Bridge Lake

Lincoln & Oneida Counties, Wisconsin

Comprehensive Management Plan

February 2009

Sponsored by:

Lake Nokomis Concerned Citizens, Inc.

LPL-1119-07 & LPL-1120-07

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Onterra LLC
Lake Management Planning

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Funded by: Lake Nokomis Concerned Citizens, Inc.
Town of Nokomis, Oneida County
Wisconsin Dept. of Natural Resources (LPL-1119-07 & LPL-1120-07)

Acknowledgements

This management planning effort was truly a team-based project and could not have been completed without the input of the following individuals:

Lake Nokomis Concerned Citizens, Inc.

Mr. David Nycz
Mr. Peter Lloyd
Mr. Ron Kampstra
Ms. Sue Kampstra
Ms. Nancy Smith
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INTRODUCTION

Bridge Lake is an approximate 411-acre, drainage lake (Map 1) with a maximum depth of 15 feet and a mean depth of 8 feet. Including islands, Bridge Lake has over 12.5 miles of shoreline. Bridge Lake is connected directly to Lake Nokomis (2,433 acres) and Deer Lake (156 acres), and together the three lakes make up the Rice River Reservoir which is part of the Wisconsin River system.

In 2004, members of the Lake Nokomis Concerned Citizens (LNCC) observed the presence of Eurasian water milfoil (*Myriophyllum spicatum*), a potentially harmful exotic species in the lake. The negative effects associated with exotic species include the loss of important native plant communities and their associated habitat value, water quality degradation, reductions in recreational opportunities, decreased aesthetic value, and loss of economic vitality. In 2005, the LNCC successfully applied for an Aquatic Invasive Species Rapid Response Grant and chemically treated approximately 50 acres of EWM in the Rice River Reservoir. The presence of EWM in Bridge Lake has led to much concern within the LNCC regarding the current and future condition of their highly valued lakes and has spurred them to seek reliable information regarding the ecology of Bridge Lake. There is overwhelming concern within the group that the infestation in Bridge Lake will spread throughout the lake and to other systems that are connected to the lake.

Realizing that the lake needs to be managed as an ecosystem and that aquatic plants are only one part of that ecosystem, the LNCC elected to conduct a management planning project that also includes assessments of Bridge Lake's water quality and its watershed. The project will also include the integration of fisheries information and the completion of substantial stakeholder participation efforts.

The primary goal of this project was to complete a *Comprehensive Management Plan* for Bridge Lake. Studies designed to collect baseline information concerning the lake's water quality, its native and non-native plant communities, and its watershed were to be used with historic data concerning those components and that of the lake's fishery to reach conclusions regarding the health and function of the lake as an ecosystem. That information, along with information obtained through the efforts for the stakeholder participation component were combined to devise a long-term and realistic management plan for Bridge Lake.

STAKEHOLDER PARTICIPATION

Stakeholder participation is an important part of any management planning exercise. During this project, stakeholders were not only informed about the project and its results, but also introduced to important concepts in lake ecology. The objective of this component in the planning process is to accommodate communication between the planners and the stakeholders. The communication is educational in nature, both in terms of the planners educating the stakeholders and vice-versa. The planners educate the stakeholders about the planning process, the functions of their lake ecosystem, their impact on the lake, and what can realistically be expected regarding the management of the lake. The stakeholders educate the planners by describing how they would like the lake to be, how they use the lake, and how they would like to be involved in managing it. All of this information is communicated through multiple meetings that involve the lake group as a whole or a focus group called a Planning Committee, the completion of a stakeholder survey, and updates within the lake group's newsletter.

The highlights of this component are described below in chronological order. Materials used during the planning process can be found in Appendix A.

Kick-off Meeting

On May 12, 2007 the LNCC held a special meeting to inform association members and other interested parties about the lake management planning project the association was undertaking. During the meeting, Tim Hoyman presented information about lake eutrophication, native and non-native aquatic plants, the importance of lake management planning, and the goals and components of the Bridge Lake management planning project. Tim also discussed the planned Eurasian water milfoil treatments that were to be completed on Lake Nokomis and Bridge Lake later that month.

Stakeholder Survey

During August 2007, a four-page, 22-question survey was mailed to 127 riparian property owners on Bridge Lake. Nearly 38% of the surveys were returned and those results were entered into an Onterra-provided spreadsheet by members of the Bridge Lake Planning Committee. The data were summarized and analyzed by Onterra for use at the planning meetings and within the management plan. The full survey and results can be found in Appendix B, while discussion of those results is integrated within the appropriate sections of the management plan.

Project Updates

Project updates were provided during this project. The first, completed in May 2007 focused primarily on the presentation made during the Kick-off meeting earlier that month. The second update, provided in September 2007, outlined the progress that had been made regarding the project studies and components along with a description of what would be occurring in the near future.

Planning Committee Meeting I

On October 30, 2007, Tim Hoyman and Eddie Heath of Onterra met with five members of the Bridge Lake Planning Committee for a little over 3½ hours. The primary focus of this meeting was the delivery of the study results and conclusions to the committee. All study components including, Eurasian water milfoil treatment results, aquatic plant inventories, water quality analysis, watershed modeling, and the stakeholder survey were presented and discussed. Many concerns were raised by the committee, including nuisance levels of aquatic plants, and low water levels.

Planning Committee Meeting II

On November 6, 2007 Tim Hoyman met with six members of the Planning Committee to begin developing management goals and actions for the Bridge Lake management plan. During this 3½-hour meeting, much of the discussion revolved around water levels, the management of those levels by the Wisconsin Valley Improvement Company (WVIC), and nuisance plant growth in the southern portion of the lake. However, by the end of the meeting, the skeleton of six management goals and accompanying actions was created.

Planning Committee Meeting III

On November 14, 2007 five members of the Bridge Lake Planning Committee met at Peter Lloyd's residence for 3½ hours to discuss the draft Implementation Plan created by Tim Hoyman that was based upon the November 6^{th} discussions. The committee also worked to refine two goals that were not included within Tim's draft document. By the end of the meeting, the framework for the Bridge Lake Implementation Plan was completed.

Communications with LNCC Board of Directors

During the extent of this project, the LNCC Board of Directors was updated regarding the results of the studies and the contents for the management plan. These updates were provided periodically during the board's regular meetings by the project's authorized representative, Mr. David Nycz or the Planning Committee Chair, Mr. Peter Lloyd.

Project Wrap-up Meeting

On June 7, 2008, the Lake Nokomis Concerned Citizens held a special meeting regarding the completion of the Bridge Lake Management Planning Project. During the meeting, Tim Hoyman presented the results of the many studies that had been completed on the lake since 2006. He also answered many questions about the lake and how it should be managed. The Implementation Plan for Bridge Lake was also presented and discussed.

RESULTS & DISCUSSION

Lake Water Quality

Judging the quality of lake water can be difficult because lakes display problems in many different ways. However, focusing on specific aspects or parameters that are important to lake ecology, comparing those values to similar lakes within the same region, and historical data from the study lake provides an excellent method to evaluate the quality of a lake's water. To complete this task, three water quality parameters are focused upon within this document:

> **Phosphorus** is a nutrient that controls the growth of plants in the vast majority of Wisconsin lakes. It is important to remember that in lakes, the term "plants" includes both *algae* and *macrophytes*. Monitoring and evaluating concentrations of phosphorus within the lake helps to create a better understanding of the current and potential growth rates of the plants within the lake.
>
> **Chlorophyll-*a*** is the green pigment in plants used during *photosynthesis*. Chlorophyll-*a* concentrations are directly related to the abundance of free-floating algae in the lake. Chlorophyll-*a* values increase during algal blooms.
>
> **Secchi disk transparency** is a measurement of water clarity. Of all limnological parameters, it is the most used and the easiest for non-professionals to understand. Furthermore, measuring Secchi disk transparency over long periods of time is one of the best methods of monitoring the health of a lake. The measurement is conducted by lowering a weighted, 20-cm diameter disk with alternating black and white quadrates (a Secchi disk) into the water and recording the depth just before it disappears from sight.

The parameters described above are interrelated. Phosphorus controls algal abundance, which is measured by chlorophyll-*a* levels. Water clarity, as measured by Secchi disk transparency, is directly affected by the particulates that are suspended in the water. In the majority of, Wisconsin lakes, the primary particulate matter is algae; therefore, algal abundance directly affects water clarity. In addition, studies have shown that water clarity is used by most lake users to judge water quality – clear water equals clean water.

Each of these parameters is also directly related to the *trophic state* of the lake. As nutrients, primarily phosphorus, accumulate within a lake, its productivity increases and the lake progresses through three trophic states: *oligotrophic*, *mesotrophic*, and finally *eutrophic*. Every lake will naturally progress through these states; however, under natural conditions (i.e. not influenced by the activities of humans) this progress can take tens of thousands of years. Unfortunately, human influence has accelerated this natural aging process in most Wisconsin lakes. Monitoring the trophic state of a lake gives stakeholders a method by which to gauge the health of their lake over time. Yet, classifying a lake into one of three trophic states does not give clear indication of where a lake really exists in its trophic progression. To solve this problem, the parameters described above can be used in an index that will specify a lake's trophic state more clearly and provide a means for which to track it over time.

The complete results of these three parameters and the other chemical data that were collected at Bridge Lake can be found in Appendix C. The results and discussion of the analysis and comparisons described above can be found in the paragraphs and figures that follow.

Comparisons with Other Datasets

Figure 1. Location of Bridge Lake within the regions utilized by Lillie and Mason (1983).

Lillie and Mason (1983) is an excellent source for comparing lakes within specific regions of Wisconsin. They divided the state's lakes into five regions each having lakes of similar nature or apparent characteristics. Lincoln and Oneida County lakes are included within the study's Northeast Region (Figure 1) and are among 243 lakes randomly picked from the region that were analyzed for water clarity (Secchi disk), chlorophyll-*a*, and total phosphorus. These data along with data corresponding to statewide impoundment means, historic, current, and average data from Bridge Lake's sample site (Map 1) are displayed in Figures 2-4. Please note that the data in these graphs represent concentrations and depths taken only during the growing season (April-October) or summer months (June-August). Furthermore, the phosphorus and chlorophyll-a data represent only surface samples. Surface samples are used because they represent the depths at which algae grow and depths at which phosphorus levels are not greatly influenced by phosphorus being released from bottom sediments. Surface samples in Bridge Lake were collected at a depth of 3 feet.

Unfortunately, very little historic water quality exists for Bridge Lake; therefore effective long-term trend analysis is impossible. In fact, the only historic data available for total phosphorus and chlorophyll-*a* are from 1979 and only represent a single water quality sample collected in mid July (Figures 2 and 3, respectively). All that can really be said in regards to these data is that the mean total phosphorus values collected during the summer of 2007 were a bit lower than those collected in 1979, and that the mean chlorophyll-*a* values determined during the summer of 2007 were a bit higher than those found in 1979. Both sets of total phosphorus values would be considered fair and lower than average values found in Wisconsin impoundments. The chlorophyll-*a* values would be considered very good and much lower than average values found in other Wisconsin impoundments.

Water clarity data extends back to 1979 with a large data gap between that year and 1999. The dataset then includes a single sample from 2000 and consistent data from 2003 to present (Figure 4). Data from 1979, 1999, and 2000 represent only single readings, while the 2003-2006 data are means calculated with multiple values collected through the WDNR Citizens Lake Monitoring Network (formerly the Self-Help Lake Monitoring Program). The value for 2007 is a mean calculated with values collected as a part of this project.

The slightly greater clarities found in the 2000 and earlier samples are likely a result of having only single samples represented from those years compared to the other years that are means calculated with as many as 11 samples. Water levels could play a role in these differences; however, determining a pattern is difficult when the limited amount clarity values are compared to water levels collected by the WVIC (Figure 5). Water levels during August of 1999 and 2000 are the highest in the dataset available on the WVIC website (http://www.wvic.com/water-level-graphs.htm), while the clarities from 2003 to 2007 are among the lowest water levels. The pattern does seem to suggest that higher water levels mean greater transparencies. If the pattern truly occurs, it may be related to higher turbidity values caused by erosion on the bottom sediments that are exposed during the low water levels. It is unfortunate that Secchi disk data was not collected during 2001 when levels were low and 2002 when levels were high again so the existence of a pattern could be further explored.

Nitrogen to phosphorus ratios indicate if algal growth within a lake is limited by nitrogen or phosphorus. If the ratio is greater than 15:1, the lake is considered phosphorus limited; if it is 10:1 or less, it is considered nitrogen limited. Ratios in between these values indicate that the lake likely fluctuates between nitrogen and phosphorus limitation. The ratios are related to the normal nitrogen to phosphorus ratio found in most algae. Bridge Lake's ratio using July 2007 values is approximately 25:1.

Regardless of a relationship between water levels and clarity, the Secchi disk readings collected from 2003 to present would be considered poor to fair, but still slightly better than those commonly found in Wisconsin impoundments.

Overall, the water quality of Bridge Lake is better than that found in most Wisconsin impoundments, which is somewhat contradictory to what most respondents to the stakeholder survey believe. In answering Question 9, over 60% of respondents ranked the water quality of Bridge Lake as less than fair, with nearly 50% saying it is poor. Furthermore, even though total phosphorus and water clarity values have remained relatively stable over the course of available data, nearly 70% of survey respondents believe water quality has degraded (Appendix B, Q10).

Bridge Lake, like most impoundments, has a very large watershed draining to it and as discussed in the Watershed Analysis section, that watershed is likely the most controlling factor in the lake's water quality. Fortunately, the land draining to Bridge Lake is of mostly good quality in terms of how it is used, so the water draining the lake is of higher quality than many watersheds produce; especially in the southern portion of the state where agriculture makes up much of the landscape.

Bridge Lake Trophic State

Figure 6 displays the Wisconsin Trophic State Index (WTSI) (Lillie, et al. 1993) values calculated from average surface levels of chlorophyll-*a*, total phosphorus, and Secchi disk transparencies measured during the summer months in Bridge Lake. The WTSI is based upon the widely used Carlson Trophic State Index (TSI) (Carlson 1977), but is specific to Wisconsin lakes. In essence, a trophic state index is a mathematical procedure that assigns an index number that corresponds to a lake's trophic state based upon three common lake parameters; chlorophyll-*a*, Secchi disk transparency, and total phosphorus. The WTSI is used extensively by the WDNR and is reported along with lake data collected by Citizen Lake Monitoring Network volunteers.

The trophic state of a lake is directly related to its production, more precisely – primary production. It is simply a classification based upon the lake's capacity to produce plants in the form of algae and macrophytes. As described above, Bridge Lake is phosphorus limited: therefore, as more phosphorus is added to the lake, its production capacity increases as does its trophic state.

The lack of historic water quality data, as discussed above, obviously impacts the lake's trophic assessment because the WTSI values are calculated using water quality data. Relying strictly on one of the three parameters is risky because although the parameters are related, there are other factors that impact total phosphorus, chlorophyll-*a*, and transparency levels in a lake. For instance, Secchi disk transparencies are the only historical data, albeit very limited, available for Bridge Lake. Looking strictly at WTSI values calculated with Secchi disk readings leads to the conclusion that Bridge Lake is eutrophic. Although Bridge Lake is indeed eutrophic, that conclusion cannot accurately be drawn from the lake's low water clarities. As mentioned in the beginning of the Water Quality section, in most Wisconsin lakes, algal content is responsible for controlling water clarity because algae makes up the bulk of the particulate matter within the water column. However, in the case of a stained lake, such as Bridge, the relationship is the opposite because water clarities are likely controlling algal abundance and not vice-versa. Additionally, this uncommon relationship also renders the use of chlorophyll-*a* levels ineffective as an indicator of trophic state because their values are not highly related to nutrient levels as with most lakes. In the end, the best parameter to use in determining Bridge Lake's trophic state is total phosphorus concentrations, which as displayed in Figure 6, indicates that the lake is eutrophic.

Further evidence that the Bridge Lake is eutrophic (productive) is its ability to support dense macrophytic plant populations through out its littoral zone. In other words, a eutrophic lake is a lake that can support a great deal of biological production. Not all lakes display their ability to produce biomass in terms of algal production – some show it through the production of vascular plants, like Bridge Lake.

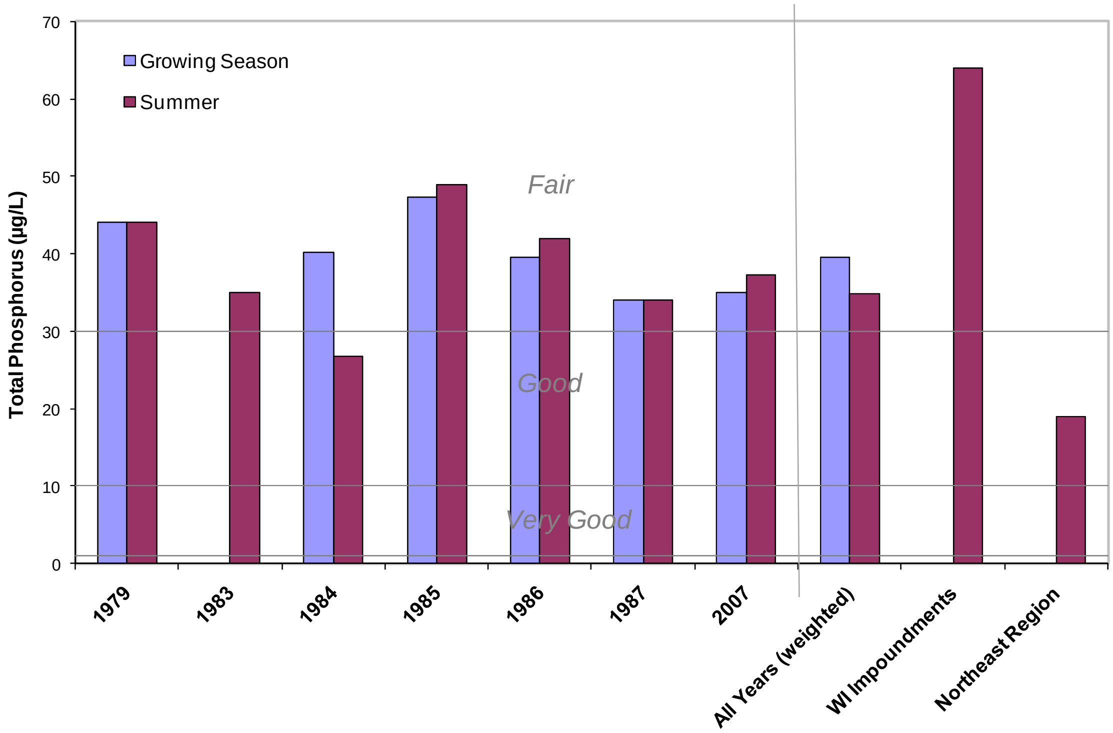

Figure 2. Bridge Lake, regional, and state total phosphorus concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from Lillie and Mason (1983). 1983-1987 data supplied by WVIC.

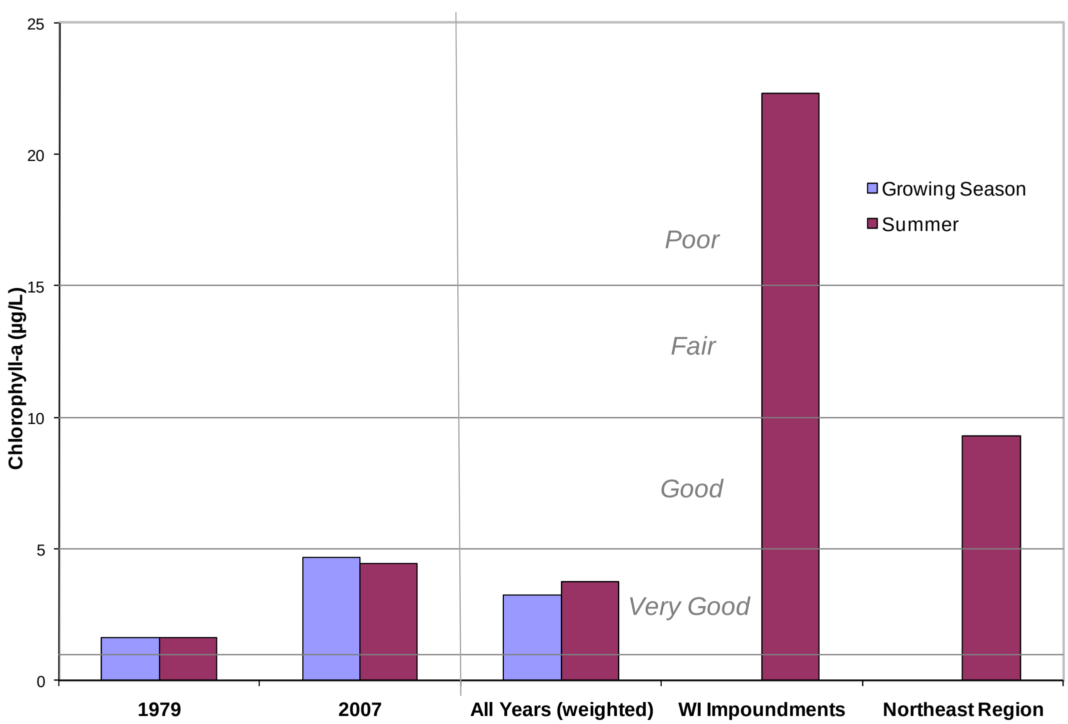

Figure 3. Bridge Lake, regional, and state chlorophyll-*a* concentrations. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

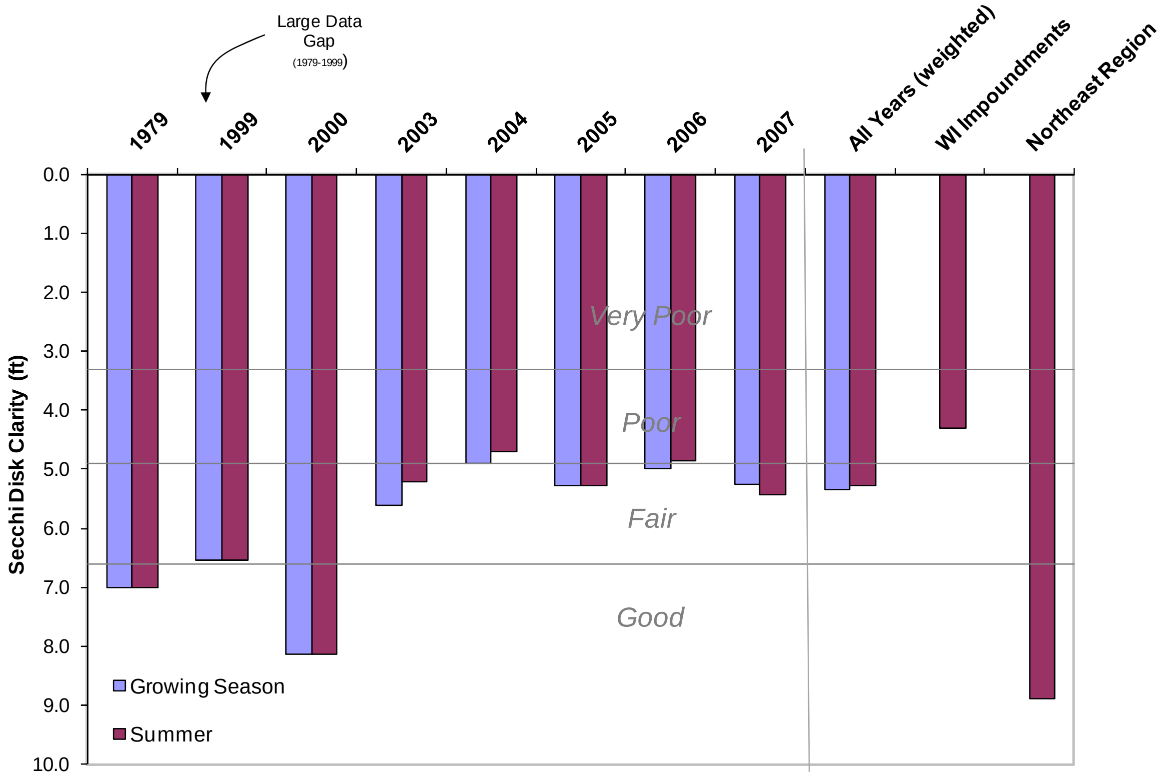

Figure 4. Bridge Lake, regional, and state Secchi disk clarity values. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

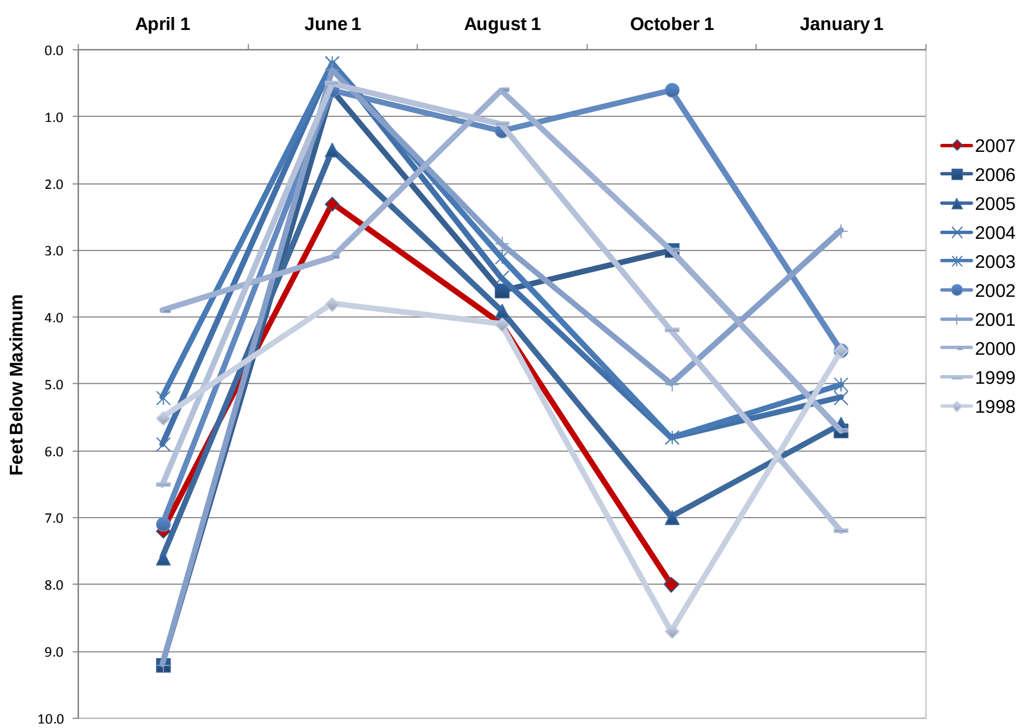

Figure 5. Rice River Reservoir water levels at Bradley Dam (1998-2007). Data adapted from WVIC (2007) water level data.

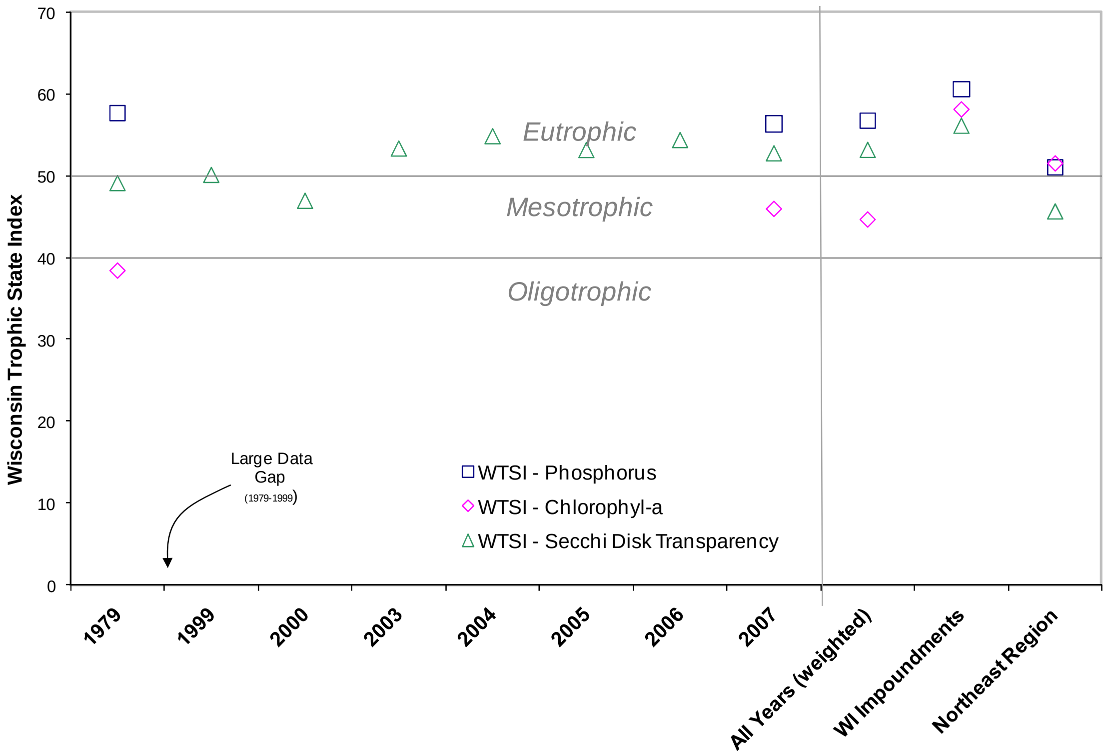

Figure 6. Bridge Lake, regional, and state Wisconsin Trophic State Index values. Values calculated with summer month surface sample data using Lillie, et al. (1993).

Watershed Assessment

The Bridge Lake watershed is approximately 31,415 acres (49 square miles) and includes the watersheds of multiple lakes, including Alva, Oneida, Hancock, Gary, and Mason (Map 2). This yields a watershed to lake area ratio of approximately 75:1. This means that for every acre of lake there are 75 acres of watershed draining to it. In general, lakes with higher watershed to lake area ratios, those exceeding 10:1, tend to exhibit higher in-lake phosphorus levels. However, land use (land cover) within the watershed is the primary factor controlling the amount of sediment and nutrients loaded to a lake. Heavily vegetated areas, such as forests and grasslands export the least amount of pollutants because the majority of the precipitation that falls on them penetrates the soil and enters the groundwater. This creates very little surface runoff to carry sediment and nutrients to the lake. Land uses with little vegetative cover, such as agricultural areas (especially row crops) and residential areas tend to allow much of the precipitation that falls on them to become surface runoff, while very little enters the groundwater. As the water moves over the surface of these land covers, it picks up sediment and nutrients which are eventually delivered to the lake.

Figure 7 summarizes the land cover data for the Bridge Lake watershed. Phosphorus load modeling using standard export coefficients contained in the Wisconsin Lake Modeling Suite (WiLMS, Appendix D) resulted in an annual load of approximately 3,236 lbs. This load was used in other models to estimate in-lake phosphorus levels, including growing season, annual, and spring turnover means. To check the alignment of the model, those estimates were compared to corresponding data collected in Bridge Lake during 2007 and indicated that the phosphorus load generated by WiLMS to be inline with phosphorus loads that would be commonly found in other artificial systems. In other words, a load of 3,236 lbs is a reasonable assessment of the amount of phosphorus that enters Bridge Lake annually.

While a little over a ton and a half of phosphorus entering Bridge Lake may appear to be a great deal, it could be much more if the watershed was not in the condition it is in. Figure 8 displays the breakdown of the Bridge Lake phosphorus load based upon the different land covers found in the lake's watershed. Forested areas are the largest contributor to the Bridge Lake phosphorus load (54.9%), with wetlands and pasture/grasslands combining to provide approximately 38% of the load. Interestingly, although row crop agriculture accounts for less than one-half of a percent of the watershed acreage, WiLMS estimates that it contributes just over 3.5% of the lake's total phosphorus load. This means that if more of the watershed were used for this type of acreage, it would be expected that the total phosphorus load to Bridge Lake would be much greater, which in turn would result in greater plant production and sedimentation.

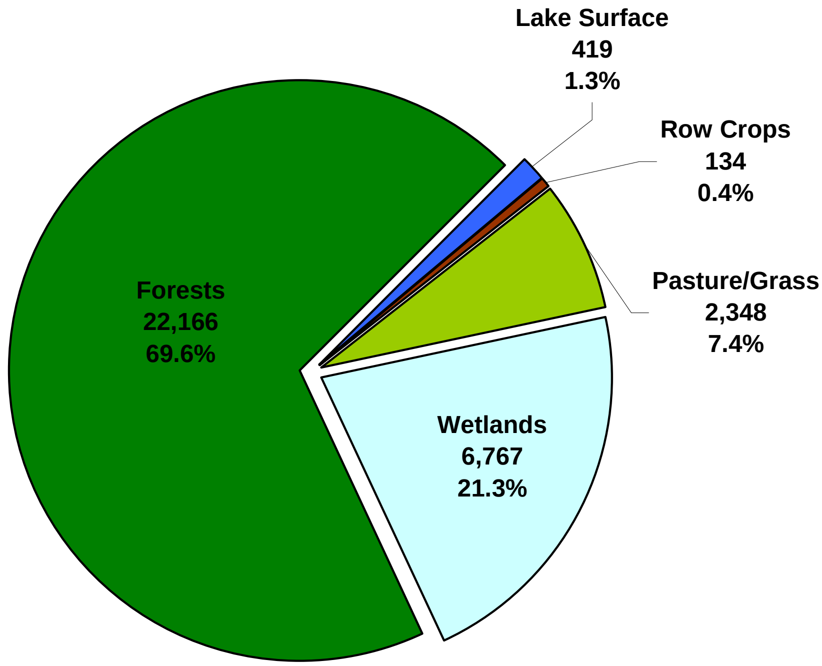

Figure 7. Bridge Lake watershed land cover types in acres. Based upon Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data (WISCLAND) (WDNR 1998).

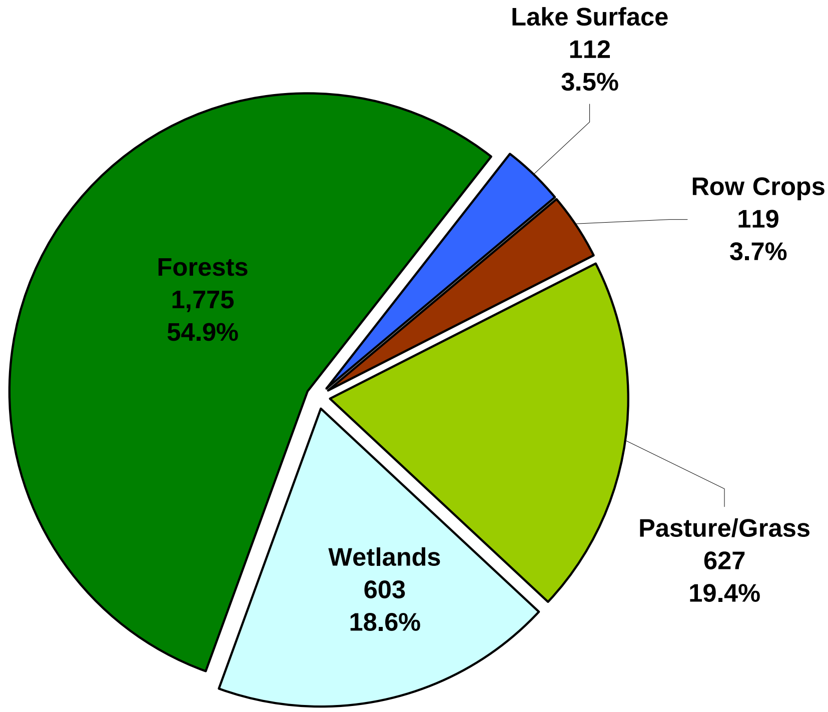

Figure 8. Bridge Lake watershed phosphorus loading in pounds. Based upon Wisconsin Lake Modeling Suite (WiLMS) estimates.

Bridge Lake Fishery

Fishery management is an important aspect in the comprehensive management of a lake ecosystem; therefore, a brief summary of available data is included here as reference. Although current fish data were not collected, the following information was compiled based upon data available from the WDNR and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) WDNR 2007 & GLIFWC 2007). Because of their interconnectedness, data from Lake Nokomis, Rice River, Bridge Lake, and Deer Lake are considered here.

Based on data collected from the stakeholder survey (Appendix B), fishing was the activity most often ranked first as the most important or enjoyable on Bridge Lake. Over 90% of these same respondents believed that the quality of fishing on Bridge Lake was either fair or poor and 100% believe that the quality of fishing has remained the same or gotten worse since they have obtained their property.

Table 1 shows the popular game fish that are present in the system. Management actions that have taken place and will likely continue on Bridge Lake according to this plan include herbicide applications to control EWM. These applications occur in May when the water temperatures are below 60°F. It is important to understand the effect the chemical has on the spawning environment which would be to remove broad-leaf (dicot) submergent plants that are actively growing at these low water temperatures. The muskellunge's spawning habitat may be affected by these types of treatments. Shallow, mucky bays with water depths below 2.5 feet of water are not areas where EWM is regularly found on Bridge Lake and efforts should be made to target only small percentages of these areas if treatments in these areas are warranted.

Approximately 22,400 square miles of northern Wisconsin was ceded to the United States by the Lake Superior Chippewa tribes in 1837 and 1842 (Figure 9). Bridge Lake falls within the ceded territory based on the Treaty of 1837. This allows for a regulated spear fishery by Native Americans on specified systems. The spear harvest is regulated by having the six Wisconsin Chippewa Tribes declaring a tribal quota based on a percent of the estimated safe harvest each year by March 15. The tribal declaration will influence the daily bag limits for hook-and-line anglers, possibly reducing it to zero if 100% of the safe harvest is declared. The tribes have historically selected a percentage which allows for a 2-3 daily bag limit for hook-and-line anglers (USDI 2007).

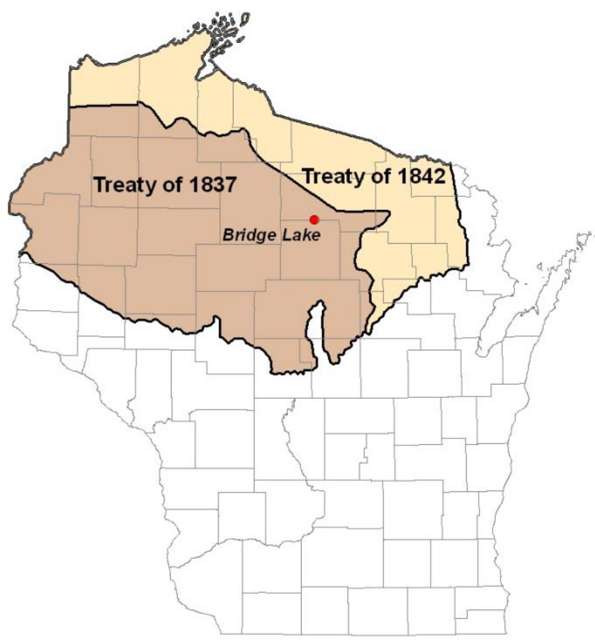

Figure 9. Location of Bridge Lake within the Native American Ceded Territory (GLIFWC 2007). This map was digitized by Onterra; therefore it is a representation and not legally binding.

Table 1. Game fish present in Bridge Lake with corresponding biological information (Becker, 1983).

Common Name	Scientific Name	Max Age (yrs)	Spawning Period	Spawning Habitat Requirements	Food Source
Northern Pike	*Esox lucius*	*25*	Late March - Early April	Shallow, flooded marshes with emergent vegetation with fine leaves	Fish including other pikes, crayfish, small mammals, water fowl, frogs
Smallmouth Bass	*Micropterus dolomieu*	*13*	Mid May - June	Nests more common on North and West shorelines, over gravel	Small fish including other bass, crayfish, insects (aq. and ter)
Largemouth Bass	*Micropterus salmoides*	*13*	Late April - Early July	Shallow, quiet bays with emergent vegetation	Fish, amphipods, algae, crayfish and other invertebrates
Walleye	*Sander vitreus*	*18*	Mid April - early May	Rocky, wave-washed shallows, inlet streams on gravel bottoms	Fish, fly and other insect larvae, crayfish
Muskellunge	*Esox masquinongy*	*30*	Mid April - Mid May	Shallow bays over muck bottom with dead vegetation, 6 - 30 in.	Fish including other muskellunges, small mammals, shore birds, frogs
Yellow Perch	*Perca flavescens*	*13*	April - early May	Sheltered areas, emergent and submergent veg	Small fish, aquatic invertebrates
Bluegill	*Lepomis macrochirus*	*11*	Late May - Early August	Shallow water with sand or gravel bottom	Fish, crayfish, aquatic insects and other invertebrates
Black Crappie	*Pomoxis nigromaculatus*	*7*	May - June	Near Chara or other vegetation, over sand or fine gravel	Fish, cladocera, insect larvae, other inverts
Pumpkinseed	*Lepomis gibbosus*	*12*	Early May - August	Shallow warm bays 0.3-0.8 m, with sand or gravel bottom	Crustaceans, rotifers, mollusks, flatworms, insect larvae (ter. and aq.)
Rock Bass	*Ambloplites rupestris*	*13*	Late May - Early June	Bottom of course sand or gravel, 1cm-1m deep	Crustaceans, insect larvae, and other inverts
Yellow Bullhead	*Ameiurus natalis*	*7*	May - July	Heavy weeded banks, beneath logs or tree roots	Crustaceans, insect larvae, small fish, some algae
Black Bullhead	*Ictalurus melas*	*5*	April - June	Matted vegetation, woody debris, overhanging banks	Amphipods, insect larvae and adults, fish, detritus, algae
Bowfin	*Amia calva*	*30*	Late April - Early June	Vegetated areas from 2-5ft with soft rootlets, sand or gravel	Fish, crayfish, small rodents, snakes, frogs, turtles

Also species present: White Sucker, Shorthead Redhorse, Silver Redhorse, Northern Hog Sucker, Golden Shiner, Burbot, and Logperch.

Table 2. Spear harvest data from GLIFWC annual reports (1998-2006) for Lake Nokomis, Bridge Lake, and Deer Lake combined (Krueger 1998-2006). Data is combined for Lac du Flambeau and Mole Lake tribes. Deer Lake did not have a quota on walleye during 1998-2000 and muskellunge during 1998-2003.

Year	Species	Total	% Quota	Mean Length* (inches)	% Male*	% Female*	% Unknown*
1998	Walleye	781	100.0	13.7	87.6	6.5	4.2
1998	Muskellunge	1	3.2	38.2	n/a	n/a	n/a
1999	Walleye	739	96.0	14.9	82.1	10.6	7.3
1999	Muskellunge	5	16.1	37.0	n/a	n/a	n/a
2000	Walleye	773	96.4	15.0	89.3	5.6	5.1
2000	Muskellunge	1	3.3	38.5	n/a	n/a	n/a
2001	Walleye	483	56.3	15.1	86.1	9.5	4.5
2001	Muskellunge	3	10.0	n/a	n/a	n/a	n/a
2002	Walleye	721	97.6	15.3	86.3	8.4	5.4
2002	Muskellunge	3	15.8	39.9	n/a	n/a	n/a
2003	Walleye	626	98.9	15.3	85.3	8.6	6.2
2003	Muskellunge	1	6.3	35.0	n/a	n/a	n/a
2004	Walleye	771	89.4	14.6	88.3	6.8	4.9
2004	Muskellunge	0	0.0	n/a	n/a	n/a	n/a
2005	Walleye	42	5.1	13.9	95.2	4.8	0
2005	Muskellunge	0	0.0	n/a	n/a	n/a	n/a
2006	Walleye	746	89.7	14.9	83.5	11.5	5.0
2006	Muskellunge	0	0.0	n/a	n/a	n/a	n/a

* Based on Measured Fish

The Lac du Flambeau tribe has the right to spear fish on Lake Nokomis and Bridge Lake and the Mole Lake tribe has the right to spear fish on Deer Lake. Spearers are able to harvest walleye, muskellunge, northern pike, and bass. Only 2 bass were harvested on the system since 1998, both during the 2006 season. Muskellunge and walleye harvest records are provided in Table 2. One common misconception is that the spear harvest targets the large spawning females. Table 2 clearly shows that the opposite is true with only 8.0% of the total walleye harvest since 1998 comprising female fish on the Rice River Reservoir.

Walleye and muskellunge have been historically stocked by the WDNR (Table 3) in an effort to influence the populations of these species. Bridge Lake is classified as a Class 2 muskellunge water body and the minimum length limit on muskellunge is specially regulated on the Rice River Flowage to fish over 40 inches. Muskellunge is actively fished on the system including fishing tournaments targeted at this species. Both walleye and muskellunge populations are sustained through natural reproduction.

Bridge Lake is primarily managed as a walleye fishery. A comprehensive fish survey performed in 2001 found that over 55% of the fish caught in the survey (electro-fishing and fyke nets) were walleye (David Seibel, WDNR personal communication). As stated above, Bridge Lake is located within ceded territory and special fisheries regulations occur, specifically in terms of walleye. An adjusted walleye bag limit pamphlet is distributed each year by the WDNR which explains the more restrictive bag or length limits that may pertain to Bridge Lake.

David Seibel, WDNR area fisheries biologist reports that although the panfish population is largely dominated by yellow perch, a healthy bluegill population also exists in the lake. Similar to many draw-down reservoirs, bluegill populations are in low density, but exhibit a large size structure. This is attributed to the inability of the reservoir to continually produce suitable macrophyte communities to serve as nursery areas, keeping bluegill populations down. Smaller or stunted bluegills often occur when population sizes get large and competition for food and space restricts their potential for growth. Although Bridge Lake may contain suitable nursery areas, other parts of the Rice Reservoir likely do not.

According to the point-intercept survey conducted by the Wisconsin Department of Natural Resources in 2006, 71.5% of the substrate sampled in the littoral zone on Bridge Lake was muck, 21.8% was sand and 6.6 was rock or gravel. Substrate and habitat are critical to fish species that do not provide parental care to their eggs, in other words, the eggs are left after spawning and not tended to by the parent fish. Muskellunge is one species that does not provide parental care to its eggs. Muskellunge broadcast their eggs over woody debris and detritus, which can be found above sand or muck. This organic material suspends the eggs above the substrate so they do not get buried in sediment and suffocate. Walleye is another species that does not provide parental care to its eggs. Walleye preferentially spawn in areas with gravel or rock in places with moving water or wave action, which oxygenates the eggs and prevents them from getting buried in sediment. Fish that provide parental care are less selective of spawning substrates. Species such as bluegill, crappie, and sunfish tend to prefer a harder substrate such as rock, gravel or sandy areas if available, but have been found to spawn in muck as well.

Table 3. Fish stocking data available from the WDNR from 1972 to 2006 (WDNR 2007).

Year	Species	Age Class	# Fish Stocked	Avg Fish Length (in)	Lake Stocked
1972	Walleye	Fingerling	5,000	5.00	Deer
1976	Walleye	Fingerling	30,000	2.00	Deer
1980	Walleye	Fingerling	4,666	5.00	Deer
1983	Walleye	Fingerling	7,600	3.00	Deer
1985	Muskellunge	Fingerling	2,500	10.00	Nokomis
1985	Walleye	Fingerling	7,600	3.00	Deer
1986	Muskellunge	Fingerling	3,000	11.67	Nokomis
1987	Walleye	Fingerling	21,000	4.00	Deer
1988	Muskellunge	Fingerling	2,503	10.00	Nokomis
1989	Muskellunge	Fingerling	1,300	11.00	Nokomis
1989	Walleye	Fingerling	15,200	2.50	Deer
1991	Muskellunge	Fingerling	1,330	11.00	Nokomis
1991	Muskellunge	Fingerling	1,023	12	Rice River Flowage
1991	Walleye	Fry	7,640	2.00	Deer
1992	Muskellunge	Fingerling	3,800	10.48	Nokomis
1992	Muskellunge	Fingerling	1,100	10	Rice River Flowage
1993	Muskellunge	Fingerling	3,800	12.00	Nokomis
1993	Muskellunge	Fingerling	1,100	12	Rice River Flowage
1993	Walleye	Fingerling	7,696	2.00	Deer
1995	Muskellunge	Fry	100,000	0.4	Rice River Flowage
1995	Walleye	Fingerling	7,605	2.30	Deer
1996	Muskellunge	Fingerling	3,196	11.60	Nokomis
1999	Walleye	Small Fingerling	15,200	1.40	Deer
2001	Walleye	Small Fingerling	15,200	1.70	Deer

Aquatic Plants

Introduction

Although the occasional lake user considers aquatic macrophytes to be "weeds" and a nuisance to the recreational use of the lake, the plants are actually an essential element in a healthy and functioning lake ecosystem. It is very important that lake stakeholders understand the importance of lake plants and the many functions they serve in maintaining and protecting a lake ecosystem. With increased understanding and awareness, most lake users will recognize the importance of the aquatic plant community and their potential negative affects on it.

Diverse aquatic vegetation provides habitat and food for many kinds of aquatic life, including fish, insects, amphibians, waterfowl, and even terrestrial wildlife. For instance, wild celery (*Vallisneria americana)* and wild rice (*Zizania aquatica* and *Z. palustris*) both serve as excellent food sources for ducks and geese. Emergent stands of vegetation provide necessary spawning habitat for fish such as northern pike (*Esox lucius*) and yellow perch (*Perca flavescens*) In addition, many of the insects that are eaten by young fish rely heavily on aquatic plants and the *periphyton* attached to them as their primary food source. The plants also provide cover for feeder fish and *zooplankton*, stabilizing the predator-prey relationships within the system. Furthermore, rooted aquatic plants prevent shoreline erosion and the resuspension of sediments and nutrients by absorbing wave energy and locking sediments within their root masses. In areas where plants do not exist, waves can resuspend bottom sediments decreasing water clarity and increasing plant nutrient levels that may lead to algae blooms. Lake plants also produce oxygen through photosynthesis and use nutrients that may otherwise be used by *phytoplankton*, which helps to minimize nuisance algal blooms.

Under certain conditions, a few species may become a problem and require control measures. Excessive plant growth can limit recreational use by deterring navigation, swimming, and fishing activities. It can also lead to changes in fish population structure by providing too much cover for feeder fish resulting in reduced numbers of predator fish and a stunted pan-fish population. *Exotic* plant species, such as Eurasian water-milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) can also upset the delicate balance of a lake ecosystem by out competing *native* plants and reducing *species diversity*. These *invasive* plant species can form dense stands that are a nuisance to humans and provide low-value habitat for fish and other wildlife.

When plant abundance negatively affects the lake ecosystem and limits the use of the resource, plant management and control may be necessary. The management goals should always include the control of invasive species and restoration of native communities through environmentally sensitive and economically feasible methods. No aquatic plant management plan should only contain methods to control plants, they should also contain methods on how to protect and possibly enhance the important plant communities within the lake. Unfortunately, the latter is often neglected and the ecosystem suffers as a result.

Aquatic Plant Management and Protection

Many times an aquatic plant management plan is aimed at only controlling nuisance plant growth that has limited the recreational use of the lake, usually navigation, fishing, and swimming. It is important to remember the vital benefits that native aquatic plants provide to lake users and the lake ecosystem, as described above. Therefore, all aquatic plant management plans also need to address the enhancement and protection of the aquatic plant community. Below are general descriptions of the many techniques that can be utilized to control and enhance aquatic plants. Each alternative has benefits and limitations that are explained in its description. Please note that only legal and commonly used methods are included. For instance, the herbivorous grass carp (*Ctenopharyngodon idella*) is illegal in Wisconsin and rotovation, a process by which the lake bottom is tilled, is not a commonly accepted practice. Unfortunately, there are no "silver bullets" that can completely cure all aquatic plant problems, which makes planning a crucial step in any aquatic plant management activity. Many of the plant management and protection techniques commonly used in Wisconsin are described below.

Please note: Even though all of these techniques may not be applicable to Bridge Lake, it is still important for lake users to have a basic understanding of all the techniques so they can better understand why particular methods are or are not applicable in their lake. The techniques applicable to Bridge Lake are discussed in Summary and Conclusions section and the Implementation Plan found near the end of this document.

Permits

The signing of the 2001-2003 State Budget by Gov. McCallum enacted many aquatic plant management regulations. The rules for the regulations have been set forth by the WDNR as NR 107 and 109. A major change includes that all forms of aquatic plant management, even those that did not require a permit in the past, require a permit now, including manual and mechanical removal. Manual cutting and raking are exempt from the permit requirement if the area of plant removal is no more than 30 feet wide and any piers, boatlifts, swim rafts, and other recreational and water use devices are located within that length. Furthermore, installation of aquatic plants, even natives, requires approval from the WDNR. It is important to note that local permits and U.S. Army Corps of Engineers regulations may also apply. For more information on permit requirements, please contact the WDNR Regional Water Management Specialist or Aquatic Plant Management and Protection Specialist.

Native Species Enhancement

The development of Wisconsin's shorelands has increased dramatically over the last century and with this increase in development a decrease in water quality and wildlife habitat has occurred. Many people that move to or build in shoreland areas attempt to replicate the suburban landscapes they are accustomed to by converting natural shoreland areas to the "neat and clean" appearance of manicured lawns and flowerbeds. The conversion of these areas immediately leads to destruction of habitat utilized by birds, mammals, reptiles, amphibians, and insects. The maintenance of the newly created area helps to decrease water quality by considerably increasing inputs of phosphorus and sediments into the lake. The negative impact of human development does not stop at the shoreline. Removal of native plants and dead, fallen timbers from shallow, near-shore areas for boating and swimming activities destroys habitat used by fish, mammals, birds, insects, and amphibians, while leaving bottom and shoreline sediments vulnerable to wave action caused by boating and wind. Many homeowners significantly decrease the number of trees and shrubs along the water's edge in an effort to increase their view of the lake. However, this has been shown to locally increase water temperatures, and decrease infiltration rates of potentially harmful nutrients and pollutants. Furthermore, the dumping of sand to create beach areas destroys spawning, cover and feeding areas utilized by aquatic wildlife.

In recent years, many lakefront property owners have realized increased aesthetics, fisheries, property values, and water quality by restoring portions of their shoreland to mimic its unaltered state. An area of shore restored to its natural condition, both in the water and on shore, is commonly called a *shoreland buffer zone.* The shoreland buffer zone creates or restores the ecological habitat and benefits lost by traditional suburban landscaping. Simply not mowing within the buffer zone does wonders to restore some of the shoreland's natural function.

Enhancement activities also include additions of *submergent*, *emergent*, and *floating-leaf* plants within the lake itself. These additions can provide greater species diversity and may compete against exotic species.

Cost

The cost of native, aquatic and shoreland plant restorations is highly variable and depends on the size of the restoration area, planting densities, the species planted, and the type of planting (e.g. seeds, bare-roots, plugs, live-stakes) being conducted. Other factors may include extensive grading requirements, removal of shoreland stabilization (e.g., rip-rap, seawall), and protective measures used to guard the newly planted area from wildlife predation, wave-action, and erosion. In general, a restoration project with the characteristics described below would have an estimated materials and supplies cost of approximately $4,200.

- The single site used for the estimate indicated above has the following characteristics:
  - An upland buffer zone measuring 35' x 100'
  - An aquatic zone with shallow-water and deep-water areas of 10' x 100' each
  - Site is assumed to need little invasive species removal prior to restoration
  - Site has a moderate slope
  - Trees and shrubs would be planted at a density of 435 plants/acre and 1210 plants/acre, respectively.
  - Plant spacing for the aquatic zone would be 3 feet
  - Each site would need 100' of biolog to protect the bank toe and each site would need 100' of wavebreak and goose netting to protect aquatic plantings.
  - Each site would need 100' of erosion control fabric to protect plants and sediment near the shoreline (the remainder of the site would be mulched).
  - There is no hard-armor (rip-rap or seawall) that would need to be removed.
  - The property owner would maintain the site for weed control and watering.

Advantages

Improves the aquatic ecosystem through species diversification and habitat enhancement.
Assists native plant populations to compete with exotic species.

Increases natural aesthetics sought by many lake users.
Decreases sediment and nutrient loads entering the lake from developed properties.
Reduces bottom sediment resuspension and shoreline erosion.
Lower cost when compared to rip-rap and seawalls
Restoration projects can be completed in phases to spread out costs.
Many educational and volunteer opportunities are available with each project.

Disadvantages

Property owners need to be educated on the benefits of native plant restoration before they are willing to participate.
Stakeholders must be willing to wait 3-4 years for restoration areas to mature and fill-in.
Monitoring and maintenance are required to assure that newly planted areas will thrive.
Harsh environmental conditions (e.g., drought, intense storms) may partially or completely destroy project plantings before they become well established.

Manual Removal

Manual removal methods include hand-pulling, raking, and hand-cutting. Hand-pulling involves the manual removal of whole plants, including roots, from the area of concern and disposing them out of the waterbody. Raking entails the removal of partial and whole plants from the lake by dragging a rake with a rope tied to it through plant beds. Specially designed rakes are available from commercial sources or an asphalt rake can be used. Hand-cutting differs from the other two manual methods because the entire plant is not removed, rather the plants are cut similar to mowing a lawn; however Wisconsin law states that all plant fragments must be removed. One manual cutting technique involves throwing a specialized "V" shaped cutter into the plant bed and retrieving it with a rope. The raking method entails the use of a two-sided straight blade on a telescoping pole that is swiped back and forth at the base of the undesired plants.

In addition to the hand-cutting methods described above, powered cutters are now available for mounting on boats. Some are mounted in a similar fashion to electric trolling motors and offer a 4-foot cutting width, while larger models require complicated mounting procedures, but offer an 8-foot cutting width.

When using the methods outlined above, it is very important to remove all plant fragments from the lake to prevent re-rooting and drifting onshore followed by decomposition. It is also important to preserve fish spawning habitat by timing the treatment activities after spawning. In Wisconsin, a general rule would be to not start these activities until after June 15th.

Cost

Commercially available hand-cutters and rakes range in cost from $85 to $150. Power-cutters range in cost from $1200 to $11,000.

Advantages

Very cost effective for clearing areas around docks, piers, and swimming areas
Relatively environmentally safe if treatment is conducted after June 15th

Allows for selective removal of undesirable plant species
Provides immediate relief in localized area
Plant biomass is removed from waterbody

Disadvantages

Labor intensive.
Impractical for larger areas or dense plant beds
Subsequent treatments may be needed as plants recolonize and/or continue to grow
Uprooting of plants stirs bottom sediments making it difficult to harvest remaining plants
May disturb *benthic* organisms and fish-spawning areas
Risk of spreading invasive species if fragments are not removed

Bottom Screens

Bottom screens are very much like landscaping fabric used to block weed growth in flowerbeds. The gas-permeable screen is placed over the plant bed and anchored to the lake bottom by staking or weights. Only gas-permeable screen can be used or large pockets of gas will form under the mat as the result of plant decomposition. This could lead to portions of the screen becoming detached from the lake bottom, creating a navigational hazard. Normally the screens are removed and cleaned at the end of the growing season and then placed back in the lake the following spring. If they are not removed, sediments may build up on them and allow for plant colonization on top of the screen.

Cost

Material costs range between $.20 and $1.25 per square-foot. Installation cost can vary largely, but may roughly cost $750 to have 1,000 square feet of bottom screen installed. Maintenance costs can also vary, but an estimate for a waterfront lot are about $120 each year.

Advantages

Immediate and sustainable control
Long-term costs are low
Excellent for small areas and around obstructions
Materials are reusable
Prevents fragmentation and subsequent spread of plants to other areas

Disadvantages

Installation may be difficult over dense plant beds and in deep water
Not species specific
Disrupts benthic fauna
May be navigational hazard in shallow water
Initial costs are high
Labor intensive due to the seasonal removal and reinstallation requirements
Does not remove plant biomass from lake
Not practical in large-scale situations

Water Level Drawdown

The primary manner of plant control through water level drawdown is the exposure of sediments and plant roots/tubers to desiccation and either heating or freezing depending on the timing of the treatment. Winter drawdowns are more common in temperate climates like that of Wisconsin and usually occur in reservoirs because of the ease of water removal through the outlet structure. An important fact to remember when considering the use of this technique is that only certain species are controlled and that some species may even be enhanced. Furthermore, the process will likely need to be repeated every two or three years to keep target species in check.

Cost

The cost of this alternative is highly variable. If an outlet structure exists, the cost of lowering the water level would be minimal; however, if there is not an outlet, the cost of pumping water to the desirable level could be very expensive.

Advantages

Inexpensive if outlet structure exists
May control populations of certain species, like Eurasian water-milfoil for up to two years
Allows some loose sediment to consolidate
May enhance growth of desirable emergent species
Other work, like dock and pier repair may be completed more easily and at a lower cost while water levels are down

Disadvantages

May be cost prohibitive if pumping is required to lower water levels
Has the potential to upset the lake ecosystem and have significant affects on fish and other aquatic wildlife
Adjacent wetlands may be altered due to lower water levels
Disrupts recreational, hydroelectric, irrigation and water supply uses
May enhance the spread of certain undesirable species, like common (giant) reed (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*)
Permitting process requires an environmental assessment that may take months to prepare
Unselective

Harvesting

Aquatic plant harvesting is frequently used in Wisconsin and involves the cutting and removal of plants much like mowing and bagging a lawn. Harvesters are produced in many sizes that can cut to depths ranging from 3 to 6 feet with cutting widths of 4 to 10 feet. Plant harvesting speeds vary with the size of the harvester, density and types of plants, and the distance to the off-loading area. Equipment requirements do not end with the harvester. In addition to the harvester, a shore-conveyor would be required to transfer plant material from the harvester to a dump truck for transport to a landfill or compost site. Furthermore, if off-loading sites are limited and/or the lake is large, a transport barge may be needed to move the harvested plants from the harvester to the shore in order to cut back on the time that the harvester spends traveling to the shore conveyor.

Some lake organizations contract to have nuisance plants harvested, while others choose to purchase their own equipment. If the latter route is chosen, it is especially important for the lake group to be very organized and realize that there is a great deal of work and expense involved with the purchase, operation, maintenance, and storage of an aquatic plant harvester. In either case, planning is very important to minimize environmental effects and maximize benefits.

Costs

Equipment costs vary with the size and features of the harvester, but in general, standard harvesters range between $45,000 and $100,000. Larger harvesters or stainless steel models may cost as much as $200,000. Shore conveyors cost approximately $20,000 and trailers range from $7,000 to $20,000. Storage, maintenance, insurance, and operator salaries vary greatly.

Advantages

Immediate results
Plant biomass and associated nutrients are removed from the lake
Select areas can be treated, leaving sensitive areas intact
Plants are not completely removed and can still provide some habitat benefits
Opening of cruise lanes can increase predator pressure and reduce stunted fish populations
Removal of plant biomass can improve the oxygen balance in the littoral zone
Harvested plant materials produce excellent compost

Disadvantages

Initial costs and maintenance are high if the lake organization intends to own and operate the equipment
Multiple treatments may be required during the growing season because lower portions of the plant and root systems are left intact
Many small fish, amphibians and invertebrates may be harvested along with plants
There is little or no reduction in plant density with harvesting
Invasive and exotic species may spread because of plant fragmentation associated with harvester operation
Larger harvesters are not easily maneuverable in shallow water or near docks and piers
Bottom sediments may be resuspended leading to increased turbidity and water column nutrient levels

Chemical Treatment

There are many herbicides available for controlling aquatic macrophytes and each compound is sold under many brand names. Aquatic herbicides fall into two general classifications:

1. *Contact herbicides* act by causing extensive cellular damage, but usually do not affect the areas that were not in contact with the chemical. This allows them to work much faster, but does not result in a sustained effect because the root crowns, roots, or rhizomes are not killed.
2. *Systemic herbicides* spread throughout the entire plant and often result in complete mortality if applied at the right time of the year.

Both types are commonly used throughout Wisconsin with varying degrees of success. The use of herbicides is potentially hazardous to both the applicator and the environment, so all lake organizations should seek consultation and/or services from professional applicators with training and experience in aquatic herbicide use.

Below are brief descriptions of the aquatic herbicides currently registered for use in Wisconsin.

Fluridone (Sonar®, Avast!®) Broad spectrum, systemic herbicide that is effective on most submersed and emergent macrophytes. It is also effective on duckweed and at low concentrations has been shown to selectively remove Eurasian water-milfoil. Fluridone slowly kills macrophytes over a 30-90 day period and is only applicable in whole lake treatments or in bays and backwaters were dilution can be controlled. Required length of contact time makes this chemical inapplicable for use in flowages and impoundments. Irrigation restrictions apply.

Glyphosate (Rodeo®) Broad spectrum, systemic herbicide used in conjunction with a *surfactant* to control emergent and floating-leaved macrophytes. It acts in 7-10 days and is not used for submergent species This chemical is commonly used for controlling purple loosestrife (*Lythrum salicaria*).. Glyphosate is also marketed under the name Roundup®; this formulation is not permitted for use near aquatic environments because of its harmful effects on fish, amphibians, and other aquatic organisms.

Diquat (Reward®, Weedtrine-D®) Broad spectrum, contact herbicide that is effective on all aquatic plants and can be sprayed directly on foliage (with surfactant) or injected in the water. It is very fast acting, requiring only 12-36 hours of exposure time. Diquat readily binds with clay particles, so it is not appropriate for use in turbid waters. Consumption restrictions apply.

Endothal (Hydrothol®, Aquathol®) Broad spectrum, contact herbicides used for spot treatments of submersed plants. The mono-salt form of Endothal (Hydrothol®) is more toxic to fish and aquatic invertebrates, so the dipotassium salt (Aquathol®) is most often used. Fish consumption, drinking, and irrigation restrictions apply.

2,4-D (Navigate®, Aqua-Kleen®, etc.) Selective, systemic herbicide that only works on broad-leaf plants. The selectivity of 2,4-D towards broad-leaved plants (dicots) allows it to be used for Eurasian water-milfoil without affecting many of our native plants, which are monocots. Drinking and irrigation restrictions apply.

Advantages

Herbicides are easily applied in restricted areas, like around docks and boatlifts
If certain chemicals are applied at the correct dosages and at the right time of year, they can selectively control certain invasive species, such as Eurasian water-milfoil.

Some herbicides can be used effectively in spot treatments

Disadvantages

Fast-acting herbicides may cause fishkills due to rapid plant decomposition if not applied correctly.

Many people adamantly object to the use of herbicides in the aquatic environment; therefore, all stakeholders should be included in the decision to use them.

Many herbicides are nonselective

Most herbicides have a combination of use restrictions that must be followed after their application

Many herbicides are slow-acting and may require multiple treatments throughout the growing season

Cost

Herbicide application charges vary greatly, between $400 to $1000 per acre, depending on the chemical used, who applies it, permitting procedures, and the size of the treatment area.

Biological Controls

There are many insects, fish and pathogens within the United States that are used as biological controls for aquatic macrophytes. For instance, the herbivorous grass carp has been used for years in many states to control aquatic plants with some success and some failures. However, it is illegal to possess grass carp within Wisconsin because their use can create problems worse than the plants that they were used to control. Other states have also used insects to battle invasive plants, such as water hyacinth weevils (*Neochetina spp.*) and hydrilla stem weevil (*Bagous spp.*) to control water hyacinth (*Eichhornia crassipes*) and hydrilla (*Hydrilla verticillata)*, respectively. Fortunately, it is assumed that Wisconsin's climate is a bit harsh for these two invasive plants, so there is no need for either biocontrol insect. However, Wisconsin, along with many other states, is currently experiencing the expansion of lakes infested with Eurasian water-milfoil and as a result has supported the experimentation and use of the milfoil weevil (*Euhrychiopsis lecontei*) within its lakes. The milfoil weevil is a native weevil that has shown promise in reducing Eurasian water-milfoil stands in Wisconsin, Washington, Vermont, and other states. Research is currently being conducted to discover the best situations for the use of the insect in battling Eurasian water-milfoil. Wisconsin is also using two species of leaf-eating beetles (*Galerucella calmariensis* and *G. pusilla*) to battle purple loosestrife. These biocontrol insects are not covered here because purple loosestrife is predominantly a wetland species.

Advantages

Milfoil weevils occur naturally in Wisconsin.

This is likely an environmentally safe alternative for controlling Eurasian water-milfoil.

Disadvantages

Stocking and monitoring costs are high.

This is an unproven and experimental treatment.

There is a chance that a large amount of money could be spent with little or no change in Eurasian water-milfoil density.

Cost

Stocking with adult weevils costs about $1.20/weevil and they are usually stocked in lots of 1000 or more.

Analysis of Current Aquatic Plant Data

Aquatic plants are an important element in every healthy lake. Changes in lake ecosystems are often first seen in the lake's plant community. Whether these changes are positive, like variable water levels or negative, like increased shoreland development or the introduction of an exotic species, the plant community will respond. Plant communities respond in a variety of ways; there may be a loss of one or more species, certain life forms, such as emergents or floating-leaf communities may disappear from certain areas of the lake, or there may be a shift in plant dominance between species. With periodic monitoring and proper analysis, these changes are relatively easy to detect and provide very useful information for management decisions.

As described in more detail in the methods section, multiple aquatic plant surveys were completed on Bridge Lake; the first looked strictly for the exotic plant, curly-leaf pondweed, while the others that followed assessed both native and non-native species. Combined, these surveys produce a great deal of information about the aquatic vegetation of the lake. These data are analyzed and presented in numerous ways; each is discussed in more detail below.

Primer on Data Analysis & Data Interpretation

Species List

The species list is simply a list of all of the species that were found within the lake, both exotic and native. The list also contains the life-form of each plant found, its scientific name, and its coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in life-forms that are present, can be an early indicator of changes in the health of the lake ecosystem.

Frequency of Occurrence

Frequency of occurrence describes how often a certain species is found within a lake. Obviously, all of the plants cannot be counted in a lake, so samples are collected from pre-determined areas. In the case of Bridge Lake, plant samples were collected from plots laid out on a grid that covered the entire lake. Using the data collected from these plots, an estimate of occurrence of each plant species can be determined. In this section, relative frequency of occurrence is used to describe how often each species occurred in the plots that contained vegetation. These values are presented in percentages and if all of the values were added up, they would equal 100%. For example, if water lily had a relative frequency of 0.1 and we described that value as a percentage, it would mean that water lily made up 10% of the population.

In the end, this analysis indicates the species that dominate the plant community within the lake. Shifts in dominant plants over time may indicate disturbances in the ecosystem. For instance, low water levels over several years may increase the occurrence of emergent species while decreasing the occurrence of floating-leaf species. Introductions of invasive exotic species may result in major shifts as they crowd out native plants within the system.

Species Diversity

Species diversity is probably the most misused value in ecology because it is often confused with species richness. Species richness is simply the number of species found within a system or community. Although these values are related, they are far from the same because diversity also takes into account how evenly the species occur within the system. A lake with 25 species may not be more diverse than a lake with 10 if the first lake is highly dominated by one or two species and the second lake has a more even distribution.

A lake with high species diversity is much more stable than a lake with a low diversity. This is analogous to a diverse financial portfolio in that a diverse lake plant community can withstand environmental fluctuations much like a diverse portfolio can handle economic fluctuations. For example, a lake with a diverse plant community is much better suited to compete against exotic infestation than a lake with a lower diversity.

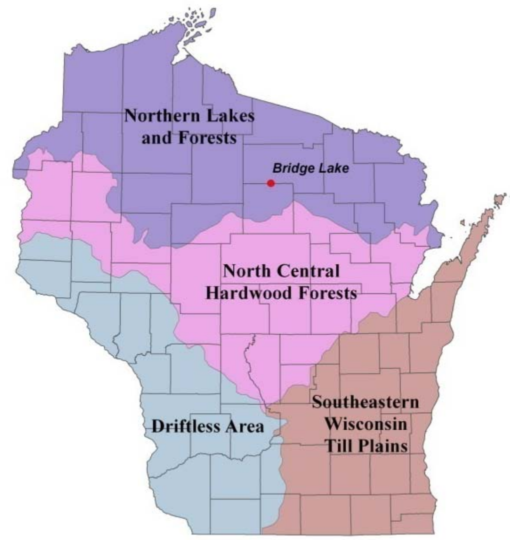

Figure 10. Location of Bridge Lake within the ecoregions of Wisconsin. After Nichols 1999.

Floristic Quality Assessment

Floristic Quality Assessment (FQA) is used to evaluate the closeness of a lake's aquatic plant community to that of an undisturbed, or pristine, lake. The higher the floristic quality, the closer a lake is to an undisturbed system. FQA is an excellent tool for comparing individual lakes and the same lake over time. In this section, the floristic quality of Bridge Lake will be compared to lakes in the same ecoregion and in the state (Figure 10).

The floristic quality of a lake is calculated using its species richness and average species conservatism. As mentioned above, species richness is simply the number of species that occur in the lake, for this analysis, only native species are utilized. Average species conservatism utilizes the coefficient of conservatism values for each of those species in its calculation. A species coefficient of conservatism value indicates that species likelihood of being found in an undisturbed (pristine) system. The values range from one to ten. Species that are normally found in disturbed systems have lower coefficients, while species frequently found in pristine systems have higher values. For example, cattail, an invasive native species, has a value of 1, while common hard and softstem bulrush have values of 5, and Oakes pondweed, a sensitive and rare species, has a value of 10. On their own, the species richness and average conservatism values for a lake are useful in assessing a lake's plant community; however, the best assessment of the lake's plant community health is determined when the two values are used to calculate the lake's floristic quality.

Community Mapping

A key component of the aquatic plant survey is the creation of an aquatic plant community map. The map represents a snapshot of the important plant communities in the lake as they existed during the survey and is valuable in the development of the management plan and in comparisons with surveys completed in the future. A mapped community can consist of submergent, floating-leaf, or emergent plants, or a combination of these life-forms. Examples of submergent plants include wild celery and pondweeds; while emergents include cattails, bulrushes, and arrowheads, and floating-leaf species include white and yellow pond lilies. Emergents and floating-leaf communities lend themselves well to mapping because there are distinct boundaries between communities. Submergent species are often mixed throughout large areas of the lake and are seldom visible from the surface; therefore, mapping of submergent communities is more difficult and often impossible.

Ecoregions are areas related by similar climate, physiography, hydrology, vegetation and wildlife potential. Comparing ecosystems in the same ecoregion is sounder than comparing systems within manmade boundaries such as counties, towns, or states.

Exotic Plants

Because of their tendency to upset the natural balance of an aquatic ecosystem, exotic species are paid particular attention to during the aquatic plant surveys. Two exotics, curly-leaf pondweed and Eurasian water milfoil are the primary targets of this extra attention.

Eurasian water-milfoil is an invasive species, native to Europe, Asia and North Africa, that has spread to most Wisconsin counties (Figure 11). Eurasian water-milfoil is unique in that its primary mode of propagation is not by seed. It actually spreads by shoot fragmentation, which has supported its transport between lakes via boats and other equipment. In addition to its propagation method, Eurasian water-milfoil has two other competitive advantages over native aquatic plants, 1) it starts growing very early in the spring when water temperatures are too cold for most native plants to grow, and 2) once its stems reach the water surface, it does not stop growing like most native plants, instead it continues to grow along the surface creating a canopy that blocks light from reaching native plants. Eurasian water-milfoil can create dense stands and dominate submergent communities, reducing important natural habitat for fish and other wildlife, and impeding recreational activities such as swimming, fishing, and boating.

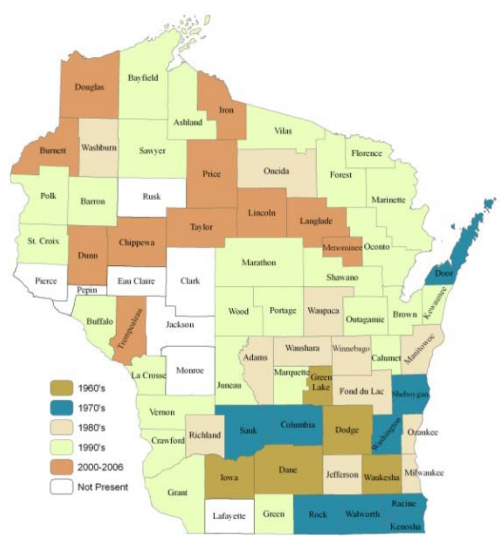

Figure 11. Spread of Eurasian water milfoil within WI counties. WDNR Data 2006 mapped by Onterra.

Curly-leaf pondweed is a European exotic first discovered in Wisconsin in the early 1900's that has an unconventional lifecycle giving it a competitive advantage over our native plants. Curly –leaf pondweed begins growing almost immediately after ice-out and by mid-June is at peak biomass. While it is growing, each plant produces many turions (asexual reproductive shoots) along its stem. By mid-July most of the plants have senesced, or died-back, leaving the turions in the sediment. The turions lie dormant until fall when they germinate to produce winter foliage, which thrives under the winter snow and ice. It remains in this state until spring foliage is produced in early May, giving the plant a significant jump on native vegetation. Like Eurasian water-milfoil, curly-leaf pondweed can become so abundant that it hampers recreational activities within the lake. Furthermore, its mid-summer die back can cause algal blooms spurred from the nutrients released during the plant's decomposition.

Because of its odd life-cycle, a special survey is conducted early in the growing season to inventory and map curly-leaf pondweed occurrence within the lake. Although Eurasian water milfoil starts to grow earlier than our native plants, it is at peak biomass during most of the summer, so it is inventoried during the comprehensive aquatic plant survey completed in mid to late summer.

2006 Survey Analysis

As mentioned above, numerous plant surveys were completed as a part of this project. During June 2006, two surveys were completed, one being conducted by Onterra that focused upon curly-leaf pondweed and the other, a point-intercept study, completed by WDNR staff that assessed all native and non-native plants within Bridge Lake. Other surveys completed by Onterra included those used to create the Bridge Lake aquatic plant community map (Map 3) during August 2006 and the pre- and post treatment surveys used to assess the 2007 Eurasian water milfoil treatment completed during May 2007. No curly-leaf pondweed was located in Bridge Lake during the June 2006 survey and therefore will not be discussed further. The results of the point-intercept survey conducted by the WDNR provided much of the information used within this report and is discussed below in detail. The results of the treatment monitoring surveys are discussed in the Eurasian water milfoil section.

During the WDNR point-intercept survey and studies conducted by Onterra, 47 species of plants were located; of those, three are considered non-native species (Table 4). One of the non-native species, Eurasian water milfoil is discussed in detail below because of its frequency within the lake. The other two exotics, common reed and purple loosestrife were found in only a few locations along the shorelands of the lake (Map 3). Regardless of their frequency at this time, both of these species present risks to the native emergent plant communities common on the lake because both are capable of taking over vast tracks of wetlands and lake shorelines.

Median Value This is the value that roughly half of the data are smaller and half the data are larger. A median is used when a few data are so large or so small that they skew the average value to the point that it would not represent the population as a whole.

Table 4. Aquatic plant species located in Bridge Lake during 2006 surveys.

Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)
Emergent	*Carex comosa*	Bristly sedge	5
	Dulichium arundinaceum	Three-way sedge	9
	Eleocharis palustris	Creeping spikerush	6
	Equisetum fluviatile	Water horsetail	7
	Iris versicolor	Northern blue flag	5
	Lythrum salicaria	Purple loosestrife	Exotic
	Phragmites australis	Giant reed	Exotic
	Pontederia cordata	Pickerelweed	9
	Sagittaria latifolia	Common arrowhead	3
	Schoenoplectus subterminalis	Water bulrush	9
	Schoenoplectus tabernaemontani	Softstem bulrush	4
	Typha sp.	Cattail	1
	Zizania palustris	Northern wild rice	8
FF	*Lemna minor*	Lesser duckweed	5
	Lemna trisulca	Forked duckweed	6
FL	*Nuphar variegata*	Spatterdock	6
	Nymphaea odorata	White water lily	6
	Polygonum amphibium	Water smartweed	5
FL/E	*Sparganium angustifolium*	Narrow-leaf bur-reed	9
	Sparganium fluctuans	Floating-leaf bur-reed	10
Submergent	*Ceratophyllum demersum*	Coontail	3
	Chara sp.	Muskgrasses	7
	Elatine minima	Waterwort	9
	Elodea canadensis	Common waterweed	3
	Elodea nuttallii	Slender waterweed	7
	Isoetes echinospora	Spiny-spored quilwort	8
	Megalodonta beckii	Water marigold	8
	Myriophyllum sibiricum	Northern water milfoil	7
	Myriophyllum spicatum	Eurasian water milfoil	Exotic
	Najas flexilis	Slender naiad	6
	Nitella sp.	Stoneworts	7
	Potamogeton amplifolius	Large-leaf pondweed	7
	Potamogeton epihydrus	Ribbon-leaf pondweed	8
	Potamogeton foliosus	Leafy pondweed	6
	Potamogeton gramineus	Variable pondweed	7
	Potamogeton natans	Floating-leaf pondweed	5
	Potamogeton praelongus	White-stem pondweed	8
	Potamogeton pusillus	Small pondweed	7
	Potamogeton richardsonii	Clasping-leaf pondweed	5
	Potamogeton spirillus	Spiral-fruited pondweed	8
	Potamogeton strictifolius	Stiff pondweed	8
	Potamogeton vaseyi	Vasey's pondweed	10
	Potamogeton zosteriformis	Flat-stem pondweed	6
	Utricularia vulgaris	Common bladderwort	7
	Vallisneria americana	Wild celery	6
S/E	*Eleocharis acicularis*	Needle spikerush	5
	Sagittaria cuneata	Arum-leaved arrowhead	7

* = Incidental, FF = Free floating, FL = Floating-leaf, FL/E = Floating-leaf & Emergent, S/E = Submergent & Emergent

Although three non-native aquatic plant species are documented within the lake, when compared to the native species, the non-native frequencies of occurrence are quite low. As Figure 12 indicates, native species such as common waterweed, coontail, and small pondweed, among others, occur much more frequently within Bridge Lake. The dominance of the native plant community over that of the exotics is good news for the lake and is an indication of the lake's overall good health in terms of its plant community. An additional positive indicator is Bridge Lake's species diversity index of 0.91. This value is considered high and inline with species diversities from lakes in the Northern Region that would be considered of high quality, such as Big Saint Germain and South Twin Lakes in Vilas County, which both were found to have diversities of 0.92.

Floristic Quality Assessment (Figure 13) is also a strong indicator of the health of Bridge Lake's aquatic plant community. Bridge Lake's native species richness of 44 is much higher than the median value for the Northern Lakes and Forests – Flowages ecoregion and that of the state. In fact, the Bridge Lake richness is well above the ecoregion's 75^{th} percentile (upper quartile) of 31.3. Bridge Lake's average conservatism value of 6.6 is again above the ecoregion and state medians, and just slightly above the ecoregion's upper quartile value of 6.5. Combining the lake's species richness and average conservatism values to produce its Floristic Quality Index (FQI) results in an exceptionally high value of 43.7; again, well above the median values of the state and ecoregion (calculation shown below). Bridge's FQI, as with the other values, is above the upper quartile value of the ecoregion (36.6).

FQI = Average Coefficient of Conservatism (6.6) * √ Number of Native Species (44)
FQI = 43.7

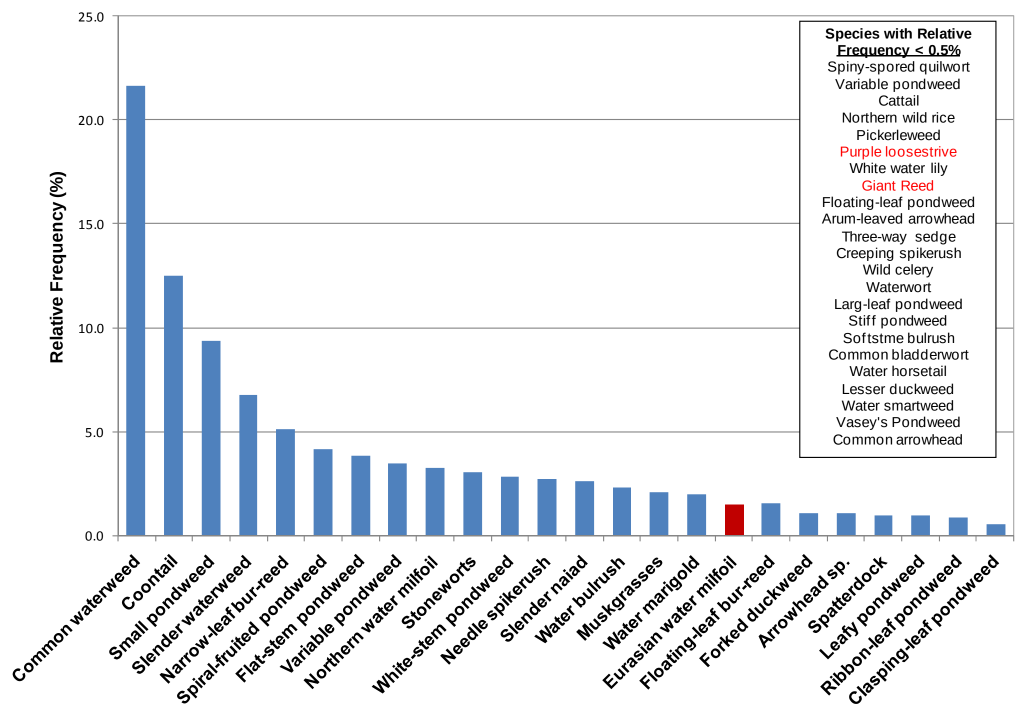

Figure 12 Bridge Lake aquatic plant occurrence analysis of 2006 survey data. Exotic species indicated with red.

Two factors are likely the primary contributors to Bridge Lake's exceptional plant community; 1) the fact that much of what is now considered to be a lake was originally a wetland, and 2) the fluctuating water levels on an annual and seasonal basis. Natural, undisturbed wetlands normally hold diverse plant communities. Remnants of Bridge Lake's origins as a wetland still exist in the lake's emergent and floating-leaf plant community and contribute to the lakes unusually high FQA values. The lake's fluctuating water levels also contribute by allowing the emergent and to some extent, the floating-leaf species, to grow prolifically around the lake, especially in the southern basin (Map 3). Although these areas are very important to the lake's health, they can, in some occasions reach nuisance levels and impact recreational enjoyment of the lake. Striking a balance between the needs of lake users and those of the lake is often a challenge, especially on a lake where motor boating ranks as one of the most important activities of its users and most riparian property owners own recreational watercraft (Appendix B, Q6 and Q7).

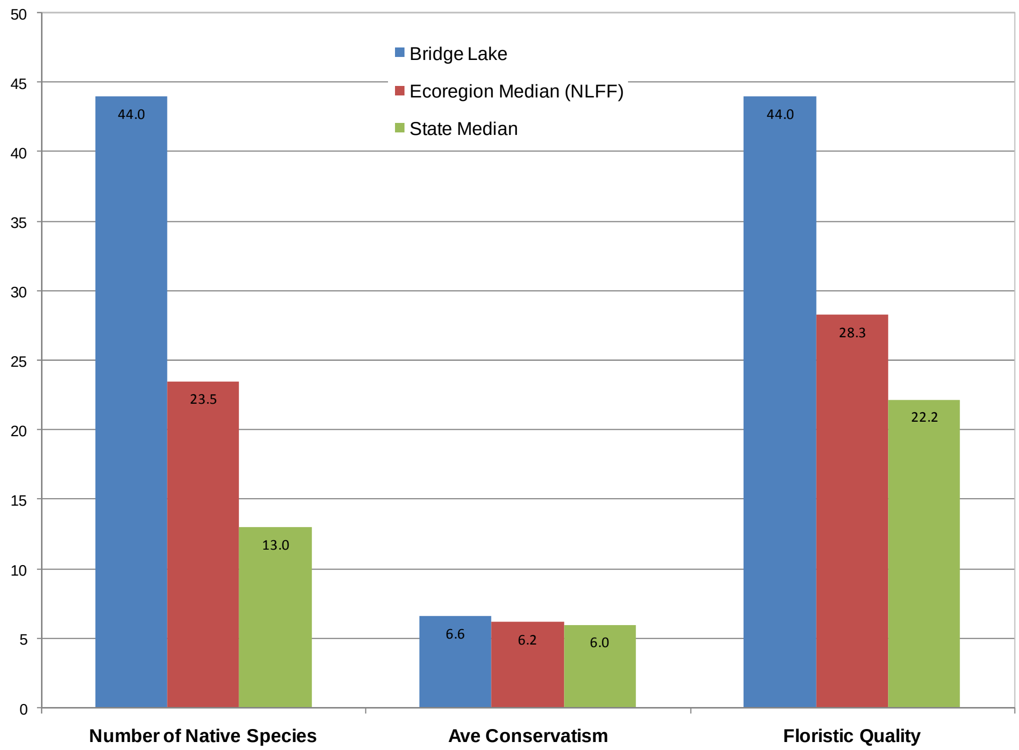

Figure 13. Floristic Quality Assessment using data from 2006 aquatic plant surveys. Analysis following Nichols (1999).

Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) is a perennial herbaceous plant native to Europe and was likely brought over to North America as a garden ornamental. This plant escaped from its garden landscape into wetland environments where it is able to out-compete our native plants for space and resources. First detected in Wisconsin in the 1930's, it has now spread to 70 of the state's 72 counties. Purple loosestrife largely spreads by seed, but also can vegetatively spread from root or stem fragments.

Numerous purple loosestrife locations were marked on Bridge Lake (Map 3), mainly within the wetland complex located lakeward from the Lost Creek inlet (southeastern part of the lake). No management actions have been directed at these occurrences.

Common Reed

Common (giant) reed (*Phragmites australis*) is an invasive perennial grass that has the ability to take over wetland ecosystems. While common reed populations often spread to new locations through seed dispersal, established populations primarily expand through underground rhizomes and above ground runners. Common reed shoots emerge from the ground in early summer, growing rapidly to 6 to 15 feet tall and are topped with large seed heads (Derr, 2008). One destructive trait of common reed is that each year when the plant dies, the plants dead stems remain standing and accumulate each year. This chokes out native vegetation and creates dense stands which provide unsuitable habitat for many bird species and decreased food value for wildlife compared with native wetlands.

It is believed that populations of common reed existed in pre-colonial Wisconsin, but exotic strains from Europe have been introduced and have invaded the genetic line of the native strain. Genetic identification of the plant is needed to determine whether the plant is a native or non-native strain; however the majority of these species occurrences are exotic (Cornell University, 2002). A few populations of common reed were located on Bridge Lake (Map 3), all of which appear to be "acting" in an invasive species by rapidly expanding their population.

Eurasian Water Milfoil

In August 2006, Onterra conducted a survey of the Eurasian water milfoil in Bridge Lake and the highest density areas served as a preliminary treatment area of approximately 25 acres that was used to obtain a conditional chemical application permit from the WDNR (Map 4). Then in early May, these areas were surveyed to refine the treatment areas. It is presumed that because of low water levels during the winter, the Eurasian water milfoil in some of the proposed treatment areas had not survived. After consultation with the LNCC, it was determined to treat an area that was of moderate density (Map 5, Site M-07) to compensate for the acreage reduced due to the drawdown. This site would serve as an experimental location to understand the effects of the chemical on plants of different densities. All locations were recommended to be treated with 2,4-D at 100 pounds/acre. Onterra provided the necessary data to the applicator, Schmidt's Aquatic Plant Control, and an application of Navigate (2,4-D) was completed on May 9, 2007 at 100 lbs/acre. There was some early morning drizzle, the winds were calm and the water temperature was 13.3°C (56°F).

Treatment Monitoring

Determining the success or failure of chemical treatments on Eurasian water milfoil is often a difficult task because the criteria used in determining success or failure is ambiguous. Most people involved with Eurasian water milfoil management, whether professionals or laypersons, understand that the eradication of Eurasian water milfoil from a lake, or even a specific area of a lake, is nearly, if not totally, impossible. Most understand that achieving control is the best criteria for success. During the surveys reported on here, two different methods of evaluation were used to understand the level of control that was achieved by the chemical treatment. A qualitative assessment was determined for each treatment site by comparing detailed notes of pre- and post treatment observations and spatial data collected with a sub-meter GPS datacollector. A quantitative assessment of the treatment was also made by collecting data at 100 point-intercept sample locations before and after the treatment (Map 5 & Appendix E). At these locations, Eurasian water milfoil presence and rake fullness was documented as well as water depth and substrate type. Native plant abundances were also determined at each plot during the pre- and post treatment surveys; however, these data are only lightly discussed here because comparisons between early spring samples and summer samples are not valid due to the lifecycles of these species.

Pretreatment Survey – May 1 & 2, 2007

The purpose of this survey was to refine the treatment areas used in the conditional permit to more accurately and effectively coordinate the control method. The conditions on the first day were sunny and cool. Conditions were similar on the second day except for a moderate wind out of the northwest. On May 1, all sites were visited to determine if treatment was warranted. It was hypothesized that because of the low water level throughout the winter, some of the shallower treatment areas would not need treatment. Sites C, F, G, H, I, & J were all dropped from the final treatment plan because sufficient Eurasian water milfoil was not located. On May 2, all sites were looked at to determine if the colony extents were accurate. The 100 point-intercept sub-sampling points were also visited on this day.

Site A Eurasian water milfoil was observed in this site, especially in the densest areas (Map 4). Of the 68 point-intercept locations sampled, 82.4% contained Eurasian water milfoil (Figure 14).

Site B Many Eurasian water milfoil plants were observed from the surface. Multiple rake tows were performed to aid in the discovery of the plants due to the stained water of the system. The sub-sampling yielded 11 out of 20 locations containing Eurasian water milfoil (55.0%) (Figure 13).

Site D Eurasian water milfoil was located in this site in the form of many large clumps with spaces of no Eurasian water milfoil. Of the 12 point-intercept locations sampled, 83.3% contained Eurasian water milfoil (Figure 13).

Site K & L These locations were quite shallow (1-2 feet water depth), but still contained Eurasian water milfoil so the decision was made to treat them. No sub-sampling occurred in these locations.

Site E This was a dense area amongst a scattered density of Eurasian water milfoil. No sub-sampling occurred at this treatment site.

Post Treatment Survey – August 20, 2007

During this survey, all treatment areas were visited to determine the efficacy of the chemical application. All point-intercept sample locations were re-visited and data were collected in the same manner as during the pretreatment survey. WVIC reported water levels to be approximately 4.5 feet below the level during the pretreatment survey.

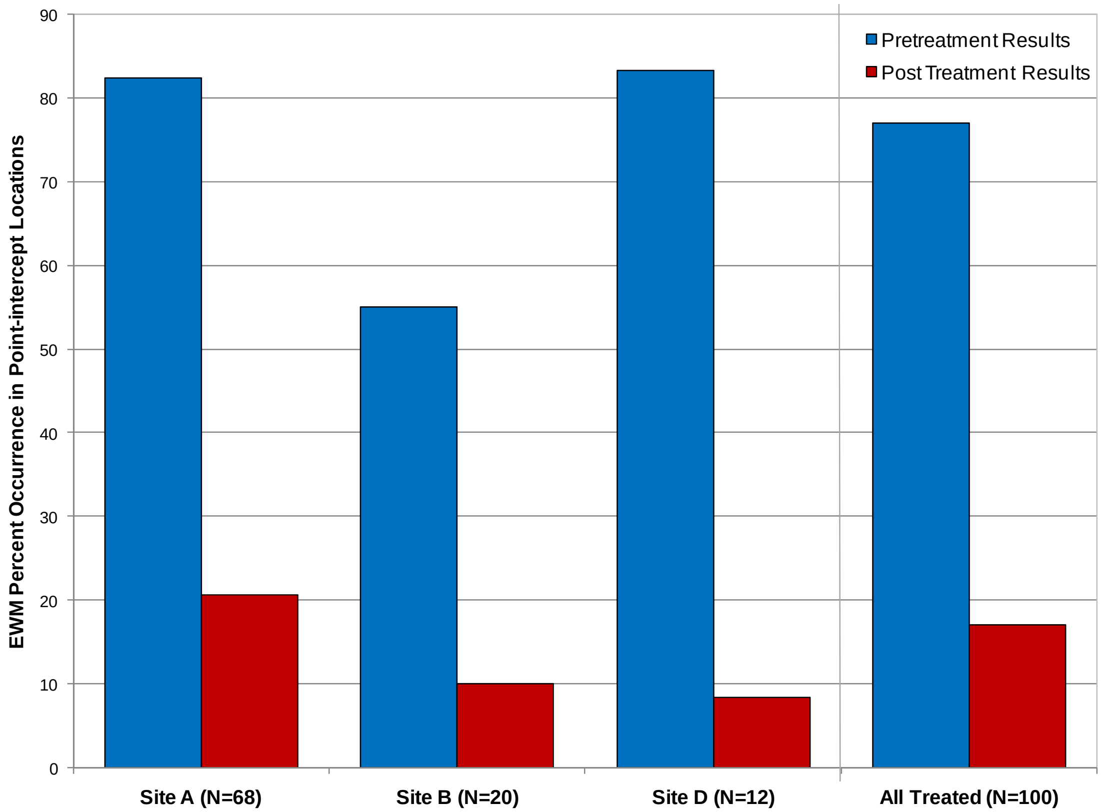

Figure 14. Eurasian water milfoil percent occurrence in point-intercept locations.

Site A Eurasian water milfoil could be located during this treatment area, but in reduced density. Percent occurrence was reduced to 20.6% (Figure 14) and of the locations that contained Eurasian water milfoil, approximately 86% was at a rake fullness of 1.

Site B Almost no Eurasian water milfoil was located in this treatment area. Only 2 out of 20 point-intercept locations contained Eurasian water milfoil (Figure 14).

Site D Most of the clumps that were located before the treatment were gone after the treatment. A few of them appeared only minimally affected and were mapped. Of the 12 point-intercept sample locations, only 1 small piece of Eurasian water milfoil was detected.

Site K & L It is difficult to evaluate treatment results in these sites because the water levels were too low to allow navigation to them. It can be assumed that less than a foot of water is not ideal conditions for the growth of Eurasian water milfoil.

Site E No Eurasian water milfoil was located in this site after the treatment.

2007 Treatment Conclusions

Before the treatment, 77.0% of the point-intercept locations contained Eurasian water milfoil and 17.0% contained the plant after the treatment (Figure 14). A rake fullness rating of 1-3 was used to determine abundance of the Eurasian water milfoil at each location. Figure 15 displays the number of point-intercept locations exhibiting each of the rake fullness ratings. Before the treatment, approximately half the sample locations contained Eurasian water milfoil with a rake fullness rating of greater than 1. Less than 12% contained a rake fullness rating of greater than 1 after the treatment.

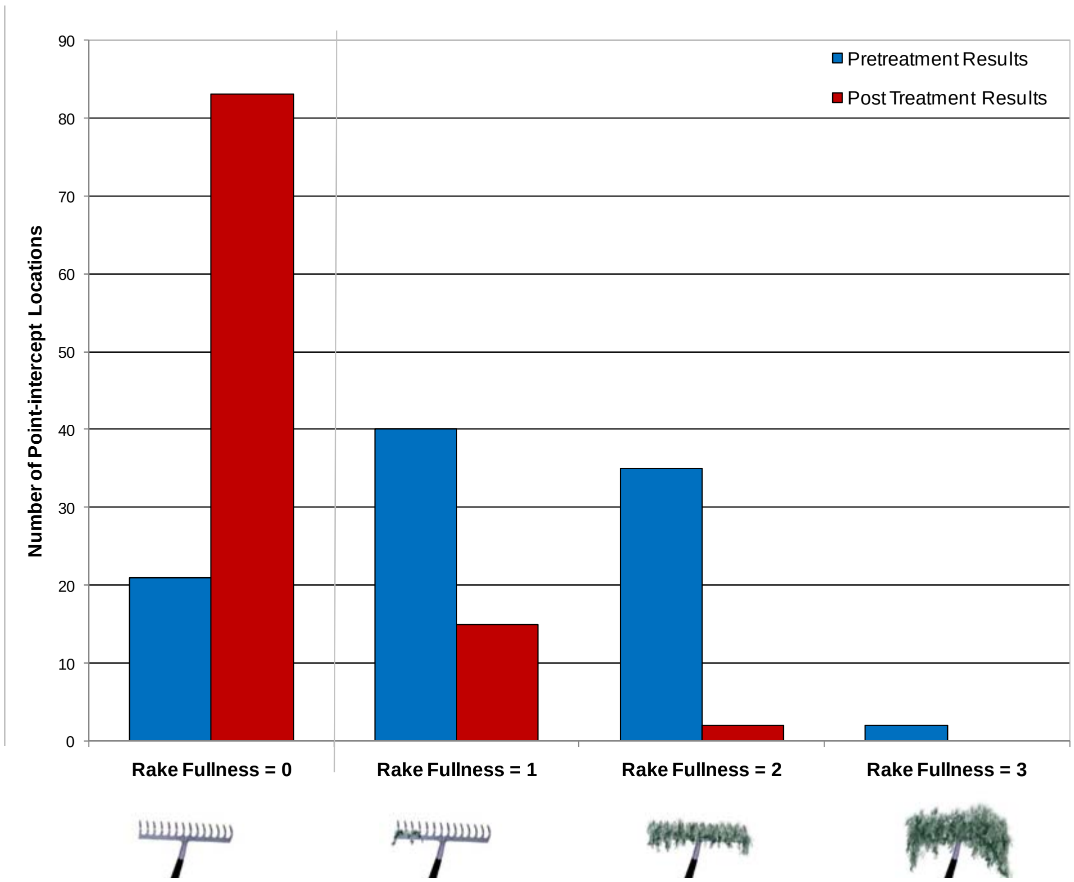

Figure 15. Eurasian water milfoil rake fullness distribution.

Due to their lifecycles most native plants should not have started growing or would be at very low biomass during the spring surveys and chemical treatments. However, it is important to understand the effects of 2,4-D, a dicot-specific herbicide, on our native plants. Special attention needs to be paid to native broad-leaved (dicot) species. Table 5 shows that coontail was not adversely impacted by the treatment because its frequency of occurrence was greater after the treatment. However, these data also show that northern water milfoil was impacted by the treatment because its occurrence was significantly lower following the treatment. Although it is never the intent of the treatments to impact native species, it is important to remember that these non-target impacts can only be considered in the context of the areas treated and not on a lake wide basis. In other words, the impact of the treatments on northern water milfoil that were documented in the treatment areas cannot be extrapolated to the entire northern water milfoil population within Bridge Lake. The same cannot be said for Eurasian water milfoil because by treating the majority of the Eurasian water milfoil within the lake successfully, the Eurasian water milfoil is being impacted on a lake wide basis. It is important to remember that the purpose of the treatment is to slow or stop Eurasian water milfoil from displacing our native species. Without intervention, an argument could be made that over time, Eurasian water milfoil would displace the northern water milfoil. In the end, the only way to truly determine the effects of the treatment on non-target species is to replicate the whole-lake point-intercept survey at a later date.

Table 5. Percent occurrence of native dicots from the treatment monitoring point-intercept survey.

	% Occurrence	
Species	**Pretreatment Results**	**Post Treatment Results**
Coontail	23.0	59.0
Northern water milfoil	20.0	1.0

It is perceived that the level of control achieved from the chemical treatments conducted on Bridge Lake was high. Because Bridge Lake is a reservoir for the purpose of maintaining other impoundment flows for generating hydroelectric power, water level fluctuations are a regular occurrence in Bridge Lake, but irregular in their magnitude and timing. This makes coordinating efficient treatments more difficult. Map 6 shows the locations of Eurasian water milfoil from the peak biomass survey completed on August 20 and 21, 2007. Some of these areas may become too shallow for Eurasian water milfoil to grow during times of low water, whereas some areas are most likely too deep for Eurasian water milfoil to be successful when the water level is high. The role of the pretreatment survey to accurately target the Eurasian water milfoil at the time of the treatment is paramount for Bridge Lake. A conditional permit for chemical application on Bridge Lake will include the 38.0 acres of treatment areas found on Map 6. The pretreatment survey may result in a reduction of the total acreage due to the effects water levels have on this species. Evaluation of the treatments on Bridge Lake needs to continue following the most widely accepted protocol at that time.

SUMMARY AND CONCLUSIONS

A primary aspect of this project is the collection of data and information that is essential in the development of the management plan, but also important as a record of the lake's condition. Many studies and surveys were completed during 2006 and 2007 that focused upon Bridge Lake's aquatic plant community, watershed, water quality, and of course, the thoughts and ideas of the people that use the lake and care for it. This section of the management plan summarizes the findings of these studies and attempts to tie all of it together as best as possible in the form of conclusions. The conclusions are a realistic picture of Bridge Lake based upon the best information available.

It is unfortunate that the historic water quality data available for Bridge Lake is so spotty; however, examination of the available data indicates that Bridge Lake's water quality is better than most impoundments in Wisconsin. Further, that water quality has stayed about the same with normal fluctuations over the course of the last two decades. As mentioned in the Water Quality section, the respondents to the survey do not seem to agree with those results as most indicated that the water quality is less than fair and that it has degraded greatly since they obtained their property.

The surveys completed by Onterra and the WDNR reveal that from an ecological standpoint, the aquatic plant community in Bridge Lake is excellent. This is indicated by the lake's high diversity and outstanding floristic quality. The truth is that the make up of Bridge Lake's plant community could be considered among the best in the state, and as pointed-out in the Aquatic Plant section, is an important aspect in not only the health of the fish and wildlife populations that flourish in the lake, but also in the health of the lake itself. It is the lake's quality native plant community that has kept Eurasian water milfoil from spreading and completely taking over Bridge Lake. In reality, Bridge Lake withstands fluctuating water levels, shoreland development pressure, and recreational use making it a disturbed system that is prime for exotic infestation. Without the competition created by the existing native plant community, it is likely that the Eurasian water milfoil infestation would resemble those that have occurred in some of our state's more southern lakes that require annual mechanical harvesting budgets exceeding $50,000 in order to maintain navigation lanes around the lake.

In Question 15 of the survey (Appendix B), more people ranked "Excessive aquatic plant growth" as one of their top three concerns regarding Bride Lake than any other category. In addition 91.5% of the respondents report that aquatic plant growth impacts their recreational use of the lake sometimes or more often (Appendix B, Q16). Although the plant community in Bridge Lake is healthy, there are areas of the lake where lush vegetation may reach nuisance levels and impede recreational use of the lake, in particular watercraft navigation. Some of these areas, especially in the southern basin near State Highway 8 are made non-navigable by a combination of sediment build up and emergent plant biomass. Both of these components are difficult to mitigate in an attempt to restore navigation. To do so, costs would be considerable and WDNR permits, which are often difficult to obtain, would be needed.

Other areas of the lake experiencing nuisance levels of plants may primarily consist of floating-leaf species, such as lilies, and some emergents, like bulrushes and cattails. Fluctuating water levels facilitate this growth with low water years likely producing the greatest biomass, especially if low levels occur in consecutive years, such as the last few years in Wisconsin. In order to facilitate reasonable access to the open water areas of the lake, chemical treatments may be necessary, but must be done under applicable WDNR permits and within the department's strategy that is made very clear in the Northern Region WDNR document produced during the summer of 2007 entitled, "Aquatic Plant Management Strategy". A part of that strategy is assuring that the treatments are truly needed and a program of treating the area regardless if it is needed or not does not occur. This would be applicable to a system like Bridge Lake where low water levels may promote nuisance plant growth and high water levels may prohibit the growth to nuisance levels.

In general, fluctuating water levels have been shown to increase diversity of aquatic plants within a lake, especially emergent species that rely on this regime for reproduction and expansion. However, Eurasian water milfoil management on Bridge Lake will always be challenging due to the fluctuating water levels that exist of this water storage reservoir. The peak biomass survey conducted in late summer of each year used to set up the following year's treatment will occur when water levels are 5 or more feet less than when the treatment will occur. Also, it is likely that water levels will continue to lower during the fall until early spring when winter snow melt and rain replenishes the reservoir. During this period of low water levels, EWM colonies desiccate or freeze in some areas while they are able to expand to other parts of the lake previously too deep for colonization. Therefore pinning down areas that should be treated is challenging. An understanding of these limitations is needed by the association when determining budgets and by managers when developing and permitting the treatments.

As described in the Watershed section, Bridge Lake has a very large area of land draining to it. In fact, for every surface acre of Bridge Lake, there are 75 acres of land draining to it, which means that the watershed is the greatest factor in determining the water quality and ecological function of the lake. Specifically, the water flowing into the lake is the primary contributor to not only the lake's water quality, but also how the lake functions as an ecosystem. In general, the larger the watershed to lake area ratio (Bridge Lake's is 75:1), the greater impact the watershed is going to have on the water quality and ecology of the lake. Naturally, the condition of the land draining to the lake is important because that is what controls the quality of inflowing water.

The watershed analysis and modeling completed for Bridge Lake indicates that although the lake has a very large watershed, the land cover within the watershed is of high quality. Nearly 70% of the watershed is forested and just over 20% is in wetlands. These two land cover types export very little phosphorus, sediment, and other pollutants to a lake. Very small amounts of agriculture, especially row crops occur within the drainage basin, so the impact of that type of land cover's normally high export rate is minimized. Still, even with the vast majority of the lake's watershed being in land cover that exports very little pollutants, the shear amount of land draining to the lake means there is going to be considerable sediment and phosphorus being delivered to the lake by its watershed. These impacts are seen in Bridge Lake in two forms 1) the lake's historic and current phosphorus levels which are much higher than other systems in the same region, and 2) by the build up of sediments in some areas of the lake.

Dealing with the two impacts described above are common in impoundments, especially those with large watersheds. This is the case because impoundments are not natural lakes. Even if some natural event occurred that created a dam where the Bradley Dam now stands, that impediment would soon be washed away through erosion. To get around that problem, humans use concrete and other hard re-enforcements to prevent the erosion. However, Mother Nature strives to remove the unnatural waterbody from the landscape, and because the dam cannot be eroded away, the next best thing is to fill it in with sediments. Those sediments can be carried into the lake by inflowing water or created within the lake through plant biomass production and its subsequent decomposition. In impoundments like Bridge Lake where much of the lake was originally a wetland, the plant production is enhanced right from the start with the nutrient rich sediments that already exist in what is now called the lake bottom.

The processes described above occur in natural lakes too, but because of their morphology and placement on the landscape, the filling in of the lake occurs much slower. Lake sedimentation is a natural process and is a part of the aging of every lake. This process is elaborated upon in the Water Quality section and is called eutrophication. All lakes go through eutrophication; however, the process is greatly accelerated in impoundments. As a result, we need to consider that fact in the management of an impoundment. In other words, Bridge Lake cannot be managed as if it is a natural lake, it must be managed as a man-made feature in the landscape. This means that there are certain aspects of the lake that cannot be easily controlled, like sedimentation and plant growth. As described above, these two factors are accelerated in an impoundment; therefore, the mitigation of their impacts, no matter how distasteful to lake users, would be very expensive and may actually expose the lake to other risks. For example, dredging would be an applicable technique for the removal of sediments and plant biomass from Bridge Lake. Besides the fact that a dredging project would be very expensive, likely $15 - $30/cubic yard of material removed, it would also expose those areas to a very likely and heavy infestation by Eurasian water milfoil. Removing three feet of sediments from the bottom of Bridge Lake would be like digging up or tilling a portion of a lawn, the first thing that would colonize the newly exposed soil in the lawn would be weedy species such as thistle and dandelion. The same would occur in Bridge Lake, but the weedy species would be Eurasian water milfoil, which flourishes in areas where native plants do not occur to compete against it. In the end, we must remember that we cannot stop the eutrophication process; however, we can work to minimize its negative impacts while not harming other aspects of the lake.

The stakeholder survey was sent out to 127 riparian property owners around Bridge Lake and approximately 38% of those surveys were returned. Many of the comments that were included within and at the end of the returned surveys referred to low water levels. As indicated in Figure 5, the 2007 levels were among some of the lowest since 1998. Unfortunately, these low levels, more specifically, their negative impact on the enjoyment of Bridge Lake by its users, may have impacted the results of the survey. In other words, the negative feelings brought on by the low water levels may not have only reduced the return rate, but they may have also crept into the responses to the questions within those surveys that were returned. Although impossible, it would be interesting to see what the return rate would have been and how the responses would compare to the current survey if this year’s water levels would have been higher than normal instead of lower.

Water levels on the Rice River Reservoir are a contentious subject among riparian property owners, the WVIC, and the WDNR. It is truly beyond the scope of this planning project to deal with this issue because it is more of a legal and social issue than an ecological issue. The fact is the fluctuating water levels in the Rice River Reservoir are not producing detectable negative ecological impacts on Bridge Lake. Further, human impacts to the lake, through shoreland development and recreational use, have more of a negative impact than the water levels. That being said, there is a definite need to address the negative impacts the fluctuating water levels are having on the folks that live around and use Bridge Lake. These impacts include limited or nonexistent access to water during a portion of the open water season, nuisance plant growth, and decreased property values. Again, none of these are impacts to the ecology of Bridge Lake, but they are definite impacts to the stakeholders that are charged with managing the lake; and therefore, certain aspects of the Implementation Plan presented in the following section were created to address at least a portion of those sociological impacts.

IMPLEMENTATION PLAN

The Implementation Plan presented below was created through the collaborative efforts of the LNCC Bridge Lake Planning Committee and ecologist/planners from Onterra. It represents the path the LNCC will follow in order to meet their lake management goals. The goals detailed within the plan are realistic and based upon the findings of the studies completed in conjunction with this planning project and the needs of the Bridge Lake stakeholders as portrayed by the members of the Planning Committee, the returned stakeholder surveys, and numerous communications between Planning Committee members and the lake stakeholders. The Implementation Plan is a living document in that it will be under constant review and adjustment depending on the condition of the lake, the availability of funds, level of volunteer involvement, and the needs of the stakeholders.

Management Goal 1: Maintain Current Water Quality Conditions

Management Action: Monitor water quality through WDNR Citizens Lake Monitoring Network.
Timeframe: Begin Summer 2008, if possible.
Facilitator: Planning Committee to recruit volunteer(s).
Description: Monitoring water quality is an import aspect of every lake management planning activity. Collection of water quality data at regular intervals aids in the management of the lake by building a database that can be used for long-term trend analysis. The lack of this type of historical information hampered the water quality analysis during this project. Early discovery of negative trends may lead to the reason as to why the trend is developing. Volunteers from Bridge Lake have collected Secchi disk clarities in the past through the WDNR Citizen Lake Monitoring Program. These efforts will be enhanced by collecting additional water quality parameters through the program's advanced protocol. Note: as a part of this program, these data are automatically added to the WDNR database and available through their Surface Water Integrated Monitoring System (SWIMS).
Action Steps:

1. Planning Committee recruit one or more volunteers from Bridge Lake.
2. Planning Committee or volunteer contact Sandy Wickman, WDNR (715.365.8951, sandra.wickman@wisconsin.gov) to arrange for training and equipment.
3. Volunteers collect data and report results to WDNR and to association members during annual meeting.

Management Action: Reduce phosphorus and sediment loads from immediate watershed.
Timeframe: Begin 2008
Facilitator: Planning Committee to recruit volunteer or form Education Committee
Description: Bridge has a very large watershed draining to it and as a result, the impacts that are most controllable at this time originate along the lake's immediate shoreline. These sources include faulty septic systems, the use of phosphorus-containing fertilizers, shoreland areas that are maintained in an unnatural manner, and impervious surfaces. To reduce these impacts, the LNCC will initiate an

educational initiative aimed at raising awareness among shoreland property owners concerning their impacts on the lake. This will include news letter articles and guest speakers at association meetings.

Action Steps:

1. Recruit facilitator.
2. Facilitator gathers appropriate information from WDNR, UW-Extension, Lincoln and Oneida Counties, and other sources.
3. Facilitator summarizes information for newsletter articles and recruits appropriate speakers for association meetings.

Management Goal 2: Control Aquatic Invasive Species within Bridge Lake

Management Action: Initiate Clean Boats Clean Waters watercraft inspections at Rice River Reservoir public access sites.

Timeframe: Start 2008 or 2009

Facilitator: Planning Committee

Description: Although Bridge Lake already contains aquatic invasive species (AIS), including purple loosestrife and Eurasian water milfoil and Lake Nokomis has been found to contain curly-leaf pondweed, it is still important to minimize the chance that other AIS be introduced into the system and that existing AIS are not transported to other waterbodies. To that end, the LNCC will initiate a WDNR Clean Boats/Clean Waters watercraft inspection program at the Rice River Reservoir public access sites.

Action Steps:

1. Members of association attend Clean Boats Clean Waters training session during spring or summer 2008
2. Training of additional volunteers completed by those trained during 2008.
3. Begin inspections during high-risk weekends
4. Report results to WDNR and LNCC.
5. Promote enlistment and training of new of volunteers to keep program fresh.

Management Action: Coordinate annual volunteer monitoring of Aquatic Invasive Species

Timeframe: Start 2009

Facilitator: Planning Committee

Description: In lakes without aquatic invasive species, early detection of pioneer colonies commonly leads to successful control and in cases of very small infestations, possibly even eradication. Even in lakes where these plants occur, monitoring for new colonies is essential to successful control.

Specific to Bridge Lake and the control plan described below, interested stakeholders already perform considerable amount of Eurasian water milfoil monitoring on their own; therefore, the framework for such a volunteer network is essentially in place. As a part of the control program, the volunteers will provide locations of Eurasian water milfoil and other aquatic invasive species for professional ecologists to focus their efforts upon, making more efficient use of professional time while engaging stakeholders in the program.

Action Steps:

1. Recruit volunteers to conduct field surveys
2. Retain consultant to coordinate monitoring strategy
3. Obtain WDNR grant
    a. Purchase GPS unit for association
    b. Consultant trains volunteers on GPS use and data collection
    c. Consultant trains volunteers on native/non native species identification
    d. Volunteers transfer data to consultant for integration and graphical representation during control program described below.

Management Action: Reduce occurrence of purple loosestrife on Bridge Lake shorelands.
Timeframe: Summer 2008
Facilitator: Planning Committee
Description: Purple loosestrife can be found in numerous locations along the shorelands of Bridge Lake. At this time, infestation levels are still low enough that hand-pulling efforts will likely keep this invasive species under control; therefore, this method will be utilized initially during the program. Information sources, such as the WDNR, UW-Extension, and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC, www.glifwc.org, 715.682.6619) will be used to properly identify purple loosestrife and provide guidance on the proper time to pull the plants.

Important aspects of this management action will be the monitoring and record keeping that will occur in association with the control efforts. These records will include maps indicating infested areas and associated documentation regarding the actions that were used to control the areas, the timing of those actions, and the results of the actions. These maps and records will be used to track and document the successfulness of the program and to keep the WDNR, WVIC, and LNCC updated.

Action Steps:

1. Recruit members to begin monitoring and control efforts
2. Group completes surveys to identify infested areas
3. Initiate applicable control methods
4. Monitor results and reapply control as necessary
5. Keep WDNR and LNCC informed regarding program results

Management Action: Reduce common reed occurrences in Bridge Lake.
Timeframe: Summer 2009
Facilitator: Planning Committee
Description: Common reed, an emergent wetland plant, is found growing in multiple locations along the shores of Bridge Lake (Map 3). An integrated strategy of mechanical removal (cutting) followed by herbicide application has shown to be effective on small populations of common reed.

Because of the hardy nature of this species, control strategies are largely only effective when conducted in the late summer/early fall of the year when the plant is actively sending sugars and carbohydrates into its rhizomes for over-winter storage. At this time of the year, the stems are tied together (at about waist height), the seed heads are cut-off slightly above where they are tied (if possible, discard by burning), and a glyphosate herbicide plus a surfactant is applied to the cut ends. Adding a die to the herbicide can aid in keeping track of the stem-bundles that have been chemically treated. Please note that the cutting and herbicide application steps do not need to occur on the same day. Herbicide applications conducted later in the year have shown to be most successfully, typically as long as temperatures exceed 28° F (Phragmites Control and Management Workshop, 2006). Depending on the stage of infestation, multiple years of treatments will need to be conducted.

Many established populations contain an accumulation of dead stems from previous years' growth. By removing this dead vegetation before the current year's growth begins, it will make bundling of the live plants easier in the upcoming fall. This can be accomplished by cutting or mowing in the spring or early summer.

Photo 1. Common reed on Bridge Lake. This colony is located above the water line when the picture was taken on August 29, 2008.

As stated within Wisconsin Administrative Code NR 107, a WDNR permit ($20 permit application fee plus $25 per acre) is required to use herbicides if the applicator is "standing in your socks and they get wet.' Along with a permit, a certified applicator is required to conduct the treatment if the area is wet. Due to the water storage needs of the WVIC, the water level on Bridge Lake in the early fall is typically lower than in the summer, leaving many of the common reed populations considerably higher than the water level. This allows these infestations to be treated without a certified applicator or permit. An approved aquatic herbicide like Rodeo® or Habitat® does need to be used if the plants are below the ordinary high water mark. Habitat® has shown to be considerably more effective than Rodeo®, but this herbicide needs to be applied either by a unit of government or a certified applicator with government authorization.

Please note that dredging, tilling, or any disturbance to the soil of the lake bottom requires a permit. Because this plant spreads mainly by rhizomes, these activities are largely ineffective and may promote the proliferation of the population.

Action Steps:

See description.

Management Action: Control Eurasian water milfoil infestation on Bridge Lake.
Timeframe: Initiate 2008
Facilitator: Planning Committee with professional help as needed
Description: As described in the Aquatic Plant section and elaborated upon within the Summary and Conclusions, Eurasian water milfoil levels are such in Bridge Lake that the most feasible management technique for its control is herbicide treatments. The responsible use of this technique is well supported by Bridge Lake riparians as indicated by over 60% of stakeholder survey respondents indicating that they are highly supportive of a herbicide control program (Question 20). Further, successful herbicide treatments were documented during 2007.

The objective of this management action is not to eradicate Eurasian water milfoil from Bridge Lake, as that would be impossible. The objective is to bring Eurasian water milfoil down to more easily controlled levels. In other words, the goal is to reduce the amount of Eurasian water milfoil in Bridge Lake to levels that would only require spot treatments to keep the exotic under control. To complete this objective efficiently, a cyclic series of steps is used to plan and implement the treatment strategies. The series includes:

1. A lakewide assessment of Eurasian water milfoil completed while the plant is at peak biomass (July or August).
2. Creation of treatment strategy for the following spring.
3. Verification and refinement of treatment plan immediately before treatments are implemented.
4. Completion of treatments.
5. Assessment of treatment results (summer after treatment).

Once Step 5 is completed, the process would begin again that same summer with the completion of a peak biomass survey. The survey results would then be used to create the next spring's treatment strategy.

Obviously, monitoring is a key aspect of the cycle, both to create the treatment strategy and monitor its effectiveness. The monitoring would also facilitate the "tuning" or refinement of the treatment strategy as the control project proceeds. It must be remembered, that this portion of the management plan (control plan) would be intended to span approximately 3 to 7 years, before it would need to be updated to account for changes within the ecosystem. The ability to tune the treatment strategies is important because it would allow for the most effective results to be achieved within the plan's life span.

Two types of monitoring would be completed to determine treatment effectiveness; 1) quantitative monitoring using WDNR protocols, and 2) qualitative monitoring using observations at individual treatment sites and on a treatment wide basis. Results of both of these monitoring strategies would be used to create the subsequent treatment strategies. The quantitative strategies include sampling plants, both Eurasian water milfoil and native species, at predetermined locations (points) within treatment areas, while the qualitative monitoring includes the determination of Eurasian water milfoil abundance based upon a continuum of density. The density continuum ranges from non-detectable levels of Eurasian water milfoil to what is considered a monoculture where Eurasian water milfoil is essentially the only plant that exists in the area. Both monitoring types would be completed before and after the treatments (pretreatment surveys and post treatment surveys). Comparing the monitoring results from the pretreatment and post treatment surveys would determine the effectiveness of the treatment on a site-by-site basis and on a treatment wide basis. Finally, a lakewide plant survey (point-intercept survey) would be completed after this management action is completed to determine the effectiveness of the intense control program.

Success Criteria

Determining the effectiveness of the treatment program is impossible unless specific success criteria (goals) are set before beginning the program. For this control program, the criteria would be evaluated at three levels

1. Treatment area (site specific)
2. Annual treatment (treatment wide)
3. Control program

Treatment Area

Qualitatively, a successful treatment on a particular site would include a reduction of Eurasian water milfoil density as demonstrated by a decrease in density rating.

Quantitatively, a successful treatment on a specific-site level would include a significant reduction in Eurasian water milfoil frequency following the treatments as exhibited by at least a 50% decrease in Eurasian water milfoil frequency from the pre- and post treatment point-intercept sub-sampling. In other words, if the Eurasian water milfoil frequency of occurrence before the treatment was 40%, the post treatment frequency would need to be 20% or lower for the treatment to be considered a success for that particular site. Further, there would be a noticeable decrease in rake fullness ratings within the fullness categories of 2 and 3.

Annual Treatment

Qualitatively, success would be achieved annually when 75% of the treatment areas are reduced by a density rating (as described above).

Similar to the site specific evaluation, annual treatment success would be observed when a 50% decrease in Eurasian water milfoil frequency from the sub-sampling occurs. Preferably, there would be no rake tows completed during the post treatment surveys exhibiting a fullness of 2 or 3.

Control Program

At the end of the project, it is hoped that no Eurasian water milfoil colonies would exist over *density=1*. Ecological function of a particular area is thought to be greatly reduced when Eurasian water milfoil becomes the dominant plant which corresponds to a *density=1* rating.

The control program would be quantitatively evaluated by recompleting the whole-lake point-intercept survey at the end of the project and observing a reduction in frequency of Eurasian water milfoil.

Control Program Specifics

This control program is anticipated to span 4 treatment years. Although it is very difficult, if not impossible, to accurately estimate how many acres of Eurasian water milfoil will need to be treated for some number of years in the future, it is obviously needed for budgeting purposes. Based upon the Eurasian water milfoil surveys completed in recent years and the results of recent treatments, a conservative estimate of treatment acreages is listed below. It is conservative in anticipation of some areas requiring treatment for multiple years to reduce densities as discussed in the success criteria.

Project Year	Treatment Year	Estimated Acreage
2008	1	38
2009	2	38
2010	3	19
2011	4	19

Project Funding Assistance

Funds from the Wisconsin Department of Natural Resources Aquatic Invasive Grant Program will be sought to partially fund this control program and other elements of this management plan. Specifically, funds would be applied for under the Established Infestation Control Project classification.

Action Steps:

1. Retain qualified professional assistance to develop a specific project design utilizing the cyclic series of steps discussed above.
2. Apply for a WDNR Established Infestation Control Grant based on developed project design.
3. Initiate control plan
4. Revisit control plan in 4 years
5. Update management plan to reflect changes in control needs and those of the lake ecosystem.

<u>Management Action:</u> Use buoys to mark dense areas of Eurasian water milfoil.
Timeframe: Summer 2008
Facilitator: Planning Committee
Description: Motor boating through dense areas of Eurasian water milfoil can result in fragmentation and subsequent spread to other areas of the lake by natural and manmade currents. To reduce this occurrence, the LNCC will use buoys to mark

dense areas of Eurasian water milfoil to prevent boats from entering the area. The significance of the buoys will be explained in the LNCC newsletter and by signage posted at Rice River Reservoir boat landings.

Before this management action is initiated, the Planning Committee will hold discussions with officials from the WDNR and the Towns of Bradley and Nokomis to assure that local and state regulations are being followed.

Action Steps:

1. Contact WDNR and town officials
2. Purchase buoys.
3. Use buoys to mark boating areas that are dominated by Eurasian water milfoil and/or canopying is occurring.

Management Goal 3: Improve Understanding of Bridge Lake, the Rice River Reservoir, and the Operations of the Wisconsin Valley Improvement Company among Bridge Lake Stakeholders

Management Action: Create series of newsletter articles addressing specific and relevant topics of interest to Bridge Lake stakeholders.

Timeframe: Begin 2008

Facilitator: Planning Committee

Description: Regularly published newsletters allow for exceptional communication within a lake group. This level of communication is important within a management group because it builds a sense of community while facilitating the spread of important association news, educational topics, and even social happenings. It also provides a medium for the recruitment and recognition of volunteers.

The LNCC currently distributes its quarterly newsletter to about 400 members and friends.. The Planning Committee will create or recruit others to create articles to be published within the newsletter that will address the following topic/question examples:

- Guidelines used by WVIC in managing water levels and flows in Wisconsin Reservoir System.
- What rights do riparians and other stakeholders have regarding property on the Wisconsin Reservoir System?
- Why does the water overflow the Jersey City Flowage dam even while Rice River Reservoir levels are low?
- Wildlife community changes on Bridge Lake.
- Is purchasing the dam from WVIC feasible?
- History of Bridge Lake and Rice River Reservoir.
- Are there certain limits or ranges that the water levels must remain in as specified by a state or federal license or regulation? Are there penalties involved if the dam is not operated so these specifications are met?
- Property taxes of waterfront property that is not always on the waterfront.

Action Steps:

See description above.

Management Action: Bridge Lake volunteer monitors water levels at Nokomis Dam
Timeframe: Initiate 2008
Facilitator: Planning Committee to recruit volunteer
Description: During the planning meetings associated with this project, it was voiced that water levels reported by WVIC on their website are intentionally inaccurate in order to mislead the public. Apparently, this is a relatively common belief among riparians.

Having a volunteer from Bridge Lake record daily water levels would be the simplest way to provide accurate data to Bridge Lake stakeholders while verifying the information the WVIC is reporting.

The staff gage at the Nokomis dam is set based upon the reservoir's maximum level of 1463.25 feet above Mean Sea Level (see photo below). A nail is set at the maximum level (see inset). The reading on November 12, 2007 was approximately 1458.8 feet above MSL.

Action Steps:

1. Planning Committee recruits multiple volunteers so water levels can be recorded on a near daily basis.
2. Monitoring team captain is selected among the volunteers to coordinate efforts and keep central water level database.
3. Captain gives report to LNCC at annual meeting discussing water levels and comparisons with data reported by the WVIC.

Management Action: Research and develop plan to slow the advancement of native bulrushes and cattails in southern portion of Bridge Lake.
Timeframe: Begin 2008
Facilitator: Planning Committee
Description: For reasons not completely understood at this time, the shallow, emergent wetland located in the southern portion of Bridge Lake appears to be advancing north and overtaking open water areas. Over the course of time, the advancement of this emergent area has blocked access of approximately 16 properties to open water. This management action is intended to investigate the causes of this apparent advancement and research feasible methods to slow or stop it from continuing. Research will include the benefits, costs, and restrictions involved with facilitating an annual burn of the area and/or the use of herbicides. The investigation will also include the possible benefit to the WVIC in terms of increased storage capacity if the area is successfully treated.

Action Steps:

1. Plot progression of native bulrushes and cattails on maps using GPS and mark advancement with buoys.
2. Research costs, benefits, restrictions, and riparian support of an annual burn and herbicide application and discuss with WDNR, WVIC, aquatic plant specialists, lake management planners, and riparian landowners.

Photo 2. Nokomis (Bradley) Dam staff gage. Center picture shows full gage as it is mounted on dam. Left picture shows close up of nail marking maximum level of 1463.25 feet above MSL. Right picture shows close up of water level reading of approximately 1458.80 feet above MSL on the day the picture was taken (November 12, 2007).

Management Goal 4: Improve Safety on Bridge Lake

Management Action: Mark navigational hazards and no-wake areas.
Timeframe: Begin 2008
Facilitator: Planning Committee
Description: Numerous navigational hazards exist in Bridge Lake, most of which are made worse by fluctuating water levels. It is the intent of this management action to increase user safety on Bridge Lake by marking the hazards as much as reasonably possible. Further, this action will initiate the creation of certain no-wake areas in order to increase safety and minimize shoreline erosion.

Potential projects in this action include:

- Marking navigation hazards, including rocks, sand bars, stump fields, and aquatic plant masses with buoys.
- Install and maintain no-wake buoys and channel markers for Deer-Bridge Lake channel.
- Add no-wake buoys to area south of County Highway N passage.
- Add permanent water level marker (buoy designed to show dangerous low water level) at entrance to southern section of Bridge Lake. This part of the lake is about 2 feet shallower than the area around the large island
- Contact Oneida County regarding removal of bridge pilings under County Highway N bridge (hazard with low water).

Action Steps:

1. Determine potential buoy locations and number required.
2. Contact Towns of Nokomis and Bradley to determine process of placing buoys.
3. Create budget and investigate possible grants through WDNR Waterways Commission.

<u>Management Action:</u> Riparian landowners monitor for unsafe or prohibited activities on Bridge Lake.

Timeframe: Begin 2008

Facilitator: Planning Committee

Description: Citizen monitoring and reporting to law enforcement of unsafe or prohibited activities will help create a lake environment on which everyone can recreate safely. A Lake Watch is an activity in which all lake users can participate. Ideally, this activity can create a sense of community among riparian landowners, lake organizations, and law enforcement officers. Emergency and law enforcement response times can also be shortened. Posted signs will place would-be violators on notice that activities on the lake are being monitored.

Action Steps:

1. Post an emergency and/or law enforcement phone number at boat launches and Wisconsin Valley Improvement Company property (with WVIC permission).
2. Distribute written articles in newsletters, newspapers, and website postings to encourage reporting of unsafe or suspicious activities on the water.
3. Distribute information to reinforce the message of "Be safe on the water".
4. Establish a communication link between law enforcement and LNCC to address safety issues on the Rice River Reservoir.

<u>Management Action:</u> Investigate creation of slow-no-wake hours on Bridge Lake.

Timeframe: Begin 2008

Facilitator: Planning Committee

Description: Like most lakes, Bridge Lake is visited by numerous user groups that recreate on the lake in different ways. Some lake users prefer more passive recreation like, swimming, fishing, or paddling; while others prefer more active recreation, like jet skiing, motor boating, and waterskiing. Occasionally the use by these different groups overlaps and causes conflicts. An appropriate remedy to these conflicts is setting certain hours of the day aside on a lake for more passive forms of recreation.

The intent of this management action would be to investigate the *possibility* of creating slow-no-wake hours for Bridge Lake. This would include the collection of stakeholder opinions regarding the idea and preliminary discussions with the Towns of Nokomis and Bradley regarding the development of ordinances.

Action Steps:

See description above.

METHODS

Lake Water Quality

Baseline water quality conditions were studied to assist in identifying potential water quality problems in Bridge Lake (e.g., elevated phosphorus levels, anaerobic conditions, etc.). Water quality was monitored at the deepest point in Bridge Lake that would most accurately depict the conditions of the lake (Map 1). Samples were collected with a 3-liter Van Dorn bottle at the subsurface (S) and near the bottom (B). Sampling occurred once in spring, fall, and winter and three times during the summer. Samples were kept cool and preserved with acid following standard protocols. All samples were shipped to the Wisconsin State Laboratory of Hygiene for analysis. The parameters measured included the following:

	Spring		June		July		August		Fall		Winter	
Parameter	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**
Total Phosphorus	●	●	●	●	●	●	●	●	●	●	●	●
Dissolved Phosphorus	●	●			●	●					●	●
Chlorophyll a	●		●		●		●		●			
Total Kjeldahl Nitrogen	●	●			●	●					●	●
Nitrate-Nitrite Nitrogen	●	●			●	●					●	●
Ammonia Nitrogen	●	●			●	●					●	●
Laboratory Conductivity	●	●			●	●						
Laboratory pH	●	●			●	●						
Total Alkalinity	●	●			●	●						
Total Suspended Solids	●	●	●	●	●	●	●	●	●	●	●	●
Calcium	●											

In addition, during each sampling event Secchi disk transparency was recorded and a temperature, pH, conductivity, and dissolved oxygen profile was completed using a Hydrolab DataSonde 5.

Aquatic Vegetation

Curly-leaf Pondweed Survey

Surveys of curly-leaf pondweed were completed on Bridge Lake during a June 14, 2006 field visit, in order to correspond with the anticipated peak growth of the plant. Visual inspections were completed throughout the lake by completing a meander survey by boat.

Comprehensive Macrophyte Surveys

Comprehensive surveys of aquatic macrophytes were conducted on Bridge lake to characterize the existing communities within the lake and include inventories of emergent, submergent, and floating-leaved aquatic plants within them. The point-intercept method as described in "Appendix C" of the Wisconsin Department of Natural Resource document, Aquatic Plant Management in Wisconsin, (April, 2005) was used to complete this study on June 12-13, 2006. A point spacing of 52 meters was used resulting in approximately 642 points.

Community Mapping

During the species inventory work, the aquatic vegetation community types within Bridge Lake (emergent and floating-leaved vegetation) were mapped using a Trimble GeoXT Global Positioning System (GPS) with sub-meter accuracy. Furthermore, all species found during the point-intercept surveys and the community mapping surveys were recorded to provide a complete species list for the lake.

2007 Treatment Monitoring

The methodology used to monitor the 2007 herbicide treatments is included within the results section under the heading: *Treatment Monitoring.*

Watershed Analysis

The watershed analysis began with an accurate delineation of Bridge Lake's drainage area using U.S.G.S. topographic survey maps and base GIS data from the WDNR. The watershed delineation was then transferred to a Geographic Information System (GIS). These data, along with land cover data from the Wisconsin initiative for Statewide Cooperation on Landscape Analysis and Data (WISCLAND) were then combined to determine the watershed land cover classifications. These data were modeled using the WDNR's Wisconsin Lake Modeling Suite (WiLMS) (Panuska and Kreider 2003)

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