Waubee Lake Aquatic Vegetation Management Plan Prepared for the Waubee Lake Association

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Funded by the Lake and River Enhancement (LARE) program and the Waubee Lake Association.

Executive Summary

Aquatic Weed Control was contracted by Waubee Lake Association to develop a long term lake wide management plan. Funding for this plan was provided by the Waubee Lake Association and the Department of Natural Resources Division of Soil Conservation. This funding was part of the Lake and River Enhancement (LARE) program. Aquatic Weed Control conducted two aquatic vegetation surveys to characterize the plant community of Waubee Lake. Following protocol established by the Indiana Department of Natural Resources, a qualitative survey called the Tier I reconnaissance survey was used to obtain an understanding of the vegetation present in Waubee Lake. Next, a quantitative survey (Tier II) was used to document the distribution and abundances of individual plant species in Waubee Lake.

Based upon the data collected in the aquatic vegetation surveys, a management plan was proposed that should help to alleviate major problems caused by invasive aquatic plants. This lake management plan is a requirement to receive additional state funding to treat the lake for invasive aquatic vegetation.

Waubee Lake possesses exotic vegetation that threatens the biodiversity of the lake and causes problems with fishing, swimming, and boating for all lake users. Eurasian milfoil is the invasive species that is of primary concern in this report. Presently, Eurasian milfoil is not overly abundant, and its spread should be stopped before this extremely diverse plant community suffers serious harm. The two major goals of this plan are to protect this native plant community while enhancing recreational opportunities at Waubee Lake. These goals cannot be achieved without providing adequate control of Eurasian milfoil.

This report will recommend the use of Renovate to control the Eurasian milfoil and kill its roots to prevent its re-growth in years to come. Selected areas will be chemically treated to manage the Eurasian milfoil before it spreads into other areas of the lake.

Eurasian milfoil control cost estimates for Waubee Lake

2005	
Pretreatment vegetation survey (required by IDNR), action plan update	$1,400.00
Chemically treat 10 acres of Eurasian milfoil in the lake.	$6,700.00
August survey and plan update	$1,400.00
2006	
Chemically treat 10 acres of Eurasian milfoil in the lake.	$6,700.00
August vegetation survey and action plan update	$1,400.00
2007	
Chemically treat areas of Eurasian milfoil re-growth	$5,000 - $7,000

Acknowledgements

Aquatic vegetation surveys conducted on Waubee Lake were made possible by funding from the Indiana Department of Natural Resources and the Waubee Lake Association. Aquatic Weed Control would like to extend special thanks to Indiana Department of Natural Resources (IDNR) District 3 biologist Jed Pearson for providing procedural training for the Tier I and Tier II aquatic vegetation surveys. Jed Pearson also provided assistance and consultation in generating plant distribution maps for Waubee Lake. Cecil Rich, aquatic biologist for the IDNR Division of Soil Conservation, provided valuable consultation regarding the requirements and objectives of this lake management plan. Jed Pearson and Cecil Rich both reviewed this management plan and provided suggestions for revision. Also, special thanks to Brad Fink, assistant fisheries biologist for the IDNR, for providing training in data analysis programs for the Tier II quantitative vegetation surveys. Jason Doll of the IDNR also provided assistance in generating data analysis reports for the Tier II survey data. Jim Donahoe and David Keister of Aquatic Weed Control conducted the aquatic vegetation sampling and are the authors of this report. Aquatic Weed Control would also like to thank the members of the Waubee Lake Association for their commitment to improving this lake and for valuable discussion and input brought forward at the informational meeting held on November 10, 2004.

Table of Contents

List of Figures

List of Tables

Introduction

Aquatic Weed Control was contracted by the Waubee Lake Association to develop a long term lake wide management plan. Funding for vegetation surveys was provided by the Waubee Lake Association and the Department of Natural Resources Division of Soil Conservation. This funding was part of the Lake and River Enhancement (LARE) program. The survey and management plan are a requirement to receive additional funding to treat the lake for exotic vegetation. The project was initiated to take a more aggressive and long term approach to controlling the Eurasian milfoil in Waubee Lake.

When a person registers a boat within the state of Indiana a lake enhancement fee is included in the cost of registry. One third of this money is then used to provide funding for projects designed to improve the quality of Indiana lakes by controlling invasive plant species. These surveys included in this report, as well as the management plan, are required by the state to receive additional funding to treat the lake for exotic aquatic vegetation. Should a lake be selected for LARE funding, up to 100,000 dollars can be given for a whole-lake treatment with a cumulative 3-year maintenance total of an additional 20,000 dollars. If the whole lake is not treated, up to 20,000 dollars can be available annually for up to three years. Requests for funding are reviewed by the Indiana Soil Conservation Board, and funds will be distributed at their discretion.

Problem Statement

Waubee Lake, located in northern Kosciusko County, is in need of intervention to protect its extremely diverse plant community from the invasive aquatic plant Eurasian water milfoil. Eurasian milfoil, while not overly abundant, is present in the lake and has the potential to devastate Waubee Lake's ecosystem while severely inhibiting recreational opportunities on the lake.

Eurasian milfoil is of primary concern because of its aggressive nature and its destructive effects on lake ecosystems. This nuisance species grows and spreads rapidly, forming dense weed beds that rob native plants of the light and nutrients they need to survive (Kannenberg and Schmidt, 1998).

In lakes where Eurasian milfoil is left unchecked, well-diversified plant communities can be decimated and replaced by a single species. Eurasian milfoil has the ability to overwinter, giving it a distinct growth advantage over many native plants. The milfoil lies dormant during the winter months instead of dying completely. As spring arrives, the dormant milfoil plants have a head start on many native plants and reach the surface faster, shading out the natives. Eurasian milfoil grows profusely, provides poor fish habitat, inhibits boat navigation, and causes annoyances and even serious health hazards to swimmers and other members of the public wishing to enjoy the lake.

The presence of Eurasian milfoil in Waubee Lake is alarming because the adverse effects of this plant are well documented. In past years, specific areas of the lake have been selectively treated with contact herbicides during the month of June. All of these treatments have been requested by residents who own property along the shore of the

lake. Some of these treatments have been considered excessive by those using this lake. These treatments have provided short-term relief from the milfoil, but this species still poses a significant threat to the ecosystem of Waubee Lake.

The ecosystem of Waubee Lake is already changing because of the accidental introduction of the zebra mussel. These invaders are extremely efficient filter feeders that remove phytoplankton, zooplankton, and particulate matter from the water column, while decreasing the overall primary productivity of the lake (Kalff, 2002). Because of these characteristics, zebra mussels can greatly increase water clarity. This means that plants can grow at greater depths, because much more light is available throughout the water column. As water clarity in Waubee lake increases with the zebra mussel population, it is of utmost importance that newly available habitat is filled by beneficial, native plants and not destructive Eurasian milfoil.

Management Goals:

The following management goals have been established by the IDNR for all lakes applying for LARE funding.

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality and is resistant to minor habitat disturbances and invasive species.

2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.

3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

Major Objectives:

Measurable, specific objectives are needed to ensure that the two major goals of this management plan are met. The following steps are considered important management components and are considered essential to the success of this management plan.

1. **The first priority will be to stop the milfoil from spreading to new areas of the lake**. This is of primary importance to the native plant community in Waubee Lake. Since native plants do not compete well with milfoil, containing the spread of milfoil is the best strategy to stop the loss of native plants.

2. **The existing areas affected by the milfoil must be treated to maintain a reasonable level of control**. Reducing the population of Eurasian milfoil in areas where it has already gained a foothold will provide multiple benefits. Recreational activities like swimming, fishing, and boating will all be enhanced by reducing the Eurasian milfoil population. It is also important to note that reducing existing beds of milfoil may provide an opportunity for native plants to reclaim areas where they have been excluded for years. The hope is that the beneficial native

plants will gradually replace the invasive milfoil.

3. **Reconnaissance surveys should be conducted to evaluate the effectiveness of the management plan.** Until this point, management strategies have been geared to provide short-term relief from the milfoil on a yearly basis. While chemical treatments in the past years have succeeded in giving some relief from the milfoil, this management plan will focus on stopping the spread of this invader, while reducing the amount of yearly maintenance needed to keep the Eurasian milfoil in check.

4. **Information and education about the management plan must be made available to the public.** Signs explaining the dangers of exotic plant species may be placed at the public access site, public informational meetings may be held, and the IDNR should consider including information about management practices that have been funded by LARE in its publications.

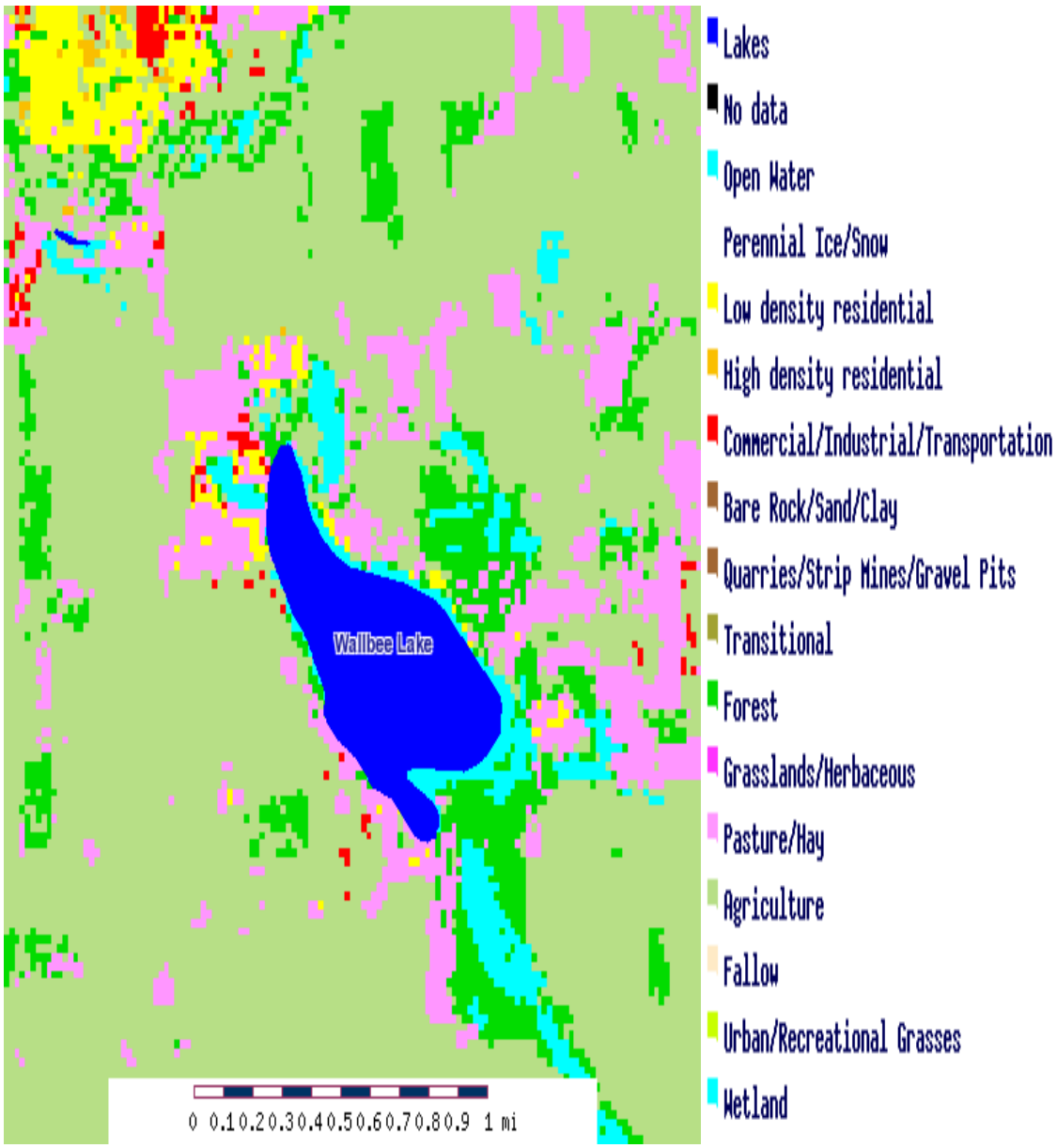
Watershed and Water Body Characteristics

Waubee Lake, located in north central Kosciusko County, has 187 surface acres with a maximum depth of 51 feet and an average depth of 25 feet (Tyllia, 2000). Although no recent diagnostic studies have been completed describing the watershed, the area around the lake is subject to heavy agricultural use.

Water quality is considered relatively good in Waubee Lake when compared to many Indiana lakes. Secchi disk readings can reach 9 feet and clarity has increased due to zebra mussels. This lake is very unproductive, but dissolved oxygen levels sufficient to support fish life are present down to 20 feet in the summer (IDNR Lake Survey, 1995). The bottom is a mix of muck, sand, and marl. Aquatic plant growth is relatively low because of a steep drop off near shore and infertile bottom composition, although weed growth can be quite abundant in the channels adjacent to this lake. The below map In Figure 1 shows what the current water shed uses are. This report is not designed to be a watershed study but a plan to manage exotic weeds. However, it is best to mention some of these watershed characteristics to have an integrated lake management plan.

The possibility of dredging the southern bay (the kettle) of Waubee Lake has long been discussed. This dredging project would deepen this area, and in theory, plant growth would be reduced. This project would reduce the amount of available space for plant growth, and should affect native plants and invasive plants in similar ways. Figure 1 shows the land use adjacent Waubee Lake.

Figure 1: Waubee Lake Watershed Land Use Map



Waubee Lake Fisheries

The following fisheries survey was conducted by The Indiana Department of Natural Resources and took place on August 9, 1995. Data was obtained by using electro fishing and gill nets to collect, count, measure, and then release fish. A total of 24 species of fish were collected, many of which were valuable game fish.

Bluegills dominated this survey, accounting for 44.1 % of the fish community. Bluegill size was very small compared to many area lakes. Ninety six percent of all bluegills collected were less than six inches long. Overpopulation and the infertile nature of Waubee Lake may contribute to the small size distribution of bluegills.

Twenty thousand and six hundred walleye fingerlings were stocked in Waubee Lake by the DNR in 1996. The goal of this stocking was to help control the panfish population as well as provide a walleye fishery in Waubee Lake. In 1995, the fisheries survey indicated that walleye were present, but in very small numbers. No survey has taken place since the latest walleye stocking, and the size of the walleye population is unknown.

Largemouth bass were abundant in the 1995 survey, but their average size was small as well. Yellow perch were sampled in moderate numbers and size was good, with fish up to 10.4 inches long being collected.

Northern pike are also present in this survey, and provide a valued fishery. Northern pike reaching 34.0 inches were collected in 1995. A table summarizing the fisheries survey results is included below.

Table 1: IDNR Fisheries Survey of Waubee Lake 8/9/95

Species	Total # Collected	Percentage	Size Range (in.)
Bluegill	350	44.1	1.5-7.6
Largemouth Bass	109	13.7	2.0-17.1
Black Crappie	87	11.0	4.3-11.9
Yellow Perch	59	7.4	2.0-10.4
Brook Silverside	40	5.0	1.9-3.8
Bluntnose Minnow	25	3.2	2.2-3.1
Redear Sunfish	25	3.2	4.5-9.2
White Sucker	19	2.4	6.4-18.7
Yellow Bullhead	13	1.6	10.2-14.4
Northern Pike	8	1.0	21.0-34.0
Spotted Sucker	8	1.0	14.9-18.1
Walleye	8	1.0	18.8-21.5
Longnose Gar	7	0.9	26.5-41.0
Spotted Gar	7	0.9	21.6-27.5
Species	Total # Collected	Percentage	Size Range (in.)
Rock Bass	6	0.8	4.9-7.3
Bowfin	4	0.5	19.2-25.2
Brown Bullhead	4	0.5	12.0-13.8
Warmouth	4	0.5	3.8-7.2
Logperch	3	0.4	3.3-3.7
Lake Chubsucker	2	0.3	5.8-7.8
Longear Sunfish	2	0.3	3.1-4.8
Carp	1	0.1	19.0
Grass Pickerel	1	0.1	12.0
Hybrid Sunfish	1	0.1	5.6

The fish community and the plant community in Waubee Lake are closely related. The aquatic plants provide escape cover for young fish, produce oxygen, and they increase the overall biodiversity of the lake helping to create a stable ecosystem. Eurasian milfoil threatens this stability, provides poor fish habitat, and threatens to take over the lake.

Present Water Body Uses

Today, Waubee Lake is highly valued to many stakeholders for a number of reasons. This lake has a 10-mile per hour speed limit, which eliminates heavy use by fast moving jet skis and ski boats. This restriction calms the waters of Waubee Lake and makes it an ideal place to swim, or take a leisurely boat ride. In addition to these activities, Waubee Lake has a diverse fishery, with largemouth bass, northern pike, bluegills, black crappies and yellow perch all being available at the lake.

The public access along Waubee's northwest shore opens this lake to thousands of citizens in the surrounding area. The residents living on Waubee Lake share this lake with the general public. Any management practices implemented on Waubee Lake will benefit both the lake residents and a large number of stakeholders who visit the lake on a regular basis. The size, location and accessibility of Waubee Lake make it an excellent site to implement management strategies that will save a valued ecosystem and benefit a large number of people.

Characterization of the Plant Community

An extremely important note is that Eurasian water milfoil may occur at greater frequencies and at higher densities than indicated by these surveys. Any chemical treatments prior to the surveys will eliminate milfoil beds that would have otherwise appeared in the Tier I and Tier II plant surveys. Previous chemical applications may result in an underestimation of the amount of Eurasian milfoil present in Waubee Lake.

Waubee Lake Tier I Survey Methods

The Tier I reconnaissance survey is designed to identify the major plant beds present in a body of water. This is a qualitative survey designed to give an overview of the aquatic vegetation present in a lake. It identifies and documents problem areas that can be targeted when management practices are implemented. Major submersed plant beds are found visually from a boat. Each bed is given a reference number that is recorded on Tier I data sheets. The general locations of these beds are recorded on a bathymetric map of the lake, and more precise locations are recorded on Tier I data sheets with the help of a WAAS enabled GPS unit.

When a major plant bed is identified, each species of plant found in that bed is recorded. Canopy ratings are given to each plant bed based on the types of plants present in that bed. The four major types of plants to be identified in this study are as follows: submersed plants, emergent plants, non-rooted floating plants and rooted floating plants. The following scale is used to describe these four types of plants based on the percentage of the plant bed canopy they occupy:

Canopy Rating

1 = <2% of canopy
2 = 2-20%
3 = 21-60%
4 = >60% of canopy

In addition to the canopy rating, another abundance rating is given to each individual species found in a particular plant bed. This abundance rating is based on the percentage of the entire bed area that species appears to occupy. The scale for this abundance rating is the same as the canopy rating scale. The difference is that this scale identifies the abundance of *individual species* in the bed:

Species Abundance Rating

1 = < 2% of the bed
2 = 2-20%
3 = 21-60%
4 = >60% of the bed

Since this is a visual survey, results are dependant upon the surveyor's ability to located plants below the water's surface. Tier I surveys are much less effective in lakes with low secchi disk readings. Polarized glasses were used to reduce glare from the sun and enable the surveyors to see more easily into the water. Even with the aid of polarized glasses, the Tier I survey should not be considered an exhaustive survey of aquatic vegetation. The Tier I survey is a tool that helps to provide an overall picture of an aquatic plant community when coupled with the Tier II quantitative survey.

During the Tier I survey of Waubee Lake ten major plant beds were found. Thirteen species of aquatic plants were identified, and their abundances at each bed were recorded. Below is a table summarizing the results of the Waubee Lake Tier I survey. A blank space for an abundance rating means that the species was not present at that particular bed. A key is provided to help interpret the data entries.

Tier I Major Plant Bed Summary

Plant Bed #1
This plant bed was approximately 100 feet long by 50 feet wide and contained four species of aquatic plants. Naiad and Illinois pondweed were both present and each had an abundance rating of 2. Chara was present with an abundance rating of 4, while white lily had an abundance rating of 1.

Plant Bed #2
This plant bed was about 300 feet long by 50 feet wide and contained 6 species. Sago pondweed, naiad, stargrass, and Illinois pondweed were all present with abundance ratings of 2. Eelgrass and Eurasian milfoil both had abundance ratings of 3.

Plant Bed #3
This plant bed was approximately 900 feet long and 75 feet wide and contained 6 species. Stargrass, Illinois pondweed, white lily and eelgrass all had abundance ratings of 2. Naiad was present with an abundance rating of 3 and chara was present with an abundance rating of 4.

Plant Bed #4
This plant bed was approximately 60 feet by 120 feet and contained 7 species. Eurasian milfoil, sago pondweed, white lily, and large leaf pondweed were all present with abundance ratings of 1. Illinois pondweed was present with an abundance rating of 2, while naiad had an abundance rating of 3.

Plant Bed #5
This plant bed was approximately 350 feet by 50 feet and contained 6 species. Sago pondweed, stargrass, white lily, and eelgrass were all present with abundance ratings of 2. Naiad had an abundance rating of 3, while chara had an abundance rating of 4.

Plant Bed #6
This plant bed had an approximate size of six acres and contained 10 plant species. Large leaf pondweed, Illinois pondweed, stargrass, naiad, sago pondweed, Eurasian milfoil, chara and coontail, all were present with abundance ratings of 2. Duckweed and white lily were both present with abundance ratings of 1.

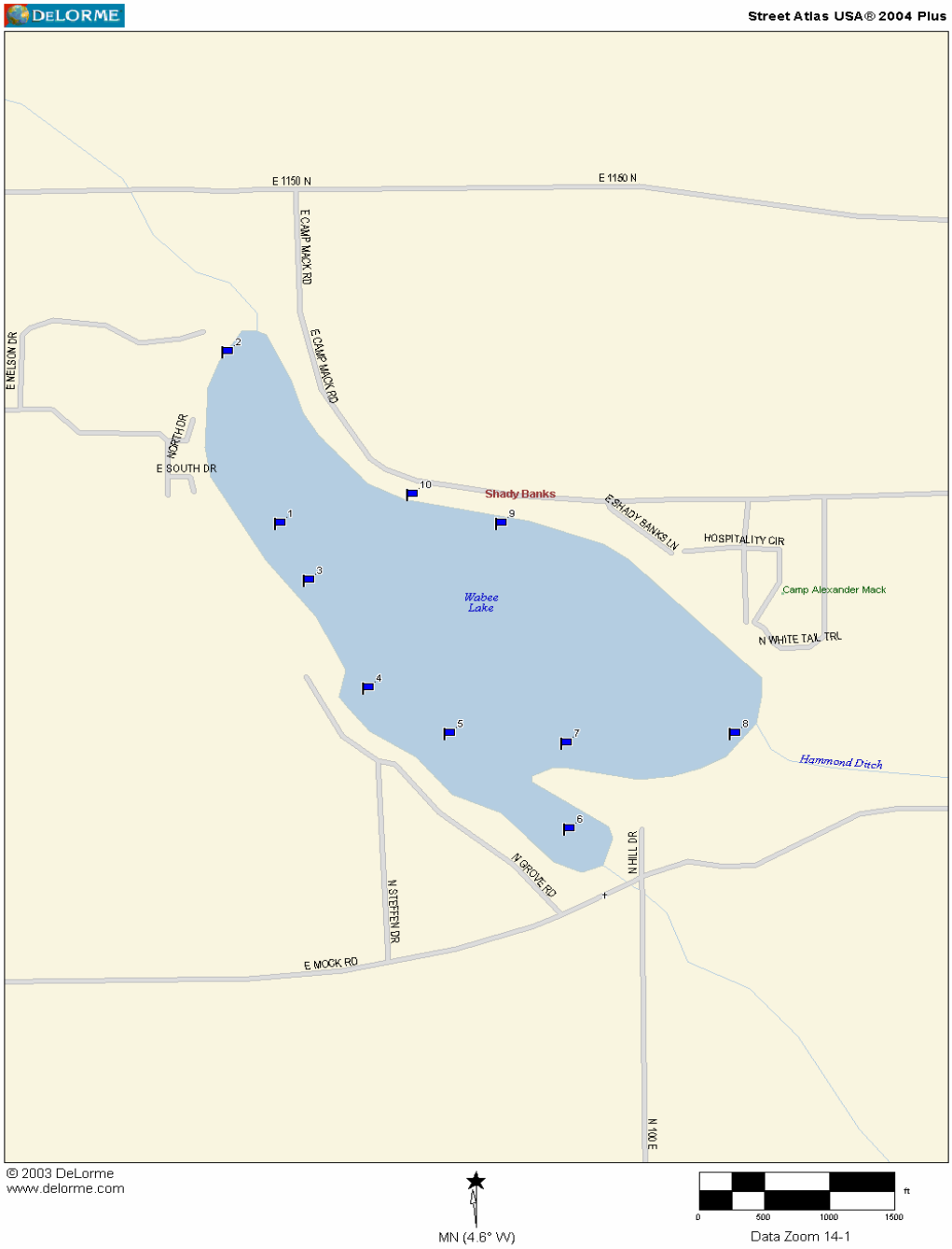
Plant Bed #7
This plant bed was approximately 1 acre in size and contained only 2 species. Sago pondweed and Illinois pondweed were both present with abundance ratings of 2.

Plant Bed #8
This plant bed was about 1.5 acres in size and contained 6 species. Coontail and Sago pondweed were both present with abundance ratings of 1. Curly leaf pondweed, large leaf pondweed and eelgrass all had abundance ratings of 2. Stargrass was present with an abundance rating of 3.

Plant Bed #9
This plant bed was approximately 100 feet by 50 feet in size and contained 4 species. Chara and Naiad were both present with abundance ratings of 2. Eelgrass, had an abundance rating of 3, while stargrass had an abundance rating of 4.

Plant Bed #10
This plant bed was also 100 feet by 50 feet in size, and also contained 4 species. Illinois pondweed was present with an abundance rating of 1. Eelgrass had an abundance rating of 2, naiad had an abundance rating of 3 and stargrass had an abundance rating of 4.

Figure 2: Tier I Major Plant Bed Sites



Tier I Survey Summary

Waubee Lake has an extremely well diversified plant community. Ten major plant beds were identified and thirteen species of aquatic plants were identified along with the presence of algae. Naiad, stargrass, and eelgrass were dominant species, occurring

frequently and having high average abundance scores. Eurasian milfoil, a species of concern for Waubee Lake, occurred 3 times with an average abundance of 2. Duckweed, a plant only found in very fertile water was present only in one location, indicating low nutrient levels in most of the lake.

Some plants observed in the Tier I visual survey were not collected in the Tier II quantitative plant survey. Excellent water clarity and emergent vegetation documenting provided records of some species that were not represented by the Tier II survey. This underscores the importance of both the Tier I and Tier II sampling processes in order to gain an accurate representation of the aquatic plant community.

Materials and Methods: Tier II Random Sampling

Summary

A Tier II quantitative survey of Waubee Lake was conducted on August 12, 2004. The purpose of this survey was to document the distribution and abundance of submersed and floating-leaved aquatic vegetation throughout the lake (IDNR 2004). A specific number of sample sites were selected based on the amount of surface acreage the lake possessed. Once sample sites were determined, sampling was accomplished using an aquatic vegetation sampling rake constructed according to the guidelines of the 2004 Tier II random sampling procedure manual.

Aquatic vegetation collected at each sample site was sorted according to species, and given a value to represent its abundance at that site. These values were immediately recorded on data sheets distributed by the IDNR. These records were used for data analysis that served to characterize the aquatic vegetation community of Waubee Lake.

Random Sampling

The IDNR issued the following chart to help determine the number of sample sites needed to accurately describe the aquatic plant community in a lake.

Table 2: Number of Sample Sites Based on Lake Size

Size of Water Body	Number of Sample Sites
1-100 acres	40
101-300 acres	60
Greater than 300 acres	Add 10 sites/100 acres

Based on Waubee Lake's 187 surface acres, 60 sample sites were accurately needed to describe this plant community. Aerial photographs and bathymetric maps were used to evenly space the 60 sample sites throughout the lake. The littoral zone of the lake was divided into four quadrants of equal length. During the vegetation collection process, an

effort was made to collect plants from 15 sites in each quadrant to ensure that the entire littoral zone was surveyed adequately and that random sample sites distributed were evenly throughout the lake.

When sampling the littoral zone of the lake. A pattern was used that also helped to ensure an accurate description of the plant community. The littoral zone was divided into three sections based on depth and sample sites alternated between each of these three zones. For example, collection site 1 would be taken in shallow water very close to shore. Collection site 2 would be taken further down the shoreline, but in slightly deeper water. Collection site 3 would be taken further down the shoreline, but in even deeper water, close to the border of the littoral and pelagic (open water) zone. This sampling strategy was recommended by District 3 fisheries biologist Jed Pearson. This strategy not only helps to accurately describe the plants in the littoral zone, but it also aids in determining the maximum depth at which plant can grow in particular lake.

Aquatic Vegetation Sampling Rake

A double-headed garden rake was used to sample aquatic vegetation. This rake design is approved and used by IDNR fisheries biologists in vegetation surveys on many Indiana lakes. It consists of two garden rake heads welded together back to back so that rake teeth are protruding from two sides. The dimensions of the rake are to be 13.5 inches wide with 2.25-inch long teeth spaced 0.75 inches apart (IDNR, 2004).

Each tooth on the rake head is divided into five equal sections and marked accordingly. These marks on the rake teeth are used to estimate the abundance of plant species when they are collected.

A nylon rope is then attached to the rake head. A black permanent marker is used to mark the rope in foot long increments. A red mark is placed every five feet along the rope. This rope is used to measure the depth at each sample site when the rake is lowered to the lake bottom.

GPS and Mapping

A WAAS enabled GPS unit was used to obtain and record the coordinates of each sample site on the lake. A WAAS enabled GPS unit is accurate to within 3 meters and was recommended by aquatic biologist Cecil Rich to obtain maximum accuracy for mapping sample sites. All GPS coordinates were then used to produce computer generated maps of the lake with each sample site labeled on the map. A spreadsheet corresponding to this map is included in this report. The species and abundances at each sample site can be found using the labeled sample sites and the spreadsheet.

Sampling Procedure

A two-person crew accomplished Tier II aquatic vegetation sampling by boat. A crew leader was responsible for driving the boat to each sample site and recording vegetation data on record sheets issued by the IDNR. An assistant was responsible for collecting the

aquatic plants using the double-headed rake.

When a sample site was reached, its GPS coordinates were obtained and recorded. The boat was then brought to a complete stop and the double-headed rake was lowered to the bottom of the lake. The boat was held stationary while the water depth at the sample site was obtained by using the marked rope attached to the rake.

When water depth had been recorded, the crew leader slowly backed the boat away from the rake as the assistant simultaneously let out another ten feet of rope. During this process the rake did not move from the lake bottom.

The rake was pulled from the water after the boat had reached the end of the ten extra feet of rope let out after the depth was recorded. This ensured that the rake was pulled horizontally through the water, giving it a greater chance of collecting weeds than if the rake had been lowered to the bottom and raised vertically. The vegetation caught on the teeth of the rake was then gathered into the boat.

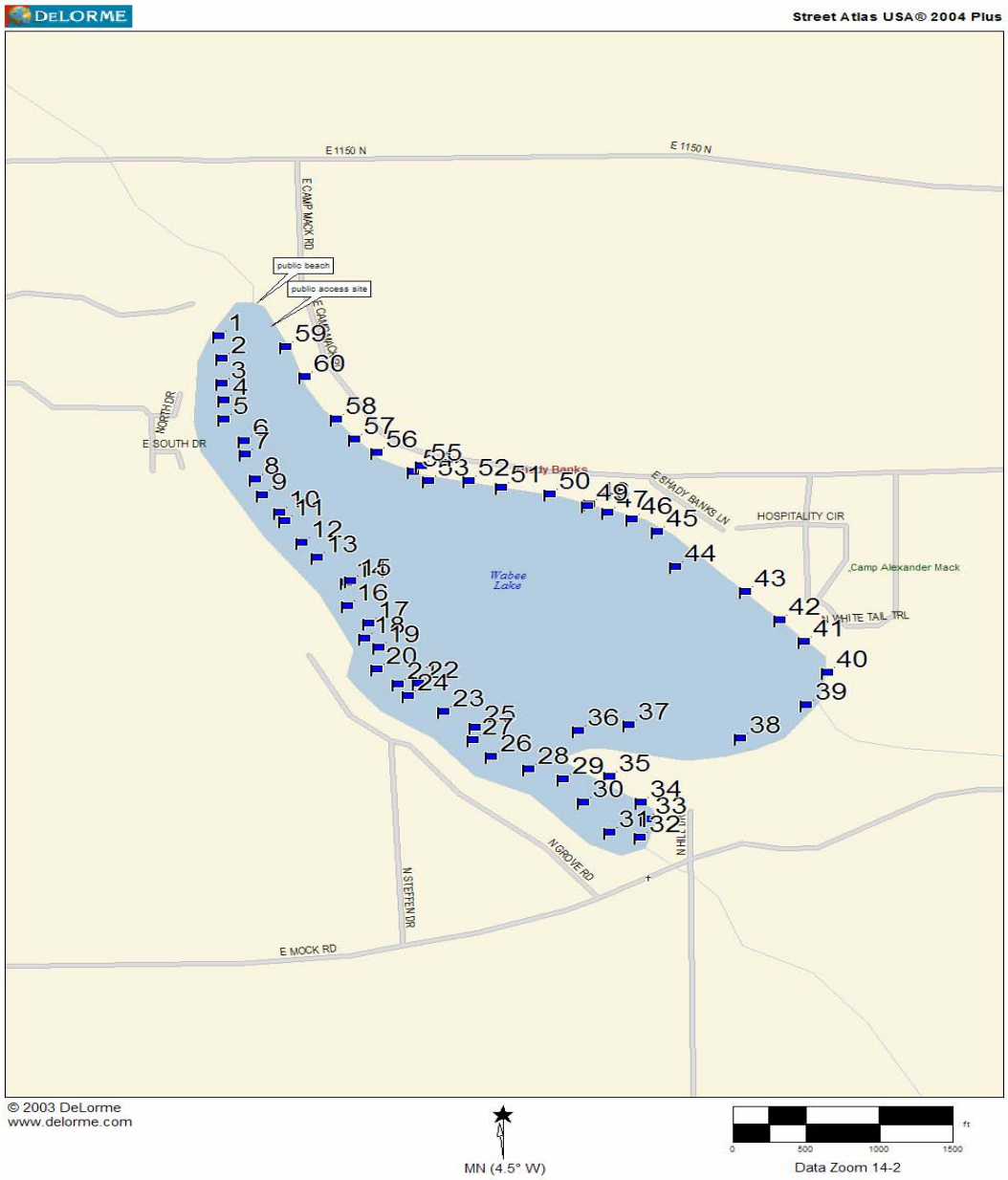
Determining Vegetation Abundance

At each sample site, every plant species collected on the rake was scored according to its abundance. This was accomplished by removing all plants from the rake and sorting them by species. As species were removed from a rake, they were placed in separate containers. Once all plants had been removed from the rake, each individual species was placed back onto the rake and evenly distributed across the marks on the rake teeth. If a species filled the rake to the first mark on the teeth, that species was given a score of one on the abundance data sheet. If it filled the rake teeth to the second mark, it was given a score of two, and so on to a maximum abundance of five.

All data was transferred from the original sheets onto a Microsoft excel worksheet to facilitate data analysis. A copy of the original Tier II data sheet is included in Appendix B of this report.

In many instances it was not necessary to place each species back onto the rake. Many species would fill the rake completely (an abundance of 5) and some species would only have one plant on the rake (an abundance of 1). In addition to abundance scores for individual species, each rake toss was given an overall abundance score, describing how much total vegetation was collected on the rake. The following figure shows the sample sites chosen for Waubee Lake.

Figure 3: Sample Points for the Waubee Lake Tier II Survey



Secchi depth was taken prior to the survey and determined to be approximately 10.0 feet. A total of eight species of aquatic plants were collected during the Tier II survey. Of these species, two of them (Eurasian milfoil and curly leaf pondweed) were exotic species. The average number of total species collected at each sample site was 2.53 while the average number of native species collected at each site was 2.14. The species diversity index for Waubee Lake was 0.83 while the native plant diversity index was 0.79. Average rake density was 4.05 while average rake diversity was 0.81. The diversity index of native plants collected on the rake was 0.77.

Chara and Eurasian milfoil had the highest average densities at 4.0 and 2.76 respectively, while Illinois pondweed had the greatest relative density at 1.24. The most dominant plant in this survey was chara with a dominance index of 27.6. The next most dominant plant was Illinois pondweed with a dominance index of 24.8.

Waubee Lake Tier II Survey Summary

August 12, 2004
Total # of sample Sites: 60
Total # of Species: 9 (excluding Algae)

Species List

Eurasian Milfoil
Sago Pondweed Chara
Naiad
Illinois Pondweed
Star Grass
Eel Grass
Coontail
Curley Leaf Pondweed
Chara

Table 3: Tier II Survey Results Summarized

Species	# of Sites Present out of 60 Total Sites	Average Abundance
Eel Grass	31	2.00
Naiad	30	2.37
Chara	29	2.76
Coontail	22	1.91
Star Grass	17	2.24
Illinois Pondweed	14	1.14
Curley Leaf Pondweed	3	1.00
Sago Pondweed	3	1.33
Eurasian Milfoil	1	4.00
Algae	1	present

Species Diversity and Species Dominance

Two of the most important values in table 8 are the diversity indices and the species dominance. A species diversity index is actually measured as a value of uncertainty (H).

If a species is chosen at random from a collection containing a certain number of species, the diversity index (H) is the probability that the chosen species will be different from the previous random selection. The diversity index (H) will always be between 0 and 1. The higher the H value, the more likely it is that the next species chosen from the collection at random will be different from the previous selection (Smith, 2001). This index is dependant upon species richness and species evenness, meaning that species diversity is a function of how many different species are present and how evenly they are spread throughout the ecosystem.

Species dominance is dependent upon how many times a species occurs, and its relative coverage area or biomass within the system. In this survey, the abundance rating given to each species at each sample site was used to determine dominance. The dominance of a particular species in this Tier II survey increases as its site frequency and relative abundance increase.

Comparison with IDNR Vegetation Surveys

Jed Pearson, District 3 fisheries biologist provided a recent vegetation survey conducted on Waubee Lake. In this survey, species diversity was calculated to be 0.85. It was calculated to be 0.83 in the 2004 IDNR survey. Native diversity calculated by Aquatic Weed Control was 0.82, while the native diversity score calculated for the IDNR's data was very similar at 0.79. Rake Diversity calculated by Aquatic Weed Control was 0.84 while rake diversity calculated by IDNR's survey was 0.80. Native rake diversity calculated by Aquatic Weed Control's survey was 0.81 while the IDNR's value was 0.80. Mean Rake score for Aquatic Weed Control's survey was 4.05, while mean rake score in the IDNR's survey was 3.58.

The most dominant plant in Waubee Lake according to both surveys was chara, with dominance indices of 28.4 and 27.6 respectively. The dominance of Eurasian milfoil was calculated as 1.5 by the IDNR and at 1.4 by Aquatic Weed Control.

The close similarities between these two surveys reflect the fact that they were conducted only days apart. Data about many of the less dominant species showed more variation between the surveys which is to be expected in a random sampling process. A summary of IDNR vegetation survey data is included in Appendix C for comparison purposes.

Table 4: Tier II Data Analysis

Occurrence and Abundance of Submersed Aquatic Plants

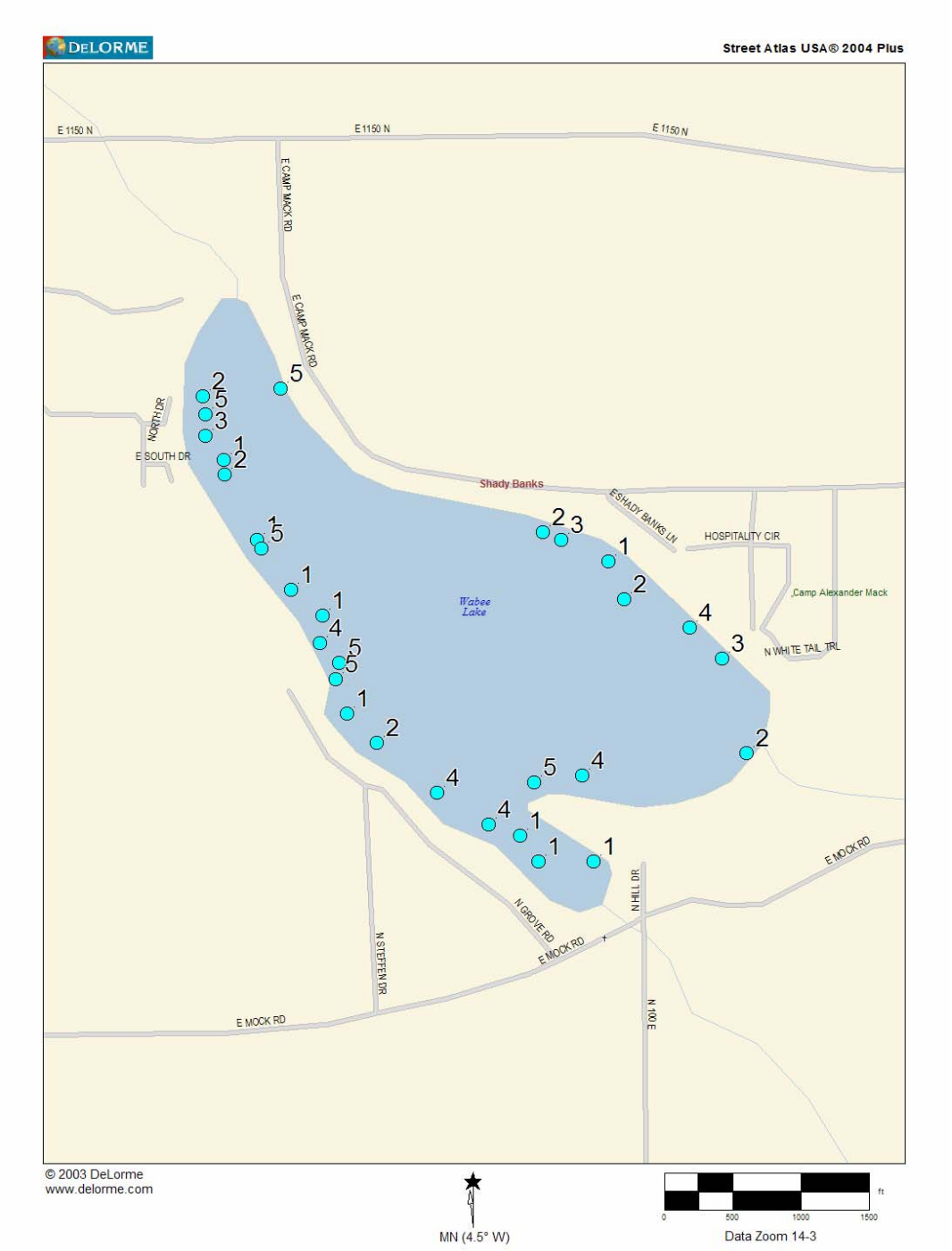
Date:	8/12/04	Littoral sites with plants:	58	Species diversity:	0.85
Littoral depth (ft):	15.0	Number of species:	8	Native diversity:	0.82
Littoral sites:	58	Maximum species/site:	5	Rake diversity:	0.84
Total sites:	60	Mean number species/site:	3.00	Native rake diversity:	0.81
Secchi:	10.0	Mean native species/site:	2.60	Mean rake score:	4.05

Common Name	Site frequency	Relative density	Mean density	Dominance
Chara	50.0	1.38	2.76	27.6
Coontail	51.7	1.07	2.07	21.4
Curly-leaf Pondweed	34.5	0.72	2.10	14.5
Eel Grass	29.3	0.71	2.41	14.1
Eurasian Watermilfoil	1.7	0.07	4.00	1.4
Illinois Pondweed	51.7	1.24	2.40	24.8
Waterstargrass	24.1	0.28	1.14	5.5
Naiad sp	51.7	1.24	2.40	24.8
Sago Pondweed	9.5	0.11	1.14	2.2
Waterstargrass	9.5	0.11	1.14	2.2
Naiad sp	14.9	0.12	0.82	2.4

Other Observed Plants:	purple loosestrife	spatterdock	cattail

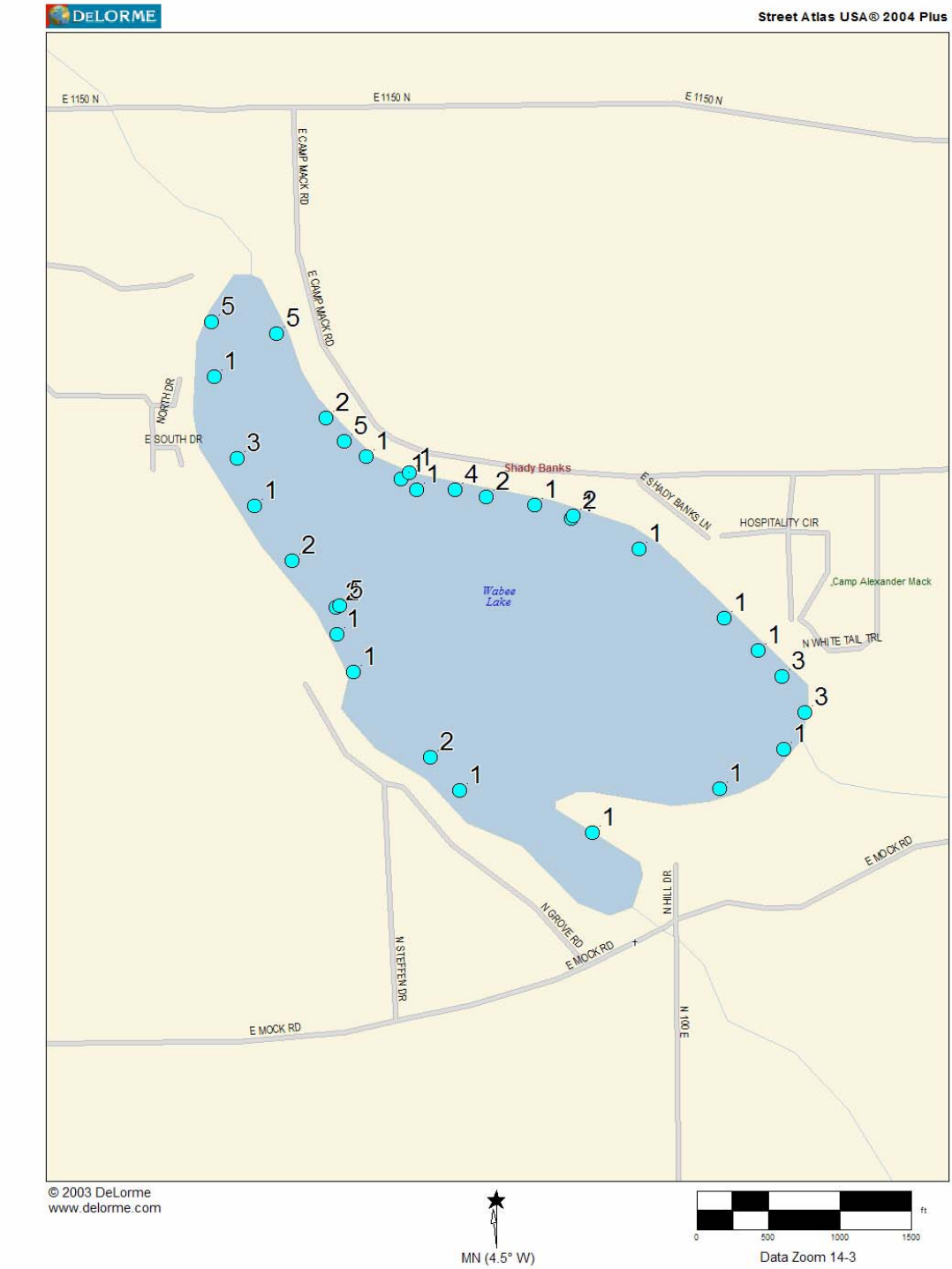
Aquatic Weed Control generated the following maps to show the locations and abundances of three major plant species in Waubee Lake. Chara and coontail are both native plants, and are extremely widespread in the lake. Eurasian milfoil was only found at one random sample site during the Tier II survey.

Figure 4: Sites Where Chara Was Collected



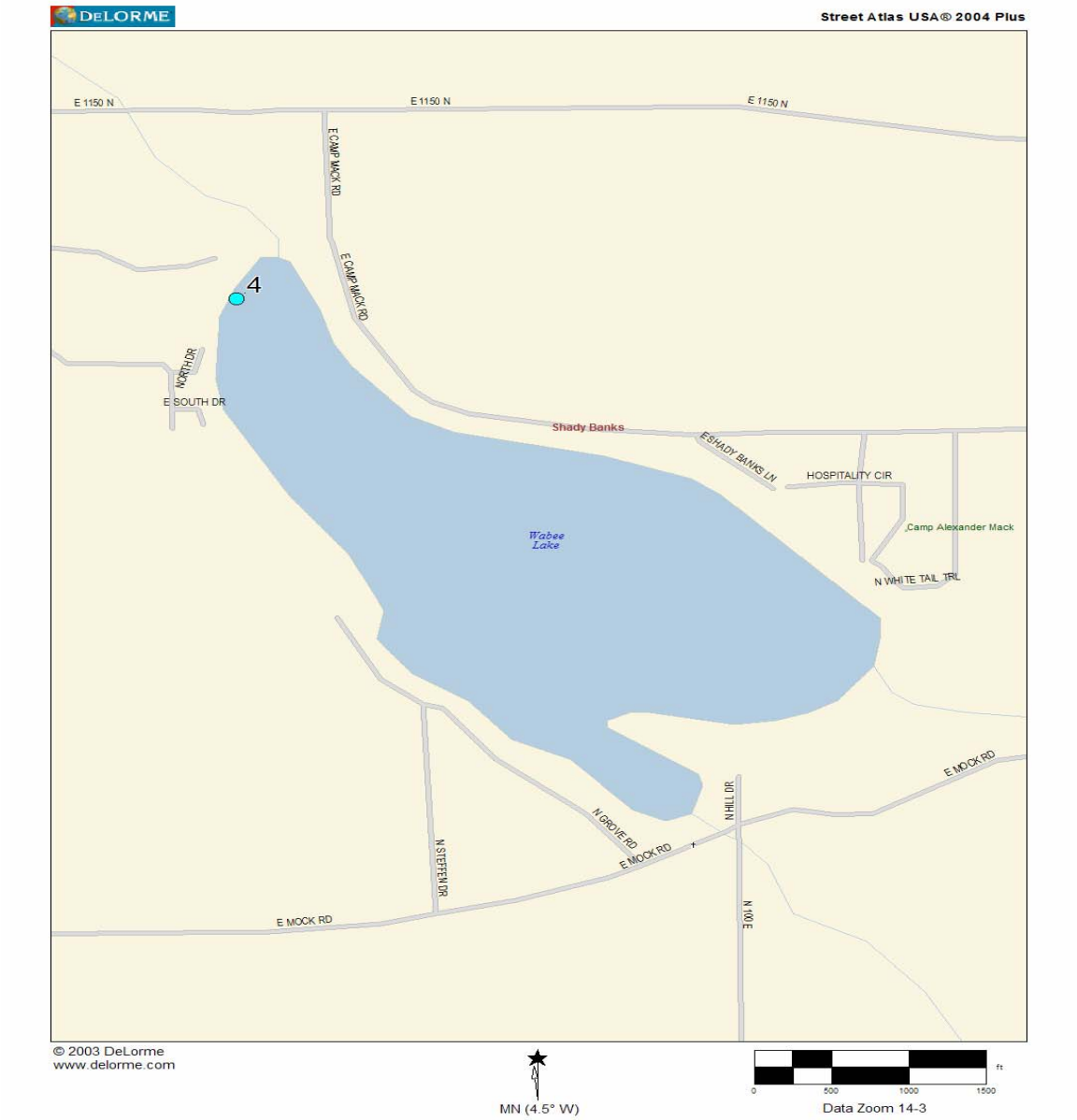
Chara was the most dominant plant in Waubee Lake. It was collected at 29 sites and had an average abundance of 2.79. It was especially abundant along the western shoreline of the lake.

Figure 5: Sites Where Coontail was Collected



Coontial, a plant often harmed by the introduction of Eurasian milfoil was abundant at the time of this survey. It was collected at 29 sample site and had an average abundance of 1.91.

Figure 6: Sites Where Eurasian Milfoil was Collected



Eurasian milfoil was only collected at one sample site during the Tier II survey. It had a very high abundance rating of 4 at this site. Previous chemical treatments earlier in 2004 had greatly reduced its population. Eurasian milfoil must not be allowed to spread throughout Waubee Lake.

Threatened and Endangered Species

No threatened or endangered species were found during the Tier I or the Tier II survey. Controlling the Eurasian milfoil will help to maintain a diverse ecosystem with high species richness. This should provide a better opportunity for threatened plants to gain a foothold in this body of water.

Aquatic Plant Management Alternatives

Waubee Lake currently has Eurasian milfoil present in selected areas of the lake. Eurasian milfoil is currently believed to have arrived in North America in the mid 1940's and has spread throughout the east coast to northern Florida and the Midwest. It is present in about 75 % of the areas treated by Aquatic Weed Control. Eurasian milfoil spreads by fragmentation, seeds, and has the ability to over-winter from year to year. Once it is in a lake it generally becomes the dominant plant species because it forms dense canopies on the water which shade out the native more beneficial weed species below. There is also increasing evidence that mat forming species like Eurasian milfoil and curly leaf pondweed exert significant negative impacts on a broad range of aquatic organisms. (Pullman, 1998).

Many management strategies have been used to control Eurasian milfoil in Indiana lakes. A management option should be chosen primarily for its selectivity toward the pest to be controlled. Eurasian milfoil must be controlled without harming beneficial native species.

No Action and Other Alternatives

If no action is taken the Eurasian milfoil will only get worse since the milfoil grows by fragmentation. Fragmentation means that if the plant is cut, the fragment has the ability to re-grow. Eurasian milfoil also over-winters as an adult plant so new generations are spawned every season. Therefore, the Eurasian milfoil plant beds become denser if left untreated.

Mechanical Harvesting

Mechanical harvesting uses a machine to cut the weeds. These machines pick up the cut weeds but will still leave small fragments that will have the ability to re-grow. Also, after an area is harvested the Eurasian milfoil generally re-grows first causing the native plants to be shaded out again. Mechanical harvesting is also not selective in its control. The harvesting will cut the native weed species as well as the exotics if both are present in the same area. For these reasons mechanical harvesting is not recommended. Harvesting can be accomplished by individual owners around their dock areas. A lake property owner can legally harvest a 625 square foot area. (25 feet by 25 feet).

Biological Control

The milfoil weevil is a native North American insect that consumes Eurasian milfoil and Northern water milfoil. The weevil was discovered after a decline in Eurasian milfoil population was observed in Brownington Pond, Vermont (Creed and Sheldon, 1993). The milfoil weevil burrows down into the stem of the plant and consumes the tissue of the plant. Holes where the larvae burrow in allow disease to get established and the holes also release the plant's gases causing the plants to lose buoyancy and sink (Creed et. Al.

1992).

The problem with using the milfoil weevil is that they have not yielded consistent results. Why they work in one lake and not in another is still not well documented. In 2003 Scribailo and Alix conducted a weevil test on Round Lake in Indiana and found no conclusive evidence that the Eurasian milfoil populations were reduced.

Environmental Manipulation

Draw down of the lake level is another way to control the Eurasian milfoil problem in the lake. Lower water levels expose the Eurasian milfoil to freezing and thawing. However, this plan will kill the native plants as well. Also this will cause the Eurasian milfoil to grow in deeper water. For these above reasons draw down is not recommended for Waubee Lake.

Chemical Control

Aquatic chemicals come in two types. There are contact and systemic herbicides. Systemic herbicides kill the roots of the plants. Examples of systemic herbicides are Sonar and Avast (active ingredient: fluridone) and Navigate, Aqua Kleen, DMA4 (active ingredient 2,4-D) and Renovate (trichlophyr active ingredient). All of these chemicals are effective in killing the Eurasian milfoil by the roots. Based on the author's experience and other lake managers in the Midwest, whole lake treatments of fluridone are the best at controlling Eurasian water milfoil provided the current population in a lake warrants this type of treatment. Fluridone can be applied at low rates to control the Eurasian milfoil and not control the majority of the native weed species present in the lake.

2, 4-D and trichlophyr are both root control herbicides which have the ability to be used in small areas where Eurasian milfoil is present. If fluridone is used, the whole lake needs to be treated. The major difference between 2, 4-D and trichlophyr is that trichlophyr is showing that it may have the ability to control the Eurasian milfoil in select areas longer than 2,4-D. Please remember that Renovate has only been available for use for the past two seasons. The ability of Renovate to provide more long term control of Eurasian milfoil than 2,4-D in spot treatment situations is still being documented. 2, 4-D is less expensive to use but if trichlophyr continues to show better long term control in treated areas it will be a better investment in the long run.

Contact herbicides are used best to control the majority of the weeds around people's piers and in man-made channels. Contact herbicides are the not the best choice to reduce the Eurasian milfoil problem in Lake Manitou since they are not selective and do not control the weeds by the roots. Examples of contact herbicides are Reward (active ingredient piquet), and Aquathal (active ingredient endothal).

The public's primary concern with the use of chemicals is safety. Every chemical registered for aquatic applications has undergone extensive testing prior to a being delivered to the market. These tests demonstrate that the chemical is safe for the

environment and will not have adverse effects on humans or the animal population in a lake when used properly.

Action Plan

In the past, prior to 2004, areas of the lake were treated with contact herbicides around individual docks based on whether the property owner wanted their area treated or not. In 2004, the kettle and the Alexander Channel were treated with 2,4-D to control the Eurasian milfoil by the roots. 2, 4-D was used because it was a root control herbicide and due to the lake association's budget it was the best alternative. The lake association is hoping to receive funding to use trichlophyr to get more long term control in the Eurasian milfoil infested areas. This plan offers an excellent opportunity to compare the success of trichlophyr to 2, 4-D when spot-treating Eurasian milfoil. Aquatic vegetation sampling prior to herbicide treatment is recommended by IDNR Fisheries Biologist Jed Pearson to quantify the Eurasian milfoil population at the time of treatment, and possibly identify new areas of infestation.

Cost Estimates for Waubee Lake Eurasian Milfoil Treatments

2005

Pretreatment vegetation survey (required by IDNR)	$1,400.00
Spray 10 acres of Eurasian milfoil in the lake.	$6,700.00
August vegetation survey and action plan update	$1,400.00

2006

Spray 10 acres of Eurasian milfoil in the lake	$6,700.00
August vegetation survey and action plan update	$1,400.00

2007

Chemically treat areas of Eurasian milfoil growth identified by vegetation surveys	$5,000 - $7,000

The lake association should begin to raise funding in 2005 for chemical treatments even if LARE funding is not available. In the past, weed control was done on an individual basis and residents could request to have lake frontages treated, with the exception of 2004. In 2004 the kettle (flags 26 to 35 in figure 3) was sprayed along with the Alexander Channel (Flag 7 in figure 3) for the root control of Eurasian milfoil. Spraying of these two areas should continue along with the third area between flags 1-6 in figure 3. The proposed treatment areas are outlined in the following map. It is important to note that this action plan would require permission from the IDNR since this treatment proposal exceeds the current level of permitted control (4ac/yr).

Figure 7: Proposed Treatment Areas of Waubee Lake

Public Involvement and Education

An informational meeting was held by the Waubee Lake Association on November 10, 2004. This meeting was held to inform lake residents about the problems facing Waubee Lake, and especially about the threat that Eurasian milfoil poses to both the ecology and the utility of the lake. Potential solutions to these problems were discussed and Jim Donahoe of Aquatic Weed control offered potential management strategies that could be used to control the Eurasian milfoil and maintain ecological diversity and recreational opportunity at Waubee Lake. There will be a second meeting in January or February.

It is important that information regarding management practices on Waubee lake be available to the public. Lake association meetings and newsletters are excellent avenues through which this information can be distributed. Informative signs about invasive weeds could also be posted at Waubee Lake's public access site. Many of these signs can be obtained through the department of natural resources. Additional information on aquatic management can be found at the following web sites: www.mapms.org www.aquatic.org www.apms.org www.nalms.org.

Monitoring and Evaluation of Plan

When the proposed action plan is implemented, follow-up surveys will be essential to monitor the effectiveness of the management activities.

A survey should be conducted in the months following the first chemical application to document any noticeable change in the milfoil's population. Another survey should be conducted the following year to determine if the initial chemical application reduced milfoil abundance from one year to the next.

In the years that follow, additional surveys can be conducted to determine the abundance and distribution of the milfoil. These surveys will begin to describe how the Eurasian milfoil population is reacting to the management strategy over a longer period of time.

These surveys will provide a basis for evaluation of the action plan and can be presented to the public should the need arise to modify the management strategy. They will also serve to keep the public interested and informed about management practices at Waubee Lake so they will be motivated and equipped to actively participate in the conservation of the Waubee Lake ecosystem. These survey results can be referenced at future lake association meetings and can be included in newsletters

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Appendix A: Macrophytes of Waubee Lake

The following appendix was compiled using information found in the 5th edition of How to Identify Water Weeds and Algae, edited by James C. Schmidt and James R. Kannenberg.

Eight major species were identified in the Tier I and Tier II aquatic vegetation surveys.

1. Naiad

Scientific name: Najas minor (brittle naiad)
Classification: Native to Indiana
Distribution: Common throughout the U.S.
Presence in Waubee Lake: collected at 30 of 60 sample sites

Description: The leaves of naiad plants are usually widest at the base and gradually become thinner near the tip of the leaf. Plants are extremely leafy and appear bush-like when viewed from above the surface of the water. Many species of naiad are very common in this area. Plant structure often resembles chara, but the absence of calcium deposits on the surface of the plant help in identification. The leaves of brittle naiad have multiple spines along the margins that are visible to the naked eye.

2. Eurasian Milfoil

Scientific Name: *Miriophyllum spicatum*
Classification: Exotic in Indiana
Distribution: Common in the Midwest and Eastern U.S. Also spreading along the Pacific coast
Presence in Waubee Lake: Collected at 1 of the 60 sample sites.

Description: This extremely aggressive and extremely destructive plant has leaves in whorls of 4 around a reddish stalk. This plant grows rapidly and can reach lengths of over 10 feet. This plant has the ability to over-winter, meaning it can lie dormant

during the winter months instead of dying out completely each year. This gives it a distinct advantage over many native species, as it competes for sunlight in early spring. The dormant milfoil plants reach the surface much faster than the native plants sprouting from the lake bottom. This enables the Eurasian milfoil to shade out other plants and form the dense beds that choke the littoral zone of many lakes.

A reproductive process called fragmentation aids the rapid dispersion of Eurasian milfoil. If a milfoil plant is damaged and some fragments are removed from the macrophyte, each small piece of the plant has the ability to grow roots and create a new milfoil plant. Eurasian milfoil is considered one of the most dangerous aquatic nuisance species because of its ability to rapidly disrupt and destroy lake ecosystems.

3. Coontail

Scientific name: *Ceratophyllum demersum*
Classification: Native to Indiana
Distribution: Coontail is common throughout the U.S., usually in hard water.
Presence in Waubee Lake: Collected at 2 of the 79 sample sites.

Description: Coontail plants are submersed and have no roots, though they appear to be attached to the lake bottom when viewed from above the surface of the water. The free-floating nature of coontail allows it to colonize new areas of a lake quickly, and it often times forms extremely dense weed beds where sufficient light and nutrients are available. Coontail has dark green leaves arranged in whorls around the stem and usually grows in long, bushy strands resembling evergreen trees beneath the surface of the water. Coontail's structure is very similar to Eurasian milfoil but coontail has forked leaves, which distinguishes it from the feather-like projections of milfoil leaves.

4. Chara

Scientific name: *Chara sp.*
Classification: Native to Indiana
Distribution: Extremely common worldwide. Found in hard water.
Presence in Waubee Lake: Collected at 2 of 79 sample sites

Description: Chara is often mistaken for a vascular plant, but it is actually an advanced form of algae. It can be gray, green or yellow in color and is usually forms extremely dense beds that may cover an entire lake. It can be identified by its distinct musky odor and calcium deposits on the algae's surface make it feel bristly to the touch. It possesses leaf-like structures that are whorled around the hollow stem, and it attaches its self to the lake bottom, although it has no actual roots. It usually grows in shallow, clear water.

5. Sago Pondweed

Scientific name: *Potemogeton pectinatus*
Classification: Native to Indiana
Distribution: Found throughout the U.S., Very common in the northern 2/3 of Indiana
Presence in Waubee Lake: Collected at 3 of the 60 sample sites.

Description: Sago Pondweed has a bushy appearance with narrow, thread-like leaves that spread out to resemble a fan. Leaves are usually 1/16 of an inch wide and 1 to 6 inches long. Nutlets are formed on a string-like structure and protrude from the surface of the water. While sago pondweed can form dense beds, many times it is found in sparse, loosely distributed arrangements.

6. Illinois Pondweed

Scientific name: *Potamogeton illinoensis*
Classification: Native to Indiana
Distribution: Very widespread and very common throughout the U.S.
Presence in Waubee Lake: Collected at 14 of the 60 sample sites.

Description: Illinois pondweed is extremely common in Indiana, especially in the northern third of the state. This leafy weed has leaves with very broad bases that extend three-fourths of the way around the stem. The upper part of its slender stem is usually branched and very leafy.

7. Eel Grass (Wild Celery)

Scientific name: *Vallisneria americana*
Classification: Native to Indiana
Distribution: Found from the Great Plains to the East Coast of the U.S.
Presence in Waubee Lake: Collected at 31 of the 60 sample sites.

Description: Eel grass has tufts of ribbon-like leaves with a horizontal stem embedded in the sediment connecting each tuft. This native plant grows thick weed beds anchored in the mud by roots. These dense beds often shade out other forms of weeds and provide excellent escape cover for small fish. The flowers of this plant are visible in late summer and sit on the top of a coiled structure protruding to the surface. This plant is found in both lakes and river, but is seldom found in stagnant systems. It is considered an extremely valuable plant to aquatic ecosystems.

8. Curley Leaf Pondweed

Scientific name: *Potamogeton crispus*
Classification: Exotic to Indiana
Distribution: Found throughout the U.S. in fresh and brackish water
Presence in Waubee Lake: Collected at 3 of the 60 sample sites.

Description: Curley leaf pondweed usually grows and spreads rapidly in early spring and begins to die out by midsummer as water temperatures approach 70 degrees Fahrenheit. Curley leaf has extremely thin, membranous leaves arranged alternately on the stem with small teeth-like projections visible along the edge of each leaf. A reproductive spike may be seen protruding from the surface of the water. Curley leaf pondweed may also leave small reproductive structures called turions in the sediment on the lake bottom that can lie dormant throughout the winter and sprout in spring.

Appendix B: Tier II Data Sheets

Key

5 is the highest score on the rake.
Blanks indicate Zero weeds on rake

Table 5: Tier II Data Sheets
Waubee Lake Tier II Survey Results

Plants Present

Site #		MYSP2	POPE6	CH?AR	NAFL	POIL	ZODU	VAAM3	CEDE4	POCR3	ALGA
		Eur. Milfoil	Sago	Chara	Naiad	Illinois	Stargrass	Eelgrass	Coontail	Curly leaf	Algae
1		4					1	5	1		
2					2						
3				2	1	1		1			9
4				5							
5				3							
6				1	3						
7				2			1	3			
8					1				1		
9					2			1	2		
10				1							
11				5	1				1		
12							2	2			
13				1	1						
14							3	2	1		
15				1	1			5			
16				4		1		1			
17				5					1		
18				5	2			1			
19					5						
20				1	5	1					
21					5						
22						1					
23					4		1	2		1	
24				2	5						
25									4		
26					5						
27				4	2			1		1	
28				4							
29			1	1	4	1					
30				1	5						
31							1		5	1	
32					1				3		
33							2		5		
34				1	2				3		

35			1		5			1			
36				5	1	2			1		
37			2	4	2	1					
38								1			
39				2	1			1			
		MYSP2	POPE6	CH?AR	NAFL	POIL	ZODU	VAAM3	CEDE4	POCR3	ALGA
		Eur. Milfoil	Sago	Chara	Naiad	Illinois	Stargrass	Eel grass	Coontail	Curly leaf	Algae
40						2		3	1		
41							3	3	1		
42				3	1			1			
43				4	1	1		1			
44				2	1						
45				1				1	1		
46									5		
47				3		1					
48							2	2	1		
49				2		1		1			
50					1	1		1			
51							2	2	1		
52							3	4	1		
53						1	5	1			
54							5	1			
55								1	1		
56							3	1			
57							5	5	1		
58					1			2	1		
59							1	5			
60				5	1	1	1				

Appendix C: IDNR Tier II Survey Summary of Waubee Lake

Table 6: IDNR Tier II Survey Summary

Occurrence and Abundance of Submersed Aquatic Plants

Date:	8/9/04	Littoral sites with plants:	54	Species diversity:	0.83
Littoral depth (ft):	17.0	Number of species:	8	Native diversity:	0.82
Littoral sites:	55	Maximum species/site:	5	Rake diversity:	0.80
Total sites:	56	Mean number species/site:	2.18	Native rake diversity:	0.80
Secchi:	10.5	Mean native species/site:	2.13	Mean rake score:	3.58

Common Name	Site frequency	Relative density	Mean density	Dominance
Chara	50.9	1.42	2.79	28.4
Coontail	29.1	0.55	1.88	10.9
Eel Grass	47.3	1.02	2.15	20.4
Eurasian Watermilfoil	5.5	0.07	1.33	1.5
Flat-stemmed Pondweed	21.8	0.22	1.00	4.4
Illinois Pondweed	7.3	0.16	2.25	3.3
Waterstargrass	40.0	0.78	1.95	15.6
Variable Pondweed	16.4	0.36	2.22	7.3

Other Observed Plants

Other Observed Plants

Arrow Arum, Cattail, White Water Lily, Purple Loosestrife, Bulrush