



Spring Lake on June 5, 2012

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# Aquatic Plant Surveys and Curlyleaf Pondweed Evaluation for Spring Lake, Scott County, Minnesota in 2012

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**No Open Lake Herbicide Application from 2007- 2012**

Spring Plant Survey and Stem Density Assessment: April 17, 2012 (water temp: 52°F)

Early Summer Plant Survey and Stem Density Assessment: June 5, 2012 (water temp: 76°F)

**Prepared for:**  
**Prior Lake/Spring Lake**  
**Watershed District**  
**Prior Lake, Minnesota**



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# Aquatic Plant Surveys and Curlyleaf Pondweed Evaluation for Spring Lake, Scott County, Minnesota in 2012

## Summary

Curlyleaf pondweed distribution and abundance were evaluated April 17, 2012. A follow-up curlyleaf assessment was conducted on June 5, 2012.

Curlyleaf was found at 7 out of 50 sites in April (Figure A) and the density of the curlyleaf growth was light. The June curlyleaf assessment found a similar distribution compared to the April 17 assessment and curlyleaf growth was still light (Figure B). There has been no open water curlyleaf treatment in Spring Lake from 2007 through 2012.

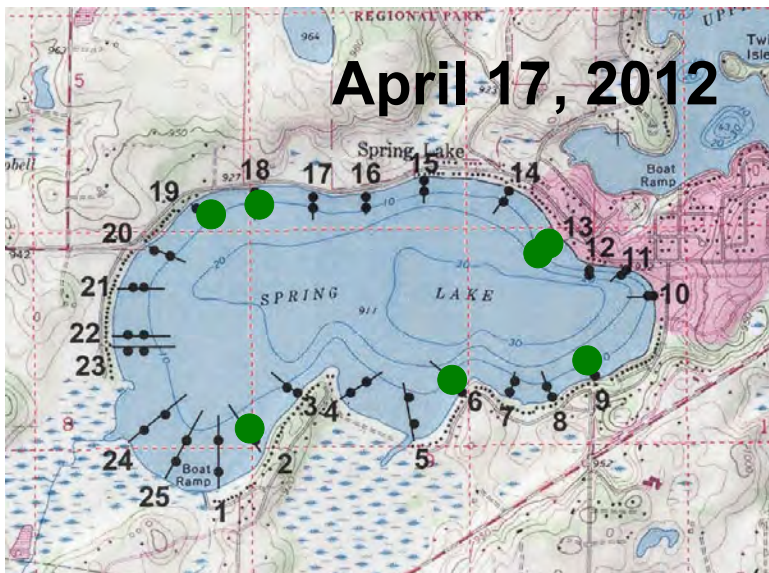


Figure A. Map of curlyleaf pondweed assessment sample areas for April 17, 2012. Colored sample areas indicate the growth in late April - early May of 2012 for curlyleaf pondweed. Green = light growth of curlyleaf pondweed.

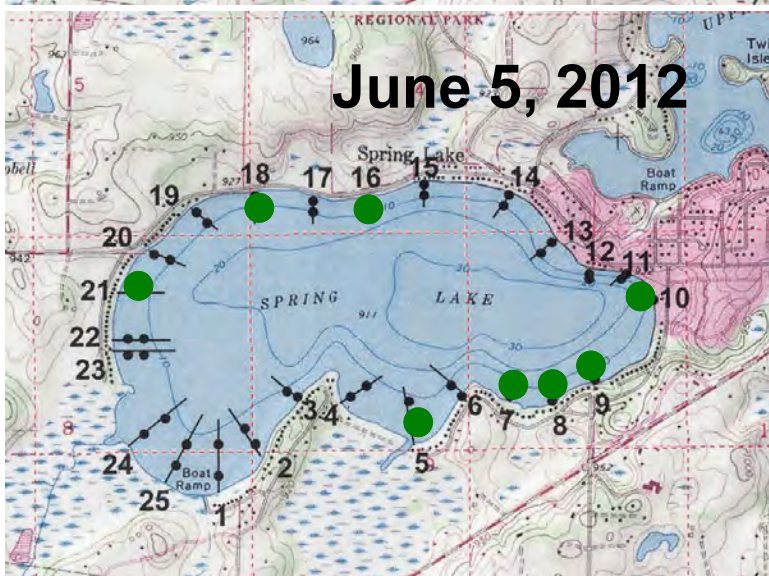
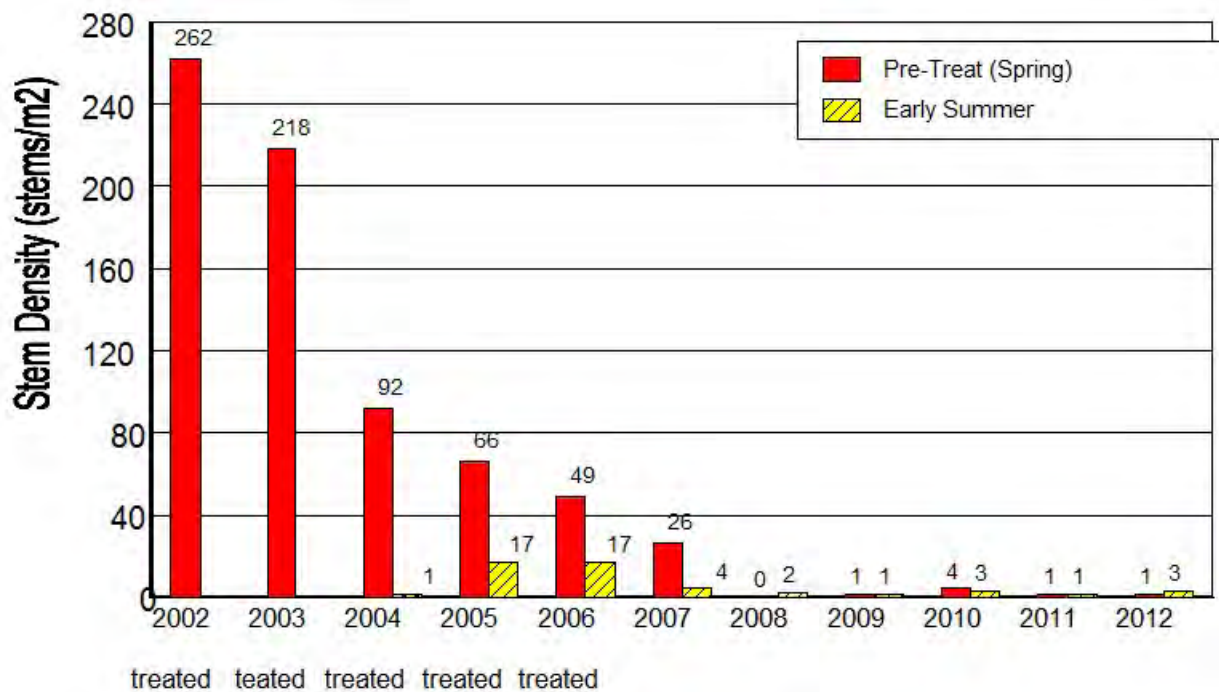


Figure B. Map of curlyleaf pondweed assessment sample areas for June 5, 2012. Colored sample areas indicate the growth in late June, 2012 for curlyleaf pondweed. Green = light growth of curlyleaf pondweed.

**What's Next?** Treating heavy growth of curlyleaf pondweed based on early season curlyleaf distribution was conducted in Spring Lake from 2002 through 2006. However, there has been no treatment necessary due to light growth from 2007-2012. Scuba diving assessments have supported the treatment or no treatment decisions (Figure C). Determining what areas to treat to control excessive growth of curlyleaf pondweed has been an ongoing challenge. Curlyleaf growth in April and May is just starting to go into a rapid growth phase. However, not all early season curlyleaf growth will result in heavy curlyleaf growth in June. It appears there are factors that limit curlyleaf growth and significant variables are associated with sediment conditions. The question is how to best delineate areas to treat what could be heavy growth in June but not overtreat areas where growth wouldn't be a nuisance for the season. Currently, for Spring Lake, the method has been to use past treatment history combined with early season scouting and then a recheck to evaluate any treatment effects and see if curlyleaf areas were missed. Using this approach, it was determined that no areas needed treatment in 2012 and the subsequent recheck found no heavy growth of curlyleaf pondweed.

To continue to make concise delineations for future possible treatments, a lake sediment survey has been conducted. Results indicate where light, moderate, and heavy curlyleaf growth are likely to occur based on sediment characteristics. These results combined with data from 2012 and then early season curlyleaf scouting in April or May will give confidence in areas to treat, if needed, in 2013. In the future, areas to be treated with herbicides can be reduced to incorporate only areas of heavy growth. Areas where light growth is expected based on lake sediment characteristics could be left untreated.



**Figure C. Curlyleaf stem densities for early season monitoring (using scuba diving) for 2002-2012 for two sites in Spring Lake. Curlyleaf stem densities have been low since 2007 and no treatment has occurred.**

# Aquatic Plant Surveys and Curlyleaf Pondweed Evaluation for Spring Lake, Scott County, Minnesota in 2012

## Introduction and Methods for 2012

Spring Lake has an area of 592 acres with a littoral area of 290 acres (source: MnDNR). An initial curlyleaf pondweed assessment was conducted on April 17, 2012. A follow-up curlyleaf pondweed assessment was conducted on June 5, 2012 to characterize the status of curlyleaf pondweed at it's peak growing period. Fifty sample locations on 25 transects are shown in Figure 1 and were selected based on areas where curlyleaf had been found in the past. A chart showing examples of curlyleaf growth conditions are shown on the next page.

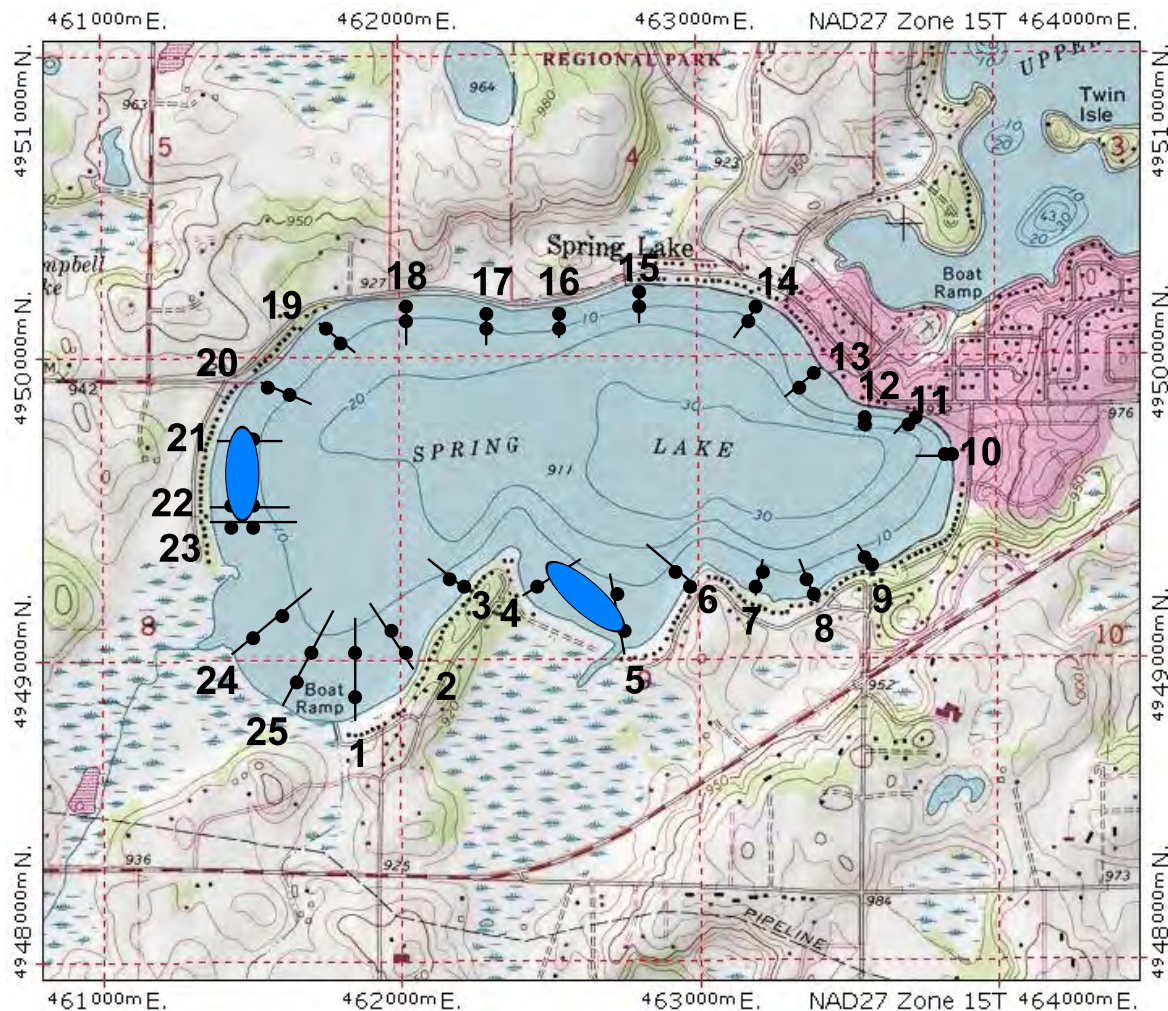


Figure 1. Sample sites for whole lake plant surveys are shown with black numbers. There are 50 aquatic plant survey sites and, in addition, there are two underwater evaluation sites located in the dark blue shaded areas. Map of treatment areas from 2002-2006 (5 years) are shown in dark blue shading.

**Methods:** Curlyleaf pondweed densities are represented on a scale of 1 to 5 with 5 being densest.

### Light Growth Conditions

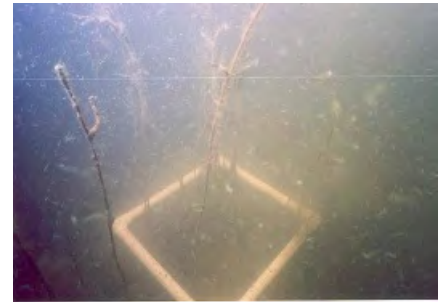
Plants rarely reach the surface.

Navigation and recreational activities are not generally hindered.

Stem density: 0 - 160 stems/m<sup>2</sup>

Biomass: 0 - 50 g-dry wt/m<sup>2</sup>

Estimated TP loading: <1.7 lbs/ac



*MnDNR rake sample density equivalent for light growth conditions: 1, 2, or 3.*

### 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/m<sup>2</sup>

Biomass: 50 - 85 g-dry wt/m<sup>2</sup>

Estimated TP loading: 2.2 - 3.8 lbs/ac



*MnDNR rake sample density equivalent for moderate growth conditions: 2, 3 or sometimes, 4.*

### 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: 400+ stems/m<sup>2</sup>

Biomass: >300 g-dry wt/m<sup>2</sup>

Estimated TP loading: >6.7 lbs/ac



*MnDNR rake sample density has a scale from 1 to 4. For certain growth conditions where plants top out at the surface, the scale has been extended: 4.5 is equivalent to a near solid surface canopy and a 5 is equivalent to a solid surface canopy. Heavy growth conditions have rake densities of a 4 (early to mid-season with the potential to reach the surface), 4.5, or 5.*

## Curlyleaf Pondweed Assessment on April 17, 2012 in Spring Lake

A curlyleaf assessment was conducted using rake sampling on April 17, 2012 and curlyleaf was found at low densities at 7 out of 50 sites (Table 1 and Figure 2). No curlyleaf pondweed treatments were proposed for offshore curlyleaf control in 2012. A total of four submerged plant species were observed.

**Table 1. Aquatic plant densities based on rake sampling for April 17, 2012. Densities are based on a scale from 1 to 5 with 5 being the densest. Curlyleaf stems per rake sample were also noted. Areas with green shading are predicted to have light to moderate growth at the peak of the curlyleaf growth cycle. Areas with yellow shading are predicted to have moderate to heavy curlyleaf growth.**

Area	Depth (ft)	Curlyleaf pondweed	Curlyleaf stems on the rake sampler	Coontail	Elodea	Stringy pondweed	Filamentous algae	No plants
T1	4							1
	6							1
T2	4					1		
	7	1	1					
T3	4					1	1	
	6					1		
	8							1
T4	4					2		
	5			2		1		
T5	4					1		
	5					1		
T6	4					1		
	6	1	3					
T7	4							1
	5				1			
T8	4							1
	7					1		
T9	4							1
	6	1	5			1		
T10	4							1
	6					1		
T11	3							1
	5							1
T12	4							1
	5					1		
T13	3	1	3					
	4	1	3					
	5							1
T14	4							1
	5					1		
	6							1
T15	4							1
	6							1
T16	4					1		
	5					1		
T17	4							1
	6							1
T18	4							1
	5	1	3					
	7							1
T19	4							1
	6	1	1					

Table 1. Concluded.

Area	Depth (ft)	Curlyleaf pondweed	Curlyleaf stems on the rake sampler	Coontail	Elodea	Stringy pondweed	Filamentous algae	No plants
T20	4							1
	5							1
T21	4							1
	5							1
T22	4							1
	5							1
T23	4							1
	5							1
T24	4					1		
	5					1		
T25	4							1
	5			1				
Average		1.0	2.7	1.5	1.0	1.1	1.0	29
Occurrence (54 sample sites)		7	7	2	1	17	1	
% Occurrence		13	13	4	2	31	2	

### Curlyleaf Distribution and Abundance in Spring Lake, April 17, 2012

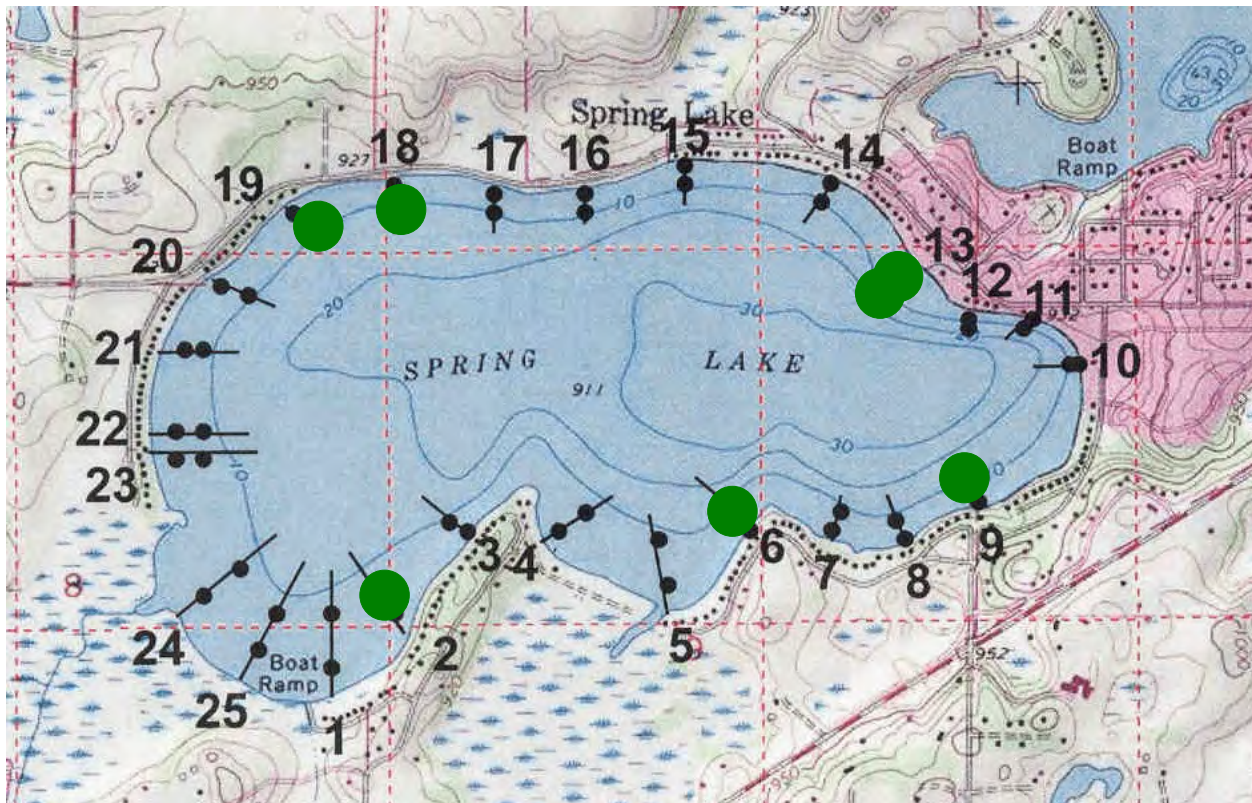


Figure 2. Curlyleaf delineation in Spring Lake on April 17, 2012. Curlyleaf was growing at light densities and was found at 7 sites. Green dots represent light curlyleaf growth.

## Curlyleaf Pondweed Assessment on June 5, 2012 in Spring Lake

Curlyleaf growth was rechecked on June 5, 2012, which was the peak growing period for curlyleaf in lakes in the area. A total of 50 sites were monitored with rake sampling on June 5, 2012. Curlyleaf was found at 8 sample sites out of the 50 that were monitored (Table 2). Curlyleaf growth was mostly light. Curlyleaf abundance did not increase significantly from April to June.

Stringy pondweed was very abundant showing up at 46 out of 50 sites.

**Table 2. Aquatic plant densities based on rake sampling for June 5, 2012. Densities are based on a scale from 1 to 3 with 3 being the densest. Curlyleaf stems per rake sample were also noted. Areas with green shading are predicted to have light to moderate growth at the peak of the curlyleaf growth cycle.**

Site	Depth (ft)	Curlyleaf pondweed	Curlyleaf stems on rake sampler	Coontail	Stringy pondweed	Water celery	Filamentous Algae	No Plants
T 1	4				3			
	6			1				
T 2	4			1	2			
	7				1			
T 3	3				2			
	6				2			
T 4	4			4				
	6			2	1			
T5	4							1
	5	1	3	1				
T 6	4				1	1		
	5							1
T 7	3				3			
	5	1	2		2			
T 8	4	1	2		2			
	6				2			
T 9	4	1	1		3			
	6				2			
T10	4	1	1		1			
	6				1		2	
T11	4			1			1	
	6				1			
T12	4				1			
	6				1			
T13	4				1		2	
	6				1			
T14	4				1			
	6				1			
T15	4			1	1		1	
	6				1			
T16	4				1	1		
	5	1	1		2			
T17	4				1			
	6				1			
T18	4			1	2		1	
	5	1	1		2			
T19	4			1	2			
	6				2			
T20	4				2	1		
	6				1			



Table 2. Concluded.

Site	Depth (ft)	Curlyleaf pondweed	Curlyleaf stems on rake sampler	Coontail	Stringy pondweed	Water celery	Filamentous Algae	No Plants
T21	4				2		1	
	6	1	1		1			
T22	4				2			
	5				1			
T23	4			1	2		1	
	5			1				
T24	4			1	1		3	
	6			1	1			
T25	4			1	2			
	6			1	1			
<b>Average</b>		<b>1.0</b>	<b>1.5</b>	<b>1.3</b>	<b>1.5</b>	<b>1.0</b>	<b>1.5</b>	<b>1.0</b>
<b>occurrence (50 sample sites)</b>		<b>8</b>		<b>15</b>	<b>46</b>	<b>3</b>	<b>8</b>	<b>6</b>
<b>% occurrence</b>		<b>16</b>		<b>30</b>	<b>92</b>	<b>6</b>	<b>16</b>	<b>12</b>

### Curlyleaf Conditions in Spring Lake, June 5, 2012

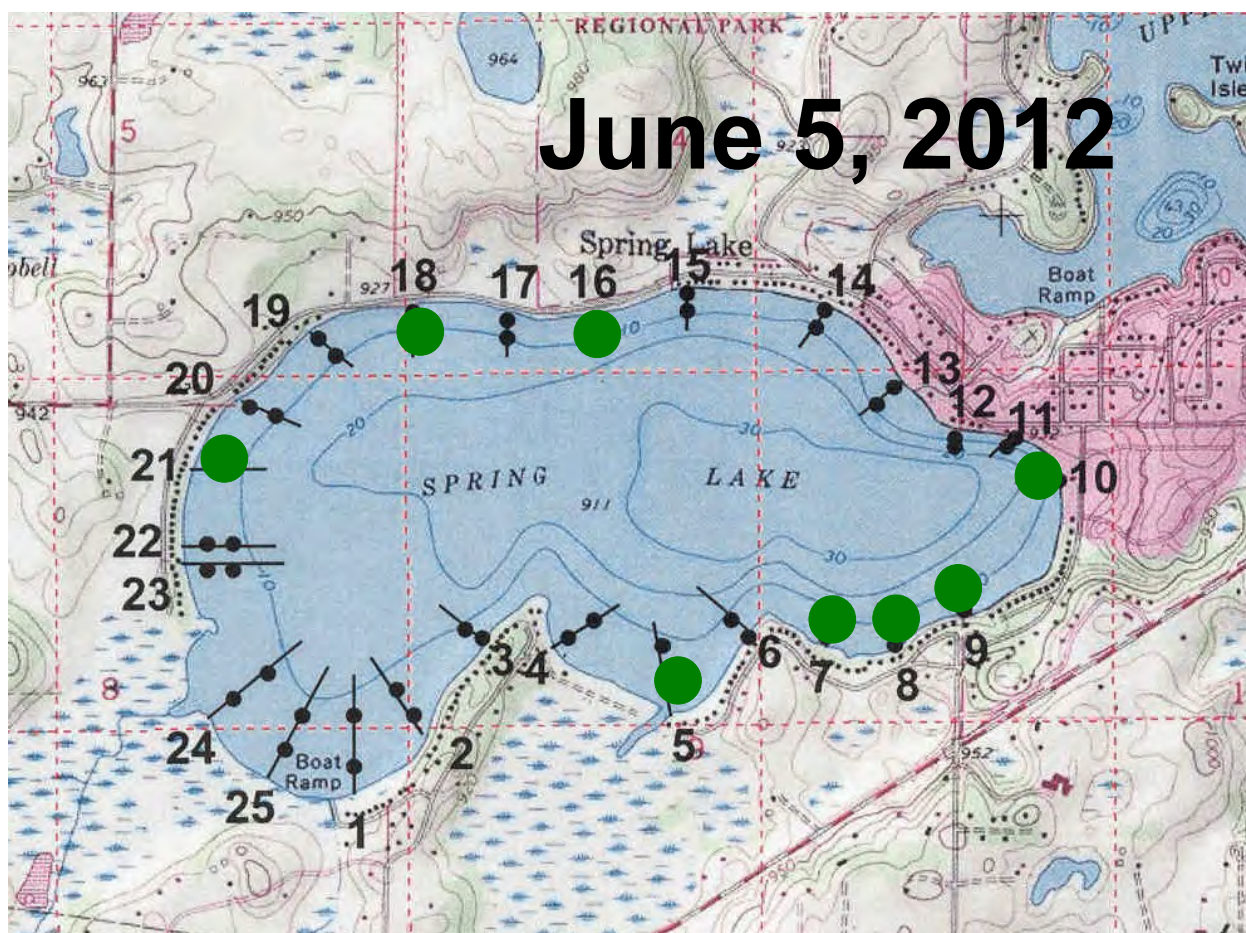


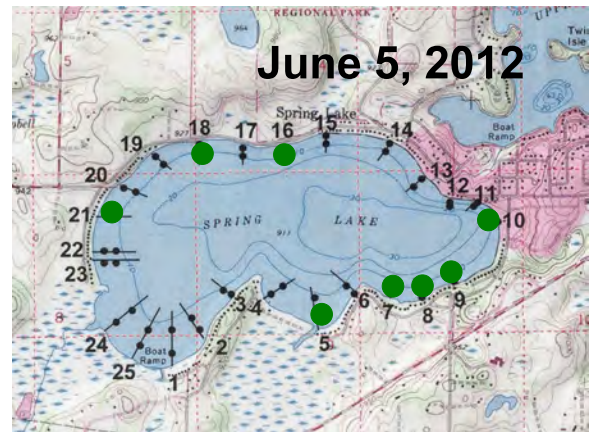
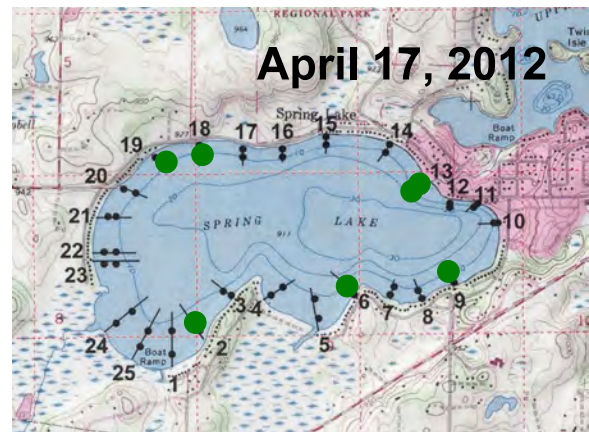
Figure 3. Map of curlyleaf distribution in Spring Lake on June 22, 2011. White circles = no curlyleaf. Green circles = curlyleaf density of a "1" or "2". Yellow circle = curlyleaf density of a "3".

# Comparison of Early Season to Late Season Curlyleaf Growth

Light growth of curlyleaf pondweed was found in the April 17, 2012 assessment (Table 3). There were no open water herbicide treatments in 2012. A curlyleaf reassessment on June 5, 2012 found curlyleaf to be growing at mostly light densities (Table 3 and Figure 4).

**Table 3. Comparison of curlyleaf pondweed stem densities based on rake sampling for April 17 and June 5, 2012. Densities are based on a scale from 1 to 5 with 5 being the densest.**

site	depth (ft)	April 17, 2012	June 5, 2012
T1	4		
	5		
	6		
T2	4		
	5		
	7	1	
T3	4		
	5		
	6		
	8		
T4	4		
	5		
	6		
T5	4		
	5		1
	6		
T6	4		
	6	1	
	7		
T7	4		
	5		1
	6		
T8	4		1
	7		
T9	4		1
	6	1	
T10	4		1
	6		
T11	3		
	4		
	5		
T12	4		
	5		
	6		
T13	3	1	
	4	1	
	5		
T14	4		
	5		
	6		
T15	4		
	5		
	6		
T16	4		
	5		1
T17	4		
	5		
	6		



**Figure 4. Maps of curlyleaf pondweed distribution are shown on the top and bottom maps. Curlyleaf treatment areas are shown in the middle map.**

**Table 3. Concluded.**

site	depth (ft)	April 17, 2012	June 5, 2012
T18	4		
	5	1	1
	6		
	7		
T19	4		
	5		
	6	1	
T20	4		
	5		
T21	4		
	6		1
T22	4		
	5		
T23	4		
	5		
T24	4		
	5		
T25	4		
	5		

### Curlyleaf Stem Densities Collected by Scuba Diving at Two Treatment Locations on April 17 and June 5, 2012

Curlyleaf stem densities were determined by scuba diving at two depths for sample locations at Transect 4.5 and Transect 22 that were treated from 2002-2006. Ten quadrat samples were taken at two depths at each location. A total of 40 quadrat samples were taken on each date. The results for 2012 show curlyleaf was sparse and was found at low stem densities for spring and early summer (Table 4). These stem densities were similar to densities found from 2008 through 2011 and are low compared to pre-treatment stem densities from 2002 where there were over 250 stems/m<sup>2</sup> (Figure 5).

**Table 4. Curlyleaf pondweed stem densities (stems/m<sup>2</sup>) for 2012.**

Quadrat	April 17, 2012 (stems/m <sup>2</sup> )				June 5, 2012 (stems/m <sup>2</sup> )			
	T4.5		T22		T4.5		T22	
	4 ft	5 - 6 ft	4 ft	5 - 6 ft	4 ft	5 - 6 ft	4 ft	5 - 6 ft
1	10	0	0	0	10	20	0	10
2	0	0	0	0	20	20	0	10
3	0	0	0	0	10	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
<b>AVE</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>	<b>0</b>	<b>2</b>

**Curlyleaf Plant Density Based on Scuba Diving from 2002 - 2012:** Scuba diving was used to collect curlyleaf stem densities at 4 feet and 5 feet for 10 sites at each depth at two locations in early and late season dates. Data from the two sites (n=40) for each date are shown in Figure 5. Curlyleaf stem densities have been very low since 2007.

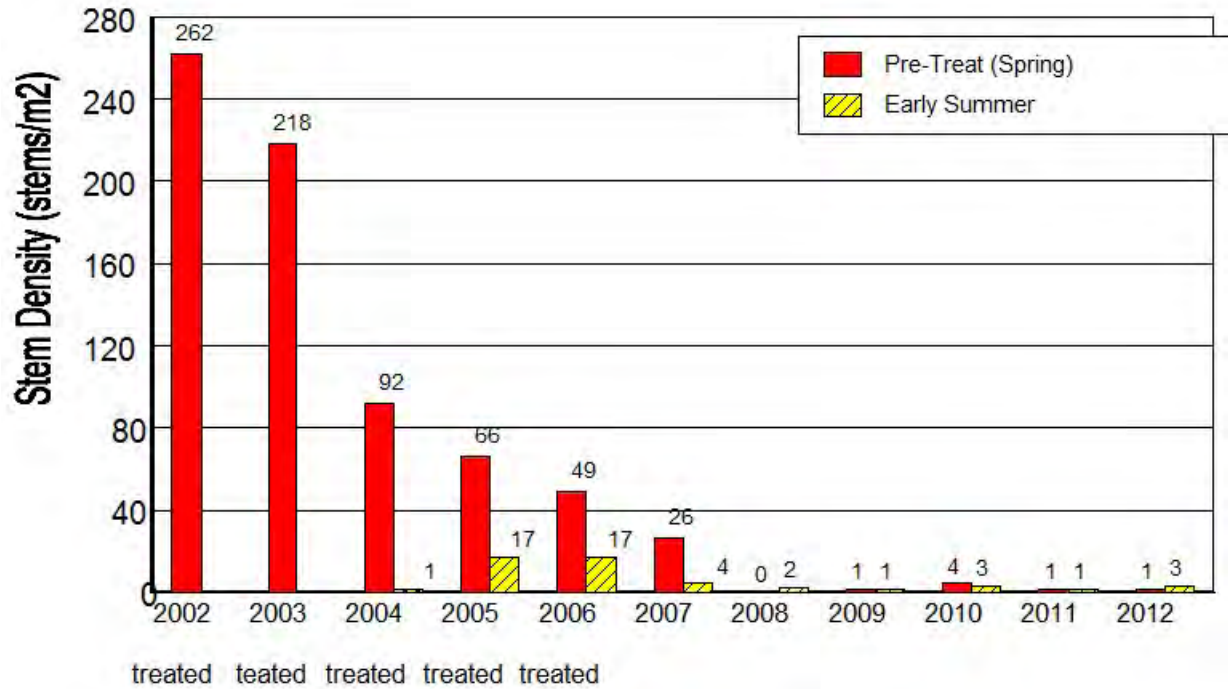
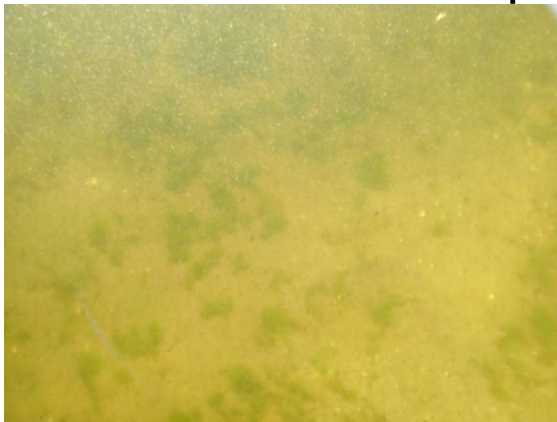


Figure 5. Curlyleaf stem densities (stems/m<sup>2</sup>) for early season and late season monitoring (using scuba diving) for 2002-2012 (ND = no data).

April 17, 2012



T4.5: Curlyleaf stem densities were sparse at Transect 4.5.



T22: No curlyleaf stems were found at Transect 22.

Figure 6. Underwater curlyleaf pondweed conditions at two sites that had been treated from 2002 through 2006. Curlyleaf growth remains sparse at these two locations in 2012.

# Review of Spring Lake Aquatic Plants Over the Years

## Summary of Whole Lake Curlyleaf Pondweed Surveys for 2007-2012

Curlyleaf pondweed was found at 7 locations out of the 50 that were monitored on April 17, 2012 in the course of an aquatic plant survey that sampled two depths on 25 line transects. Curlyleaf growth was sparse in 2012 and has been sparse since 2007. From 2007 through 2012 there have been no open water herbicide applications (Table 5). (Transect and sample locations are shown in Figure 1.)

**Table 5. Density of curlyleaf, at two depths, shallow (S) which is 0-4 feet, and deep (D) which is 5-8 feet, for each transect, for the early season plant surveys from 2007-2012. The density rating is on a scale from 0.5 to 5 with 5 being the highest density. For 2010, 2011, and 2012, the numbers in parentheses indicate the number of CLP stems found in the rakehead sampler.**

Transect		2007		2008		2009		2010		2011		2012	
		Curlyleaf Plant Density		Curlyleaf Plant Density		Curlyleaf Plant Density		Curlyleaf Plant Density		Curlyleaf Plant Density		Curlyleaf Plant Density	
		Apr 15	Jun 5	Apr 29	Jun 13	Apr 23	Jun 10	Apr 27	Jun 20	May 12	Jun 10	Apr 17	Jun 5
1	S		2			0.5	2						
	D			0.7	1	1					0.5 (1)		
2	S									0.5 (1)			
	D		1.8		1							0.5 (1)	
3	S								1 (3)				
	D		1.5					0.5 (1)					
4	S			0.5			1				0.5 (1)		
	D		1		0.5						0.5 (1)		
5	S		0.7				0.5	1 (1)	1 (3)		2.5 (9)		
	D							1 (1)	1.3 (3)		0.3 (1)		1 (3)
6	S				1						1 (1)		
	D	1						0.5 (1)				0.5 (3)	
7	S	1	1		1					0.5 (1)			
	D	0.5	0.5										0.5 (2)
8	S							0.5 (1)		0.5 (1)			1 (2)
	D						0.5			1 (2)			
9	S		1					1 (1)	0.5 (2)		2 (8)		1 (1)
	D	0.5	1.8				0.5		0.5 (1)			1 (5)	
10	S		0.5								1 (2)		1(1)
	D		1										
11	S												
	D												
12	S		1				1	1 (1)					
	D		1		0.3								
13	S												1 (3)
	D	0.8	3.5		3						1 (2)		
14	S	1	1		1			1 (1)	1 (1)	0.5 (1)	1 (4)		
	D	1	2.8		1.5			0.3 (1)	1 (1)		1 (2)		
15	S		3.5		1		2	1 (2)	1 (3)				
	D	1.3	2.8		2		0.3	1 (3)	1 (1)	0.5 (1)	0.5 (1)		
16	S		1					1 (1.5)	1 (1)		0.8 (2)		
	D	0.5	1.8					1 (1)	1 (2)		0.5 (2)		0.5 (1)
17	S	0.5						1 (4)			0.5 (1)		
	D	0.3	2	0.3			0.3	1 (3)	1 (2)				
18	S	0.5			1			1 (3)					
	D	0.5	1	0.3				1 (4)		0.5 (1)	0.5 (1)	0.3 (3)	0.5 (1)
19	S		1				0.5	1 (2)	1 (1)				
	D								1 (3)			0.5 (1)	
20	S	0.5	2.8					0.5 (1)	1 (3)				
	D	0.5			1	0.3		0.5 (1)	0.5 (1)				
21	S		1.5				1	1 (1)	0.5 (1)	0.5 (1)			
	D		4										1 (1)
22	S	1	1		1			1 (1)					
	D	1						0.3 (0.5)					
23	S	1					1		1 (4)	0.5 (1)			
	D	0.5	1		0.5								
24	S	1			1	1	2		1 (2)				
	D	0.5			1			1 (1.5)	1 (2)				
25	S	1	0.5		1	1	1		2 (6)	0.5 (1)	1 (3)		
	D				1			1 (3)			0.8 (2)		
<b>Sites Where Curlyleaf Was Found</b>		<b>22</b>	<b>29</b>	<b>4</b>	<b>19</b>	<b>5</b>	<b>14</b>	<b>25</b>	<b>21</b>	<b>10</b>	<b>18</b>	<b>6</b>	<b>8</b>



**Curlyleaf Pondweed Treatment and Coverage from 2002 - 2012:** Spring Lake is a 580 acre eutrophic lake in Scott County, Minnesota with a history of nuisance curlyleaf pondweed growth going back to the 1980s. In 2000, heavy growth of curlyleaf pondweed was estimated at 180 acres. Major nuisance areas of curlyleaf were managed annually in Spring Lake from 2002 through 2006 (5-years). In 2006, there was an estimated 150 acres of curlyleaf pondweed but at mostly low to moderate abundance, prior to treatment. From 2007 through 2012, herbicides have not been applied in offshore areas. However, the coverage of curlyleaf has not increased in this time span. It is not clear why curlyleaf has been under control. In 2007, curlyleaf covered about 113 acres and in 2008 curlyleaf covered about 60 acres in June. In 2009 through 2012, curlyleaf covered about 50 to 90 acres and no heavy growth was observed (Figure 8).

**Table 6. Curlyleaf treatment history for 2002 through 2012.**

	Between T4 & T5	Between T19-25	Shorelines
2002	herbicides (14 ac)	harvesting (60 ac)	herbicides (individual permits)
2003	herbicides (14 ac)	harvesting (74 ac)	herbicides (individual permits)
2004	herbicides (14 ac)	herbicides (45 ac)	herbicides (individual permits)
2005	herbicides (14 ac)	herbicides (45 ac)	herbicides (individual permits)
2006	herbicides (14 ac)	herbicides (45 ac)	herbicides (individual permits)
2007	no treatment	no treatment	no treatment
2008	no treatment	no treatment	herbicides (individual permits)
2009	no treatment	no treatment	herbicides (individual permits)
2010	no treatment	no treatment	herbicides (individual permits)
2011	no treatment	no treatment	herbicides (individual permits)
2012	no treatment	no treatment	herbicides (individual permits)

**Recommendations for 2013:** Based on the findings for the last three years, no offshore herbicide treatments for the areas of T4-T5 (14 ac) and T19-25 (45 ac) are expected. However, early season scouting and plant surveys should be conducted to monitor potential curlyleaf problems. A late summer survey is recommended as well. It appears native plants may be increasing in Spring Lake and this survey would document the dynamics of the aquatic plant community.

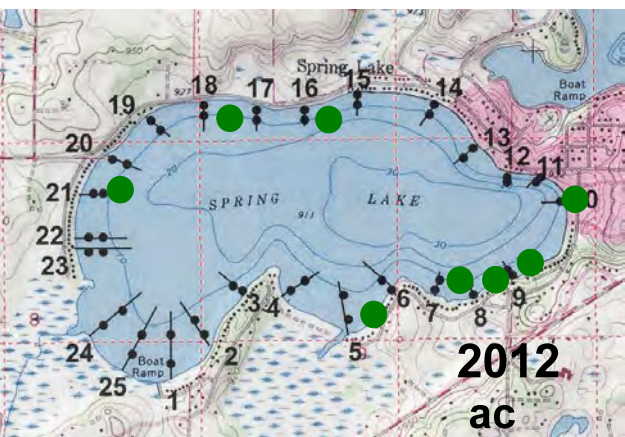
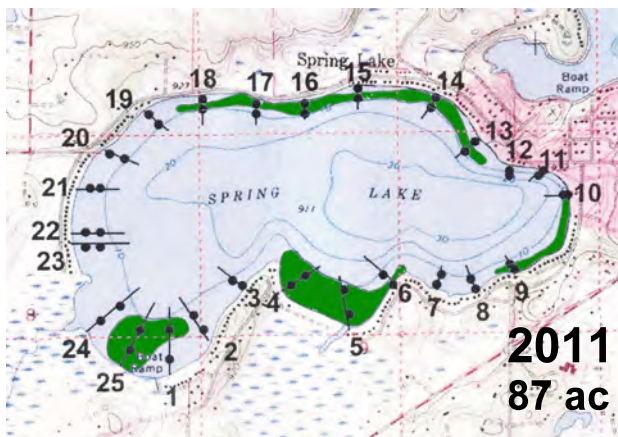
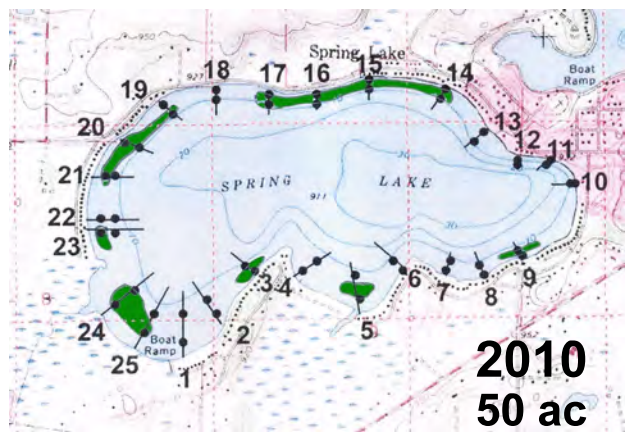
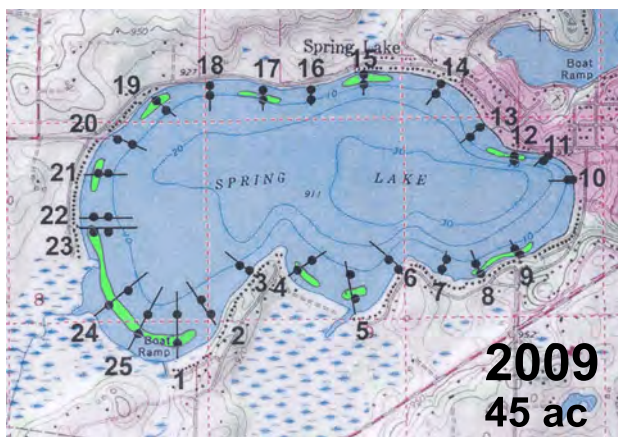
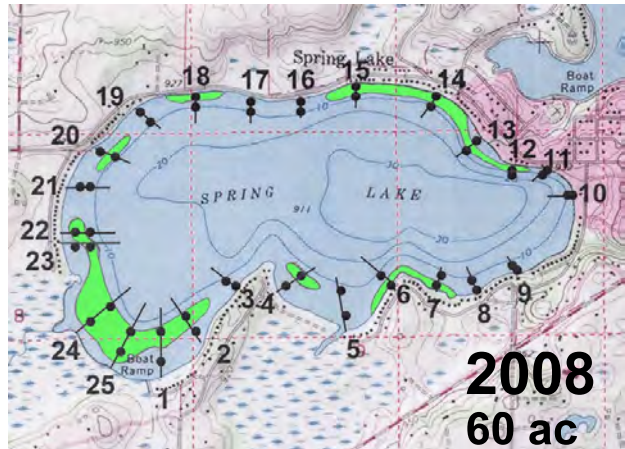
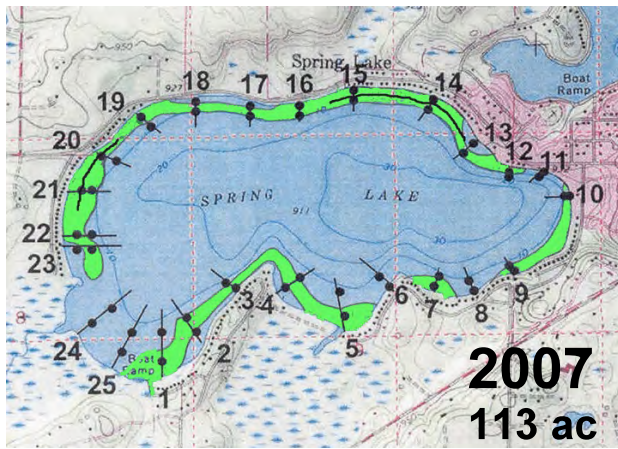


Figure 8. Curlyleaf pondweed distribution from 2007 through 2012.



Figure 9. Curlyleaf pondweed growth was very heavy in 2000.



Figure 10. Curlyleaf pondweed growth was light in 2010.



## Summary of All Species in Aquatic Plant Surveys from 1948 - 2012

Since 1948, a number of plant species within the aquatic plant community have appeared and others have disappeared (Table 7). The percent occurrence of the native plants elodea and water stargrass have decreased since 2000. Curlyleaf distribution and curlyleaf density are lower in 2012 compared to 2000. Curlyleaf changes observed in the lake may be due to the curlyleaf management program.

Overall, the native aquatic plant community has been fairly stable for a number of years but stringy pondweed, a native plant, may be increasing which is an encouraging sign that native plants are starting to increase.



Figure 11. Aquatic plants in Spring Lake on June 5, 2012.

**Table 7. List of aquatic plants found in past surveys. Surveys from 1948 to 1988 were conducted by MnDNR. Surveys in 2000 and 2002 through 2012 were conducted by Blue Water Science. Numbers for plant species in 2000 and 2002 through 2012 represent percent occurrence.**

Year	1948	1973	1982	1986	1988
Date (month.day)	9.18	7.9	8.16	7.2	8.15
Secchi disc (ft)	2.6	3.0	3.3	--	2.5
Lesser duckweed ( <i>Lemna minor</i> )				X	R
Duckweed ( <i>Lemna sp</i> )			O		
White waterlilies ( <i>Nymphaea tuberosa</i> )					
Greater duckweed ( <i>Spirodela polyrhiza</i> )				X	
Coontail ( <i>Ceratophyllum demersum</i> )	R	O	A	X	O
Chara ( <i>Chara sp</i> )					
Elodea ( <i>Elodea canadensis</i> )			O		O
Moss ( <i>Drepanocladus sp</i> )					
Naiads ( <i>Najas flexilis</i> )					
Berchtold's pondweed ( <i>Potamogeton berchtoldi</i> )	R	O			
Curlyleaf pondweed ( <i>P. crispus</i> )			R	X	
Variable pondweed ( <i>P. gramineus</i> )	R	C	O		
Floatingleaf ( <i>P. natans</i> )	R	C			P
Stringy pondweed ( <i>P. pusillus</i> )					
Claspingleaf ( <i>P. Richardsonii</i> )	R	C			O
Stringy pondweed ( <i>P. strictifolius</i> )					
Narrowleaf pondweed ( <i>P. sp</i> )			O	X	
Sago* ( <i>Stuckenia pectinata</i> )	R	C			C
Star duckweed ( <i>Lemna trisulca</i> )		C			
Wild celery ( <i>Vallisneria americana</i> )			O		P
Mud plantain* ( <i>Zosterella dubia</i> )	R	R	C		C
Number of submerged species	7	8	8	5	8

\* *Stuckenia pectinata* = *Potamogeton pectinatus*    Mud plantain = water stargrass    *Zosterella dubia* = *Heteranthera dubia*

Table 7. Concluded.

Year	2000		2002		2003	2004			2005			2006			2007			2008			2009			2010		2011		2012	
Date (month.day)	6.3	9.3	6.7	9.3	5.15	5.2	6.14	8.27	4.20	6.1	8.18	4.26	6.2	9.1	4.15	6.5	7.13	4.29	6.12	8.13	4.23	6.10	8.19	4.27	6.2	5.12	6.10	4.17	6.5
Secchi disc (ft)	7.0					7.1	7.2	3.5	16.7	6.9	2.0	4.7	5.0	2.0				2.3	3.9		3.5	6.2	2.9		2.2		5.6		
Lesser duckweed ( <i>Lemna minor</i> )																2													
Duckweed ( <i>Lemna sp</i> )											6																		
White waterlilies ( <i>Nymphaea tuberosa</i> )																													
Greater duckweed ( <i>Spirodela polyrhiza</i> )								2																					
Coontail ( <i>Ceratophyllum demersum</i> )		29	4	22		13	28	40	8	14	58	16	26	50	22	28	30	8	30	16	4	8	24	18	26	16	22	4	30
Chara ( <i>Chara sp</i> )		4		2			4									2				8		2		12					
Elodea ( <i>Elodea canadensis</i> )		25	8	18	6	25	48	68	22	54	76	64	68	48	20	6	2			4			4	2	2	2	4	2	
Moss ( <i>Drepanocladus sp</i> )																		1											
Naiads ( <i>Najas flexilis</i> )																							6						
Berchtold's pondweed ( <i>Potamogeton berchtoldi</i> )																													
Curlyleaf pondweed ( <i>P. crispus</i> )	98	40	86	4	72	78	6	10	58	72	12	64	64	2	44	58		5	38	8	10	28	18	50	42	20	36	14	16
Variable pondweed ( <i>P. gramineus</i> )																													
Floatingleaf ( <i>P. natans</i> )																													
Stringy pondweed ( <i>P. pusillus</i> )		2	6	8	2			4		6	8		20			26													
Claspingleaf ( <i>P. Richardsonii</i> )				10				6		2	4		2	4		2	2		2	2		2	6		4		2		
Stringy pondweed ( <i>P. strictifolius</i> )														2	2		2			24		14	66	52	34		64	36	92
Narrowleaf pondweed ( <i>P. sp</i> )																						2							
Sago* ( <i>Stuckenia pectinata</i> )	40	15		36	2		24	6		6	14			6		8	2	1	24	8		24	20		26				
Star duckweed ( <i>Lemna trisulca</i> )																													
Wild celery ( <i>Vallisneria americana</i> )		6		16			2	22		2	32		2	18		6	12			18		2	18		4		2		6
Mud plantain* ( <i>Zosterella dubia</i> )		17		22				24			30			4						8			24						
Number of submerged species	2	8	4	9	4	3	6	9	3	7	9	3	6	8	4	8	6	4	4	9	2	8	9	5	7	3	6		4

\* Stuckenia pectinata = Potamogeton pectinatus

Mud plantain = water stargrass

Zosterella dubia = Heteranthera dubia

## Spring Lake Curlyleaf Growth Potential Based on Lake Sediment Characteristics

A Spring Lake sediment survey was conducted on August 13, 2008. Lake sediment sampling results from 2008 have 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 are shown in Figure 12.

Except for two sites, curlyleaf pondweed growth is predicted to produce mostly light to moderate growth around the lake based on lake sediment characteristics (Figure 12).

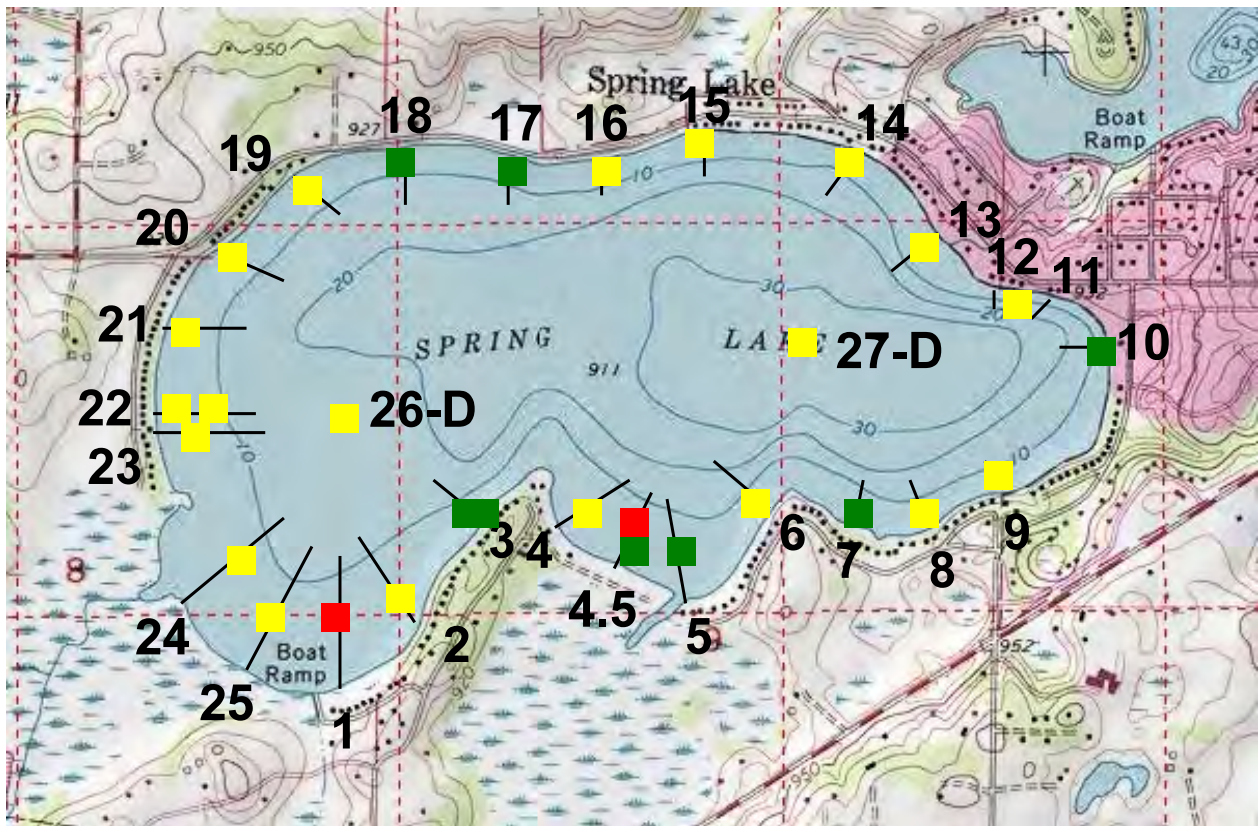


Figure 12. Sediment sample locations are shown with a square. The square color indicates the potential for curlyleaf pondweed growth to occur at that site. Key: green = light; yellow = moderate; red = heavy. A key that illustrates the three types of growth is shown on the next page.