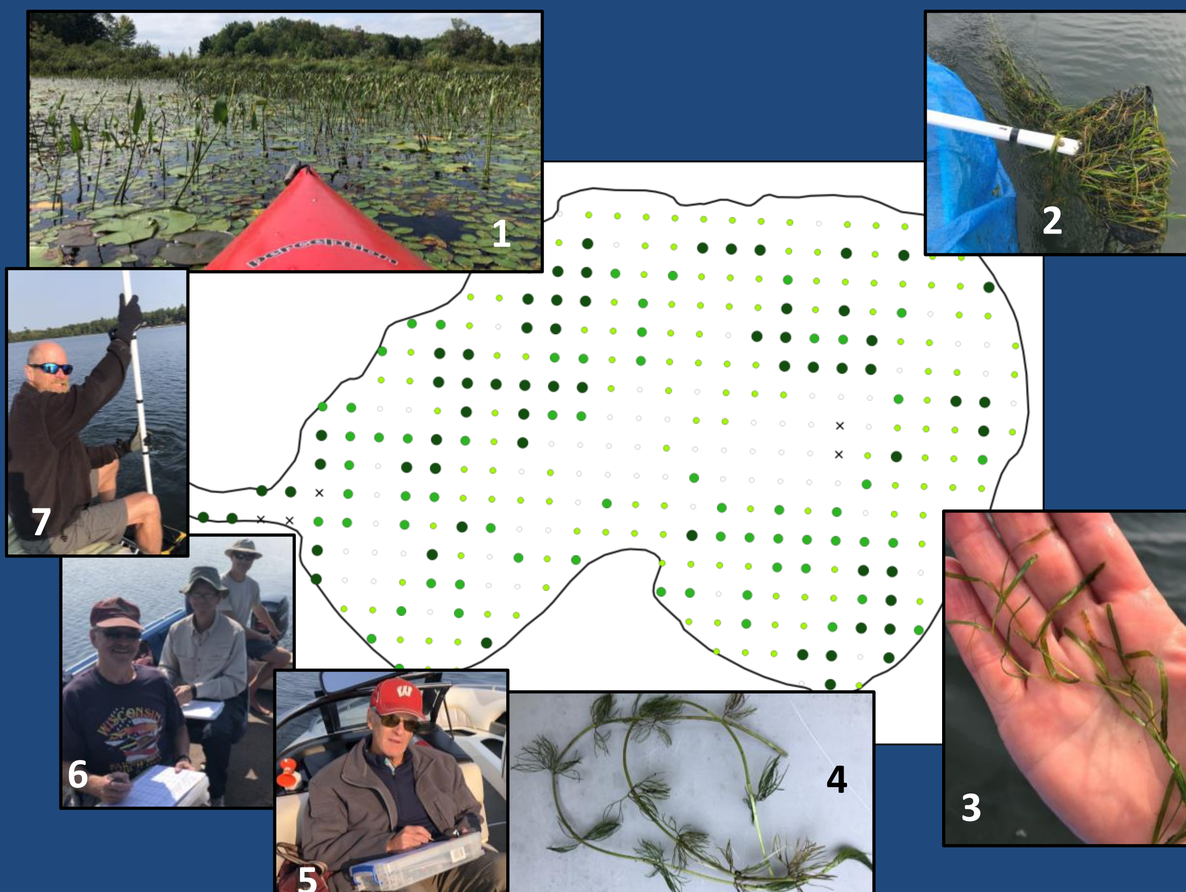
Aquatic Plant Management Plan

for

Moshawquit Lake
Menominee County, Wisconsin

2024-2029

Plan approved XXXXXX, 2024



Prepared for the Moshawquit Lake Association & Waterways Association of Menominee & Shawano Counties

Funded in part by WDNR Aquatic Invasive Species Planning Grant AEPP71623

Prepared by Aquatic Plant and Habitat Services LLC

Sara Hatleli, Sarahatleli97@gmail.com, Taylor, WI 54659, 715-299-4604

Photos from Cover Page: 1) Survey of western inlet area of Moshawquit Lake. Kayak provided by Alice Emerick. 2) Example of a rake full of native aquatic plants in Moshawquit Lake. 3) Blunt-leaf pondweed from Moshawquit Lake. 4) White-water crowfoot from Moshawquit Lake. 5) Volunteer Gary Sturtevant records data. 6) Volunteers Corbin Keller & Mark Emerick record data while Jeremy Johnson (Menominee County Land Conservation/Forestry/Zoning) navigates to sample points. 7) Volunteer Steve O'Shea uses the long-handles rake to sample for plants.

DRAFT 2 – This draft of the APMP was posted on the MLA website for a 3-week public review and comment period August 2-23, 2024. Notice of the public review and comment period was advertised in the Shawano Leader Classifieds on August 2, 2024.

PLEASE SUBMIT COMMENTS TO: Sara Hatleli at sarahatleli97@gmail.com

NEXT STEP (DRAFT 3): Adoption by MLA and Determination of Eligibility for Surface Water Grants by WDNR

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Executive Summary

Moshawquit Lake is located in Menominee County near the southeastern county line. The lake is 301 acres in surface area with clear water, a maximum depth of 30 feet, moderately abundant vegetation, and high species diversity. The lake is a deep headwater drainage lake formed by a dam in Linzy Creek.

Eurasian water-milfoil (EWM) and curly-leaf pondweed (CLP) were documented in 2006 and 2007, respectively. Hybrid watermilfoil (HWM) was documented in 2012. Since then, management efforts related to aquatic plants have largely focused on the control of EWM and HWM and, to a lesser degree, CLP. The Moshawquit Lake Association has been engaged in management activities since 2007 in collaboration with partners including WDNR, Menominee Indian Tribe of Wisconsin, Menominee County, and Waterways Association of Menominee & Shawano Counties.

Surveys of EWM beds began in 2007 by Cason & Associates to allow early small-scale herbicide treatments. There have been many whole-lake point-intercept aquatic plant surveys since 2010 to track AIS occurrence, particularly EWM/HWM. A point-intercept EWM presence/absence survey in 2021 revealed the highest frequency of EWM/HWM[1] of 15% since point-intercept surveys began in 2010. This was despite ongoing management efforts including 3 large-scale (>10 ac) herbicide treatments (2,4-D) and 4 small-scale (<10 ac) herbicide treatments (2,4-D) 2007-2021, diver assisted suction harvest, and small-scale manual removal. With genetic analysis confirming HWM in 2012 and continued shifts in best management practices, decisions are shifting away from 2,4-D, toward trying ProcellaCOR, and continuing DASH and manual removal.

This management plan provides background information about Moshawquit Lake, identifies the issues and need for management, reviews past management activities, and presents management options. Furthermore, a public input meeting in May 2024 and follow-up planning meeting were vital in collecting public input and providing information to partners and the public. All these components were considered in honing the goals and objectives developed in this management plan. The outcome is a strategy that includes the following goals that are detailed on pages 40-48:

Goal 1 – Protect native aquatic plants, organisms, and associated native mammal and fish populations.
Goal 2 – Provide educational opportunities pertaining to aquatic plants and aquatic invasive species.
Goal 3 – Protect the water quality of Moshawquit Lake through monitoring & assessment, reduced surface runoff, and increased lake stewardship.
Goal 4 - Monitor native plants, EWM, and CLP and implement control activities using criteria as resources and permits allow.
Goal 5 - Prevent the spread of aquatic invasive species.

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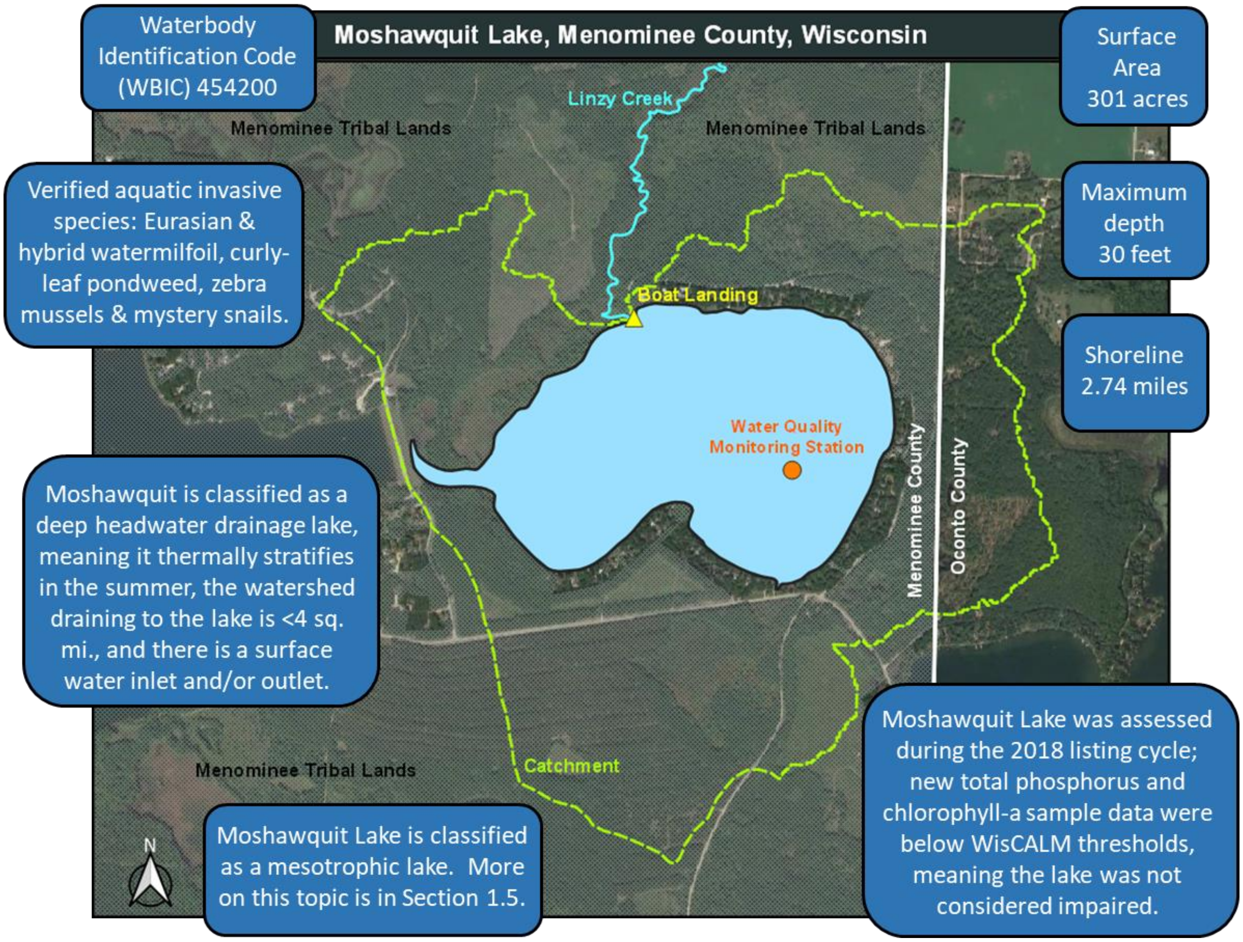
[1] HWM and EWM are used interchangeably throughout the document because they require genetic analysis for differentiation.

1.0 Moshawquit Lake Background

1.1 Study Site & Stakeholders

Figure 1 illustrates the location, county boundary, tribal lands, and natural features of land surrounding Moshawquit Lake. Stakeholders for the lake include Moshawquit Lake Association, Menominee Indian Tribe of Wisconsin (MITW), Menominee County, Waterways Association of Menominee & Shawano Counties (WAMSCO), Wisconsin Department of Natural Resources, and individual property owners. The boat landing shown in Figure 1 is owned by MITW and is open to property owners of Moshawquit Lake and MITW tribal members.

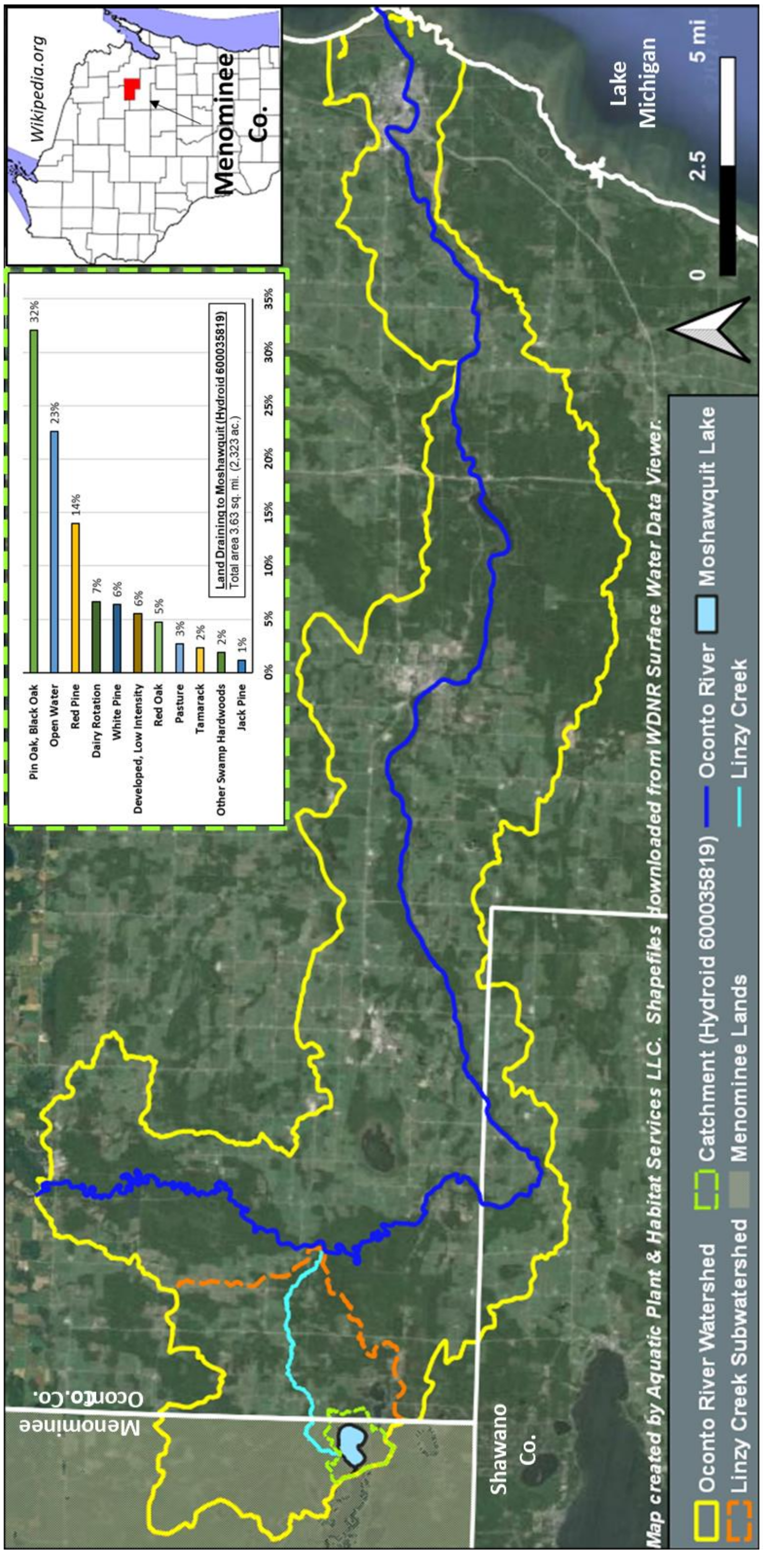
Figure 1 – Moshawquit Lake Map & Information



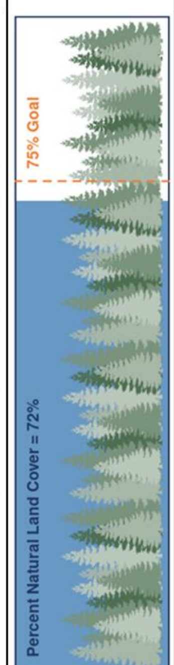
1.2 Watershed

1.2.1 Catchment, Sub-watershed, Watershed Map & Landcover Information

Figure 2 – Watershed Map & Landcover Information



- Land draining to Moshawquit Lake (hydroid 600035819) is outlined in green dashed line in Figure 2.
- Orange dashed boundary in Figure 2 illustrates the Linzy Creek Sub-watershed.
- Moshawquit Lake, the hydroid layer, and sub-watershed lie within the Oconto River Watershed outlined in yellow.



When less than 75% of the Linzy Creek Subwatershed is in natural land cover, water quality and aquatic habitat declines and can impact fisheries, wildlife communities, and beneficial recreational uses. Enhancing natural land cover and implementing water quality and land use best practices that go above and beyond minimum standards can prevent further decline and may protect water resources. ENHANCEMENT OF NATURAL LAND COVER RECOMMENDED. *Source: WDNR Water Explorer*

1.1 Shorelands & Water Quality Implications

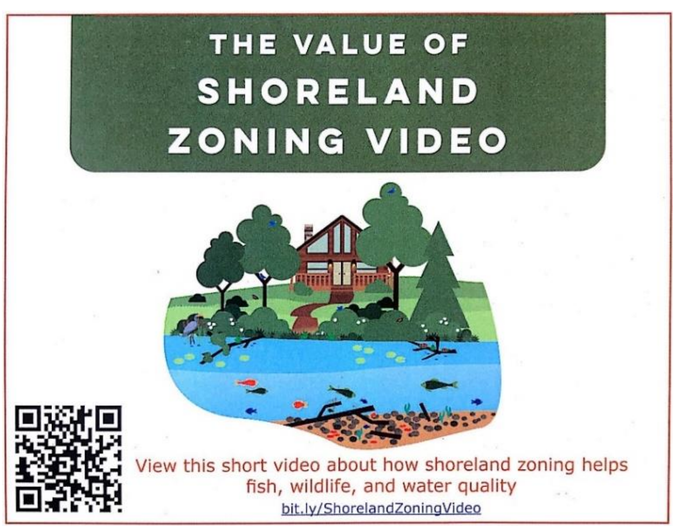
The water quality of a lake, stream, or river is directly impacted by its watershed, which includes land that is directly adjacent to a lake. When waterfront land changes from forest-covered to a house, driveway, deck, garage, septic systems, lawns and sandy beaches, the water quality will be directly affected. It is the cumulative land cover change of many waterfront properties that leads to a decline in water quality.

Lake property owners are the last line of defense in protecting water quality and habitat from the impacts of human development.

For example, the amount of phosphorus (P) entering a lake increases as land use changes from forested to residential (Panuska & Lillie 1995, Jeffrey 1985). A developed site with a lawn will allow more runoff volume carrying P and nitrogen (N) than a forested site (Graczyk et al 2003). P is generally the key nutrient that leads to algae and nuisance aquatic plant growth. P sources include human waste (failing septic systems), animal waste (farm runoff), soil erosion, detergents, and lawn fertilizers (Shaw et al. 2004). Detergents and lawn fertilizer are presumed less of an issue with recent laws. Developed sites have more impervious surface that does not allow precipitation to infiltrate into the soils. This precipitation becomes surface water runoff at warmer temperatures than at non-developed sites (Galli 1988). The warmer water that flows into the lake can lead to increased lake water temperatures, and as water temperatures increase the amount of dissolved oxygen it can "hold" decreases.

Shoreland development can lead to increased water temperatures, lower dissolved oxygen, higher nutrient input, and habitat degradation.

"The Value of Shoreland Zoning Video" is a 3-minute production developed by the UW-Stevens Point Center for Land Use Education that illustrates the impacts of shoreland development.



1.2 Healthy Lakes Practices

Healthy Lakes & Rivers is a collaborative effort among shoreland property owners, businesses, and the Wisconsin Lakes Partnership (WDNR, UWEX, & Wisconsin Lakes) to promote and install relatively simple and inexpensive best practices benefiting habitat and water quality. There are 5 “best practices” that improve habitat and water quality on shoreland property including native plantings, rain gardens, water diversions, rock infiltration, and “fish sticks” (i.e. tree drops to serve as habitat). Grant funding is available to pay for up to $1000 toward each practice with a cost share of 75% coming from the state and 25% covered by the sponsor. Grants must be sponsored by an eligible sponsor (i.e. individual property owners do not qualify to apply on their own).

The Menominee County Land Conservation, Forestry, & Zoning Department can offer a county-sponsored shoreland survey in 2025 and serve as a resource for shoreland restoration workshop / education sessions. The county can also offer cost share for shoreland improvement at 50-50% for rip-rap / rock and 70-30% for planting shoreline buffers[2].

Figure 3 – Healthy Lakes Practices

Photos from healthylakeswi.com provide examples of some best practices

[2] Cost-share funds provided by Wisconsin Department of Ag, Trade, & Consumer Protection (DATCP).

1.3 Trophic State & Water Quality

Trophic state and water quality are often used interchangeably and while the two are related, they are not the same.

- ✓ **Water quality** – a somewhat subjective descriptor of a lake's condition based on the observer's use of the lake. EXAMPLE → clear-water lakes are often described as having "good" or "excellent" water quality, which may be true for swimmers or SCUBA divers while the same ultra-clear lake may have a limited fishery leading to an "average" water quality classification by an angler.
- ✓ **Trophic state** - the biological condition of a lake using a scale that is based on measurable and objective criteria. EXAMPLE → Moshawquit Lake average total P levels (0.014 mg/L or 14ug/L) classify the lake as a mesotrophic system.

1.3.1 Trophic State of Moshawquit Lake

This section describes the trophic state of Moshawquit Lake using water clarity, total phosphorus, and chlorophyl-*a* found in the online database. The trophic state of a lake is defined as the total weight of living biological material (or biomass) in a lake at a specific location and time.

- ✓ **Eutrophic** lakes tend to have abundant aquatic plant growth, high nutrient (phosphorus) concentrations, and low water clarity due to algae blooms.
- ✓ **Mesotrophic** lakes have intermediate nutrient levels and only occasional algae blooms and moderate-to-high plant growth.
- ✓ **Oligotrophic** lakes are nutrient poor and have little plant and algae growth.

Red ovals in Figure 4 represent average water clarity (Secchi depth), total phosphorus, and chlorophyll in Moshawquit Lake[3].

Figure 4 – Trophic State Gradient adapted from Simpson & Carlson (1996)

TSI	Chlorophyll-a (ug/L)	Secchi Depth (ft)	Total Phosphorus (ug/L)	Attributes	Fisheries & Recreation
<30	<0.95	>26	<6	Oligotrophic: Clear water, oxygen throughout the year in the hypolimnion	Salmonid fisheries dominate
30-40	0.95 - 2.6	13 - 26	6 - 12	Oligotrophic: Hypolimnia of shallower lakes may become anoxic	Salmonid fisheries in deep lakes only
40-50	2.6 - 7.3	6.5 - 13	12 - 24	Mesotrophic: Water moderately clear; increasing probability of hypolimnetic anoxia during summer	Hypolimnetic anoxia results in loss of salmonids. Walleye may predominate
50-60	7.3 - 20	3 – 6.5	24 - 48	Eutrophic: Anoxic hypolimnia, macrophyte problems possible	Warm-water fisheries only. Bass may dominate.
60-70	20 - 56	1.5 - 3	48 - 96	Eutrophic: Blue-green algae dominate, algal scums and macrophyte problems	Nuisance macrophytes, algal scums, and low transparency may discourage swimming and boating.
70-80	56 - 155	0.75 – 1.5	96 - 192	Hypereutrophic: (light limited productivity). Dense algae and macrophytes	Rough fish dominate; summer fish kills possible
>80	>155	<0.75	192 - 384	Algal scums, few macrophytes	

[3] Average calculated using values from July 15 through September 15, 2014-2023.

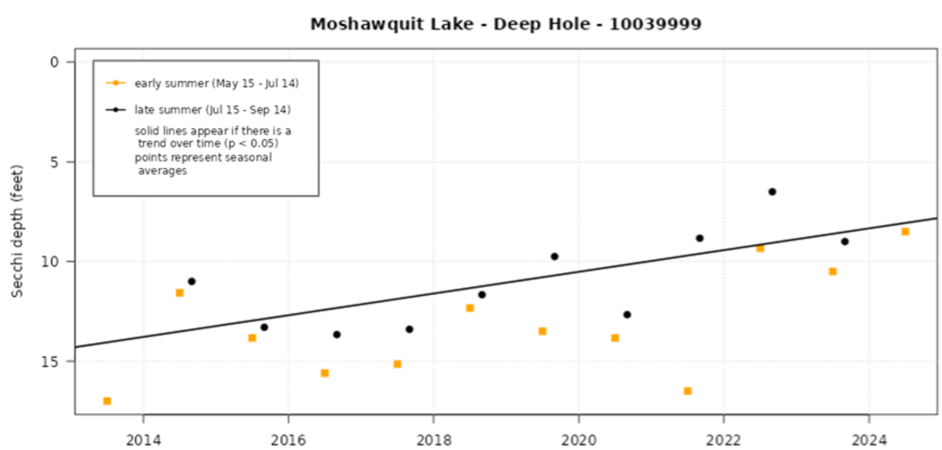
1.3.2 Water Clarity

Figure 5 – Secchi Disk

The depth to which light can penetrate, or water clarity, is a factor that limits aquatic plant growth. Water clarity is measured by lowering a black and white Secchi disk (8 inches diameter) in the water and recording the depth of disappearance. The disk is then lowered further and slowly raised until it reappears. The Secchi depth is the mid-point between the depth of disappearance and the depth of reappearance. Because light penetration is usually associated with nutrient levels and algae growth, a lake is considered eutrophic when Secchi depths are less than 6.5 feet. Secchi depths vary throughout the year, with shallower readings in summer when algae concentrations increase, thus limiting light penetration. Conversely, deeper readings occur in spring and late fall when algae growth is lower. Secchi depth has been consistently monitored since 2014 at the Water Quality Monitoring Station (Figure 1) in early summer (May 15-July 14) and late summer (July 15-Sept.14). The average late summer Secchi depth is 11 ft, which classifies Moshawquit Lake as a **MESOTROPHIC** system from a water clarity standpoint (Figure 4 & Figure 8).

Unfortunately, there is a statistically significant decrease in late summer (July 15-Sept 14) Secchi depth since 2014 as highlighted in yellow in Figure 6. The data suggest there is approximately 0.5-ft loss in Secchi depth per year since 2014!

Figure 6 - Trends in Secchi Depth 2014-2024



Season	# Years	# Results	Slope (ft/yr)	Statistically Significant?
May 15-July 14	12	53	-0.465	No
July 15-Sept 14	10	49	-0.544	Yes * p-value < 0.05

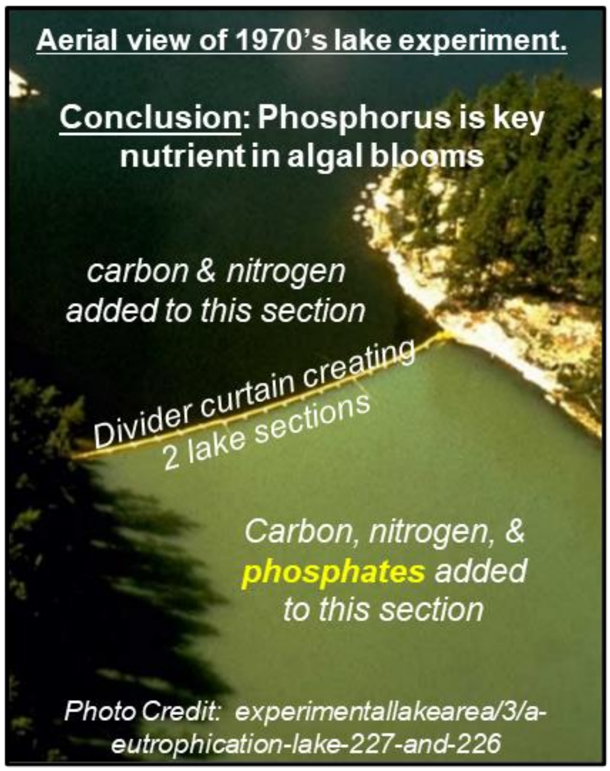
**there is a 5% chance that the result is insignificant, or that it just happened by chance alone.*

1.3.3 Phosphorus

Phosphorus is an important nutrient for plant growth and is commonly the limiting nutrient for plant production in Wisconsin lakes. As a limiting factor, adding small quantities of phosphorus to a lake can lead to dramatic increases in plant and algae growth.

Total phosphorus was monitored in Moshawquit Lake since 2015 using surface water samples (0-6 ft deep) from the Water Quality Monitoring Station illustrated in Figure 1. The late summer (July 15-Sept 14) average is 0.014mg/L (14ug/L), therefore classifying Moshawquit Lake as a **MESOTROPHIC** system from a nutrient standpoint (Figure 4 & Figure 8).

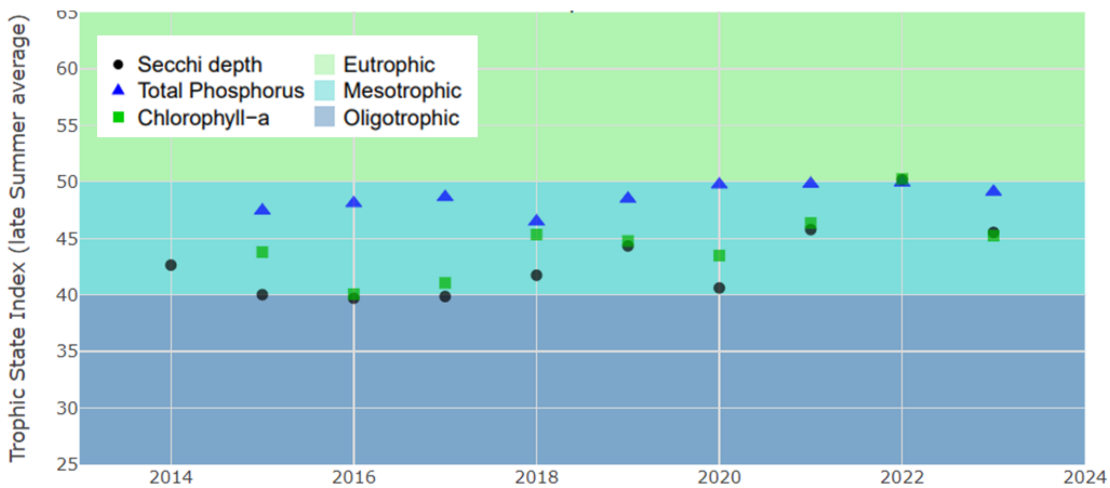
Figure 7 – Famous Lake Experiment Photo



1.3.4 Chlorophyll-a

Chlorophyll-*a* is the green pigment found in plants and algae. The concentration of chlorophyll-*a* is used as a measure of the algal population in a lake. For trophic state classification, preference is given to the chlorophyll-*a* trophic state index (TSI_{CHL}) because it is the most accurate at predicting algal biomass. Chlorophyll-*a* has been monitored consistently in Moshawquit Lake since 2015 using water samples from the surface (0-6 feet) at the Water Quality Monitoring Station illustrated in Figure 1. The late summer (July 15-Sept 14) average chlorophyll-*a* since 2015 is 3.9ug/L, or TSI_{CHL} of 45, therefore classifying Moshawquit Lake as a **MESOTROPHIC** system from an algal biomass standpoint (Figure 4 & Figure 8).

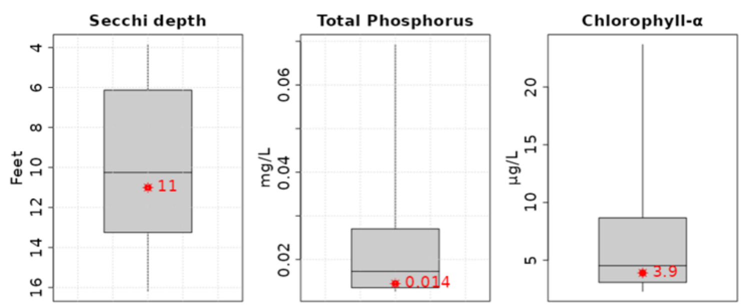
Figure 8 – Moshawquit Lake Trophic State Index Chart



1.3.5 Moshawquit Trophic Status Compared to other Deep Headwater Lakes

Despite the concerning evidence of declining Secchi depth (Figure 6), Moshawquit Lake averages greater Secchi depth, lower total phosphorus, and lower chlorophyll compared to other deep headwater lakes (Figure 9).

Figure 9 - Trophic Status Compared to Other Lakes

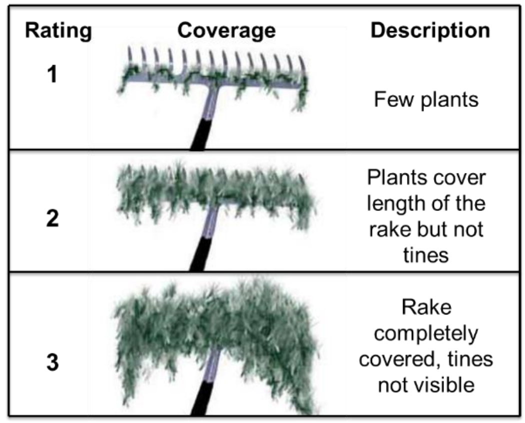


Late summer (July 15-Sept 14) tropic indicator averages (red) from the last 10 years in Moshawquit Lake compared to other DEEP HEADWATER lakes (gray box and whiskers plot).

1.4 Aquatic Plants

1.4.1 2022-2023 Survey Methods

Figure 10 – Total Rake Fullness Illustration



Whole-lake Point-Intercept Survey

A whole-lake point-intercept aquatic plant survey of Moshawquit Lake was completed September 13-14 2022 and August 22-23rd, 2023 by volunteers Mark Emerick, Steve O'Shea, Corbin Keller, Gary Sturtevant, Menominee Co. Jeremy Johnson, and APHS Consultant Sara Hatleli. The plant survey followed a statewide standard protocol developed by Hauxwell et al. (2010) with 337 predetermined survey points (Appendix A). The plants were surveyed from a boat using a double-sided rake head on a telescopic pole or rope, depending on site depth. Rake fullness was determined using guidelines in Figure 10. Aquatic plant survey data were uploaded to an open-source geographic information systems (GIS) program known as QGIS[4] for map creation.

1.4.2 2023 Survey Results

Table 1 – Aquatic Plant Survey Results 2022-23

Summary Statistic		Sept 13-14 2022	Aug. 15-17 2023
Total # of sites visited		322	333
Total # of sites with vegetation		232	264
Max. depth of plants (feet)		18	22.5
Total # of sites shallower than max. depth of plants		305	326
Frequency of occurrence (FOO) at sites shallower than max. depth of plants. AKA Littoral frequency		76%	81%
Avg. # of species per site	a) Shallower than max. depth	1.84	2.25
	b) Vegetated sites only	2.44	2.78
	c) Native shallower than max. depth	1.84	2.17
	d) Native species at vegetated sites only	2.43	2.69
Species Richness	a) Total # species on rake at all sites	37	40
	b) Including visuals	39	43
Simpson's Diversity Index		0.91	0.92

The maximum rooting depth of plants was 22.5 feet and there were 326 sample points shallower than the maximum rooting depth. Of those sites, 264 (81%) had vegetation present (Figure 11,Table 1). Diversity was high with a species richness of 40 species found on the rake (not including filamentous algae), another 3 species within 6ft of survey points but not on the rake (considered "visual"), and another 4 species found greater than 6ft from survey points (considered "boat survey"). Southern naiad, common waterweed, and slender nitella were the 3 most common species found in 2023 with littoral frequencies of 29%, 24%, and 23%, respectively (Table 2). Together, they accounted for 34% of the total relative frequency, indicating that the plant community in Moshawquit is heterogeneous. Maps of individual species are in Appendix B.

Floristic quality index (FQI) indicates whether the plant community is indicative of human disturbance. The mean FQI for Moshawquit is high at 37 while the mean conservatism (C), which indicate a species' tolerance to human disturbance, is moderately high at 6.3 (Figure 12).

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[4] QGIS Development Team, 2024. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org.

Figure 12 – FQI for Moshawquit Lake Compared to Other Northern Drainage Lakes

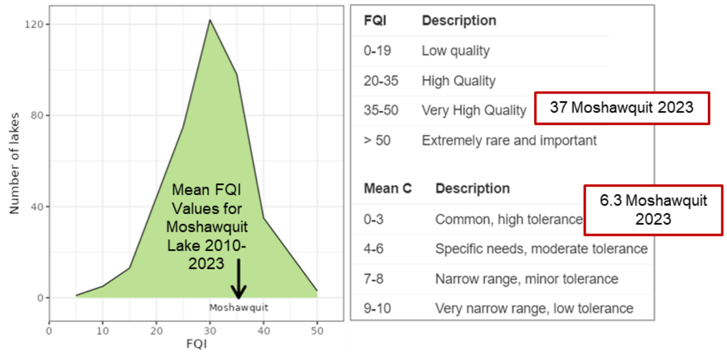


Figure 11 – Total Rake Fullness & Plant Species Richness Maps, 2023

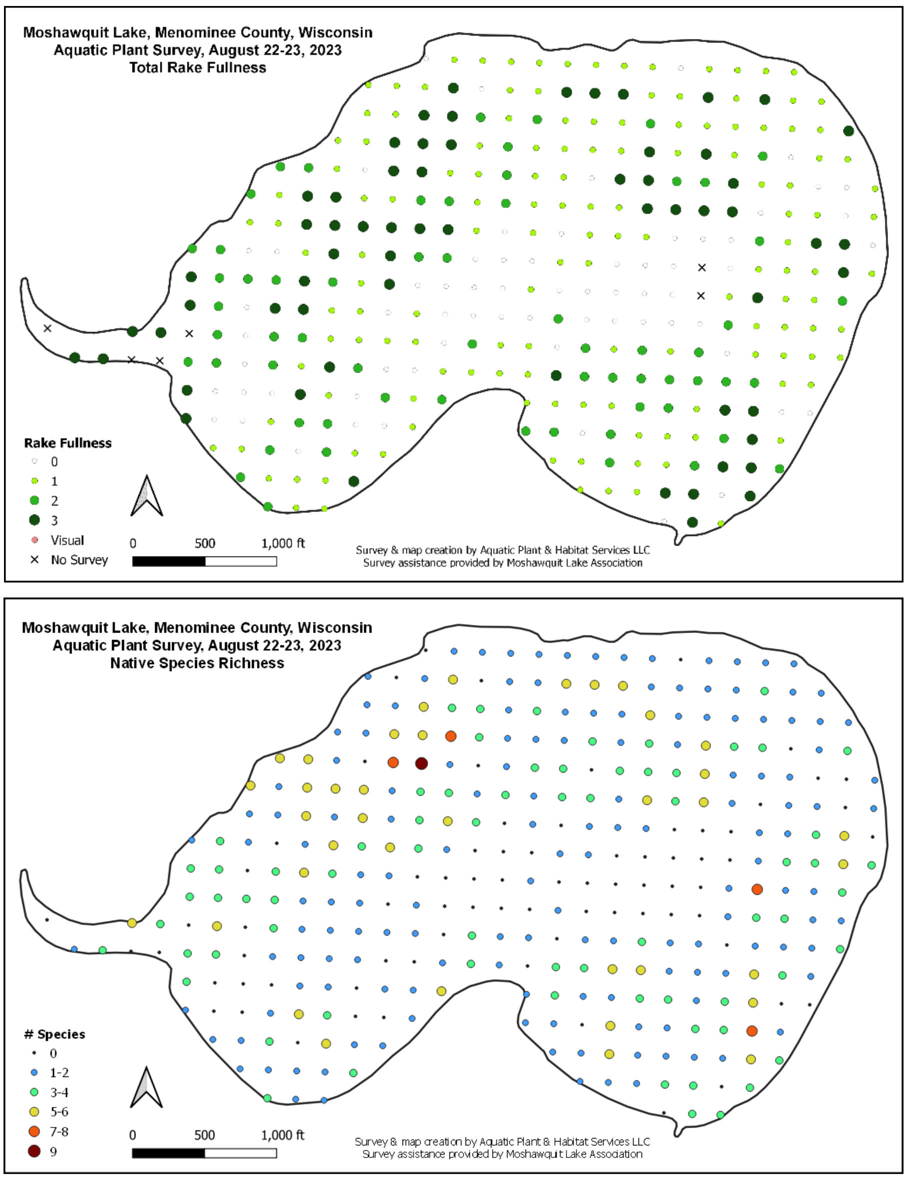


Table 2 – Moshawquit Lake Individual Species Statistics, 2023

Common Name	Scientific Name	FOO in Veg. Areas	Littoral Frequency (%)	Relative Frequency (%)	# Sites	Avg. Rake Fullness	# Visual
Southern naiad	*Najas guadalupensis*	35.23	28.53	12.77	93	1.27	0
Common waterweed	*Elodea canadensis*	29.92	24.23	10.85	79	1.25	0
Slender Nitella	*Nitella flexilis*	28.03	22.70	10.16	74	1.32	0
Slender naiad	*Najas flexilis*	26.14	21.17	9.48	69	1.04	0
Common stonewort	*Chara contraria*	25.76	20.86	9.34	68	1.25	0
Wild celery	*Vallisneria americana*	25.76	20.86	9.34	68	1.43	0
Flat-stem pondweed	*Potamogeton zosteriformis*	21.97	17.79	7.97	58	1.36	0
Small pondweed	*Potamogeton pusillus*	11.74	9.51	4.26	31	1.03	0
Clasping-leaf pondweed	*Potamogeton richardsonii*	9.47	7.67	3.43	25	1.12	0
Globular stonewort	*Chara globularis*	9.09	7.36	3.30	24	1.04	0
Filamentous algae		9.09	7.36		24	1.08	0
Variable pondweed	*Potamogeton gramineus*	6.82	5.52	2.47	18	1.00	0
Sago pondweed	*Stuckenia pectinata*	6.06	4.91	2.20	16	1.25	0
Braun's Stonewort	*Chara braunii*	5.68	4.60	2.06	15	1.20	0
Illinois pondweed	*Potamogeton illinoensis*	4.55	3.68	1.65	12	1.08	1
White-stem pondweed	*Potamogeton praelongus*	4.17	3.37	1.51	11	1.00	0
Fern pondweed	*Potamogeton robbinsii*	3.41	2.76	1.24	9	1.11	0
Coontail	*Ceratophyllum demersum*	2.65	2.15	0.96	7	1.29	0
Blunt-leaf pondweed	*Potamogeton obtusifolius*	2.65	2.15	0.96	7	1.29	0
Utricularia sp.	*Utricularia sp.*	2.65	2.15	0.96	7	1.00	0
Watershield	*Brasenia schreberi*	2.27	1.84	0.82	6	2.17	1
Spatterdock	*Nuphar variegata*	1.89	1.53	0.69	5	1.20	5
Eurasian water milfoil	*Myriophyllum spicatum*	1.14	0.92	0.41	3	1.00	1
Muskgrasses	*Chara sp.*	1.14	0.92	0.41	3	2.00	0
Water star-grass	*Heteranthera dubia*	1.14	0.92	0.41	3	1.67	0
White water lily	*Nymphaea odorata*	1.14	0.92	0.41	3	1.33	2
Rough stonewort	*Chara aspera*	1.14	0.92	0.41	3	1.00	0
Fries' pondweed	*Potamogeton friesii*	0.76	0.61	0.27	2	1.00	0
Floating-leaf pondweed	*Potamogeton natans*	0.76	0.61	0.27	2	1.00	1
Stiff pondweed	*Potamogeton strictifolius*	0.76	0.61	0.27	2	1.00	0
Water bulrush	*Schoenoplectus subterminalis*	0.76	0.61	0.27	2	1.50	0
Needle spikerush	*Eleocharis acicularis*	0.38	0.31	0.14	1	1.00	0
Creeping spikerush	*Eleocharis palustris*	0.38	0.31	0.14	1	1.00	0
Small duckweed	*Lemna minor*	0.38	0.31	0.14	1	1.00	0
Large-leaf pondweed	*Potamogeton amplifolius*	0.38	0.31	0.14	1	1.00	0
Leafy pondweed	*Potamogeton foliosus*	0.38	0.31	0.14	1	1.00	0
White water crowfoot	*Ranunculus aquatilis*	0.38	0.31	0.14	1	1.00	0
Crested arrowhead	*Sagittaria cristata*	0.38	0.31	0.14	1	1.00	0
Large duckweed	*Spirodela polyrrhiza*	0.38	0.31	0.14	1	1.00	0
Small purple bladderwort	*Utricularia resupinata*	0.38	0.31	0.14	1	1.00	0
Northern wild rice	*Zizania palustris**	0.38	0.31	0.14	1	1.00	1
Pickerelweed	*Pontederia cordata*	0.00	0.00	0.00	0	0.00	2
Hardstem bulrush	*Schoenoplectus acutus**	0.00	0.00	0.00	0	0.00	3
Cattail	*Typha sp.*	0.00	0.00	0.00	0	0.00	1
Torrey's bulrush	*Schoenoplectus torreyi**	-	-	-	-	-	-
Forked duckweed	*Lemna trisulca*	-	-	-	-	-	-
Northern watermilfoil	*Myriophyllum sibiricum*	-	-	-	-	-	-
Furcate nitella	*Nitella furcata**	-	-	-	-	-	-

Non-native invasive species | Species of Special Concern | *High coefficient of concervatism (C value of 9 or 10*

**Species verified by Dr. Robert Freckmann 9/22/23. Dashed cells indicate the species were not found at/near any sample points but were documented while surveying the lake.*

1.4.3 Aquatic Plant Species Changes 2019 vs. 2023

Chi-square tests of data from pre-treatment with ProcellaCOR (2019) compared to 2023 reveal statistically significant (SS) increases or decreases. This information helps compare aquatic plant communities before and after herbicide treatment. Between 2019 and 2023 there were SS increases in 6 native species (not including *Utricularia sp*. because plants were not identifiable to species in 2023. Also not including filamentous algae.). There was a decrease in 6 native species, although the *U. gibba and U. vulgaris* may be accounted for to some degree with the finding of *Utricularia sp*. in 2023. On a positive note, there was still a SS decrease in EWM in 2023, which was one whole year after ProcellaCOR treatment (see Past Management Section 5.0).

Table 3 – Chi-square Results 2019 vs. 2023

Common Name	Scientific Name	Monocot or Dicot (A=Annual, P=Perennial)	2019 vs. 2023 Number of Sites		2019-23 Increase or Decrease*
Eurasian watermilfoil	Myriophyllum spicatum	Dicot, P	10	3	-
Watershield	Brasenia schreberi	Dicot, P	6	6	no change
Water marigold	Bidens beckii	Dicot, P	1	0	-
Coontail	Ceratophyllum dermersum	Dicot, P	57	7	-
Muskgrasses	Chara	Macroalgae	125	113	-
Needle spikerush	Eleocharis acicularis	Monocot, P	2	1	-
Common waterweed	Elodea canadensis	Monocot, P	15	79	+
Slender waterweed	Elodea nuttallii	Monocot, P	1	0	-
Water star-grass	Heteranthera dubia	Monocot, P	15	3	-
Small duckweed	Lemna minor	Monocot, P	0	1	+
Forked duckweed	Lemna triscula	Monocot, P	11	0	-
Northern watermilfoil	Myriophyllum sibiricum	Dicot, P	2	0	-
Slender naiad	Najas flexilis	Monocot, A	78	69	-
Southern naiad	Najas guadalupensis	Monocot, A/P	165	93	-
Nitella	Nitella spp.	Macroalgae	80	74	-
Spatterdock	Nuphar variegata	Dicot, P	4	5	+
White water lily	Nymphaea odorata	Dicot, P	4	3	-
Pickerelweed	Pontederia cordata	Monocot, P	1	0	-
Large-leaf pondweed	Potamogeton amplifolius	Monocot, P	1	1	no change
Berchtold's pondweed	Potamogeton berchtoldii	Monocot, P	3	0	-
Variable pondweed	Potamogeton gramineus	Monocot, P	8	18	+
Illinois pondweed	Potamogeton illinoensis	Monocot, P	2	12	+
Floating-leaf pondweed	Potamogeton natans	Monocot, P	0	2	+
Blunt pondweed	Potamogeton obtusifolius	Monocot, P	0	7	+
White-stem pondweed	Potamogeton praelongus	Monocot, P	5	11	+
Small pondweed	Potamogeton pusilus	Monocot, P	8	31	+
Clasping-leaf pondweed	Potamogeton richardsonii	Monocot, P	15	25	+
Fern pondweed	Potamogeton robbinsii	Monocot, P	16	9	-
Stiff pondweed	Potamogeton strictifolius	Monocot, P	0	2	+
Flat-stem pondweed	Potamogeton zosteriformis	Monocot, P	5	58	+
White water crowfoot	Ranunculus aquatilis	Dicot, P	0	1	+
Hardstem bulrush	Schoenoplectus acutus	Monocot, P	2	0	-
Water bulrush	Schoenoplectus subterminalis	Monocot, P	1	2	+
Sago pondweed	Stuckenia pectinata	Monocot, P	7	16	+
Creeping bladderwort	Utricularia gibba	Dicot, P	8	0	-
Small purple bladderwort	Utricularia resupinata	Dicot, P	1	1	no change
Common bladderwort	Utricularia vulgaris	Dicot, P	8	0	-
Wild celery	Vallisneria americana	Monocot, P	85	68	-
Creeping spikerush	Eleocharis palustris	Monocot, P	0	1	+
Filamentous algae		Algae	0	24	+
Leafy pondweed	Potamogeon foliosus	Monocot, P	0	1	+
Fries' pondweed	Potamogeton friesii	Monocot, P	0	2	+
Crested arrowhead	Sagittaria cristata	Monocot, P	0	1	+
Large duckweed	Spirodela polyrrhiza	Monocot, P	0	1	+
Bladderwort	Utricularia sp.	Dictot, P	0	7	+
Wild Rice	Zizania sp.	Monocot, A	0	1	+
Increase is statistically significant		*Decrease is statistically significant*			

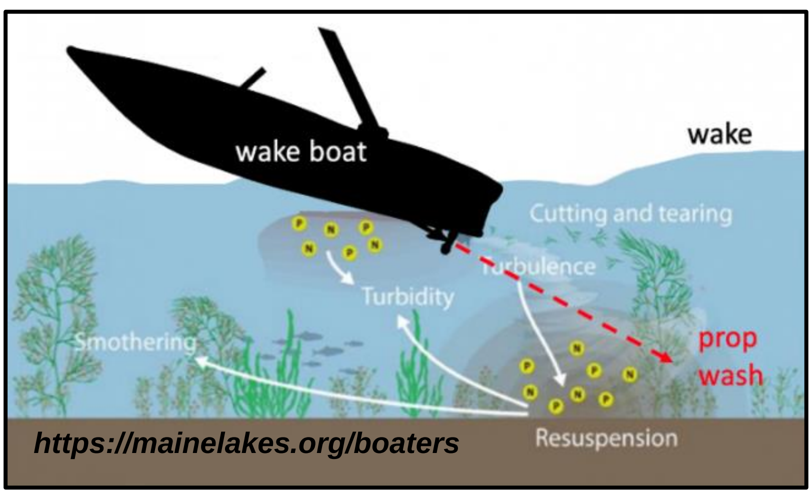
1.4.4 Impact of Wake Enhancing Watercraft on Aquatic Plants

The topic of wake enhancing watercraft operating on Wisconsin Lakes is a controversial one. Water sports enthusiasts using these types of boats feel their sport is being unfairly attacked and potentially limited by legislation due to the irresponsible behavior of few. Opponents feel their enjoyment of the lake, personal safety, property, and lake ecology is threatened by the propeller downwash, significant wave propagation, threat of AIS carried in ballast, and lack of consideration and safety exhibited by some operators of wake enhancing watercraft.

Wake enhancing watercraft are equipped with ballast tanks and mechanical systems designed to create large wakes for the purpose of wake surfing. Wake surfing requires the boat to plow water at slow speeds with the bow of the boat elevated while the stern is submersed and propellers are directed much more downward than if the boat was operating on plane. The powerful motors and downward propeller direction disturbs the lake bed sediment situated in depths of 16.4 feet (Raymond and Galves, 2015) or even >20 feet (Terra Vigilis, 2022).

The direct impacts of wake enhancing watercraft on aquatic plants is an ongoing topic of research. Preliminary results suggest that "propeller downwash characteristics have been measured showing significant bottom effects from Wakeboard boats in *surf mode* at depths greater than 20 feet. This depth effect is not observed from the other three categories of vessels owing to reduced engine power, propeller angles, hull design, lack of ballasting, and the mode of operation (planing)" (Terra Vigilis, 2022). The same source reveals that "re-deposition effects are notable from persistent Wakeboard boat activity …….. Depositional materials appear to have an impact on aquatic plant life." Terra Vigilis is in Phase 3 of a study on North Lake in Waukesha County, Wisconsin, and researching more in depth about the impacts to aquatic plant life.

Figure 13 – Wake Enhancing Watercraft Propeller Downwash Illustration



1.5 Fishery

The following is copied from a report provided by Ryan Wehse from Menominee Indian Tribe of Wisconsin, Environmental Services Department (MITW ESD).

In 2023 the MITW ESD conducted a night time electrofishing run to monitor the fish populations, primarily largemouth bass and previously stocked walleye. A spring fyke netting survey was also done on Moshawquit Lake in 2020. Some data shown in this report compares surveys from both years with some focused on the spring of 2020 only and the more detailed 2020 report can be found on the tribal website.

All fish were identified, measured and aging structures were collected on most gamefish. A total of 245 fish were sampled in 2023 with largemouth bass accounting for 36 % and pumpkinseed accounting for 25 % of the catch. Other fish species included black crappie, rock bass, yellow perch, bowfin, lake chubsucker, white sucker, northern pike and walleye.

The table shows size ranges for certain fish species and size parameters such as stock, quality and proportion of stock density (PSD) based on state of Wisconsin metrics. These metrics indicate the overall health and size balance of that particular fish species. Stock size is considered the length when the fish species typically reaches maturity and when they are vulnerable to capture in surveys. Quality size refers to the minimum size for each species that anglers prefer to catch.

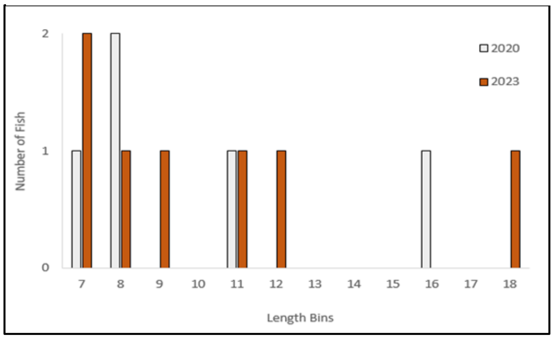
Stock and quality size for each species is labeled in inches in parenthesis before the number of fish in that category. PSD is calculated by dividing the number of quality fish by number of stock fish and a score of 40-60 indicates a balanced size average for that fish species.

The table below shows fish sampled during the electrofishing run in 2023 only and not all fish were measured. Additional weight and age data from the 2020 surveys can be found in the 2020 Moshawquit Lake report. Length is show in inches and weighs were not collected in 2023.

Species	Number of Fish	Average Length	Length Range	# Stock	# Quality	PSD
Black crappie	16	8.6	2.2-9.9	(5”) 15	(8”) 15	100
Bluegill	41	6.2	3.1-8.3	(3”) 41	(6”) 29	71
Pumpkinseed	60	6.9	2.6-8.3	(3”) 59	(6”) 52	88
Yellow perch	11	6.9	4.9-8.7	(5”) 10	(8”) 5	50
Largemouth bass	89	11.6	5.7-18.7	(8”) 81	(12”) 41	51
Northern pike	12	19.5	16.5-25.0	(14”) 12	(21”) 2	17
Walleye	7	10.2	6.7-18.0	(10”) 3	(15”) 1	33

- *Average length of bluegill was just over an inch longer in 2020 compared to 2023. Based on sizes and past years age/length data, several year classes were present in both sample years.*
- *The majority of crappie measured in the quality size range in both sample years.*
- *The longest yellow perch in 2020 was 9.6 inches and 55 % measured 8 inches or longer in 2023.*
- *Over a hundred pike were sampled in 2020 compared to 11 in 2023 due to time of survey and where pike were present throughout the lake.*
- *Average length of largemouth bass in 2020 was 10.5 inches and 11.6 in 2023. Growth rates during both years were relatively close to state average with 2020 showing slightly slower growth than 2023.*

Figure 14 – Walleye Size Structure Graph & Photo/Table of Walleye Stocked in Moshawquit Lake



Year	Number of Fish Stocked	Average Length
2018	2,033	5.5
2019	2,638	5
2020	7,000	1.5
2021	1,600	7
2022	2,000	6.5
2023	2,700	6

Summary and Management Recommendations

Significantly different numbers of each fish species were sampled between the two years based on the survey methods. Size averages and growth rates for largemouth bass were slightly better in 2023 compared to 2020. Staff continue to encourage tree drops or fish sticks be added to the shoreline in improve fish habitat. Walleye will continue to be stocked annually and more surveys will be done in the coming years. ESD staff do not recommend any changes to tribal or non-tribal regulations at this time.

1.6 Wildlife

The Wisconsin Natural Heritage Inventory (NHI) lists species and natural communities that are known or suspected to be rare in Wisconsin. The species are legally designated as endangered or threatened or they may be listed in an advisory capacity of special concern. The NHI lists species according to township and range, which includes T28N R16E for Moshawquit Lake (Table 4).

Table 4 – Rare Plant & Animal Species near Moshawquit

Common Name	Scientific Name	State Status
Northeastern bladderwort	*Utricularia resupinate*	Special Concern
Missouri rock-cress	*Boechera missouriensis*	Special Concern
Karner blue butterfly	*Lycaeides melissa samuelis*	Special Concern
Robbins' spike-rush	*Eleocharis robbinsii*	Special Concern
Persius dusky wing	*Erynnis persius*	Special Concern
Dwarf milkweed	*Asclepias ovalifolia*	Threatened
Plox moth	*Schinia indiana*	Endangered
Northern blue	*Lycaeides idas*	Endangered
Confusing bumble bee	*Bombus perplexus*	Special Concern
Yellowbanded bumble bee	*Bombus terricola*	Special Concern
Bald eagle	*Haliaeetus leucocephalus*	

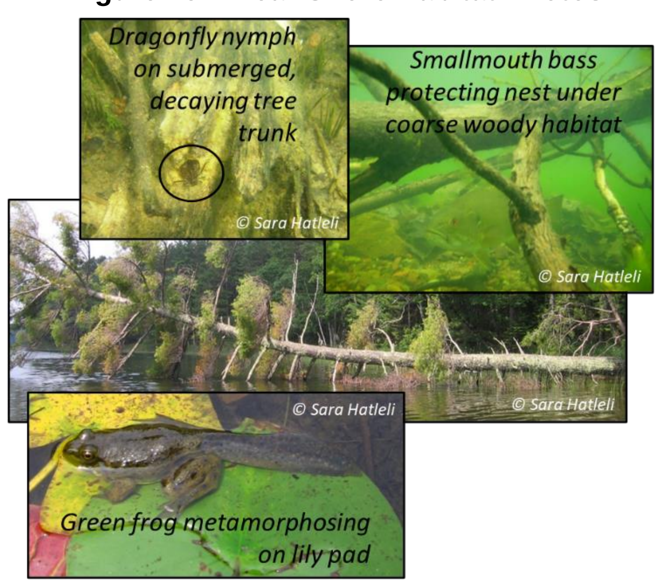
Information retrieved from https://dnrx.wisconsin.gov/nhiportal/public/data/township *June 5*, 2024

1.6.1 Wildlife Habitat

Lakeshore residents can improve wildlife habitat by leaving trees, shrubs, and vegetation within 100 feet of land from the lakeshore and into the shallows of the lake. This 100-ft riparian zone is a critical area for mammals, birds, reptiles, amphibians, and fish. Simple habitat restoration could include selection of areas that will not be mowed. Planting native plants and landscaping in a way that is aesthetically pleasing also supplies habitat for wildlife.

Near shore vegetation in the lake shallows creates habitat for frogs, turtles, furbearers, and waterfowl. Minimal clearing in this area maintains critical habitat and important areas for fish spawning and development. Fallen trees along the lakeshore provide structural habitat for wildlife and fish (Figure 15). Healthy Lakes grants promote placement of trees back in the water, but it is much easier to leave trees where they naturally fall whenever possible.

Figure 15 – Near Shore Habitat Photos



1.6.2 Canada Geese

The population of resident Canada geese in Wisconsin has dramatically increased over the last few decades. Canada geese are large, adaptable and long-lived. They are productive and protective of nests and young. These traits often lead to conflicts with humans. Protecting and restoring lakeshore buffers and natural shoreline helps prevent issues with Canada geese, which show preference for mowed lawns because it is easier to elude predators. The addition of taller native plantings along the lakeshore can help deter geese. Beaches are also a popular loafing area for geese (Figure 16). Nuisance management techniques are copied here from the WDNR Nuisance, Urban, and Damaging Wildlife webpage[5]: Some of these techniques can become controversial.

- Do not feed geese.
- Modify habitat to make it less appealing to geese. Allow grass to grow longer or plant buffer strips of native vegetation around water bodies.
- Erect fence barriers to make it difficult for geese to access water.
- Use scare tactics such as trained dogs, auditory calls, predator effigies, mylar flagging, pyrotechnics and human harassment.
- With a permit, nest and eggs can be destroyed to decrease nesting success and aggressiveness.
- USDA Wildlife Services can conduct round-ups in areas with nuisance flocks.

Figure 16 – Photo of Geese Gathering at a Beach

[5] https://dnr.wisconsin.gov/topic/WildlifeHabitat/damage

2.0 Aquatic Invasive Species

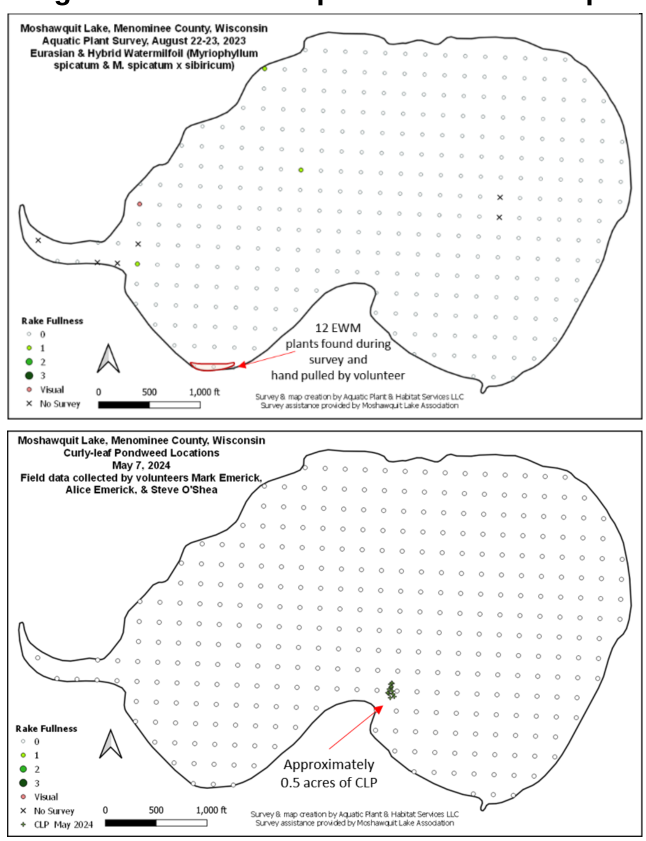
2.1 Aquatic Invasive Plant Species in Moshawquit Lake

Aquatic invasive species (AIS) are defined by their tendency to out-compete native species thereby threatening the diversity and balance of plants and animals that are native to a particular system. The aquatic invasive plants of greatest concern in Moshawquit Lake are hybrid watermilfoil (*Myriophyllum spicatum x sibiricum,* verified 2012), Eurasian watermilfoil (*Myriophyllum spicatum,* verified 2006), and curly-leaf pondweed (*Potamogeton crispus,* verified 2007). These species may outcompete native aquatic plants some years and can cause beneficial use (fishing, swimming, boating, etc) impairment for people.

2.1.1 EWM/HWM in Moshawquit Lake in 2022-2023

Following a whole-lake herbicide treatment using Procella COR on June 13, 2022 to control EWM/HWM, a survey of all aquatic plants was completed September 13, 2022. There was only one sample point (0.3% frequency of occurrence) with EWM. In 2023 there were only three sample points (0.9% frequency of occurrence) where EWM was found on the rake and one sample point with EWM documented as a visual observation (within 6 feet of the sample point but not found on the rake) during the whole-lake aquatic plant survey on August 21-22 (Figure 17). There were also 12 EWM plants found in the area illustrated in Figure 17 but all those plants were hand-pulled by volunteer Steve O'Shea. These findings in 2022 and 2023 were encouraging, especially considering the high EWM occurrence in 2021.

Figure 17 – Moshawquit EWM & CLP Maps



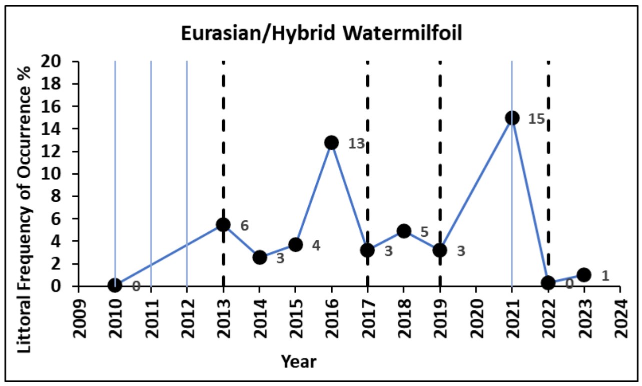
2.1.2 CLP in Moshawquit Lake in 2024

A half-acre bed of curly-leaf pondweed was documented by volunteers on May 7th. Additional CLP was documented by a volunteer in early June. Based on these findings, MLA is interested in pursuing a treatment strategy in spring 2025.

2.1.3 EWM/HWM in Moshawquit Lake 2010 – 2023

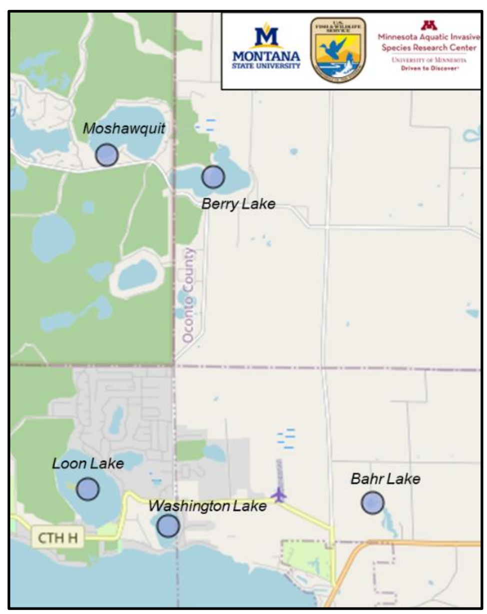
Eurasian/hybrid watermilfoil occurrence in Moshawquit Lake is illustrated in Figure 18. The light blue vertical lines in the graph symbolize small-scale (<10-acre) treatments while the black dashed vertical lines in the graph symbolize large-scale (>10-acre) treatments in Moshawquit Lake. In 2021 there was a high level of navigation impediment observed with 15% frequency of occurrence. The 10% EWM/HWM littoral frequency referenced in Goal 4 (Section 7.4) is based on EWM/HWM data collected since 2010 that has revealed frequencies over 10% are usually associated with observed navigation impediments.

Figure 18 – EWM/HWM Frequency 2010-2023



2.1.4 Hybrid Watermilfoil

Figure 19 – Locations of HWM Genotype H_MYR_8018



Hybrid watermilfoil (HWM) has intermediate characteristics and can only be verified using genetic analysis. HWM occurs when Eurasian watermilfoil (EWM) flowers and cross-pollinates with flowering native northern watermilfoil (*Myriophyllum sibiricum*). The hybrid can then backcross with one of the parent plants or cross-pollinate with another hybrid. Although spreading by seed is possible, EWM and HWM mainly reproduce and spread clonally, a.k.a. through fragmentation or root/rhizome spread. HWM is more genetically diverse as demonstrated in a study of 81 lakes in Minnesota, 55 of which had EWM and 39 of which had HWM (some lakes had both milfoils). In that study, there were 9 genotypes of EWM while there were 96 genotypes of HWM[6].

[6] Newman, R., R. Thum & K. Gannon. 2021, September. Genetic Tools for Watermilfoil Management [Webinar]. Minnesota Aquatic Invasive Species Research Center, University of Minnesota. https://www.youtube.com/watch?v=shPoDb-hTdk.

Due to this diversity, the hybrid presents a challenge in management due to herbicide resistance. Not all HWM genotypes are necessarily resistant to all herbicides, but due to high diversity there is greater probability that some of the HWM genotypes will persist after treatment. The HWM genotype found in Moshawquit Lake is known as H_MYR_8018 and found in four other lakes nearby (Figure 19)[7]. Whether this genotype is resistance to herbicides is not yet known through peer-reviewed research. The 2022 whole-lake ProcellaCOR treatment suggests H_MYR_8018 is not resistant to that herbicide (see Table 6 for treatment history).

2.2 Aquatic Invasive Animals in Moshawquit Lake

2.2.1 Zebra Mussels

Zebra mussels were verified in Moshawquit Lake in 2009. The zebra mussel (*Dreissena polymorpha)* is a tiny (1/8-inch to 2-inch) bottom-dwelling clam that filter feeds on beneficial algae, which is a critical component of a lake ecosystem's food web. Microscopic eggs are released by zebra mussel females and fertilized outside the body by males. After 3-5 days the tiny larvae, also known as veligers, emerge and remain free-floating and microscopic for about a month until their development allows for settling and attachment to hard surfaces. The free-floating veligers can remain in ballast, bait buckets, or other water receptacles and introduced to other lakes if prevention measures are not observed. Once introduced, there are no feasible options for lake-wide control.

Figure 20 – Zebra Mussels Photos

2.2.2 Mystery Snails

Mystery snails were verified in Moshawquit Lake in 2016. Mystery snails produce young by means of eggs which are hatched within the body of the parent. Females live up to 5 years, while males live up to 3-4 years. Female fertility is high, with brood pouches containing >100 embryos at once. Young are born from June through October in shallow water, then females begin migrating to deeper water in the fall (Jokinen 1982). Mystery snails can be impactful when they die off in large number and foul beaches and shore land areas. Residents can remove mystery snails from shallow lake areas adjacent to their property using the medium Garden Weasel Nut Gatherer (Figure 21). Mystery snails are not reported to be a serious threat to the lake ecosystem or recreation at this time.

Figure 21 – Chinese Mystery Snail Removal

[7] HWM is also found in Legend Lake directly west of Moshawquit, but at the time of writing it was not known if the HWM genotype was H_MYR_8018.

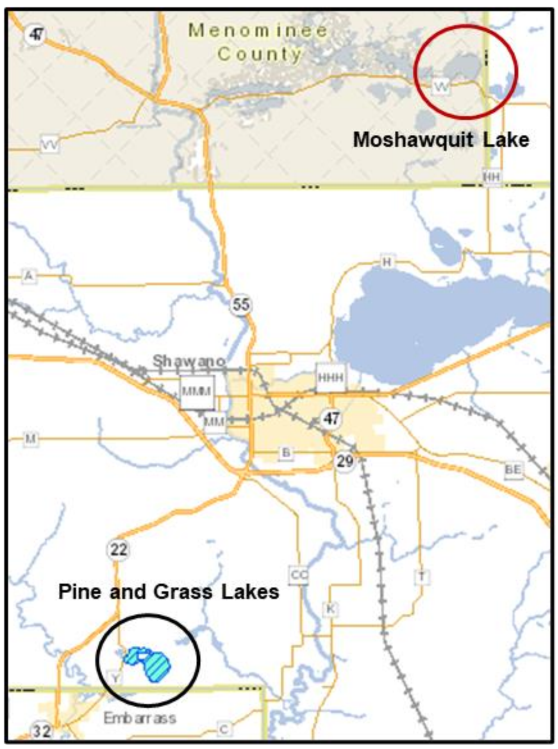
2.3 Aquatic Invasive Species NEAR Moshawquit Lake

Starry stonewort (*Nitellopsis obtusa*) is verified approximately 16 miles southwest of Moshawquit Lake in Pine and Grass Lake of southern Shawano County. The proximity of these lakes is relevant because boats leaving a lake with AIS can introduce them into other lakes if proper prevention steps are not taken (see section 4.0 on AIS prevention). Although starry stonewort is not the only invasive species that could be introduced, steps taken to prevent its introduction will help prevent the introduction of other invasive plants and animals.

Figure 22 – Starry Stonewort

Starry stonewort looks like an aquatic plant but it is actually a type of macro algae. It can outcompete other vegetation and forms monotypic stands that may reduce fish spawning habitat.

Figure 23 - Nearest Lakes with Starry Stonewort



3.0 Public Input & Planning

3.1.1 Public Meeting

A public meeting was held May 6th, 2024 at Primal Eats Restaurant (14109 Cty VV, Gillett, WI) to share survey results from the 2023 aquatic plant survey and gather public input regarding aquatic plant management in Moshawquit Lake. A public notice was published in the Shawano Leader on April 26th and May 3rd. There were 21 people in attendance, including the facilitator (Sara Hatleli, Aquatic Plant & Habitat Services LLC), Claire Hetzel (WDNR), and Heather Pyatskowit (MITW). During the meeting, information was shared on the 2023 aquatic plant survey results, aquatic invasive species in Moshawquit Lake, hybrid watermilfoil, aquatic plant management options for the lake, and lake protection. Participants were given the opportunity to provide written comments while verbal input was summarized in minutes recorded by the MLA secretary.

Verbal Input (parking lot)

1. How many lakes in Wisconsin have EWM/HWM? The answer was not known during the meeting. The answer has since been found from Shelby Adler with WDNR. There are 898 verified records of EWM and 187 records of HWM. Records includes lakes, rivers, and streams.
2. The ice out in Moshawquit was very early (end of February), as was the case for all lakes in Wisconsin in 2024.
3. Current rule is that a property owner must be present to launch boats. The boat landing is owned by MITW. During major holiday weekends there is very high traffic of boats from outside Moshawquit.
4. Suggestion that property owners could take a quiz to assess their level of lake stewardship.
5. The dam is owned by MITW and requires maintenance. This task of requesting maintenance is ongoing by the MLA.
6. Curly-leaf pondweed management should be a part of the APMP.

Herbicide Contamination in Private Wells

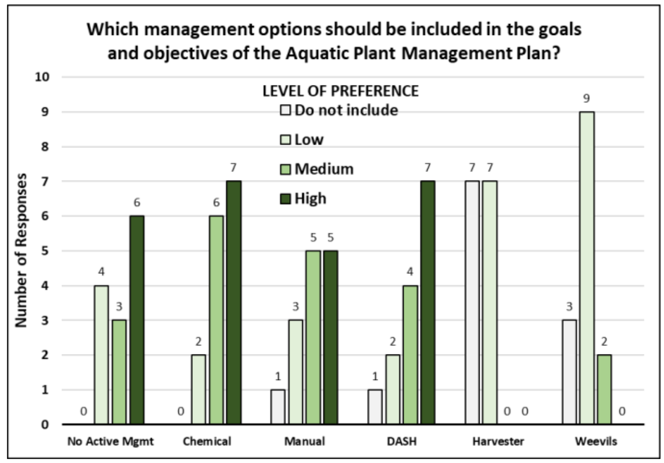
There was a question on whether herbicide from lake treatments can get into private wells. Sandy soil helps filter herbicide. ProcellaCOR herbicide breaks down quickly after application. Research is focused on terrestrially-applied pesticides leeching into groundwater/wells. Although there may be a possibility that aquatic herbicide *could* move through the sediment and into the groundwater/private wells, the likelihood of this occurrence would depend on many factors including groundwater flow direction, lake classification (seepage, drainage, etc), soil type, proximity of well to the lake, dosage, type of herbicide, number of years herbicide is used, and productivity of the lake. If herbicide such as 2,4-D were found in a private well, it would be difficult if not impossible with current technology to discern whether the 2,4-D was due to the in-lake 2,4-D treatment vs. background 2,4-D levels due to terrestrial run-off. Private well owners could collect water samples for analysis by contacting the Water and Environmental Analysis Lab at UW-Stevens Point.[8]

[8] weal@uwsp.edu. 715-346-3209

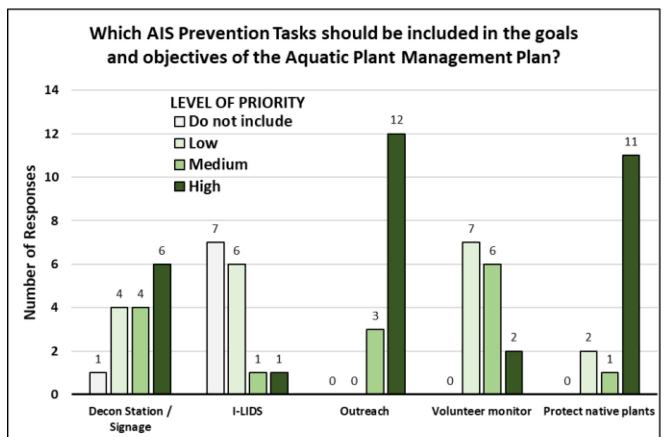
Written Input

A worksheet with Plant Management, AIS Prevention Tasks, and Lake Management Issues was provided and participants were invited to weigh in on whether a particular activity should be included in the updated APMP. If so, what level of preference or priority (low, medium, high) should be given to each idea. The results were tallied and are listed on the next page.

In summary:
Highest preference for DASH & Chemical treatment.
Medium preference for manual and no active management (below thresholds).
Lowest preference for harvesters and weevils.

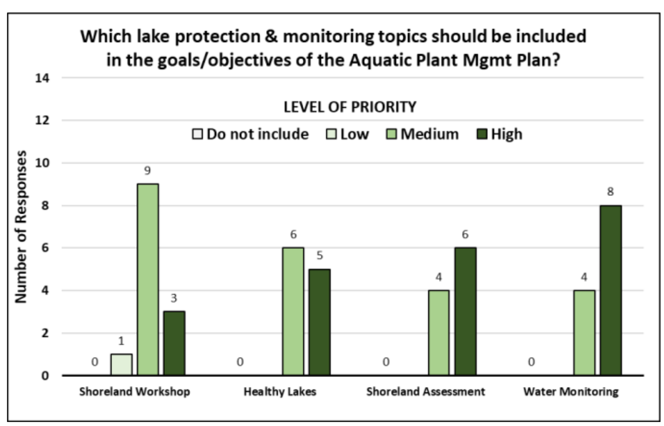


In summary:
Highest priority for outreach and protecting native plants.
Medium priority for volunteer monitoring and decontamination station / signage.
Low priority for I-LIDS.



Additional Suggestions: Property owner registered boats only, include tribal members. Worsheet / sign off on lake stewardship for all owners.

In summary:
All four protection and monitoring topics largely ranked as medium or high priority.



3.1.2 Follow-up Meeting

A second (follow-up) meeting was led by Sara Hatleli (APHS) and occurred via Zoom on May 21, 2024. A summary of information presented at the public meeting in September was discussed, public input themes were presented, and possible goals and objectives were discussed during this follow-up meeting. Those present included: Mark Emerick, Steve O'Shea, Gary Sturtevant, and Bob Kemps from MLA; Heather Pyatskowit from MITW; Brenda Nordin & Claire Hetzel from WDNR; and Jeremy Johnson from Menominee County. The following topics were also discussed:

GOAL 1 – PROTECT NATIVE PLANTS
"Protect native aquatic plants, organisms, and associated native mammal and fish populations."

- Keep all presented objectives for the APMP.
- Include section in APMP on wakeboat impacts to aquatic plants.
- Include, "it is illegal to operate a vessel within 100 feet of the shoreline, dock, raft, pier at > **slow, no wake speed**.
- Brenda suggested a numeric goal for fish sticks / tree drops. Suggested 5 clusters per year.

GOAL 2 – EDUCATION
"Provide educational opportunities pertaining to aquatic plants and AIS".

- Keep all presented objectives for the APMP.
- Jeremy suggested including CO AIS Coordinator as resource for education sessions.
- Heather suggested including MITW as resources for education sessions.
- MLA website add an "Aquatic Invasive Species" tab.

GOAL 3 – PROTECT WATER QUALITY
"Reduce surface water runoff and promote lake stewardship".

- Keep all presented objectives for the APMP.
- Brenda suggested a numeric goal for restoration practices. Group decided to aim for 3 per year. The limiting factor may be the relatively low number of tax parcels on the lake (80) and getting buy-in. Positive note: 60% of the shoreline is undeveloped!
- Jeremy offered county-sponsored shoreland survey in 2025 and to serve as a resource for shoreland restoration workshop / education sessions. Current cost share through DATCP of 50-50% for rip-rap / rock and 70-30% for planting shoreline buffers.

GOAL 4 – AIS SURVEYS & CONTROL
"Monitor EWM & CLP and implement control activities as resources and permits allow."

- Keep all presented objectives for the APMP.
- Littoral Frequency graph of EWM/HWM 2010-2023, include asterisk for 2021 indicating there was high level of navigation impairment observed that year as much of the EWM was at/near the surface and between sample points.
- CLP whole-lake PI and bed mapping for spring 2025.
- Include EWM presence / absence survey using PI map every year.
- Current 0.25-acre CLP to be monitored. Example, Legend Lake CLP is spread throughout the lake but not taking over so it is currently being monitored but not actively controlled.
- Include table of criteria for helping decide whether chemical control of EWM should proceed.

GOAL 5 – PREVENTION
"Prevent the spread of AIS."

- Decontamination station not widely used at other lakes in the area (bleach solution is never empty when refilled by CO). Tools are often stolen. This objective will not be included in the APMP.
- Exploring new signage at the boat landing can be included in the APMP.
- MLA will search for the original agreement to clarify which boats should be allowed to launch at the boat landing (property owners and tribal members only? Property owners, their guests, and tribal members only?)

3.1.3 APMP Review and Comment

A draft of this management plan was available to the MLA, WDNR, MITW, and Menominee County July 1 through 22, 2024 for internal review. A second draft of the plan was made available to the general public for review and comment from August 2 through August 23. A public notice was placed in the Shawano Leader Classifieds on xxxxxxx. Public input received is copied in Appendix D.

Adoption by the Moshawquit Lake Association

The MLA Board of Directors voted to adopt the plan on xxxxxx.

Approval by the WDNR

The APMP was provided to the WDNR with the request for official approval on xxxxxxx. The plan was officially approved by the WDNR on xxxxxxx (approval letter in Appendix E).

4.0 AIS Prevention & Monitoring

4.1 Watercraft Inspection

Watercraft inspection involves a trained volunteer or paid employee stationed at a public boat landing, often during high traffic periods. The boat landing on Moshawquit Lake is owned by the MITW and not open to the general public yet some form of voluntary watercraft inspection is important, especially when watercraft was used in another lake within 5 days prior to launching. During watercraft inspections, boaters are asked to:

- **Inspect** boat, trailer and equipment
- **Remove** all attached plants or animals
- **Drain** all water from boats, motors, live wells and other equipment.
- **Never** move live fish away from a waterbody
- **Dispose** of unwanted bait in the trash
- **Buy** minnows from a Wisconsin bait dealer, and use leftover minnows only if using them on that same waterbody.

4.2 Boater's Advisory Signage

There are many different signage options to capture boaters' attention and increase compliance with watercraft inspection steps. Figure 24 illustrates some examples that could be considered for the Moshawquit Lake boat landing with permission from MITW.

Figure 24 – Boater Advisory Signage Examples

4.3 Know Your Guests & Disinfection Protocols

Lake property owners who invite guest watercraft to Moshawquit Lake are advised to inquire where and when the guest watercraft was last launched. This information will allow the property owner and guest to determine the best steps for disinfection before the guest watercraft is launched. If a boat is coming from a waterbody that has confirmed invasive species not already present, it is recommended that the boat not be used in Moshawquit Lake but if both parties decide to proceed, the guest watercraft should be disinfected using bleach in accordance with the literature review by Bates et al.[9] The literature is helpful in understanding how to properly disinfect watercraft based on scientific studies. Table 5 copied from the literature review document provides an example of how different methods of disinfection are effective on certain invertebrates but not on others.

Table 5 – Efficacy of Disinfection for Invertebrates

AIS	Steam Cleaning (212°F)	Hot Water (140°F)	Drying (5 days)	Chlorine (500 ppm, 10 min)	Virkon (2:100 solution, 20 min)	Freezing (26°F†)
Faucet Snail	☑ 18*	☑ 18*	⊗ 35	⊗ 18	Ⓡ	Ⓡ
New Zealand mud snail	☑ 4, 65*	☑ 4, 65*	☑ 6*, 66*	⊗ 76*	☑ 9, 10*, 74, 76, 83	☑ 4, 6*
Quagga Mussel (Adults)	☑ 7*,16*	☑ 7*,16*	☑ 14*	Ⓡ	☑ 9	Ⓡ
Quagga Mussel (Veligers)	☑ 4, 17, 80*	☑ 4, 17	☑ 69*	Ⓡ	☑ 9	Ⓡ
Zebra Mussel (Adult)	☑ 7*, 8*, 25	☑ 7*, 8*, 25	☑ 14*, 25*, 27	☑ 22*	Ⓡ	☑ 25, 27
Zebra Mussel (Veligers)	☑ 4, 80*	☑ 4	Ⓡ	☑ 22*, 25	Ⓡ	Ⓡ
Asian Clam	☑ 4, 37, 78	☑ 4, 37	⊗ 4	⊗ 37*, 38*	Ⓡ	Ⓡ
Spiny Water Flea (Adult)	☑ 7*, 47*, 80*	☑ 7*, 47*	Ⓡ	☑ 76, 83	☑ 76, 83	☑ 76, 83
Spiny Water Flea (Resting Eggs)	☑ 2*, 80*	☑ 2*	☑ 2*, 4	⊗ 2	Ⓡ	⊗ 2*
Bloody Red Shrimp	Ⓡ	☑ 83*	☑ 83*	☑ 83*	☑ 83*	Ⓡ
Rusty Crayfish	☑ †	☑ †	Ⓡ	Ⓡ	Ⓡ	Ⓡ

Key:
☑= Effective- Eliminates spp when applied at rates outlined in the manual code.
⊗=Not Effective- Requiring higher rates and/or longer time periods than outlined in code to eliminate spp.
Ⓡ= Research Needed- No/insufficient sources or references found.

[9] Literature Review on Efficacy of Disinfection Methods by Species
https://dnr.wisconsin.gov/topic/Invasives/disinfection.html, click on “disinfection methods for species present.”

5.0 Past Management

5.1 Aquatic Plant Management Summary

Herbicides have been used to control Eurasian watermilfoil, hybrid watermilfoil, and to a lesser degree curly-leaf pondweed since EWM was discovered in 2006. Table 6 summarizes treatment history from 2007 to 2023. Diver assisted suction harvest (DASH) was done in 2016[10], 2019, and 2021 to help control EWM and HWM.

Table 6 – Aquatic Plant Management Summary of Moshawquit Lake 2007-2023

Year	Date of Treatment	Size of Treatment (acres)	Herbicide Amount, Brand, Active Ingredient(s) & Applied Concentration	CLP or EWM Survey	Aquatic Plant Survey	Herbicide Monitoring
2007	Oct	1	Navigate granular 2,4-D @ 150 lbs per ac (150 lbs)	-	-	-
2008	June	4	Navigate granular 2,4-D @ 150 lbs per ac (785 lbs)	-	-	-
2009	May-June	3	Navigate granular 2,4-D @ 150 lbs per ac (450 lbs)	EWM Aug	-	-
2010	May	9	Navigate granular 2,4-D @ 200 lbs per ac (1800 lbs)	EWM Oct	Aug 5 by Cason	-
2011	May 25 Oct 11	1 6.5	Navigate granular 2,4-D @ 200 lbs per ac (1500 lbs total)	EWM June 9	-	-
2012	May 14	3	Navigate granular 2,4-D @ 200 lbs per ac (600 lbs)	Both April 23-24, CLP July 6 EWM Oct 22-23	-	2 monitoring stations for Aquathol K, dropped below 0.1 ppm 5 HAT
		2.8	Aquathol K endothall @ 3.0 ppm (27 gal)			
2013	May-June	17.9	Navigate 2,4-D @ 200 lbs per acre (4787 lbs)	EWM Aug 28	Aug 28 by WDNR	-
2014	Late ice-out, no treatment			EWM spring/fall	Sept 11 by WDNR	-
2015	Low EWM, no treatment			EWM spring/fall	Sept 9 by WDNR	-
2016	No treatment, DASH 4200 lbs EWM removed			-	Sept 12 by WDNR	-
2017	May 19	300	DMA IV liquid 2,4-D → 0.300ppm conc. (550 gal)	-	Sept 5 by WDNR	4 monitoring stations, target achieved (0.3pmm for 7 days)
2018	No treatment, DASH 9000 lbs EWM removed			-	Aug 29 by WDNR	-
2019	May	14.9	Aquastrike, endothall. DASH 11,384 EWM removed	EWM May 9 EWM Sept 6	Aug 12 by Onterra	-
2020	No treatment or DASH due to COVID19			-	-	-
2021		8.3	0.6 ac Liquid 2,4-D @ 3.0 ppm. 5.35 ac PCOR @ 2 PDU. 1.7 ac liqud 2,4-D @ 3.0 ppm. 0.65 ac 2,4-D & endothall @ 0.6 ppm and 1.5 ppm respectively. DASH 33,246 lbs EWM removed	EWM Aug 30 & fall	-	2 monitoring stations. Limno-curtain used at all 5 locations on loan from Chute Pond & Long Lake.
2022	June 13	131.3	ProcellaCOR @ 3.0PDU per ac/ft	Sept 13 by APHS	Sept 13 by APHS	-
2023	Low EWM, no treatment			Aug 21 by APHS	Aug 21 by APHS	-

[10] The first DASH activity was a test treatment in 2016 by Eco Waterways System which removed 4200 lbs. of EWM.

6.0 Plant Management Options

The best way to manage aquatic plants will be different for each lake and depends on the plant community, the species that require control, whether AIS are present, the level and type of human use of the lake, and other background information presented in this management plan. Aquatic plant management rules can be found in Wisconsin Administrative Codes, Chapters NR107 (chemical), NR109 (manual/mechanical), NR40 (invasive species) and Chapter 30/31 (waterways). Many management activities require a permit. There are five broad categories for aquatic plant management:

- **No active management,** which means nothing is done to control plant growth, but a strong monitoring and education component may be included.
- **Manual & mechanical removal of plants**, which includes hand pulling, raking, using plant harvesters, and diver assisted suction harvest.
- **Chemical treatment**, which is the use of herbicide to kill aquatic plants.
- **Physical habitat alteration,** which means plants are reduced by altering variables that affect growth such as sediment, light availability, or depth.
- **Biological control**, which includes the use of living organisms, such as insects, to control plant growth.

The benefits and limitations of each of these broad groups is described in this section. All actions are accompanied by risks and potential impact to non-target aspects of a lake, but the benefits must outweigh those risks and potential detriments.

6.1 Feasibility Factors

In order for a control method to be appropriate, it must be feasible from a biological, social, financial, and capacity perspective. ***Biological feasibility*** infers the control action will not cause significant harm to other aspects of lake ecology. ***Socially feasible*** actions are those that have support from project partners and in this case include the MLA, WDNR, MITW, WAMSCO, and Menominee County. Social feasibility also infers that control actions meet regulatory requirements and will be formally permitted by regulatory agencies. ***Financial feasibility*** simply implies that any control action is affordable for the BLA and partners providing cost share. ***Capacity feasibility*** implies that the MLA and partners have the volunteers and leadership necessary to accomplish goals.

6.2 No Active Management

Sometimes the best course of management is to take no immediate action. There are many benefits including the lack of disturbance to desirable native species and the lake system, there are no unintended consequences of chemical treatment, and no permit is required. Disadvantages to this approach include the potential for AIS colonies to grow, but that does not always occur. This approach often includes a strong monitoring and educational component. ***A "No Active Management" approach is feasible for Moshawquit Lake when EWM, HWM, and CLP frequencies and/or bed sizes are below a certain threshold identified in Obj. 4b.***

Manual & Mechanical Control

Manual and mechanical control includes pulling plants by hand or by using harvesting machines or devices. Permits are required for some activities and there are a variety of options under this type of control. Mechanical control is regulated under Chapter NR 109[11].

6.2.1 Manual Plant Removal

Figure 25 – Manual Removal Photo

Shore land property owners are allowed to manually remove a 30-foot-wide section of native aquatic plants parallel to their shoreline without a permit. This can only occur in a single area and there must be piers, boatlifts, swim rafts, or other recreational equipment within that 30-foot zone, and the plants must be removed from the lake. This method is allowed where other plant control methods are not being used. EWM, HWM, and CLP can be manually removed anywhere in the lake without a permit. Regulations require that the native plant community is not harmed during manual removal of AIS. Benefits of these techniques include little overall damage to the lake and plant community; removal can be highly selective and effective in small clusters of AIS. On the other hand, this method can be very labor intensive. ***Manual removal in Moshawquit Lake is feasible for small-scale control around docks, boat lifts, and other water use equipment. Manual removal is also feasible to complement herbicide treatment one year later.***

6.2.2 Diver Assisted Suction Harvest (DASH)

Figure 26 – DASH Photo

This form of mechanical removal involves suction tubes connected to pumps mounted on a barge/pontoon. The suction tubes reach to the bottom of the lake and SCUBA divers manually uproot plants (often EWM) to be sucked through the tubes, up to the barge, and strained. EWM fragments can grow new plants so it is important to minimize fragmentation and remove plant fragments. DASH is labor intensive and costly at $2,600-$3,000 per day and removal rate depends on EWM density, height, and the number of different locations. Moshawquit has its own DASH unit and volunteer divers, making the cost considerably lower. The process is labor intensive for volunteers. ***Continuing DASH to control EWM/HWM is feasible in small infestation sites. DASH is also feasible to complement herbicide treatment one year later. This integrated approach of herbicide treatment followed by DASH or manual control is recommended.***

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[11] Chapter NR 109 https://docs.legis.wisconsin.gov/code/admin_code/nr/100/109.pdf.

6.2.3 Mechanical Harvest

This method includes "mowing" of aquatic plants down to depths of 5 feet and then collecting the plants and removing them from the lake. Mechanical harvesters are required to operate in depths of 3 feet or greater in order to minimize sediment disturbance in shallow areas. This technique is most appropriate for lake systems with large-scale or whole-lake aquatic plant issues. Mechanical harvesters provide immediate results and usually cause minimal impact to lake ecology. A disposal site for harvested plants is a necessary part of a harvesting plan. The cost of hiring a mechanical harvester to visit the lake costs approximately $2,500 per day. The purchase of a brand-new harvester is highly variable and depends on the type of harvester purchased. Cutting harvesters begin at $100,000. A harvester that can skim and pull the plants is $76,000. With a cutting harvester, a shore conveyor (starting at $35,000) is needed to offload the plants into a truck or dumpster for transport to a disposal site. A Recreational Boating Facilities Grant may help pay for up to 50% of eligible costs associated with purchasing harvesting equipment. Annual costs include paying an operator, storage of the harvester, insurance, and maintenance. As an example, Blake Lake's (Polk County) 2018 harvesting budget was $27,700[12].

Mechanical harvest is not a feasible management option for Moshawquit Lake due to the low EWM/HWM and CLP occurrence on a whole-lake scale. Mechanical harvest is most approapriate for lake systems with large-scale or whole-lake aquatic plant issues.

Figure 27 – Mechanical Harvester Photos

[12] 2018 Annual Harvesting Budget Blake Lake: $2,500 APM Coordinator, $1,500 Lakes Convention, $475 Dues, $8,500 Harvester Labor & Expenses, $4,500 Insurance, $4,525 Administration, $5,700 Lake Management Plan.

6.3 Chemical Control

Figure 28 – Chemical Treatment Photo

This method entails partnering with a certified herbicide applicator that will then follow label guidelines and restrictions. There are different herbicides that are intended to target specific plant species. For EWM and HWM control, an herbicide generally known as 2,4-D is often used because it is supposed to be selective to broadleaf plants such as milfoils. More recently, ProcellaCOR is being used and studied in Wisconsin to better understand its efficacy and if there are any impacts to native plants. If the native plants are reduced by repeated chemical control, there is more area for invasive species to grow. Also, if the duration of EWM control only lasts for one or two growing seasons, one should weigh the financial costs combined with impacts to native plants versus the relatively short-lived control.

Chemical control of EWM, HWM, and CLP is feasible in Moshawquit Lake when frequencies and/or bed sizes are above a certain threshold identified in Obj. 4b.

6.4 Physical Habitat Alteration

Various physical habitat alterations exist and most are not appropriate for consideration in Moshawquit Lake. Many of these alterations require a Chapter 30 permit.

6.4.1 Bottom Barriers

Bottom barriers prevent light from reaching aquatic plants, but kill all plants, and some allow for gas accumulation under the barrier and subsequent dislodging, they can impact fish spawning and food sources, and an anaerobic environment below the barrier could cause nutrient release from the sediment. ***Bottom barriers are appropriate for public swimming areas but not recommended in front of private properties.***

6.4.2 Drawdown

This control technique involves the lowering of water levels in fall and exposing sediments to freezing and drying, which results in plant death before allowing the lake to refill the following spring and summer. A water control structure is required but not present at the outlet of Moshawquit Lake. ***Drawdown is not feasible as a control technique.***

6.4.3 Dredging

Dredging includes the removal of plants along with sediment and is most appropriate for systems that are extremely impacted with sediment deposition and nuisance plant growth. Dredging is highly expensive and ecologically impactful and consists of three main steps that include removing the sediment, processing the removed material (dewatering and transportation to disposal site), and placement of the dredged material at the disposal site. Permits or regulatory approval from the WDNR may be needed at each step. The cost of dredging depends on the amount of material targeted for removal, the content and condition of material that needs to be dredged, and distance to disposal site. Because these factors are highly variable among different lakes and ponds, it is difficult to determine a cost estimate without a sediment analysis. One website suggests the cost is anywhere from $20,000 to $75,000 per acre[13]. For every 2 acres of lake or pond dredged, an average of 3 feet of material is removed. A sediment analysis provides information on sediment thickness and therefore can guide the amount of material to be dredged. For reference, almost all of the bays in Lake Redstone (Sauk Co.) were dredged in 2019 with an estimated 104,000 cubic yards of sediment removed at a cost of $3.5 million.

Figure 29 – Dredging Lake Redstone

Dredging in Moshawquit Lake is not feasible as a way to control aquatic plant growth.

6.4.4 Non-point Source Nutrient Control

No permit is required for this type of nutrient management, which reduces the runoff of nutrients from the watershed. As a result, fewer nutrients enter the lake and are therefore not available for plant growth. This approach is beneficial because it attempts to correct the source of a nutrient problem and not just treat the symptoms. Controlling non-point source pollution is always a good idea, especially since trends suggest water clarity in Moshawquit Lake is declining (Figure 6).

Non-point source nutrient control is feasible and efforts are underway to install Healthy Lakes practices to reduce surface water runoff in near-shore areas.

[13] https://www.clean-flo.com/maintenance/alternative-dredging-techniques-muck-removal. accessed April 5, 2018.

6.5 Biological Control

6.5.1 Insects

Figure 30 – Milfoil Weevil

A native insect commonly known as the milfoil weevil (*Euhrychiopsis lecontei*) is a biological control agent for EWM and HWM. The native weevils lay eggs in the tips of milfoil plants. When the larvae hatch, they feed on the tips of the stem and burrow into the stem. Furthermore, adult weevils feed on leaves of milfoil plants. The weevils are native to Wisconsin and normally feed on northern water-milfoil (*Myriophyllum sibiricum*) but have demonstrated preference for EWM, even when native milfoil species are present (Solarz & Newman, 2001). It is not known whether native populations of weevils already exist in Moshawquit Lake. Stocking weevils has been done on other lakes, but whether they effectively control EWM depends on the ability for the weevil to survive in the introduced lake. They require natural shorelines for overwintering and seem to survive best in shallow milfoil beds (Jester, 1999). Furthermore, predation can be a major limiting factor in weevil survival, especially when high populations of sunfish (*Lepomis sp.,* including bluegill) are present (Ward & Newman, 2006). ***If biological control were to be pursued, the first step would be to determine whether the native weevils are already naturally present. This would be accomplished by following the appropriate protocol[14] which entails collecting EWM for analysis for weevil presence.***

[14] Biological Control of Eurasian Watermilfoil Using the Native Milfoil Weevil (*Eurychiopsis lecontei*). A Manual of Lake Groups & Lake Managers.

7.0 Management Strategy 2024-2029

7.1 Goal 1 – Protect native aquatic plants, organisms, and associated native mammal and fish populations.

Objective 1a: Minimize the manual removal of native plants.

- Property owners can remove aquatic plants but there are restrictions under Chapter NR109 (more detail is provided in Section 6.2.1).
- If property owners remove the plants manually (not mechanically or chemically), this should only be done at a minimal level. This message will be shared at education sessions listed in Obj. 2a.

Objective 1b: Maintain high floristic quality (mean is 37 for Moshawquit) and species richness (43 species in 2023) while reducing recreational impediments caused by AIS .

- See Goal 4 for native plant surveys & AIS control objectives.
- Inform landowners near locations of moderate-to-high plant species richness (5-8 species) to increase awareness when surveys reveal high species richness in near-shore areas.

Objective 1c: Protect and improve important fish & wildlife habitat.

- Avoid locations with important fish & wildlife habitat when completing aquatic plant control activities.
- Leave fallen trees in the lake to serve as fish habitat.
- Increase awareness of wake enhancement impacts to aquatic plants (Figure 13). Also continue to inform lake users "it is illegal to operate a vessel within 100 feet of the shoreline, dock, raft, pier at greater than slow, no wake speed".
- Install 2 fish sticks clusters per year (2025-2029) to provide important structural habitat for fish and other wildlife. A fact sheet about fish sticks is copied in Appendix C.

This leaning white pine along the shoreline is excellent future fish habitat – AND it's FREE!

Implementation of Goal #1 - Protect native aquatic plants, organisms, and associated native mammal and fish populations.								
Goals, Objectives, and Action Items		Entities Involved	2025	2026	2027	2028	2029	Surface Water Grant Eligible
1a	**Minimize the manual removal of aquatic plants.**							NA
	Property owners may remove the plants manually at a minimal level.	MLA, riparians	All years					
1b	**Maintain high floristic quality and species richness while reducing navigation impediment caused by AIS.**							NA
	Refer to Goal 4 for native plant surveys & AIS control.	MLA	All years					
	Inform landowners near locations of moderate-high plant species richness to increase awareness.	MLA	All years					Education is eligible expenses if funds are required.
1c	**Protect important fish & wildlife habitat.**							NA
	Avoid locations with important fish & wildlife habitat when controlling aquatic plants.	MLA, RP	All years					
	Leave fallen trees in the lake to serve as fish habitat.	MLA	All Years					Education is eligible expenses if funds are required.
	Increase awareness of wake enhancement impacts to aquatic plants.	MLA	All Years					
	Install 5 fish sticks clusters per year. See Appendix C.	MLA, WDNR, RP	X	X	X	X	X	Healthy Lakes Grant.

MLA = Moshawquit Lake Association. RP = Resource Professional. WDNR = Wisconsin Department of Natural Resources

7.2 Goal 2 – Provide educational opportunities pertaining to aquatic plants and AIS.

Objective 2a: Organize, sponsor, and/or host educational sessions that focus on issues relevant to Moshawquit Lake.

- Possible topics include AIS identification, preventing the spread of AIS, native plant identification and their ecological importance, connections among water clarity and plants, impacts of fertilizers, minimizing the manual removal of native aquatic plants (as a deterrence to AIS), the goals of this management plan, and/or other relevant topics in a given year.
- Advertise educational sessions on MLA website and via email to membership. Post educational sessions, if recorded, on website.
- Work with Menominee County AIS Coordinator to provide instruction, especially for AIS-related and shoreland-related sessions.
- Work with Menominee Indian Tribe of Wisconsin to provide instruction.
- Work with WAMSCO personnel (AIS Coordinator) to provide assistance and instruction.
- Include educational events in grant applications submitted in 2024 and beyond.

Objective 2b: Sponsor an educational session/workshop focusing on the shoreland restoration.

- Work with Menominee County & MITW to provide instruction.
- Include WDNR Healthy Lakes program and recruit landowners.

Implementation of Goal #2 – Provide educational opportunities pertaining to aquatic plants and AIS.								
Goals, Objectives, and Action Items		Entities Involved	2025	2026	2027	2028	2029	Surface Water Grant Eligible
2a	**Organize, sponsor, and/or host educational sessions that focus on issues relevant to Moshawquit Lake.**							Yes for education (costs related to grant application services are not eligible)
	See list of possible topics. Work with County, tribe, consultant or other entity to provide instruction.	MLA, RP, WDNR, MITW, CO	X	X	X	X	X	
	Include in grant applications.	MLA, RP	Include in grant applications					
2b	**Sponsor an educational session focusing on shoreland restoration.**							Yes
	Work with County and tribe to provide instruction	MLA, CO, MITW	At least once during 5 year period					
	Recruit landowners to participate in shoreland restoration practices.	MLA	Depends on when workshop occurs.					

MLA = Moshawquit Lake Association. RP = Resource Professional. WDNR = Wisconsin Department of Natural Resources. MITW = Menominee Indian Tribe of Wisconsin. CO = Menominee County

7.3 Goal 3 - Protect the water quality of Moshawquit Lake through monitoring & assessment, reduced surface water runoff, and increased lake stewardship.

Objective 3a: Continue monitoring efforts through the Citizen Lake Monitoring Network.

- Volunteers continue to collect Secchi depth (water clarity) data and water samples for phosphorus and chlorophyll-*a* from the sample station. Volunteer will follow CLMN protocols and enter data into the Surface Water Integrated Monitoring System (SWIMS).

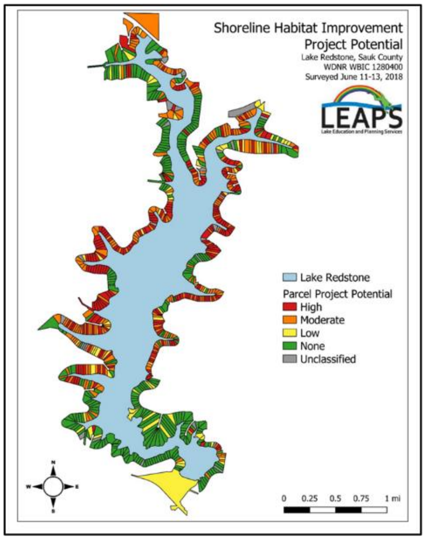
Objective 3b: Complete a shoreland assessment.

- Coordinate with Menominee County to complete field shoreland assessment in 2025 and then provide a final report of results. MLA could host a webinar to discuss results to help decide on properties for Obj. 3c.
- Use results as baseline of shoreline condition for future comparison and to encourage shoreland residents to implement shoreline protection practices that will reduce surface water runoff.
- Target the implementation of 3 Healthy Lakes practices per year for 3-4 years to help reduce surface water runoff

Objective 3c. Implement shoreland restoration practices to reduce surface water runoff into Moshawquit Lake.

- The following are steps and sample timeline:
  - 2024-2025 - Recruit shoreland property owners to install Healthy Lakes practices near shore. This objective ties closely with Obj. 2b. Use results from shoreland assessment (Obj. 3b) to guide efforts in recruiting shoreland property owners (efforts to complete the shoreland assessment can occur while working to recruit property owners).
  - 2025-2026- Site visits by trained or certified individuals that will sketch a site plan for shoreland practices. The most likely partner for this step is Menominee County.
  - 2026 - Apply for a Healthy Lakes grant to help land owners install practices on their shore. Applications are accepted year-round, limit one application per fiscal year but there can be more than one property/practice in an application. Site plans are required and projects should be shovel-ready when applying for the grant.
  - 2027 – Aim to install 10 practices after the grant is awarded.

Figure 31 – Example of Shoreland Assessment Map



Objective 3d. Encourage MLA members to end the use of fertilizers.

- Provide education opportunities explaining impacts of fertilizer on lake health and how they contribute harmful algal blooms. This objective ties closely with Obj. 2a.

Implementation of Goal #3 – Protect the water quality of Moshawquit Lake through monitoring & assessment, reduced surface water runoff and increased lake stewardship.

	Goals, Objectives, and Action Items	Entities Involved	2025	2026	2027	2028	2029	Surface Water Grant Eligible
3a	**Continue CLMN water quality monitoring.**							Volunteer time is eligible as match for surface water grants.
	Volunteer collect data and samples according to protocol and enter into SWIMS database.	MLA	X	X	X	X	X	
3b	**Complete a shoreland assessment.**							County shoreland assessment can be used as match in grant application(s) for other tasks.
	Coordinate with County to complete field work	MLA, CO	X					
	Use results as baseline and to guide future efforts.	MLA, CO		X	X	X	X	
	Aim for 3 Healthy Lakes practices per year.	MLA		x	X	X	X	
3c	**Implement shoreland restoration practices to reduce surface water runoff. Listed here is a sample timeline.**							Yes for Healthy Lakes practices (Costs related to grant application services are not eligible).
	Recruit property owners.	MLA	X					
	Site visits and site plans.	CO	X	X				
	Apply for Healthy Lakes grant.	MLA, RP		X				
	Install 10 practices after the grant is awarded	MLA, RP			X			
3d	**Encourage MLA members to end fertilizer use.**							Yes
	Education opportunities	MLA, RP, CO, MITW	At least once during 5 year period					

MLA = Moshawquit Lake Association. RP = Resource Professional. WDNR = Wisconsin Department of Natural Resources. MITW = Menominee Indian Tribe of Wisconsin. CO = Menominee County

7.4 Goal 4 – Monitor native plants, EWM, and CLP and implement control activities using criteria as resources and permits allow.

Objective 4a: Monitor native and invasive aquatic plants as resources allow.

- Native plants – Hire consultant to conduct whole-lake PI survey (at least) every 5 years in July or August. A whole-lake PI is scheduled for August 2024 (soon after this APMP was drafted and finalized).
- Eurasian watermilfoil – Conduct EWM bed mapping and meander survey every late August or September. Include subPI surveys of EWM beds being chemically treated to gauge pre-post treatment effectiveness. Pre-treatment subPI surveys can occur in September or June before chemical treatment occurs. Post-treatment subPI surveys can occur the September following treatment.
- Curly-leaf pondweed – Hire consultant to complete CLP bed mapping, and pre-treatment subPI of CLP (if herbicide treatment is going to be done) in spring (likely May), 2025. Conduct whole-lake PI CLP survey if CLP is widespread throughout the lake.

Objective 4b: Explore herbicide treatment in EWM colonies according to criteria in Figure 32. Explore CLP treatment using endothall when colonies are greater than 5 acres.

- Review Figure 32 each year and cross reference recent survey information to determine whether MLA might consider herbicide treatment.
- For reference, the 10% EWM littoral frequency trigger is based on results of previous surveys as summarized in Section 2.1.3.
- When surveys from Obj.4a indicate CLP is greater than 5 acres in a colony, endothall can be considered.

Figure 32 – Criteria for EWM Control Using Herbicide

SIZE/FREQUENCY	DENSITY	TRAFFIC	IMPEDIMENTS	HABITAT	SURVEY DATA
•Small-scale Control - Is the bed size/colony >1 acre (subPI)? •Large-scale control - is the EWM littoral frequency of occurrence >10% (PI)?	•Is EWM dominant species in the colony (subPI) •Is EWM one of top 5 species in the lake (PI)? •Is EWM rake fullness >2 on average in the colony (subPI)?	•Is the EWM in an area of high boat traffic?	•Is this area causing beneficial use impediments? (EWM prevent activities such as angling, boating, swimming, or other navigation /recreation)	•Is EWM the dominant species in the colony or whole-lake to the detriment of native plants? •Would treatment have limited impact on native plants.	•Has a pre-treatment survey been completed using standardized methods to document location, size, density, and height?

HOW TO USE THESE CRITERIA – Answer the 6 questions for a particular colony of EWM or for the entire lake. If the answer is "yes" for most questions (ideally 4 or more), then further discussion/planning for that colony of EWM or the whole lake is needed. When there are fewer "yes" answers, control actions can still be considered but perhaps is less critical. This graphic is meant to help the Moshawquit Lake Association prioritize if and where herbicide treatment should be considered in any given year. Areas that do not receive attention in one year may be considered higher priority the following year.

Graphic developed by Aquatic Plant & Habitat Services LLC

Objective 4c: Reduce impairment around docks with manual removal.

- See Objective 1a.

Objective 4d: Increase longevity of herbicide treatments by using DASH and/or manual removal.

- Volunteers monitor locations of CLP and EWM herbicide treatments the following year.
- Use DASH and/or manual removal the year after herbicide treatments to remove remaining EWM and CLP.

Implementation of Goal #4 – Monitor native plants, EWM, and CLP. Implement control activities using criteria as resources and permits allow.

	Goals, Objectives, and Action Items	Entities Involved	2025	2026	2027	2028	2029	Surface Water Grant Eligible
4a	**Monitor native and invasive aquatic plants.**							Yes
	Whole-lake PI survey at least every 5 years.	MLA, RP					X	
	EWM bed mapping. Include pre-post subPI if chemical treatment is being done.	MLA, RP	X	X	X	X	X	
	CLP bed mapping and pre-post subPI of CLP beds if chemical treatment is being done. Whole-lake PI CLP survey if CLP is widespread in the lake.	MLA, RP	X					Yes
4b	**Explore herbicide treatment in EWM colonies according to criteria in Figure 32. Explore CLP treatment using endothall when colonies are greater than 5 acres.**							Herbicide treatment is grant eligible if included in APMPs reviewed by WDNR.
	Use Figure 32 to guide conversations around herbicide treatment of EWM.	MLA, RP, WDNR, CO, MITW	X	X	X	X	X	
	Use results of surveys from Obj. 4a reveal a bed of CLP >5ac, consider treatment with endothall.	MLA, RP, WDNR, CO, MITW	X	X	X	X	X	
4c	**Reduce impairment around docks with manual removal.**							Yes
	Follow guidelines in Objective 1a.	MLA	X	X	X	X	X	
4d	**Increase longevity of herbicide treatments by using DASH and/or manual removal.**							
	Monitor locations of CLP and EWM treatments.	MLA, RP	During and following years of herbicide treatment					Yes, volunteer time can be used as match.
	Us DASH and/or manual removal after herbicide treatment.	MLA	Following years of herbicide treatment.					DASH or manual removal when contracted out are eligible if included in APMPs reviewed by WDNR.

MLA = Moshawquit Lake Association. RP = Resource Professional. WDNR = Wisconsin Department of Natural Resources. MITW = Menominee Indian Tribe of Wisconsin. CO = Menominee County

7.5 Goal 5 – Prevent the spread of aquatic invasive species.

Objective 5a: Protect native aquatic plants as they provide a natural limitation to non-native & invasive plant species establishment & dispersal.

- See Goal 1.

Objective 5b: Advise Moshawquit Lake residents to know where their guests' boats were last launched and follow disinfection protocols.
If a guest's boat is coming from a waterbody that has confirmed aquatic invasive invertebrate less than 6 days from launching in Moshawquit Lake, it is recommended that the boat not be used in Moshawquit Lake. If both parties decide to proceed despite the risk of introducing an invasive invertebrate, the guest watercraft should be disinfected using bleach in accordance with the literature review by Bates et al.[15] See Table 5.

- MLA will communicate this message at annual meetings, on social media, and website when possible.

Objective 5c: Monitor for new AIS.

- Coordinated with Menominee Co. and MITW to provide training for volunteers when needed.
- Establish and maintain a network of volunteers that will be trained to identify and report new AIS.
- Early detection and rapid response enable early intervention to control new populations.

Objective 5d: Work with MITW (land owner) to update signage at the boat landing.

- Collaborate with MITW. Examples of some signage options are illustrated in Figure 24.
- MLA will search for the original agreement to clarify which boats should be allowed to launch at the boat landing (property owners and tribal members only? Property owners, their guests, and tribal members only?)

[15] Literature Review on Efficacy of Disinfection Methods by Species https://dnr.wisconsin.gov/topic/Invasives/disinfection.html, click on "disinfection methods for species present."

Implementation of Goal #5 – Prevent the introduction of new aquatic invasive species.								
Goals, Objectives, and Action Items		Entities Involved	2025	2026	2027	2028	2029	Surface Water Grant Eligible
5a	**Protect native aquatic plants.**							NA
	See Goal 1.	MLA	X	X	X	X	X	
5b	**Advise Moshawquit Lake residents to know where their guests' boats were last launched and follow disinfection protocols.**							NA
	Share message and disinfection protocols at meetings and online.	MLA	X	X	X	X	X	
5c	**Monitor for new AIS**							Yes
	Volunteer training.	MLA, CO, MITW	X	X	X	X	X	
	Establish & maintain volunteer network to detect AIS early.	MLA	X	X	X	X	X	
5d	**Work with MITW to update signage at boat landing.**							Yes
	Explore sign options with MITW.	MLA, MITW	Anytime					
	Retrieve original boat landing agreement.	MLA	Anytime					No

MLA = Moshawquit Lake Association. RP = Resource Professional. WDNR = Wisconsin Department of Natural Resources. MITW = Menominee Indian Tribe of Wisconsin. CO = Menominee County

8.0 References

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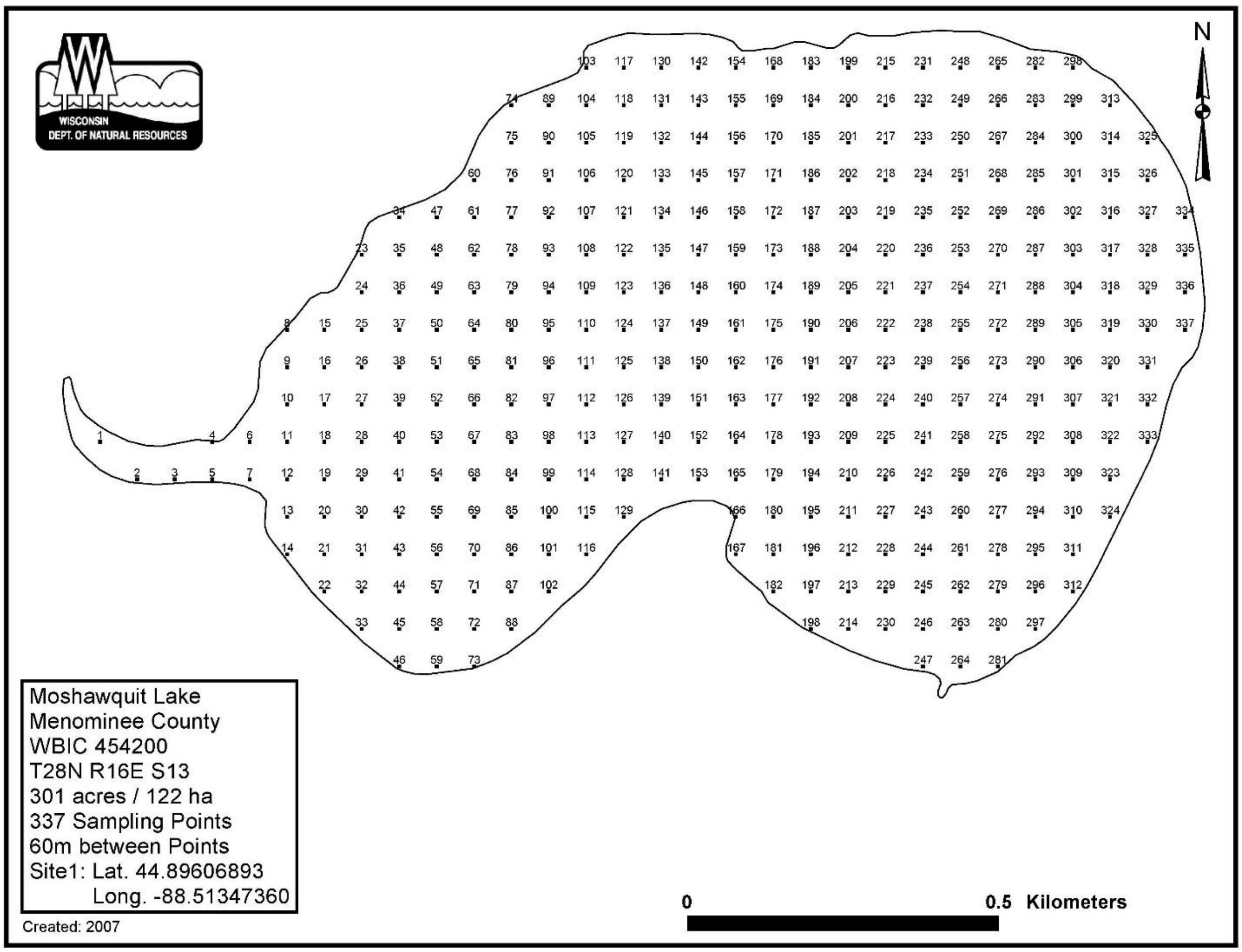
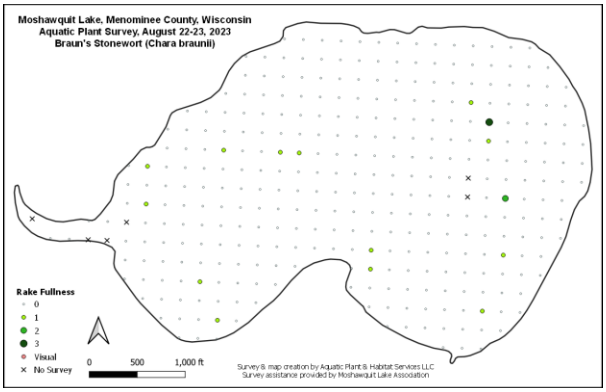
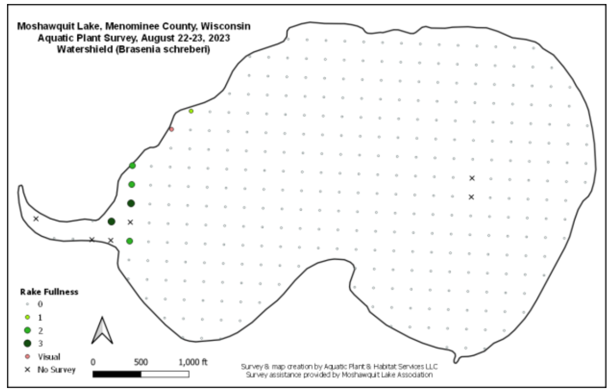
9.0 Appendix

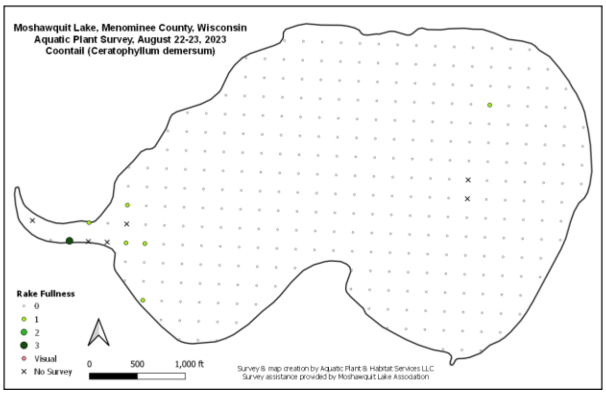
9.1 Appendix A – Moshawquit Lake Aquatic Plant Survey Grid

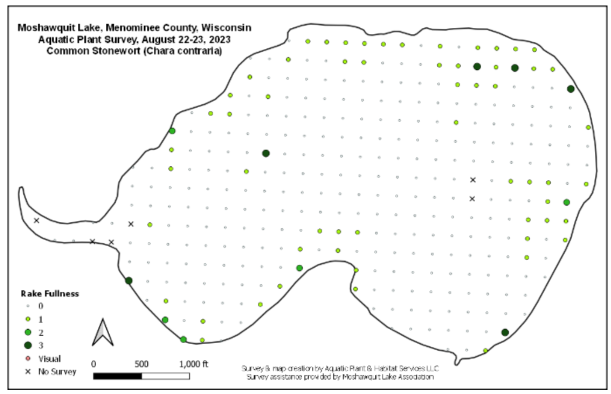


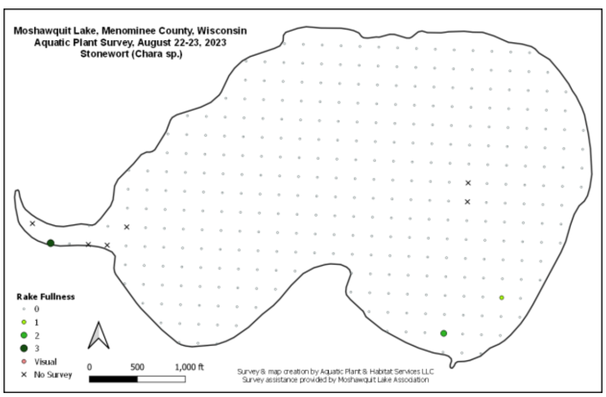
9.2 Appendix B – Moshawquit Lake Aquatic Plant Species Maps

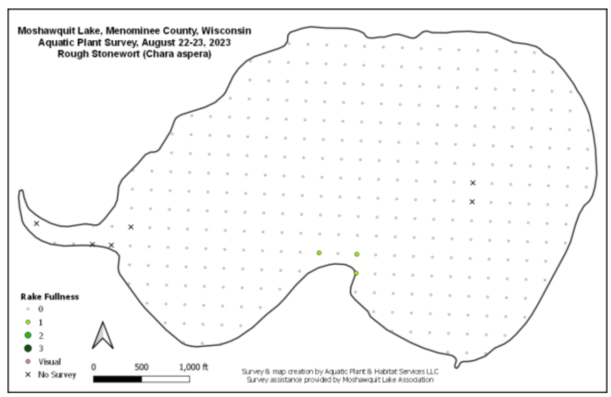


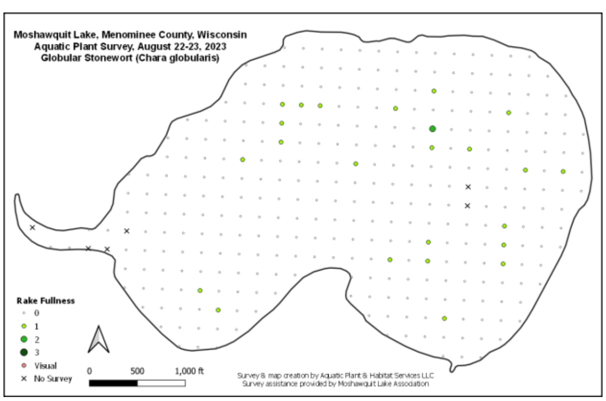


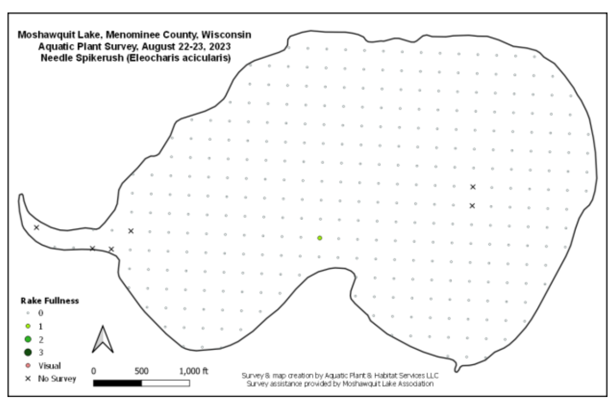


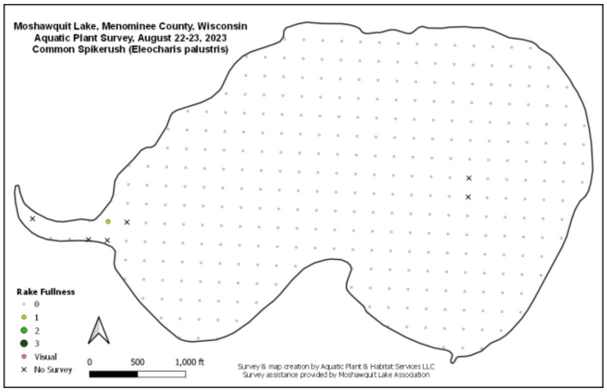


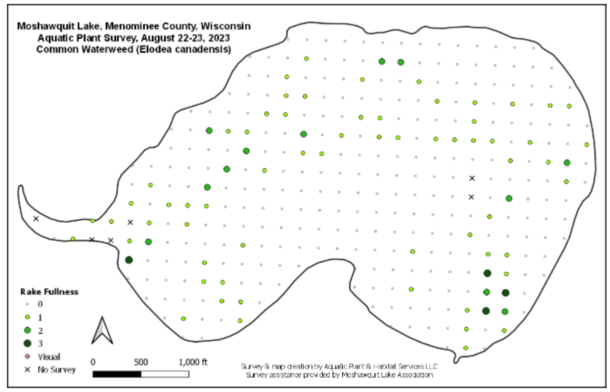









Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Common Spikerush (Eleocharis palustris)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Common Waterweed (Elodea canadensis)
Rake Fullness
0
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Visual
No Survey
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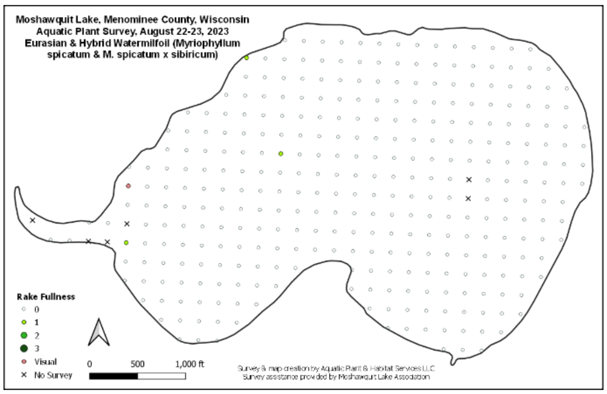
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Eurasian & Hybrid Watermilfoil (Myriophyllum
spicatum & M. spicatum x sibiricum)
Rake Fullness
0
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Visual
No Survey
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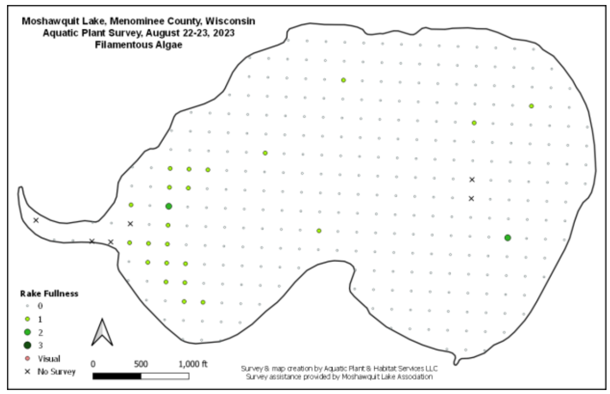
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Filamentous Algae
Rake Fullness
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Visual
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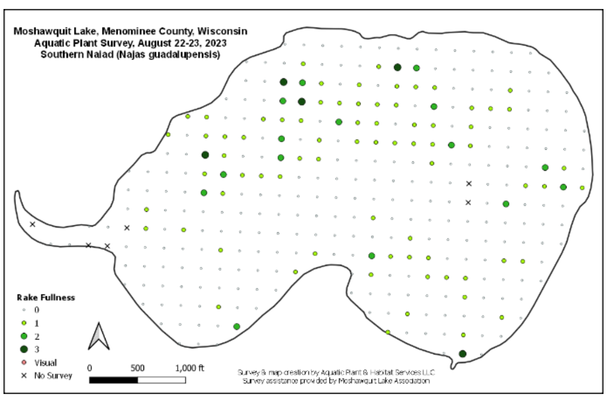
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Southern Naiad (Najas guadalupensis)
Rake Fullness
0
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Visual
No Survey
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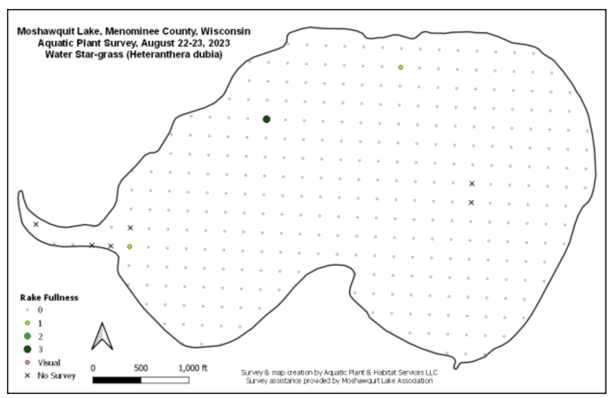
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Water Star-grass (Heteranthera dubia)
Rake Fullness
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Visual
No Survey
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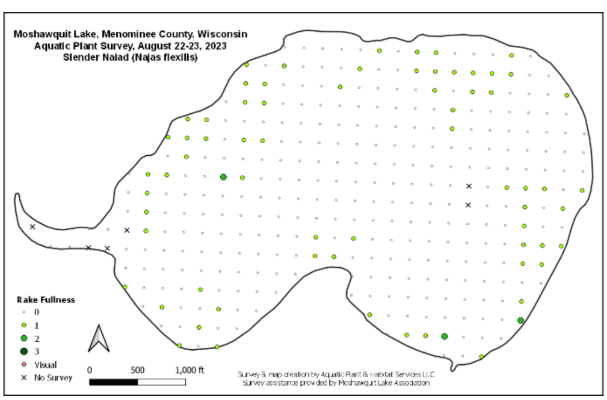
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Slender Naiad (Najas flexilis)
Rake Fullness
0
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Visual
No Survey
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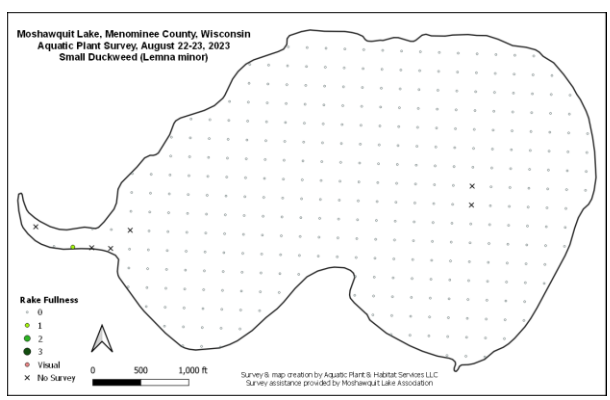
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Small Duckweed (Lemna minor)
Rake Fullness
0
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Visual
No Survey
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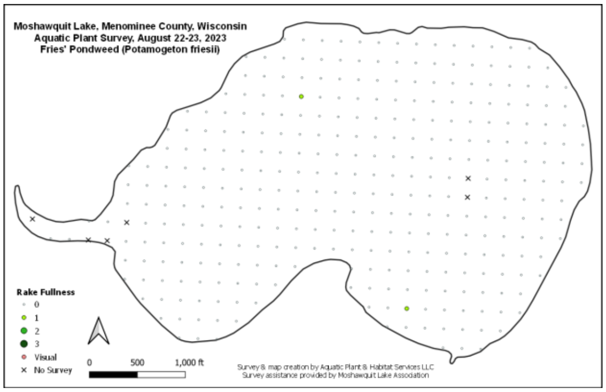
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Fries' Pondweed (Potamogeton friesii)
Rake Fullness
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Visual
No Survey
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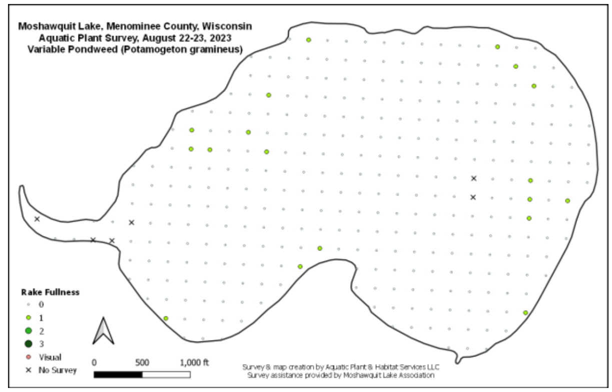
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Variable Pondweed (Potamogeton gramineus)
Rake Fullness
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Visual
No Survey
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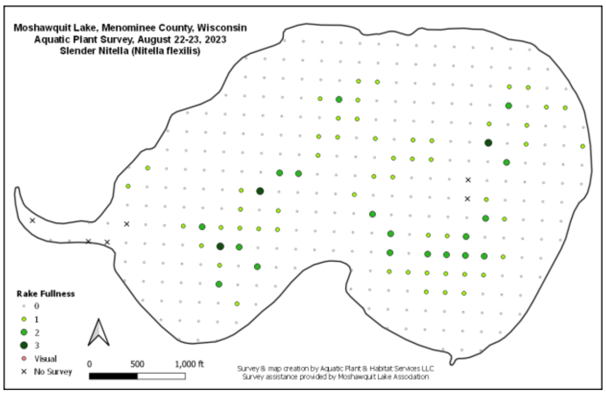
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Slender Nitella (Nitella flexilis)
Rake Fullness
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Visual
No Survey
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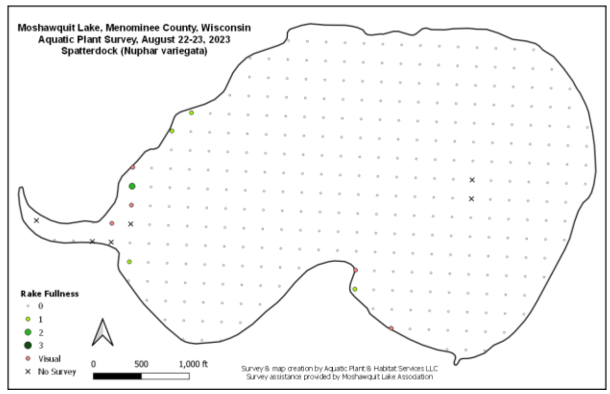
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Spatterdock (Nuphar variegata)
Rake Fullness
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Visual
No Survey
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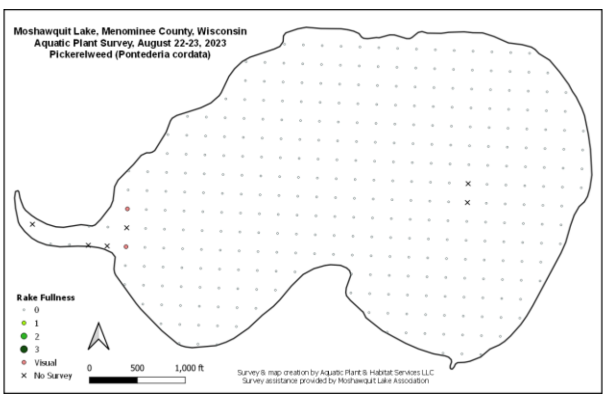
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Pickerelweed (Pontederia cordata)
Rake Fullness
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Visual
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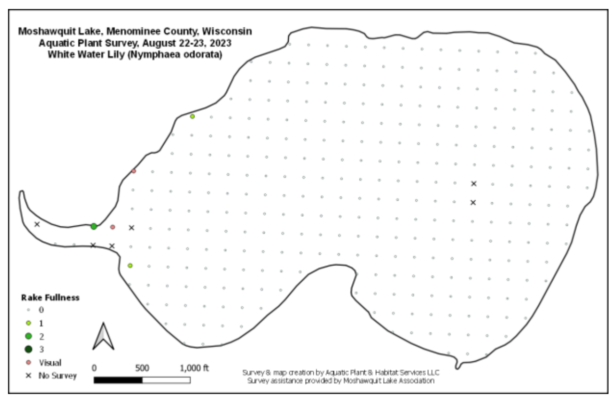
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
White Water Lily (Nymphaea odorata)
Rake Fullness
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Visual
No Survey
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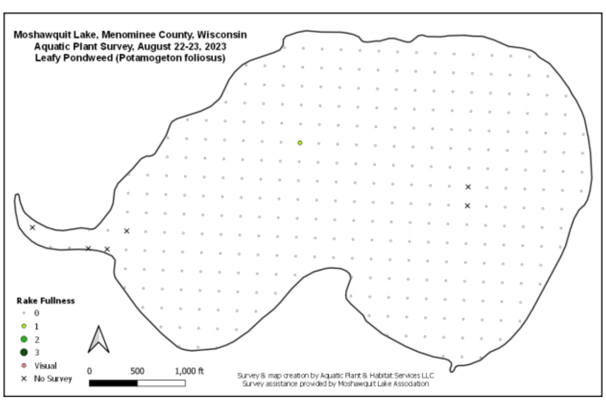
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Leafy Pondweed (Potamogeton foliosus)
Rake Fullness
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Visual
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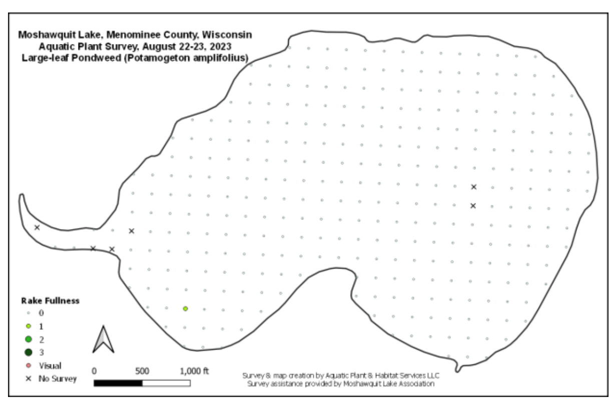
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Large-leaf Pondweed (Potamogeton amplifolius)
Rake Fullness
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Visual
No Survey
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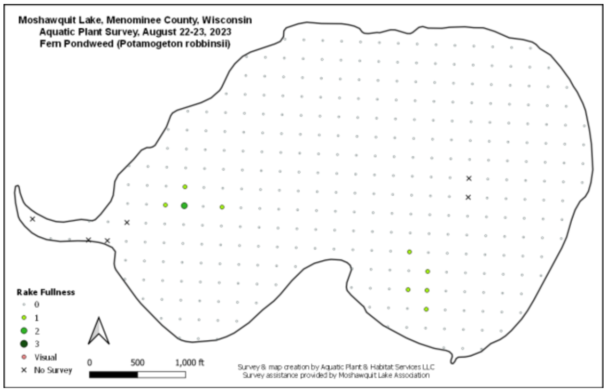
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Fern Pondweed (Potamogeton robbinsii)
Rake Fullness
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Visual
No Survey
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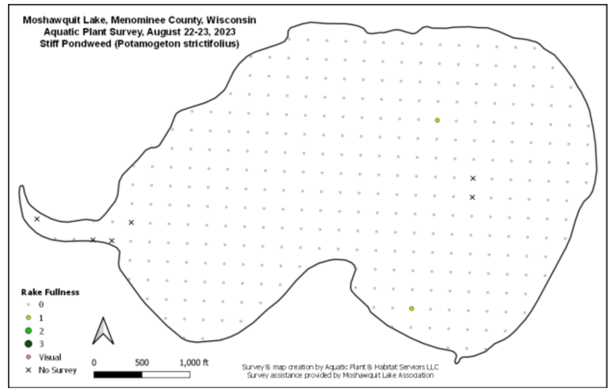
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Stiff Pondweed (Potamogeton strictifolius)
Rake Fullness
0
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Visual
No Survey
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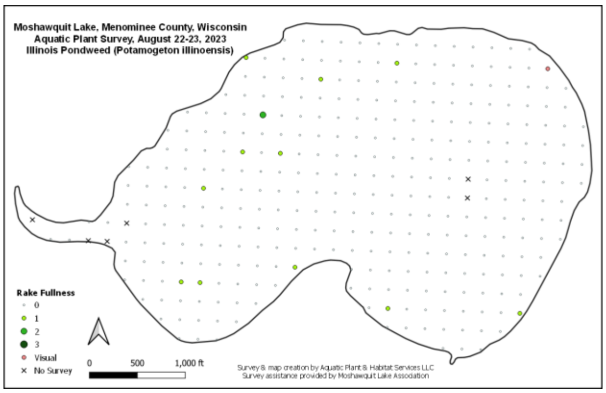
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Illinois Pondweed (Potamogeton illinoensis)
Rake Fullness
0
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Visual
No Survey
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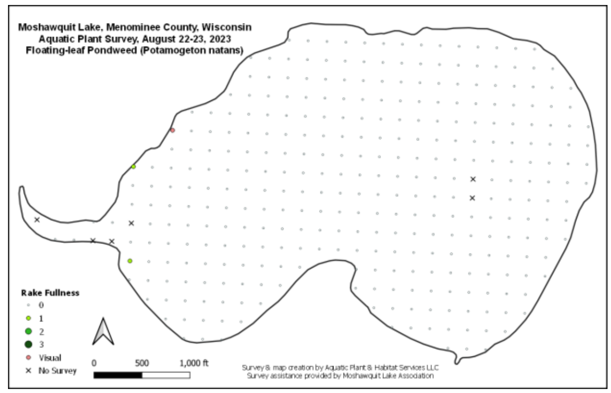
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Floating-leaf Pondweed (Potamogeton natans)
Rake Fullness
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Visual
No Survey
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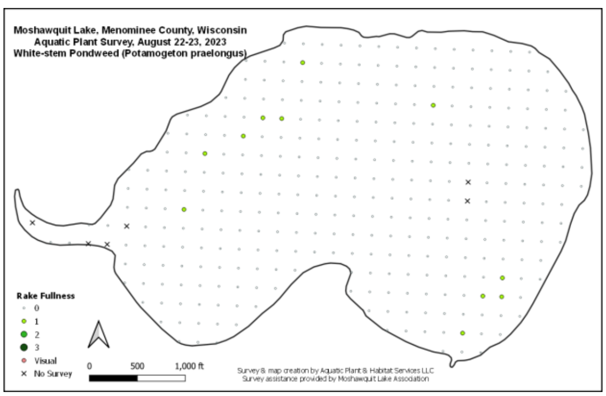
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
White-stem Pondweed (Potamogeton praelongus)
Rake Fullness
0
1
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Visual
No Survey
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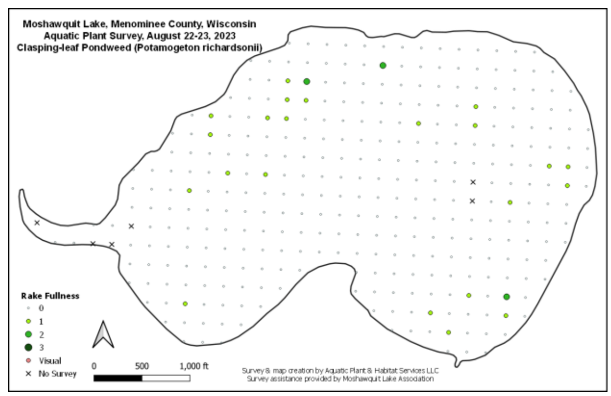
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Clasping-leaf Pondweed (Potamogeton richardsonii)
Rake Fullness
0
1
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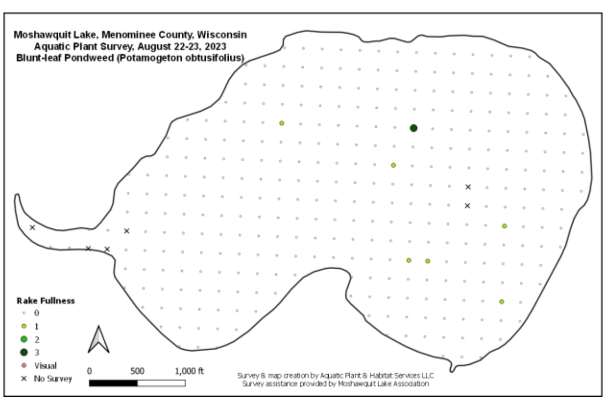
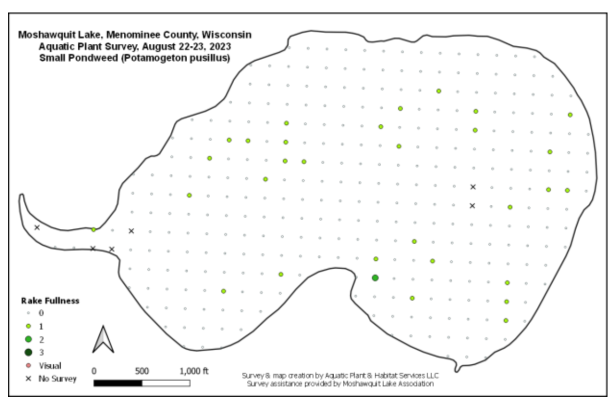
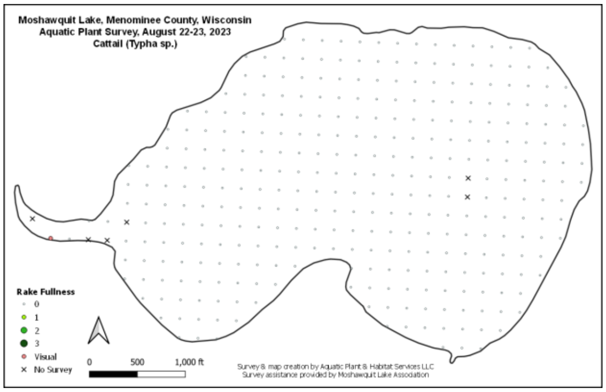
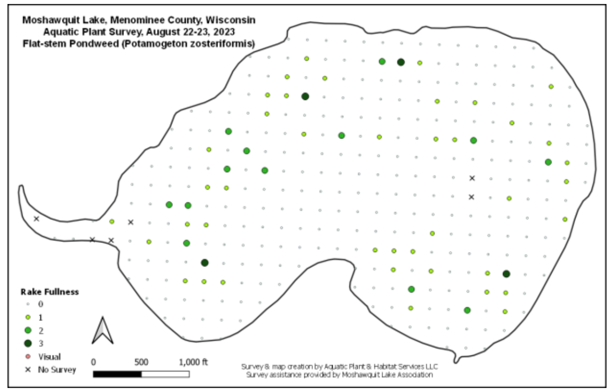
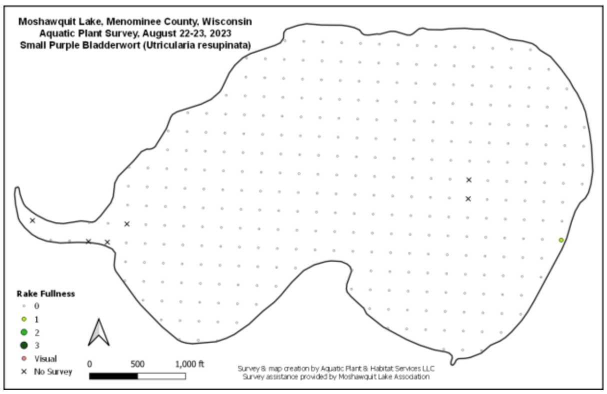
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

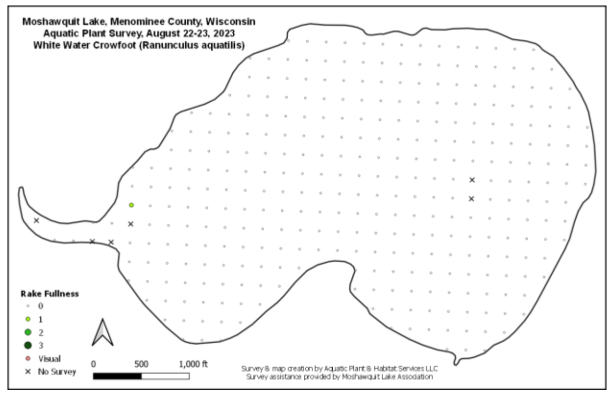

Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Blunt-leaf Pondweed (Potamogeton obtusifolius)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

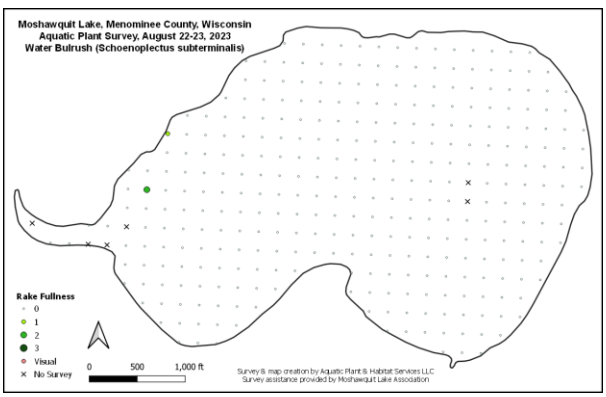

Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Small Pondweed (Potamogeton pusillus)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

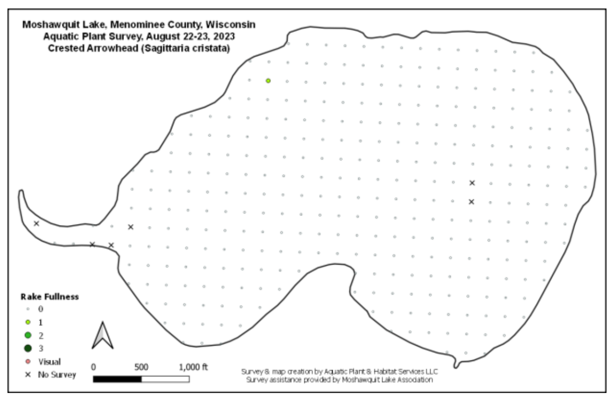

Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Cattail (Typha sp.)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

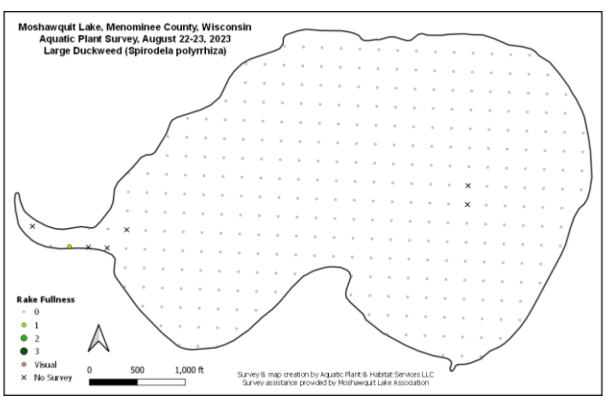

Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Flat-stem Pondweed (Potamogeton zosteriformis)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

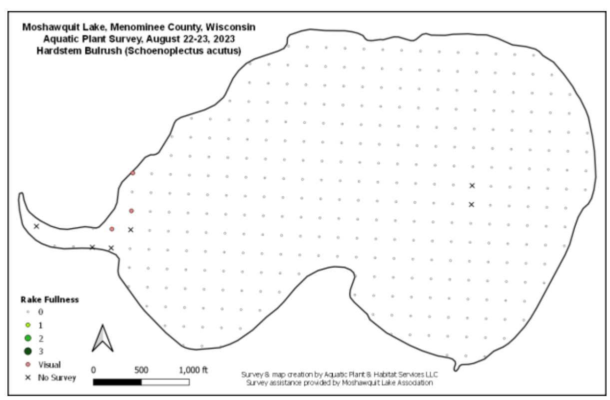

Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Small Purple Bladderwort (Utricularia resupinata)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

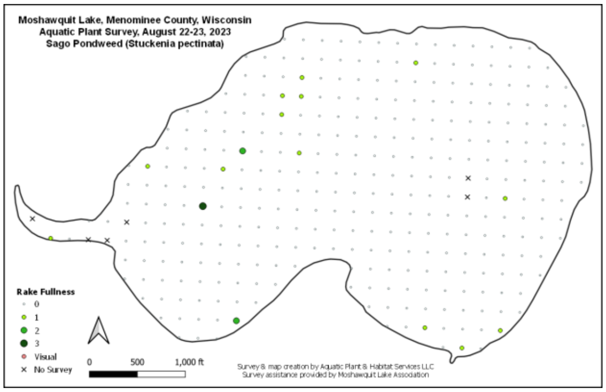

Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
White Water Crowfoot (Ranunculus aquatilis)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

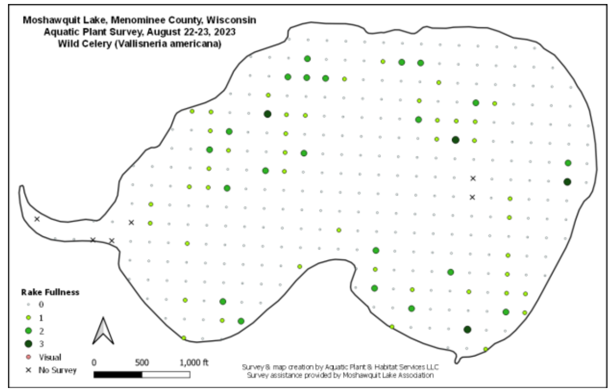

Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Water Bulrush (Schoenoplectus subterminalis)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

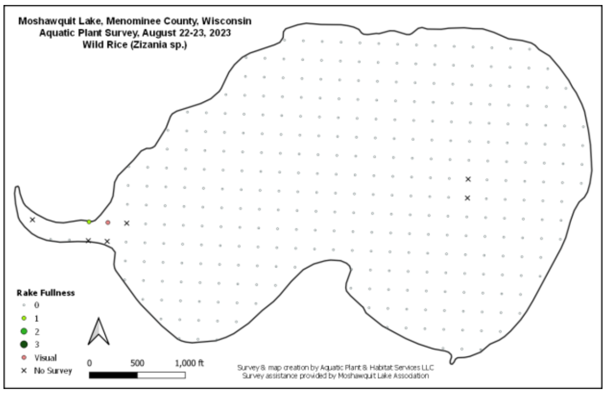

Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Crested Arrowhead (Sagittaria cristata)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

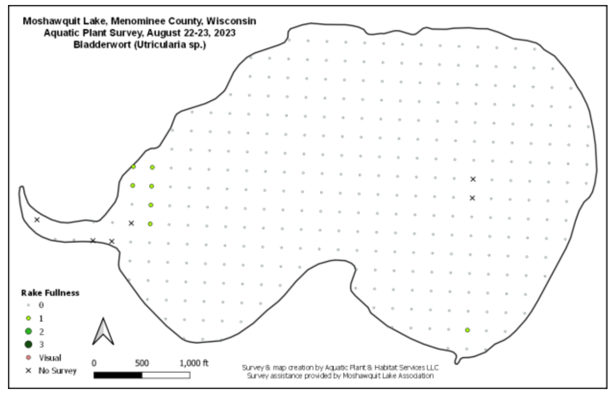

Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Large Duckweed (Spirodela polyrrhiza)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Hardstem Bulrush (Schoenoplectus acutus)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Sago Pondweed (Stuckenia pectinata)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Wild Celery (Vallisneria americana)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Wild Rice (Zizania sp.)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association


Moshawquit Lake, Menominee County, Wisconsin
Aquatic Plant Survey, August 22-23, 2023
Bladderwort (Utricularia sp.)
Rake Fullness
0
1
2
3
Visual
No Survey
0
500
1,000 ft
Survey & map creation by Aquatic Plant & Habitat Services LLC
Survey assistance provided by Moshawquit Lake Association

9.3 Appendix C – Fish Sticks Fact Sheet

FACT SHEET SERIES:

FISH STICKS

Healthy Lakes & Rivers

Berry Lake, Bayfield County - Pamela Toshner

MAINTENANCE

COSTS

- Range: $50 – $1300 per cluster of 3-5 trees, installed *(average = $890)*
- Healthy Lakes & Rivers grant funding available: *$1000 per Fish Sticks Cluster*

MATERIALS

- Whole, live trees from outside shoreland vegetation protection area
- Cables/cabling gear
- Heavy equipment including snowplow and chainsaw
- Safety gear

DNR PERMIT REQUIRED

FISH STICKS, an in-lake best practice (not eligible for rivers), are large woody habitat structures that utilize whole trees grouped together, resulting in the placement of more than 1 tree per 50 feet of shoreline. Fish Sticks are anchored to the shore and are partially or fully submerged. Fish sticks are not tree drops since the trees utilized for the projects come from further than 35 feet from shore, thus they don't "rob from the bank" of trees that may otherwise grow and fall in naturally.

PURPOSE

This fish and wildlife habitat best practice creates food, shelter, and breeding areas for all sorts of creatures from small aquatic insects, to fish, to turtles, ducks, and songbirds. Fish Sticks can also help prevent bank erosion – protecting lakeshore properties and your lake.

HOW TO BUILD

It may be necessary to work with your local DNR fisheries biologist, county land and water conservation department, or landscaper to design and/or construct this practice. Logging companies may assist with tree supply, cutting, and transportation. Check with your local zoning department to determine if any permits are necessary.

Detailed guidance is found here: http://dnr.wi.gov/topic/fishing/outreach/fishsticks.html.

1. Find a location

Ideal Fish Sticks sites have low ice energy – places like protected bays and shorelines leading to and from bays. High ice energy areas on lakes greater than 250 acres require alternate methods that ensure they remain in place.

Typically a single Fish Sticks cluster occupies 50 linear feet of shoreline, so it should be placed on an area of your lakeshore that is not used for pier(s) or swimming. If you have a lot of frontage, you may choose to add more than a single Fish Sticks cluster.

PROJECT TIMELINE

SITE PREP	INSTALLATION	MAINTENANCE	PROJECT END
2 MONTHS	< 1 DAY	Spring safety check	3 YEARS
winter ice road			cable removal

FACT SHEET SERIES: **FISH STICKS**

2. Create a design

Fish Sticks structures are commonly made up of three to five whole trees. The butt ends of the trees, at the water's edge, are cabled to live trees on shore.

Sketch the design and dimensions to be sure you understand what area it will cover and how it may function or fit into your landscape. Consider the following:

- Is the water deep or shallow? Trees sink and settle with branches breaking off soon after installation, but more trees can be placed in a deepwater cluster.
- Is your lakeshore mowed adjacent to the proposed Fish Sticks site? If so, and if you would like DNR Healthy Lakes & Rivers grant funding, you must commit to not mowing a 350 ft² area at the base of the cluster or installing a 350 ft² native planting.

3. Apply for a permit

The DNR recently streamlined the water regulation permits to make it easier for you to install Fish Sticks. There is a $303 fee unless this practice is funded through the Wisconsin DNR. Eligibility standards and application materials are on the DNR website http://dnr.wi.gov/Permits/Water/.

FUNDING NOTE

In order to be eligible for Healthy Lakes & Rivers grant funding, properties must comply with local shoreland zoning vegetation protection area (i.e. buffer) standards. If not, the property owner must commit to a 350 ft² no-mow zone at the base of the Fish Sticks cluster(s) or to installing a 350 ft² native planting.

Scott Toshner

4. Lay out the best practice

Flag the area(s) along your waterfront property where Fish Sticks will be installed. This is important because most projects take place in the winter, making it more difficult to identify landscape features and location preferences.

5. Construct the practice

Installing Fish Sticks on ice is the most practical and inexpensive method. Identify an ice road and maintain with snow plowing until ice is adequate thickness for installation (18 inches). Cut live trees from outside the shoreline vegetation protection area, which is usually at least 35 feet from the water's edge. Transport and place the trees in criss-cross clusters or stacks and then cable and anchor them to a live tree on shore.

MAINTAINENCE

- Check on the site soon after spring ice out to be certain all the trees remain in place.
- The cables should be removed approximately three years after installation so they don't damage the live trees or litter the shore.
- Trees should remain in place for ten years if funded through a DNR Healthy Lakes & Rivers grant.

LINKS

Healthy Lakes & Rivers Website – http://healthylakeswi.com
Fish Sticks Guidance – http://dnr.wi.gov/topic/fishing/outreach/fishsticks.html
DNR Surface Water Grants – http://dnr.wi.gov/aid/surfacewater.html

WISCONSIN LAKES & RIVERS PARTNERSHIP

Design and layout by Amy Kowalski, Extension Lakes

9.4 Appendix D – Input Received during Public Review Period

- I'm still of the opinion that only lake property owner registered boats should be allowed. There were at least two "guest" boats and one jet ski on the lake this weekend.
- There is an elevated potential for the transmission of invasives such as zebra mussels associated with **Enhanced Wake boats** due to the residual water which remains in the ballast tanks. Non resident-owner boats such as these should be restricted from launching in Moshawquit.

9.5 Appendix E – WDNR Letter of Approval of Plan