



South Lindstrom Lake, June 17, 2004

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# Aquatic Plant Surveys for South Lindstrom Lake, Chisago County, Minnesota in 2004

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Early Summer Survey: June 17, 2004  
Late Summer Survey: September 7, 2004

Prepared for:  
**Chisago Lakes**  
**Lake Improvement District**  
**Chisago County, MN**

Prepared by:  
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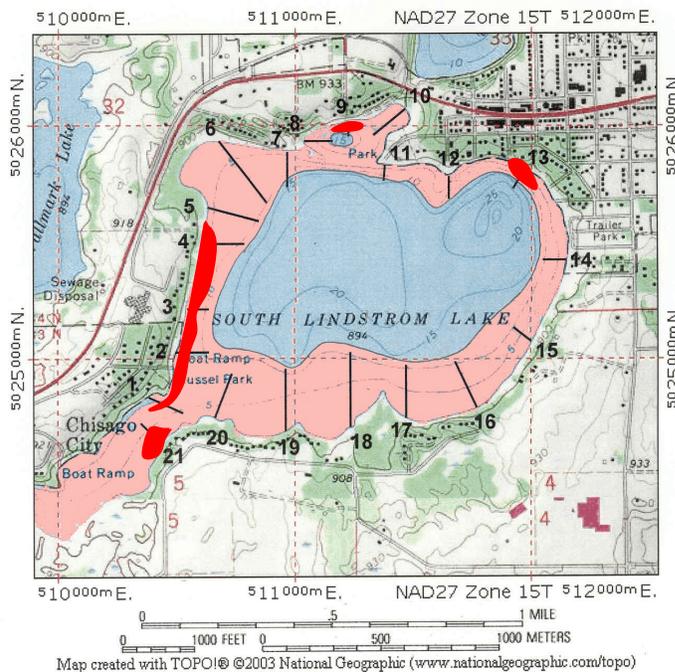
# Aquatic Plant Surveys for South Lindstrom Lake, Chisago County, Minnesota in 2004

## Summary

Two aquatic plant surveys were conducted on South Lindstrom Lake (499 acres) in 2004. The early summer survey of June 17 emphasized the distribution and abundance of curlyleaf pondweed. The late summer survey of September 7 characterized any changes in the plant community and checked for Eurasian watermilfoil. For each survey, 21 transects and 3 depths were monitored.

Curlyleaf pondweed was the most common plant in South Lindstrom Lake in early summer and showed up at 94% of the stations (Table 1). Curlyleaf pondweed is an exotic plant that dies back in mid-summer. In the early summer of 2004, curlyleaf pondweed was found around the perimeter of South Lindstrom Lake and out to about 12-feet of water although it was mainly a nuisance in water depths of under 8 feet (Figure 1). It covered approximately 270 acres out of the 499 acre lake with nuisance coverage of about 16 acres. Dense beds of curlyleaf can be a recreational nuisance but there is another problem as well. When curlyleaf dies back in early summer, it releases significant amounts of phosphorus. This can add to algae blooms in late summer.

In September, a new crop of curlyleaf pondweed had already sprouted and was the dominant plant in the lake. Coontail, a native plant, was the next most abundant plant. Eurasian watermilfoil was not found in South Lindstrom Lake in 2004. The acreage of aquatic submerged plants in South Lindstrom Lake in late summer was about 105 acres and submerged plant growth was generally sparse.



**Figure 1. The coverage of aquatic plants in June of 2004 is shown in pink and nuisance curlyleaf pondweed is shown in red. Curlyleaf pondweed was the dominant plant and the area of distribution was about 270 acres with nuisance growth covering about 16 acres.**

**Aquatic Plant Overview:** In the early summer of 2004, Curlyleaf pondweed was found around the perimeter of South Lindstrom Lake out to a water depth of about 12 feet. However, it was found to mat at the surface in only about 16 acres.

By the early part of September, both curlyleaf pondweed and stringy pondweed densities were down. There was fairly good native plant diversity with several plant species increasing from early to late summer (Table 1). Flatstem pondweed was the most common plant in September.

The acreage of aquatic submerged plants in South Lindstrom Lake decreased from early to late summer primarily because of the dieback of curlyleaf pondweed and stringy pondweed.

**Table 1. The percent occurrence of aquatic plants for South Lindstrom Lake in 2004. 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 milfoil was found in 25 out of 50 stations, its percent occurrence would be 50%.**

	June 17, 2004 % Occurrence (63 stations)	September 7, 2004 % Occurrence (63 stations)	Changes from June to September
Swamp loosestrife ( <i>Decodon verticillatus</i> )	3	--	-
Cattails ( <i>Typha sp</i> )	--	2	+
Duckweed ( <i>Lemna sp</i> )	--	2	+
White waterlilies ( <i>Nymphaea sp</i> )	3	5	+
Coontail ( <i>Ceratophyllum demersum</i> )	3	27	+
Chara ( <i>Chara sp</i> )	--	2	+
Northern watermilfoil ( <i>Myriophyllum sibiricum</i> )	2	6	+
Naiads ( <i>Najas flexilis</i> )	--	2	+
Water smartweed ( <i>Polygonum sp</i> )	--	2	+
Curlyleaf pondweed ( <i>Potamogeton crispus</i> )	95	2	-
Stringy pondweed ( <i>P. pusillus</i> )	70	--	-
Fern pondweed ( <i>P. Robbinsii</i> )	5	13	+
Flatstem pondweed ( <i>P. zosteriformis</i> )	3	38	+
Water celery ( <i>Vallisneria americana</i> )	--	21	+
Filamentous algae	25	19	-
Aquatic Plant Coverage (acres)	270	105	-
Secchi disc (ft)	7.5	3.5	-

**Conclusions and Recommendations for Aquatic Plant Management in South Lindstrom Lake:** The aquatic plant community has six species of submerged plants in early summer and nine species in late summer. This is a fair plant diversity condition.

Curlyleaf pondweed covers 270 acres in early summer and then dies back. In late summer, aquatic plants cover about 105 acres and grow out to about 8-feet of water depth representing about 21% of the lake bottom.

If native plant distribution could increase, water clarity could improve as well.

Curlyleaf pondweed is an exotic aquatic plant that grows in early summer in South Lindstrom Lake and then dies off by the end of June. As the curlyleaf plant beds decompose in the lake, phosphorus is released and feeds into algae blooms. Nuisance curlyleaf growth was delineated in 2004 and was found to occur in about 16 acres, or 3% of the lake area. This is a low nuisance condition and curlyleaf management is not needed at this time.

# South Lindstrom Lake, Chisago County

Lake ID: 13-0028

Size: 499 acres (source: MnDNR)

Littoral area: 208 acres (source: MnDNR)

Maximum depth: 34 ft (source: MnDNR lake map)

Mean Depth: 16 feet

## Introduction

South Lindstrom Lake is a 499 acre moderately fertile lake in Chisago County, Minnesota.

The aquatic plants of South Lindstrom Lake were sampled to evaluate curlyleaf pondweed, to look for Eurasian watermilfoil and to document the extent of native plant coverage. Steve McComas, Blue Water Science, with the assistance of Al Wahlgren, South Lindstrom lake resident, conducted two aquatic plant surveys on South Lindstrom Lake on June 17 and September 7, 2004.

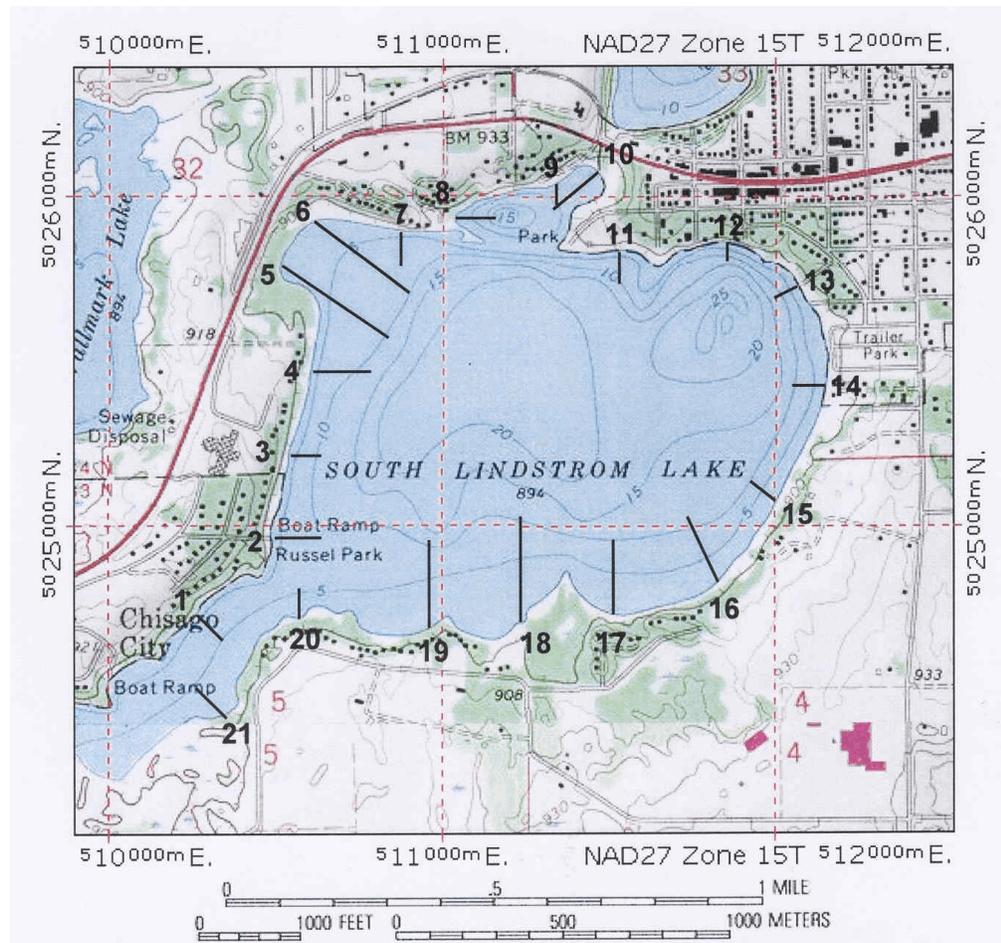


Figure 1. Transects for South Lindstrom Lake plant surveys on June 17 and September 7, 2004.

## Methods

Several techniques were used to characterize aquatic plants in South Lindstrom Lake. We used 21 line transects with several passing through known curlyleaf areas (Figure 1). A recording sonar (Lowrance X-16) was used to delineate the depths of weed colonization. Three depths (0-4 feet, 5-8 feet, and 9-12 feet) on a transect were sampled with a rake to characterize species presence and density.

Aquatic plant density was estimated based on a scale from 1-5 with 1 being the less dense and 5 representing plants matting at the surface. Plant density ratings were based on the amount of plants collected on a rake head. A single stem or a trace of an identifiable plant was rated at a density of "1". If plants were collected up to at least one half of the rake head (7 out of 14 tines) it was rated at a density of "2". If plants covered all of the rake tines, the density was a "3". If plants covered all 14 tines and was dense on all tines (even obscuring them) the density was a "4". A density of "5" was only assigned to plants matting at the surface. An example of a plant density of a 4 is shown in Figure 2.

Two to four rake samples were collected at each depth interval. A density for each plant species was determined for each rake sample and the species density was averaged based on the number of rake samples for a depth interval.

For plant surveys of this type, depth intervals are determined based on the maximum depth of plants found in the lake. Two depth intervals are used if plant growth is 10 feet or less and three depth intervals are used if plant growth is 12 feet or greater. Aquatic plants colonized out to 12 feet in South Lindstrom Lake, so the three depth zones were used and they were: 0-4 feet, 5-8 feet, and 9-12 feet.



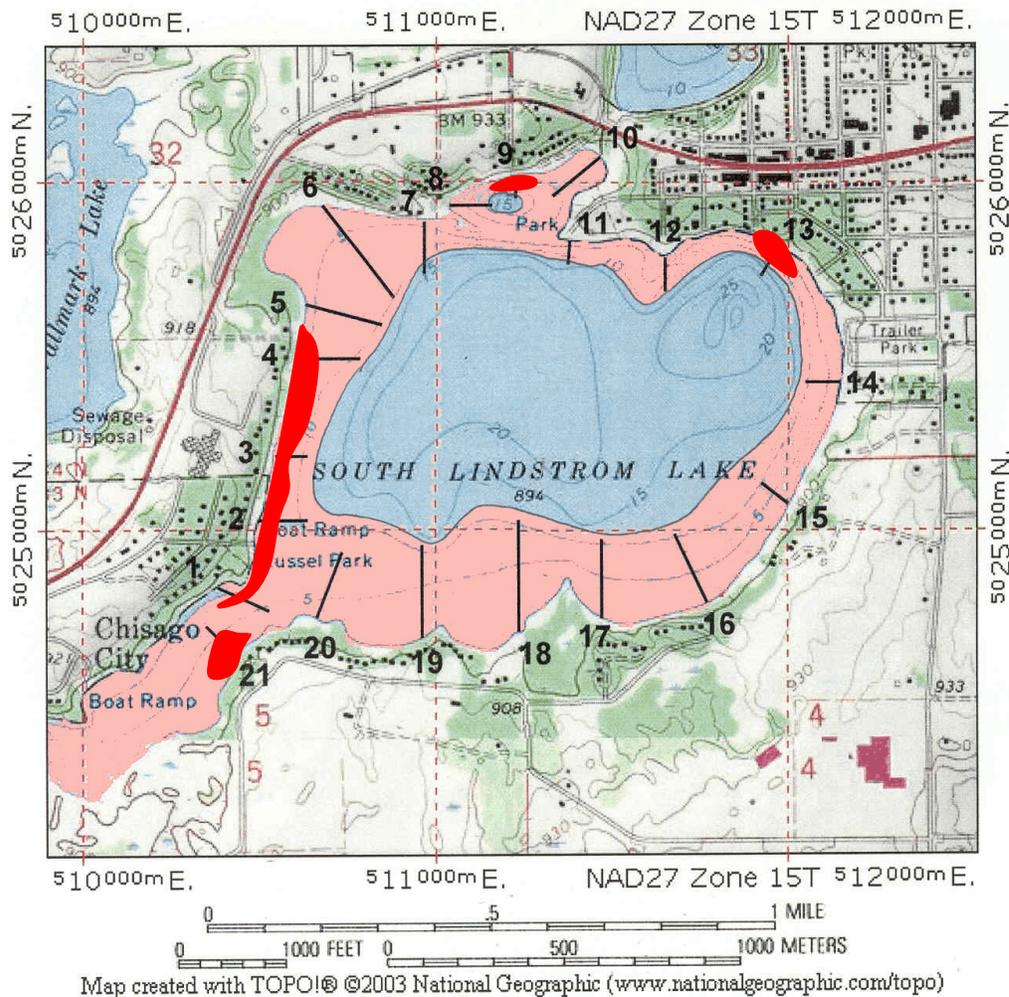
**Figure 2. Aquatic plants were sampled with a rake. Al Wahlgren, South Lindstrom Lake resident, holds a rake with curlyleaf pondweed at a density of a "4".**

## Results of the Early Summer Survey -- June 17

The most abundant plant in early summer in South Lindstrom Lake was curlyleaf pondweed and it was found at 60% of the 63 stations for a 95% occurrence (Table 1). Curlyleaf pondweed was growing in water depths out to 12 feet deep. Stringy pondweed, a native plant was also common. However, other native plants were scarce in South Lindstrom Lake.

An aquatic plant coverage map is shown in Figure 3. Curlyleaf pondweed coverage is basically the same as the aquatic plant coverage map. Curlyleaf coverage is about 270 acres and nuisance curlyleaf pondweed is slight and covers about 16 acres of the 499 acre South Lindstrom Lake.

A summary of plant density and occurrence for individual transects is listed in Table 2. No Eurasian watermilfoil was found in this survey.



**Figure 3. Aquatic plant coverage and curlyleaf coverage on June 17, 2004. Pink shading represents non-nuisance curlyleaf growth along with other plants and covers about 270 acres. Within the 270 acres are about 16 acres of nuisance curlyleaf pondweed growth, shown in red.**

**Table 1. South Lindstrom Lake aquatic plant occurrences and densities for the June 17, 2004 survey based on 21 transects and 3 depths, for a total of 63 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.**

	Depth 0-4 feet (n=21)			Depth 5-8 feet (n=21)			Depth 9-12 feet (n=21)			All Stations (n=63)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Swamp loosestrife ( <i>Decodon verticillatus</i> )	2	10	1.0	--	--	--	--	--	--	2	3	1.0
White waterlilies ( <i>Nymphaea sp</i> )	1	5	1	1	5	0.5	--	--	--	2	3	0.8
Coontail ( <i>Ceratophyllum demersum</i> )	1	5	3.3	1	5	2.2	--	--	--	2	3	2.8
Northern watermilfoil ( <i>Myriophyllum sibiricum</i> )	--	--	--	1	5	0.5	--	--	--	1	2	0.2
Curlyleaf pondweed ( <i>Potamogeton crispus</i> )	18	86	3.1	21	100	2.5	21	100	1.9	60	95	2.5
Stringy pondweed ( <i>P. pusillus</i> )	16	76	1.5	18	86	1.9	10	48	1.1	44	70	1.6
Fern pondweed ( <i>P. robbinsii</i> )	1	5	1.0	2	10	0.8	--	--	--	3	5	0.8
Flatstem pondweed ( <i>P. zosteriformis</i> )	--	--	--	1	5	1.0	1	5	0.3	2	3	0.8
Filamentous algae	10	48	1.4	5	24	1.4	1	5	1.5	16	25	1.4



**Figure 4. Nuisance growth of curlyleaf pondweed was rare in South Lindstrom. The nearshore areas typically did not exhibit matted growth.**

**Table 2. Individual transect data for South Lindstrom Lake on June 17, 2004.**

	T1			T2			T3			T4			T5		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Swamp loosestrife															
White waterlilies													1	0.5	
Coontail													3.3	2.2	
Northern watermilfoil															
Curlyleaf pondweed		3	0.8	4	2	1.5	5	2.8	1.5	4	2.5	1.8		2.2	2.3
Stringy pondweed	2	0.5	2.8	1	2.5		1			1	3	1			
Fern pondweed													1	0.5	
Flatstem pondweed														1	
Filamentous algae	0.5										1		1		

	T6			T7			T8			T9			T10		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Swamp loosestrife	1														
White waterlilies															
Coontail															
Northern watermilfoil															
Curlyleaf pondweed	2	0.5	1.8	1	2	2.5	3	2.3	3.0	1	5	2.3	3	3.3	2
Stringy pondweed	4	4	0.5		1	0.3		2.5		2	1		1	1.5	
Fern pondweed															
Flatstem pondweed			0.3												
Filamentous algae		1					2	2		1					

	T11			T12			T13			T14			T15		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Swamp loosestrife															
White waterlilies															
Coontail															
Northern watermilfoil															
Curlyleaf pondweed	3.8	2	2.3	1	3	2		4.5	2.3	2.5	1	2.3	2	1.8	2
Stringy pondweed	0.5	3	1		0.5		3.5			1	2		1	1.3	1
Fern pondweed															
Flatstem pondweed															
Filamentous algae				3	1		1			2	2		2		

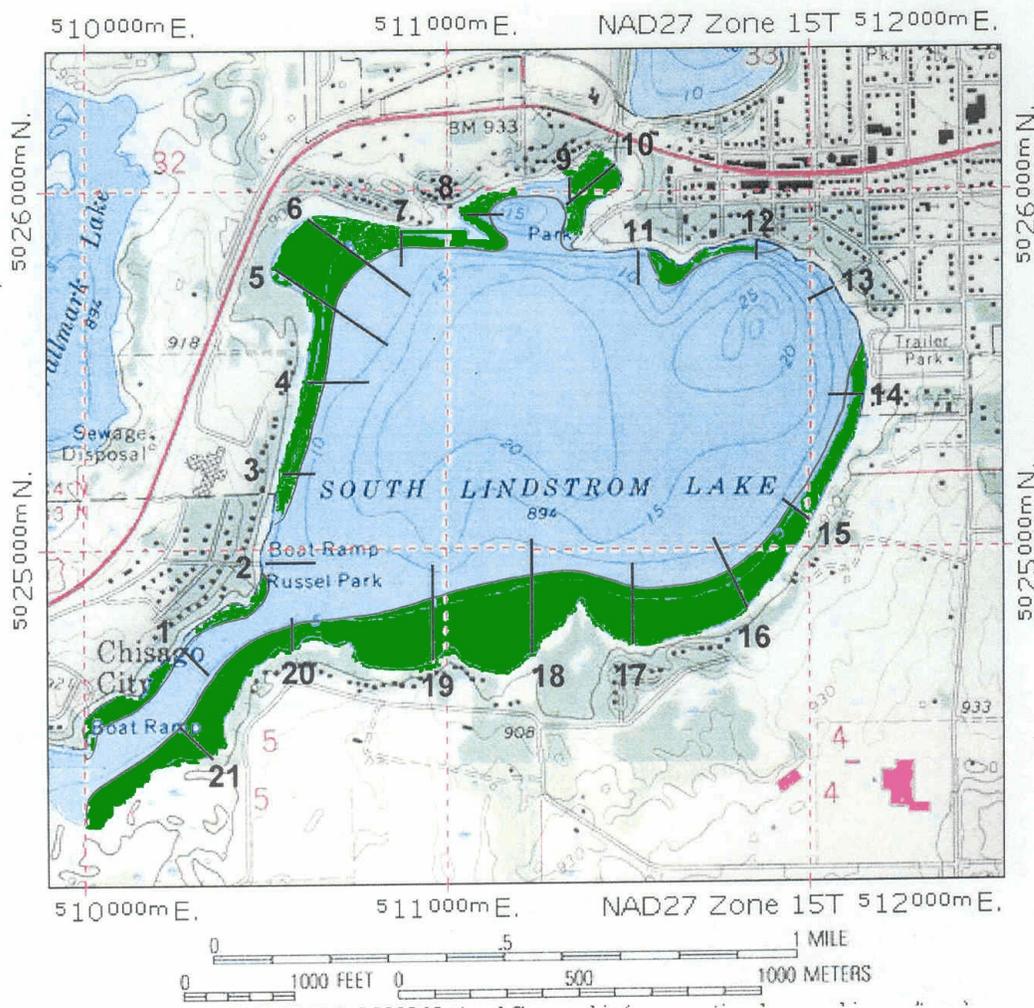
	T16			T17			T18			T19			T20			T21		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Swamp loosestrife																1		
White waterlilies																		
Coontail																		
Northern watermilfoil					0.2													
Curlyleaf pondweed	2	2.5	1.2	3.5	2	1.3	3	3	2.4	5	2.8	2	5	3	1.5	4.5	1	1.5
Stringy pondweed	1	2.8	0.5	1	1.7	1.8	2	2	0.8	1	1.5		1	1.3			2	1.2
Fern pondweed																	1	
Flatstem pondweed																		
Filamentous algae	1								1.5							0.5		

## Results of the Late Summer Survey -- September 7

A significant change in the plant community was found in the September survey compared to the June survey. The significant growth of curlyleaf pondweed and stringy pondweed found in June had died back and native plants dominated in September. Coontail, flatstem pondweed, and water celery all increased in September compared to the June survey (Table 3). The Secchi reading was 7.5 feet on June 17 and was 3.5 feet on September 7.

A map of aquatic plant coverage is shown in Figure 5. Aquatic plants covered about 21 of the bottom or roughly 105 acres. Within the 105 acres, white lilies were dense in the shallow bays. Submerged plants had low densities (Figure 6). No Eurasian watermilfoil was found in this survey.

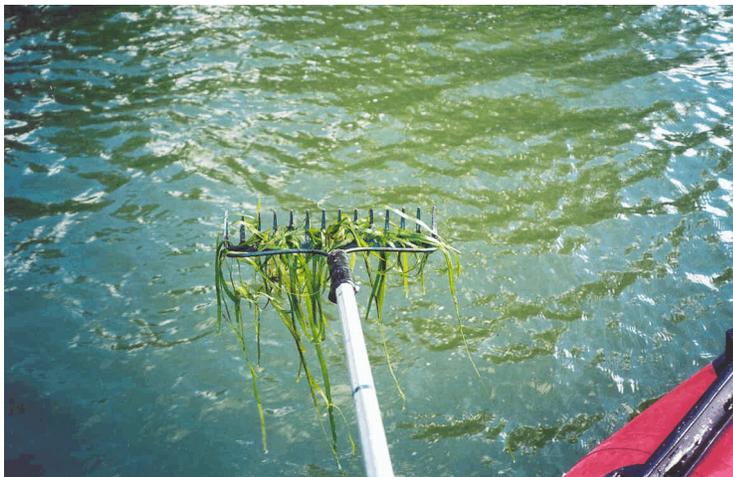
The occurrence and density of plants for individual transects are shown in Table 4.



**Figure 5. Aquatic plant coverage map for South Lindstrom Lake on September 7, 2004. The green area shows coverage of aquatic plants. Plants covered about 105 acres.**

**Table 3. South Lindstrom Lake aquatic plant occurrences and densities for the September 7, 2004 survey based on 21 transects and 3 depths, for a total of 63 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.**

	Depth 0-4 feet (n=21)			Depth 5-8 feet (n=21)			Depth 9-12 feet (n=21)			All Stations (n=63)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Cattails ( <i>Typha sp</i> )	1	5	0.5	--	--	--	--	--	--	1	2	0.5
Duckweed ( <i>Lemna sp</i> )	1	5	1.0	--	--	--	--	--	--	1	2	1.0
White waterlilies ( <i>Nymphaea sp</i> )	2	10	1.3	1	5	0.5	--	--	--	3	5	1.0
Coontail ( <i>Ceratophyllum demersum</i> )	9	43	0.9	8	38	0.9	--	--	--	17	27	0.9
Chara ( <i>Chara sp</i> )	1	5	1.0	--	--	--	--	--	--	1	2	1.0
Northern watermilfoil ( <i>Myriophyllum sibiricum</i> )	3	14	0.8	1	5	1.0	--	--	--	4	6	0.9
Naiads ( <i>Najas flexilis</i> )	--	--	--	1	5	0.5	--	--	--	1	2	0.5
Water smartweed ( <i>Polygonum sp</i> )	1	5	1.0	--	--	--	--	--	--	1	2	1.0
Curlyleaf pondweed ( <i>Potamogeton crispus</i> )	1	5	0.5	--	--	--	--	--	--	1	2	0.5
Fern pondweed ( <i>P. robbinsii</i> )	4	19	1.6	4	19	1.1	--	--	--	8	13	1.4
Flatstem pondweed ( <i>P. zosteriformis</i> )	11	52	1.0	13	62	0.8	--	--	--	24	38	0.9
Water celery ( <i>Vallisneria americana</i> )	8	38	1.4	5	24	1.3	--	--	--	13	21	1.4
Filamentous algae	5	24	0.8	7	33	0.9	--	--	--	12	19	0.8



**Figure 6. Water celery showed up at 13 stations. This is a desirable native aquatic plant because of its wildlife and fish habitat value and it can help maintain good water clarity.**

**Table 4. Individual transect data for South Lindstrom Lake on September 7, 2004.**

	T1			T2			T3			T4			T5		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Cattails													0.5		
Duckweed													1		
White waterlilies													1.5	0.5	
Coontail							1	1					1.5	1	
Chara															
Northern watermilfoil															
Naiads															
Water smartweed													1		
Curlyleaf pondweed															
Fern pondweed													1.5		
Flatstem pondweed	1	1					0.5	0.5			0.5		0.5	2	
Water celery	2						0.5			1	0.5				
Filamentous algae								0.5							

	T6			T7			T8			T9			T10		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Cattails															
Duckweed															
White waterlilies															
Coontail	1	1								0.5	0.5		1	0.5	
Chara															
Northern watermilfoil															
Naiads											0.5				
Water smartweed															
Curlyleaf pondweed													0.5		
Fern pondweed															
Flatstem pondweed	1	0.5					1	1			1		1		
Water celery				2	2		2	1		2	2			1	
Filamentous algae	2	1													

	T11			T12			T13			T14			T15		
	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12	0-4	5-8	9-12
Cattails															
Duckweed															
White waterlilies															
Coontail										1	0.5				
Chara													1		
Northern watermilfoil															
Naiads															
Water smartweed															
Curlyleaf pondweed															
Fern pondweed					1										
Flatstem pondweed											0.5			1	
Water celery										1					
Filamentous algae				0.5	1		0.5	1		0.5					

**Table 4. Individual transect data for South Lindstrom Lake on September 7, 2004 concluded.**

	T16			T17			T18			T19			T20			T21		
	0 -4	5 -8	9 -12	0 -4	5 -8	9 -12	0 -4	5 -8	9 -12	0 -4	5 -8	9 -12	0 -4	5 -8	9 -12	0 -4	5 -8	9 -12
Cattails																		
Duckweed																		
White waterlilies																1		
Coontail				1	2		1						0.5				1	
Chara																		
Northern watermilfoil				1			1									0.5	1	
Naiads																		
Water smartweed																		
Curlyleaf pondweed																		
Fern pondweed		0.5		3	2								1			1	1	
Flatstem pondweed				1			1	0.5		1	0.5		2	1		1	0.5	
Water celery									1									
Filamentous algae		0.5						1		0.5				1				



**Figure 7. Shallow bays in South Lindstrom produce a good diversity of aquatic plants.**

## Comparison of Early and Late Summer Aquatic Plant Surveys in 2004

In the early summer of 2004, Curlyleaf pondweed was found around the perimeter of South Lindstrom Lake out to a water depth of about 12 feet. However, it was found to mat at the surface in only about 16 acres.

By the early part of September, both curlyleaf pondweed and stringy pondweed densities were down. There was fairly good native plant diversity with several plant species increasing from early to late summer (Table 5). Flatstem pondweed was the most common plant in September.

The acreage of aquatic submerged plants in South Lindstrom Lake decreased from early to late summer primarily because of the dieback of curlyleaf pondweed and stringy pondweed.

**Table 5. The percent occurrence of aquatic plants for South Lindstrom Lake in 2004. 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 milfoil was found in 25 out of 50 stations, its percent occurrence would be 50%.**

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Chara ( <i>Chara sp</i> )	--	2	+
Northern watermilfoil ( <i>Myriophyllum sibiricum</i> )	2	6	+
Naiads ( <i>Najas flexilis</i> )	--	2	+
Water smartweed ( <i>Polygonum sp</i> )	--	2	+
Curlyleaf pondweed ( <i>Potamogeton crispus</i> )	95	2	-
Stringy pondweed ( <i>P. pusillus</i> )	70	--	-
Fern pondweed ( <i>P. Robbinsii</i> )	5	13	+
Flatstem pondweed ( <i>P. zosteriformis</i> )	3	38	+
Water celery ( <i>Vallisneria americana</i> )	--	21	+
Filamentous algae	25	19	-
Aquatic Plant Coverage (acres)	270	105	-
Secchi disc (ft)	7.5	3.5	-

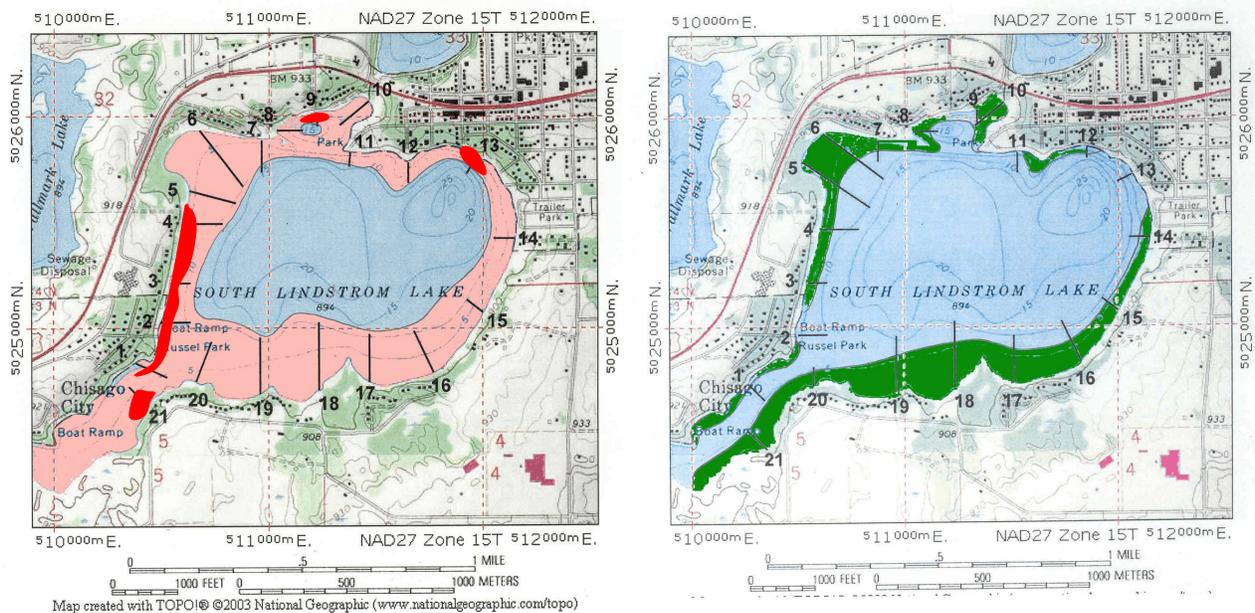
# Conclusions and Recommendations for Aquatic Plant Management in South Lindstrom Lake

The aquatic plant community has six species of submerged plants in early summer and nine species in late summer. This is a fair plant diversity condition.

Curlyleaf pondweed covers 270 acres in early summer and then dies back. In late summer, aquatic plants cover about 105 acres and grow out to about 8-feet of water depth representing about 21% of the lake bottom.

If native plant distribution could increase, water clarity could improve as well.

Curlyleaf pondweed is an exotic aquatic plant that grows in early summer in South Lindstrom Lake and then dies off by the end of June. As the curlyleaf plant beds decompose in the lake, phosphorus is released and feeds into algae blooms. Nuisance curlyleaf growth was delineated in 2004 and was found to occur in about 16 acres, or 3% of the lake area. This is a low nuisance condition and curlyleaf management is not needed at this time.

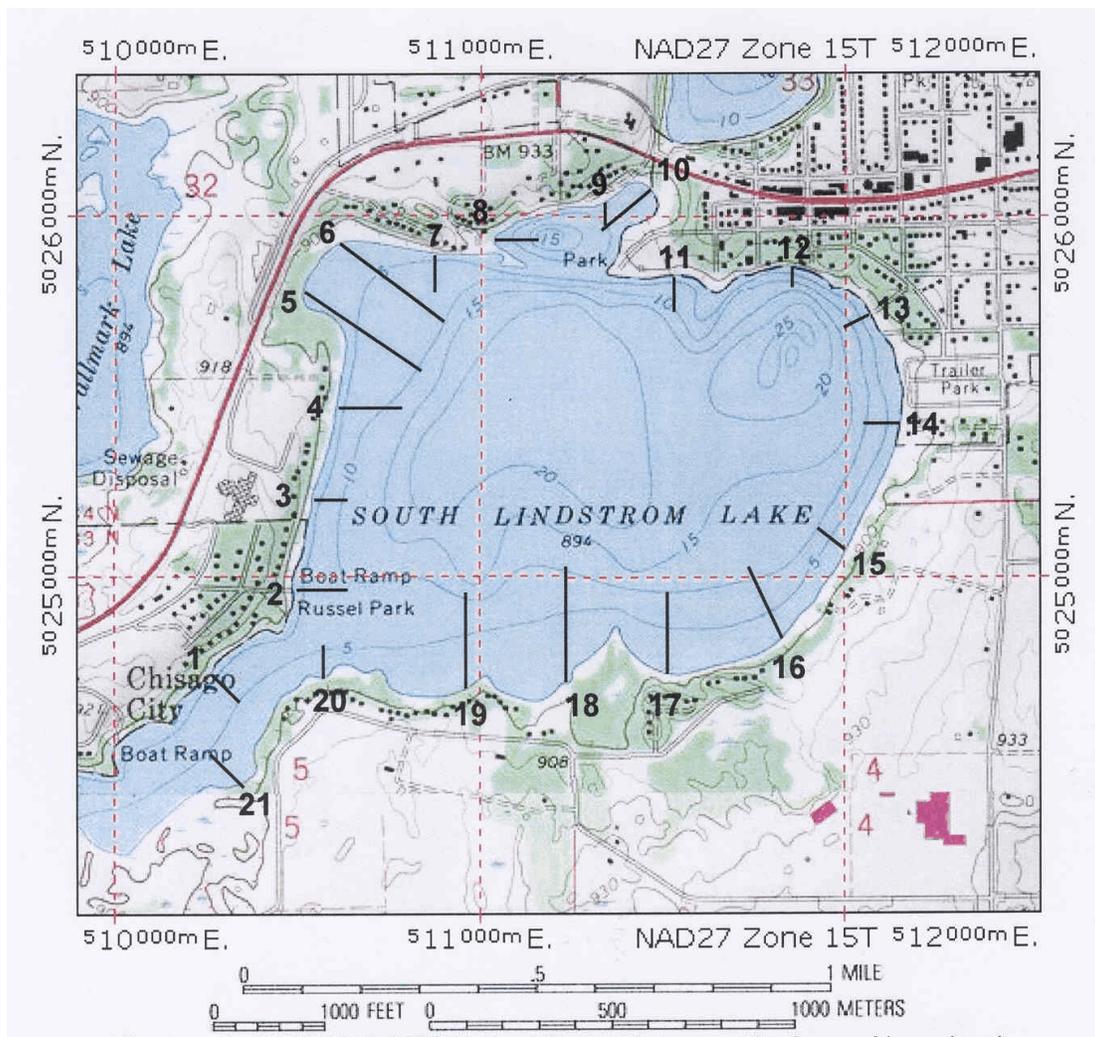


**Figure 7. (left) Early summer aquatic plant coverage in 2004 represents about 270 acres. Nuisance curlyleaf pondweed is shown in red and covers about 16 acres out of a total of 270 acres (shown in pink). (right) Late summer aquatic plant coverage in 2004 is about 210 acres (shown in green).**

**Appendix**  
**Transect Descriptions**  
**Sonar Graphs**  
**Previous Survey from 1995**



**Curlyleaf pondweed in South Lindstrom on June 17, 2004 – a non-nuisance condition.**



Transect Number	GPS Coordinates		Description
	North	East	
1	50 24 745	05 10 262	Landing
2	50 24 953	05 10 571	Right of old landing
3	50 25 188	05 10 545	In-between 2 whitish rip-rap shores
4	50 25 468	05 10 612	2 houses left of point
5	50 25 744	05 10 540	Around the point
6	50 25 906	05 10 609	100 m left of 1 <sup>st</sup> developed property - shoreland shed
7	50 25 846	05 10 871	House with a treble clef on chimney, wood retaining wall with back columns
8	50 25 926	05 11 100	Right of Rosehill Resort
9	50 26 008	05 11 337	2 <sup>nd</sup> house from North Lindstrom channel
10	50 26 029	05 11 442	Right of stairs
11	50 25 761	05 11 516	Left of white boathouse on shore
12	50 25 800	05 11 824	Gray rip-rap shore
13	50 25 691	05 12 057	Right of landing, right of a birdhouse on pole
14	50 25 446	05 12 062	Right of last mobile house
15	50 25 116	05 11 950	1 <sup>st</sup> house on natural shoreline, has a wood deck and a dock
16	50 24 883	05 11 763	Left of a gravel road coming down a hill
17	50 24 761	05 11 509	1 <sup>st</sup> house left of point
18	50 24 717	05 11 223	Right of cattail bed
19	50 24 736	05 10 974	Rambler left of shoreline shed
20	50 24 756	05 10 570	Left of birdhouse
21	50 24 500	05 10 288	Right before indent of slough