MEMORANDUM REPORT NO. 274

AQUATIC PLANT MANAGEMENT PLAN FOR TURTLE LAKE

WALWORTH COUNTY, WISCONSIN

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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INTRODUCTION 1

Credit: Commission Staff

The Southeastern Wisconsin Planning Commission (Commission or SEWRPC) completed this aquatic plant inventory and management study of Turtle Lake on behalf of the Turtle Lake Improvement and Protective Association (Association). This memorandum report is the Commission's first study focusing on Turtle Lake. The Wisconsin Department of Natural Resources (WDNR) will use data and conclusions generated as part of the Commission's study to help evaluate the Lake's aquatic plant community and draft an updated Aquatic Plant Control permit.

1.1 PROJECT SETTING, BACKGROUND, SCOPE, AND INTENT

Turtle Lake (Lake) is a 141-acre drainage lake located entirely within the Town of Richmond in Walworth County. An 866-acre watershed comprised largely of agricultural, residential, and natural land uses contributes surface runoff to the Lake (see Maps 1.1 and 1.2). The Lake is the headwater for Turtle Creek, which drains south to Lake Comus in the City of Delavan before turning southwest until its confluence with the Rock River near Beloit. Turtle Creek, which is listed as impaired on the 303(d) impaired waters lists due to excessive total phosphorus and sediment, is the subject of a recently published nine key element prepared by the Commission in collaboration with the Lake Comus Protection and Rehabilitation District.[1] Turtle Lake has been recognized for its high-quality aquatic life as it was designated as a high-quality water by WDNR in 2022 and as an Aquatic Area of Countywide or Regional Significance.[2,3]

The Lake has had 13 aquatic plant surveys completed since 2009 with the most recent survey in 2013 and the most recent aquatic plant management plan completed in 2016. Previous aquatic plant surveys have observed several beneficial native species including several species of muskgrass (*Chara* spp.), bladderworts (*Utricularia* spp.), naiads (*Najas* spp.), and pondweeds (*Potamogeton* spp.). Several non-native aquatic plant

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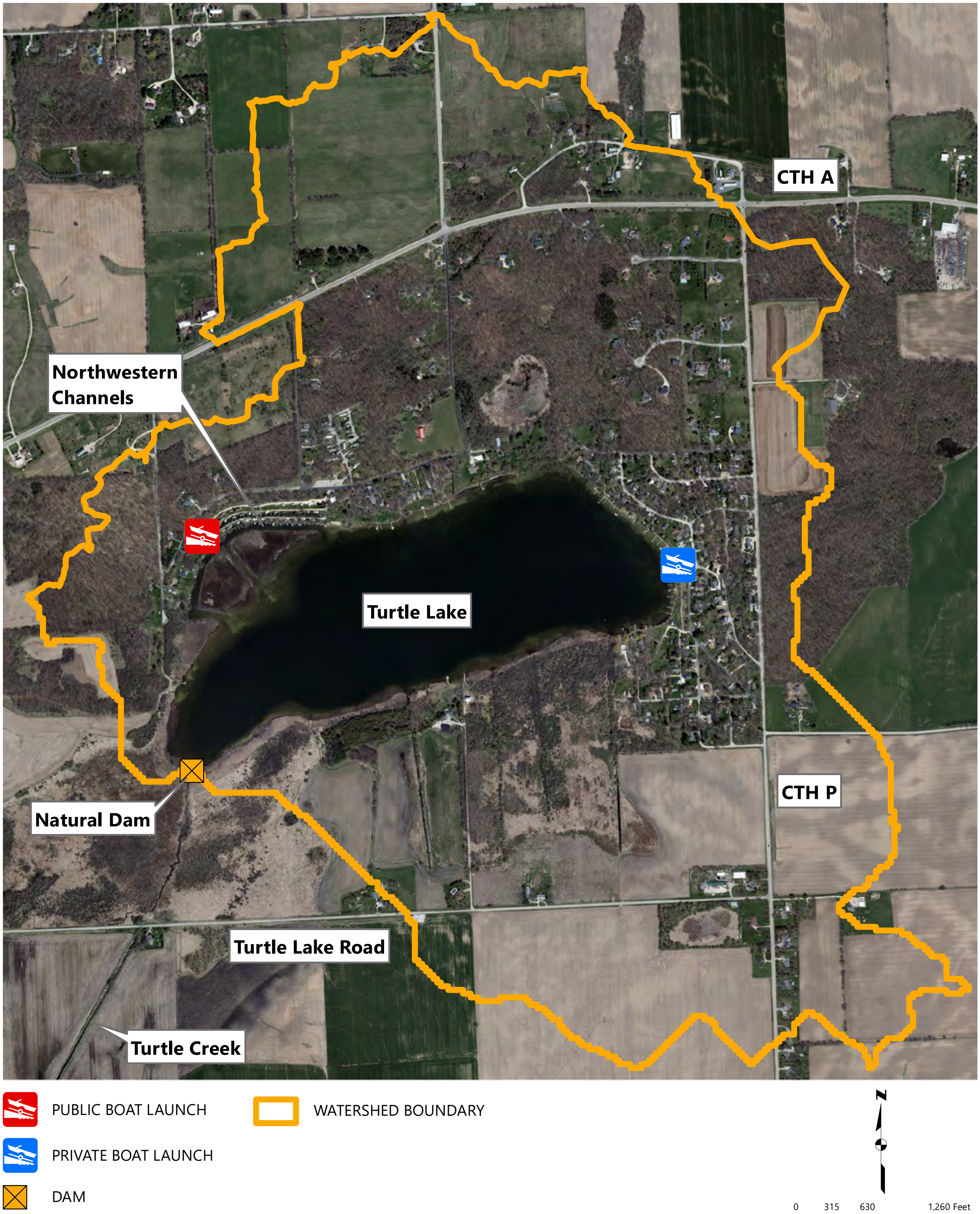
[1] *SEWRPC Memorandum Report No. 272,* A Nine Key Element Plan for Upper Turtle Creek, Walworth County, Wisconsin*, April 2025. www.sewrpc.org/SEWRPCFiles/Publications/mr/mr-272-nine-key-element-upper-turtle-creek.pdf.*

[2] *For more information on the WDNR's Healthy Watersheds, High-Quality Waters program, see the following link: dnr.wisconsin.gov/topic/SurfaceWater/HQW.html.*

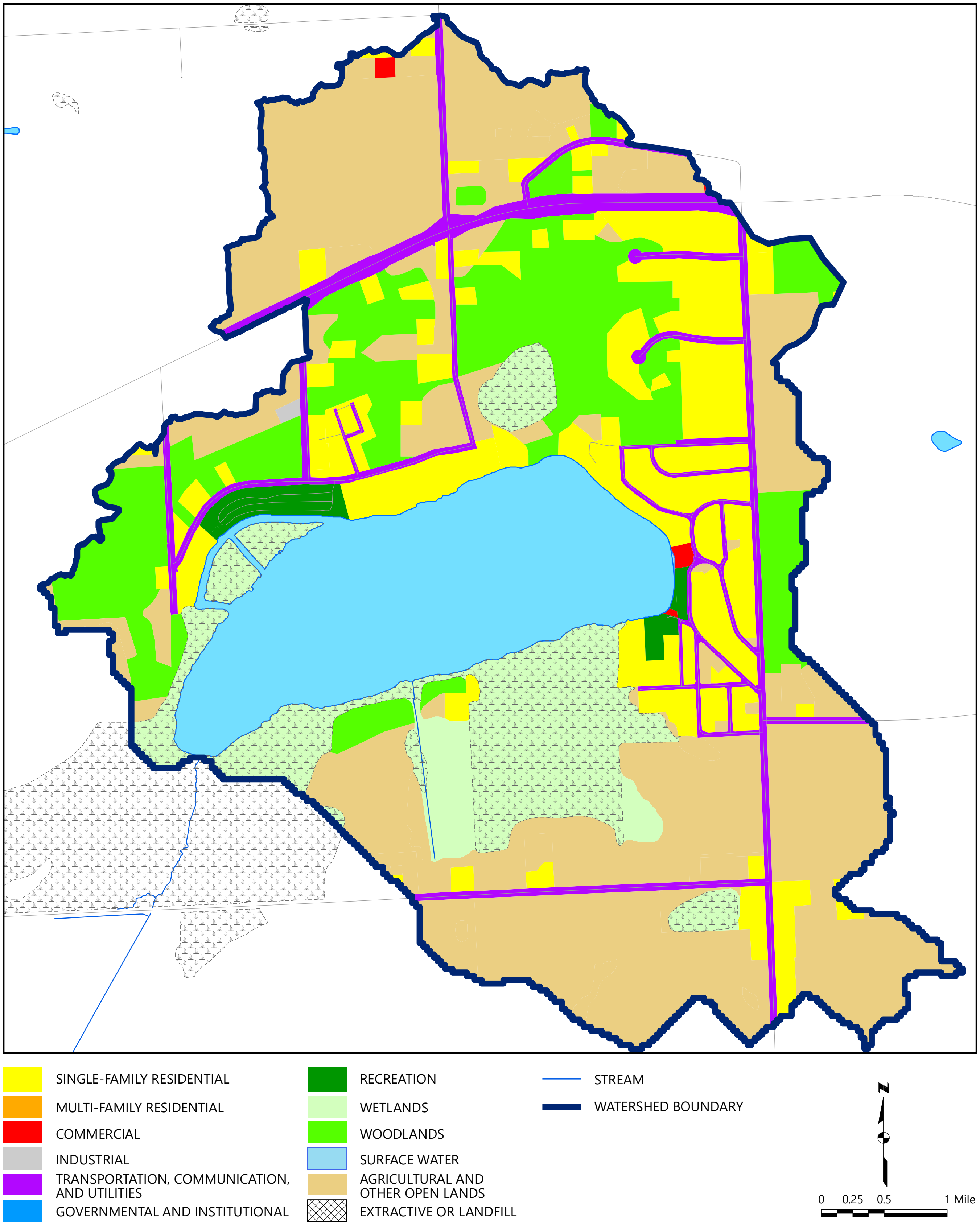
[3] *See the following link for information regarding the Commission's Regional Natural Areas plan: www.sewrpc.org/Regional-Planning/Natural-Areas.*

Map 1.1
Turtle Lake Watershed and Placenames



Source: SEWRPC

Map 1.2
Land Use for the Turtle Lake Watershed: 2020



Source: SEWRPC

species have also been identified in previous surveys: Eurasian watermilfoil (EWM) (*Myriophyllum spicatum*), hybrid milfoil (*Myriophyllum spicatum x Myriophyllum sibiricum),* spiny naiad (*Najas marina*), and curly-leaf pondweed (CLP) (*Potamogeton crispus*). Eurasian watermilfoil was first verified on the Lake in 1994.[4] Curly- leaf pondweed was verified in 2009.[5] In 2013 it was verified that the EWM population had hybridized with the native species of milfoil (northern milfoil, *Myriophyllum sibiricum)* in the Lake.[6] Spiny naiad was vouchered and verified in the Lake in 2014.

The Association manages aquatic plant growth on Turtle Lake to enhance navigation and recreational opportunities, including maintaining a healthy fishery. Since 2019, the Association's members have agreed to no chemical usage for aquatic plant management in the Lake.[7] Diver-assisted suction harvesting (DASH) to control the EWM population has been the primary in-lake management method employed by the Association in recent years. In 2022, the Association surveyed its members to gauge their opinions on Lake activities they participate in, issues of concern, suggestions for improvement, and lake management.[8] Out of 48 respondents, boating, swimming, and use of non-motorized craft were the most common activities while invasive aquatic species and lake water quality were the most common concerns. Most respondents indicated that they were either "Very satisfied" or "Satisfied" with the effectiveness of diver-assisted hand-pulling as an aquatic plant treatment method.

This aquatic plant management (APM) plan summarizes information and recommendations needed to manage nuisance plants (including EWM and curly-leaf pondweed). The plan covers four main topics:

- APM Goals and Objectives
- Aquatic Plant Community Changes and Quality
- Aquatic Plant Control Alternatives
- Recommended Aquatic Plant Management Plan

This memorandum focuses upon approaches to monitor and control actively growing nuisance populations of aquatic plants and presents a range of alternatives that could potentially be used to achieve desired APM goals and provides specific recommendations related to each alternative. These data and suggestions can be valuable resources when developing requisite APM permit applications and implementing future aquatic plant management efforts.

[4] *See apps.dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=795100&page=invasive.*

[5] Ibid.

[6] Ibid.

[7] *Correspondence with Linda Szramiak, May 1st, 2024.*

[8] *Turtle Lake Improvement and Protective Association, April 2022 Survey Results.*

INVENTORY FINDINGS AND RELEVANCE TO RESOURCE MANAGEMENT 2

Credit: Commission Staff

2.1 AQUATIC PLANT MANAGEMENT GOALS AND OBJECTIVES

Aquatic plant management (APM) programs are designed to further a variety of lake user and riparian landowner goals and desires. For example, most APM programs aim to improve lake navigability. However, APM programs must also be sensitive to other lake uses and must maintain or enhance a lake's ecological integrity. Consequently, APM program objectives are commonly developed in close consultation with many interested parties. The Turtle Lake (Lake) APM plan considered input from the Turtle Lake Improvement Association (Association), Wisconsin Department of Natural Resources (WDNR), and the public. Objectives of the Turtle Lake APM program include the following.

- Effectively control the quantity and density of nuisance aquatic plant growth in well-targeted portions of Turtle Lake. This objective helps:
    - Enhance water-based recreational opportunities,
    - Improve community-perceived aesthetic values, and
    - Maintain or enhance the Lake's natural resource value.
- Manage the aquatic plant community to promote the continued health of the lake's fishery.
- Manage the lake in an environmentally sensitive manner in conformance with *Wisconsin Administrative Code* standards and requirements under Chapters NR 103, "Water Quality Standards for Wetlands," NR 107, "Aquatic Plant Management," and NR 109, "Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations." Following these rules helps the Association preserve and enhance the lake's water quality, biotic communities, habitat value, and essential structure and relative function in relation to adjacent areas.
- Protect and maintain public health and promote public comfort, convenience, and welfare while safeguarding the lake's ecological health through environmentally sound management of vegetation, wildlife, fish, and other aquatic/semi-aquatic organisms in and around the lake.

- Promote a high-quality water-based experience for residents and visitors to the lake consistent with the policies and practices of the WDNR, as described in the regional water quality management plan, as amended.[9]

To meet these objectives, the Association executed an agreement with the Southeastern Wisconsin Regional Planning Commission (Commission or SEWRPC) to examine the lake's aquatic plant community and to develop an aquatic plant management plan. This chapter presents the results of previous aquatic plant surveys and management efforts on the lake.

2.2 AQUATIC PLANT COMMUNITY COMPOSITION, CHANGE, AND QUALITY

All healthy lakes have plants and native aquatic plants form a foundational part of a lake ecosystem. Aquatic plants form an integral part of the aquatic food web, converting sediments and inorganic nutrients present in the water into organic compounds that are directly available as food to other aquatic organisms. Through photosynthesis, plants utilize energy from sunlight and release the oxygen required by many other aquatic life forms into the water. Aquatic plants also serve several other valuable functions in a lake ecosystem, including:

- Improving water quality by filtering excess nutrients from the water
- Providing habitat for invertebrates and fish
- Stabilizing lake bottom substrates
- Supplying food for waterfowl and various lake-dwelling animals

Even though aquatic plants may hinder human use and/or access to a lake, aquatic plants should not necessarily be eliminated or even significantly reduced in abundance because they often support many other beneficial functions. For example, water lilies play a significant role in providing shade, habitat, and food for fish and other important aquatic organisms. They also help prevent damage to the lakeshore by dampening the power of waves that could otherwise erode the shoreline. Additionally, the shade that these plants provide helps reduce the growth of undesirable plants because it limits the amount of sunlight reaching the lake bottom. Given these benefits, large-scale removal of native plants that may be perceived as a nuisance should be avoided when developing plans for aquatic plant management.

Aquatic Plant Surveys

Turtle Lake's aquatic plant community has been evaluated thirteen times since 2009 with the most recent survey in 2023 (see Table 2.1). All aquatic plant surveys on Turtle Lake have been conducted by WDNR staff working out of the central office in Madison. Few lakes across southeastern Wisconsin have as many aquatic plant surveys as Turtle Lake, especially by WDNR staff. These surveys have been conducted in support of ongoing WDNR research on the biology and management of Eurasian watermilfoil (*Myriophyllum spicatum*). Turtle Lake is one of several lakes across the state that were designated as long-term trends lakes to monitor EWM populations and what ecological and recreational impacts these populations have on Wisconsin lakes. Each of these surveys have used the same point-intercept grid and methodology.[10,11] In this method, sampling sites are based on predetermined global positioning system (GPS) location points that

[9] *SEWRPC Planning Report No. 30,* A Regional Water Quality Management Plan for Southeastern Wisconsin—2000, Volume One, Inventory Findings*, September 1978,* Volume Two, Alternative Plans*, February 1979,* Volume Three, Recommended Plan*, June 1979, and SEWRPC Memorandum Report No. 93,* A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report*, March 1995.*

[10] *R. Jesson and R. Lound, Minnesota Department of Conservation,* Game Investigational Report No. 6, An Evaluation of a Survey Technique for Submerged Aquatic Plants*, 1962; as refined in the Memo from S. Nichols to J. Bode, J. Leverence, S. Borman, S. Engel, and D. Helsel, entitled "Analysis of Macrophyte Data for Ambient Lakes-Dutch Hollow and Redstone Lakes Example," Wisconsin Geological and Natural History Survey, University of Wisconsin-Extension, February 4, 1994.*

[11] *J. Hauxwell, S. Knight, K. Wagner, A. Mikulyuk, M. Nault, M. Porzky, and S. Chase,* Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications*, Wisconsin Department of Natural Resources, Bureau of Science Services, Publication No. PUB-SS-1068 201, March 2010.*

Table 2.1
Turtle Lake Aquatic Plant Survey Summaries: 2009-2023

Survey Date	Species Richness	Maximum Depth of Colonization (feet)	Littoral Zone Frequency of Occurrence (%)	Average Number of Native Species Per Site	Floristic Quality Index	Mean Coefficient of Conservatism
7/6/2023	21	24.0	79	1.40	21.57	4.95
6/30/2022	17	22.0	68	1.24	21.59	5.24
7/6/2021	25	24.0	79	1.64	24.73	5.27
7/16/2020	27	22.0	64	1.87	26.27	5.48
7/3/2019	29	21.0	60	2.28	25.72	5.25
6/15/2018	29	23.0	69	1.97	27.40	5.48
6/3/2015	22	21.5	65	1.07	21.92	5.17
7/10/2014	16	22.0	68	1.23	19.11	4.93
6/13/2013	22	20.5	65	1.31	23.57	5.14
6/5/2012	20	20.0	61	1.39	22.94	5.26
6/16/2011	17	15.5	47	1.40	19.00	4.75
6/7/2010	20	16.5	46	1.45	23.93	5.35
6/9/2009	19	23.0	67	1.31	22.16	5.22

Source: WDNR and SEWRPC

are arranged in a grid pattern across the entire surface of a lake. The grid pattern for Turtle Lake consists of 419 sampling points spaced at 37 meters (121.4 feet) apart (see Figure 2.1). At each grid point sampling site, a single rake haul is taken and a qualitative assessment of the rake fullness, on a scale of zero to three, is made for each species identified. The lake bathymetry is presented on Map 2.1.

Aquatic Plant Survey Metrics

Each aquatic plant species has preferred habitat conditions in which that species thrives as well as conditions that limit or completely inhibit its growth. For example, water conditions (e.g., depth, clarity, source, alkalinity, and nutrient concentrations), substrate composition, the presence or absence of water movement, and pressure from herbivory and/or competition all can influence the type of aquatic plants found in a water body. All other factors being equal, water bodies with a diverse array of habitat variables are more likely to host a diverse aquatic plant community. Human management can also affect the biological diversity (biodiversity) of waterbodies.

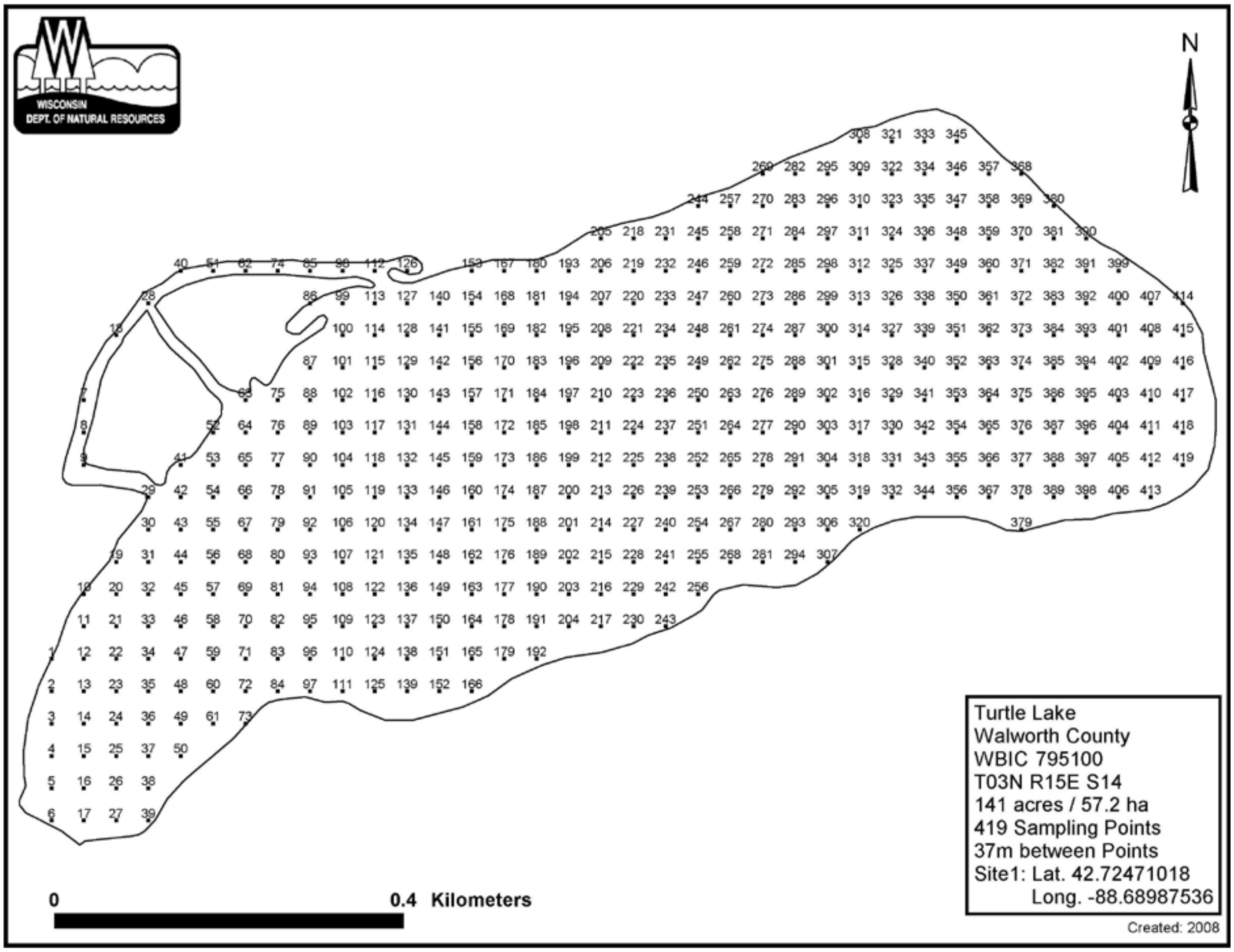
Several metrics are useful to describe aquatic plant community condition and design management strategies. These metrics include total rake fullness, maximum depth of colonization, species richness, biodiversity, evaluation of sensitive species, and relative species abundance. Metrics derived from the 2009 through 2023 point-intercept surveys are described below.

Total Rake Fullness

The Turtle Lake plant surveyors qualitatively rated the plant abundance at each survey point by how much of the sampling rake was covered by all aquatic plant species.[12] This rating, called total rake fullness, can be a useful metric evaluating general abundance of aquatic plants as part of the point-intercept survey. As shown in Figure 2.2, total rake fullness across all surveyed points in Turtle Lake averaged 1.68 in 2023. Total rake fullness in 2023 was highest in the northwest portion of the Lake. Across the range of surveys since 2009, total rake fullness is generally greatest in the northwest and southwest portions of the lake but there have been surveys where rake fullness was higher in the eastern portion of the lake (e.g., June 2013 and June 2015).

[12] *This method follows the standard WDNR protocol.*

Figure 2.1
Turtle Lake Aquatic Plant Point-Intercept Survey Grid



Source: WDNR and SEWRPC

Maximum Depth of Colonization

Maximum depth of colonization (MDC) can be a useful indicator of water quality, as turbid and/or eutrophic (nutrient-rich) lakes generally have shallower MDC than lakes with clear water.[13] It is important to note that for surveys using the point-intercept protocol, the protocol allows sampling to be discontinued at depths greater than the maximum depth of colonization for vascular plants. However, aquatic moss and macroalgae, such as muskgrass and nitella (*Nitella* spp.), frequently colonize deeper than vascular plants and thus may be under-sampled in some lakes. For example, *Chara globularis* and *Nitella flexilis* have been found growing as deep as 37 feet and 35 feet, respectively, in Silver Lake, Washington County.

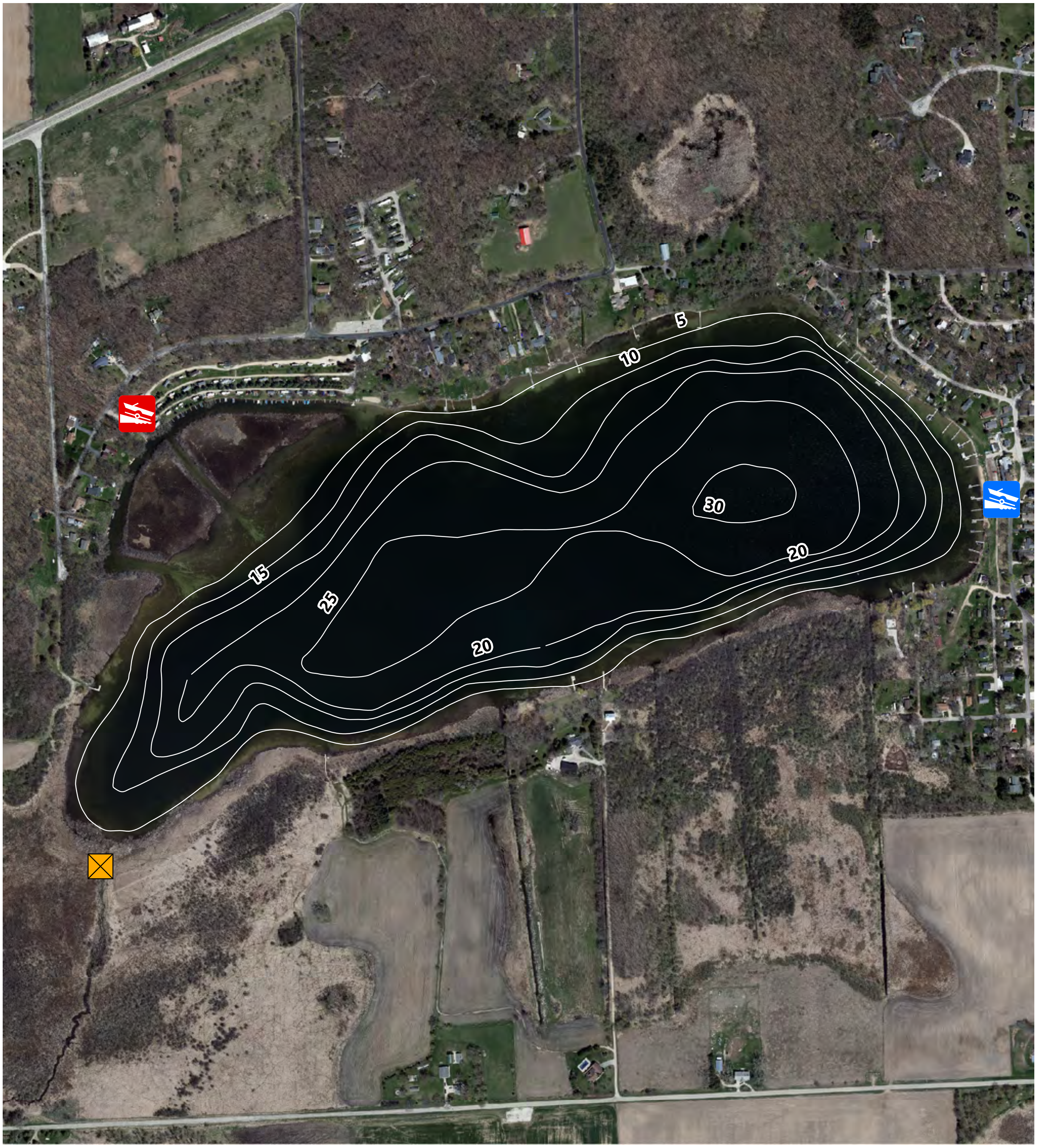
In Turtle Lake, the MDC has ranged between 15.5 feet (June 2011) and 24 feet (July 201 and July 2023). Many of the plant observations deeper than 20 feet in these surveys were of *Nitella*, a non-vascular macroalgae that can tolerate low light conditions. Based on the increasing MDC over time, water clarity appears to have improved or at least been consistent from 2011 to 2023.

Species Richness

The number of distinct types of aquatic plants present in a lake is referred to as the *species richness* of the lake. Larger lakes with diverse lake basin morphology, less human disturbance, and/or healthier, more resilient lake ecosystems have greater species richness. Aquatic plants provide a wide variety of benefits to lakes, examples of which are briefly described in Table 2.2.

[13] *D.E. Canfield Jr, L. Langeland, and W.T. Haller, "Relations Between Water Transparency and Maximum Depth of Macrophyte Colonization in Lakes,"* Journal of Aquatic Plant Management *23, 1985.*

Map 2.1
Turtle Lake Bathymetry



PUBLIC BOAT LAUNCH

PRIVATE BOAT LAUNCH

DAM

BATHYMETRIC LINE

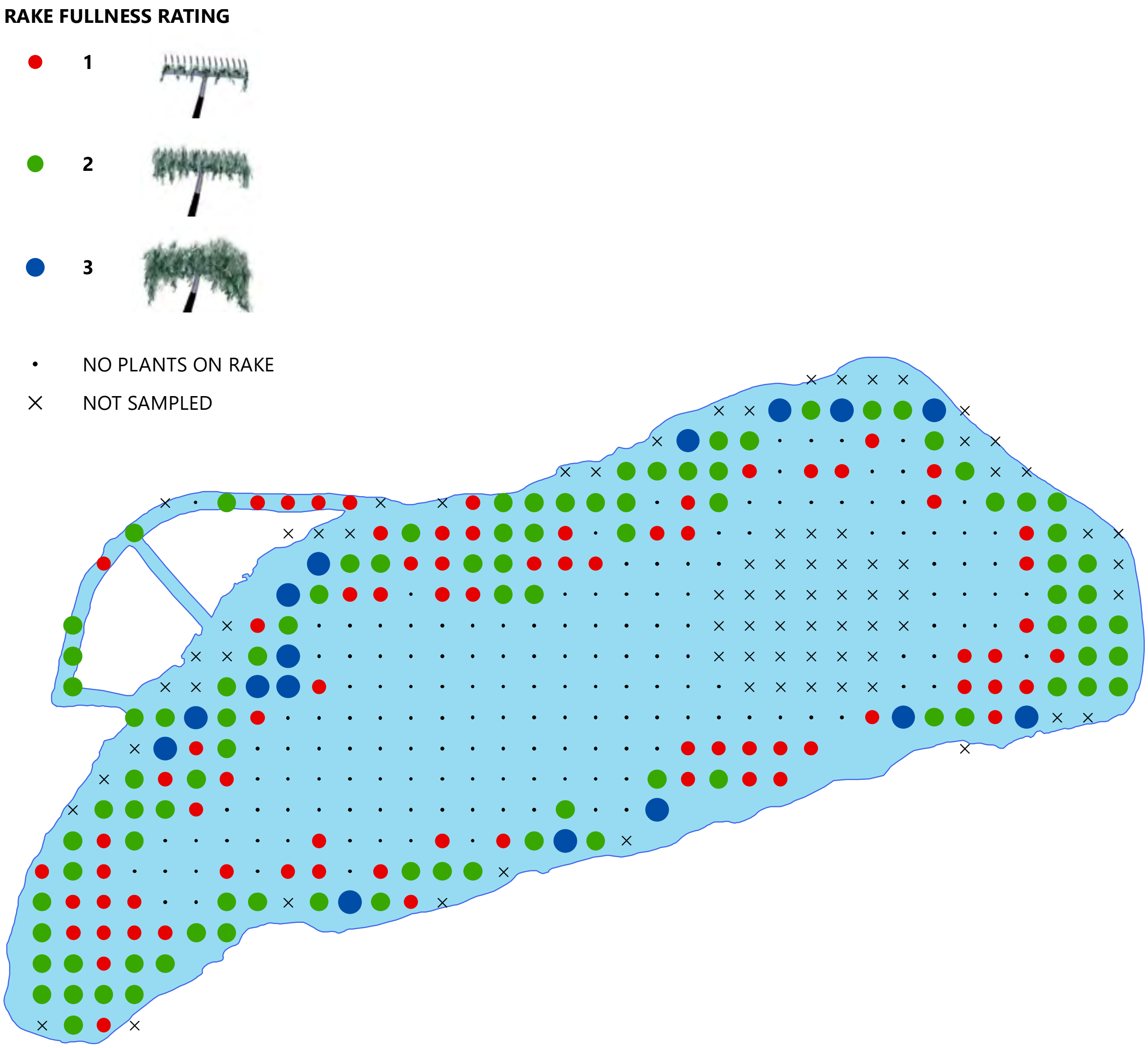
20 WATER DEPTH (FEET)

N

0 187.5 375 750 Feet

Source: WDNR and SEWRPC

Figure 2.2
Turtle Lake Aquatic Plant Total Rake Fullness: 2023



Source: SEWRPC

The observed species richness of Turtle Lake has varied throughout the plant surveys between 2009 and 2023, which may reflect cyclical changes in the aquatic plant population as well as differences between individual surveyors (see Table 2.1). Some species observed in earlier surveys were not observed during the 2023 survey (see Table 2.3). Additionally, there are plants identified to the genus level in earlier surveys that were identified to the species level in later surveys, e.g., the identification of muskgrass to species beginning in 2018. It is not uncommon for aquatic plant community diversity to fluctuate in response to a variety of drivers such as weather/climate, predation, and lake-external stimuli such as nutrient supply. This is especially true in the case of a lake's individual pondweed species, which tend to vary in abundance throughout the growing season in response to temperature, insolation, and other ecological factors. The 2023 aquatic plant survey identified 21 species in the Lake, including visual observations and boat survey species. This species richness is higher than average for lakes within Southeastern Wisconsin. The total number of species observed at each sampling point in 2023 is shown in Figure 2.3.

Table 2.2
Ecological Qualities Associated with Aquatic Plant Species in Turtle Lake

Aquatic Plant Species Present	Ecological Significance
Ceratophyllum demersum (coontail)	Provides good shelter for young fish; supports insects valuable as food for fish and ducklings
Chara spp. (muskgrasses)	A favorite waterfowl food and fish habitat, especially for young fish
Elodea canadensis (common waterweed)	Provides shelter and support for insects which are valuable as fish food
Heteranthera dubia (water stargrass)	Locally important food source for waterfowl and forage for fish; native
Myriophyllum sibiricum (northern watermilfoil)	Leaves and fruit provide food for waterfowl and shelter and foraging for fish
Najas flexilis (slender naiad)	Important food source for waterfowl, marsh birds, and muskrats; provides food and shelter for fish; native
Najas guadalupensis (southern naiad)	Important food source for waterfowl, marsh birds, and muskrats; provides food and shelter for fish; native
Nitella spp. (stonewort)	Sometimes grazed by waterfowl; forage for fish; native
Nuphar variegata (spatterdock)	Provides food for waterfowl and mammals; provides habitat for fish and aquatic invertebrates
Nymphaea odorata (white water lily)	Seeds consumed by waterfowl while rhizoids consumed by mammals
Potamogeton friesii (Fries' pondweed)	Seeds provide food for waterfowl and habitat for fish and aquatic invertebrates
Potamogeton gramineus (variable pondweed)	The fruit is an important food source for many waterfowl; also provides food for muskrat, deer, and beaver; native
Potamogeton illinoensis (Illinois pondweed)	Provides shade and shelter for fish; harbor for insects; seeds are eaten by waterfowl
Potamogeton natans (floating-leaf pondweed)	The late-forming fruit provides important food source for ducks; provides good fish habitat due to its shade and foraging opportunities; native
Potamogeton zosteriformis (flat-stem pondweed)	Provides some food for ducks; native
Ranunculus aquatilis (white water crowfoot)	Provides habitat for fish and macroinvertebrates
Schoenoplectus spp. (bulrushes)	Provide food and nesting habitat for birds, spawning habitat for largemouth bass, and food for macroinvertebrates
Stuckenia pectinata (Sago pondweed)	This plant is the most important pondweed for ducks, in addition to providing food and shelter for young fish; native
Utricularia spp. (bladderworts)	Stems provide food and cover for fish; native
Vallisneria americana (eelgrass/water celery)	Provides good shade and shelter, supports insects, and is valuable fish food; native

Note: Information obtained from A Manual of Aquatic Plants by Norman C. Fassett, University of Wisconsin Press; Guide to Wisconsin Aquatic Plants, Wisconsin Department of Natural Resources; and, Through the Looking Glass: A Field Guide to Aquatic Plants, Wisconsin Lakes Partnership, University of Wisconsin-Extension.

Source: SEWRPC

Biodiversity and Species Distribution

Species richness is often incorrectly used as a synonym for biodiversity. The difference in meaning between these terms is both subtle and significant. Biodiversity is based on the number of species present in a habitat along with the abundance of each species. For the purposes of this study, abundance was determined as the percent of observations of each species compared to the total number of observations made. Aquatic plant biodiversity can be measured with the Simpson Diversity Index (SDI).[14] Using this measure, a community dominated by one or two species would be considered less diverse than one in which several different species have similar abundance. In general, more diverse biological communities are better able to maintain ecological integrity. Promoting biodiversity not only helps sustain an ecosystem but preserves the spectrum of options useful for future management decisions.

The Lake has good biodiversity with an SDI of 0.89 in 2023. Between one and eight aquatic plant species were found at any single sampling point throughout the Lake in 2023, with the highest richness at the points within the northwestern channels and in the southeastern corner of the lake (Figure 2.3). The diversity of the lake has increased over time since the 2009 with an SDI of 0.79 to a high mark of 0.9 in 2021. This increase in diversity may reflect an improvement in the plant community but may also indicate better identification skills by the WDNR staff conducting these surveys over this period. Actions that conserve and promote aquatic plant biodiversity are critical to the long term health of the Lake. Such actions not only help

[14] *The SDI expresses values on a zero to one scale where 0 equates to no diversity and 1 equates to infinite diversity.*

Table 2.3
Turtle Lake Aquatic Plant Littoral Frequency of Occurrence: 2009-2023

Aquatic Plant Species	2009	2010	2011	2012	2013	2014	2015	2018	2019	2020	2021	2022	2023	Avg.	Min.	Max.
Aquatic moss	--	--	--	--	--	0.36	0.39	--	0.81	0.39	--	--	--	0.49	0.36	0.81
Ceratophyllum demersum, Coontail	19.46	20.67	17.11	19.57	22.99	38.3	27.8	28.8	46.3	42.2	28.8	28.5	23.0	28.0	17.1	46.3
Chara aspera, Rough stonewort	--	--	--	--	--	--	--	0.72	2.44	1.56	0.96	--	0.34	1.20	0.34	2.44
Chara contraria, Common stonewort	--	--	--	--	--	--	--	18.4	38.2	31.3	28.1	--	23.7	27.9	18.4	38.2
Chara globularis, Globular stonewort	--	--	--	--	--	--	--	39.9	24.0	17.2	22.4	--	12.7	23.2	12.7	39.9
Chara sp., Muskgrasses	67.42	75.42	68.45	57.83	51.72	43.7	46.33	--	--	--	--	31.1	--	54.2	31.1	75.4
Elodea canadensis, Common waterweed	0.45	1.68	0.53	0.43	0.77	0.36	--	1.08	2.03	2.73	0.96	0.88	1.03	1.08	0.36	2.73
Elodea nuttallii, Slender waterweed	--	--	--	--	--	--	--	--	--	--	--	0.44	--	0.44	0.44	0.44
Filamentous algae	0.9	--	7.49	5.22	10.73	--	29.3	16.9	4.47	0.39	0.32	--	--	8.41	0.32	29.3
Heteranthera dubia, Water star-grass	2.26	0.56	--	--	0.77	--	--	2.52	3.66	3.13	1.92	--	1.4	2.03	0.56	3.66
Lemna minor, Small duckweed	--	0.56	--	--	--	--	--	--	0.41	--	--	--	0.34	0.44	0.34	0.56
Lemna trisulca, Forked duckweed	0.45	--	--	0.43	--	--	--	--	0.41	--	--	--	--	0.43	0.41	0.45
Myriophyllum sibiricum, Northern watermilfoil	0.9	0.56	--	--	--	--	--	--	--	--	--	--	--	0.73	0.56	0.9
Myriophyllum spicatum, Eurasian watermilfoil	12.22	18.44	17.11	17.39	6.13	0.36	1.16	33.1	27.2	27.3	16.0	9.65	9.62	15.1	0.36	33.1
Najas flexilis, Slender naiad	--	--	--	1.3	1.92	2.89	--	1.8	3.25	3.91	4.79	0.44	0.69	2.33	0.44	4.79
Najas guadalupensis, Southern naiad	5.43	0.56	0.53	--	0.38	--	0.39	1.8	0.81	2.34	0.96	--	1.7	1.49	0.38	5.43
Najas marina, Spiny naiad	--	--	3.21	--	--	6.86	3.09	8.27	7.32	2.34	1.6	--	3.1	4.47	1.6	8.27
Nitella flexilis, Slender nitella	--	--	--	--	--	--	--	11.9	7.72	7.81	10.9	11.4	14.1	10.6	7.72	14.1
Nitella sp., Nitella	--	1.12	1.6	15.22	15.33	7.22	5.02	--	--	--	--	--	--	7.59	1.12	15.3
Nuphar variegata, Spatterdock	0.9	1.12	1.07	0.43	0.77	0.36	1.16	0.36	0.81	0.78	0.32	0.44	--	0.71	0.32	1.16
Nymphaea odorata, White water lily	0.45	0.56	1.07	0.87	0.77	1.44	0.77	2.88	6.1	3.52	1.28	0.88	2.06	1.74	0.45	6.1
Potamogeton crispus, Curly-leaf pondweed	1.36	3.35	2.67	3.04	0.77	--	0.77	4.32	2.44	0.78	0.64	0.88	0.34	1.78	0.34	4.32
Potamogeton foliosus, Leafy pondweed	--	--	--	--	--	--	--	--	0.81	--	--	--	--	0.81	0.81	0.81
Potamogeton friesii, Fries' pondweed	10.86	16.76	11.76	13.48	6.9	3.97	5.02	37.1	37.0	21.9	17.9	14.9	17.2	16.5	3.97	37.1
Potamogeton gramineus, Variable pondweed	0.45	0.56	--	--	1.53	--	0.39	0.36	0.41	0.78	0.64	--	--	0.64	0.36	1.53
Potamogeton illinoensis, Illinois pondweed	--	--	--	--	--	--	--	0.36	--	0.39	0.96	0.44	--	0.54	0.36	0.96
Potamogeton natans, Floating-leaf pondweed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potamogeton nodosus, Long-leaf pondweed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potamogeton pusillus, Small pondweed	--	--	--	--	--	--	--	2.16	2.03	0.78	1.28	--	--	1.56	0.78	2.16
Potamogeton strictifolius, Stiff pondweed	--	--	--	--	--	--	0.39	--	--	--	--	--	--	0.39	0.39	0.39
Potamogeton zosteriformis, Flat-stem pondweed	5.43	1.68	8.56	4.35	0.38	0.36	1.54	3.24	3.25	1.56	5.75	1.32	3.78	3.17	0.36	8.56
Ranunculus aquatilis, White water crowfoot	--	1.68	--	0.43	0.38	--	0.39	1.44	2.03	0.39	0.96	1.32	0.34	0.94	0.34	2.03
Schoenoplectus acutus, Hardstem bulrush	1.36	1.12	3.74	2.17	3.45	3.25	2.32	1.08	2.85	1.56	--	--	--	2.29	1.08	3.74
Schoenoplectus pungens, Three-square bulrush	--	--	--	0.43	0.77	--	0.39	1.08	--	--	2.24	--	1.03	0.99	0.39	2.24
Sparganium sp., Bur-reed	--	--	--	--	--	--	--	0.36	--	--	--	--	--	0.36	0.36	0.36
Stuckenia pectinata, Sago pondweed	17.19	6.15	9.63	11.74	14.18	5.78	6.95	24.1	27.2	24.2	20.5	19.7	22.3	16.1	5.78	27.2

Table continued on next page.

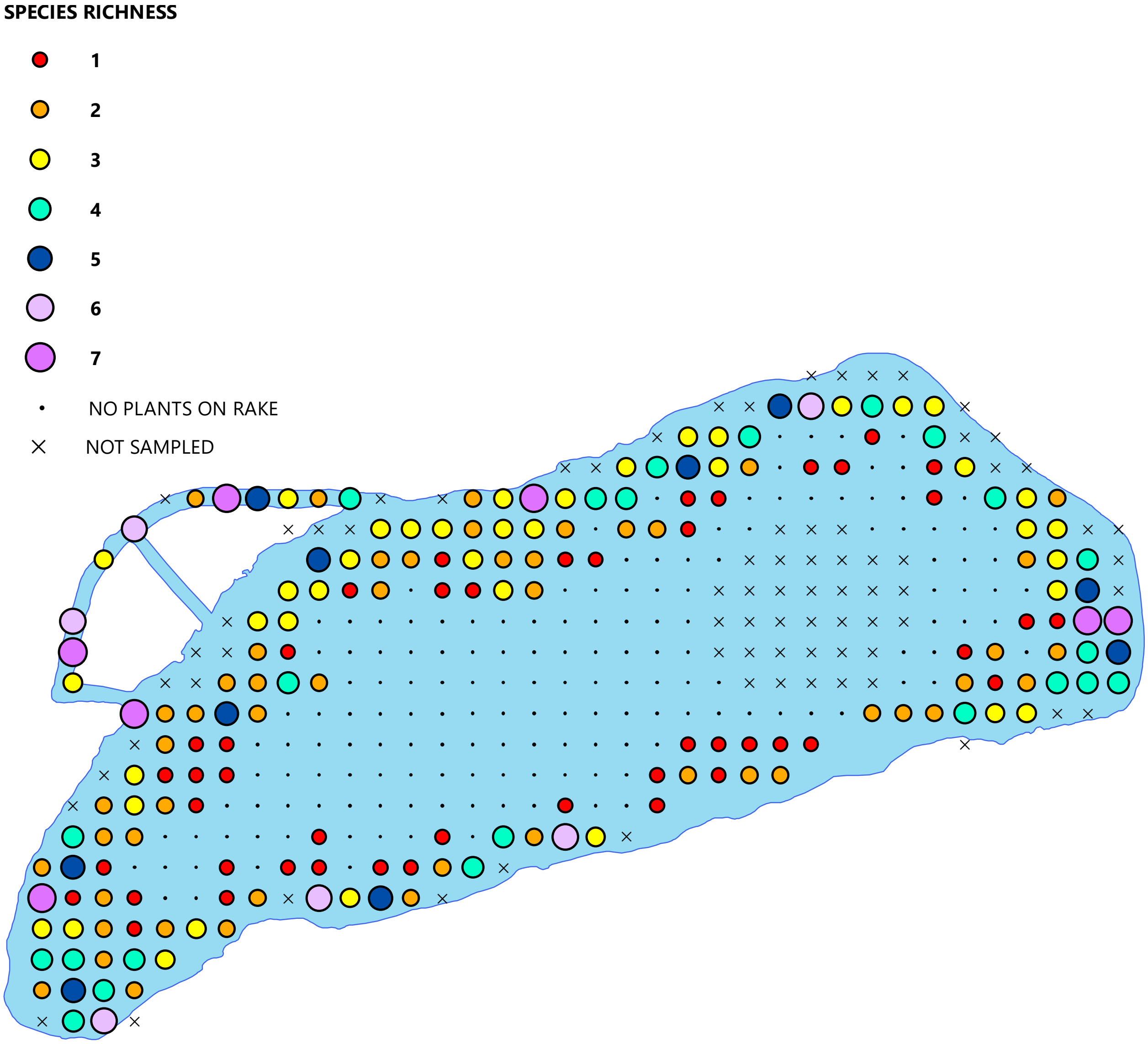
Table 2.3 (Continued)

Aquatic Plant Species	2009	2010	2011	2012	2013	2014	2015	2018	2019	2020	2021	2022	2023	Avg.	Min.	Max.
Typha sp., Cattail	--	--	--	--	0.38	--	0.39	--	0.41	--	--	--	--	0.39	0.38	0.41
Utricularia gibba, Creeping bladderwort	--	--	--	--	--	--	--	0.36	--	--	--	--	--	0.36	0.36	0.36
Utricularia minor, Small bladderwort	--	--	--	--	--	--	--	--	--	0.39	--	--	--	0.39	0.39	0.39
Utricularia vulgaris, Common bladderwort	3.62	3.91	6.95	0.43	0.38	0.36	0.39	0.72	--	3.91	3.19	1.32	3.78	2.41	0.36	6.95
Vallisneria americana, Wild celery	9.5	10.06	9.09	9.13	7.66	15.16	7.34	14.4	16.7	15.2	8.95	10.5	9.97	11.1	7.34	16.7
Zannichellia palustris, Horned pondweed	--	--	--	0.43	--	--	--	0.36	0.81	--	--	--	--	0.53	0.36	0.81
Total Number of Species	19	20	17	20	22	16	22	29	29	27	25	17	21	--	--	--

Note: This table presents the frequency of occurrence within areas of the Lake that were shallow enough to support aquatic plant growth. Two species, *Potamogeton natans* and *P. nodosus*, have only ever been observed as visual observations and thus do not have a calculated frequency of occurrence. The Avg., Min., and Max. columns present the average, minimum, and littoral frequency of occurrence across the year range for each species. For the Muskgrass row, the individual species of muskgrass were summed in 2018-2021 and 2023 to calculate these statistics.

Source: WDNR and SEWRPC

Figure 2.3
Turtle Lake Aquatic Plant Species Richness: 2023



Source: SEWRPC

sustain and increase the robustness and resilience of the existing ecosystem, but also promote efficient and effective future aquatic plant management.

Sensitive Species

Aquatic plant metrics, such as species richness and the floristic quality index (FQI), can be useful for evaluating lake health. In hard water lakes, such as those common in Southeastern Wisconsin, species richness generally increases with water clarity and decreases with nutrient enrichment.[15] The FQI is an assessment metric used to evaluate how closely a lake's aquatic plant community matches that of undisturbed, pre-settlement conditions.[16] To formulate this metric, Wisconsin aquatic plant species were assigned conservatism (C) values on a scale from zero to ten that reflect the likelihood that each species occurs in undisturbed habitat. These values were assigned based on the species substrate preference, tolerance of water turbidity, water

[15] *Vestergaard, O. and Sand-Jensen, K. "Alkalinity and Trophic State Regulate Aquatic Plant Distribution in Danish Lakes,"* Aquatic Botany *67, 2000.*

[16] *S. Nichols, "Floristic Quality Assessment of Wisconsin Lake Plant Communities with Example Applications,"* Lake and Reservoir Management *15(2), 1999.*

drawdown tolerance, rooting strength, and primary reproductive means. Native "sensitive" species that are intolerant of ecological disturbance receive high C values, while natives that are disturbance tolerant receive low C values. Invasive species are assigned a C value of 0. A lake's FQI is calculated as the average C value of species identified in the lake, divided by the square root of species richness. The Lake's FQI in 2009 was 22.16 while the 2023 FQI was 21.57. Both surveys had higher FQI values than the 20.0 average FQI for the Southeastern Wisconsin Till Plains ecoregion, indicating that the Lake supports species that are more sensitive to ecological disturbance than the average lake in the Region.

The WDNR currently uses an aquatic plant bioassessment method published by Mikulyuk et al., 2017 to assess whether lakes should be listed on the 303(d) impaired waters list. This method identifies species that are tolerant, moderately tolerant, and sensitive to human disturbance. Three sensitive species, as identified in this methodology, were identified during the 2023 survey: slender naiad, southern naiad, and slender nitella.[17] Of these species, slender nitella was the most observed in 2023 and was typically found in deeper water in the main body of the Lake. The number of sensitive species identified at each survey points are shown in Figure 2.4.

Relative Species Abundance

Based on the 2023 point-intercept survey, the five most abundant submerged aquatic plant species in the Lake were, in decreasing order of abundance: 1) common stonewort (*Chara contraria*), 2) coontail (*Ceratophyllum demersum*), 3) sago pondweed (*Stuckenia pectinata*), 4) Fries pondweed (*Potamogeton friesii*), and 5) slender nitella (*Nitella flexilis*). The shallow, nearshore areas around much of the lake are characterized by a mixture of muskgrass, coontail, Eurasian watermilfoil, Fries' pondweed, Sago pondweed, and to a lesser extent common bladderwort and eelgrass. White water lily (*Nymphaea odorata*) and spatterdock (*Nuphar variegata*) were only found in the northwestern channels and along the southwestern shore of the lake. Stands of emergent hard-stem bulrush (*Schoenoplectus acutus*) were found along the undeveloped western and southwestern shores of the lake. White water crowfoot (*Ranunculus aquatilis*), which can indicate the presence of groundwater springs, was observed in the northwestern channels. Deeper areas of the lake were largely dominated by slender nitella, which grew at an average depth of 18 feet and a maximum depth of 24 feet. The distribution of the most common aquatic plant species identified as part of the 2023 survey is mapped in Appendix A.

Apparent Changes in Observed Aquatic Plant Communities: 2009-2023

Changing aquatic plant communities are often the result of change in and around a lake. Causes of change include aquatic plant management practices, land use (which in turn commonly affects nutrient and water supply and availability), lake use, climate, and natural biological processes such as natural population cycles of specific plants. Regarding plant-specific population cycles, it is not uncommon for various pondweed species to succeed each other during the growing season, with some species being more prevalent in cooler water, while others are more prevalent in warmer water. In contrast to such seasonal succession, aquatic plants such as EWM are known to have year-to-year abundance and relative scarcity cycles, possibly due to climatic factors and/or herbivory cycles related to the relative abundance of milfoil weevils (*Eurhychiopsis lecontei*).

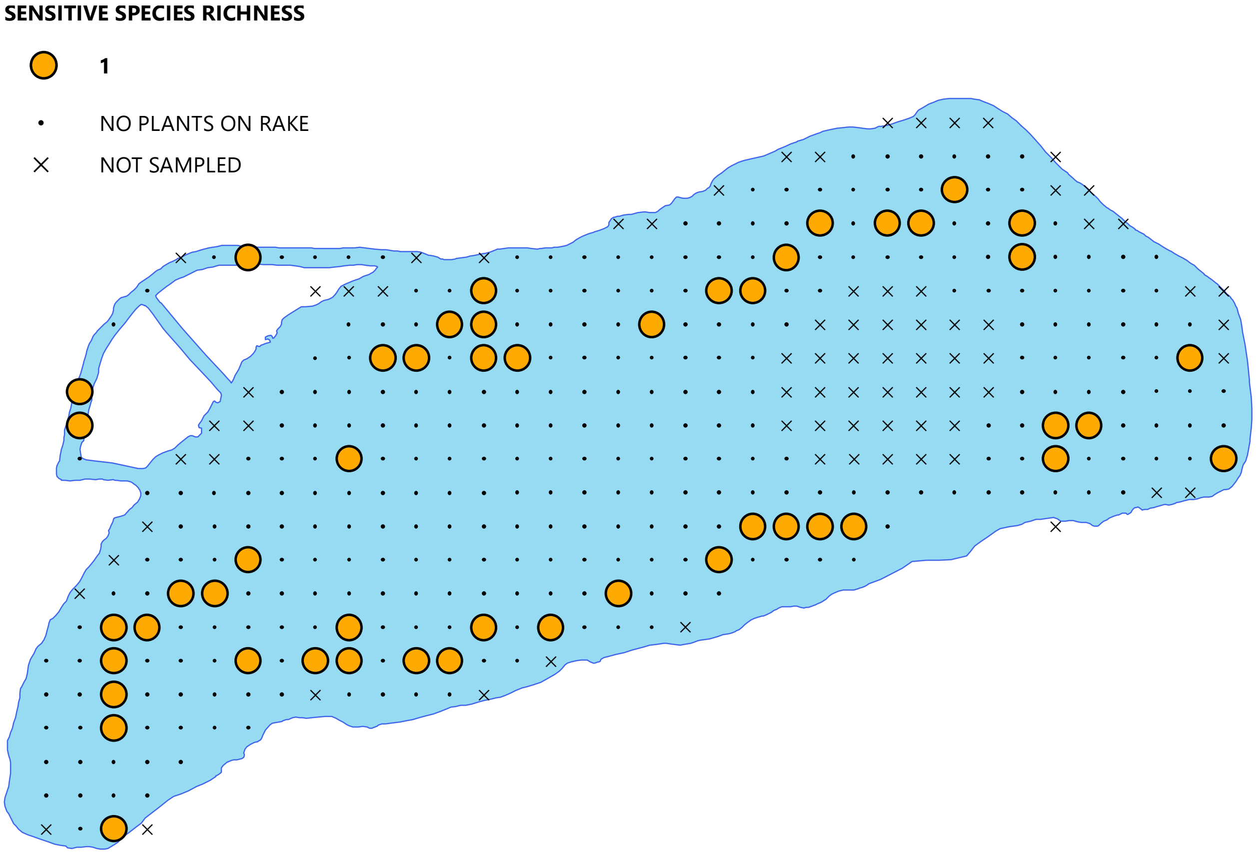
As mentioned earlier in this chapter, few lakes in southeastern Wisconsin have as much aquatic plant data collected as consistently over the past fifteen years as Turtle Lake. This data enabled Commission staff to examine how the plant community has changed over time. Major themes and changes in the Turtle Lake aquatic plant community are as follows:

- Although the area with enough light for vegetation to grow has increased over the years from 15.5 feet in 2011 to 24 feet in 2024, the aquatic plant community has not filled this seemingly available habitat as the total number of points with vegetation has remained relatively similar.

- Across all these surveys, several plants are consistently among the most commonly observed within the lake. These plants, listed with their average percent littoral frequency of occurrence are: muskgrass (54 percent), coontail (28 percent), Fries' pondweed (17 percent), Sago pondweed (16 percent), and EWM (15). Most of these species are commonly observed in other hardwater lakes across southeastern Wisconsin. Despite being the most common species, each has fluctuated

[17] *Mikulyuk, A.M., et al., "A Macrophyte Bioassessment Approach Linking Taxon-Specific Tolerance and Abundance in North Temperate Lakes,"* Journal of Environmental Management *199: 172-180, 2017.*

Figure 2.4
Turtle Lake Aquatic Plant Sensitive Species Richness: 2023



Source: SEWRPC

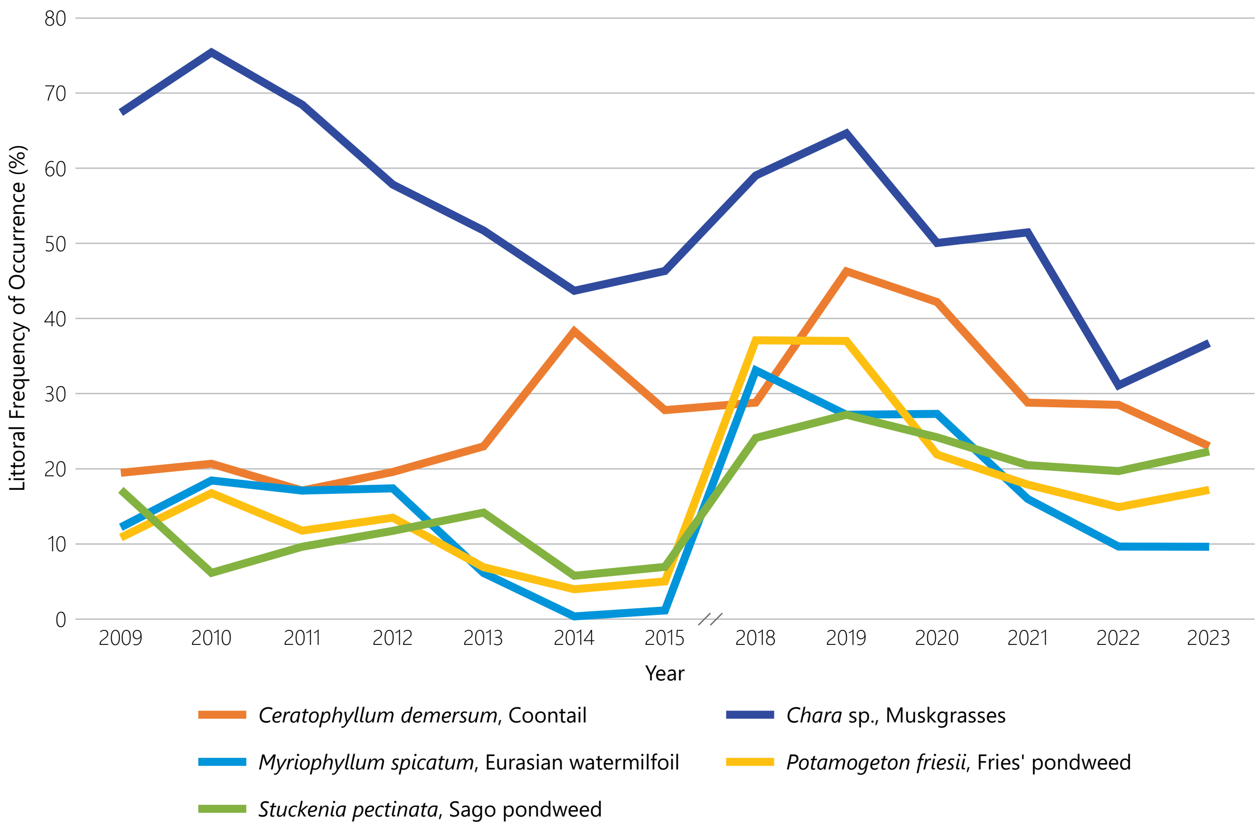
significantly over the years with minimum occurrence for Fries' pondweed at 4 percent and a maximum occurrence at 38 percent in 2018 as one example. These changes likely reflect changes in the lake ecology, including responses to aquatic plant management, as many of the WDNR staff who conducted these surveys were the same over the years. Figure 2.5 illustrates changes in littoral frequency of occurrence for common species.

- Since the 2009 survey, muskgrass, a type of macroalgae, has always been the most frequently observed plant in the Lake. This is a critical group of species to protect, as muskgrass has several unique environmental preferences as well as beneficial functions in lakes. Muskgrass is nearly always associated with hard water lakes, particularly those with significant groundwater seepage and springs. This species has been found to promote marl formation and induce dissolved phosphorus to be precipitated to the lake bottom, reducing phosphorus concentrations in the water column and thus improving water clarity.[18] Additionally, muskgrass is a favorite waterfowl food and helps stabilize lake-bottom sediment, as it has been observed to grow deeper than most vascular plants. Its prevalence in a lake's aquatic plant community may tangibly contribute to lake water quality, promoting the growth of other desirable native plant species.

- The abundance of muskgrass within the lake has declined from a maximum littoral frequency of occurrence of 75.4 percent in 2010 to a low of 31.1 percent in 2022. The cause of this decline is not immediately clear, but several other species including coontail, Sago pondweed, and Fries' pondweed have increased during this period so this decline may be partially due to competition from these species.

[18] *M. Scheffer and E.H. van Ness, "Shallow Lakes Theory Revisited: Various Alternative Regimes Driven by Climate, Nutrient, Depth, and Lake Size,"* Hydrobiologia *584, 2007.*

Figure 2.5
Trends in Common Aquatic Plants Within Turtle Lake



Source: WDNR and SEWRPC

- Several aquatic plant species have small populations within Turtle Lake but are consistently observed in most survey years. These species include bulrush, common bladderwort, curly leaf-pondweed, elodea, flat-stem pondweed, spatterdock, variable leaf-pondweed, and white water lily. Some of these species are observed in generally the same locations each survey year, with spatterdock most frequently found in the southwestern bay and white water lily observed in or near the northwestern channels. Bulrush, an emergent species, is only found in shallow areas around the lake periphery like the southwestern bay and thus never constitutes a major portion of the observed species. Flat-stem pondweed is most frequently observed along the eastern half of the Lake. Other species are observed sporadically around the Lake, which may indicate that these populations disperse or that they are diffuse and are missed during some surveys. One such species, common bladderwort, is a free-floating plant that can drift around the Lake and thus the population can physically move within the same year.

Invasive Species

This subsection will discuss invasive species observations in Turtle Lake, as these are often the focus of aquatic plant management efforts. The results of an April 2022 Association survey indicated that aquatic invasive species was the most common issue of concern amongst survey respondents.

Eurasian Watermilfoil (EWM)

EWM is one of eight milfoil species found in Wisconsin and is the only exotic or nonnative milfoil species. EWM favors mesotrophic to moderately eutrophic waters, fine organic-rich lake-bottom sediment, warmer water with moderate clarity and high alkalinity, and tolerates a wide range of pH and salinity.[19,20] In Southeastern

[19] *U.S. Forest Service,* Pacific Islands Ecosystems at Risk (PIER)*, 2019: hear.org/pier/species/myriophyllum_spicatum.htm.*

[20] *S.A. Nichols and B. H. Shaw, "Ecological Life Histories of the Three Aquatic Nuisance Plants: Myriophyllum spicatum, Potamogeton crispus, and Elodea canadensis,"* Hydrobiologia *131(1), 1986.*

Wisconsin, EWM can grow rapidly and has few natural enemies to inhibit its growth. Furthermore, it can grow explosively following major environmental disruptions, as small fragments of EWM can grow into entirely new plants.[21] For reasons such as these, EWM can grow to dominate an aquatic plant community in as little as two years.[22, 23] In such cases, EWM can displace native plant species and interfere with the aesthetic and recreational use of waterbodies. However, established populations may rapidly decline after approximately ten to 15 years.[24]

Human produced EWM fragments (e.g., created by boating through EWM), as well as fragments generated from natural processes (e.g., wind-induced turbulence, animal feeding/disturbance) readily colonize disturbed sites. contributing to EWM spread. EWM fragments can remain buoyant for two to three days in summer and two to six days in fall, with larger fragments remaining buoyant longer than smaller ones.[25] The fragments can also cling to boats, trailers, motors, and/or bait buckets where they can remain alive for weeks contributing to transfer of milfoil to other lakes. For these reasons, it is especially important to remove all vegetation from boats, trailers, and other equipment after removing them from the water and prior to launching in other waterbodies.

EWM was observed at 13.2 percent of vegetated points in Turtle Lake in 2009, 34.6 percent in 2018, and 11.3 percent in 2023. The EWM population had a brief downturn during 2014 and 2015 where it was observed at fewer than 2 percent of vegetated points before rising again to a high in 2018. In the 2023 survey, the largest EWM populations were in the southeastern and southwestern corners of the Lake along with a moderate density population in the northwestern channels (see Map A.2 in Appendix A).

Curly-Leaf Pondweed

Curly-leaf pondweed (CLP) has maintained a low abundance within Turtle Lake since 2009 and has never exceeded five percent of vegetated points within any aquatic plant survey. From 2009 to 2013, CLP was only observed along the eastern shoreline and in the northwestern channels. This species was not observed in the 2014 survey and only found at four points in 2015. Beginning in 2019, CLP was observed along the western shoreline where it has been more prevalent in the subsequent surveys with few observations along the eastern shore. This plant, like EWM, is identified in Chapter NR 109 of the *Wisconsin Administrative Code* as a nonnative invasive aquatic plant. Although survey data suggests that it is presently a minor species in terms of dominance, and, as such, is less likely to interfere with recreational boating activities, the plant can grow dense stands that exclude other high value aquatic plants. For this reason, curly-leaf pondweed must continue to be monitored and managed as an invasive member of the aquatic community. As curly-leaf pondweed senesces by midsummer, it may be underrepresented in the inventory data presented in this report.

Spiny Naiad

Spiny naiad is native to North America but was introduced to, and has become naturalized in, Wisconsin. Like CLP, this species is not common within Turtle Lake and attained its maximum occurrence of 8.6 percent of vegetated points in the 2018 survey. There were no observations of spiny naiad in the 2009, 2010, 2012, or 2022 surveys. Across these surveys, spiny naiad has been observed in various locations around the lake in both deep and shallow water although it is more commonly observed in shallow nearshore areas. The WDNR has labeled spiny naiad as a restricted species in Wisconsin, identifying it as an established invasive species that has the potential to cause significant environmental or economic harm.[26] However, spiny naiad is reported to be used as a food source for waterfowl, marsh birds, muskrat, and shelter/forage area for fish.

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[21] Ibid.

[22] *S.R. Carpenter, "The Decline of Myriophyllum spicatum in a Eutrophic Wisconsin (USA) Lake,"* Canadian Journal of Botany *58(5), 1980.*

[23] *Les, D. H., and L. J. Mehrhoff, "Introduction of Nonindigenous Vascular Plants in Southern New England: a Historical Perspective,"* Biological Invasions *1: 284-300, 1999.*

[24] *S.R. Carpenter, 1980,* op. cit.

[25] *J.D. Wood and M. D. Netherland, "How Long Do Shoot Fragments of Hydrilla (Hydrilla verticillata) and Eurasian Watermilfoil (Myriophyllum spicatum) Remain Buoyant?",* Journal of Aquatic Plant Management *55: 76-82, 2017.*

[26] *Wisconsin Department of Natural Resources, Chapter NR 40, Invasive Species Identification, Classification and Control, April 2017.*

Starry Stonewort

Starry stonewort (*Nitellopsis obtusa*) is a relatively new aquatic invasive macroalga species in Wisconsin. As a member of the Characeae, starry stonewort is related to native *Chara*, *Lychnothamnus*, *Nitella*, and *Tolypella* species, which have roughly similar characteristics and are found in many hardwater lakes across Wisconsin. Native to Eurasia, the first discovery of the species in North America was in the St. Lawrence Seaway in 1978; it has since spread to several northeastern and midwestern US states as well as southern Ontario.[27] First observed within Wisconsin in Little Muskego Lake during September 2014, starry stonewort has spread to several lakes throughout Southeastern Wisconsin, including Geneva Lake in Walworth County.[28] Starry stonewort has not been observed in Turtle Lake, but given its spread throughout the Region anyone monitoring Turtle Lake for invasive species should be aware of and able to identify this species.

In its native range, SSW has been shown to provide food and habitat for aquatic organisms as well as enhance lake water quality by reducing sediment suspension and acting as a phosphorus sink.[29] In invaded lakes, SSW can form dense beds, with reported maximum heights of 4 to 7 feet, outcompete both native and other invasive plant species, and cover fish spawning areas.[30,31,32] This species is capable of both sexual and asexual reproduction, which can occur through plant fragments as well as the star-shaped bulbils for which the species is named.[33] Only male species have been observed in North America thus far, indicating that all spread has been through asexual reproduction. Bulbils may stay viable in lake sediment for several years, making it extremely difficult to eradicate SSW from a waterbody.

Impairment Listing

In 2024, the WDNR placed Turtle Lake on the 2024 303(d) impaired water list with an impairment of "degraded aquatic plant community (macrophytes)" with pollutant listed as "cause unknown." The reason for this listing is due to the application of an aquatic plant assessment model that was utilized as a standalone metric in 2024 for the first time.[34] Commission staff disagree with this impairment listing due to how the model is being applied and its use as a standalone metric when other aquatic plant metrics indicate that Turtle Lake has a relatively healthy aquatic plant community. Commission and WDNR staff have and will continue to discuss this listing and the model application with WDNR Water Evaluation staff who conduct waterbody assessments. Commission staff hope that WDNR Water Evaluation staff will reconsider the designation of Turtle Lake as impaired in the 2026 listing cycle. This impairment listing is discussed in greater detail in Appendix B.

2.3 AQUATIC PLANT MANAGEMENT PRACTICES

The mission of the Association is to protect Turtle Lake and its shoreline. In furtherance of that mission, the Association studies and manages the Turtle Lake aquatic plant community to enhance lake health and recreational opportunities, including maintaining a healthy fishery. The following section will provide an overview of benefits and considerations of existing aquatic plant management practices and describe which practices have recently been utilized on Turtle Lake.

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[27] *starrystonewort.org/maps.*

[28] *apps.dnr.wi.gov/lakes/invasives/AISLists.aspx?species=STARRY_STONEW.*

[29] *For a more complete review of SSW ecology in its native and invasive range, see D.J. Larkin, A.K. Monfils, A. Boissezon, R.S. Sleith, P.M. Skawinski, C.H. Welling, B.C. Cahill, and K.G. Karol, "Biology, Ecology, and Management of Starry Stonewort (Nitellopsis obtusa; Characeae): A Red-listed Eurasian Green Alga Invasive in North America,"* Aquatic Botany *148: 15-24, 2018 as well as State of Michigan, Status and Strategy for Starry Stonewort (Nitellopsis obtusa (Desv. In Loisel.) J. Groves) Management, last updated December 2017 (www.michigan.gov/documents/invasives/egle-ais-nitellopsis-obtusa-strategy_708937_7.pdf).*

[30] Ibid.

[31] *dnr.wisconsin.gov/sites/default/files/topic/Invasives/Nitellopsis%20obtusa.pdf.*

[32] *G.D. Pullman and G. Crawford, "A Decade of Starry Stonewort in Michigan,"* Lakeline *36-42, 2010.*

[33] *dnr.wisconsin.gov/topic/Invasives/fact/StarryStonewort.*

[34] *Mikulyuk et al., 2017,* op. cit.

Aquatic plant management techniques can be classified into six categories.

- *Physical measures* include lake bottom coverings
- *Biological measures* include the use of organisms such as herbivorous insects
- *Manual measures* involve physically removing plants by hand or using hand-held tools such as rakes
- *Mechanical measures* rely on artificial power sources and remove aquatic plants with a machine known as a harvester or by suction harvesting
- *Chemical measures* use aquatic herbicides to kill nuisance and nonnative plants *in-situ*
- *Water level manipulation measures* utilize fluctuations in water levels to reduce aquatic plant abundance and promote growth of specific native species

All aquatic plant control measures are stringently regulated and most require a State of Wisconsin permit. Chemical controls, for example, require a permit and are regulated under *Wisconsin Administrative Code* Chapter NR 107, "Aquatic Plant Management" while placing bottom covers (a physical measure) requires a WDNR permit under Chapter 30 of the *Wisconsin Statutes*. All other aquatic plant management practices are regulated under *Wisconsin Administrative Code* Chapter NR 109, "Aquatic Plants: Introduction, Manual Removal and Mechanical Control Regulations." Furthermore, the aquatic plant management measures described in this plan are consistent with the requirements of Chapter NR 7, "Recreational Boating Facilities Program," and with the public recreational boating access requirements relating to eligibility under the State cost-share grant programs set forth in *Wisconsin Administrative Code* Chapter NR 1, "Natural Resources Board Policies." Water level manipulations require a permit and are regulated under *Wisconsin Statutes* 30.18 and 31.02.[35,36] More details about aquatic plant management measures are discussed in the following sections while recommendations are provided later in this document.

Non-compliance with aquatic plant management permit requirements is an enforceable violation of Wisconsin law and may lead to fines and/or complete permit revocation. The information and recommendations provided in this memorandum help frame permit requirements. Permits can cover up to a five-year period.[37] At the end of that period, the aquatic plant management plan must be updated. The updated plan must consider the results of a new aquatic plant survey and should evaluate the success, failure, and effects of earlier plant management activities that have occurred on the lake.[38] These plans and plan execution are reviewed and overseen by the WDNR regional lakes and aquatic invasive species coordinators.[39]

Physical Measures

Lake-bottom covers and light screens provide limited control of rooted plants by creating a physical barrier that reduces or eliminates plant-available sunlight. Various materials such as pea gravel or synthetics like polyethylene, polypropylene, fiberglass, and nylon can be used as covers. The longevity, effectiveness, and overall value of some physical measures is questionable. The WDNR does not permit these kinds of controls. Consequently, lake-bottom covers are not a viable aquatic plant control strategy for the Lake.

Biological Measures

Biological control offers an alternative to direct human intervention to manage nuisance or exotic plants. Biological control techniques traditionally use herbivorous insects that feed upon nuisance plants. This

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[35] *docs.legis.wisconsin.gov/statutes/statutes/30/ii/18.*

[36] *docs.legis.wisconsin.gov/statutes/statutes/31/02.*

[37] *Five-year permits allow a consistent aquatic plant management plan to be implemented over a significant length of time. This process allows the selected aquatic plant management measures to be evaluated at the end of the permit cycle.*

[38] *Aquatic plant harvesters must report harvesting activities as one of the permit requirements.*

[39] *Information on the current aquatic invasive species coordinator is found on the WDNR website.*

approach has been effective in some southeastern Wisconsin lakes.[40] For example, milfoil weevils (*Eurhychiopsis lecontei)* have been used to control EWM. Milfoil weevils do best in waterbodies with balanced panfish populations,[41] where dense EWM beds reach the surface close to shore, where natural shoreline areas include leaf litter that provides habitat for over-wintering weevils, and where there is comparatively little boat traffic. This technique is not presently commercially available making the use of milfoil weevils non-viable.

Manual Measures

Manually removing specific types of vegetation is a highly selective means of controlling nuisance aquatic plant growth, including invasive species such as EWM. Two commonly employed methods include hand raking and hand pulling. Both physically remove target plants from a lake. Since plant stems, leaves, roots, and seeds are actively removed from the lake, the reproductive potential and nutrients contained by pulled/raked plants material is also removed. These plants, seeds, and nutrients would otherwise re-enter the lake's water column or be deposited on the lake bottom. Hence, this aquatic plant management technique helps incrementally maintain water depth, improves water quality, and can help decrease the spread of nuisance/exotic plants. Hand raking and hand pulling are readily allowed by WDNR and are practical methods to control riparian landowner scale problems.

Raking with specially designed hand tools is particularly useful in shallow nearshore areas. This method allows nonnative plants to be removed and provides a safe and convenient aquatic plant control method in deeper nearshore waters around piers and docks. Advantages of this method include:

- Tools are inexpensive ($100 to $150 each)
- The method is easy to learn and use
- It may be employed by riparian landowners without a permit if certain conditions are met
- Results are immediately apparent
- Plant material is immediately removed from a lake (including seeds)

The second manual control method, hand-pulling whole plants (stems, roots, leaves, seeds) where they occur in isolated stands, is a simple means to control nuisance and invasive plants in shallow nearshore areas that may not support large-scale initiatives. This method is particularly helpful when attempting to target nonnative plants (e.g., EWM, curly-leaf pondweed) during the high growth season when native and nonnative species often comingle. Hand pulling is more selective than raking, mechanical removal, and chemical treatments, and, if carefully applied, is less damaging to native plant communities. Recommendations regarding hand-pulling, hand-cutting, and raking are discussed later in this document.

Mechanical Measures

Two methods of mechanical harvesting are currently employed in Wisconsin - mechanical harvesting and suction harvesting. Both are regulated by WDNR and require a permit.[42]

Mechanical Harvesting

Aquatic plants can be mechanically gathered using specialized equipment commonly referred to as harvesters. Harvesters use an adjustable depth cutting apparatus that can cut and remove plants from the water surface to up to about five feet below the water surface. The harvester gathers cut plants with

[40] *B. Moorman, "A Battle with Purple Loosestrife: A Beginner's Experience with Biological Control,"* LakeLine *17(3): 20-21, 34-37, September 1997; see also, C.B. Huffacker, D.L. Dahlsen, D.H. Janzen, and G.G. Kennedy, Insect Influences in the Regulation of Plant Population and Communities, pp. 659-696, 1984; and C.B. Huffacker and R.L. Rabb, editors,* Ecological Entomology, *John Wiley, New York, New York, USA.*

[41] *Panfish such as bluegill and pumpkinseed are predators of herbivorous insects. High populations of panfish lead to excess predation of milfoil weevils.*

[42] *Mechanical control permit conditions depend upon harvesting equipment type and specific equipment specifications.*

a conveyor, basket, or other device. Mechanical harvesting is often a very practical and efficient means to control nuisance plant growth and is widely employed in Southeastern Wisconsin.

In addition to controlling plant growth, gathering and removing plant material from a lake reduces in-lake nutrient recycling, sedimentation, and targets plant reproductive potential. In other words, harvesting removes plant biomass, which would otherwise decompose and release nutrients, sediment, and seeds or other reproductive structures (e.g., turions, bulbils, plant fragments) into a lake. Mechanical harvesting is particularly effective and popular for large-scale open-water projects. However, small harvesters are also produced that are particularly suited to working around obstacles such as piers and docks in shallow nearshore areas.

An advantage of mechanical harvesting is that the harvester, when properly operated, "mows" aquatic plants and, therefore, typically leaves enough living plant material in place to provide shelter for aquatic wildlife and stabilize lake-bottom sediment. Harvesting, when done properly, does not kill aquatic plants, it simply trims plants back. Aside from residual plant mass remaining because of imperfect treatment strategy execution, none of the other aquatic plant management methods purposely leave living plant material in place after treatment. Aquatic plant harvesting has been shown to allow light to penetrate to the lakebed and stimulate regrowth of suppressed native plants. This is particularly effective when controlling invasive plant species that commonly grow quickly early in the season (e.g., EWM, curly-leaf pondweed) when native plants have not yet emerged or appreciably grown.

A disadvantage of mechanical harvesting is that the harvesting process may fragment plants and thereby unintentionally propagate EWM and curly-leaf pondweed. EWM fragments are particularly successful in establishing themselves in areas where plant roots have been removed. This underscores the need to avoid harvesting or otherwise disrupting native plant roots. Harvesting may also agitate bottom sediments in shallow areas, thereby increasing turbidity and resulting in deleterious effects such as smothering fish breeding habitat and nesting sites. To this end, most WDNR-issued permits do not allow deep-cut harvesting in water less than three feet deep,[43] which limits the utility of this alternative in many littoral and shoal areas. Nevertheless, if employed correctly and carefully under suitable conditions, harvesting can benefit navigation lane maintenance and can reduce regrowth of nuisance plants while maintaining, or even enhancing, native plant communities.

Cut plant fragments commonly escape the harvester's collection system and form mats or accumulate on shorelines. To compensate for this, most harvesting programs include a plant pickup program. Some plant pickup programs use a harvester to gather and collect significant accumulations of floating plant debris as well as sponsor regularly scheduled aquatic plant pick up from lakefront property owner docks. Property owners are encouraged to actively rake plant debris along their shorelines and place these piles on their docks for collection. This kind of program, when applied systematically, can reduce plant propagation from plant fragments and can help alleviate the negative aesthetic consequences of plant debris accumulating on shorelines. Nevertheless, it is important to remember that normal boating activity (particularly during summer weekends) often creates far more plant fragments than generated from mechanical harvesting. Therefore, a plant pickup program is often essential to protect a lake's health and aesthetics, even in areas where harvesting has not recently occurred.

The most recent mechanical harvesting operation on Turtle Lake occurred in 2019 with the goal of improving navigation by reducing the abundance of EWM, The WDNR permitted this harvesting of a combined three acres in the northwestern portion of the main body of the lake. A farm located at N6327 STH 89 in the Town of Richmond was designated as the primary disposal site for harvested plants.

Diver-Assisted Methods

Another mechanical plant harvesting method, known as suction harvesting, uses suction to remove sediment, aquatic plants, and any seeds or bulbils in the sediment and disposes this material outside the lake. Since bottom material is removed from the lake, this technique also requires a dredging permit in addition to the aquatic plant management permit.

[43] *Deep-cut harvesting is harvesting to within one foot of the lake bottom. This is not allowed in shallow water because it is challenging to ensure that the harvester avoids lake-bottom contact in such areas.*

First permitted in Wisconsin in 2014, diver-assisted hand-pulling is a mechanical process where divers identify and pull select aquatic plants and roots from the lakebed and then insert the entire plant into a suction hose that transports the plant to the surface for collection and disposal. The process is a mechanically assisted method for hand-pulling aquatic plants. Such labor-intensive work by skilled professional divers is, at present, a costly undertaking and long-term monitoring will need to evaluate the efficacy of the technique. Nevertheless, many apparent advantages are associated with this method including: 1) lower potential to release plant fragments when compared to mechanical harvesting, raking, and hand-pulling, thereby reducing spread and growth of invasive plants like EWM; 2) increased selectivity of plant removal when compared to mechanical techniques and hand raking which in turn reduces native plant loss; and 3) lower potential for disturbing fish habitat.

Since 2019, the Association has utilized diver-assisted hand-pulling as the primary management method to control the lake's EWM population. In June 2020, the Association contracted Eco Waterway Services, LLC to treat 1.94 acres near the private boat launch and at the eastern end of the northwestern channels to target dense EWM populations (see Table 2.4 and Appendix C). This treatment resulted in the removal of 7,950 pounds of aquatic plants, which were estimated to be 95 percent EWM and 5 percent native plants. This treatment was expanded to 2.89 acres in June 2021 with treatment in the area in front of the private launch and the western end of the northwestern channels (see Appendix C). This treatment resulted in the removal of 8,000 pounds of plants, which were estimated to be 90 percent EWM and 10 percent native. In June 2022, 2.82 acres of the northern shoreline of the Lake were treated, resulting in 4,750 pounds of plants removed that were 90 percent non-native and 10 percent native. The most recent treatment for which Commission staff could find records was in June 2023, in which 10,000 pounds of plants at 90 percent non-native were removed from a 0.9 acre strip near the eastern shore.[44]

These monitoring efforts have been informed by the frequent aquatic plant surveys of the Lake which assist in identifying dense EWM populations and evaluating the response of these populations. Each survey was conducted following the hand-pulling treatment each year, so there is no prior data to show a change in EWM density due to the treatment. However, as illustrated on Figure 2.5, the EWM littoral frequency of occurrence has declined from 27 to 9 percent between 2019 and 2023 which may indicate the success that these treatments have had in reducing EWM and allowing native species to compete. As mentioned in chapter 1, Association members seem satisfied with the effectiveness of the hand-pulling efforts as indicated in April 2022 survey results.

Chemical Measures

Aquatic chemical herbicide use is stringently regulated. A WDNR permit and direct WDNR staff oversight is required during application. Chemical herbicide treatment is used for short time periods to temporarily control excessive nuisance aquatic plant growth. Chemicals are applied to growing plants in either liquid or granular form. Advantages of chemical herbicides aquatic plant growth control include low cost as well as the ease, speed, and convenience of application. However, many drawbacks are also associated with chemical herbicide aquatic plant control including the following examples.

- **Unknown and/or conflicting evidence about the effects of long-term chemical exposure on fish, fish food sources, and humans.** The U.S. Environmental Protection Agency, the agency responsible for approving aquatic plant treatment chemicals, studies aquatic plant herbicides to evaluate short-term exposure (acute) effects on human and wildlife health. Some studies also examine long-term (chronic) effects of chemical exposure on animals (e.g., the effects of being exposed to these herbicides for many years). However, it is often impossible to conclusively state that no long-term effects exist due to the animal testing protocol, time constraints, and other factors. Furthermore, long-term studies cannot address all potentially affected species.[45] For example, conflicting studies/opinions exist regarding the role of the chemical 2,4-D as a human carcinogen.[46] Some lake property owners judge the risk of using chemicals as being excessive

[44] *The 2023 diver-assisted hand-pulling report states that 0.09 acres were treated but the associated map shows a 41,335 square-foot (0.9-acre) treatment area.*

[45] *U.S. Environmental Protection Agency,* EPA-738-F-05-002, 2,4-D RED Facts*, June 2005.*

[46] *M.A. Ibrahim et al., "Weight of the Evidence on the Human Carcinogenicity of 2,4-D",* Environmental Health Perspectives *96: 213-222, December 1991.*

Table 2.4
Summary of Diver-Assisted Hand-Pulling Treatments on Turtle Lake: 2020-2023

Year	Treated Acreage	Total Plants Removed (lbs.)	Percent EWM or CLP in Removed Plants (%)	EWM or CLP Removed (lbs.)	Reported Native Species Removed
2020	1.94	7,950	95	7,552	N/A
2021	2.89	8,000	90	7,200	N/A
2022	2.82	4,750	90	4,275	Muskgrass
2023	0.90	10,000	90	9,000	Muskgrass

Source: WDNR; Turtle Lake Improvement and Protective Association; Eco Waterway Service, LLC; and SEWRPC

despite legality of use. Consequently, the concerns of lakefront owners should be considered whenever chemical treatments are proposed. Moreover, if chemicals are used, they should be applied as early in the season as practical. This helps assure that the applied chemical decomposes before swimming, water skiing, and other active body-contact lake uses begin.[47] Early season application also is generally the best time to treat EWM and curly-leaf pondweed for a variety of technical reasons explained in more detail as part of the "loss of native aquatic plants and related reduction or loss of desirable aquatic organisms" bullet below.

- **Reduced water clarity and increased risk of algal blooms.** Water-borne nutrients promote growth of both aquatic plants and algae. If rooted aquatic plant populations are depressed, demand for dissolved nutrients will be lessened. In such cases, algae tend to become more abundant, a situation reducing water clarity. For this reason, lake managers must avoid needlessly eradicating native plants and excessive chemical use. Lake managers must strive to maintain balance between rooted aquatic plants and algae - when the population of one declines, the other may increase in abundance to nuisance levels. In addition to upsetting the nutrient balance between rooted aquatic plants and algae, dead chemically treated aquatic plants decompose and contribute nutrients to lake water, a condition that may exacerbate water clarity concerns and algal blooms.

- **Reduced dissolved oxygen/oxygen depletion.** When chemicals are used to control large mats of aquatic plants, the dead plant material settles to the bottom of a lake and decomposes. Plant decomposition uses oxygen dissolved in lake water, the same oxygen that supports fish and many other vital beneficial lake functions. In severe cases, decomposition processes can deplete oxygen concentrations to a point where desirable biological conditions are no longer supported.[48] Ice covered lakes and the deep portions of stratified lakes are particularly vulnerable to oxygen depletion. Excessive oxygen loss can inhibit a lake's ability to support certain fish and can trigger processes that release phosphorus from bottom sediment, further enriching lake nutrient levels. These concerns emphasize the need to limit chemical control and apply chemicals in *early* spring, when EWM and curly-leaf pondweed have not yet formed dense mats.

- **Increased organic sediment deposition.** Dead aquatic plants settle to a lake's bottom, and, because of limited oxygen and/or rapid accumulation, may not fully decompose. Flocculent organic rich sediment often results, reducing water depth. Care should be taken to avoid creating conditions leading to rapid thick accumulations of dead aquatic plants to promote more complete decomposition of dead plant material.

- **Loss of native aquatic plants and related reduction or loss of desirable aquatic organisms.** EWM and other invasive plants often grow in complexly intermingled beds. Additionally, EWM is physically similar to, and hybridizes with, native milfoil species. Native plants, such as pondweeds,

[47] *Though the manufacturers indicate that swimming in 2,4-D-treated lakes is allowable after 24 hours, it is possible that some swimmers may want more of a wait time to lessen chemical exposure. Consequently, allowing extra wait time is recommended to help lake residents and l users can feel comfortable that they are not being unduly exposed to aquatic plant control chemicals.*

[48] *The WDNR's water quality standard to support healthy fish communities is 5 mg/L for warmwater fish communities and 7 mg/L for coldwater fish communities.*

provide food and spawning habitat for fish and other wildlife. A robust and diverse native plant community forms the foundation of a healthy lake and the conditions needed to provide and host desirable gamefish. Fish, and the organisms fish eat, require aquatic plants for food, shelter, and oxygen. If native plants are lost due to insensitive herbicide application, fish and wildlife populations often suffer. For this reason, if chemical herbicides are applied to the Lake, these chemicals must target EWM or curly-leaf pondweed and therefore should be applied in early spring when native plants have not yet emerged. Early spring application has the additional advantage of being more effective due to colder water temperatures, a condition enhancing herbicidal effects and reducing the dosing needed for effective treatment. Early spring treatment also reduces human exposure concerns (e.g., swimming is not particularly popular in early spring).

- **Need for repeated treatments.** Chemical herbicides are not a one-time silver-bullet solution—instead, treatments need to be regularly repeated to maintain effectiveness. Treated plants are not actively removed from the Lake, a situation increasing the potential for viable seeds/fragments to remain after treatment, allowing target species resurgence in subsequent years. Additionally, leaving large expanses of lakebed devoid of plants (both native and invasive) creates a disturbed area without an established plant community. EWM thrives in disturbed areas. In summary, applying chemical herbicides to large areas can provide opportunities for exotic species reinfestation and new colonization which in turn necessitates repeated and potentially expanded herbicide applications.

- **Hybrid watermilfoil's resistance to chemical treatment**. The presence of hybrid watermilfoil complicates chemical treatment programs. Research suggests that certain hybrid strains may be more tolerant to commonly utilized aquatic herbicides such as 2,4-D and Endothall.[49,50] Consequently, further research regarding hybrid watermilfoil treatment efficacy is required to apply appropriate herbicide doses. This increases the time needed to acquire permits and increases application program costs.

- **Effectiveness of small-scale chemical treatments**. Small-scale EWM treatments using 2,4-D have yielded highly variable results. A study completed in 2015 concluded that less than half of 98 treatment areas were effective or had more than a 50 percent EWM reduction.[51] For a treatment to be effective, a target herbicide concentration must be maintained for a prescribed exposure time. However, wind, wave and other hard to predict mixing actions often dissipate herbicide doses. Therefore, when deciding to implement small-scale chemical treatments, the variability in results and treatment cost of treatment should be examined and contrasted.

In 2019, a chemical treatment was permitted within the northwestern channels of the lake with the goal of mitigating navigational impediments caused by growth of EWM and curly-leaf pondweed. The permitted treatment was intended to be a littoral application to a 1.5-acre area of these channels adjoining the Snug Harbor Inn riparian property and another riparian property west of the boat launch. However, members of the Association noted that abundance of native aquatic plants, turtles, and fish spawning in the channels and opposed the application, which did not occur.[52] Since 2019, the Association's members have agreed to no chemical usage for aquatic plant management in the Lake and no other chemical application permits have been approved.[53]

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[49] *L.M. Glomski and M.D. Netherland, "Response of Eurasian and Hybrid Watermilfoil to Low Use Rates and Extended Exposures of 2,4-D and Triclpyr,"* Journal of Aquatic Plant Management *48: 12-14, 2010.*

[50] *E.A. LaRue et al., "Hybrid Watermilfoil Lineages are More Invasive and Less Sensitive to a Commonly Used Herbicide than Their Exotic Parent (Eurasian Watermilfoil),"* Evolutionary Applications *6: 462-471, 2013.*

[51] *M. Nault et al., "Control of Invasive Aquatic Plants on a Small Scale,"* Lakeline *35-39, 2015.*

[52] *Correspondence with Linda Szramiak, February 3rd, 2025.*

[53] *Correspondence with Linda Szramiak, May 1st, 2024.*

Water Level Manipulation Measures

Manipulating water levels can also be an effective method for controlling aquatic plant growth and restoring native aquatic plant species, particularly emergent species such as bulrush and wild rice.[54] In Wisconsin, water level manipulation is considered to be most effective by using winter lake drawdowns, which expose lake sediment to freezing temperatures while avoiding conflict with summer recreational uses. One to two months of lake sediment exposure can damage or kill aquatic plant roots, seeds, and turions through freezing and/or desiccation. As large areas of lake sediment need to remain exposed for extended periods, water level manipulation is most cost effective in lakes with operable dam gates that can provide fine levels of control of water elevations within the lake. In lakes without dams, high capacity water pumping can be used to reduce lake levels at much greater cost.

While water level manipulation affects all aquatic plants within the drawdown zone, not all plants are equally susceptible to drawdown effects. Abundance of water lilies and milfoils (*Myriophyllum* spp.) can be greatly reduced by winter drawdowns while other species, such as duckweeds, may increase in abundance.[55] Two studies from Price County, Wisconsin show reduced abundance of invasive EWM and curly-leaf pondweed and increased abundance of native plant species following winter drawdowns.[56,57] Thus, drawdowns can be used to dramatically alter the composition of a lake's aquatic plant community. Many emergent species rely upon the natural fluctuations of water levels within a lake. Conducting summer and early fall drawdowns have effectively been used to stimulate the growth of desired emergent vegetation species, such as bulrush, burreeds, and wild rice, in the exposed lake sediments, which subsequently provide food and habitat for fish and wildlife. However, undesired emergent species, such as invasive cattails and phragmites, can also colonize exposed sediment, so measures should be taken to curtail their growth during a drawdown.[58]

Water level manipulation can also have unintended impacts on water chemistry and lake fauna.[59,60] Decreased water clarity and dissolved oxygen concentrations as well as increased nutrient concentrations and algal abundance have all been reported following lake drawdowns. Rapid drawdowns can leave lake macroinvertebrates and mussels stranded in exposed lake sediment, increasing their mortality, and subsequently reducing prey availability for fish and waterfowl. Similarly, drawdowns can disrupt the habitat and food sources of mammals, birds, and herptiles, particularly when nests are flooded as water levels are raised in the spring. Therefore, thoughtful consideration of drawdown timing, rates, and elevation as well as the life history of aquatic plants and fauna within the lake is highly recommended. Mimicking the natural water level regime of the lake as closely as possible may be the best approach to achieve the desired drawdown effects and minimize unintended and detrimental consequences.

As discussed above, water level manipulation is large-scale, permitted operation that can major effects on lake ecology. Consequently, detailed information on the Lake's hydrology, including groundwater, should be compiled before undertaking such an operation. The WDNR would likely require and consider the following during review of the drawdown permit application:

- Existing lake bottom contours should be reevaluated with any changes mapped to develop updated bathymetric information.
- Lake volume needs to be accurately determined for each foot of depth contour.

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[54] *For detailed literature reviews on water level manipulation as an aquatic plant control measure, see C. Blanke, A. Mikulyuk, M. Nault, et al., Strategic Analysis of Aquatic Plant Management in Wisconsin, Wisconsin Department of Natural Resources, pp. 167-171, 2019 as well as J.R. Carmignani and A.H. Roy, "Ecological Impacts of Winter Water Level Drawdowns on Lake Littoral Zones: A Review,"* Aquatic Sciences *79: 803-824, 2017.*

[55] *G.D. Cooke, "Lake Level Drawdown as a Macrophyte Control Technique,"* Water Resources Bulletin *16(2): 317-322, 1980*

[56] *Onterra, LLC, Lac Sault Dore, Price County, Wisconsin: Comprehensive Management Plan, 2013.*

[57] *Onterra, LLC, Musser Lake Drawdown Monitoring Report, Price County, Wisconsin, 2016.*

[58] *Blanke et al., 2019,* op. cit.

[59] Ibid.

[60] *Cooke, 1980,* op. cit.

- Lake bottom acreage exposed during various intervals of the drawdown must be determined.
- Knowledge of the drawdown and refill times for the Lake would guide proper timing of drawdown to maximize effectiveness and minimize impacts to Lake users.
- A safe drawdown discharge rate would need to be calculated to prevent downstream flooding and erosion.
- Effects on the lake drawdown to the structural integrity of outlet dams should be examined.
- A WDNR permit and WDNR staff supervision are required to draw down a lake. Additionally, lakeshore property owners need to be informed of the drawdown and permit conditions before the technique is implemented. Targeted invasive species populations should be monitored before and after refill is complete to assess efficacy and guide future management.

The impacts of several dams and dam modifications on Lake water levels have been well studied on Turtle Lake.[61] Although the lake is controlled by an outlet dam, the dam is a natural constriction immediately south of the lake at an elevation of 900 feet, National Geodetic Vertical Datum of 1929 (NGVD 29).[62] During drought years, the Lake water level drops below this elevation and the lake outlet stream, Turtle Creek, runs dry. As a natural constriction, there are currently no mechanisms to raise or lower the water levels at this dam. A study conducted by AECOM in 2014 examined whether repairing a dam breach further downstream near Turtle Lake Road would stabilize water levels in the lake and found that this breach would only control levels between one and six percent of the time. Repairing this dam breach and installing water control mechanisms would also not provide capacity for managing aquatic plants using water level fluctuations.

2.4 FISHERIES

Turtle Lake supports a warmwater fish population with several sport fish species. A 1961 WDNR report indicates that the Lake was managed for northern pike, panfish, largemouth bass, and yellow perch.[63] A fishery classification approach developed for Wisconsin lakes designates the Turtle Lake fishery as a complex, warm, dark system. This approach describes these systems as "*Greater than or equal to four sportfish species, high degree days, low secchi, low in landscape, Walleye are an indicator species, Black Crappie can be in abundance, can develop quality Northern Pike and/or Muskellunge size structure*."[64] Several nearby lakes in Walworth County share the same classification, including Delavan Lake, Middle and Mill of the Lauderdale Lakes, and Whitewater Lake.

A 2017 fishery survey conducted by WDNR using boom-shocking equipment observed ten species within Turtle Lake: black crappie, bluegill, brook silverside, brown bullhead, largemouth bass, northern pike, pumpkinseed, warmouth, yellow bullhead, and yellow perch (see Table 2.5). Lake chubsucker, a Wisconsin species of Special Concern, has also been observed within the lake. As described in Table 2.5, many of the observed fish species prefer dense vegetation beds for reproduction, as a food source, or as shelter from predation. Largemouth bass and northern pike often utilize shallow areas with emergent plants for reproduction—similar habitat can be found along the southwestern shore of Turtle Lake. Most of the observed fish species are also intermediately tolerant of poor water conditions, such as low dissolved oxygen concentrations, while brown and yellow bullhead are considered tolerant of low oxygen. An examination of the dissolved oxygen profiles concentrations available for Turtle Lake in the WDNR Water Explorer tool indicated that the lake depths below 15 feet frequently have dissolved oxygen concentrations below 5 mg/l in the summer.[65] A minimum DO concentration of 5 mg/l is considered necessary for the survival of many desirable fish species.

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[61] *For more information, see the studies linked on the Turtle Lake Improvement and Protective Association website at turtlelakers.org/lake-water-level-data.*

[62] *WDNR Dam Report for the Dam Number 1533, Turtle Lake Dam.*

[63] *apps.dnr.wi.gov/water/waterDetail.aspx?key=18244.*

[64] *A.L. Rypel, T.D. Simonson, D.L. Oele, et al., Flexible Classification of Wisconsin Lakes for Improved Fisheries Conservation and Management*, Fisheries *44:5 225-238, 2019.*

[65] *The WDNR Water Explorer tool can be accessed at dnr-wisconsin.shinyapps.io/WaterExplorer.*

Table 2.5
Ecological Qualities Associated with Observed or Stocked Fish Species in Turtle Lake

Common Name	Scientific Name	Ecological Significance
Black crappie	*Pomoxis nigromaculatus*	Prefer cools, clear, and still water with sand or mud bottom and vegetative cover. Nests in dense vegetation. Omnivores. Prey item for largemouth bass and channel catfish.
Bluegill	*Lepomis macrochirus*	Live in lakes and streams with dense vegetation beds. Nest in sand or fine gravel. Primarily carnivores. Prey item for largemouth bass.
Brook silverside	*Labidesthes sicculus*	Lives at top of clear lakes with dense vegetation. Spawn around vegetation. Insectivores. Prey item for smallmouth bass, cisco, and gar.
Brown bullhead	*Ameiurus nebulosus*	Bottom-dwelling fish found in lakes and pools of streams. Can tolerate wide range of water conditions, including warm temperatures and low dissolved oxygen. Nest in sand, gravel, or mud near vegetation or wood cover. Omnivores. Prey item for sunfish, northern pike, and walleye.
Lake chubsucker	*Erimyzon sucetta*	Special Concern species. Prefer clear lakes with dense vegetation beds. Spawn in vegetation beds or over gravel. Vegetation can constitute major part of diet. Prey item for largemouth bass.
Largemouth bass	*Micropterus salmoides*	Thrive in many lakes and streams but most abundant in warm, well-vegetated lakes. Prefer shallow habitat near woody or vegetative cover. Nest in sand, clay, or marl. Omnivorous/piscivorous - adults are often a top predator in lakes. Juveniles are prey item for black crappie, channel catfish, sunfish, northern pike, walleye, and yellow perch.
Northern pike	*Esox lucius*	Adaptable and thrive in many lakes and streams. Spawn in shallow wetlands near lakes and streams. Carnivorous – adults are often a top predator in lakes. Juveniles are prey item for piscivorous fish.
Pumpkinseed	*Lepomis gibbosus*	Prefer cool to warm, clear water with dense vegetation. Nest in shallow, vegetated bays of lakes. Inhabit dense vegetation to avoid predators. Omnivore. Prey item for largemouth bass, northern pike, walleye, and yellow perch.
Smallmouth bass	*Micropterus dolomieu*	Prefers cool and clear rivers and lakes with structures like logs and rocks. Nest in gravel. Omnivore – highly visual predator. Large adults can be top predators but juveniles are prey item to other fish.
Walleye	*Sander vitreus*	Prefer cool to warm water in rivers and lakes. Can tolerate low dissolved oxygen concentrations but are sensitive to oxygen supersaturation. Spawn on extensive shallow sandbars and shoals. Inhabit shallow areas but migrate to deeper water daily. Piscivorous – adults are often a top predator in lakes. Juveniles and small adults are prey items for bass, black crappie, and yellow perch.
Warmouth	*Lepomis gulosus*	Found in lakes and streams with wide range of conditions. Can tolerate lower dissolved oxygen levels than other sunfish. Nest in gravel substrates near cover. Inhabit waters near wood or vegetation. Omnivore. Prey item for piscivorous fish.
Yellow bullhead	*Ameiurus natalis*	Bottom-dwelling fish found in lakes and pools of streams. Can tolerate wide range of water conditions, including warm temperatures and low dissolved oxygen. Nest in mud or stream banks near vegetation or wood cover. Omnivores. Prey item for bluegill, black crappie, catfish, and largemouth bass.
Yellow perch	*Perca flavescens*	Prefer lakes or river impoundments with clear water. Tolerant of low dissolved oxygen. Spawn in shallow water over sand, gravel, and vegetation. Juveniles school together. Carnivorous. Prey item for northern pike and walleye.

Note: Information compiled by the United States Geological Survey, University of Michigan, and WDNR from multiple studies.

Source: USGS, University of Michigan, WDNR, and SEWRPC

The WDNR manages fisheries on lakes by regulating fish stocking and bag limits. According to WDNR records, public and private fish stocking has occurred on Turtle Lake since 1975 and likely occurred prior to these recorded events.[66] In 1975 and 1976, the WDNR stocked adult catfish into the lake. Intermittently from 1991 through 2010, the WDNR stocked fingerlings and yearlings of northern pike and walleye; this stocking continued almost every year from 2012 through 2019. Since 2020, the WDNR has recorded private stocking of channel catfish, smallmouth bass, and walleye fingerlings. Results from the April 2022 Association survey indicate that survey respondents were largely either "Very Satisfied" or "Satisfied" with

[66] *Records accessed using the WDNR Fish Stocking Summary: apps.dnr.wi.gov/fisheriesmanagement/Public/Summary/Index.*

the fish stocking efforts sponsored by the Association. The fishery regulations for each lake are set to help achieve management goals for game fish populations.[67] Fishery biologists change the regulations on a lake in responses to changes in the goals, fish population, or the waterbody itself. On Turtle Lake, the current fishery regulations indicate that the goals for game fish are as follows:

- Catfish
  - Regulation: No minimum length and the daily bag limit is 10
  - Goal: Quality Opportunity. Sustain/increase densities; maintain current conditions

- Largemouth and smallmouth bass
  - Regulation: The minimum length limit is 14″ and the daily bag limit is 5
  - Goal: Quality Opportunity. Sustain/increase densities; maintain current conditions

- Northern pike
  - Regulation: The minimum length limit is 26″ and the daily bag limit is 2
  - Goal: Quality Opportunity. Sustain/increase densities; maintain current conditions

- Panfish
  - Regulation: No minimum length limit and the daily bag limit is 10
  - Goal: Memorable Opportunity or Fishery Rehabilitation. Maintain/increase density of moderate/large adults; improve reproduction; increase predation beyond current conditions

- Walleye
  - Regulation: The minimum length limit is 18″ and the daily bag limit is 3
  - Goal: Memorable Opportunity or Fishery Rehabilitation. Maintain/increase density of moderate/large adults; improve reproduction; increase predation beyond current conditions

[67] *For more information, see the WDNR Fishery Management Regulation Toolbox at dnr.wisconsin.gov/sites/default/files/topic/Fishing/RegsToolboxWebFeb22.pdf.*

MANAGEMENT RECOMMENDATIONS AND PLAN IMPLEMENTATION 3

Credit: WDNR Staff

Turtle Lake (Lake) supports an abundant and diverse aquatic plant community that helps maintain a healthy fishery. The Wisconsin Department of Natural Resources (WDNR) has identified Turtle Lake in their published list of state high-quality waters.[68] However, the invasives Eurasian watermilfoil (EWM) and curly-leaf pondweed are present in the lake and require careful management. On account of these and other factors, aquatic plant management continues to be an important approach to maintaining the excellent natural resource service the lake provides. This chapter presents holistic management alternatives and recommended refinements to the existing aquatic plant management plan.

3.1 RECOMMENDED AQUATIC PLANT MANAGEMENT PLAN

The most effective plans to manage nuisance and invasive aquatic plant growth rely on a combination of methods and techniques as well as consideration of when and where these techniques should be applied. The recommended aquatic plant management plan is presented in Figure 3.1 and summarized in the following sections.

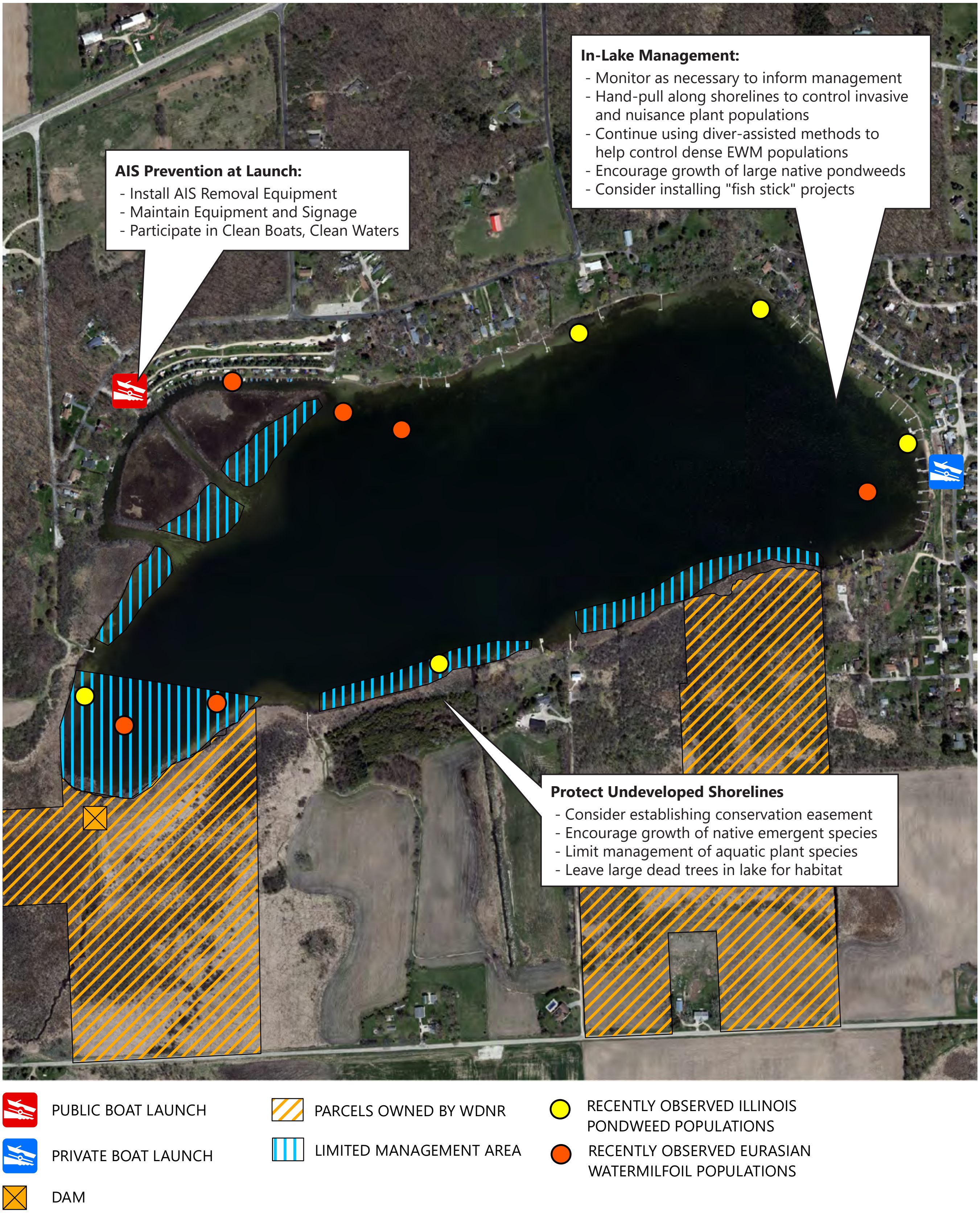
Monitoring

As discussed in chapter 2, Turtle Lake was selected by WDNR as a long-term trend lake to monitor EWM populations. Consequently, the lake has benefitted from much more numerous aquatic plant surveys by WDNR staff than almost any other lake in southeastern Wisconsin. This information has not only been useful to help understand EWM in the context of species management but also has been used to help manage the Lake's population and target areas for treatment. If WDNR is unable to continue this level of monitoring in Turtle Lake due to staffing limitations or redirected priorities, the Association should be prepared to conduct their own monitoring and/or fund monitoring efforts by water resource professionals.

At a minimum, the Association should ensure that an aquatic plant point-intercept survey is completed on the lake every five years in order to maintain a current dataset upon which to apply for APM permits. If the Association does intend to conduct a point-intercept survey of the lake, WDNR staff should be informed in advance so survey efforts are not duplicated. In addition, the Association could consider conducting spot

[68] *For more information on the WDNR's Healthy Watersheds, High-Quality Waters initiative, see the following: dnr.wisconsin.gov/topic/SurfaceWater/HQW.html.*

Figure 3.1
Turtle Lake Aquatic Plant Management Plan



Source: SEWRPC

checks for aquatic invasive species near public and private launches to allow for more rapid detection of any newly introduced invasive species, such as starry stonewort (*Nitellopsis obtusa*) which has spread amongst lakes in the Region. Given that boating between lakes is the most likely dispersal method for this species in the Region, monitoring for this species near the launches should be considered in order to formulate a rapid response after potential introduction to the lake. The Association should share updates on its invasive species population monitoring with WDNR and Walworth County staff.

Watercraft Inspection

The Association should consider joining the WDNR Clean Boats, Clean Waters program.[69] Participation in this program proactively encourages lake users to clean boats and equipment before launching and using them in the Lake.[70] This will help lower the probability of invasive species entering and leaving the lake. The WDNR provides grants that help fund participation in this program (see "Future Funding" section later in this chapter). Additionally, the Association should acquire and maintain AIS and aquatic plant removal equipment at the public launch and encourage the owners of any private launches to maintain AIS removal signage and equipment as well.[71]

Communication

The Association should stay abreast of best management practices to address invasive species. Association leadership should regularly communicate with Walworth County and WDNR staff about the most effective treatment options for EWM and other invasive species as novel techniques that may more effectively target these species become available.

Management Techniques

The following subsection recommends aquatic plant management methods that are currently suitable for Turtle Lake and provides consideration for alternatives if conditions on the Lake drastically change.

Nearshore Manual Aquatic Plant Removal

In nearshore areas where other management efforts are not feasible, raking is a viable and practical method to manage overly abundant and/or undesirable plant growth. Should Lake residents decide to utilize raking to manually remove aquatic plants, the Association or other interested party could acquire several specially designed rakes for riparian owners to use on a trial basis and/or rent or loan. If those rakes satisfy users' needs and objectives, additional property owners would be encouraged to purchase their own rakes.

Hand-pulling EWM is considered a viable option in the Lake and should be employed wherever practical. Volunteers or homeowners could employ this method, if they are properly trained to identify EWM, curly-leaf pondweed, or any other invasive plant species of interest. WDNR provides a wealth of guidance materials (including an instructional video describing manual plant removal) to help educate volunteers and homeowners.[72]

Pursuant to Chapter NR 109, "Aquatic Plants: Introduction, Manual Removal and Mechanical Control Regulations" of the *Wisconsin Administrative Code*, riparian landowners may rake or hand pull aquatic plants without a WDNR permit under the following conditions:

- EWM, curly-leaf pondweed, and purple loosestrife may be removed by hand if the native plant community is not harmed in the process
- Raked, hand-cut, and hand-pulled plant material must be removed from the lake

[69] *Watercraft inspections under the Clean Boats, Clean Waters program last occurred at the Turtle Lake public launch in 2015. A summary of the watercraft inspection efforts at the launch can be viewed here: apps.dnr.wi.gov/lakes/invasives/WatercraftSummary.aspx?landing=10017640.*

[70] *Further information about Clean Boats Clean Waters can be found on the WDNR website at: dnr.wi.gov/lakes/cbcw.*

[71] *An AIS removal sign is already placed at the Turtle Lake public launch.*

[72] *Visit dnr.wi.gov/lakes/plants for more information on identification and control of invasive aquatic plants.*

- No more than 30 lineal feet of shoreline may be cleared; however, this total must include shoreline lengths occupied by docks, piers, boatlifts, rafts, and areas undergoing other plant control treatment. In general, regulators allow vegetation to be removed up to 100 feet out from the shoreline
- Plant material that drifts onto the shoreline must be removed

Any other manual removal technique requires a State permit, unless specifically used to control designated nonnative invasive species such as EWM. Mechanical equipment (e.g., dragging equipment such as a rake behind a motorized boat or the use of weed rollers) is not authorized for use in Wisconsin at this time. Nevertheless, riparian landowners may use mechanical devices to cut or mow exposed lakebed. Furthermore, purple loosestrife may also be removed with mechanical devices if native plants are not harmed and if the control process does not encourage spread or regrowth of purple loosestrife or other nonnative vegetation.

Prior to the hand-pulling season, shoreline residents should be reminded of the utility of manual aquatic plant control through an educational campaign. This campaign should also foster shoreline resident awareness of native plant values and benefits, promote understanding of the interrelationship between aquatic plants and algae (i.e., if aquatic plants are removed, more algae may grow), assist landowners identify the types of aquatic plants along their shorelines, and familiarize riparian landowners with the specific tactics they may legally employ to "tidy up" their shorelines.[73]

Diver-Assisted Hand-Pulling

Since 2019, the Association has utilized diver-assisted hand-pulling to manage EWM populations on the Lake. As discussed in chapter 2, this technique is effective for targeting small, dense populations of nuisance plants and is less suitable for wide-spread lake management. Given the generally low abundance of EWM and the small treatment areas requested, this method should continue to be a primary means of aquatic plant management within the Lake. The Association and its contractors should continue to monitor EWM and CLP and target dense populations, particularly in highly trafficked areas of the Lake. If a novel invasive species establishes a dense population in the Lake, then diver-assisted hand-pulling should be considered as a primary option to treat these populations.

Any treatments planned within the "Limited Management Areas" on Figure 3.1 should be limited as management may disturb the high-quality habitat that these areas provide. If treatment is deemed necessary, aquatic plant management in these areas should be avoided during fish spawning (typically April through early June for most species in Turtle Lake).

Mechanical Harvesting

If invasive populations become larger or other species become a nuisance through excessive plant growth, utilizing a harvester in highly trafficked areas of the Lake may be pursued as an option for controlling growth and maintaining recreational opportunities while also maintaining species diversity. Acquiring a harvester could be partially financially supported through the WDNR's Recreational Boating Facilities grant program (see "Future Funding" section later in this chapter). However, operating and maintaining a harvesting program is still an expensive endeavor. If the Association is unwilling or unable to acquire its own harvester, then the Association could consider contracting a local private harvesting firm if harvesting within the Lake is permitted through WDNR. Alternatively, there may be opportunities to acquire and share equipment with neighboring lakes (e.g., Lake Lorraine or Whitewater and Rice lakes).

Chemical Treatment

Large-scale chemical treatment is not recommended in Turtle Lake due to the low relative abundance of invasive species and the high diversity of native species distributed throughout much of the Lake; these native species may be negatively affected by such a treatment. If monitoring suggests a dramatic change in invasive species populations, recommendations regarding large-scale chemical treatments should be reviewed. For example, the Association may want to consider a rapid response chemical treatment for Chapter NR 40 prohibited species (e.g., hydrilla, *Hydrilla verticillata)*, where appropriate, if such a species were to appear in the Lake in the future. However, this method of aquatic plant control has several drawbacks (e.g., water quality, comparatively nonselective, chemical side effects, and more) and should only be considered under exceptional circumstances.

[73] *Commission and WDNR staff could help review documents developed for this purpose.*

Water Level Manipulation

Due to the lack of water control mechanisms on the Lake's natural dam, water level manipulation is not a feasible aquatic plant management strategy for Turtle Lake.

Enhancing Fish Habitat

As discussed in chapter 2, most of the fish species either stocked or observed in Turtle Lake utilize dense beds of vegetation at some parts of their life stages, whether for reproduction, shelter from predation, or as a food source. Maintaining a healthy and diverse aquatic plant community is essential to enhancing the health of the Lake's fishery. The following recommendations are intended to help enhance fish habitat within the Lake and consequently improve the Lake's fishery:

- Limit aquatic plant management within the "Limited Management Areas" in Figure 3.1. Given their bathymetry and the emergent and floating-leaf plant species present, these areas may be especially suitable habitat for fish spawning and/or shelter for smaller fish. Any management in these areas should be avoided during fish spawning periods.

- Encourage the growth of native species, particularly large pondweeds like Illinois pondweed (*Potamogeton illinoensis*). Large pondweed species, which are also known as "cabbage", are preferred habitat for several species of sport fish. In addition, these species support macroinvertebrates that are a food source for smaller fish species. Illinois pondweed only occurs sparingly within Turtle Lake, with the most frequently observed population along the northern shoreline (see Figure 3.1). This population should be protected and encouraged to expand to other areas of the Lake through natural expansion or intentional dispersal.

- Consider installing "fish stick" and "fish crib" projects into the Lake. These are constructed large woody structures that are sunk to the Lake bottom to provide shelter and reproductive habitat for fish species. The Association should consider applying for the WDNR Healthy Lakes & Rivers grant program to help fund installation (see "Future Funding" section below).

- Leave any large woody habitat, e.g. dead trees and large branches, in the Lake. Trees and large branches provide habitat not only for fish but for frogs, turtles, and birds as well. This habitat would be useful anywhere in the Lake, but may be especially suitable along undeveloped shorelines where it is less likely to interfere with navigation.

- Consider protecting undeveloped shorelines that are not already under WDNR ownership (see Figure 3.1). As previously discussed, the Lake littoral zones near these shorelines are likely some of the highest quality habitat within the Lake. In order to protect these areas from development and maintain the habitat quality, working with a local land trust to establish a conservation easement on these properties should be considered.

Future Funding

Current efforts pursued by the Association have been exhibiting effectiveness at maintaining a healthy and diverse aquatic plant community while suppressing aquatic invasive species communities. The Association should continue to utilize WDNR Surface Water Grants to further their efforts with monitoring in the Lake, watercraft inspection efforts at the boat launch, and targeted management within Turtle Lake. Key grant programs to fund these efforts are as follows:

- **Clean Boats, Clean Waters** – this grant program covers up to 75 percent of up to $24,000 to conduct watercraft inspections, collect data, educate boaters about invasive species, and reporting invasive species to the WDNR.

- **Aquatic Invasive Species Supplemental Prevention** – this grant program provides supplemental funding for waterbodies that are high priorities for AIS spread statewide, due to large amounts of boat traffic and/or the presence of particular invasive species. Turtle Lake is an eligible waterbody for this program, which covers up to 75 percent of up to $4,000 that can fund the acquisition of decontamination equipment at the boat launches as well as targeted management at the boat launch or other access points. However, the Association must participate in the Clean Boats, Clean Waters program to become eligible for this grant program.

- **Aquatic Invasive Species Control** – this grant program covers up to 75 percent of up to $50,000 for small-scale projects and $150,000 for large-scale projects that suppress or reduce an AIS population within a lake. Aquatic Invasive Species Control grants fund projects that utilize integrated pest management and are designed to cause multi-season suppression of the target species. An approved aquatic plant management plan is a requirement to participate in this program and only approved recommendations from the plan are eligible projects for funding through this program.

- **Recreational Boating Facilities** – this grant program covers up to 50 percent of up to $250,000 for projects that enhance navigational access. Eligible costs include aquatic plant harvesting equipment as well as boat ramps, navigational aids, and dredging projects near public launches.[74]

- **Healthy Lakes & Rivers** – this grant program provides up to $1,000 per practice per parcel to help implement the following practices on lakes: fish sticks, native plantings on shorelines, water diversions, rock infiltrations, and rain gardens.[75] The Association can act as a sponsor for multiple riparian owners who wish to participate in this program. Grant applications are now being accepted year-round for this program.

The Association should consider applying for these grant programs whenever possible to support the monitoring, communication, watercraft inspection, and targeted management recommended in this aquatic plant management plan.

3.2 SUMMARY AND CONCLUSIONS

As requested by the Association, the Commission collaborated with the Association and WDNR staff to assess the aquatic plant and fish communities of Turtle Lake, inventory management activities, and recommend practices, programs, and grants to manage the Lake's aquatic plants. This report, which documents the findings and recommendations of the study, examines existing and anticipated conditions, aquatic plant management problems, and lake-use. Conformant with the study's intent, the plan includes recommended actions and management measures. Figure 3.1 summarizes and locates where aquatic plant management and fish habitat enhancement recommendations should be implemented.

Successfully implementing this plan will require effort, cooperation, and enthusiasm from the Association, State and regional agencies, Walworth County, municipalities, and residents/users of the Lake. The recommended measures help foster conditions sustaining and enhancing the natural beauty and ambience of Turtle Lake while promoting its ecological health and a wide array of suitable water-based recreational activities.

[74] *For more information on this grant program, see the following link: dnr.wisconsin.gov/aid/RBF.html.*

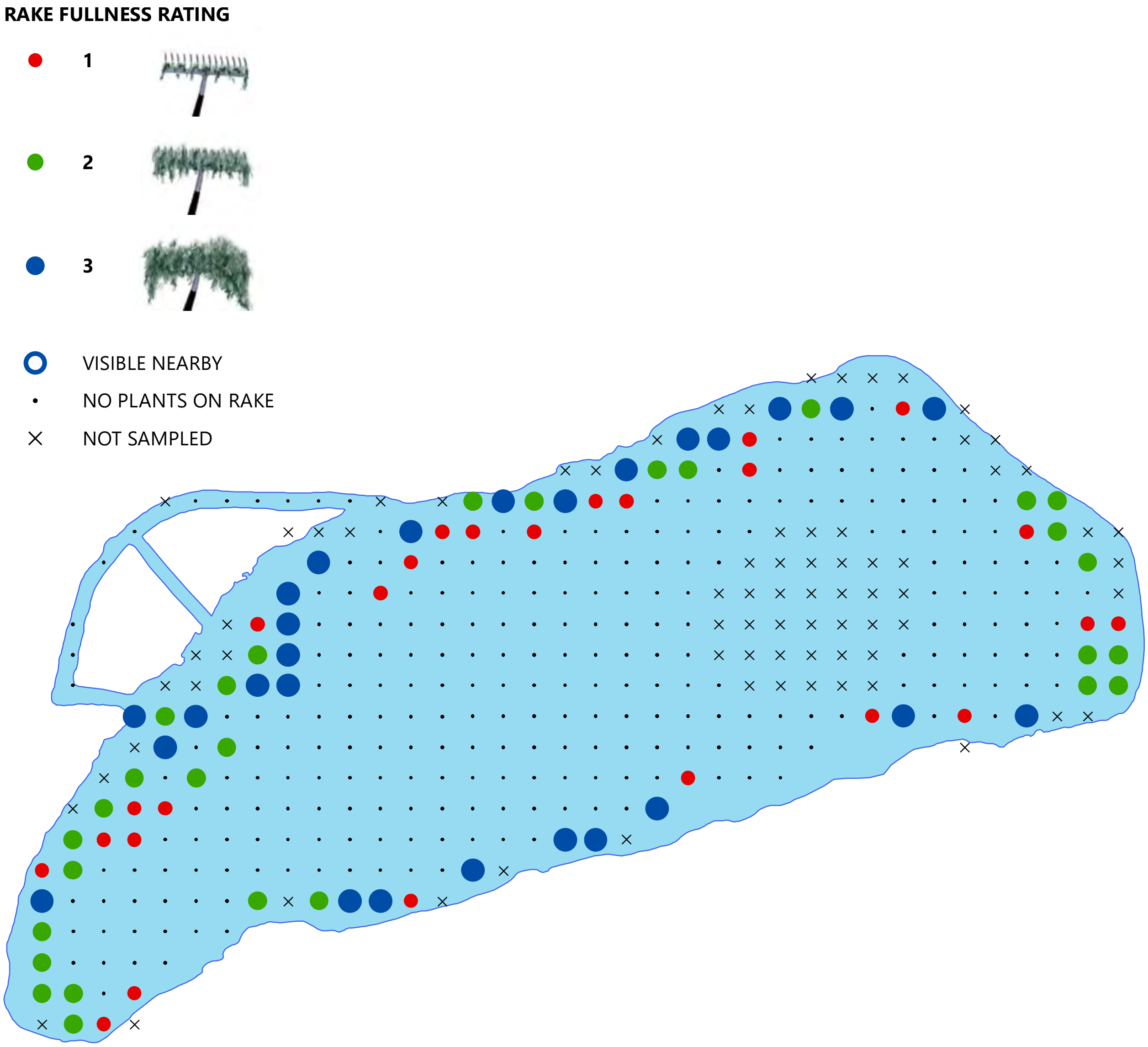
[75] *For more information, see healthylakeswi.com/grants.*

APPENDICES

AQUATIC PLANT SPECIES DISTRIBUTION MAPS

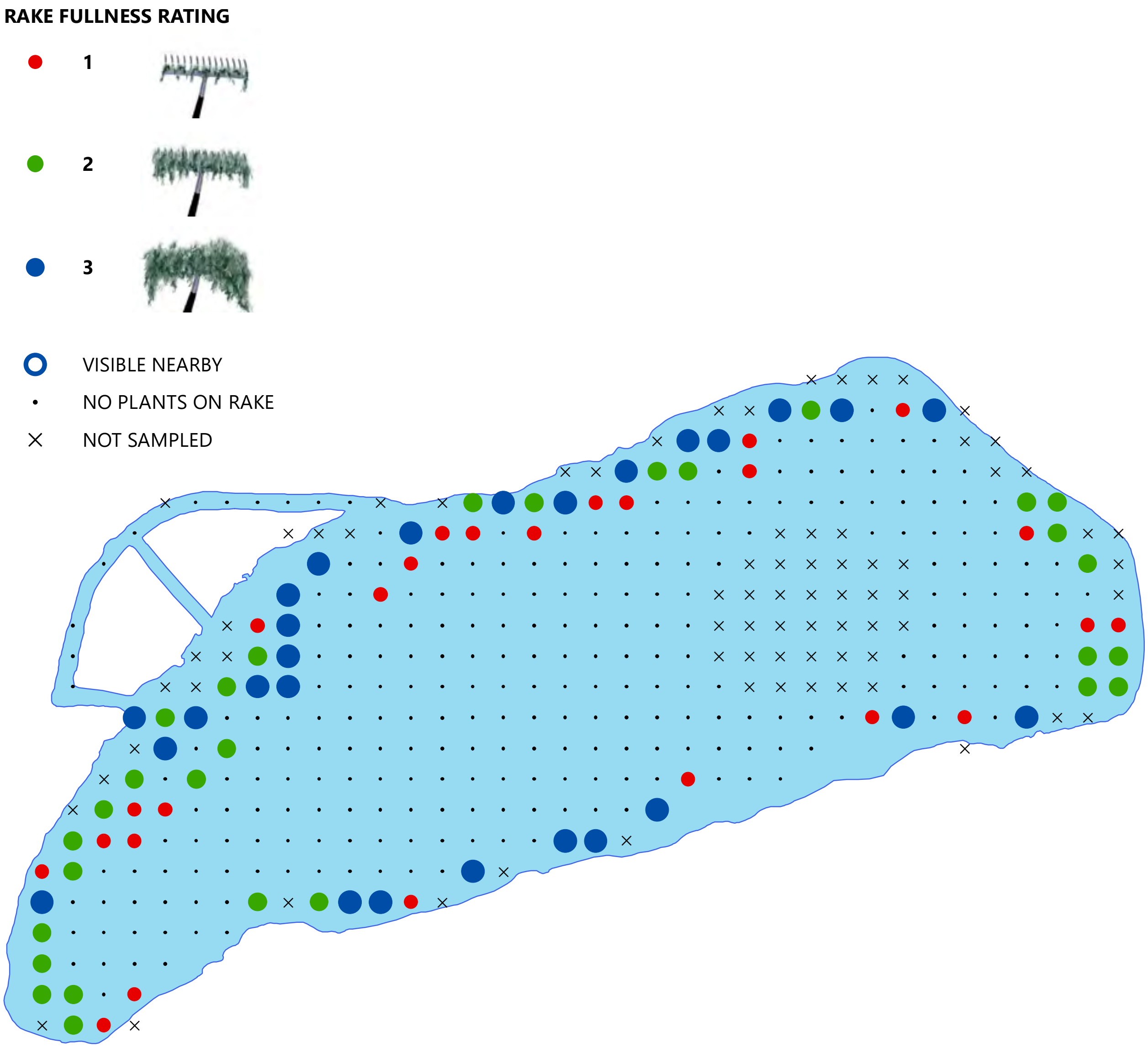
APPENDIX A

Figure A.1
Muskgrass (*Chara* sp.) Rake Fullness in Turtle Lake: 2023



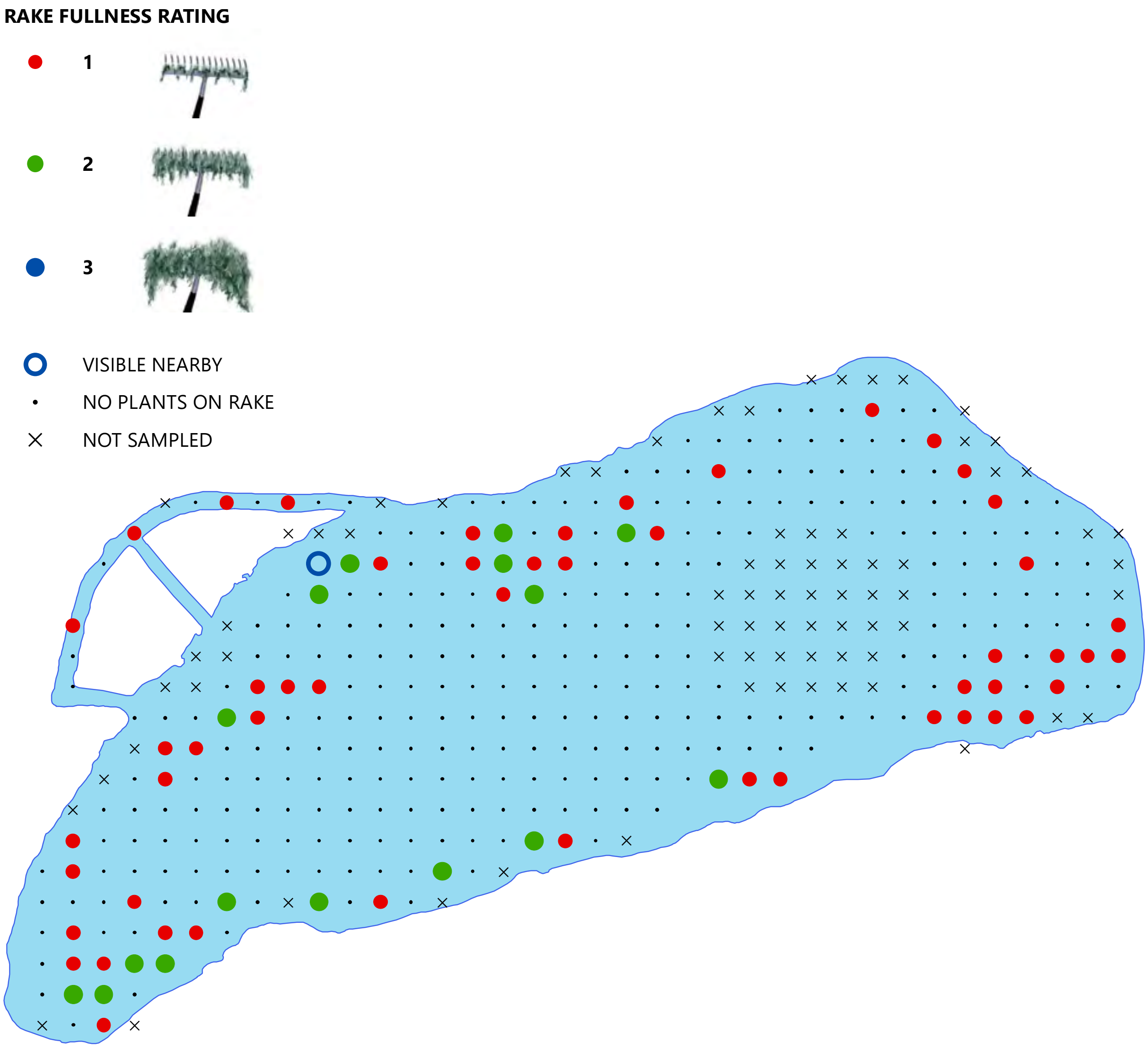
Source: SEWRPC

Figure A.2
Eurasian Watermilfoil (*Myriophyllum spicatum*) Rake Fullness in Turtle Lake: 2023



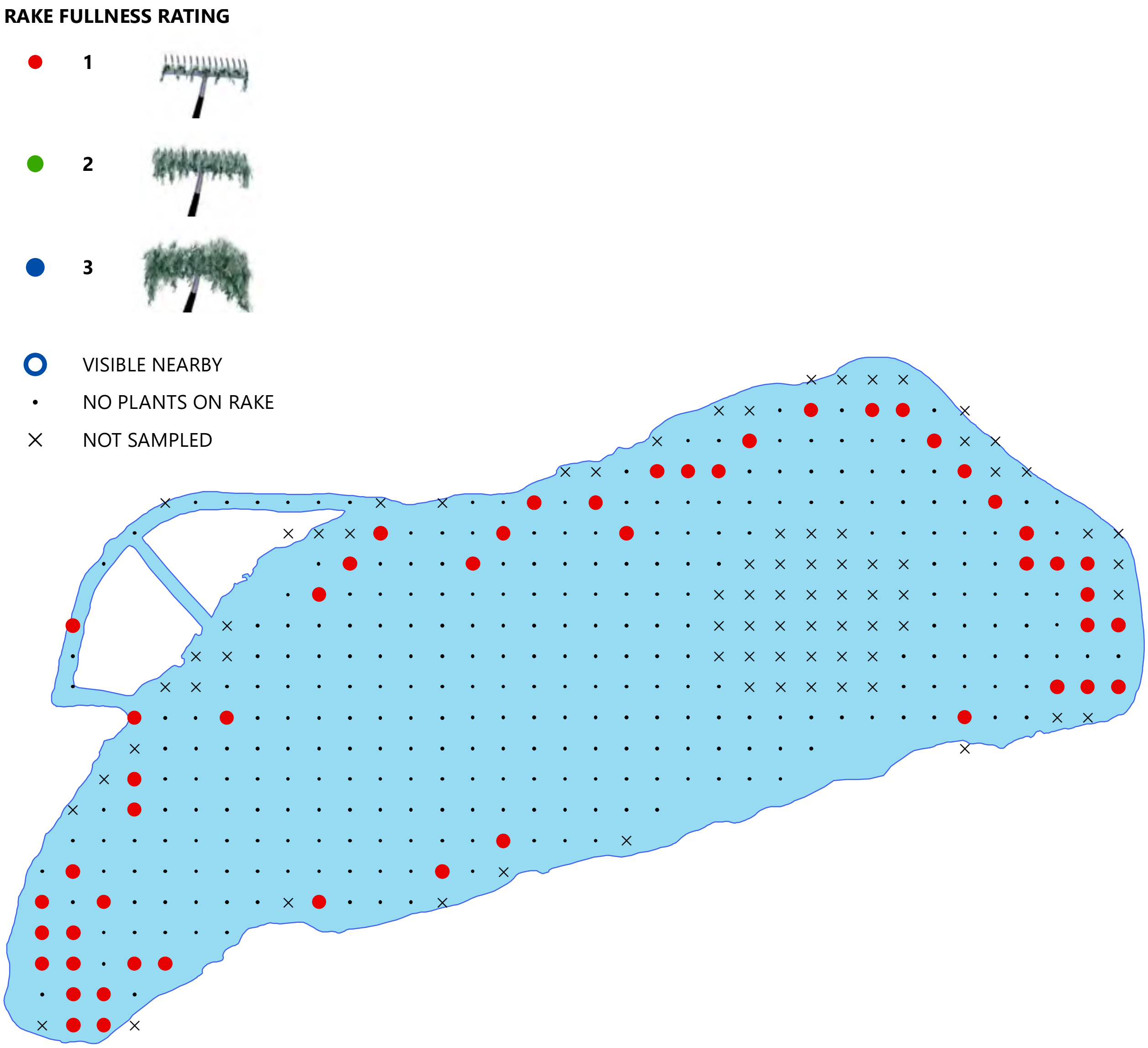
Source: SEWRPC

Figure A.3
Coontail (*Ceratophyllum demersum*) Rake Fullness in Turtle Lake: 2023



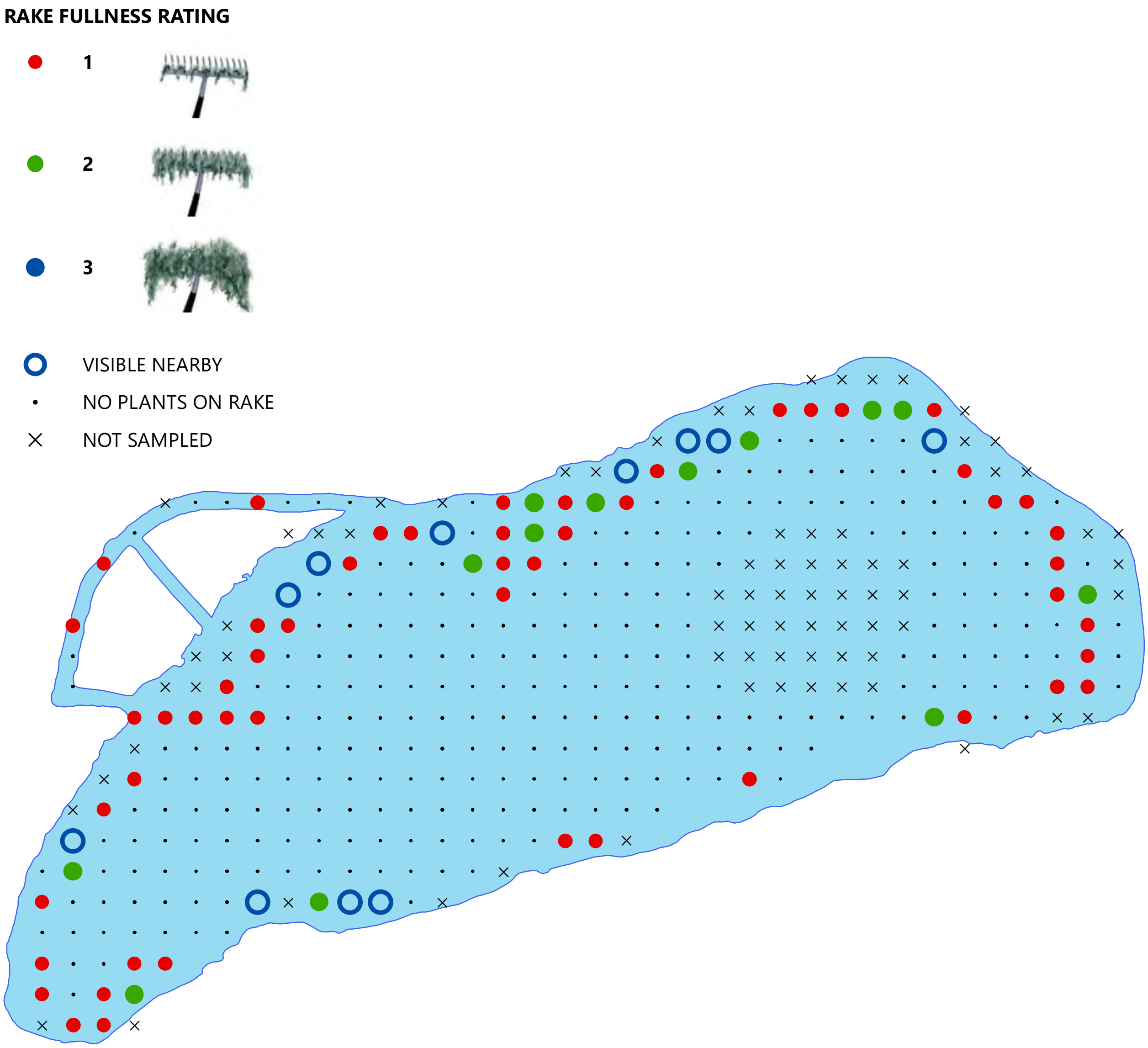
Source: SEWRPC

Figure A.4
Fries' Pondweed (*Potamogeton friesii*) Rake Fullness in Turtle Lake: 2023



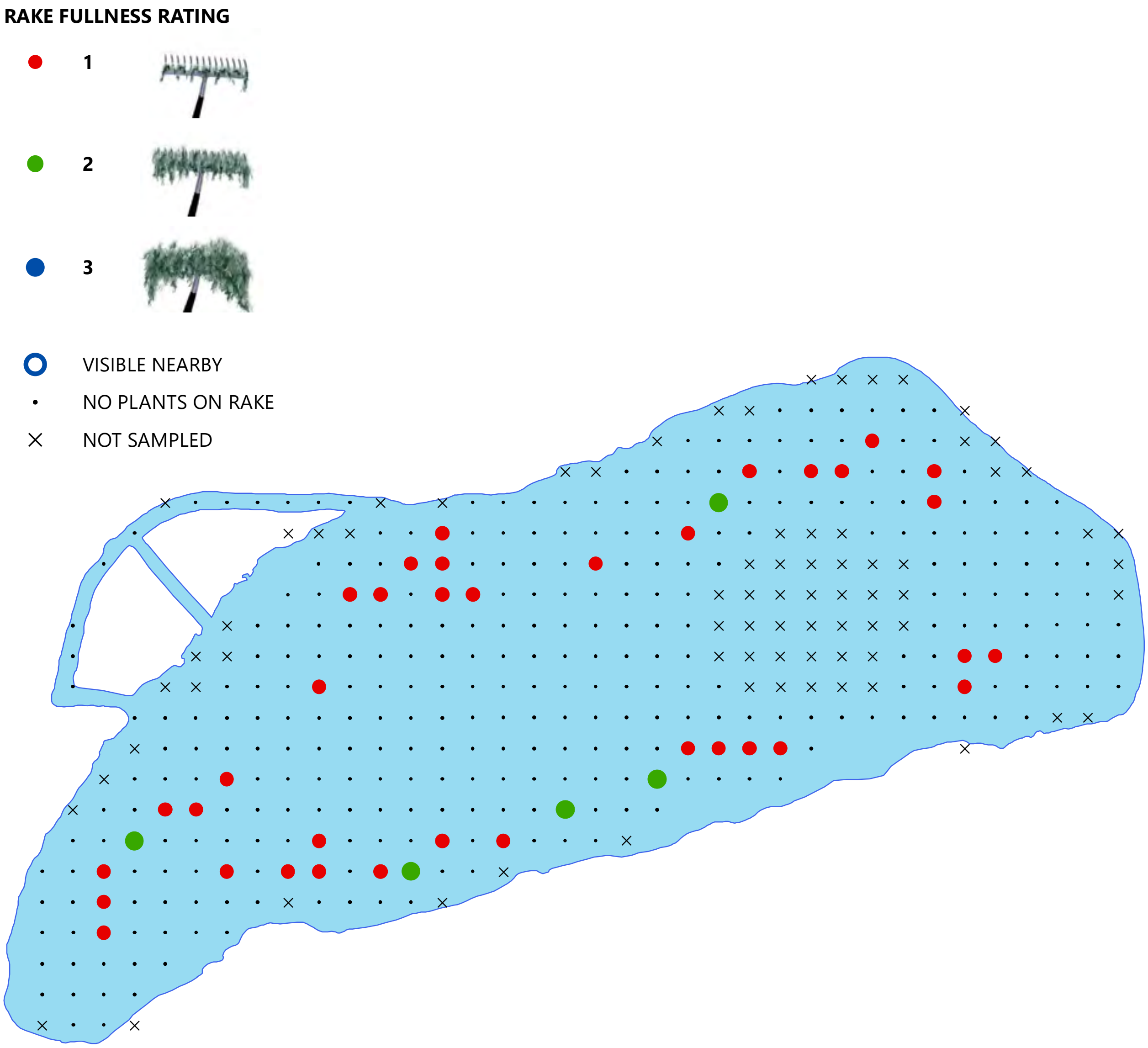
Source: SEWRPC

Figure A.5
Sago Pondweed (*Stuckenia pectinata*) Rake Fullness in Turtle Lake: 2023



Source: SEWRPC

Figure A.6
Slender Nitella (*Nitella flexilis*) Rake Fullness in Turtle Lake: 2023



Source: SEWRPC

APPENDIX B

IMPAIRMENT LISTING DISCUSSION

As required by Sections 303(d) and 305(b) of the Clean Water Act, the WDNR assesses the condition of each waterbody within Wisconsin every two years to determine which waters do not meet water quality standards.[76] The waterbodies determined to not meet these standards are designated as "impaired." In the 2024 listing cycle, the WDNR began utilizing aquatic survey results as standalone data to assess waterbodies. In previous cycles, aquatic plant data could only be used to support other findings, such as the exceedance of water quality criteria.

The methodology used to assess lake aquatic plant communities for impairment is based on Mikulyuk et al., 2017, which describes how data generated from aquatic plant point-intercept surveys were used to develop a macrophyte bioassessment model.[77] This model evaluates whether a lake has been disturbed by human activity using aquatic plant species sensitivity to anthropogenic disturbance as well as the littoral frequency of occurrence of each species observed on the lake. In designing the model, fifty-nine aquatic plant species were evaluated to determine their tolerance to anthropogenic disturbance variables, with each species being designated as "tolerant", "moderately tolerant", or "sensitive" to these variables.[78] Of the thirteen species labeled as "tolerant," only three species are considered invasive by the WDNR (EWM, CLP, and spiny naiad). The other species are all native and some are observed in both pristine as well as disturbed lakes, with a some "tolerant" species (e.g., white-stem pondweed, *Potamogeton praelongus*, and horned pondweed, *Zannichellia palustris*) commonly recognized as indicators of good water quality.[79,80]

Based on recent plant surveys conducted during the growing season, lakes are assessed based on their lake type (seepage vs. drainage), region within the state (north vs. south), and the proportions of species found that are tolerant, moderately tolerant, and tolerant of human disturbance. Under this model, lakes that receive a rating of "Not Attaining" have an aquatic plant community that indicates significant disturbance by human activity while "Attaining" lakes indicate a lower impact from human disturbance. Lakes that have recently undergone chemical treatment for aquatic plant management or other remediation work are not considered eligible for impairment assessments using this method.[81] Similarly, river impoundments and reservoirs are also not considered eligible for assessment with this method.

As a southern drainage lake, Turtle Lake must have aquatic plant species that are tolerant of human disturbance at fewer than 50 percent of the littoral survey points within the Lake to be considered "Attaining." Based on the results of the aquatic plant surveys conducted between 2018 and 2023, the lake received a rating of "Not Attaining" for each of these surveys. Consequently, the WDNR placed Turtle Lake on the 2024 303(d) impaired water list with an impairment of "degraded aquatic plant community (macrophytes)" with pollutant listed as "cause unknown." The proximate reason for this listing is based in part on the widespread distribution of the coontail within the Lake, as this native species is considered "tolerant" of anthropogenic disturbance but can also be found in undisturbed lakes. Other common "tolerant" species within Turtle Lake include EWM, Sago pondweed, duckweeds, and water stargrass. Despite their designation as "tolerant," all these species (aside from EWM) are natives and most provide habitat for fish and other aquatic life (see

[76] *The WDNR publishes a document entitled the "Wisconsin Consolidated Assessment and Listing Methodology (WisCALM)" that provides guidance regarding waterbody assessments and impaired waters listing. The 2024 WisCALM document can be viewed at the following link: dnr.wisconsin.gov/topic/SurfaceWater/WisCALM.html.*

[77] *Mikulyuk, A.M., et al., "A Macrophyte Bioassessment Approach Linking Taxon-Specific Tolerance and Abundance in North Temperate Lakes," Journal of Environmental Management 199: 172-180, 2017.*

[78] *Disturbance variables in the model included the lake's nutrient status, specific conductance (a proxy measurement for salt concentrations), and the amount of developed land use (e.g., agriculture, roads, urban lands) within the lake's watershed. Other factors known to cause disturbance within lake ecosystems, such as the use of chemical treatments for aquatic plant management, frequent and intense recreational use, and high density of piers and other shoreline structures, were not included in the model.*

[79] *White-stem pondweed is intolerant of water turbidity and has a C value of 8, indicating a preference for undisturbed habitat. See S.A. Nichols, "Floristic Quality Assessment of Wisconsin Lake Plant Communities with Example Applications,"* Lake and Reservoir Management 15(2): 133-141, *1999* for more information.

[80] *Horned pondweed has a C value of 7, indicating a preference for less disturbed habitat, and in southern Wisconsin is frequently observed in areas with significant groundwater contributions.*

[81] *Wisconsin Department of Natural Resources,* Wisconsin Consolidated Assessment and Listing Methodology (WisCALM) for CWA Section 303(d) and 305(b) Integrated Reporting: Assessment Guidance for 2023 – 2024, *Guidance # 3200-2023-04*, *April 2023.*

Table 2.2). The abundance of these species should be considered reflective of overall lake health rather than nuisance species that should be removed.

Commission and WDNR staff have discussed the application of this model in the case of Turtle Lake and other similar lakes with WDNR Water Evaluation section staff, who are responsible for waterbody assessments. In the opinion of Commission staff, the model is being unfairly applied as lakes with arguably worse aquatic plant communities (i.e., low species richness, low C values, and "Not Attaining" in this model) are exempt from consideration because these lakes are impoundments and/or have been subject to chemical treatments. The WDNR should consider incorporating any commonly used aquatic plant community metrics, such as species richness and diversity, mean C values, and the percentage of littoral points with an invasive species present, in addition to this model for waterbody assessments.[82] Using this more holistic evaluation approach, Turtle Lake should not be considered impaired based on its higher than average species richness and floristic quality index for a southern lake as well as its low percentage of survey points with an invasive species present. Commission staff will continue to discuss the model application for assessments with WDNR staff and hope that the WDNR reconsiders the designation of Turtle Lake as "impaired" on the 303(d) list.

[82] *The Commission used a similar approach when evaluating aquatic plant communities as part of the updated Regional Natural Areas plan. Turtle Lake scored above average for southeastern Wisconsin lakes with aquatic plant point-intercept data using this approach. See https://www.sewrpc.org/Regional-Planning/Natural-Areas for more information.*

APPENDIX C

DASH HARVESTING: 2020 - 2023

October 2, 2020

State of Wisconsin
Department of Natural Resources
PO Box 7185
Madison WI 53707-7185
Annual Summary Report - DASH HARVESTING
Permit # SE-2020-65-7827M

Holder: Linda Szramiak
2454 West Lake Ave
Glenview IL 53115
Lake: Turtle Lake

Site Address
Anderson Drive
Delavan WI 53115

Starting and Ending Dates of Project:
DASH Weed Harvesting took place 6/17/2020 6/19/2020
Harvest Hours: 20 hours

Map of the area harvested:
Attached

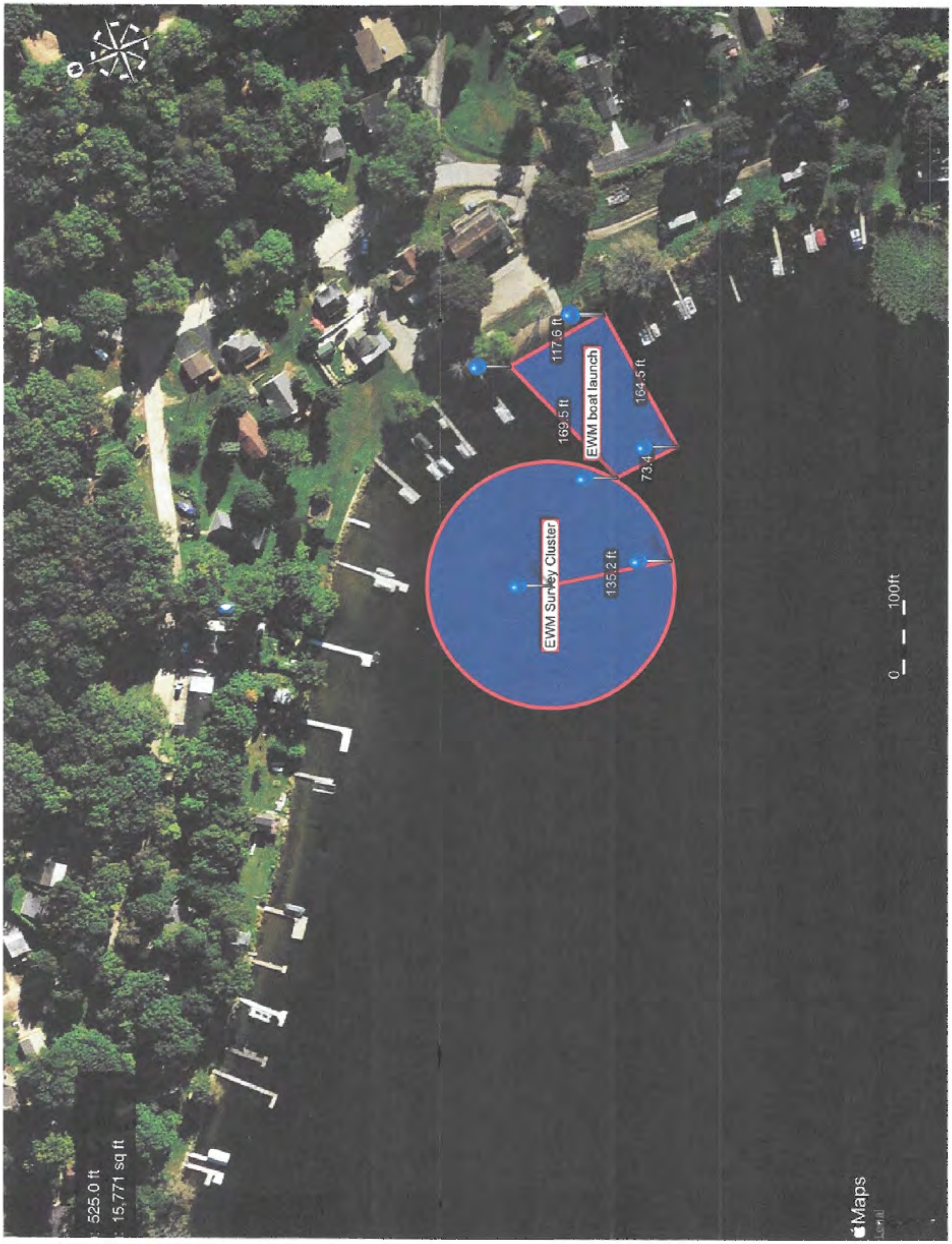
Total Acreage of the lake harvested:
141 acres lake surface area
1.94 Acres harvested area of lake

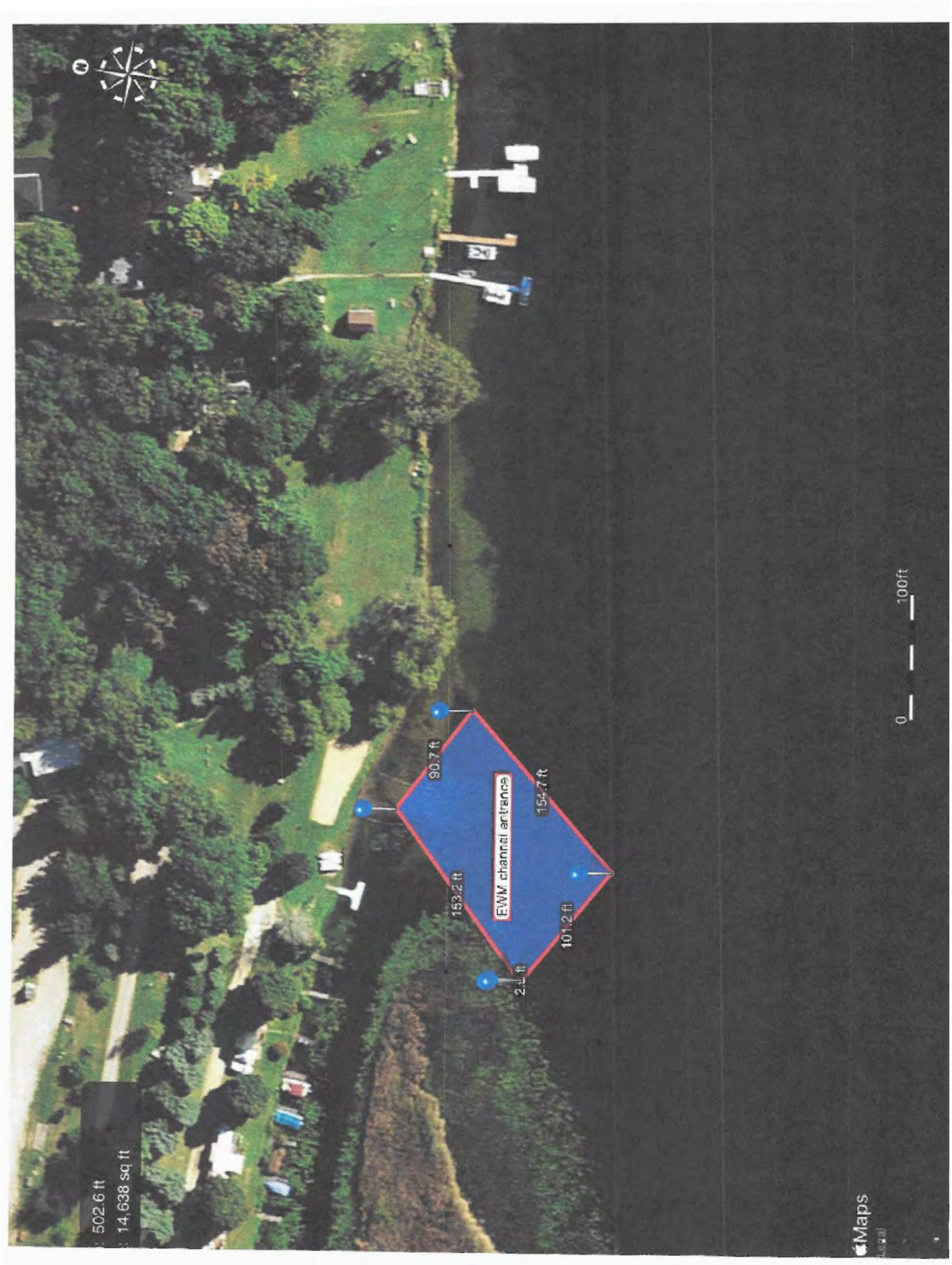
Total amount of plant material removed:
(159) 19" x 32" onion bags at 50 lbs each or 7950 lbs of weeds

Types of plants harvested by area:
Target removal of EWM
95% non-native; 5% native

Weather Conditions
6/17 – 82 degrees, sunny, 12mph SE winds
6/18- 80 degrees, sunny, 10 mph SE winds
6/19- 84 degrees, sunny, 9 mph S winds

Submitted by: Pat Dalman
Eco Waterway Services, LLC
W346 S4109 Virgin Forest Drive
Dousman, WI 53118


EWM boat launch
117.6 ft
169.5 ft
164.5 ft
73.4
EWM Survey Cluster
135.2 ft
0
100ft
525.0 ft
15,771 sq ft
Maps


502.6 ft
14,638 sq ft
90.7 ft
154.7 ft
EWM channel entrance
153.2 ft
101.2 ft
0
100ft
Maps

July 12, 2021

State of Wisconsin
Department of Natural Resources
PO Box 7185
Madison WI 53707-7185

Annual Summary Report – DASH HARVESTING

Permit # SE-2021-65-11090M

Holder: Linda Szramiak
2454 West Lake Ave.
Glenview, WI 53115

Site Address: Anderson Drive
Delavan, WI 53115

Lake: Turtle Lake

Starting and Ending Dates of Project:
DASH Weed Harvesting took place 6/15/2021, 6/21/2021 – 6/22/2021
Harvest Hours: 18

Map of the area harvested:
Attached

Total Acreage of the lake harvested:
141 Acres lake surface area
2.89 Acres harvested area of lake

Total amount of plant material removed:
160 – 19" x 32" onion bags at 50 lbs each or 8,000 lbs. of weeds

Type of plants harvested by area:
Target removal of EWM
90% non-native; 10% native

Weather Conditions:
6/15 – 73 degrees, mostly cloudy, 10mph E/NE winds with up to 21mph gusts
6/21 – 64 degrees, mostly cloudy, 15mph W/NW winds with up to 30mph gusts
6/22 – 66 degrees, most cloudy, 10mph W/NW winds with up to 24mph gusts

Submitted by: Pat Dalman
Eco Waterway Services, LLC
111 Wilmont Dr. Unit L
Waukesha, WI 53189

July 7, 2022

State of Wisconsin
Department of Natural Resources
PO Box 7185
Madison WI 53707-7185

Annual Summary Report – DASH HARVESTING

Permit # SE-2022-65-14195M

Holder: Linda Szramiak
2454 West Lake Ave.
Glenview, WI 53115

Site Address: Anderson Drive
Delavan, WI 53115

Lake: Turtle Lake

Starting and Ending Dates of Project:
DASH Weed Harvesting took place 6/13/2022 – 6/15/2022
Harvest Hours: 18

Total Acreage of the lake harvested:
141 Acres lake surface area
2.82 Acres harvested area of lake

Total amount of plant material removed:
95 – 19" x 32" onion bags at 50 lbs each or 4,750 lbs. of weeds

Type of plants harvested by area:
Target removal of EWM and CLP
90% non-native; 10% native

Weather Conditions:
6/13 – 83 degrees, light rain, cloudy, 8 mph E/NE winds with up to 12 mph gusts
6/14 – 93 degrees, sunny, 12 mph S/SW winds with up to 17 mph gusts
6/15 – 90 degrees, sunny, 10 mph S/SW winds with up to 20 mph gusts

Submitted by: Kelly Csizmadia
Eco Waterway Services, LLC
111 Wilmont Dr. Unit L
Waukesha, WI 53189

July 7, 2022

State of Wisconsin
Department of Natural Resources
PO Box 7185
Madison WI 53707-7185

Annual Summary Report – DASH HARVESTING

Permit # SE-2022-65-14195M

Holder: Linda Szramiak
2454 West Lake Ave.
Glenview, WI 53115

Site Address: Anderson Drive
Delavan, WI 53115

Lake: Turtle Lake

Starting and Ending Dates of Project:
DASH Weed Harvesting took place 6/12-6/13/2023
Harvest Hours: 12

Total Acreage of the lake harvested:
141 Acres lake surface area
.09 Acres harvested area of lake

Total amount of plant material removed:
202 – 19” x 32” onion bags at 50 lbs each or 10,100 lbs. of weeds

Type of plants harvested by area:
Target removal of EWM and CLP
90% non-native; 10% native
Native plants removed: Chara

Weather Conditions:
6/12 – 72 degrees, partly sunny, 11 mph WNW winds
6/13 – 82 degrees, sunny, 5 mph W winds

Submitted by: Kelly Csizmadia
Eco Waterway Services, LLC
111 Wilmont Dr. Unit L
Waukesha, WI 53189