Spring Lake, Scott County, MN (Google Earth Map)

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

[Sediments Collected August 13, 2008 and October 16, 1997]

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Introduction

For managing non-native plants it is helpful to know where the plants have the potential to grow to nuisance conditions. A technique developed by Blue Water Science shows where nuisance growth of curlyleaf pondweed and Eurasian watermilfoil can occur in a lake based on lake sediment characteristics. This technique was applied to Spring Lake.

Spring Lake sediments were collected from 31 sites around the lake on August 13, 2008. The lake sediments were analyzed at the Soils lab at the University of Minnesota and results are presented in this report.

Methods

Lake Soil Collection: A total of 31 lake sediment samples were collected from the depth of 4 to 8 feet on August 13, 2008 by Steve McComas, Blue Water Science. Samples were collected using a modified soil auger, 5.2 inches in diameter (Figure 1) and soils were sampled to a depth of 6 inches. The lake soil from the sampler was transferred to 1-gallon zip-lock bags and delivered to the University of Minnesota soil testing laboratory.

Lake Soil Analysis: At the lab, sediment samples were air dried at room temperature, crushed and sieved through a 2 mm mesh sieve. Sediment samples were analyzed using standard agricultural soil testing methods. Fifteen parameters were tested for each soil sample. A summary of extractants and procedures is shown in Table 1. Routine soil test results are given on a weight per volume basis.

Table 1. Soil testing extractants used by University of Minnesota Crop Research Laboratory. These are standard extractants used for routine soil tests by most Midwestern soil testing laboratories (reference: Western States Laboratory Proficiency Testing Program: Soil and Plant Analytical Methods, 1996-Version 3).

Parameter	Extractant
P-Bray	0.025M HCL in 0.03M NH_4F
P-Olsen	0.5M $NaHCO_3$
NH_4-N	2N KCL
K, Ca, Mg	1N NH_4OA_c (ammonium acetate)
Fe, Mn, Zn, Cu	DTPA (diethylenetriamine pentaacetic acid)
B	Hot water
SO_4-S	$Ca(H_2PO_4)_2$
pH	water
Organic matter	Loss on ignition at 360°C

Figure 1. Soil auger used to collect lake sediments.

Reporting Lake Soil Analysis Results: Lake soils and terrestrial soils are similar from the standpoint that both provide a medium for rooting and supply nutrients to the plant.

However, lake soils are also different from terrestrial soils. Lake soils (or sediments) are water logged, generally anaerobic and their bulk density ranges from being very light to very dense compared to terrestrial soils.

There has been discussion for a long time on how to express analytical results from soil sampling. Lake sediment research results are often expressed as grams of a substance per kilogram of lake sediment, commonly referred to as a weight basis (mg/kg). However, in the terrestrial sector, to relate plant production and potential fertilizer applications to better crop yields, soil results typically are expressed as grams of a substance per cubic foot of soil, commonly referred to as a weight per volume basis. Because plants grow in a volume of soil and not a weight of soil, farmers and producers typically work with results on a weight per volume basis.

That is the approach used here for lake sediment results: they are reported on a weight per volume basis or $\mu g/cm^3$.

A bulk density adjustment was applied to lake sediment results as well. For agricultural purposes, in order to standardize soil test results throughout the Midwest, a standard scoop volume of soil has been used. The standard scoop is approximately a 10-gram soil sample. Assuming an average bulk density for an agricultural soil, a standard volume of a scoop has been a quick way to prepare soils for analysis, which is convenient when a farmer is waiting for results to prepare for a fertilizer program. It is assumed a typical silt loam and clay texture soil has a bulk density of 1.18 grams per cm^3. Therefore a scoop size of 8.51 cm^3 has been used to generate a 10-gram sample. It is assumed a sandy soil has a bulk density of 1.25 grams per cm^3 and therefore a 8.00 cm^3 scoop has been used to generate a 10-gram sample. Using this type of standard weight-volume measurement, the lab can use standard volumes of extractants and results are reported in ppm which is close to $\mu g/cm^3$. For all sediment results reported here a scoop volume of 8.51 cm^3 was used.

However lake sediment bulk density has wide variations but only a single scoop volume of 8.51 cm^3 was used for all lake sediment samples. This would not necessarily produce a consistent 10-gram sample. Therefore, for our reporting, we have used corrected weight volume measurements and results have been adjusted based on the actual lake sediment bulk density. We used a standard scoop volume of 8.51 cm^3, but sediment samples were weighed. Because test results are based on the premise of a 10 gram sample, if our sediment sample was less than 10 grams, then the reported concentrations were adjusted down to account for the less dense bulk density. If a scoop volume weighed greater than 10.0 grams than the reported concentrations were adjusted up. For example, if a 10-gram scoop of lake sediment weighed 4.0 grams, then the correction factor is 4.00 g/ 10.00 g = 0.40. If the analytical result was 10 ppm based on 10 grams, then it should be 0.40 x 10 ppm = 4 ppm based on 4 grams. The results could be written as 4 ppm or 4 $\mu g/cm^3$. Likewise, if a 10-gram scoop of lake sediment weighed 12 grams, then the correction factor is 12.00 g / 10.00 g = 1.20. If the analytical result was 10 ppm based on a 10 gram scoop, then it should be 1.20 x 10 ppm = 12 ppm based on 12 grams. The result could be written as 12 ppm or 12 µg/cm^3. These are all dry weight determinations.

Delineating Areas of Potential Nuisance Curlyleaf and Milfoil Growth: Delineating an area of potential nuisance plant growth is based on conventional soil survey methods. When a sediment sample analysis has a nitrogen reading over 10 ppm and has an organic matter content of less than 20%, it has a high potential for nuisance milfoil growth. For sediment results with a high growth potential collected in a cove, typically, the water depths in the cove from 5 to 7 feet would be designated as having a potential for nuisance growth. If high potential samples are found along a stretch of shoreline, a designated high potential area would be delineated until there was a shoreline break or change in sediment texture. In other cases, if the next site down the shoreline records a low potential reading, then the designated nuisance area would extend midway between a high and low potential sample sites.

Results

Potential for Heavy Growth of Non-native Invasive Plants Based on Lake Sediment Characteristics

A total of 31 sediment sites were sampled around Spring Lake. Sediment sites and locations are shown in Table 2 and Figure 2.

Table 2. Spring Lake sediment sample locations and field observations on August 13, 2008.

Sample ID	Sample Depth (ft)	GPS Coordinates (WGS 84 datum)		Notes
		East	North	
1	5	61 916	49 144	Soft, brown, organic sediments. 85 yards from shore.
2	5	61 009	49 304	Sand, silt sediments. No plants. 65 yards from shore.
3	4	62 214	49 519	Sandy sediments. No plants. This sample mimics one done in 2004.
3	6	62 196	49 530	55 yards from shore.
4	4	62 456	49 495	Brown, silty, mucky sediments.
4.5	5	62 594	49 439	Sandy, silt, no muck sediments.
4.5	7	62 588	49 479	Brown, mucky sediments. 150 yards from shore.
5	5	62 736	49 402	Dark brown, sandy, silt with some muck sediments.
6	6	62 899	49 466	Dark brown, sandy silt sediments. 50 yards from shore.
7	6	63 179	49 520	
8	5	63 390	49 472	
9	4	63 581	49 548	
10	6	63 790	49 708	
11.5	7	63 693	50 001	30 yards from shore
13	5	63 361	50 130	Gray marl, clay-like sediments. Two years ago curlyleaf at the surface. Area has been treated. 72 yards from shore.
14	5	63 082	50 401	35 yards from shore.
15	5	62 795	50 425	
16	5	62 478	50 354	40 yards from shore.
17	5	62 280	50 353	40 yards from shore.
18	5	62 069	50 420	37 yards from shore.
19	5	61 757	50 318	50 yards from shore.
20	4	61 593	50 175	43 yards from shore.
21	4	61 470	50 016	75 yards from shore.
22	4	61 421	49 836	Soft sediments. Treated area. 70 yards from shore.
22	7	61 500	49 842	
22	8	61 508	49 826	174 yards from shore.
23	5	61 457	49 669	Light brown, soft, muck sediments. 117 yards from shore.
24	6	61 583	49 293	
25	5	61 715	49 140	
26	17	61 883	49 806	Deep lake sediment sample.
27	35	63 137	49 856	Deep lake sediment sample.

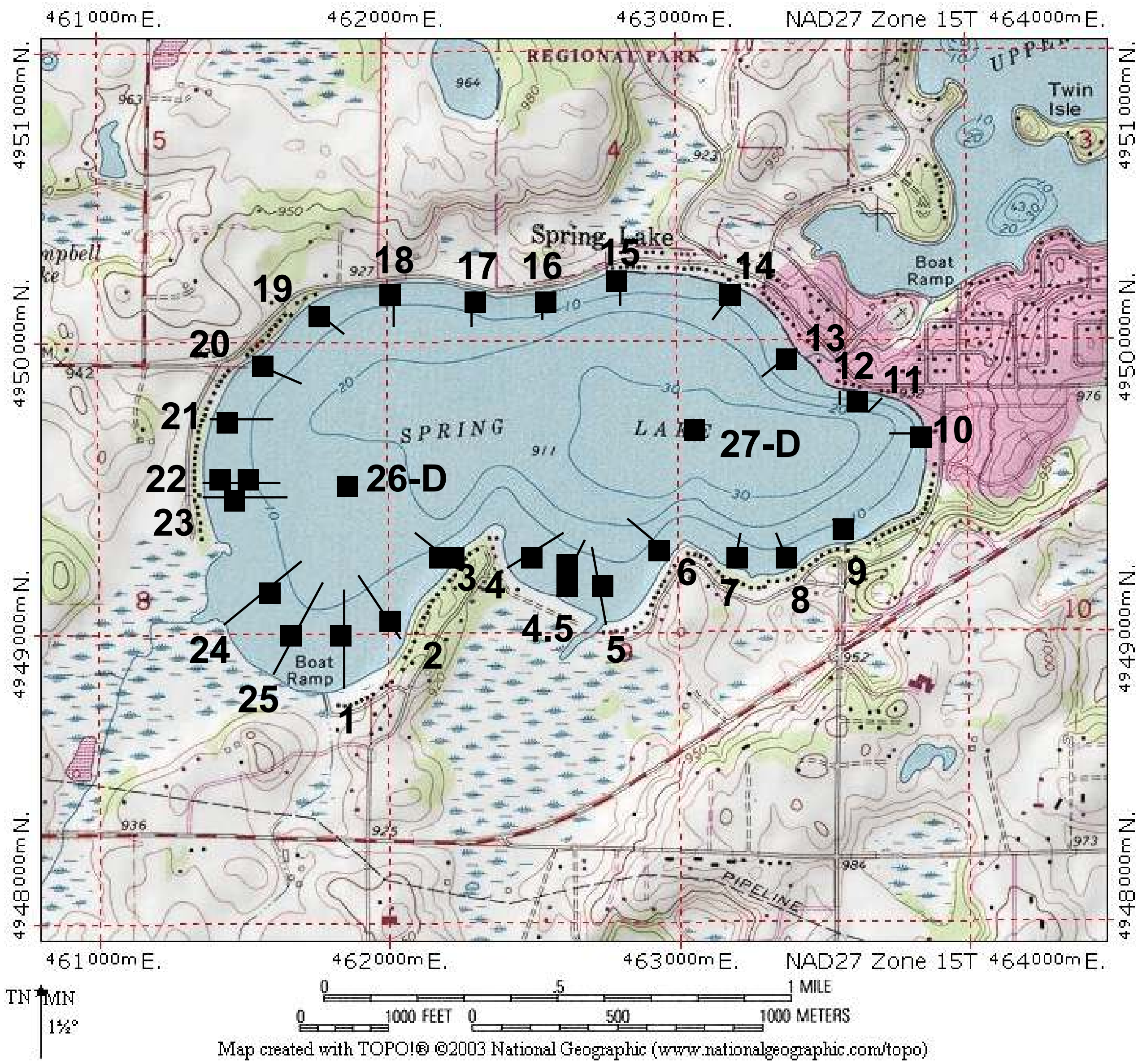


Figure 2. Lake sediment sample locations are shown with black squares.

Spring Lake sediment results are shown in Table 3   A total of 15 parameters were analyzed for each sediment sample. A low bulk density (less than 0.60 g/cm^3) indicates lake sediments are soft and mucky. Typically high organic matter content is associated with the soft mucky sediments sample sites. Lake sediment phosphorus concentrations were variable and ranged from low to high.

Table 3. Spring Lake soil data. Sample were collected on August 13, 2008. Soil chemistry results are reported as µg/cm^3-dry which is equivalent to ppm except for organic matter (%) and pH (standard units).

Sample Number	Depth (ft)	Bulk Density (g/cm3)	O.M. (%) by L.O.I.	pH	Bray-P (ppm) (corr)	Olsen-P (ppm) (corr)	K (ppm) (corr)	Ca (ppm) (corr)	Mg (ppm) (corr)	Boron (ppm) (corr)	NH4-N (ppm) (corr)	Fe (ppm) (corr)	Cu (ppm) (corr)	Mn (ppm) (corr)	Zn (ppm) (corr)	SO4-S (ppm) (corr)
1	5	0.44	17.8	7.8	0	5	10	1501	115	0.24	4.8	4.4	0.2	19.1	0.3	7
2	5	0.98	1.8	7.8	1	10	21	2389	146	0.30	1.9	8.5	1.7	21.8	1.8	63
3	4	1.44	0.7	7.7	4	5	34	3172	159	0.31	0.5	18.0	0.7	25.5	0.5	73
3	6	1.31	0.9	7.7	9	4	20	2553	152	0.29	1.7	20.0	0.9	31.2	0.7	76
4	4	0.75	5.1	7.7	1	8	12	1945	107	0.41	3.2	4.9	0.8	22.8	0.7	24
4.5	5	1.28	1.1	7.7	1	4	22	2889	153	0.25	0.4	8.7	0.3	24.0	0.3	56
4.5	7	0.62	11.5	7.8	1	6	14	2172	163	0.39	3.8	16.3	0.4	19.7	0.6	16
5	5	1.05	2.5	7.7	1	4	24	2878	205	0.37	2.9	46.6	1.0	8.2	0.9	93
6	6	0.99	3.8	7.8	1	7	49	2611	218	0.35	5.1	16.3	1.4	28.9	1.2	51
7	6	1.35	0.8	7.3	6	2	34	1930	113	0.25	0.3	33.4	0.5	17.8	0.5	266
8	5	1.33	1.0	7.8	10	5	29	2662	165	0.30	0.8	16.7	0.5	12.9	0.5	113
9	4	1.42	0.6	7.8	8	4	17	1918	131	0.23	0.4	21.3	0.7	13.3	1.1	111
10	6	1.39	0.5	7.6	9	5	26	2133	133	0.25	0.4	29.9	1.1	15.9	2.2	156
11.5	7	1.49	0.4	7.6	10	5	22	1928	94	0.27	0.4	20.4	1.4	16.6	1.4	112
13	5	1.24	0.9	8.2	1	6	158	3474	380	0.15	8.1	67.8	3.4	27.4	0.5	34
14	5	1.50	0.4	7.7	8	5	18	2071	117	0.28	1.1	19.7	1.0	19.1	0.9	123
15	5	1.45	0.5	7.6	11	6	99	2180	124	0.32	1.5	16.4	1.2	16.3	0.9	89
16	5	1.48	0.4	7.8	10	5	26	1775	120	0.34	0.1	16.8	1.8	14.9	0.8	106
17	5	1.40	0.6	7.7	8	10	18	1654	127	0.29	0.1	22.7	0.5	10.3	0.5	114
18	5	1.52	0.5	7.5	13	5	13	2157	132	0.27	0.3	20.3	0.6	19.6	0.8	67
19	5	1.35	0.7	7.7	10	5	18	2138	138	0.25	1.2	18.1	0.7	21.2	0.7	76
20	4	1.44	0.5	7.3	12	5	13	2057	108	0.26	0.2	15.6	0.6	17.5	0.7	73
21	4	1.37	0.7	7.8	5	5	23	2833	127	0.28	0.6	19.0	0.9	17.1	0.9	75
22	4	0.57	8.0	7.9	0	4	8	1740	111	0.29	2.2	5.1	0.2	18.0	0.2	13
22	7	0.74	13.2	7.6	1	8	44	2425	251	0.65	9.1	20.9	1.7	44.2	1.7	33
22	8	0.84	17.8	7.6	1	7	88	3026	368	0.60	14.0	53.2	1.7	46.6	1.8	34
23	5	0.49	17.3	7.9	0	3	14	1630	127	0.34	5.4	8.9	0.2	19.1	0.4	8
24	6	0.54	26.3	7.6	0	10	25	1974	177	0.55	8.3	49.5	0.4	39.8	0.5	8
25	5	0.75	17.3	7.5	1	22	106	2989	411	0.80	28.5	20.3	7.5	45.7	4.8	51
26	17	0.47	12.1	7.8	0	4	10	1402	93	0.20	2.3	4.8	0.2	23.7	0.3	10
27	35	0.38	13.4	7.7	0	11	21	1099	78	0.20	8.2	12.9	0.8	9.6	0.7	27

Curlyleaf Pondweed Growth Potential in Spring Lake

Lake sediment sampling results from 2008 have been used to predict lake bottom areas that have the potential to support nuisance 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 Table 4 and Figure 3.

Curlyleaf pondweed growth is predicted to produce mostly moderate growth (where plants may occasionally top out in a broken canopy) in Spring Lake.

Table 4. Spring Lake sediment data and ratings for potential nuisance curlyleaf pondweed growth.

Site	Depth (ft)	pH (su)	Bulk Density (g/cm^3 dry)	Organic Matter (%)	Fe:Mn Ratio	Potential for Nuisance Curlyleaf Pondweed Growth
Light Growth		**6.8**	**1.04**	**5**	**4.6**	**Low (green)**
Moderate Growth		**6.2**	**0.94**	**11**	**5.9**	**Medium (yellow)**
Heavy Growth		**>7.7**	**<0.51**	**>20**	**<1.6**	**High (red)**
1	5	7.8	0.44	17.8	0.2	High
2	5	7.8	0.98	1.8	0.4	Medium
3	4	7.7	1.44	0.7	0.7	Low
3	6	7.7	1.31	0.9	0.6	Low
4	4	7.7	0.75	5.1	0.2	Medium
4.5	5	7.7	1.28	1.1	0.4	Low
4.5	7	7.8	0.62	11.5	0.8	High
5	5	7.7	1.05	2.5	5.7	Low
6	6	7.8	0.99	3.8	0.6	Medium
7	6	7.3	1.35	0.8	1.9	Low
8	5	7.8	1.33	1.0	1.3	Medium
9	4	7.8	1.42	0.6	1.6	Medium
10	6	7.6	1.39	0.5	1.9	Low
11.5	7	7.6	1.49	0.4	1.2	Medium
13	5	8.2	1.24	0.9	2.5	Medium
14	5	7.7	1.50	0.4	1.0	Medium
15	5	7.6	1.45	0.5	1.0	Medium
16	5	7.8	1.48	0.4	1.1	Medium
17	5	7.7	1.40	0.6	2.2	Low
18	5	7.5	1.52	0.5	1.0	Low
19	5	7.7	1.35	0.7	0.9	Medium
20	4	7.3	1.44	0.5	0.9	Medium
21	4	7.8	1.37	0.7	1.1	Medium
22	4	7.9	0.57	8.0	0.3	Medium
22	7	7.6	0.74	13.2	0.5	Medium
22	8	7.6	0.84	17.8	1.1	Medium
23	5	7.9	0.49	17.3	0.5	Medium
24	6	7.6	0.54	26.3	1.2	Medium
25	5	7.5	0.75	17.3	0.2	Medium
26 - deep	17	7.8	0.47	12.1	0.4	Medium
27 - deep	35	7.7	0.38	13.4	1.3	Medium

Spring Lake Curlyleaf Growth Potential Based on Lake Sediments

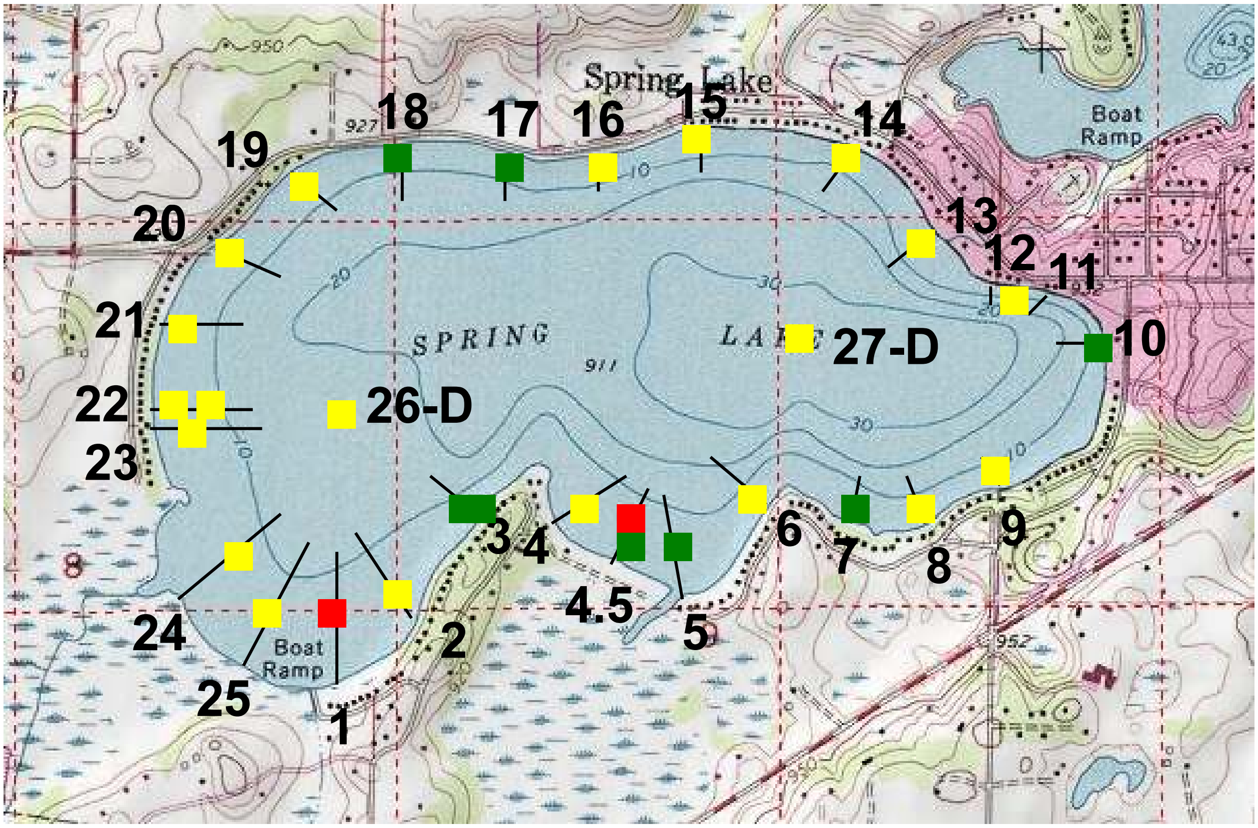


Figure 3. Sediment sample locations are shown with a square. The square color indicates the potential for nuisance curlyleaf pondweed to occur at that site. Key: green = low; yellow = medium; red = high potential.

Light growth (left) refers to light nuisance growth that is mostly below the surface and is not a recreational or ecological problem. Heavy growth (right) refers to nuisance matting curlyleaf pondweed. This is the kind of nuisance growth predicted by high sediment pH and a sediment bulk density less than 0.51.

Eurasian Watermilfoil Growth Potential in Spring Lake

Lake sediment sampling results from 2008 have been used to predict lake bottom areas that have the potential to support nuisance EWM growth. Eurasian watermilfoil has not been found in Spring Lake as of August 2008. Based on the key sediment parameters of NH_4 and organic matter (McComas, unpublished), a table and map were prepared that predict what type of growth could be expected in the future if Eurasian watermilfoil invades Spring Lake (Table 5 and Figure 4).

The sediment nitrogen conditions in Spring Lake are relatively low combined with a variety of organic matter conditions. Only a couple of areas are predicted to exhibit nuisance milfoil growth if milfoil comes into Spring Lake. Eurasian watermilfoil may grow widely through Spring Lake, but it is predicted that it not will produce extensive perennial nuisance matting conditions (which are defined as heavy growth conditions).

Table 5. Spring Lake sediment data and ratings for potential nuisance EWM growth.

Site	Depth (ft)	NH_4 Conc (ppm)	Organic Matter (%)	Potential for Nuisance EWM Growth
Light Growth or Moderate Growth		<10	>20	Low (green) to Medium (yellow)
Heavy Growth		>10	0.6 - 20	High (red)
1	5	4.8	17.8	Medium
2	5	1.9	1.8	Medium
3	4	0.5	0.7	Medium
3	6	1.7	0.9	Medium
4	4	3.2	5.1	Medium
4.5	5	0.4	1.1	Medium
4.5	7	3.8	11.5	Medium
5	5	2.9	2.5	Medium
6	6	5.1	3.8	Medium
7	6	0.3	0.8	Medium
8	5	0.8	1.0	Medium
9	4	0.4	0.6	Low
10	6	0.4	0.5	Low
11.5	7	0.4	0.4	Low
13	5	8.1	0.9	Medium
14	5	1.1	0.4	Low
15	5	1.5	0.5	Low
16	5	0.1	0.4	Low
17	5	0.1	0.6	Low
18	5	0.3	0.5	Low
19	5	1.2	0.7	Medium
20	4	0.2	0.5	Low
21	4	0.6	0.7	Medium
22	4	2.2	8.0	Low
22	7	9.1	13.2	Medium
22	8	14.0	17.8	High
23	5	5.4	17.3	Medium
24	6	8.3	26.3	Medium
25	5	28.5	17.3	High
26	17	2.3	12.1	Medium
27	35	8.2	13.4	Medium

Spring Lake Eurasian Watermilfoil Growth Potential Based on Lake Sediments (milfoil is not currently found in Spring Lake)

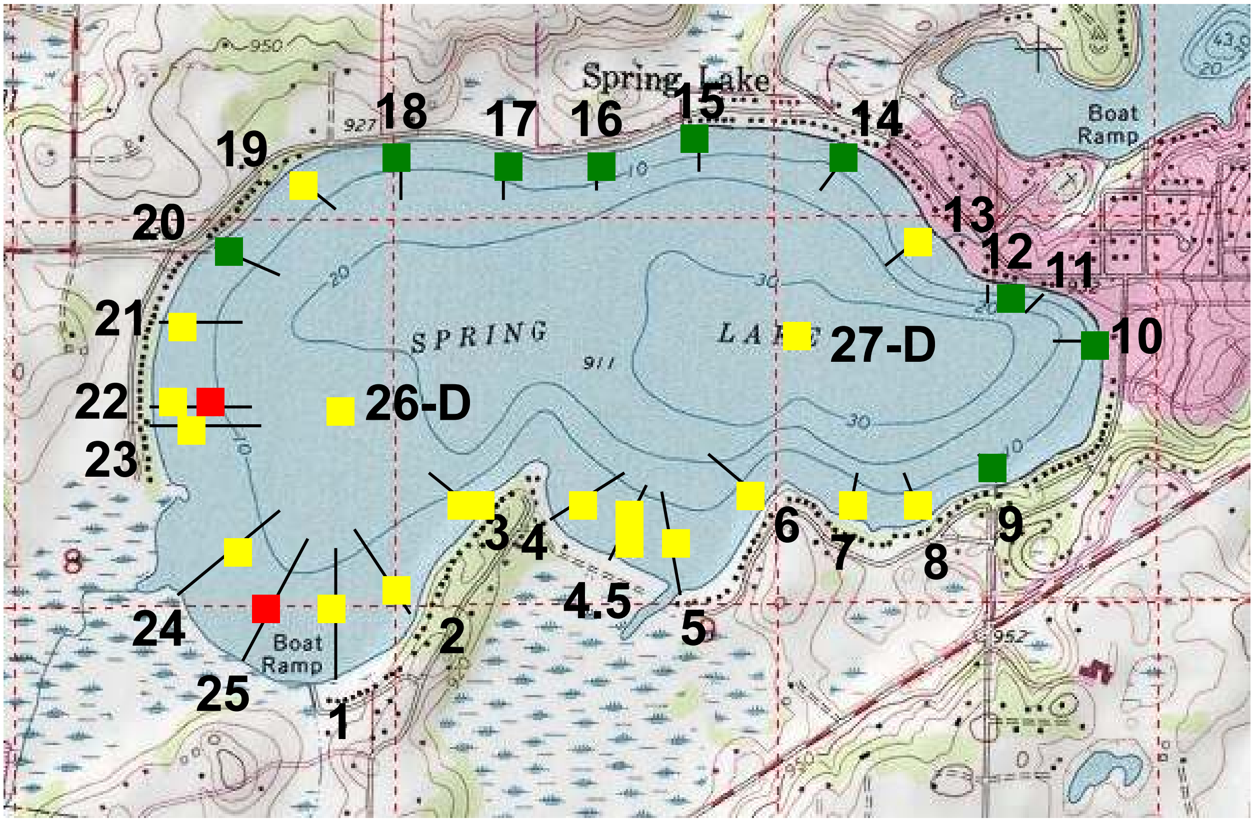


Figure 4. Sediment sample locations are shown with a square. The square color indicates the potential for nuisance Eurasian watermilfoil to occur at that site. Key: green = low; yellow = medium; red = high potential.

Light growth (left) refers to light nuisance growth that is mostly below the surface and is not a recreational or ecological problem. Heavy growth (right) refers to nuisance matting Eurasian watermilfoil. This is the kind of nuisance growth predicted by high sediment nitrogen values and a sediment organic matter content less than 20%.

Predicted Curlyleaf Pondweed Growth

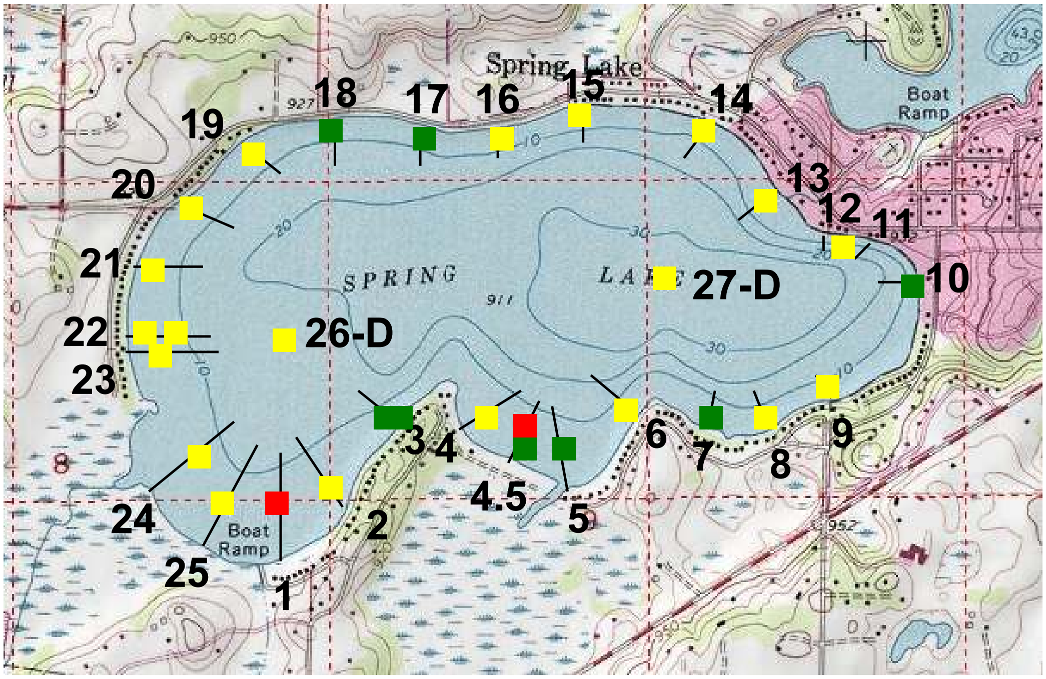


Figure 5a. Sediment sample locations are shown with a square. The square color indicates the potential for nuisance curlyleaf pondweed to occur at that site. Key: green = low; yellow = medium; red = high potential.

Actual Curlyleaf Pondweed Growth - 2008

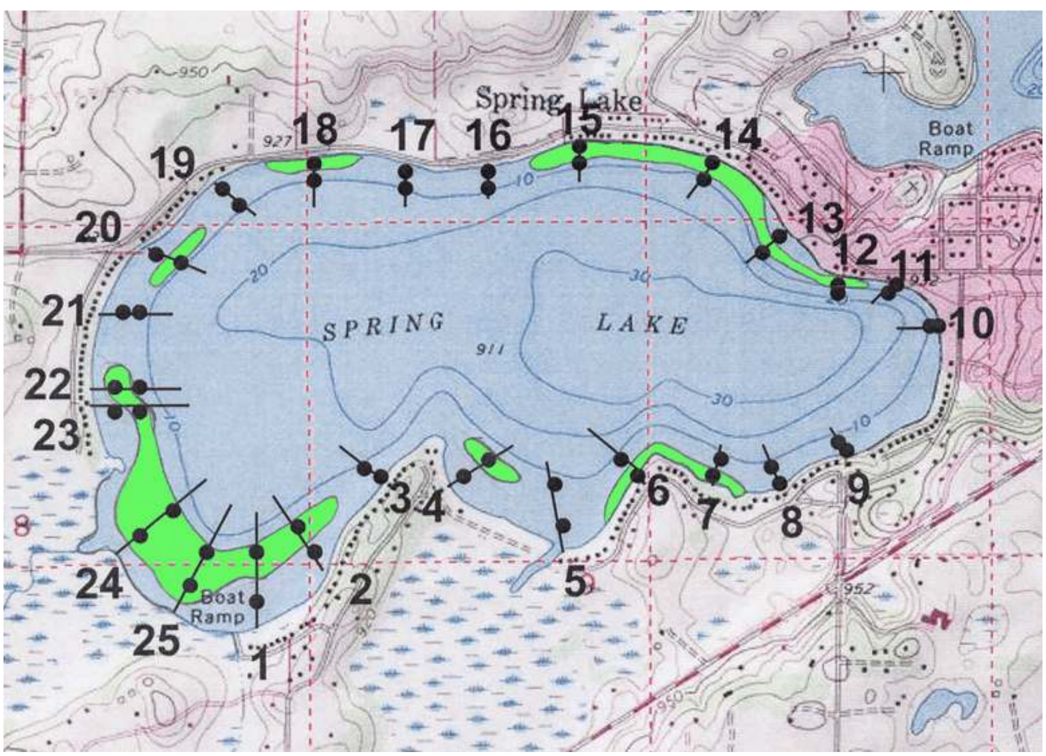


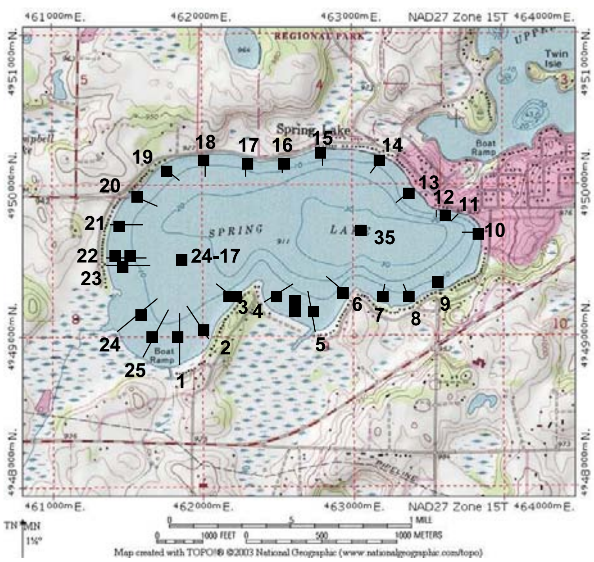
Figure 5b. Curlyleaf pondweed coverage for June 13, 2008.

Comparing 1997 and 2008 Lake Sediment Results

Four lake sediment samples were collected on October 16, 1997 and those same sites were resampled on August 13, 2008 (Table 6 and Figure 6). In 2008, the sediment pH and ammonia-nitrogen concentrations were lower compared to 1997. The curlyleaf abundance was also lower in 2008 compared to 1997. The causes of the pH and NH_4 decreases are unknown.

Table 6. Comparison of sediment data from 1997 (October 16) and 2008 (August 13) for four Spring Lake sites.

	Site 3		Site 9		Site 15		Site 20	
	1997	2008	1997	2008	1997	2008	1997	2008
pH	7.9	7.7	8.1	7.8	8.2	7.6	7.9	7.3
Organic Matter	2.8	0.7	0.8	0.6	0.5	0.5	1.6	0.5
Fe/Mn	0.7	0.4	0.7	1.6	1.3	1.0	2.3	0.9
NH_4	11.9	1.7	7.0	0.4	7.5	1.5	9.0	0.2
Curlyleaf Density	4	0	4	0	4	1	4	1



Sediment sample location map.

Appendix A

Spring Lake Sediment Samples from October 16, 1997

Appendix: Spring Lake, October 16, 1997

Potential for Nuisance Growth of Non-Native Invasive Plants Based on Lake Sediment Characteristics

A total of 4 sediment sites were sampled around Spring Lake. Sediment sites and locations are shown in Table 1 and Figure 1.

Table 1. Spring Lake sediment sample locations and field observations on October 16, 1997.

Sample Location	Water Depth (feet)
1	4
2	4
3	4
4	4

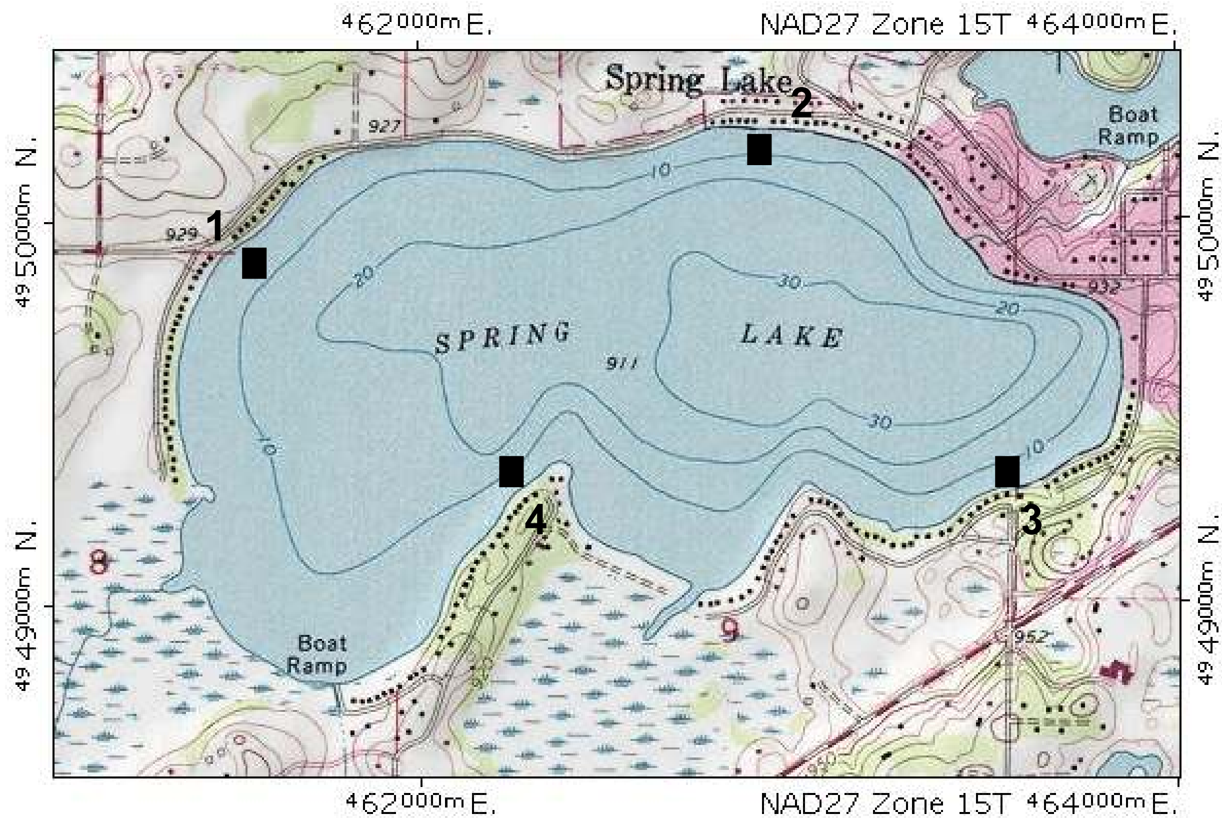


Figure 1. Lake sediment sample locations shown with black squares were sampled on October 16, 1997.

Spring Lake sediment results are shown in Table 2. A total of 16 parameters were analyzed for each sediment sample.

Table 2. Spring Lake soil data. Sample were collected on October 16, 1997. Soil chemistry results are reported as μg/cm^3-dry which is equivalent to ppm except for organic matter (%) and pH (standard units).

Sample	Depth (ft)	% OM	pH unit	NH4 ppm corr	Bray P ppm corr	Olsen P ppm corr	Potassi ppm corr	Zinc ppm corr	Sulfate ppm corr	Iron ppm corr	Copper ppm corr	Man ppm corr	Boron ppm corr	Calc ppm corr	Magn ppm corr	Na	CEC
1	4	1.6	7.9	9.0	5	4	43	0.52	82	50.8	0.94	22.2	0.29	5200	315	46	28.9
2	4	0.5	8.2	7.5	9	1	17	0.20	15	19.6	0.20	15.0	0.12	1200	112	58	7.2
3	4	0.8	8.1	7.0	7	2	21	0.28	37	21.6	0.76	29.0	0.36	3848	192	84	21.2
10	4	2.8	7.9	11.9	3	6	36	0.42	49	41.0	0.82	62.0	0.25	5360	265	52	29.3

Curlyleaf Growth Potential Based on Lake Sediment Characteristics From 1997 Samples: Lake sediment sampling results from 1997 have been used to predict lake bottom areas that have the potential to support nuisance 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 Table 3 and Figure 2.

Curlyleaf pondweed growth is predicted to produce mostly low to moderate nuisance growth (where plants top out) at only several locations (Figure 2).

Table 3. Spring Lake sediment data and ratings for potential nuisance curlyleaf pondweed growth.

Site	pH (su)	Organic Matter (%)	Fe:Mn Ratio	Potential for Nuisance Curlyleaf Pondweed Growth
Non-Nuisance	**6.8**	**5**	**4.6**	**Low (green)**
Light Nuisance	**6.2**	**11**	**5.9**	**Medium (yellow)**
Heavy Nuisance	**>7.7**	**>20**	**<1.6**	**High (red)**
1	7.9	1.6	2.2	
2	8.2	0.5	1.3	
3	8.1	0.8	0.7	
4	7.9	2.8	0.7	

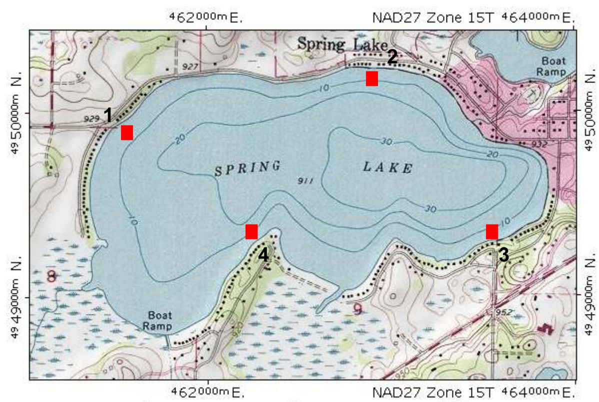


Figure 2. Sediment sample locations are shown with a square. The square color indicates the potential for nuisance curlyleaf pondweed to occur at that site. Key: green = low; yellow = medium; red = high potential.

Eurasian Watermilfoil Growth Potential Based on Lake Sediment Characteristics From 1997 Samples: Lake sediment sampling results from 1997 have been used to predict lake bottom areas that have the potential to support nuisance EWM growth. Based on the key sediment parameters of NH_4 and organic matter (McComas, unpublished), a table and map were prepared that predict what type of growth could be expected of milfoil in Spring Lake (Table 4 and Figure 3).

The sediment nitrogen conditions in Spring Lake are moderate. Eurasian watermilfoil may grow widely through Spring Lake, but it is predicted that if it invades Spring Lake, it not will produce perennial nuisance matting conditions (which are defined as heavy nuisance condition).

Table 4. Spring Lake sediment data and ratings for potential nuisance EWM growth.

Site	NH_4 Conc (ppm)	Organic Matter (%)	Potential for Nuisance EWM Growth
Non-Nuisance or Light Nuisance	<10	>20	Low (green) to Medium (yellow)
Heavy Nuisance	>10	<20	High (red)
1	9.0	1.6	
2	7.5	0.5	
3	7.0	0.8	
4	11.9	2.8	

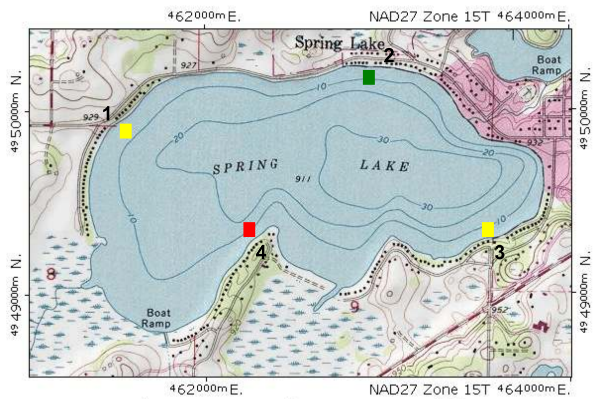


Figure 3. Sediment sample locations are shown with a square. The square color indicates the potential for nuisance Eurasian watermilfoil to occur at that site. Key: green = low; yellow = medium; red = high