



Bed of Curlyleaf Pondweed, Moody Lake, Chisago County, Minnesota, June 1, 2023

Curlyleaf Pondweed Delineation and Assessment Surveys for Moody Lake, Chisago County, Minnesota, 2023

Curlyleaf Pondweed Delineation: April 25, 2023

Curlyleaf Treatment: No Treatment in 2023

Curlyleaf Pondweed Assessment: June 1, 2023

Prepared for:
Comfort Lake/Forest Lake
Watershed District
Forest Lake, Minnesota



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November 30, 2023

Curlyleaf Pondweed Delineation and Assessment Surveys for Moody Lake, Chisago County, Minnesota, 2023

Summary

Curlyleaf Pondweed Delineation: Moody Lake (MnDNR ID #13-0023) is a 45 acre lake located in Chisago County, Minnesota. Water clarity has a summer average of 4.2 feet in 2022 (source: CLFLWD). A full point intercept survey were conducted on April 25, 2023 by Blue Water Science. Data from the point intercept survey was used to determine areas for curlyleaf pondweed treatment and to look for Eurasian watermilfoil. Results of the curlyleaf delineation found curlyleaf pondweed was found in a few sample sites but at mostly low projected growth (Figure 1). No treatment for curlyleaf pondweed was conducted in 2023.

Curlyleaf Pondweed Assessment: A point intercept survey was used for the curlyleaf pondweed assessment and was conducted on June 1, 2023 by Blue Water Science (Figure 1). Results of the curlyleaf pondweed assessment found curlyleaf pondweed in Moody Lake had expanded slightly and was growing at light to heavy densities. Heaviest curlyleaf growth was on the west side of the lake. Also, in June, Moody Lake had a low diversity of submerged aquatic plants, with chara, coontail, elodea, and flatstem pondweed the only other submerged aquatic plant species observed.

Moody Lake Curlyleaf Pondweed Delineation
April 25, 2023

Moody Lake Curlyleaf Pondweed
June 1, 2023

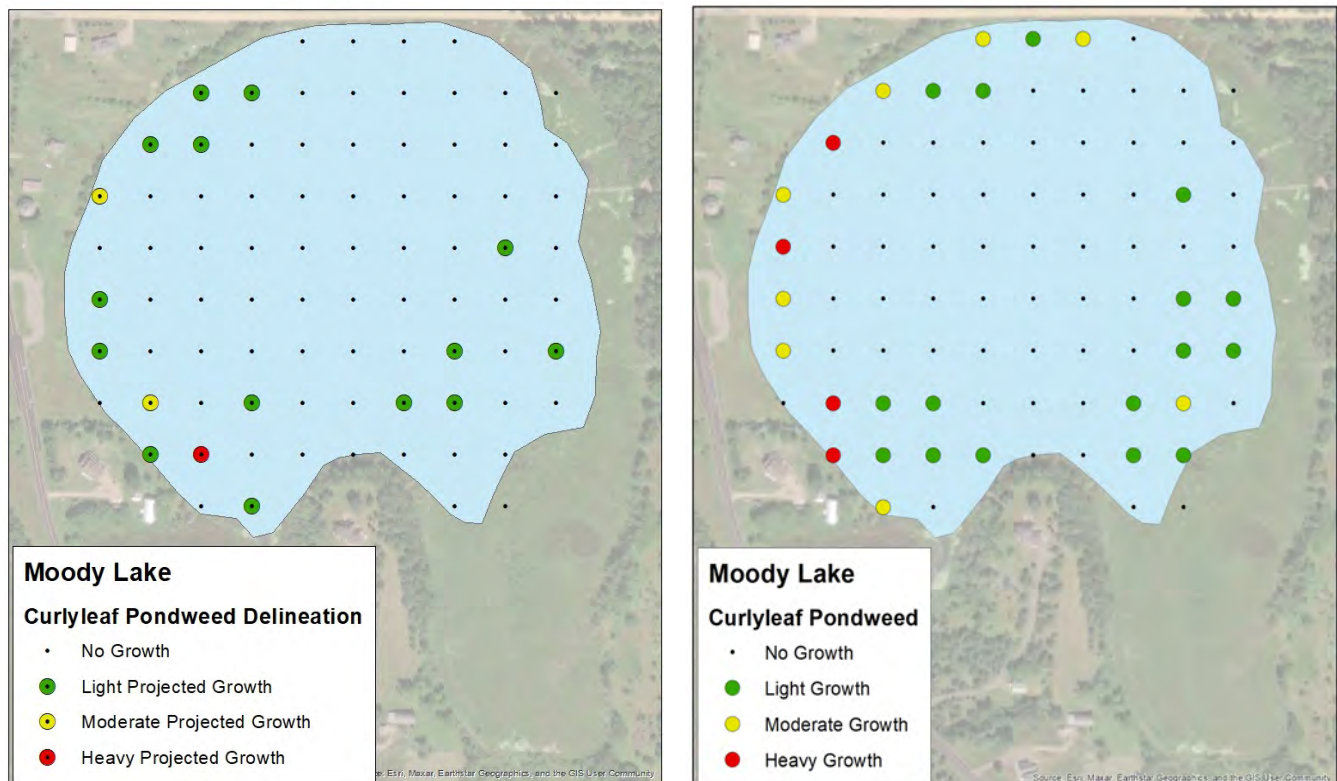


Figure 1. [left] Curlyleaf pondweed treatment areas Moody Lake that were delineated on April 25, 2023. [right] Curlyleaf pondweed coverage for Moody Lake on June 1, 2023.

Key: green dots = light growth, yellow dots = moderate growth, red dots = heavy growth, and black dots = sample site without plants.

Curlyleaf Pondweed Delineation and Assessment Surveys for Moody Lake, Chisago County, Minnesota, 2023

Moody Lake, Chisago County (ID: 13-0023)

Size: 45 acres (MnDNR)

Littoral area: 22 acres (MnDNR)

Maximum depth: 48 ft (MnDNR)

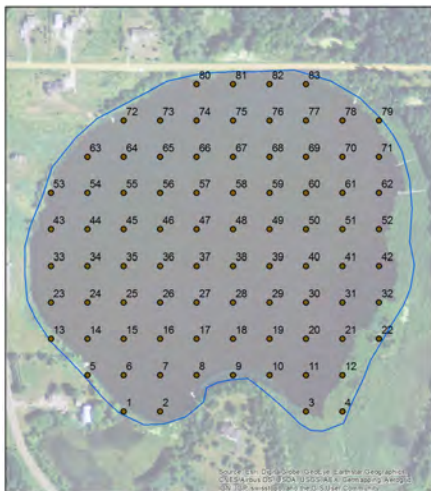
Introduction

A curlyleaf pondweed delineation was conducted on April 25, 2023 on 45 acre Moody Lake, Chisago County. The objective of the delineation was to check the distribution and abundance of curlyleaf pondweed. A curlyleaf pondweed assessment was conducted on June 1, 2023 again to check the distribution and abundance of curlyleaf pondweed and Eurasian watermilfoil and to characterize all native plants.

Methods

Curlyleaf Pondweed Delineation: At the time of the spring CLP delineations, only a fraction of the peak curlyleaf biomass is present. For spot treatments, the areas to be treated should be delineated prior to curlyleaf developing peak biomass. Curlyleaf stem counts on a rake sampler were used to identify areas that had a potential to produce dense curlyleaf. After a short sweep of about 1-foot (30 cm), 4 curlyleaf stems or more per rake sample generally indicated some CLP plants had developed runners and would likely produce heavy growth in the next few weeks. Alternatively, sites where 3 stems or less were collected per rake sample were not predicted to produce dense growth at the peak growing period. These areas were not treated. This delineation method was used for spot lake treatments in Gleason Lake and has worked for other lakes as well (McComas et al, 2015*).

Point Intercept Surveys and the Curlyleaf Pondweed Assessment: Two point intercept surveys were conducted by Blue Water Science on April 25



and June 1, 2023. Grid spacing was 50 meters. The plant species were recorded and the density of each species was assigned. Densities were based on the coverage on the teeth of the rake. Density ratings were from 1 to 3 with 1 being sparse and 3 being a nuisance. Based on these sample sites, plant distribution maps were constructed.

Figure 2. Point intercept site map for Moody Lake.

*McComas, S.R., Y.E. Christianson, and U. Singh. 2015. Effects of curlyleaf pondweed control on water quality and coontail abundance in Gleason Lake, Minnesota. *Lake and Reservoir Management*. 31:109-114.

Results for the CLP Delineation: April 21, 2022

A point intercept survey was conducted to delineate CLP on April 21, 2022 (Figure 3). Results from the survey found that CLP stem densities at most of the sites were not predicted to produce heavy growth of CLP abundance in June therefore no areas were delineated for treatment. No treatment occurred in 2022. Coontail and elodea was the only other submerged plant species observed (Tables 1 and 2).

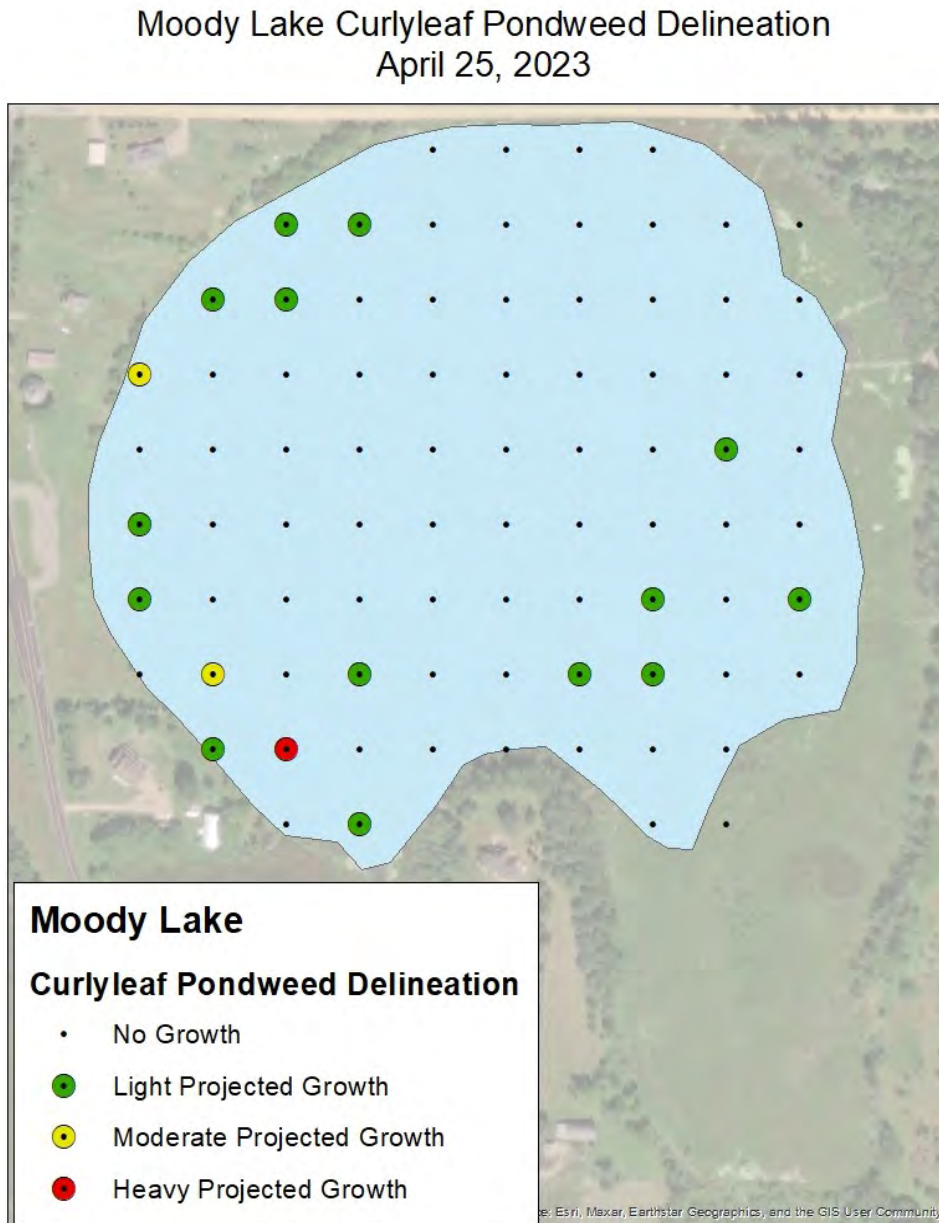


Figure 3. Curlyleaf pondweed from the point intercept survey conducted on April 25, 2023.
Key: Green dots = light growth, red dots = heavy growth, and black dot = sample site, no plants.

Table 1. Moody Lake aquatic plant occurrences and densities for the April 25, 2023 point intercept survey based on 83 sites. Density ratings are 1-3 with 1 being low and 3 being most dense.

	All Stations (n=83)		
	Occur	% Occur	Density
Coontail (<i>Ceratophyllum demersum</i>)	33	40	1.2
Chara (<i>Chara sp</i>)	3	4	1.3
Elodea (<i>Elodea canadensis</i>)	34	41	1.2
Curlyleaf pondweed - stems (<i>Potamogeton crispus</i>)	17	20	1.7

Table 2. Aquatic plant occurrence and stem density for the point intercept sample points in Moody Lake, April 25, 2023.

Site	Depth (ft)	Chara	Coontail	CLP Stems	Elodea
1	4		1		
2	4		1	1	
3	3		1		1
5	4		1	2	1
6	4			4	
7	6		1		2
8	6		1		2
9	3		1		
10	4				1
11	4				1
12	3		1		1
13	3		1		1
14	6		1	3	1
15	8		1		
16	9			1	
17	7		1		2
18	7				1
19	6	2	1	1	1
20	6			1	1
21	4				1
22	5		2		
23	5		1	2	
24	7		1		1
25	23				
27	22				
28	12				
29	8				
30	7	1	1	1	
31	6				2
32	5		2	1	1
33	6		1	1	1
34	17				
35	27				
39	15				
40	8				1
41	6	1			1
42	5		2		
43	5		1		1
44	13				
50	10				
51	6			2	2
52	5		1		1
53	4				1
54	7				2
60	11				
61	7				1
62	5				1
63	5				2
64	7				1
70	6			2	
71	3			1	
72	5			1	2
73	6			1	1
74	6				2
75	8			1	
76	10				
77	13				
78	6			1	1
80	4			1	
81	4			2	
82	5				1
83	6			1	1
Average		1.3	1.2	1.7	1.2
Occur (83 sites)		3	33	17	34
% occurrence		4	40	20	41

Results for the June 1, 2023 Point Intercept Survey and CLP Assessment

Results of the June 1, 2023 assessment using a point intercept survey found there were 5 submerged plant species, chara, coontail, curlyleaf pondweed, elodea, and flatstem pondweed with coontail being the dominant plant (Tables 3 and 4). No CLP treatment occurred in 2023 and CLP distribution increased from 17 sites to 28 sites. The heaviest CLP growth was on the west side of Moody Lake (Table 3 and Figure 4). Results from the assessment found native plants growing out to a depth of 11 feet (Table 4).

Table 3. Moody Lake aquatic plant occurrences and densities for the June 1, 2023 survey based on 83 sites. Density ratings are 1-3 with 1 being low and 3 being most dense.

	All Stations (n=83)		
	Occur	% Occur	Density
Cattails (<i>Typha sp</i>)	2	2	1.0
White waterlily (<i>Nymphaea ordata</i>)	3	4	1.0
Coontail (<i>Ceratophyllum demersum</i>)	48	58	1.7
Chara (<i>Chara sp</i>)	7	8	1.1
Elodea (<i>Elodea canadensis</i>)	36	43	1.3
Curlyleaf pondweed (<i>Potamogeton crispus</i>)	28	34	1.6
Flatstem pondweed (<i>P. zosteriformis</i>)	1	1	1.0

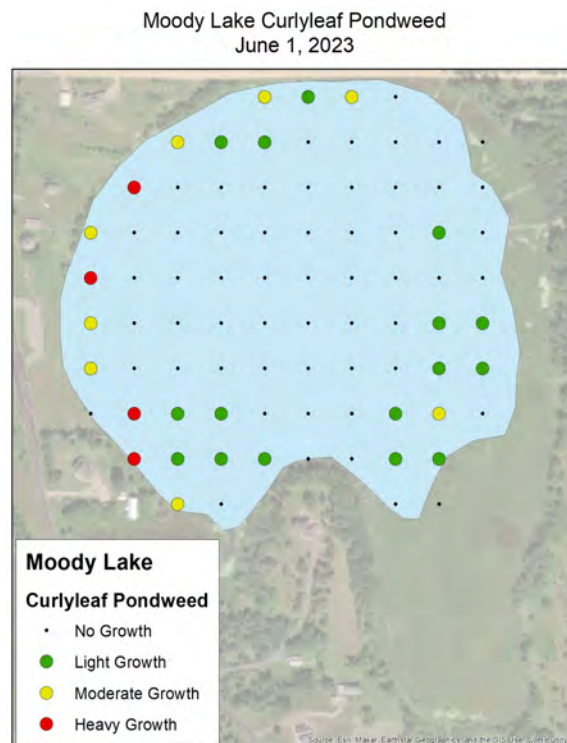


Figure 4. Curlyleaf pondweed coverage for Moody Lake on June 1, 2023. Key: black dots = no growth, green dot = light growth, yellow dots = moderate growth, and red dots = heavy growth.

Aquatic Plant Conditions

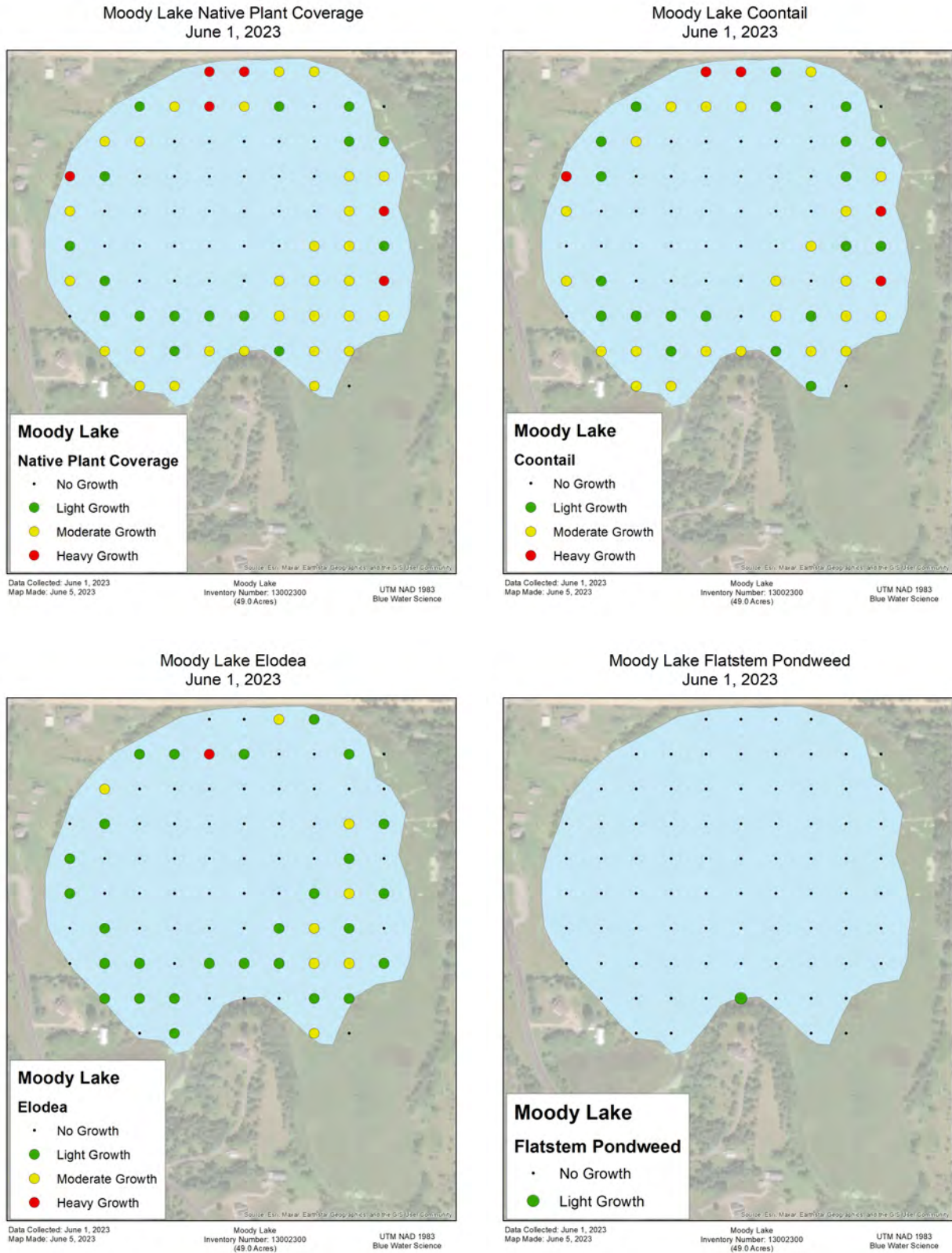
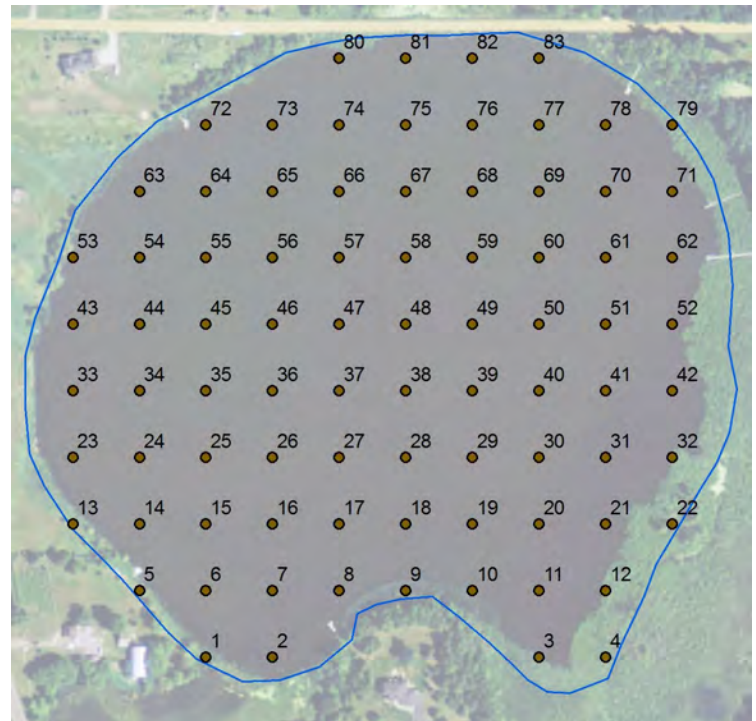


Figure 5. Aquatic plant conditions on June 1, 2023.

Table 4. Aquatic plant occurrence and density for the point intercept sample points in Moody Lake, June 1, 2023.

Site	Depth (ft)	Cat-tails	White lily	Chara	Coon-tail	CLP	Elodea	Flat-stem	Fila algae
1	1	1	1		2	2			1
2	2		1		2		1		1
3	2				1		2		
4	0								
5	3				2	3	1		
6	5				2	1	1		
7	5				1	1	1		
8	5				2	1			
9	3				2			1	
10	3				1				
11				1	2	1	1		
12	1				2	1	1		2
13	0								
14	5				1	3	1		
15	7				1	1	1		
16	8				1	1			
17	6				1		1		
18	6						1		
19	6			2	2		1		
20	5				1	1	2		
21	5				2	2	2		
22	4				2		1		
23	4				2	2			
24	8			1	1		1		
25	22								
26	27								
27	22								
28	13								
29	7				2		1		
30	6						2		1
31	5				2	1	1		
32	3				3	1			2
33	5					2	1		
34	16								
38	23								
39	17								
40	7			1	2		1		
41	6			1	1	1	2		
42	4			1	1	1	1		1
43	5				2	3	1		
44	17								
45	26								
50	11								
51	6				2		1		
52	4				3				1
53	3		1		3	2			
54	6			1	1		1		
55	18								
60	12								
61	6				1	1	2		
62	4				2		1		
63	6				1	3	2		
64	7				2				
65	9								
66	9								
67	14								
68	26								
69	18								

Site	Depth (ft)	Cat-tails	White lily	Chara	Coon-tail	CLP	Elodea	Flat-stem	Fila algae
70	5				1				
71	3				1				
72	5				1	2	1		
73	6				2	1	1		
74	6				2	1	3		
75	7				2		1		
76	10				1				
77	9								
78	5				1		1		
79	1	1							
80	4				3	2			
81	3				3	1			
82	5				1	2	2		
83	4				2		1		
Average		1.0	1.0	1.1	1.7	1.6	1.3	1.0	1.3
Occur (83 sites)		2	3	7	48	28	36	1	7
% occur		2	4	8	58	34	43	1	8





Bone Lake, October 2023

Aquatic Invasive Species Search in Bone Lake, Washington County, Minnesota

Zebra Mussel Found: July 20, 2023
Second Search Date: October 12, 2023

Prepared for:
Comfort Lake Forest Lake
Watershed District



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December 4, 2023

Aquatic Invasive Species Search in Bone Lake, Washington County, Minnesota

July 20, 2023 Zebra Mussel Discovery: A single zebra mussel was first observed at the public access in Bone Lake and the public access area was treated with Earthtec copper sulfate in 2019. AIS searches at the public water access continued from 2020 through 2023. On July 20, 2023, a single zebra mussel attached to a naiad plant was found by Blue Water Science on the east side of Bone Lake.

During a July 20, 2023 full lake point intercept survey, samples of naiads from 3 sites were placed in a bag and were brought back to the lab for identification. A single zebra mussel was found attached to the naiads. The 5 mm zebra mussel was likely from this year and indicates a reproducing population is probably established in Bone Lake.

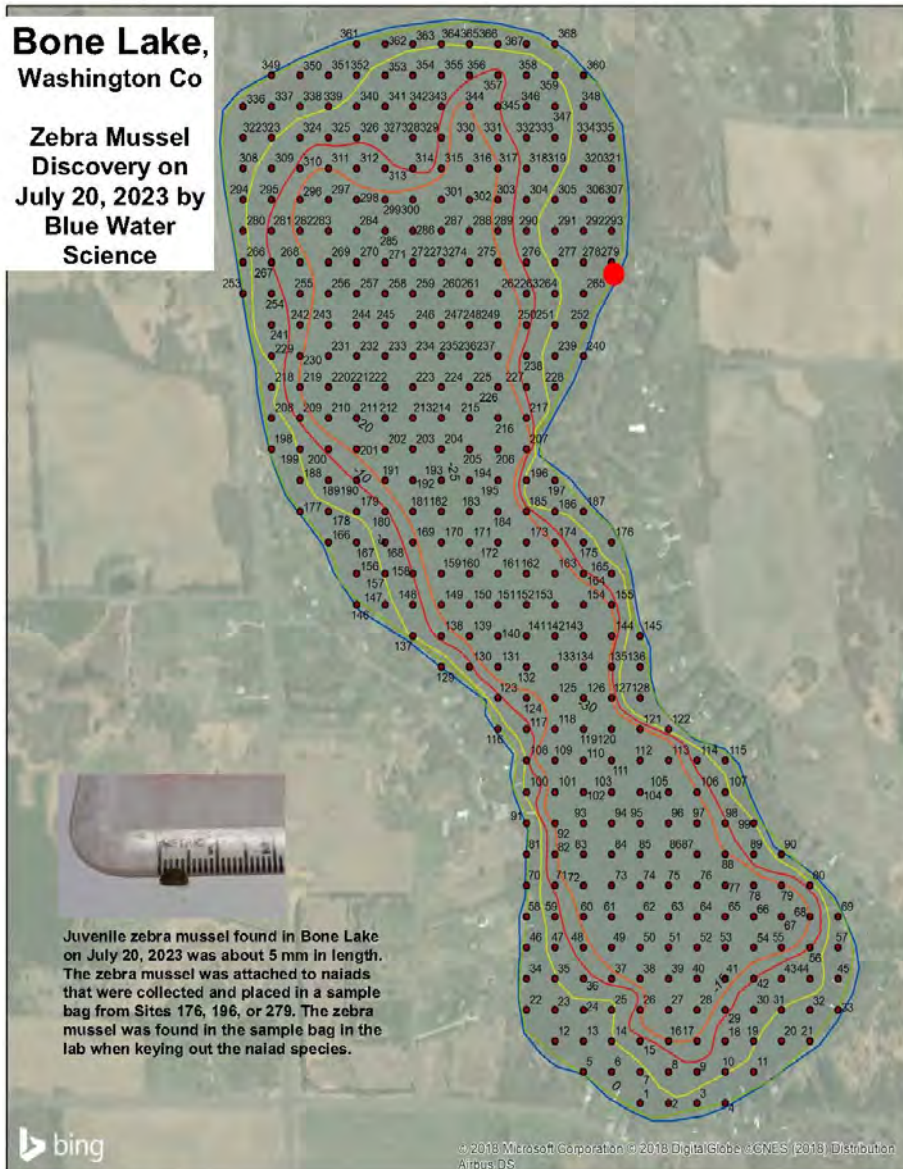


Figure 1. Location of the zebra mussel on July 20, 2023.

Summary of the 2023 search: Two searchers from Blue Water Science surveyed the boat access and surrounding areas in Bone Lake on October 12, 2023 searching for occurrences of invasive species, primarily zebra mussels or starry stonewort.

No starry stonewort and no additional zebra mussels were observed on the October 12, 2023. Representative photos and observations shown below.

Table 1. Site data for the two aquatic invasive species searches on October 12, 2023.

	Number of Searchers	Starry Stonewort (SSW)	Zebra Mussels (ZM)	Bottom Conditions
October 12, 2023				
1. Public Access and surrounding area	2	No SSW found	No ZM observed	Sandy, rocks rare, some branches. Moderate plant growth.
2. Inlet area		No SSW found	No ZM observed	Sandy, rocks rare, some branches. Moderate plant growth.
3. NW shore area	2	No SSW found	No ZM observed	Sandy, rocks rare, some branches. Moderate plant growth.

Photos from the July 20, 2023 Point Intercept Survey and October 12, 2023 AIS Search



Figure 2. A single zebra mussel was found during the July 20, 2023 point intercept survey (top photos). Plants were still actively growing in Bone Lake in October but no zebra mussels were found (bottom pictures).

Starry Stonewort Information Sheet

INVASIVE **Starry stonewort**
Nitellopsis obtusa

KEYS TO ID

- Long, smooth branchlets are attached in whorls of 5 - 8
- Small, star-shaped bulbils form on clear threads at base of plant and may be found above or below the sediment surface
- Small, orange spheres called antheridia may be visible, these are male reproductive structures
- Typical branchlets are long; can be up to twelve inches
- Can form dense mats in water




LOOKS SIMILAR TO

- Native *Chara* (native)
- Native *Nitella* (native)
- Sago pondweed (native)
- Water stargrass (native)

WHERE TO LOOK

- In shallow, still water and near access

CURRENTLY FOUND

Actual size of bulbils
Below: orange antheridia



Figure 3a. [left] Starry stonewort identification page from the University of Minnesota Aquatic Invasive Species Research Center (MAISRC).

NATIVE **Muskgrasses**
Chara spp.

KEYS TO ID

- Stems are typically rough and crunchy
- Thin branchlets form whorls around thin stems
- May produce bulbils, but not star-shaped
- May have musky odor




LOOKS SIMILAR TO

- Starry stonewort (invasive)
- Native *Nitella* (native)
- Sago pondweed (native)
- Water stargrass (native)
- Minnesota has nine *Chara* species

WHERE TO LOOK

- Fully submerged
- Along lake bottoms forming patches called meadows

CURRENTLY FOUND

Rough stems; whorled branchlets

Figure 3b. *Chara* identification page from the MAISRC.

Starry stonewort looks a lot like some growth forms of chara and nitella (Figure 3). Starry stonewort was not observed in Bone Lake in 2023.

Initial searches for Starry Stonewort focus on public access points as a priority, nearly all new SSW infestations are found at boat launch locations.

Rapid Response Plan for Starry Stonewort

Starry stonewort was not found in Bone Lake on the October 12, 2023 search. However a single zebra mussel was found on July 20, 2023. A rapid response plan for starry stonewort, shown in Table 2, has a number of preventative steps as well as actions to be considered after a potential new AIS sighting.

Table 2. Tasks and assignments for an early detection and rapid response program for Bone Lake, Minnesota.

	Bone Lake Association	CLFLWD	Washington County	MnDNR	Others	Treatment Contractor	BWS
1. Early Detection							
1.1. Create website information.	X						
1.2. Designate contact person.	X						
1.3. Conduct training session for volunteer searchers.	Late summer	Late summer					Late summer
1.4. Conduct monthly targeted searches (late summer).	X						X
1.5. Press release if SSW is found.	X			X			
2. Rapid Response Assessment							
2.1. Conduct an initial exploratory search after the first report of a starry stonewort observation.				X			X
2.2. Organize and train lake resident searchers for a full search effort.	X						X
2.3. Conduct an expanded targeted search with diving (if needed).	X	X		X			X
3. Rapid Response Action							
3.1. Meet to determine treatment options.	X		X	X	X	X	X
3.2. Close public access, if necessary.	X		X	X	X		
3.3. Treat area with copper sulfate.						X	
3.4. Evaluate treatment.				X			X
3.5. Report all findings and results.	X			X			X



White Water Lilies in Bone Lake, July 20, 2023

Curlyleaf Pondweed and Eurasian Watermilfoil Management and Point Intercept Survey for Bone Lake, Washington County, Minnesota, 2023

	Delineation	Treatment	Assessment
CLP	May 1, 2023	No treatment	June 2, 2023
EWM	June 2, 2023	No treatment	July 20, 2023

Meander Surveys: May 1 and June 2, 2023
Point Intercept Survey: July 20, 2023

Prepared for:
Comfort Lake/Forest Lake
Watershed District
Forest Lake, Minnesota



December 4, 2023

Prepared by:
Steve McComas
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Blue Water Science

Curlyleaf Pondweed and Eurasian Watermilfoil Management and Point Intercept Survey for Bone Lake, Washington County, Minnesota, 2023

Summary

Curlyleaf Pondweed Delineation and Assessment: Bone Lake (MnDNR ID #82-0054) is a 221 acre lake located in Washington County, Minnesota. On May 1, 2023 the curlyleaf pondweed (CLP) delineation survey sampled 117 sites. Curlyleaf pondweed growth was light and sparse and was found at 5 sample sites (Figure 1). No CLP treatment is necessary at this time.

No treatment of curlyleaf pondweed was conducted in 2023.

A CLP assessment was conducted on June 2, 2023, during the peak growth of CLP. Curlyleaf was sampled at 10 sites at light to moderate growth conditions on June 2, 2023 (Figure 1). One area in the southwest corner of the lake had one site of moderate CLP growth.

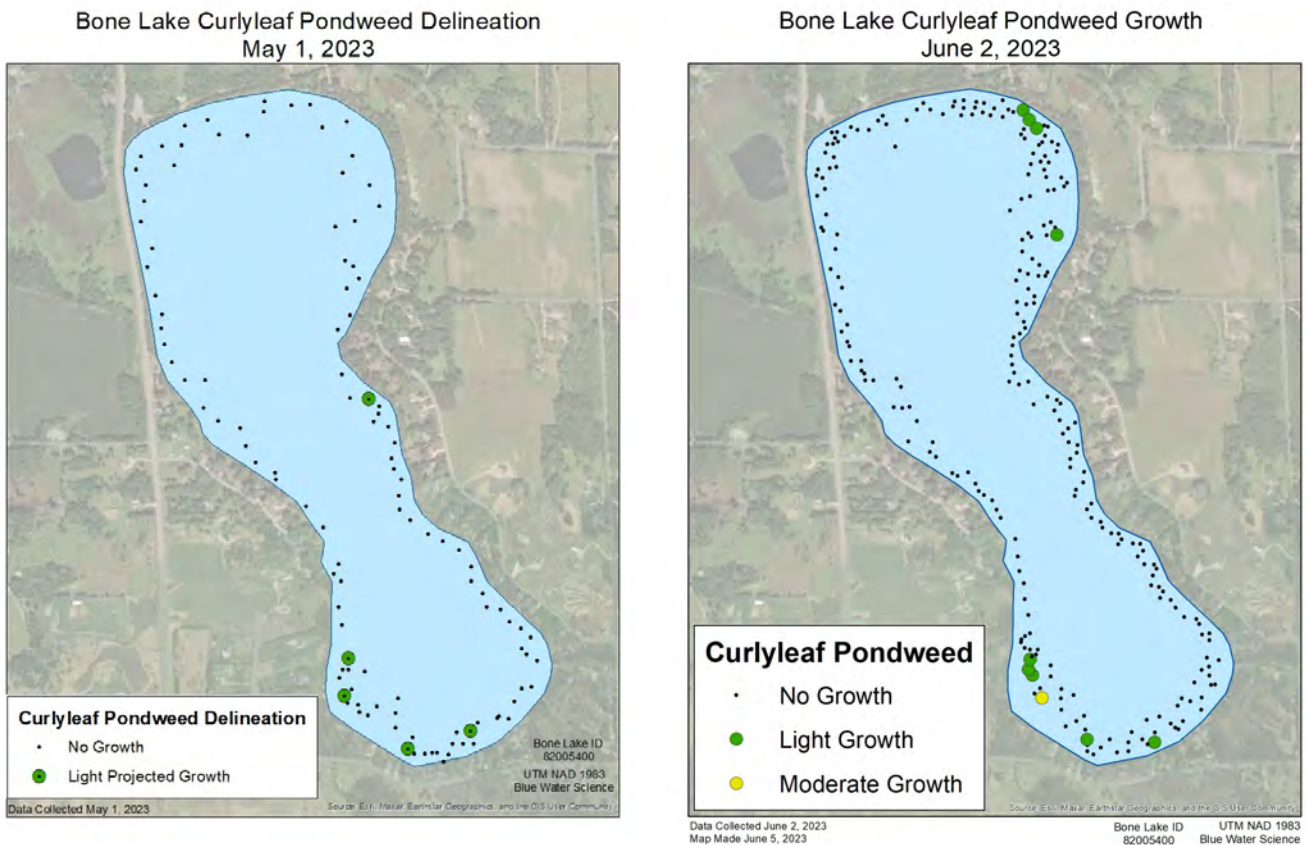


Figure 1. [left] CLP was found at 5 out of 117 sample sites in Bone Lake on May 1, 2023. [right] CLP was found at 10 out of 261 sample sites on June 2, 2023. Key: green = light growth potential and yellow = moderate growth potential.

Eurasian Watermilfoil Delineation and Assessment: Eurasian watermilfoil (EWM) was verified in Bone Lake in 2006. On May 1, 2023 the Eurasian watermilfoil (EWM) delineation survey sampled 117 sites. Eurasian watermilfoil growth was light and sparse and was found at 6 sample sites (Figure 2).

No treatment was conducted in 2023.

An assessment combined with a point intercept survey was conducted on July 20, 2023. Eurasian watermilfoil was sampled at 3 sites out of 163 sample locations out to 9 feet (depth of plant growth). EWM density was mostly light in 2023 (Figure 2).

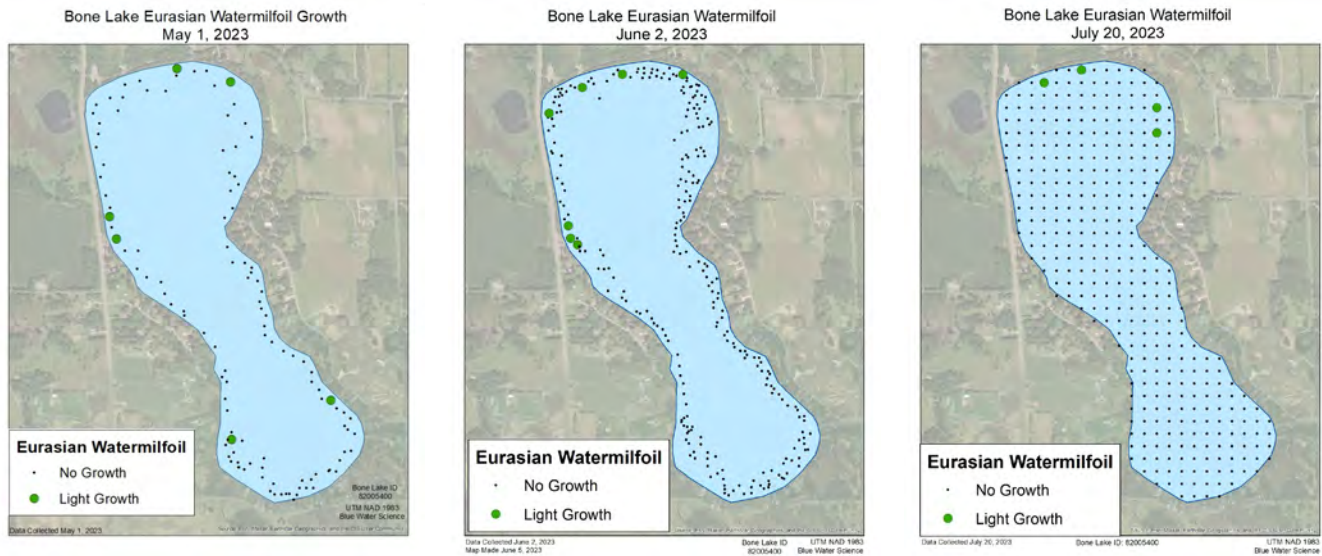


Figure 2. [left] EWM coverage for Bone Lake on May 1, 2023. [middle] EWM coverage for Bone Lake on June 2, 2023. [right] EWM coverage on for Bone Lake on July 20, 2023.

Summary of CLP and EWM Bone Lake Treatments: CLP has been treated in 5 out of the last 10 years. EWM has been treated in 3 out of the last 10 years. However, no CLP or EWM was treated in 2023 (Figure 3).

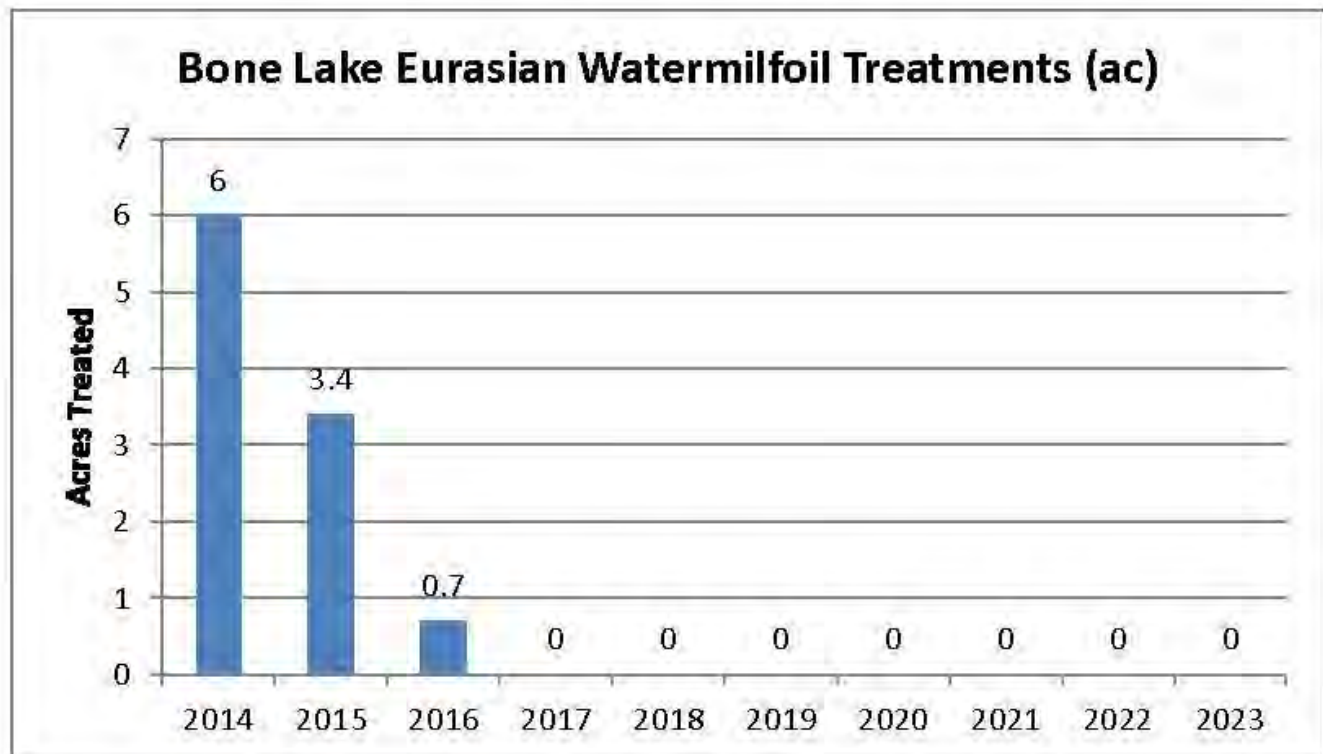
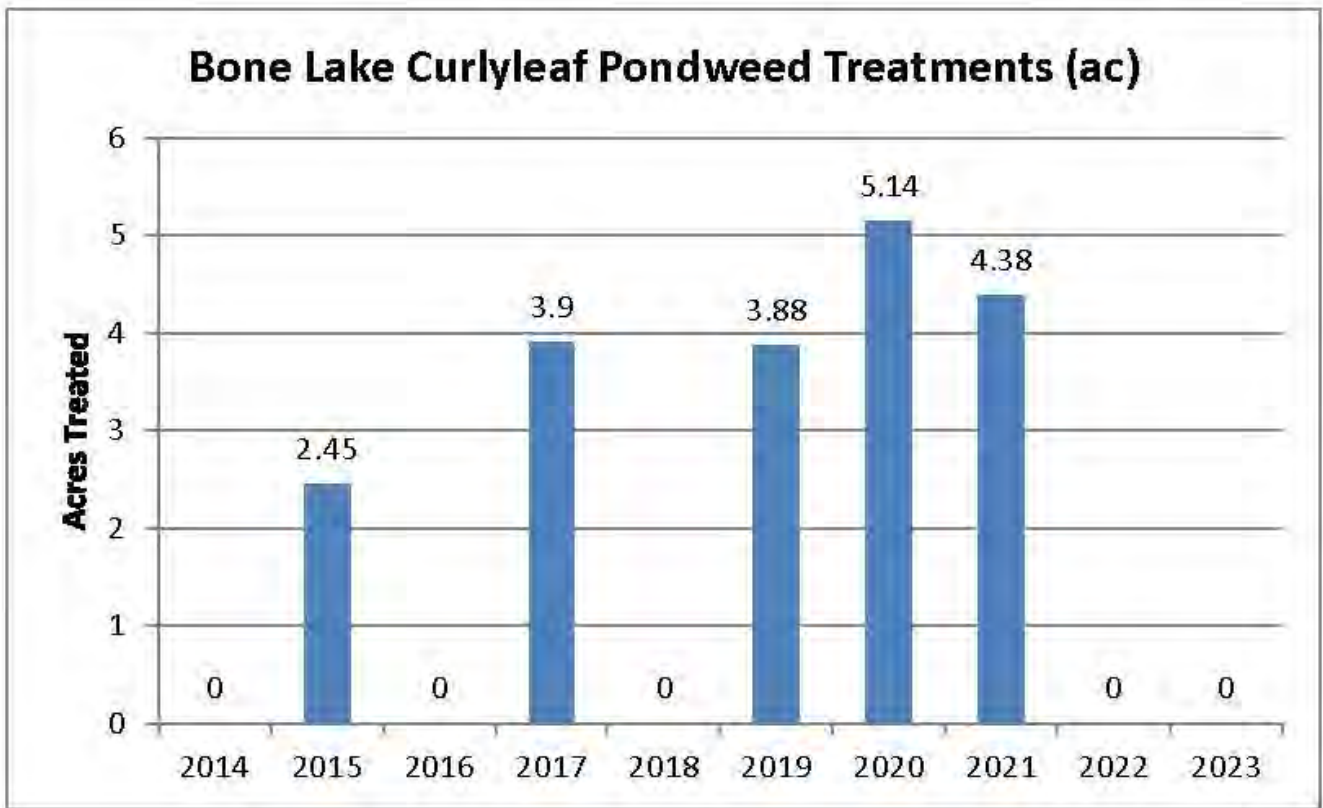


Figure 3. Summary of CLP and EWM treatment acreage for 2014-2023.

Curlyleaf and Milfoil Treatments from 2015-2023: A summary of CLP and EWM treatments from 2015 through 2023 is shown in Figure 4. Curlyleaf pondweed growth has fluctuated over the years. No treatment was conducted in 2022 and 2023. EWM treatment areas have decreased since 2014 with no treatment occurring 2017 through 2023 in Bone Lake.

A hotspot map of sites of CLP and EWM that show moderate and heavy growth for 2015 through 2023 is shown in Figure 4. CLP and EWM have typically grown to a water depth of 6 feet or less.

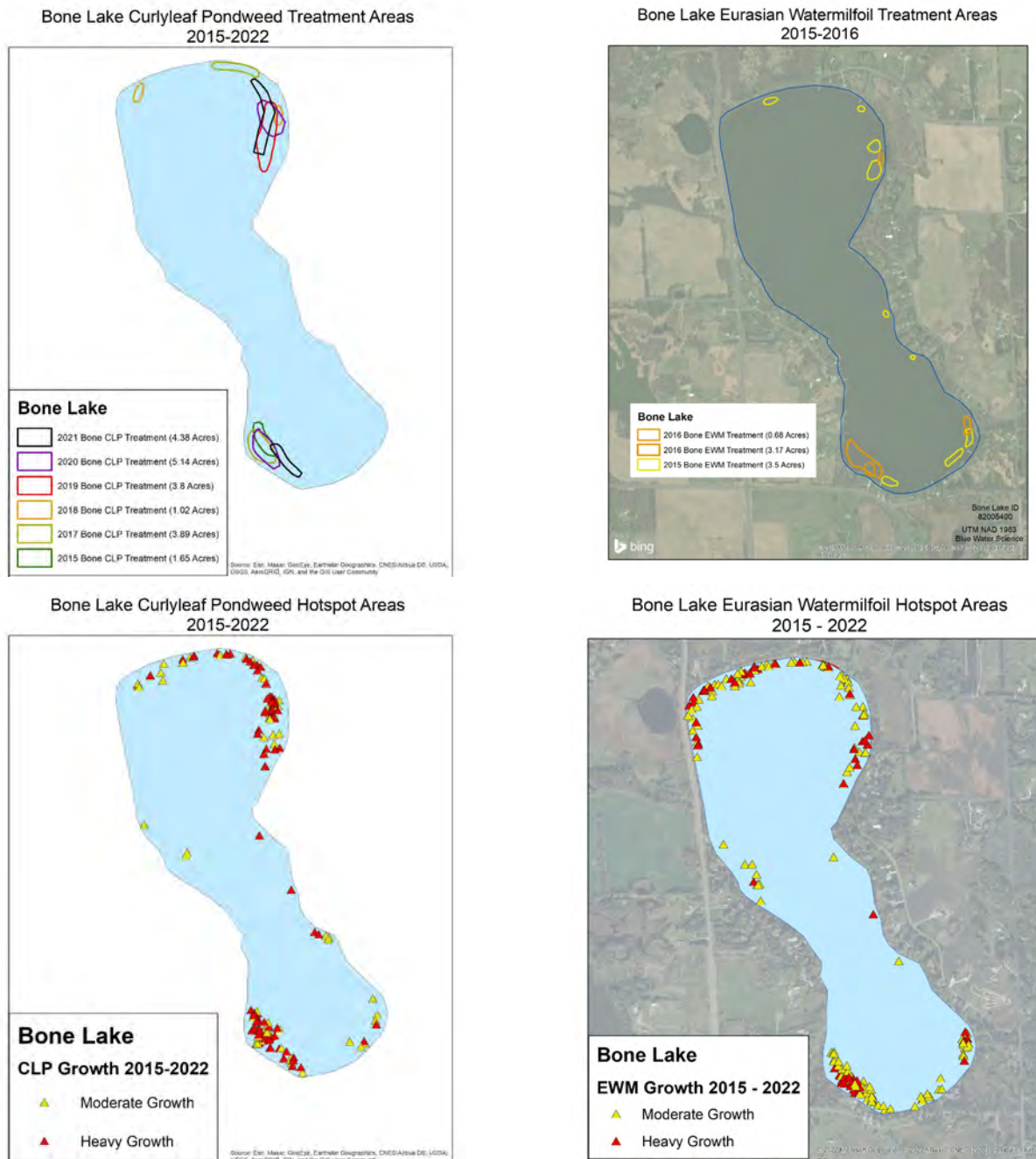


Figure 4. [top-left] Bone Lake CLP treatment map 2015-2022. [top-right] Bone Lake EWM treatment map 2015-2016. [bottom-left] Hotspot map of CLP growth over the years of 2015-2022 placed on a single map. [right] Hotspot map of EWM growth over the years of 2015-2022 placed on a single map. Key: yellow = moderate growth, and red = heavy growth.

Aquatic Plant Point Intercept Survey: On July 20, 2023 an aquatic plant point intercept survey using 50 m spacing between sites was conducted on Bone Lake. During the survey non-native species including curlyleaf pondweed, Eurasian watermilfoil, starry stonewort, and zebra mussels as well as characterized all aquatic plants. Eight submerged aquatic plant species and 2 water lily species were sampled on July 20, 2023 in Bone Lake.

In July, the most abundant native aquatic plant species were naiads (found at 43% of the sites out to 9 feet) followed by coontail (found at 35% of the sites)(Table 1). Eurasian watermilfoil was found at 3 out of 163 sites (2%). Plants were found at 163 sites and grew out to 9 feet of water depth. Aquatic plants covered about 67 acres or 30% of the lake area.

Table 1. The percent occurrence of aquatic plants for Bone Lake. Percent occurrence is calculated based on the number of times a plant species occurs at a sampling station divided into the total number of stations for the survey. For example, if coontail was found in 25 out of 50 stations, its percent occurrence would be 50%.

	July 20, 2023 % Occur (0-9 feet, 163 sites)
Spatterdock (<i>Nuphar variegatum</i>)	6
White water lily (<i>Nymphaea odorata</i>)	19
Coontail (<i>Ceratophyllum demersum</i>)	35
Chara (<i>Chara spp</i>)	1
Northern watermilfoil (<i>Myriophyllum sibiricum</i>)	2
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	2
Naiads (<i>Najas flexilis</i>)	43
Stringy pondweed (<i>Potamogeton sp</i>)	16
Sago pondweed (<i>Stuckenia pectinata</i>)	1
Water celery (<i>Vallisneria americana</i>)	1
Number of submerged aquatic plant species	8

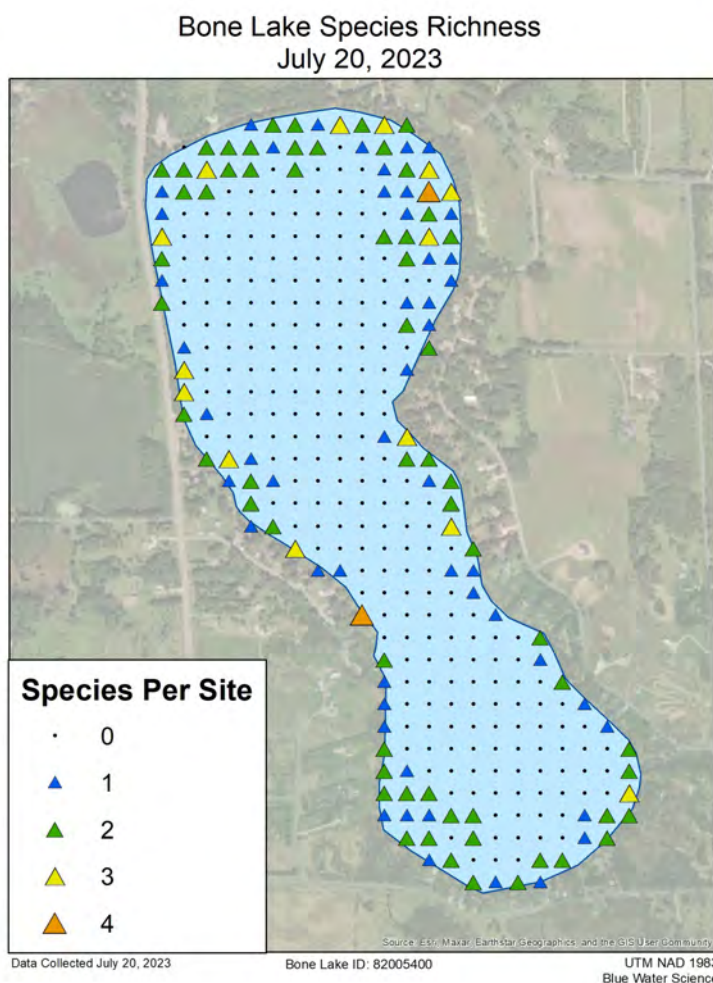


Figure 5. Species richness coverage on July 20, 2023.

Curlyleaf Pondweed and Eurasian Watermilfoil Management and Point Intercept Survey for Bone Lake, Washington County, Minnesota, 2023

Bone Lake, Washington County (ID: 82-0054)

Size: 221 acres (MnDNR) Littoral area: 124 acres (MnDNR)

Maximum depth: 30 ft (MnDNR)

Introduction

Curlyleaf pondweed (CLP) and Eurasian watermilfoil (EWM) are non-native species and both are present in Bone Lake. Curlyleaf pondweed and Eurasian watermilfoil delineations and assessments were conducted in Bone Lake in 2023. The objectives of the delineations were to locate areas of nuisance invasive species and recommend areas for potential treatments. The purpose of the assessments were to determine if any nuisance growth of CLP or EWM were missed during the delineations. In addition, an aquatic plant point intercept survey was conducted on July 20, 2023 to characterize the entire plant community.

Methods

Curlyleaf Pondweed Delineation Method: At the time of the spring curlyleaf delineation on May 1 only a fraction of the peak curlyleaf biomass is present compared to what could be present in June, at its peak. For spot treatments, the areas to be treated are delineated prior to curlyleaf developing peak biomass. The CLP delineation survey is conducted using a meandering path around the nearshore area of the entire lake. Curlyleaf is sampled using a fixed 14 tine rakehead on a pole. Curlyleaf stem counts on a rake sampler were used to identify areas that had a potential to produce curlyleaf growth at its June peak. After a short sweep of about 1-foot (which samples about 0.1 m²), if one or two stems (10-20 stems/m²) were collected on the rake sweep, it was predicted that this area would produce only future light growth at its peak and was not delineated for treatment. Alternatively, sites where 3 stems (30 stems/m²) were collected per rake sample future potential growth was considered to be moderate. However if 4 curlyleaf stems (40 stems/m²) or more per rake sample generally indicated some plants had developed runners and would likely produce heavy growth in the next few weeks and this site would be marked for potential treatment. This survey method used for determining curlyleaf pondweed spot herbicide treatments was similar to the methodology published in a peer reviewed journal (McComas et al, 2015)*.

*McComas, S.R., Y.E. Christianson, and U. Singh. 2015. Effects of curlyleaf pondweed control on water quality and coontail abundance in Gleason Lake, Minnesota. *Lake and Reservoir Management*, 31:109–114.
<https://doi.org/10.1080/10402381.2015.1014583>

Curlyleaf Assessment and Eurasian Watermilfoil Delineation and Assessment Sampling: An EWM initial delineation along with a CLP assessment were conducted on June 2 and 261 sites were sampled. On July 20 an EWM assessment was conducted and the entire perimeter of the lake was checked for CLP and EWM. A point intercept survey was also conducted at this time.

Point Intercept Survey: An aquatic plant survey of Bone Lake using a point intercept sampling method was conducted by Blue Water Science on July 20, 2023. A map and sampling grid were prepared by Blue Water Science and a consisted of a total of 368 points that were distributed throughout the lake (Figure 6). Points were spaced 50 meters apart. Each point represented about 0.6 acres. At each sample point, plants were sampled with a rake sampler. A plant density rating was assigned to each plant species on a scale from 1 to 3 (Figure 7). A density of a “1” indicated sparse growth with one or two stems present on the rake sampler. A 3 rating indicated matting surface plant growth.

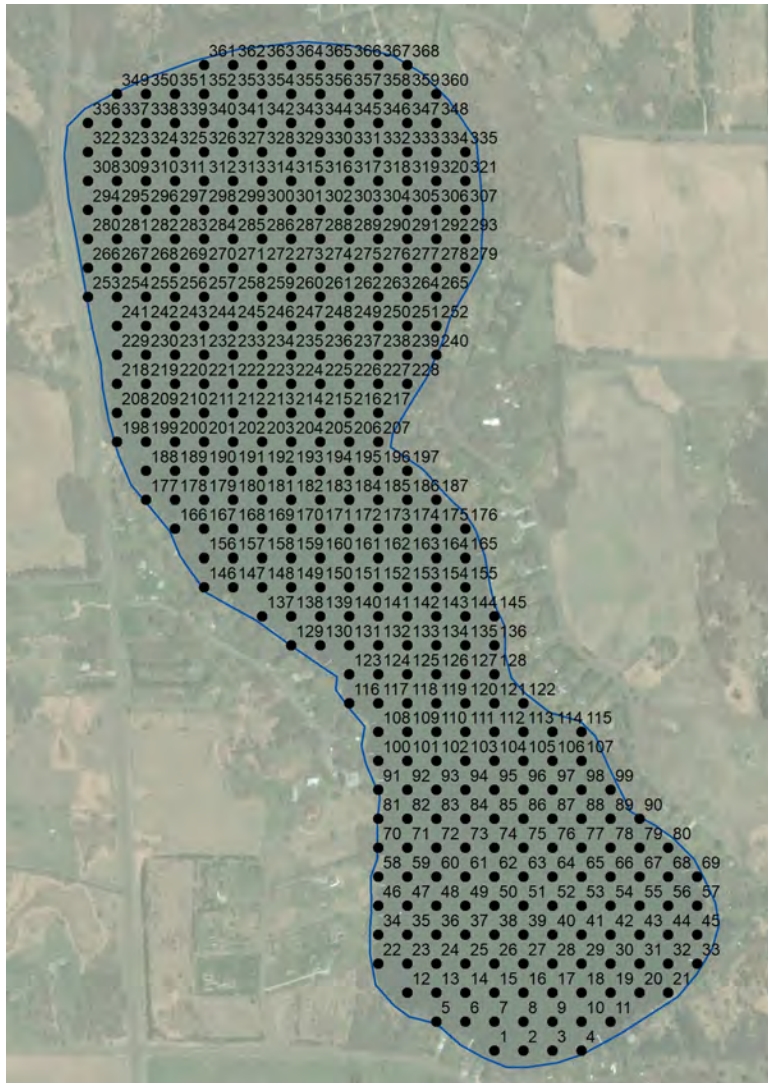


Figure 6. Point locations for the aquatic plant surveys.

Chart of Aquatic Plant Density Ratings



Figure 7. Aquatic plant density ratings from 1 to 3.

Curlyleaf Pondweed Delineation on May 1, 2023

A CLP delineation conducted on May 1, 2023 and found CLP was present at 5 sample sites out to a total of 117 sampled sites. No CLP treatment was not recommend in 2023 (Figure 8).

Bone Lake Curlyleaf Pondweed Delineation
May 1, 2023

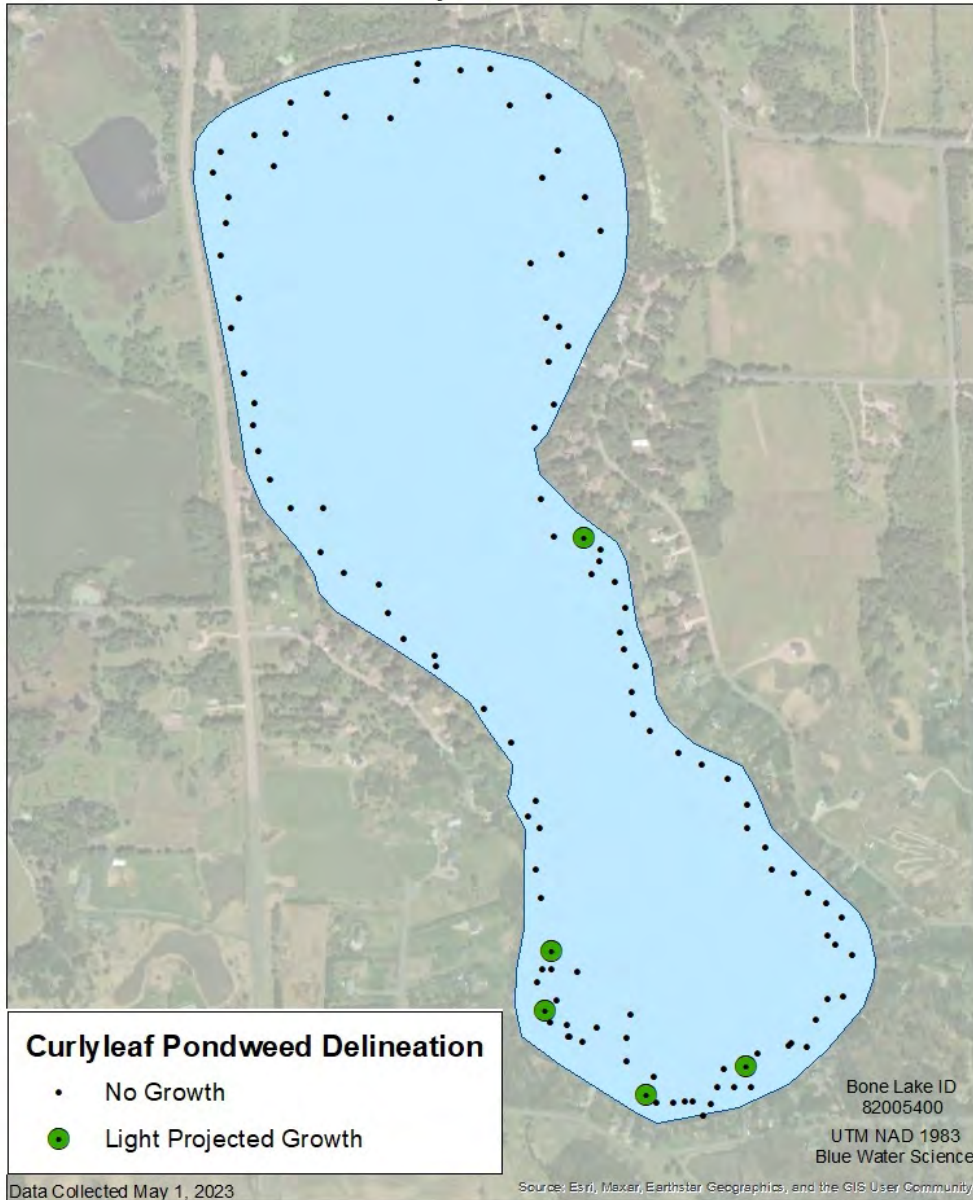


Figure 8. Curlyleaf coverage for Bone Lake on May 1, 2023. Key: black dot = no growth and green dots = light growth.

Curlyleaf Pondweed Assessment on June 2, 2023

An assessment was conducted on June 2, 2023 and found CLP was present at 10 sites out of the 261 sample sites (Figure 9). Curlyleaf growth had increased slightly since May 1, 2023. Moderate growth of CLP was found at 1 site in the lower southwest corner of Bone Lake.

Bone Lake Curlyleaf Pondweed Growth
June 2, 2023

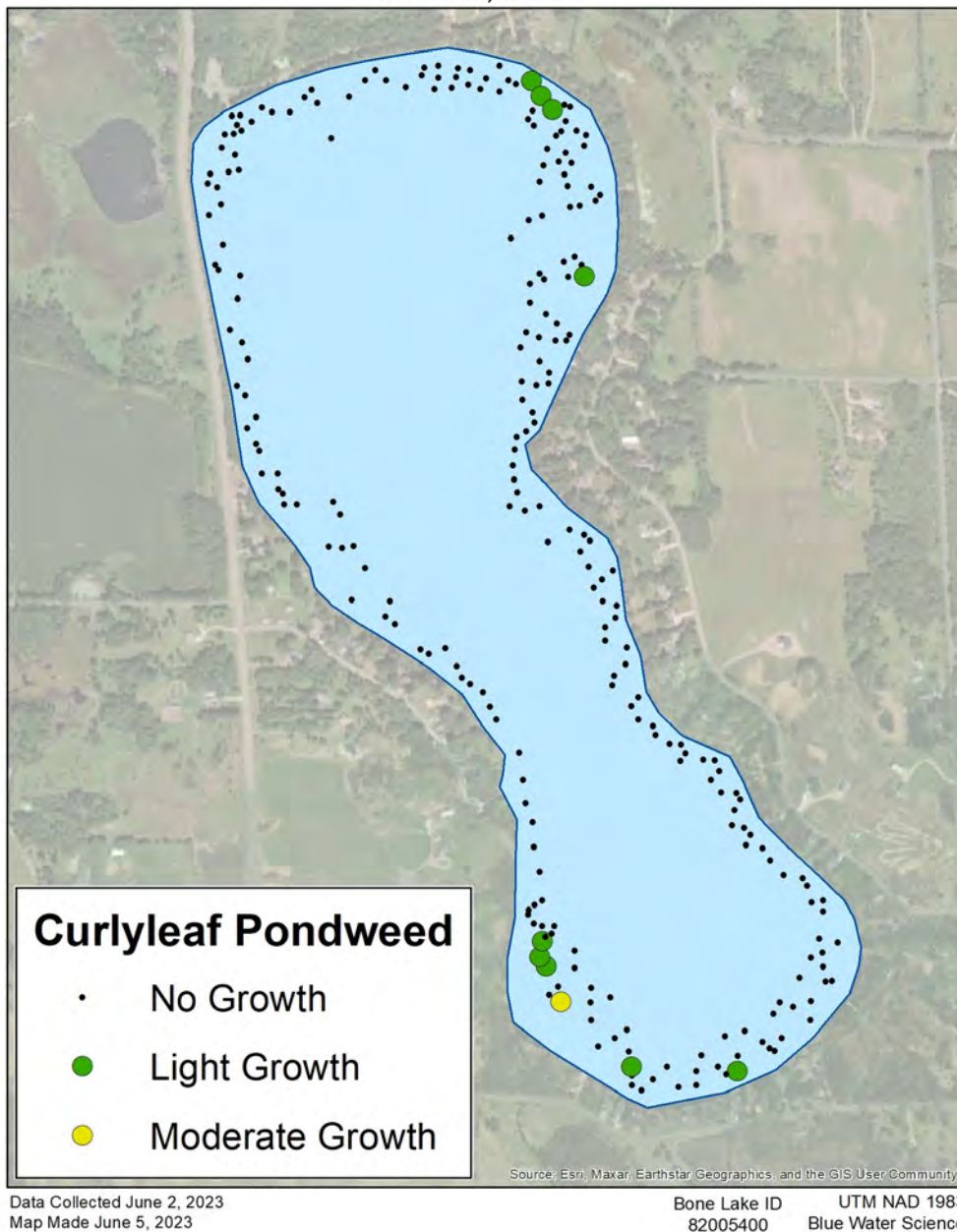


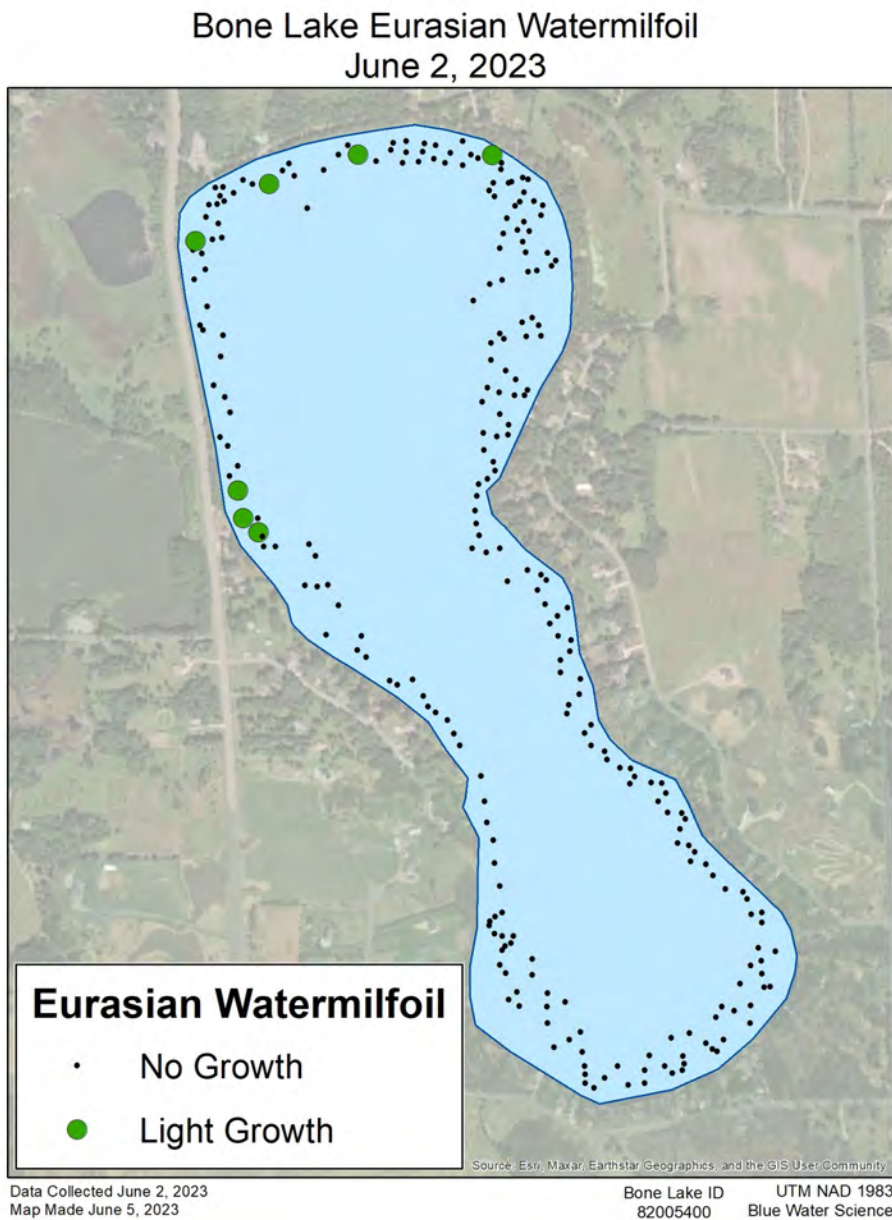
Figure 9. Curlyleaf growth in Bone Lake on June 2, 2023.

Key: black dot = no curlyleaf growth, green dot = light growth, and yellow dot = moderate growth.

Eurasian Watermilfoil Delineation on June 2, 2023

An EWM delineation was conducted on June 2, 2023. Eurasian watermilfoil was sampled at 7 sites out of 261 sites sampled and all sites had light growth (Figure 10).

No treatment areas were delineated for 2023.



**Figure 10. Eurasian watermilfoil coverage for Bone Lake on June 2, 2023.
Key: black dot = no growth and green dots = light growth.**

Point Intercept Survey Conducted on July 20, 2023

Bone Lake Point Intercept Survey Statistics: A summary of plant statistics from the point intercept survey is shown in Tables 2 and 3 and Figure 11. A total of 177 points were sampled. A total of 163 points were sampled in the depths out to 9 feet which was the maximum depth of plant growth. (Table 3). The mean number of native plant species identified at each sample point was 1.0 species per point (Table 2).

Table 2. MnDNR Template Statistics

Total # Points Sampled	177
Depth Range of Rooted Veg	1-9 feet
Maximum Depth of Growth (95%) in feet	8
# Points in Max Depth Range	163
# Points in Littoral Zone (0-15 feet)	176
% Points w/ Submersed Native Taxa	63
Mean Submersed Native Taxa/Point	1.0
# Submersed Native Taxa	8
# Submersed Invasive Taxa	1
Max Depth of EWM in feet	4
% Frequency of EWM	2
Mode Rake Abundance of EWM	1
Max Depth of CLP in feet	0
% Frequency of CLP	0
Mode Rake Abundance of CLP	NA

Table 3. Aquatic plants sampled by depth.

Depth (feet)	Number of Points Sampled	Percent of Sampling Points with Submersed Species Observed
1	6	0%
2	31	77%
3	38	87%
4	18	100%
5	21	62%
6	14	71%
7	7	57%
8	15	47%
9	13	8%
10	9	0%
11	2	0%
12	0	0%
13	0	0%
14	2	0%
15	0	0%
16	0	0%
17	0	0%
18	0	0%
19	1	0%
20	0	0%
All sites	177	

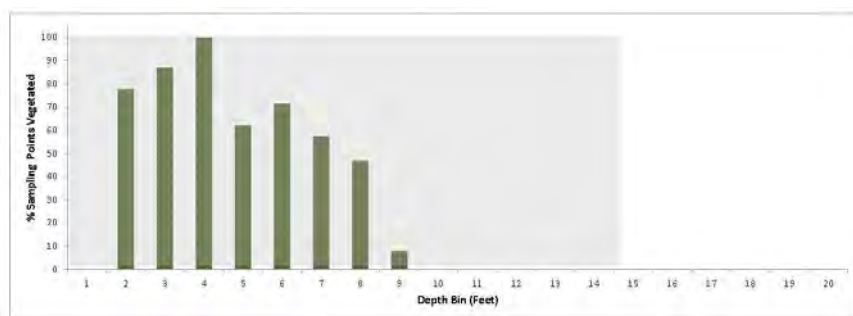


Figure 11. Depth of plant colonization (in feet).

Aquatic Plant Occurrence and Density

The most common plant in the point intercept plant survey was the native naiad followed by coontail (Table 4). A total of 8 submerged species were observed. Native plant coverage is shown in Figure 12 and covered approximately 30% of the lake bottom.

Table 4. The percent occurrence and density of aquatic plants for Bone Lake. Percent occurrence is calculated based on the number of times a plant species occurs at a sampling station divided into the total number of stations for the survey. For example, if coontail was found in 25 out of 50 stations, its percent occurrence would be 50%. Density is a rating scale from 1 to 3 with 3 being the densest.

	July 20, 2023	
	% Occur (163 sites)	Density
Spatterdock (<i>Nuphar variegatum</i>)	6	1.8
White water lily (<i>Nymphaea odorata</i>)	19	1.9
Coontail (<i>Ceratophyllum demersum</i>)	35	1.3
Chara (<i>Chara spp</i>)	1	1.5
Northern watermilfoil (<i>Myriophyllum sibiricum</i>)	2	1.0
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	2	1.0
Naiads (<i>Najas flexilis</i>)	43	1.5
Stringy pondweed (<i>Potamogeton sp</i>)	16	1.1
Sago pondweed (<i>Stuckenia pectinata</i>)	1	1.0
Water celery (<i>Vallisneria americana</i>)	1	1.0
Number of submerged aquatic plant species	8	

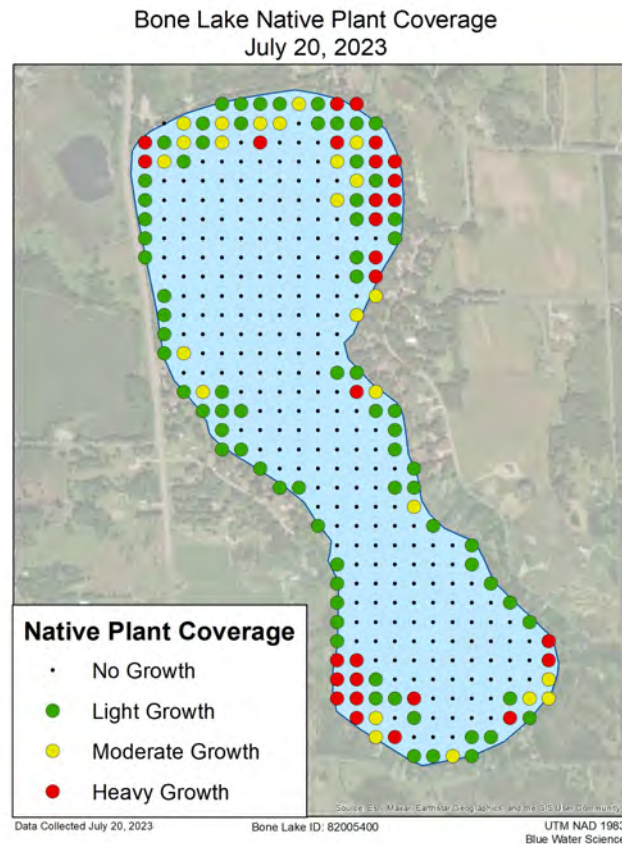


Figure 12. Native plant coverage on July 20, 2023. Key: green = light growth, yellow = moderate growth, and red = heavy growth.

Aquatic Plant Maps

The most abundant native plant on the July 20, 2023 point intercept plant survey for Bone Lake was naiads, found at 70 out of 163 sites sampled out to 9 feet (43%)(Figure 13). The other submerged plant species observed were also found to be growing at light to moderate conditions (Figure 13).

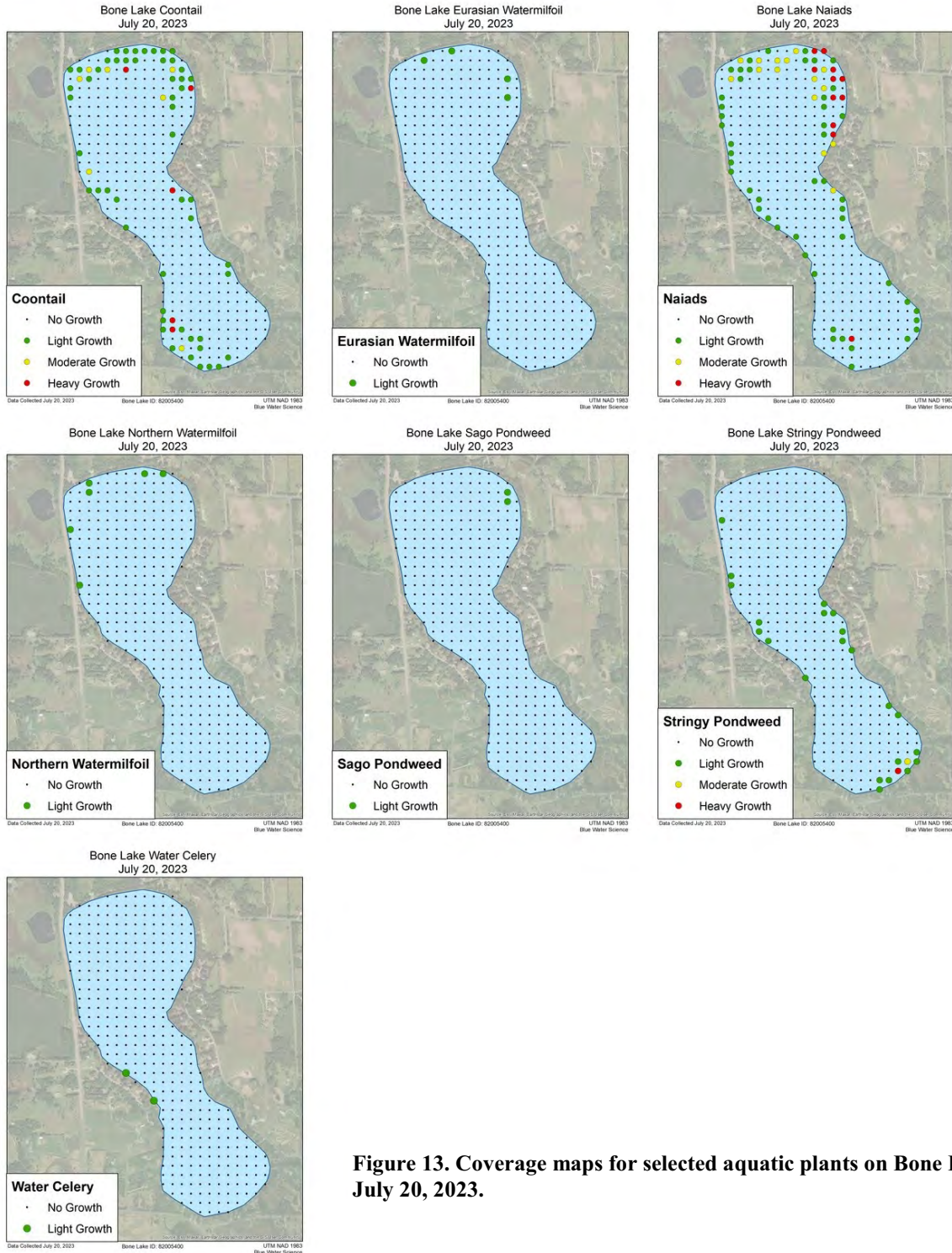


Figure 13. Coverage maps for selected aquatic plants on Bone Lake on July 20, 2023.

A summary of plant density and occurrence at each sample site is shown in Table 5.

Table 5. Individual site data for August 2, 2018. Numbers indicate plant density.

Site	Depth (ft)	Spatterdock	White lilies	Chara	Coontail	EWM	Naiads	NWM	Sago	Stringy	Water celery	No Plants
1	3				1		1					
2	3				1							
3	3	2			1							
4	2									1		
5	1		2									
6	2		3		1							
7	5											1
8	10											1
9	9											1
10	3				1					1		
11	2	1								1		
12	2		3		1							
13	3		2		2							
14	2											1
15	5				1		1					
18	9											1
19	5											1
20	3									3		
21	2		1							1		
22	1		3									
23	3		3									
24	4						1					
25	5				1		1					
26	7				1		3					
30	8											1
31	6									1		
32	3						1			2		
33	2		2							1		
34	2		3		1							
35	4		2		3							
36	5				1		1					
37	9											1
42	14											1
43	11											1
44	5											1
45	3		2				1			1		
46	2		3		1							
47	6				3							
56	6											1
57	2		3				1					
58	1		1		1							
59	8											1
68	9											1
69	3		3				1					
70	2	1										
71	10											1
79	11											1
80	4						1					
81	1	1										
89	9											1
90	3									1		
91	2		1									
98	9											1
99	3						1			1		
100	5				1		1					
107	5				1							
108	7											1
114	6											1

Table 5. Individual site data for August 2, 2018. Numbers indicate plant density.

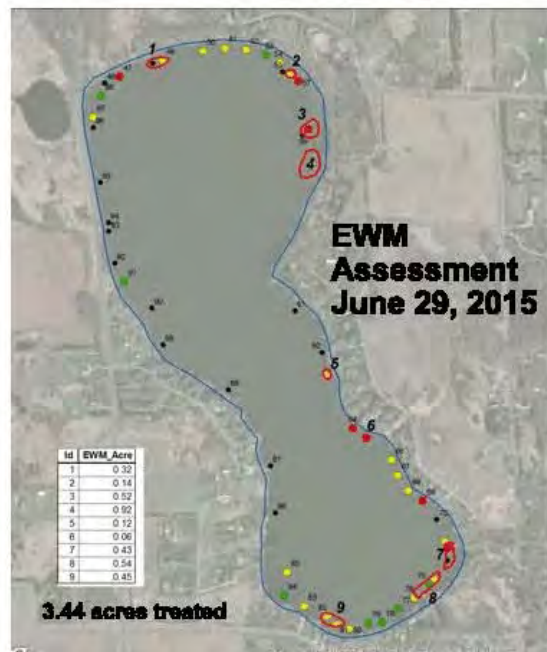
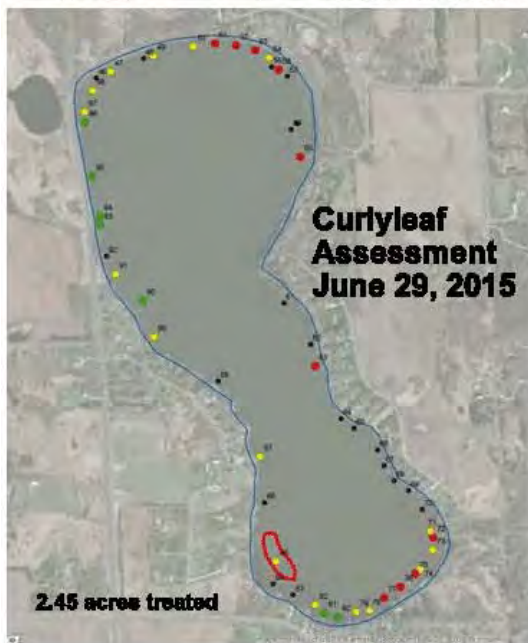
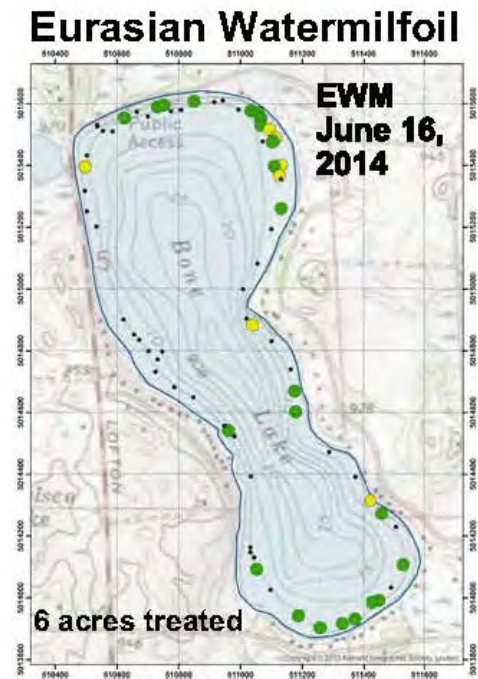
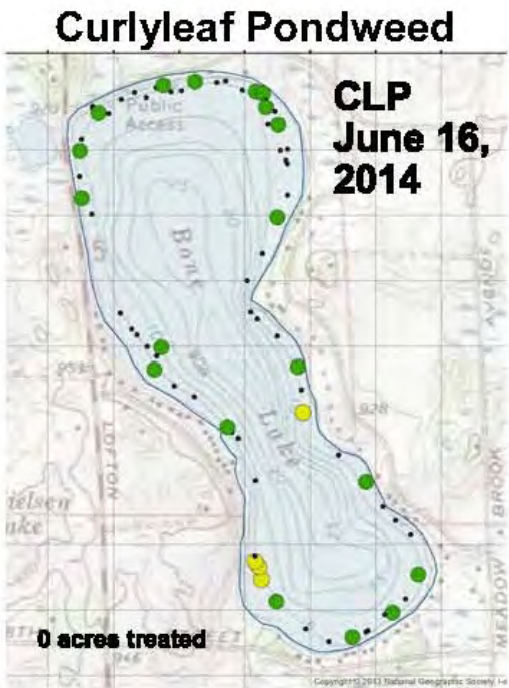
Site	Depth (ft)	Spatterdock	White lilies	Chara	Coontail	EWM	Naiads	NWM	Sago	Stringy	Water celery	No Plants
115	3		1		1							
116	3		1				1			1	1	
121	19											1
122	5		1									
123	5											1
127	10											1
128	2			2								
129	1		1									
130	3						1					
135	3						1					
136	2		1									
137	3				1		1				1	
138	6											1
144	7											1
145	2		1							1		
146	2		1									
147	3						1			1		
148	7											1
155	6				1		1			1		
156	2						1			1		
157	5											1
158	9											1
164	10											1
165	5						1			1		
166	1		1									
167	2						1			1		
168	4				1							
169	9											1
175	6				1							
176	3				1		1					
177	2		1		1							
178	4	2			1		1					
179	6				1							
180	9											1
186	5				3					1		
187	3						2			1		
188	5											1
189	6											1
196	2						1					
197	2			1			1			1		
198	3		1				1					
199	6				2							
200	9											1
208	3						1	1		1		
209	9											1
218	4				1		1			1		
227	14											1
228	5						2					
229	5						1					
239	5											1
240	2	2					2					
241	8											1
251	6				1		1					
252	3						3					
253	2		1				1					
254	8											1
264	5						1					
265	2						3					
266	2						1					
267	8											1
276	8											1
277	3											1
278	3											1

Table 5. Individual site data for August 2, 2018. Numbers indicate plant density.

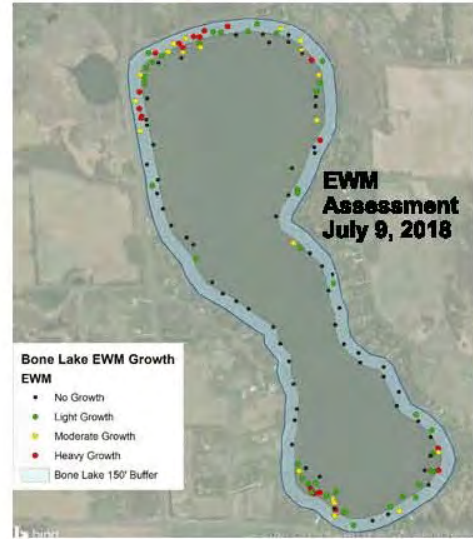
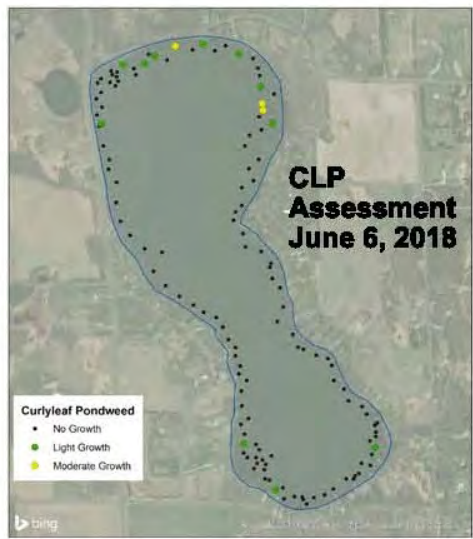
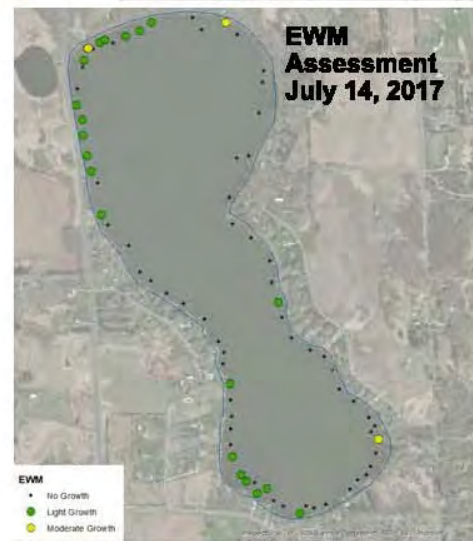
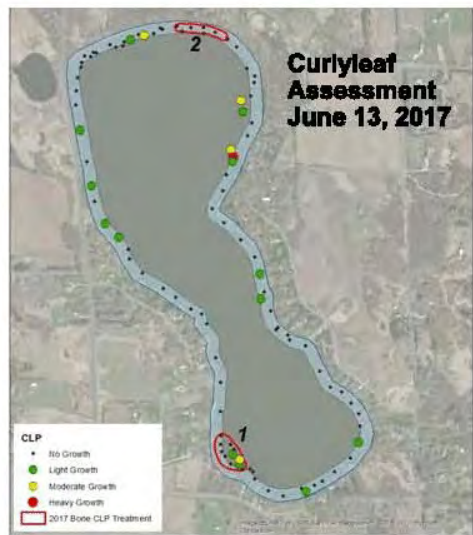
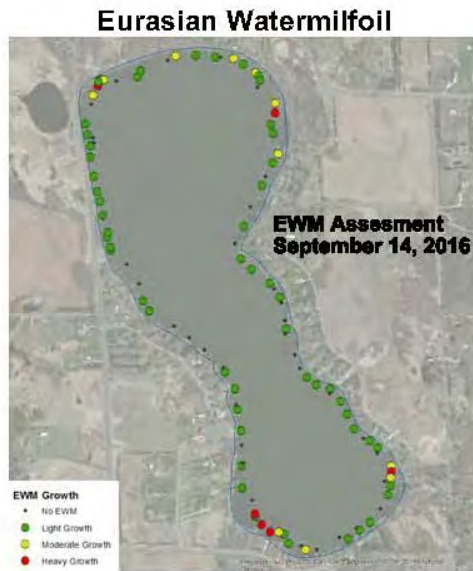
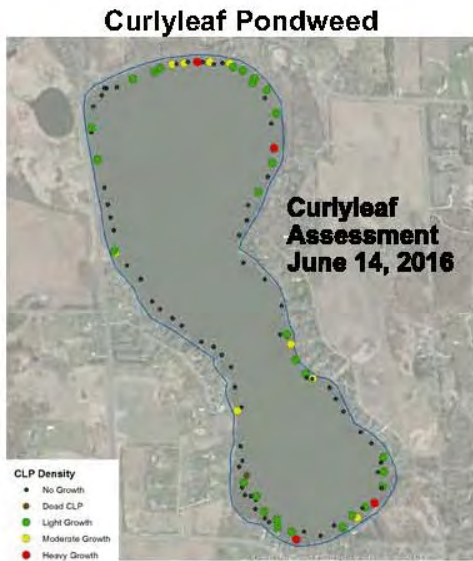
Site	Depth (ft)	Spatterdock	White lilies	Chara	Coontail	EWM	Naiads	NWM	Sago	Stringy	Water celery	No Plants
279	2						1					
280	3						1	1				
290	10											1
291	3				1		1					
292	2		3									
293	2	1										
294	3				1		1			1		
295	8											1
304	8				2		2					
305	4				1		1					
306	3	3				1	3					
307	3		3				3					
308	4				1							
309	8											1
318	10											1
319	5						2					
320	4				1		1					
321	4				3							
322	3	3										
323	6				2		2					
324	8				1		1					
325	10											1
332	8						2					
333	7				1							
334	3				1	1	3		1			
335	3		2		1		3					
336	3		3		1							
337	4				1		1					
338	5				2		1	1				
339	6				1		1					
340	8				2		2					
341	9											1
342	8				3		2					
345	10											1
346	8						3					
347	5				2		2					
348	4				1		3		1			
350	2						2	1				
351	3					1	1					
352	4				1		2					
353	6				1							
354	7				1		2					
355	8				1		2					
356	10											1
357	9						1					
358	7				1		1					
359	4				1							
360	2						1					
361	3		1									
362	3				1		1					
363	4				1	1						
364	4				1							
365	4				1		2	1				
366	4				1		1					
367	3				1		3	1				
368	2				1		3					
Average		1.8	1.9	1.5	1.3	1.0	1.5	1.0	1.0	1.1	1.0	
Occur to 9 ft	163	9	31	2	57	3	70	4	2	24	2	51
% Occur		6	19	1	35	2	43	2	1	15	1	

APPENDIX

Curlyleaf Pondweed and Eurasian Watermilfoil Assessments from 2014 - 2022

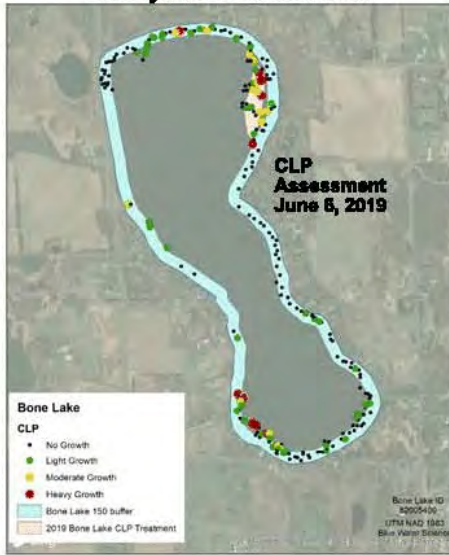


CLP and EWM maps for 2014 through 2022 (continued on the next 2 pages).



CLP and EWM maps for 2014 through 2022.

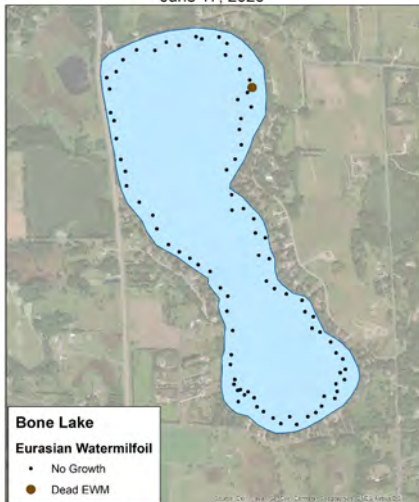
Curlyleaf Pondweed



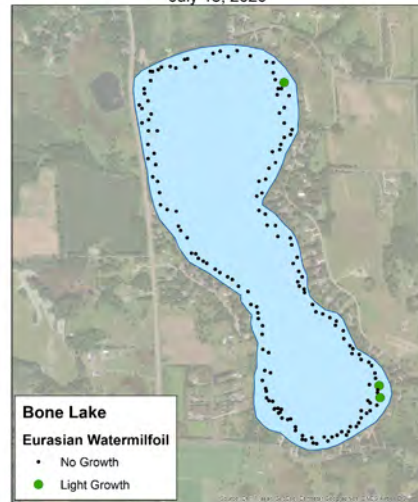
Eurasian Watermilfoil



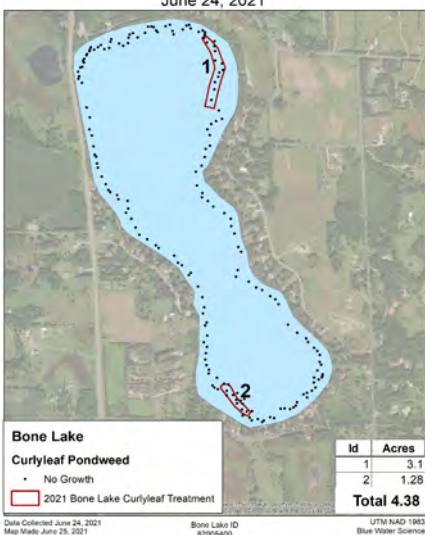
Bone Lake Eurasian Watermilfoil
June 17, 2020



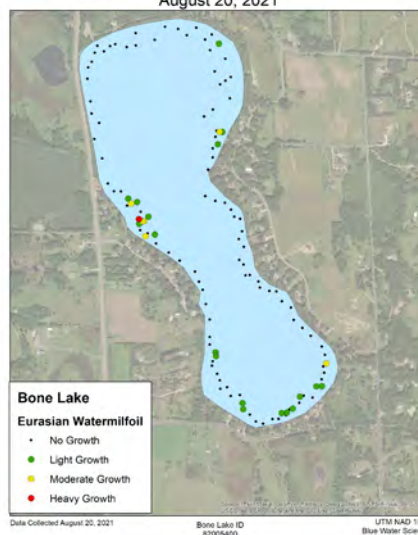
Bone Lake Eurasian Watermilfoil
July 15, 2020



Bone Lake Curlyleaf Pondweed Assessment
June 24, 2021



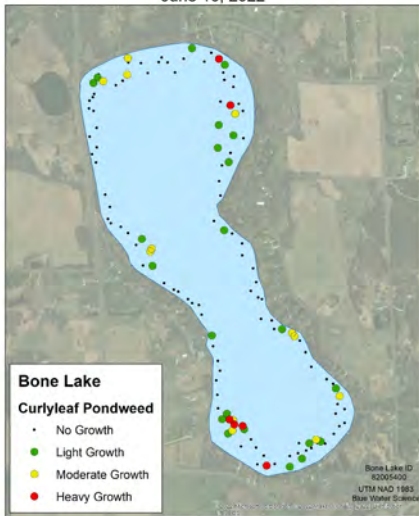
Bone Lake Eurasian Watermilfoil
August 20, 2021



CLP and EWM maps for 2014 through 2022.

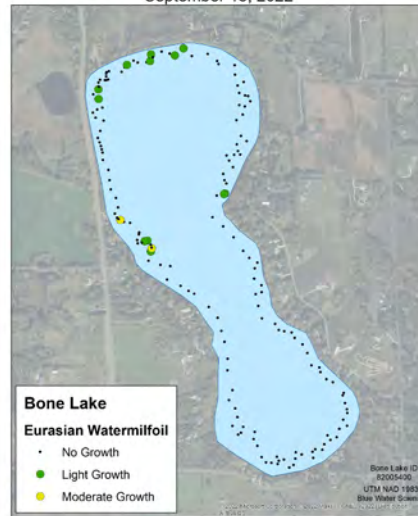
Curlyleaf Pondweed

Bone Lake Curlyleaf Pondweed Growth
June 10, 2022



Eurasian Watermilfoil

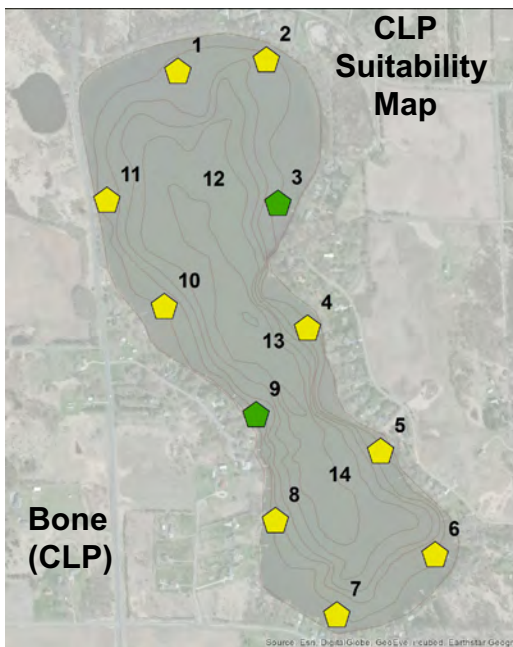
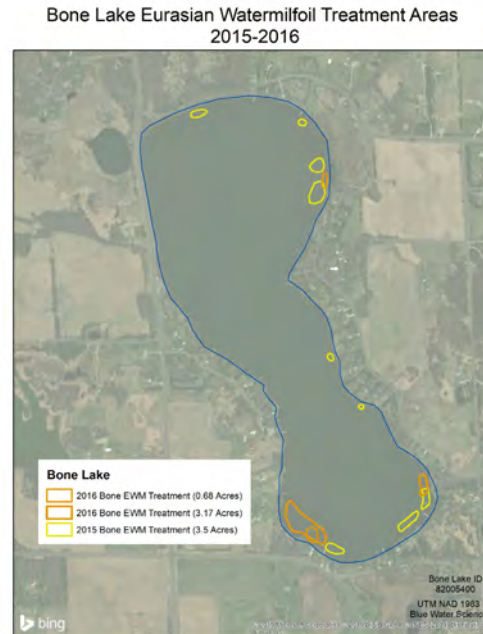
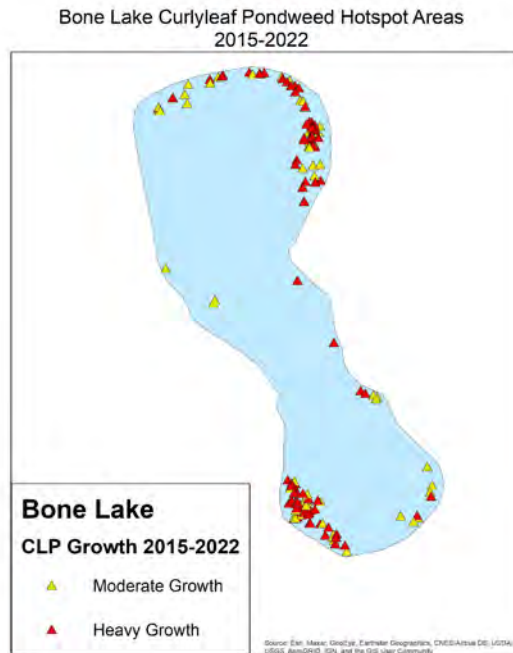
Bone Lake Eurasian Watermilfoil Growth
September 15, 2022



CLP and EWM maps for 2014 through 2022.

Curlyleaf Pondweed from 2015 - 2022

A summary of CLP treatments from 2015 through 2022 is shown below. CLP growth has been variable for the last couple of years. Lake ice, snow cover, and even cloudy days can limit curlyleaf growth. A hotspot map of sites of CLP moderate and heavy growth for 2015 through 2022 is shown in Figure 8. In the last 5 years CLP growth has been most evident in the northern and southern ends of Bone Lake where growing conditions are conducive to heavy plant growth. CLP has typically grown to a water depth of 6 feet or less.



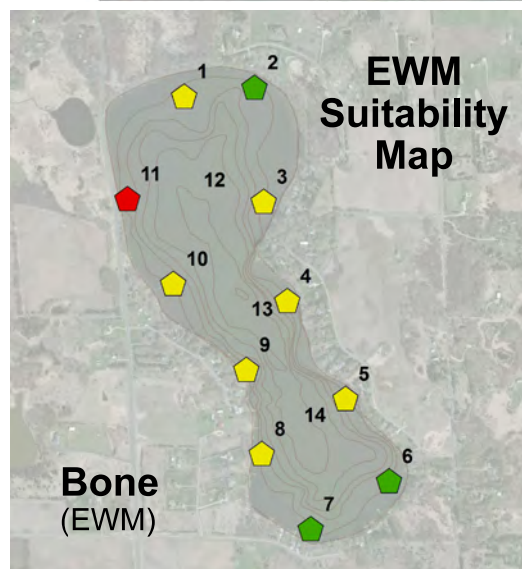
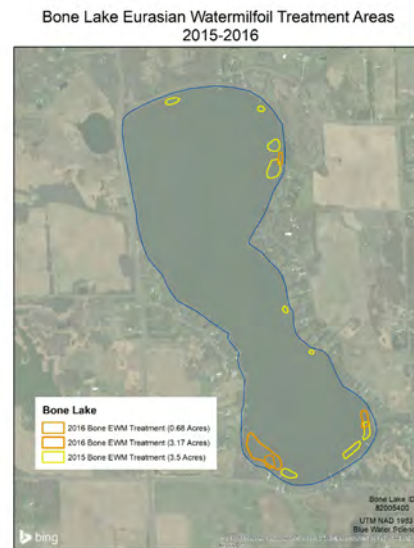
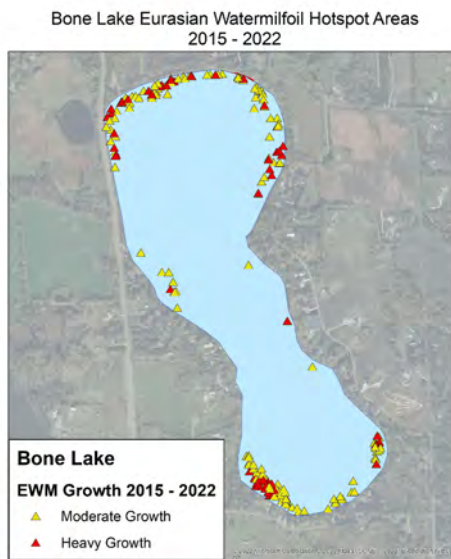
[top-left] Bone Lake CLP hotspot map 2015-2022. [top-right] Treatment map of CLP growth over the years of 2015-2022 placed on a single map. [bottom-left] Curlyleaf pondweed potential growth based on lake sediment analyses for Bone Lake. Key for Potential Growth: green = light growth, yellow = moderate growth, red = heavy growth (shown with octagons).

Eurasian Watermilfoil from 2015 - 2022

EWM has been in Bone Lake since 2006. Although control of EWM has been ongoing since 2006, EWM continued to expand around the lake. A map showing the occurrence of moderate to heavy growth of EWM in Bone Lake from 2015 through 2022 is shown below. Some nearshore areas in the north and south ends of Bone Lake support consistently significant growth. These “hotspot” areas are shown below.

Heavy milfoil growth has been correlated with high sediment nitrogen conditions and from a soils survey conducted in 2014, Bone Lake has at least 1 area with high lake sediment nitrogen conditions. The potential for long term milfoil growth, based on lake sediment sampling, predicts mostly moderate growth with the potential for annual heavy growth limited to the northwest side of Bone Lake.

For Bone Lake, it is estimated the plants have the potential to grow down to at least 7 feet of water depth based on low Secchi transparencies, restricting milfoil growth to nearshore areas. Results of the sediment survey indicate growth would be primarily light on a long term basis.



[top-left] Hotspot map of EWM growth over the years of 2015 to 2022 placed on a single map.

[top-right] Treatment map of EWM growth over the years of 2015-2022 placed on a single map.

[bottom-left] Suitability map for EWM growth in Bone Lake.

Key: green = light growth, yellow = moderate growth, and red = heavy growth.



Shields Lake, Washington County, Minnesota, June 1, 2023

Curlyleaf Pondweed Delineation and Assessment Surveys for Shields Lake, Washington County, Minnesota, 2023

Curlyleaf Delineation (point intercept): April 25, 2023

Curlyleaf Treatment: May 22, 2023 (3.07 ac)

Curlyleaf Assessment (point intercept): June 1, 2023

Prepared for:
Comfort Lake/Forest Lake
Watershed District
Forest Lake, Minnesota



Prepared by:
Steve McComas
Jo Stuckert
Connor McComas
Blue Water Science

December 1, 2023

Curlyleaf Pondweed Delineation and Assessment Surveys for Shields Lake, Washington County, Minnesota, 2023

Summary

Curlyleaf Pondweed Delineation: Shields Lake (MnDNR ID #82-016200) is a 30 acre lake located in Washington County, Minnesota. Water clarity has a summer average of 6.5 feet in 2022 (source: Comfort Lake/Forest Lake Watershed District). A curlyleaf pondweed point intercept survey was conducted on April 25, 2023 by Blue Water Science. Results of the curlyleaf delineation survey found curlyleaf pondweed was widespread in water depths to 10 feet of Shields Lake (Figure 1). A treatment area of 3.07 acres was delineated and was treated on May 22, 2023 using Aquathol K at 1.25 ppm (3.2 gallons/acre). A lakewide concentration of the active ingredient was 59 ppb. Curlyleaf pondweed and coontail were the only aquatic plant species found on April 25, 2023.

Curlyleaf Pondweed Assessment: A point intercept survey was used for the curlyleaf pondweed assessment and was conducted on June 1, 2023 by Blue Water Science (Figure 1). Results of the curlyleaf pondweed assessment found viable curlyleaf in two sites in Shields Lake. Coontail and elodea were the only other submerged plant was found in Shields Lake on June 1, 2023.

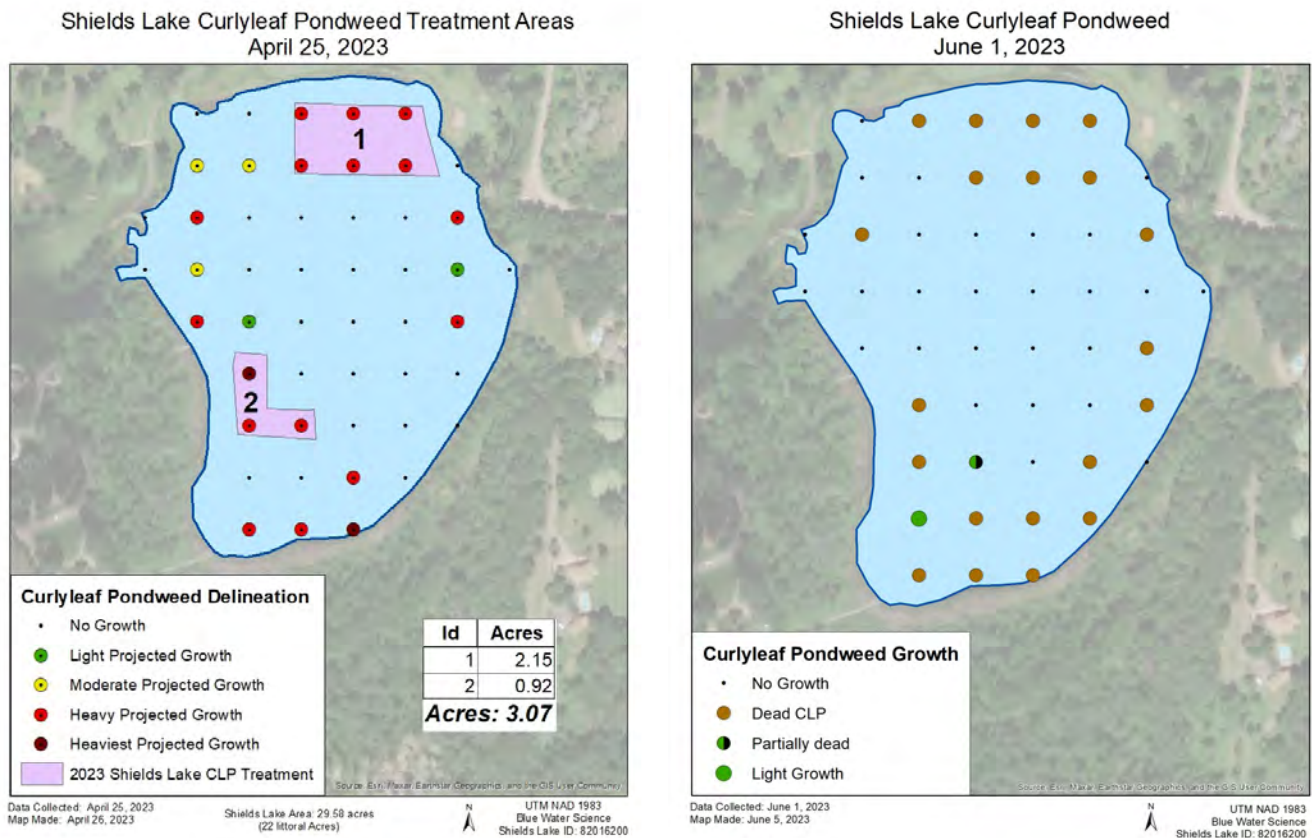


Figure 1. [left] Curlyleaf pondweed treatment areas Shields Lake that were delineated on April 25, 2023. [right] Curlyleaf pondweed coverage for Shields Lake on June 1, 2023.

Curlyleaf Pondweed Delineation and Assessment Surveys for Shields Lake, Washington County, Minnesota, 2023

Shields Lake, Washington County (ID: 82-016200)

Size: 29.6 acres (MnDNR)

Littoral area: 22 acres (MnDNR)

Maximum depth: 27 ft (MnDNR)

Introduction

A curlyleaf pondweed delineation using a point intercept survey was conducted on April 25, 2023 on 30 acre Shields Lake, Washington County. The objective of the delineation was to check the distribution and abundance of curlyleaf pondweed. About a month after a CLP treatment, a second point intercept was conducted on June 1, 2023 to assess the status of CLP and to check the distribution and abundance of all aquatic plants.

Methods

Curlyleaf Pondweed Delineation: At the time of the spring CLP delineations, only a fraction of the peak curlyleaf biomass is present. For spot treatments, the areas to be treated should be delineated prior to curlyleaf developing peak biomass. Curlyleaf stem counts on a rake sampler were used to identify areas that had a potential to produce dense curlyleaf. After a short sweep of about 1-foot (30 cm), 4 curlyleaf stems or more per rake sample generally indicated some CLP plants had developed runners and would likely produce heavy growth in the next few weeks. Alternatively, sites where 3 stems or less were collected per rake sample were not predicted to produce dense growth at the peak growing period. These areas were not treated. This delineation method was used for spot lake treatments in Gleason Lake and has worked for other lakes as well (McComas et al, 2015*).

An endothall herbicide application at 3.2 gallons/acre was conducted by Lake Management, Inc and a total of 3.07 acres were treated in May, 2023. A lakewide concentration of the active ingredient was estimated at 59 ppb.

Point Intercept Surveys and the Curlyleaf Pondweed Assessment: Two point intercept surveys were conducted by Blue Water Science on April 25 and June 1, 2023. Grid spacing was 50 meters. The plant species were recorded and the density of each species was assigned. Densities were based on the coverage on the teeth of the rake. Density ratings were from 1 to 3 with 1 being sparse and 3 being a nuisance. Based on these sample sites, plant distribution maps were constructed.

*McComas, S.R., Y.E. Christianson, and U. Singh. 2015. Effects of curlyleaf pondweed control on water quality and coontail abundance in Gleason Lake, Minnesota. *Lake and Reservoir Management*. 31:109-114.

Results for the CLP Delineation on April 25, 2023

A point intercept survey was conducted to delineate curlyleaf pondweed in 2023 on April 25, 2023 (Figure 1). Results from the survey determined areas of significant curlyleaf pondweed growth were delineated (Figure 2) based on CLP stem densities that were predicted to produce heavy growth at peak CLP abundance in June (Figure 2). Two areas totaling 3.07 acres were delineated for treatment. No other submerged aquatic plant species observed (Tables 1, 2, and 3).

Shields Lake Curlyleaf Pondweed Treatment Areas
April 25, 2023

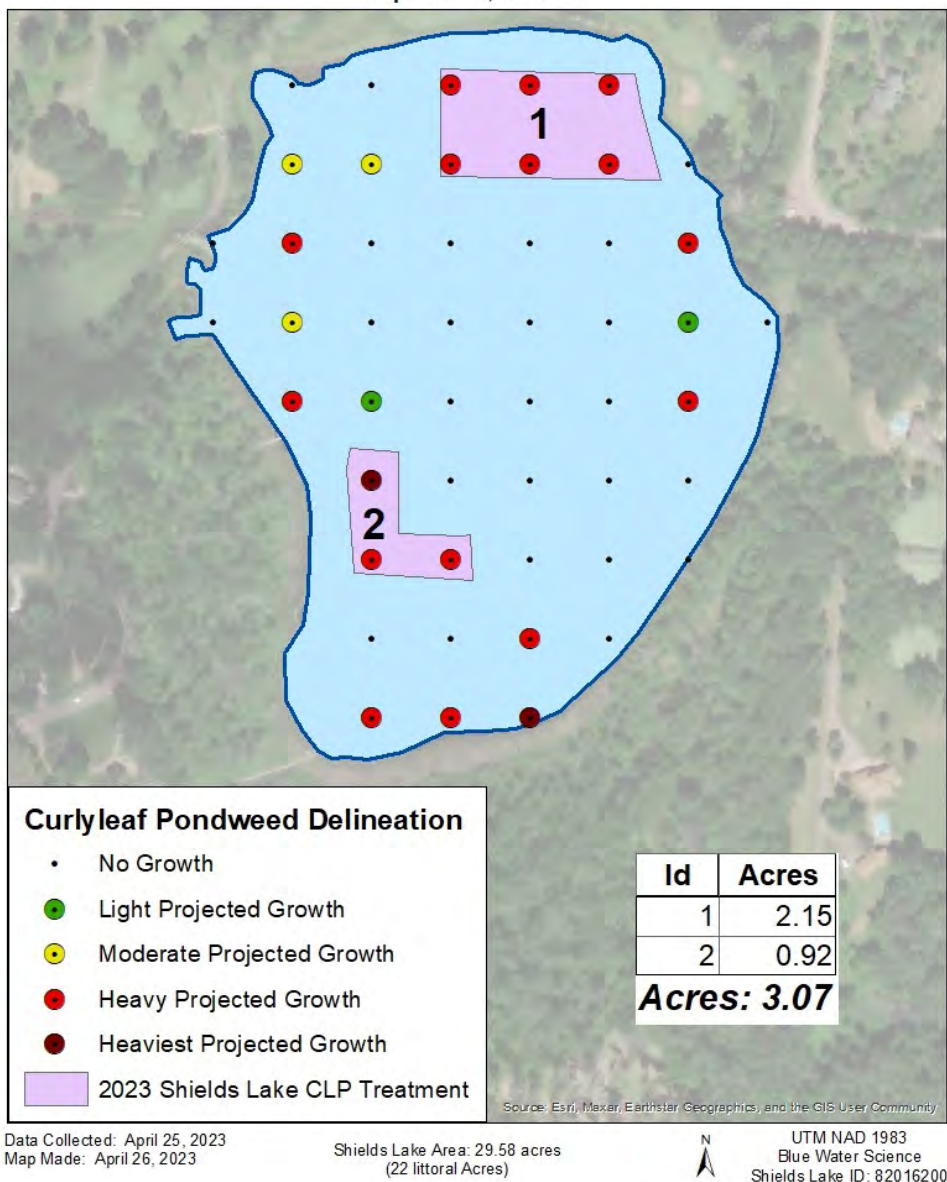


Figure 2. Curlyleaf pondweed potential treatment areas Shields Lake that were delineated on April 25, 2023.

Point Intercept Survey on April 25, 2023: Results of the point intercept survey conducted on April 25, 2023 found there was significant curlyleaf pondweed growth at many of the sample sites in the nearshore area (Table 1). Based on results from the point intercept surveys, two areas representing 3.07 acres were delineated that had the characteristic stem densities that were predicted to produce heavy growth at peak CLP abundance in June (Figure 2).

Table 1. Curlyleaf pondweed occurrences and stem densities for the April 25, 2023 point intercept survey based on 49 sites.

	All Stations (n=49)		
	Occur	% Occur	Density
Coontail (<i>Ceratophyllum demersum</i>)	16	33	1.1
Curlyleaf pondweed - stems (<i>Potamogeton crispus</i>)	22	45	6.7



Figure 3. Curlyleaf pondweed rake density on April 25, 2023.

Point Intercept Survey on April 25, 2023 Plant Data for the Delineation: Low plant diversity was found in Shields Lake in the April 25, 2023 point intercept survey with curlyleaf pondweed and coontail being the only aquatic plant species observed (Table 2).

Table 2. Aquatic plant occurrence and stem density for the point intercept sample points in Shields Lake, April 25, 2023.

Site	Depth (ft)	Coontail	CLP_stems
1	5		7
2	5		5
3	4	1	17
4	10		
5	10		
6	7		6
7	5	1	
8	5		7
9	9		5
10	13		
11	10		
12	3	1	
13	6		13
14	13		
15	18		
16	17		
17	6	1	
18	5		7
19	10		1
22	20		
23	8		8
24	3	1	
25	8	1	3
26	13		
30	10		2
31	5	1	
32	3	2	
33	6		11
34	13		
35	15		
36	18		
37	12		
38	5		4
39	4	1	3
40	5	1	3
41	7		10
42	7		11
43	5	1	5
44	3	1	
45	3		
46	4	2	
47	5	1	7
48	5	1	9
49	4	1	4
Average		1.1	6.7
Occurrence (49 sites)		16	22
% occurrence		33	45



Results of the June 1, 2023 Point Intercept Survey and CLP Assessment

Results of the June 1, 2023 assessment using a point intercept survey found three native submerged plant species, including curlyleaf pondweed, coontail, and elodea (Table 2). The curlyleaf pondweed was observed in the lake both living and dead (Table 3 and Figure 4). Results from the assessment found native plants growing out to a depth of 6 feet (Table 4)(Figure 5).

Table 3. Shields Lake aquatic plant occurrences and densities for the June 1, 2023 survey based on 49 sites. Density ratings are 1-3 with 1 being low and 3 being most dense.

	All Stations (n=49)		
	Occur	% Occur	Density
Coontail (<i>Ceratophyllum demersum</i>)	21	43	1.6
Elodea (<i>Elodea canadensis</i>)	1	2	1.0
Curlyleaf pondweed (<i>Potamogeton crispus</i>)	2	4	1.0

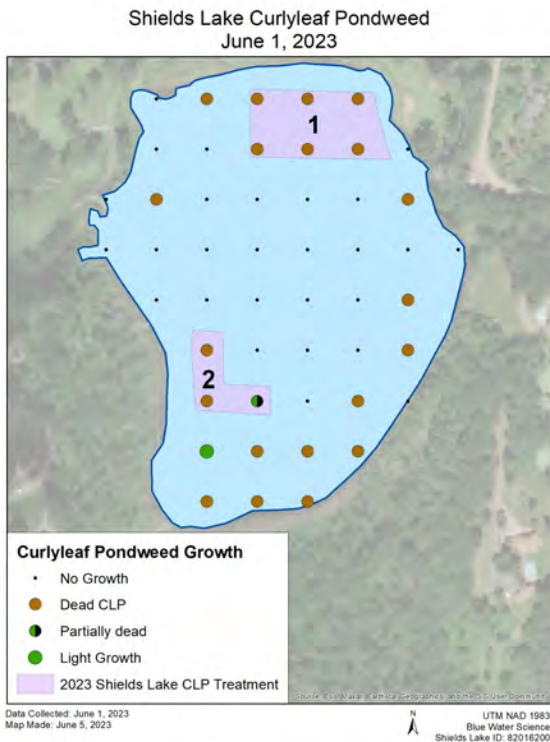


Figure 4. Curlyleaf pondweed coverage for Shields Lake on June 1, 2023. Key: black dots = no growth, green dot = light growth, and brown dots = dead curlyleaf pondweed.

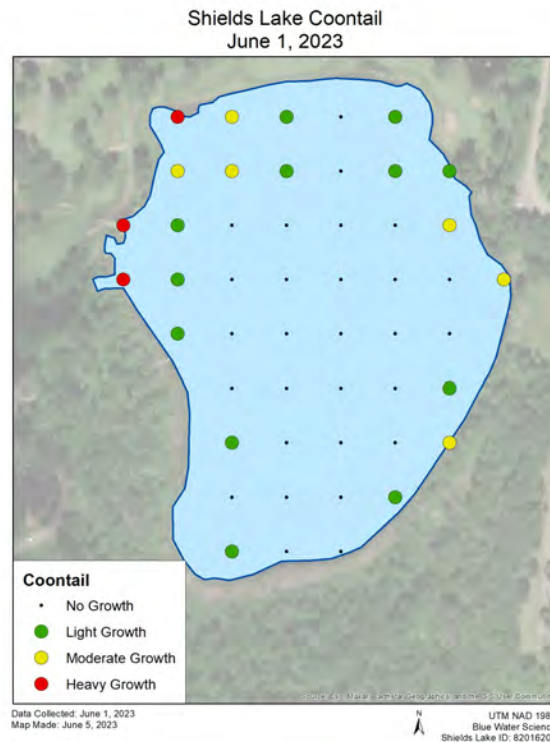


Figure 5. Coontail coverage for Shields Lake on June 1, 2023. Key: black dot = no growth, green dots = light growth, yellow dots = moderate growth, and red dot = heavy growth.

Point Intercept Survey (June 1, 2023) Plant Data for the Assessment

Low plant diversity was found in Shields Lake with a total of 3 submerged aquatic plant species (Table 4).

Table 4. Aquatic plant occurrence and density for the point intercept sample points in Shields Lake, June 1, 2023.

Site	Depth (ft)	Coontail	CLP	CLP-dead	Elodea	FA
1	5	1		1		2
2	3			2		1
3	3			1		1
4	9		1			
5	7			1		
6	5			1		1
7	4	1		1		
8	5	1		1		1
9	9		1	1		
10	12					
11	8			1		
12	3	2			1	2
13	6			2		
14	13					
16	14					
17	4	1		1		1
18	4	1				2
19	12					
22	17					
23	7			1		
24	2.5	3				3
25	6	1				
26	12					
29	20					
30	10					
31	2	2				1
32	2	3				3
33	5	1		1		2
34	11					
35	15					
36	16					
37	12					
38	5	2		1		1
39	4	2				1
40	5	2				
41	6	1		2		
42	6			1		
43	4.5	1		1		1
44	2	1				1
45	3	3				2
46	4	2		1		2
47	4	1		1		1
48	4			1		
49	3	1		1		1
Average		1.6	1.0	1.1	1.0	1.5
Occur (49 sites)		21	2	21	1	20
% occurrence		43	4	43	2	41



Aquatic plant conditions on June 1, 2023



Figure 6. Aquatic plant growth on June 1, 2023.



Curlyleaf Pondweed on a Sample Rake Pole, Forest Lake on June 13, 2023

Curlyleaf Pondweed and Eurasian Watermilfoil Delineation, Treatment, and Assessment for Forest Lake, Washington County, 2023

	Delineation	Treatment	Assessment
CLP	May 9, 2023	May 22, 2023 (61.55 acres)	June 13, 2023
EWM	June 13, August 8, 2023	August 18, 2023 (8.41 acres)	September 20, 2023

Prepared for:
**Comfort Lake-Forest Lake
 Watershed District
 Forest Lake, Minnesota**



Prepared by:
**Steve McComas
 Blue Water Science
 St. Paul, MN 55116**

November 8, 2023

Curlyleaf Pondweed and Eurasian Watermilfoil Delineation, Treatment, and Assessment for Forest Lake, Washington County, 2023

Summary

Curlyleaf Pondweed (CLP) Delineation, Treatment, and Assessment: Forest Lake (MnDNR ID#82-015900) is a 2,271 acre lake in Washington County, Minnesota. Early season curlyleaf pondweed distribution and abundance were evaluated May 9, 2023.

In the delineation survey, heaviest potential curlyleaf growth was found in the Second Lake and potential early summer heavy growth was estimated at 61.55 acres for all 3 basins (Figure 1). A total of 61.55 acres of curlyleaf areas were treated on May 22, 2023.

A post treatment curlyleaf assessment was conducted on June 13, 2023. The June curlyleaf assessment found excellent control in the treated areas although there was some new curlyleaf pondweed sprouting in 3rd lake (Figure S1).

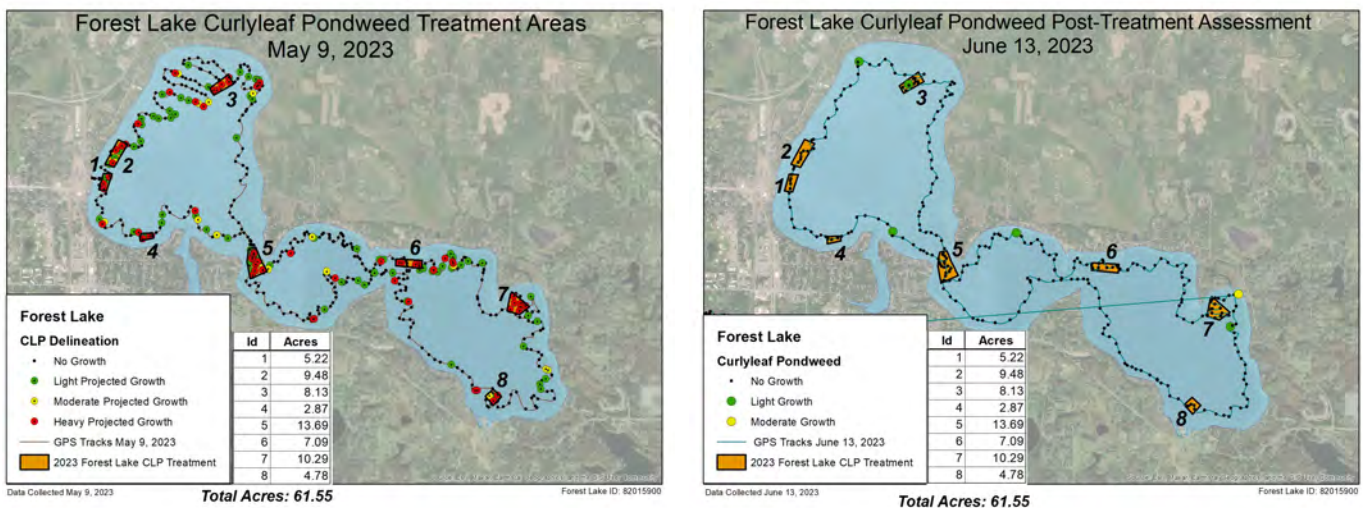


Figure 1. [left] DELINEATION: Map of curlyleaf pondweed distribution from the May 9, 2023 survey. Approximately 61.55 acres were delineated for CLP treatment.

[right] ASSESSMENT: Map of curlyleaf pondweed assessment sites for June 13, 2023.

Key: green dots = light growth, yellow dots = moderate growth, red dots = heavy growth, and black dots = no curlyleaf growth. Orange shaded areas indicates treatment areas.

Eurasian Watermilfoil (EWM) Delineation, Treatment, and Assessment: EWM distribution and abundance were evaluated June 13, 2023. EWM growth was light and based on that delineation, no treatment was recommended at that time (Figure S2).

Later in the summer, another EWM delineation was conducted on August 8, 2023 and a few EWM locations were found that could be treated. Based on this delineation, a treatment area of 8.41 acres was constructed.

Treatment of 8.41 acres occurred on August 18, 2023 using ProcellaCor herbicide.

On September 20, 2023, after the EWM treatment, an EWM assessment found good control in the treated areas. Only a few scattered plants were observed outside of the treatment polygons (Figure 2). Northern watermilfoil was abundant in much of Forest Lake in water depths of 3 to 6 feet.

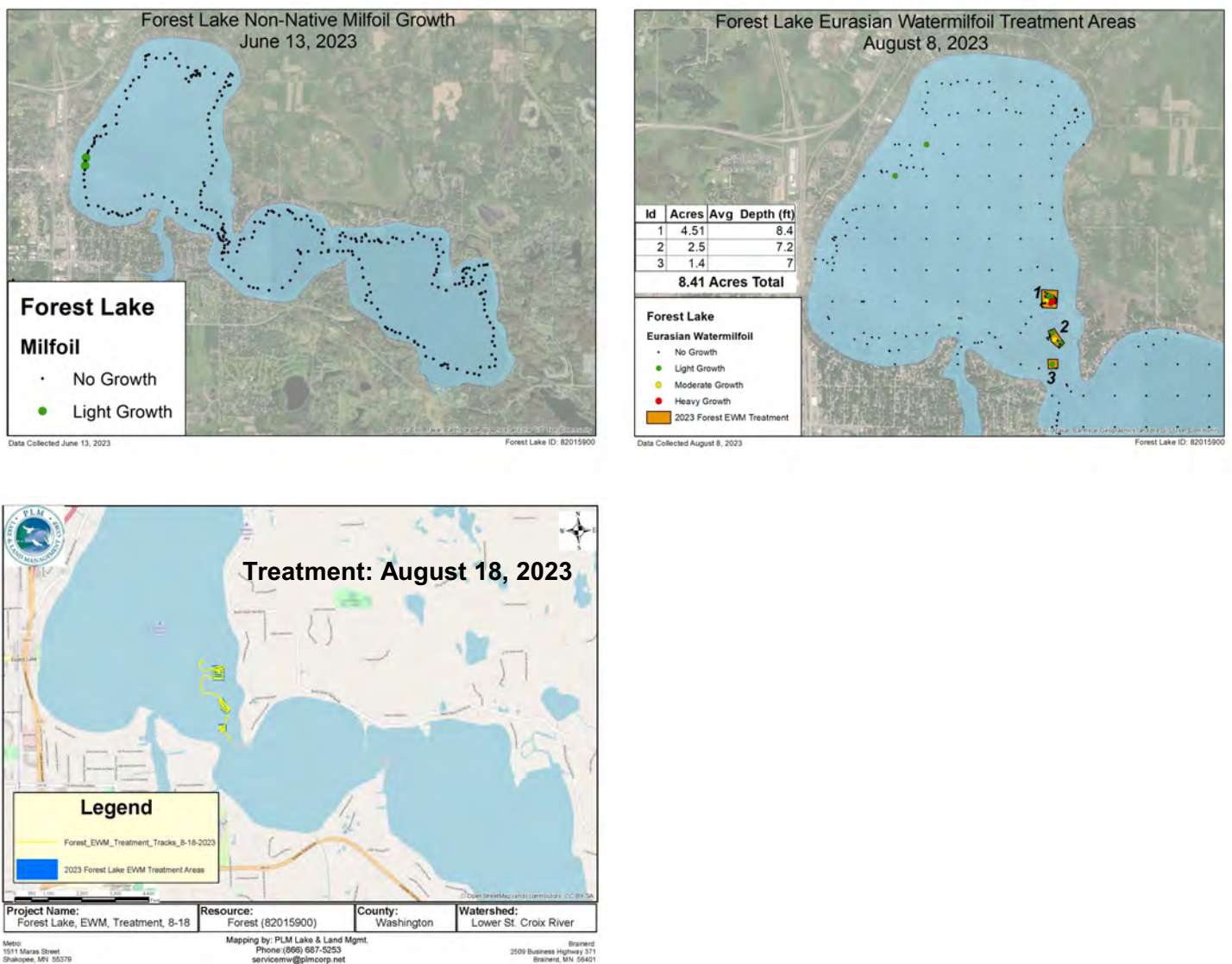


Figure 2. [top-left] DELINEATION: Map of EWM distribution from the June 13, 2023 survey. [top-right] Proposed treatment map, based on the August 8, 2023 EWM delineation. [bottom-left] Treatment map on August 18, 2023.

Summary of CLP and EWM Treatments from 2009-2023: Historically two non-native submerged aquatic plants were treated with herbicides and again in 2023 both curlyleaf pondweed and Eurasian watermilfoil were treated (Table 1 and Figure 3). Curlyleaf pondweed treatments have ranged from 16 to 169 acres from 2009 through 2023 with variability from year to year.

Eurasian watermilfoil was discovered in Forest Lake in 2015 and 30 acres were treated in the first year. From 2016 through 2023, EWM treatments have ranged from 5.86 acres to 53.83 acres (Table 1 and Figure 3). Eurasian watermilfoil has been confined mostly to the first lake but there is some growth in the second lake at the end of 2023. The greatest number of acres treated were in 2020 (Figure 3).

Table 1. Acres of non-native plants treated from 2009 through 2023.

	CLP (acres)	EWM (acres)
2009	98	
2010	155	
2011	168	
2012	155	
2013	60	
2014	101	
2015	88	30
2016	114	13.9
2017	169	33.35
2018	16.59	40.74
2019	99.11	49.34
2020	59.29	53.83
2021	120.33	5.86
2022	103.96	22.3
2023	61.55	8.41

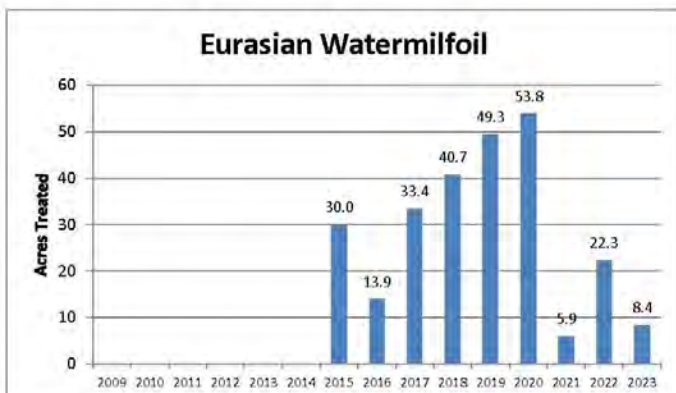
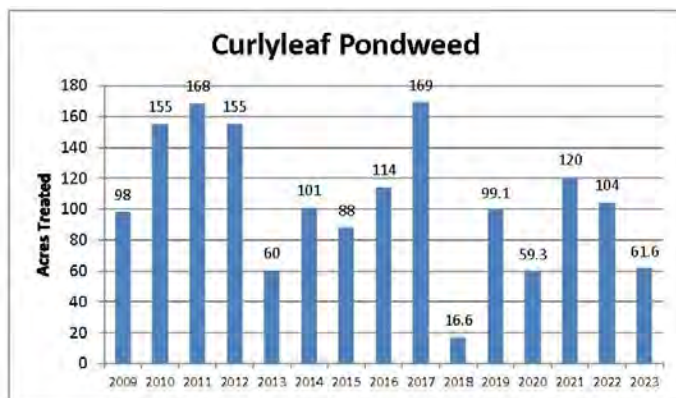


Figure 3. [top] Curlyleaf pondweed treated from 2009-2023. [bottom] Eurasian watermilfoil treated from 2015-2023. Eurasian watermilfoil was first found in Forest Lake in 2015.

A hotspot map of curlyleaf pondweed treatment areas over the last 10 years is shown in Figure 4. There appears to be about 100 acres of persistent curlyleaf in the 3 basins. The actual acreage of curlyleaf treated varies from year to year based on climatic factors. A hotspot map of EWM areas that have been treated from 2015 to 2022 is shown in Figure 4. EWM is found primarily in the 1st lake.

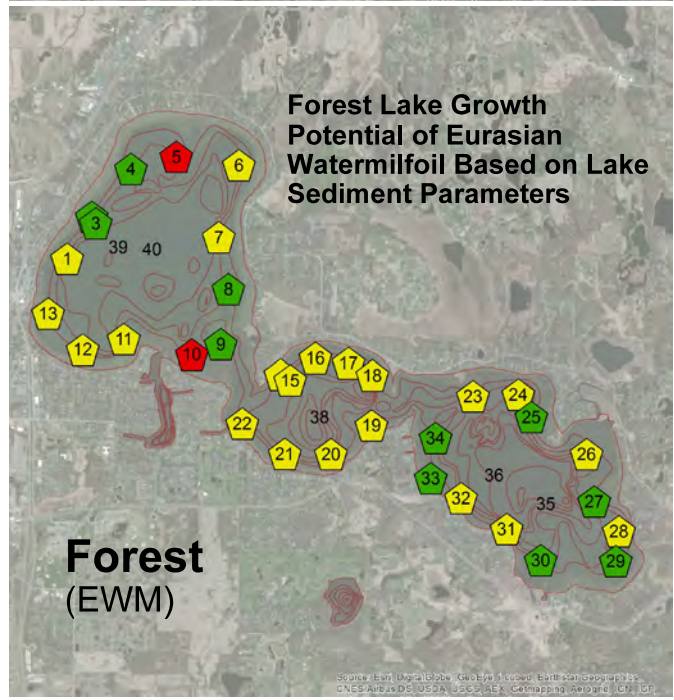
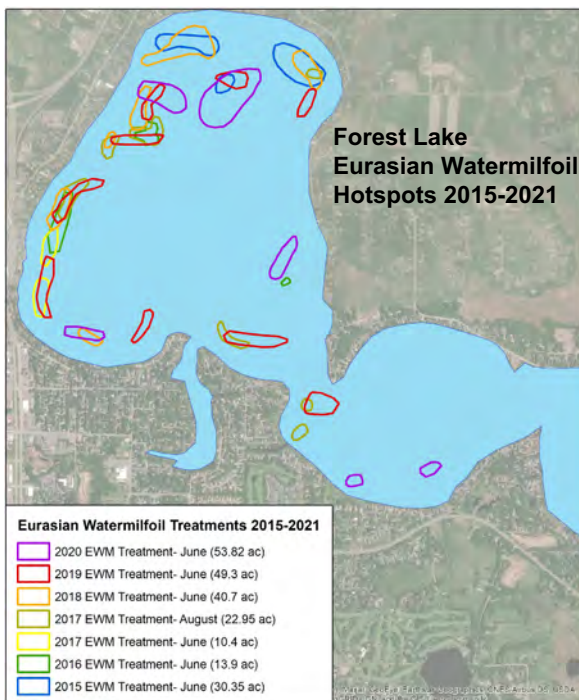
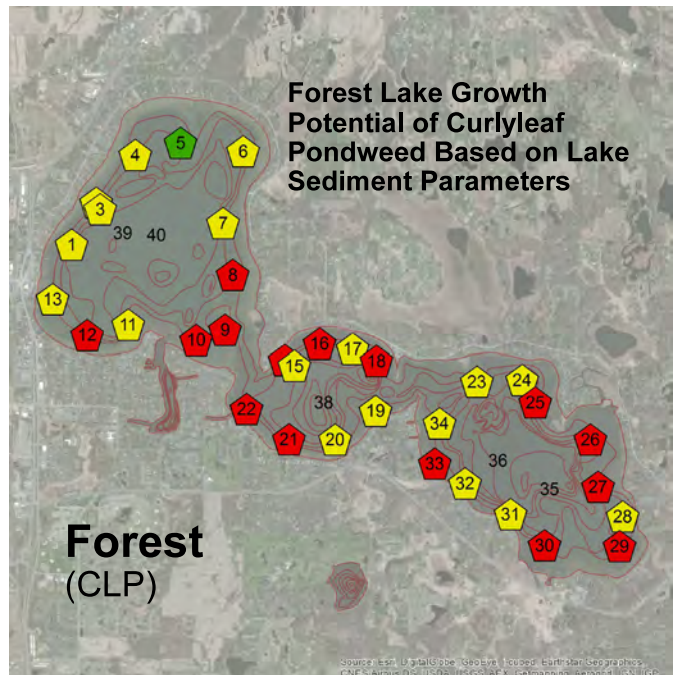
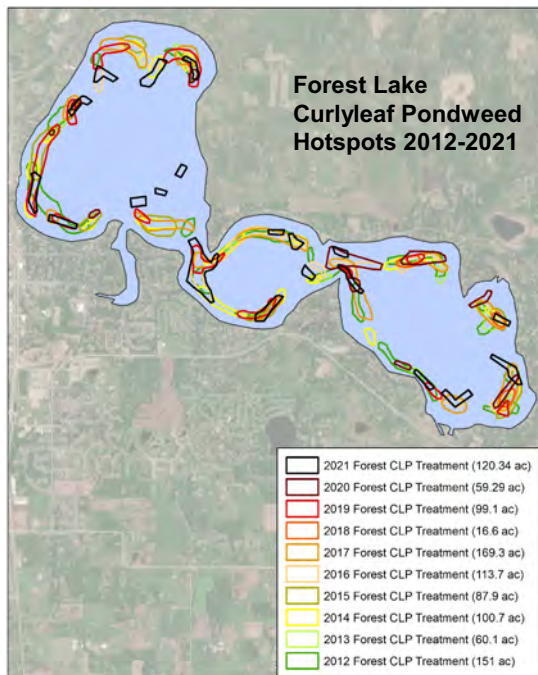


Figure 4. [top-left] Map of historical treatment of curlyleaf pondweed in Forest Lake, 2012-2021. [top-right] Curlyleaf potential growth based on lake sediment analyses for Forest Lake. Key: green = light growth, yellow = moderate growth, and red = heavy growth. [bottom-left] Map of historical treatment of Eurasian watermilfoil in Forest Lake, 2015-2020. [bottom-right] Eurasian watermilfoil potential growth based on lake sediment analyses for Forest Lake. Key: green = light growth, yellow = moderate growth, and red = heavy growth.



Flowering Rush Flowerhead, Forest Lake, September 20, 2023

Flowering Rush Delineation, Treatment, and Assessment for Forest Lake, Washington County, Minnesota, 2023

Pre-Treatment Delineation: July 11, 2023

*Treatment: **July 26, 2023***

*Treatment: **August 15, 2023***

*Shoreline Treatment (test): **August 29, 2023***

Post Treatment Assessment: September 20, 2023

*Shoreline Treatment (entire shoreline): **September 27, 2023***

*Treatment - off shore: **October 10, 2023***

Prepared for:
Washington County and
Comfort Lake - Forest Lake
Watershed District



Prepared by:
Steve McComas
Blue Water Science

November 8, 2023

Flowering Rush Delineation, Control, and Assessment for Forest Lake, Washington County, Minnesota, 2023

Summary

July 11, 2023 - Delineation

- A total of 84 flowering rush sites were observed.
- Over 300 patches of flowering rush were observed.
- A total area of flowering rush was estimated at 10,470 square feet (0.24 acres)
- At least 20 sites have flowers present.

July 26, August 15, August 29 - Flowering Rush Treatments

September 20, 2023

- A total of 160 flowering rush sites were observed.
- Over 1,000 patches of flowering rush were observed.
- A total area of flowering rush was estimated at 33,895 square feet (0.78 acres)
- At least 20 sites have flowers present.

September 27 and October 10 - Flowering Rush Treatments

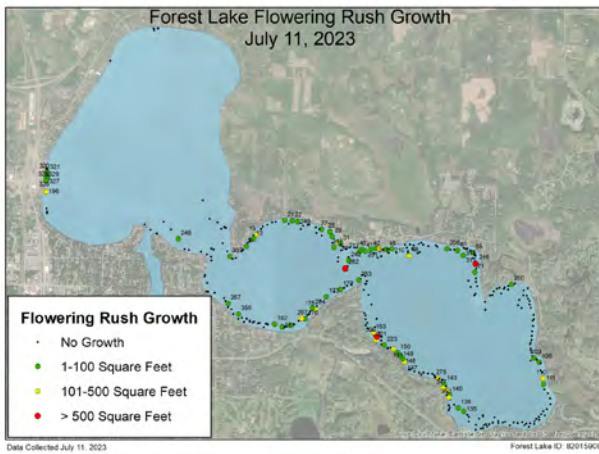
Table 1. Summary of delineations and herbicide treatments for flowering rush.

	Delineations		Treatment		
	Flowering Rush Sites	Total Area	Diquat*		Cide-kick**
			(acres)	(gal/ac)	(gal/ac)
July 11	84	0.24 ac			
July 26			2.92	2.0	0.137
August 15			4.5	1.0	0.44
August 29			1.0	1.0	
September 20	160	0.78 ac			
September 27			1.34	0.7	
October 10			4.50	0.56	0.11

*Diquat - brand name was Tribune

**Cide-kick: an adjuvant that breaks down the waxy cuticle on a leaf surface to allow more effective herbicide uptake

Flowering Rush Delineation and Treatments



July 11: Delineation



July 26: Treatment - 2.92 ac



August 15: Treatment - 4.5 ac



August 29: Treatment - 1.0 ac



September 20: Delineation



September 27: Treatment - 1.34 ac



October 10: Treatment - 4.50 ac

APPENDIX

Table 1. Individual flowering rush sites on July 11, 2023. Gray shading indicates largest groups of flowering rush patches.

Site	FR (sq ft)	FR patches	FR on shore (out to edge of docks)	FR off shore	Site with Flowers	Notes
9	100			1		
13	20	2		1		
15	200	8		1		
21	20			1		
22	10			1		
27	20	2		1		
28	10			1		
29	40	3		1		
30	140	7	1		1	
31	100	1	1		1	
40	100		1			
41	60			1		
42	100	6		1		
45	100	2		1		
48	200			1		
61	20	2		1		
65	300	20	1			
71	100			1		
103	20		1		1	
106	10	1		1		
110	200	1				
111	40	2	1			
135	50	5		1		
136	60	4		1		
140	60	4		1		
141	160	8	1	1		
143	60	5		1		
147	150		1			
148	100			1		
149	100		1			
150	50		1			
151	300	2	1			
153	110	6	1			
172	60		1			
173	100	2	1			
175	200		1		1	
178	100		1		1	
179	60	3		1		
181	80	6		1		
182	10			1		
196	400		1			
206	10	1		1		
210	100	2	1			
211	100	6	1	1		
212	100	2		1		
221	300	30	1		1	
223	100		1			
241	10			1		
242	100			1		

Table 1. Individual flowering rush sites on July 11, 2023. Gray shading indicates largest groups of flowering rush patches.

Site	FR (sq ft)	FR patches	FR on shore (out to edge of docks)	FR off shore	Site with Flowers	Notes
246	1000	15		1		
248	30			1		
249	100		1		1	
250	100		1			
261	200	12				
262	800	20		1		
275	200	1	1			
284	100			1		
291	120	6	1			
297	400	20		1	1	
307	100			1		
309	510	50	1	1		
315	10	1		1		
320	100		1		1	Continuous bed
321	100		1		1	Continuous bed
322	100		1		1	Continuous bed
323	100		1		1	Continuous bed
324	100		1		1	Continuous bed
325	100		1		1	Continuous bed
326	100		1		1	Continuous bed
327	100		1		1	Continuous bed
328	100		1		1	Continuous bed
329	100		1		1	Continuous bed
347	150	10	1			
353	100		1		1	
356	100		1			
357	10	1		1		
1N	100					Beginning of NWM bed
2N						End of NWM bed
3N	100	10		1		
4N	200	6		1		
5N						NWM 2 ac topping out
6N	200		1		1	
7N						NWM 1 ac topping out
Average	132.1	7.4				
Occur	84	40	40	40	20	
Total	10570	295				

Table 2. Individual flowering rush sites on September 20, 2023.

New Site	Existing Site	FR (sq ft)	FR patches	FR on shore	FR between docks	FR past docks	Site with Flowers	Sagittaria (sq ft)	Sagittaria present	Sagittaria patches	Wild rice (sf)	Wild rice present
	2	200			1		1					
	5	300				1	1					
	6	600	50		1							
	8	10			1							
	9	100			1							
	10	20			1							
	11	100	10			1						
	14	400	20			1						
	15	80	4			1						
	18	60	5		1	1						
	20	150	10			1						
	21	150	10			1						
	22	100	5			1						
	23	60	6			1						
	27	200	1			1						
	29	300	15		1	1						
	34	200	5			1						
	35	2000	50			1						
	39	100	10		1							
	41	200	10			1						
	42	400	20			1						
	45	200	10			1						
	48	200	1			1						
	49	200	10			1						
	54	600	15			1						
	55	600				1						
	57	100				1						
	59	80	4			1						
	61	80	4			1						
	62	50	2			1						
	73	20				1						
	86	60	3			1						
	89	40	3		1	1						
	92	20	1		1							
	98	20				1						
	99	60	4			1						
	108	20			1							
	108	300	10		1	1						
	109	40			1							
	110	400		1								
	111	80	50		1							
	115	100			1							
	116	100			1							
	117	200			1							
	118	800			1							
	120	300			1	1						
	135	300	30									
	136	60	5			1						
	141	200	10		1							
	142	600	50		1	1	1					
	143	400			1							
	146	200			1							
	147	500			1	1						
	148	1000	50		1	1						
	149	500			1	1						
	150	1000	50		1	1						
	151	400	20		1							
	153	200	20			1						
	159	500	15			1						
	161	20	1			1						

Table 2. Individual flowering rush sites on September 20, 2023.

New Site	Existing Site	FR (sq ft)	FR patches	FR on shore	FR between docks	FR past docks	Site with Flowers	Sagittaria (sq ft)	Sagittaria present	Sagittaria patches	Wild rice (sf)	Wild rice present
	164	400			1							
	170	200			1	1						
	173	150	10			1						
	174	20	2			1						
	176	800	20			1	1					
	184	100	5			1						
	185	600	30			1						
	189	400	16			1						
	190	150	10			1						
	191	100	6			1						
	192	100		1			1					
	198	100	8			1						
	205	1000	10			1						
	207	150	10			1						
	211	200	10			1						
	212	80	2			1						
	214	60	3			1						
	216	80	4			1						
	226	300			1							
	240	200				1						
	241	400	2			1						
	242	400	10			1						
	248	100	4			1						
	250	600	20			1						
	250	200			1							
	256	50			1		1					
	256	1000			1	1	1					
	260	200			1							
	261	300	15			1						
	261	100				1						
	262	100	5			1						
	263	400	20		1							
	263	60				1						
	264	60	3			1						
	269	600				1						
	272	200	5			1						
	273	200	10			1						
	283	400			1		1					
	284	800			1		1					
	286	100	5			1						
	292	100			1							
	294	400	15		1	1	1					
	295	200			1							
	297	600	20			1	1					
	299	600				1	1					
	309	300	20			1	1					
	312	40	2			1						
	313	600	30			1						
	315	80	4			1						
	317	20	3			1						
	318	30	3			1						
	332	100				1						
	333	10				1						
	341	400	12									
	345	600	20		1							
	351	50	5									
	353	100			1	1						
1								1000				
2								1000				
3								100				

Table 2. Individual flowering rush sites on September 20, 2023.

New Site	Existing Site	FR (sq ft)	FR patches	FR on shore	FR between docks	FR past docks	Site with Flowers	Sagittaria (sq ft)	Sagittaria present	Sagittaria patches	Wild rice (sf)	Wild rice present
4								50				
5		100		1								
6		50		1								
7								100		2		
8								20				
9								10				
10								20				
11		20			1							
12								20				
13								20				
14								20				
15								20				
16								20				
17		10			1							
18		20			1							
19		20			1							
20		20			1							
21		500		1			1					
22												1
23												1
24											1000	
25				1								
26		1000		1								
27												1
28								20	1			
29								20	1			
30												300
31												3000
32								600				
33												10
34		15		1								
35		60		1								
36		10		1								
37									1			
38									1			
39									1			
40												
41								2500				
42								300				
43		100				1						
44		1000	30			1						
45		20	2		1							
46		20				1						
47		60	3			1						
48		200	1		1	1						
49		50	5			1						
50		200				1						
51		100	6			1						
52		40	2			1						
53		40	2			1						
54		20	1			1						
55		200	9			1						
56		200	10									
57		1000	30			1						
58		60	20			1						
59		2000	100			1						
60		300	10			1						
61		150	6			1						
63		10				1						
64		400	10			1	1					

Table 2. Individual flowering rush sites on September 20, 2023.

New Site	Existing Site	FR (sq ft)	FR patches	FR on shore	FR between docks	FR past docks	Site with Flowers	Sagittaria (sq ft)	Sagittaria present	Sagittaria patches	Wild rice (sf)	Wild rice present
65		1000	30			1	1					
66		150	6			1						
67		1000	20		1	1						
68		300	20			1						
69		60	4			1						
70		1000		1	1				1			
71		1000		1	1		1					
72		1000		1	1		1					
73		1000		1	1		1					
74		1000		1	1		1					
Average		296.7	13.3					324.4	1.0	2.0		
Occurrence		160	98	15	56	107	20	84	6	1	1	6
Total		33895	1305					5840	6	2		



Northern Watermilfoil in Forest Lake on August 8, 2023

Aquatic Plant Point Intercept Survey for Forest Lake, Washington County, 2023

Point Intercept Aquatic Plant Survey: August 8, 2023

Prepared for:
Comfort Lake/Forest
Lake Watershed District
Forest Lake, Minnesota



Prepared by:
Steve McComas
Jo Stuckert
Connor McComas
Blue Water Science
St. Paul, MN 55116

November 22, 2023

Aquatic Plant Point Intercept Survey for Forest Lake, Washington County, 2023

Summary

An aquatic plant point intercept survey (250 meter spacing between points) was conducted on August 8, 2023 on Forest Lake (2,271 ac) by Blue Water Science to characterize conditions of aquatic plants.

The coverage of native plants is shown in Figure 1 and plants grow out to a water depth of about 15 feet. Plants covered approximately 1,386 acres (61% of the lake). The dominant plant in the August point intercept survey was coontail followed by water celery. In the survey, curlyleaf pondweed was found at 3 sample sites and was found to be growing at a low density. Eurasian watermilfoil (EWM) was first observed in Forest Lake in 2015. EWM was found at 1 site in the point intercept survey. Growth of EWM was been found in the first lake (northern basin). About 8.41 acres of EWM were treated in 2023.

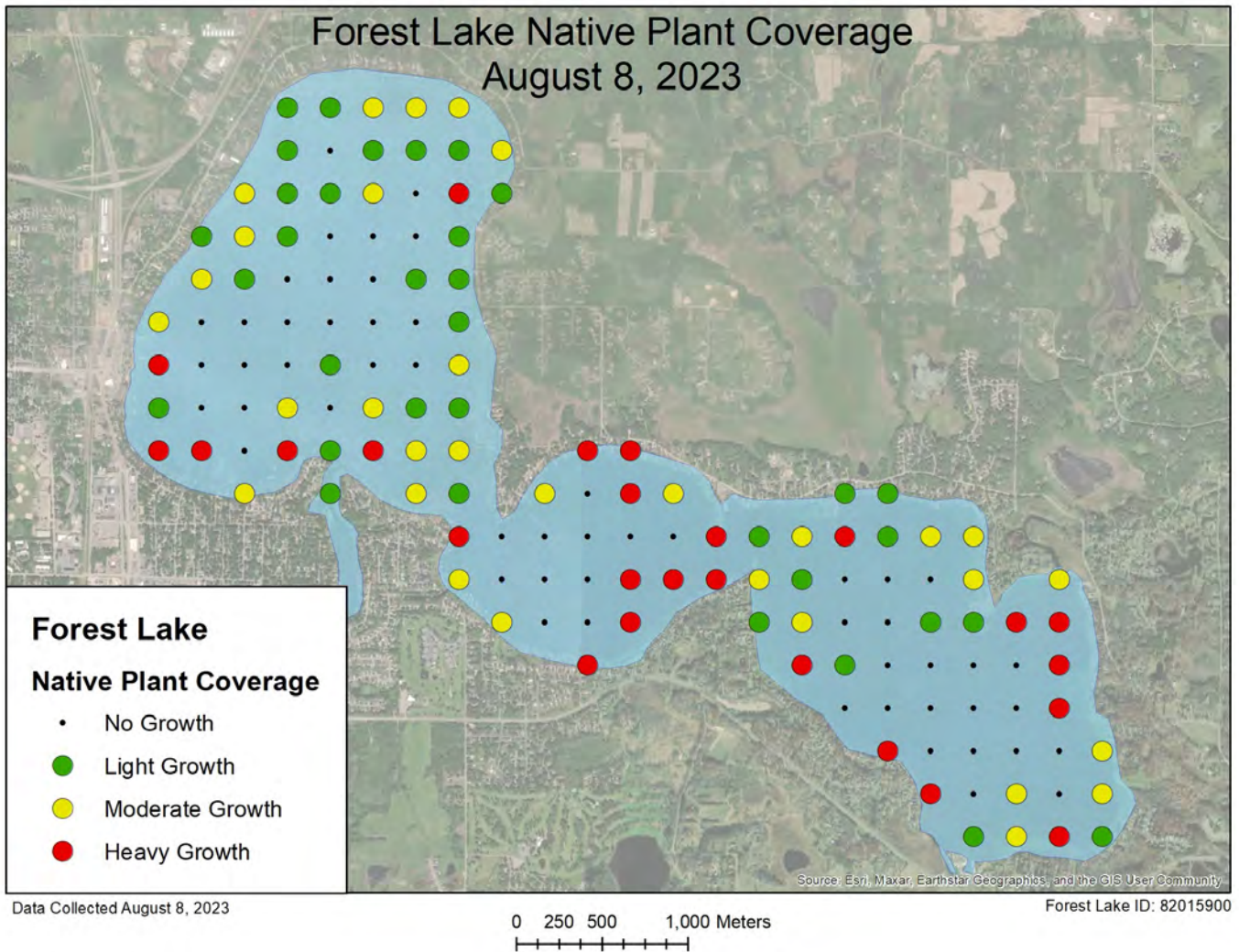


Figure 1. Native aquatic plant coverage of Forest Lake on August 8, 2023.

Key: Green shading = light growth, yellow shading = moderate growth, and red shading = heavy growth.

Forest Lake has a good diversity of aquatic plants, with 18 submerged species, 2 floatingleaf species, and 3 emergent species. Plant occurrence and relative densities are listed in Table 1. In 2023 the most common plant in the lake is coontail followed by water celery.

Table 1. Forest Lake aquatic plant occurrences and densities for the 2013, 2018, and 2023 surveys. Density ratings are 1-3 with 1 being low and 3 being most dense.

	2013 July 11-12 (n=97)(growth to 12 feet)		2018 August 15 (n=101)(growth to 15 feet)		2023 August 8 (102 sites)(growth to 15 feet)	
	% Occurrence	Density	% Occurrence	Density	% Occurrence	Density
Flowering rush (<i>Butomus umbellatus</i>)					1	1.0
Bulrush (<i>Scirpus sp</i>)	7	2.6	3	2.3	2	2.0
Cattails (<i>Typha sp</i>)	1	5.0			1	1.0
Spatterdock (<i>Nuphar variegatum</i>)	2	2.0			3	1.3
White waterlily (<i>Nymphaea sp</i>)	1	2.0	2	1.5	2	1.5
Marsh marigold (<i>Bidens Beckii</i>)	2	1.0	3	1.0		
Coontail (<i>Ceratophyllum demersum</i>)	30	1.5	46	1.1	52	1.4
Chara (<i>Chara sp</i>)	38	2.1	28	1.3	17	1.4
Elodea (<i>Elodea canadensis</i>)	1	1.0	3	1.0	4	1.5
Star duckweed (<i>Lemna trisulca</i>)	4	1.3	2	1.0	2	1.0
Northern watermilfoil (<i>Myriophyllum sibiricum</i>)	21	1.2	17	1.1	36	1.7
Eurasian watermilfoil (<i>M. spicatum</i>)			10	1.0	5	1.4
Naiads (<i>Najas flexilis</i>)	18	1.6	23	1.2	21	1.1
Nitella (<i>Nitella spp</i>)			2	1.0		
Cabbage (<i>Potamogeton amplifolius</i>)					2	1.0
Curlyleaf pondweed (<i>Potamogeton crispus</i>)	22	1.0	4	1.3	3	1.0
Fries pondweed (<i>P. friesii</i>)					1	1.0
Variable pondweed (<i>P. gramineus</i>)			1	1.0		
Illinois pondweed (<i>P. illinoensis</i>)			6	1.3	6	1.0
Whitstem pondweed (<i>P. praelongus</i>)	6	1.0	2	1.0	8	1.0
Claspingleaf pondweed (<i>P. Richardsonii</i>)	10	1.4	11	1.0	4	1.0
Stringy pondweed (<i>P. sp</i>)	8	1.6			13	1.0
Flatstem pondweed (<i>P. zosteriformis</i>)	4	1.3			27	1.2
Buttercup (<i>Ranunculus sp</i>)	1	1.0				
Sago pondweed (<i>Stuckenia pectinata</i>)	1	1.0	2	1.0	1	1.0
Water celery (<i>Vallisneria americana</i>)	21	1.3	41	1.8	42	1.8
Horned pondweed (<i>Zannichellia palustris</i>)	19	1.5				
Water stargrass (<i>Zosterella dubia</i>)	4	1.0	22	1.5	37	1.3
Number of submerged species	17		17		18	

2023 Aquatic Plant Maps for Selected Species

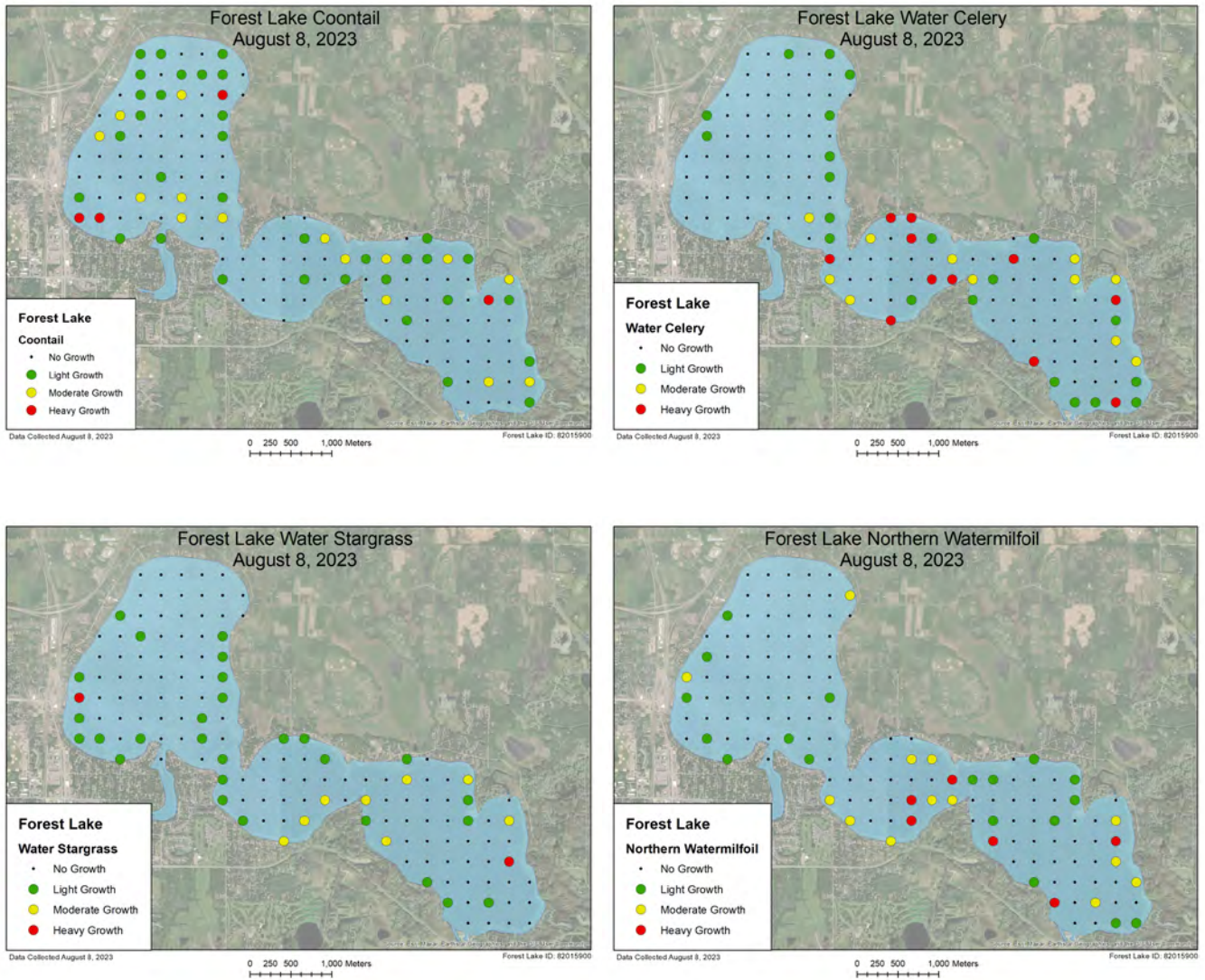


Figure 2. Coontail, water celery, water stargrass, and northern watermilfoil were the most common native submerged plants in 2023.



Water Lilies were Common in Comfort Lake on August 8, 2023

Curlyleaf Pondweed and Eurasian Watermilfoil Management and Point Intercept Surveys for Comfort Lake, Chisago County, 2023

June 2, 2022: Whole Lake Fluridone Treatment

	Delineation	Treatment	Assessment
CLP	April 24, 2023	No Treatment	June 2, 2023
EWM	April 24, 2023	September 19, 2023 (2.77 ac)	June 2 and August 8, 2023

Meander Surveys: April 24 and August 8, 2023

Point Intercept Survey: June 2, 2023

Prepared for:
**Comfort Lake/Forest
 Lake Watershed District
 Forest Lake, Minnesota**



December 6, 2023

Prepared by:
**SteveMcComas
 Blue Water Science
 St. Paul, MN 55116**

Eurasian Watermilfoil Delineation, Treatment, and Assessment Surveys: A whole lake EWM treatment using Fluridone was conducted on June 22, 2022. Surveys in 2023 were intended to assess results from the 2022 whole lake treatment and delineate and assess 2023 EWM growth. An EWM delineation for distribution and abundance was conducted on April 24, 2023 and EWM was not observed at any of the sample sites. A point intercept survey combined with a meander survey was conducted on June 2, 2023. Eurasian watermilfoil was found at 3 meander sites and 1 point intercept site on June 2, 2023 (Figure 2). Another meander survey was conducted on August 8, 2023 and EWM was sampled at 21 sites. Based on the August findings, 2.77 acres of EWM were delineated for treatment.

A treatment of 2.77 acres of EWM was conducted on September 19, 2023 in 2 areas on Comfort Lake using ProcellaCOR (Figure 2).

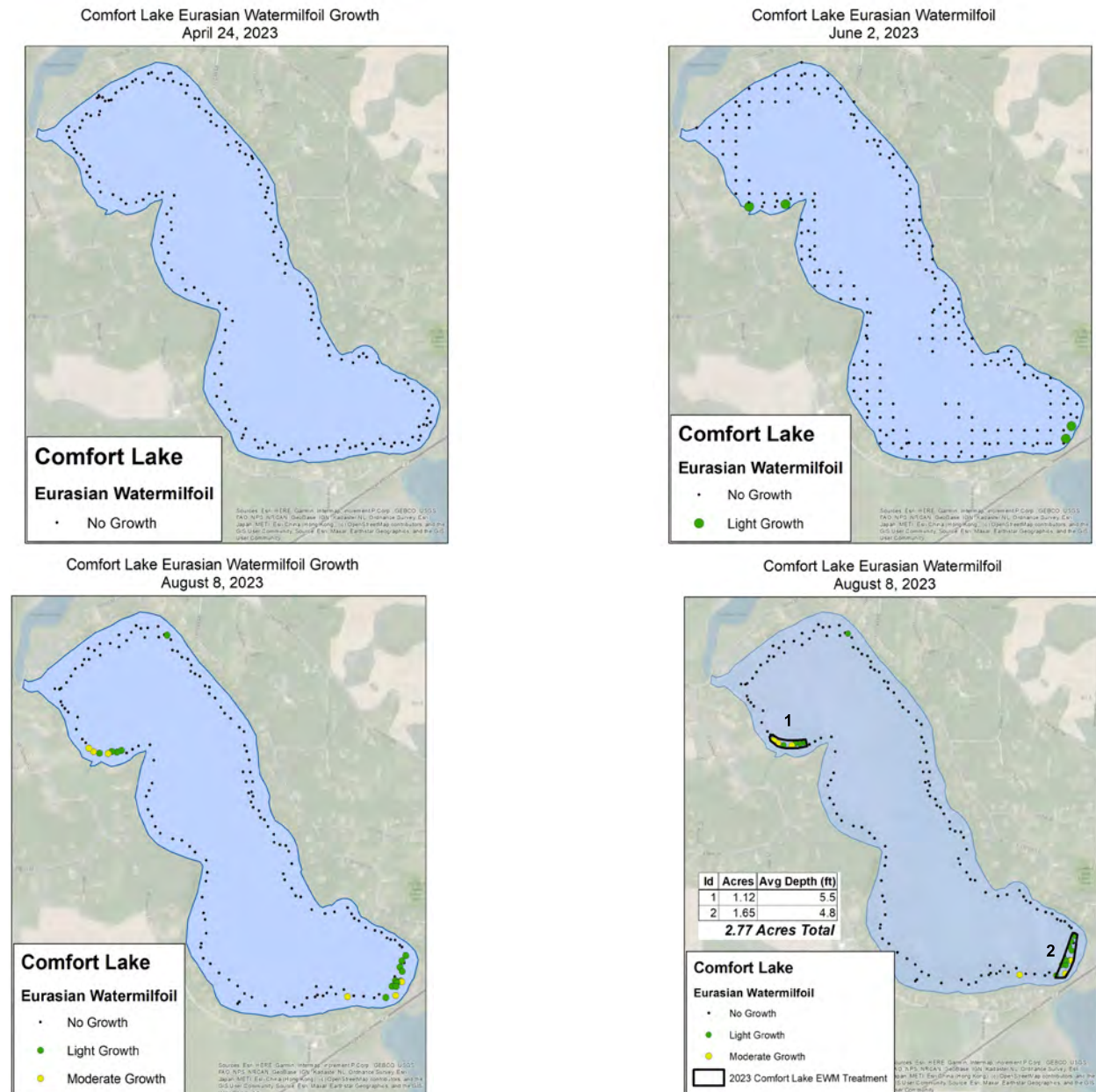


Figure 2. [top-left] DELINEATION: Map of EWM distribution from the April 24, 2023 survey. No EWM was sampled. **[top-right] ASSESSMENT:** Map of point intercept and meander survey for June 2, 2023. EWM was found at 4 sites and all light growth. **[bottom-left] DELINEATION/ASSESSMENT:** Map of a meander survey on August 8, 2023. EWM was found at 21 sites. **[bottom-right] TREATMENT:** Map of meander survey for August 8, 2023 showing the two treatment areas. EWM was treated on September 19, 2023.

Curlyleaf Pondweed and Eurasian Watermilfoil Treatments from 2014 Through 2023: A summary of CLP and EWM treatments from 2014-2023 is shown in Figure 3. Curlyleaf was only treated at 1 acre in 2015. Curlyleaf has been sparse in Comfort Lake since then. EWM was first observed in 2014 and it has spread around the lake in the last few years. A total of 7.5 acres was treated in 2016 and 3.2 acres were treated in 2017. Spot herbicide treatments were conducted from 2018 to 2021 in nearshore areas by the Comfort Lake Association. On June 22, 2022 a whole lake fluridone treatment of 218 acres was conducted and on September 19, 2023 two areas totaling 2.77 acres were treated.

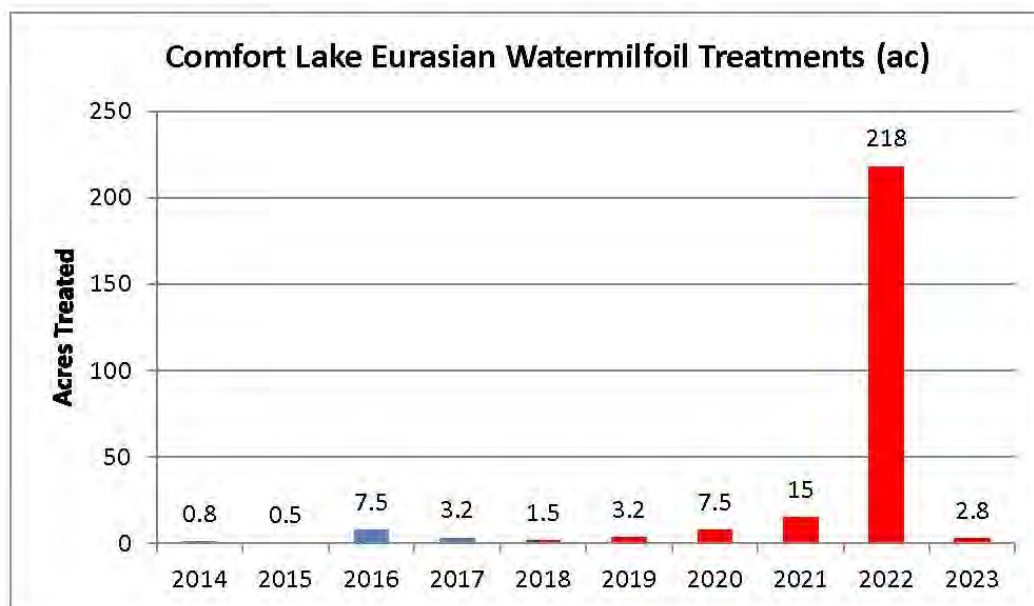
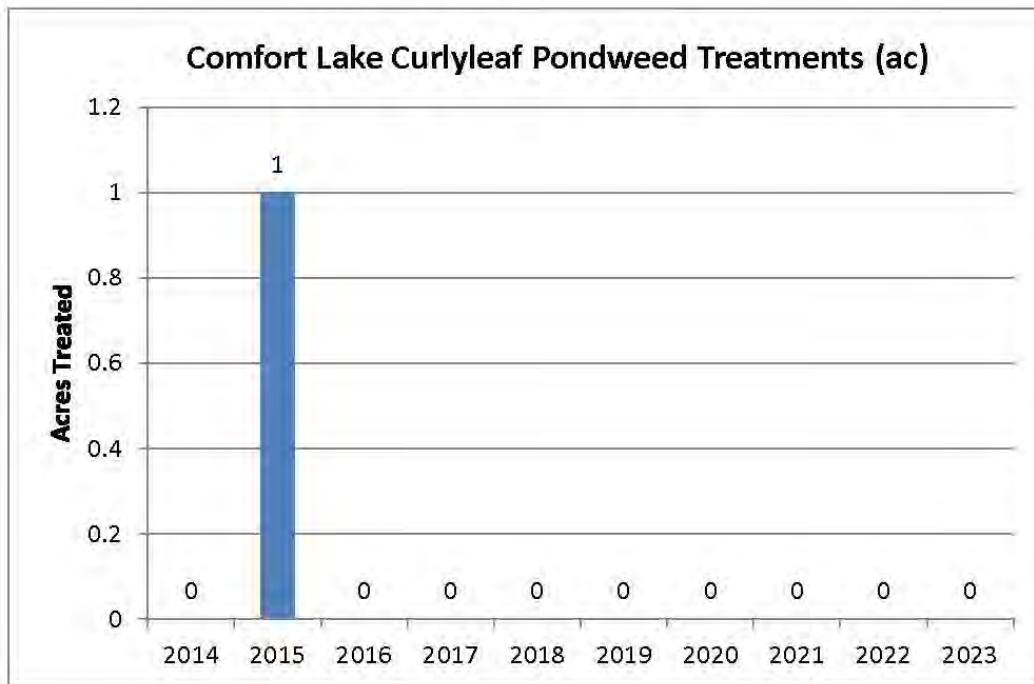


Figure 3. CLFLWD Sponsored Treatments with blue bars and Comfort Lake Association sponsored treatments with red bars: [top] Curlyleaf pondweed treated in 2014-2023. [bottom] Eurasian watermilfoil treated in 2014-2023 (2018 is estimated based on individual permits and 2019, 2020, and 2021 treatments were by the Comfort Lake Association). A full lake fluridone treatment was conducted in 2022. An EWM treatment of 2.77 acres occurred in 2023.

Comparison of Point Intercept Surveys in 2022 and 2023: Results of aquatic plant occurrence for the 2022 and 2023 point intercept surveys are shown in Table 1. A whole lake fluridone herbicide treatment was conducted on June 22, 2022. The results of the September 2022 point intercept survey which reflects the impact of the fluridone treatment showed a significant decrease in EWM. Several other aquatic plant species also decreased in occurrence in September of 2022 compared to the June 10, 2022 survey.

A point intercept survey conducted on June 2, 2023 showed a decrease in EWM compared to June 10, 2022. An increase in submerged aquatic plants was observed compared to the September 15, 2022 survey. Eurasian watermilfoil was found in 1 sample site on June 2, 2023 point intercept survey growing at light conditions. The fluridone treatment reduced EWM in 2022 and through June of 2023. Future surveys will track EWM occurrences.

Table 1. Comfort Lake aquatic plant occurrences for the two point intercept surveys in 2022 and one survey in 2023. All three surveys used the same sample grid based on 180 sample sites.

	June 10, 2022	Sept 15, 2022	June 2, 2023
Bulrush (<i>Typha sp</i>)	2	1	2
Spatterdock (<i>Nuphar advena</i>)	25	51	6
White lilies (<i>Nymphaea odorata</i>)	35	19	28
Cabbage (<i>Potamogeton amplifolius</i>)	3	2	13
Chara (<i>Chara sp</i>)	18		5
Coontail (<i>Ceratophyllum demersum</i>)	26	3	6
Curlyleaf (<i>P. crispus</i>)	26		32
Elodea (<i>Elodea canadensis</i>)	16		
EWM (<i>Myriophyllum spicatum</i>)	35		1
Flatstem (<i>P. zosteriformis</i>)	9	1	7
Illinois (<i>P. illinoensis</i>)	2		
Naiad (<i>Najas sp</i>)	7		
Narrowleaf (<i>P. sp</i>)			1
NWM (<i>M. sibiricum</i>)	1		
Sago (<i>Stuckenia pectinata</i>)		2	7
Stringy (<i>P. sp</i>)	10		29
Water celery (<i>Vallisneria americana</i>)	1		
Water stargrass (<i>Heteranthera dubia</i>)			1
Total number of species	15	7	13



Figure 4. Eurasian watermilfoil on June 2, 2023.

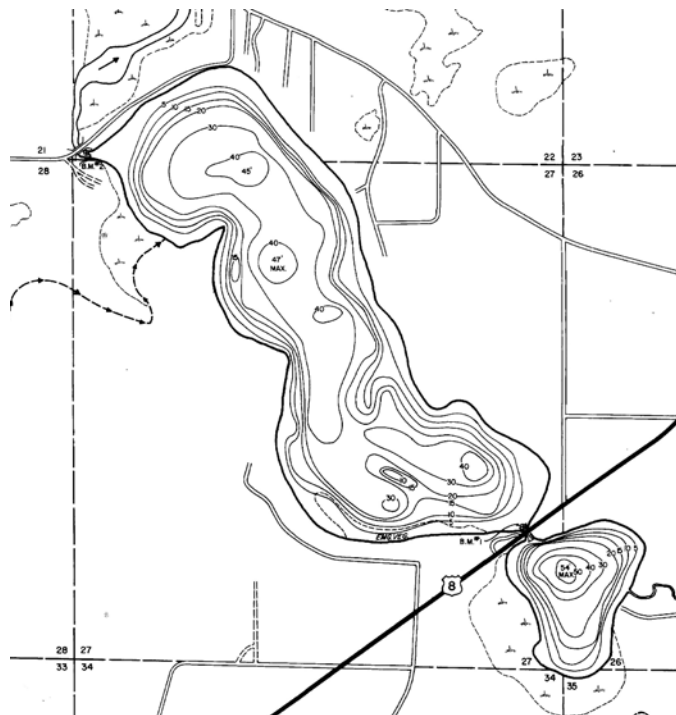
Curlyleaf Pondweed and Eurasian Watermilfoil Management and Point Intercept Surveys for Comfort Lake, Chisago County, 2023

Introduction and Methods

Comfort Lake has an area of 218 acres with a littoral area of 90 acres (MnDNR). The maximum depth of Comfort Lake is 37 feet. Curlyleaf pondweed (CLP) and Eurasian watermilfoil (EWM) have been managed in Comfort Lake since at least 2014. The objectives of the curlyleaf surveys were to delineate the acreage of curlyleaf pondweed to treat and then treat is necessary and then after treatment, assess the effectiveness of the treatment. The objectives of the Eurasian watermilfoil (EWM) surveys were to delineate the acreage of EWM to treat and then treat is necessary and then after treatment, assess the effectiveness of the treatment.

Curlyleaf Pondweed Delineation and Assessment Methods: An initial curlyleaf pondweed delineation was conducted on April 24, 2023. The entire perimeter of the lake was checked for curlyleaf pondweed. A total of 176 sites were sampled for aquatic plants. A follow-up curlyleaf pondweed assessment was conducted on June 2, 2023 to characterize the status of curlyleaf pondweed at it's peak growing period. The methodology that was used for the assessment included a point intercept survey combined with a meander survey. A total of 240 sites were sampled for aquatic plants.

Eurasian Watermilfoil Delineation and Assessment Methods: An initial EWM delineation was conducted on April 24, 2023 with a meander survey. The entire perimeter of the lake was checked for EWM. A total of 176 sites were sampled for aquatic plants.



An EWM assessment was conducted on June 2, 2023. In this survey a meander survey was combined with a point intercept survey. A total of 60 meander points were sampled along with 180 point intercept points for a total of 240 points.

An additional EWM assessment was conducted on August 8, 2023 with a meander survey. The entire perimeter of the lake was checked for EWM. A total of 150 sites were sampled for aquatic plants.

Figure 5. Contour map of Comfort Lake (source: MnDNR).

Point Intercept Survey Methods: A point intercept aquatic plant survey of Comfort Lake was conducted by Blue Water Science on June 2, 2023 and 180 points were sampled (Figure 6). The deepest depth of plant colonization in Comfort Lake was out to 8 feet on June 2, 2023. Sample points were placed 50 meters apart on a grid that covered the lake. Each sample point was equal to 0.62 acres. At each sample point, a sampling rake was lowered into the water and a plant sample was taken. The plant species were recorded and the density of each species was assigned. Densities were based on the coverage on the teeth of the rake. Density ratings were from 1 to 3 with 1 being sparse and 3 being a matted nuisance (Figure 7). Based on these sample sites, plant distribution maps were constructed.

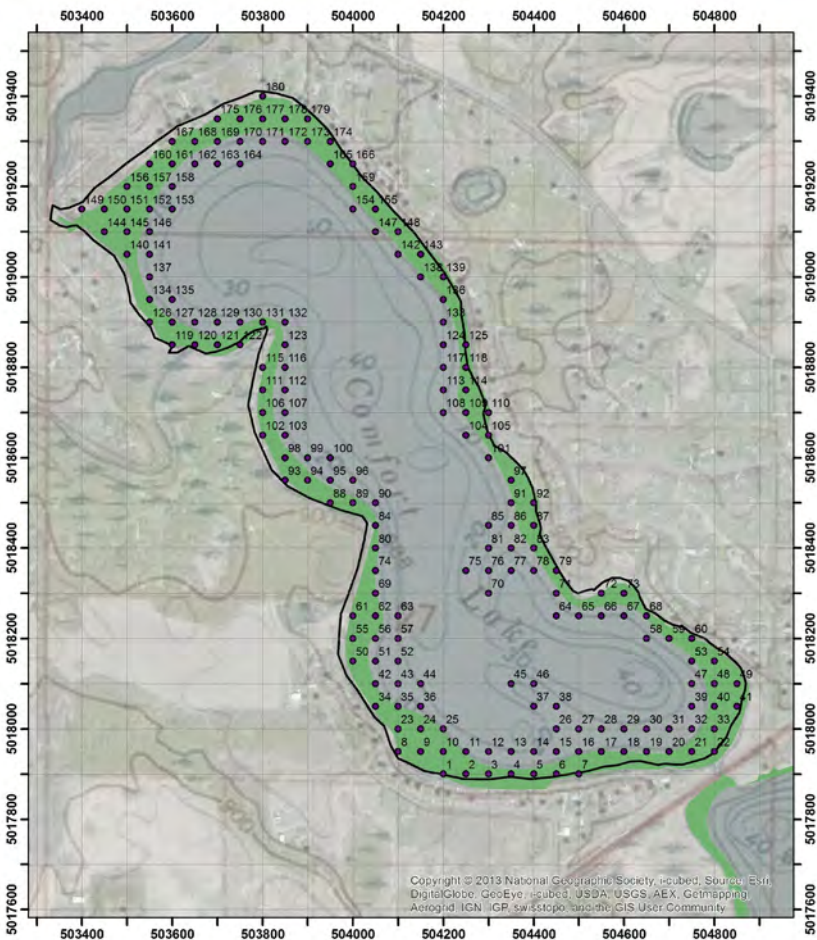


Figure 6. Sample location map for the aquatic plant surveys conducted on Comfort Lake. Green shading represents the littoral zone of Comfort Lake.

Chart of Aquatic Plant Density Ratings

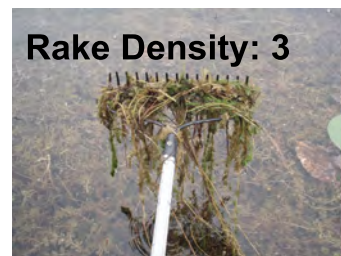
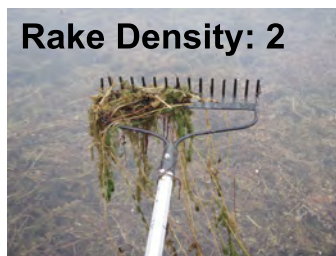


Figure 7. Aquatic plant density ratings from 1 to 3.

Curlyleaf Pondweed Results

April 24, 2023 Delineation and June 2, 2023 Assessment

A curlyleaf delineation was conducted using a meander rake sampling survey on April 24, 2023 and 176 sites were examined. Curlyleaf was found at 4 sites in Comfort Lake (Table 2 and Figure 8). No curlyleaf treatment occurred in 2023.

A curlyleaf assessment occurred on June 2, 2023 using both a meander survey and a point intercept survey. A total of 240 sites were sampled. Curlyleaf was found at 32 sample sites in the point intercept survey (180 sample sites total). Curlyleaf growth was mostly light (Figure 8 and Table 2).

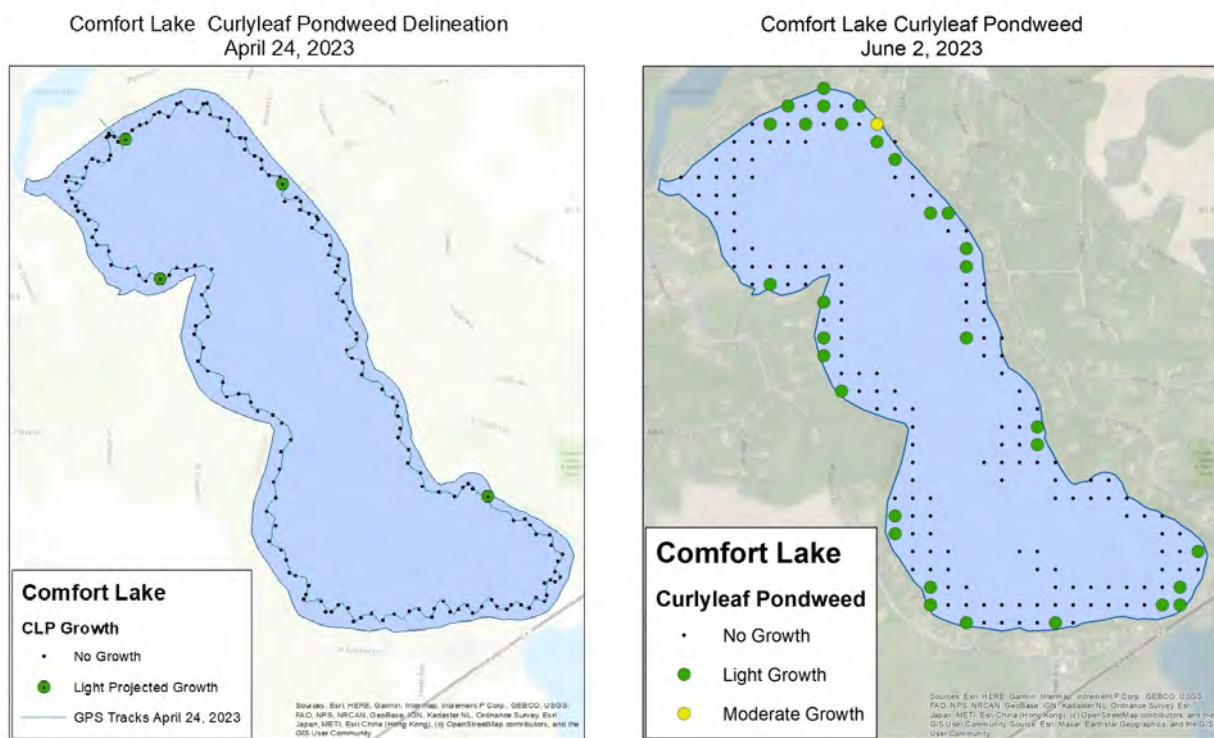


Figure 8. [left] DELINEATION: Map of curlyleaf pondweed distribution from the April 24, 2023 meander survey. Key: black dots = sample locations and green dot = light growth potential. **TREATMENT:** No curlyleaf pondweed treatment occurred in 2023. **[right] ASSESSMENT:** Map of curlyleaf pondweed assessment sites for June 2, 2023 included a point intercept combined with a meander survey. Key: black dots = no curlyleaf growth, green dots = light growth, and yellow dots = moderate growth.

Table 2. Occurrences of curlyleaf pondweed for the April 24, 2023 and delineation using a meandering survey. EWM was not sampled on April 24, 2023.

	Curlyleaf	EWM
April 24, 2023		
Occurrence (176 sites)	4	0
June 2, 2023		
Occurrence (240 sites)	32	4

Eurasian Watermilfoil Results

April 24, 2023 Delineation: An EWM delineation was conducted using a meander rake sampling survey on April 24, 2023 and 176 sites were examined. EWM was not found in Comfort Lake on April 24, 2023 (Table 3).

June 2, 2023 Assessment: On June 2, 2023, an EWM assessment survey using both a meander survey combined with a point intercept survey found EWM at 4 sample sites out of the 240 sites (Figure 9 and Table 3).

August 8, 2023 Assessment: On August 8, 2023, an EWM assessment survey using a meander survey found EWM at 21 sample sites out of the 150 sites (Figure 9 and Table 3).

September 19, 2023 EWM Treatment: An EWM treatment on 2.77 acres was conducted on September 19, 2023 using ProcellaCOR herbicide.

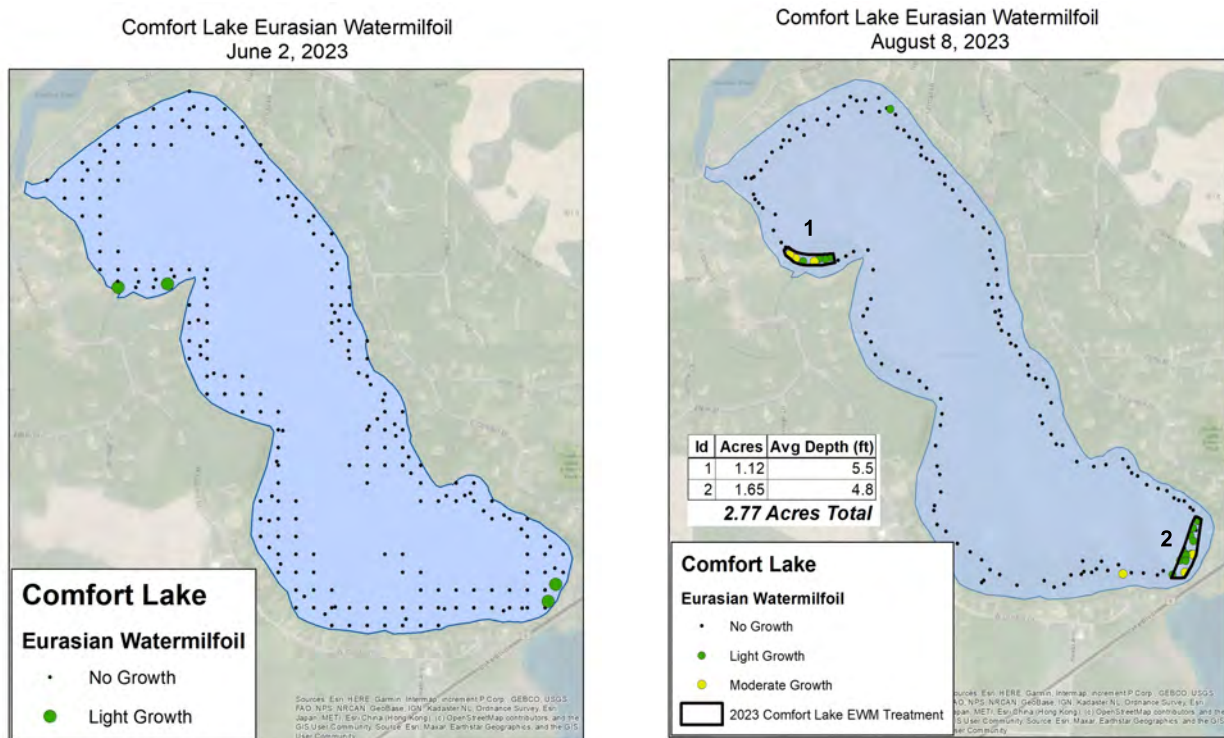


Figure 9. ASSESSMENT: Map of EWM distribution from the June 2, 2023 (left) survey. EWM was sampled at 4 sites. Map of EWM distribution from the August 8, 2023 (right) survey. EWM was sampled at 21 sites and 2 areas totaling 2.77 acres were treated on September 19, 2023.

Table 3. Eurasian watermilfoil occurrences from the EWM surveys.

Survey	April 24, 2023	June 2, 2023	August 8, 2023
Meander	0	3	21
Point Intercept	0	1	0
Total Sites	176	240	150

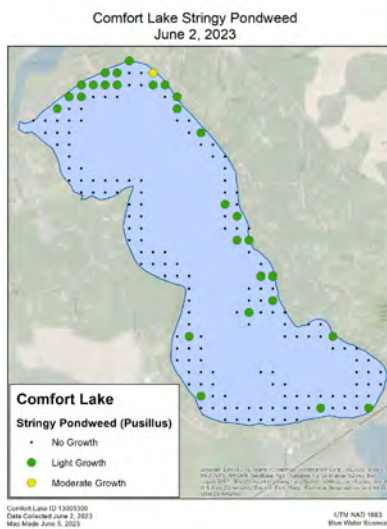
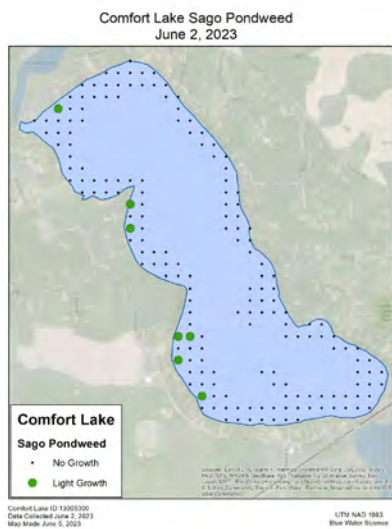
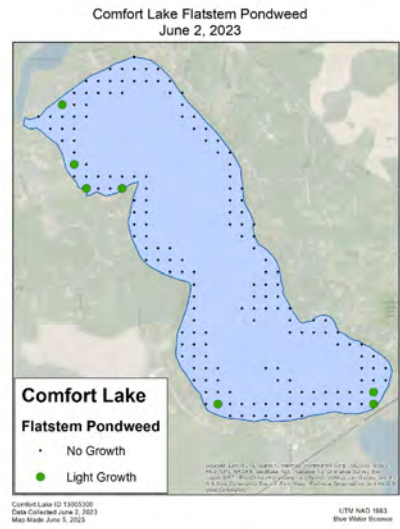
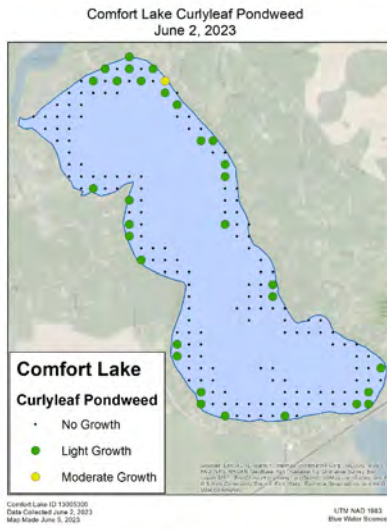
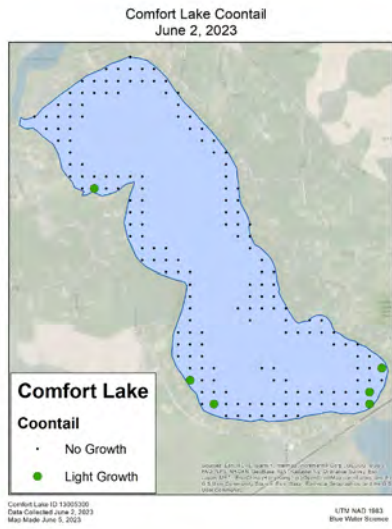
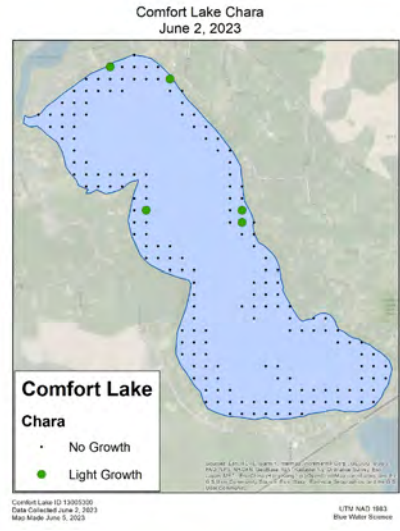
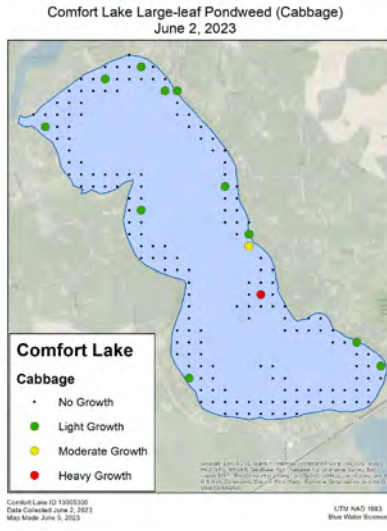
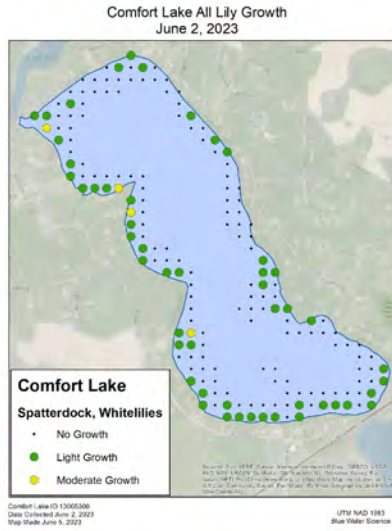
Point Intercept Survey of June 2, 2023

A whole lake fluridone herbicide treatment was conducted on June 22, 2022. The point intercept survey that was conducted on June 2, 2023 found 13 species of aquatic plants (Table 4). Eurasian watermilfoil was found at 1 sample site on June 2, 2023 growing at light conditions. The dominant plant in June was curlyleaf pondweed followed by a stringy pondweed (Table 4).

Table 4. Comfort Lake aquatic plant occurrences for the June 2, 2023 point intercept survey. Based on 180 sample sites.

	June 2, 2023
Bulrush (<i>Typha sp</i>)	2
Spatterdock (<i>Nuphar advena</i>)	6
White lilies (<i>Nymphaea odorata</i>)	28
Cabbage (<i>Potamogeton amplifolius</i>)	13
Chara (<i>Chara sp</i>)	5
Coontail (<i>Ceratophyllum demersum</i>)	6
Curlyleaf (<i>P. crispus</i>)	32
EWM (<i>Myriophyllum spicatum</i>)	1
Flatstem (<i>P. zosteriformis</i>)	7
Narrowleaf (<i>P. sp</i>)	1
Sago (<i>Stuckenia pectinata</i>)	7
Stringy (<i>P. sp</i>)	29
Water stargrass (<i>Heteranthera dubia</i>)	1
Total number of species	13

Point Intercept Aquatic Plant Maps - June 2, 2023



Comparison of Point Intercept Surveys in 2022 and 2023

Results of aquatic plant occurrence for the 2022 and 2023 point intercept surveys are shown in Table 5. A whole lake fluridone herbicide treatment was conducted on June 22, 2022. The results of the September 2022 point intercept survey which reflects the impact of the fluridone treatment showed a significant decrease in EWM. Several other aquatic plant species also decreased in occurrence in September of 2022 compared to the June 10, 2022 survey.

A point intercept survey was conducted on June 2, 2023 showed a decrease in EWM compared to June 10, 2022. An increase in submerged aquatic plants was observed compared to the September 15, 2022 survey. Eurasian watermilfoil was found in 1 sample site on June 2, 2023 point intercept survey growing at light conditions. The fluridone treatment reduced EWM in 2022 and through June of 2023. Future surveys will track EWM occurrences.

Table 5. Comfort Lake aquatic plant occurrences for the two point intercept surveys in 2022 and one survey in 2023 based on 180 sample sites for each of the surveys.

	June 10, 2022	Sept 15, 2022	June 2, 2023
Bulrush (<i>Typha sp</i>)	2	1	2
Spatterdock (<i>Nuphar advena</i>)	25	51	6
White lilies (<i>Nymphaea odorata</i>)	35	19	28
Cabbage (<i>Potamogeton amplifolius</i>)	3	2	13
Chara (<i>Chara sp</i>)	18		5
Coontail (<i>Ceratophyllum demersum</i>)	26	3	6
Curlyleaf (<i>P. crispus</i>)	26		32
Elodea (<i>Elodea canadensis</i>)	16		
EWM (<i>Myriophyllum spicatum</i>)	35		1
Flatstem (<i>P. zosteriformis</i>)	9	1	7
Illinois (<i>P. illinoensis</i>)	2		
Naiad (<i>Najas sp</i>)	7		
Narrowleaf (<i>P. sp</i>)			1
NWM (<i>M. sibiricum</i>)	1		
Sago (<i>Stuckenia pectinata</i>)		2	7
Stringy (<i>P. sp</i>)	10		29
Water celery (<i>Vallisneria americana</i>)	1		
Water stargrass (<i>Heteranthera dubia</i>)			1
Total number of species	15	7	13

Point Intercept Survey Statistics (using the MnDNR format)

	June 10, 2022	Sept 15, 2022	June 2, 2023
Total # Points Sampled	155	116	149
Depth Range of Rooted Veg	1-9 feet	1-5 feet	1-8 feet
Maximum Depth of Growth (95%) in feet	7	5	6
# Points in Max Depth Range	99	92	108
# Points in Littoral Zone (0-15 feet)	135	114	141
% Points w/ Submersed Native Taxa	42	7	36
Mean Submersed Native Taxa/Point	0.7	0.1	0.5
# Submersed Native Taxa	11	4	9
# Submersed Invasive Taxa	2	0	2
Max Depth of EWM in feet	7	0	3
% Frequency of EWM	26	0	1
Mode Rake Abundance of EWM	1	0	1
Max Depth of CLP in feet	9	0	8
% Frequency of CLP	19	0	23
Mode Rake Abundance of CLP	1	0	1

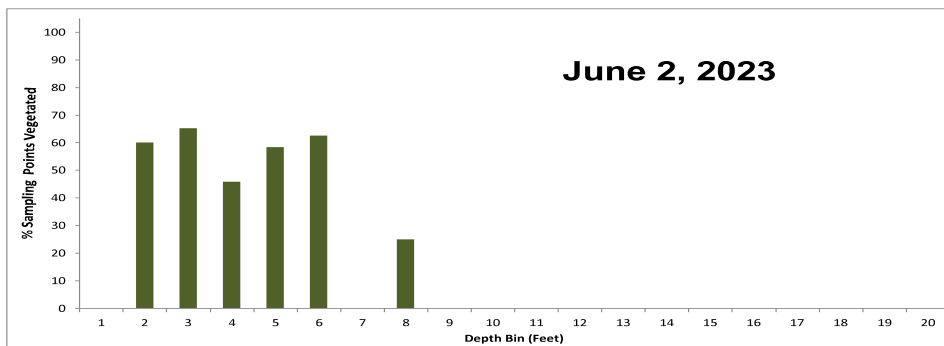
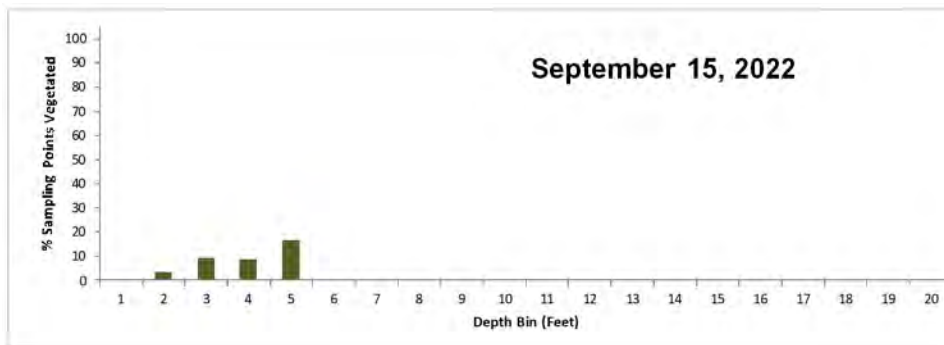
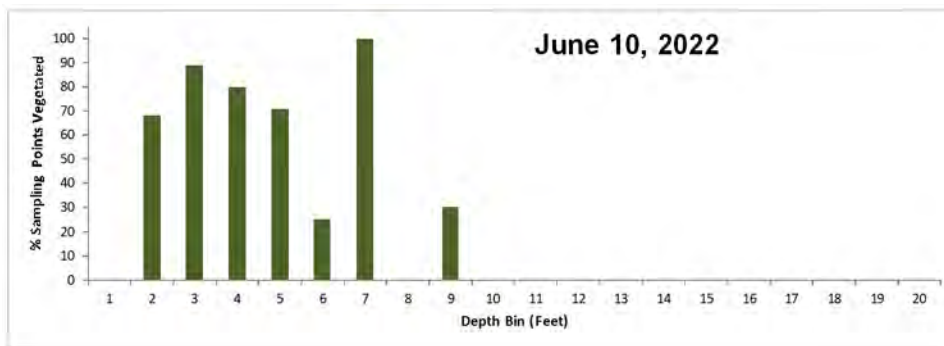


Figure 10. Number of vegetated sites by depth.

Milfoil Hotspots and Growth Potential in Comfort Lake: Eurasian watermilfoil was first observed in Comfort Lake in 2014. Areas of moderate and heavy growth of EWM for 2015 through 2022 are shown on the hotspot map in Figure 11. In the last couple of years EWM has nearly ringed the lake with growth (Figure 11). However lake sediment nitrogen concentrations collected in 2014 found mostly low nitrogen, except for 1 location near the Comfort Lake inlet (Figure 11). High nitrogen is correlated with heavy milfoil growth. EWM is still in a heavy growth mode that is typical of new invasive species. EWM growth will likely be reduced in the future but is difficult to pin down a year.

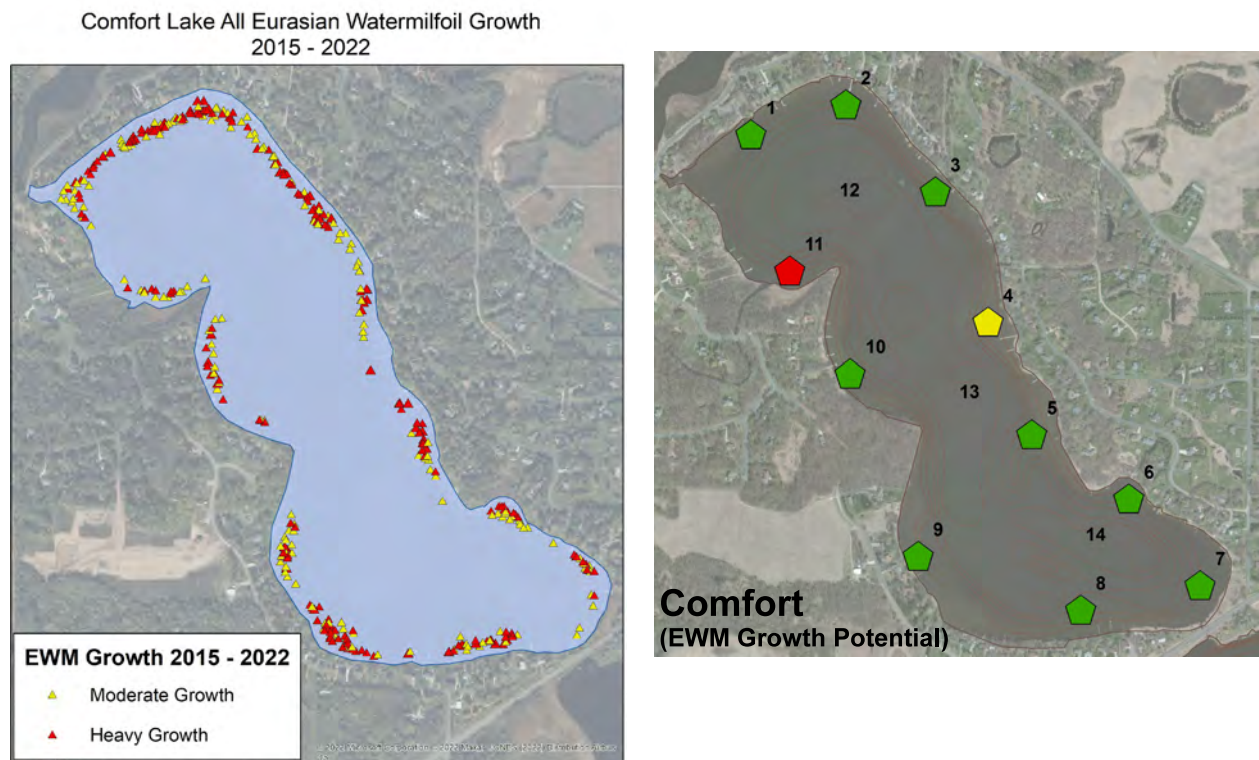


Figure 11. [left] EWM growth distribution and density for 2015-2022. [right] EWM potential growth based on lake sediment analyses for Comfort Lake. Key: green = light growth, yellow = moderate growth, and red = heavy growth.

APPENDIX

Point Intercept Individual Site Data for 2023

June 10, 2022

Site	Depth (ft)	Bulrush	Spatter dock	White lilies	Cab-bage	Chara	Coon-tail	CLP	EWM	Flat-stem	Narrow leaf	Sago	Stringy	Water star-grass	No plants
1	3			1				1							
2	2		1												
3	3		1												
4	3	1	1												
5	3			1											
6	2							1							
7	3			1											
8	2			1				1							
9	3						1			1					
10	4		1	1											
11	12														1
12	14														1
13	20														1
14	15														1
15	6														1
16	4			1											
17	4														1
18	3			1									1		
19	3			1											
20	3			1											
21	6							1							
22	3			1			1	1		1			1		
23	3			1				1				1	1		
24															1
25	10														1
26	20														1
27															1
28															1
29															1
30															1
31	19														1
32	14														1
33	3			1			1	1		1					
34	3			1	1		1								
35	7														1
36															1
37															1
38															1
39	15														1
40	7														1
41	3		1	1											
42	5														1
43	17														1
44															1
45															1
46															1
47	14														1
48	9														1
49	3			1	1		1	1							
50	3							1				1			
51	14														1
52															1
53	17														1
54	4														1
55	3			1				1							
56	3			1											
57															1
58	16														1
59	9														1
60	3				1										
61	2			1								1			
62	3			2								1	1		

June 10, 2022

Site	Depth (ft)	Bulrush	Spatter dock	White lilies	Cabbage	Chara	Coon-tail	CLP	EWM	Flat-stem	Narrow leaf	Sago	Stringy	Water star-grass	No plants
63															1
64	15														1
65	17														1
66	10														1
67	12														1
68	4												1		1
69	5														1
70															1
71	4														1
72	3			1											1
73	2														1
74	13														1
75															1
76	6												1		1
77	13														1
78	4			1											1
79	2			1											1
80	10														1
81	8														1
82	5				3										1
83	3							1					1		1
84	4														1
85	20														1
86	5			1											1
87	3							1							1
88	3			1											1
89	4	1		1											1
90															1
91	4			1									1		1
92	2			1									1		1
93	3			1				1			1				1
94	8														1
95	11														1
96															1
97	2		1	1											1
98	4			1											1
99															1
100															1
101	4				2										1
102	2			1				1							1
103	15														1
104	4												1		1
105	3				1								1	1	1
106	3			1				1				1			1
107	12														1
108	6							1							1
109	3					1									1
110	2														1
111	3			2											1
112	4				1	1									1
113	12														1
114	2					1							1		1
115	2			1				1				1			1
116															1
117	5												1		1
118	2														1
119	3		1	1				1	1						1
120	1			1			1	1							1
121	4			1											1
122	3			2						1					1
123															1
124	5				1										1
125	3														1
126	3			1											1
127															1
128	12														1
129	11														1
130	4														1
131	7														1

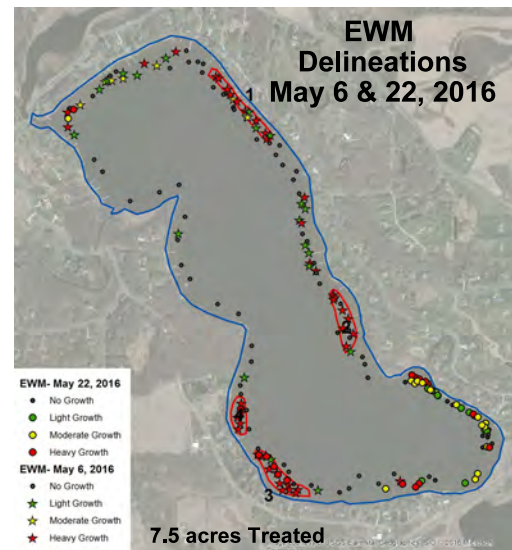
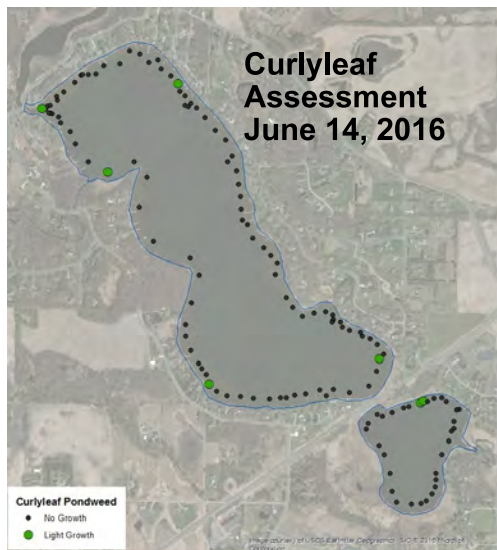
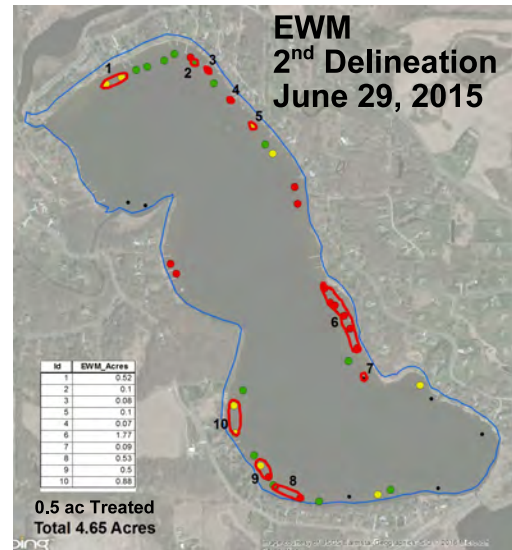
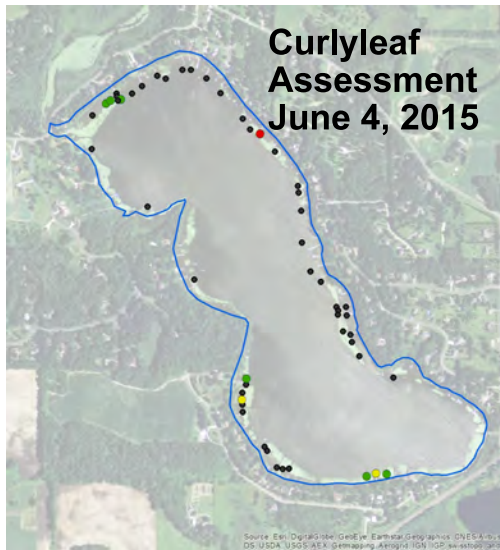
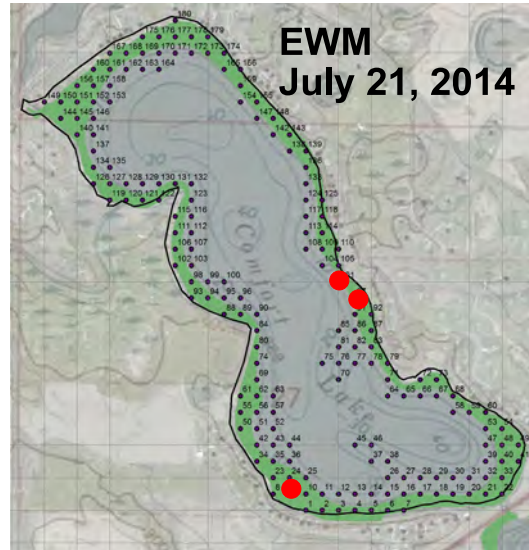
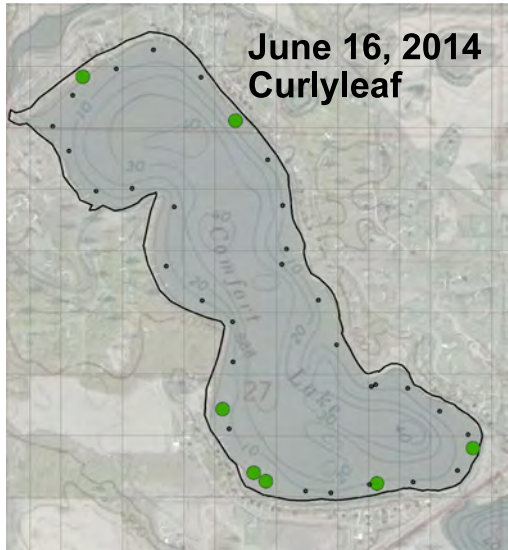
June 10, 2022

Site	Depth (ft)	Bulrush	Spatter dock	White lilies	Cab-bage	Chara	Coon-tail	CLP	EWM	Flat-stem	Narrow leaf	Sago	Stringy	Water star-grass	No plants
132															1
133	6							1							
134	4			1						1					
135															1
136	5							1							
137	5														1
138	4														1
139	2			1											
140	4		1	1											
141	15														1
142	4							1							
143	2		1	1				1							
144	3			2	1										
145	11														1
146															1
147	6														1
148	3												1		
149	3		1	1											
150	2			1											
151	5														1
152	15														1
153															1
154	10														1
155	3			1											
156	2									1		1	1		
157	6			1											
158															1
159	4							1					1		
160	3												1		
161	5												1		
162															1
163															1
164															1
165	4				1			1							
166	2				1								1		
167	3												1		
168	4							1					1		
169	5				1								1		
170	6							1					1		
171	8														1
172	8							1							
173	5												1		
174	3					1		2					1		
175	3					1		1					1		
176	3			1									1		
177	4							1							
178	3			1	1										
179	2							1					2		
180	2		1					1					1		
Average		1	1	1	1	1	1	1	1	1	1	1	1	1	
Occur (180 sites)		2	11	50	13	5	6	32	1	7	1	7	29	1	84
% occur		1	6	28	7	3	3	18	1	4	1	4	16	1	47

CLP and EWM Delineation or Assessments

Curlyleaf Pondweed 2014-2023

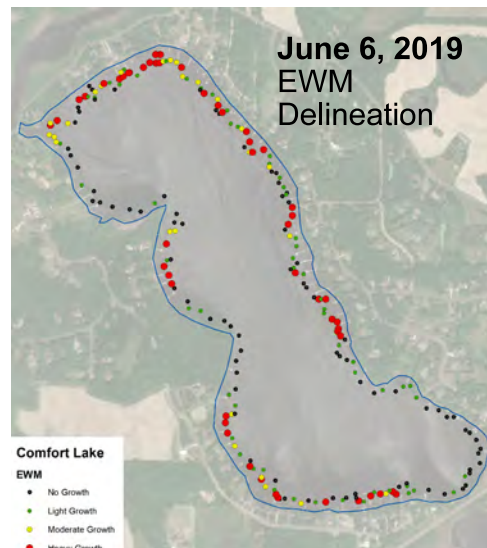
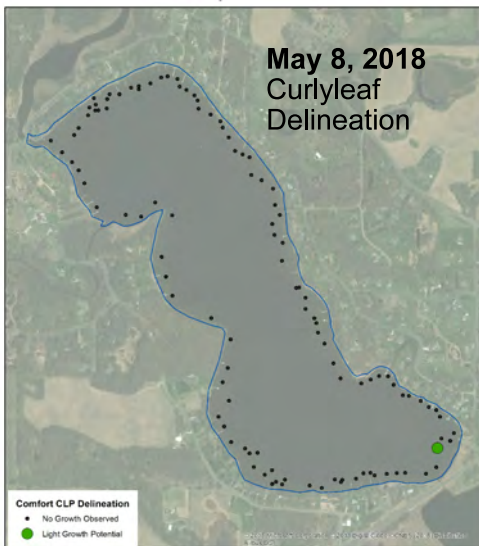
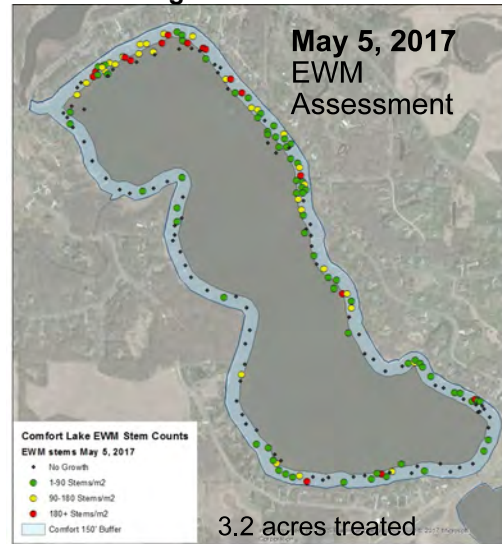
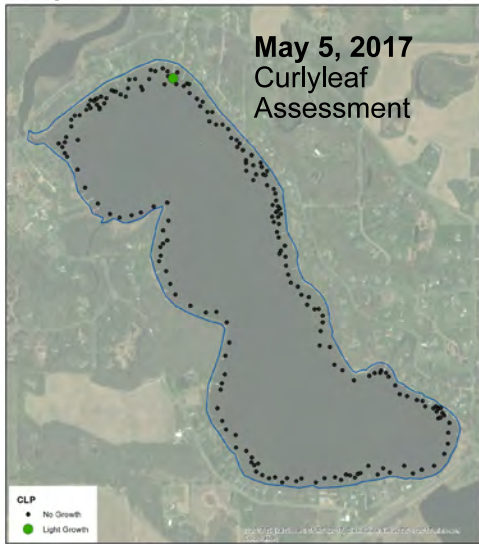
Eurasian Watermilfoil 2014-2023



Curlyleaf Pondweed 2014-2023

Eurasian Watermilfoil 2014-2023

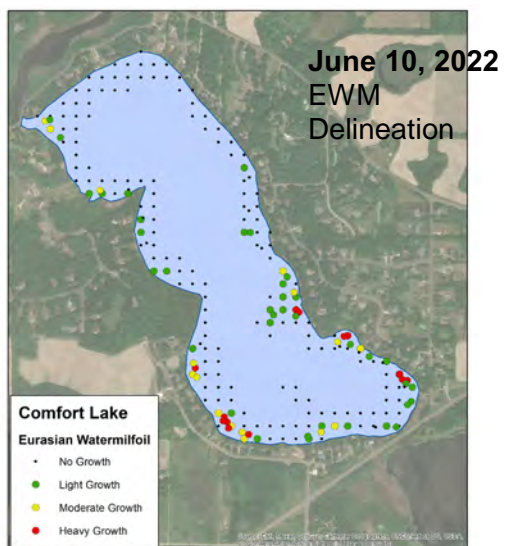
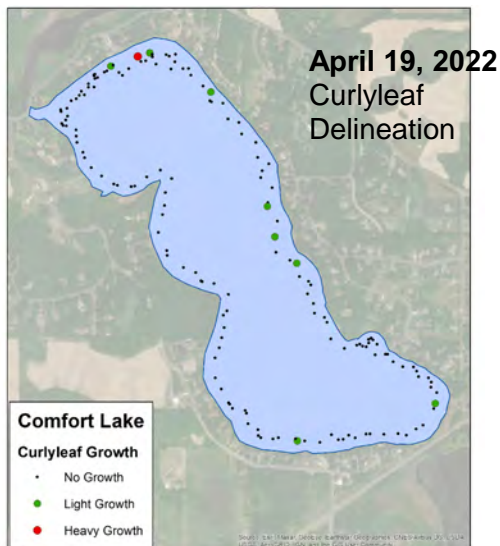
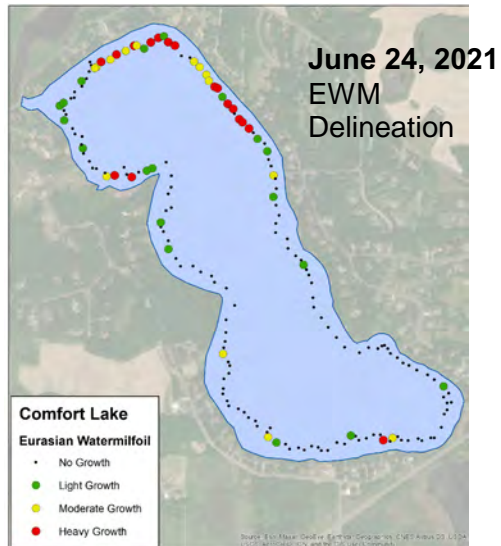
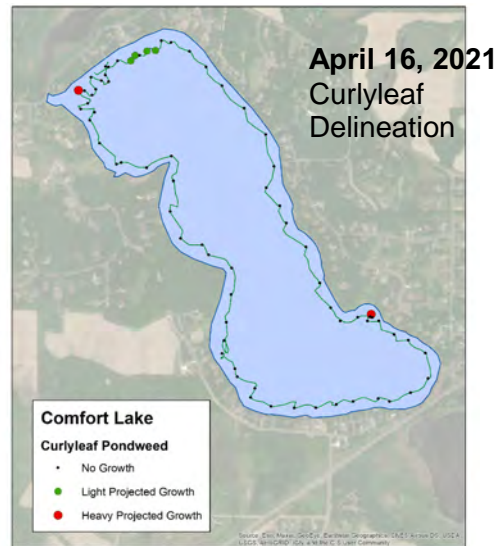
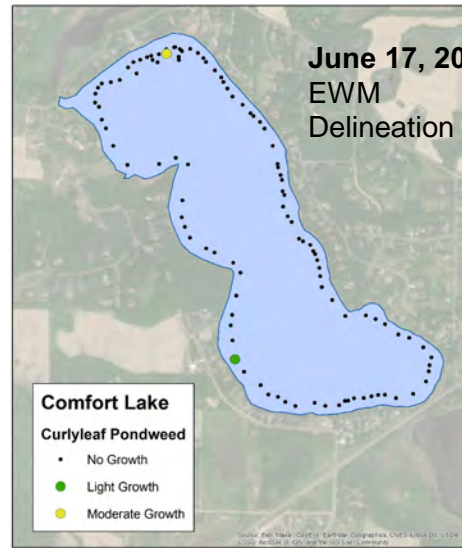
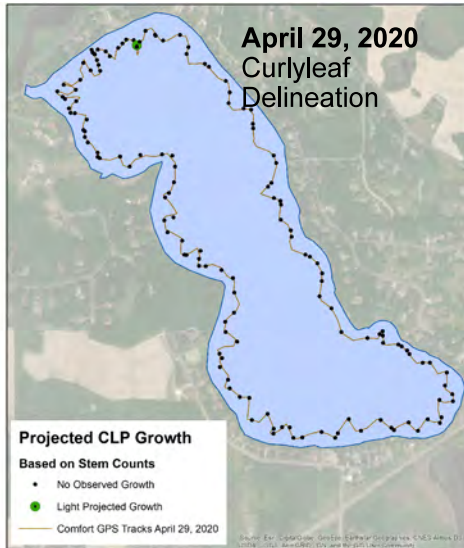
Curlyleaf pondweed and Eurasian watermilfoil maps for 2014 through 2023



Curlyleaf pondweed and Eurasian watermilfoil maps for 2014 through 2023.

Curlyleaf Pondweed 2014-2023

Eurasian Watermilfoil 2014-2023



Curlyleaf pondweed and Eurasian watermilfoil maps for 2014 through 2023.

