William Merritt Chase: *Idle Hours*, 1894-95

# Lake Nancy, Washburn County, Wisconsin
# Lake Management Plan

May 2001

Prepared by Steve McComas, Blue Water Science
with contributions from Wisconsin Department of Natural Resources
and the Lake Nancy Association

*Funded in part by the Wisconsin Lake Management Planning Grants Program*

# Lake Nancy
# Washburn County, Wisconsin
# Lake Management Plan

## Table of Contents

# ACKNOWLEDGEMENTS

Members of the Lake Nancy Association and many others contributed in various ways to the work effort on the projects that formed the basis for this Management Plan. They include:

**LAKE NANCY CONTRIBUTORS:**

**Water Quality Monitoring Team**

Calvin Buck
Kate Zimmerman
Becky and Ed Polgar

**Aquatic Vegetation and Shoreland Inventory Team**

Calvin Buck
Jerry Struth

**Questionaire Address List and Mailing**

Ken Lippin

**Washburn County Land and Water**

Brent Edlin

**Wisconsin DNR**

Dan Ryan, Spooner, Project Manager

# 1. Introduction and Project Setting

Lake Nancy is located in Washburn County, Wisconsin (Figure 1). Lake Nancy is composed of several lake basins. Big Lake is the largest, and Deep Lake is the deepest (Table 1).

The objectives of this study were to characterize existing lake conditions and to make recommendations to protect and improve the lake environment where feasible.

**Table 1. Lake statistics.**

| | Big Lake | Deep Lake | Shallow Lake | Lake Nancy |
|---|---|---|---|---|
| Size (acres) | 400 | 90 | 282 | 772 |
| Mean depth (ft) | 16 | 20 | 4 | 12 |
| Maximum depth (ft) | 28 | 39 | 6 | 39 |

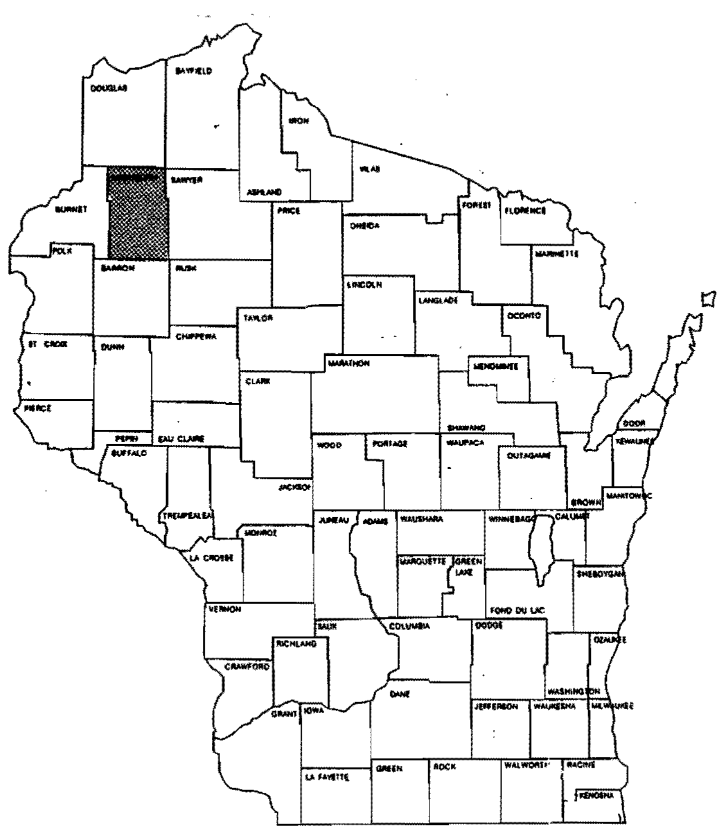



**Figure 1. Lake Nancy is located in Washburn County, Wisconsin.**

# 2. Historical Background

## 2.1. Glaciers and Soils

Lake Nancy was formed approximately 10,000 years ago during the last glacial retreat of the Superior Lobe (Figure 2). The soils deposited by the Superior Lobe glacier were primarily sands and loamy-sands. Beneath these soils, at depths of about 50-350 feet, is Precambrian bedrock that is over one billion years old. The bedrock is referred to as the North American shield.

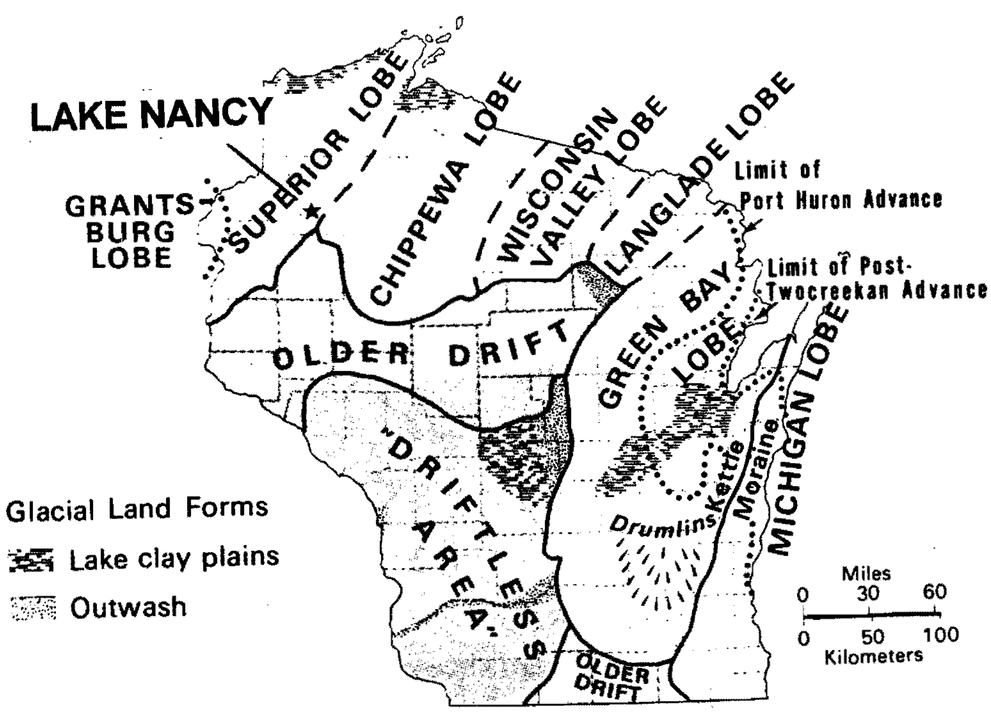



**Figure 2. Glacial lobes of the Wisconsin glaciation. Lake Nancy is located in the Superior lobe.**

Lake Nancy rests in Soils Group (21) referred to as the Vilas, Omega, Pence group (Figure 3). The soils sitting on top of glacial sands are some of the most acid (pH 5.5) and have some of the highest available phosphorus (138 lbs/acre) of any soil in Wisconsin.

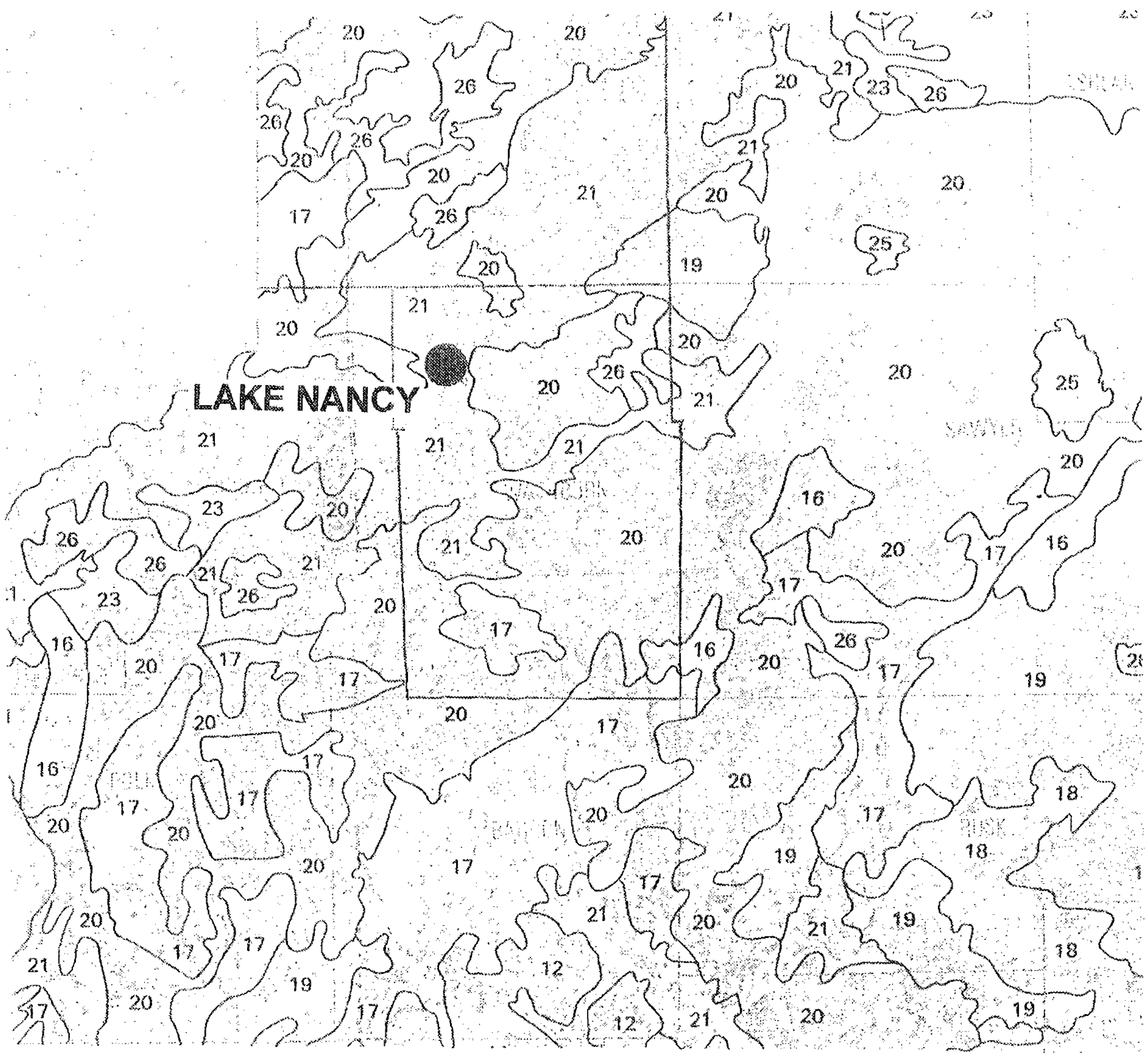



**Figure 3. Lake Nancy is located in a depression in soil group 21.**

# 2.2. Recent Lake History

**Timeline of Lake Nancy related topics. This timeline was excerpted from: Cranwood: The Lewis Cranberry Company History, by Samuel Lewis, 1988.**

| Period | Activities |
|---|---|
| 1886 | Land in the Lake Nancy area was acquired by a patent to Chicago, St. Paul, Minneapolis, & Omaha Railway |
| 1907 | Charles Lewis purchased property fronting Lake Nancy and built a cabin. Land was previously owned by Chicago, St. Paul, Minneapolis, & Omaha Railway. He thought the swampy area between Lake Nancy and Lake Kimball ( a lake which was a mile north and drained, via the swampy area, into Lake Nancy) could be used as a cranberry bog. |
| 1908 | Charles bough approximately 834 acres from individuals and the railroad. Charles sold half the interest to his brother Edward. This began Cranwood. |
| 1909 | Cranberry bog construction began. Removal of trees and stumps was first. Secondly the land was leveled, diked. Sections were built and ditched and dammed so individual sections could be flooded or drained. Each section was rectangular and two to three acres. |
| 1910 | The Lewis Cranberry Company incorporated. |
| 1913 | First cranberry crop of 235 crates was produced. |
| 1915 | Part of lot 1 sold to company. |
| 1916-1928 | The company showed a profit in each year. In 1918 the crop was 1,156 barrels (a barrel = 100 pounds of berries). |
| 1929-1934 | The company suffered loses in all but one year (1932). In 1933, Sam devised a mechanical weed cutter to cut the weeds that grew in the section. This was previously done by hand. |
| 1935-1945 | The company reported profits each year ranging from $187 (1936) to $21,616 (1938). |
| 1946-1955 | The introduction of amino-triazole, a chemical used to control certain weeds, was used on a number of farms. Some farmers used the chemical. In August, XXXX, the federal government issued an order that all cranberries be destroyed because amino-triazole had proven to possibly cause cancer if ingested by humans. Lewis Cranberry did not use the chemical. |
| 1955-1965 | Ocean Spray required that records be kept of applications of pesticides, herbicides, fungicides, and fertilizers treatments, including dates and amount. In 1965, $20,000 was borrowed from the Federal Land Bank to help with cost for more land and installing a sprinkler system. |
| 1966-1976 | Mechanical harvesting had began |
| 1968 | Amino-triazole was applied to a small area of the marsh through an error. Ocean Spray declined to accept the entire crop. |
| 1976 | Cranberry bog was shut down. |

# 3. Watershed Features

## 3.1. Drainage Area to the Lakes

Drainage areas to individual lakes are displayed in Table 2 and are shown in Figure 4. The size of the direct drainage watersheds that drain to the lakes are typical for northern Wisconsin glacial lakes.

**Table 2. Watershed areas for Lake Nancy (prepared by Blue Water Science).**

| | Lake Size (ac) | Direct Watershed (not including lake) (ac) | Contributing Watershed (ac) | Total Contributing Watershed Area (not including lake)(ac) |
|---|---|---|---|---|
| Big Lake | 400 | 663 | 1,609 | 2,272 |
| Deep Lake | 90 | 242 | 0 | 242 |
| Shallow Lake | 282 | 611 | 0 | 611 |
| Lake Nancy | 772 | 1,516 | 1,609 | 3,125 |

***Definitions***

***Direct watershed:*** *land area that drains to the lake.*
***Contributing watershed:*** *land areas that drain to the lake by way of a defined channel or stream (in this case, the Cranberry bog and Kimball Lakes).*
***Total contributing watershed area:*** *this is the direct drainage area plus the contributing watershed area.*

The drainage areas to Lake Nancy are dominated by forests and wetlands. The forests have been clear-cut at least once in the last 150 years, but have grown back and existing conditions are dominated by undeveloped land use. This condition allows the potential for good water quality to run off the land and into the lake, thus sustaining good water quality in the lake as well.

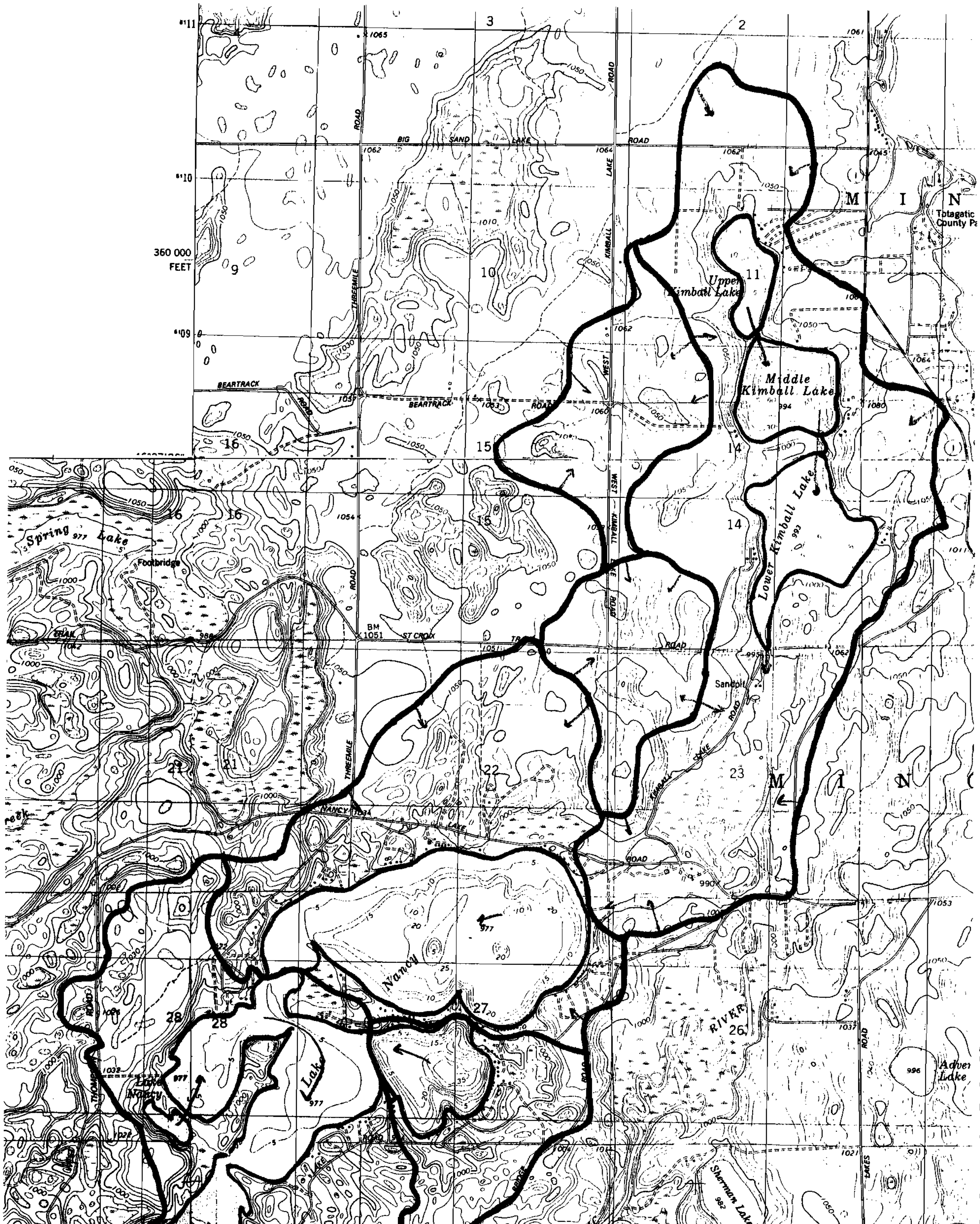



**Figure 4. Watershed area for Lake Nancy.**

## 3.2. Source of Water to the Lakes

Source of water to Lake Nancy is from groundwater that seeps into the lakes from fringe wetlands, from surface runoff, and from rainfall. The amount of water flowing into and out of Lake Nancy is estimated to be about 4 cubic feet per second. Flows were estimated based on runoff amounts listed for Washburn County in the Wisconsin Spreadsheet Lake Model (Table 3).

**Table 3. Average annual water flow into Lake Nancy.**

| | |
|---|---|
| Watershed size (acre) | 3,125 |
| Average yearly runoff for Washburn County (feet) | 0.98 |
| Total water inflow (acre-feet) | 3,063 |

***3,063 acre-feet would be enough water to fill a 3,000 foot deep swimming pool the size of a football field. It would also be enough drinking water to supply a town of 40,000 for a year.**

Although this is a lot of water coming into Lake Nancy, the volume of Lake Nancy is 9,660 acre-feet. If Lake Nancy completely dried up, it would take 3 years to fill.

## 3.3. Shoreland Status

The shoreland area encompasses three components: the upland fringe, the shoreline, and shallow water area by the shore. A photographic inventory of the Lake Nancy shoreline was conducted on September 21, 2000. The objective of the survey was to characterize existing shoreland conditions which will serve as a benchmark for future comparisons.

For each photograph we looked at the shoreline and the upland condition. Examples of shoreland conditions are shown in Figure 5. Our criteria for natural conditions were the presence of 50% native vegetation in the understory and at least 50% natural vegetation along the shoreline in a strip at least 15 feet deep. We evaluated shorelands at the 75% natural level as well.

A summary of the inventory results is shown in Table 4 and comparison to other lakes are shown in Table 5. Based on our subjective criteria over 60% of the parcels in the Lake Nancy shoreland area meet the natural rankings for shorelines and upland areas. This is good for a lake in northern Wisconsin. However in the next 10 years there could be pressure to reduce natural conditions. Proactive volunteer native landscaping should maintain existing conditions and improve other parcels.

The full shoreland inventory is found in a separate report with copies at the WDNR-Rhinelander and at the lake association archives.

**Table 4. Summary of buffer and upland conditions in the shoreland area of Lake Nancy. Approximately 217 parcels were examined.**

| Nancy Lake Photo ID #* | Natural Shoreline Condition | | Natural Upland Condition | | Undeveloped Photo Parcels | Shoreline Structure Present | |
|---|---|---|---|---|---|---|---|
| | >50% | >75% | >50% | >75% | | riprap | wall |
| Big Lake (no. of photos = 111) | 84 (76%) | 70 (63%) | 81 (73%) | 62 (56%) | 22 | 8 (7%) | 0 (0%) |
| Shallow Lake (no. of photos = 52) | 47 (90%) | 46 (88%) | 46 (88%) | 43 (83%) | 13 | 0 (0%) | 0 (0%) |
| Deep Lake (no. of photos = 40) | 29 (73%) | 26 (65%) | 26 (65%) | 22 (55%) | 1 | 2 (5%) | 2 (5%) |
| Pegal Bay (no. of photos = 14) | 14 (100%) | 14 (100%) | 14 (100%) | 14 (100%) | 5 | 0 (0%) | 0 (0%) |
| TOTALS (no. of photos = 217) | 174 (80%) | 156 (72%) | 167 (77%) | 141 (65%) | 41 (19%) | 0 (5%) | 2 (1%) |

## Table 5. Summary of shoreland inventories from Lake Nancy and 14 other lakes in Minnesota and Wisconsin.

| Lake | Eco-region | Date of Survey | Total Number of Parcels (#) | Undevel. Parcels # (%) | Natural Upland Condition | | Natural Shoreline Condition | | Parcels with Erosion # (%) | Parcels with Shoreline Structure # (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | > 50% # (%) | >75% # (%) | > 50% # (%) | >75% # (%) | | |
| Nancy Lake Washburn Co, WI | LF | 9.21.00 | 217 | 41 (19) | 167 (77) | 141 (65) | 174 (80) | 156 (72) | | 11 (5) |
| Bear Oneida Co, WI | LF | 6.8.99 | 115 | 7 (6) | 107 (93) | 90 (78) | 97 (84) | 89 (77) | 1 (1) | 9 (8) |
| Big Bearskin Oneida Co, WI | LF | 8.10.99 | 130 | -- | 95 (73) | 82 (63) | 104 (80) | 87 (67) | -- | 0 |
| Ballard chain Vilas Co, WI | LF | 7.23.99 | 110 | -- | 108 (98) | 106 (96) | 106 (96) | 105 (95) | -- | 0 |
| Comfort Chisago Co, MN | CHF | 10.9-11.2.98 | 100 | -- | 62 (62) | -- | 50 (50) | -- | -- | 12 (12) |
| Maple Grove Lake Summary, MN | CHF | 9.30 - 10.12.99 | 644 | 89 (14) | 431 (67) | 312 (48) | 385 (60) | 310 (48) | 3 (1) | 129 (20) |
| Cedar Island | CHF | 9.30 - 10.12.99 | 93 | 5 (5) | 58 (62) | 33 (35) | 51 (55) | 36 (39) | 0 | 21 (22) |
| Eagle | CHF | 9.30 - 10.12.99 | 90 | 13 (14) | 58 (64) | 47 (52) | 42 (47) | 37 (41) | 0 | 32 (35) |
| Edward | CHF | 9.30 - 10.12.99 | 34 | 4 (12) | 31 (91) | 30 (88) | 26 (76) | 24 (71) | 2 (6) | 1 (3) |
| Fish | CHF | 9.30 - 10.12.99 | 170 | 12 (7) | 126 (74) | 75 (44) | 97 (57) | 70 (41) | 1 (1) | 34 (20) |
| Pike | CHF | 9.30 - 10.12.99 | 9 | 5 (56) | 9 (100) | 9 (100) | 9 (100) | 9 (100) | 0 | 0 |
| Rice | CHF | 9.30 - 10.12.99 | 137 | 45 (33) | 97 (71) | 87 (64) | 111 (81) | 102 (74) | 0 | 25 (19) |
| Weaver | CHF | 9.30 - 10.12.99 | 111 | 5 (5) | 52 (47) | 31 (28) | 49 (44) | 32 (29) | 0 | 16 (14) |
| Powers City of Woodbury, MN | CHF | | 30 | 27 (90) | 27 (90) | 27 (90) | 29 (97) | 29 (97) | 0 | 0 |
| Upper Prior Scott Co, MN | CHF | 9.30-10.12.99 | 366 | 37 (10) | 187 (51) | 132 (36) | 128 (35) | 113 (31) | 15 (4) | 168 (46) |
| Lower Prior Scott Co, MN | CHF | 9.24-30.99 | 691 | 66 (10) | 249 (36) | 166 (24) | 152 (22) | 117 (17) | 35 (5) | 373 (54) |

* CHF = Central Hardwood Forest Ecoregion

** LF = Lake and Forests Ecoregion* CHF = Central Hardwood Forest Ecoregion

**Figure 5. Typical shoreland conditions around Lake Nancy.**
**[top] An undeveloped shoreline on Lake Nancy.**
**[bottom] An shoreland area with a residence on Lake Nancy.**

## 3.4. On-site Wastewater Treatment Systems

The status of on-site wastewater treatment systems in the watershed are rated as satisfactory. A typical on-site system is shown in Figure 6.

There may be some movement of septic effluent toward the lake, but this occurs in nearly all lake settings. Questionnaire responses indicate there is a low to medium risk of onsite systems to pollute Lake Nancy. Therefore we conclude the septic tanks are not polluting the lakes. This is based on several additional factors:

- soils have infiltration capacity so any overland septic flow would be rare.
- homes and drainfields are set back from the lake allowing adequate septic tank effluent treatment.
- there is a low density of residences around the lakes.

With new regulations in place for Washburn County, water pollution problems from on-site systems are not anticipated in the future.

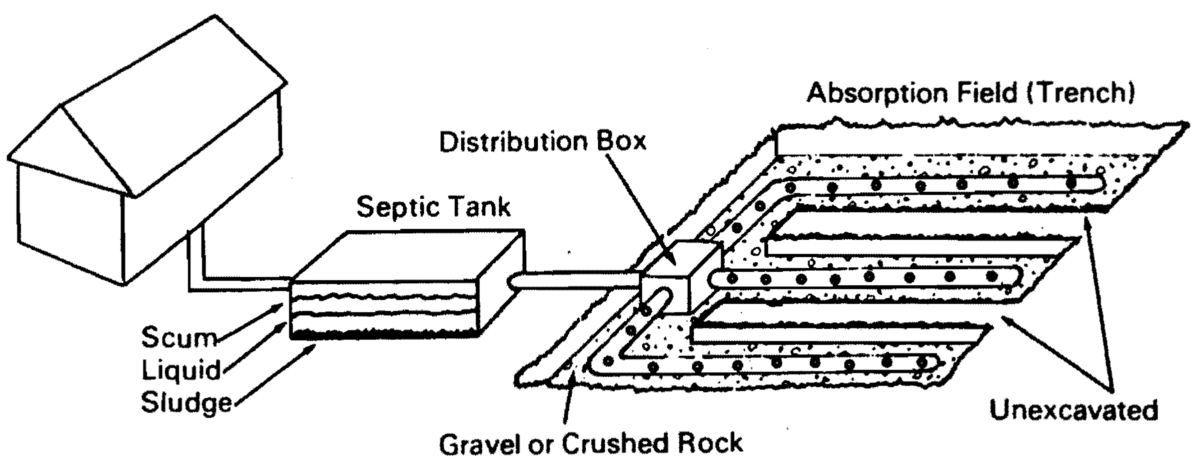



**Figure 6. Typical septic tank/drainfield configuration (from McComas 1993. LakeSmarts).**

**Table 6. Lake Nancy questionnaire results for questions pertaining to onsite treatment systems.**

**What is the age and capacity of your septic system?**

| A. Low risk | B. Medium risk | C. High risk | ANSWER: |
|---|---|---|---|
| System is five years old or less | System is between six and twenty years old | System is more than twenty years old | A= 31<br>**B= 54**<br>C= 23 |

**Where is your septic system located in relationship to the lake?**

| A. Low risk | B. Medium risk | C. High risk | ANSWER: |
|---|---|---|---|
| Drainfield is at least 200 feet from surface water. | Drainfield is at least 100 feet from surface water. | Drainfield is less than 100 feet from surface water. | **A= 62**<br>B= 36<br>C= 11 |

**Has your septic tank been pumped recently?**

| A. Low risk | B. Medium risk | C. High risk | ANSWER: |
|---|---|---|---|
| The septic tank is pumped on a regular basis as determined by annual inspection or about every 1-2 years. | The septic tank is pumped, but not regularly. | The septic tank is not pumped. | **A= 54**<br>B= 43<br>C= 12 |

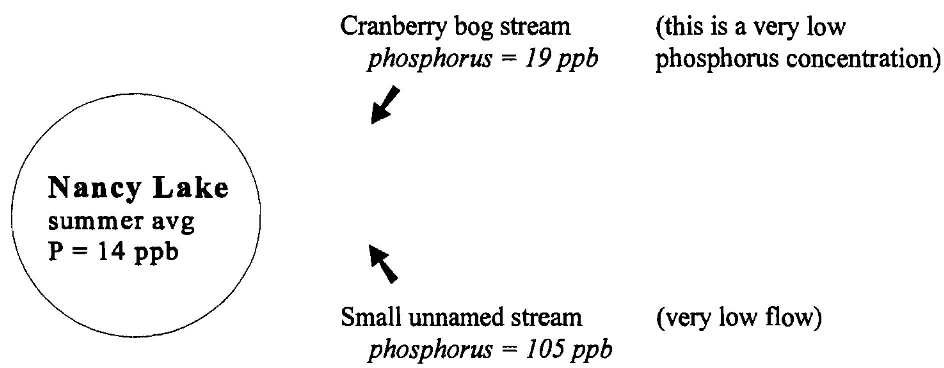
**Is your system exhibiting any signs of problems?**

| A. Low risk | B. Medium risk | C. High risk | ANSWER: |
|---|---|---|---|
| Household drains flow freely. There are no sewage odors inside or outside. Soil over drainfield is firm and dry. | Household drains run slowly. Soil over drainfield is sometimes wet. | Household drains back up. Sewage odors can be noticed in the house or yard. Soil is wet or spongy in the drainfield area. | **A= 110**<br>B= 0<br>C= 0 |

## 3.5. Watershed Synopsis

The watershed area that drains to Lake Nancy is dominated by wilderness areas and is composed primarily of forests and wetlands.

Questions have been raised by lake users about the water quality coming into Lake Nancy. Special efforts were conducted by lake volunteers to explore the watershed of Lake Nancy. Results of the exploration and water testing indicate water coming into Lake Nancy is typical for the region and is not polluted. Although there had been a cranberry bog in the Lake Nancy watershed, there is no evidence that it is polluting groundwater that flows into Lake Nancy.




**Results of water testing in ponds feeding into Lake Nancy are shown above.**

# 4. Lake Features

## 4.1. Lake map and lake statistics

The lake is shown in Figure 7 and lake characteristics are shown in Table 7. We have separated Lake Nancy into three basins.

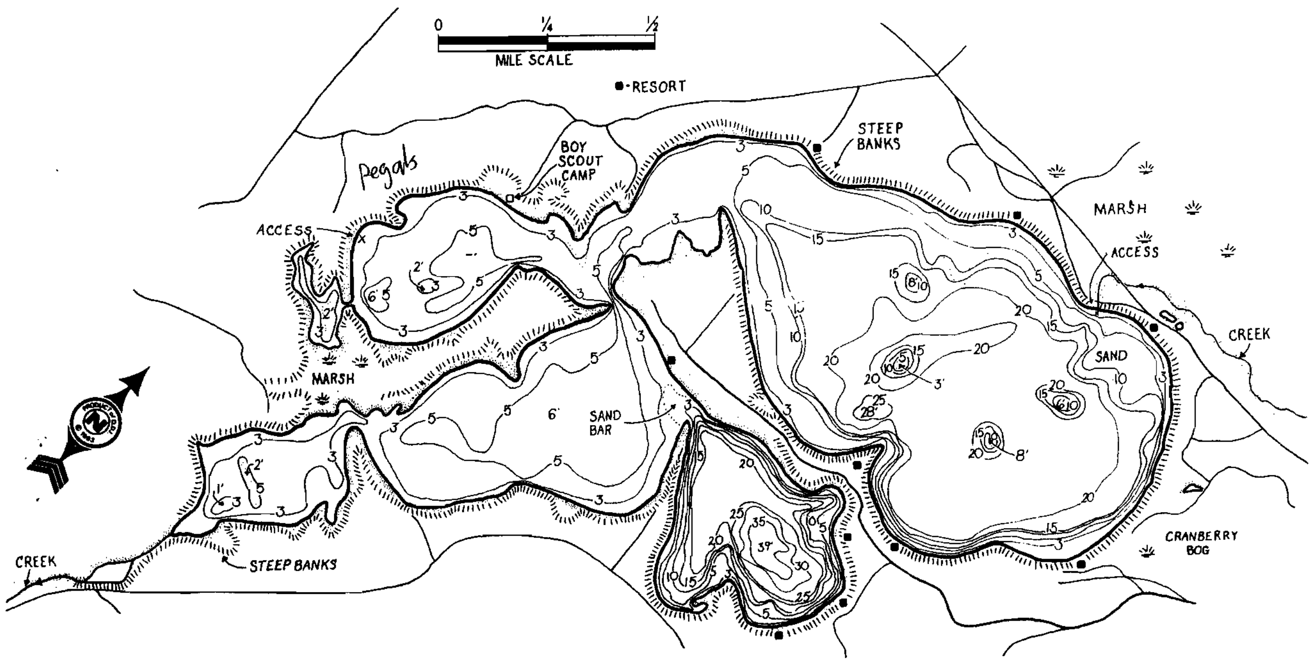



**Figure 10. Lake map of Lake Nancy.**

**Table 7. Lake Nancy characteristics.**

| | Big Lake | Deep Lake | Shallow Lake | Lake Nancy |
|---|---|---|---|---|
| Area (ac) | 400 | 90 | 282 | 772 |
| Mean depth (ft) | 16 | 20 | 4 | 12 |
| Maximum depth (ft) | 28 | 39 | 6 | 39 |
| Volume (ac-ft) | 6,912 | 1,620 | 1,128 | 9,660 |
| Watershed area (ac) (not including lake) | 2,272 | 242 | 611 | 3,125 |
| Watershed area:lake ratio | 5.7 | 2.7 | 2.2 | 4.0 |
| Annual water input (acre-feet) | -- | -- | -- | 3,063 |
| Lake water retention time (years) | -- | -- | -- | 3.1 |
| Public Access | 1 | 1 | -- | 2 |
| Inlets | 2 | -- | -- | 2 |
| Outlets | -- | -- | 1 | 1 |

## 4.2. Lake Sediment Fertility

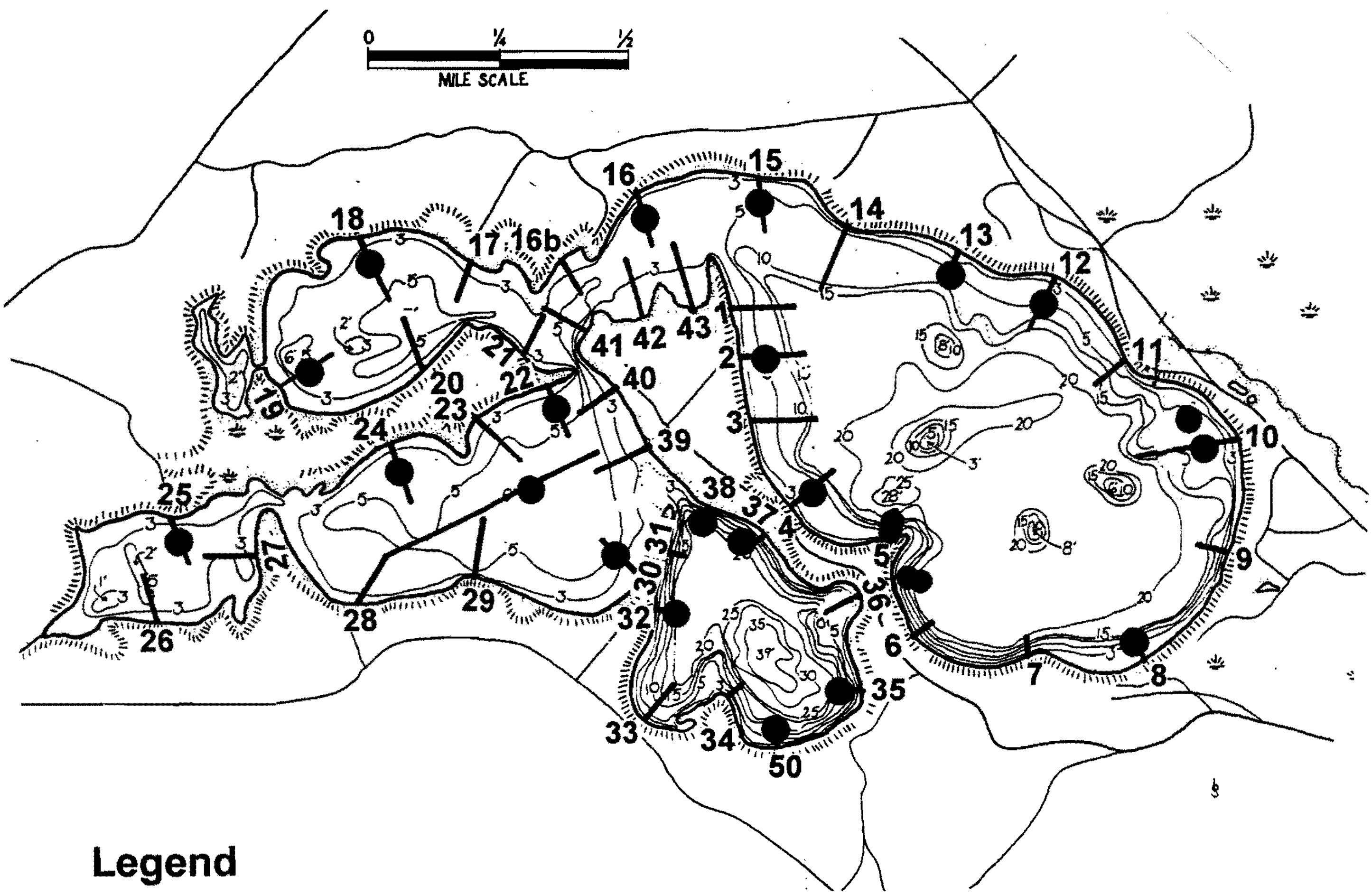
**Summary.** A total of 25 lake sediment samples were collected around 772 acre Lake Nancy on October 11, 2000 to characterize lake sediment fertility. The lake "soils" were analyzed for 16 parameters including ammonia, phosphorus, and potassium. Lake Nancy has a history of Eurasian watermilfoil colonization with milfoil first reported in 1989. The question we addressed was: can we use sediment fertility results to predict where milfoil will maintain nuisance levels (a nuisance is defined as milfoil matting at the surface). Based on sample results we predict that about 16 acres of the lake bed has the potential to exhibit nuisance conditions this is about 2% of the lake bed area.

**Methods:** Twenty-five sediment samples were collected from Lake Nancy on October 11, 2000 from depths ranging from 3 to 9 feet (Figure 8). Samples were collected using a modified soil auger, 5.2 inches in diameter. Soils were sampled to a depth of 6 inches. The lake soil from the sampler was transferred to 1-gallon zip-lock bags, packaged in a cardboard box, and mailed to a soil testing laboratory.

Lake sediment samples were collected from sites where plants were present or from open areas were plants were absent. At each sample location, within about a 10-foot radius we noted all aquatic plant species and rated their density on a scale from 1 to 5 with one representing a low density.

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

| Transect Number | Depth of Sample (Feet) | EWM Density | Transect Number | Depth of Sample (Feet) | EWM Density | Transect Number | Depth of Sample (Feet) | EWM Density |
|---|---|---|---|---|---|---|---|---|
| 2 | 5 | 0 | 12 | 5 | 0 | 28 | 5 | 0 |
| 3 | 5 | 5 | 13 | 5 | 1 | 30 | 3 | 0 |
| 5a | 8 | 5 | 15 | 7 | 2 | 32 | 8 | 0 |
| 5b | 5 | 1 | 16 | 5 | 1 | 35 | 7 | 0 |
| 5.5a | 5 | 1 | 18 | 3 | 0 | 37 | 6 | 4 |
| 5.5b | 7 | 5 | 19 | 3 | 0 | 38 | 6.5 | 5 |
| 8 | 9 | 5 | 22 | 3 | 1 | 50 | 6 | 0 |
| 10a | 5 | 0 | 24 | 3 | 0 | | | |
| 10b | 5 | 5 | 25 | 2.5 | 0 | | | |




## Legend

● = sample location

**Figure 8. Location map of the soil sediment collections sites.**

**Lake Soil Survey Results:** Twenty-five locations were sampled around Lake Nancy in water depths from 3 to 9 feet. At each location the types of plants were identified and specie's densities were noted (Table 8).

Eurasian watermilfoil was found matting at the surface (density = 5) at 6 locations. For the remaining 19 locations milfoil was either absent (12 locations) or was present but not matting at the surface (7 locations). We wanted to know if elevated nitrogen concentrations would be correlated locations of nuisance matting.

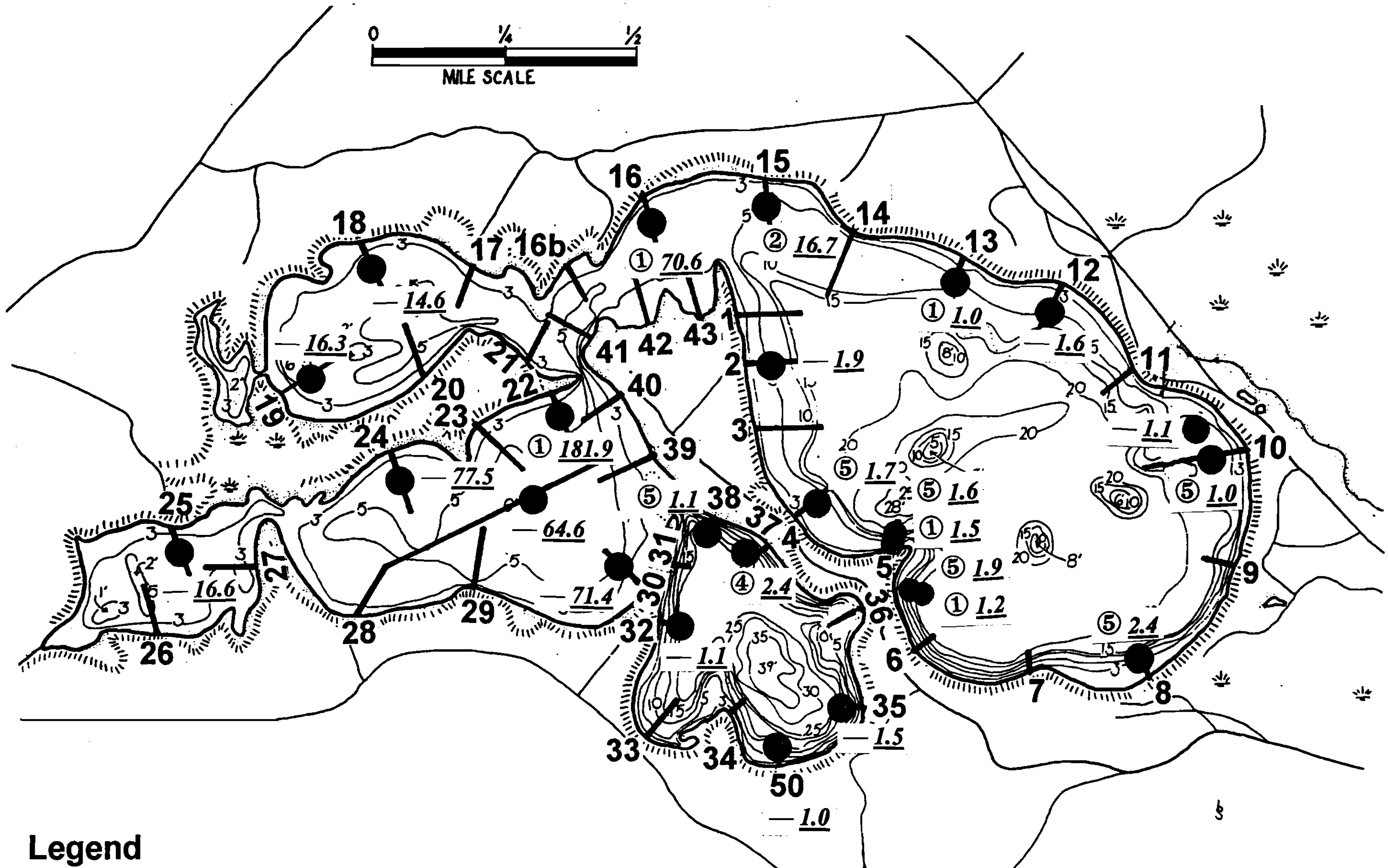
**Table 8. Plant densities (1-5 scale, with 5 the most dense) at individual sediment sample locations.**

| Sample Number | Water Depth (feet) | EWM | Total number of species | Fern pondweed | Cabbage | Spike rush | Stringy pondweed | Pickeral plant |
|---|---|---|---|---|---|---|---|---|
| 2 | 5 | 0 | 2 | X | X | | | |
| 4 | 5 | 5 | 1 | | | | | |
| 5a | 8 | 5 | 1 | | | | | |
| 5b | 5 | 1 | 2 | | X | | | |
| 5.5a | 7 | 5 | 1 | | | | | |
| 5.5b | 5 | 1 | 2 | | X | | | |
| 8 | 9 | 5 | 1 | | | | | |
| 10a | 5 | 0 | 0 | | | | | |
| 10b | 5 | 5 | 1 | | | | | |
| 12 | 5 | 0 | 1 | | | X | | |
| 13 | 5 | 1 | 2 | | | X | | |
| 15 | 7 | 2 | 2 | | X | | | |
| 16 | 5 | 1 | 1 | | | | | |
| 18 | 3 | 0 | 1 | | | | X | |
| 19 | 3 | 0 | 0 | | | | | |
| 22 | 3 | 1 | 2 | X | | | | |
| 24 | 3 | 0 | 1 | | | | | X |
| 25 | 3 | 0 | 0 | | | | | |
| 28 | 5 | 0 | 0 | | | | | |
| 30 | 3 | 0 | 1 | | X | | | |
| 32 | 8 | 0 | 1 | | | X | | |
| 35 | 7 | 0 | 2 | | X | X | | |
| 37 | 6 | 4 | 1 | | | | | |
| 38 | 6.5 | 5 | 1 | | | | | |
| 50 | 6 | 0 | 1 | | | | | |

Lake soil sampling results are listed in Table 9. For locations where milfoil was matting at the surface, exchangeable ammonium was generally slightly elevated. Locations of matting milfoil and high nitrogen are shown in Figure 9.

**Table 9. Lake soil data. Sample were collected on October 11, 2000. Soil chemistry results are reported as ppm except for organic matter (%), pH (standard units). EWM density is given on a scale from 1 to 5 with 5 representing nuisance growth.**

| Sample Location | Depth (ft) | EWM Density | # of Other Plant Species | $NH_4$ ppm by weight | Bray P ppm | Olsen P ppm | Potassi. ppm | Zinc ppm | Sulfur ppm | Iron ppm | Copper ppm | Mang ppm | Boron ppm | % Organic Matter by weight | pH unit | Buff pH unit | Calcium ppm | Magn. ppm | Sodium ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 5 | 0 | 1 | 1.88 | 3 | 2 | 15 | 0.84 | 9 | 52.6 | 0.32 | 2.9 | 0.29 | 0.98 | 7.0 | — | 160 | 18 | 78 |
| 4 | 5 | 5 | 0 | 1.68 | 7 | 1 | 7 | 0.62 | 1 | 104.2 | 0.34 | 12.9 | 0.19 | 0.75 | 6.7 | — | 120 | 20 | 84 |
| 5a | 8 | 5 | 0 | 1.61 | 4 | 1 | 14 | 0.82 | 18 | 38.2 | 0.32 | 1.5 | 0.38 | 0.86 | 6.1 | 7.4 | 80 | 15 | 66 |
| 5b | 5 | 1 | 1 | 1.50 | 5 | 1 | 15 | 1.00 | 8 | 24.0 | 0.28 | 1.0 | 0.5 | 0.98 | 6.3 | 7.5 | 120 | 20 | 18 |
| 5.5a | 7 | 5 | 0 | 1.92 | 4 | 1 | 15 | 0.90 | 10 | 37.6 | 0.40 | 2.3 | 0.23 | 0.88 | 6.1 | 7.5 | 200 | 25 | 66 |
| 5.5b | 5 | 1 | 1 | 1.21 | 5 | 2 | 12 | 1.18 | 7 | 63.7 | 0.36 | 3.5 | 0.32 | 1.25 | 5.9 | 7.4 | 120 | 23 | 126 |
| 8 | 9 | 5 | 0 | 2.43 | 3 | 4 | 17 | 2.02 | 36 | 82.3 | 0.46 | 3.2 | 0.25 | 1.29 | 5.2 | 7.3 | 160 | 23 | 72 |
| 10a | 5 | 0 | 0 | 1.05 | 5 | 4 | 11 | 0.88 | 3 | 34.4 | 0.30 | 4.8 | 0.40 | 0.95 | 6.4 | -- | 80 | 13 | 14 |
| 10b | 5 | 5 | 0 | 0.95 | 4 | 2 | 10 | 0.72 | 2 | 52.4 | 0.36 | 1.2 | 0.50 | 0.78 | 6.2 | 7.5 | 80 | 15 | 80 |
| 12 | 5 | 0 | 1 | 1.64 | 2 | 1 | 10 | 2.34 | 7 | 55.4 | 0.36 | 1.6 | 0.25 | 1.00 | 5.6 | 7.4 | 120 | 20 | 102 |
| 13 | 5 | 1 | 1 | 1.00 | 5 | 3 | 26 | 0.54 | 4 | 42.6 | 0.46 | 4.8 | 0.52 | 0.77 | 6.4 | -- | 480 | 50 | 64 |
| 15 | 7 | 2 | 1 | 16.67 | 4 | 2 | 48 | 1.84 | 55 | 126.5 | 0.78 | 16.5 | 0.62 | 65.31 | 5.8 | 7 | 880 | 88 | 46 |
| 16 | 5 | 1 | 0 | 70.57 | 2 | 3 | 91 | 1.62 | -- | 138.4 | 0.98 | 16.9 | -- | 31.48 | 5.9 | 6.5 | 960 | 138 | 224 |
| Pegal Bay | | | | | | | | | | | | | | | | | | | |
| 18 | 3 | 0 | 1 | 14.62 | 4 | 11 | 173 | 2.60 | 35 | 79.9 | 0.74 | 7.5 | 1.02 | 37.09 | 5.9 | 6.8 | 880 | 135 | 156 |
| 19 | 3 | 0 | 0 | 16.26 | 9 | 5 | 73 | 1.10 | -- | 64.2 | 0.52 | 14.9 | -- | 56.44 | 6.4 | -- | 1240 | 138 | 162 |
| Shallow Lake | | | | | | | | | | | | | | | | | | | |
| 22 | 3 | 1 | 1 | 181.93 | — | — | 36 | — | — | 53.4 | — | — | — | 20+ | — | — | 1280 | 143 | 156 |
| 24 | 3 | 0 | 1 | 77.51 | — | — | 30 | — | — | — | — | — | — | 20+ | — | — | 920 | 128 | 84 |
| 25 | 3 | 0 | 0 | 16.60 | 5 | 3 | 35 | 2.04 | 11 | 53.4 | 0.58 | 2.3 | — | 51.55 | 5.9 | 6.7 | 1400 | 153 | 156 |
| 28 | | 0 | 0 | 64.57 | 4 | 1 | 31 | 3.58 | — | 119.3 | — | — | — | 30.24 | 5.9 | 6.9 | 960 | 113 | 114 |
| 30 | 3 | 0 | 1 | 71.35 | 2 | 2 | 15 | 4.02 | — | 105.2 | 0.96 | 3.4 | — | 49.79 | 6 | 6.9 | 120 | 18 | 26 |
| Deep Lake | | | | | | | | | | | | | | | | | | | |
| 32 | 8 | 0 | 1 | 1.12 | 4 | 7 | 9 | 0.74 | 8 | 24.1 | 0.30 | 0.6 | 0.34 | 0.85 | 6.4 | — | 80 | 18 | 42 |
| 35 | 7 | 0 | 2 | 1.48 | 12 | 1 | 27 | 0.92 | 15 | 26.0 | 0.34 | 0.8 | 0.15 | 0.55 | 5.8 | 7.4 | 240 | 33 | 44 |
| 37 | 6 | 4 | 0 | 2.38 | 15 | 1 | 15 | 1.88 | 4 | 77.2 | 0.48 | 2.1 | 0.35 | 3.28 | 5.7 | 7.2 | 120 | 20 | 42 |
| 38 | 6.5 | 5 | 0 | 1.10 | 2 | 1 | 17 | 0.90 | 1 | 32.4 | 0.34 | 1.0 | 0.18 | 0.90 | 5.9 | 7.4 | 120 | 18 | 66 |
| 50 | 6 | 0 | 1 | 0.99 | 2 | 2 | 15 | 1.12 | 6 | 32.1 | 0.3 | 0.7 | 0.22 | 1.46 | 6.0 | 7.5 | 120 | 18 | 34 |
| Ranges for no milfoil growth (does not include locations 18-30)(n=6) | | | | 0.99-1.88 | 2-12 | 1-7 | 9-27 | 0.74-2.34 | 3-15 | 24-55 | 0.30-0.36 | 0.6-4.8 | 0.15-0.40 | 0.55-1.46 | 5.6-7.0 | 7.4-7.5 | 80-240 | 13-33 | 14-78 |
| Ranges of non-nuisance growth (density 1-4)(does not include locations 15, 16, 22)(n=4) | | | | 1.00-2.38 | 5-15 | 1-3 | 12-26 | 0.54-1.88 | 4-8 | 24-77 | 0.28-0.48 | 1.0-4.8 | 0.32-0.52 | 0.77-3.28 | 5.7-6.4 | 7.2-7.5 | 120-480 | 20-50 | 18-126 |
| Ranges of nuisance milfoil growth >4 feet deep (density = 6) | | | | 0.95-2.43 | 2-7 | 1-2 | 7-17 | 0.72-2.02 | 1-36 | 32.4-104 | 0.28-0.46 | 1.0-12.9 | 0.18-0.50 | 0.78-1.29 | 5.9-6.7 | 7.3-7.5 | 80-200 | 15-25 | 66-84 |




## Legend

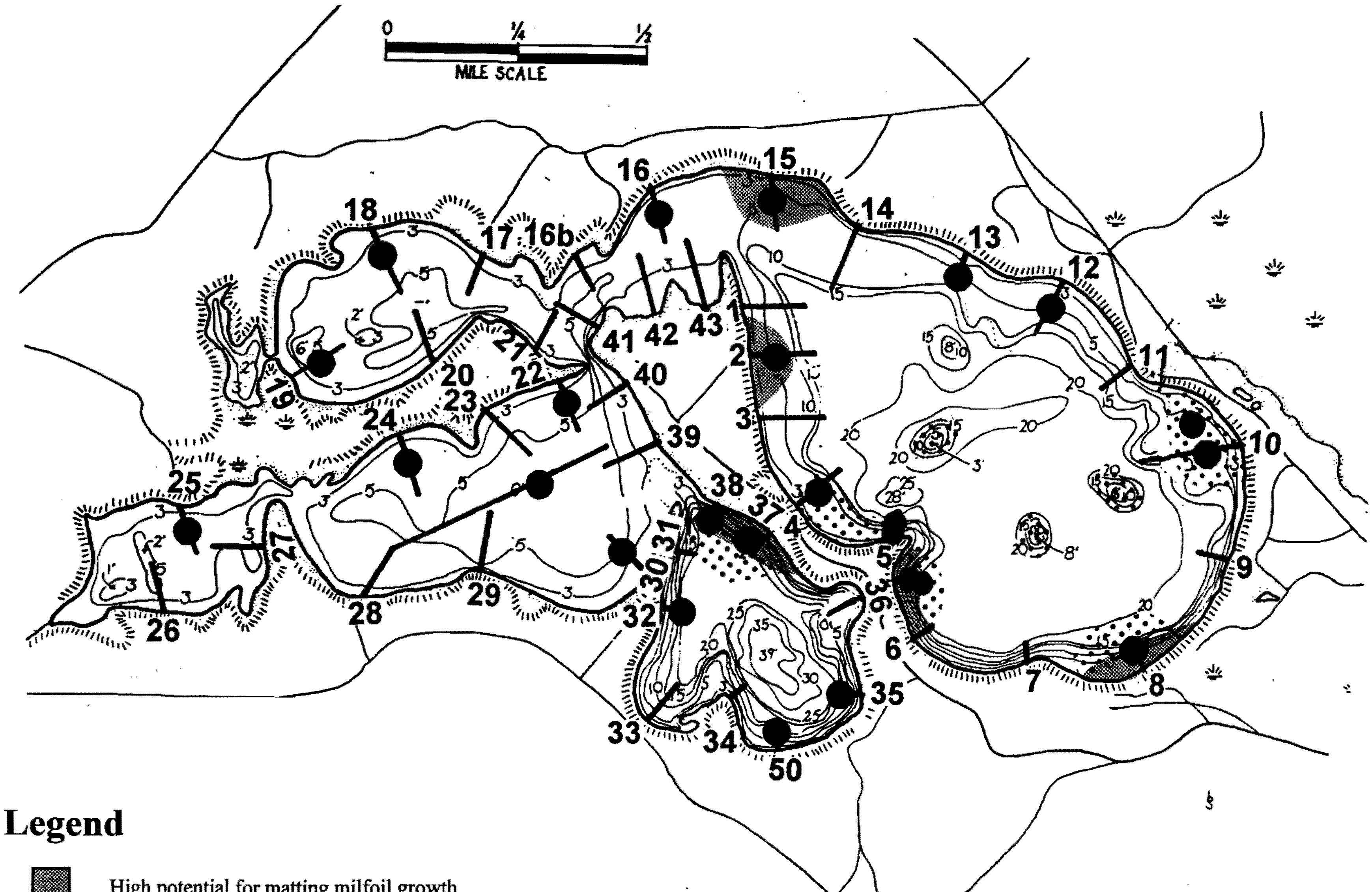
● = sample location; ③ = EWM density; <u>4</u> = Exchangeable Ammonia Nitrogen in ppm

**Figure 9. Eurasian watermilfoil density and exchangeable ammonia concentrations (ppm) for 25 samples locations in Lake Nancy for 2000.**

**Lake Soil Fertility Overview:** The use of lake soil fertility sampling to predict milfoil growth is an evolving area. Not all of the Lake Nancy sediment results fit the general pattern of high densities of EWM being correlated with high concentrations of nitrogen (as exchangeable ammonium). However other studies have found a nitrogen threshold for nuisance milfoil growth. When nitrogen concentrations are greater than about 3 ppm, nuisance conditions are often found.

From Lake Nancy results, it appears the nitrogen threshold may be around 2 ppm of nitrogen. Using this as a basis for predicting long-term nuisance conditions, a map has been constructed. There are five areas around Lake Nancy that fit the nitrogen threshold criteria and have organic matter content less than 20% (Figure 10).

There is also a limiting factor for nuisance milfoil growth and that is the content of organic matter. When organic matter exceeds 20% in a sediment sample, milfoil generally does not grow very well. Nearly all the sediments in shallow lake have organic matter contents greater than 20%.




# Legend

High potential for matting milfoil growth.

Areas with matted milfoil growth in 2000.

**Figure 10. Areas of potential nuisance Eurasian watermilfoil growth based on sediment fertility (in water 9 feet or less).**

## 4.3. Lake water quality analysis: clarity, and nutrients

Water testing was conducted by volunteers and by Blue Water Science in 2000. Lake monitoring characterized lake water quality conditions and helped us understand factors influencing water quality in all three basins.

### Temperature and Dissolved Oxygen in the Lakes

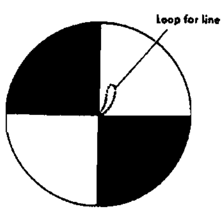
Dissolved oxygen and temperature measurements reveal several things about a lake. If oxygen is absent in the bottom of the lake, phosphorus can be released from the lake sediments. If the temperature is the same from the top to the bottom of the lake in the open water season, all the water will mix. If oxygen is depleted over the winter, winterkill can occur.

Deep Lake stratifies over the summer and Big Lake is weakly stratified. Dissolved oxygen readings were not taken due to a broken meter.

## Secchi Disc Transparency

Transparency in lakes is measured with a white and black disc (Secchi disc) that is lowered over the side of a boat into the water. The depth at which the disc is no longer visible is considered the Secchi disc measurement. The Secchi disc measurement gives some insight into the amount of nutrients in the lake. The deeper the Secchi disc transparency the clearer the lake is and the less algae present. Because nutrients make algae grow, we suspect good water transparency means low phosphorus concentrations in the lake.

Secchi disc measurements are an easy way to measure the trends of a lake. Measurements made over the years can help determine if the lake is improving or declining. Fluctuation of a couple feet is normal from year to year, but if the growing season average declines for several years, potential nutrient sources should be looked at more closely. Lake Nancy's yearly averages are about normal for mesotrophic lakes (Figure 11).




Secchi disc.

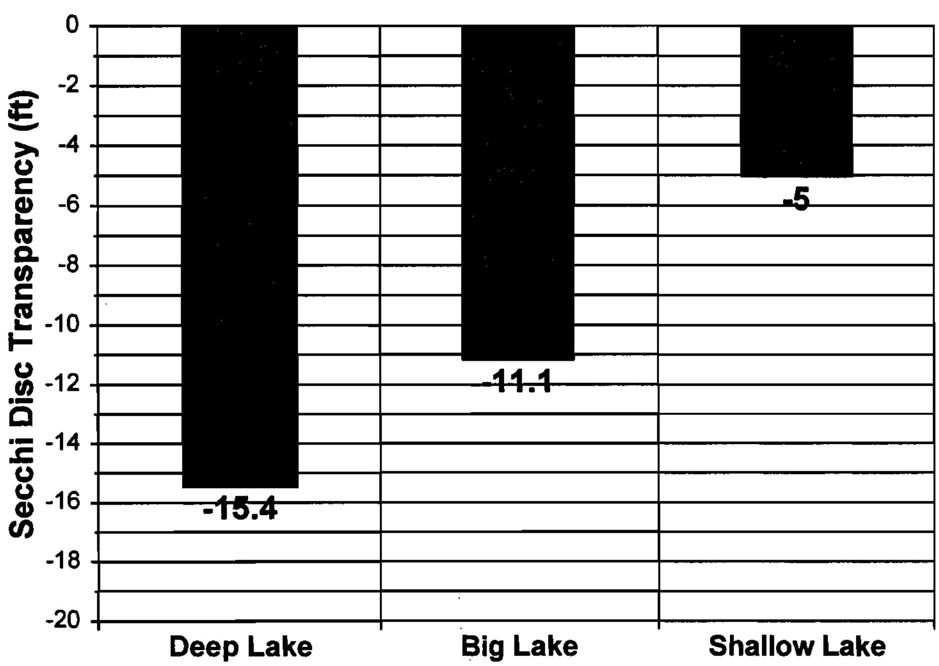



**Figure 11. Lake Nancy growing season mean secchi transparency. Shallow lake transparency was good. The secchi disc was always visible on the lake bottom at 5 feet.**

## Water Chemistry and Nutrients

**Total phosphorus:** Summertime phosphorus levels in Lake Nancy in 2000 were low to moderate. Average summer phosphorus concentrations (May-August) for 2000 are shown below and in Figure 12:

- Big Lake: 14 ppb (number of samples = 6)
- Deep Lake: 14 ppb (number of samples = 5)
- Shallow Lake: 15 ppb (number of samples = 5)

A summary of water chemistry data for Lake Nancy is shown in Table 10. Phosphorus concentrations of two incoming streams were monitored over the summer and results are shown in Table 11. Phosphorus levels were consistently low in the former Cranberry bog outflow into Lake Nancy. Phosphorus levels in the second, intermittent stream were typical for streams in this part of Wisconsin.

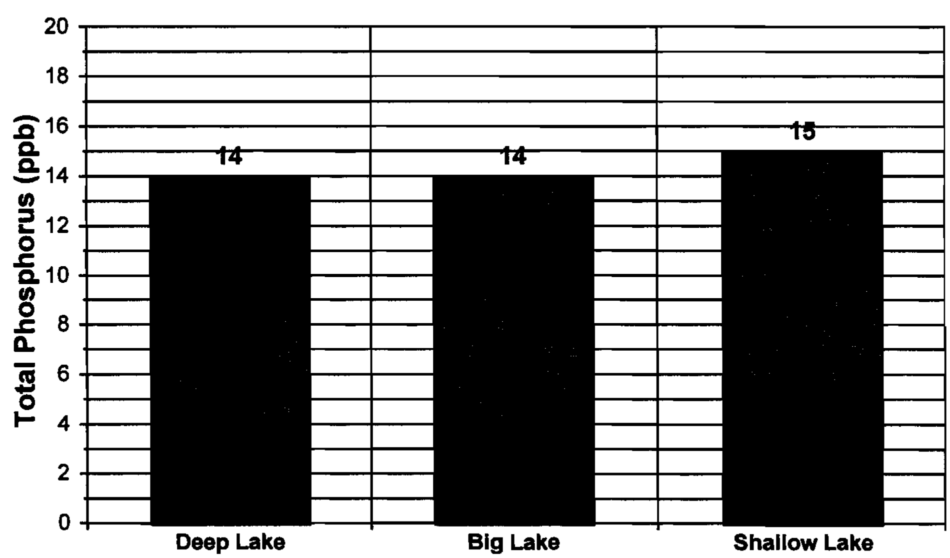



**Figure 12. Lake Nancy total phosphorus concentrations.**

**Table 10. Lake Nancy water chemistry results for 2000.**

| | | Secchi Disc (ft) | | | Total Phosphorus (ppb) | | | Chl a (ppb) | | TKN (mg/l) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Big Lake | Deep Lake | Shallow Lake | Big Lake | Deep Lake | Shallow Lake | Big Lake | Deep Lake | Big Lake | Deep Lake |
| May 6 (Braun Lab) | top | 18.5 | 18.4 | 5-bot | 17 | 13 | 18 | | 2 | | 0.41 |
| | bottom | | | | | 22 | | | | | |
| May 22 (Braun Lab) | top | | | | 30 | | | | | | |
| June 15 (Braun Lab) | top | 11.3 | 18.0 | 5-bot | 13 | 14 | 15 | 2 | | 1.2 | |
| | bottom | | | | 14 | | | | | | |
| July 18 (Braun Lab) | top | 8.6 | 11.5 | 5-bot | 11 | | 12 | | | | |
| | bottom | | | | 11 | | | | | | |
| August 17 (WI State Lab) | top | 7.0 | 13.8 | 5-bot | | 14 | | | 6 | | 0.61 |
| | bottom | | | | | 26 | | | | | |
| (Braun Lab) | top | | | | 10 | 20 | 20 | | | | |
| September 21 (WI State Lab) | top | 10.1 | 15.1 | 5-bot | | 13 | | | 3 | | 0.49 |
| | bottom | | | | | 33 | | | | | |
| (Braun Lab) | top | | | | 11 | | <10 | | | | |
| **May-September Season Average** | | **11.1** | **15.4** | **5-bot** | **14** | **14** | **15** | **2** | **4** | **1.2** | **0.5** |

**Table 11. Lake Nancy incoming streams total phosphorus results for 2000. Samples were analyzed at Braun Intertec Labs and reported in ppb.**

| | Cranberry Bog Stream (P-ppb) | Little Stream (P-ppb) |
|---|---|---|
| May 22 | 30 | -- |
| May 28 (1" rain) | 30 | -- |
| June 16 (0.75" rain) | 12 | -- |
| July 8 | 17 | 86 |
| July 9 | – | 36 |
| August 16 | 10 | 30 |
| August 30 | 30 | 40 |
| September 14 | 15 | 218 |
| October 4 | 24 | 15 |
| **May-September Season Average** | **19** | **105** |

## 4.4. Algae

The normal transition for algae in lakes over the summer months begins with diatoms which then die back while green algae become dominant. Next, the green algae die back and then blue-green algae become dominant. Examples of the type of algae found in the lakes are shown in Figure 13.

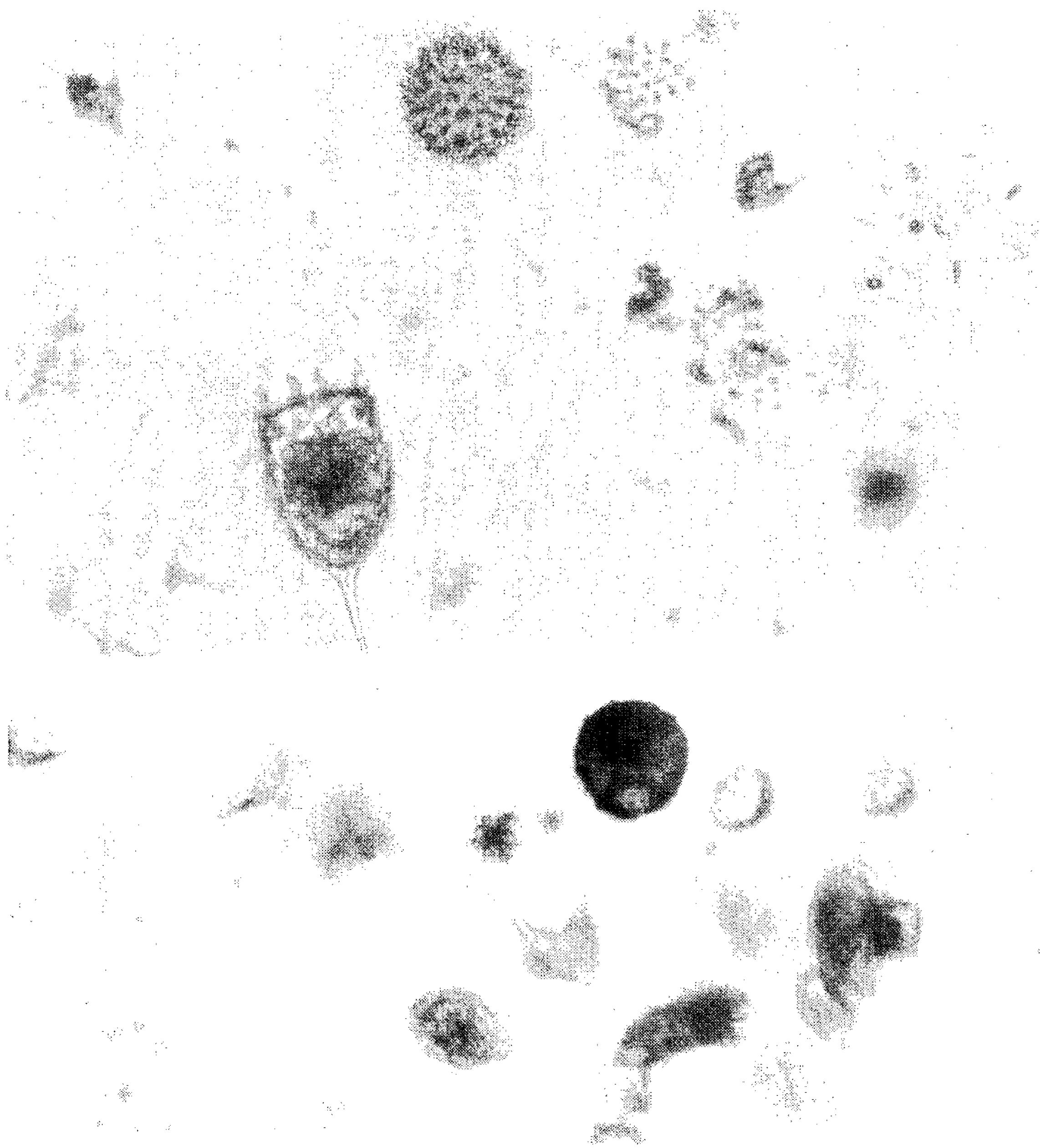


**Figure 13. Examples of algae found in Lake Nancy.**
**[top] July 18, 2000.**
**[bottom] August 17, 2000.**

## Chlorophyll a

Chlorophyll a is a rough measurement of the amount of algae there is in a lake. Lake Nancy summer chlorophyll average for 2000 was 3 μg/l with a maximum concentration of 6 μg/l.

Algae bloom intensities can be ranked by the amount of chlorophyll in a system (Table 12).

**Table 12. Chlorophyll a concentrations related to algae blooms for 2000 (MPCA 1994).**

| | Lake Nancy | |
|---|---|---|
| | Big Lake | Deep Lake |
| May 6 | | 2 |
| June 15 | 2 | |
| August 17 | | 6 |
| September 21 | | 3 |
| Average | 2 | 4 |

| Chlorophyll a concentrations | Degree of algae bloom |
|---|---|
| 0-9 μg/l | No bloom |
| 10 - 20 μg/l | Mild bloom |
| 21 - 29 μg/l | Nuisance bloom |
| 30 μg/l and greater | Severe bloom |

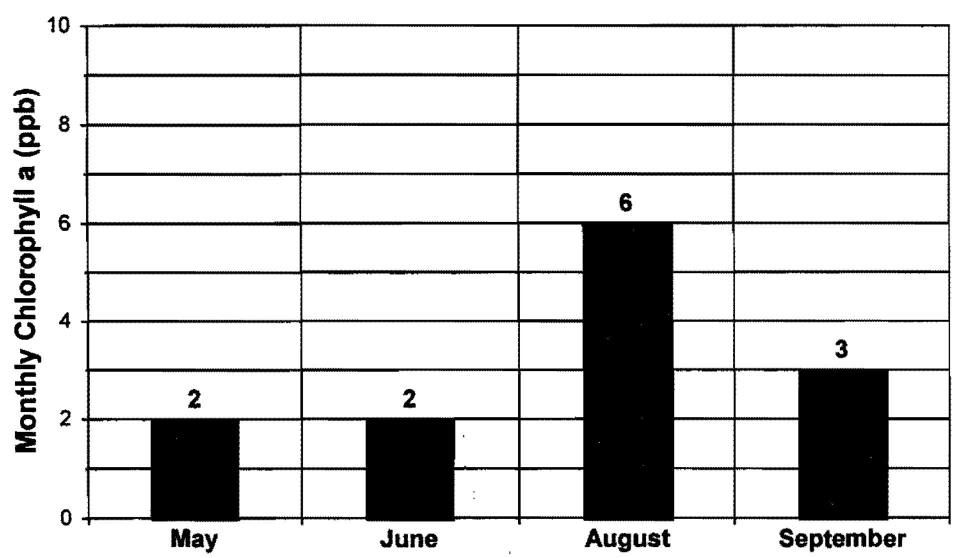



**Figure 14. Chlorophyll levels for May, June, August, and September, 2000 for Lake Nancy.**

## 4.5. Zooplankton and Other Invertebrates

Zooplankton are important in lakes. They graze on algae. If the algae population is composed of small algae cells, these are edible by zooplankton, and this grazing action can actually keep the lake relatively clear. The zooplankton community is composed of species of daphnia and copepods in the three lakes (Figures 15 and 16). The zooplankton communities are typical of lakes in this region.

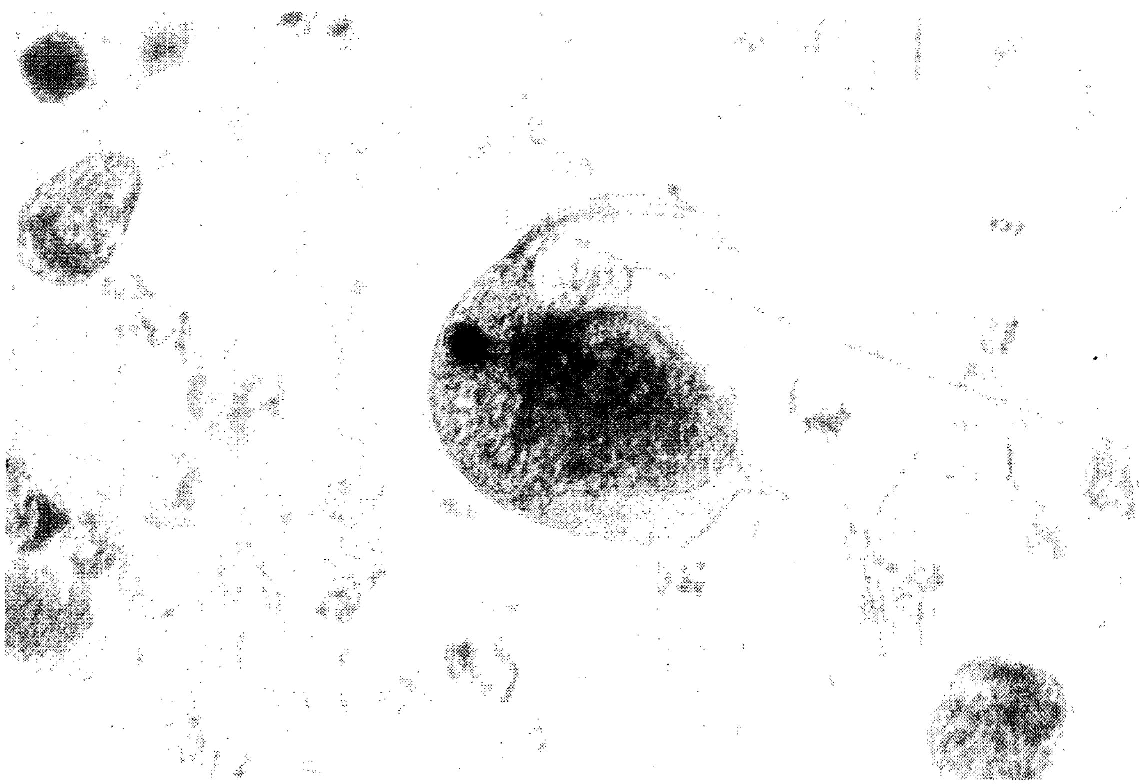


**Figure 15. Examples of zooplankton species from Lake Nancy in June, 2000. This is a cladoceran.**

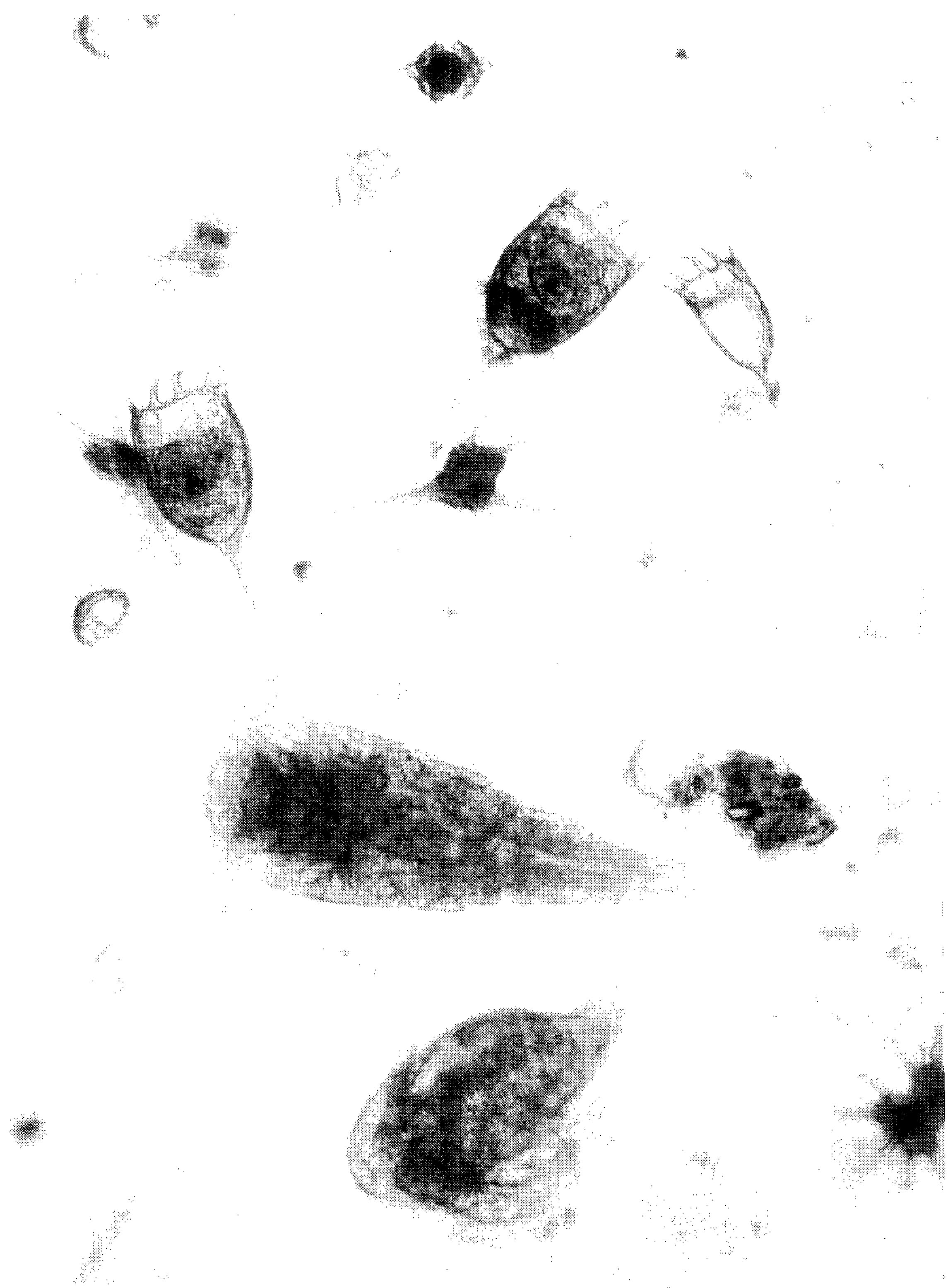


**Figure 16. [top] Rotifers from Lake Nancy in August 2000. The 3-legged things are dinoflagellates, an algal species.**
**[bottom] Copepods from Lake Nancy in August 2000.**

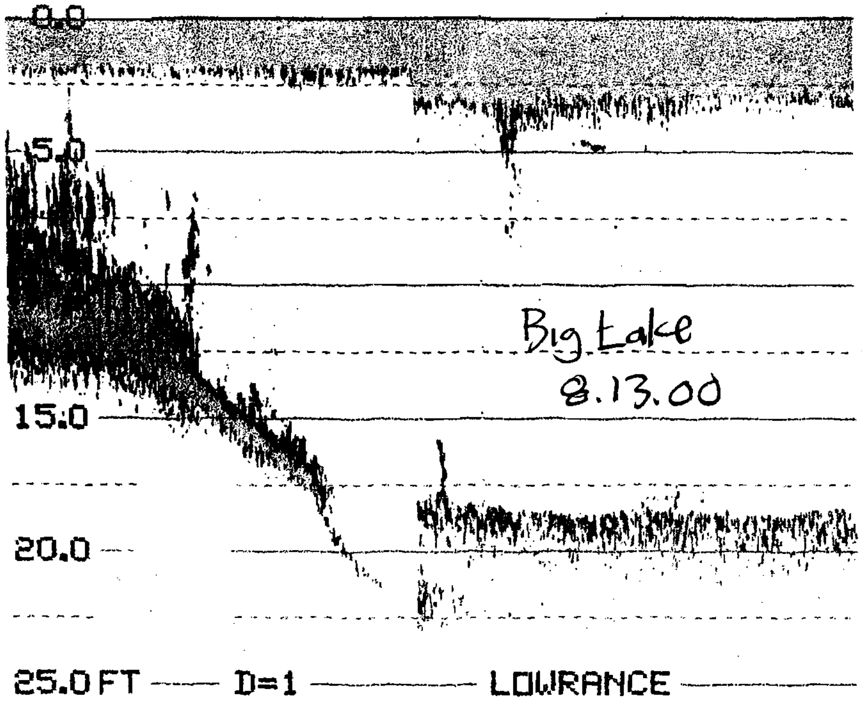
## 4.6. Aquatic plant status

Aquatic plants are very important to lakes. They act as nurseries for small fish, refuges for larger fish, and they help to keep the water clear. Currently Lake Nancy has a wide diversity of aquatic plants (Figure 17).

The coverage of aquatic plants over the lake bottoms for Lake Nancy is shown in Figure 18. The density of Eurasian watermilfoil is shown in Figure 19. Details for individual transects for the plant surveys is included in the Appendix.

**Figure 17. Example of diversity of aquatic plants found in Lake Nancy.**

A sonar with recording paper graph (Lowrance X16) was used to determine depth of plant growth and canopy characteristics. For this transect on Big Lake, the deepest depth of plant growth is 17 feet.



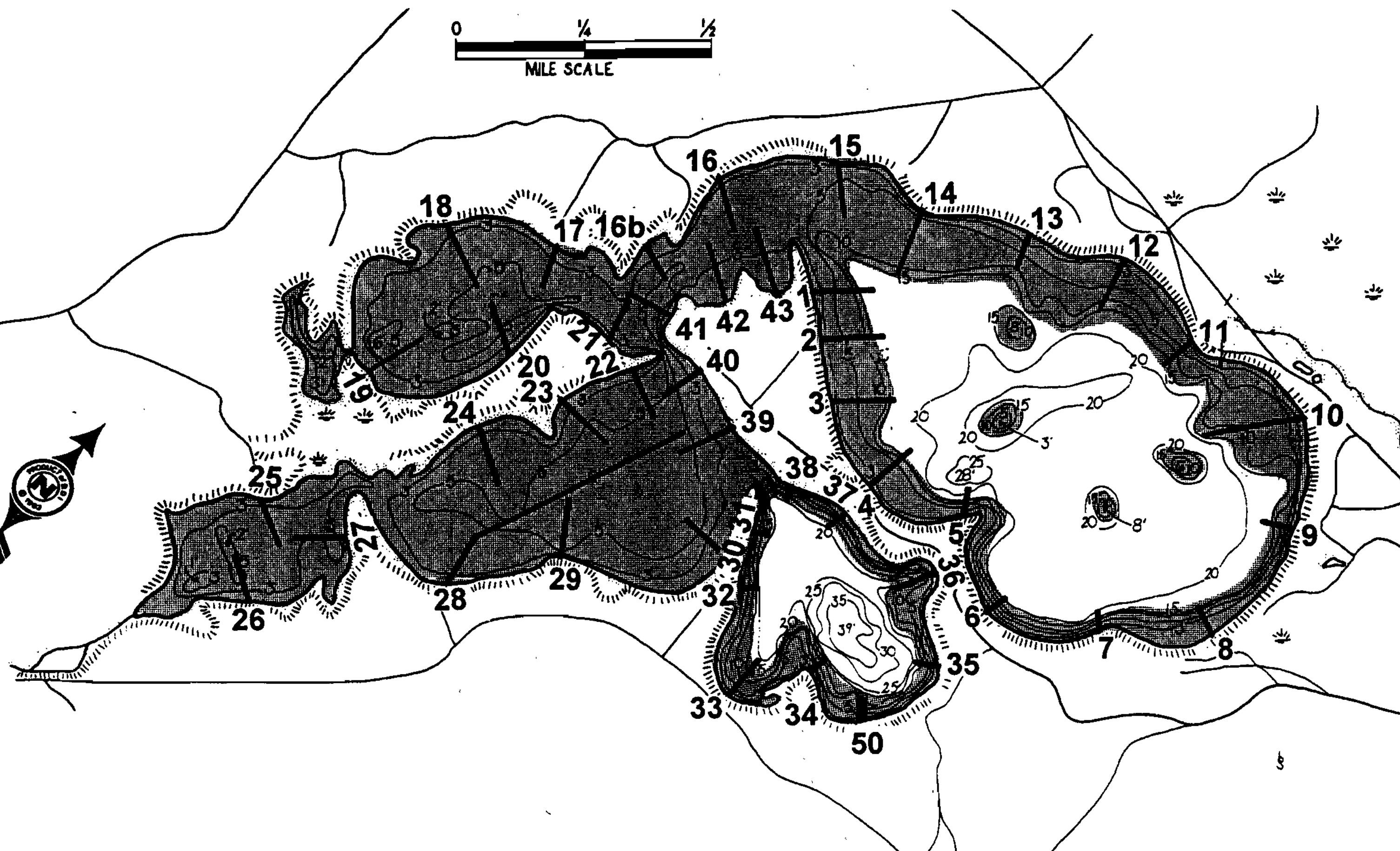




**Figure 18. Lake Nancy aquatic plant coverage based on the 2000 survey conducted by Blue Water Science. In Shallow Lake, plants are scattered and are scarce in the middle.**

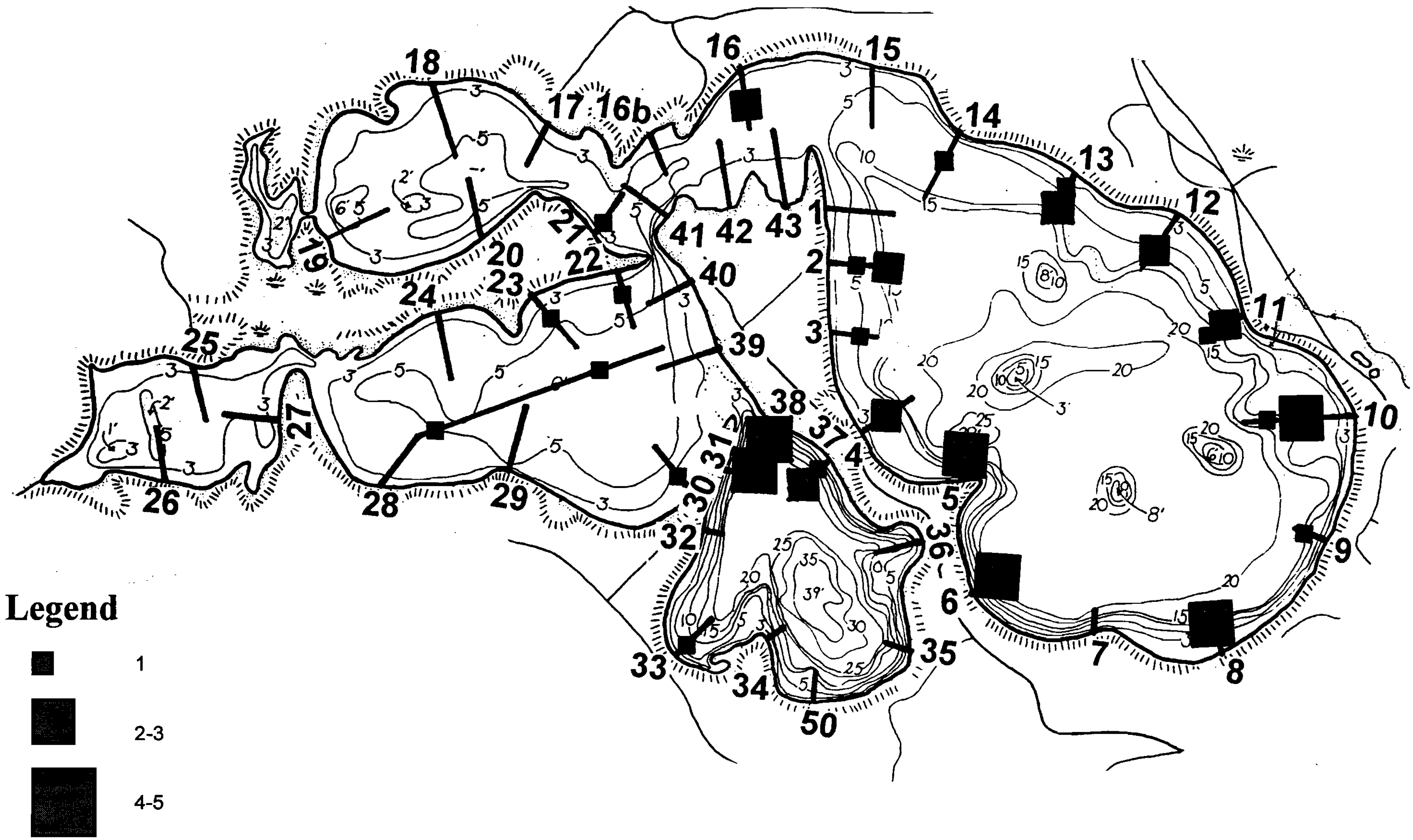



**Figure 19. Areas of Eurasian watermilfoil density based on the aquatic plant survey. 1=low density and 4 and 5 are the highest density ratings with milfoil at the lake surface.**

A summary of aquatic plant statistics is shown in Table 13. The frequency of aquatic plant occurrence and their density is shown in Tables 14, 15, and 16.

### Table 13. Aquatic Plant Survey Summary

| | Big Lake | Deep Lake | All Stations (includes Shallow Lake) |
|---|---|---|---|
| Number of aquatic plant species found | 19 | 10 | 24 |
| Most common plant | Cabbage | Variable pondweed | Cabbage |
| Rarest plant | Claspingleaf and Chara | Elodea, Naiads, Northern milfoil (tie) | Claspingleaf pondweed and dwarf milfoil (tie) |
| Rank of Eurasian watermilfoil in terms of how common it is | Third | Fifth | Third |
| Maximum depth of plant growth | 17 feet | 18 feet | 18 feet |

**Calvin Buck, Lake Nancy volunteer, shows the modified rake used to sample plants in Lake Nancy.**

**Table 14. Lake Nancy (all stations) aquatic plant occurrences and densities for the September 21, 2000 survey based on 45 transects and 3 depths, for a total of 93 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.**

| | Depth 0-5 feet (n=45) | | | Depth 6-10 feet (n=24) | | | Depth 11-15 feet (n=24) | | | All Stations (n=93) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Occur | % Occur | Density | Occur | % Occur | Density | Occur | % Occur | Density | Occur | % Occur | Density |
| Bulrush-hardstem (*Scirpus acutus*) | | | | | | | | | | | | |
| Bulrush-softstem (*S. validus*) | | | | | | | | | | | | |
| Pickeral plants (*Pontederia cordata*) | 8 | 18 | 1.5 | -- | -- | -- | -- | -- | -- | 8 | 9 | 1.5 |
| Bladderwort (*Utricularia spp*) | 6 | 13 | 1.0 | -- | -- | -- | -- | -- | -- | 6 | 6 | 1 |
| Cabbage (*Potamogeton amplifolius*) | 20 | 44 | 1.4 | 20 | 83 | 1.5 | 12 | 50 | 1.3 | 52 | 56 | 1.4 |
| Chara (*Chara spp*) | 3 | 7 | 1.0 | 1 | 4 | 2.0 | 2 | 8 | 1.0 | 6 | 6 | 1.2 |
| Claspingleaf pondweed (*P. richardsonii*) | 1 | 2 | 1.0 | -- | -- | -- | -- | -- | -- | 1 | 1 | 1.0 |
| Coontail (*Ceratophyllum demersum*) | -- | -- | -- | 1 | 4 | 1.0 | 2 | 8 | 0.5 | 3 | 3 | 0.7 |
| Crowfoot (*Ranunculus spp*) | -- | -- | -- | 2 | 8 | 0.8 | -- | -- | -- | 3 | 3 | 0.7 |
| Dwarf milfoil] (*Myriophyllum tenellum*) | 1 | | 0.5 | -- | -- | -- | -- | -- | -- | 1 | 1 | 0.5 |
| Elodea (*Elodea canadensis*) | 3 | 7 | 0.8 | 9 | 38 | 0.9 | 8 | 33 | 1.4 | 20 | 22 | 1.1 |
| Eurasian watermilfoil (*M. spicatum*) | 9 | 20 | 1.6 | 14 | 58 | 2.2 | 9 | 38 | 2.3 | 32 | 34 | 2.1 |
| Fern pondweed (*P. robbinsii*) | 11 | 24 | 1.5 | 20 | 83 | 1.8 | 13 | 54 | 2.1 | 44 | 47 | 1.8 |
| Flatstem pondweed (*P. zosteriformis*) | -- | -- | -- | 2 | 8 | 1.0 | 2 | 8 | 1.0 | 4 | 4 | 1.0 |
| Floatingleaf pondweed (*P. natans*) | 5 | 11 | 0.9 | -- | -- | -- | -- | -- | -- | 5 | 5 | 0.9 |
| Hay-like plant | 3 | 7 | 1.0 | -- | -- | -- | -- | -- | -- | 3 | 3 | 1.0 |
| Marigold (*Bidens beckii*) | 1 | 2 | 1.0 | 3 | 13 | 1.0 | -- | -- | -- | 4 | 4 | 1.0 |
| Naiads (*Najas spp*) | 4 | 9 | 1.1 | 1 | 4 | 1.0 | -- | -- | -- | 5 | 5 | 1.1 |
| Northern watermilfoil (*Myriophyllum sibiricum*) | 3 | 7 | 0.7 | 4 | 17 | 1.1 | -- | -- | -- | 7 | 8 | 0.9 |
| Pipewort (*Eriocaulon aquaticum*) | 2 | 4 | 1.0 | -- | -- | -- | -- | -- | -- | 2 | 2 | 1.0 |
| Quillwort (*Isoetes spp*) | 5 | 11 | 1.2 | 1 | 4 | 2.0 | -- | -- | -- | 6 | 6 | 1.3 |
| Spatterdock (*Nuphar variegatum*) | 3 | 7 | 1.0 | -- | -- | -- | -- | -- | -- | 3 | 3 | 1.0 |
| Spike rush (*Eleocharis palustris*) | 17 | 38 | 2.9 | 7 | 29 | 1.6 | -- | -- | -- | 24 | 26 | 2.5 |
| Stringy pondweed (*Potamogeton spp*) | 5 | 11 | 0.9 | -- | -- | -- | -- | -- | -- | 5 | 5 | 0.9 |
| Variable pondweed (*P. gramineus*) | 14 | 31 | 1.0 | 9 | 38 | 1.4 | 5 | 21 | 1.4 | 28 | 30 | 1.2 |
| Water celery (*Vallisneria americana*) | 10 | 22 | 1.2 | 10 | 42 | 1.0 | 4 | 17 | 0.9 | 24 | 26 | 1.0 |
| Watershield (*Brasenia schreberi*) | 10 | 22 | 1.0 | -- | -- | -- | -- | -- | -- | 10 | 11 | 1.0 |
| White lilies (*Nuphar spp*) | 16 | 36 | 1.3 | -- | -- | -- | -- | -- | -- | 16 | 17 | 1.3 |

**Table 15. Lake Nancy-Big Lake (transects 1-16) aquatic plant occurrences and densities for the September 21, 2000 survey based on 45 transects and 3 depths, for a total of 93 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.**

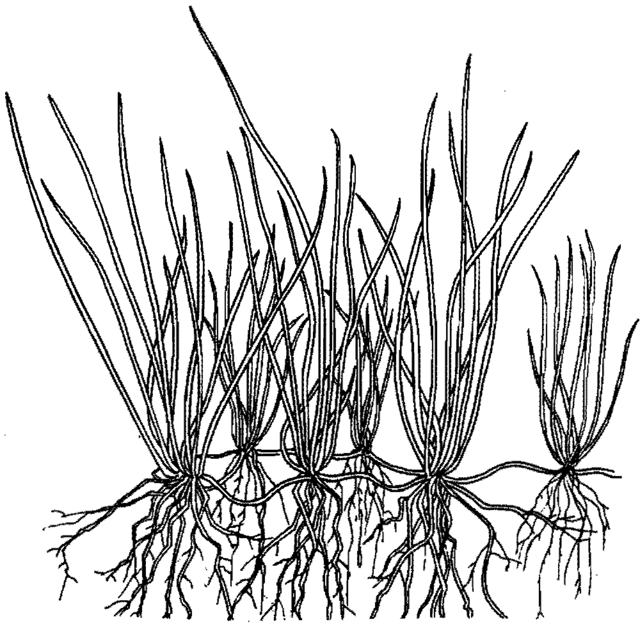
| | Depth 0-5 feet (n=16) | | | Depth 6-10 feet (n=16) | | | Depth 11-15 feet (n=15) | | | All Stations (n=47) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Occur | % Occur | Density | Occur | % Occur | Density | Occur | % Occur | Density | Occur | % Occur | Density |
| Bulrush-hardstem (*Scirpus acutus*) | 2 | 13 | 1.0 | -- | -- | -- | -- | -- | -- | 2 | 4 | 1.0 |
| Bulrush-softstem (*S. validus*) | 1 | 6 | 1.0 | -- | -- | -- | -- | -- | -- | 1 | 2 | 1.0 |
| Pickeral plant (*Pontederia cordata*) | 1 | 6 | 1.0 | -- | -- | -- | -- | -- | -- | 1 | 2 | 1.0 |
| Cabbage (*Potamogeton amplifolius*) | 8 | 50 | 1.4 | 15 | 94 | 1.5 | 9 | 60 | 1.3 | 32 | 68 | 1.4 |
| Chara (*Chara spp*) | 1 | 6 | 1.0 | -- | -- | -- | -- | -- | -- | 1 | 2 | 1.0 |
| Claspingleaf pondweed (*P. richardsonii*) | 1 | 6 | 1.0 | -- | -- | -- | -- | -- | -- | 1 | 2 | 1.0 |
| Coontail (*Ceratophyllum demersum*) | -- | -- | -- | -- | -- | -- | 2 | 13 | 0.5 | 2 | 4 | 0.5 |
| Crowfoot (*Ranunculus spp*) | -- | -- | -- | 2 | 13 | 0.8 | -- | -- | -- | 2 | 4 | 0.8 |
| Elodea (*Elodea canadensis*) | 2 | 13 | 0.8 | 7 | 44 | 0.8 | 6 | 40 | 0.9 | 15 | 32 | 0.8 |
| Eurasian watermilfoil (*M. spicatum*) | 2 | 13 | 2.8 | 11 | 69 | 2.1 | 8 | 53 | 2.1 | 21 | 45 | 2.2 |
| Fern pondweed (*P. robbinsii*) | 2 | 13 | 2.0 | 15 | 94 | 1.8 | 9 | 60 | 2.1 | 26 | 55 | 1.9 |
| Flatstem pondweed (*P. zosteriformis*) | -- | -- | -- | 2 | 13 | 0.5 | 2 | 13 | 1.0 | 4 | 9 | 0.8 |
| Marigold (*Bidens beckii*) | -- | -- | -- | 3 | 19 | 2.5 | -- | -- | -- | 3 | 6 | 0.8 |
| Northern watermilfoil (*Myriophyllum sibiricum*) | 1 | 6 | 0.5 | 1 | 6 | 1.0 | -- | -- | -- | 2 | 4 | 0.8 |
| Pipewort (*Eriocaulon aquaticum*) | 2 | 13 | 1.0 | -- | -- | -- | -- | -- | -- | 2 | 4 | 1.0 |
| Quillwort (*Isoetes spp*) | 5 | 31 | 1.2 | 1 | 6 | 2.0 | -- | -- | -- | 6 | 13 | 1.3 |
| Spike rush (*Eleocharis palustris*) | 9 | 56 | 2.6 | 2 | 13 | 0.8 | -- | -- | -- | 11 | 23 | 2.3 |
| Stringy pondweed (*Potamogeton spp*) | 1 | 6 | 1.0 | -- | -- | -- | -- | -- | -- | 1 | 2 | 1.0 |
| Variable pondweed (*P. gramineus*) | 7 | 44 | 0.9 | 3 | 19 | 1.0 | 1 | 7 | 1.0 | 11 | 23 | 1.0 |
| Water celery (*Vallisneria americana*) | 5 | 31 | 0.9 | 4 | 25 | 0.8 | 1 | 7 | 1.0 | 10 | 21 | 0.9 |
| Watershield (*Brasenia schreberi*) | 1 | 6 | 1.0 | -- | -- | -- | -- | -- | -- | 1 | 2 | 1.0 |
| White lilies (*Nuphar spp*) | 2 | 13 | 1.0 | -- | -- | -- | -- | -- | -- | 2 | 4 | 1.0 |

**Table 16. Lake Nancy-Deep Lake (transects 31-38) aquatic plant occurrences and densities for the September 21, 2000 survey based on 45 transects and 3 depths, for a total of 93 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.**

| | Depth 0-5 feet (n=45) | | | Depth 6-10 feet (n=24) | | | Depth 11-15 feet (n=24) | | | All Stations (n=93) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Occur | % Occur | Density | Occur | % Occur | Density | Occur | % Occur | Density | Occur | % Occur | Density |
| Cabbage (*Potamogeton amplifolius*) | 3 | 38 | 1.2 | 3 | 38 | 1.0 | 3 | 38 | 1.3 | 9 | 38 | 1.2 |
| Chara (*Chara spp*) | 2 | 25 | 1.0 | 1 | 13 | 1.0 | 2 | 25 | 1.0 | 5 | 21 | 1.0 |
| Elodea (*Elodea canadensis*) | -- | -- | -- | 2 | 25 | 1.3 | 2 | 25 | 0.8 | 4 | 17 | 1.0 |
| Eurasian watermilfoil (*M. spicatum*) | 2 | 25 | 3.0 | 3 | 38 | 2.3 | 1 | 13 | 4.0 | 6 | 25 | 2.8 |
| Fern pondweed (*P. robbinsii*) | 3 | 38 | 1.0 | 2 | 25 | 2.0 | 4 | 50 | 1.8 | 9 | 38 | 1.6 |
| Naiads (*Najas spp*) | 3 | 38 | 1.2 | 1 | 13 | 1.0 | -- | -- | -- | 4 | 17 | 1.1 |
| Northern watermilfoil (*Myriophyllum sibiricum*) | 1 | 13 | 1.0 | 3 | 38 | 1.3 | -- | -- | -- | 4 | 17 | 1.3 |
| Spike rush (*Eleocharis palustris*) | 6 | 75 | 3.5 | 5 | 63 | 2.0 | -- | -- | -- | 11 | 46 | 2.8 |
| Variable pondweed (*P. gramineus*) | 5 | 63 | 1.2 | 6 | 75 | 1.7 | 4 | 50 | 1.5 | 15 | 63 | 1.5 |
| Water celery (*Vallisneria americana*) | 5 | 63 | 1.4 | 6 | 75 | 1.2 | 3 | 38 | 0.8 | 14 | 58 | 1.2 |

## Common Plants in Lake Nancy

### Needle Spike Rush



Needle spike rush (*Eleocharis acicularis*) is found in shallow water, usually in sand.

### Variableleaf Pondweed

Variableleaf pondweed (*Potamogeton gramineus*) is found in all water depths.

### Fern Pondweed

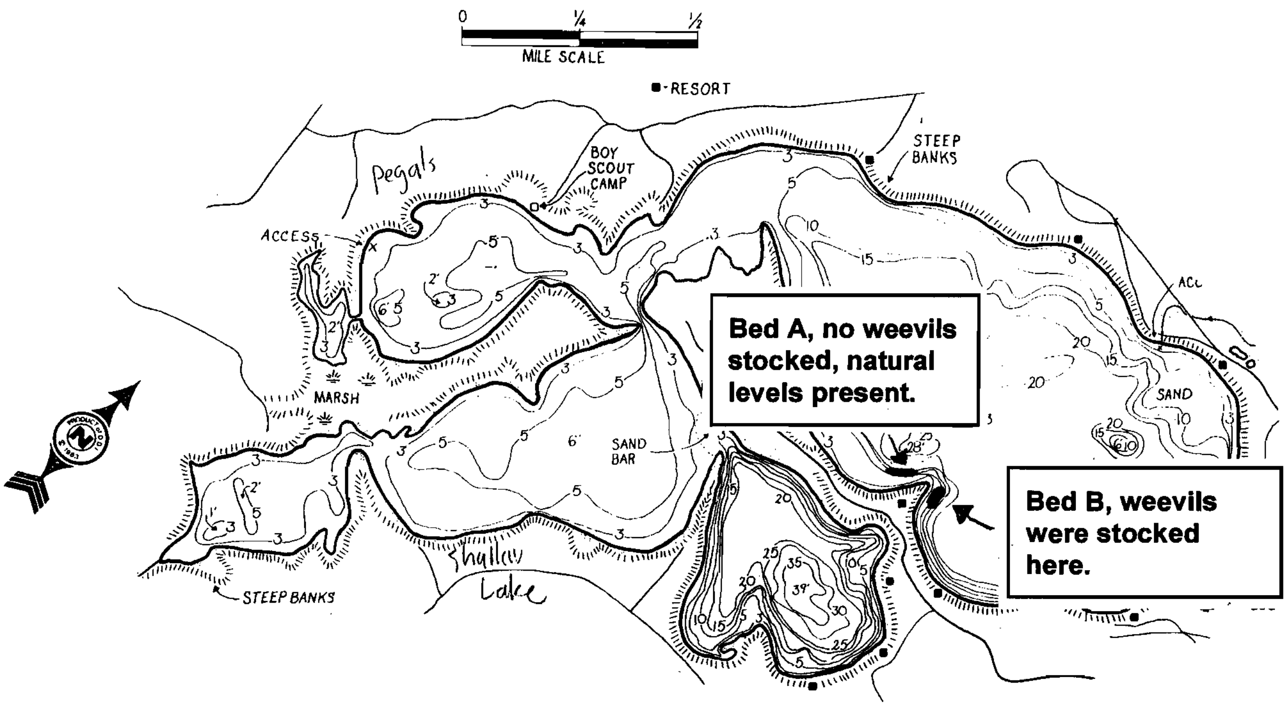
Fern pondweed (*Potamogeton richardsonii*) is found in all water depths.

### Cabbage

Cabbage (*Potamogeton amplifolius*) is found in all water depths.

## Milfoil Weevil Status

The milfoil weevil is still present in Lake Nancy, but apparently at levels found prior to weevil stocking in 1997. Results for a 2000 weevil inspection are shown below. Steve McComas collected the weevils and Laura Jester analyzed the stems for weevil presence or absence.




**Weevil density within Eurasian watermilfoil beds. Results from 1996-1998 are from Laura Jester's report on the Lake Nancy milfoil weevil project. In 2000, two beds were sampled. In each milfoil bed, there were three transects with five points per transect and two stems per point.**

| | Weevils/Milfoil Stem | | | | |
|---|---|---|---|---|---|
| | **Bed with Stocked Weevils (Bed B)** | **Bed A** | **Bed C** | **Bed D** | **Whole Lake** |
| 1996 (8.6) | 0.53 | 2.2 | 0.9 | 1.1 | 1.2 |
| 1997 (6.30) | 0.51 | | | | |
| 1997 (8.26) | 0.40 | | | | |
| 1998 (6.29) | 0.28 | | | | |
| 1998 (9.2) | 0.98 | | | | |
| 2000 (8.17) | 0.53 | 0.1 | | | 0.32 |

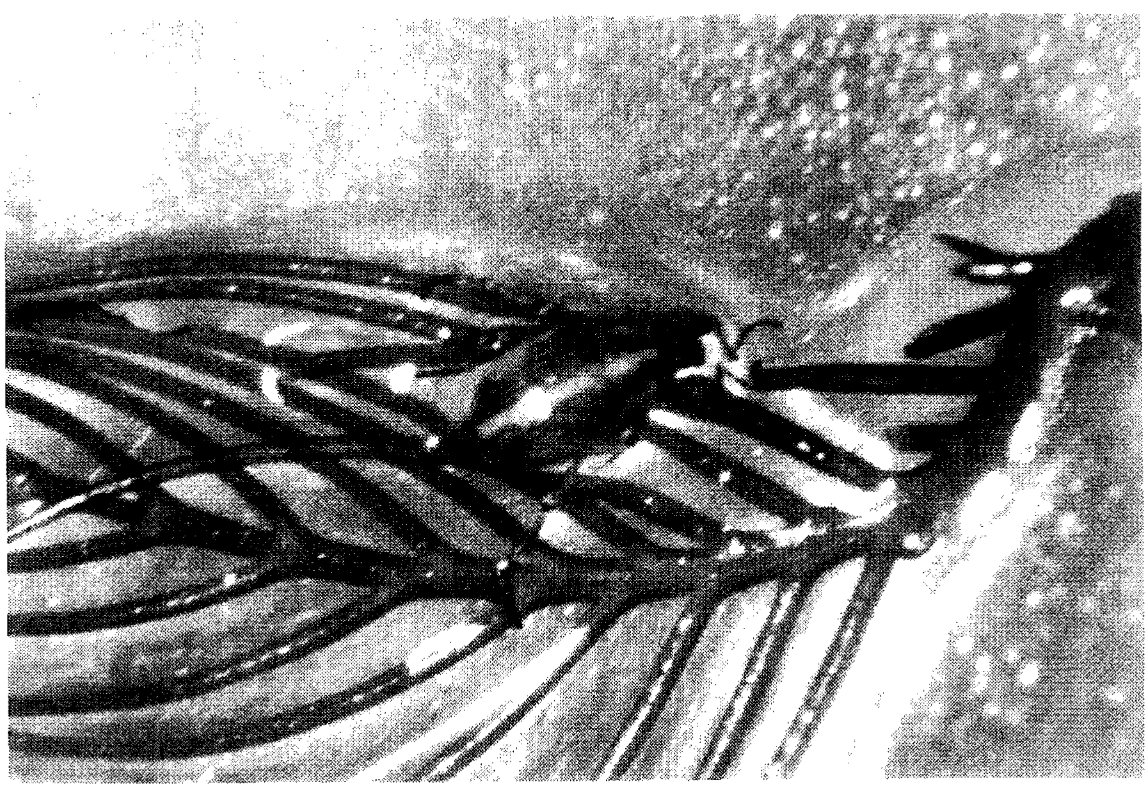


**Figure 19. [top] Adult milfoil weevil.**
**[bottom] Milfoil weevil on a milfoil leaflet.**

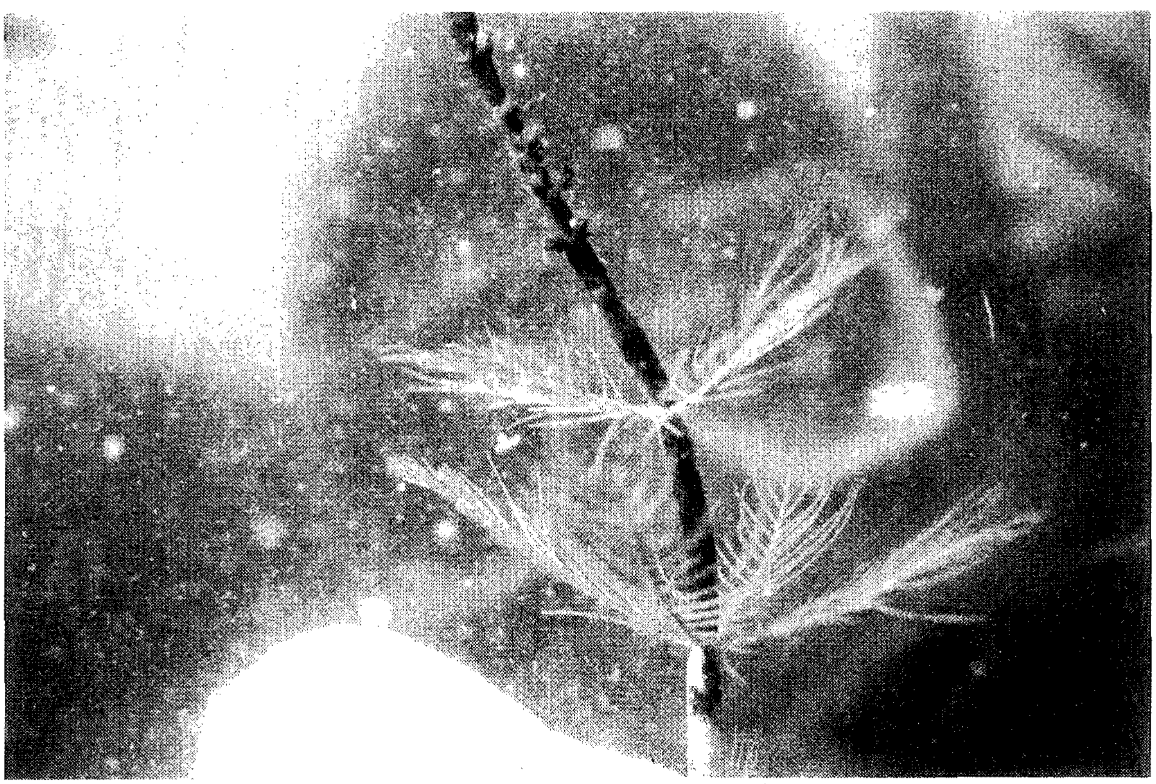


**Figure 20. Apical stem damage attributed to a milfoil weevil.**

## 4.7. Fishery Status

**Fishery Highlights Include the Following:**

- Lake Nancy is a natural walleye lake . . . meaning there has been natural reproduction occurring. This is rare for this part of the state. Stocking was curtailed because reproduction was going well.
- There was a number of years of poor "recruitment" (meaning poor spawning success) which left the walleye fishery vulnerable. Poor spawning success may have been related to high lake levels caused by beaver dams in the outlet stream. It may have been overfished at the top for a couple of years.
- Stocking resumed and walleyes have increased and there is evidence of walleye spawning success.
- Walleye spawning reefs were placed in Lake Nancy to aid spawning success.
- Nancy was an experimental muskie lake in the early 1980s. The Leech Lake (Minnesota) muskie strain was introduced because of their potential to reproduce in lakes with northern pike present. Reproduction occurred for a period and then dropped off.

# 5. Lake and Watershed Assessment

## 5.1. Lake Questionnaire Results

A lake use survey was mailed or handed out to member households and there were 120 surveys returned. Responses are shown in the next few pages (Table 17).

Wildlife viewing and fishing ranked as the most enjoyable activities on the lakes. Water quality was rated as good to excellent for Lake Nancy.

The most serious lake problems mentioned by respondents varied from lake to lake.

Highlights of some of the questions responses were:

**Table 17. The Lake Nancy questionnaire results. The questionnaire was developed to gage the concerns, goals, and attitudes of homeowners living around Lake Nancy. The questionnaire was handed out of the annual meeting and 30 responses were received. For lake residents not present the questionnaire was mailed to the remainder of the lake residents with a stamp for return mail. A total of 90 mailed responses were received for a grand total of 120 responses.**

**1. What do you enjoy most about Lake Nancy?** (Ranked 1 through 8 with 1 being the highest rank.The lower the score the higher the preference.)

1 (2.8)* Fishing (113 responses)
2 (2.9) Boating, canoeing, etc (107)
3 (2.9) Swimming (109)
4 (3.1) Aesthetics and viewing (108)
5 (4.1) Wildlife (106)
6 (4.6) Water sports (86)
7 (6.2) Ice fishing (73)

** represents average value based on the number of responses.*

**2. What is the current water quality of Lake Nancy?** (Water quality indicators are things such as water clarity, algae, weeds or plants, swimming conditions, or fishing conditions. Numbers for a category represent the number of responses for that category.)

12 Excellent
67 Good
34 Fair
10 Poor

**3. Since you have lived on or near Lake Nancy, the quality has:**

4 Improved
21 Remained the same
34 Degraded slightly
44 Degraded considerably
3 No opinion/can't tell
2 Other

*[The average length of residency on Lake Nancy was 18.4 years.]*

**4. What do you see as the most important issue regarding the lake?**
(Ranked with 1 being the most important and 10 being the least important. The lower the score the greater the importance.)

1 (1.5)* Eurasian watermilfoil (117 responses)
2 (3.8) Water quality (89)
3 (4.2) Water craft (93)
4 (4.3) Lake water levels (93)
5 (5.3) Poor fishing (81)
6 (5.4) Development (84)
7 (5.5) Lake crowding (81)
8 (5.8) Excessive algae (79)
9 (6.6) Wildlife (66)
10 (6.8) Erosion (71)

** represents average value based on the number of responses.*

**5. Because Lake Nancy is moderately fertile, there will be some type of plant growth in the lake. Aquatic plants are good for lakes. However some aquatic plants can create nuisance conditions. If you could manage Lake Nancy for plant growth what aquatic plant condition would you prefer?**

4 A. Existing conditions are acceptable. (4 respondents out of 120 checked this.)

B. Reduce nuisance exotic plant growth associated with Eurasian watermilfoil. The following methods are control options (rank options with 1 the highest priority):

| Rank | Method Preference | | | | Total Responses for Each Method | |
|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | | |
| 1 (1.75)* | 37 | 27 | 8 | 5 | (77) | Mechanical harvesting |
| 1 (1.75) | 48 | 7 | 8 | 11 | (74) | Chemical control with herbicides |
| 3 (2.35) | 13 | 16 | 24 | 12 | (65) | Hand pulling using scuba gear |
| 4 (2.40) | 26 | 15 | 14 | 15 | (70) | Continue efforts to use the milfoil weevil for milfoil control |

** represents average value based on number of responses.*

C. Here is my plan: *Some of the responses included: raise water level, use blanket to cover plants and combinations of methods.*

**6. Who do you think is responsible for protecting and improving the lake. Enter the three most important groups or agencies by putting their letter in the spaces provided.**

| | 1st | 2nd | 3rd |
|---|---|---|---|
| A. Federal government | 6 | 3 | 7 |
| B. State government | **44** | 25 | 11 |
| C. County government (Washburn County) | 16 | **35** | 21 |
| D. Local government | 4 | 6 | 16 |
| E. Lake Nancy Protective Association | 20 | 28 | **27** |
| F. Individual lake residents | 19 | 11 | 18 |
| G. The general public | 3 | 4 | 7 |
| H. All equally | 6 | 1 | 4 |
| I. Other | 0 | 2 | 0 |

**7. What is the age and capacity of your septic system?**

| A. Low risk | B. Medium risk | C. High risk | ANSWER: |
|---|---|---|---|
| System is five years old or less | System is between six and twenty years old | System is more than twenty years old | A= 31<br>**B= 54**<br>C= 23 |

**8. Where is your septic system located in relationship to the lake?**

| A. Low risk | B. Medium risk | C. High risk | ANSWER: |
|---|---|---|---|
| Drainfield is at least 200 feet from surface water. | Drainfield is at least 100 feet from surface water. | Drainfield is less than 100 feet from surface water. | **A= 62**<br>B= 36<br>C= 11 |

**9. Has your septic tank been pumped recently?**

| A. Low risk | B. Medium risk | C. High risk | ANSWER: |
|---|---|---|---|
| The septic tank is pumped on a regular basis as determined by annual inspection or about every 1-2 years. | The septic tank is pumped, but not regularly. | The septic tank is not pumped. | **A= 54**<br>B= 43<br>C= 12 |

**10. Is your system exhibiting any signs of problems?**

| A. Low risk | B. Medium risk | C. High risk | ANSWER: |
|---|---|---|---|
| Household drains flow freely. There are no sewage odors inside or outside. Soil over drainfield is firm and dry. | Household drains run slowly. Soil over drainfield is sometimes wet. | Household drains back up. Sewage odors can be noticed in the house or yard. Soil is wet or spongy in the drainfield area. | **A= 110**<br>B= 0<br>C= 0 |

**11. What do you believe would be *realistic* goals to accomplish for Lake Nancy?** (All that applied were checked.)

- 103 Eliminate weeds that create a nuisance.
- 88 Maintain crystal clear lake such as found in Northern Wisconsin.
- 68 Increase gamefish fishing opportunities.
- 32 Reduce intensity of algae blooms.
- 9 Eliminate algae blooms for the whole summer.
- 8 Eliminate all submerged weeds.
- 5 Elimination of roughfish.
- 0 The lake cannot be improved.
- 14 Other

**12. What should be done to improve or protect the quality of the lake?** (Examples of projects are watershed practices, buffer strips, wetland restoration, fish stocking, educational materials, etc).

*A variety of projects were mentioned.*

**13. You have options for managing your yard. How is your yard maintained?**

93 No fertilizer applied
17 Fertilizer is applied: 11 One; 3 Two; 1 Three times per year
2 Use a commercial fertilizer service
66 Maintain natural landscaped area
56 Maintain a vegetative buffer between lake and mowed lawn

**14. Are you interested in participating in a Lake Management Program on a personal level?**

Are you willing to do any of the following: Yes: 87 No: 12 No Answer: 21

19 Use soil test recommendations for fertilizer application.
51 Plant native wildflowers, grasses, etc to attract wildlife.
49 Leave as is or restore natural shoreland vegetation.
56 Volunteer to help control nuisance growth of aquatic plants as part of a whole lake effort.
12 Other ideas

**15. Where do you get your information on how lakes work?**

94 Lake Association newsletters
50 Wisconsin DNR
38 Newspapers
17 Television
23 Other

## 5.2. How Do the Lakes Rate?

The status of Lake Nancy are graded as good to excellent. Although clarity and phosphorus levels are out of range for Lake Nancy, they are about where they should be for lakes in this part of Wisconsin (Table 18). Values for phosphorus, chlorophyll and Secchi depth are within ecoregion ranges for 2000.

Shallow lake produces more algae from phosphorus inputs compared to Deep or Big Lakes where the same amount of phosphorus is assimilated and diluted. Shallow Lake rates good compared to other shallow lakes in the region.

**Table 18. Range of summer water quality characteristics for lakes in the Northern Lakes and Forest ecoregion, as noted in Descriptive Characteristics of the Seven Ecoregions in Minnesota, by G. Fandrei, S. Heiskary, and S. McCollar. 1988. Minnesota Pollution Control Agency.**

| Parameter | Northern Lakes & Forests | Big Lake | Deep Lake | Shallow Lake | Lake Nancy |
|---|---|---|---|---|---|
| Total Phosphorus (ppb) (top water summer average) | 14-27 | 14 | 14 | 15 | 14 |
| Algae (chlorophyll mean (ppb) | <10 | 2 | 4 | -- | 3 |
| Algae (chlorophyll maximum (ppb) | <15 | 2 | 6 | -- | 6 |
| Secchi disc (feet) | 8-15 | 11.1 | 15.4 | 5+ bottom | 10.5 |
| Total Kjeldahl Nitrogen (ppb) | <750 | 1,200 | 500 | -- | 850 |
| TN:TP Ratio | 25:1-35:1 | 86:1 | 36:1 | -- | 61.:1 |

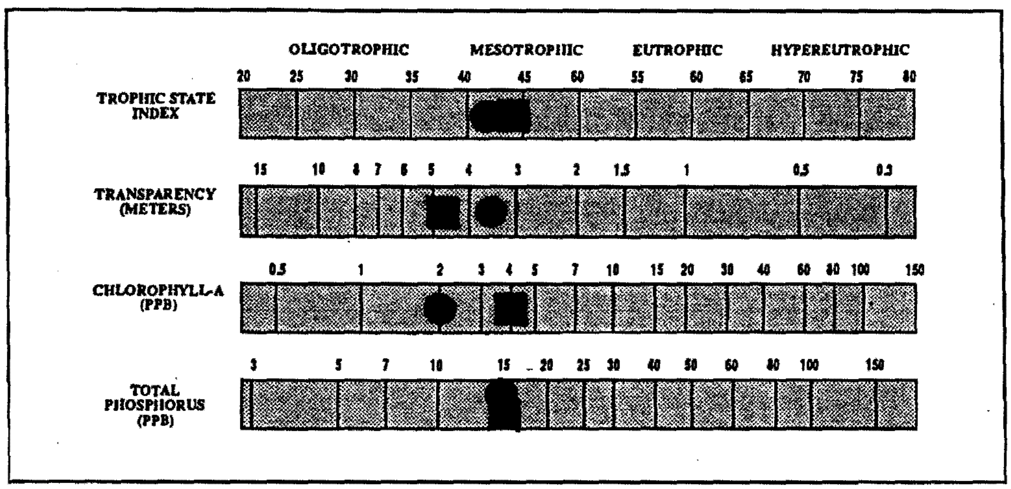
An important component to watch and to control is nutrient inputs -- both phosphorus and nitrogen. When phosphorus concentrations increase to around 30 ppb or above in deep lakes, nuisance algae blooms can develop. This causes a cascade of problems.

New construction and lake resident activities can have significant impacts on phosphorus inputs. Studies in Maine show that clearing the trees off your property, even a partial clearing can increase phosphorus inputs to the lake from the runoff. Maintaining natural shoreland vegetation will help reduce the amount of nutrients going into your lake.

## 5.3. Factors Affecting Water Quality

Water quality in Lake Nancy is excellent. The small watershed, low soil fertility and natural land use cover, and large lake volume can account for the water quality observed in the lake. Lake phosphorus models were run using this information. Results are shown in Table 19. There is good agreement between the predicted lake phosphorus concentration and the observed phosphorus concentration for Lake Nancy.

The chart below shows that chlorophyll (a measure of algae), the secchi disc, and phosphorus readings are in the mesotrophic range, indicating Lake Nancy is moderately fertile.




After Moore, I. and K. Thornton, [Ed.] 1988. Lake and Reservoir Restoration Guidance Manual. USEPA> EPA 440/5-88-002..

## LEGEND

● = Big Lake

■ = Deep Lake

**Figure 21. This chart ranks lakes on the basis of transparency, algae (measured as chlorophyll), and phosphorus. Lake Nancy is in good shape.**

**Lake Nancy Nutrient Loads:** The pounds of phosphorus entering Lake Nancy was estimated using the Wisconsin Spreadsheet Lake Model. A total of 428 pounds of phosphorus per year is estimated to enter Lake Nancy (Table 19). Phosphorus in rainfall accounts for nearly half the phosphorus at 48%. Septic systems represent a small contribution at about 5% of the total phosphorus input.

### Table 19. Lake modeling results for Lake Nancy.

| Lake Statistics | Lake Nancy |
|---|---|
| Size (acres) | 772 |
| Mean depth (feet) | 12 |
| Volume (ac-ft) | 9,568 |
| Direct drainage area (not including lake) | 1,516 |
| Contributing watershed (ac) | 1,609 |
| Total watershed area (not including lake) | 3,125 |
| Estimated inflow (ac-ft) based on 11.8 inches of runoff/year | 3,063 |

| Land use and P inputs | Lake Nancy | Pounds/year | Percent Loading |
|---|---|---|---|
| Rainfall on lake | 772 ac | 205 | 48 |
| Forests | 915 ac | 73 | 17 |
| Wetlands | 516 ac | 47 | 11 |
| Residential shorelands | 85 ac | 9 | 2 |
| Septic systems | 100 systems | 21 | 5 |
| P from contributing watershed | 1,609 ac | 73 | 17 |
| Total P input | 428 lbs | 428 | 100 |

| | |
|---|---|
| **Observed Lake P Concentrations (May-Sept, 2000)** | **15 ppb** |
| **Predicted Lake P Concentrations (based on 4 different lake models)** | **12-21ppb** |

# What is the impact of aquatic plants on Lake Nancy?

### Water Quality Impacts of Aquatic Plants in Lake Nancy

- Aquatic plants help maintain good water clarity in Lake Nancy and have other benefits as well (Figure 22).

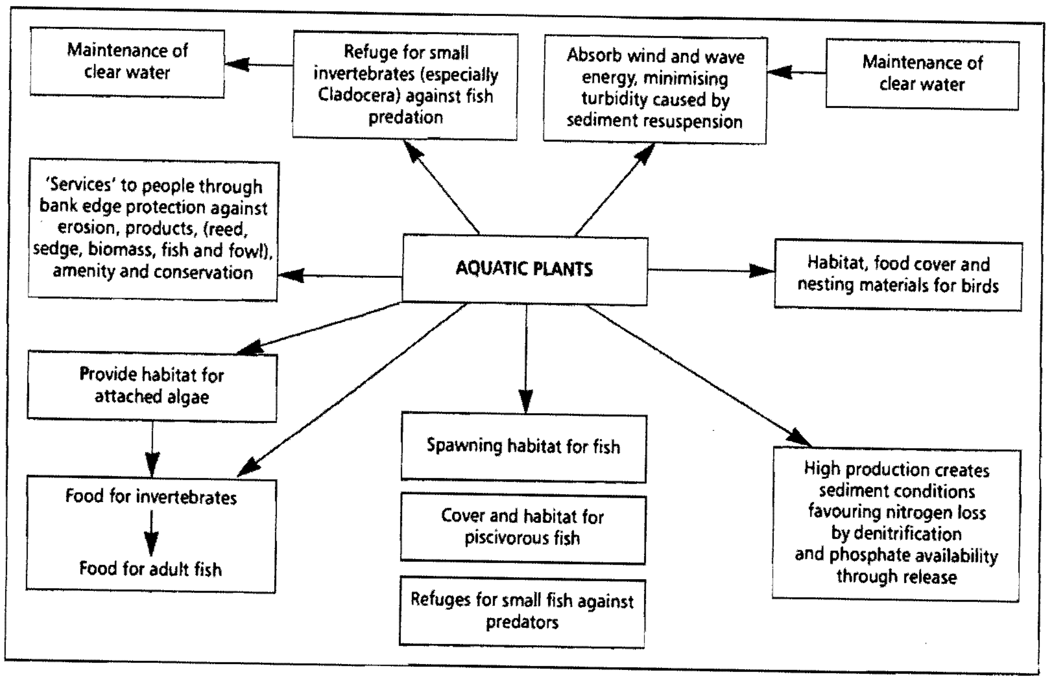



**Figure 22. Links between aquatic plants and other organisms, including ourselves (source: Moss and others. 1996. A guide to the restoration of nutrient-enriched shallow lakes. Broads Authority Norwich, England).**

- The type of plants in Lake Nancy do not adversely impact water quality or significantly hinder recreation.

- Eurasian watermilfoil has been in Lake Nancy since 1989 and has scattered coverage in Big and Deep Lake. Only several milfoil beds mat out at the lake surface.

# 6. Lake Project Ideas for Protecting the Lake Environment (which includes water quality and wildlife)

Project ideas for Lake Nancy are geared toward long-term protection of water quality. Aquatic plant management has a corrective component with small-scale approaches proposed for addressing nuisance growth of milfoil.

A list of lake projects ideas has 4 broad categories:

1. Watershed stewardship through education (*forest crop management, on-site wastewater treatment systems*).
2. Shoreland protection (*maintain native shorelines and uplands*).
3. Aquatic plant management (*maintain native diversity and manage nuisance patches of milfoil*).
4. Water quality monitoring program (*keep track of any lake changes*).

Details for these projects areas are given in the next few pages.

## 6.1. Watershed Stewardship

- Protecting the natural character of the watershed helps maintain good runoff water quality.
- Other watershed topics include:
    - Educating new water front property owners on the value of shoreline habitat and good landscaping practice.
    - Maintain functioning on-site wastewater treatment systems.

## 6.2. Shoreland Protection

Controls are in place at the county level to guide new shoreland development. Shoreland development guidelines are shown on the next several pages.

Shown below is the first page of the Washburn County Shoreland Ordinance.

### Article XXVII Shorelands Regulations

Section 270 Purpose

The purpose of the Shorelands Regulations is to insure the proper management and development of the shorelands of all navigable lakes, ponds, flowages, rivers and streams in the unincorporated areas of Washburn County. The intent of these regulations is to further the maintenance of safe and healthful conditions: prevent and control water pollution; protect spawning grounds for fish and aquatic life; control building sites, placements of structures, and land uses; and preserve shore cover and natural beauty. For those reasons development and alterations which may affect the natural functioning of the shorelands of Washburn County shall be controlled and regulated.

**Section 270.1 Areas to be regulated**

The shorelands area shall be considered as those lands within one thousand (1,000) feet of the ordinary high-water mark of any navigable lake, pond, or flowage, and those lands within three hundred (300) feet of the ordinary high-water mark of any navigable river or stream, or to the landward side of the flood plain, whichever is greater.

All lands within the shoreland area shall be placed within one of the zoning districts listed in Article II, in accordance with its best use, efficiency, and general continuity with existing land uses. Uses within the shorelands area shall conform to the requirements of respective zoning districts and in addition, each use and property shall be subject to the requirements listed within this article and Article XXVIII.

Determinations of navigability and ordinary high-water mark location shall initially be made by the Zoning Administrator. When questions arise, the Zoning Administrator shall contact the appropriate office of the Department of Natural Resources for a final determination on navigability or ordinary high-water mark.

**Section 270.2 Greater Restrictions**

The provisions of the Shorelands and Shorelands-Wetlands regulation supersede all the provisions of any county zoning ordinance adopted under Statute 59, Wisconsin Statutes, which relate to shorelands. However, where an ordinance adopted under a statute other than Statute 59, Wisconsin Statutes, is more restrictive than this Ordinance, that ordinance shall continue in full force and effect to the extent of the greater restrictions, but not otherwise.

1. Shorelands and Shorelands-Wetlands regulations shall not require approval or be subject to disapproval by any town or town board.
2. If an existing town ordinance relating to shorelands is more restrictive than this Ordinance or any amendments thereto, the town ordinance continues in all respects to the extent of the greater restrictions, but not otherwise.

## Washburn County Shorelands Class Development Standards

| Lake Classification | Lot Width per Single Family Unit | Minimum Lot Area | Minimum Shoreline Setback | Vegetation Removal | Minimum Side Yard Setback | Minimum Rear Yard Setback |
|---|---|---|---|---|---|---|
| Class 1 | 150 feet | 30,000 sq. ft | 75 feet | 30 foot limited removal corridor within 50 feet of OHWM | 10 feet One side<br><br>30 feet total both Sides | 40 feet |
| Class 2 | 200 feet | 80,000 sq. ft. | 100 feet<br><br>(Set back averaging per Section 271(1)) | 30 foot limited removal corridor within 75 feet of OHWM | 20 feet one side<br><br>60 feet total both sides | 40 feet |
| Class 3 Includes all lakes of less than 50 acres and all rivers and streams | 300 feet | 3 acres | 100 feet on Lakes 125 feet Rivers and Streams<br><br>(Set-back averaging per Section 271(1)) | 30 foot limited removal corridor within 75 feet of OHWM, | 30 feet one side<br><br>90 feet total both sides | 40 feet |
| Mapped Wetlands | | | 25 feet | | | |
| Drainageways and non-navigable intermittent streams | | | 10 feet | | | |
| Planned Residential or Cluster Development | Optional in Class 3 with parcel size of 35 acres or greater Minimum lot size 30,000 sq. ft, 150 ft width 50% open space dedication (See Article XIV-A) | | | | | |
| Multi-unit Attached | Minimum lot size and width by class, plus 25% additional per unit | | | | | |
| Multi-unit Detached | Minimum lot size and width by class, plus 50% additional per unit. | | | | | |

Adopted 09/17/98: Effective 10/01/98: Amended 03/21/00 15

**Lake Nancy is a Class 2 lake.**

# Washburn County Shoreline Protection and Buffer Cost Share Programs

**Land & Water Resource Management Plan Funding**

- The Land & Water Conservation Department receives an annual grant from the Department of Agriculture Trade & Consumer Protection (DATCP) to implement the Washburn County Land & Water Resource Management Plan (LWRMP). The purpose of the grant is to cost-share conservation practices that contribute towards the implementation of the LWRMP. Projects cost-shared under the program are required to be recorded with the deed of the property for a period of 10 years for operation & maintenance of the practice.

  - Eligible Practices
    - Shoreline Buffers
    - Shoreline Stabilization (Rip rap, biologs, etc.)
    - Critical Area Stabilization
    - Diversions

  - Cost-share Rates
    - 70% cost-share up to $2500
      - ✓ Plans submitted by contractors for their own installation
      - ✓ Landowner submitted plans for their own installation
    - 70% cost-share with no cap
      - ✓ Plans developed by LWCD or contractor and placed out for competitive bids

**Lake Management Protection Grant (DNR)**

- The Lake Management Protection Grant was awarded from the Wisconsin Department of Natural Resources for establishing shoreline buffers and/or aquatic planting adjacent to buffers. The cost-share agreement is recorded with the deed of the property in perpetuity.

  - Eligible Practices
    - Shoreline Buffers
    - In-lake plantings/buffers

  - Cost-Share Rates
    - 70% Cost-share for all projects – no cap
    - Perpetual deed restriction (May not mow or remove buffer for life of property)

## 6.3. Aquatic Plant Management

A high priority lake protection approach is to maintain a robust native aquatic plant community in Lake Nancy. Currently, Lake Nancy has aquatic plant growth covering over 40% of the lake bottom. Aquatic plants are primarily of the submerged variety in Lake Nancy. In all of the lake basins, the aquatic plants are vital for helping sustain clear water conditions and contribute importantly to fish habitat.

It is recommended that there should be minimal disturbance to native plants. However, a small-scale milfoil control program is recommended and is outlined in Table 20. This is envisioned to be an evolving program. The Lake Association should evaluate the effectiveness of the various techniques annually and plan for the next year. Only nuisance milfoil beds should be considered and even then the minimum amount of removal is recommended.

**Dense growth of Eurasian watermilfoil occurs in several areas in Lake Nancy.**

## Table 20. Eurasian watermilfoil control plan for Lake Nancy.

| Site | Size (in feet) 1999 | Size (in feet) 2000 | Area 2000 (sq ft) | Herbicide | Mechanical Harvesting | Hand Pulling | No Action | Comments |
|---|---|---|---|---|---|---|---|---|
| **Big Lake** | | | | | | | | |
| A. Mother bed | 100x600 | 200x600 | 120,000 | | X (lanes) | | | Cut lanes, remove 50% of bed, will help to deplete sediment nitrogen. |
| B. Ehler's Point | 50x200 | 50x200 | 10,000 | | | | | Weevils present. |
| C. McCafferty's | 50x200 | 50x200 | 10,000 | X | | | | If herbicide is used, compare results to Site B. |
| D. West mid lake | 100x100 | 100x100 | 10,000 | X | | | | Bed is dominated by milfoil, see if other plants come back. |
| E. Sunken Island | 100x100 | 100x100 | 10,000 | X | | | | |
| F. N.E. area | 100x100 | 100x100 | 10,000 | | | | X | |
| G. Creek mouth | 50x50 | 100x150 | 15,000 | | X | | | Harvesting may deplete sediment nitrogen. |
| H. Scattered: N shore | -- | -- | | | | | X | |
| I. Scattered: W shore | -- | -- | | | | | X | |
| J. T-8 | -- | 50x150 | 15,000 | | X | | | |
| **Shallow Lake** | | | | | | | | |
| K. Scattered: T-22, 23, 28, 30 | -- | -- | -- | -- | -- | X | 11 | Only single plants are present. |
| **Deep Lake** | | | | | | | | |
| L. T31 | -- | 50x100 | 5,000 | X | | | | |
| M. T33 | -- | 50x50 | 5,000 | | | X | | |
| N. T37 | -- | 50x50 | 5,000 | | | | X | |
| O. T38 | -- | 50x150 | 15,000 | | X | | | Close to take out point. |
| | | | | 35,000 | 105,000 | | | |

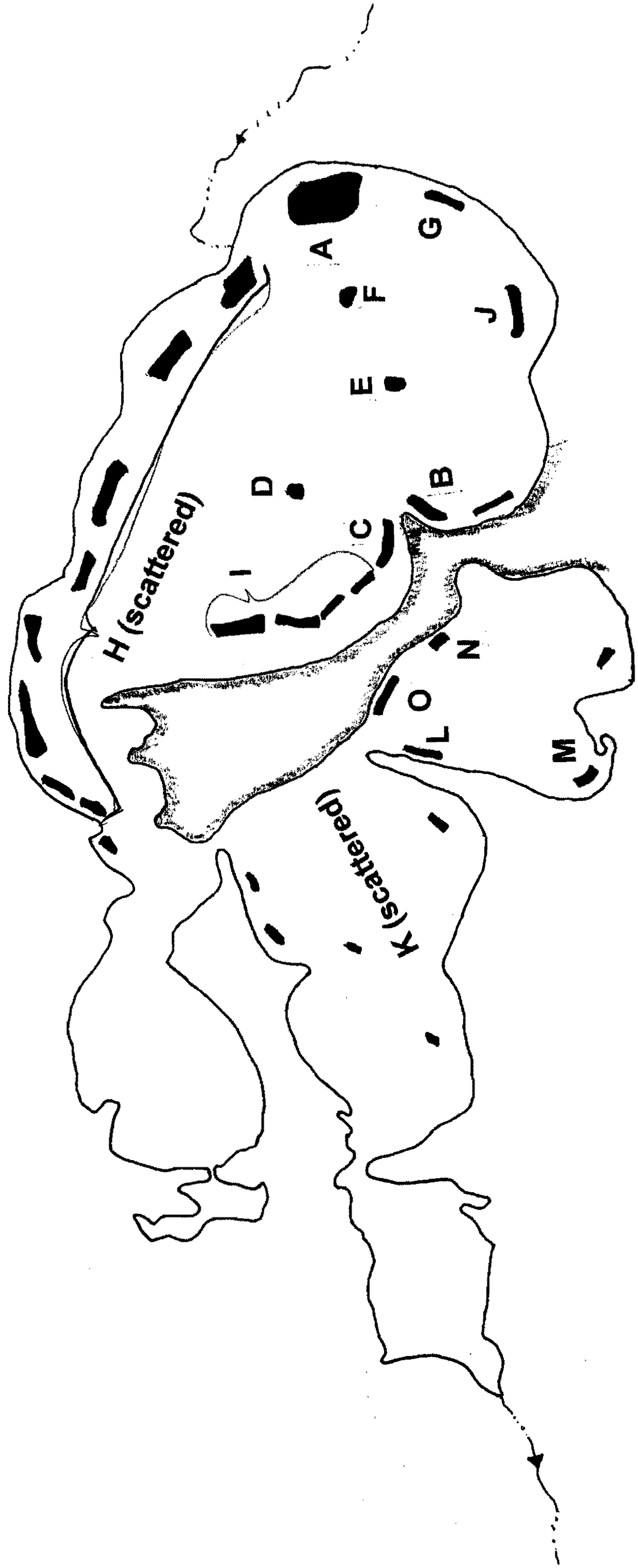



**Figure 25. 45 ac of Eurasian watermilfoil. 16 ac of matting.**

## 6.4. Lake Monitoring Program

A lake monitoring program is outlined in Table 21. It is designed to be flexible to accommodate the volunteer work force and a fluctuating budget.

**Table 21. Lake Nancy Water Quality Monitoring Program**

| Category | Level | Alternative | Labor Needed | Cost/Year |
|---|---|---|---|---|
| A. Dissolved oxygen | 1 | Check dissolved oxygen at Lake Nancy outlet every one to two weeks in December, January, February, and March depending on winter conditions. | Moderate | $0 |
| | 2 | Check dissolved oxygen at Lake Nancy outlet every one to two weeks in December, January, February, and March, depending on winter conditions. | Moderate | $0 |
| | 3 | Check dissolved oxygen in several locations around Lake Nancy in December, January, February, and March. | Moderate to high | $0 |
| | 4 | Collect dissolved oxygen and temperature profiles in all three lakes, once or twice a month from May-September. | Moderate | $0 |
| B. Water clarity | 1 | Secchi disc taken at spring and fall turnover. | Low | $0 |
| | 2 | Secchi disc monitoring once per month May - October. | Low-moderate | $0 |
| | 3 | Secchi disc monitoring twice per month, May - October. | Moderate | $0 |
| C. Water chemistry | 1 | Spring and fall turnover samples are collected and sent to UW-Stevens Point. Selected parameters for analysis include: TP and chlorophyll. | Low | $200 |
| | 2 | Spring and fall turnover samples are collected and sent to UW-Steven Point. Standard package of parameters is analyzed. | Low | $600 |
| | 3 | Sample for phosphorus and chlorophyll once per month from May - September (surface water only). | Low-moderate | $300 |
| | 4 | Sample for phosphorus and chlorophyll twice per month from May - October. | Moderate | $600 |
| | 5 | Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N once per month (May-October) | Moderate | $960 |
| | 6 | Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N twice per month (May-October). | Moderate | $1,920 |
| D. Special samples or surveys | 1 | Special samples: suspended solids, BOD, chloride, turbidity, sampling bottom water, and other parameters as appropriate. Aquatic plant surveys, etc. | -- | $50+ |

UW-Stevens Point Lab Analysis Costs:

| | | | |
|---|---|---|---|
| Total phosphorus | $12.00 | Total suspended solids | $8.00 |
| Chlorophyll a | $20.00 | Total volatile solids | $8.00 |
| Kjeldahl-N | $12.00 | Dissolved solids | $8.00 |
| Nitrate/Nitrite-N | $10.00 | Turbidity | $6.00 |
| Ammonia-N | $10.00 | BOD | $20.00 |

**For 2001, a recommended program consists of Level A1 on an annual basis, Level C3 every 2 to 3 years and an aquatic plant survey (Level D1) every three years.**