1.0 INTRODUCTION

Lake Minnesuing is an approximate 465-acre, meso-eutrophic, deep lowland drainage lake within the Brule River Watershed in Douglas County, Wisconsin (Figure 1.0-1). The lake sustains a species-rich aquatic plant community with 46 native species documented to date.

Figure 1.0-1 Lake Minnesuing, Douglas County, Wisconsin.

In August of 2018, the non-native, invasive aquatic plant curly-leaf pondweed (*Potamogeton crispus*; CLP) was discovered in the southern bay of Lake Minnesuing during an aquatic plant point-intercept survey being completed by Onterra ecologists. Because most of the CLP population dies-back by mid-summer, it was unclear what the complete population extent of CLP was in Lake Minnesuing. Onterra ecologists mapped the full extent of the lake's CLP population in June of 2019 to coincide with its peak-growth period. During this survey, the majority of the CLP population was located in the southern bay of the lake, while a few occurrences were located elsewhere in the lake.

1.1 Recent CLP Management History

During a series of meetings with a Lake Minnesuing stakeholder planning committee in 2019, Onterra outlined three broad potential CLP population perspectives for consideration including a recommended action plan to help reach CLP management goals. These potential goals included: 1) no coordinated active management of CLP (let nature take its course), 2) minimize navigation and recreation impediment (nuisance control), or 3) reduce the CLP population on population or lake-wide level (lake-wide population management).

While CLP has been observed to naturalize within some northern Wisconsin lakes without behaving invasively, the presence of small yet dense colonies of CLP with high biomass indicated that conditions were present for this species to behave aggressively and expand rapidly in Lake Minnesuing. The Lake Minnesuing Sanitary District (LMSD) elected to initiate an aggressive hand-harvesting program in an effort to prevent the CLP population from reaching levels which could negatively affect lake ecology, water quality, recreation/navigation, and aesthetics (*surface matting*). In addition, the planning committee understood that maintaining a small CLP population in Lake Minnesuing reduces the likelihood of it being spread to other nearby waterbodies.

In early 2020, the LMSD was awarded a Wisconsin Department of Natural Resources (WDNR) Aquatic Invasive Species (AIS) Early Detection and Response (EDR) grant to fund professional hand-harvesting control and monitoring of the CLP population in 2020 and 2021. Understanding that the eradication of CLP from Lake Minnesuing is impossible with current management techniques available, the LMSD's ultimate goal of the active CLP management strategy is to maintain a population which imparts minimal to no detectable impacts to the lake's ecology, water quality, recreation, navigation, and aesthetics. In other words, the goal was to reduce or eliminate

large, contiguous, monotypic colonies of CLP, and maintain a population primarily comprised of single-plant occurrences. The 2020 hand-harvesting was largely met with success as the majority of areas harvested saw an observable decline CLP abundance and met the pre-determined success criteria. However, monitoring conducted in 2021 showed a large increase in the CLP population in the lake including in all sites managed with hand harvesting (Map 1). The rapid expansion of the CLP population in 2021 proved to outpace the effort of hand-harvesting. Following two years of professional hand-harvesting in Lake Minnesuing, it was clear that a level of hand-harvesting effort beyond which is realistic would be needed to achieve district's goal of reducing or eliminating large, contiguous, monotypic colonies of CLP.

The LMSD amended its CLP control plan with an addendum to the *Lake Minnesuing Comprehensive Management Plan* to follow an integrated approach to CLP management utilizing annual herbicide treatments of the most abundant areas and continued professional hand-harvesting of the less dense areas. The LMSD self-funded the first herbicide treatment in 2022, along with 5 days of professional hand-harvesting. The updated strategy involves four consecutive years of herbicide applications over the densest colonies of CLP in the southern basin with an overall goal of reducing the turion reserve in the sediment. Regardless of progress through 2025, no herbicide treatments would be completed in 2026 to allow for an accurate reassessment of the CLP population in absence of management. The LMSD applied for and was awarded a WDNR Large Scale Population Control grant following the fall 2022 cycle which provides funding assistance to carry out the multi-year CLP management and monitoring project. This report details the monitoring surrounding the second year of annual herbicide management conducted during 2023 and serves as the first report deliverable for ACEI32623.

1.2 2023 CLP Control Strategy

The objective of CLP management on Lake Minnesuing is not to eradicate it from the lake, as that is currently impossible with available management tools and techniques. The objective is to maintain a CLP population that exerts little to no detectable impacts on the lake's ecology and ecosystem services (i.e., recreation and aesthetics). The goal of CLP management is to annually remove/kill the plants before they are able to produce and deposit new turions, and thus, over continued annual management, deplete the existing reserve of turions in the sediment. To achieve this goal, management of CLP plants must occur in spring (May to early June) before the development of mature turions.

The aim is following multiple years of management, the turion reserve becomes exhausted and the CLP population declines. Typically, CLP management involves annual management for 5-7 years within the same areas before the turion reserve is depleted. However, it may take fewer years in instances where the CLP population is in the early stages of infestation. Following an initial and aggressive management approach, continued population maintenance often occurs to keep the CLP population at a lower level.

The LMSD amended its 2020 control plan to follow an integrated approach to CLP management utilizing annual herbicide treatments of the most abundant areas and continued professional hand-harvesting of the less dense areas. The LMSD self-funded the first herbicide treatment in 2022, along with five days of professional hand-harvesting. The control actions were monitored with a combination of qualitative (polygon and point-mapping) and quantitative (sub-PI) surveys that

were partially funded through a Surface Water Planning Grant. This report details the CLP monitoring and management activities that took place during 2022.

1.3 2023 CLP Pretreatment Confirmation and Refinement Survey

On May 16, 2023, Onterra ecologists conducted the Spring Pre-treatment Confirmation and Refinement Survey on Lake Minnesuing. The purpose of the survey was to conduct a pretreatment sub-sample point-intercept survey focused over the application areas, to evaluate the growth stage of the CLP population in the treatment areas, as well as to confirm the average depth of the sites for dosing purposes. This survey was conducted using a combination of survey methods including visual sightings and the use of a submersible camera.

The field crew encountered relatively low biomass of CLP within all treatment sites. Most plants were 1-3' tall, with no signs of turion formation (Photo 1.3-1). Plants were not visible from the surface. Overall, the sub-sample point-intercept survey yielded 18.8% CLP within the application areas. Common waterweed (*Elodea canadensis*), large-leaf pondweed (*P. amplifolius*), muskgrasses (*Chara spp.*) and coontail (*Ceratophyllum demersum*) were present in low amounts within all treatment sites.

Photo 1.3-1. CLP plants observed during a May 16, 2023 pretreatment survey on Lake Minnesuing. Photo by Onterra, LLC

A water temperature profile was taken within each of the three application sites, with surface water temps at 62-63°F, mid-depth at 60°F, and bottom at 51-56°F. Actively growing CLP was observed within all application areas, and average depths of the treatment sites were confirmed. Based on water temperatures and the stage of CLP/native plant growth observed during the survey, Onterra advised the district that the treatment should occur approximately one week or more later to allow for additional CLP active growth tissue to be present.

The final herbicide treatment included the application of liquid endothall over 13.6 acres of Lake Minnesuing and was completed on May 23, 2023 (Map 2). The applicator noted southwest winds between 2-3 mph at the time of the application and the surface water temperature was 59°F.

2.0 PROFESSIONAL HAND HARVESTING ACTIONS

The LMSD contracted with Aquatic Plant Management, LLC (APM) to conduct professional hand-harvesting services of CLP in 2023. The hand harvesting strategy was based on the CLP mapped during the previous year (2022) and included all known occurrences outside of the southern-most bay of the lake (Map 3). No harvesting efforts were planned for the southern bay which was included in the herbicide management program. Plant removal specialists from APM

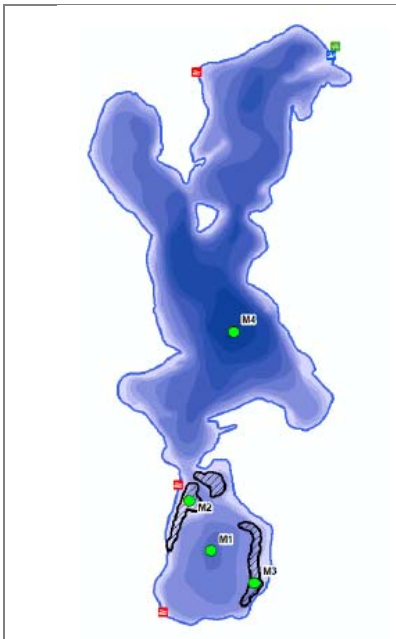
worked on Lake Minnesuing from June 12-14, 2023. The dive crews encountered sparse CLP in the lake with low CLP biomass at all visited sites. Due to the low amount of CLP being encountered, the team ceased operations after three days rather than working for the originally planned five days. A combined 15.9 underwater diver hours resulted in the harvest of 11.0 cubic feet of CLP from lake (Appendix A). Native pondweeds were noted as being present at many of the dive locations. A summary report authored by APM provides details of the professional hand-harvesting efforts and is included in Appendix A.

3.0 2023 MONITORING RESULTS

3.1 Herbicide Concentration Monitoring

Endothall is an aquatic herbicide that is applied as either a dipotassium salt or an amine salt. These active ingredients break down following application to endothall acid, the form that acts as an herbicide (Netherland 2009). The Lake Minnesuing treatments used the dipotassium salt at a concentration of 2.0 ppm active ingredient (ai) 2022-2023. When broken down into the acid, 2.0 ppm ai equates to 1.42 ppm acid equivalent (ae). The WI State Laboratory of Hygiene is able to test water samples for endothall using an ELISA (enzyme-linked immunosorbent *assay*) method and reports the results as acid equivalent.

In association with the 2023 CLP treatment, an herbicide concentration monitoring plan was developed jointly by Onterra and the WDNR (Appendix B). LMSD volunteers were given equipment and instruction by Onterra on how to collect and preserve water samples from Lake Minnesuing that would be analyzed by the Wisconsin State Laboratory of Hygiene for concentrations of endothall. Water samples were collected with a 6-foot integrated sampler at two locations in the treatment areas, the deep hole location in the center of the lake and in the center of the southern basin of the lake (outside of the application areas). The sampling site details are displayed on Figure 3.1-1. Data in the following section are discussed in regards to hours after treatment (HAT) or days after treatment (DAT).



Sampling Interval Matrix
(X indicates sample to be collected)

Interval	Application Area		Deep Hole	South Basin
	Site M2	Site M3	Site M4	Site M1
2 HAT	X	X		
4 HAT	X	X		
8 HAT	X	X		
24 HAT	X	X	X	X
3 DAT	X	X	X	X
5 DAT	X	X	X	X
7 DAT	X	X	X	X
14 DAT	X	X	X	X

HAT = Hours After Treatment, DAT = Days After Treatment

Figure 3.1-1. Lake Minnesuing herbicide concentration monitoring locations from the 2023 endothall treatment.

Figure 3.1-2 displays the results of the herbicide concentration monitoring from samples collected during 2023. Endothall concentrations remained above detection limits at all monitoring locations during the last sampling interval collected at 14 DAT.

Concentrations within the application areas were variable in the earliest sampling intervals collected at 2 HAT, 4 HAT, and 8 HAT with the highest measured concentration being 0.820 at site M3 at 2 HAT. By 24 HAT, concentrations were below 0.2 ppm at sites within the application areas and concentrations declined in each subsequent sampling interval from 24 HAT to 14 DAT.

The samples collected from site M1 in the center of the southern bay of the lake show that herbicide concentrations were approximately the same as was measured in application areas from 24 HAT through 14 DAT. This indicates that the herbicide mixed within the southern bay of the lake.

Based on published literature, 3 DAT corresponds roughly with when a lake will reach a whole-lake equilibrium herbicide concentration. In 2023, samples were collected at 3 DAT from the deep hole location center of the lake location from 24 HAT through 14 DAT. The measured concentrations at this site were between 0.01-0.02 ppm ae in all sampling intervals. For whole-lake CLP treatments, the manufacturers of endothall (UPI) recommend whole-lake target concentrations of 0.53 ppm ae (0.75 ppm ai) to 0.71 ppm ae (1.0 ppm ai). This is much greater than the measured concentrations from the deep hole monitoring site in Lake Minnesuing. Based on the measured endothall concentrations observed in the center of the lake, the impacts of the spot treatments are anticipated to be confined to the approximate area of the southern-most bay of the lake without having a lake-wide impact.

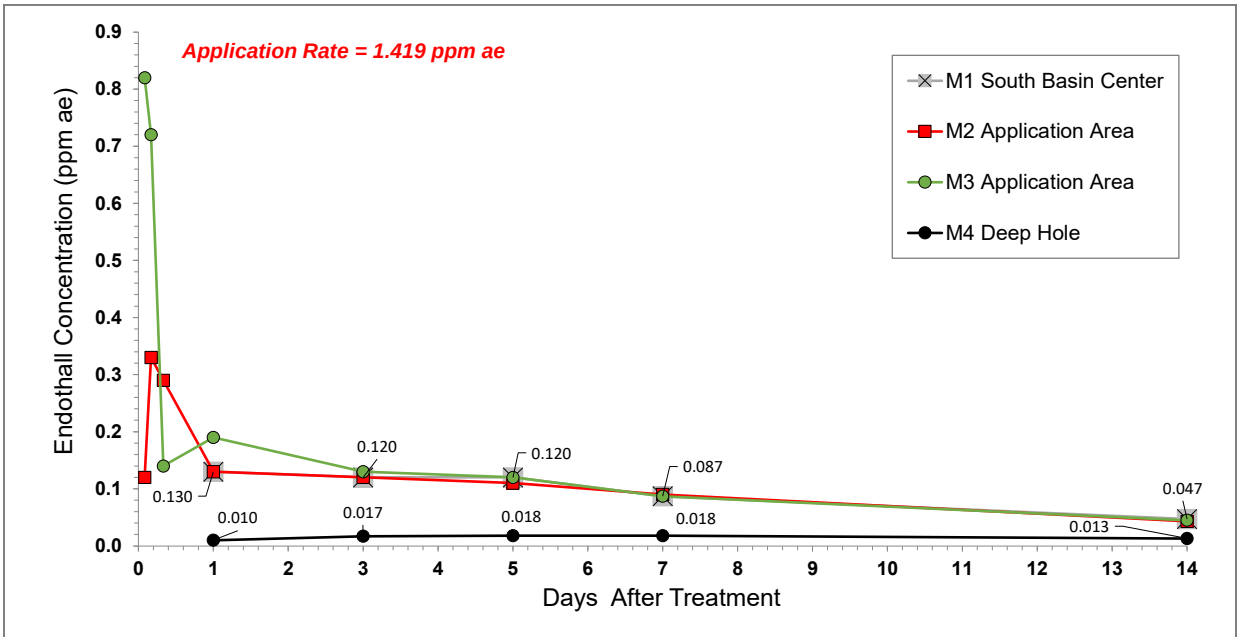
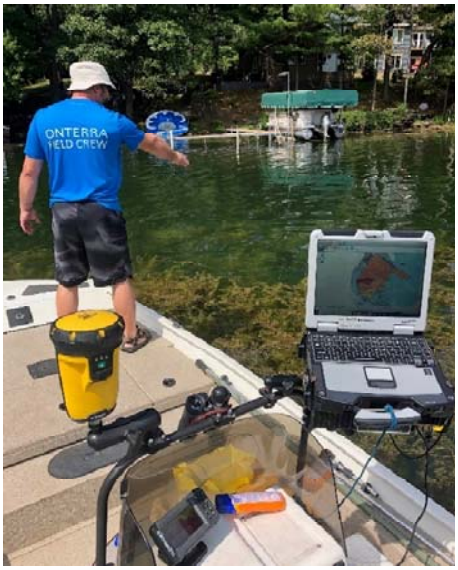


Figure 3.1-2. Endothall concentrations following the 2023 treatment in Lake Minnesuing.

3.2 Early Season CLP Mapping Survey

During a CLP Mapping Survey, the entire littoral area of the lake is surveyed through visual observations from the boat (Photograph 3.0-1). Field crews supplement the visual survey by deploying a submersible camera along with periodically doing rake tows. Using sub-meter GPS technology, CLP locations were mapped by using either 1) point-based or 2) area-based methodologies. Large colonies >40 feet in diameter are mapped using polygons (areas) and were qualitatively attributed a density rating based upon a five-tiered scale: *highly scattered* < *scattered* < *dominant* < *highly dominant* < *surface matting.* Point-based techniques were applied to CLP locations that were considered as *Small Plant Colonies* (<40 feet in diameter), *Clumps of Plants*, or *Single or Few Plants*.

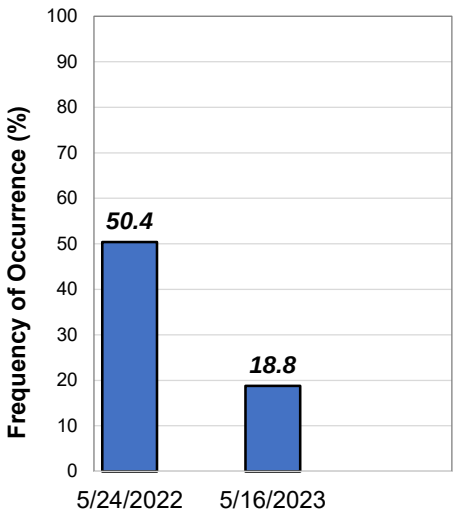


Photograph 3.2-1. AIS mapping survey on a Wisconsin Lake. Photo credit Onterra.

Onterra ecologists conducted the Early-Season AIS Survey on June 26-27, 2023 to map CLP throughout the lake. Crews noted mostly sunny conditions with 5-10mph winds during the survey. A Secchi disk measurement of 7.2' was recorded during the survey. The field crews surveyed the entire littoral area of the lake visually while also taking rake tows within several sites where CLP colonies have been mapped in recent years. At the conclusion of the survey, just three *single or few plants* occurrences and one *clump of plants* were mapped while taking rake tows in and around the past known CLP locations (Map 4). None of the CLP occurrences were visible from the surface. The CLP plants that were observed were characterized as being small and seemingly newly sprouted plants.

4.0 CONCLUSIONS & DISCUSSION

The 2023 herbicide treatment appeared to have effectively controlled the CLP population in the targeted area. Very little CLP was observed in the treated sites in a late-June mapping survey while significant CLP was detected in the target sites in the pretreatment survey. Aside from the CLP mapping surveys, one of the methods used to determine the effectiveness of the CLP herbicide treatment program is to monitor turion germination each year before any control action is taken. To demonstrate a declining CLP turion base in the treated site, the pretreatment point-intercept survey would need to indicate a decreasing occurrence of CLP over time. A pretreatment point-intercept survey just before the 2022 treatment served as the first dataset for this monitoring with CLP present at 50.4% of the sampling locations. A replication of the survey during the 2023 pretreatment survey showed that CLP had a littoral occurrence of 18.8% which is a promising indication of a declining turion base (Figure 4.0-1).



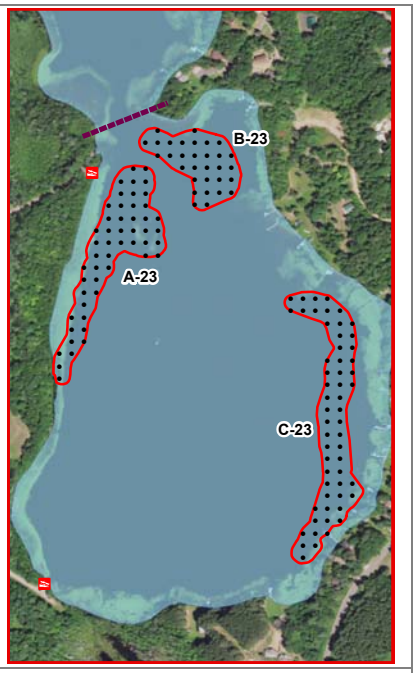


Figure 4.0-1. Pretreatment CLP LFO in the 2022-2023 sub sample survey. (N=139).

The herbicide concentration monitoring data that were collected in association with the 2023 treatment were consistent with expectations. The data indicates that herbicide mixed within the southern basin of the lake by approximately one day after treatment as demonstrated by nearly uniform measured concentrations between sampling sites located in direct application areas and a site in the center of the southern bay. The data show that up-front concentration exposure times with elevated concentrations were short-lived (<24 hours) before mixing occurred. In order to achieve plant mortality, this treatment design likely benefits from both initial high concentrations in areas where herbicide was applied as well as an extended period of time with sustained lower concentrations after mixing occurs.

The measured concentrations in the southern bay (0.13 ppm ae) are approximately 25% of what a target intentional whole lake treatment design would employ (0.53 ppm ae); however, are likely still resulting in impacts to CLP throughout the southern bay based on the lack of CLP being located throughout the untreated areas of the bay after treatment in recent surveys. Measured concentrations from the deep hole site near the center of the lake were above detection limits (0.01-0.02 ppm ae), but were at levels believed to be too low to impact CLP or other sensitive native plant species.

Assessing the effectiveness of a CLP hand harvesting strategy in any one particular year is difficult. With minimal CLP being located in Lake Minnesuing in 2023, including in sites where CLP was reported to have been harvested from, the strategy seems likely to be meeting control goals.

CLP populations can be variable in lakes with some years favoring more turion germination than others when favorable environmental conditions are present. While the active management occurring on the lake is expected to be influencing the population, the low CLP population observed during 2023 may have also been a result of it not being a particularly good year for turion propagation.

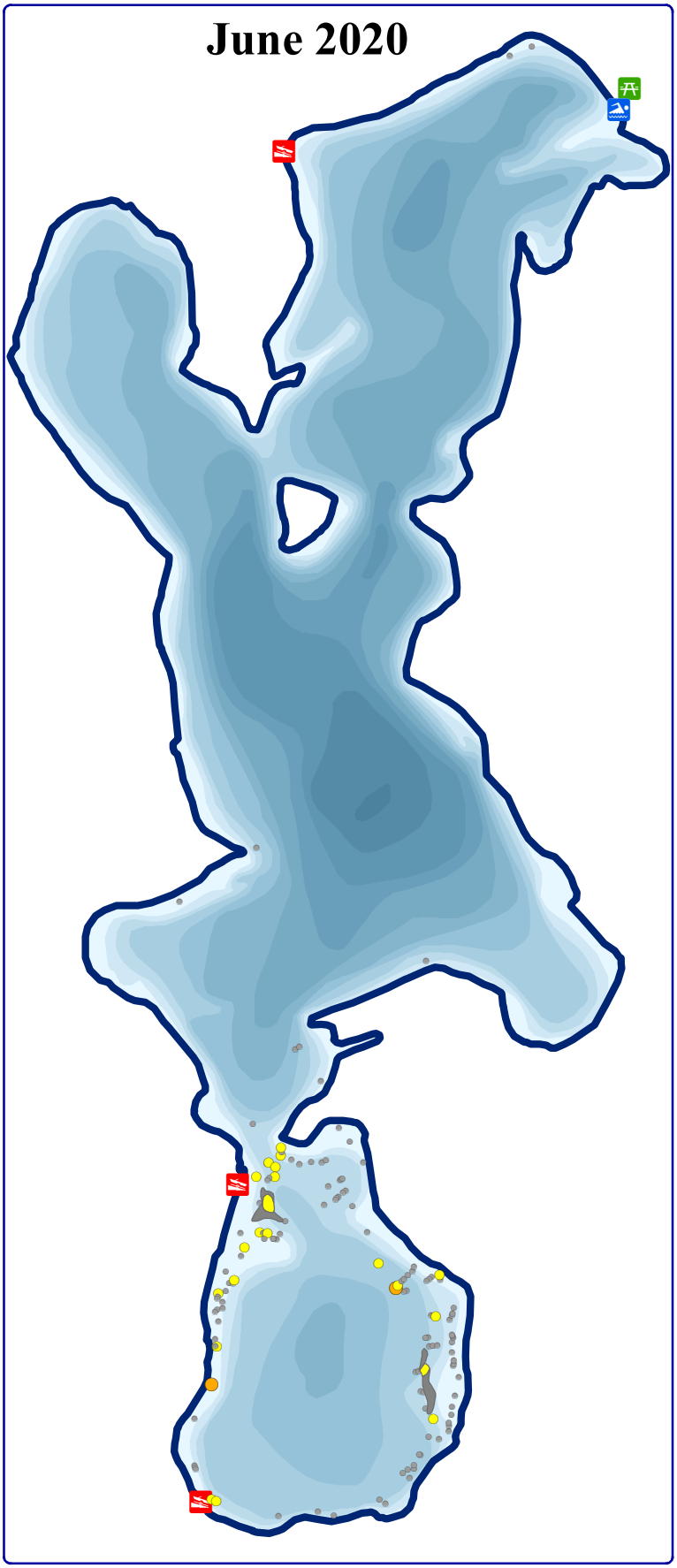
4.1 2024 CLP Control & Monitoring Strategy

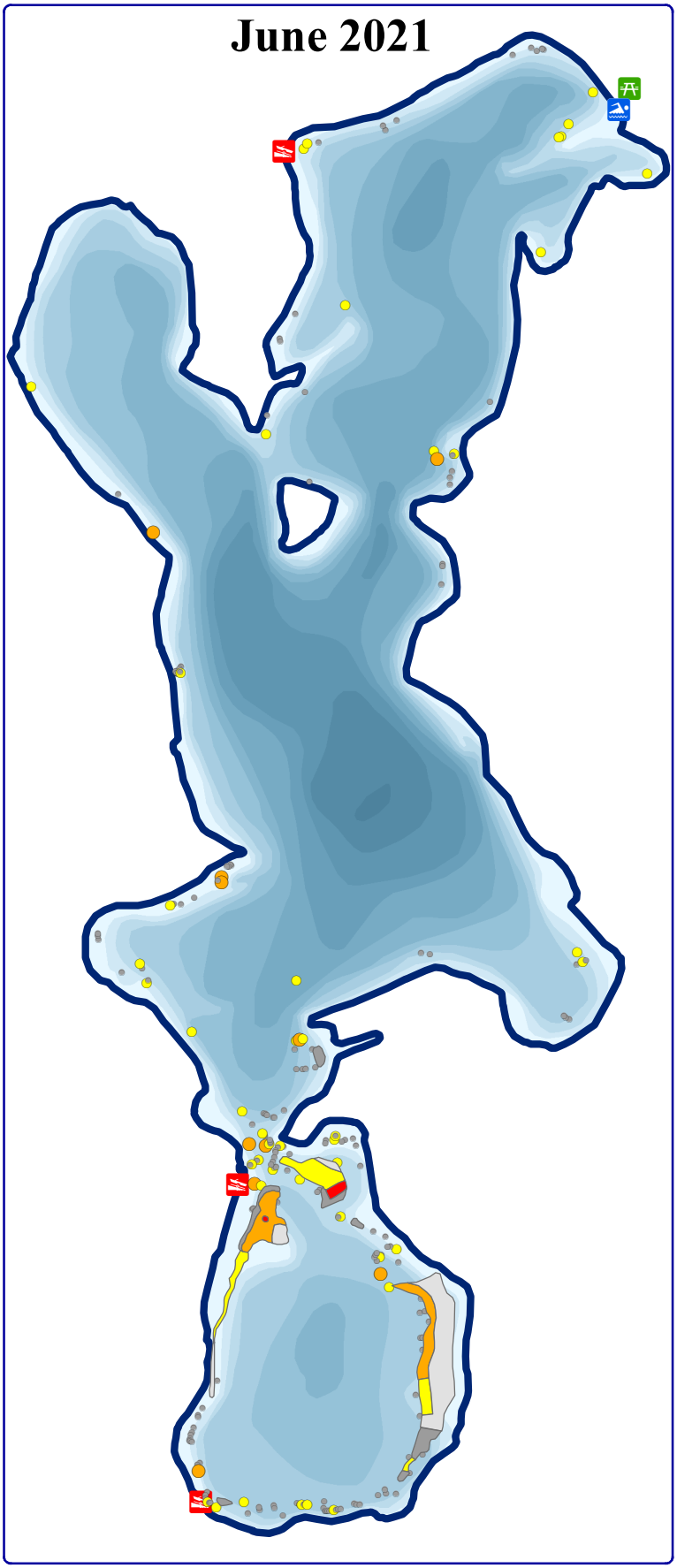
The 2024 CLP management strategy would mirror those that took place during 2022-2023 and includes both an herbicide treatment and professional hand harvesting. Map 5 displays the proposed endothall treatment sites and application dosing rates which are the same as the 2022 and 2023 treatment areas. Three sites in the southern bay of the lake are to be treated with liquid endothall at 2.0 ppm ai. During approximately mid-May, Onterra will conduct a pretreatment survey in advance of the proposed 2024 treatment in order to collect quantitative CLP monitoring data as well as to confirm that plants are actively growing and ready for treatment. Herbicide concentration monitoring does not accompany the 2024 spot treatment.

In the event that little or no CLP is located in the proposed 2024 application areas during the pretreatment survey, considerations will be made to either postpone or cancel the herbicide treatment. If only modest CLP is located in the proposed treatment areas, a hand harvesting strategy may be warranted rather than herbicide management. Onterra will convey the results of the pretreatment survey to WDNR, LMSD, and other project partners to ensure all parties are in agreement of the final management strategy decision.

All known CLP occurrences will be considered for inclusion in the professional hand harvesting effort during 2024. With minimal CLP identified in the 2023 CLP mapping survey, a 2024 hand harvesting strategy may initially be limited to 1-2 days with the potential for more based on early CLP observations in 2024. Onterra will provide the spatial data of the CLP population to the contracted professional hand harvesting firm to guide their efforts.

Shortly after the professional hand harvesting efforts are completed, Onterra staff will conduct an ESAIS survey during approximately late-June 2024. This survey will serve to evaluate the sites that were targeted with hand harvesting/herbicide treatment as well as to map the CLP population throughout the lake from which the 2025 management strategy will be determined.





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Onterra LLC
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815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Project Location in Wisconsin

Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- Public Beach
- Park
- Public Boat Launch

Map 1
Lake Minnesuing
Douglas County, Wisconsin

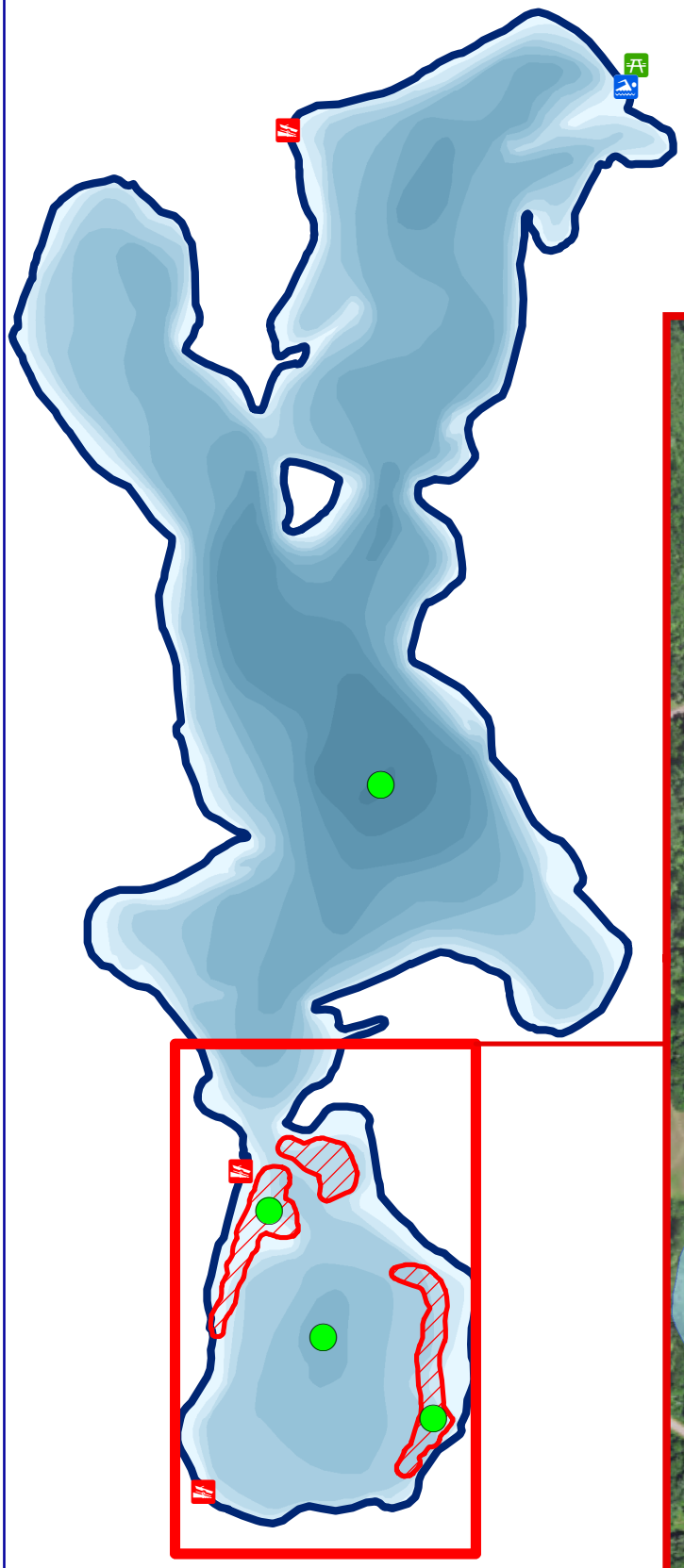
June 2020-2021
Curly-leaf Pondweed
Survey Results

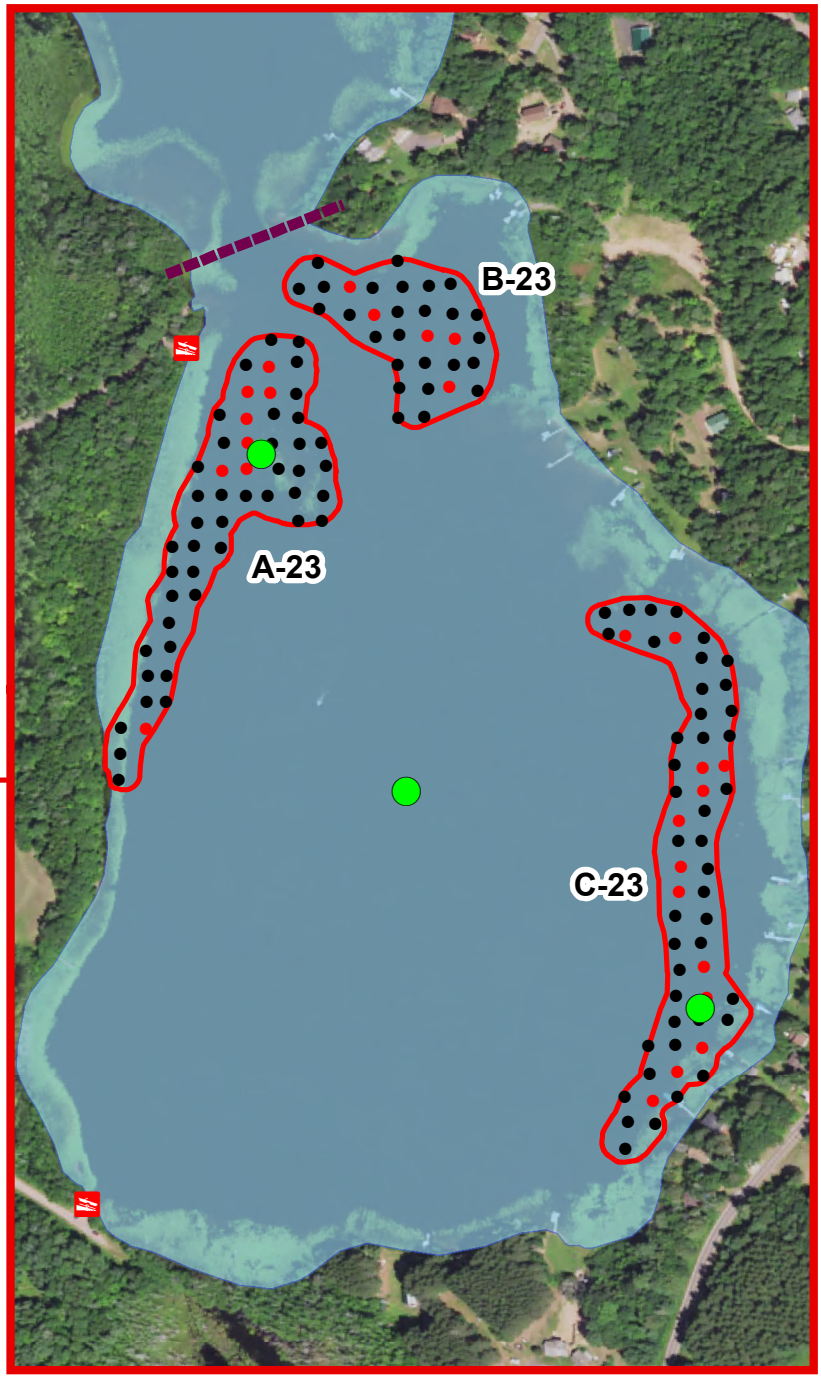
Final 2023 CLP Treatment Strategy

Liquid endothall - dipotassium salt

Site	Acres	Ave. Depth (feet)	Volume (ac-ft)	Endothall PPM ai
A-23	5.0	8.0	40.2	2.0
B-23	3.1	8.0	24.4	2.0
C-23	5.6	7.5	41.7	2.0
Total	**13.6**		106.4	

** Potential 0.226 ppm ai (0.161 ppm ae) south basin concentration*





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Sources:
Roads and Hydro: WDNR
Aerial Photography: NAIP 2022

Map Date: May 18, 2023 - TWH

Project Location in Wisconsin

Legend

- Sub Point-Intercept Without CLP
- Sub Point-Intercept With CLP Present (18.8%)
- 2023 Final Herbicide Application Area
- Herbicide Concentration Monitoring Location

Map 2

Lake Minnesuing

Douglas County, Wisconsin

Final 2023 CLP Treatment Strategy

Please Note: Survey occured after herbicide treatment and hand-harvesting efforts

Project Location in Wisconsin

N
W E
S

1,200
Feet

Legend

Curly-leaf Pondweed (*June 27, 2022*)

- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2022 CLP Treatment Area
- 2018 Emergent Plant Communities

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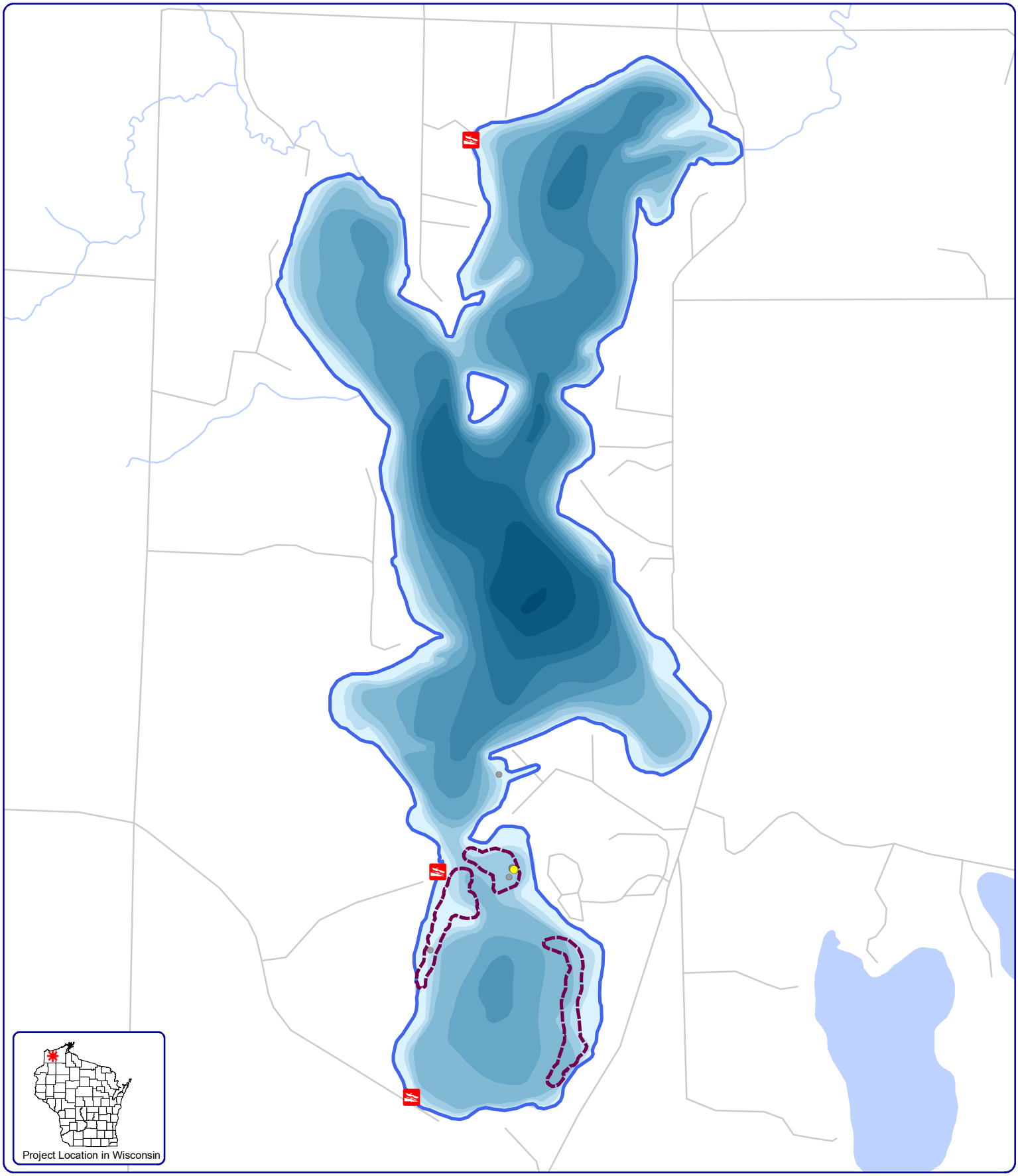
Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR
Aquatic Plants: Onterra, 2022
Orthophtography: NAIP, 2020

Map Date: August 24th, 2022 KLW

Map 3
Lake Minnesuing
Douglas County, Wisconsin

June 2022 CLP Survey Results



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Sources
Roads and Hydro: WDNR
Bathymetry: Digitized by Onterra
Aquatic Plants: Onterra, 2023
Map Date: June 30th, 2023 KLW
Filename: *Minnesuing_CLP_June23.mxd*

Legend

Curly-leaf pondweed (June 20th, 2023)

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- Public Boat Landing
- C3 2023 Herbicide Application Area

Map 4

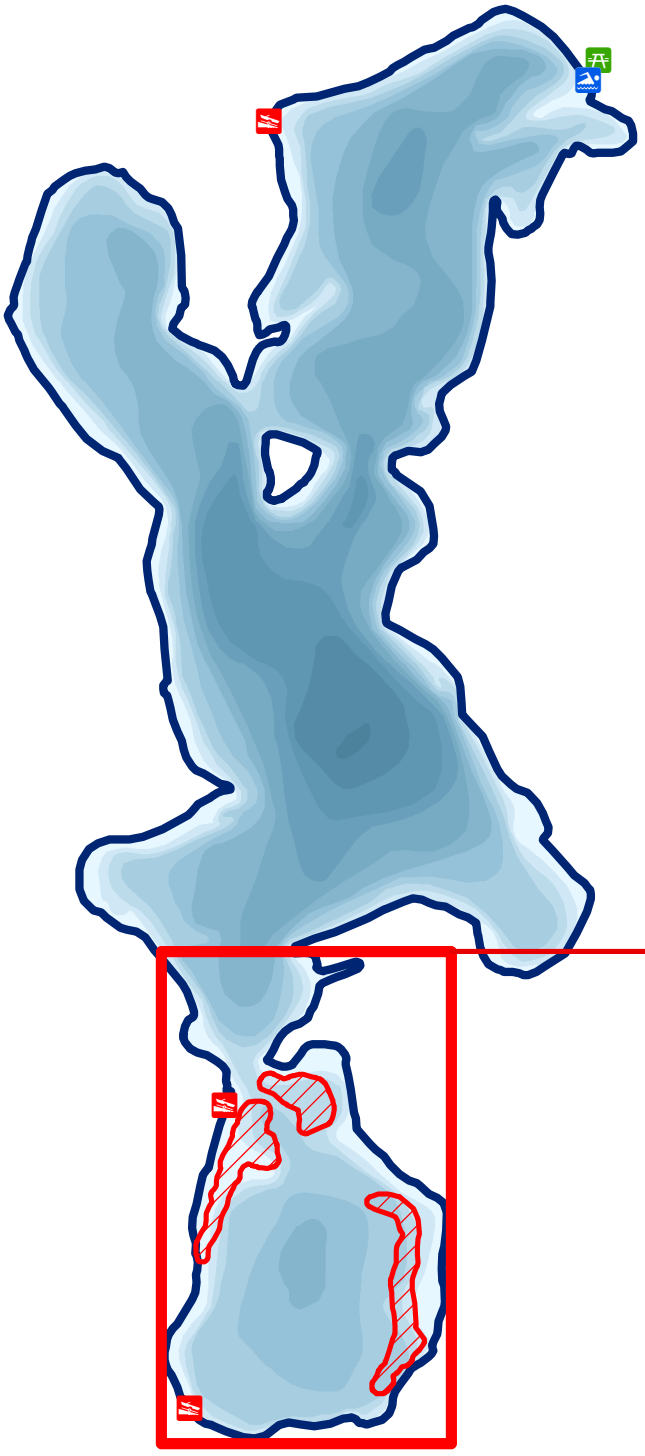
Lake Minnesuing

Douglas County, Wisconsin

June 2023 CLP Survey Results

Preliminary 2024 CLP Treatment Strategy				
Site	Acres	Ave. Depth (feet)	Volume (ac-ft)	Endothall PPM ai
A-24	5.0	8.0	40.0	2.0
B-24	3.1	8.0	24.8	2.0
C-24	5.6	7.5	42.0	2.0
Total	**13.7**		106.8	

** Potential 0.227 ppm ai (0.161 ppm ae) south basin concentration*



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920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Aerial Photography: NAIP 2022
Map Date: January 31, 2024 - RMF

Project Location in Wisconsin

Legend

Proposed 2024 Herbicide Application Area

Map 5
Lake Minnesuing
Douglas County, Wisconsin

Proposed 2024 CLP Control Strategy

A

APPENDIX A

Lake Minnesuing CLP Removal Report 2023 – Aquatic Plant Management LLC

Lake Minnesuing CLP Removal Report 2023

PO Box 1134 Minocqua, WI 54548

Lake Minnesuing CLP Removal Summary 2023

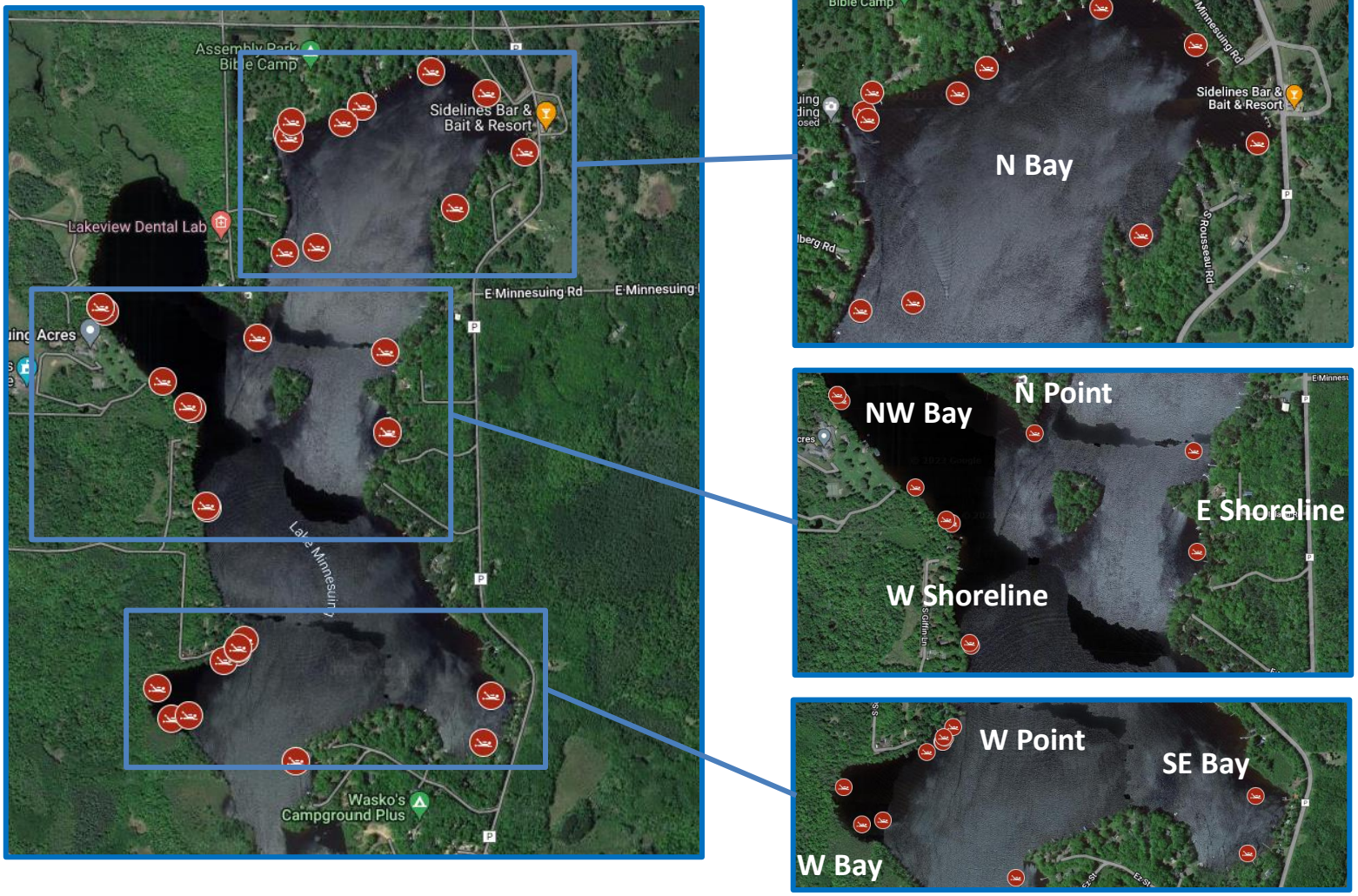
Dive Background: In mid June Aquatic Plant Management LLC (APM) conducted three (3) days of Hand Harvesting for Curly Leaf Pondweed (CLP) on Lake Minnesuing in Douglas County, WI. The team focused their efforts throughout the northern basin of the lake as prioritized by the Lake Minnesuing Sanitary District. In total APM was able to remove **11 cubic feet of CLP** from the lake.

Date	Weather Conditions	Water Temp (F)	Underwater Dive Time (hrs)	AIS Removed (cubic ft)
6/12/2023	Partly Cloudy	70	4.6	1.5
6/13/2023	Sunny	68	6.9	3.5
6/14/2023	Cloudy	69	4.4	6.0
Grand Total			**15.9**	**11.0**

Dive Location	Avg. Water Depth	# of Dives	Underwater Dive Time	AIS Removed (cubic feet)
E Shoreline	1.5	1	0.5	0.5
N Bay	4.0	12	5.8	3.5
N Point	1.5	1	0.3	0.0
NE Shoreline	5.0	1	0.8	0.0
NW Bay	3.6	6	2.5	2.5
NW Channel	2.0	1	0.3	0.5
SE Bay	4.8	2	1.3	0.5
W Bay	2.5	3	0.8	2.0
W Point	4.3	6	2.8	0.5
W Shoreline	2.5	2	1.0	1.0
Grand Total	**3.6**	**35**	**15.9**	**11.0**

Dive Highlights and Recommendations: The team spent the bulk of their time focusing on CLP in north bay, northwestern bay, and along a point on the western shoreline. In general, CLP population was highly scattered and the amount of biomass removed was low. As such, the dive team cut short the original planned five days of diving to only three days. Overall, the lake group should continue to take an Integrated Pest Management (IPM) approach and evaluate different strategies to manage the CLP population on the lakes. Continued monitoring and management efforts are important to prevent the spread of CLP.

Map of Dive Sites



Detailed Diving Activities

Date	Dive Location	Latitude	Longitude	Underwater Dive Time (hrs)	AIS Removed (cubic ft)	AIS Density	Avg Water Depth (ft)	Native Species	Native By-Catch	Substrate Type
6/12/2023	N Bay	46.47863	-91.74588	1.00	0.5	Single or Few	4.0	Pondweeds	0.5	Organic/Sand
6/12/2023	N Bay	46.47935	-91.74298	0.42	0.0	None	3.5	Pondweeds	0.0	Organic/Sand
6/12/2023	N Bay	46.47935	-91.74298	0.58	0.0	None	4.5	Pondweeds	0.0	Sand
6/12/2023	W Point	46.46462	-91.74788	0.50	0.0	None	3.0	Pondweeds	0.0	Sand
6/12/2023	W Point	46.46462	-91.74785	0.83	0.5	Single or Few	3.0	Pondweeds	0.0	Sand
6/12/2023	NW Bay	46.47117	-91.74962	0.75	0.5	Single or Few	4.0	Pondweeds	0.0	Organic
6/12/2023	N Point	46.47310	-91.74702	0.25	0.0	None	1.5	Pondweeds	0.0	Sand
6/12/2023	NW Bay	46.47380	-91.75307	0.25	0.0	None	5.5	Pondweeds	0.0	Organic
6/13/2023	N Bay	46.47850	-91.74580	1.00	0.5	Single or Few	4.0	Pondweeds	0.0	Organic/Sand
6/13/2023	N Bay	46.47893	-91.74368	0.50	0.0	None	6.0	Pondweeds	0.0	Organic/Sand
6/13/2023	N Bay	46.48032	-91.74028	0.58	0.5	Single or Few	3.0	Pondweeds	0.0	Organic/Sand
6/13/2023	NE Shoreline	46.47272	-91.74207	0.75	0.0	None	5.0	Pondweeds	0.0	Organic
6/13/2023	W Shoreline	46.46853	-91.74902	0.67	0.5	Single or Few	3.5	Pondweeds	0.0	Organic/Sand
6/13/2023	W Point	46.46439	-91.74837	0.75	0.0	None	3.5	Pondweeds	0.0	Organic/Sand
6/13/2023	W Point	46.46470	-91.74780	0.33	0.0	None	6.0	Pondweeds	0.0	Organic/Sand
6/13/2023	SE Bay	46.46344	-91.73792	0.58	0.5	Single or Few	5.0	Pondweeds	0.0	Organic
6/13/2023	SE Bay	46.46217	-91.73818	0.67	0.0	None	4.5	Pondweeds	0.0	Organic
6/13/2023	N Bay	46.47895	-91.74569	0.42	0.5	Highly Scattered	5.0	Pondweeds	0.0	Organic/Sand
6/13/2023	N Bay	46.47541	-91.74597	0.42	0.0	None	4.0	Pondweeds	0.0	Organic/Sand
6/13/2023	NW Bay	46.47393	-91.75320	0.25	1.0	Clumps	3.0	Pondweeds	0.0	Organic
6/14/2023	NW Bay	46.47393	-91.75320	0.67	0.5	Highly Scattered	3.5	Pondweeds	0.5	Organic/Sand
6/14/2023	NW Bay	46.47193	-91.75076	0.25	0.0	None	1.5	Pondweeds	0.0	Organic/Sand
6/14/2023	NW Bay	46.47124	-91.74979	0.33	0.5	Scattered	4.0	Pondweeds	0.0	Organic/Sand
6/14/2023	W Shoreline	46.46859	-91.74905	0.33	0.5	Single or Few	1.5	Grasses	0.0	Sand
6/14/2023	W Point	46.46494	-91.74754	0.25	0.0	None	5.0	Pondweeds	0.0	Organic/Sand
6/14/2023	W Point	46.46472	-91.74783	0.17	0.0	None	5.0	Pondweeds	0.0	Sand
6/14/2023	W Bay	46.46363	-91.75101	0.17	0.0	None	2.5	None	0.0	Organic
6/14/2023	W Bay	46.46281	-91.75043	0.25	0.5	Single or Few	2.0	Elodea	0.0	Organic
6/14/2023	W Bay	46.46290	-91.74976	0.42	1.5	Clumps	3.0	Pondweeds	0.0	Organic
6/14/2023	NW Channel	46.46165	-91.74554	0.25	0.5	Single or Few	2.0	Pondweeds	0.0	Organic/Sand
6/14/2023	N Bay	46.47663	-91.73933	0.25	0.5	Single or Few	3.5	Pondweeds	0.0	Organic
6/14/2023	E Shoreline	46.47056	-91.74196	0.50	0.5	Scattered	1.5	Pondweeds	0.0	Sand
6/14/2023	N Bay	46.47554	-91.74472	0.25	0.5	Single or Few	2.5	Pondweeds	0.0	Sand
6/14/2023	N Bay	46.47813	-91.73659	0.17	0.5	Single or Few	5.0	Pondweeds	0.0	Organic/Sand
6/14/2023	N Bay	46.47972	-91.73805	0.17	0.0	None	2.5	Pondweeds	0.0	Sand
Total	**35**			**15.93**	**11.0**					

B

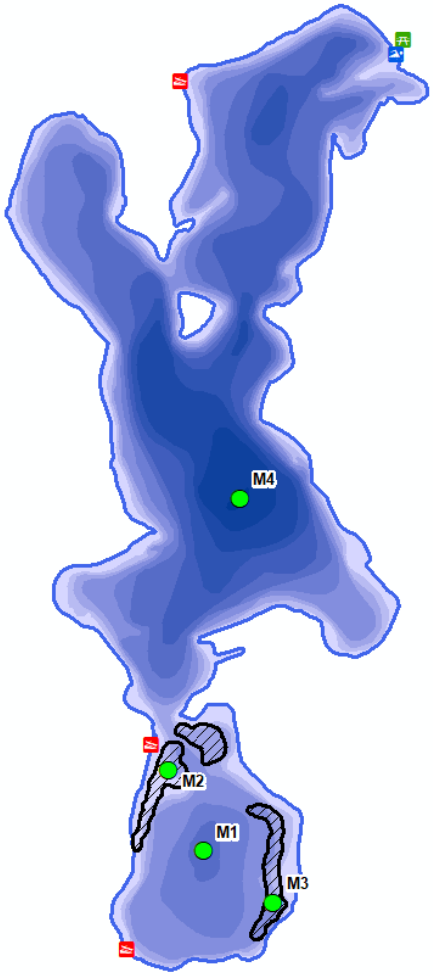
APPENDIX B

2023 Herbicide Concentration Monitoring Plan

Lake Minnesuing, Douglas County (WBIC: 2866200)
2023 Herbicide Sample Plan
Onterra, LLC

Lake Minnesuing, located in Douglas County, is an approximately 450-acre drainage lake that has a maximum depth of 43 feet. Liquid endothall is proposed to be applied to three application areas totaling 13.65 acres in spring 2023 to control curly-leaf pondweed. Herbicide concentration sampling will be conducted in order to monitor the herbicide concentrations in the hours and days following the application.

Water samples will need to be collected at the sites and depths listed below. Coordinates are in decimal degrees. Locations of each sampling site are displayed with green circles on the image below.



Lake Minnesuing Herbicide Sample Sites					
Site Label	**Site Description**	**Station ID**	**Latitude**	**Longitude**	**Sample Depth**
M1	South Basin	10057525	46.455899	-91.744755	Integrated (0-6 feet)
M2	Application area	10057526	46.45824	-91.746302	Integrated (0-6 feet)
M3	Application area	10057527	46.454426	-91.741731	Integrated (0-6 feet)
M4	Deep Hole	163125	46.466257	-91.743537	Integrated (0-6 feet)

Finalized 5/1/2023

After the herbicide application is completed, 26 samples will need to be collected at eight different time intervals throughout the project and are listed in the table below. Sample collection intervals are listed either as Hours After Treatment (HAT) or Days After Treatment (DAT). Direct communication between the water sample collector and the herbicide applicator is necessary to ensure the collector is prepared to begin two hours after treatment is completed. If a sample cannot be collected at the interval listed below, please collect the sample as soon as reasonably possible and record the change.

Sampling Interval Matrix (X indicates sample to be collected)				
	Application Area		Deep Hole	South Basin
Interval	Site M2	Site M3	Site M4	Site M1
2 HAT	X	X		
4 HAT	X	X		
8 HAT	X	X		
24 HAT	X	X	X	X
3 DAT	X	X	X	X
5 DAT	X	X	X	X
7 DAT	X	X	X	X
14 DAT	X	X	X	X
HAT = Hours After Treatment, DAT = Days After Treatment				

All water samples will be collected using a six-foot integrated sampler and a custom transfer bottle (Photo 1). A video tutorial demonstrating the proper sample collection methodology is available on Onterra's YouTube web page: click here

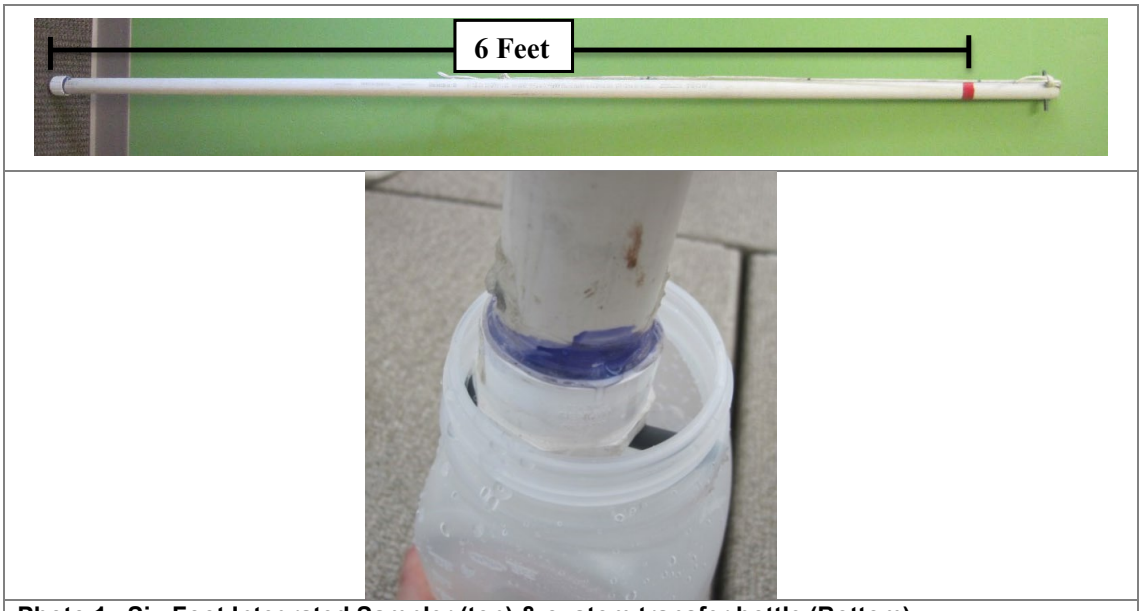


Photo 1. Six-Foot Integrated Sampler (top) & custom transfer bottle (Bottom).

Water is collected by pushing the integrated sampler straight down to an approximate depth of six feet; or in water shallower than six feet, down to approximately one foot above the bottom sediment. The sampler is brought to the surface and emptied into a customized mixing bottle by pushing open the stop valve at the end of the integrated sampler. The mixing bottle should be

given a brief stir to mix the contents, and then emptied from the mixing bottle into the appropriately labeled final sampling bottle. Once in the final sampling bottle, the water sample must be preserved by adding 3-4 drops of sulfuric acid with an eye dropper.

Onterra will provide all of the necessary supplies to complete the sampling and provide training to the volunteer(s) collecting the samples. Onterra has a supply of GPS units, temperature probes, and integrated sampler devices available to loan out for the duration of the sampling upon request. All other materials including pre-labeled sampling bottles, a customized mixing bottle, vials of sulfuric acid, eye droppers, datasheets, and a shipping container will be provided.

It is important to use a separate data sheet for each day that is monitored. Fill out one data sheet for each sample interval and fill in the highlighted boxes. Store the preserved samples in a refrigerator within a dark, enclosed container. When all of the sample intervals are completed, please ship all of the samples and the data sheets to the Wisconsin State Lab of Hygiene (WSLH) within the insulated shipping box. Please review the attached *Herbicide Sample Handling Instructions* for specific shipping instructions.

If you have any questions, please reach out to one of the contacts listed below.

Project specifics, logistics and sampling methods	
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