

Underwater View of Eurasian Watermilfoil in Comfort Lake on August 28, 2019

Curlyleaf Pondweed Delineation and Assessment and a Point Intercept Plant Survey For Comfort Lake, Chisago County, 2019

Delineation: May 1, 2019
Assessment: June 6, 2019
Summer Point Intercept Survey: August 28, 2019

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



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Curlyleaf Pondweed Delineation and Assessment and a Point Intercept Plant Survey for Comfort Lake, Chisago County, 2019

Summary

Curlyleaf Pondweed Delineation and Assessment Surveys: Curlyleaf pondweed delineation for distribution and abundance was conducted on May 1, 2019. A follow-up curlyleaf assessment was conducted on June 6, 2019.

In the delineation survey, curlyleaf was not found in Comfort Lake (Figure S1) but a few native plants were sampled. Curlyleaf pondweed was found at 3 locations and no treatment occurred in 2019.

About a month later, in the June curlyleaf assessment, curlyleaf had sprouted and was found at 16-sites but growth was mostly light (Figure S1).

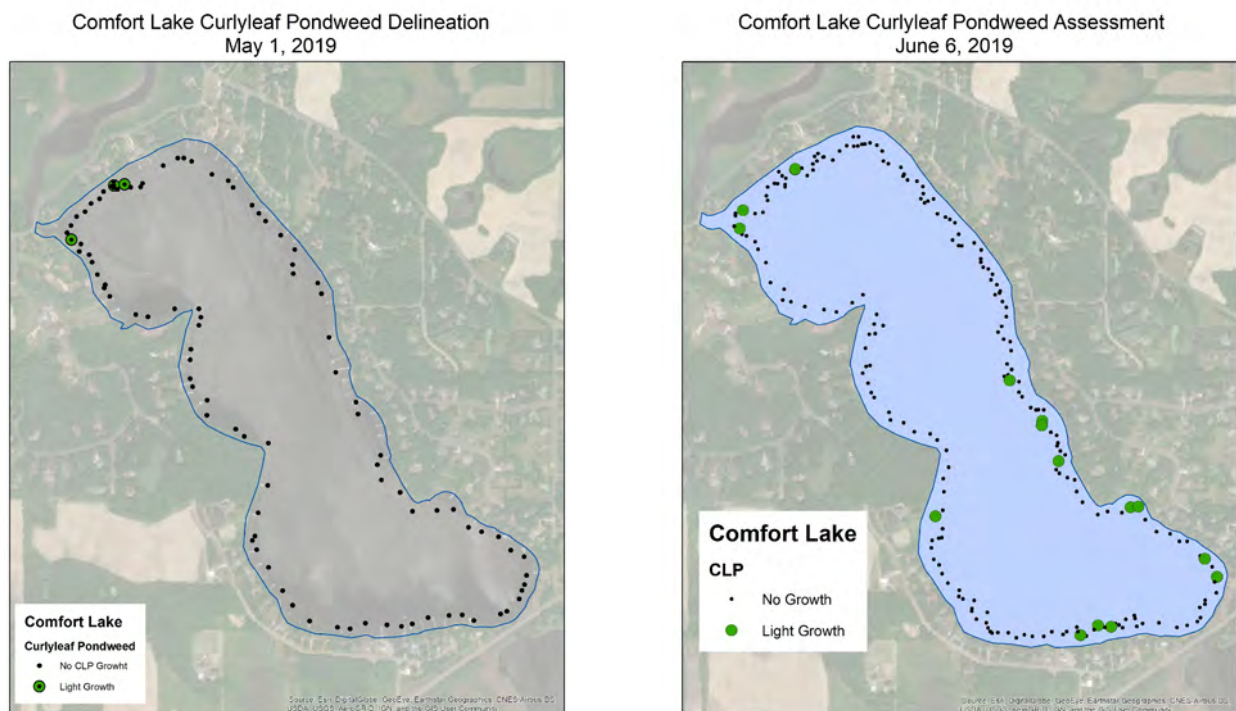


Figure S1. [left] **DELINEATION:** Map of curlyleaf pondweed distribution from the May 1, 2019 survey. Black dots = sample locations. Curlyleaf pondweed was observed at 3 sites on May 1, 2019. **TREATMENT:** No curlyleaf pondweed treatment occurred in 2019.

[right] **ASSESSMENT:** Map of curlyleaf pondweed assessment sites for June 6, 2019. Black dots = no curlyleaf and green circles = light growth.

Eurasian Watermilfoil Delineation, Treatment, and Assessment Surveys: Eurasian watermilfoil (EWM) was first observed in Comfort Lake in 2014. An EWM delineation for distribution and abundance was conducted on May 1, 2019 and a mix of dead EWM combined with light growth of new EWM was observed. Another survey was conducted about a month later on June 6, 2019 and EWM was found at 135 sites. No herbicide treatment was sponsored by the CLFLWD in 2019 although spot treatments in the nearshore areas were conducted.

An EWM assessment on August 28, 2019 found EWM growth had been reduced and was growing at light to moderate densities with a few sites of heavy EWM growth (Figure S2).

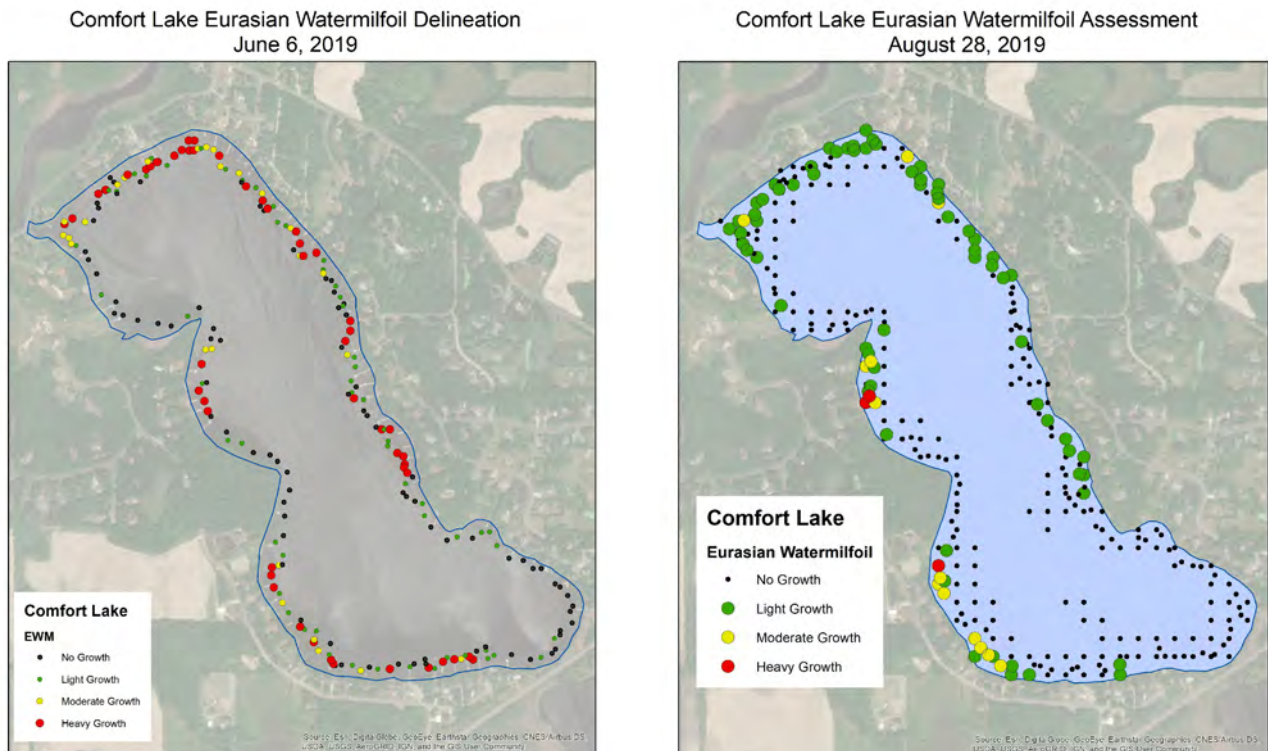


Figure S2. [left] DELINEATION: Map of EWM distribution from the June 6, 2019 survey. **[right] ASSESSMENT:** Map of EWM sites for August 28, 2019. **Key:** black dot = no EWM, green dot = light growth, yellow dot = moderate growth, and red dot = heavy growth.

Curlyleaf Pondweed and Eurasian Watermilfoil Treatments from 2014 Through 2019: A summary of CLP and EWM treatments from 2014-2019 is shown in Figure S3. Curlyleaf was only treated at 1 acre in 2015. Curlyleaf has been sparse in Comfort Lake. 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 in 2018 and 2019 around individual nearshore areas of lake residents. EWM is still relatively new in Comfort Lake and may expand further in the next few years.

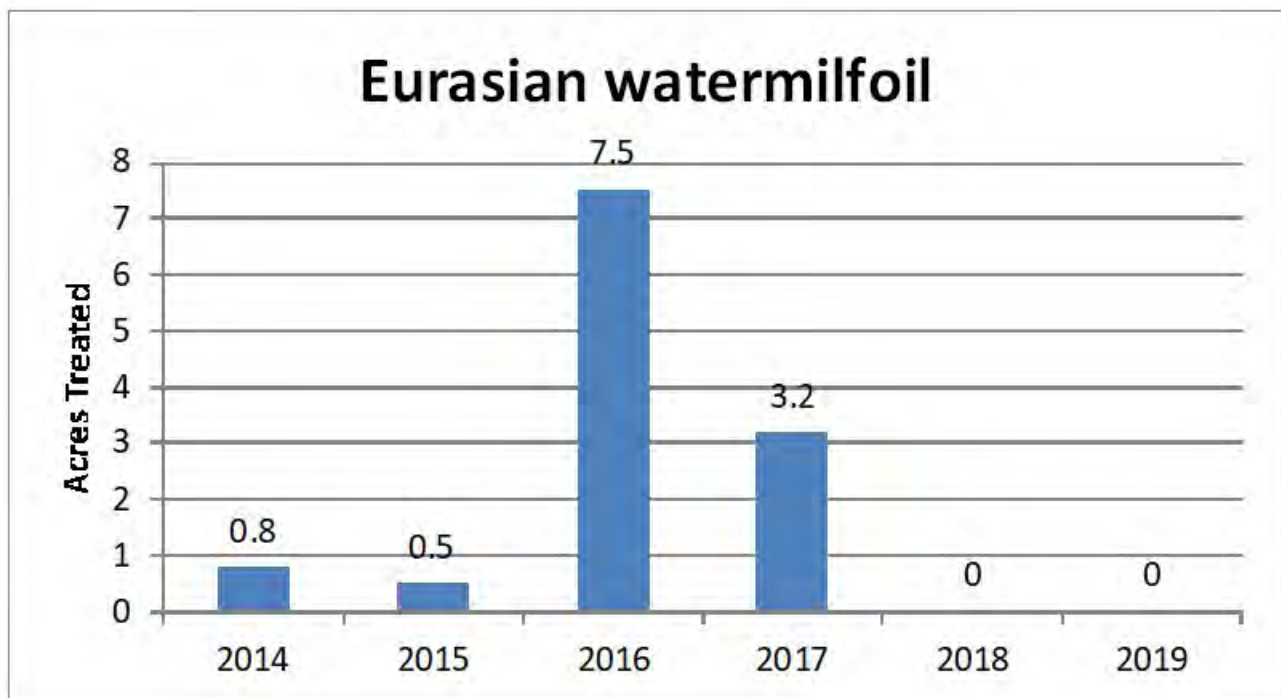
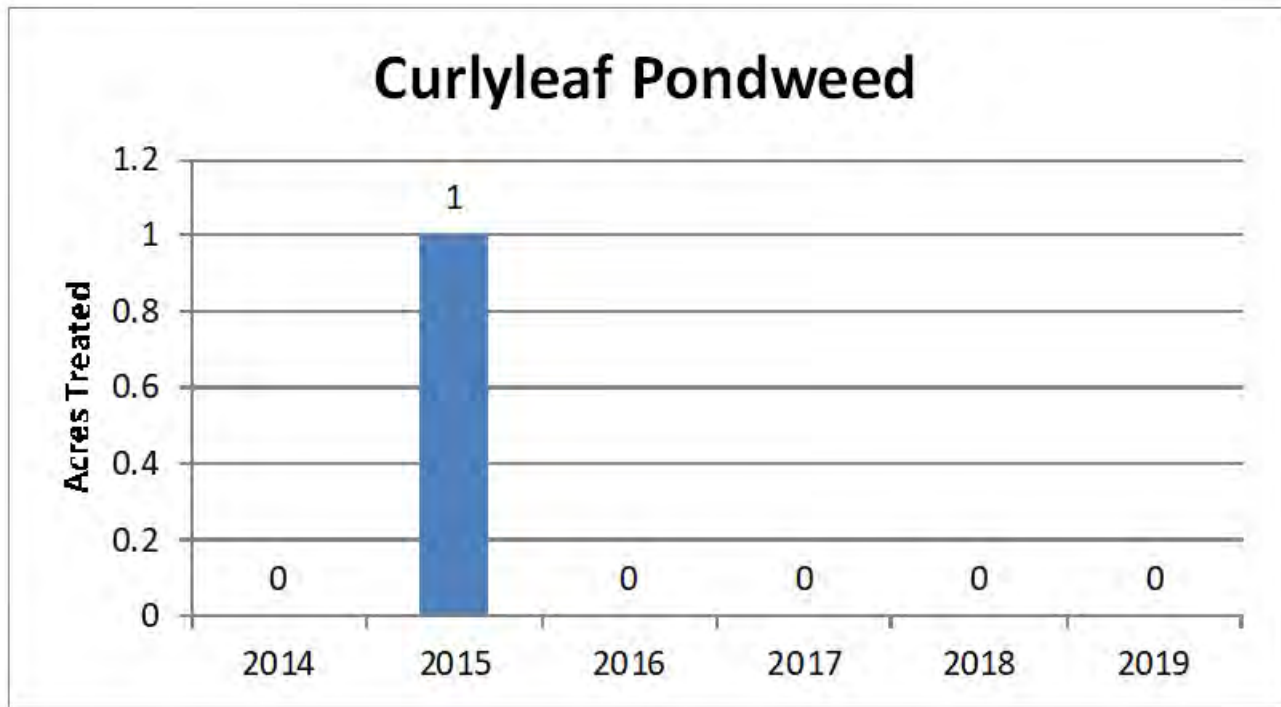


Figure S3. CLFLWD Sponsored Treatments: [top] Curlyleaf pondweed treated in 2014-2019. [bottom] Eurasian watermilfoil treated in 2014-2019.

Milfoil Hotspots and Growth Potential in Comfort Lake: Areas of moderate and heavy growth of EWM for 2015 through 2019 are shown on the hotspot map in Figure S4. In the last couple of years EWM has nearly ringed the lake with growth (Figure S4). However lake sediment nitrogen concentrations collected in 2014 found mostly low nitrogen, except for 1 location near the Comfort Lake inlet (Figure S4). 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.

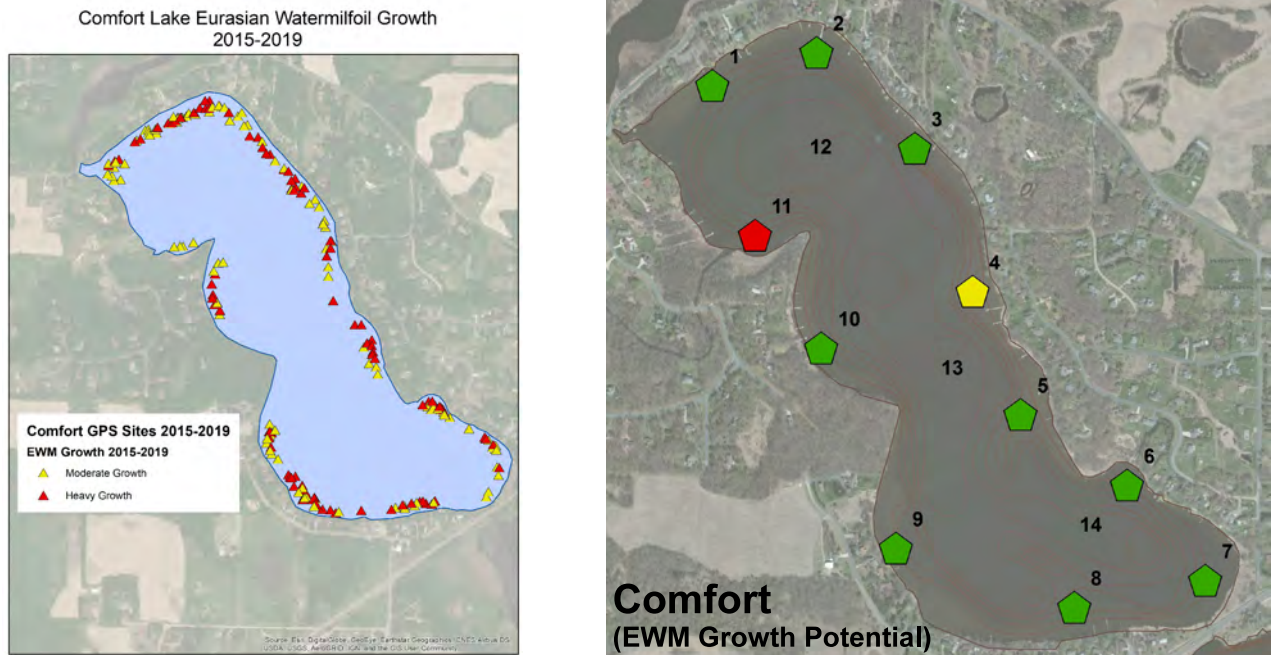


Figure S4. [left] EWM growth distribution and density for 2015-2019. [right] EWM potential growth based on lake sediment analyses for Comfort Lake. Key: green = light growth, yellow = moderate growth, and red = heavy growth.

Summer Aquatic Plant Point Intercept Survey

On August 28, 2019 a full point intercept aquatic plant survey was conducted on Comfort Lake. A total of 139 sites out to 15 feet deep were monitored. Comfort Lake has a fair diversity of aquatic plants, with 9 submerged species (including EWM) and 2 water lily species. A summary of plant occurrence and relative densities is listed in Tables S1 and S2. The most common submerged aquatic plants in the lake are EWM and coontail. A map of aquatic plant species richness (species/site) is shown below. The south end of Comfort Lake has the highest diversity.

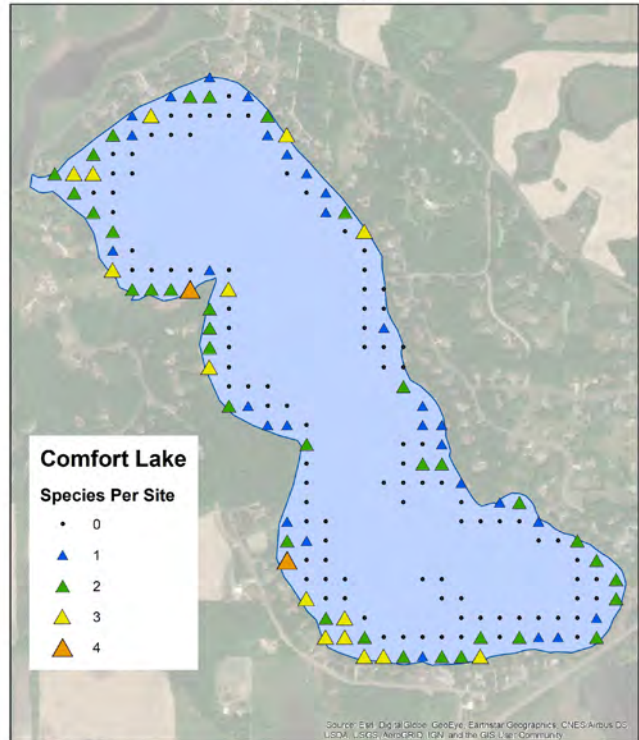
Table S1. Comfort Lake aquatic plant statistics for the August 28, 2019 survey.

Total # Points Sampled	180
Depth Range of Rooted Veg	2-6 feet
Maximum Depth of Growth (95%) in feet	5.0
# Points in Max Depth Range	87
# Points in Littoral Zone (0-15 feet)	180
% Points w/ Native Submersed Taxa	33
Mean Native Submersed Taxa/Point	0.4
Mean Density of Native Submersed Taxa	1.1
# Submersed Native Taxa	8

Table S2. Comfort Lake aquatic plant occurrences and densities for the August 28, 2019 survey. Density ratings are 1-3 with 1 being low and 3 being most dense.

	All Stations (n=180 points 0-15 feet)		
	Occur	% Occur	Density
Spatterdock (<i>Nuphar variegatum</i>)	38	21	2
White waterlily (<i>Nymphaea sp</i>)	21	12	1
Coontail (<i>Ceratophyllum demersum</i>)	32	18	1
Water stargrass (<i>Heteranthera dubia</i>)	1	1	1
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	36	20	1
Naiad (<i>Najas flexilis</i>)	1	1	1
Cabbage (<i>Potamogeton amplifolius</i>)	4	2	1
Illinois pondweed (<i>P. illinoensis</i>)	10	6	1
Stringy pondweed (<i>P. sp</i>)	1	1	1
Flatstem pondweed (<i>P. zosteriformis</i>)	7	4	1
Sago pondweed (<i>Stuckenia pectinata</i>)	1	1	1

Comfort Lake Species Richness
August 28, 2019



Curlyleaf Pondweed Delineation and Assessment and a Point Intercept Plant Survey for Comfort Lake, Chisago County, 2019

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. The extent of heavy growth of curlyleaf pondweed is unknown. 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. The objective of the point intercept survey was to determine the distribution and abundance of aquatic plants in Comfort Lake.

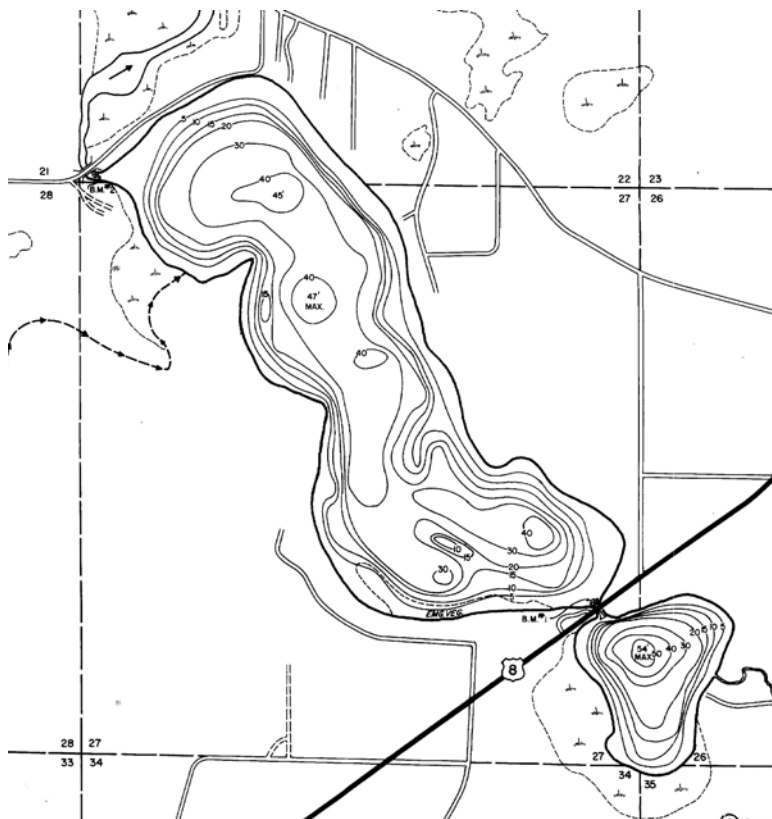
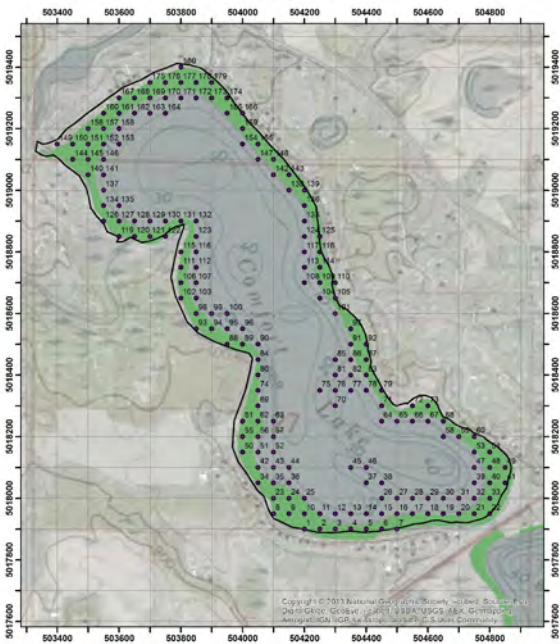


Figure 1. Contour map of Comfort Lake (source: MnDNR).

Curlyleaf Pondweed Delineation and Assessment Methods: An initial curlyleaf pondweed delineation was conducted on May 1, 2019. The entire perimeter of the lake was checked for curlyleaf pondweed. A total of 98 sites were sampled for aquatic plants. A follow-up curlyleaf pondweed assessment was conducted on June 6, 2019 to characterize the status of curlyleaf pondweed at it's peak growing period. The same methodology that was used for the delineation was used for the assessment. A total of 217 sites were sampled for aquatic plants.

Eurasian Watermilfoil Delineation and Assessment Methods: An initial EWM was conducted on May 1, 2019. The entire perimeter of the lake was checked for EWM. A total of 98 sites were sampled for aquatic plants. Another delineation was conducted on June 6, 2019 and 217 sites were sampled. A follow-up EWM assessment was conducted on August 28, 2019 to characterize the status of EWM at it's peak growing period. The same methodology that was used for the delineation was used for the assessment. A total of 127 sites were sampled for aquatic plants.

Summer Point-Intercept Survey Methods: A point intercept aquatic plant survey of Comfort Lake was conducted by Blue Water Science on August 28, 2019 and 180 points were sampled out to 15 feet of water depth (Figure 2). The deepest depth of plant colonization in Comfort Lake was out to 6 feet, although all sites were sampled. 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. Based on these sample sites, plant distribution maps were constructed. A chart showing examples of curlyleaf growth conditions are shown on the next page.



Curlyleaf pondweed densities are represented on a scale of 1 to 3 with 3 being densest.

Curlyleaf Pondweed Growth Characteristics

(source: Steve McComas, Blue Water Science)

Light Growth Conditions

Plants rarely reach the surface.

Navigation and recreational activities are not generally hindered.

Stem density: 0 - 160 stems/m²
Biomass: 0 - 50 g-dry wt/m²
Estimated TP loading: <1.7 lbs/ac

MnDNR rake sample density equivalent for light growth conditions: 1.



Moderate Growth Conditions

Broken surface canopy conditions.

Navigation and recreational activities may be hindered.

Lake users may opt for control.

Stem density: 100 - 280 stems/m²
Biomass: 50 - 100 g-dry wt/m²
Estimated TP loading: 2.2 - 3.8 lbs/ac

MnDNR rake sample density equivalent for moderate growth conditions: 2.



Heavy Growth Conditions

Solid or near solid surface canopy conditions.

Navigation and recreational activities are severely limited.

Control is necessary for navigation and/or recreation.

Stem density: 280+ stems/m²
Biomass: >100 g-dry wt/m²
Estimated TP loading: >6.7 lbs/ac

MnDNR rake sample density = 3.



Results of the May 1, 2019 Delineation

A curlyleaf delineation was conducted using rake sampling on May 1, 2019. Ninety-eight sites were examined. At this time of the year curlyleaf was found at 3 sites in Comfort Lake (Table 1 and Figure 3).

An EWM was conducted using rake sampling on May 1, 2019. Ninety-eight sites were examined. At this time of the year EWM was found at 29 sites in Comfort Lake (Table 1 and Figure 3).

Curlyleaf Pondweed and EWM Conditions in Comfort Lake, May 1, 2019

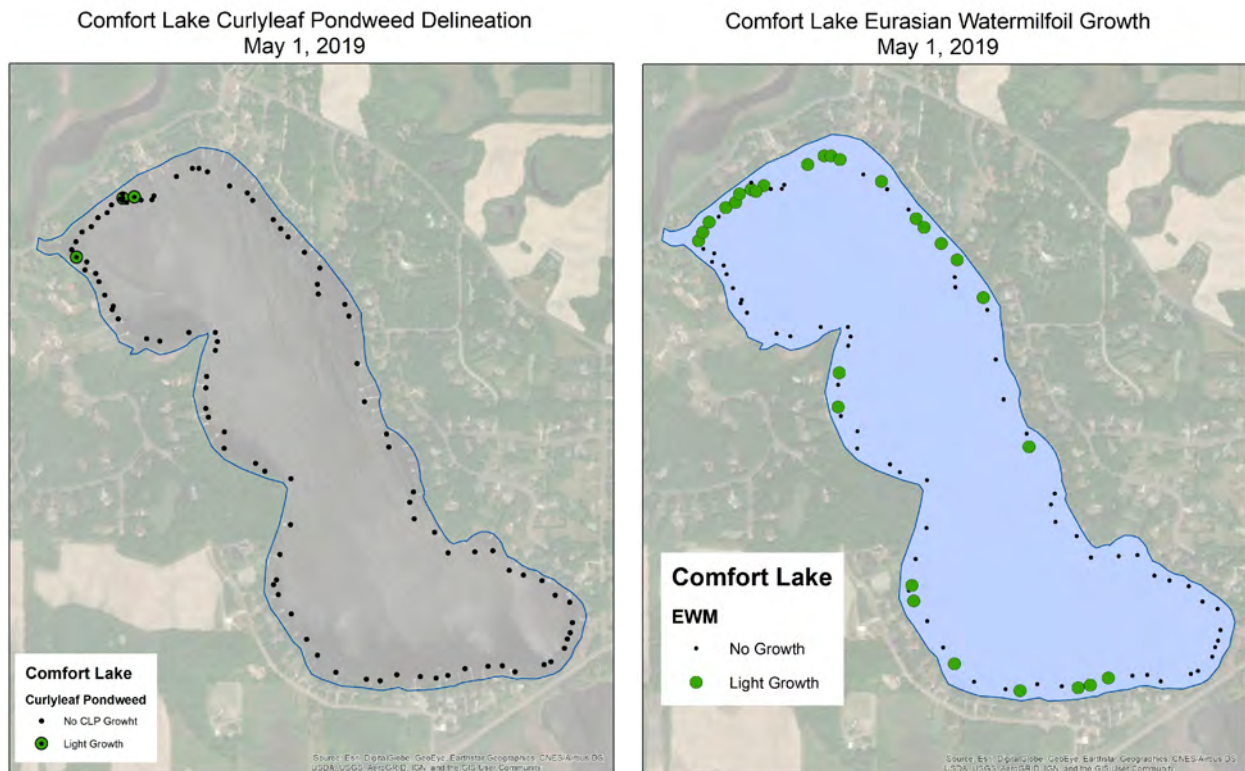


Figure 3. Map of curlyleaf delineation (left) and EWM delineation (right) in Comfort Lake on May 1, 2019.

Table 1. Aquatic plant occurrences and densities based on rake sampling for May 1, 2019. Densities are based on a scale of 1 to 3 with '1' being light and '3' representing heavy growth.

Site	Depth (ft)	CLP-stems	EWM	No plants
311	5			1
312	6	2		
313	6	1	1	
314	8			1
315	11			1
316	9			1
317	6		1	
318	5		1	
319	5		1	
320	5		1	
321	5			1
322	5		1	
323	6			1
324	5			1
325	5		1	
326	6		1	
327	5		1	
328	5		1	
329	7			1
330	15			1
331	5		1	
332	5			1
333	4			1
334	4			1
335	3			1
336	4		1	
337	4			1
338	6			1
339	3			1
340	3			1
341	8			1
342	8			1
343	5			1
344	16			1
345	8			1
346	8			1
347	8			1
348	4			1
349	5			1
350	5			1
351	5			1
352	4			1
353	5			1
354	6			1
355	3			1
356	4			1
357	5			1
358	4		1	
359	4		1	
360	4		1	
361	5			1
362	8			1
363	4		1	
364	4			1
365	4			1
366	4		1	
367	4			1
368	8			1
369	4		1	
370	4			1
371	5		1	
372	4			1
373	9			1
374	10			1
375	4			1
376	4			1
377	3			1
378	10			1
379	10			1
380	4		1	
381	4			1
382	4		1	
383	4			1
384	4			1
385	4			1
386	7			1
387	5			1
388	4			1
389	5			1
390	5			1
391	6			1
392	4			1
393	4			1
394	7			1
395	4			1
396	4			1
397	5	1		
398	5		1	
399	5		1	
400	4		1	
401	4			1
402	4		1	
403	4		1	
404	4		1	
405	5			1
406	6		1	
407	6		1	
408	4			1
Average		1	1	
Occurrence (98 sites)		3	29	67

Curlyleaf Assessment and Eurasian Watermilfoil Delineation on June 6, 2019

A total of 217 sites were assessed with rake sampling on June 6, 2019. Curlyleaf was found at 16 sample sites out of the 217 that were monitored (Table 2). Curlyleaf growth was found to be light at all sites (Figure 4 and Table 2). EWM was found at 29 sample sites out of the 217 sites (Table 2). EWM growth was light.

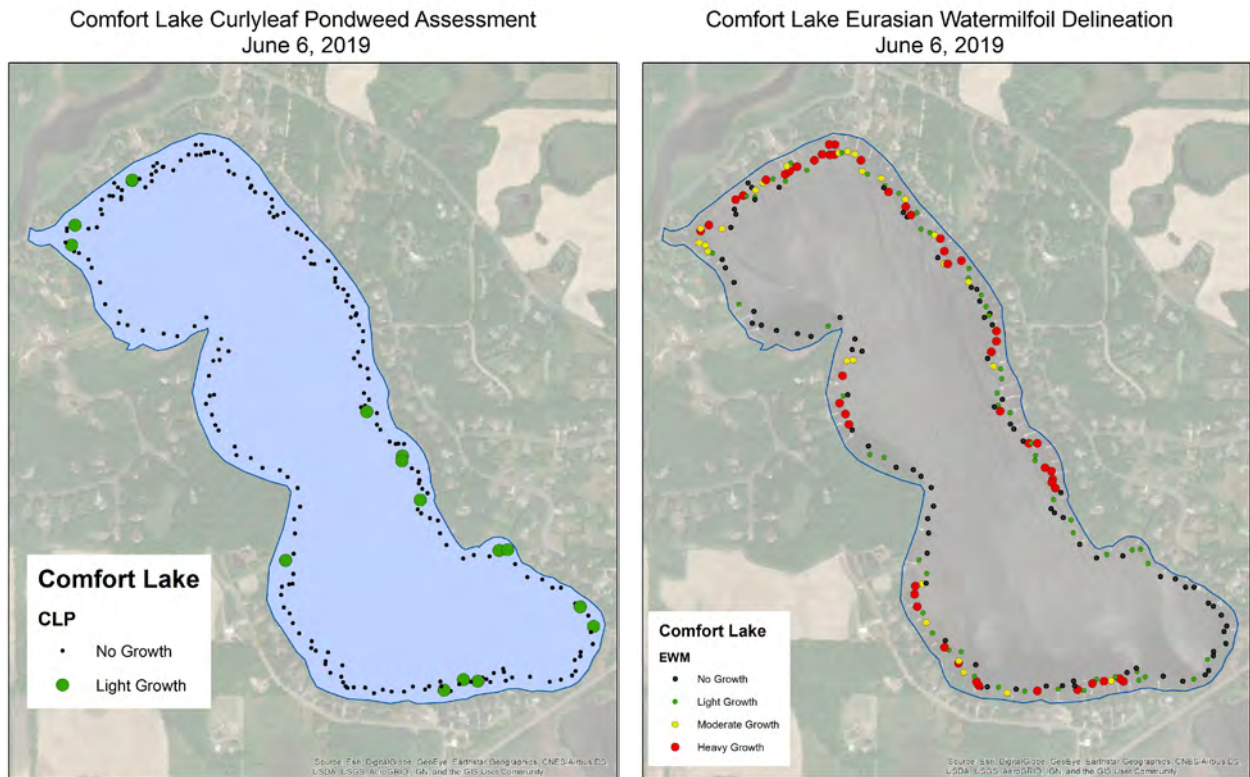


Figure 4. Map of curlyleaf distribution (left) and EWM distribution (right) in Comfort Lake on June 6, 2019. Green circles = light growth and black dots = sample locations.



Figure 5. Eurasian watermilfoil was found around Comfort Lake on June 6, 2019. [left] Eurasian watermilfoil on a sample rake. [right] Eurasian watermilfoil reaching the surface in Comfort Lake.

Table 2. Aquatic plant stem densities based on rake sampling for June 6, 2019. Densities are based on a scale from 1 to 3 with 3 being the densest.

Site	Depth (ft)	Spatter-dock	White lilies	Cabbage	Chara	Coontail	CLP	Elodea	EWM	Flatstem	Sago	Fila algae	No plants
1	5												1
2	5				1	1		1					
3	6								2				
4	6								2				
5	6						1		2				
6	6						1		3				
7	7								1				
8	8												1
9	6								1				
10	6								3				
11	5			1					3				
12	3								3				
13	3								1				
14	3								2				
15	6								3				
16	7								1				
17	6								3				
18	6								3				
19	6								3				
20	5								3				
21	4								3				
22	4								3				
23	6								2				
24	6								1				
25	5								2				
26	5								2				
27	6								3				
28	6								2				
29	8								1				
30	5								2				
31	7								1				
32	7												1
33	6								3				
34	4								1				
35	4								2				
36	6								3				
37	8												1
38	10												1
39	6								3				
40	4								1				
41	7								1				
42	6								1				
43	5								2				
44	5								3				
45	6								3				
46	8												1
47	7								2				
48	6								3				
49	4								3				
50	4								1				
51	4								1				
52	5								2				
53	7												1
54	6			2									
55	6								1				
56	8												1
57	6					1			1				
58	6												1
59	8								1				
60	9												1
61	5												1
62	5					1			3				
63	5								3				
64	6								3				
65	7												1
66	6								2				
67	5								1				
68	5								1				
69	6			1					1				
70	4												1
71	6								1				
72	7												1
73	6						1		3		1		
74	4			1					1				
75	8												1
76	8												1

Table 2. Aquatic plant stem densities based on rake sampling for June 6, 2019. Densities are based on a scale from 1 to 3 with 3 being the densest.

Site	Depth (ft)	Spatter-dock	White lilies	Cabbage	Chara	Coontail	CLP	Elodea	EWM	Flatstem	Sago	Fila algae	No plants
77	8												1
78	6								3				
79	4								1				
80	3								3				
81	5						1		1				
82	6						1		1				
83	5								3				
84	5								3				
85	5								3				
86	5								3				
87	4								3				
88	4												1
89	5						1		1				
90	5	1											
91	6												1
92	4												1
93	4								1				
94	4			1					1				
95	4												1
96	12												1
97	4			1					1				
98	8												1
99	4			1			1		1				
100	4						1		1				
101	6					2			1	1			
102	8												1
103	5												1
104	9												1
105	4												1
106	4			1		1						2	
107	4			1		1	1			1		3	
108	5					3				1			
109	5					2	1						
110	5					2				1		1	
111	4					2				1		1	
112	4					2						2	
113	4					2						3	
114	6					1			1				
115	4					2						1	
116	4					2						1	
117	5								1				
118	2	1				1						1	
119	4												1
120	4			1					1	1			
121	5								1				
122	7								1				
123	8												1
124	6												1
125	4								3				
126	5								3				
127	5								1				
128	5						1		2				
129	5								3				
130	5						1		1				
131	5								3				
132	4								1				
133	4						1		3				
134	5												1
135	8												1
136	8												1
137	6					1			1				
138	8												1
139	5					1			3				
140	5			1					1				
141	5												1
142	4			1					2	1			
143	5								1				
144	5					3						3	
145	5					3						2	
146	5								3				
147	5								3				
148	5								1				
149	5												1
150	5					2			2				
151	4					1			3				
152	4					3			2				

Table 2. Aquatic plant stem densities based on rake sampling for June 6, 2019. Densities are based on a scale from 1 to 3 with 3 being the densest.

Site	Depth (ft)	Spatter-dock	White lilies	Cabbage	Chara	Coontail	CLP	Elodea	EWM	Flatstem	Sago	Fila algae	No plants
153	6								1				
154	5					3			1			3	
155	5					1			3				
156	8												1
157	5								1				
158	5			1					2				
159	6			1					1				
160	5								3				
161	5								3				
162	5								3				
163	6								2				
164	5												1
165	5					1			1				
166	5						1		1				
167	8												1
168	12												1
169	5												1
170	9												1
171	5												1
172	6												1
173	8												1
174	4			1									
175	5		1						1				
176	4								1				
177	8												1
178	6												1
179	5					1			3				
180	5					1			3				
181	5								3				
182	6					1			1				
183	8												1
184	5					1			3				
185	4								2				
186	6								2				
187	11												1
188	8												1
189	5												1
190	9												1
191	5					1			1				
192	5		1	1		1							
193	8												1
194	8												1
195	9												1
196	5		1			1							
197	11												1
198	5		1	1		1			1	1			
199	5		1			1				1			
200	9												1
201	8												1
202	5								1				
203	5		1						2				
204	5						1		2				
205	5					1			2				
206	5								3				
207	4		1						2				
208	4						1		3				
209	5								2				
210	9												1
211	7												1
212	5												1
213	5								3				
214	5								3				
215	5								1				
216	7								1				
217	8												1
Average Occurrence (217 sites)		1	1	1	1	2	1	1	2	1	1	2	62
		2	7	17	1	36	16	1	135	9	1	12	

EWM Assessment

The 2019 summer was somewhat unusual. Warm temperatures arrived early and by June 6, 2019 there was significant EWM growth although it was in water depths of 4 feet or less (Figure 6). By August 28, 2019 the EWM was still present but at mostly light growth. A map of a EWM meander survey combined with a point intercept survey is shown in Figure 6. Some spot treatments may have occurred, but also some natural dieback may have taken place as well.

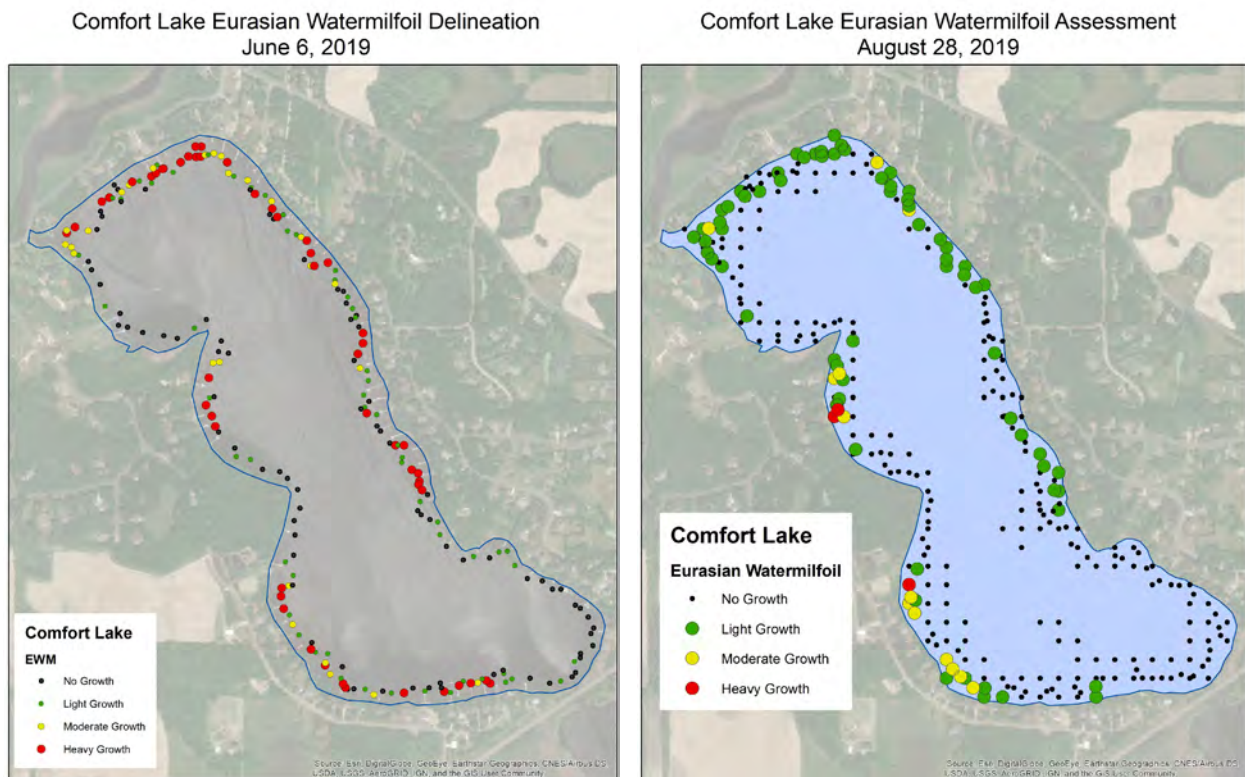


Figure 6. [left] Map of EWM distribution in Comfort Lake on June 6, 2019. [right] Map of EWM assessment in Comfort Lake on August 28, 2019. Green circles = light growth and black dots = sample locations.

Comfort Lake Summer Aquatic Plant Point-Intercept Survey

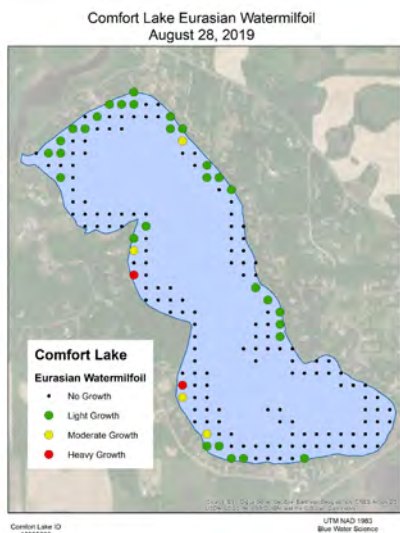
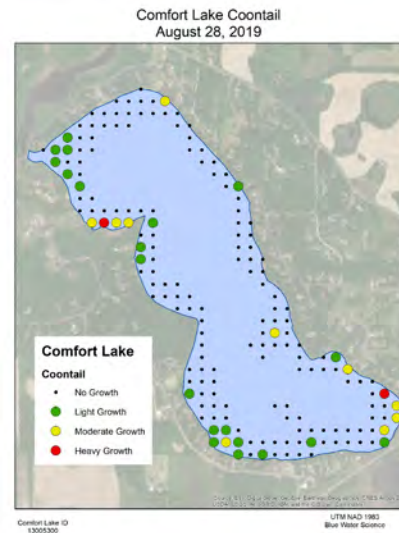
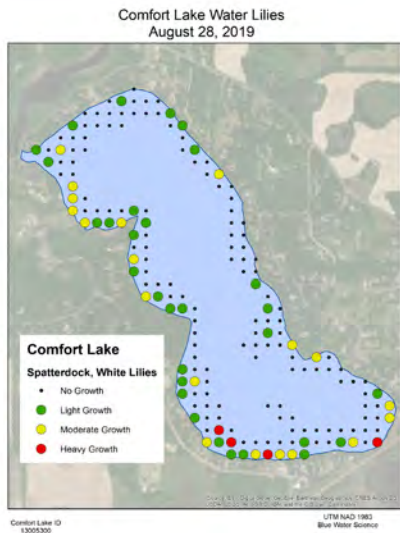
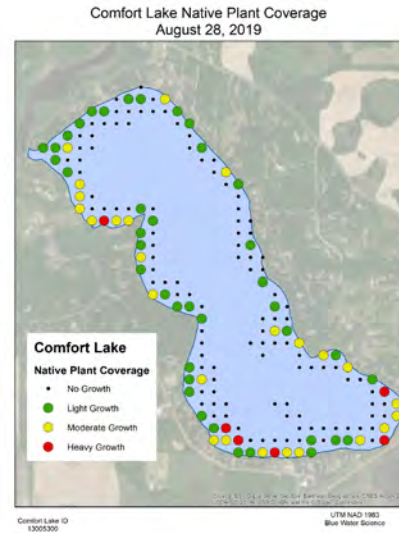
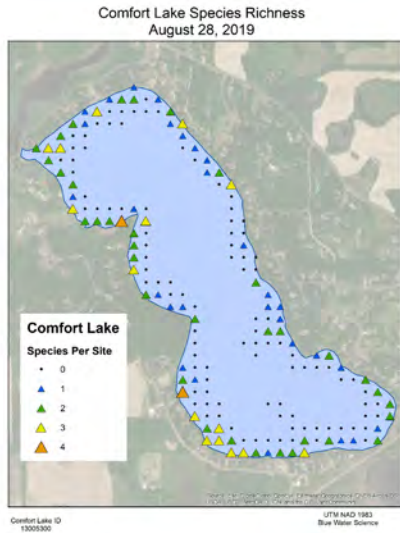
On August 28, 2019 a full point-intercept aquatic plant survey was conducted on Comfort Lake. A total of 180 sites were monitored.

Comfort Lake has a fair diversity of aquatic plants, with 9 submerged species (including curlyleaf pondweed and Eurasian watermilfoil) and 2 water lily species. A summary of plant occurrence and relative densities is listed in Table 3. The most common native submerged aquatic plants in the lake was coontail.

Table 3. Comfort Lake aquatic plant occurrences and densities for the August 28, 2019 survey. Density ratings are 1-3 with 1 being low and 3 being most dense. Plants grew to a depth of 6 feet.

	All Stations (n=180)		
	Occur	% Occur	Density
Spatterdock (<i>Nuphar variegatum</i>)	38	21	2
White waterlily (<i>Nymphaea</i> sp)	21	12	1
Coontail (<i>Ceratophyllum demersum</i>)	32	18	1
Water stargrass (<i>Heteranthera dubia</i>)	1	1	1
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	36	20	1
Naiads (<i>Najas flexilis</i>)	1	1	1
Cabbage (<i>Potamogeton amplifolius</i>)	4	2	1
Illinois pondweed (<i>P. Illinoensis</i>)	10	6	1
Stringy pondweed (<i>P. sp</i>)	1	1	1
Flatstem pondweed (<i>P. zosteriformis</i>)	7	4	1
Sago pondweed (<i>Stuckenia pectinata</i>)	1	1	1

Aquatic Plant Maps of Comfort Lake from the August 28, 2019 Plant Survey



Plant diversity was above average in Comfort Lake with a total of 9 submerged aquatic plant species (Table 4). Eurasian watermilfoil was the most common plant followed by coontail.

Table 4. Aquatic plant occurrence and density for individual sample points in Comfort Lake, Aug 28, 2019.

Meander	Site	Depth (ft)	Spatter-dock	White lilies	Cabbage	Coontail	EWM	Flatstem	Illinois	Naiad	Sago	Stringy	Water stargrass	No plants
	1	3		1		1	1							
	2	3		1	1		1							
	3	4				1								
	4	3	2											
	5	4	3											
	6	3	2	1					1					
	7	3	1	1			1							
	8	3		2		1	1							
	9	3	1			2	1							
	10	4	3			1								
	11	12												1
	12													1
	13	11												1
	14	12												1
	15	5												1
	16	4	1			1								1
	17	4												1
	18	4						1	1					
	19	4	1											
	20	4	2											
	21	8												1
	22	3	3			1								
	23	3				1	2							
	24	4	3			1		1						
	25													1
	26													1
	27													1
	28													1
	29													1
	30													1
	31													1
	32	10												1
	33	5				2								
	34	4		1	1			1						
	35	8												1
	36	19												1
	37													1
	38													1
	39													1
	40	7												1
	41	4	2			2								
	42	8												1
	43													1
	44													1
	45													1
	46													1
	47													1
	48	8												1
	49	4	2			2								
	50	3		1		1	2	1						
	51	12												1
	52													1
	53													1
	54	4	1			3								
	55	4		1			3							
	56	5	2											
	57													1
	58													1
	59	10												1
	60	4			1				1					
	61	3		1										
	62	7												1
	63													1
	64													1
	65	13												1
	66	13												1
	67	10												1
	68	3				2								
	69	8												1
	70													1
	71	5												1
	72	2	2											
	73	3				1							1	
	74	12												1
	75													1
	76													1
	77	14												1
	78	6												1
	79	3	2											
	80	8												1
	81	8												1

Table 4. Aquatic plant occurrence and density for individual sample points in Comfort Lake, Aug 28, 2019.

Meander	Site	Depth (ft)	Spatter-dock	White lilies	Cabbage	Coontail	EWM	Flatstem	Illinois	Naiad	Sago	Stringy	Water stargrass	No plants
	82	5	1			2								
	83	3					1		1					
	84	4						1	1					
	85	9												1
	86	6												1
	87	4					1							
	88	3		1										
	89	5	1											
	90													1
	91	4	1											
	92	3					1							
	93	3	2	1										
	94	3	1											
	95	12												1
	96													1
	97	3					1							
	98	8												1
	99	20												1
	100													1
	101	5	1				1							
	102	3		1			3	1						
	103	11												1
	104	8												1
	105	3												1
	106	4	2			1								
	107	13												1
	108													1
	109	3												1
	110	2												1
	111	4				1	2							
	112													1
	113	8												1
	114	3							1					
	115	3		1			1							
	116	6												1
	117	8												1
	118	3												1
	119	4		2		2								
	120	4		1		3								
	121	5		1		2								
	122	3	2	1	1	2								
	123	5	1			1	1							
	124	10												1
	125	3												1
	126	2	2	1								1		
	127	11												1
	128	15												1
	129	10												1
	130	9												1
	131	6	1											
	132	9												1
	133	8												1
	134	6		2										
	135	18												1
	136	6												1
	137	5	2			1								
	138	9												1
	139	3				1	1		1					
	140	6				1	1							
	141													1
	142	5					1							
	143	3	2				1							
	144	3		1		1								
	145	9												1
	146													1
	147	9												
	148	3					1							
	149	3	1	1										
	150	3				1	1	1						
	151	4	2			1	1							
	152													1
	153													1
	154	16												1
	155	4	1											
	156	3				1	1							
	157	8												1
	158	12												1
	159	5					2							
	160	3	1				1							
	161	6					1							
	162	8												1
	163	13												1
	164													1
	165	5					1							
	166	3	1				1		1					
	167	4							1					
	168	3					1			1	1			
	169	6												1
	170													1

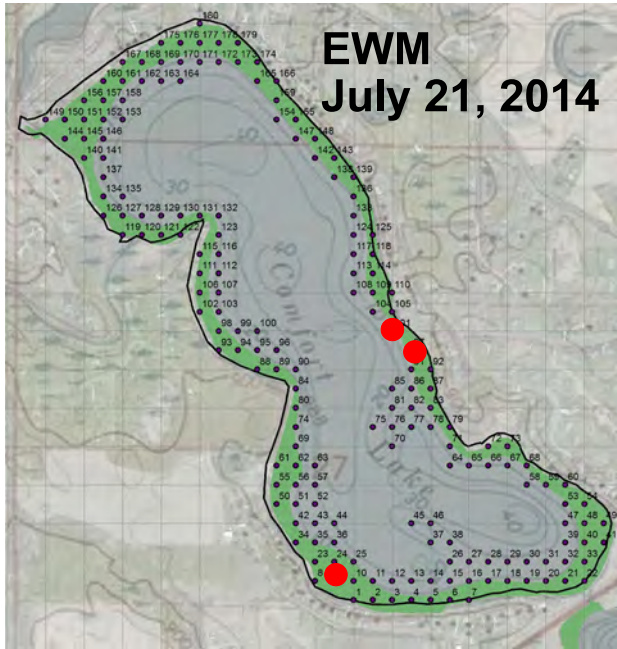
Table 4. Aquatic plant occurrence and density for individual sample points in Comfort Lake, Aug 28, 2019.

Meander	Site	Depth (ft)	Spatter-dock	White lilies	Cabbage	Coontail	EWM	Flatstem	Illinois	Naiad	Sago	Stringy	Water stargrass	No plants
	171													1
	172	8												1
	173	5												1
	174	3	1				1							
	175	2					1							
	176	4	1				1							
	177	5					1		1					
	178	5												1
	179	3				2								
	180	3					1							
6							1							
7														
8														
9							1							
10							1							
11							1							
12							1							
13							1							
14														
15							2							
16							1							
17							1							
18														
19							1							
20							1							
21							1							
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23							1							
24							1							
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37							1							
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42							1							
43														
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45														
46							1							
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62														
63														
64														
65														
66														
67														
68														
69														
70														
71														
72														
73							1							
74														
75														
76														
77														
78														
79														
80														
81							1							
82							2							
83							2							
84							2							

Table 4. Aquatic plant occurrence and density for individual sample points in Comfort Lake, Aug 28, 2019.

Meander	Site	Depth (ft)	Spatter-dock	White lilies	Cabbage	Coontail	EWM	Flatstem	Illinois	Naiad	Sago	Stringy	Water stargrass	No plants
	85													
	86													
	87													
	88						1							
	89						2							
	90						2							
	91						1							
	92													
	93													
	94													
	95													
	96													
	97													
	98													
	99													
	100						1							
	101						2							
	102						3							
	103						1							
	104						1							
	105						1							
	106						2							
	107						1							
	108													
	109													
	110													
	111													
	112													
	113													
	114						1							
	115													
	116													
	117													
	118													
	119						1							
	120						1							
	121						1							
	122													
	123						1							
	124						2							
	125													
	126													
	127						1							
	128						1							
	129													
	130						1							
	131													
	132													
Sites	Average		2	1	1	1	1	1	1	1	1	1	1	
	Occur (180 sites)		38	21	4	32	36	7	10	1	1	1	1	98
	% occur		21	12	2	18	20	4	6	1	1	1	1	
Meander	Average						1							
	Occur (127 sites)						46							0
	% occur						36							
All sites	Average		2	1	1	1	1	1	1	1	1	1	1	
	Occur (307 sites)		38	21	4	32	82	7	10	1	1	1	1	98
	% occur		12	7	1	10	27	2	3	1	1	1	1	

Eurasian Watermilfoil Discovered in Comfort Lake in 2014



During the point-intercept survey on July 21, 2014, Eurasian watermilfoil (EWM) was identified at three sites (Figure 7a). EWM was verified by the MnDNR on August 6, 2014 at 13 sites (Figure 7b). Due to the lateness of the season, only the EWM area at the public access was treated (Figure 7c). EWM will be monitored in the next few years to characterize distribution and abundance.

Figure 7a. EWM locations (red dots) on the July 21, 2014 point-intercept survey.



Comfort Lake, Chisago County (13005300)
Eurasian watermilfoil Inspection: August 6, 2014
Invasive Species Program

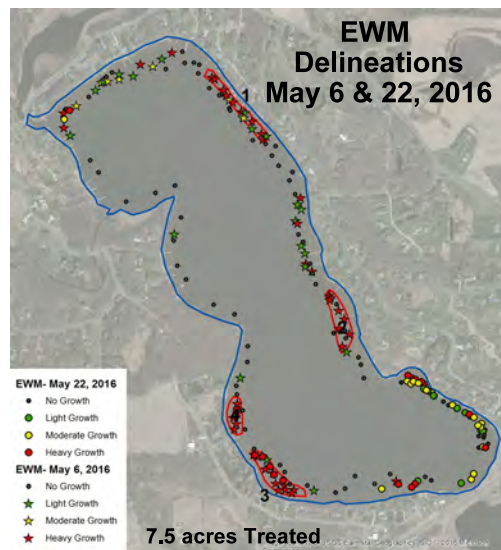
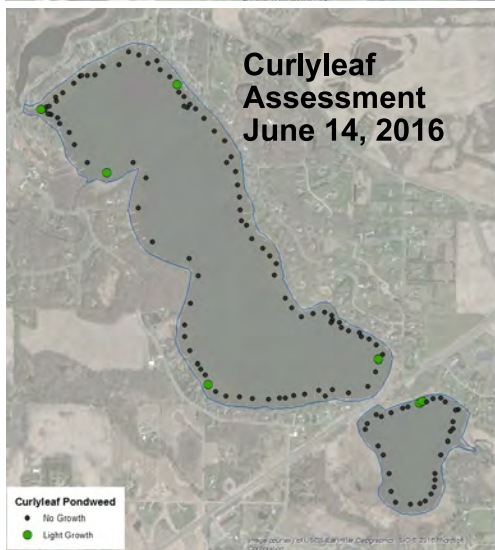
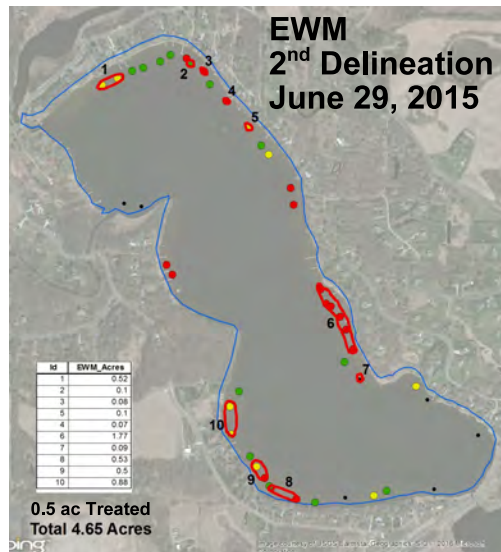
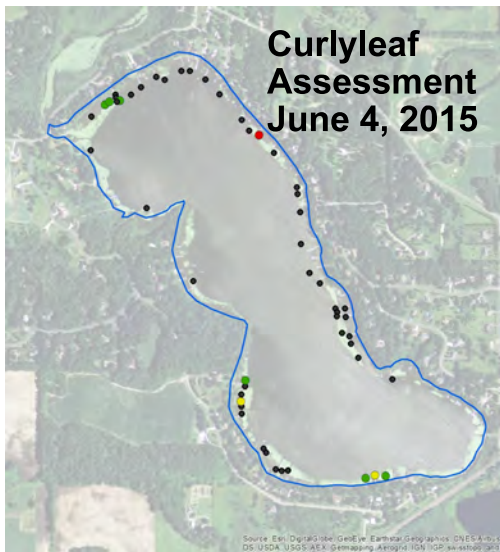
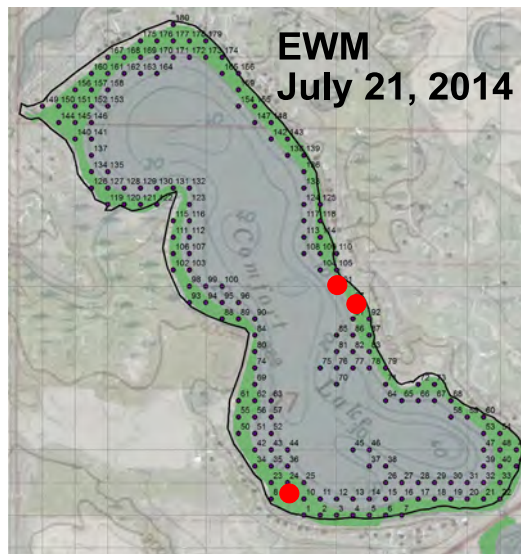
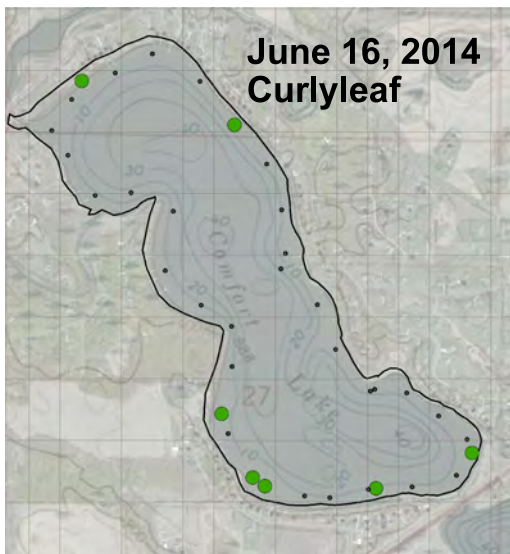


Figure 7c. EWM treatment area in front of the public access.

APPENDIX

Curlyleaf Pondweed 2014-19

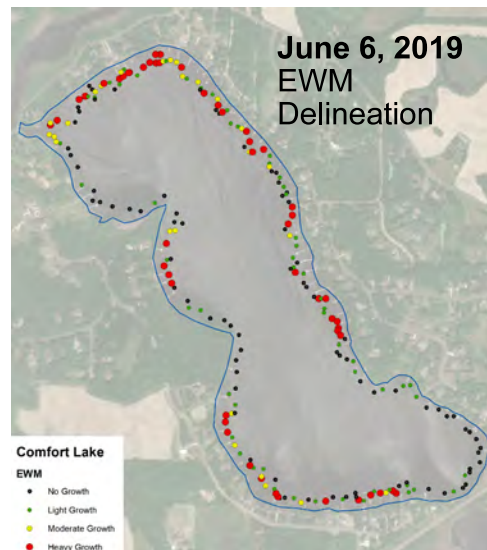
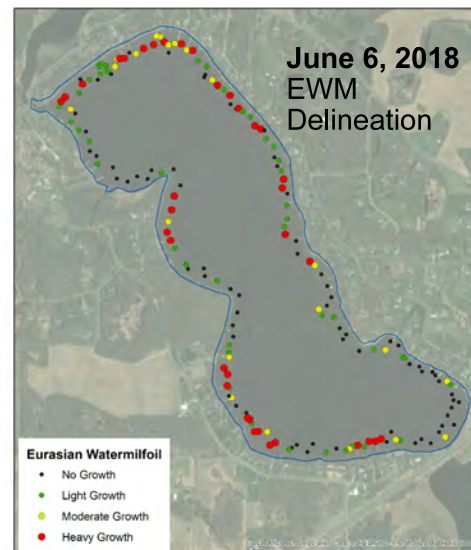
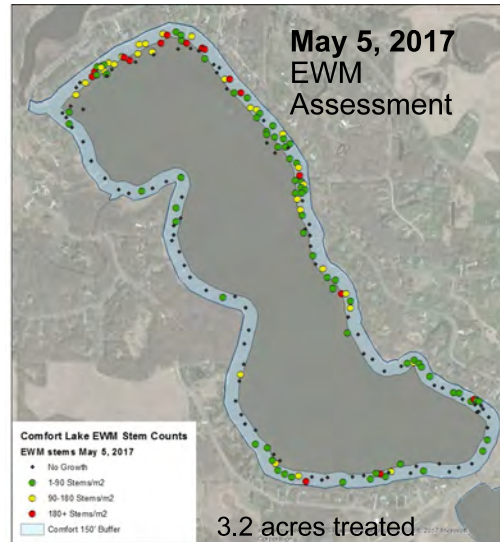
Eurasian Watermilfoil 2014-19



Curlyleaf pondweed and Eurasian watermilfoil maps for 2014 through 2019

Curlyleaf Pondweed 2014-19

Eurasian Watermilfoil 2014-19



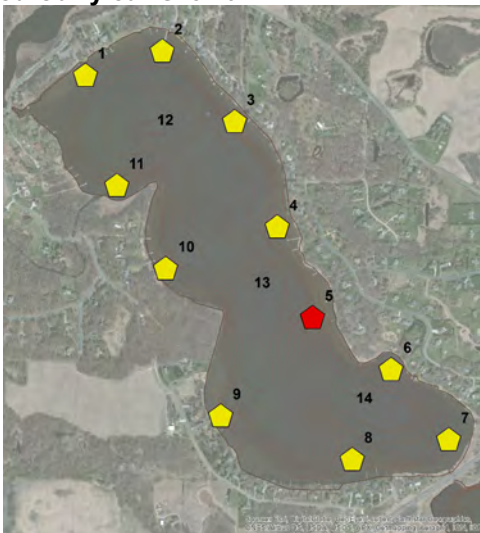
Curlyleaf pondweed and Eurasian watermilfoil maps for 2014 through 2019.

Potential for Curlyleaf Pondweed and Eurasian Watermilfoil Growth Based on Lake Sediment Characteristics

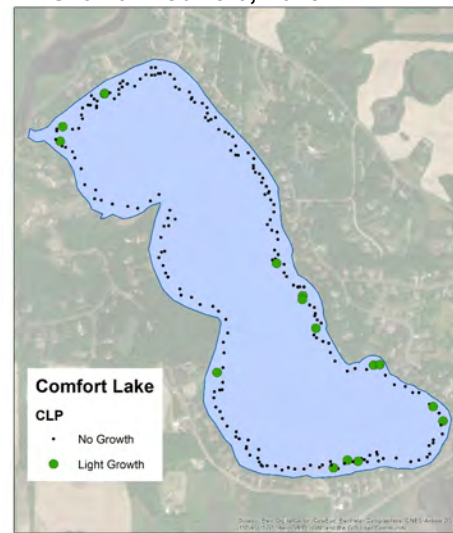
Lake sediment sampling has been used to predict lake bottom areas that have the potential to support heavy curlyleaf pondweed plant growth. Based on the key sediment parameters of pH, sediment bulk density, organic matter, and the Fe:Mn ratio (McComas, unpublished), the predicted growth characteristics of curlyleaf pondweed in Comfort Lake are shown below.

Lake sediment sampling also has been used to predict lake areas that have the potential to support various types of EWM growth. Based on the key sediment parameters of NH_4 and organic matter (McComas, unpublished), a map was prepared that predict the type of growth that could be expected in the future in Comfort Lake.

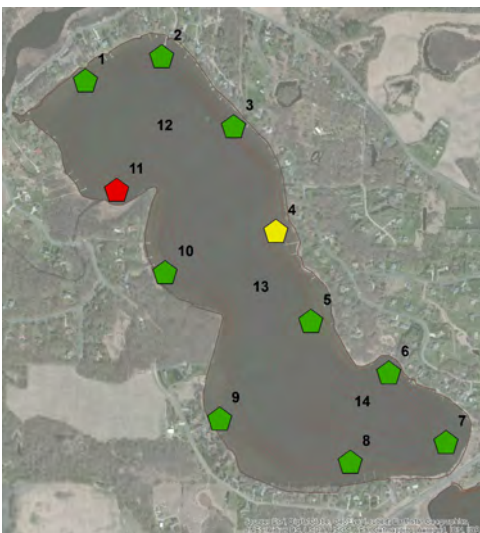
Predicted Curlyleaf Growth



Actual CLP Growth - June 6, 2019



Predicted Eurasian watermilfoil Growth



Actual EWM Growth - June 6, 2019



[top] Curlyleaf pondweed predicted (left) and actual (right) growth maps.

[bottom] Eurasian watermilfoil predicted (left) and actual (right) growth maps.

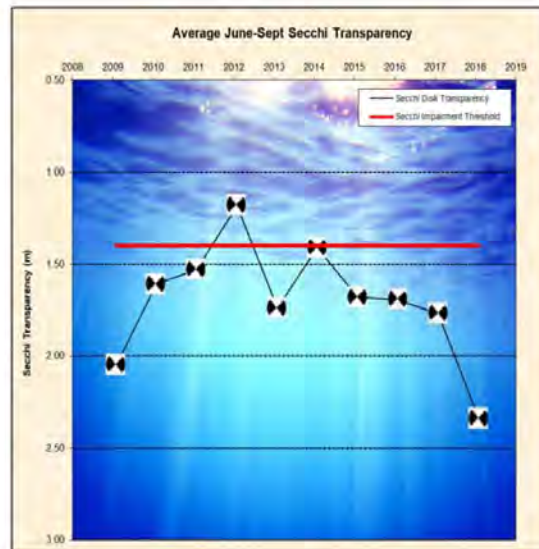
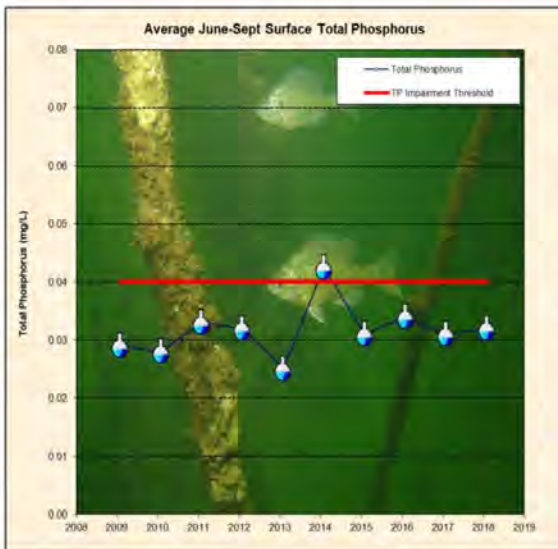
Comfort Lake 2018 Lake Grade: B

- DNR ID #: 13005300
 - Municipality: City of Wyoming
 - Location: Section 27 T33N-R21W
 - Lake Size: 217.82 acres
 - Maximum Depth (2018): 46 ft.
 - Ordinary High Water Mark: 887.2 ft.
 - 41% Littoral
- Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Comfort Lake was considered eutrophic in 2018, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p < 0.05$) there is a statistically significant **improving** trend for the average chlorophyll-*a* and no trend for average Secchi transparency or total phosphorus.
- The major land use is a mix of semi-urban, rural, and agricultural.
- The lake stratified in 2018 with the thermocline around 5 meters.
- Comfort Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Eurasian watermilfoil and Curly-leaf pondweed (invasive aquatic plants) and Zebra mussels are present in this lake.



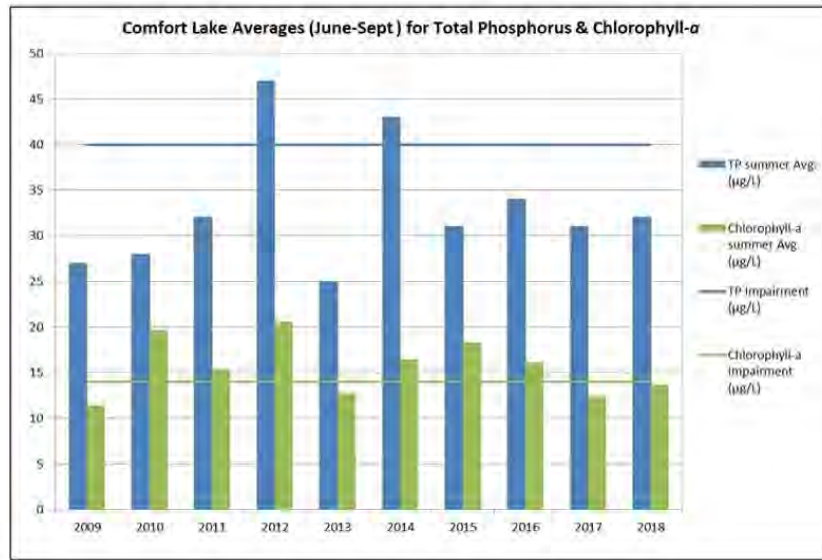
2018 CLFLWD Water Monitoring Summary Prepared by: Washington Conservation District

Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-a (µg/L)	Pheophytin-Corrected Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
5/15/2018 11:28	0.023	8.4	7.2	0.94	1.83	17.6	11.20
5/29/2018 11:45	0.013	4.4	4.2	0.86	3.66	24.6	8.04
6/14/2018 11:02	0.051	4.8	4.2	0.84	4.27	22.2	8.41
6/28/2018 8:44	0.020	9.9	9.4	0.95	2.59	24.2	8.62
7/10/2018 11:23	0.034	8.6	9.5	1.00	2.13	26.3	8.09
7/24/2018 9:13	0.038	35.0	33.0	1.40	1.37	24.9	8.69
9/6/2018 14:36	0.024	14.0	12.0	1.10	1.83	23.0	7.38
9/18/2018 14:04	0.022	14.0	14.0	0.92	1.83	21.9	7.31
10/4/2018 11:36	0.041	13.0	12.0	1.10	1.83	12.9	6.93
10/23/2018 14:13	0.026	9.6	8.5	1.30	2.29	8.1	8.56
2018 Average	0.029	12.1	11.4	1.04	2.36	20.6	8.32
2018 Summer Average	0.032	14.3	13.7	1.04	2.34	23.8	8.08
Volunteer Data							
5/31/2018 14:45	0.017	5.4	5.8	0.63	2.50	25.3	NA
6/18/2018 14:30	0.030	11.0	9.8	0.85	2.20	24.4	NA
7/12/2018 13:10	0.022	8.8	7.9	0.95	1.70	27.5	NA
7/28/2018 14:13	0.043	25.0	23.0	1.20	1.30	26.1	NA
8/16/2018 12:15	0.021	19.0	18.0	1.10	1.40	28.1	NA
9/10/2018 14:02	0.017	12.0	1.0	0.81	1.50	22.1	NA
9/27/2018 13:02	0.018	16.0	16.0	0.80	1.40	17.7	NA
10/3/2018 12:10	0.022	16.0	17.0	1.10	1.80	14.7	NA
2018 Average	0.024	14.2	12.3	0.93	1.66	23.2	NA
2018 Summer Average	0.025	15.3	12.6	0.95	1.56	24.3	NA

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth
 Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth

2018 Elevation (ft)	High	High Date	Low	Low Date	Average
	886.67	8/6/2018	886.15	5/21/2018	886.40

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters. *Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a-corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made.*



	Lake Water Quality Summary									
	Lake Grades (May-Sept)									
	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009
Total Phosphorus (mg/L)	B	C	B	B	C	B	C	B	B	B
Chlorophyll-a (µg/L)	B	B	B	C	B	B	C	B	B-	B
Secchi depth (ft)	B	C	C	C	C	C	C	C	C	C
Overall	B	C+	B-	C+	C+	B-	C	B-	B-	B

Comfort Lake Water Surface Elevation Statistics

Outlet Elevation (rock weir): 885.4 ft.

Ordinary High Water Level (OHW) Elevation: 887.2 ft.

100 Year Flood Elevation (CLFLWD): 889.5 ft.

Highest Recorded Elevation: 888.32 ft. (07/02/1975)

Lowest Recorded Elevation: 884.8 ft. (10/08/1969)

Datum: NGVD 29 (ft.)

Additional elevation data can be found at <https://www.clflwd.org/waterbody-comfort-lake.php>.

