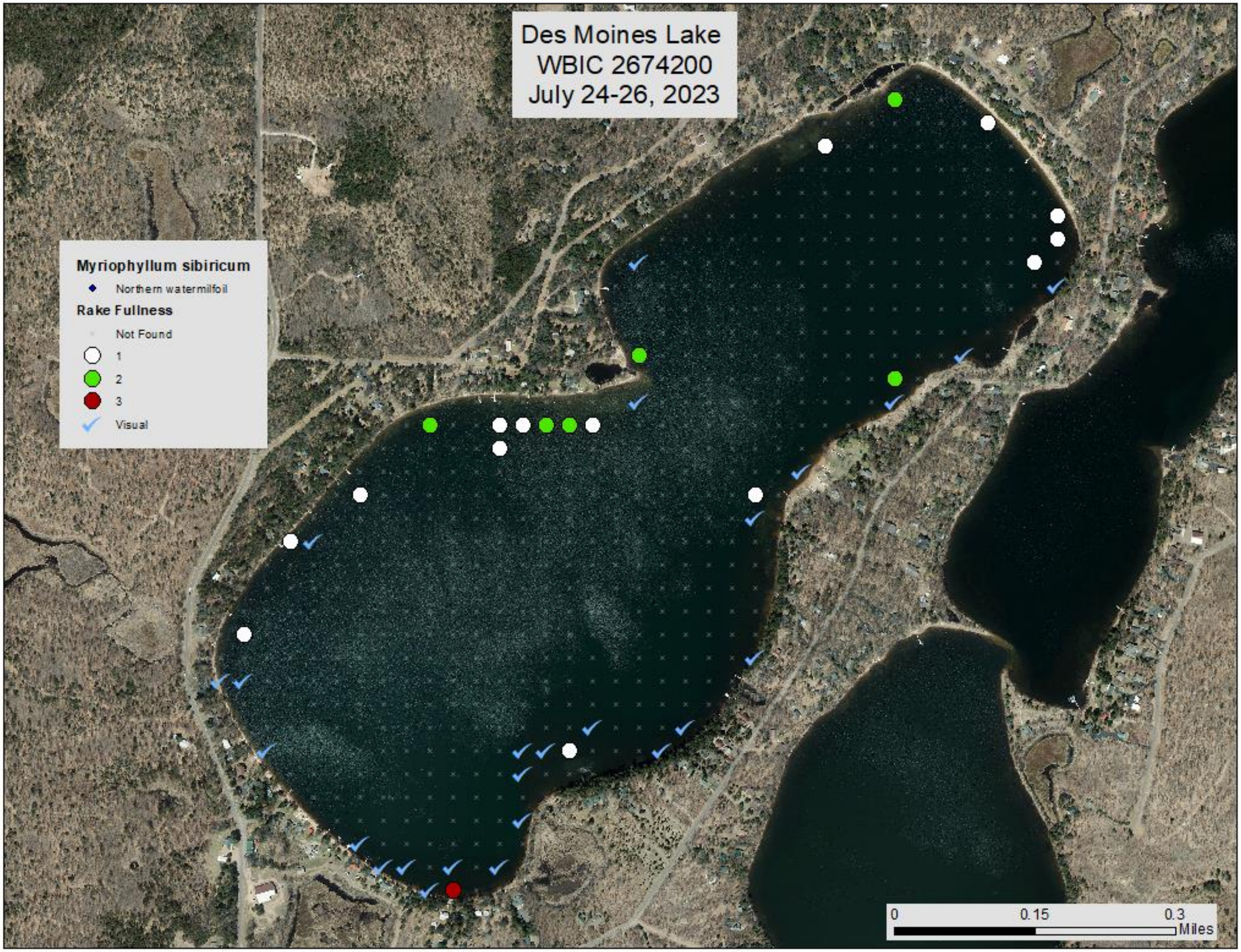


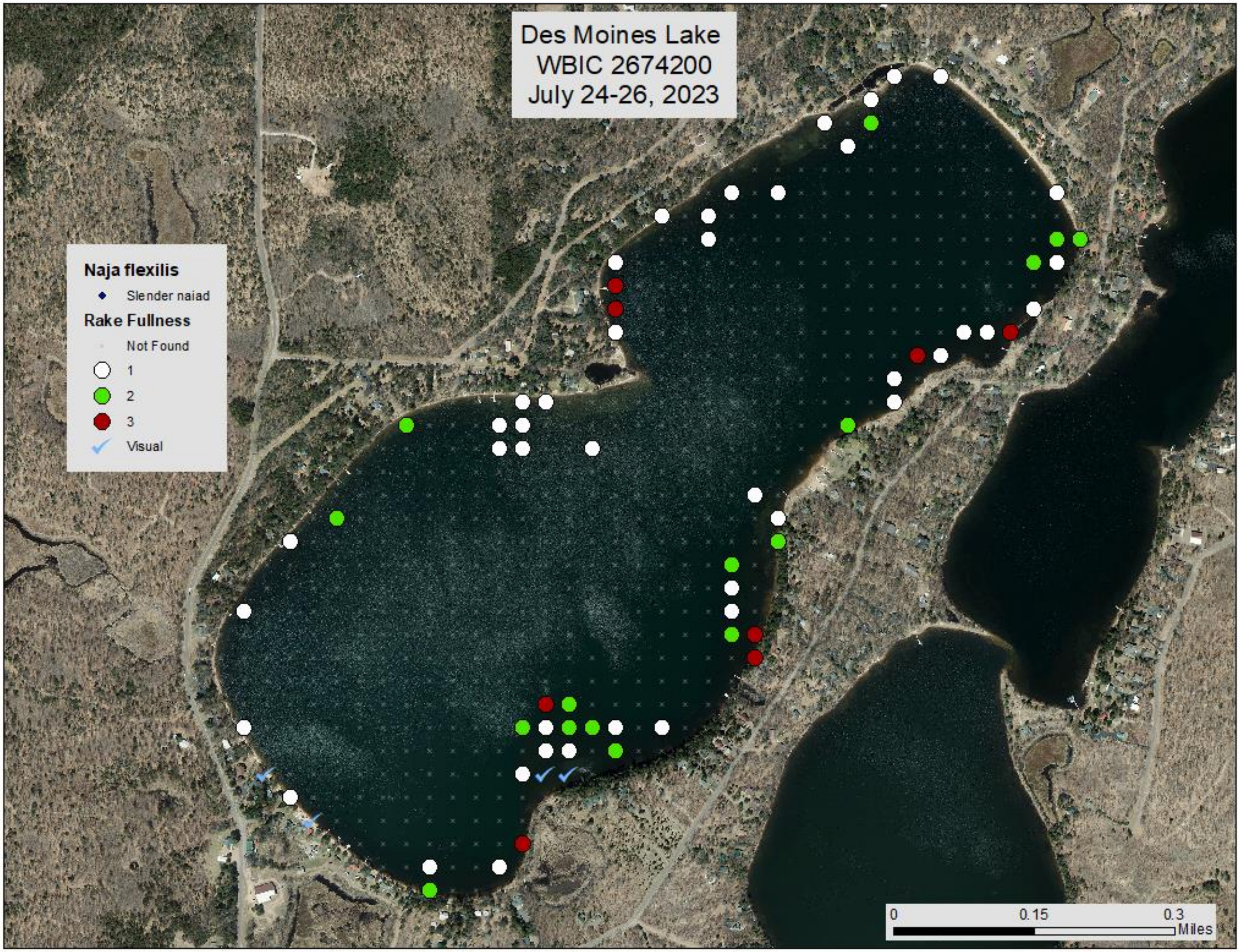
Des Moines Lake
WBIC 2674200
July 24-26, 2023
Elodea canadensis
Common waterweed
Rake Fullness
Not Found
1
2
3
Visual
0
0.15
0.3
Miles

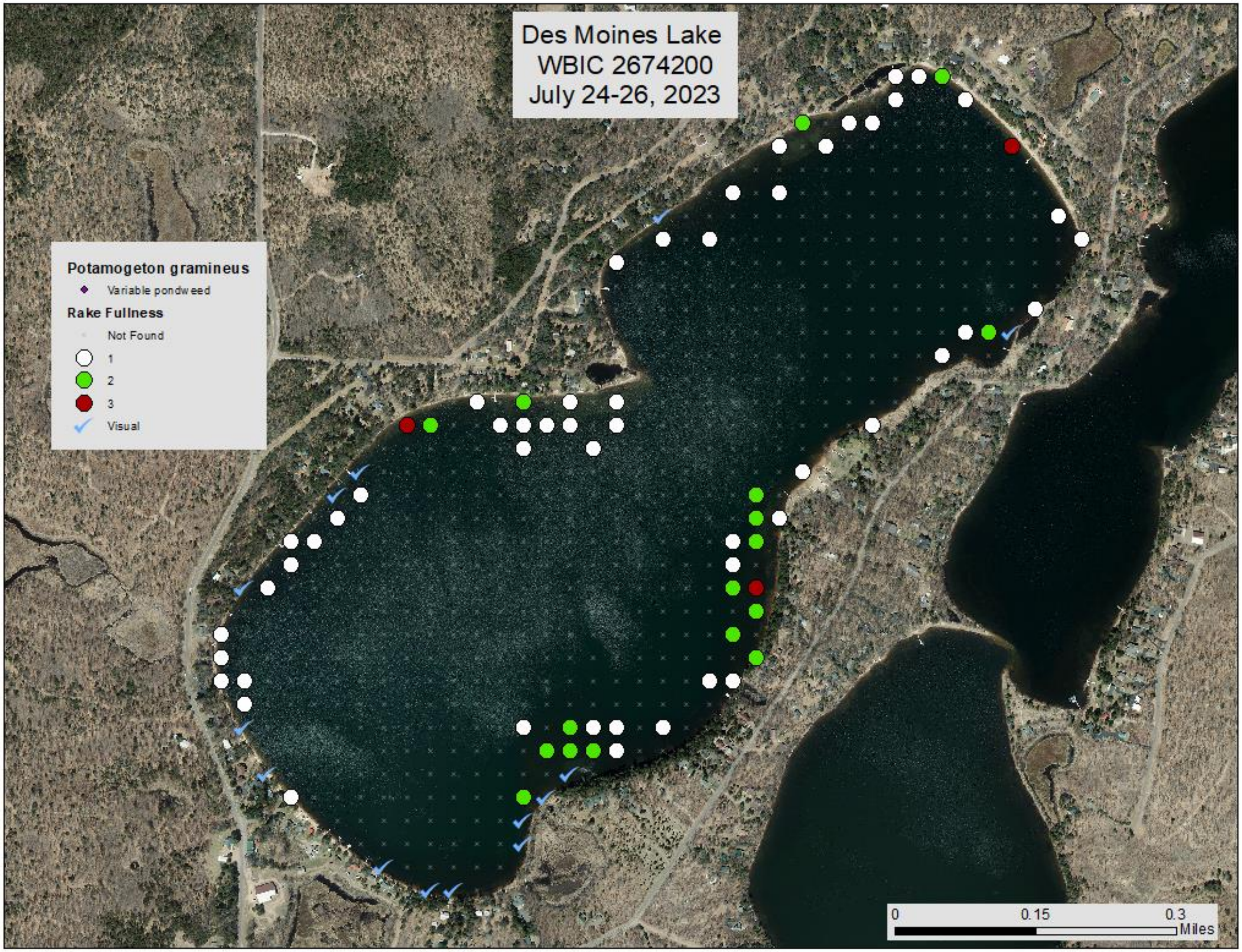

Des Moines Lake
WBIC 2674200
July 24-26, 2023
Eleocharis acicularis
Needle spikerush
Rake Fullness
Not Found
1
2
3
Visual
0
0.15
0.3
Miles

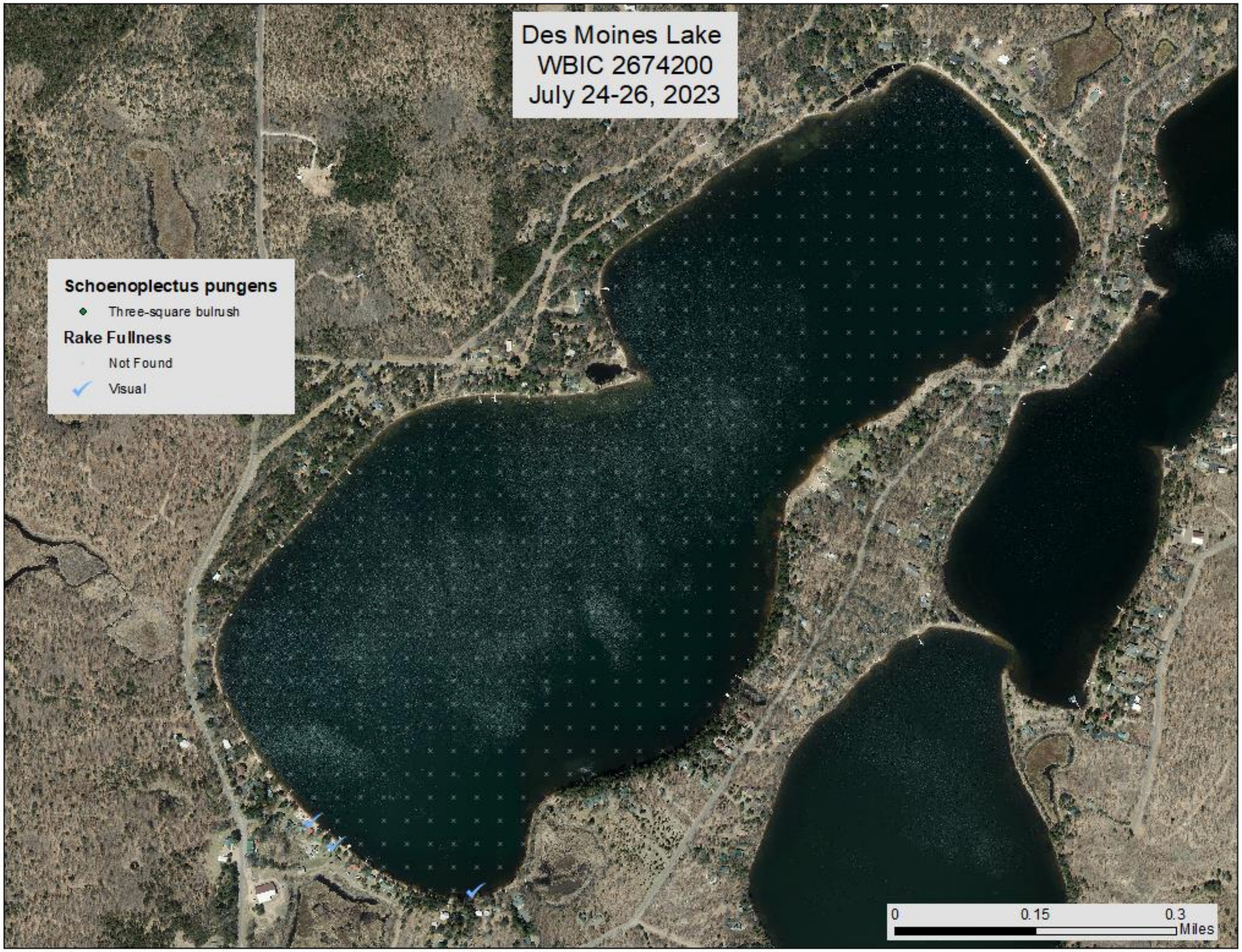

Des Moines Lake
WBIC 2674200
July 24-26, 2023
Heteranthera dubia
Water stargrass
Rake Fullness
Not Found
1
2
Visual
0
0.15
0.3
Miles


Des Moines Lake
WBIC 2674200
July 24-26, 2023
Juncus pelocarpus f. submersus
Brown-fruited rush
Rake Fullness
Not Found
Visual
0
0.15
0.3
Miles


Des Moines Lake
WBIC 2674200
July 24-26, 2023
Myriophyllum sibiricum
Northern watermilfoil
Rake Fullness
Not Found
1
2
3
Visual
0
0.15
0.3
Miles


Des Moines Lake
WBIC 2674200
July 24-26, 2023
Naja flexilis
Slender naiad
Rake Fullness
Not Found
1
2
3
Visual
0
0.15
0.3
Miles


Des Moines Lake
WBIC 2674200
July 24-26, 2023
Potamogeton gramineus
Variable pondweed
Rake Fullness
Not Found
1
2
3
Visual
0
0.15
0.3
Miles


Des Moines Lake
WBIC 2674200
July 24-26, 2023
Schoenoplectus pungens
Three-square bulrush
Rake Fullness
Not Found
Visual
0
0.15
0.3
Miles

Aquatic Plant Rake Criteria: At each point a double-sided rake is thrown and aquatic plants are documented by a fullness criteria. Below outlines this criteria:

- **Rake fullness 1** – there are not enough plants to cover the length of the rake in a single layer.
- **Rake fullness 2** – there are enough plants to cover the length of the rake in a single layer, but the tines are not covered.
- **Rake fullness 3** – the rake is completely covered with plants, and the tines are not visible.

We also recorded visual sightings of plants within six feet of the sample point. Substrate type was assigned at each site where the bottom was visible or it could be reliably determined using the rake. The substrate is defined as either being sand, muck or rock.

Data Analysis

We entered all data collected into the standard UW-Extension APM spreadsheet. From this, we calculated the following:

Total number of points sampled: This included the total number of points on the lake that were within the littoral zone (0-maximum depth where plants are found).

Total number of sites with vegetation: These included all sites where we found vegetation after doing a rake sample. For example, if 20% of all sample sites have vegetation, it suggests that 20% of the lake has plant coverage.

Total number of sites shallower than the maximum depth of plants: This is the number of sites that are in the littoral zone. Because not all sites that are within the littoral zone actually have vegetation, we use this value to estimate how prevalent vegetation is throughout the littoral zone. For example, if 60% of the sites shallower than the maximum depth of plants have vegetation, then we estimate that 60% of the lake’s littoral zone has plants.

Frequency of occurrence: The frequency of all plants (or individual species) is generally reported as a percentage of occurrences at all sample points. It can also be reported as a percentage of occurrences at sample points within the littoral zone.

Frequency of occurrence example:
Plant A is sampled at 70 out of 700 total points = 70/700 = 0.10 = 10%
This means that plant A's frequency of occurrence = 10% considering the entire lake sample.

Plant A is sampled at 70 out of 350 total points in the littoral zone = 70/350 = 0.20 = 20%
This means that plant A's frequency of occurrence = 0.20% when only considering the littoral zone.

From these frequencies, we can estimate how common each species was at depths where plants were able to grow. Note the second value will be greater as not all the points (in this example only ½) occur at depths shallow enough for plant growth.

Simpson's diversity index: A diversity index allows the entire plant community at one location to be compared to the entire plant community at another location. It also allows the plant community at a single location to be compared over time thus allowing a measure of community degradation or restoration at that site. With Simpson's diversity index, the index value represents the probability that two individuals (randomly selected) will be different species. The index values range from 0 -1 where 0 indicates that all the plants sampled are the same species, to 1 where none of the plants sampled are the same species. The greater the index value, the higher the diversity in a given location. Although many natural variables like lake size, depth, dissolved minerals, water clarity, mean temperature, etc. can affect diversity, in general, a more diverse lake indicates a healthier ecosystem. Perhaps most importantly, plant communities with high diversity also tend to be **more resistant** to invasion by exotic species.

Maximum depth of plants: This indicates the deepest point that vegetation was sampled. In clear lakes, plants may be found at depths of over 20 feet, while in stained or turbid locations, they may only be found in a few feet of water. While some species can tolerate very low light conditions, others are only found near the surface. In general, the diversity of the plant community decreases with increased depth.

Number of sites sampled using rope/pole rake: This indicates which rake type was used to take a sample. Protocol suggests a 15 foot pole rake, and a 25 foot rope rake for sampling.

Average number of species per site: This value is reported using four different considerations.

1. *Shallower than maximum depth of plants* indicates the average number of plant species at all sites in the littoral zone.
2. *Vegetative sites only* indicate the average number of species where plants were found.
3. *Native species shallower than maximum depth of plants* and

4. *Native species at vegetative sites only* excludes exotic species from consideration.

Species richness: This value indicates the number of different plant species found in and directly adjacent to (on the waterline) the lake.

Mean and median depth of plants: The mean depth of plants indicates the average depth in the water column where plants were sampled. Because a few samples in deep water can skew this data, median depth is also calculated. This tells us that half of the plants sampled were in water shallower than this value, and half were in water deeper than this value.
Relative frequency: This value shows a species' frequency relative to all other species. It is expressed as a percentage, and the total of all species' relative frequency will add up to 100%. Organizing species from highest to lowest relative frequency value gives us an idea of which species are most important within the macrophyte community.

Relative Frequency Example:
Suppose that 100 points were sampled, and 4 species of plants were found with the following results:

Plant A was found at 70 sites. Its frequency of occurrence is thus 70/100 = 70%
Plant B was found at 50 sites. Its frequency of occurrence is thus 50/100 = 50%
Plant C was found at 20 sites. Its frequency of occurrence is thus 20/100 = 20%
Plant D was found at 10 sites. Its frequency of occurrence is thus 10/100 = 10%

To calculate an individual species' relative frequency, divide the number of sites a plant is sampled at by the total number of times all plants were sampled. In our example, this would be 150 samples (70+50+20+10).

Plant A = 70/150 = 0.4667 = 46.67%
Plant B = 50/150 = 0.3333 = 33.33%
Plant C = 20/150 = 0.1333 = 13.33%
Plant D = 10/150 = 0.0667 = 6.67%

This tells us that 46.67% of all plants sampled were plant A.

Floristic Quality Index (FQI): This index measures the impact of human development on a lake's aquatic plants. Species in the index are assigned a Coefficient of Conservatism (C) which ranges from 0-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and often exploit these changes to the point where they may crowd out other species. The FQI is calculated by averaging the conservatism value for each species found in the lake. Consequently, a higher index value indicates a healthier macrophyte community. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, Northern Central Hardwood Forests, Driftless Area and

Southeastern Wisconsin Till Plain. It is recommended to make comparisons of lakes within ecoregions to determine the target lake's relative diversity and health.

Invasive Species Survey:
Invasive species surveys consists of sampling all points on a sampling grid provided by the WDNR in early June. The Des Moines Lakes point intercept sampling grid can be viewed in Figure 1. Aquatic plants surveyed are determined to be either "native" or "invasive" and are not identified to species level.

Complete Macrophyte Survey:
A complete aquatic plant (macrophyte) survey utilizes the same point intercept sampling grid as the invasive species survey. However, at each point every plant is identified down to species level. This survey goes beyond determining whether what is examined is a "native" or "invasive" species.

Maintaining the current healthy native plant populations on Des Moines Lake is the priority of this plan. However, information regarding aquatic plant management is included in this plan for reference. This information could become useful if AIS invasions occur or nuisance levels of aquatic plants arise. Contact must be made with the WDNR and BCLSD before any management occurs.

This section reviews the potential management methods available, and reports recent management activities on the lakes. The application, location, timing, and combination of techniques must be considered carefully.

Permitting Requirements

The Department of Natural Resources regulates the removal of aquatic plants when chemicals are used, and in some instances when plants are removed mechanically. The requirements for chemical plant removal are described in Administrative Rule NR 107 – Aquatic Plant Management.[(18)] A permit is required for any aquatic chemical application in Wisconsin. Additional requirements exist when a lake is considered an ASNRI (Area of Special Natural Resource Interest).

The requirements for manual and mechanical plant removal are described in NR 109 – Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations.[(19)] 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 within their viewing corridor. A riparian landowner may also manually remove invasive plants along their shoreline without a permit. Manual removal refers to the control of aquatic plants by hand or hand–held devices without the use or aid of external or auxiliary power.

Manual Removal[10]

Manual removal—hand pulling, cutting, or raking—will effectively remove plants from small areas. It is likely that plant removal will need to be repeated more than once during the growing season. The best timing for hand removal of herbaceous plant species is after flowering but before seed head production. For plants with rhizomatous (underground stem) growth, pulling roots is not generally recommended since it may stimulate new shoot production. Careful hand removal 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 20 feet wide.

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

Mechanical Control[10]

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

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water. The cutter head uses sickles similar to those found on farm equipment, and generally cut to depths from 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 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 1000 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 in order to increase the efficiency of the cutting process. The plants are deposited on shore, where they can be transported to a local farm (the nutrient content of composted aquatic plants is comparable to that of cow manure) or to an upland landfill for proper disposal. Most harvesters can cut between 2 and 8 acres of aquatic vegetation per day, and the average lifetime of a mechanical harvester is 10 years.

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

While the enjoyed 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. Harvesting may also result in re-suspension of contaminated sediments and the excess nutrients they contain.

Disposal sites are a key component when considering the mechanical harvesting of aquatic plants. The sites must be on shore and upland to make sure the plants and their reproductive structures 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 determine the efficiency of the operation, in terms of time as well as cost.

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 to avoid spreading of 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, 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, be sure to inspect the equipment 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. One must also consider prevailing winds, since cut vegetation can be blown into open areas of the lake or along shorelines.

Diver dredging 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. Diver dredging is especially effective against the pioneering establishment of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology can be considered. To be effective, the entire plant, including the subsurface portions, should be removed.

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

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

Rotovation involves using large underwater rototillers to remove plant roots and other plant tissue. Rotovators can reach bottom sediments to depths of 20 feet. Rotovating may significantly affect non-target organisms and water quality as bottom sediments are disturbed. However, the suspended sediments and resulting turbidity produced by rotovation settles fairly rapidly once the tiller has passed. Tilling contaminated sediments could possibly release toxins into the water column. If there is any potential of contaminated sediments in the area, further investigation should be performed to determine the potential impacts from this type of treatment. Tillers do not operate effectively in areas with many underwater obstructions such as trees and stumps. If operations are releasing large amounts of plant material, harvesting equipment should be on hand to collect this material and transport it to shore for disposal.

Biological Control[10]

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 native pests to the target invasive organism, the exotic invasive species may be maintained at lower densities.

Weevils have potential for use as a biological control agent against Eurasian water milfoil. There are several documented "natural" declines of EWM infestations. In these cases, EWM was not eliminated but its abundance was reduced enough so that it did not achieve dominance. These declines are attributed to an ample population of native milfoil weevils (*Euhrychiopsis lecontei*).

Weevils feed on native milfoils but will shift preference over to EWM when it is present. Lakes where weevils can become an effective control have an abundance of native Northern water milfoil and fairly extensive natural shoreline where the weevils can over winter. Because native milfoils are susceptible to higher doses of herbicides, any control strategy for EWM that would also harm native milfoil may hinder the ability of this natural bio-control agent. Lakes with large bluegill populations are not good candidates for weevils because bluegills feed on the weevils. The presence and efficacy of stocking weevils in EWM lakes is being evaluated in Wisconsin lakes. So far, stocking does not appear to be effective.

The effectiveness of biocontrol efforts varies widely (Madsen, 2000). Beetles are commonly used to control Purple loosestrife populations in Wisconsin with good success. As mentioned above, weevils are used as an experimental control for Eurasian water milfoil once the plant is established. Tilapia and carp are used to control the growth of filamentous algae in ponds. Grass carp, an herbivorous fish, is sometimes used to feed on pest plant populations, but grass carp introduction is not allowed in Wisconsin.

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 agents for particular target species, and relatively specific environmental conditions necessary for success.

Biological control is not without risks; new non-native species introduced to control a pest population may cause problems of its own. Biological control is not currently proposed for management of aquatic plants in Des Moines Lake, although it will be considered for Purple loosestrife control.

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

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. Because they involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 DNR permit would be required.

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

Benthic barriers or other bottom-covering approaches are another physical management technique. The basic idea is to cover the plants with a layer of a growth-inhibiting substance. Many materials have been used, including sheets or screens of organic, inorganic, and synthetic materials; sediments such as dredge sediment, sand, silt or clay; fly ash; and various combinations of the above materials (Cooke 1980b; Nichols 1974; Perkins 1984; Truelson 1984). The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984). The problem with synthetic sheeting is that the gasses evolved from plant and sediment decomposition collect underneath and lift the barrier (Gunnison and Barko 1992). Benthic barriers will typically kill the plants under them within 1 to 2 months, after which time they may be removed (Engel 1984). Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively (Carter et al. 1994). Sites from which barriers are removed will be rapidly re-colonized (Eichler et al. 1995). Synthetic barriers, if left in place for multi-year control, will eventually become sediment-covered and will allow colonization by plants. Benthic barriers may be best suited to small, high-intensity use areas such as docks, boat launch areas, and swimming areas. However, they are too expensive to use over widespread areas, and heavily affect benthic communities by removing fish and invertebrate habitat. A WDNR permit would be required for a benthic barrier.

Shading or light attenuation reduces the light plants need to grow. Shading has been achieved by fertilization to produce algal growth, by application of natural or synthetic dyes, shading fabric, or covers, and by establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974).

During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general these techniques are of only limited applicability. Physical control is not currently proposed for management of aquatic plants in Des Moines Lake.

Herbicide and Algaecide Treatments[10]

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

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

General descriptions of herbicide classes are included below.[10]

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

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

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

Selective herbicides 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.

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

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

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

Endothal 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.

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

Herbicide Use to Manage Invasive Species

Eurasian water milfoil The WDNR identifies the following herbicides for control of Eurasian water milfoil: 2,4-D, Diquat, and Endothall. 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. The herbicide 2,4-D is most commonly used to treat EWM in Wisconsin. This herbicide kills dicots including native aquatic species such as northern water milfoil, coontail, water lilies, spatterdock, and watershield. Early season (April to May) treatment of Eurasian water milfoil is recommended to limit the impact on native aquatic plant populations because EWM tends to grow before native aquatic plants.

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

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

Curly leaf pondweed The WDNR identifies three herbicides for control of curly leaf pondweed: Diquat, Endothall, and Fluridone. Fluridone requires exposure of 30 to 60 days making it infeasible to target a discreet area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction following treatment. Diquat (Reward) has the following use restrictions: drinking water 1-3 days, swimming and fish consumption 0 days. Endothall (Aquathol K) has the following use restrictions: drinking water 7 – 25 days, swimming 0 days, fish consumption 3 days.

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 can 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 selectively targets curly leaf pondweed. Staff from the Minnesota Department of Natural Resources and the U.S Army Engineer Research and Development Center are conducting trials of this method.

Because the dosage is at lower rates than the dosage recommended on the label, a greater herbicide residence time is necessary. To prevent drift of herbicide and allow greater contact time, application in shallow bays is likely to be most effective. Herbicide applied to a narrow band of vegetation along the shoreline is likely to drift, rapidly decrease in concentration, and be rendered ineffective.

Management Options for Aquatic Plants (No Management)				
Option	**Permit Needed?**	**How it Works**	**PROS**	**CONS**
No Management	No	Do not actively manage aquatic plants	*Minimizing disturbance can protect native species that provide habitat for aquatic fauna, reduce shoreline erosion, may improve water clarity, and may limit spread of invasive species. *No financial cost. *No system disturbance. *No unintended effects of chemicals. *Permit not required.	*May allow small populations of invasive plants to become larger, and more difficult to control later. *Excessive plant growth can hamper navigation and recreational use. *May require modification of lake users' behavior and perception.

Management Options for Aquatic Plants (Mechanical Control)				
Option	**Permit?**	**How it Works**	**PROS**	**CONS**
Mechanical Control	May be required under NR 109	*Plants reduced by mechanical means. *Wide range of techniques, from manual to highly mechanized.	*Flexible control. *Can balance habitat and recreational needs.	*Must be repeated, often more than once per season. *Can suspend sediments and increase turbidity and nutrient release.
Hand pulling/raking	Yes/No	*SCUBA divers or snorkelers remove plants by hand or plants are removed with a rake. *Works best in soft sediments.	*Little to no damage done to the lake or to native plant species. *Can be highly selective. *Can be done by shoreline property owners without permits within an area <30 feet wide OR where selectively removing exotics.	*Very labor intensive. *Needs to be carefully monitored. *Roots, runners, even fragments of some species, particularly EWM will start new plants, so all of the plant must be removed. *Small-scale control only.
Harvesting	Yes	*Plants are "mowed" at depths of 2-5 feet. *Harvest invasive species only if invasive is already present throughout the lake.	*Immediate results. EWM removed before it has the opportunity to auto-fragment, which may create more fragments than created by harvesting. *Harvested lanes through dense weed beds can increase growth and survival of some fish. *Can remove some nutrients from the lake.	*Not selective in species removed. *Fragments of vegetation can re-root sometimes causing increased invasive species expansion. *Can remove some small fish and reptiles from the lake. *Initial cost of the harvester is expensive.

Management Options for Aquatic Plants (Biological Control)				
Option	**Permit Needed?**	**How it Works**	**PROS**	**CONS**
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 the 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.
Weevils on EWM	Yes	*Native weevil prefers EWM to other native water-milfoils.	*Native to Wisconsin – weevil cannot "escape" and become a problem. *Selective control of target species. *Longer-term control with limited management.	*Need to stock large numbers, even if there are some already present. *Need good habitat for overwintering on shore (leaf litter) associated with undeveloped shorelines. *Bluegill populations decrease densities through predation.
Pathogens	Yes	*Fungal, bacterial, or 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.
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 EWM growth.	*Initial transplanting slow and labor-intensive.

Native Plantings of aquatic plants	**Yes**	*Diverse native plant community established to compete with invasive species.	*Native plants provide food and habitat for aquatic fauna. *Diverse native community more repellant to invasive species.	*Initial transplanting slow and labor-intensive. *Nuisance invasive plants may outcompete plantings. *Transplants from another lake or nursery may unintentionally introduce invasive species.

Management Options for Aquatic Plants (Physical Control)				
Option	**Permit Needed?**	**How it Works**	**PROS**	**CONS**
Physical Control	Yes	*Plants are reduced by altering variables that affect growth, such as water depth or light levels.	*Varies by treatment.	*Varies by treatment.
Fabrics/Bottom Barriers	Yes	*Prevents light from getting to the lake bottom.	*Reduces turbidity in soft-substrate areas. *Useful for small areas.	*Eliminates all plants, including native plants important to a healthy lake ecosystem. *May inhibit spawning of some fish, and affects benthic invertebrates. *Needs maintenance or will become covered in sediment and be ineffective. *Gas accumulation under the blankets can cause them to dislodge from the bottom. *Anaerobic environment forms that can release excessive nutrients from the sediment.
Drawdown	Yes, may require an environmental assessment.	*Lake water lowered with siphon or water control device; plants killed when sediment dries, compacts, or freezes. *Season or duration of drawdown can change effects.	*Winter drawdown can be effective at restoration, provided drying and freezing occur. Sediment compaction is possible over winter. *Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction.	*Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling. *May impact attached wetlands and shallow wells near shore. *Species growing in deep water (e.g. EWM) that survive might increase, particularly if desirable native species are reduced. *Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning.

			*Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization, and increased water quality. *Success demonstrated for reducing EWM, variable success for curly leaf pondweed (CLP).	Winter drawdown must start in early fall or will kill hibernating reptiles and amphibians. Navigation and use of lake is limited during a drawdown.

Management Options for Aquatic Plants (Physical Control)				
Option	**Permit Needed?**	**How it Works**	**PROS**	**CONS**
Physical Control	Yes	*Plants are reduced by altering variables that affect growth, such as water depth or light levels.	*Varies by treatment.	*Varies by treatment.
Fabrics/Bottom Barriers	Yes	*Prevents light from getting to the lake bottom.	*Reduces turbidity in soft-substrate areas. *Useful for small areas.	*Eliminates all plants, including native plants important to a healthy lake ecosystem. *May inhibit spawning of some fish, and affects benthic invertebrates. *Needs maintenance or will become covered in sediment and be ineffective. *Gas accumulation under the blankets can cause them to dislodge from the bottom. *Anaerobic environment forms that can release excessive nutrients from the sediment.
Drawdown	Yes, may require an environmental assessment.	*Lake water lowered with siphon or water control device; plants killed when sediment dries, compacts, or freezes. *Season or duration of drawdown can change effects.	*Winter drawdown can be effective at restoration, provided drying and freezing occur. Sediment compaction is possible over winter. *Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction.	*Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling. *May impact attached wetlands and shallow wells near shore. *Species growing in deep water (e.g. EWM) that survive might increase, particularly if desirable native species are reduced. *Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning.

Dredging	Yes	*Plants are removed along with sediment. *Most effective when soft sediments overlay a harder substrate. *For extremely impacted systems.	*Increases the water depth. *Removes nutrient rich sediments. *Removes soft bottom sediments that may have high oxygen demand.	*Severe impact on the lake ecosystem. *Increases turbidity and releases nutrients. *Exposed sediments may be recolonized by invasive species. *Sediment testing may be necessary. *Removes benthic organisms. *Dredged materials must be disposed of.
Dyes	Yes	*Colors the water, reducing light. *This reduces plant and algal growth.	*Impairs plant growth without increasing turbidity. *Usually non-toxic, degrades naturally over a few weeks.	*Appropriate for very small waterbodies. *Should not be used in a pond or lake having an outflow. *Impairs aesthetics. *Effects to microscopic organisms unknown.
Non-point source nutrient control	No	*Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use) thereby providing fewer nutrients available for growth.	*Attempts to correct source of the problem, not treat symptoms. *Could improve the water clarity and reduce occurrences of algal blooms. *Native plants may be able to better compete with invasive species in low-nutrient conditions.	*Results can take years to be evident due to internal recycling of already present lake nutrients. *Requires landowner cooperation and regulation. *Improved water clarity may increase plant growth.

Management Options for Aquatic Plants (Chemical Control)				
Option	**Permit Needed?**	**How it Works**	**PROS**	**CONS**
Chemical Control	Required under NR 107	*Granules or liquid chemicals kill plants or cease algal growth. *Chemical must be used to label guidelines.	*Results usually within 10 days of treatment, but repeat treatments may be needed. *Some flexibility for different situations. *Some can be selectively applied. *Can be used for restoration activities.	*Possible toxicity to aquatic animals or humans, especially applicators. *Often affect desirable plant species that are important to lake ecology. *Treatment set-back requirements from potable water sources and/or drinking water. *May cause severe drop in dissolved oxygen.
2, 4-D	Yes	*Systemic herbicide selective to broadleaf plants that inhibits cell division in new tissue. *Applied as a liquid or granules during early plant growth phase.	*Moderately to highly effective, especially on EWM. *Monocots, such as pondweeds (e.g. CLP) and many other native species are not affected. *Can be used in synergy with endothall for early season CLP and EWM treatments. *Can be selective depending on concentration and seasonal timing. *Widely used aquatic herbicide.	*May cause oxygen depletion after plants die and decompose. *May affect native dicots such as water lilies and coontail. *Can be used in combination with copper herbicides (used for algae). *Toxic to fish.

Endothall (e.g. Aquathol)	Yes	*Broad-spectrum, contact herbicide that inhibits protein synthesis. *Applied as liquid or as granules.	*Especially effective on CLP and also effective on EWM. *May be effective in reducing reestablishment of CLP if reapplied several years in a row during early spring. *Can be selective depending on concentration and seasonal timing. *Can be combined with 2, 4-D for early season CLP and EWM treatments, or with copper compounds. *Limited off-site drift.	*Affects many native pondweeds. *Not as effective in dense plant beds; heavy vegetation requires multiple treatments. *Not to be used in water supplies; post-treatment restriction on irrigation. *Toxic to aquatic fauna (to varying degrees).
Diquat (e.g. Reward)	Yes	*Broad-spectrum, contact herbicide that disrupts cellular functioning. *Applied as a liquid, can be combined with copper treatments.	*Mostly used for water-milfoil and duckweed. Rapid action. *Limited direct toxicity on fish and other animals.	*May affect non-target plants, especially native pondweeds, coontail, elodea, and naiads. *Toxic to aquatic invertebrates. *Must be reapplied several years in a row. Ineffective in muddy or cold water (<50F).
Fluridone (e.g. Sonar or Avast)	Yes; special permit and environmental assessment	*Broad-spectrum, systemic herbicide that inhibits photosynthesis.	*Effective on EWM for 1 to 4 years with aggressive follow-up treatments.	*Affects native milfoils, coontail, elodea, and naiads, even at low concentrations. *Requires long contact time: 60-90 days.

	may be required.	*Must be applied during the early growth stage. *Available with a special permit only; chemical applications beyond 150 feet from shore are not allowed under NR 107. *Applied at very low concentration at whole lake scale.	*Some reduction in non-target effects can be achieved by lowering dosage. *Slow decomposition of plants may limit decreases in dissolved oxygen. *Low toxicity to aquatic animals.	*Often decreases water clarity, particularly in shallow eutrophic systems. *Demonstrated herbicide resistance in hydrilla subjected to repeat treatments. *Unknown effect of repeat whole-lake treatments on lake ecology.
Glyphosate (e.g. Rodeo)	Yes	*Broad-spectrum, systemic herbicide that disrupts enzyme formation and function. *Usually used for purple loosestrife stems or cattails. Applied as a liquid spray or painted on.	*Effective on floating and emergent plants. Selective if carefully applied to individual plants. *Non-toxic to most aquatic animals at recommended dosages. *Effective control for 1-5 years.	*RoundUp is often illegally substituted for Rodeo; surfactants in RoundUp believed to be toxic to reptiles and amphibians. Human exposure should be limited as well. *Cannot be used near potable water intakes. *Ineffective in muddy water. *No control of submerged plants.
Triclopyr (e.g. Renovate)	Yes	*Systemic herbicide selective to broadleaf plants that disrupts enzyme function. *Applied as liquid spray.	*Effective on many emergent and floating plants. *Most effective on dicots, such as purple loosestrife; may be more effective than glyphosate.	*Impacts may occur to some native plants at higher doses (e.g. coontail). *May be toxic to sensitive invertebrates at higher concentrations. *Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm). *Sensitive to UV light; sunlight can break herbicide down prematurely.

			*Control of target plants occur in 3-5 weeks. *Low toxicity to aquatic animals. *No recreational use restrictions following treatment.	
Copper compounds (e.g. Cutrine Plus)	Yes	*Broad-spectrum, systemic herbicide that prevents photosynthesis. *Used to control planktonic and filamentous algae. *Wisconsin allows small-scale control only.	*Reduces algal growth and increases water clarity. *No recreational or agricultural restrictions on water use following treatment. *Herbicidal action on hydrilla.	*Elemental copper accumulates and persists in sediments. *Short-term results. *Long-term effects of repeat treatments to benthic organisms unknown. *Toxic to invertebrates, trout and other fish, depending on the hardness of the water. *Clear water may increase plant growth.

Appendix D: Aquatic Plant Control Techniques Not Allowed in Wisconsin

Aquatic Plant Control Techniques Not Allowed in Wisconsin			
Option	**How it works**	**PROS**	**CONS**
Biological Control Carp	Plants are 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 re-suspension 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 and CLP can lead to accelerated spreading of the plants.
Crayfish	Plants are eaten by stocked crayfish.	*Reduces macrophyte biomass.	*Illegal to transport or stock crayfish in Wisconsin. *Control not selective and may deteriorate the plant community. *Not successful in productive, soft-bottom lakes with many fish predators. *Complete alteration of fish assemblage possible.
Mechanical Control Cutting (no removal)	Plants are "mowed" with underwater cutter.	*Creates open water areas rapidly. *Works in water up to 25 feet.	*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 land owners. *Not selective in species removed. *Small-scale control only.

Rototilling	*Sediment is tilled to uproot plants and stems. Works in deep water (17 feet).	*Decreases stem density, can affect entire plant. *Small-scale control. *May provide long-term control.	*Creates turbidity. *Not selective in species removed. *Fragments of vegetation can re-root. *Complete elimination of fish habitat. *Releases nutrients into the water column. *Increased likelihood of invasive species recolonization.
Hyrdroraking	*Mechanical rake removes plants from the lake. Works in deep water (14 feet).	*Creates open water areas rapidly.	*Fragments of vegetation can re-root, and creates turbidity in the lake. Requires plant disposal. *May impact the lake fauna. *Plants re-grow quickly.

Des Moines Lake User Survey

<u>Section 1 – Residency</u>

These first few questions will help us to determine who is responding to this survey and how those people would like to use Des Moines Lake. If you have more than one property on the lake, please comment on the one property you have had the longest.

1. How is your property on Des Moines Lake utilized? If you have more than one type of property, please report on only the property you have had the longest. *(Please select one)*

7 Permanent residence
20 Seasonal residence
7 Weekend visits throughout the year
0 Business
0 Underdeveloped land
0 Other________________________________

2. How long have you owned your property on Des Moines Lake? ***(If less than 1 year, please write '1' in the space provided. If you own multiple properties, please comment on the one you have owned for the longest period of time.)***

I have owned the property for **16** year(s).

3. During a 12-month period (Jan. 1 – Dec. 31) how many days are you, members of your family, or guests at the property indicated in Question 1? ***(Please provide your best estimate in the space below)***

There are people at the property approximately **66** days a year.

4. On average, about how many people are at the property each time it is being used?______

<u>Section 2 – Lake Use</u>

The purpose of this section is to gather information on how Des Moines Lake is used by its residents.

1. From the list below, check all activities on Des Moines Lake that you, your family, or guests participate in.

25 A. Fishing from shore
29 B. Fishing from a boat
13 F. Ice fishing
19 G. Speed boating
25 K. Wildlife viewing
20 L. Canoe/Kayak/Paddle.

32 C. Pontoon boating
33 D. Rest/Relaxation
32 E. Swimming/Wading
10 H. Jet Skiing
0 I. Wild rice harvest
3 J. Sailing
24 M. Water skiing/Tubing
1 N. Other (please list) **Snorkeling**

2. Which 3 activities from the above list do you or members of your family or guests participate in most often? ***(Write the letters of the corresponding activities in the spaces below)***

I (We) participate in **C** most often, **E** second most often, and **D** third most often.

During the open-water (no ice) season, how frequently do you use the lake for any of the activities listed in Question 1, this section?

5 Daily
19 Several times per week
9 3 or 4 times per month
0 Once or twice per month
0 Once or twice per open-water season

3. What type(s) of watercraft do you own, rent, or use on Des Moines Lake? ***(Check all that apply. If you do not use any watercraft on Des Moines Lake, please check the last box.)***

17 Motorized boat (0-50 hp)
16 Motorized boat (greater than 50 hp)
7 Paddle boat
29 Pontoon boat
8 Personal watercraft – PWC (jet ski)
21 Canoe or Kayak
3 Sailboat
1 Other - Row Boat
0 I do not own, rent, or use a boat or other watercraft on Des Moines Lake

Section 3 – Lake Stewardship

This section of the survey will provide information about the lake stewardship practices of lake property owners.

1. Which of the following do you consider the most desirable shoreline for your property? ***(Please check one)***

1 Mowed lawn at shoreline (no plantings)
1 Landscaped shoreline (ex., planted flowers, shrubs, trees)
13 Managed natural vegetation at shoreline
7 Unmanaged natural vegetation at shoreline

2. Which, if any, of the following water quality/landscaping practices do you have some knowledge of? **(*Check all that apply)***

13 Rain garden
20 Shoreline buffers
11 Native prairie restoration
19 Natural shoreline restoration
17 Septic system upgrade
1 Native flower/tree planting

26 Benefits of not fertilizing

18 Using zero phosphorus fertilizers

9 Diversion of surface water runoff away from the lake

0 Other ***(please describe)***________________

0 Not familiar with any of these ***(skip to Question 4)***

3. Which, if any, of the following water quality/landscaping practices have been installed or do you practice on your property on Des Moines Lake? **(*Check all that apply)***

1 Rain garden
8 Shoreline buffers
4 Native prairie restoration
22 Benefits of not fertilizing

9 Using zero phosphorus fertilizers

4 Diversion of surface water runoff away from the lake

8 Natural shoreline restoration
14 Septic system upgrade
8 Native flower/tree planting
0 Other ***(please describe)***________________

0 None of the above water quality/landscaping practices

4. Which, if any, of the following outcomes might motivate you to install a water quality/landscaping practice on your property? ***(Check all that apply)***

17 A. Increasing the natural beauty of your property
22 B. Improving the water quality of Des Moines Lake
17 C. Improving the water quality around your property's shoreline
14 D. Providing better habitat for fish
13 E. Providing better habitat for birds and wildlife
9 F. Setting an example for other lake residents
6 G. Less lawn mowing time
15 H. A property tax rebate
10 I. Financial assistance that pays a portion of the cost/installation
7 J. Technical assistance that would evaluate my property for water quality concerns
8 K. Technical assistance that would identify appropriate practices to install
2 L. Other ***(please describe)***________________
8 M. I have no interest in installing additional practices or brand new practices on my property **(skip to question 6)**

5. What type of septic system do you have on your property? ***(Select all that apply)***

1 Mound system
1 At-grade system
16 Convention system
10 Holding tank
8 Lift pump system
1 None ***(skip to Section 4)***

_1__ Other ***(please list)***
Unsure____

6. How many years ago was your septic system last inspected? ***(Please provide your best recall)***

_28_ 1-5 years **_4__** 6-10 years **_0__** 11+ years **_0__** Never **_2__** Not Sure

7. When was your septic system last 'pumped' or 'sewered'? ***(Please provide your best recall)***

_33_ 1-5 years **_0__** 6-10 years **_0__** 11+ years **_0__** Never **_1__** Not Sure

Section 4 – Lake Issues

The questions in this section pertain to various possible issues in Des Moines Lake including water quality, lake level, and aquatic plant growth.

1. Below are numerous issues that may negatively affect your use of Des Moines Lake. From the list below, please mark all of the issues that are of concern to you.

_16_ A. Poor quality fishing
_16_ B. Too much public use
_0__ C. Not enough weed growth
_7_ D. Poorly maintained boat access
_9__ E. Low water level in the lake
_6__ F. High water level in the lake
_9_ G. Overdevelopment of the shoreline
_6__ H. Foul or offensive odor
_6_ I. "Icky" or "green" water
_6__ J. Too much shoreline lighting
_0__ K. Too much wild rice
_0__ L. Not enough wild rice
_11__ M. Too much weed growth (not including algae)
_19_ N. Introduction of undesirable aquatic plants and animals
_10_ O. Nuisance wildlife: Beavers, snails, zebra mussels__________________
_1__ P. Other: shoreline erosion, non-adherence to no-wake times, wake boats
_2__ Q. Not concerned about any of these issues ***(Skip to Question 3)***

2. Which **three** issues from the above list are of the most concern to you? ***(Write the letters of the corresponding issues in the spaces below)***

I am most concerned about issues **_N__, _B__,** and **_A_.**

3. In your opinion, the water quality in the summer (June – September) in Des Moines Lake is:

_16_ Excellent **_15_** Good **_1__** Fair **_0__** Poor **_0__** Very Poor **_1__** I don't know

4. Please check the answer that best completes the following sentence: "In my opinion, the overall level of the lake, given fluctuation with rainfall, seems to be …."

1 Too high **22** Just Right **9** Too low **1** I don't know

5. How often, if ever has low water prevented you from using Des Moines Lake?

4 Yes **28** No **0** I don't use the lake

6. Aquatic plants (rooted and floating) are an important part of any healthy lake system. In the time that you have owned the property indicated in Section 1, Question 1, would you say the amount of visible aquatic plant growth in the lake, **excluding algae**, has:

8 Increased **21** Decreased **0** Stayed the same **3** Unsure

7. Aquatic plant growth varies throughout the open water season. Which month(s) of the season do you consider aquatic plant growth, excluding algae, to be problematic in Des Moines Lake? ***(Check all that apply)***

1 May **1** June **1** July **20** It is never a problem

17 August **4** September **0** October **5** I don't know

8. Do you think you would recognize Wild Rice in the lake if you saw it?

5 definitely yes **4** probably yes **3** unsure **16** probably not **5** definitely not

9. Please check all answers that best complete the following sentence: "Wild rice…"

5 is a valuable resource in the lake

6 is a state protected plant species

1 can legally be removed from the lake

1 is a nuisance weed

3 has no resource value

0 is not a state protected species

2 cannot be legally removed from the lake

11 fill in blank: Not in Des Moines (1), unsure (14), good to eat (3)

SECTION 5 – Aquatic Invasive Species

This section of the survey seeks to determine how much lake residents know about aquatic invasive species. Aquatic invasive species are plants and animals that are foreign to Des Moines Lake and do not belong there.

Curly-leaf pondweed (CLP)

Curly-leaf pondweed has not been documented in Des Moines Lake but could be a threat in the future. CLP can create nuisance levels of plant growth and negatively impact water quality in a lake.

1. How much do you know about CLP and the problems it can cause in a lake?

2 a lot **4** some **13** very little **15** just what I read here

2. Do you think you would recognize CLP in the lake if you saw it?

2 Definitely yes **3** Probably yes **6** Unsure **8** Probably not **14** Definitely not

Eurasian Watermilfoil (EWM)

Eurasian watermilfoil has not been documented in Des Moines Lake but could be a threat in the future. EWM can form dense beds of vegetation that interfere with many lake uses.

3. Prior to reading the above statement, were you aware of the potential problems EWM can cause?

4 a lot **17** some **6** very little **7** just what I read here

4. Do you think you would recognize EWM in the lake if you saw it?

3 Definitely yes **12** Probably yes **6** Unsure **7** Probably not **7** Definitely not

Purple Loosestrife

Purple loosestrife, an invasive shoreline/wetland plant species, has been documented in Des Moines Lake. Purple loosestrife can take over shorelines and wetlands displacing more beneficial native plants.

5. Prior to reading the above statement, were you aware of the potential problems purple loosestrife can cause?

4 a lot **14** some **11** very little **4** just what I read here

6. Do you think you would recognize purple loosestrife in the lake if you saw it?

__9__ Definitely yes   __11__ Probably yes   __7__ Unsure   __3__ Probably not   __6__ Definitely not

Other Aquatic Invasive Species

7. Below is a list of additional aquatic invasive species. Please check all of those that you have heard of before.

__8__ Rusty crayfish
__34__ Zebra mussels
__13__ Chinese mystery snail
__2__ New Zealand mudsnail
__8__ Spiny waterflea
__5__ Banded mystery snail
__3__ Freshwater jellyfish
__27__ Carp
__2__ Hydrilla
__0__ Phragmites (giant reed grass)
__3__ Japanese knotweed
__0__ I have not heard of these AIS

8. In order to gauge *potential* interest, would you be willing to take part in a training session to help you identify aquatic invasive species in the lake?

__8__ Definitely yes   __9__ Probably yes   __6__ Unsure   __9__ Probably not   __1__ Definitely not

SECTION 6 – Aquatic Plant Management

Currently aquatic plant growth in Des Moines Lake is not managed. Algae growth is also not managed. A benefit of aquatic plant management strategies is that they can also help reduce algae growth. Aquatic plants in a lake can be managed in many different ways. Sometimes no aquatic plant management may be the best option.

1. Do you think that management of aquatic plants in Des Moines Lake is necessary?

__5__ definitely yes   __13__ probably yes   __11__ unsure   __3__ probably not   __0__ definitely not

2. Which type(s) of aquatic plants do you think should be managed on Des Moines Lake? ***(Check all that apply)***

__13__ Grow below the water's surface
__17__ Stick out of the water
__2__ Float on the water's surface (non-algae)
__13__ Algae on the water's surface
__16__ Grow on the shoreline, out of the water
__2__ Other: Harmful plants

Common Aquatic Plant Management Methods

If plant management is recommended for Des Moines Lake, what methods might you support? Please assume that the following management methods are safe and legal, and would only be performed by professionals and only be used if approved by the State of Wisconsin. Total removal or eradication of aquatic plants is not possible.

3. Please mark whether you would support, oppose, or need more information about the use of these aquatic plant management methods on Des Moines Lake.

Small-scale (less than 10 acres) mechanical harvesting:

12 Support **4** Oppose **13** Need more information

Large-scale (10 acres or greater) mechanical harvesting:

9 Support **2** Oppose **17** Need more information

Hand-pulling and raking in shallow waters:

22 Support **0** Oppose **8** Need more information

Small-scale (less than 10 acres) of chemical herbicide application:

11 Support **5** Oppose **13** Need more information

Large-scale (10 acres or greater) of chemical herbicide application:

7 Support **6** Oppose **18** Need more information

Biological control (using one live species to control another):

9 Support **4** Oppose **7** Need more information

No management:

1 Support **7** Oppose **19** Need more information

4. Have you made any attempts to remove or control aquatic plants in Des Moines Lake by your shore property? ***(Check one)***

16 No *(Skip to Section 7)*
17 Yes, I did it myself
0 Yes, I hired someone
0 Yes, I did some myself and I hired someone

5. What have you done to remove aquatic plants from the lake by your property? ***(Check all that apply)***

1 Hire someone to hand-pull or rake
20 Self-hand pull or rake
0 Hire someone to apply chemical herbicide
0 Self-application of chemical herbicide
1 Mechanical plant removal with boat and motor or other apparatus
1 Other

SECTION 7 – Community Support

Local, county, state, and federal resources will be sought in addition to Lake Association funds to implement management recommendations for Des Moines Lake. Donations of volunteer time, services, materials, and equipment can be used as match funding for many grant programs reducing the overall financial burden to the Lake Association. The following questions will help to determine your willingness to support future projects involving the implementation of aquatic plant and lake management recommendations.

1. The following are activities that lake residents could participate in. ***Please check all those activities you might be willing to volunteer your time if additional assistance is needed. This is not a commitment but rather a measure of possible assistance if needed.***

10 Watercraft inspection at the boat landings such as Clean Boats Clean Waters
11 On the water monitoring for aquatic invasive species
10 Shore land monitoring for aquatic invasive species
7 Raising beetles for purple loosestrife control
6 Native aquatic plant monitoring and identification
12 Water quality monitoring
10 Wildlife monitoring (ex. frogs, turtles, loons, other waterfowl, mussels & clams)
10 I am not interested in volunteering any time ***(skip to question 3)***

2. How much time would you be willing to contribute to support any of the activities in Question 1 above?

11 A few hours a year
9 A few days a year
4 Longer periods of time

3. Donated service needs are varied and somewhat unknown, but could include any of the options listed below. Do you think you would be willing to provide any of the services that

may be necessary? This is not a commitment but rather a measure of possible assistance if needed. ***(Check all that apply)***

5 GPS use	**2** Graphic design	**0** Legal services
1 SCUBA diving	**1** Grant writing	**12** Physical labor
1 Printing services	**4** Construction services	**0** Other **(please specify)**______
2 Garden/Landscaping design	**2** Sewing	**15** I am not interested or not able to provide assistance
1 Web development	**4** Outdoor design	

4. Have you ever attended a Des Moines Lake Property Owners Association meeting?

24 Yes ***(skip to Question 6)*** **8** No

5. What, if anything, has prevented you from attending a Des Moines Lake Property Owners Association meeting?

2 Not interested **3** I don't have time **1** I never know when they are occurring

1 Other *(please explain)* **First lake season, bad timing**

6. The Des Moines Lake Association annual meeting is generally held on the Saturday of Memorial Day Weekend. ***In the following list of meeting dates and times, please check up to three meeting dates that would work for you.***

20 The current date and time works for me
2 Hold the meeting in the afternoon on the Saturday of Memorial Day
5 Hold the meeting in the evening on the Saturday of Memorial Day
2 Hold the meeting the Saturday before Memorial Weekend
2 Hold the meeting the Saturday after Memorial Weekend
1 Hold the meeting a different day (please indicate when) Friday evening/Sat Morning non-holiday weekends
5 I am not interested in the Des Moines Lake Association annual meeting

7. What is your affiliation with the Des Moines Lake Property Owners Association?

23 Current member **(skip to Question 9)** **3** Former member **4** Never been a member

8. What, if anything has kept you from being a member of the association **(check all that apply)**?

2 Not interested
1 Dues are too high
1 I did not know it existed
2 I do not have enough time
0 I disagree with what they are doing
0 I haven't been asked to be a member
0 I feel there is no benefit for being a member
1 Other____________

9. How satisfied are you with the following aspects of Lake Association activity? If you are unfamiliar with an activity, please check the last column.

	Very Satisfied	Somewhat Satisfied	Unsure	Somewhat Dissatisfied	Very Dissatisfied
Communication with community	**18**	**7**	**7**	**0**	**0**
Meeting Frequency	**16**	**5**	**11**	**0**	**0**
Meeting atmosphere (parliamentary procedure)	**12**	**6**	**12**	**1**	**0**
Executing Lake Association business	**14**	**6**	**11**	**0**	**0**
Promoting cooperation to achieve goals and objectives	**20**	**7**	**2**	**0**	**0**
Management of Association finances	**15**	**7**	**8**	**1**	**0**
Listening to property owners' needs and concerns	**13**	**3**	**13**	**2**	**0**

10. When information from Des Moines Lake Property Owners Association is available, how would you most prefer to be contacted? ***(Please check one)***

10 Mail **25** Email **4** Phone **1** In person **1** I do not want to be contacted

11. If there are any additional issues you would like the Lake Association to address, please use the space below to explain. These are comments directly from the riparian landowners.
    - What about overall living and not just lake environmental? What about organizing getting better broadband service?
    - dnr fish stocking?
    - Increasing number of members joining and contributing to the assoc, working with township to improve boat launch, encourage lake residents to minimize the impact of fireworks/noise on dates other than the 4th of July
    - Maintain no wake rules 4 hours!!
    - Concerned with septic systems on north and south ends of lake. Also, formet desmoine lake resort cabins sitting right on lake

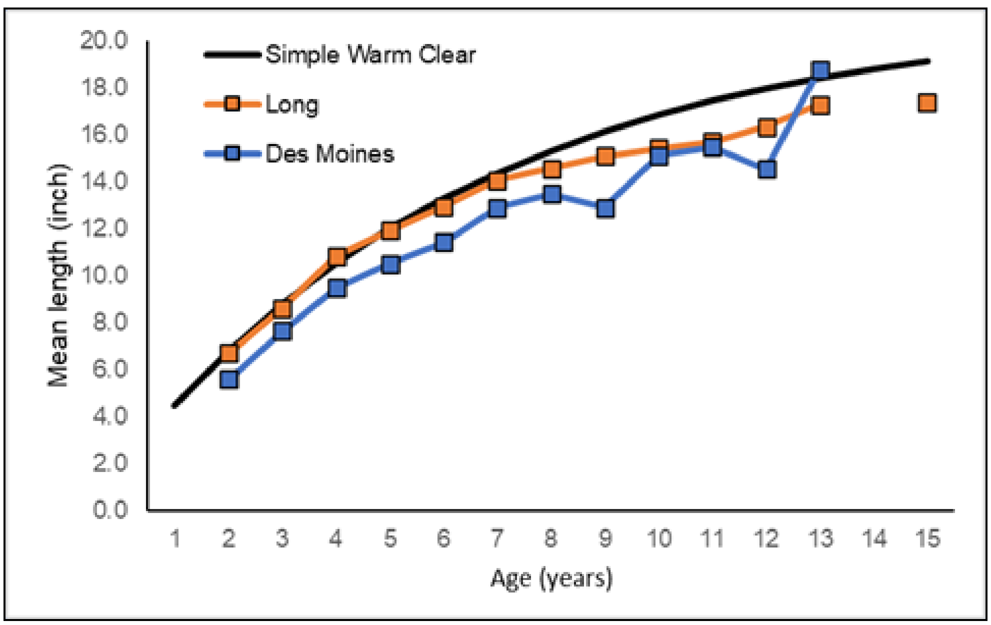
- “Jet-ski education regarding shoreline protection, preservation of underdeveloped shorelines, share water quality data, what does the data say about trends into the future? Would be interested in building a historical timeline of the lake, plotting of lots, lake residents 50-100 years of age, etc.”
- “Although it doesn’t affect our use, we are very concerned about increased motor boat traffic and huge waves that are seriously eroding natural shorelines.”
- “All property owners should be required to join the association.”
- “Create focus on minimizing impact on the lake, habitat, and wildlife. Address lack of guidelines for use of motorized watercraft, noise pollution, overdevelopment, and the use of chemicals in lake and to create lawns.”
- “We understand that walleye used to be in Des Moines Lake, and that the WDNR has programs to stock the lakes in WI. Could this or has it ever been addressed?”
- What is Wild Rice?
- Address use of buoys to section off owners lake shore, think they are illegal
- Low water, couldn’t put boat in

Short and brief summary report of the 2022 Des Moines fisheries report. The final is still not posted on the WDNR website.

2022 Des Moines Lake Survey Summary

Fish Species	Number	Min	Max	Average
Largemouth Bass	258	5.0	18.5	11.2
Bluegill	147	1.4	9.6	6.5
Northern Pike	8	14.5	24.5	18.8
Black Crappie	12	9.8	13.7	11.1
Pumpkinseed	43	4.5	8.6	7.1
Rock Bass	15	3.1	8.9	6.3

Largemouth Bass averaged 11.2 inches, identical to 2009 (11.2 inches) and above the 75th percentile for Simple-Warm Clear lakes. The Largemouth Bass catch rate increased from 67 fish/mile (2009) to 89 fish/mile. This rate is above the 50th percentile for Simple-Warm Clear lakes. Bluegill averaged 6.5 inches, similar to 2009 (6.6 inches), above the 95th percentile for Simple-Warm Clear lakes. The Bluegill catch rate increased from 116 fish/mile (2009) to 147 fish/mile. This catch rate is below the 50th percentile for Simple-Warm Clear lakes. Northern Pike and Black Crappie were caught at lower rates.



Based on our aging data, bass are growing slower than average for Simple Warm-Clear Lakes for most ages. When compared to neighboring Long Lake, bass growth is also slower for most ages. Bass growth did improve for age 4 to age 8 fish when compared to 2009. Bluegill aging data was not finished in time for this summary.

Rapid Response for Early Detection of Curly Leaf Pondweed, Eurasian Water Milfoil and Zebra Mussels

1. The Des Moines Lake Association community will be directed to contact the Aquatic Invasive Species (AIS) identification (ID) lead, if they see a plant or animal in the lake they suspect might be Curly leaf pondweed (CLP), Eurasian water milfoil (EWM) or zebra mussels (ZM). Signs at the public boat landings, web pages, and newsletter articles will provide contact information and instructions.
2. If plant/animal is likely CLP/EWM/ZM, the AIS ID lead will confirm identification with Burnett County AIS Coordinator and WDNR then inform the rest of the lake association board.
3. Mark the location of suspected invasive species (AIS ID Lead). Use GPS points, if available, or mark the location with a small float.
4. Confirm identification of CLP/EWM/ZM (or other AIS) with the WDNR (within 72 hours) (AIS ID Lead).
    a. CLP/EWM: Two entire intact rooted adult specimens of the suspect plants will be collected and bagged and delivered to the WDNR. Gather turions if possible on CLP.
    b. ZM: Two adult specimens will be collected and delivered to the WDNR. WDNR may confirm identification with the herbarium at the University of Wisconsin – Stevens Point or the University of Wisconsin – Madison.
5. If the suspect plants are determined to be CLP/EWM, the location of CLP/EWM will be marked with a more permanent marker. If the suspect animals are determined to be ZM, the appropriate signage will be posted at the landing (AIS ID Lead).
6. If identification is positive, inform the board, Burnett County Land Services Department (BCLSD), herbicide applicator, the person who reported the invasive species, lake management consultant, and all lake residents. (AIS ID Lead).
7. If identification is positive, post a notice at the public landing and include a notice on the website. These notices will inform residents and visitors of the approximate location of the invasive species and provide appropriate means to avoid spread. (Lake Association)
8. Contact BCLSD to seek assistance in CLP/EWM/ZM control efforts. The county has a rapid response plan in place that includes assisting lakes where new invasive species are discovered. CLP/EWM: Request that the county determine the extent of the introduction and conduct initial removal efforts. ZM: Request that the county determine the extent of the ZM introduction and conduct ZM veliger tows. If unavailable to assist within two weeks, proceed to step 9.
9. Hire a consultant to determine the extent of the CLP/EWM/ZM introduction. A diver may be used. CLP/EWM: If small amounts of the plant are found during this assessment, the consultant will be directed to identify locations with GPS points and hand pull plants found. All plant fragments will be removed from the lake when hand pulling. ZM: If small amounts of ZM are found, the consultant will be directed to hand remove and record GPS points.

10. Select a control plan in cooperation with Burnett County AIS Coordinator and WDNR (board of directors).
    Control methods may include hand pulling, use of divers to manually or mechanically remove the CLP/EWM/ZM from the lake bottom, application of herbicides (CLP/EWM), and/or other effective and approved control methods. The goal of the control plan will be eradication of the CLP/EWM/ZM

11. Implement the selected control plan including applying for the necessary permits. Regardless of the control plan selected, it will be implemented by persons who are qualified and experienced in the technique(s) selected.
12. Lake Association funds may be used to pay for any reasonable expense incurred in implementing the selected control plan, and implementation will not be delayed by waiting for WDNR to approve or fund a grant application.
13. The President of the Des Moines Lake Association will work with the WDNR to confirm, as soon as possible, a start date for an Early Detection and Rapid Response AIS Control Grant. Thereafter, the lake association shall formally apply for the grant.
14. The Des Moines Lake Association shall have the authority to accept donations or borrow money for the purpose of paying for control of CLP, EWM or ZM.
15. Frequently inspect the area of the CLP/EWM/ZM to determine the population size and/or the effectiveness of the treatment and whether additional treatment is necessary.
16. Contract for professional monitoring to supplement volunteer monitoring in years following CLP, EWM and/or ZM discovery.

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AIS Lead: Chris Franken, chrisfranken5@gmail.com

Burnett County Land Services – Conservation Division – 715-349-2109
Emily Moore, AIS Coordinator
Dave Ferris, County Conservationist

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Grants	Austin Dehn: 715-919-8059
Permits	Austin Dehn: 715-919-8059
AIS Notice	Alex Selle: 715-413-2376

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