Construction Activity on North Lindstrom Lake, August 30, 2005

Aquatic Plant Surveys for North Lindstrom Lake, Chisago County, Minnesota in 2005

Early Summer Survey: June 9, 2005
Late Summer Survey: August 30, 2005

Prepared for:
Chisago Lakes
Lake Improvement District
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Summary

Two aquatic plant surveys were conducted on North Lindstrom Lake (137 acres) in 2005. The early summer survey of June 9 emphasized the distribution and abundance of curlyleaf pondweed. The late summer survey of August 30 was to characterize changes in the plant community and to scout for Eurasian watermilfoil. For each survey, 17 transects and 3 depths were checked.

Curlyleaf pondweed was the most common plant in North Lindstrom Lake in early summer and showed up at 96% of the stations (Table 1). Curlyleaf pondweed is a non-native plant that dies back in mid-summer. In the early summer of 2005, curlyleaf pondweed was found around the edge of most of North Lindstrom Lake (Figure 1). It covered approximately 49 acres out of the 137 acre lake with nuisance coverage of about 3 acres.

In August, the curlyleaf pondweed had died back and a new crop of curlyleaf pondweed had sprouted. However, the dominant plant was a native plant, fern pondweed. The acreage of aquatic submerged plants in North Lindstrom Lake in late summer was about 30 acres. Eurasian watermilfoil was found for the first time in the lake on Transect 7 in August, 2005.

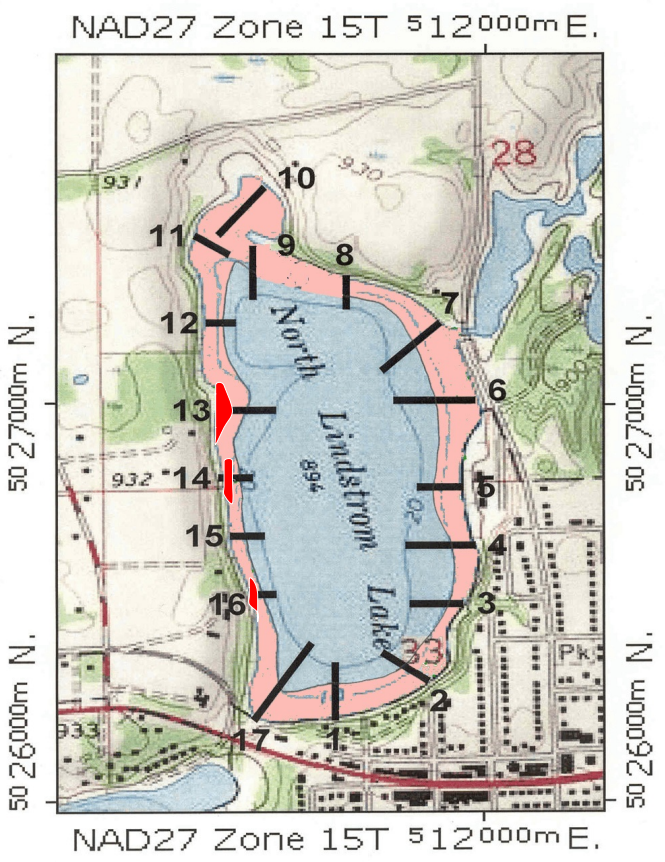


Figure 1. The coverage of aquatic plants in June of 2005 is shown in pink and nuisance curlyleaf pondweed is shown in red. Curlyleaf pondweed was the dominant plant and the area of distribution was about 505 acres with nuisance growth covering about 55 acres.

Conclusions and Recommendations for Aquatic Plant Management in North Lindstrom Lake: The aquatic plant community had six species of aquatic plants in early summer and twelve species in late summer. This is a fair plant diversity condition.

Curlyleaf pondweed covers 49 acres in early summer and then dies back. In late summer, aquatic plants cover about 30 acres and grow out to about 7-feet of water depth.

Curlyleaf pondweed is a non-native aquatic plant that grows in early summer in North Lindstrom Lake and then dies off by the end of June. It is not much of a nuisance in North Lindstrom Lake. No active management (herbicides or harvesting) is needed.

However, Eurasian watermilfoil was found in North Lindstrom in the late summer survey. A follow-up survey should be conducted in 2006 to track its spread and potential nuisance growth. Herbicide applications could be used, but Eurasian watermilfoil is past the eradication stage. Herbicides would be recommended only for areas of nuisance growth.

Table 1. The percent occurrence of aquatic plants for North Lindstrom Lake in 2005. 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 9, 2005 % Occurrence (51 stations)	August 30, 2005 % Occurrence (51 stations)	Changes from June to August
Duckweed (*Lemna sp*)	--	4	+
White waterlilies (*Nymphaea sp*)	6	8	+
Coontail (*Ceratophyllum demersum*)	2	25	+
Northern watermilfoil (*Myriophyllum sibiricum*)	--	2	+
Hybrid watermilfoil (*M. sp*))	--	2	+
Cabbage (*Potamogeton amplifolius*)	4	6	+
Curlyleaf pondweed (*Potamogeton crispus*)	96	22	-
Nuttall's pondweed (*P. epihydrus*)	2	--	-
Stringy pondweed (*P. pusillus*)	2	6	+
Fern pondweed (*P. Robbinsii*)	--	35	+
Flatstem pondweed (*P. zosteriformis*)	--	2	+
Sago pondweed (*Vallisneria americana*)	--	6	+
Water celery (*Vallisneria americana*)	2	29	+
Filamentous algae	18	--	--
Aquatic Plant Coverage (acres)	49	30	
Secchi disc (feet)	10.3	4.5	

North Lindstrom Lake, Chisago County

Lake ID: 13-0035
Size: 137 acres (source: MnDNR)
Littoral area: 55 acres (source: MnDNR)
Maximum depth: 29 ft (source: MnDNR lake map)

Introduction

North Lindstrom Lake is a 137 acre moderately fertile lake in Chisago County, Minnesota.

The aquatic plants of North Lindstrom Lake were sampled to evaluate curlyleaf pondweed and to look for Eurasian watermilfoil and to document the extent of native plant coverage. Steve McComas, Blue Water Science, conducted two aquatic plant surveys on North Lindstrom Lake on June 9 and August 30, 2005.

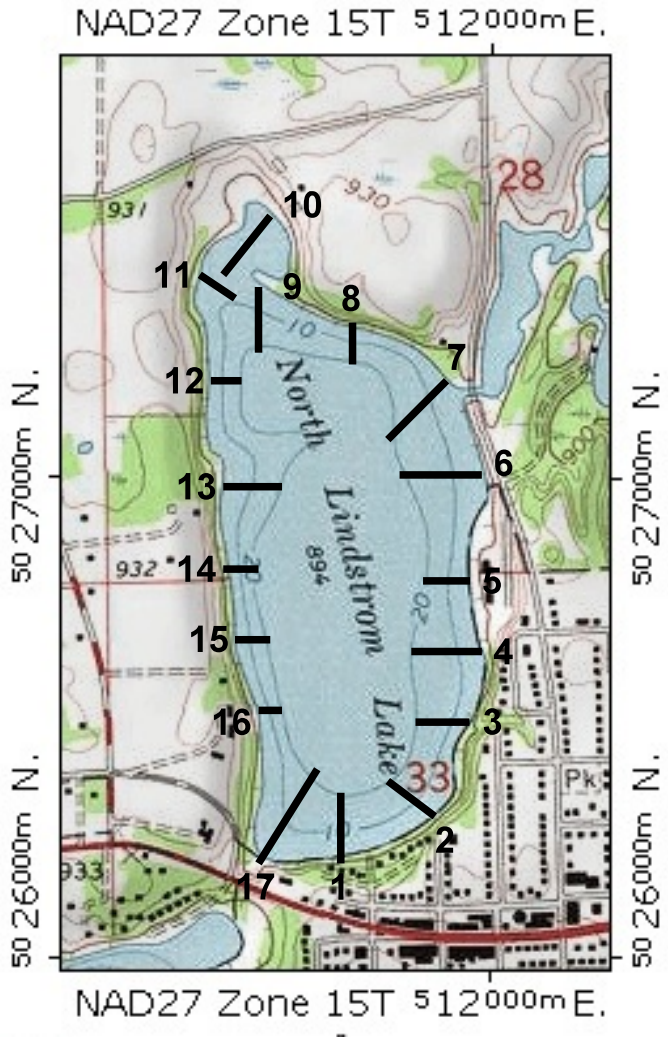


Figure 1. Transects for plant surveys on June 9 and August 30, 2005.

Methods

Several techniques were used to characterize aquatic plants in North Lindstrom Lake. We used 17 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 3 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 North 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. Here is a sample of sago pondweed at a density of a "3" and curlyleaf pondweed at a density of a "1".

Results of the Early Summer Survey -- June 9

The most abundant plant in early summer in North Lindstrom Lake was curlyleaf pondweed, a non-native plant, and it was estimated to cover 49 acres of the 137 acre lake, roughly 36% of the lake. Within the 49 acres of coverage, there was an estimated 3 acres of nuisance curlyleaf growth (Figure 3). Curlyleaf pondweed was found at 49 of the 51 stations and was by far the most common plant in North Lindstrom Lake (Table 1). Curlyleaf grew out to a depth of 12 feet. The next most common plant was cabbage and it occurred at 2 out of 51 stations. Native plants are scarce in North Lindstrom Lake, although there are several beds of water lilies on Transects 10 and 11.

An inventory of plant occurrence and density is shown in Table 2.

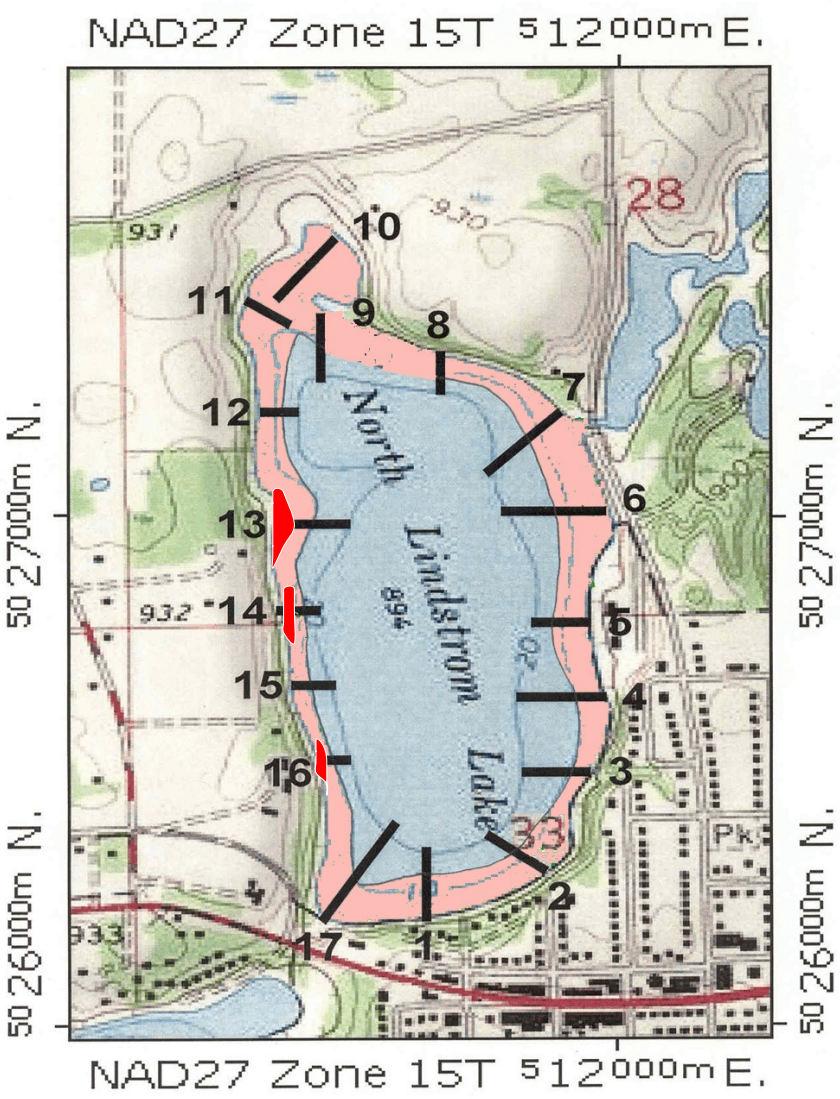


Figure 3. Aquatic plant coverage and curlyleaf coverage on June 9, 2005. Pink shading represents non-nuisance curlyleaf growth along with other plants and covers about 49 acres. Within the 49 acres are about 3 acres of nuisance curlyleaf pondweed growth, shown in red.

Table 1. North Lindstrom Lake aquatic plant occurrences and densities for the June 9, 2005 survey based on 17 transects and 3 depths, for a total of 51 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	Depth 0 - 4 feet (n=17)			Depth 5 - 8 feet (n=17)			Depth 9 - 12 feet (n=17)			All Stations (n=51)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
White waterlily (*Nymphaea sp*)	3	18	1.3	--	--	--	--	--	--	3	6	1.3
Coontail (*Ceratophyllum demersum*)	--	--	--	1	6	0.5	--	--	--	1	2	0.5
Cabbage (*Potamogeton amplifolius*)	2	12	2.5	--	--	--	--	--	--	2	4	2.5
Curlyleaf pondweed (*P. crispus*)	15	88	2.8	17	100	2.4	17	100	1.1	49	96	2.1
Nuttall's pondweed (*P. epihydrus*)	1	6	1.0	--	--	--	--	--	--	1	2	1.0
Stringy pondweed (*P. pusillus*)	1	6	0.5	--	--	--	--	--	--	1	2	0.5
Water celery (*Vallisneria americana*)	1	6	0.5	--	--	--	--	--	--	1	2	0.5
Filamentous algae	6	35	1.0	2	12	0.5	1	6	0.5	9	18	0.8

Figure 4. On June 9, 2005 curlyleaf pondweed on the rakehead is shown here with a density of "3".

Table 2. Individual transect data for North Lindstrom Lake for June 9, 2005.

	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
White waterlily															
Coontail															
Cabbage															
Curlyleaf pondweed	0.8	1	1	1.5	1	1	1.5	2.5	0.5	1	2.5	0.5		0.5	0.8
Epihydrus															
Stringy pondweed															
Water celery															
Filamentous algae	0.5		0.5				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
White waterlily													3	0.5	
Coontail															
Cabbage				4											
Curlyleaf pondweed	3	2.5	1	4	3.3	1.5	2	2.5	1	4	3.3	1.3	3	2	1
Epihydrus															
Stringy pondweed															
Water celery															
Filamentous algae	0.5	0.5													

	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
White waterlily	0.5														
Coontail														0.5	
Cabbage															
Curlyleaf pondweed	2	4	1.5	2.5	3	1	5	1.5	1	4.5	2.5	1	2	3	2
Epihydrus															
Stringy pondweed				0.5											
Water celery				0.5											
Filamentous algae										0.5			1		

	T16			T17		
	0 - 4	5 - 8	9 - 12	0 - 4	5 - 8	9 - 12
White waterlily						
Coontail						
Cabbage				1		
Curlyleaf pondweed	4.5	3.5	1		3	1
Epihydrus				1		
Stringy pondweed						
Water celery						
Filamentous algae	3	0.5				

Results of the Late Summer Survey -- August 30

A significant change in the plant community was found in the August survey compared to the June survey. The widespread growth of curlyleaf pondweed found in June had died back and the new curlyleaf growth was observed in August only grew out to a water depth of about 8 feet, compared to the 12 feet found in June. Fern pondweed was the most common native plant found in North Lindstrom Lake in August (Table 3).

A map of aquatic plant coverage is shown in Figure 5. Aquatic plants covered about 22% of the bottom or roughly 30 acres. Eurasian watermilfoil was found in this survey at one location on Transect 7.

A example of water lily conditions in shallow water areas in August are shown in Figure 6.

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

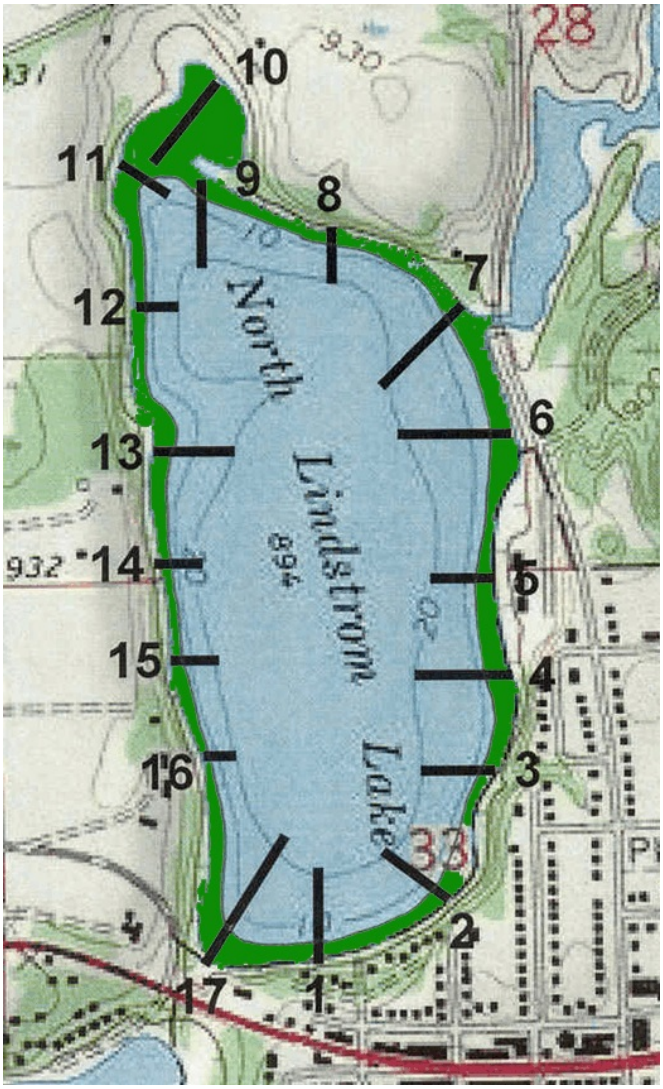


Figure 5. Aquatic plant coverage map for North Lindstrom Lake on August 30, 2005. The green area shows coverage of aquatic plants. Plants covered about 30 acres.

Table 3. North Lindstrom Lake aquatic plant occurrences and densities for the August 30, 2005 survey based on 17 transects and 2 depths, for a total of 34 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	Depth 0 - 4 feet (n=17)			Depth 5 - 8 feet (n=17)			All Stations (n=34)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Duckweed (*Lemna sp*)	1	6	1.0	1	6	0.3	2	6	0.7
White waterlily (*Nymphaea sp*)	3	18	1.5	1	6	1.0	4	12	1.4
Coontail (*Ceratophyllum demersum*)	6	35	0.8	7	41	1.2	13	38	1.0
Northern watermilfoil (*Myriophyllum sibiricum*)	1	6	0.5	--	--	--	1	3	0.5
Hybrid watermilfoil (*M. sp*)	1	6	1.0	--	--	--	1	3	1.0
Cabbage (*Potamogeton amplifolius*)	3	18	0.6	--	--	--	3	9	0.6
Curlyleaf pondweed (*P. crispus*)	5	29	0.6	6	35	0.4	11	32	0.5
Stringy pondweed (*P. pusillus*)	3	18	0.7	--	--	--	3	9	0.7
Fern pondweed (*P. Robbinsii*)	10	59	1.6	8	47	0.7	18	53	1.2
Flatstem pondweed (*P. zosteriformis*)	--	--	--	1	6	0.7	1	3	0.7
Sago pondweed (Stuckenia pectinata)	3	18	0.7	--	--	--	3	9	0.7
Water celery (*Vallisneria americana*)	11	65	1.8	4	24	1.0	15	44	1.6

Figure 6. White lilies were abundant in shallow water in the north end of North Lindstrom Lake.

Table 4. Individual transect data for North Lindstrom Lake for August 30, 2005.

	T1		T2		T3		T4		T5		T6		T7		T8	
	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8
Duckweed																
White waterlily																
Coontail	1	2						0.3		1	0.5				0.5	0.5
Northern watermilfoil																
Hybrid watermilfoil													1			
Cabbage											1				0.3	
Curlyleaf pondweed					0.3		0.5				0.3	0.3		0.3		0.5
Stringy pondweed																
Fern pondweed							1	0.8	0.8				1		1	0.5
Flatstem pondweed														0.7		
Sago pondweed							0.5		0.5		1					
Water celery			3				1	0.5		1			1	0.3	2.5	

	T9		T10		T11		T12		T13		T14		T15		T16		T17	
	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8	0 - 4	5 - 8
Duckweed			1	0.3														
White waterlily			3	1			0.5										1	
Coontail			1	1.5			1					1	0.5	2				
Northern watermilfoil																	0.5	
Hybrid watermilfoil																		
Cabbage																	0.5	
Curlyleaf pondweed									0.5	0.3		0.5	1.5			0.2		
Stringy pondweed									0.5				1		0.5			
Fern pondweed	4	1		0.3	4	1	1		0.3	0.3	0.5					0.2	2.5	1.5
Flatstem pondweed																		
Sago pondweed																		
Water celery	0.5				1		4	2			0.5		1.5		4		1	

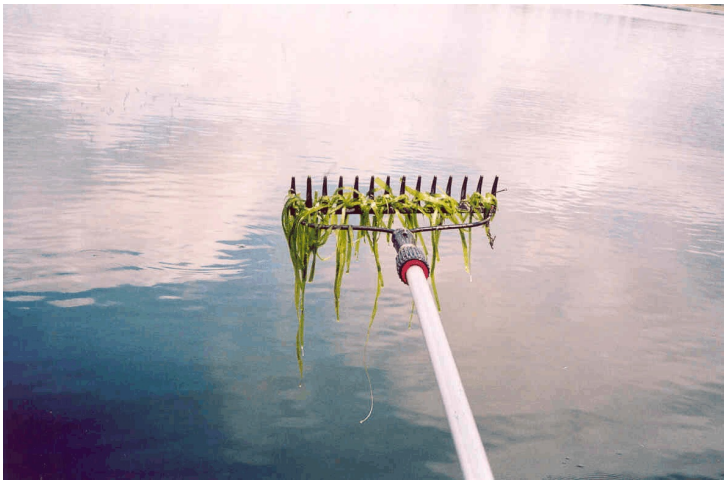


Figure 7. Water celery at a density of a "3" on Transect 2.

Comparison of Early and Late Summer Aquatic Plant Surveys in 2005

In the early summer of 2005, Curlyleaf pondweed was found around the perimeter of North Lindstrom Lake. Curlyleaf grew out to about 12 feet of water, although it was mostly low density. Other plants in North Lindstrom were scarce.

In August, curlyleaf pondweed distribution was down but the sprouting of new curlyleaf had occurred. Fern pondweed was the most common plant followed by water celery (Table 5). Plants grew out to about 7 feet of water depth.

The acreage of aquatic submerged plants in North Lindstrom Lake from early to late summer changed as did the species composition. As is typical, native plants increased in occurrence from June to August.

Table 5. The percent occurrence of aquatic plants for North Lindstrom Lake in 2005. 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 9, 2005 % Occurrence (51 stations)	August 30, 2005 % Occurrence (51 stations)	Changes from June to August
Duckweed (*Lemna sp*)	--	4	+
White waterlilies (*Nymphaea sp*)	6	8	+
Coontail (*Ceratophyllum demersum*)	2	25	+
Northern watermilfoil (*Myriophyllum sibiricum*)	--	2	+
Hybrid watermilfoil (*M. sp*))	--	2	+
Cabbage (*Potamogeton amplifolius*)	4	6	+
Curlyleaf pondweed (*Potamogeton crispus*)	96	22	-
Nuttall's pondweed (*P. epihydrus*)	2	--	-
Stringy pondweed (*P. pusillus*)	2	6	+
Fern pondweed (*P. Robbinsii*)	--	35	+
Flatstem pondweed (*P. zosteriformis*)	--	2	+
Sago pondweed (*Vallisneria americana*)	--	6	+
Water celery (*Vallisneria americana*)	2	29	+
Filamentous algae	18	--	--
Aquatic Plant Coverage (acres)	49	30	-
Secchi disc (feet)	10.3	4.5	-

Conclusions and Recommendations for Aquatic Plant Management in North Lindstrom Lake

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

Curlyleaf pondweed covers 49 acres in early summer and then dies back. In late summer, aquatic plants cover about 30 acres and grow out to about 7-feet of water depth.

Curlyleaf pondweed is a non-native aquatic plant that grows in early summer in North Lindstrom Lake and then dies off by the end of June. It is not much of a nuisance in North Lindstrom Lake. No active management (herbicides or harvesting) is needed.

However, Eurasian watermilfoil was found in North Lindstrom in the late summer survey. A follow-up survey should be conducted in 2006 to track its spread and potential nuisance growth. Herbicide applications could be used, but Eurasian watermilfoil is past the eradication stage. Herbicides would be recommended only for areas of nuisance growth.

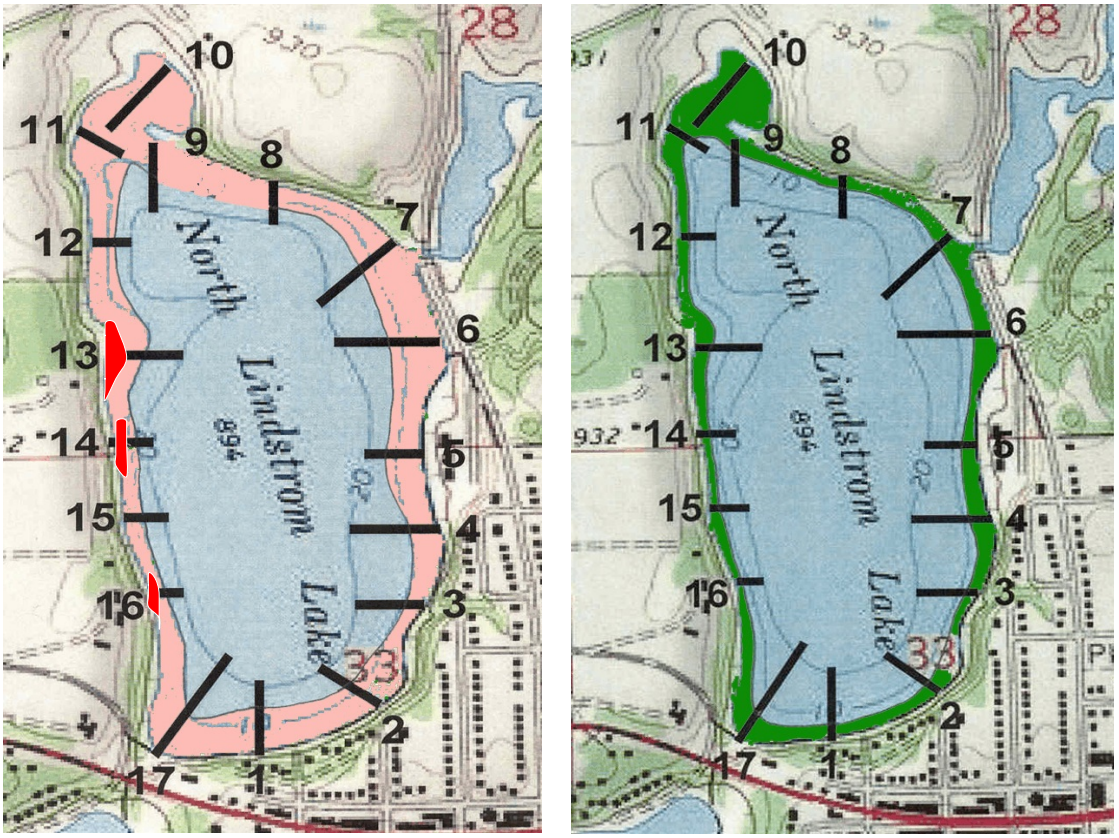
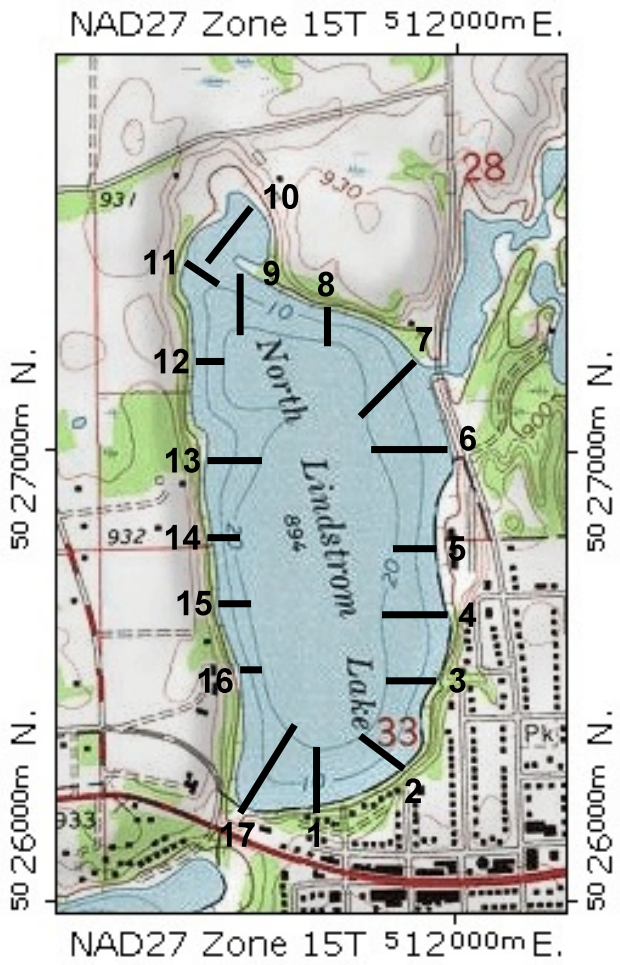


Figure 8. (left) Early summer aquatic plant coverage in 2005. Nuisance curlyleaf pondweed is shown in red and covers about 3 acres out of a total of 49 acres (shown in pink).
(right) Late summer aquatic plant coverage in 2005 was about 30 (shown in green).

Appendix

Transect Descriptions



North Lindstrom Lake

Transect	GPS Coordinates		Transect Description
	East	North	
1	05 11 705	50 26 308	Between two homes with 2nd story decks.
2	05 11 833	50 26 364	Left of wood retaining wall.
3	05 11 888	50 26 486	Left of shoreline gazebo.
4	05 11 921	50 26 637	Right of shoreline birdhouse, brown house with flag pole.
5	05 11 912	50 26 787	House right of cattails.
6	05 11 903	50 27 000	Right of old gravel landing off Highway.
7	05 11 881	50 27 155	Right of 1st house on shoreline.
8	05 11 749	50 27 306	Middle of shoreline.
9	05 11 539	50 27 331	Right of old stump.
10	05 11 544	50 27 519	Brown house.
11	05 11 469	50 27 383	Natural shoreline.
12	05 11 481	50 27 205	Where trees stop and meadow starts.
13	05 11 478	50 26 981	1st house after natural shoreline.
14	05 11 502	50 26 816	Left of gray house with little keystone wall.
15	05 11 519	50 26 684	Middle of three wooden stairways.
16	05 11 555	50 26 530	Left of green shoreline fish house.
17	05 11 593	50 26 373	Large fallen tree truck.