## 1. Executive Summary

The study described in this report was initiated as a result of concerns about Ward Lake's declining walleye population and concerns about lake water quality and quantity. The Polk County Land and Water Resource Department (LWRD) carried out this lake inventory and planning effort in cooperation with Wisconsin Department of Natural Resources (WDNR), Bone Lake Township and the Ward Lake Association.

Key results of the study include: data confirming a significantly decreased walleye population; findings of phosphorous contamination below the gully on the northwest portion of the lake; data on possible impacts from runoff; and the presence of key aquatic plant communities and walleye spawning habitats in the lake that must be protected to preserve lake health.

A number of management recommendations have been developed to address the issues listed above and to maintain and improve the overall health of Ward Lake. These recommendations include: stocking the lake with walleye fingerlings and other activities to increase the walleye population; reduction of largemouth bass populations; addressing phosphorous contamination; encouraging the continued involvement of area residents in water quality monitoring; and promoting shoreline buffers — planting projects designed to capture and filter runoff before it enters Ward Lake.

## 2. Ward Lake and *its* Watershed

Ward Lake and its watershed lie in a particularly vital natural area that is home to some of Wisconsin's most beautiful natural resources. The 95.6-acre lake is located in north central Polk County, nine miles northeast of Luck, Wisconsin. Ward Lake is a landlocked lake, fed by seepage from groundwater. The lake has a maximum depth of 45 feet and is surrounded by 2.1 miles of shoreline.

Ward Lake currently maintains good water quality, a thriving fisheries community, and is used by lakefront property owners and area residents lor a variety of recreational activities. The lake's fishery consists of walleye, bluegill, yellow perch, largemouth bass, northern pike, pumpkinseed, black crappie, and rock bass. Its good water quality makes Ward Lake desirable for boating, fishing. swimming, and aesthetic viewing.

The Ward Lake watershed — the land area that drains into the lake — consists of 448 acres, most of which lie to the west of the lake. The lake and its watershed are in the southwestern section of the watershed of the Clam River, a St. Croix River tributary that has been classified as an outstanding water resource by the Wisconsin Department of Natural Resources (WDNR). The lake itself is not without problems though. In recent years, phosphorus levels in the lake have declined while mercury remains an issue. Ward Lake is 3030 listed by the DNR meaning it has degraded water quality in the area of mercury. Currently, for walleye, the lake is under a *fish* consumption advisory. Walleye up to 22 inches are listed in category 1 and walleye greater than 22 inches fall into group 2. (Group 1 – pregnant women should eat no more than one meal a month of Group 1 fish. Group 2 – pregnant or breast feeding women who plan to have children and children under 15 should not eat Group *2* fish.

Land use in the Ward Lake watershed have a large impact on local water quality While lakefront property is in use primarily for residences — for both year-round and seasonal use — there are several farms, roads, and other land uses within the watershed. With some changes, such as the planting of vegetative buffers, both residential areas and other sites in the watershed can be improved to enhance local water quality. There is strong support among area residents for engaging in watershed improvement activities, many of which are outlined in the recommendations section of this report.

## 3. The Ward Lake – Lake Management Planning Study

While Ward Lake appears to be healthy in many ways, there have been strong concerns about lake water quality, fluctuations in lake water quantity, and the decrease in the lake's walleye population. Representatives from the Ward Lake Association expressed those concerns to the Polk County Land and Water Resource Department [LWRD). Working in cooperation with WDNR, Bone Lake Township, and the Ward Lake Association, the LWRO launched a lake inventory and planning effort.

Through the support of the WDNR planning grant program, the LWRD assessed lake health and other issues through a number of methods. Ward Lake Association members were very active in guiding LWKD staff and also volunteered with actual monitoring. The findings of the lake inventory and planning effort are summarized in this report, along with recommendations to guide future management activities to benefit the quality of Ward Lake.

## 4. Study Components

In 1998 and 1999 the LWRD and other project partners oversaw a number of research activities used to determine the cause of recent changes to Ward Lake's ecosystem. The study components are summarized in the sections below. Where indicated, full data is available in the appendix section of this report.

### 4.A. Digitized Watershed Delineation and Boundary Map

Created by the LWRD staff, the watershed boundary map sets the parameters for determining the specific land areas that drain to, and therefore affect the health of, Ward Lake. The map is also an invaluable tool for outreach work to landowners in the watershed, and informed the land use and soils inventory conducted as part of this study. {See Figure 1 on page 8 for watershed boundary map).

### 4.B. Shoreline Video Survey

A shoreline video of Ward Lake was taken and will be utilized to guide educational activities carried out by the county and the Ward Lake Association. The video will also be used to show a comparison in five years to see progress made on establishing shoreland buffers and other protection measures.

### 4.C. Sociological Landowner Surveys

In September 1999, a survey was sent to all landowners within the Ward Lake Watershed and to all Ward Lake Association members. A total of 75 surveys were sent cut and 35 were returned.

The goal of the survey was to assess landowner objectives, concerns, and ideas. The survey also generated data on how landowners use their property. Survey results found that declining fish populations were the largest problem and concern for respondents. The survey also documented a commitment to continued monitoring of water quality. A full description of landowner survey results can be found in Appendix A.

## 4.0. Well Water Sampling

Lake homeowners were offered free private drinking water well test sampling packages and tests were conducted by the LWRD. Parameters checked included total coliform bacteria, nitrate, ammonia, chloride, alkalinity, hardness, pH and saturation index. A total of 36 wells were tested and results showed natural background levels for all the nutrients tested. The conductivity of the water showed that the groundwater entering the lake is largely free of nutrients (nitrate, chloride, etc.). Conductivity testing did not indicate septic and animal wastes in the groundwater around Ward Lake.

## 4.E. Groundwater Monitoring

The goal of this project was to identify areas of groundwater inflow and outflow and to test the chemical quality of groundwater supplies to the lake.

Samples of groundwater entering shallows showed little variation from well water samples (see above) with the exception of water from the wetland bay near the boat landing. This area, which is fed by run-off entering through a culvert and groundwater, showed elevated phosphorus and ammonia levels. The presence of these nutrients may be attributed to the impact of run-off from road side ditches, farm fields across 80th St. (which occurs only during high flows), and possibly through groundwater entering the wetland recharging from the same fields (groundwater flows to the lake from the southwest.) Further testing would be necessary to determine the specific phosphorus source.

The inlet that drains the water from the farms in the northwest corner of the watershed also showed elevated levels of nutrients. Were, nitrate and chloride levels were much higher than surrounding samples. This may be attributed to run-off or groundwater recharged from nearby farm fields and soil eroded from the ravine itself.

Overall, the sampling showed some evidence that land use impacts groundwater. However, encouraging stormwater infiltration is recommended in order to maintain this trend.

## 4.F. Digitized Land Use and Soils Inventory

After extensive mapping, it was determined that Ward Lake's 448-acre watershed, not including the 127 acres of water surface areas, is made up of the following components:

| | |
|---|---|
| Forest cover | 132 acres |
| Residential | 52 acres |
| Wetlands | 9 acres |
| Row Crops | 107 acres |
| Farmsteads | 21 acres |

(See Figure 2 on page 9 for watershed map that includes land use information.)

Soil sampling was conducted throughout the watershed. (See Figure 3 on page 10 for watershed map that includes sample points). When examining soils in the watershed there are two key concerns:

1. Presence of nutrients in the soil that may upset the lake ecosystem; and
2. The likelihood that soils will enter the lake, which is dictated by the location of the soils in question and surrounding land uses.

Soil analysis found that phosphorus is a primary concern for Ward Lake. Phosphorous is a nutrient that determines that amount of algae and aquatic plants in lakes. While it is a natural component of lake systems, high concentrations of phosphorous – which generally enters lakes when it runs off surrounding land areas — disrupts lake ecosystems and leads to depleted oxygen.

High phosphorous levels were found at the northwest end of the **lake,** a former dairy farm. However, while sources of phosphorus are high within the fields tested, there is a low potential for transport of nutrients to the lake due to current farming practices in the area. Future concern will arise if farming practices become more row crop intense or animal numbers increase within the watershed. To keep **soil** transport to a minimum, it is important that the gully on the northwest corner of **Ward Lake (a** major drainage way **to** the lake) be maintained and well **vegetated.** See Appendix B. for more detailed information.

The **roads** and homes that surround the immediate shoreline of Ward Lake **are** *a* typical **land use** which generally export 2-5 times the phosphorus into the **lake** as opposed to land in its undisturbed state. Farms and **residences in** the watershed can help prevent the flow of phosphorous into the lake **by** not using fertilizers — or using only low phosphorous fertilizers. Other key activities are regularly maintaining septic systems and creating shoreland buffers.

### 4.G. Water Quality Survey

Ward Lake Association members have collected "**Self-Help** Monitoring" data for the last few years, *with* support from WDNR. **As part** of new **research** efforts **on the** lake, **a** 1999-2000 sampling **program was launched** to **build** on this data.

The **water** samples showed the lake to be relatively free **of *excess*** algae growth connected to nutrients such as phosphorous **and** nitrogen. Data **collected over the past** decade through **secchi disc** readings, which measure lake clarity, indicate that Ward Lake's water quality has been steadily improving. Even at their highest levels, nitrogen and phosphorus were not found to be excessive in any samples taken in 1999.

The nutrient cycling trend in Ward Lake **shows a** slight response to elevated rainfall in the month of June. Reactive phosphorus and nitrate were at the highest levels of the summer for that month. Chlorophyll levels also were elevated. This can be **attributed** to nutrients brought to the **lake** during runoff events. The nutrient levels **are** reduced *over* **the** course **of the** summer as more algae are found in the water column. Algae utilize these nutrients for growth. Algae and ammonia levels peaked in September as algae decomposed and ammonia was released.

Depth profiting found that Ward Lake stratifies in early May. In early June the lake bottom becomes anoxic, which means that it lacks oxygen. The oxygen **depleted** zone increases over the course of the summer. By the middle of August the bottom 8 meters of **the** lake (at the deepest point) are anoxic. Mid-August and mid-June also had the lowest secchi readings, reflecting **the peak population growth** of **different** types of algae. Though algae is a natural occurring **feature** of most lakes, excess nutrients from fertilizers. leaking septic systems and other **sources** can speed **up** the **growth** of algae. This, in turn, may negatively impact fish habitat **and** make the lake less pleasant for swimming and boating.

### 4.H. Lake Level and Precipitation Monitoring

**Ward** Lake has a history of fluctuating lake levels. During the 1999 season, Ward Lake volunteers conducted lake level and precipitation monitoring to measure the level of the lake. June 1999 saw the highest lake levels with the lowest levels being in December. This data is consistent with expected seasonal **trends.** {See Figure **4** on page 11 for lake level monitoring data.)

### 4.I. Lake Bottom Topography - Transect Survey

There is much concern over possible accumulated silt in Ward Lake. As part of this project, the lake bottom was mapped at a close interval to specifically show contours. This data is used to determine total lake volume, which is a big factor in the hydrologic budget for the lake. The data also aids the WDNR Fisheries Department in determining where to enhance walteye spawning beds. See Appendix C. for the survey.

A computer generated model, Wisconsin Lake Model Spreadsheet, (WILMS) was used to describe the phosphorus loading for Ward Lake. Using the model and water quality monitoring data, WILMS can be used as a lake water quality planning tool. Predicted land use changes and implementation of Best Management Practices can be input into the model. The model then provides projected phosphorus loadings and in-lake phosphorus concentrations. See Appendix D for WILMS results and analysis.

### 4.J. Fisheries Census Data

On the evening of September 14, 1998 an electrofishing survey was conducted to update information on the gamefish and panfish populations of Ward Lake. Previous electrofishing surveys were conducted in 1961, 1978 and 1989.

The most significant finding of the electrofishing survey was that, between 1989 and 1998, Ward Lake has shifted from a walleye dominated fishery to a largemouth bass dominated fishery. It has long been recognized that bass and walleye populations tend to have an inverse relationship in small lakes. While there is not clear explanation for the shift in Ward Lake's fish populations, the 14-inch bass length limit — which went into effect in 1989 — may be a key contributing factor in the bass dominance of the lake.

Recommendations for increasing the walleye population in Ward Lake include initiating walleye fingerling stocking, and protection of walleye and northern pike spawning areas through aquatic plant management and water regulations programs. See recommendafions chapter for more details. A full copy of the 1998 Ward Lake Fish Survey can be found in Appendix E.

### 4.K. Sensitive Areas and Macrophyte Survey

The WDNR and LWRD identified six key sites on Ward Lake, analyzed their resource value and developed recommendations for maintaining the health of the aquatic plant communities on each site. (See Figure 5 on page 12 for survey sites). The results of this effort were published in the *Ward* Lake *Sensitive Area* Survey *Report and Management Guidelines.* *See* Appendix F for a full copy of this report.

The sites surveyed, fell into two categories: aquatic plant communities providing key fish and wildlife habitat (sites 2,5,6) and gravel and coarse rock rubble lake bottom important for walleye spawning (sites 1.3, 4).

To maintain aquatic plant community health, the report recommends the fallowing management on sites 2, 5, and 6:

Limit aquatic vegetation removal to navigation channels and only where serious problems exist;

- Leave large woody debris, logs, trees, and stumps in shallow areas to provide habitat.
- Leave a 50-60 lout buffer of un-mowed natural vegetative cover;
- *Prevent erosion,* especially at construction sites; and
- Eliminate nutrient inputs to the lake caused by lawn fertilizers. failing septic systems and other sources.

To maintain walleye spawning habitat, the report recommends the following on sites 1,3, and 4:

* No alteration of gravel and course rock substrate **should** occur at these sites;
* Erosion control on or near shorelines is especially important adjacent to walleye spawning areas **to** prevent **siltation** of spawning habitat; and
* Removal of aquatic plants need not be quite as **restrictive as** in aquatic plant sensitive areas.

Overall recommendations focus **on educating residents** on the importance of retaining and enhancing natural vegetation and encouraging shoreline buffers.

## 5. Summary of Research Results

Research conducted in Ward Lake and its watershed paint **a** picture of a lake that is generally healthy. However, a number of issues of concern emerged or were verified through this research. including:

* The lake's significantly decreased walleye population,
* High phosphorous below the gully **on** the northwest portion of the lake,
* The **lake's** potential to become affected by runoff from **the lakeshore and** from other **areas** of **the** watershed through culverts and drainage ravines,
* **The presence** of key aquatic plant communities and walleye spawning habitats in the lake that must be protected to preserve take health and
* The mercury advisory on walleyes.

## 6. Next Steps and Recommendations for Management Actions

Everyone with a stake in **the health of Ward Lake,** including residents, Ward Lake Association **and** county and state officials can play a rote in maintaining and improving the **health** of ward lake. Below are seven **key recommendations.**

### 6.A. Work to Restore Walleye Population

Research determined that the large decline in the walleye population in Ward Lake warrants the initiation of walleye fingerling stocking. While stocking is not expected to restore walleye population to levels enjoyed in 1989, it may help ensure the presence of a moderate walleye population to complement the **take's largemouth bass** population. Reducing the largemouth bass population will facilitate the increase in walleye populations, through **a** decrease in competition. Also a slot size management of the walleye population would assist in the recover of the fishier.

It is recommended that alternate year walleye fingerling stocking at a rate ***of*** 75 **per acre be** implemented on a trial **basis,** with an evaluation survey to take place in five to six years.

In addition, it is **recommended** that walleye **and** northern pike spawning habitat be protected. This work wilt take the form of making sure gravel **and** course rock substrate are not altered in sites identified as spawning grounds in the sensitive areas survey conducted on the lake. Further, erosion control practices on or near shorelines should be implemented adjacent to walleye spawning areas to prevent siltation of spawning habitat.

**6.5. Stabilize Soils in Channels Leading To and From Culverts**
Sediments and nutrients that impact lake health can run off into Ward Lake through channels and culverts. By keeping these areas well-vegetated and undisturbed, runoff is reduced. The LWRD is currently working to determine how to best provide the assistance needed to implement work on channels and culverts around the lake.

**6.C. Remove Source of Phosphorous from Northwest Area of the Lake**
Ward Lake is primarily supported by surface runoff and groundwater discharge. The northwest side of Ward Lake contains a gully, which was created by high velocity surface runoff. The gully is presently quite stable, but is very high in nutrients. The land use upstream of the gully is primarily agricultural. Pesticides, fertilizers, nutrients, and sediment from the agricultural fields are allowed to flow directly to the lake.

Surface runoff can be controlled by implementing Best Management Practices that stabilize erosion areas, maintain permanent vegetation, and that reduce nutrients in gully and in the northwestern part of the lake. The installation of a sedimentation basin (Standard 350) will collect sediment and other debris, which will reduce the nutrients and chemicals entering the lake. The water outflow from the sedimentation basin will flow to the lake in a constructed waterway (Standard 412 or 468).

**6.D. Continue Volunteer Monitoring Efforts**
Lake Association members and other residents play an invaluable role in collecting data on the health of Ward Lake. It is highly recommended that this monitoring continue.

**6.E. Make Runoff Prevention a Priority for New Projects**
During construction, both private and public, measures should be taken to reduce runoff into the lake. The "Wisconsin Construction Site Handbook" recommended Best Management Practices should be strictly enforced. These practices could involve installation of sediment basins, rain gardens *or* "mini wetlands" specially landscaped and planted to capture and filter runoff, and grassed swales. One way to promote runoff prevention efforts is to establish a watershed goal of reducing sediment loads to the lake.

**6.F. Encourage Landowners to Plant Buffers and Implement Other Best Management Practices**
The residents of Ward Lake have shown a great deal of interest in preserving the lake through Best Management Practices – activities on the land known to improve water quality. The first step in this work involves landowner education. The focus of educational efforts to date has been on helping individuals learn what they can do to lessen the phosphorus levels of the lake. As part of the recommendations derived from this study, education efforts will place special emphasis on facilitating the planting and maintenance of vegetative buffer strips on shoreline properties.

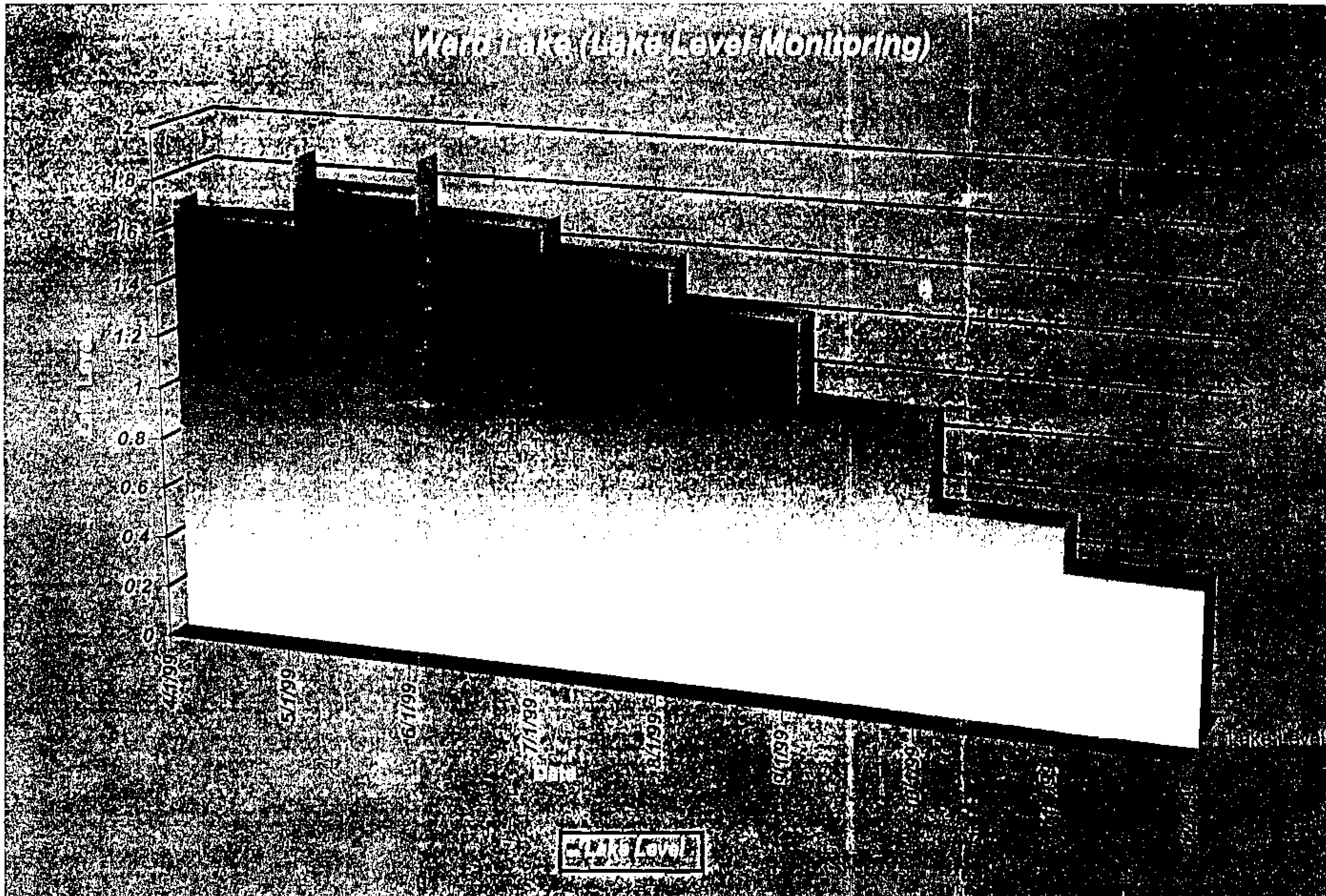
The educational process needed to encourage landowners to plant effective shoreland buffers will involve outlining the function and importance of buffers, explaining no-mow buffers along with replanted buffers, and the process of replanting. The importance of utilizing proper Best Management Practices will also be a focus. As we *see* more cabins replaced with large homes, this becomes a greater factor in phosphorus budgeting. Increasing stormwater retention, reducing chemical use on each property, identifying exotics (such as purple loosestrife), functions of aquatic vegetation, and fish habitat management are topics that need to be addressed in the future. The LWRD is committed to working with the Lake Association and individuals to accomplish these goals

## 6.G. Educate Landowners on the Risks Involved with a Mercury Advisory and How to Reduce the Release of Mercury into the Environment

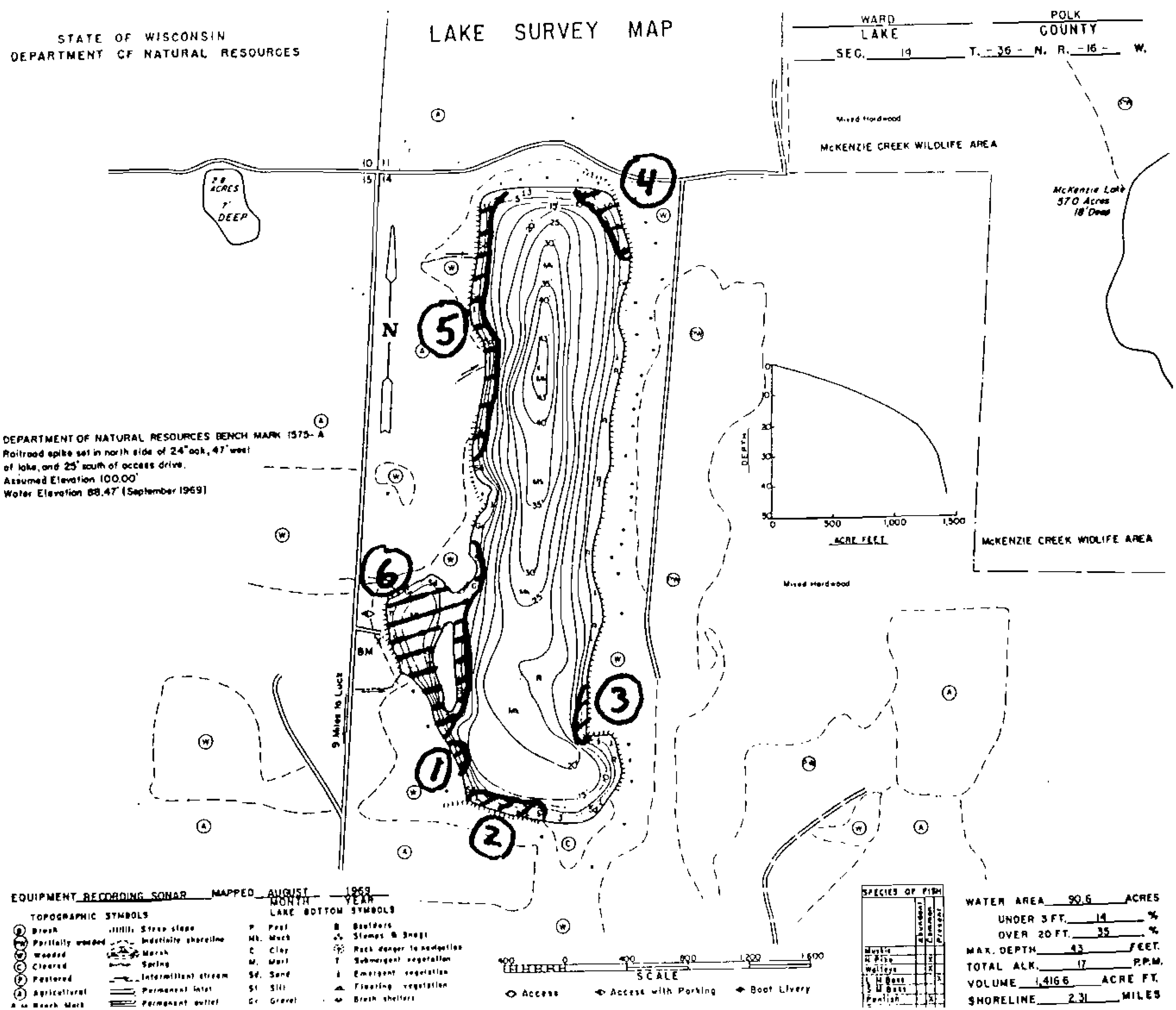
Mercury has been used in many products and in manufacturing for years. Mercury is prevalent in household items such as thermometers, thermostat switches and fluorescent lights. Mercury emissions occur from incinerators, electricity generating plants and other industrial sources.

Mercury enters a lake or river from runoff, rain, and snowmelt. Once in the body of water, it is converted by bacteria into a form that is available to other small organisms. The concentration of mercury within an organism increases with the size of the organism. This phenomenon is known as bioaccumulation. The process conversion of the mercury is facilitated by acid rain, which makes the body of water more acidic. An increase in acidity of the water body appears to assist the bacteria in the conversion process that allows the mercury to enter the food chain.

The Ward Lake Association in cooperation with the LWRO and the DNR can help educate the community about the hazards of mercury use, through the sponsorship of a mercury roundup. A mercury roundup event collects thermometers. fluorescent lights and other items with mercury. Items made with mercury can be replaced with non-mercury containing devices.



Ward Lake (Lake Level Monitoring)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Lake Level
4/1/99
5/1/99
6/1/99
7/1/99
8/1/99
Date
Lake Level


STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
LAKE SURVEY MAP
WARD
LAKE
POLK
COUNTY
SEC. 14 T. 36 N. R. 16 W.
Mixed Hardwood
McKENZIE CREEK WILDLIFE AREA
McKenzie Lake
570 Acres
18' Deep
28 ACRES
7' DEEP
N
DEPARTMENT OF NATURAL RESOURCES BENCH MARK 1575-A
Railroad spike set in north side of 24" oak, 47' west
of lake, and 25' south of access drive.
Assumed Elevation 100.00'
Water Elevation 88.47' (September 1969)
DEPTH
ACRE FEET
9 Miles to Luck
BM
EQUIPMENT RECORDING SONAR
MAPPED AUGUST 1969
MONTH YEAR
TOPOGRAPHIC SYMBOLS
Brush
Partially wooded
Wooded
Cleared
Pastured
Agricultural
Bench Mark
Steep slope
Indefinite shoreline
Marsh
Spring
Intermittent stream
Permanent inlet
Permanent outlet
LAKE BOTTOM SYMBOLS
P Peat
Mk Muck
C Clay
M Marl
Sd Sand
St Silt
Gr Gravel
B Boulders
Stumps & Snags
Rock danger to navigation
T Submergent vegetation
Emergent vegetation
Floating vegetation
Brush shelters
SCALE
Access
Access with Parking
Boat Livery
SPECIES OF FISH
WATER AREA 90.6 ACRES
UNDER 3 FT. 14 %
OVER 20 FT. 35 %
MAX. DEPTH 43 FEET.
TOTAL ALK. 17 P.P.M.
VOLUME 1,416.6 ACRE FT.
SHORELINE 2.31 MILES

**Appendix B. Sediment Contamination Information**

Soil samples were taken in the Ward Lake watershed from fields that were identified to have direct drainage to the lake. Direct drainage was defined as being drainage within 1000 fee! of the lake with little or no buffering of channelized flaw. A series of core samples were taken from fields within 200 feet of the lake and mixed to get an average soil test value. Soil test values help to indicate high phosphorus (P) sources. In the three fields sampled, P2O5 ranged from 58 to 63 parts per million (ppm). Organic matter in these same samples ranged from 1.9-2.4 %. Most crops grown in Wisconsin will not show a response to added P when soil test values are over 30 ppm. Thus the actual soil test divided by 30 will indicate an *excess* or deficiency of soil P in regards to crop needs. In the case of Ward Lake, there is a twofold excess of P in the soil solution compared to crop needs.

Utilization of P must be viewed throughout the entire crop rotation; an excess in one year may be drawn down in subsequent years. Although these soils are very high according to U.W soil test recommendations as a source of P2O5, we must also look at the potential to transport these enriched soil particles. " Variability in runoff volume and erosion as a result of climatic, topographic and agronomic factors plays a larger role than soil test P in determinlng the amount of P losses from agricultural land, " (Sibbesson and Sharpley, 1997).

There are basically four factors to estimate probability of transporting these nutrients from the field. These factors include, soil erosion, soil runoff, slope, fertilizer application and distance to channelized flow.

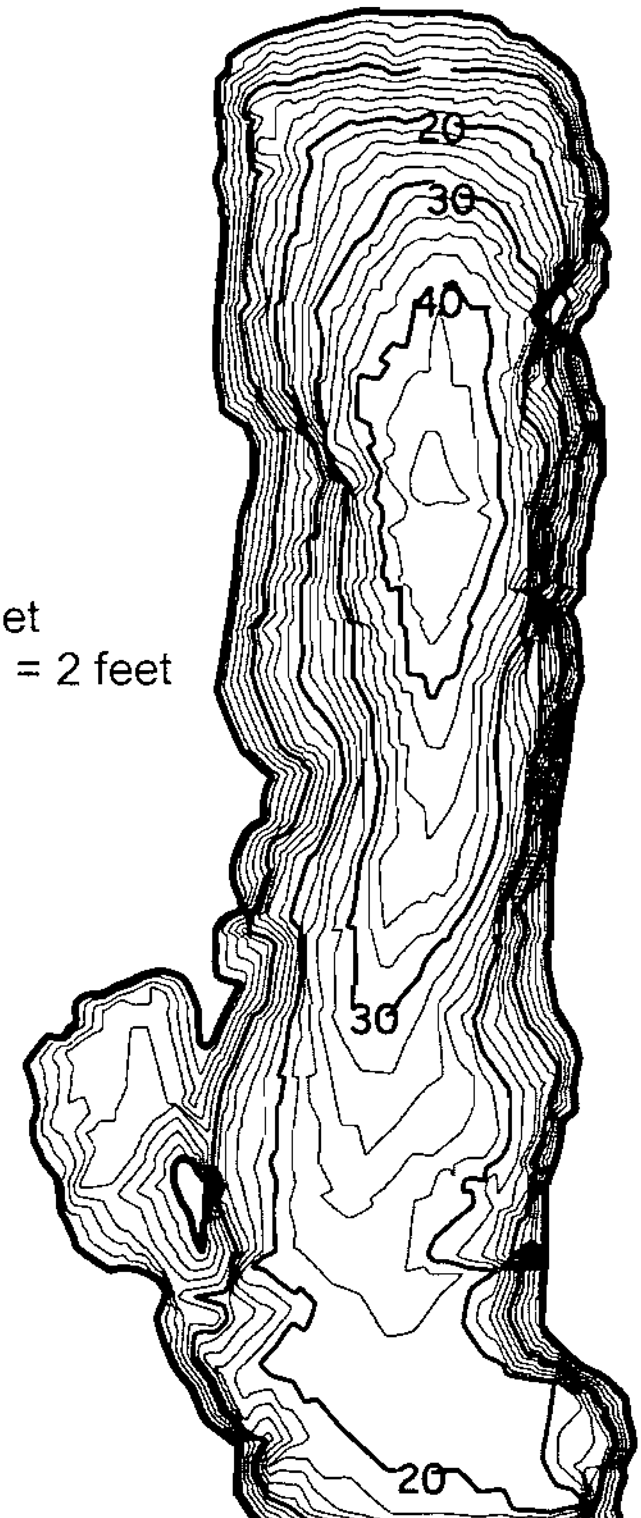
The fields tested have been in a high hay rotation and are farmed well below the tolerable soil loss (T). Most soils in this area are of a B hydrologic group meaning it has a high rate of infiltration of water in to the soil. This will give a low factor for soil erosion and soil runoff.

Slopes on these fields range from 5-7%. which will yield a medium potential for sediment loss. Fertilizer application rates would also rate low under the current conditions. Few animals are contained within the watershed.

A sample was taken in the ravine leading to the lake located on the northwest corner of the lake. Currently the ravine is well vegetated, but the soil probe indicated sedimentation over time. Sediment was layered, with heavy particle trapped.first and finer particle carried further down stream.

Conclusion: Phosphorus is primary concern for Ward Lake and most contaminated sediment is at the northwest end of the lake, a former dairy farm. However, while sources of phosphorus are high within the fields tested, there is a low potential for transport of nutrients to the lake due to current farming practices in the area. Future concern will arise if farming practices become more row crop intense or animal numbers increase within the watershed. To keep soil transport to a minimum, it is important that the ravine on the northwest comer of Ward Lake (a major drainage way) be maintained and well vegetated.

# Ward Lake Bathometric Map




1"=500 feet
Contour Interval = 2 feet


0 700 1400 Feet

Polk County Land & Water Resources

CORRESPONDENCE/MEMORANDUM — State of Wisconsin

RECEIVED
APR 01 1999
EAU CLAIRE

**TO:** Bill Smith

**FROM:** Rick Cornelius *RC*

**DATE:** March 17, 1999

**SUBJECT:** Fish Survey, Ward Lake (2599400), Polk County - 1998

## INTRODUCTION AND METHODS

Ward Lake is a 91-acre landlocked lake located in north central Polk County. The lake has a maximum depth of 43 feet and has a small littoral zone. The water of Ward Lake is clear and has an MPA of 17ppm. Littoral substrate is primarily sand, gravel, and rubble. Neither algae blooms nor aquatic macrophytes occur at nuisance levels. A public access is located on the west side of the lake.

Ward Lake has a history of widely fluctuating water levels, and in 1984 water was pumped out of the lake to prevent several houses from being flooded. Walleyes were first stocked in Ward Lake in 1933, and fry or fingerlings were stocked sporadically through 1953. Northern pike fry were stocked twice, in 1939 and 1943. Previous electrofishing surveys were conducted in 1961, 1978, and 1989. On the evening of September 14, 1998, an electrofishing survey was conducted to update information on the gamefish and panfish populations of Ward Lake. Total effort was 0.8 hours and 2.3 miles of shoreline.

## RESULTS AND DISCUSSION

A total of 10 walleyes ranging in size from 10.0 to 17.9 inches in length were captured. Comparing the 1998 walleye catch per effort (13/hr) to walleye CPEs in 1978 (102/hr) and 1989 (157/hr), there was clearly a substantial decline in walleye numbers between 1989 and 1998 (Table 1). In fact, in 1969 walleyes were abundant enough in Ward Lake that walleye growth rates were below average for northwest Wisconsin. By contrast, walleye growth in 1998 was slightly above average, and considerably faster than in 1989.

A total of 106 largemouth bass were captured in the 1998 survey ranging in size from 2.5 to 19.4 inches in length. The bass population, in contrast to the walleye population, has increased significantly in Ward Lake during the last decade. In 1939 the bass CPE was 10 per hour, while in 1998 the bass CPE was 133 per hour. The size distribution of the 1998 bass population was fair, with 19% of the captured bass being 14.0 inches or larger. Bass growth rates were above average for northwest Wisconsin.

A total of 10 northern pike were captured ranging in size from 11 0 to 21.9 inches in length. Catch per effort (13/hr) indicates the presence of a moderate northern population. The 1989 CPE was 5 per hour, so it is likely the northern population has increased in the last 10 years. No large northern pike were captured, and the growth rate of northerns was below average.

Bluegills were common, and were the most numerous panfish captured. The size distribution of the bluegill population was only fair, with a percent stock density of 24%, a relative stock density (7') of 3%, and bluegills were captured up to 7.5 inches in length. This is similar to the bluegill size distribution found in a 1978 survey. Bluegill growth was slightly below average.

Rock bass were the second most numerous panfish captured, followed by pumpkinseeds and yellow perch. No crappies were captured, but crappies were likely in deeper water at the time of the survey and so were not susceptible to capture by electrofishing.

## CONCLUSIONS AND RECOMMENDATIONS

The gamefish population of Ward Lake between 1989 and 1998 shifted significantly from a walleye dominated fishery to a largemouth bass dominated fishery. In 1989, walleyes were common to abundant and slow growing, and a fairly low bass population was present. In 1998, bass were common to abundant and the walleye population was fairly low.

The reasons for this dramatic shift in species dominance are unclear, and can only be speculated upon. No readily observable significant changes in habitat conditions seem to have occurred in the last 10 years. It is obvious that poor walleye year classes have been produced in recent years.

Water levels can fluctuate widely over tune on Ward Lake, which could adversely affect walleye spawning some years by either dewatering spawning substrate during low water, or by putting spawning areas too deep during high water. However, fluctuating water levels are nothing new to Ward Lake, and a good naturally reproducing walleye population sustained itself for many years in spite of fluctuating water levels.

The 14-inch bass minimum length limit which went into effect in 1989 has resulted in a general increase in bass numbers on area lakes, and in some cases this increase has been large. It seems safe to assume that the 14-inch bass length limit is at least partly responsible for the increase in bass numbers in Ward Lake during the last 10 years.

It has long been recognized that bass and walleye populations tend to have an inverse relationship in small lakes. As the population of one species increases, there is a tendency for the population of the other species to decline. Therefore, it could be speculated that several consecutive poor walleye year classes (which is not uncommon) coupled with an increasing bass population due to the 14-inch length limit tipped the balance to produce a bass dominated rather than a walleye dominated predator population.

The trend of increasing bass populations and decreasing walleye populations has been observed on a number of area lakes. The response has been to initiate the stocking of small walleye fingerlings. Such stockings have had only limited success.

The large decline in the walleye population in Ward Lake seems to warrant the initiation of walleye fingerling stocking. However, it is unrealistic to expect that stocking will restore the walleye population to 1989 levels. Rather, stocking will hopefully help ensure the presence of a moderate walleye populatron to compliment the large bass population.

it is recommended that alternate year walleye fingerling stocking at the rate of 75 per acre be implemented on a trial basis, with an evaluation survey to take place in five to six years.

Northern pike and panfish populations in 1998 appear similar or somewhat improved compared to those found in previous surveys. No change in current management for these species is recommended.

Tho protection of walleye and northern pike spawning areas through the aquatic plant management and water regulations programs is important. Because walleye and northern pike spawning locations have not yet been documented on Ward Lake with early spring fyke netting, all likely looking walleye and northern pike spawning habitat should be assumed to be spawning sites. Walleyes spawn on clean gravel, rock, and rubble substrate, while northern pike spawn in shallow, heavily vegetated areas. During the summer of 1999, it is planned to locate fish and wildlife sensitive areas on Ward Lake, and make management recommendations fcr these areas.

Approved:

Phil Anderson 3-23-99
Phil Anderson Date

Tom Beard 3-23-99
Tom Beard Date

Chuck Johnson 3-29-99
Chuck Johnson Date



Bureau of Fish & Habitat Date

cc: NOR Region-Spooner
Cumberland Office
Brian Fellrath
Bureau of Fish & Habitat

Table 1. Fall Electrofishing Catch Per Effort of Gamefish in Ward Lake, 1978, 1989, and 1998.

| | Number Per Hour | | |
|---|---|---|---|
| Date | Walleye | Largemouth Bass | Northern Pike |
| 9/21/78 | 102 | 10 | 6 |
| 9/5/89 | 157 | 10 | 5 |
| 9/14/98 | 13 | 133 | 13 |

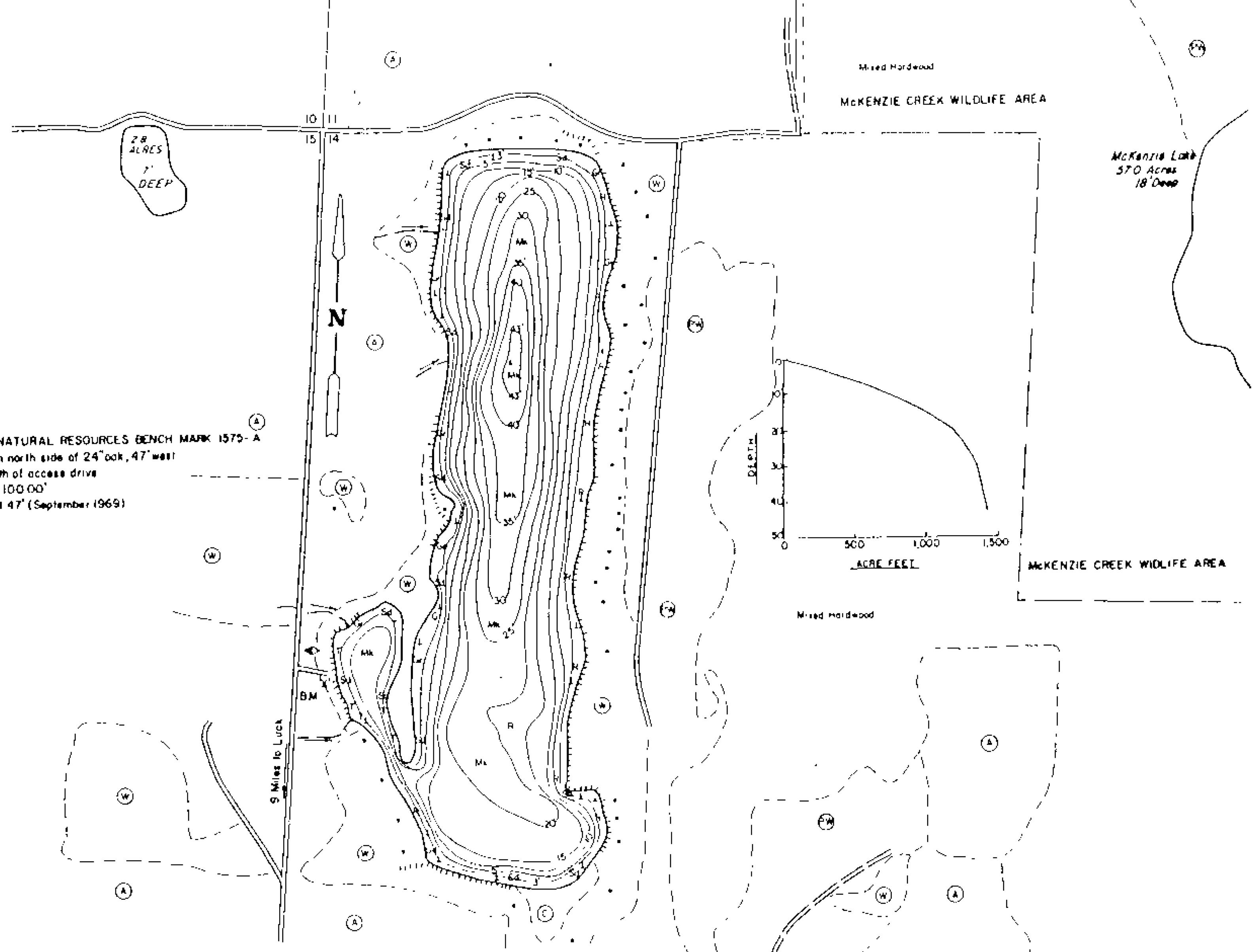
Table 2. Age-Length Relationships of Gamefish and Panfish, Ward Lake

| Age | Nr | Ave Length | Range | NW Wis Average | 1989 Ave |
|---|---|---|---|---|---|
| | | | Walleye | | |
| 2 | 2 | 10.4 | 10.0-10.6 | 9.6 | 8.8 |
| 3 | 2 | 14.3 | 14.0-14.6 | 12.2 | 10.9 |
| 4 | 4 | 14.9 | 14.2-16.0 | 14.3 | 13.2 |
| 6 | 1 | 17.6 | 17.6 | 18.0 | 16.5 |
| | | | Northern Pike | | |
| 2 | 2 | 12.5 | 11.2-13.7 | 13.5 | |
| 3 | 2 | 15.7 | 15.3-16.0 | 18.9 | |
| 4 | 3 | 16.7 | 16.2-17.5 | 19.7 | |
| 5 | 3 | 19.8 | 18.7-21.8 | 21.7 | |
| | | | Largemouth Bass | | |
| 1 | 3 | 3.6 | 3.4-3.8 | 3.8 | |
| 2 | 16 | 7.0 | 5.0-7.9 | 6.3 | |
| 3 | 35 | 10.2 | 7.8-12.0 | 8.8 | |
| 4 | 7 | 12.9 | 12.0-13.6 | 11.2 | |
| 5 | 15 | 14.4 | 13.6-15.5 | 13.0 | |
| 6 | 4 | 15.3 | 14.8-15.9 | 15.0 | |
| 8 | 1 | 19.0 | 19.0 | 17.5 | |
| | | | Bluegill | | |
| 3 | 17 | 3.4 | 3.0-4.0 | 4.5 | |
| 4 | 23 | 4.5 | 3.7-5.1 | 5.4 | |
| 5 | 30 | 6.0 | 5.0-7.0 | 6.2 | |
| 6 | 7 | 7.0 | 6.5-7.5 | 6.8 | |

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

# LAKE SURVEY MAP

WARD LAKE — POLK COUNTY
SEC. 14 T. 36 N. R. 16 W.




EQUIPMENT RECORDING SONAR MAPPED AUGUST (MONTH) 1969 (YEAR)

TOPOGRAPHIC SYMBOLS
- (B) Brush
- (PW) Partially wooded
- (W) Wooded
- (C) Cleared
- (P) Pastured
- (A) Agricultural
- B M Bench Mark
- Steep slope
- Indefinite shoreline
- Marsh
- Spring
- Intermittent stream
- Permanent inlet
- Permanent outlet

LAKE BOTTOM SYMBOLS
- P Peat
- Mk Muck
- C Clay
- M Marl
- Sd Sand
- St Silt
- Gr Gravel
- B Boulders
- Stumps & Snags
- Rock danger to navigation
- Submergent vegetation
- Emergent vegetation
- Floating vegetation
- Brush shelters

SCALE 400 0 400' 800' 1,200 1,600'

Access — Access with Parking — Boat Livery

Drawn by

| SPECIES OF FISH | Abundant | Common | Present |
|---|---|---|---|
| Muskie | | | |
| N Pike | | X | |
| Walleye | | X | |
| L M Bass | | | X |
| S M Bass | | | |
| Panfish | | X | |
| Trout | | | |

WATER AREA 90.6 ACRES
UNDER 5 FT. 14 %
OVER 20 FT 35 %
MAX. DEPTH 43 FEET.
TOTAL ALK. 17 PPM
VOLUME 1,416.6 ACRE FT.
SHORELINE 2.31 MILES

SUMMARY FISHING RECORD
FORM 3600-63

DEPARTMENT OF NATURAL RESOURCES

COUNTY: POLK

WATERS: WARD

SAMPLING OBJECTIVE

NUMBER AND LOCATION OF STATIONS (HABITAT)

PERIOD FISHED (DATES)

9/14/98

## GEAR

BOOM SHOCKER (HOURS)

0.8

TIME

X NIGHT ______ DAY

VISUAL HOURS | TIME OF DAY | HAUL SEINE (LENGTH) | MESH | AREA COVERED

ANGLING (HOURS) | TIME OF DAY | TRAP NET (NO. OF NET LIFTS) | MESH | DEPTH

MINNOW SEINE (NO. HAULS), AREA COVERED | GILL NET (NO. OF FEET X NO. OF LIFTS) | MESH SIZE | DEPTH

OTHER (HOURS OR LIFTS)

CHARACTERISTICS

## FISHING RESULTS

| SPECIES | NO. | MODAL SIZE(S) | SIZE RANGE | CATCH/UNIT |
|---|---|---|---|---|
| LARGEMOUTH BASS | 106 | | 3.0 - 18.9 | 133/HR |
| WALLEYE | 10 | | 10.0 - 17.9 | 13/HR |
| NORTHERN PIKE | 10 | | 11.0 - 21.9 | 13/HR |
| BLUEGILL | 172 | | <3.0 - 7.5 | |
| PUMPKINSEED | 14 | | 4.3 - 6.9 | |
| ROCK BASS | 32 | | 3.8 - 10.0 | |
| YELLOW PERCH | 10 | | 3.1 - 8.8 | |
| | | | | |
| | | | | |
| | | | | |

OBSERVATIONS

SIGNED (COMPILER): Cornelius

DATE: 3/17/99

REV. 10-73

ake WARD MWB Code: 2599400 Date: 9 / 14 / 98 County: POLK Collector: LUND

arget Fish: ______ Survey Type: GENERAL Mark Given: ______ $H_2O$ Temp: 73 Time 20 : 00

.dverse Conditions: ______ $H_2O$ Conduct: ______ Station: ______

olts: 475 Amps: 5.5 Current Type (AC/DC/Pulsed DC) [AC circled] Pulse Rate: ______ Duty Cycle: ______

ear Type: BOOMSHOCKER Start Time: 70.7 End Time: 71.5 (.8HR) Distance Shocked: 2.3 MILES

of Dippers: (1/2) [2 circled] Entire Shoreline Shocked: (Y/N/I) [Y circled] Dip net mesh size: 3/8 $H_2O$ Clarity: (Clear/Turbid/Very Turbid) [Clear circled]

| ize inge | SPECIES | | | | |
|---|---|---|---|---|---|
| | N. PIKE | LM BASS | WALLEYE | | |
| - 3.4 | | 3 | | | |
| - 3.9 | | 3 | | | |
| - 4.4 | | | | | |
| - 4.9 | | | | | |
| 5.4 | | | | | |
| - 5.9 | | | | | |
| - 6.4 | | 2 | | | |
| - 6.9 | | 6 | | | |
| - 7.4 | | 10 | | | |
| - 7.9 | | 5 | | | |
| - 8.4 | | 5 | | | |
| - 8.9 | | 4 | | | |
| - 9.4 | | 4 | | | |
| - 9.9 | | 9 | | | |
| -10.4 | | 10 | 1 | | |
| -10.9 | | 6 | 1 | | |
| -11.4 | 1 | 4 | | | |
| -11.9 | | 3 | | | |
| -12.4 | | 3 | | | |
| -12.9 | | 3 | | | |
| -13.4 | | 1 | | | |
| -13.9 | 1 | 4 | | | |
| -14.4 | | 6 | 3 | | |
| -14.9 | | 7 | 2 | | |
| -15.4 | 1 | 4 | 1 | | |
| -15.9 | | 2 | | | |
| -16.4 | 3 | | 1 | | |
| -16.9 | | | | | |
| -17.4 | | | | | |
| -17.9 | 1 | | 1 | | |
| -18.4 | | | | | |
| -18.9 | 2 | 1 | | | |
| -19.4 | | | | | |
| 19.9 | | | | | |
| 20.4 | | | | | |
| 20.9 | | | | | |
| 21.4 | | | | | |
| 21.9 | 1 | | | | |
| 22.4 | | | | | |
| 22.9 | | | | | |
| 23.4 | | | | | |
| 23.9 | | | | | |
| 24.4 | | | | | |
| 24.9 | | | | | |
| 25.4 | | | | | |
| 25.9 | | | | | |
| 26.4 | | | | | |
| 26.9 | | | | | |
| | 10 | 106 | 10 | | |

| Size Range | SPECIES | |
|---|---|---|
| 27.0-27.4 | | |
| 27.5-27.9 | | |
| 28.0-28.4 | | |
| 28.5-28.9 | | |
| 29.0-29.4 | | |
| 29.5-29.9 | | |
| 30.0-30.4 | | |
| 30.5-30.9 | | |
| 31.0-31.4 | | |
| 31.5-31.9 | | |
| 32.0-32.4 | | |
| 32.5-32.9 | | |
| 33.0-33.4 | | |
| 33.5-33.9 | | |
| 34.0-34.4 | | |
| 34.5-34.9 | | |
| 35.0-35.4 | | |
| 35.5-35.9 | | |
| 36.0-36.4 | | |
| 36.5-36.9 | | |
| 37.0-37.4 | | |
| 37.5-37.9 | | |
| 38.0-38.4 | | |
| 38.5-38.9 | | |
| 39.0-39.4 | | |
| 39.5-39.9 | | |
| 40.0-40.4 | | |
| 40.5-40.9 | | |
| 41.0-41.4 | | |
| 41.5-41.9 | | |
| 42.0-42.4 | | |
| 42.5-42.9 | | |
| 43.0-43.4 | | |
| 43.5-43.9 | | |
| 44.0-44.4 | | |
| 44.5-44.9 | | |
| 45.0-45.4 | | |
| 45.5-45.9 | | |
| 46.0-46.4 | | |
| 46.5-46.9 | | |
| 47.0-47.4 | | |
| 47.5-47.9 | | |
| 48.0-48.4 | | |
| 48.5-48.9 | | |
| 49.0-49.4 | | |
| 49.5-49.9 | | |

# LAKE ELECTROFISHMC DATA COLLECTION SHEET (3.0 in. - 13

Form 3600-190 Rev. 4-94

Lake WARD MWB Code: 2599400 Date: 9 / 14 / 98 County: POLK Collector: LUND

Target Fish: ______ Survey Type: GENERAL Mark Given: ______ $H_2O$ Temp: 73 Time 20 : 0

Adverse Conditions: ______ $H_2O$ Conduct: ______ Station: ______

Volts: 475 Amps: 5.5 Current Type (AC/DC/Pulsed DC) [AC circled] Pulse Rate: ______ Duty Cycle: ______

Gear Type: BOOMSHOCKER Start Time: 70.7 End Time: 71.2 (.5HR) Distance Shocked: ______

# of Dippers: (1/2) [2 circled] Entire Shoreline Shocked: (Y/N) [N circled] Dip net mesh size: 3/8 $H_2O$ Clarity: (Clear/Turbid/Very Turbid) [Clear circled]

| Inches | BLUEGILL | PSD | RB | YP | Inches | | | RB | YP | |
|---|---|---|---|---|---|---|---|---|---|---|
| <3.0 | 45 | | | | | | | | | |
| 3.0 | 4 | | | | 8.0 | | – | 2 | 1 | |
| 3.1 | 3 | | | 1 | 8.1 | | | | | |
| 3.2 | 7 | | | | 8.2 | | | | 1 | |
| 3.3 | 3 | | | | 8.3 | | | 1 | | |
| 3.4 | 3 | | | | 8.4 | | | | | |
| 3.5 | 4 | | | | 8.5 | | | 1 | | |
| 3.6 | 1 | | | | 8.6 | | | | | |
| 3.7 | 2 | | | | 8.7 | | | | | |
| 3.8 | 2 | | 1 | | 8.8 | | | | 1 | |
| 3.9 | 2 | | | | 8.9 | | | | | |
| 4.0 | 3 | | | 1 | 9.0 | | | 2 | | |
| 4.1 | 2 | | | | 9.1 | | | | | |
| 4.2 | 5 | | | | 9.2 | | | | | |
| 4.3 | 3 | 1 | | 1 | 9.3 | | | 1 | | |
| 4.4 | 3 | | | | 9.4 | | | | | |
| 4.5 | 4 | 1 | | 1 | 9.5 | | | | | |
| 4.6 | 5 | 1 | | | 9.6 | | | | | |
| 4.7 | 10 | 1 | | | 9.7 | | | | | |
| 4.8 | 6 | 2 | | | 9.8 | | | | | |
| 4.9 | 3 | | | | 9.9 | | | | | |
| 5.0 | 4 | 1 | | | 10.0 | | | 1 | | |
| 5.1 | 3 | | | | 10.1 | | | | | |
| 5.2 | 4 | | | | 10.2 | | | | | |
| 5.3 | 7 | | | | 10.3 | | | | | |
| 5.4 | 3 | 1 | | | 10.4 | | | | | |
| 5.5 | 1 | | | | 10.5 | | | | | |
| 5.6 | 2 | | 1 | 1 | 10.6 | | | | | |
| 5.7 | | | | | 10.7 | | | | | |
| 5.8 | 1 | | | 1 | 10.8 | | | | | |
| 5.9 | 1 | | | | 10.9 | | | | | |
| 6.0 | 4 | 1 | | | 11.0 | | | | | |
| 6.1 | 3 | | | | 11.1 | | | | | |
| 6.2 | 3 | 1 | 2 | 1 | 11.2 | | | | | |
| 6.3 | 4 | 1 | | | 11.3 | | | | | |
| 6.4 | 3 | | | | 11.4 | | | | | |
| 6.5 | 2 | 1 | 1 | | 11.5 | | | | | |
| 6.6 | 1 | | 1 | | 11.6 | | | | | |
| 6.7 | 2 | | 2 | | 11.7 | | | | | |
| 6.8 | 2 | 1 | 1 | | 11.8 | | | | | |
| 6.9 | 3 | 1 | 1 | | 11.9 | | | | | |
| 7.0 | 2 | | 1 | | 12.0 | | | | | |
| 7.1 | | | | | 12.1 | | | | | |
| 7.2 | | | 3 | | 12.2 | | | | | |
| 7.3 | | | 1 | | 12.3 | | | | | |
| 7.4 | | | 2 | | 12.4 | | | | | |
| 7.5 | 2 | | 2 | | 12.5 | | | | | |
| 7.6 | | | | | 12.6 | | | | | |
| 7.7 | | | 1 | | 12.7 | | | | | |
| 7.8 | | | 2 | | 12.8 | | | | | |
| 7.9 | | | 3 | | 12.9 | | | | | |
| | 172 | 14 | | | | | | 32 | 10 | |

Other fish: **(Can include rarely** caught species **and** fish greater than 30 inches.)

# Appendix A

## Ward Lake Property Owner Survey

*The following survey is an important component of a lake planning project being undertaken by the Ward Lake Association in partnership with the Polk County Land & Water Resources Department, Bone Lake Township, and the Wisconsin Department of Natural Resources. The survey is designed to obtain your input regarding the water quality and future of Ward Lake. Your responses are very important and will help guide the future management of Ward Lake. For those questions that may not be applicable, please fill in NA for not applicable*

1. Are you? (Check **all** that apply)

_48%_ Year-round resident ___Seasonal resident (Did not receive adequite responses)

_52% Retired Empfoyed (Did not receive adequite responses)

2. How many years have you or your family owned property on or near the lake? **19.6 yrs. avg.**

3. How many weeks, on average, do you use this lake property during the year? **27 wk avg.**

4. On an average **day,** how many people use your **lake** property? ***2.5 avg.***

5. Are you a member of the **Ward Lake Association?** _87% *Yes*_ _13%_No

6. What are the most important reasons why you live on or near Ward *Lake*? (List **the** letter of your top three reasons in order of importance.)

1st___ 2nd____ 3rd____

A. Entertaining friends and relatives *(7)*

B. **Property** investment *(9)*

C. **Fishing (27)**

D. Observing wildlife (9)

E. Swimming/scuba diving/snorkeling (5)

F. Peace and tranquility **(21)**

G. Natural scenic beauty (15)

H. Water **skiing** (2)

I. Jet sluing (1)

J. Motor boating *(2)*

K. Canoeing/kayaking (0)

L. Sailing/Windsurfing (1)

hi. Other (please state): ____________________

7. How many of the following watercraft are **kept** on your property?

**(Numbers listed is the total of all the surveys)**

__14__ canoes/kayaks  __5__ **sailboats**  __1__ windsurf  __5__ rowboats  __0__ jet skis

__11__ motorboats < 25 AP  __6__ motorboats > 25 HP  __15__ pontoon boats

__19__ paddleboats  ____Other **(please list)**________________

**8.** Approximately how many days each year docs your family participate in the following activities on Ward Lake? (Average)

__24.5__ Fishing  __**13.1**__ Swimming

__25.1__ Motor boating/pontoon  __0.00__ Jet skiing

__2.9__ Water skiing  __4.0__ Canoeing/kayaking/rowing

__**76.5**__ Viewing wildlife/sunsets  __**1.6**__ Sailing/wind surfing

**9.** Approximately how many feet of lake frontage do you own? (Average)

__109.44__ fret  __1__ not applicable

**10.** Please estimate the composition of your waterfront shoreline.

__**59.5**__ % mowed turf grass

__**63.X**__ % trees/shrubs/groundcover

__**13**__ % dock path. stairs/structures/impermeable surfaces

**11.** How would you characterize the primary living residence?

__2__ Year round home (3 rooms or **less)**  __**18**__ Year round home (greater than 3 rooms)

__2__ Seasonal cabidcottage **(3** room or less)  __1__ Seasonal cabin/cottage (greater than 3 rooms)

__3__ Stationary trailer (3 rooms or less)  __1__ Stationary trailer (greater than 3 rooms)

**3** other **(please** describe):________________________

**12.** How many additional structures exist on your lakefront property? **32 total in responses**

Briefly describe what they are (i.e. shed, garage, guest house, etc.):

13. Please estimate the **setback distance** of the primary residence from the **take.** __90__ feet **(Avg)**

14. What type of septic system is on your lakefront property?

__9__ Holding **tank** __13__ Septic tank with drain field __5__ Mound system __5__ Outhouse __0__ undeveloped

15. What year was your current septic system installed/upgraded?

**1977,1978(3),1980,1981,1985,1988(2), 1990,1991,1992,1993,1994,1995,1996,1997,1998**

16. Where is your **septic** system located?

**(Number indicates how many are located in each direction according to the responses we received.)**

Nonh *(7)* South **(2)** **East (6)** West **(8)** (circle one) - side of primary **residence**

Is this the lakeward **side** of the residence? (circle **one**) **Yes (2)** No **(20)**

How **far back** from **the lake** do **you** estimate **your** septic system **to** be? __**96.9 avg.**__ **feet**

17. Have you noticed any of the following: (check those that apply)

slowly draining **sinks** *or* toilets

___water backed **up** *into* house from **drains**

___water pooled over **septic** drainfield

___brighter ***or*** **thicker** grass growing over your drainfield

__**22**__ haven't **noticed any of** these **things**

18. What **year** was your septic tank last **pumped** or inspected? __**1997 (2), 1998 (9), 1999 (9)**__

19. Since you have lived on or **near** the **lake,** how has the **water quality** changed? (check one)

__**0**__ Improved

__**9**__ Considerably degraded

__**5**__ Remained the same

__**5**__ **No** opinion, **can't tell**

__**9**__ Slightly degraded

___Other:___________

20. Since you have lived on or near the lake, how has the **lake level** changed? (chock one)

__**15**__ Increased considerably

__**2**__ Decreased considerably

__**3**__ Remained the ***same***

__**6**__ Fluctuates often

__**4**__ No opinion, can't **tell**

___Other:___________

21. What is your perception of the water quality of the lake? (circle onej

_7_ Very good   _13_ Good   _9_ Fair   _2_ Poor   ___ Seriously polluted

**22.** For each type of fish, what is your perception of the quality of fishing? (Please fill in a number):

**(Average of the responses we received)**

0-Declining   1-Greatly Declining   **2-Staying** the Same   3-Improving   4-Greatly Improving   5-Don't know

Walleye _1_   Bluegill _3_   Yellow Perch _3_   Largemouth Bass _3_

Northern Pike _3_   Pumpkinseed _3_   Black Crappie _3_   Rock Bass _3_

**23.** What do you consider to be the biggest problems or threats to Ward **Lake?**
(List the letters of your three most important concerns in order)

1st ___ 2nd ___ 3rd ___

A. Greater fishing pressures (10)

B. Declining fish populations (15)

**C.** Failing septic systems **(5)**

**D.** Nutrients from functioning septic systems (1)

**E.** Loss of shoreline wildlife habitat **(8)**

**F.** Shoreline erosion and slumping **(4)**

***G.*** **Lakefront** development ***(9)***

**H.** Soil erosion from surrounding watershed **(2)**

I. Back lot/off water development (0)

**J. Lake** user conflicts **(3)**

**K.** Fluctuating lake water levels (5)

**L.** Lawn and garden fertilizers & pesticides **(1)**

**M.** Algae blooms **(7)**

N. Exotic (invasive) species invading the **lake** (3)

**O.** Declining aquatic plants **(0)**

**P.** Abundant aquatic plants ***(5)***

***Q.*** Fuel and **oil** spills from motorboats(0)

**R.** Sedimentation of the lake bed ***(5)***

S. Other (specify)_______________

T. Other (specify)_______________

**25.** To what extent do you feel your most important problems or concerns are impacted by the use of the public boat access on Ward Lake?

_3_ No impact   _6_ Little impact   _15_ Some impact   _7_ Great impact

**26.** Please rate the level of summer boat traffic on the lake? (check one)

_0_ Congested   _6_ Heavy   _21_ Moderate   _4_ Slight

27. Which statement best describes the **peace** and tranquillity at the lake? (circle one)

A. Few **disturbances, rarely see** and hear another **person.** (2)

B. Moderate disturbances, it is easy to share the lake. (25)

C. Heavily **used, sometimes** the noise **and activities** of others **disturb** me. (2)

D. **Over** used, I **have to** regularly **plan around** the noise and activities of **others.** (1)

E. Unusable, there is so much noise and activity that I normally can't enjoy the tranquility of the lake. (0)

**28.** Which, if any, of **the** following have most frequently negatively affected the peace **and** tranquillity of the lake for you? (List the letter of the top three in order of priority)

1st____ 2nd____ 3rd____

A. Pleasure boats (8)

B. Water **skirrs** (9)

C. Jet skis (15)

D. Day fishermen (1)

E. Night fishermen (0)

F. Noise from shoreline (11)

G. Nothing, I am satisfied with the level of peace and tranquility (9)

H. Other (specify)__________________

29. If water quality declines in Ward Lake, to what extent **do** you feel it would affect your property values? (circle one)

A. No **Impact** (1)

B. Somewhat decrease **value** (14)

C. Greatly decreasr value (13)

**30.** What lake management activities **do you** feel the **Ward** Lake Association should undertake or continue? (circle all that apply)

**(Average number from the responses we received)**

A. Form an **official** lake district (2.8)

B. Continue **study** of Ward **Lake** watershed *(7.9)*

C. Continue to monitor lake **water** quality (10.7)

D. Assist with management of fishery (7.1)

E. Encourage shoreline habitat protection (8.3)

F. **Help** control shoreline soil erosion (1.7)

G. Provide more educational material *(3.6)*

H. **Boat** landing education & outreach (5.2)

I. Monitor and encourage wildlife **use** of lake *(5.9)*

J. **Address** nuisance issues on the lake (4.8)

K. **Attend** state lake conventions/other meetings (2.8)

L. Coordinate a neighborhood watch program (3.6)

M. **Sponsor** septic system maintenance program (5.9)

N. **Sponsor** borne drinking water **testing** (3.6)

O. **Exotic** (invasive) species prevention/monitoring (i.e. zebra **mussels, purple** loosestrife, eurasion watermilfoil, spiny water **flea,** etc ) **(5.6)**

P. Sponsor social **activities** for the **lake** community **(2.8)**

Q. Offer speakers at lake association meetings **(3.6)**

R. **Represent concerns** of lake **association to** local, **state,** and federal government **(5.9)**

S. No action needed **(0)**

T. Other___________________

**31.** Would you be willing to provide financial support to maintain or improve the water quality of Ward Lake? __22__ yes __4__ no

If yes, how much would you be willing to contribute each year?

__4__ $0-10 __7__ $10-50

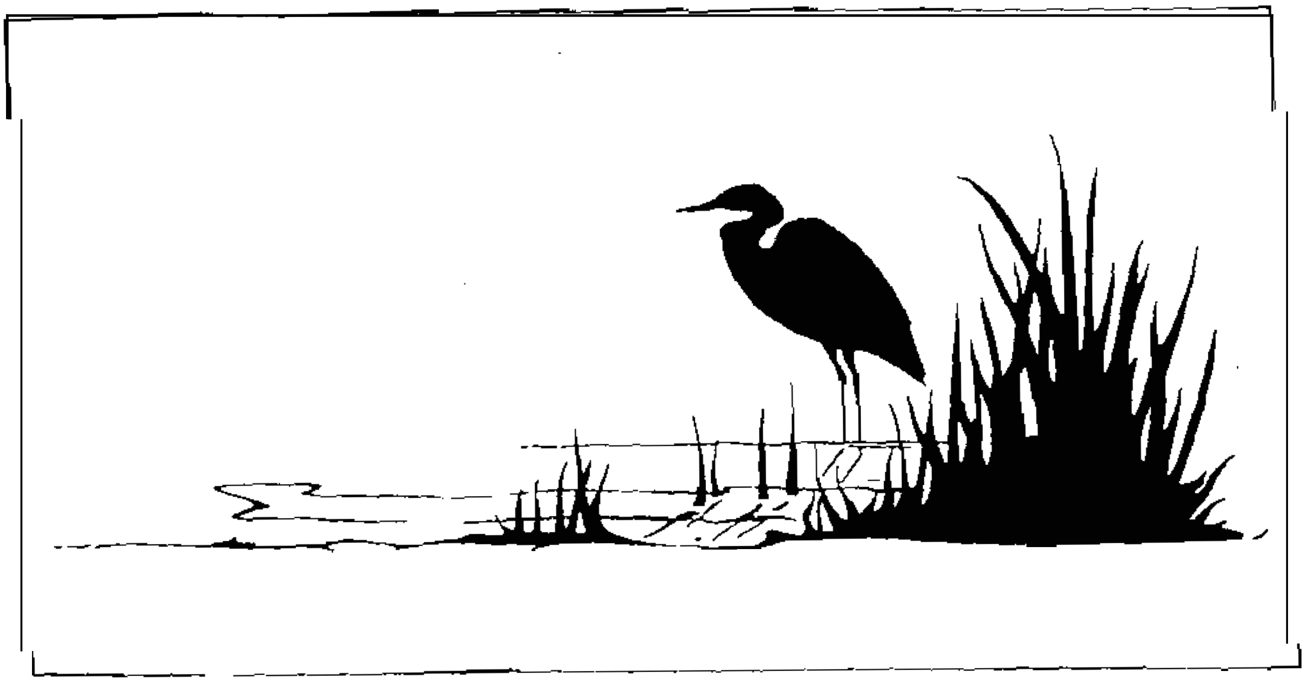
__6__ $50-100 __4__ $100+

**32.** Any other comments or suggestions?

*Thank you for taking the time to provide us with **your** input! Summer interns will be **stopping** by your Ward Lake residence in **curly** July to answer any questions you may have and to pick up the completed surveys. For seasonal residents, **please** bring **the** completed survey with you to the lake. If you are not visited **in** person by mid-July, please return this survey **to** the **Polk** County Land & Water Resources Department at the address below by no later than July 31". Questions **or** comments may also be directed to (715) 485-8637. **Thank** you once again.*

Jacob Bellinsky, Water Resources Specialist
**Polk** County Land & Water Resources Department
215 Main Street, P.O. Box 460
Balsam Lake, WI 54810

# GUIDELINES FOR PROTECTING, MAINTAINING, AND UNDERSTANDING LAKE SENSITIVE AREAS



**A companion document** to **better help understand lakes sensitive area reports**

# GUIDELINES FOR PROTECTING, MAINTAINING, AND UNDERSTANDING LAKE SENSITIVE AREAS

## A companion document to better help understand lakes sensitive area reports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## CONTENTS

# GUIDELINES FOR PROTECTING, MAINTAINING, AND UNDERSTANDING LAKE SENSITIVE AREAS

This document was originally designed to be used in conjunction with specific lake sensitive area survey reports; **but it can** also **be useful to other parties interested** in **protecting lakes by helping them understand important factors which determine** the **health of lake ecosystems.** This document will concentrate on several main areas within the **lake** and its' shoreline areas that can be protected or restored to insure lake ecosystem health. These main areas include aquatic plant sensitive areas, shoreline land use and **lakeshore** buffers, gravel and coarse rock rubble habitat, large woody debris, and various water regulations and zoning concerns. This document will not attempt to deal with land use problems that do not fall within the immediate shoreline areas; although it is recognized that lakes may have problems that occur in these outlying areas of their watershed resulting in significant nutrient and sediments.

## UNDERSTANDING AQUATIC PLANT SENSITIVE AREAS

The importance of aquatic plant communities are frequently under appreciated and their importance to a lakes ecosystem health misunderstood. This is often evident by the way people refer to aquatic plants as problem weeds or weed beds. **A** weed by definition is a plant that is out of place or a plant of no value. The vast majority of aquatic plants are not out of place and as previously stated are extremely important for the proper functioning of a healthy lake ecosystem and **are** an integral part of the biotic integrity. Fisheries **are** dependent upon them for cover, spawning habitat, important habitat and cover for fingerlings and young of the year, habitat for aquatic insects **and** other important food or forage species (minnows), and they also serve an important function in reducing the shoreline erosion associated with wave action while stabilizing sediments in place.

Aquatic plants also provide many important functional values for wildlife: Loons require aquatic vegetation for their nests, waterfowl for food **and** cover, furbearers for food and cover, songbirds, shoreline waterbirds, frogs and other amphibians, reptiles, and a host of other wildlife require aquatic vegetation for some critical need throughout different life cycles.

In most cases chemical treatments for the removal of aquatic vegetation should be discouraged because they result in a loss or fragmentation of important habitat while also directly killing or impacting immobile species such mussels and other invertebrates. Leading plant experts agree that chemical treatment often does not result in the desired effects with many species not affected by the chemical or free-floating species **such** as coon tail (*Ceratophyllum* **sp.)** and duckweed (*Lemna* sp.)quickly drifting back into treated areas with the next pervasive **wind** eliminating any benefit to chemical treatment while the introduced chemicals and their breakdown components continue to persist in the lake ecosystem. Mechanical removal of aquatic vegetation should also **be** discouraged *or* at least limited to narrow navigational channels (<20' wide) and small areas next to docks when needed.

Many lakes have limited aquatic vegetation restricted to shallow bays Property owners in shallow bays may think they are cleaning up their bay but in actuality they are further reducing important habitat that may already be in short supply and may be the limiting factor suppressing game fish numbers for the rest of the lake. In these circumstances we need to especially consider the impacts of having clearly defined navigational channels through already scarce aquatic plant communities. We need to think of the cumulative impacts of our actions. If everyone removed the aquatic vegetation from in front of their property the health of the lake ecosystem would be severely impacted, limiting the fishery and water quality. Aquatic.plants lock up available phosphorus which would otherwise drive undesirable algae blooms. Lake districts should carefully consider the value of purchasing shallow water bays with extensive aquatic plant communities to insure that future development does not result in an impact or a loss of this valuable habitat.

While current water regulations allow for the mechanical removal of aquatic plants provided the lake bottom **is** not disturbed **and** the cut plants are removed from the lake and not allowed to drift free it is hoped that property owners will carefully consider the cumulative impacts of the decisions they make for their property under the insight of this and other documents. Chemical treatment of aquatic plant communities requires a permit review and approval process, but adequate staff are not available to educate individual landowners about the full ramifications of chemical treatment and it is difficult to deny permits without adequate time to carefully research each individual application. Impacts to the native aquatic plant community also increase opportunities for exotic species to become established.

**Summary of management recommendations for the protection and restoration of aquatic plant communities**

'The following management recommendations provide some basic concepts that can be used or implemented to insure the long term health of aquatic plant communities and the overall health of lakes ecosystems.

1. Prohibit chemical treatment of aquatic plants accept under extenuating circumstances such as:
   A. The habitat to be treated is a dominant feature in the lake and the cumulative treatment of small areas will not reduce the overall percentage of coverage from historic coverages.
   B. There is no other management alternative
   C. 'Treatment will nut result in a loss of critical habitat
   . It car! be shown that chemical treatment will result in an improvement to the overall health of the ecosystem.
   . a serious use problem clearly exists
2. Discourage mechanical harvesting of aquatic plants in most circumstances. Clear only navigational channels <20' wide and small areas adjacent to **docks,** please consider the cumulative impacts if everyone was to duplicate the actions you take on your property around the rest of the lake.
3. Educate lake users about the value of aquatic plants
4. Apply aggressive erosion control measures *to* all bare soil areas
5. Protect existing natural plant cover in upland areas within a 50'-60' corridor of the waters edge and reestablish an effective buffer of natural plant cover where *it* has been eliminated. This corridor or buffer is an important component in protecting water quality and habitat against eutrophication and sedimentation.
6. Encourage the strict enforcement of existing zoning regulations and encourage their strengthening **and** uniform enforcement.
7. Provide follow through and feed back with public officials when it conies to waivers 2nd variances of existing zoning regulations and building codes
8. Encourage the requirement of mandatory erosion control

plans for **all** building permits that rcquirc ground breaking

9. Filling, dredging, or other shoreline or littoral zone alterations covered by chapter 30, Wisconsin Statutes, should be prohibited unless there is clear evidence that such an alteration would benefit the lake's ecosystem.

## SHORELINE LANDUSE AND LAKESHORE BUFFERS

The impacts that can result from shoreline development can be greatly reduced if done carefully with respect to the many important functional values that must exist to maintain **a** healthy lakes e osystem. Natural shoreline vegetation provides important protection for lake water quality as well as ecosystem health and should be maintained for at least a 50-60' buffer strip adjacent to any waterbody. If shorelines have a steeper gradient than 10-15% the buffer strip width should be increased. Access corridors through this buffer zone are restricted by most county zoning regulations. Restrictions usually prevent the clearing of woody vegetation to no more than *30'* ou: of every 100' of shoreline. Property ouners that care about the health of their lake's ecosystem can go a step further by reducing the clearing of vegetation to a narrow foot path. The best design for a foot path is an irregular trail that does not go in a direct line to the lake but has irregular meanders much **like** a stream with small bcrms and humps to prevent runoff from flowing directly down the path **and** preventing the path from become an area of concentrated **flow** for the direct delivery of sediments and nutrients.

The importance of maintaining the zone of no disturbance of the natural vegetation along the lake shoreline is important for several reasons. As land is cleared and developed, irregular surface areas are lost, leveled, and filled in by earth moving equipment, reducing infiltration and increasing runoff. Soil porosity is also decreased, decreasing infiltration and increasing runoff. **As** we loose or simplify the Iayers present (trees, shrubs, and herbaceous ground cover) in the shoreline areas we decrease the layers present for the interception of rainfall; each layer present reduces the energy and volume of rainfall striking the grounds surface thereby reducing what is available for the mobilization and transport of sediments and nutrients from the grounds surface to the **lake.** The greater the volume of runoff the more energy available for the transport of nutrients and sediments from surrounding land uses into thc lake to drive algae blooms and bury important shoreline habitats.

Each of these thee layers (trees, shrubs, and herbaceous ground cover) provide different important habitat components for different life cycle requirements of various wildlife. If any one layer is missing the ability of certain wildlife species to survive may be compromised. Leaving wider areas of uncut vegetation (Buffer Zones) increases the likelihood that adequate habitat will exist for many species of songbirds, who are at **risk** from the loss of this valuable lake shoreline habitat. Furbearers, raptors, frogs, deer, and other wildlife also benefit from these wider natural areas.

The aesthetic perspective also needs to be evaluated. Everyone **likes** to look out and see the lake, but very few people **like** to look at an intensively developed shoreline that reminds them of the urban yards and hectic pace they were trying to get away from. Maintaining the natural wild character of a **lake** should be the highest priority guiding any development activities Both man and wildlife will loose if the natural character is allowed to be manipulated to the point our lakeshores begin to resemble urban yards and lawns. This emphasizes the importance of insuring that development is done carefully to maintain as many of the important functional values that the natural undeveloped shoreline had

The restoration of a naturally vegetated buffer for at least 50'-60' from waters edge should be a very high priority for properties that have been cleared or converted. **As** previously stated **a** healthy buffer includes the native trees, shrubs, and herbaceous ground cover that would naturally have existed on a given site or location. The native species can usually be identified by looking at undeveloped shoreline areas.

Summary **of management recommendations for** the **protection** and **restoration of natural vegetative** shoreline **buffers** .

1. Educate landowners about the importance of **a** healthy lakeshore buffer
2. Encourage the strict enforcement of existing zoning regulations and encourage their strengthening and uniform enforcement.
3. Provide follow through and feed **back** with public officials when it comes to waivers and variances of existing zoning regulations and building codes
4. Encourage the requirement of mandatory erosion control

plans for all building permits **that** require ground breaking

5. Provide direct oversight of **all** building crews and insure that **as** little as possible of the natural plant cover is disturbed during the construction phases.

## PROTECTION OF GRAVEL AND COARSE ROCK RUBBLE HABITAT

Gravel and coarse rock rubble free of silt and sediments is critical to the successful reproduction of some walleye stocks. Gravel and coarse rock rubble free of silt and sediments is also critical to the survival of different components of the aquatic food chain that supports a healthy lake ecosystem, including aquatic insects, crayfish, and other forage or food species. The greatest threat to these critical habitats is shoreline development that is not accomplished in a manner that maintains an adequate buffer of undisturbed land and does not implement and maintain proper erosion control measures. This buffer is particularly important during ground breaking and construction of lake shoreline areas, because it traps sediments and nutrients within the vegetation and irregular surface areas and small depressions preventing them from reaching the lake and driving algae biooms or burying important habitat.

Summary **of** management recommendations **for** the **protection** of **rock rubble** *walleye spawning* **habitat**

1. Educate landowners about the importance of a healthy lakeshore buffer (filter out sediments)
2. Encourage the strict enforcement of existing zoning regulations and encourage their strengthening **and** uniform enforcement.
3. Provide follow through and feed **back** with public officials when it comes to waivers and variances of existing zoning regulations and building codes
4. Encourage the requirement of a mandatory erosion control plan for all building permits that require ground breaking
5. Provide direct oversight of all building crews and insure that as little as possible of the natural plant cover is disturbed during the construction phases.
6. Do not use sand blankets to convert natural bottom types to sterile beach sand.

7. Filling, dredging, or other shoreline or littoral zone alterations covered by chapter 30, Wisconsin Statutes, should be prohibited unless there is **clear** evidence that such an alteration would benefit the lake's ecosystem.

## MAINTENANCE OF LARGE WOODY DEBRIS

Large woody debris or trees should be left in the lake as they naturally collapse and fall into the lake. Large Woody debris is often overlooked for its importance in providing critical fish habitat. Species such as largemouth bass require some sort of cover to successfully nest and rear offspring. Bluegills **and** other species also benefit from the presence of large woody debris. The conversion or removal of natural plant cover within **a** 50'-60' corridor of the lake reduces or eliminates completely the opportunity fur the replacement of large woody debris as well as other important functional areas important the any lakes ecosystem health and should be discouraged. The way **we** look at large woody debris should in the context of its importance to the health of the lake ecosystem. Preformulated perceptions drawn from urban experiences or practices used in urban areas can be very destructive to the way natural environments function in a complex interconnected fashion. **A** shoreline ringed with fallen trees should not be looked at as untidy or unkempt but one that is providing important habitat for fish and wildlife. Fishermen have recognized for decades that fallen trees are often some of the best habitat to fish for bass and panfish. This emphasizes the need to re-assess our value system and begin leaving them for important habitat. Fisheries managers in recent years have begun to increase their educational efforts in this particular area but still have a majority of the public to reach with this important message.

### **Management recommendations for woody** debris

I. Educate lake shore owners about the value of allowing trees to Call into the lake naturally in order to provide valuable habitat for fish and wildlife.

II. Encourage lake shore property owners to become involved in the long term **planning** for woody **debris** on their property. Plant young trees for the replacement of older trees.

## ZONING AND REGULATION CONSIDERATIONS FOR LAKE PROTECTION

Filling, dredging, or other shoreline or littoral zone alterations covered by chapter 30, Wisconsin Statutes, should be prohibited unless there is clear evidence that such an alteration would benefit the lake's ecosystem. Sea-walls should not be used and sand blankets should not be allowed in almost all situations. Rock rip-rap should be used only when anchoring difficult shorelines with problematic erosion.

County shoreland and wetland zoning regulations apply to the areas within 1000 feet of lakes, ponds, and flowages and within 300 feet of rivers, streams, and creeks. The intent of zoning regulations is to promote wise land use planning while allowing careful, development around our precious surface water resources.

In all cases during development, the maintenance of a naturally vegetated buffer zone is critical to preserve a healthy lake ecosystem. In situations where the vegetation has been removed or altered it is encouraged to reestablish a buffer zone composed of the natural plant communities that belong there. This can usually be easily identified by looking at undeveloped shoreline areas and utilizing the same plant species. This ensures that you not only get water quality protection, but you also get the important functional values that the native plants were providing for food and cover for shoreline species of wildlife dependent upon them.

### Erosion control during lot development

This is one area that can have a dramatic effect on water quality and habitat if it is not done correctly. The volume of sediments and nutrients that can be transported to a lake during the construction phase can equal the amount that would normally have only come off from the same parcel of land over a period of hundreds of years. The compounding effect of this nutrient load can have a dramatic effect on long term lake water quality. By following some basic rules during the construction phase we can keep most of these sediments and nutrients in place and prevent them from becoming a part of the lakes internal nutrient cycle that could cause a shift from a clear lake to one that has ample nutrients to drive extensive algae blooms each year.

Adequate soil erosion control measures and their proper maintenance during construction are very important and should become **a** very high priority for individual property owners. Lake association members could play an active part in reaching property owners before the damage is done or minimizing impacts by identifying active sites that need erosion control measures and contacting **property** owners to encourage proper implementation of erosion control measures. County zoning staff and officials need public **support** to get more effective zoning regulations on the hooks. Public support needs to be expressed if adequate county staff are to be hired to meet the increasing demands that are being placed on them by expanding development. As is most counties suffer from inadequate staff to deal with existing work demands. Mandatory erosion control plans should be **a** requirement for all building permits that will involve ground breaking. This needs to be coupled with adequate staff to insure that erosion control plans are being followed and properly implemented and that erosion control measures are properly maintained. More recently county governments have begun to deal with these difficult issues.

Until county wide erosion control ordinances can be established it is strongly recommended that individuals require contractors to develop erosion control plans prior to the initiation of any construction, then the landowner should ensure that it is adequate. Aggressive follow through after construction has begun is also important to insure erosion control practices are properly implemented and maintained.

By giving erosion control careful consideration prior to construction serious impacts to our lake; and streams can be minimized or avoided entirely. Yards can be designed with subtle burms to divert runoff into internally drained areas or into constructed depressions to allow sediments and nutrients to settle out and be trapped before reaching our streams and lakes. Silt screen fences, properly installed during construction can protect against "sheet" runoff. Other erosion control methods are required on steep slopes or difficult sites. Your county land conservation staff or DNR technical support can provide expert advice about erosion control.

Protect all top soil piles by properly locating them away from drainage ways and as far away from the lake as possible. Surround them with a ring of silt screen fence while also seeding them **down** with an annual rye grass to provide additional stabilization until they are needed.

Never divert rainfall runoff from driveways, roofs, or access roads directly to the **lake** through draintiles, culverts, or waterways. **Instead,** divert runoff into internally drained areas, constructed depressions to allow for settling of sediments and nutrients, or at least into a thickly vegetated site that will provide some **degree** of filtration **and** infiltration of runoff.

**Management recommendations for constructions site erosion control**

I. Minimize disturbance of natural plant communities within shoreline areas *(50'-60'* from waters *edge)* so they can continue *to* act as a buffer *protecting* lake water quality **by** filtering runoff and providing for infiltration before it reaches the lake.

II. Provide direct oversight of the construction crew during development. Insure that clearing of vegetation is kept to the minimum needed to accomplish the desired construction and avoid any disturbances within at least *50'-60'* of any shoreline

A. Insure that silt screen fences are installed and maintained.

B. **Apply** mulch to all bare soil areas that may be exposed to precipitation during none work hours, and especially make sure mulch is applied before weekends. Purchase and use excelsior erosion control mats and other products where necessary.

C. Provide coarse gravel and crushed rock cover for all areas that have regular heavy equipment traffic, i.e. driveways. Keep all vehicle traffic confined to these protected road surfaces.

D. Include landscape designs for the protection of water quality i.e., such as holding ponds and depressions which provide for the opportunity to capture and hold runoff while maximizing infiltration and allowing sediments and nutrients **to** settle out.

E. Try to eliminate or minimize areas of concentrated flow by reducing the surface area draining through a single path or channel and encouraging flow over multiple paths into depressional areas through the use of berms and other best management practices (BMPs).

## VI. Use of **fertilizers on lake side lawns**

From a water quality standpoint lawn **fertilizers** are a recognizable source of nutrients that property owners can eliminate or control through proper application, more is not better. Landowners are also encouraged to strongly consider the consequences of having **a** large lawn that extends into the recommended buffer area (within 50'- 60' of the lakeshore). By reducing your lawn size you not only reduce the amount of sediments and nutrients entering the lake you also provide important habitat necessary to support Wisconsin's wildlife species dependent upon this important shoreline habitat that is quickly disappearing in the face of increasing development pressures. Another benefit to decreasing lawn size is the reduction in **work** load necessary to maintain it; hence you can spend more time relaxing and enjoying your property.

If you feel the need to fertilize your lawn have your soil tested for phosphorus and potassium levels. When applying fertilizers consider the need to have soil phosphorus levels at the maximum recommended level. By applying fertilizers at a lesser rate you can still enhance your lawn without the increased risk ***of*** having excess drain into the lake to drive undesirable algae blooms. Remember that fertilizer supplier.; are in the business to sell chemicals. The recommended bag application rates are often to high. Get advice from your county or university extension offices and remind them that you are applying the fertilizers to a lakeshore lawn and do not want to over apply.

Never bum brush or leaves, especially along the lakeshore, in road ditches, or in drainage ways that drain into the lake, The ashes are very high in phosphorus and nitrogen and are soluble in rainwater. The best way to deal with leaves is to compost them. Spreading them in a wooded area that does not drain to the lake is also a good way *to* deal leave disposal. If neither of these **is** an option bag your leaves and take them to a yard waste collection site for proper disposal.

Do not remove grass clippings from lawns. They contain all the nitrogen and phosphorus your lawn needs which you will not have to replace with annual fertilizer applications. Use a mulching lawnmower it recycles the clippings into your lawn more efficiently. Never spread wood stove ashes in area; draining to **the** lake; instead dispose *of* them with your household garbage during normal refuse pickup times.

Management recommendations for fertilizer use

I. **Apply** fertilizers only if a soils test has determined that it is nutrient deficient and add less than the maximum recommended.

II. The use of a low phosphorus content fertilizer is strongly recommended if the fertilizer is to be **applied** an lakeshore property.

## VII. Septic system maintenance and necessary replacement of old failing systems

Failing septic systems can pose a significant threat to water quality, especially when large portions of shoreline are developed **and** when the overall percentage of a **lakes** watershed is dominated by lakeshore properties. Septic systems that are older then 20 years should be looked at to insure that the filtration **field** is properly functioning and that waste is not perching above the drain field and entering the lake directly without adequate filtration of nutrients **and** other components. There is no specific rule that septic systems have *to* be evaluated to determine if they are functioning properly, unless there is a complaint filed.

It is generally recommended that you have your septic system pumped of the normal sludge buildup every two to three years. This sludge removal is essential for maintaining rhe absorptive capacity of your drain field.

Inspect your system regularly for surfacing effluent around the drainfield. Are there wet areas or strong odors? Do the drains in your home seem to work properly or are they sluggish? Do they make noisy gurgling sounds? If your septic system has any of these systems you should have it inspected by a licensed installer.

Never make any changes to your sanitary system or wastewater piping. This work must be done by a licensed installer. It is not only dangerous to health and human safety, as well as water quality, it is also illegal and can result in fines or penalties.

**Avoid** using a garbage disposal with private septic systems. Put kitchen scraps in **a** compost **pile** if at all possible; otherwise, as a last resort put them in with your household garbage. Limit rhe use washing machines, *if* possible. Laundry washwater is high in lint, synthetic fibers, and pet hair all of which can cause premature failure of your drainfield. Use a commercial laundry if possible or if you are a weekend resident with a lakeshore septic system wait until you return to your midweek residence with public water and sewer.

A septic system is only intended to break down organic wastes. Never put solvents, furniture stripping solutions, degreasers, petroleum compounds, oil based paints and stains, or other chemicals into your sanitary system.

Diverting sink and shower drains (so called gray water) to lawns and other properties adjacent to the lake will not only impact lake water quality it is also illegal. Gray water must be run through your septic system to allow for the proper filtration of pollutants. There are no exceptions to this without first obtaining necessary permits.

## Appendix D. Lake Modeling

The Wisconsin Lake Model Spreadsheet (WILMS), Version 2.0, was chosen by the LWRD as a lake-modeling tool for **water** quality planning. This mathematical lake model was developed by the Wisconsin Department of Natural Resources. WILMS uses empirical models. Empirical lake models are devetoped from statistical analyses of lake and watershed monitoring data. Empirical models use statistical methods to describe the input/output relationship of a system. WlLMS couples 10 empirical **lake** response models.

The 10 empirical lake response models that are used within WILMS use data collected from lakes monitored in North America, Canada, and Northern Europe. The models predict the mean in-lake phosphorus concentrations for two points in time, spring turnover and during the growing season, as well as the annual phosphorus loading. Phosphorus concentrations are an excellent way of interpreting the overalt lake health.

Controlling and reducing the ability of phosphorus to enter the lake is the basis of lake management. Phosphorus is considered, in most lakes, to be the limiting nutrient in algae growth, which leads to eutrophication. Eutrophication is a natural step in the aging process of lakes, often times accelerated by human activities, and is identified by the increase in biological productivity causing the water to become murky with phytoplankton. Decaying organic matter then depletes the available oxygen. Sunlight, carbon, oxygen, hydrogen, and nitrogen are needed, along with phosphorus for algae growth. Sunlight, carbon, oxygen, hydrogen and nitrogen cannot be effectively controlled in a lake system. Nitrogen is obtained directly from the atmosphere by the dominant species of algae known as blue-green algae. Therefore, the only practical method to control eutrophication is to focus on phosphorus.

The purpose of the WILMS is to act as a management and planning tool. WlLMS provides annual simulation results by estimating the annual phosphorus loadings and in-lake phosphorus concentrations. This data can then be used for planning and goal setting purposes.

The computer-generated WILMS model was used to describe the phosphorus loading for Ward Lake. This model has helped LWRD provide insight into the effectiveness of management actions.

The WILMS model is split into modules, two input modules and seven output modules. The data collected from water sampling, the water quality survey, the lake bottom survey, landowner surveys, and the watershed land use delineation was needed for the model inputs.

Using the Phosphorus Prediction Module data, the model WlLMS first predicts the total phosphorus loading using each of the 10 empirical models. The empirical models predict either a spring turnover mean phosphorus concentration or a growing season mean phosphorus concentration. The observed spring and growing mean total phosphorus concentrations are then compared to the predicted concentrations.

The Uncertainty Analysis Module helps the user decide on which empirical model best describes the lake in question. It also gives a range of predicted phosphorus loadings for a user specified confidence interval. The confidence interval means that at a user specified percent of time the average in-lake phosphorus concentration can be expected to be between within the range shown in the model. A 70 percent confidence interval was chosen, to facilitate in determining a representative WlLMS model for Ward Lake. (Two of the empirical models are considered to predict a "single point estimate", and therefore, only provide a confidence interval of 95 percent, regardless of the confidence interval input by the user.)

Next, the Parameter Range Module determines whether the lake in question's input data parameters fall within each of the empirical models' specific ranges. If the input data satisfies the ranges of the specific empirical model the program displays <FIT>, if not, <NO FIT> is displayed.

Aiso, the number of lakes used to develop each of the models is shown. Ward Lake does not fit three of the 10 empirical models, and one of those models will not calculate and displayed #N/A.

The Watershed Load Back Calculation Module uses the lake in question's spring and/or growing season mean in-lake phosphorus concentrattons to back calculate an annual phosphorus load in Kg/Yr. The back calculation is done for each of the empirical models. Using the spring and growing season mean in-lake phosphorus the back calculation was completed. One of the models would not calculate and returned an #N/A.

Three modules remain to be used in the WILMS model. They provide information about the lake independent of the 10 empirical models. Using the data in the previous modules, an empirical model that best represents Ward Cake must be chosen. The two most important things considered when making this determination was that the empirical model matched the Ward Lake data, and the model that matched used similar lakes to Ward Lake in its development. Using these criteria, the Reckhow, 1979, Natural Lake Model was chosen. See Table D-1, for comparisons between Ward Lake and the Reckhow Model.

Table D-1. Comparison data between Ward Lake and the Reckhow Model.

| Module | Ward Lake | Reckhow Model |
|---|---|---|
| Phosphorus Prediction Module | 23 mg/m$^3$ | 21 mg/m$^3$ |
| Uncertainty Analysis Module | 23 mg/m$^3$ | 11 - 37 mg/m$^3$ * |
| Parameter Range Module | --------------- | <FIT> ** |
| Watershed Load Back Calculation Module | 101 Kg/Yr | 98 Kg/Yr |

* A 70 percent confidence interval was used. Therefore, 70 percent of the time the observed in-lake phosphorus concentration can be expected to fall within the range shown.
** The key parameters of the model fit Ward Lake.

A selection from the book "Engineering Approaches for Lake Management," by Kenneth H. Reckhow, Director of the Water Resources Research Institute, was used to determine the similarity between Ward Lake and the lakes used to develop the model. The Reckhow mode! was developed using 47 natural lakes, as opposed to artificial or reservoir lakes. The lakes used in the modet were north temperate lakes. Therefore, Ward Lake is similar to the lakes used to develop the model.

The Lake Condition Module has the user input the average in-lake spring turnover phosphorus, the growing season chlorophyll, and the average growing season chlorophytl. Using these inputs the module uses a regression equation to predict secchi depths for mixed and stratified, natural and impoundment lakes. The modeled secchi depth for the stratified natural lake was 2.21 meters, and was the closest to the average growing season secchi depth for Ward Lake. The Lake Condition Module also determines the Tropic State Indicies (T.S.I) for total phosphorus (T.S.I = 51), Chlorophyll (T.S.I = 50), and secchi disc depth (T.S.I = 49).

The Steady State Response Time Module estimates the amount of time it takes for 95% of the steady-state phosphorus concentration to occur Steady state is the point where the system comes to equilibrium. It theoretically takes an infinite amount of time to reach steady state; therefore, 95% of steady state is used. It should be noted that a lake environment is very dynamic and always in a state of flux. The steady state response time should be used as a planning tool to determine the time it would take to see a change in the lake after something in the system has changed. Keep in mind that before the steady state is reached other things will change in the system, causing the system to try to come to a new steady state. The estimated steady state response time for Ward Lake is 1.5 years.

To effectively use the WILMS model as a planning tool, it is necessary to determine *the* amount of phosphorus that will be reduced by implementing the recommendations and then re-running the program. Predicted land use changes can also be input into the program. The WILMS model will then provide data on the lake based on the land use changes and the phosphorus reductions.

Unfortunately the water sampling that was to be done during storm event at the seven culverts was overlooked. This oversight has made it nearly impossible to confidently determine the amount of phosphorus that would be reduced by installing a sedimentation basin and waterway to control nutrients and sediment from entering the lake through the gully on the northwest side of the lake. Therefore, it is necessary for sampling to be completed before construction of the recommended practices begins on the northwest side of the lake.

Without the sampling data for the culverts, a conservative estimation was done to provide information about possible phosphorus reduction of the northwest side of the fake This is not a site-specific approach. An assumption was made that each acre of a given land use provides an equal amount on phosphorus. The recommended Best Management Practices will affect 16 percent of the agricultural land in the watershed. Sixty-four percent of the phosphorus loading in the watershed comes from agricultural land. The soils in this part of the watershed are loamy sands so the trap efficiency of the sedimentation basin has been estimated to be 70 percent. Using the assumption stated above, the recommended Best Management Practices will reduce phosphorus loading by 7.3 percent.

Using data provided in "Riparian Development Load Estimate," by John Panuska, on average, 4.5 times more phosphorus comes from developed lake lots(21% imperviousness) than from an undeveloped lakeshore lot. Phosphorus in runoff from high ground in the watershed must also flow across the lakeshore properties to reach the **lake.** It should be noted that the **buffers** provide a reduction in phosphorus not only for the lakeshore property in which they are located but also reduce the phosphorus loading from 'back lots." Recommendations were made for 50 - 60 feet of buffers to be installed. The medium-density urban lakeshare lots provide 7.4 percent of the phosphorus loading to the lake. The buffers were recommended around the entire lake, with special attention placed on sensitive sites 2, 5, and 6. If the entire lakeshore were planted to native shoreland vegetation, lakeshore lots would provide approximately 1.6 percent of the phosphorus loading to the lake, a 5.8 percent reduction in phosphorus.

Table D-2. Modeling Ward Lake with a 5.8% phosphorus reduction'

| Module | Modeling of Ward Lake - *6* % Phosphorus Reduction |
|---|---|
| Phosphorus Loading Module (Based on Land Use) | 94.8 Kg/Yr |
| Phosphorus Prediction Module | 19 mg/m³ (Predicted growing season phosphorus) |
| Uncertainty Analysis Module | 10 - 35 mg/m³ |
| Watershed Load Back Calculation Module | 93 Kg/Yr |

- **5.8% reduction in phosphorus loading to Ward take, could be accomplished by planting the shoreline to native shoreland vegetation (50 - 60 foot is recommended). Reductions based on "Riparian Development Load Estimate," Panuska.**

**A 70 percent confidence interval was used. Therefore, 70 percent of the time the observed in-lake phosphorus concentration can be expecled to fall within the range shown.**

The gully on the northwest side of the lake is key in reducing the phosphorus entering Ward Lake. Removing source phosphorus and the installation of a sedimentation basin will reduce phosphorus entering **Ward** Lake. Estimates of phosphorus reductions were done based on the soil sampling and culvert water sampling. One soil sample was taken in the gully and three others where taken in the surrounding cropland. The sample taken in the gully contained three times the amount of phosphorus that the cropland did. Comparisons were made between culvert samples and their subwatershed. There is a direct correlation between the size of the subwatershed and the amount of phosphorus entering the lake. It has been estimated that 21.2 percent of the phosphorus would be removed by implementing Best Management Practices at the northwestern part of the lake, based on the soil sampling and culvert sampling data. (Assuming trap efficiency of 70 percent for the sedimentation basin.) See Table D-3, for lake modeling results with a 21.2 percent phosphorus reduction.

Table D-3. Modeling Ward Lake with a 21.2 % phosphorus reduction.

| Module | Modeling of Ward Lake – 21 % Phosphorus Reduction |
|---|---|
| Phosphorus Loading Module (Based on Land Use) | 81.0 Kg/Yr |
| Phosphorus Prediction Module | 16 mg/m$^3$ (Predicted growing season phosphorus) |
| Uncertainty Analysis Module | 9 – 30 mg/m$^3$ |
| Watershed Load Back Calculation Module | 79 Kg/Yr |

*** A 70 percent confidence interval was used. Therefore, *70 percent of the* time the observed in-lake phosphorus concentration can be expected to fall within the range shown.**

Land use in the Ward Lake watershed is predicted to change significantly within the next 10 – 20 years. Polk County is experiencing increased growth due to its proximity to the Twin Cities. This phenomenon will continue, **as** more people are willing to commute further. Number of tourists and part-time residents will continue to grow with a strong economy. Ward Lake's location in the northeastern part of Polk County has allowed it to be somewhat protected from some of the major development that is occurring in the southwestern part of the county, however, this will not last indefinitely Changing the land use factor to follow current development trends was done using the WICMS program. The following is the predicted land use of the Ward Lake watershed:

| | |
|---|---|
| Mixed Agricultural | = 21.2 acres |
| Pasture/Grass | = 41.0 acres |
| Medium-Density Urban | = 60.9 acres |
| Rural Residential | = 57.2 acres |
| Wetlands | = 9.3 acres |
| Forest | =132 0 **acres** |

Nutrient output from septic systems was changed, by changing the Total Number of Capita Years to 258 0, to reflect the residential dominated land use. ***See*** Table 0-4, for lake modeling results with the predicted land use changes.

Table D-4. Modeling Ward Lake with Predicted Land Use Changes.

| Module | Modeling of Ward Lake – Land Use Changes |
|---|---|
| Phosphorus Loading Module (Based on Land Use) | 56.6 Kg/Yr |
| Phosphorus Prediction Module | 12 mg/m$^3$ (Predicted growing season phosphorus) |
| Uncertainty Analysis Module | 6 – 22 mg/m$^3$ |
| Watershed Load Back Calculation Module | 59 Kg/Yr |

**A 70 percent confidence interval *was* used. *Therefore, 70* percent of the time the observed in-lake phosphorus concentration can be expected to fall within the range shown.**

By implementing the recommendations (erosion control practices at the gully on the northwest side of Ward Lake and Shoreland Buffer Restorations) there would be combined reduction in phosphorus of approximately 27.0 percent. The implementation of these recommendations could occur more quickly than land use changes. See Table D-5, for lake modeling results.

Table D-5. Modeling Ward Lake with a 27 % phosphorus reduction.*

| Module | **Modeling of Ward Lake –** Combined **Practices** (27%) |
|---|---|
| Phosphorus **Loading** Module (Based on Land Use) | 75.8 Kg/Yr |
| Phosphorus Prediction Module | 15 mg/m$^3$ (Predicted growing season phosphorus) |
| Uncertainty Analysis Module | 8 – 28 mg/m$^3$ |
| Watershed Load Back Calculation Module | 74 Kg/Yr |

*** Implementation of practices at the gully on the northwest side of Ward Lake and the planting of native shoreland vegetation (buffers).**

**** A 70 percent confidence interval was used. Therefore, *70* percent of the *time the* observed *in-lake* phosphorus concentration can be expected to fall within the range shown.**

Finally, combining the implementation of recommendations (27% phosphorus) **and** the changes in land use. See Table D-6, for lake modeling results.

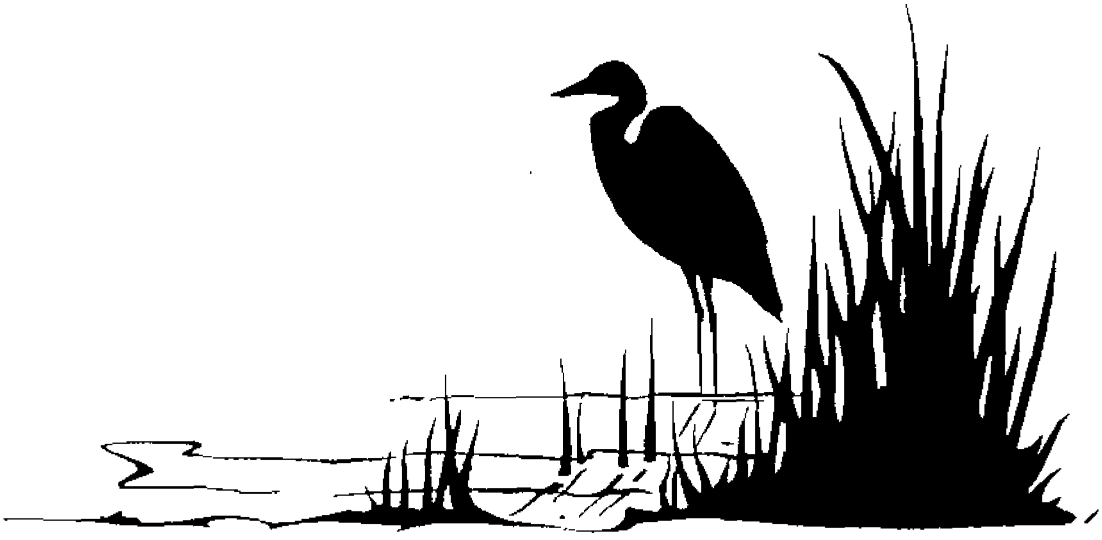
Table D-6. Modeling Ward Lake – Combined Practices with Land Use Changes

| Module | Modeling of **Ward Lake – Combined Practices & Land Use Changes** |
|---|---|
| Phosphorus Loading Module (Based on Land Use) | 44.1 Kg/Yr |
| Phosphorus Prediction Module | 9 mg/m$^3$ (Predicted growing season phosphorus) |
| Uncertainly Analysis Module | 5 – 18 mg/m$^3$ |
| Watershed Load Back Calculation Module | 44 Kg/Yr |

**Implementation of practices at the gully on the northwest side of Ward Lake and the planting of native shoreland vegetation (buffers) combined with *the* phosphorus reduction caused by land use changes.**
**** A70 percent confidence interval was used. Therefore, 70 percent of the time the observed in-lake phosphorus concentration can be expected to fall within the range shown.**

In conclusion, the phosphorus loading to Ward Lake can be significantly reduced. Ward Lake is a drainage lake and does not have an inflow *or* outflow. The watershed that **feeds** Ward Lake is quite small; therefore, implementing the recommendations will have a significant impact on the phosphorus loading and can drastically improve the water quality Land **use** changes in the watershed provide **some** of the most significant reduction in phosphorus loadings to Ward Lake. Land use of the watershed will primarily change from agricultural to residential. Due to this type *of* **change** in **land *use*** it is imperative to the health of Ward Lake that the Best Management Practices in the "Wisconsin Construction Site Handbook," are strictly enforced on all construction site in the watershed.

# WARD LAKE SENSITIVE AREA SURVEY REPORT *AND* MANAGEMENT GUIDELINES



**This document is to be used With its companion document "Guidelines for protecting, maintaining, And understanding lake sensitive areas"**

# WARD LAKE SENSITIVE AREA SURVEY REPORT AND MANAGEMENT GUIDELINES

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DNR, Northern Region, Spooner

Richard R. Cornelius
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DNR, Northern Region, Barron

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## A BRIEF SUMMARY OF WARD LAKE, POLK COUNTY, SENSITIVE AREAS AND MANAGEMENT GUIDELINES

The following is a brief summary of the Ward Lake sensitive area sites and the management guidelines. A detailed description of Ward Lake's sensitive areas can be found in the attached "Integrated Sensitive Area Assessment". Also, the attached "Guidelines for Protecting, Maintaining, and Understanding Sensitive Areas" provides management guidelines for the sensitive areas. It is hoped that these two attached documents will be used as guidance when deaiing with the valuable resource that is Ward Lake.

I The following sensitive areas contain aquatic plant communities which provide important fish and wildlife habitat: 2, 5, and 6 (see attached map). Management guidelines for these sites are:

1. Limit aquatic vegetation removal to navigation channels and only where serious use problems exist. See the site-specific recommendations.

2. Prohibit littoral zone alterations covered by Wisconsin Statutes Chapter 30, unless there is clear evidence that such alterations would benefit the lake's ecosystem.

3. Leave large woody debris, logs, trees, and stumps, in shallow water areas to provide habitat for fish and other aquatic organisms.

4 Leave an adequate shoretine buffer of un-mowed natural vegetative cover,

5. Prevent erosion, especially at construction sites.

6. Strictly enforce zoning ordinances.

7. Eliminate nutrient inputs to the lake caused by lawn fertilizers, failing septic systems, and other sources.

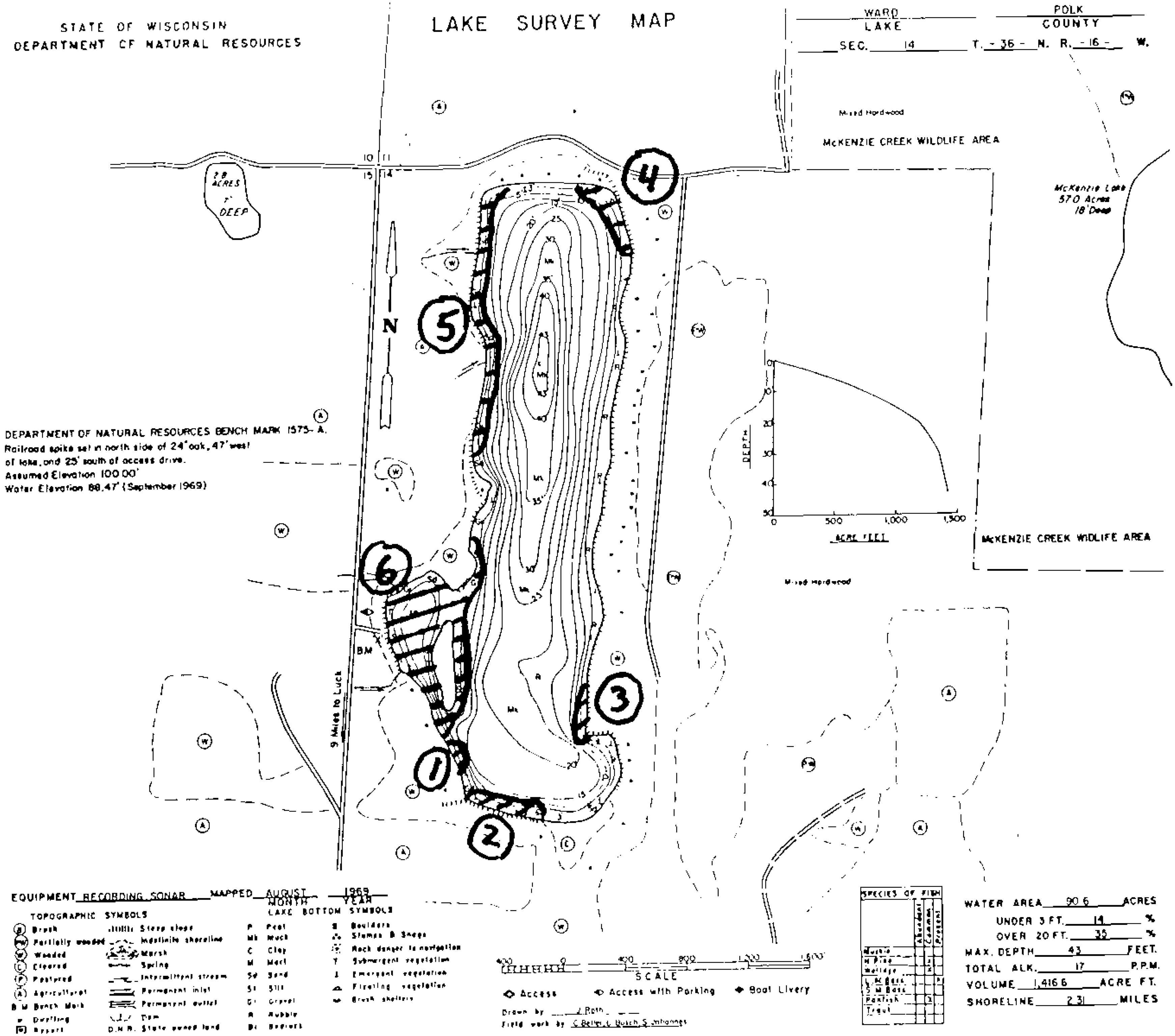
II. The following sensitive areas provide gravel and coarse rock rubble habitat that are important for walleye spawning: 1, 3, and 4 (see map). The management guidelines for grave! and coarse rock rubble sensitive areas are basically similar to the guidelines for the aquatic plant community sensitive areas. The emphasis may be somewhat different in that:

1. It is <u>critically</u> important that no alteration of the gravel and coarse rock substrate occur at these sites, unless such alterations would improve walleye spawning. Chapter 30, Wisconsin Statutes, regulates such alterations.

2. Erosion control on or near shorelines is especially important adjacent to walleye spawning areas to prevent siltation of spawning habitat.

3. Chemical treatment and mechanical removal of aquatic plants need not be quite as restrictive as in aquatic plant sensitive areas. However, no removal of aquatic plants should be done unless necessary.

It should be noted that **the** recommendations **made** in **these sensitive** area management guidelines are in general good guidelines for managing the entire lake, but are especially important in the designated sensitive areas.



STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
LAKE SURVEY MAP
WARD LAKE
POLK COUNTY
SEC. 14 T. - 36 - N. R. - 16 - W.
Mixed Hardwood
McKENZIE CREEK WILDLIFE AREA
McKenzie Lake 57.0 Acres 18' Deep
2.8 ACRES 7' DEEP
N
DEPARTMENT OF NATURAL RESOURCES BENCH MARK 1575- A.
Railroad spike set in north side of 24" oak, 47' west of lake, and 25' south of access drive.
Assumed Elevation 100.00'
Water Elevation 88.47' (September 1969)
9 Miles to Luck
BM
DEPTH
ACRE FEET
0 500 1,000 1,500
McKENZIE CREEK WIDLIFE AREA
Mixed Hardwood
EQUIPMENT RECORDING SONAR MAPPED AUGUST MONTH 1969 YEAR
TOPOGRAPHIC SYMBOLS
LAKE BOTTOM SYMBOLS
SCALE
Access
Access with Parking
Boat Livery
Drawn by J. Roth
Field work by C. Beller, L. Busch, S. Johannes
SPECIES OF FISH
Abundant
Common
Present
WATER AREA 90.6 ACRES
UNDER 3 FT. 14 %
OVER 20 FT. 35 %
MAX. DEPTH 43 FEET.
TOTAL ALK. 17 P.P.M.
VOLUME 1,416.6 ACRE FT.
SHORELINE 2.31 MILES

## LAKE MANAGEMENT

### INTEGRATED SENSITIVE AREA ASSESSMENT SUMMARY

LAKE: Ward lake **COUNTY:** Polk

DATE OF SURVEY. August 25, 1999 NUMBER OF SENSITIVE AREAS: *6*

SITE EVALUATORS: D.N.R. Fish Biologist: Rick Cornelius
D.N.R. Water Resources Biologist: Jim Cahow
D.N.R. Fish Technician: Gary Lund
Polk Co L.C.D. Water Resource Specialist: Jacob Bellinsky

**Introduction**

This sensitive area lake survey is an integrated approach to resource management providing Lake Associations, individual property owners, zoning officials, boards of adjustment, and other interested groups or individuals with specific management recommendations that can be used to improve and protect the overall health of the Ward Lake ecosystem. Some of these recommendations will provide guidance as to what should be maintained or protected to insure future health of the lake ecosystem, while also acknowledging special and exceptional resource areas: other recommendations will *focus* on what should **be** restored or fixed to insure the different functional attributes of the ecosystem are all properly functioning together to insure full ecosystem health and biotic integrity. Readers of this document **should** refer to the accompanying companion document "**Guidelines** for **protecting, maintaining, and understanding lake sensitive areas**" which provides specific recommendations on how to protect the identified sensitive areas, while also helping the reader better understand why they are important to a healthy lake ecosystem.

The sensitive area survey was **conducted** on Ward Lake, which is located in north central Polk County. Ward Lake is a 91-acre landlocked lake which has a maximum depth of **43 feet.**

The water of Ward Lake is clear and has an MPA of 17 ppm. The littoral zone is small, and littoral substrate is primarily sand, with some gravel and rubble. The lake has a history of widely fluctuating water levels.

Primary gamefish species are largemouth bass (common), northern pike (common), walleye (present), bluegills (common), rock bass (common), black crappies (present), pumpkinseeds (present), and yellow perch (present). Until recent years, the primary gamefish in Ward Lake was walleyes, which were the product of natural reproduction. In recent years, the walleye population has declined and the bass population has increased.

Vegetation on some of the shoreline is composed of natural plant cover consisting of all three layers that should be present in any healthy lake shoreline buffer (trees, shrubs, herbaceous ground cover). Efforts should be made to educate residents about the importance of retaining the existing natural plant cover in shoreline areas while encouraging the restoration of those areas that have been previously converted to lot-wide mowed lawns to the water's edge.

Sensitive areas were assrgned a number designation beginning with 1 at a **site** on the southwest shore and continuing in a counter clockwise direction (see map). Sensitive areas fell into two basic categories: aquatic plant communities providing important fish and wildlife habitat (sensitive areas: 2, 5, and 6), and gravel and coarse rock rubble substrate important for walleye spawning (sensitive areas: 1, 3, and 4).

## Resource Value of Site "1"

This site, located on the southwest shore, is a small area (about 50 feet of shoreline) which has gravel, rock, and rubble substrate which provides walleye spawning habitat. The bottom substrate should not be altered in any way at this location. Erosion prevention is important. Management efforts to protect the rock rubble walleye spawning habitat in this area should follow the general recommendations found in the accompanying companion document.

## Resource Value of Site "2"

Site 2 is an undeveloped stretch of shoreline an the south shore. About 500 feet of shoreline are within this site. Woody debris, logs, and stumps are common in the shallow water areas and provide valuable cover for fish In addition, waterfowl, furbearers and reptiles use the logs and stumps as nesting and loafing areas.

Aquatic vegetation at the site includes eelgrass, fern pondweed, and elodea. This vegetation provides valuable habitat for fish and wildlife.

Logs, stumps, and woody debris should be left in place. No vegetation removal should occur. Other management activities to protect the aquatic plant community in this area should follow the general recommendations found in the accompanying companion document.

## Resource Value of Site "3"

This site is about 350 feet of shoreline which has gravel, rock, and rubble bottom substrate suitable for walleye spawning. The bottom substrate should not be altered, arid erosion prevention is important.

## Resource Value of Site "4"

This site is located at the northeast end of the lake, and has the largest area of walleye spawning habitat on the take (about 600 feet). The bottom substrate is primarily rock and rubble, and should not be altered in any way, and erosion prevention is important.

## Resource Value of Site "5"

Site 5 encompasses approximately 1,700 feet of shoreline on the northwest and west shore of the lake. The aquatic vegetation on this shoreline consists of a narrow band of arrowhead close to shore, and includes some elodea and fern pondweed into deeper water. This site provides valuable spawning, feeding, and nursery areas for northern pike, largemouth bass, and panfish The site also provides habitat for waterfowl, furbearers, amphibians, and reptiles. Woody debris and logs in the water provide additional valuable habitat. Aquatic vegetation removal should be limited to narrow navigation channels if necessary, and logs and woody debris should be left in the water.

## Resource Value of Site "6"

Site 6 is the bay on the southwest side of the lake. The shallow waters of this bay, including the island, contain beds of aquatic vegetation as well as logs and woody debris that provide good quality fish and wildlife habitat. Aquatic vegetation at this site includes largeleaf pondweed, arrowhead, spike rush, fern pondweed, and yellow water lily. Aquatic vegetation removal should be limited to narrow navigation channels if necessary, and logs and woody debris should be left in the water.

# General Lake Wide Recommendations

The following different areas/RECOMMENDATIONS were identified as priorities by the DNR's integrated team of biologists and water regulations and zoning staff for the maintenance and protection of a healthy Ward Lake ecosystem. To help better understanding the specific management recommendations that should be followed for each of the following areas the reader should refer to the accompanying companion document "**Guidelines for protecting, maintaining, and understanding lake sensitive areas**".

I. Protection and restoration of shoreline buffers. This provides protection for water quality, aquatic plant communities, and other habitat.

II. Protection of existing aquatic plant communities.

III. Aggressive erosion control measures for all bare soil areas with an emphasis an all construction and ground breaking. This provides protection for water quality, aquatic plant communities, and coarse rock rubble walleye spawning habitat.

IV. Limit the use of fertilizers on takeshore lawns.

V. Support the aggressive application of exisiing zoning regulations and support the development of future ones to prevent unnecessary impacts to the ecosystem, which could be avoided if future development is accomplished in a wise and careful manner considerate of the resource.

VI. Encourage the retention of large woody debris in near shore areas. Fallen trees provide critical habitat.

VII. Develop an aggressive education program by local lake association to promote the above mentioned guidelines.

VIII. Implement land acquisition or easements to protect critical areas from any possible future development.

# Ward Lake Aquatic Plant Species List

| PLANT SPECIES | COMMON NAME |
|---|---|
| Elatine Minima | Waterwort |
| Eleocharis sp | Spikerush |
| Elodea canadensis | Elodea |
| Eriocaulon sp. | Pipewort |
| Isoetes sp. | Quillwort |
| Nuphar sp. | Yellow Water Lily |
| Polygonum amphibum | Smartweed |
| Potamogeton sp. | Fine leaf Pondweed |
| Potamogeton amplifolius | Large-leaf Pondweed |
| Potamogeton rabbinsii | Fern Pondweed **(Robbins'** [redacted] |
| Sagittaria sp. | Arrowhead |
| Scirpus americanus | Three-square **Sedge** |
| Scirpus cyprinus | Woolgrass |
| Vallisneria americana | **Eel Grass** (Wild Celery) |
| Zizania aquatica | Wild Rice |

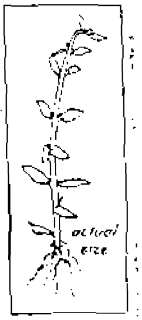
## *Elatine minima* (el-AT-ten-ee MIN-e-ma)

### Waterwort

*Elatine* – (L) low creeping plant *minima* – (L) smallest

*The children knelt in the shallow water, scooping sand to build their castle. One handful of sand was peppered with miniature green plants – a perfect addition for the castle garden.*

**Description:** The whole waterwort plant is not more than a few centimeters tall when it's growing in the water. On exposed mudflats it forms a low spreading mat with branches up to 5 cm long. Stems emerge from shallow tufts of roots. The leaves (3-8 mm long) are oblong to oval and attached directly to the stem (no stalk). There is generally a shallow notch at the leaf tip. Flowers have 2-4 sepals and petals and are barely visible in the leaf axils. The capsular fruit is easier to see. It is thin-walled and usually composed of two sections. Inside the capsule the seeds are all basally attached and stand upright to about the same height. The surface of the seed has an engraved appearance with distinct rows of round to oval shaped pits.




### A Closer Look:

Welcome to the world of "Bonsai aquatics" – the really little plants. These diminutive lake inhabitants are often completely missed or mistaken for plant seedlings. Pinhead-sized fruits that form a pod in the leaf axil give away the plant's maturity. Under magnification, you'll notice that the walls of the pods are so thin you can see the seeds inside.

The "signature" created by the pitting pattern on waterwort seeds can only be seen with a microscope, but is a valuable tool for identification. Seeds from a variety of plants have been preserved in sediments for hundreds and even thousands of years. Scientists have been able to identify them by their shape and surface markings.

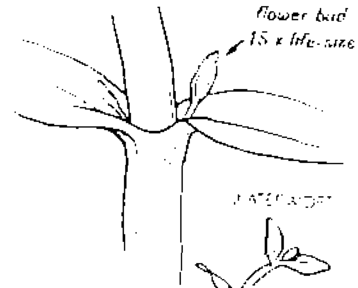
**Similar species:** There is one other species of waterwort that occurs in Wisconsin, **matted waterwort** (*Elatine triandra*). A close look at the fruits separate these two species. Matted waterwort has three sections per capsule, seeds attached at different levels inside the capsule and six-sided pits on the seed coat. Matted waterwort is listed as a **Special Concern** species in Wisconsin.

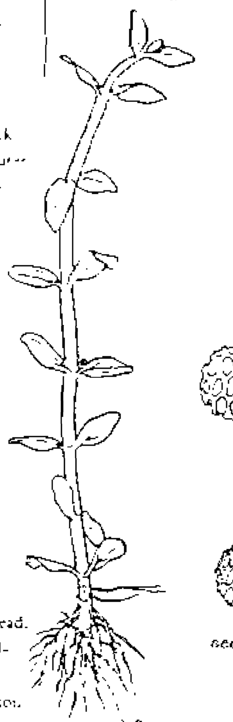
**Origin & Range:** Native; found at scattered locations in the northern lakes and forest ecoregion of Wisconsin; range includes eastern U.S.

**Habitat:** Waterwort can be found from exposed mudflats out to water several meters deep. It is usually found on sandy sites with low disturbance.

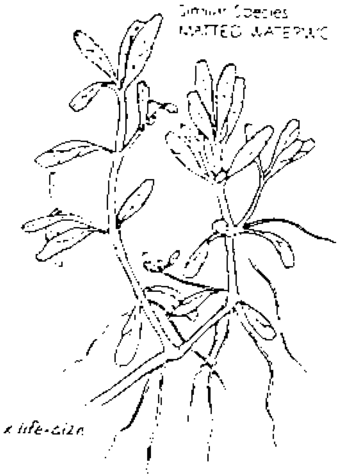
**Through the Year:** This small annual plant relies on the viability of seeds to make a comeback in spring. Good water clarity and low disturbance are both important for successful germination and seedling growth. Capsules are usually evident in the leaf axils by midsummer.

**Value in the Aquatic Community:** Moss-like mats of waterwort are grazed by a variety of ducks including black duck, bufflehead, canvasback and mallard. It also offers habitat for zooplankton and fish fingerlings.



3 x life-size




3 x life-size

seed of waterwort
(*Elatine minima*)
100 x life-size

seed of matted waterwort
(*Elatine triandra*)
100 x life-size

Native

## *Eleocharis acicularis* (el-ee-OCK-er-res a-SIK-u-lar-us)

**Needle spikerush, hairgrass**

*Eleocharis*: (Gk) helos, marsh + charis, grace; *acicularis* (L) needle-like

*A puff of sand grains drifts from the siphon of a clam that has taken up residence between the dense clumps of needle spikerush. The plants cover the lake bottom, creating a carpet of grass-like turf in the shallow water.*

**Description** The stems of needle spikerush are slender (up to 0.25 mm thick) and rather short (3-12 cm long). They emerge in tufts from fine spreading rhizomes. Leaves are reduced to sheaths at the base of the stem. Each stem is topped with a solitary oval spikelet 2.5-7 mm long that is noticeably wider than the stem.

The spikelet has a tight spiral of tiny flowers (later nutlets) covered by scales (1.5-2.2 mm long). The scales have a greenish midrib and brown-tinted margins. Mature nutlets are used for positive identification among spikerushes. It is worth the effort to look at these nutlets under magnification. The surface detail is like a fine ceramic vase and the body of the nutlet is topped with a cap called a tubercule. The nutlet of needle spikerush is rounded (0.7-1 mm long) with a pale gray to yellow surface. The surface is textured with [illegible] lengthwise ridges and many fine cross-bars. The cap rests on top shaped like a miniature chocolate chip.

**Similar species** Needle spikerush can be distinguished from other sedges by the absence of noticeable leaves and the single terminal spikelet on each stem. Needle spikerush is sometimes confused with other small spikerushes such as *E. intermedia* or *E. olivacea*. Examining the nutlets will separate them. Both *E. intermedia* and *E. olivacea* also have thicker stems and the lowest scales on their spikelets are sterile.

A sterile submersed form of needle spikerush (*E. acicularis* f. *inundata*) is often found offshore. The stems become elongated and hair-like. They can be distinguished from other thread-like submersed plants by the thin rhizomes and tufted arrangement of the stems.

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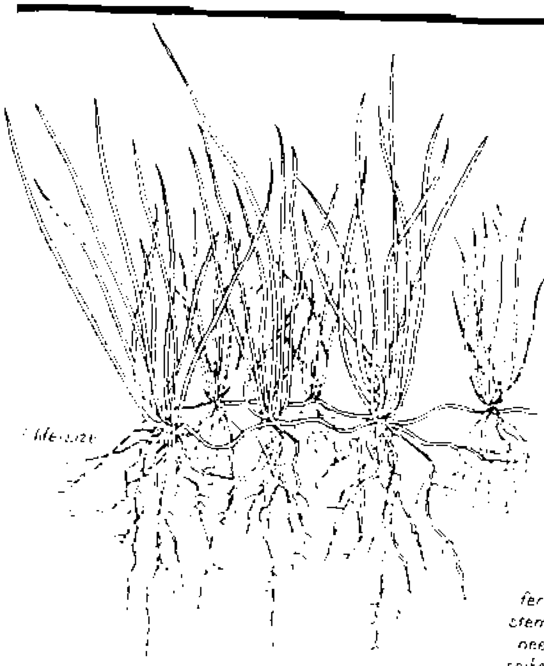
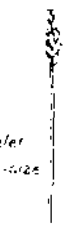
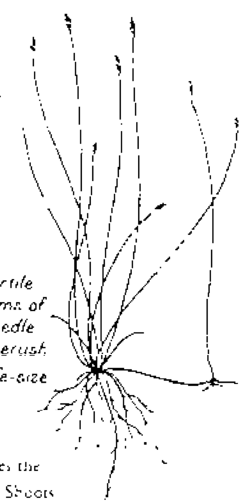



**Origin & Range** Native; common in Wisconsin, particularly in the northern part of the state; range includes most of U.S.

**Habitat** Needle spikerush can be found from moist shorelines to water 2 meters deep. It is found more often on firm substrates and can tolerate some turbidity.

**Through the Year:** This small spikerush survives the winter as buried rhizomes. Shoots emerge in the spring and fruit develops in the spikelets by midsummer.

**Value in the Aquatic Community** Needle spikerush provides food for a wide variety of waterfowl as well as muskrats. Submersed beds offer spawning habitat and shelter for invertebrates.

Native

# *Elodea canadensis* (el-oh-DEE-a can-a-DEN-sir)

**Common waterweed, elodea**

*Elodea* - (Gk.) *elodes* marshy; *canadensis* Canada

*The marina was a popular layover with good fishing from the pier, a bait shop and a restaurant. Props and trailers dangling elodea were the only evidence of the luxuriant growth thriving in the harbor's murky waters.*

**Description.** Common waterweed has slender stems (up to 1 m long) that emerge from a shallow rootstalk. The small, lance-shaped leaves (6-17 mm long, 1-5 mm wide) attach directly to the stem (no leaf stalk). Leaves are in whorls of three, or occasionally only two and tend to be more crowded toward the stem tips. The branching stems often form a tangled mat that can become a nuisance.

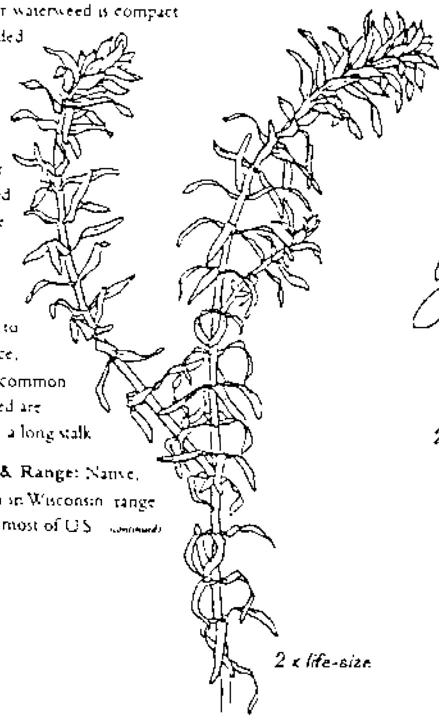
Male and female flowers are on separate plants. Female flowers have three small white petals with a waxy surface that improves flotation. They are raised 13 the surface on a long, slender stalk. Male flowers develop in a vase-like structure called a spathe that is 7-19 mm long. At maturity, the male flowers are also raised to the surface on thread-like stalks. There the anthers split open, releasing pollen to drift away and possibly fertilize female flowers. However, male plants are quite rare. So although you may see dozens of tiny white flowers floating above a bed of common waterweed, they are usually all female flowers that will not produce seed.

**Similar species:** The only other species of *Elodea* in our region is **slender waterweed** (*Elodea nuttallii*). These two plants look very similar. You need to look at fine details to tell the difference. Slender waterweed is more delicate in structure with finer stems and narrower leaves. The average leaf width for common waterweed is about 2 mm; the leaves of slender waterweed have an average width of 1.3 mm. Leaves of common waterweed tend to be more crowded toward the tip of the stem, whereas the leaves are more evenly spread out on the stems of slender waterweed.

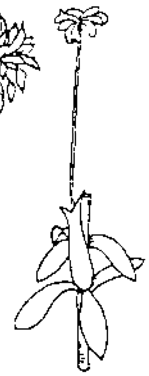
Male flowers are quite a bit more common in slender waterweed and they can help distinguish between these two species. While the male flowers of common waterweed develop in a long, slender spathe (7-10 mm), the spathe on slender waterweed is compact and rounded (only 2-4 mm long). Male flowers of slender waterweed break free from the spathe at maturity and float to the surface; those of common waterweed are raised on a long stalk.

**Origin & Range:** Native, common in Wisconsin; range includes most of U.S.

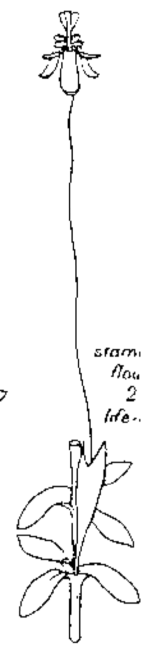
(continued)



2 x life-size



pistillate flower
2 x life-size



stam
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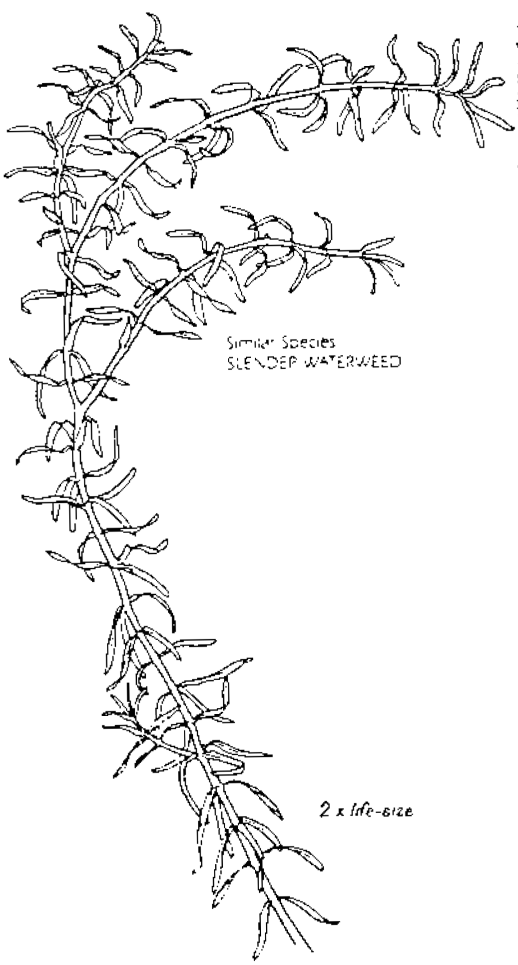
*Elodea canadensis* (continued)




*2 x life-size*

**Habitat:** Common waterweed is found in water depths ranging from ankle deep to several meters deep. It is most abundant on fine sediments enriched with organic matter.

**Through the Year:** Common waterweed often overwinters as an evergreen plant. Photosynthesis continues at a reduced rate under the ice. In the spring, fresh green shoots develop on the ends of stems. Flowering occurs by early to midsummer. Since seeds are rarely produced, the plant spreads primarily by stem fragments.

**Value in the Aquatic Community:** The branching stems of common waterweed offer valuable shelter and grazing opportunities for fish, although very dense stands can obstruct fish movement. It also provides food for muskrats and waterfowl. They can eat the plant itself or feed on a wide variety of invertebrates that use the plant as habitat.

### A Closer Look:

The success of common waterweed can be attributed to many factors including disease resistance and a tolerance for low light conditions.

In Europe, ***Elodea canadensis*** is considered an aggressive exotic and is the target of nuisance control programs. Europeans call it "American waterweed." Its ability to spread by stem fragments and tolerate low light have made it a formidable invader.

Elodea also has a "big brother" known as giant elodea (*Egeria densa*). This southern elodea has larger leaves and there are 4-6 leaves in each whorl. It was originally introduced from South America as an aquarium plant, but now grows at nuisance levels in many southern lakes, ponds and ditches.

## *Eriocaulon aquaticum* (er-ee-oh-CALL-on ah-KWA-ti-cum)

**(formerly known as *Eriocaulon septangulare*)**

**Pipewort**

*Eriocaulon* – (Gk *erion*, wool + *kaulos*, stalk) *aquaticum* – (L.) of the water

> *Wading in the shallow water of a northern lake, the children found a carpet of pale green rosette. Slender flower stalks rose out of the water, each tipped with a single pearly-gray blossom that is the hallmark of pipewort. Each flower resembled nonpareil candy covered with tiny white pellets of sugar.*

**Description:** Pipewort has pale unbranched roots with closely-spaced partitions that make them look cross-hatched. The translucent green leaves (.2-5 mm wide, 2-10 cm long) grow in a basal rosette. Leaves taper from base to tip and have a checkerboard appearance created by many short cross-veins.

Each rosette usually produces a single flower stalk. The stalk is slightly twisted with 5-7 ridges. It can range from a few centimeters to a couple meters in length depending on the depth of the water. The flower head (4-6 mm) is rounded with many small flowers packed closely together. Sepals and petals of the pearl-colored flowers are tipped with fine white hairs.

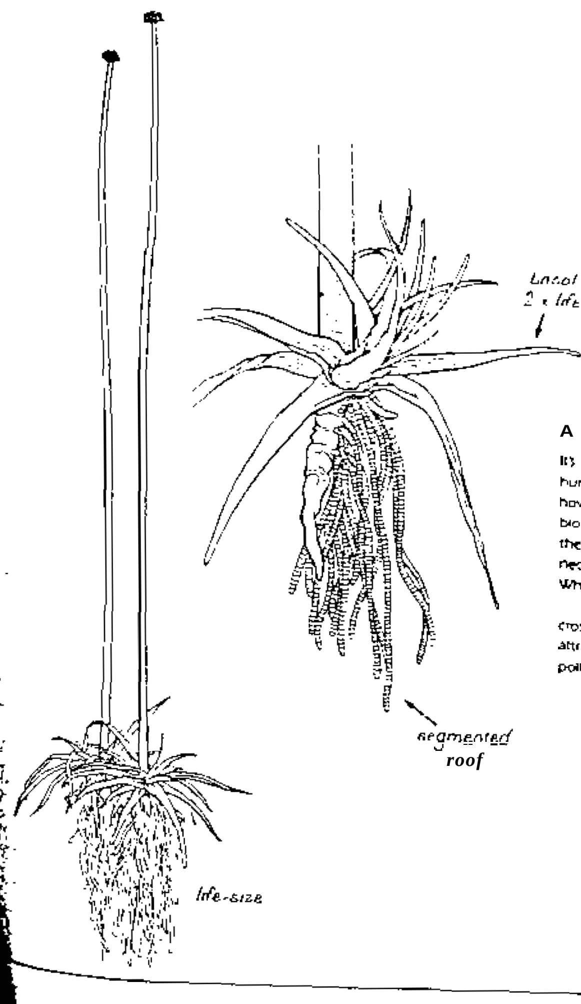
**Similar species:** Pipewort may be confused with other small rosette forming species such as quillwort (*Isoetes* sp.) or water lobelia (*Lobelia dortmanna*). However, the cross-hatched roots and button-like flowers distinguish pipewort.

**Origin & Range:** Native; common in soft-water lakes of central and northern Wisconsin; range includes eastern and central U.S.

**Habitat:** Pipewort is usually found on sandy shores and in shallow water of soft-water lakes. It needs good water clarity and will grow from moist shorelines to water over 2 meters deep.

**Through the Year:** The rosettes of pipewort can overwinter green in some circumstances, but on exposed sites it freezes and must grow back from the perennial rootstalk. Flowers are produced by early to midsummer. Small capsular fruits develop by late summer.

**Value in the Aquatic Community:** Beds of pipewort create shallow water structure for young fish, amphibians and invertebrates. The leaves are sometimes grazed by ducks including black duck and American wigeon.




### A Closer Look:

It's not unusual to see hummingbird moth or b
hovering over a pipewor
blossom. That's because
the petals have a small
nectar gland near their t
While many aquatic plan
on wind or water fo
cross-pollination, pipewo
attracts insects to serve a
pollinators

Nativ

## *Isoetes* spp. (ice-OH-et-eez)

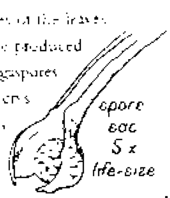
### Quillworts

[illegible] probably referring to [illegible] nature of [illegible]

*[illegible] the perfect [illegible] Looking down from the [illegible] the compact rosettes of the quillworts tucked into the [illegible] like [illegible] plants [illegible] set out in a garden*

spiny megaspore
60 x life-size

**Description:** The [illegible] of quillworts [illegible] and [illegible] Each [illegible] four longitudinal [illegible] that can be seen in cross section. Spores form in sacs located on the spoon-like bases of the leaves. Two types of spores are produced on different leaves: megaspores about the size of sugar crystals and microspores as fine as baking powder.




**Similar Species:**
There are two species of *Isoetes* found in this region.

ridged megaspore
60 x life-size

**Spiny-spored quillwort** (*Isoetes echinospora*, also known as *I. braunii*) has soft, pale to medium green leaves (5-15 cm long, 0.5-1.5 mm wide) that gradually taper from their base to a long slender tip. The spore sacs (4-7 mm) are often brown-spotted when fully developed. Mature megaspores are needed for species identification. The megaspores (0.25-[illegible] mm wide) of spiny-spored quillwort are covered with short spines.

**Lake quillwort** (*Isoetes* [illegible], also known as *I.* [illegible]) has leaves (5-[illegible] cm long, [illegible]-2 mm wide) that are dark green, firm, and often twisted. The spore sacs (3-5 mm) are pale and usually not spotted. The mature megaspores (0.5-0.8 mm wide) have a convoluted network of ridges on their surface.

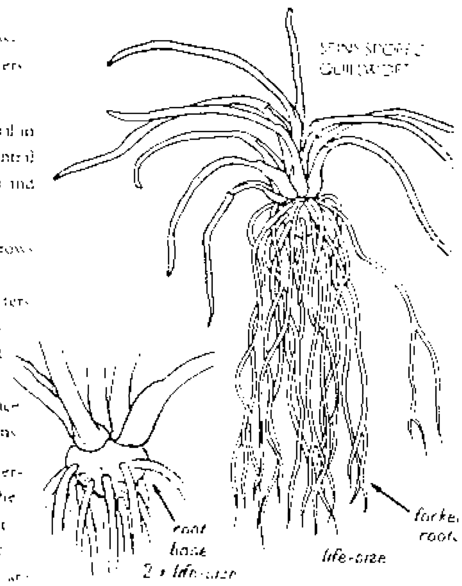
A hybrid of *I.* [illegible] and *I. echinospora* is sometimes found and has been named *Isoetes* x *hickeyi*. It exhibits a blend of features from the two species. Other species that may be confused with quillwort include plantain shoreweed (*Littorella uniflora*) and pipewort (*Eriocaulon aquaticum*). The leaves of plantain shoreweed can look similar, but the rosettes are connected by rhizomes and the leaves have two air chambers rather than four. Pipewort also has tapered leaves, but the cross-[illegible] roots and button-like flowers set it apart.

**Origin & Range:** Native; occasional in softwater lakes of northern and central Wisconsin; range includes northern and [illegible] portions of U.S.

**Habitat:** Spiny-spored quillwort grows on soft or sandy sediment in water depths ranging from a few centimeters to several meters. Lake quillwort is usually found in sand or gravel and often in water 1-3 meters or more deep. Both species show a preference for soft water lakes, ponds or streams.

**Through the Year:** Quillworts overwinter with dark green leaves or the leaves are lost [illegible] bright green leaves are produced in spring. Spores develop [illegible] and are released when the spore sac decays at the end of the growing season. Spores may germinate near the parent plant or be carried to new sites by waves and currents. Viable spores have also been found in worm feces so other organisms may aide in dispersal (Boston and Adams 1987).

**Value in the Aquatic Community:** Quillworts provide habitat in low nutrient lakes that may have very limited plant growth. The foliage is sometimes consumed by waterfowl or game birds including sharp-tailed grouse.




### *A Closer Look:*

*Isoetes is the name-sake for a group of plants known as the "isoetids." Some of the plants in this group include quillwort, pipewort (**Eriocaulon aquaticum**), plantain shoreweed (**Littorella uniflora**), water lobelia (**Lobelia dortmanna**) and golden pert (**Gratiola aurea**). These plants are compact, slow-growing evergreens with special adaptations for successful growth in carbon-poor, low-nutrient habitat. Among the adaptations are small size, low leaf turnover, high root-to-shoot ratio, and slow growth rate (Madsen 1991).*

## *Nuphar advena* (NU-far ad-VEEN-a)

**Yellow pond lily**

*Nuphar* – (Arabic) *nufar* water lily; *advena* – (L.) *advenire* to come to, immigrant

*The breeze increased throughout the morning. In the once quiet pond, yellow flowers the size of ping-pong balls could be seen bobbing on the surface.*

**Description:** The leaf and flower stalks of yellow pond lily emerge directly from a robust, spongy rhizome the diameter of a baseball bat. Stalks can grow to be several meters long. Leaves are heart-shaped (20-40 cm long) with rather pointed lobes and have a triangular notch or sinus at their base that looks like it could accommodate a miniature rack of pool balls. Most of the leaves are emergent, growing at an assortment of angles above the water's surface.

Flowers are globular to saucer-shaped (3-5 cm diameter) with five to six yellow sepals (often with a green patch at the base). The sepals curve around many small, strap-like petals, stamen and a yellowish-green disc with the stigmas. This central disc eventually develops into a seed pod.

**Similar species:** Yellow pond lily most closely resembles the more common spatterdock (*Nuphar variegata*). However, spatterdock has winged leaf stalks, leaves with rounded lobe, and sepals with a red rather than green patch.

**Origin & Range:** Native, distribution in Wisconsin is primarily in the southeastern part of the state; range includes eastern and central U.S.

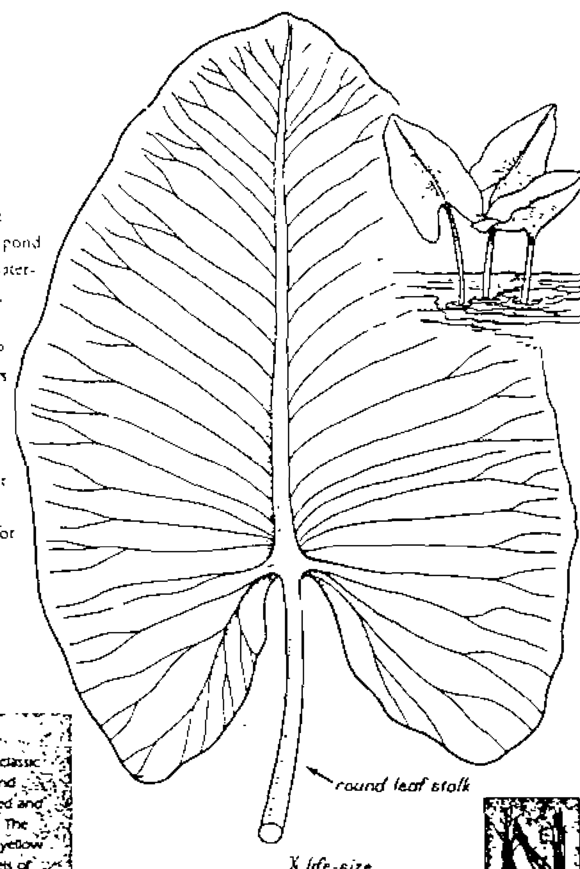
**Habitat:** Yellow pond lily is usually found in ponds or slow-moving streams. It can grow in sun or shade but flowering is more abundant in good light. Yellow pond lily shows a preference for soft sediment and water 2 meters or less deep.

**Through the Year:** In early summer, clusters of underwater leaves can be seen emerging from the rhizome. As the summer progresses, leaf and flower stalks emerge above the water's surface. Flowering occurs throughout the summer. Flowers open during the day and close at night. The flowers have a fragrance like fermented fruit that attracts insects for pollination. Later in the season, the sepals drop and the central flower structure develops into a fleshy, well-rounded fruit about 4 cm long.

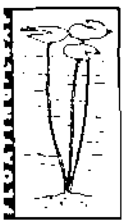
**Value in the Aquatic Community:** Yellow pond lily provides seeds for waterfowl including mallard, northern pintail, ring-necked duck and scaup. Leaves, stems and flowers are grazed by deer. Muskrat, beaver and porcupine eat the rhizomes. The leaves offer shade and shelter for fish as well as habitat for invertebrates.

**A Closer Look:**

Yellow pond lilies are a classic element of quiet bays and ponds, creating a shaded and protected environment. The leaves and rhizomes of yellow pond lily have high levels of tannin (a brown pigment) and have been used in dying, tanning and folk medicine remedies.




Native



## *Polygonum amphibium* (po-LIG-o-num am-FIB-ee-um)

**water smartweed, water knotweed**

*Polygonum* = Greek *poly*: many + *gonum*: knee, joint;
*amphibium* (Gk) *amphi*: on both sides • *bios*: life

*The water smartweed created a sprawling chain of leaves and flowers that reached across the water's surface. The bright pink flowers poked out of the water like candles on a birthday cake.*

**Description:** Water smartweed has a variable appearance with both water and land forms. Two primary varieties are generally recognized – the aquatic-adapted variety *stipulaceum* and the terrestrial-adapted variety *emersum*.

The truly aquatic variety, *stipulaceum* (also known as *P. natans*), shown here, has floating branches with alternate, smooth, elliptical leaves that have a rounded tip. Flowers are arranged in an oval or conical cluster (1.5–4 cm long). When this variety grows on shore it seldom flowers.

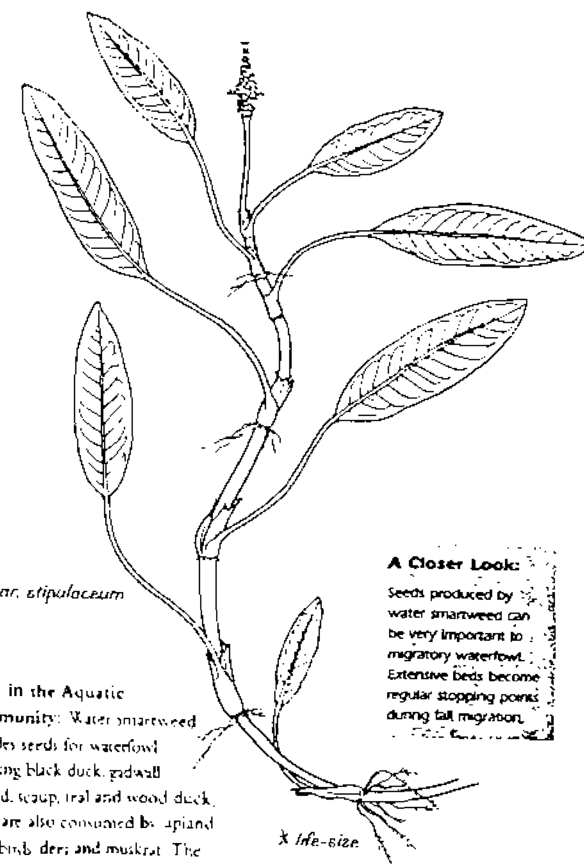
The more land-adapted variety *emersum* (also known as *P. coccineum*) has upright stems even when growing in the water and does not produce floating leaves. Leaves of variety *emersum* are hairy and have pointed tips. Flowers are arranged in an extended cylindrical shape that is 4-15 cm long.

**Similar species:** The floating leaves of water smartweed could be [illegible] for the floating leaves of some pondweeds, such as large-leaf pondweed (*Potamogeton amplifolius*), long-leaf pondweed (*Potamogeton nodosus*) or floating-leaf pondweed (*Potamogeton natans*). However, water smartweed can be easily separated from these pondweeds by its lack of submersed leaves and its swollen nodes on the stem.

**Origin & Range:** Native; widely distributed in Wisconsin; range includes most of U.S.

**Habitat:** Water smartweed is usually found in quiet water of lakes, ponds and backwaters. It grows in a variety of sediment types in water less than 2 meters deep.

**Through the Year:** Water smartweed is a perennial, reproducing by seeds and overwintering rhizomes. New growth emerges from the rhizomes in early summer and flowers develop by midsummer. As the summer progresses, dark, shiny nutlets mature. Late in the growing season, foliage dies back and seeds then drop to [illegible] sediment.



*var. stipulaceum*

*x life-size*

**Value in the Aquatic Community:** Water smartweed provides seeds for waterfowl including black duck, gadwall, mallard, scaup, teal and wood duck. Seeds are also consumed by upland game birds, deer and muskrat. The leaves offer shade and shelter for fish as well as habitat for invertebrates.

**A Closer Look:**
Seeds produced by water smartweed can be very important to migratory waterfowl. Extensive beds become regular stopping points during fall migration.