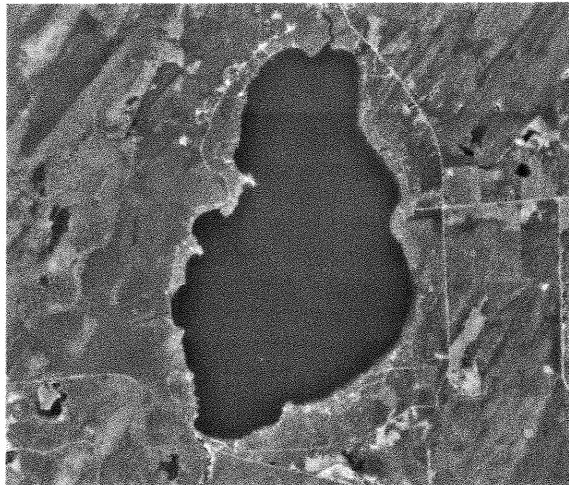

**Proposal for the Development of an Aquatic Plant
Management Plan for Pine Lake, Forest County,
Wisconsin**



Prepared by:



**Brad Roost
P.O. Box 109
Berlin, WI 54923-0109
920-361-4088**

Requested by:

**The Pine Lake Protection and Rehabilitation District
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10735 West Pine Lake Road
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715-649-3242**

January 10, 2006

Introduction

Pine Lake is a large shallow drainage lake located near the town of Hiles in Forest County (**Figure 1**). It is approximately 1670 acres with a maximum depth of 14 feet (**Figure 2**). As one of the largest lakes in Forest County with over 400 property owners in the District, Pine Lake receives heavy recreational use. Land uses in the surrounding countryside include forestry and light agriculture. Three inlet streams, Pine Creek, Wildcat Creek, and Copper Creek feed Pine Lake. The outlet for the lake is the Wolf River to the south. At present, the lake contains a diverse community of aquatic plants and a high quality fishery, including northern pike, walleye, bass and panfish.

The Pine Lake Protection and Rehabilitation District represents the interests of lakeshore property owners and other lake users. District members are very concerned over the ecological health of the lake. As a result, they play an active role in lake management largely through volunteer efforts and the sponsoring of numerous studies over the years.

In a recent survey of property owners conducted by the District, a majority indicated they chose to live on Pine Lake for its recreation opportunities including swimming, fishing, relaxing and wildlife viewing. However, excessive weed growth has been a major issue for lake users for a number of years. For years, the District has operated a weed harvester to manage aquatic plants in Pine Lake. The harvesting program has encountered a number of challenges including frequent harvester breakdowns and disagreement over the use of harvesting as a management tool. Over 85% of the property owners surveyed feel aquatic plant growth continues to be excessive and the current control program is ineffective at controlling nuisance plants.

According to the Wisconsin Department of Natural Resources, Eurasian watermilfoil (*Myriophyllum spicatum*), an aggressive exotic plant species was confirmed in Pine Lake in January 2004. However, the general consensus is that Eurasian watermilfoil has been present much longer. In 1992 and 2004, Northern Lakes Service, Inc was retained by the P & R District to conduct aquatic plant surveys. Data from these surveys were used to determine the distribution and density of aquatic plants in Pine Lake. The 2004 survey was performed at the request of the P & R District for the purpose of assessing and rewriting their management plan.

In both the 1992 and 2004 aquatic plant surveys, a species of hybrid milfoil was found. At the time of the 1992 survey, this species was identified as a native milfoil. It was not until a few years later, however, that this species was identified as a hybrid. In 2004, DNA analysis further confirmed that the milfoil growing in Pine Lake is a hybrid species. However, as of the 2004 survey, the hybrid milfoil had not dominated the submergent plant community.

In addition to the hybrid milfoil, the 2004 survey found the presence of curly-leaf pondweed (*Potamogeton crispus*). Specimens were collected at two sample sites in the southern half of the lake. An additional survey was conducted on August 15, 2005 by

Aquatic Biologists, Inc. staff to estimate the full extent of curly-leaf pondweed in the southern end of Pine Lake. This survey identified three locations of curly-leaf pondweed totaling 16.0 acres (**Figure 3**).

In an attempt to better manage the nuisance plant growth, The Pine Lake Protection and Rehabilitation District is seeking financial support from the Wisconsin DNR's Aquatic Invasive Species Rapid Response Grant Program to help fund herbicide treatment of the 16 acres of curly-leaf pondweed in Pine Lake.

In addition, the District would like to reassess the management of excessive weed growth in Pine Lake. To this end, the District is seeking additional financial support from the Wisconsin DNR's Lake Management Planning Grant Program to help update their Aquatic Plant Management Plan. With the knowledge gained by this project, the District hopes to take the appropriate actions needed to best management the aquatic plants in Pine Lake for lake users and the biotic community alike.

Project Goals

The primary goals of this lake survey will be 1) to gather baseline information on the physical, chemical and biological aspects of Pine Lake and its watershed, 2) to address excessive weed growth through the development of a comprehensive Aquatic Plant Management Plan for Pine Lake, 3) to identify and prioritize management concerns including harvesting, shoreline treatments, and navigation lanes, and 4) to provide information needed to make informed decisions regarding the future management of the lake both ecologically and sociologically.

Project Work Elements

Field Studies

Specific elements of this study will focus on the aquatic plant community, water quality parameters, and the watershed surrounding Pine Lake as follows:

A. Aquatic Plant Assessment

1. Conduct a point-intercept survey of submergent aquatic plants
2. Map the distribution and acreage of nuisance aquatic plants

B. Water Quality Assessment

1. Assess a broad range of in-lake water chemistry and limnological parameters
2. Develop dissolved oxygen and temperature profiles
3. Develop nutrient budget from data collected from Pine Lake and its tributaries
4. Represent the productivity of the lake by developing Trophic State Indices (TSIs)

C. Watershed Assessment

1. Delineate watershed boundaries
2. Document land uses and cover types within the watershed
3. Identify potential nutrient and other pollution loading sources

Aquatic Plant Assessment

In July or August 2006, a submergent aquatic plant survey will be conducted utilizing reproducible methods so that future surveys can accurately assess changes to the plant community. In 1992 and 2004, plant surveys were conducted to assess the aquatic plant community. Within the past year, DNR guidelines pertaining state-wide to the design and implementation of aquatic plant surveys have been established. These guidelines specifically require the use of a point-intercept method. Under the guidance of Jennifer Hauxwell from the DNR, an approved plant survey map for Pine has been designed (**Figure 4**). A series of grid points were mapped across the lake. Where grid lines intercept, aquatic plant samples will be collected from a boat. A single rake tow will be made at each point intercept. In total 828 points will be sampled in Pine Lake.

According to DNR guidelines, the rake used will consist of two short-toothed garden rake heads welded together and attached to a 15 foot telescoping pole. Where depths are too great to collect samples with the telescoping pole, a rake will be attached to a rope and thrown from the boat. At each sample point, the rake will be dragged along the bottom for approximately 2.5 feet to collect plants. All plant samples collected will be identified to *genus* and *species* whenever possible, and recorded. An abundance rating will be given for exotic species collected using the criteria described in **Figure 5**. In addition to the plant data, depth, and bottom substrate composition will be recorded for each point intercept. Data collected will be used to determine species composition, percent frequency and relative abundance. They will also be compared to data collected during the 1992 and 2004 surveys to assess any changes to the aquatic plant community.

Plant Distribution Mapping

The extent and locations of any nuisance plant species, including the exotic plant species Eurasian watermilfoil, its hybrids, and curly-leaf pondweed, found in Pine Lake will be determined from surface observations and rake tows. The locations of the beds will be mapped with the use of a Garmin V GPS unit and drawn on lake contour maps using shoreline features as references. GPS technology and/or modified acreage grid analysis will be used to determine the area of each location.

Water Quality Assessment

During the summer of 2006, a one-time assessment of the water quality of Pine Lake will be made. This will involve collecting water samples from Pine Lake, its tributaries and outlet to determine the source and fate of nutrients within the system (**Figure 6**). All samples collected will be sent to the State Lab of Hygiene for analysis. Samples collected in the main body of the lake will be analyzed for:

- Dissolved (ortho) phosphorus
- Total phosphorus
- Total Kjeldahl nitrogen
- Nitrate + nitrite as N
- Ammonia as N
- Chlorophyll *a*
- pH
- Dissolved oxygen
- Temperature
- Transparency (Secchi depth)

Water samples will be taken one foot below the surface and one foot above the lakebed at the deepest point of the lake for all analyses except chlorophyll *a*, which will be collected at the surface only. Dissolved oxygen and temperature profiles will be developed and readings for pH and Secchi depth will be collected directly in the field.

At the same time, water samples will be collected from each of the three tributaries to Pine Lake as well as from the Wolf River to the south (**Figure 6**). Analyses conducted on these samples will include:

- pH
- Total phosphorus
- Nitrate + nitrite as N
- Temperature

Total phosphorus, chlorophyll *a* and Secchi depth are often used as indicators of the water quality or productivity (trophic state) of lakes. Values measured for these parameters throughout the system will be used to calculate Trophic State Index (TSI) values. In addition a nutrient budget for the system will be completed for data collected from the main body of the lake as well as the inlets and outlet.

Watershed Assessment

The boundary of the watershed of Pine Lake will be delineated and its physical characteristics described by using topographic maps and county soil surveys. Land use patterns, vegetative cover, potential nutrient loading sources, and environmentally sensitive areas will be further assessed by ground surveys. Pollutant loads will be estimated using standard runoff coefficients. The potential impacts of these features on the aquatic plant community of Pine Lake will be presented and discussed. Management strategies for watershed features which are potential pollution sources will be incorporated.

Special attention will be made to the condition of Pine Lake's shoreline. A significant amount of nutrients and sediments can enter a lake from areas closest to the lake, it will be important to focus on the entire lake shore and identify potential areas of concern. These would include areas of disturbance, high erosion, or generally poor riparian health. Areas identified will be mapped and presented with management recommendations for remediation or improvement.

Aquatic Plant Management Plan

Review of Management Alternatives

In the development of the Aquatic Plant Management Plan a number of management alternatives will be reviewed in an ongoing attempt to prioritize long-term lake management needs. These alternatives will include, but not be limited to, continued weed harvesting and herbicides treatments. If it is decided that harvesting is to be continued, a harvesting plan will be designed to meet the DNR permit requirements and would include the prioritizing of harvesting locations on the lake including navigation lanes. The use of herbicides will also be discussed including the herbicides available, their modes of actions, environmental fate, use restrictions, and herbicide selectivity. Herbicide use in shoreline treatments and in the opening of navigation lanes will specifically be evaluated as management options.

Literature Review

The review of available literature will be an important component of this survey, and will be based in part on the findings of the project. The literature review will encompass 1) native aquatic plant values for habitat and water quality, 2) aquatic plant management options, including weed harvesting and herbicide treatment, 3) nutrient management and habitat protection techniques for lakefront property owners, 4) additional information available for Pine Lake including previous studies, and 5) other areas of concern identified during the course of this project.

Project Deliverables

Information gathered from all project elements will be used to develop an Aquatic Plant Management Plan for Pine Lake. This report will present and summarize the findings of this study and literature review. The management implications of these findings will be discussed, and management recommendations will be given. It will be designed to establish the Lake District's long-term aquatic plant management goals.

This management plan will include a number of elements:

- A presentation and interpretation of the findings of the study
- Identification of areas of concern within the lake, the immediate surrounding area and the watershed as a whole.
- Management recommendations for improving water quality, habitat conditions, and recreational opportunities in the Lake.
- Management recommendations for the control of exotic species in Pine Lake.
- Management recommendations for individual property owners as well as the District to improve water quality and land-use practices in the watershed.

This plan will be communicated to the Pine Lake Protection and Rehabilitation District and the Wisconsin Department of Natural Resources in a written report. Ten printed and bound copies of the plan will be presented to the Lake District. Copies will also be submitted to the local DNR aquatic plant manager, and lake grants coordinator. Electronic copies of the plan will also be sent to the Wisconsin DNR and the Pigeon Lake Protection and Rehabilitation District.

Project Costs and Timeframe

An itemized breakdown of costs and a timeline for implementation of activities is shown in Table 1. The total project cost will be \$12,729.07. If the District decides to apply for a cost-sharing grant through the DNR's Lake Management Planning Grant program, the applicants' share of the total costs would be \$ 3,182.27. Wisconsin Lake and Pond Resource staff will encourage community involvement throughout this project. District members should be encouraged to participate in the study. There will be a number of opportunities for volunteers to assist in the fieldwork and gain a better understanding of the condition of Pigeon Lake. This volunteer time can also count toward the District's portion of the study cost at a rate of \$8.00 per volunteer hour.

Figure 1. Pine Lake in Forest County and the surrounding area.

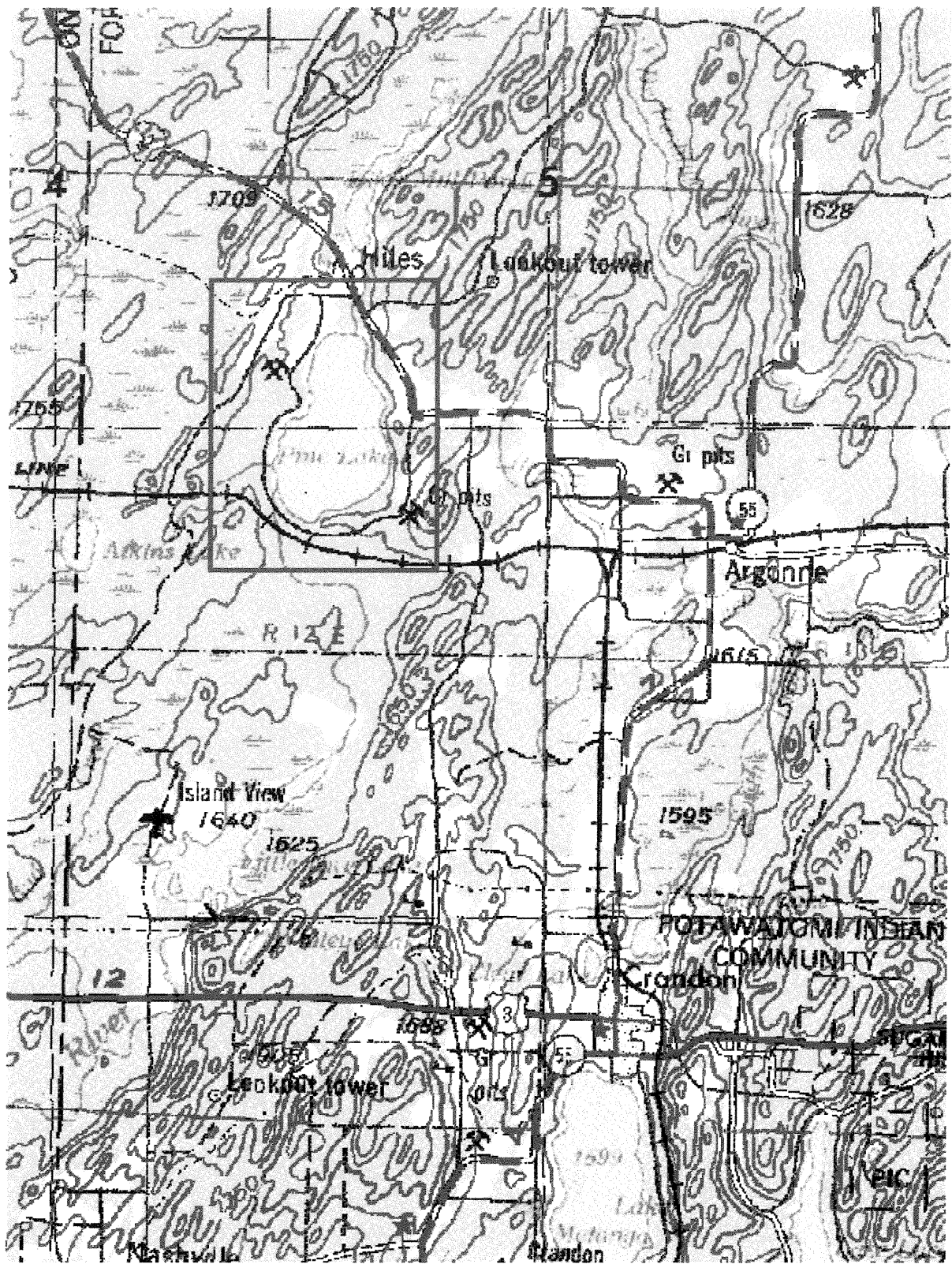
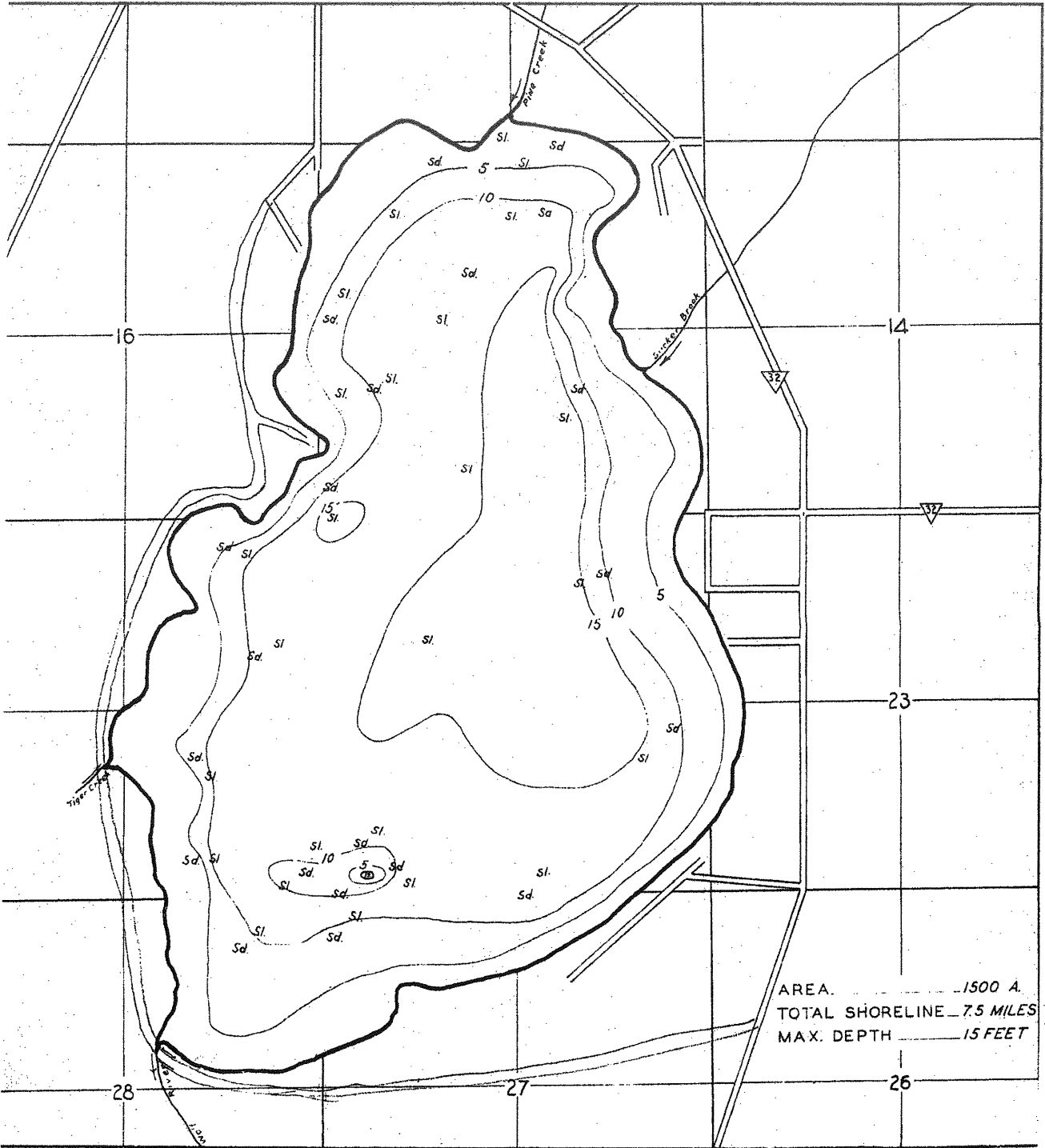


Figure 2. Pine Lake in Forest County, Wisconsin

LAKE SECTION 15.16.21.22.27.28
 TOWNSHIP 37 N
 RANGE 12 E
 TOWN OF CRANDON
 COUNTY FOREST

CONSERVATION DEPARTMENT

IMPROVEMENT SECTION



AREA 1500 A.
 TOTAL SHORELINE... 7.5 MILES
 MAX. DEPTH 15 FEET

† 10. 1938

LAKE IMPROVEMENT RECORD

SCALE 1 inch = 1320 Feet

Service Lake Survey

TYPE	DATE
⊗ BRUSH REFUGES	
~ SAPLING TANGLES	
□ SPAWNING BOXES	
* MINNOW SPAWNERS	
TOTAL	

LEGEND

- ▭ WEED BEDS
- ⊗ ROCKY SHOALS
- Sd SAND
- Cl CLAY
- G Gr GRAVEL
- M M MUCK
- DWELLING
- ABANDONED DWELLING
- ⊠ RESORT

Figure 3. Distribution of curly-leaf pondweed in Pine Lake on August 15, 2005.

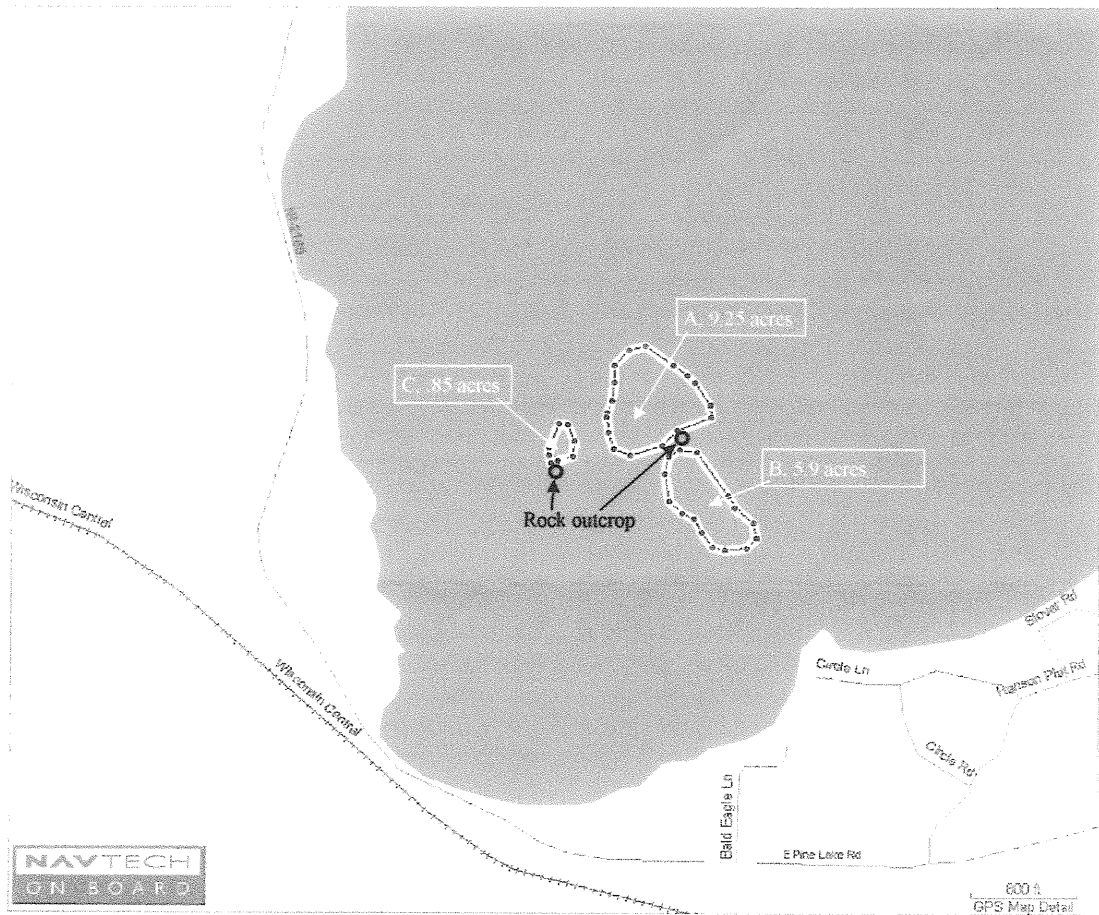


Figure 4. Submergent aquatic plant survey map for Pine Lake, Forest County developed by the Wisconsin Department of Natural Resources (90 meter grid).

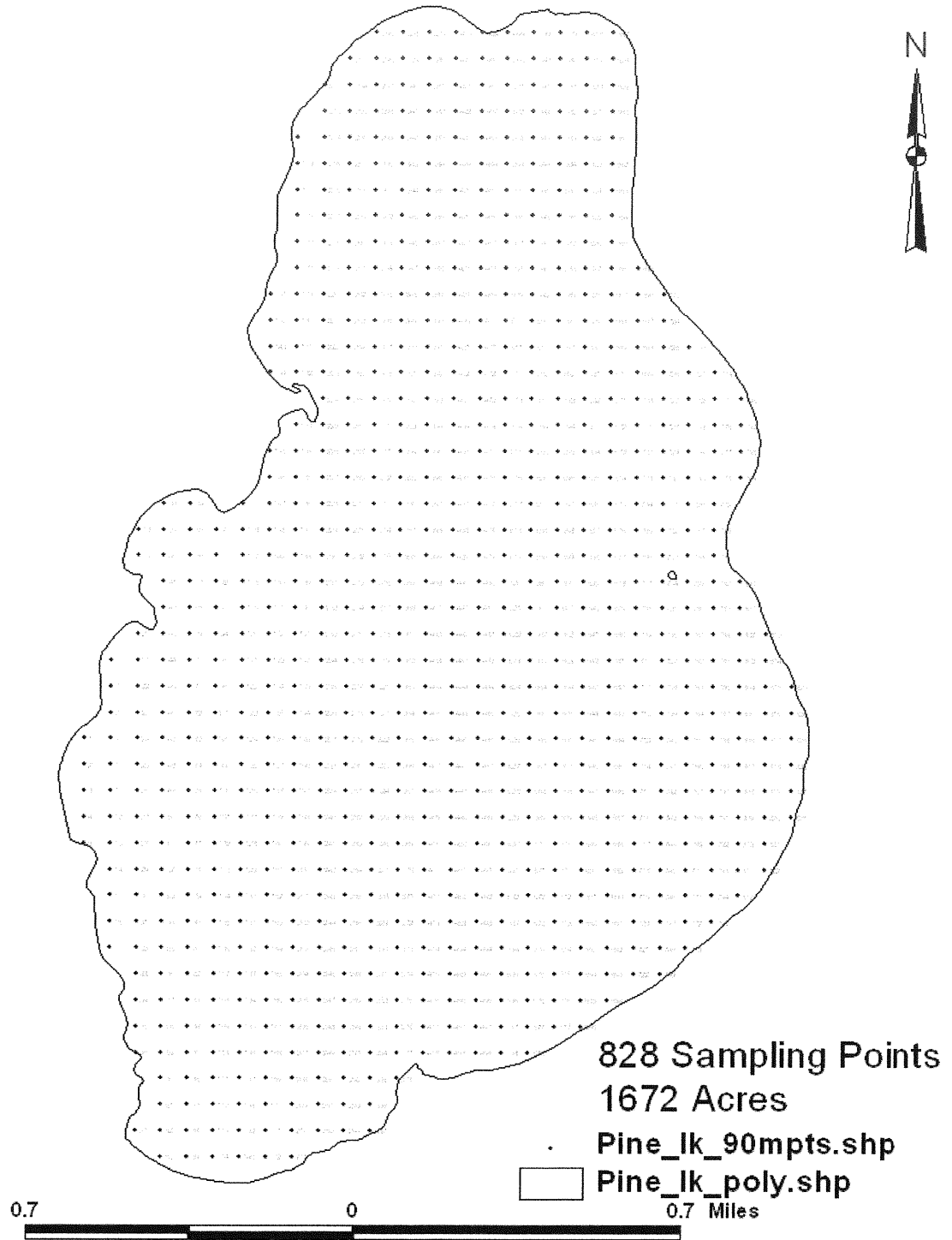


Figure 5. Plant abundance rating criteria used in submergent aquatic plant surveys.

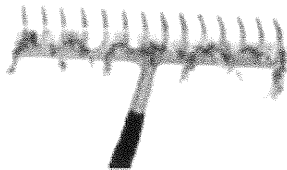
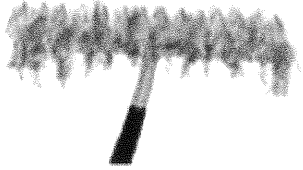
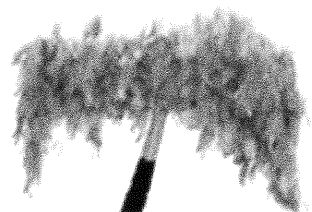
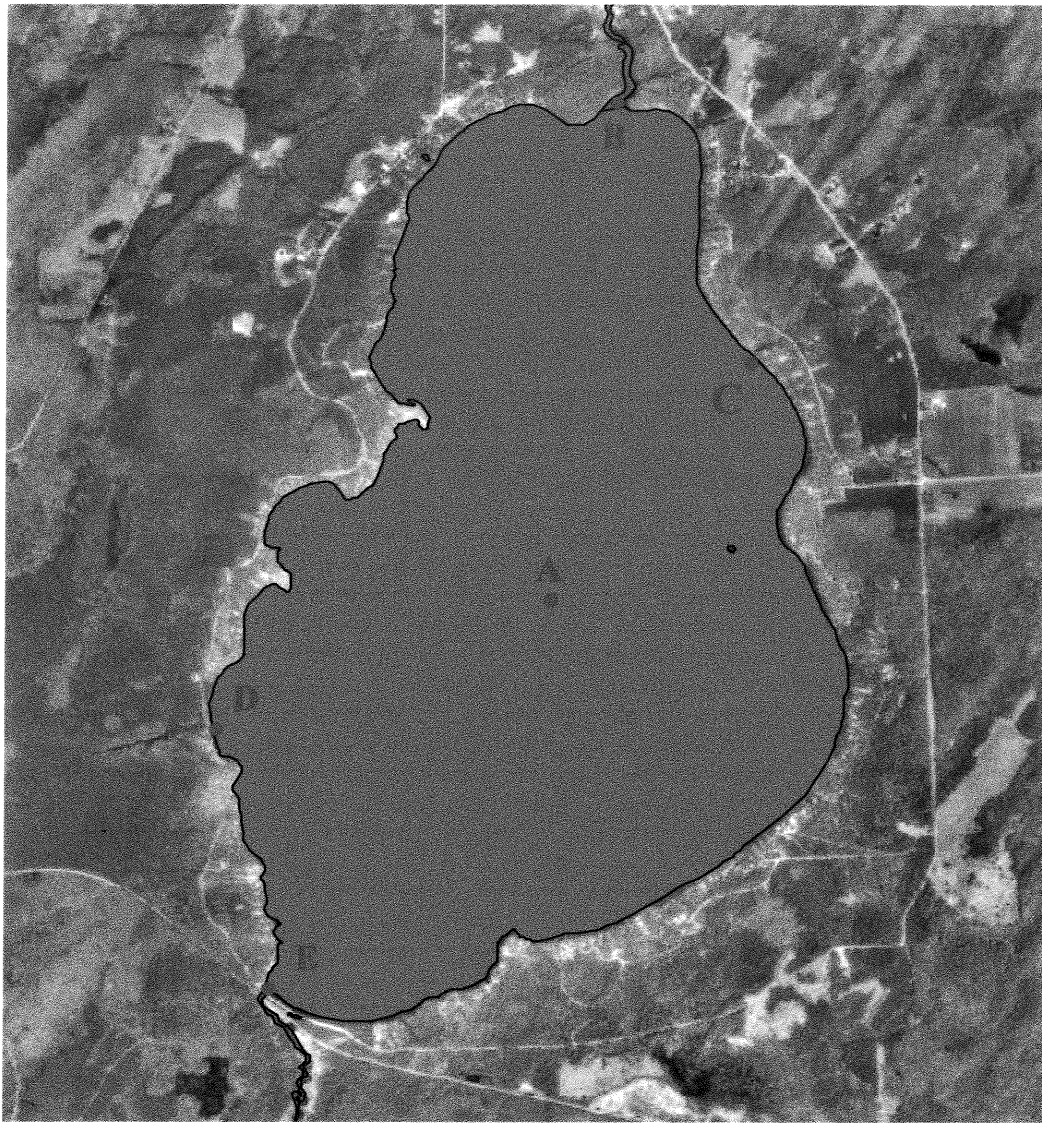
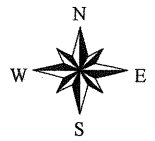
<u>Rating</u>	<u>Coverage</u>	<u>Description</u>
1		A few plants on rake head
2		Rake head is about 1/3 full Can easily see top of rake head
3		Overflowing Cannot see top of rake head

Figure 6. Water quality assessment map for Pine Lake, Forest County.



0.3 0 0.3 Miles

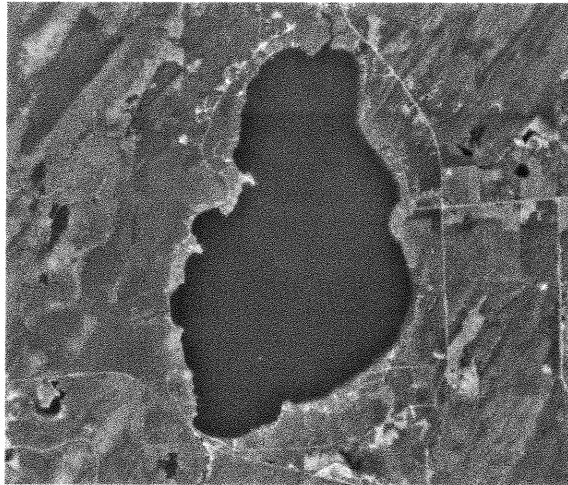


- A Water quality sampling locations.

Table 1. Pine Lake work elements, timetable and cost breakdown

Timeframe	Activity	Labor	Travel Exp.	Other Exp.	Total
July 2006	Conduct submergent plant survey, conduct emergent plant survey, map distribution	\$6,000.00	\$650.00		\$6,650.00
August 2006	Conduct watershed assessment, water quality analysis	\$960.00	\$325.00		\$1,285.00
February 2007	Literature review, data analysis and report writing	\$4,250.00		\$150.00	\$4,400.00
	State Lab of Hygiene Costs (estimated)			\$394.07	\$394.07
Total Project Cost:					\$12,729.07

**Proposal for the Development of an Aquatic Plant
Management Plan for Pine Lake, Forest County,
Wisconsin**



Prepared by:
 **Wisconsin
Lake & Pond Resource LLC**

**P.O. Box 109
Berlin, WI 54923-0109
920-361-4088**

Requested by:
**The Pine Lake Protection and Rehabilitation District
c/o Paul Jenkins
10735 West Pine Lake Road
Hiles, WI 54511
715-649-3242**

April 19, 2006

Introduction

This proposal is being submitted by Wisconsin Lake and Pond Resource, LLC to the Pine Lake Protection and Rehabilitation District for the development of an Aquatic Plant Management Plan for Pine Lake. The primary goals of this lake survey will be 1) to gather baseline information on the physical, chemical and biological aspects of Pine Lake and its watershed, 2) to address excessive weed growth through the development of a comprehensive Aquatic Plant Management Plan for Pine Lake, 3) to identify and prioritize management concerns including harvesting, shoreline treatments, and navigation lanes, and 4) to provide information needed to make informed decisions regarding the future management of the lake both ecologically and sociologically.

Project Work Elements

Field Studies

Specific elements of this study will focus on the aquatic plant community, water quality parameters, and the watershed surrounding Pine Lake as follows:

- A. Aquatic Plant Assessment
 - 1. Conduct a point-intercept survey of submergent aquatic plants
 - 2. Map the distribution and acreage of nuisance aquatic plants
- B. Water Quality Assessment
 - 1. Collect basic in-lake water chemistry parameters
 - 2. Develop dissolved oxygen and temperature profiles
- C. Watershed Assessment
 - 1. Delineate watershed boundaries
 - 2. Document land uses and cover types within the watershed
 - 3. Identify potential nutrient and other pollution loading sources

Aquatic Plant Assessment

In July or August 2006, a submergent aquatic plant survey will be conducted utilizing reproducible methods so that future surveys can accurately assess changes to the plant community. In 1992 and 2004, plant surveys were conducted to assess the aquatic plant community. Within the past two years, DNR guidelines pertaining state-wide to the design and implementation of aquatic plant surveys have been established. These guidelines specifically require the use of a point-intercept method. Under the guidance of Jennifer Hauxwell from the DNR, an approved plant survey map for Pine has been designed (**Figure 1**). A series of grid points were mapped across the lake. Where grid lines intercept, aquatic plant samples will be collected from a boat. A single rake tow will be made at each point intercept. In total 828 points will be sampled in Pine Lake.

	A	G	J	K	L	N	P	R	V	W	AC	AY	BE	BF	BS	BU	CA	CC	CE	CI	DO	DP	DS	DT	DV	DW	DX	EJ	EK
1	Entry																												
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796	Sampled holding rake pole (P) or rake rope (R)?																												

- Depth (m)
- Donnant sediment type (M=muck, S=sand, R=Rock)
- Myriophyllum spicatum*, Eurasian water-milfoil Record 1,2,3
- Myriophyllum demersum*, Coontail
- Brasenia schradetii*, Watershield
- Myriophyllum spicatum*, Eurasian water-milfoil
- X. sibiricum*
- Eloaea canadensis*, Common waterweed
- Najas flexilis*, Bushy pondweed
- Najas variegata*, Spatterdock
- Najas flexilis*, White water-lily
- Potamogeton illinoensis*, Illinois pondweed
- Potamogeton praecox*, Whitesiam pondweed
- Potamogeton pectinatus*, Small pondweed
- Potamogeton robbinsii*, Robbins pondweed
- Potamogeton zosteriformis*, Fatsiam pondweed
- Vallisneria spiralis*, Common
- Vallisneria spiralis*, Wild celery
- STAR DUCKWEED
- FLAMENTOUS ALGAE
- SOFTSTEM BULLRUSH
- WATER MARGOLD
- UNKNOWN BULLRUSH
- PICKEREL WEED

Entry	Sampling point	Depth (ft)	Dominant sediment type (M=muck, S=sand, R=Rock)	Sampled holding rack pole (P) or rake rope (R)?	Mycophyllum spicatum	Mycophyllum spicatum X. suberulum	Chara, Muskgrasses	Eloëe caradensis, Common waterweed	Najas flexilis, Bushy pondweed	Nymphaea odorata, White water lily	Potamogeton gramineus, Variable pondweed	Potamogeton praelongus, Illinois pondweed	Potamogeton pusillus, Small pondweed	Potamogeton rostratus, Small pondweed	Potamogeton zosterifolius, Flat-stem pondweed	Utricularia vulgaris, Common	Filamentous algae	Star duckweed	Softstem bullrush	Water margold	Unknown bullrush	Pickerel weed	EJ	EK			
																									A	G	J
797	10.2 M	R																									
798	13 M	R																									
799	12.9 M	R																									
800	8.1 M	R			1																						
801	9.6 M	R			1																						
802	7.8 M	R			2																						
803	11.2 M	R			2																						
804	11.2 M	R			1																						
805	12.1 M	R			1																						
806	12.3 M	R			1																						
807	11.7 M	R			1																						
808	12.6 M	R			1																						
809	13.1 M	R			1																						
810	13.2 M	R			1																						
811	12.5 M	R																									
812	11.8 M	R			1																						
813	11.2 M	R			1																						
814	11.5 M	R			3																						
815	11.6 M	R																									
816	13.8 M	R																									
817	14.1	R																									
818	14 M	R																									
819	11.7 M	R			1																						
820	12 M	R			2																						
821	10.8 M	R			2																						
822	11.2 M	R			2																						
823	10.3 M	R			2																						
824	10.6 M	R			2																						
825	9.3 M	R			1																						
826	10.7 M	R			1																						
827	11 M	R			1																						
828	9.1 M	R			1																						
829	9.4 M	R			1																						
830																											
831																											
832																											
833																											