Seven Island Lake

Lincoln County, Wisconsin

Comprehensive Management Plan

May 2011

Sponsored by:

Lincoln County Land Information and Conservation Department

Seven Island Lake Association, Inc

Wisconsin Department of Natural Resources Lake Management Planning Grants

LPL-1175-07 & LPL-1176-07

Onterra, LLC
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Onterra LLC
Lake Management Planning

Seven Island Lake

Lincoln County, Wisconsin

Comprehensive Management Plan

May 2011

Created by: Eddie Heath and Tim Hoyman
Onterra, LLC
De Pere, WI

Funded by: Seven Island Lake Association, Inc.
Lincoln County Land Information and Conservation Department
Wisconsin Dept. of Natural Resources (LPL-1175-07 & LPL-1176-07)

Acknowledgements

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

Seven Island Lake Association

Anthony Baumann
Dan Nordall
Irv Sumner
Judy Geurink
Kathleen McFadden
Tim McFadden

Lincoln County

Diane Hanson

Wisconsin Dept. of Natural Resources

Kevin Gauthier
Kyle McLaughlin

TABLE OF CONTENTS

FIGURES

TABLES

MAPS

APPENDICES

1.0 INTRODUCTION

Seven Island Lake is a 132-acre seepage lake nestled in the Harrison Hills region of Lincoln County, Wisconsin (Map 1). The lake has a maximum depth of approximately 31 feet and mean depth of 14 feet. Interestingly, the lake's name comes from the fact that one of the five islands is shaped like the number "7".

Eurasian water milfoil was discovered in the lake during the fall of 2004 and was believed to occupy approximately 1 to 3 acres near the lake's sole boat landing. By midsummer 2005, the colony had spread to 5 or 6 acres, and by the fall of 2005 it had spread to about 9 acres. From its discovery, the Seven Island Lake Association (SILA) has reacted swiftly, but calmly, to stop its spread. The association initiated hand-removal by divers, the creation of a buoyed slow-no-wake zone near the infestation site, and of course, educated itself on how to best handle the situation. During the summer of 2005, the association, along with its new partner, the Lincoln County Land Information and Conservation Department (LICD), successfully applied for a Wisconsin Department of Natural Resources (WDNR) Aquatic Invasive Species (AIS) Rapid Response Grant. Those funds were used to chemically treat approximately 9 acres of Eurasian water milfoil during September 2005.

SILA members kept a watchful eye on the treatment site (and the entire lake) during the 2006 growing season. As of fall 2006, there was no sign of Eurasian water milfoil in the lake; however, the association understands that it is highly improbable that Eurasian water milfoil has been eradicated from their lake and as a result is preparing to continue its control efforts. The first step in those continued efforts would be the creation of a management plan for Seven Island Lake.

Although the discovery and ensuing battle with Eurasian water milfoil spurred the association's wish to create a lake management plan, it would definitely not be the sole focus of the plan. Since its inception in the late 1980's, the SILA has worked to protect and holistically manage their lake. They have been collecting water quality data as a part of the Citizens Lake Monitoring Network for years, they manage the camping area on one of the lake's islands so all lake users can enjoy it, they have installed fish cribs meeting WDNR guidelines, they worked with a local fishing club to stock fish in the lake and orchestrate a kid's fishing contest, and they have partnered with various other groups to raise funds for charity work outside of their lake. Further, with the help of the WDNR, the association facilitated the falling of many trees around the shore of the lake to increase valuable fish habitat. In a highly proactive approach, an association member donated over 60 acres of land, which includes considerable Seven Island Lake shorelands, to the Northwoods Land Trust in order to preserve its wild nature.

It is obvious that the SILA is in tune with the needs of their lake; however, their recent efforts in managing Eurasian water milfoil has brought to light the need to create a lake management plan that would not only guide the group in its battle against Eurasian water milfoil, but also facilitate the continuation of their current management efforts and bring forth other management actions that can aid in the protection of their lake. To complete this task, the SILA has once again partnered with the LICD to complete a comprehensive management plan for Seven Island Lake.

2.0 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. Stakeholders were also informed about how their use of the lake's shorelands and open water areas impact the lake. Stakeholder input regarding the development of this plan was obtained through communications and meetings with the Seven Island Lake Association and via a stakeholder survey. A description of each stakeholder participation event can be found below, while supporting materials can be found in Appendix A.

Newsletter Articles

During the course of the project, updates were provided to the SILA for inclusion in their association newsletter. These updates, provided during September 2007 and June 2008 summarized the activities that had been completed thus far and the next steps that were to be taken during the planning project.

Kick-off Meeting

On July 28, 2007 the SILA held a meeting to inform association members and other interested parties about the lake management planning project the association was undertaking. During the meeting, Eddie Heath, an ecologist with Onterra, presented information about lake eutrophication, native and non-native aquatic plants, the importance of lake management planning, and the goals and components of the Seven Island Lake management planning project.

Stakeholder Survey

During December 2007, a six-page, 27-question survey was mailed to Seven Island Lake stakeholders. The mailing included all riparian property owners and all off lake members of the SILA. Over 50% of the surveys were returned and those results were entered into an Onterra-provided spreadsheet by SILA planning committee members. The data were summarized and analyzed by Onterra for use at the planning meeting 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.

Planning Committee Meeting

On July 14, 2008 Tim Hoyman and Eddie Heath of Onterra met with 7 members of the SILA Planning Committee for a little over 3 hours. All study components including, aquatic plant inventories, water quality analysis, watershed modeling, and the stakeholder survey were presented and discussed. Being that Seven Island Lake is in excellent health and no Eurasian water milfoil was located within that lake during the summer, much of the discussion revolved around actions that could be undertaken by the association to protect the lake.

Following the planning meeting, the Planning Committee met again to review a draft Implementation Plan supplied by Onterra. The Implementation Plan contained near the end of this document is based upon that draft and the comments and suggestions provided by the Planning Committee.

Project Wrap-up Meeting

On July 25, 2009, Eddie Heath presented the study findings and conclusions to 38 members of the SILA. The Implementation plan created as a part of the project was also presented and all questions were answered regarding the study results and the draft plan.

Management Plan Review and Adoption Process

In December 2009, a draft of the Seven Island Management Plan was supplied to the WDNR and the SILA Planning Committee. Comments were received from the planning committee within a few weeks after the draft report was made available.

The WDNR provided written comments to the draft management plan on February 3, 2011. A second draft of the plan was provided to the WDNR during May of 2011. A short list of additional comments was provided by the WDNR on August 31, 2011. This report reflects the integration of WDNR and SILA comments. The final report will be reviewed by the SILA Board of Directors and a vote to adopt the management plan will be held during the association's next annual meeting.

3.0 RESULTS & DISCUSSION

3.1 Lake Water Quality

Primer on Water Quality Data Analysis and Interpretation

Reporting of water quality assessment results can often be a difficult and ambiguous task. Foremost is that the assessment inherently calls for a baseline knowledge of lake chemistry and ecology. Many of the parameters assessed are part of a complicated cycle and each element may occur in many different forms within a lake. Furthermore, not all chemical attributes collected may have a direct bearing on the lake's ecology, but may be more useful as indicators of other problems. Finally, water quality values that may be considered poor for one lake may be considered good for another because judging water quality is often very subjective. 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.

Many types of analysis are available for assessing the condition of a particular lake's water quality. In this document, the water quality analysis focuses upon attributes that are directly related to the ecology of the lake. In other words, the water quality that impacts and controls the fishery, plant production, and even the aesthetics of the lake are related here. Six forms of water quality analysis are used to indicate not only the health of the lake, but also to provide a general understanding of the lake's ecology and assist in management decisions. Each type of analysis is elaborated on below.

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 natural, 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.

Comparisons with Other Datasets

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 County lakes are included within the study's Northeast Region (Figure 3.1-1) 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 natural lake means, historic, current, and average data from Seven Island Lake are displayed in Figures 3.1-2 - 3.1-5. 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.

Figure 3.1-1. Location of Seven Island Lake within the regions utilized by Lillie and Mason (1983).

Apparent Water Quality Index

Water quality, like beauty, is often in the eye of the beholder. A person from southern Wisconsin that has never seen a northern lake may consider the water quality of their lake to be good if the bottom is visible in 4 feet of water. On the other hand, a person accustomed to seeing the bottom in 18 feet of water may be alarmed at the clarity found in the southern lake.

Lillie and Mason (1983) used the extensive data they compiled to create the *Apparent Water Quality Index* (WQI). They divided the phosphorus, chlorophyll-*a*, and clarity data of the state's lakes in to ranked categories and assigned each a "quality" label from "Excellent" to "Very Poor". The categories were created based upon natural divisions in the dataset and upon their experience. As a result, using the WQI as an assessment tool is very much like comparing a particular lake's values to values from many other lakes in the state. However, the use of terms like, "Poor", "Fair", and "Good" bring about a better understanding of the results than just comparing averages or other statistical values between lakes. The WQI values corresponding to the phosphorus, chlorophyll-*a*, and Secchi disk values for Seven Island Lake are displayed on Figures 3.1-2 – 3.1-4.

Trophic State

Total phosphorus, chlorophyll-*a*, and water clarity values are 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 and under natural conditions (i.e. not influenced by the activities of humans) this process can take tens of thousands of years. Unfortunately, human influence has accelerated this natural aging process in many Wisconsin lakes. Monitoring the trophic state of a lake gives stakeholders a method by which to gauge the productivity of their lake over time. Yet, classifying a lake into one of three trophic states often does not give clear indication of where a lake really exists in its trophic progression because each trophic state represents a range of productivity. Therefore, two lakes classified in the same trophic state can actually have very different levels of production. However, through the use of a *trophic state index* (TSI), a number can be calculated using phosphorus, chlorophyll-*a*, and clarity values that represent the lake's position within the eutrophication process. This allows for a clearer understanding of the lake's trophic state while facilitating understandable long-term tracking.

Trophic states describe the lake's ability to produce plant matter (production) and include three continuous classifications: *Oligotrophic* lakes are the least productive lakes and are characterized by being deep, having cold water, and few plants. *Eutrophic* lakes are the most productive and normally have shallow depths, warm water, and high plant biomass. *Mesotrophic* lakes fall between these two categories.

Carlson (1977) presented a trophic state index that gained great acceptance among lake managers. Because Carlson developed his TSI equations on the basis of association among water clarity, chlorophyll-*a*, and total phosphorus values of a relatively small set of Minnesota Lakes, researchers from Wisconsin (Lillie et. al. 1993), developed a new set of relationships and equations based upon the data compiled in Lillie & Mason (1983). This resulted in the Wisconsin Trophic State Index (WTSI), which is essentially a TSI calibrated for Wisconsin lakes.

The WTSI is used extensively by the WDNR and is reported along with lake data collected by Citizen Lake Monitoring Network volunteers. The methodology is also used in this document to analyze the past and present trophic state of Seven Island Lake.

Limiting Nutrient

The *limiting nutrient* is the nutrient which is in shortest supply and controls the growth rate of algae and some macrophytes within the lake. This is analogous to baking a cake that requires four eggs, and four cups each of water, flour, and sugar. If the baker would like to make four cakes, he is going to need 16 of each ingredient. If he is short two eggs, he will only be able to make three cakes even if he has sufficient amounts of the other ingredients. In this scenario, the eggs are the limiting nutrient (ingredient).

In most Wisconsin lakes, phosphorus is the limiting nutrient controlling the production of plant biomass. As a result, phosphorus is often the target for management actions aimed at controlling plants, especially algae. The limiting nutrient is determined by calculating the nitrogen to phosphorus ratio within the lake. Normally, total nitrogen and total phosphorus values from the surface samples taken during the summer months are used to determine the ratio. Results of this ratio 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 less than 10:1, it is considered nitrogen limited. Values between these ratios indicate a transitional limitation between nitrogen and phosphorus.

Temperature and Dissolved Oxygen Profiles

Temperature and dissolved oxygen profiles are created simply by taking readings at different water depths within a lake. Although it is a simple procedure, the completion of several profiles over the course of a year or more provides a great deal of information about the lake. Much of this information concerns whether the lake thermally stratifies or not, which is determined primarily through the temperature profiles. Lakes that show strong stratification during the summer and winter months need to be managed differently than lakes that do not. Normally, deep lakes stratify to some extent, while shallow lakes (less than 17 feet deep) do not.

Lake stratification occurs when temperature gradients are developed with depth in a lake. During stratification the lake can be broken into three layers: The *epiliminion* is the top layer of water which is the warmest water in the summer months and the coolest water in the winter months. The *hypolimnion* is the bottom layer and contains the coolest water in the summer months and the warmest water in the winter months. The *metalimnion*, often called the thermocline, is the middle layer containing the steepest temperature gradient.

Dissolved oxygen is essential in the metabolism of nearly every organism that exists within a lake. For instance, fishkills are often the result of insufficient amounts of dissolved oxygen. However, dissolved oxygen's role in lake management extends beyond this basic need by living organisms. In fact, its presence or absence impacts many chemical process that occur within a lake. Internal nutrient loading is an excellent example that is described below.

Internal Nutrient Loading

In lakes that support strong stratification, the hypolimnion can become devoid of oxygen both in the water column and within the sediment. When this occurs, iron changes from a form that normally binds phosphorus within the sediment to a form that releases it to the overlaying water. This can result in very high concentrations of phosphorus in the hypolimnion. Then, during the spring and fall turnover events, these high concentrations of phosphorus are mixed within the lake and utilized by algae and some macrophytes. This cycle continues year after year and is termed "internal phosphorus loading"; a phenomenon that can support nuisance algae blooms decades after external sources are controlled.

The first step in the analysis is determining if the lake is a candidate for significant internal phosphorus loading. Water quality data and watershed modeling are used to screen non-candidate and candidate lakes following the general guidelines below:

Non-Candidate Lakes

- Lakes that do not experience hypolimnetic anoxia.
- Lakes that do not stratify for significant periods (i.e. months at a time).
- Lakes with hypolimnetic total phosphorus values less than 200 μg/L.

Candidate Lakes

- Lakes with hypolimnetic total phosphorus concentrations exceeding 200 µg/L.
- Lakes with epilimnetic phosphorus concentrations that cannot be accounted for in watershed phosphorus load modeling.

Specific to the final bullet-point, during the watershed modeling assessment, the results of the modeled phosphorus loads are used to estimate in-lake phosphorus concentrations. If these estimates are much lower than those actually found in the lake, another source of phosphorus must be responsible for elevating the in-lake concentrations. Normally, two possibilities exist; 1) shoreland septic systems, and 2) internal phosphorus cycling.

If the lake is considered a candidate for internal loading, modeling procedures are used to estimate that load.

Seven Island Lake Water Quality Analysis

The historic water quality data that exists for Seven Island Lake is largely from the last decade, so it is difficult to complete a reliable long-term trend analysis. This is unfortunate because having understanding of how the lake has changed over the years is always interesting and leads to sounder management decisions. According to the results of the stakeholder survey, roughly 94% of respondents consider the water quality of Seven Island Lake to be fair to excellent (Appendix B, Question #14); and the majority of stakeholders believe that the lake's water quality has remained the same (61 %) since they have owned their property (Appendix B, Question #15). The historic data that does exist shows that while there are fluctuations in many parameters, the water quality appears to have remained relatively the same over the past decade or so.

As described above, three water quality parameters are of most interest; total phosphorus, chlorophyll-*a*, and Secchi disk transparency. Total phosphorus data from Seven Island Lake are contained in Figure 3.1-2. Examination of these data indicates that the total phosphorus level of Seven Island Lake is low, especially when compared to other lakes in the region and within the state. While all values would be considered to be within the good to very good range, there are only minor fluctuations of the phosphorus concentrations between years within the lake, likely resulting from precipitation amounts and differences in water levels. The phosphorus values from the early 90's are in some cases over twice the values found during the other years within the data. These higher values are likely the result of high precipitation rates during the spring and possibly summer months within the Seven Island Lake watershed. If data were collected during 2004, it too would have likely indicated higher phosphorus values as that year was considered very wet.

The data follows the normal phosphorus/chlorophyll-*a* relationship in that the low phosphorus values within Seven Island Lake have lead to incredibly low chlorophyll *a* values. In addition, Seven Island Lake's chlorophyll-*a* values are well below state and regional means and correspond with very good levels in the WQI.

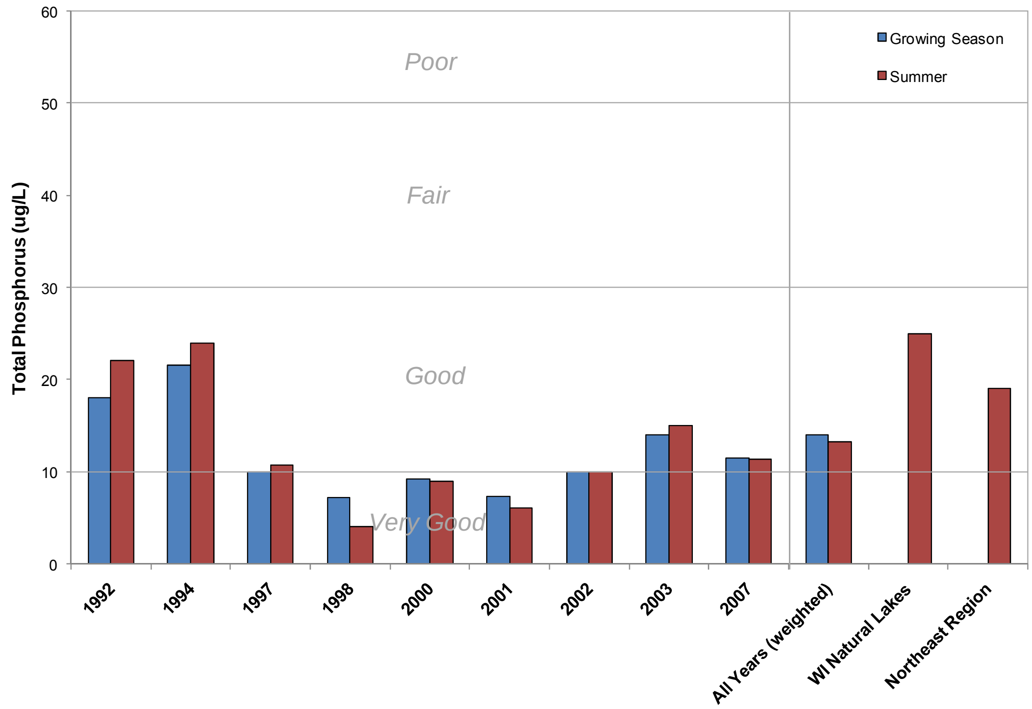


Figure 3.1-2. Seven Island Lake total phosphorus concentrations. Mean values calculated with summer and growing season surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

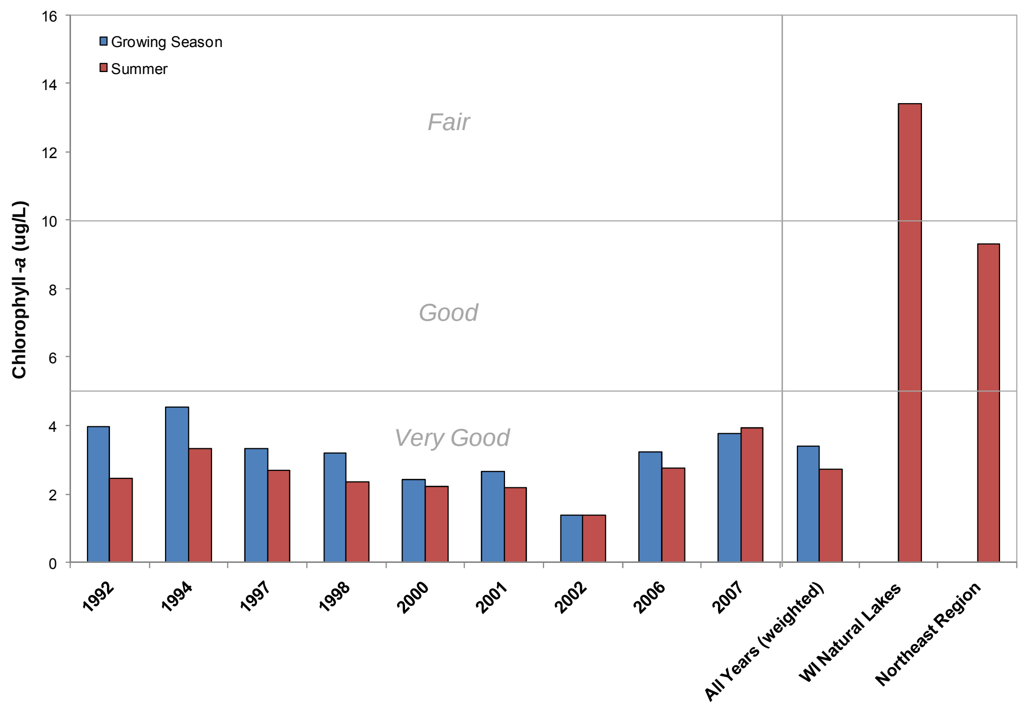


Figure 3.1-3. Seven Island Lake chlorophyll-*a* concentrations. Mean values calculated with summer and growing season surface sample data. Water Quality Index values adapted from Lillie and Mason (1983).

All of the Secchi disk transparency averages from Seven Island Lake surpass those of the ecoregion and the state and fall within the very good range of the WQI. As alluded to above, there really is no trend towards improved or degraded water quality within the dataset and as with most lakes, the clarity of Seven Island Lake fluctuates from year-to-year.

In summary, the current and historic data indicate that the water quality of Seven Island Lake has seen minor levels of fluctuation over the course of the past decade, but all indicate that the water quality within the lake is good to very good. The primary reason for this level of water quality is the watershed that drains to the lake. That aspect of the Seven Island Lake ecosystem is discussed in detail within the Watershed Section.

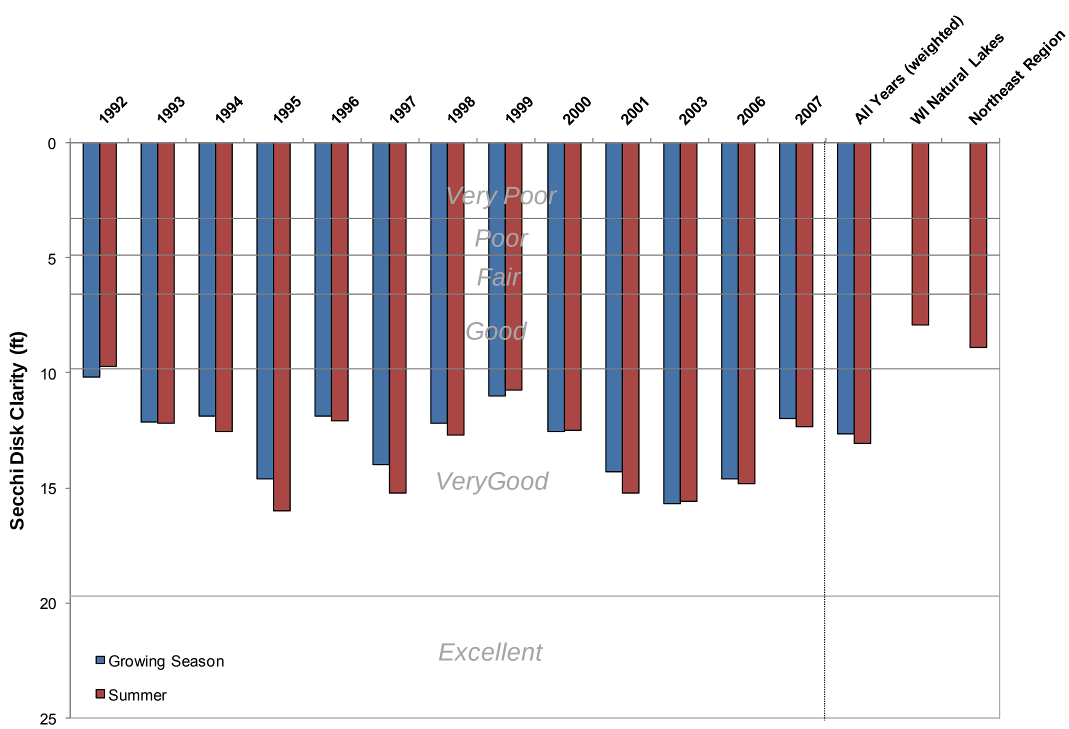


Figure 3.1-4. Seven Island Lake Secchi disk transparency values. Mean values calculated with summer and growing season sample data. Water Quality Index values adapted from Lillie and Mason (1983).

Seven Island Lake Trophic State

Figure 3.1-5 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 Seven Island Lake. The WTSI values indicate that the lake's productivity ranges from upper oligotrophic to moderately mesotrophic. Being that the WTSI values are calculated with the same parameters discussed above, it is not surprising that the trophic state values for the lake follow the same pattern discussed earlier.

Limiting Plant Nutrient of Seven Island Lake

Midsummer nitrogen and phosphorus concentrations collected during 2007 were 470 µg/L and 11 µg/L, respectively. These figures yield a nitrogen:phosphorus ratio of 43:1, indicating that Seven Island Lake is strongly phosphorus limited. This is also the case with the vast majority of Wisconsin lakes.

Internal Nutrient Loading in Seven Island Lake

Sufficient data were not collected as a part of this project to truly determine if internal loading is a significant source of nutrients within Seven Island Lake. While sufficient temperature and dissolved oxygen data were collected, the lack of bottom phosphorus data prevents internal loading from being estimated. However, as discussed in the watershed section, there is no evidence that there are unaccounted sources of phosphorus to the lake; therefore, internal nutrient loading is likely not a significant source of phosphorus to Seven Island Lake at this time.

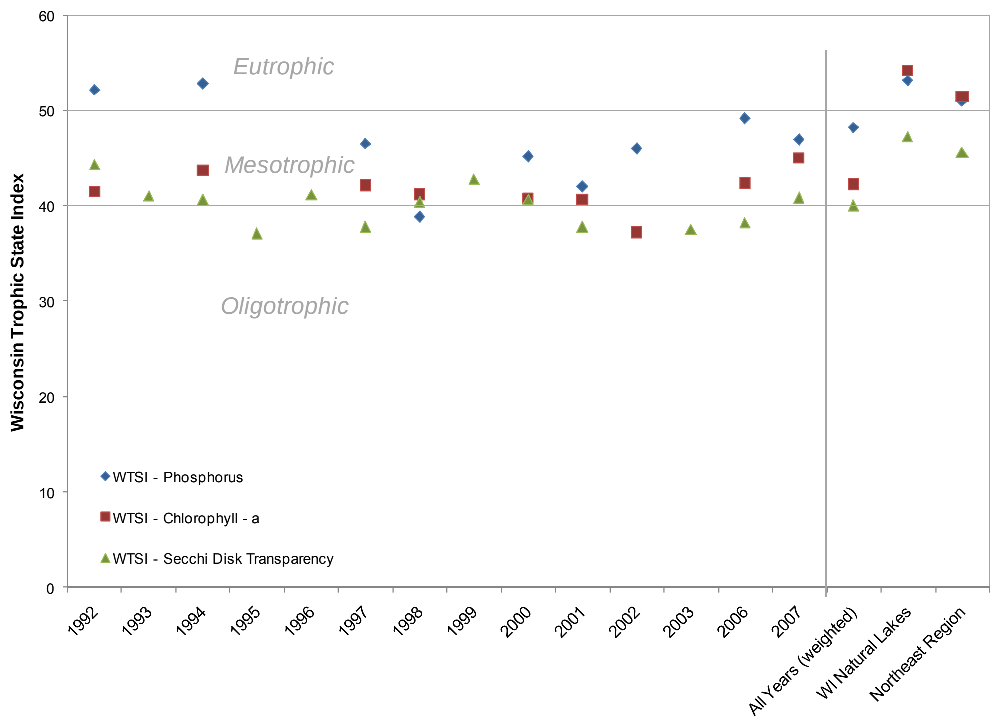


Figure 3.1-5. Seven Island Lake Wisconsin Trophic State Index values. Values calculated with summer month surface sample data using Lillie et al. (1993).

Dissolved Oxygen and Temperature in Seven Island Lake

As a part of the grant that funded this project, the SILA purchased a Hach Luminescence Dissolved Oxygen (LDO) probe and meter. The LDO probe was used to complete dissolved oxygen and temperature profiles throughout this project and will be used in the future to collect additional information.

The profiles collected at Seven Island Lake indicated that during the summer and winter months, the lake stratifies. During stratification, the hypolimnetic layer does approach anoxia; however sufficient oxygen is present in the upper layers to support aquatic life throughout the entire year.

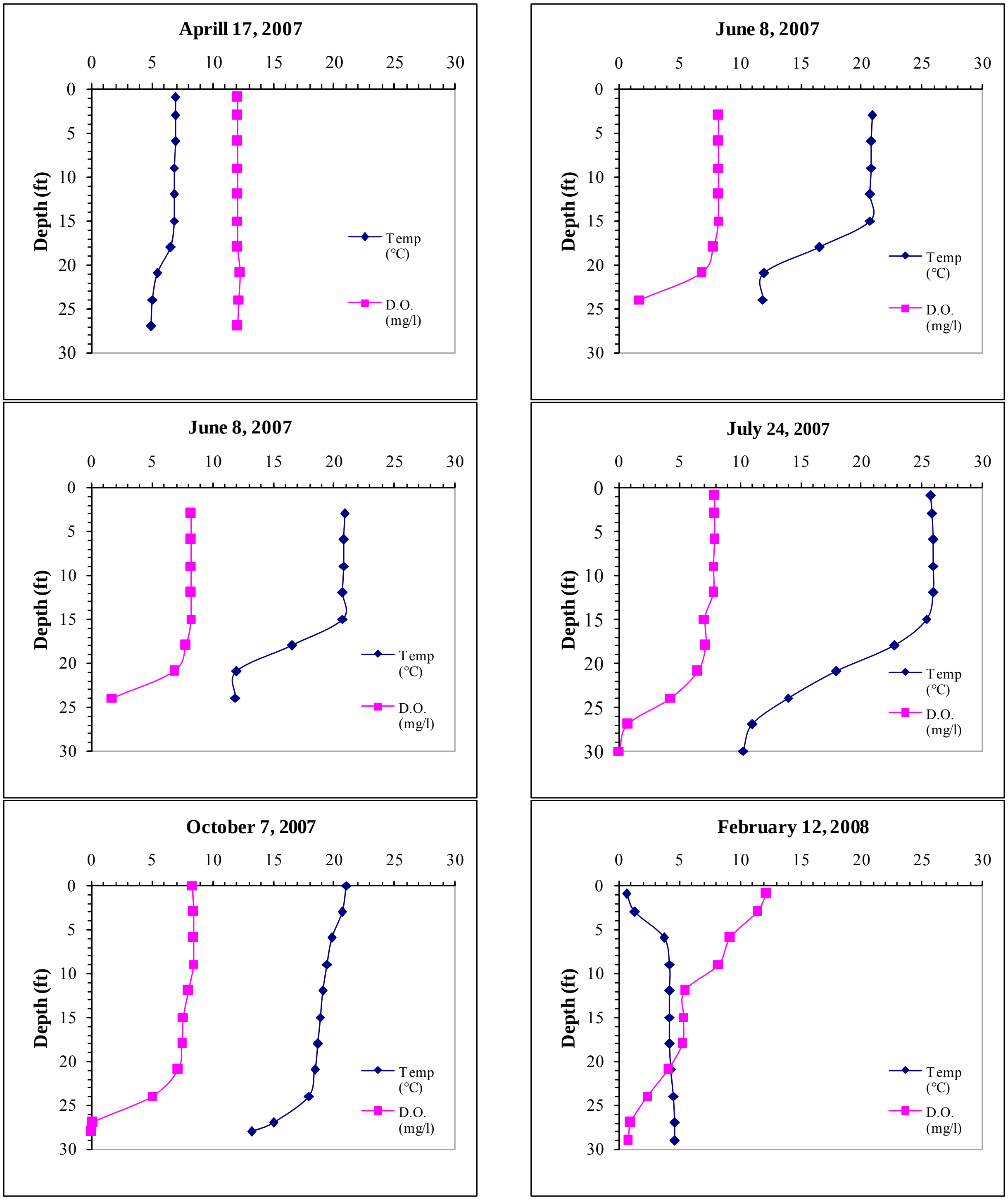


Figure 3.1-6. Seven Island Lake dissolved oxygen and temperature profiles. February 12, 2008 data collected through the ice by Onterra staff. All other data collected by Seven Island Lake CLMN volunteer.

Additional Water Quality Data Collected at Seven Island Lake

The water quality section is centered on lake eutrophication. However, parameters other than water clarity, nutrients, and chlorophyll-*a* were collected as part of the project. These other parameters were collected to increase the understanding of Seven Island Lake's water quality and are recommended as a part of the WDNR long-term lake trends monitoring protocol. These parameters include; pH, alkalinity, and calcium.

The pH scale ranges from 0 to 14 and indicates the concentration of hydrogen ions (H^+) within the lake's water and is an index of the lake's acidity. Water with a pH value of 7 has equal amounts of hydrogen ions and hydroxide ions (OH^-), and is considered to be neutral. Water with a pH of less than 7 has higher concentrations of hydrogen ions and is considered to be acidic, while values greater than 7 have lower hydrogen ion concentrations and are considered basic or alkaline. The pH scale is logarithmic; meaning that for every 1.0 pH unit the hydrogen ion concentration changes tenfold. The normal range for lake water pH in Wisconsin is about 5.2 to 8.4, though values lower than 5.2 can be observed in some acid bog lakes and higher than 8.4 in some marl lakes. In lakes with a pH of 6.5 and lower, the spawning of certain fish species such as walleye becomes inhibited (Shaw et al. 2004). The pH in of Seven Island Lake was found to be slightly alkaline with a value of 7.3, and falls within the normal range for Wisconsin Lakes.

Alkalinity is a lake's capacity to resist fluctuations in pH by neutralizing or buffering against inputs such as acid rain. The main compounds that contribute to a lake's alkalinity in Wisconsin are bicarbonate (HCO_3^-) and carbonate (CO_3^-), which neutralize hydrogen ions from acidic inputs. These compounds are present in a lake if the groundwater entering it comes into contact with minerals such as calcite ($CaCO_3$) and/or dolomite ($CaMgCO_3$). A lake's pH is primarily determined by the amount of alkalinity. Rainwater in northern Wisconsin is slightly acidic naturally due to dissolved carbon dioxide from the atmosphere with a pH of around 5.0. Consequently, lakes with low alkalinity have lower pH due to their inability to buffer against acid inputs. The alkalinity in Seven Island Lake ranged between 14.8 and 15.0 (mg/L as $CaCO_3$), indicating that the lake has a substantial capacity to resist fluctuations in pH and has a low sensitivity to acid rain.

Like associated pH and alkalinity, the concentration of calcium within a lake's water depends on the geology of the lake's watershed. Recently, the combination of calcium concentration and pH has been used to determine what lakes can support zebra mussel populations if they are introduced. The commonly accepted pH range for zebra mussels is 7.0 to 9.0, so Seven Island Lake's pH of 7.3 falls within the low end of this range. Lakes with calcium concentrations of less than 12 mg/L are considered to have very low susceptibility to zebra mussel establishment. The calcium concentration of Seven Island Lake was found to be 3.9 mg/L, falling well below the optimal range for zebra mussels. Plankton tows were completed by Onterra staff during the summer of 2007 and these samples were processed by the WDNR for larval zebra mussels. Their analysis returned a negative result for the presence of these exotic species.

3.2 Watershed Assessment

Two aspects of a lake's watershed are the key factors in determining the amount of phosphorus the watershed exports to the lake; 1) the size of the watershed, and 2) the land cover (land use) within the watershed. The impact of the watershed size is dependent on how large it is relative to the size of the lake. The watershed to lake area ratio (WS:LA) defines how many acres of watershed drains to each surface-acre of the lake. Larger ratios result in the watershed having a greater role in the lake's annual water budget and phosphorus load.

A lake's **flushing rate** is simply a determination of the time required for the lake's water volume to be completely exchanged. **Residence time** describes how long a volume of water remains in the lake and is expressed in days, months, or years. The parameters are related and both determined by the volume of the lake and the amount of water entering the lake from its watershed. Greater flushing rates equal shorter residence times.

The type of land cover that exists in the watershed determines the amount of phosphorus (and sediment) that runs off the land and eventually makes its way to the lake. The actual amount of pollutants (nutrients, sediment, toxins, etc.) depends greatly on how the land within the watershed is used. Vegetated areas, such as forests, grasslands, and meadows, allow the water to permeate the ground and do not produce much surface runoff. On the other hand, agricultural areas, particularly row crops, along with residential/urban areas, minimize infiltration and increase surface runoff. The increased surface runoff associated with these land cover types leads to increased phosphorus and pollutant loading; which, in turn, can lead to nuisance algal blooms, increased sedimentation, and/or overabundant macrophyte populations.

In systems with lower WS:LA ratios, land cover type plays a very important role in how much phosphorus is loaded to the lake from the watershed. In these systems the occurrence of agriculture or urban development in even a small percentage of the watershed (less than 10%) can unnaturally elevate phosphorus inputs to the lake. If these land cover types are converted to a cover that does not export as much phosphorus, such as converting row crop areas to grass or forested areas, the phosphorus load and its impacts to the lake may be decreased. In fact, if the phosphorus load is reduced greatly, changes in lake water quality may be noticeable, (e.g. reduced algal abundance and better water clarity) and may even be enough to cause a shift in the lake's trophic state.

In systems with high WS:LA ratios, like those exceeding 10-15:1, the impact of land cover may be tempered by the sheer amount of land draining to the lake. Situations actually occur where lakes with completely forested watersheds have sufficient phosphorus loads to support high rates of plant production. In other systems with high ratios, the conversion of vast areas of row crops to vegetated areas (grasslands, meadows, forests, etc.) may not reduce phosphorus loads sufficiently to see a change in plant production. Both of these situations occur frequently in impoundments.

Regardless of the size of the watershed or the makeup of its land cover, it must be remembered that every lake is different and other factors, such as flushing rate, lake volume, sediment type, and many others, also influence how the lake will react to what is flowing into it. For instance, a deeper lake with a greater volume can dilute more phosphorus within its waters than a less voluminous lake and as a result, the production of a lake is kept low. However, in that same lake, because of its low flushing rate (high residence time, i.e., years), there may be a buildup of phosphorus in the sediments that may reach sufficient levels over time that internal nutrient loading may become a problem. On the contrary, a lake with a higher flushing rate (low residence time, i.e., days or weeks) may be more productive early on, but the constant flushing of its waters may prevent a buildup of phosphorus and internal nutrient loading may never reach significant levels.

A reliable and cost-efficient method of creating a general picture of a watershed's affect on a lake can be obtained through modeling. The WDNR created a useful suite of modeling tools called the Wisconsin Lake Modeling Suite (WiLMS). Certain morphological attributes of a lake and its watershed can be entered into WiLMS along with the acreages of different types of land cover within the watershed to produce useful information about the lake ecosystem. This information includes an estimate of annual phosphorus load and the partitioning of those loads between the watershed's different land cover types and atmospheric fallout entering through the lake's water surface. WiLMS also calculates the lake's flushing rate and residence times using county-specific average precipitation/evaporation values or values entered by the user. Predictive models are also included within WiLMS that are valuable in validating modeled phosphorus loads to the lake in question and modeling alternate land cover scenarios within the watershed. Finally, if specific information is available, WiLMS will also estimate the significance of internal nutrient loading within a lake and the impact of shoreland septic systems.

The drainage basin of Seven Island Lake encompasses approximately 450 acres of mostly heavily forested land (Map 2). In fact, approximately 66% of the watershed is forested, with the remaining terrestrial areas being primarily in wetland and a small amount in grasses (Figure 3.2-1). The lake's surface makes up about 30% of the total watershed. The watershed:lake area ratio for Seven Island Lake is very low at 2:1. Obviously, the lake receives the vast majority of it water via groundwater inputs.

Modeling of phosphorus loads entering the lake via the watershed indicates that approximately 62 lbs of phosphorus enters the lake on an annual basis. This amount of phosphorus being added to Seven Island Lake with a volume of roughly 1,900 acre-feet is nearly insignificant. This is evidenced in the very good water quality the lake exhibits.

While the lake's watershed is in excellent shape by being so small when compared to the surface area of the lake and by having nearly the entire terrestrial component in land cover types that export minimal amounts of phosphorus, we still need to be concerned about nutrients and other pollutants entering the lake via the watershed. Seven Island Lake's flushing rate, as determined by WiLMS, is exceeding low as only 19% of its volume is replaced annually. This means that the entire volume of the lake is only replaced every 5.2 years (water residence time). It also means that the nutrients that are added to the lake, tend to remain in the lake. Over the course of the lake's lifespan, the lake will buildup sediment and nutrients as this is a normal course for all natural lakes. This process, called lake *eutrophication*, is a natural process. However, when anthropogenic (human) impacts are increased in the lake's watershed, including its shorelands, the process is accelerated (*cultural eutrophication*). Barring unanticipated development within Seven Island Lake's watershed, the most significant source for these unwanted pollutants will be from the lakes immediate watershed – its shoreland area. When a lake's shoreline is developed, the increased impervious surface, removal of natural vegetation, installation of septic systems, and other human practices, can severally increase nutrient loads to the lake while degrading important habitat. Limiting these anthropogenic affects on the lake is important in maintaining the current high quality of the lake's water and habitat.

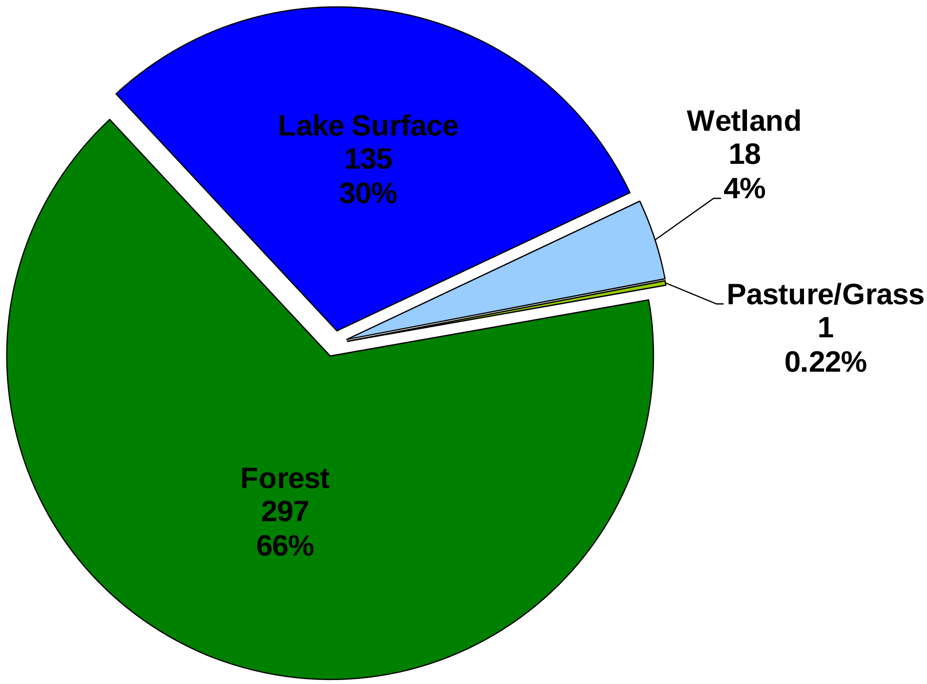


Figure 3.2-1. Seven Island Lake watershed land cover types in acres. Based upon Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data (WISCLAND) (WDNR, 1998).

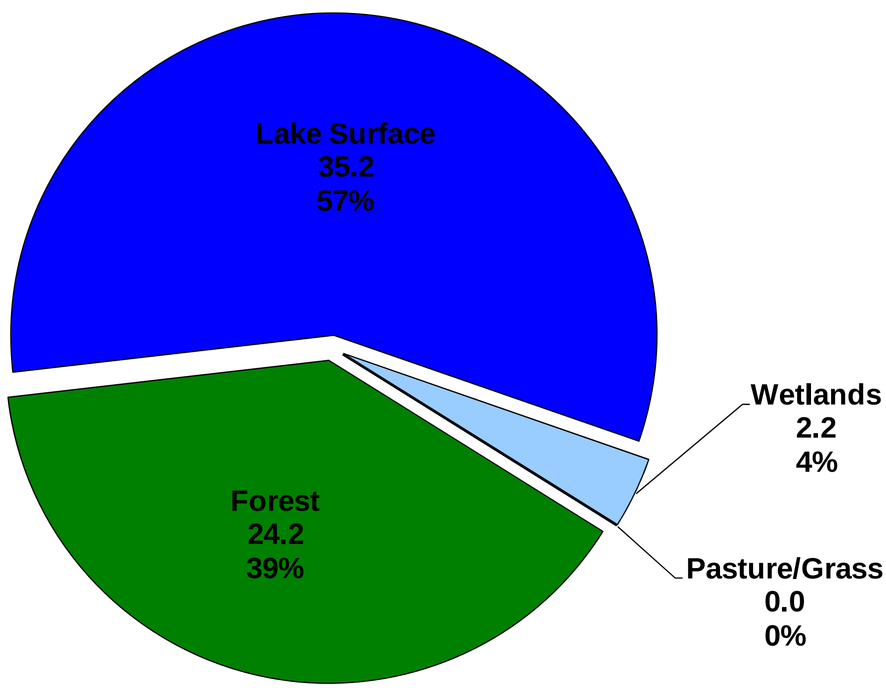


Figure 3.2-2. Seven Island Lake watershed phosphorus loading in pounds. Based upon Wisconsin Lake Modeling Suite (WiLMS) estimates.

3.3 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 effects 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.

Important Note:
Even though most of these techniques are not applicable to Seven Island 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 Seven Island 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 30 feet. This action can be conducted up to 150 feet from shore. Please note that a permit is needed in all instances if wild rice is to be removed. Furthermore, installation of aquatic plants, even natives, requires approval from the WDNR.

Permits are required for chemical and mechanical manipulation of native and non-native plant communities. Large-scale protocols have been established for chemical treatment projects covering >10 acres or areas greater than 10% of the lake littoral zone and more than 150 feet from shore. Different protocols are to be followed for whole-lake scale treatments (≥160 acres or ≥50% of the lake littoral area). Additionally, 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 (Jennings et al. 2003). 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 (Jennings et al. 2003, Radomski and Goeman 2001, and Elias & Meyer 2003). 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 (Scheuerell and Schindler 2004).

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 depend 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	***Disadvantages***
• 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 re-suspension 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.	• 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.

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. Please note that the use of powered cutters require a mechanical harvesting permit to be issued by the WDNR.

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 $1,200 to $11,000.

Advantages	***Disadvantages***
• 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.	• 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 conduct action. • 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 is about $120 each year.

Advantages	*Disadvantages*
• 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.	• Requires WDNR permit. • 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. If a hydro-electric facility is operating on the system, the costs associated with loss of production during the drawdown also need to be considered, as they are likely cost prohibitive to conducting the management action.

Advantages	***Disadvantages***
• Inexpensive if outlet structure exists. • May control populations of certain species, like Eurasian water-milfoil for a few years. • Allows some loose sediment to consolidate, increasing water depth. • 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.	• 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 reed (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*). • Permitting process may require an environmental assessment that may take months to prepare. • Unselective.

Mechanical 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	***Disadvantages***
• 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.	• Requires WDNR permit. • Initial costs and maintenance are high if the lake organization intends to own and operate the equipment. • Multiple treatments are likely required. • 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. • Bottom sediments may be re-suspended 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.

Applying herbicides in the aquatic environment requires special considerations compared with terrestrial applications. WDNR administrative code states that a permit is required if "you are standing in socks and they get wet." In these situations, the herbicide application needs to be completed by an applicator licensed with the Wisconsin Department of Agriculture, Trade and

Consumer Protection. All herbicide applications conducted under the ordinary high water mark require herbicides specifically labeled by the United States Environmental Protection Agency.

Herbicides that target submersed plant species are directly applied to the water, either as a liquid or an encapsulated granular formulation. Factors such as water depth, water flow, treatment area size, and plant density work to reduce herbicide concentration within aquatic systems. Understanding concentration exposure times are important considerations for aquatic herbicides. Successful control of the target plant is achieved when it is exposed to a lethal concentration of the herbicide for a specific duration of time. Some herbicides are applied at a high dose with the anticipation that the exposure time will be short. Granular herbicides are usually applied at a lower dose, but the release of the herbicide from the clay carrier is slower and increases the exposure time.

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.

> 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.

> Endothall (Hydrothol®, Aquathol®) Broad spectrum, contact herbicides used for spot treatments of submersed plants. The mono-salt form of Endothall (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®, DMA IV®, 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 may apply.

> Triclopyr (Renovate®) Selective, systemic herbicide that is effective on broad leaf plants and, similar to 2,4 D, will not harm native monocots. Triclopyr is available in liquid or granular form, and can be combined with Endothal in small concentrations (<1.0 ppm) to effectively treat Eurasian water-milfoil. Triclopyr has been used in this way in Minnesota and Washington with some success.

> 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.

Imazapyr (Habitat®) Broad spectrum, system herbicide, slow-acting liquid herbicide used to control emergent species. This relatively new herbicide is largely used for controlling common reed (giant reed, *Phragmites*) where plant stalks are cut and the herbicide is directly applied to the exposed vascular tissue.

The use of herbicides for aquatic plant control in northern Wisconsin is largely for the control of aquatic invasive species and not for nuisance levels of native plants. Initially released by the WDNR during the summer of 2007, Aquatic Plant Management Strategy Northern Region has a goal to "not issue permits for chemical or large-scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities."

Cost

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

Advantages	***Disadvantages***
• 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.	• 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. • Overuse may lead to plant resistance to herbicides

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 waterhyacinth weevils (*Neochetina spp.*) and hydrilla stem weevil (*Bagous spp.*) to control waterhyacinth (*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. Currently the milfoil weevil is not a WDNR grant-eligible method of controlling Eurasian water milfoil.

Cost

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

Advantages	***Disadvantages***
• Milfoil weevils occur naturally in Wisconsin. • Likely environmentally safe and little risk of unintended consequences.	• 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.

Wisconsin has approved the use of two species of leaf-eating beetles (*Galerucella calmariensis* and *G. pusilla*) to battle purple loosestrife. These beetles were imported from Europe and used as a biological control method for purple loosestrife. Many cooperators, such as county conservation departments or local UW-Extension locations, currently support large beetle rearing operations. Beetles are reared on live purple loosestrife plants growing in kiddy pools surrounded by insect netting. Beetles are collected with aspirators and then released onto the target wild population. For more information on beetle rearing, contact your local UW-Extension location.

In some instances, beetles may be collected from known locations (*cella* insectaries) or purchased through private sellers. Although no permits are required to purchase or release beetles within Wisconsin, application/authorization and release forms are required by the WDNR for tracking and monitoring purposes.

Cost

The cost of beetle release is very inexpensive, and in many cases is free.

Advantages	***Disadvantages***
• Extremely inexpensive control method. • Once released, considerably less effort than other control methods is required. • Augmenting populations many lead to long-term control.	• Although considered "safe," reservations about introducing one non-native species to control another exist. • Long range studies have not been completed on this technique.

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 Seven Island 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 Seven Island 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.

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 Seven Island Lake will be compared to lakes in the same ecoregion and in the state (Figure 3.3-1).

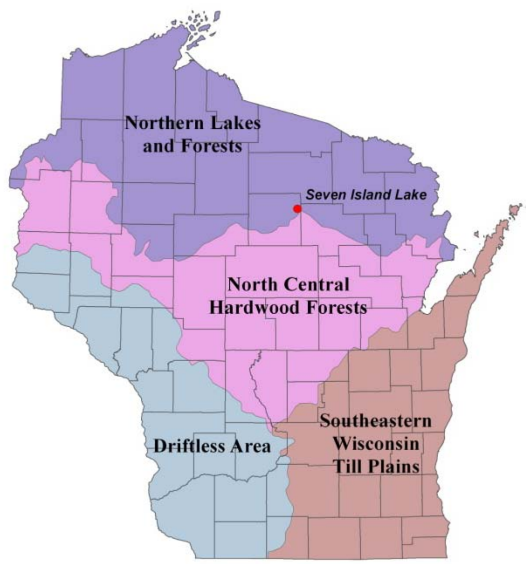


Figure 3.3-1. Location of Seven Island Lake within the ecoregions of Wisconsin. After Nichols 1999.

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.

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.

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.

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 3.3-2). 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.

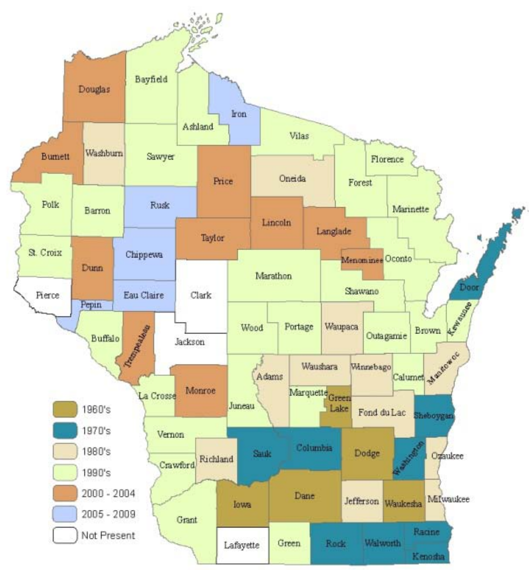


Figure 3.3-2. Spread of Eurasian water milfoil within WI counties. WDNR Data 2009 mapped by Onterra.

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.

Aquatic Plant Survey Results

As mentioned above, numerous plant surveys were completed as a part of this project. In June 2007, a survey was completed that focused upon curly-leaf pondweed. This meander-based survey did not locate any occurrences of curly-leaf pondweed. It is believed that this aquatic invasive species either does not occur in Seven Island Lake or exists at an undetectable level.

Point-intercept surveys were conducted by Wisconsin Department of Natural Resources Science Services in August 2005 and August 2007. The most recent survey (2007) is used in the subsequent analysis and discussion of the Seven Island Lake aquatic plant community. An additional survey was completed by Onterra to create the aquatic plant community maps (Map 3) during August 2007.

During the 2007 WDNR point-intercept survey and studies conducted by Onterra, 29 native plants species were located in Seven Island Lake (Table 3.3-1). At this time, it is believed that Seven Island Lake does not contain any non-native aquatic plant species. In 2005, Eurasian water milfoil was discovered in Seven Island Lake. Vigorous hand-removal attempts (including an innovative vacuum system to aid in plant collection) and a single herbicide treatment were conducted in 2005. That same year, previous to the herbicide treatment but after hand-removal methods were used, WDNR Science Services only found the plant from a single sample location (Map 4). This exotic plant was not located during the WDNR's 2007 point-intercept survey or the numerous plant surveys Onterra conducted, including a scuba survey of the area previously known to contain Eurasian water milfoil.

Special Note: A few Eurasian water milfoil occurrences were located by the SILA and the AIS coordinator in charge of Lincoln County (Chris Hamerla) after this management plan was finalized, but before printing. These locations have been integrated into Map 4 for reference.

Only one milfoil species (genus *Myriophyllum*), dwarf water milfoil, was located from Seven Island Lake. This isoetid species is morphologically much different from the other 6 milfoil species known to occur in Wisconsin waters. Northern water milfoil, arguably the most common milfoil species in Wisconsin lakes, is frequently found growing in soft sediments and high water clarity. While these conditions occur in Seven Island Lake, this species does not. Reports of Eurasian water milfoil control in the Midwest from a native weevil (*Euhrychiopsis lecontei*) exist; however, the demise of Eurasian water milfoil in Seven Island Lake can likely not be linked to this weevil, as its host plant (and food source), northern water milfoil is not present within the system.

Northern water milfoil is often falsely identified as Eurasian water milfoil, especially since it is known to take on the 'reddish' appearance of Eurasian water milfoil as the plant reacts to increased sun exposure, largely from lowering water levels. Since northern water milfoil is not known to exist in Seven Island Lake, any milfoil species observed, other than dwarf water milfoil, should be suspect of being Eurasian water milfoil.

Table 3.3-1. Aquatic plant species located in Seven Island Lake during 2007 surveys.

Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)
Emergent	*Dulichium arundinaceum**	Three-way sedge	9
	*Eleocharis palustris**	Creeping spikerush	6
	*Equisetum fluviatile**	Water horsetail	7
	*Iris versicolor**	Northern blue flag	5
	*Pontederia cordata**	Pickerelweed	9
	Sagittaria latifolia	Common arrowhead	3
	*Typha latifolia**	Broad-leaved cattail	1
FL	*Brasenia schreberi*	Watershield	7
	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	*Callitriche palustris**	Common water starwort	8
	Chara sp.	Muskgrasses	7
	Elodea canadensis	Common waterweed	3
	Isoetes echinospora	Spiny-spored quilwort	8
	Lobelia dortmanna	Water lobelia	10
	Myriophyllum tenellum	Dwarf water milfoil	10
	Najas flexilis	Slender naiad	6
	Nitella sp.	Stoneworts	7
	Potamogeton amplifolius	Large-leaf pondweed	7
	Potamogeton epihydrus	Ribbon-leaf pondweed	8
	Potamogeton pusillus	Small pondweed	7
	Potamogeton robbinsii	Fern pondweed	8
	Utricularia gibba	Creeping bladderwort	9
S/E	*Eleocharis acicularis*	Needle spikerush	5
	Juncus pelocarpus	Brown-fruited rush	8
	*Sagittaria graminea**	Grass-leaved arrowhead	9

FL = Floating Leaf
FL/E = Floating Leaf and Emergent
S/E = Submergent and Emergent
* = Species Found During Community Mapping Survey

Aquatic plants were found growing to a maximum depth of 22 feet, with the largest number of point intercept locations between 11 and 18 feet containing aquatic plants. This is a testament to the good water clarity of Seven Island Lake. Approximately 86% of the point-intercept sampling locations that fell within the maximum depth of plant growth contained aquatic vegetation. This shows that most available spaces (niches) for plant growth are filled.

While some plants are best suited to grow in shallow water, others are more suited for deeper water. Understanding the distribution of aquatic plants within a lake can reveal the structural component the plants play within the ecosystem. Relative to the depth range of plant growth in Seven Island Lake, Figure 3.3-3 shows that muskgrasses and small pondweed were largely found in deeper water while common waterweed and large-leaf pondweed were found growing at intermediate depths. Although stoneworts were found growing at the maximum depth range of plant growth in Seven Island Lake, these macro-algae were also found at intermediate depths with high abundance. Muskgrasses, common waterweed, and stoneworts are largely found growing horizontally close to the substrate. While both pondweed species exhibit more vertical growth forms, large-leaf pondweed is a robust species offering cover for larger fish (a particular favorite of ambush predators like muskellunge), and small-pondweed's stringy nature may be sought by zooplankton or other smaller organisms for cover.

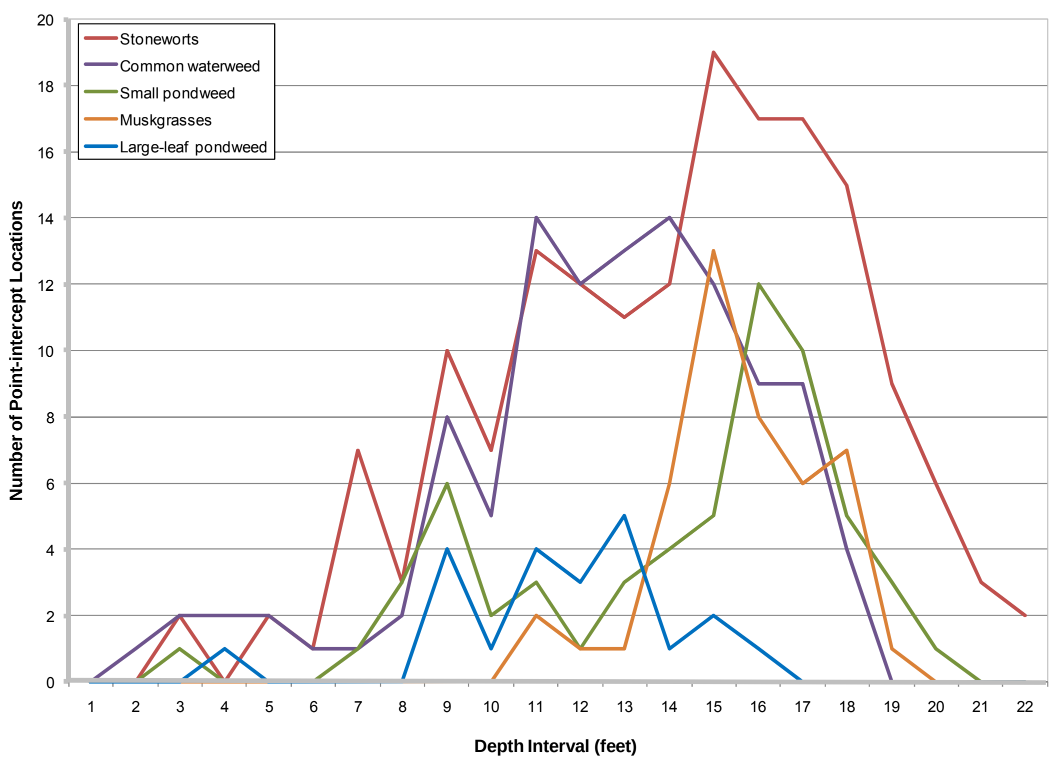


Figure 3.3-3. Seven Island Lake select aquatic plant depth distribution. Created using data from WDNR 2007 survey. Top five most frequent plant species displayed.

As stated within the Water Quality Section, Seven Island Lake is a relatively low nutrient lake with high water clarity values. Based on data collected as a part of the point-intercept vegetation survey, approximately 25% of the littoral zone is comprised of sandy (16%) or rocky soils (9%). These habitats are often colonized by a collective group of rooted plants known as *isoetids*. The isoetids are small, slow-growing, inconspicuous submerged plants that have evergreen leaves located in a rosette and are usually found growing in sandy soils within the near-shore areas of a lake (Boston and Adams 1987, Vestergaard and Sand-Jensen 2000). Conversely, the elodeid growth forms exhibit leaves on tall, erect stems which grow up into the water column. The elodeid species are the leafy plants that most people have in their minds when it comes to aquatic plants. Seven Island Lake contains six isoetid species (brown-fruited rush, needle spikerush, dwarf water milfoil, water lobelia, spiny-spored quillwort, and common water starwort).

Seven Island Lake has a high number of aquatic plant species, and because of this, one may assume that the system would also have a very high diversity. As discussed earlier, how evenly the species are distributed throughout the system also influence the diversity. The diversity index for Seven Island Lake's plant community (0.80) shows that the lake has an uneven distribution (relative frequency) of plant species throughout the lake. Lower productive lakes, like Seven Island Lake may have contain a lower number of species and this aspect may lend them more susceptible to being dominated by one or two species that are best suited for the lower availability of nutrients.

Figure 3.3-3 clearly shows that the lake is dominated by stoneworts and common water weed, and to a lesser extent – small pondweed and muskgrasses. Of these four species, two are non-rooted macro-algae (stoneworts and muskgrasses), and common waterweed which largely acts as a non-rooted plant. Due to their lack of developed root structures, the locations of common waterweed may be influenced by water movement and their tendency to become entangled in plants, rocks, or debris.

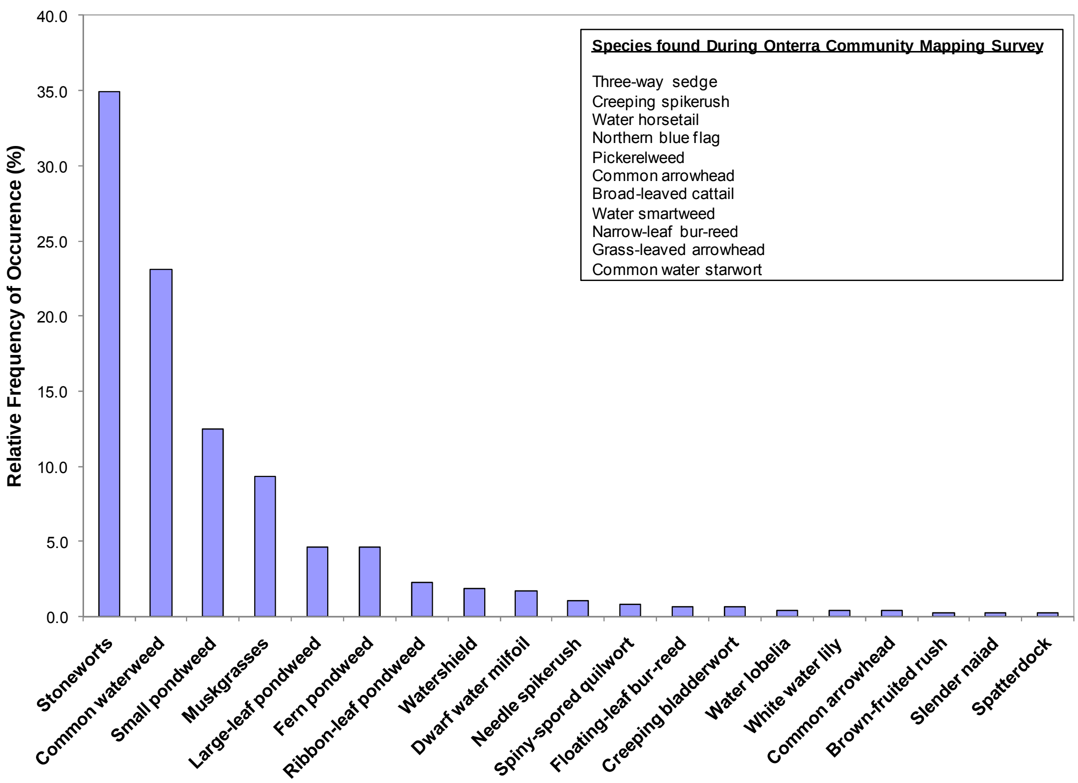


Figure 3.3-4. Seven Island Lake aquatic plant occurrence analysis of 2007 survey data..

Comparing the 2005 and 2007 point-intercept surveys, the majority of aquatic plant species displayed relatively no change in occurrence. However, the four of the five most commonly encountered species in 2007 statistically increased since 2005 (Table 3.3-2). Three of these species were identified as the most dominant plant species within Seven Island Lake (stoneworts, common waterweed, and small pondweed). While the analysis shows that these species have increased, the cause remains unknown, but may be a result of climactic or environmental variations. The fact that species frequency and distribution can vary within such a short time is not alarming. Actually, it lends to the importance of diversity. As environmental and climactic factors change, a diverse plant community is more resilient to these changes. Overall, it appears that the plant community of Seven Island Lake is relatively stable and comparing these datasets with those collected in the future will allow for trend analysis to be constructed.

Table 3.3-2. Native plant change in percent frequency within Seven Island Lake from 2005 to 2007. Statistical significance is determined by Chi-square distribution analysis (alpha = 0.05).

	Scientific Name	Common Name	2005 FOO	2007 FOO	Percent Change	Direction	Chi-square Analysis	
							Significance	p-value
Dicots	Myriophyllum spicatum	Eurasian water milfoil	0.4	0.0	-0.4	▼	No	0.319
	Nuphar variegata	Spatterdock	0.0	0.4	0.4	▲	No	0.314
	Brasenia schreberi	Watershield	2.5	3.2	0.7	▲	No	0.597
	Myriophyllum tenellum	Dwarf water milfoil	3.3	2.9	-0.4	▼	No	0.823
Non-dicots	Nitella sp.	Stoneworts	30.2	60.4	30.2	▲	Yes	0.000
	Elodea canadensis	Common waterweed	17.1	39.9	22.8	▲	Yes	0.000
	Potamogeton pusillus	Small pondweed	10.5	21.6	11.0	▲	Yes	0.000
	Potamogeton robbinsii	Fern pondweed	1.8	7.9	6.1	▲	Yes	0.001
	Potamogeton amplifolius	Large-leaf pondweed	3.3	7.9	4.6	▲	Yes	0.015
	Potamogeton epihydrus	Ribbon-leaf pondweed	2.2	4.0	1.8	▲	No	0.210
	Utricularia gibba	Creeping bladderwort	0.0	1.1	1.1	▲	No	0.081
	Isoetes echinospora	Spiny-spored quilwort	0.4	1.4	1.1	▲	No	0.174
	Eleocharis acicularis	Needle spikerush	1.1	1.8	0.7	▲	No	0.467
	Juncus pelocarpus	Brown-fruited rush	0.0	0.4	0.4	▲	No	0.314
	Sparganium fluctuans	Floating-leaf bur-reed	0.7	1.1	0.4	▲	No	0.644
	Sagittaria latifolia	Common arrowhead	0.7	0.7	0.0	▼	No	0.991
	Potamogeton illinoensis	Illinois pondweed	0.4	0.0	-0.4	▼	No	0.319
	Lobelia dortmanna	Water lobelia	1.1	0.7	-0.4	▼	No	0.662
	Nymphaea odorata	White water lily	1.1	0.7	-0.4	▼	No	0.662
	Sparganium angustifolium	Narrow-leaf bur-reed	0.7	0.0	-0.7	▼	No	0.159
	Najas flexilis	Slender naiad	1.5	0.4	-1.1	▼	No	0.182
	Chara sp.	Muskgrasses	20.4	16.2	-4.2	▼	No	0.250

The 2007 community maps indicate that there are many areas (over 12 acres) of the lake where diverse floating-leaf and emergent communities can be found (Table 3.3-3, Map 3). Each of these areas provides valuable fish and wildlife habitat important to the ecosystem of the lake. Continuing the analogy that the community map represents a 'snapshot' of the important plant communities, a replication of this survey in the future will provide a valuable understanding of the dynamics of these communities within Seven Island Lake.

Table 3.3-3. Seven Island Lake acres of plant community types from the 2007 community mapping survey.

Plant Community	Acres
Emergent	1.1
Floating-leaf	0.1
Mixed Floating-leaf and Emergent	11.0
Total	12.2

This is important, because these communities are often negatively affected by recreational use and shoreland development. Radomski and Goeman (2001) found a 66% reduction in vegetation coverage on developed shorelines when compared to undeveloped shorelines in Minnesota Lakes. Furthermore, they also found a significant reduction in abundance and size of northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) associated with these developed shorelines. Many studies have documented the adverse affects of motorboat traffic on aquatic plants (e.g. Murphy and Eaton 1983, Vermaat and de Bruyne 1993, Mumma et al. 1996, Asplund and Cook 1997). In all of these studies, lower plant biomasses and higher turbidity were associated with motorboat traffic. Of the top four most common watercraft types used on Seven Island Lake, three are non-motorized and have the least ability to affect, aquatic plant growth (Appendix B, Question #5).

A series of questions were posed within the stakeholder survey regarding different slow-no-wake options for the lake (Appendix B). Respondents overwhelmingly supported a slow-no-wake zone near the public boat landing extending to encompass the two islands closest to the landing. Map 5 shows that much of this area is already considered slow-now-wake for personal water crafts (jet skis) and recent legislation has made portions of this area slow-no-wake for all boats (see Implementation Plan).

Data collected from the aquatic plant surveys indicate that the average conservatism values are higher than the state median and the Northern Lakes Ecoregion median. This shows that the aquatic plants within Seven Island Lake are more indicative of a pristine condition than those found in most lakes in the state and the ecoregion. Combining the lake's species richness and average conservatism values to produce its Floristic Quality Index (FQI) results in an exceptionally high value of 37.7 (calculation shown below); again, well above the median values of the state and ecoregion (Figure 3.3-5).

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.

FQI = Average Coefficient of Conservatism (7.0) * √ Number of Native Species (29)
FQI = 37.7

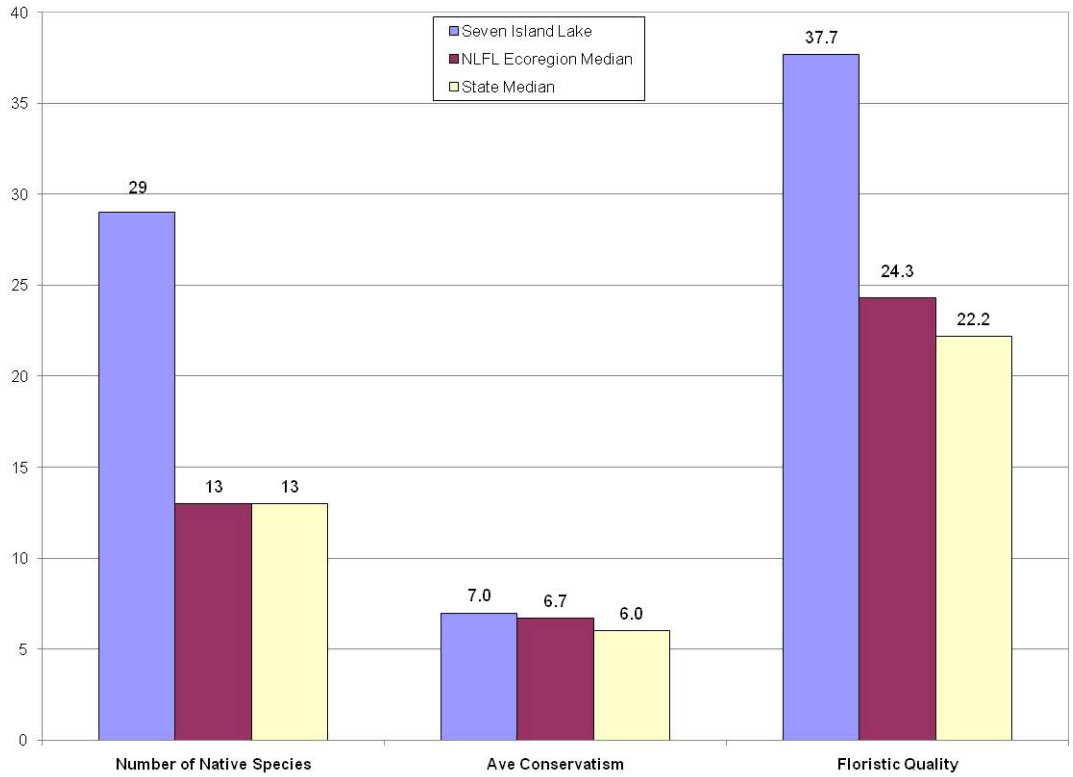


Figure 3.3-5. Floristic Quality Assessment using data from 2007 aquatic plant surveys. Analysis following Nichols (1999).

3.4 Seven Island 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 (WDNR 2009).

Table 3.4-1. Gamefish present in the Seven Island Lake with corresponding biological information (Becker 1983)**.**

Common Name	Scientific Name	Max Age (yrs)	Spawning Period	Spawning Habitat Requirements	Food Source
Black Crappie	*Pomoxis nigromaculatus*	7	May - June	Near Chara or other vegetation, over sand or fine gravel	Fish, cladocera, insect larvae, other inverts
Bluegill	*Lepomis macrochirus*	11	Late May - Early August	Shallow water with sand or gravel bottom	Fish, crayfish, aquatic insects and other invertebrates
Largemouth Bass	*Micropterus salmoides*	13	Late April - Early July	Shallow, quiet bays with emergent vegetation	Fish, amphipods, algae, crayfish and other invertebrates
Muskellunge	*Esox masquinongy*	30	Mid April - Mid May	Shallow bays over muck bottom with dead vegetation, 6 - 30 in.	Fish including other muskies, small mammals, shore birds, frogs
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
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
Walleye	*Sander vitreus*	18	Mid April - Early May	Rocky, wave-washed shallows, inlet streams on gravel bottoms	Fish, fly and other insect larvae, crayfish
Yellow Perch	*Perca flavescens*	13	April - Early May	Sheltered areas, emergent and submergent vegetation	Small fish, aquatic invertebrates

Based on data collected from the stakeholder survey fishing was the second highest ranked important or enjoyable activity on Seven Island Lake (Appendix B, Question #9). Approximately 92.5% of these same respondents believed that the quality of fishing on Seven Island Lake was either fair or poor (Appendix B, Question #6) and over 100% believe that the quality of fishing has remained the same or gotten worse since they have obtained their property (Appendix B, Question #7).

Table 3.4-1(above) shows the popular game fish and that are present in Seven Island Lake. Management actions that have taken place and may need to be repeated if Eurasian water milfoil re-establishment occurs on Seven Island Lake according to this plan include herbicide applications to control Eurasian water milfoil. In the future, these applications will 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 is to remove broad-leaf (dicot) submergent plants that are actively growing at these low water temperatures. Yellow perch is one species that could be affected by early season herbicide applications, as the treatments could eliminate nursery areas for the emerged fry of these species.

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 3.4-1). Seven Island 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 15th. 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).

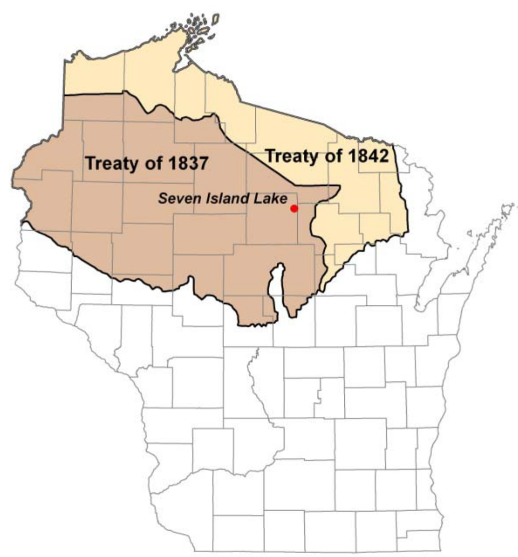


Figure 3.4-1. Location of Seven Island Lake within the Native American Ceded Territory (GLIFWC 2009). This map was digitized by Onterra; therefore it is a representation and not legally binding.

Seven Island Lake was not declared as a spear harvest lake in 2008 and has not been harvested in the past. A combination of a low estimated safe harvest for walleye and the availability to spear other lakes in the region with higher estimated safe harvest have likely contributed to Seven Island Lake not being declared as a spear harvest lake.

Walleye is a prized game fish in northern Wisconsin and are present in Seven Island Lake. As stated above, Seven Island Lake is located within ceded territory and special fisheries regulations may occur if the lake receives tribal declaration. An adjusted walleye bag limit pamphlet is distributed each year by the WDNR which would explain the more restrictive bag or length limits for the lake. There are currently no special regulations on Seven Island Lake, allowing for 5 walleye greater than 15 inches to be harvested per day and 1 muskellunge greater than 34 inches to be harvested per day.

Area fisheries biologist, Dave Seibel, indicates that fall electrofishing surveys conducted each year on Seven Island Lake show that little or no natural reproduction is occurring within the Lake. Table 3.4-2 shows that Seven Island Lake was frequently stocked for walleye between 1972 and 1996. Figure 3.4-2 shows that during the 2006-07 Comprehensive Fisheries Survey conducted on Seven Island Lake, the majority of the walleye caught during the 2006 survey were above 14 inches, also showing that little to no recruitment from natural reproduction is occurring in the system. Due to the lack of success of the stocking program, the WDNR ceased stocking Seven Island Lake for slightly over a decade. Pressure from the SILA resulted in the lake being stocked in 2009 for the first time in over a decade (Table 3.4-2). The SILA hopes that Seven Island Lake will continue to be stocked for walleye every-other year.

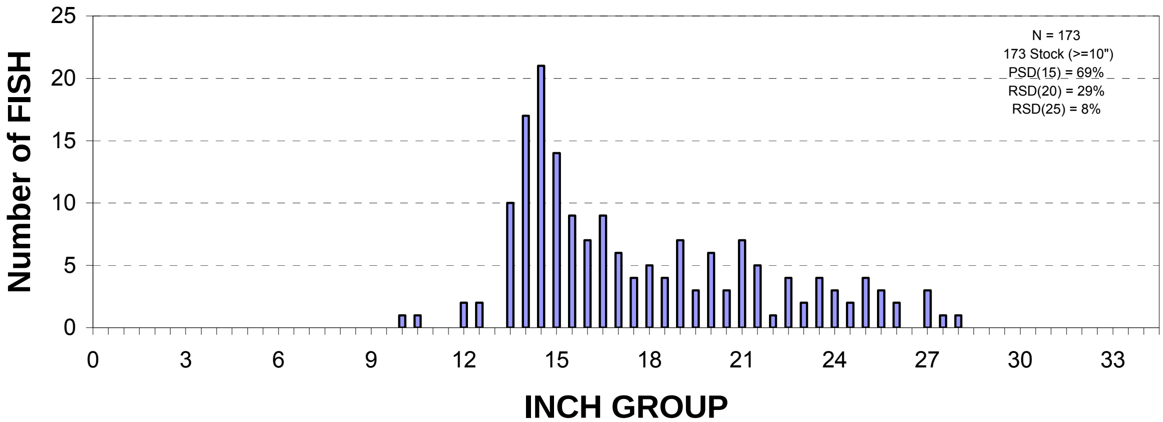


Figure 3.4-2 Walleye size distribution from 2006 electrofishing and fyke net surveys. Figure provided by Dave Seibel, WDNR Fisheries Biologist.

Seven Island Lake is also known for its muskellunge population. Anecdotal evidence suggests that this species did not exist in Seven Island Lake until the early 1970's when it was first stocked by the WDNR. Many stakeholders feel that the muskellunge population competes for resources (space, food, etc.) with the walleye population. Based on the 2006-2007 survey, the muskellunge population in Seven Island Lake is approximately 0.59 fish/acre. According to Dave Seibel, this population is not high enough to warrant a special regulation being placed on this species. While he agrees that Seven Island Lake's relatively small size makes having 2 apex predators exist in balance difficult, encouraging harvest of muskellunge within regulations may have a positive effect on struggling walleye populations.

Seven Island Lake is a Class B muskellunge lake which means that while the lake provides good fishing potential, the success and catch rates are less than in prime waters. At this time, Seven Island Lake is considered a Category 2 muskellunge lake, whereas natural reproduction occurs, however some stocking may need to occur to supplement natural recruitment.

Table 3.4-2. Fish stocking data available from the WDNR from 1972 to 2009 (WDNR 2008).

Year	Species	Age Class	# Stocked
1972	Muskellunge	Fingerling	275
1973	Walleye	Fingerling	6,440
1974	Muskellunge	Fingerling	340
1976	Muskellunge	Fingerling	275
1977	Walleye	Fingerling	7,000
1979	Muskellunge	Fingerling	275
1980	Walleye	Fingerling	8,333
1982	Walleye	Fingerling	6,600
1983	Walleye	Fingerling	6,600
1985	Walleye	Fingerling	6,600
1987	Walleye	Fingerling	18,000
1988	Walleye	Fingerling	6,600
1989	Walleye	Fingerling	6,650
1990	Walleye	Fingerling	1,320
1991	Walleye	Fingerling	1,320
1992	Walleye	Fingerling	10,074
1994	Walleye	Fingerling	8,252
1996	Walleye	Fingerling	6,926
2009	Walleye	Fingerling	4,620

According to the point-intercept survey conducted by the Wisconsin Department of Natural Resources in 2007, most of the substrate sampled in the littoral zone on Seven Island Lake was muck (75%), followed by sand (16%), and rock (9%) (Map 6). 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 the eggs 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 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 (Becker 1983).

Information collected during the 2006-2007 Comprehensive Fisheries Survey completed on Seven Island Lake show that bluegill and yellow perch comprise the majority of the fish caught during the survey (Figure 3.4-3). These species are sought after by anglers as well as smaller individuals being targeted by the apex predators within the system as food items.

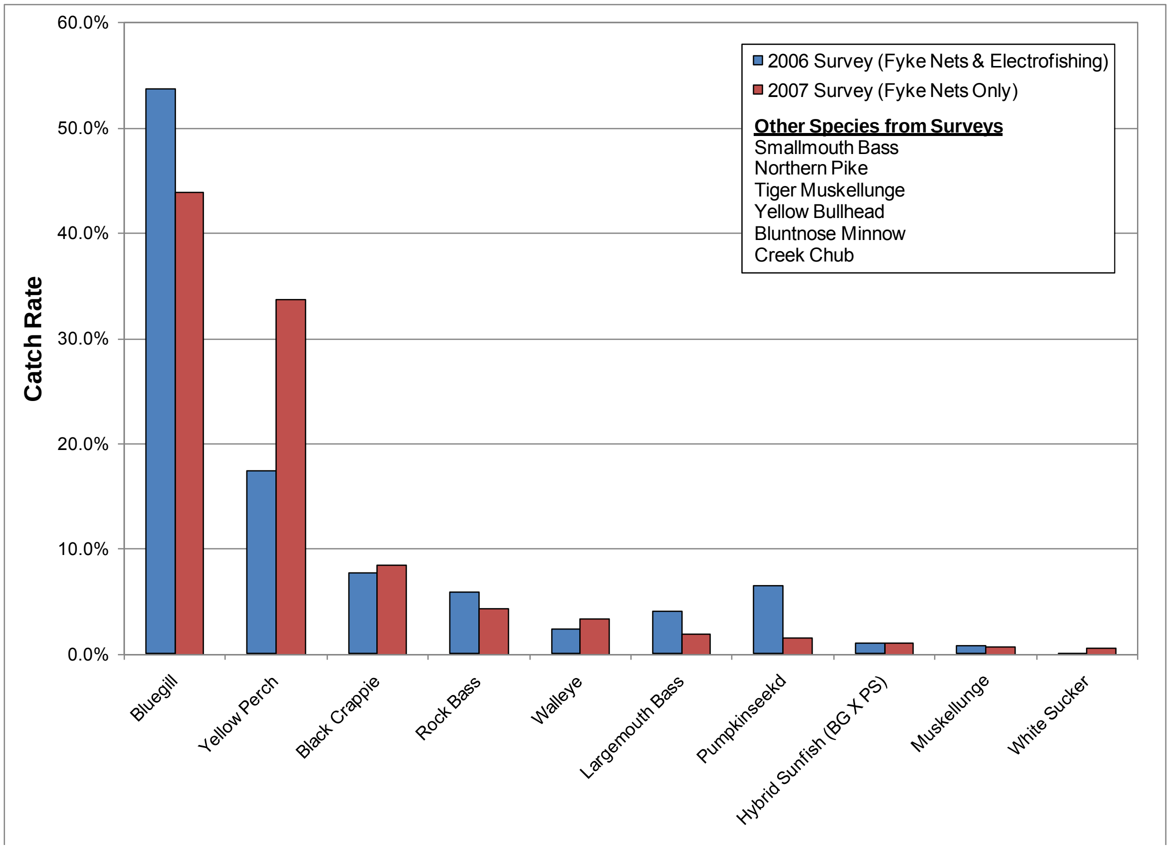


Figure 3.4-3. Catch rate of fish species from 2006-2007 comprehensive fisheries survey. Data provided by Dave Seibel, WDNR Fisheries Biologist and compiled by Onterra.

4.0 SUMMARY AND CONCLUSIONS

The design of this project was intended to fulfill three objectives:

1) Collect baseline data to increase the general understanding of the Seven Island Lake ecosystem.
2) Collect detailed information regarding invasive plant species within the lake with a primary focus on Eurasian water milfoil.
3) Collect sociological information from Seven Island Lake stakeholders regarding their use of the lake and their thoughts pertaining to the past and current conditions of the lake and its management.

The three objectives were fulfilled during the project and have lead to a good understanding of the Seven Island Lake ecosystem, the folks that care about the lake, and what needs to be completed to protect and enhance it.

Three primary aspects of the Seven Island Lake ecosystem were studied as a part of this management planning project; the system's water quality, its native and non-native aquatic plant community, and the watershed that supplies a small portion of system's water. In general, the studies indicate that the lake is in exceptionally good health. The paragraphs that follow cover the highlights of the studies that were completed and further, they elaborate on the conclusions that were drawn from them.

The Seven Island Lake watershed is largely composed of forested areas. In fact, roughly 66% of the watershed's 450 acres contain forest cover. Forests export very little phosphorus and other pollutants within runoff as most of precipitation that falls on them infiltrates the ground. Being that so much of the lake's drainage basin is in forest cover means that little phosphorus enters the lake via runoff. Modeling of the lake's watershed phosphorus load is very small and at 62 lbs annually and that this low annual phosphorus load leads to the outstanding water quality apparent within the lake as discussed below.

Current data collected from Seven Island Lake indicates that its water quality is superior to most lakes in the state and northeast region. Unfortunately, long-term trend analysis that would lead to an understanding of how Seven Island Lake's water quality has changed over more than the past 1 ½ decades was precluded by a lack of historic data from prior to that timeframe. Still, the fact remains that Seven Island Lake's nutrient levels are currently quite low and as a result the water remains unusually clear. Degradation of water quality is of great concern among Seven Island Lake stakeholders as nearly 18% of stakeholder survey respondents rated it as one of their top three concerns about the lake (Appendix B, Question 18).

As described above, the high quality of Seven Island Lake's lake water is largely the result of the high quality of the water that arrives from its drainage basin. This means that the lake is very sensitive to increases in nutrient loads, and the most likely source for those increases occurs in the lake's immediate shoreland watershed. In other words, continued impacts in the shoreland areas of the lake will most likely result in higher nutrient loads entering the lake and those higher loads will first be seen in decreased water clarity. These impacts include further shoreland development, overcutting of trees, fertilizer use, faulty septic systems, and increases in impervious surfaces. Control of these impacts is required to maintain the water quality and habitat value within the lake.

Numerous plant surveys were completed on Seven Island Lake by the WDNR and Onterra in order to better understand the native and exotic plant communities that exist within it. The results of these surveys are used as a baseline for future studies and lead to more effective management strategies.

Analysis of the plant survey results indicates that the aquatic plant community of Seven Island Lake is healthy, although it is of only moderate diversity. The floristic quality of the lake is quite high and well above state and ecoregion medians. Analysis of the 2007 plant data also indicates that the lake's plant community is made up of many plants that prefer more pristine (less disturbed) aquatic systems.

Eurasian water milfoil was discovered near the Seven Island Lake boat landing in 2005. Following intensive control efforts conducted by the SILA, including a single herbicide treatment and numerous hand-removal sessions, all available evidence indicates that this harmful exotic has been eradicated from the lake. Eradication of Eurasian water milfoil from a lake once it is found in nearly unheard of in the State of Wisconsin. The success of this incredible eradication project can be attributed to the tenacity of the association's efforts and the support of the WDNR.

Based on studies conducted by the WDNR, little to no natural recruitment of walleye occurs in Seven Island Lake and the population needs to be augmented through stocking. Stocking of walleye in lakes without natural reproduction remains low on the WDNR list of priorities and continued dialogue between the Seven Island Lake Association and the WDNR will be needed to continue this program.

At this time, muskellunge populations are not high enough to warrant changes in the current regulations. However, encouraging harvest of muskellunge within regulations may reduce the competitive dynamics between muskellunge and walleye and have a positive effect on struggling walleye populations.

Overall, the results and conclusions drawn from the many studies completed on Seven Island Lake during this project indicate that the lake is in excellent health. With that in mind, the Implementation Plan contained within the next section, is primarily aimed at protecting this unique resource.

5.0 IMPLEMENTATION PLAN

The Implementation Plan presented below was created through the collaborative efforts of the Seven Island Lake Association Planning Committee and ecologist/planners from Onterra. It represents the path the SILA 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 Seven Island 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: Increase Seven Island Lake Association's Capacity to Communicate with Lake Stakeholders

Management Action: Support an Education Committee to promote clean boating, water quality, public safety, and quality of life on Seven Island Lake

Timeframe: Begin summer 2009

Facilitator: Board of Directors to form Education Committee

Description: Education represents a good tool to address issues that impact water quality such as lake shore development, lawn fertilization and other issues such as air quality, noise and boating safety. An Education Committee will be created to promote lake protection and the quality of life through a variety of educational efforts.

Currently, the SILA regularly publishes newsletters to association members which allows for exceptional communication within the 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. Perhaps most importantly, the dispersal of a well written newsletter can be used as a tool to increase awareness of many aspects of lake ecology and management among association members. By doing this, meetings can often be conducted more efficiently and misunderstandings based upon misinformation can be avoided. Educational pieces within the association newsletter may contain monitoring results, association management history, as well as other educational topics listed below.

In addition to creating regularly published association newsletter a variety of educational efforts will be initiated by the Education Committee. These may include educational materials, awareness events and demonstrations for lake users as well as activities which solicit local and state government support.

Example Educational Topics:

Aquatic Invasive Species Updates
Specific topics brought forth in other management actions
Boating safety
Catch and release fishing

Noise, air, and light pollution
Shoreland restoration and protection
Septic system maintenance

Action Steps:

1. Recruit volunteers to form Education Committee.
2. Investigate if WDNR small-scale Lake Planning Grant would be appropriate to cover initial setup costs.
3. The SILA Board will identify a base level of annual support for educational activities to be undertaken by the Education Committee.

Management Goal 2: Maintain Current Water Quality Conditions

Management Action: Monitor water quality through WDNR Citizens Lake Monitoring Network.

Timeframe: Continuation of current effort.

Facilitator: Dan Nordall

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. Early discovery of negative trends may lead to the reason as of why the trend is developing. Volunteers from the SILA have collected Secchi disk clarities and water chemistry samples during the past through the WDNR Citizen Lake Monitoring Program. A set of volunteers would be solicited from the SILA to collect water quality samples on the lake, including dissolved oxygen using the probe owned by the association. The volunteer monitoring of the water quality is a large commitment and new volunteers may be needed in the future as the volunteer's level of commitment changes. It is the responsibility of the Planning Committee to coordinate new volunteers as needed. When a change in the collection volunteer occurs, it will be the responsibility of the Planning Committee to contact the Sandra Wickman (715.365.8951) or the appropriate WDNR/UW Extension staff to ensure the proper training occurs and the necessary sampling materials are received by the new volunteer. It is alos important to note that as a part of this program, the data collected are automatically added to the WDNR database and available through their Surface Water Integrated Monitoring System (SWIMS) by the volunteer.

Action Steps:

Please see description above.

Management Action: Reduce phosphorus and sediment loads from shoreland watershed to Seven Island Lake.

Timeframe: Begin 2009

Facilitator: Education Committee

Description: As the watershed section discusses, the Seven Island Lake watershed is in good condition; however, watershed inputs still need to be focused upon, especially in terms of the lake's shoreland properties. These sources include faulty septic systems, shoreland areas that are maintained in an unnatural manner, impervious surfaces.

On April 14th, 2009, Governor Doyle signed the "Clean Lakes" bill (enacted as 2009 Wisconsin Act 9) which prohibits the use of lawn fertilizers containing phosphorus. Phosphorus containing fertilizers were identified as a major contributor to decreasing water quality conditions in lakes, fueling plant growth. This law will go into effect in April 2010. While this law also bans the display and sale of phosphorus containing fertilizers, educating lake stakeholders about the regulations and their purpose is important to ensure compliance.

To reduce these negative impacts, the SILA will initiate an educational initiative aimed at raising awareness among shoreland property owners concerning their impacts on the lake. This will include newsletter articles and guest speakers at association meetings.

Topics of educational items may include benefits of good septic system maintenance, methods and benefits of shoreland restoration, including reduction in impervious surfaces, and the options available regarding conservation easements and land trusts.

Action Steps:

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

Management Action: Complete Shoreland Condition Assessment as a part of next management plan update

Timeframe: Begin 2009

Facilitator: Board of Directors

Description: As the discussed above, unnatural shorelands can negatively impact the health of a lake, both by decreasing water quality conditions as well as removing valuable habitat for fish and other aquatic species that reside within the lake. Understanding the shoreland conditions around Seven Island Lake will serve as an educational tool for lake stakeholders as well as identify areas that would be suitable for restoration. Shoreland restorations would include both in-lake and shoreline habitat enhancements. In-lake enhancements would include the introduction of course woody debris, a fisheries habitat component lacking around the shores of Seven Island Lake. Shoreline enhancements would include leaving 30-foot no-mow zones or by planting native herbaceous, shrub, and tree species as appropriate for Lincoln County. Ecologically high-value areas delineated during the survey would also be selected for protection, possibly through conservation easements or land trusts (www.northwoodslandtrust.org).

Projects that include shoreline condition assessment and restoration activities will be better qualified to receive state funding in the future. These activities could be completed as an amendment to this management plan and would be appropriate for funding through the WDNR small-scale Lake Planning Grant program.

Action Steps: See description above.

Management Goal 3: Control Aquatic Invasive Species within Seven Island Lake

Management Action: Initiate *modified* Clean Boats Clean Waters watercraft inspections at Seven Island Lake public access

Category: Prevention & Education

Timeframe: In progress

Facilitator: Planning Committee

Description: At this time, Seven Island Lake is believed to be free of aquatic invasive species. Initiating a modified program of watercraft inspections based upon the WDNR Clean Boats Clean Waters program will help to reduce the chance that the other exotic species, such as Eurasian water milfoil, zebra mussels, and curly-leaf pondweed would be introduced to the lake. Seven Island Lake is not considered a primary fishing-destination in Lincoln County, mainly due to the other large waterbodies in the region. Therefore, it is not visited on a frequent basis by lake users that do not have property on the lake; and a modified inspection program aimed at the most busy weekends of the year would be targeted for watercraft inspections by volunteers from Seven Island Lake.

Action Steps:

1. Members of association attend Clean Boats Clean Waters training session through the AIS Coordinator for Lincoln County (Chris Hamerla – 715.362.5972).
2. Training of additional volunteers completed by those trained during the summer of 2010.
3. Begin inspections during high-risk weekends
4. Report results to WDNR and SILA.
5. Promote enlistment and training of new of volunteers to keep program fresh.

Management Action: Coordinate annual volunteer monitoring of Aquatic Invasive Species

Timeframe: Ongoing

Facilitator: Planning Committee

Description: In lakes without Eurasian water milfoil, early detection of pioneer colonies commonly leads to successful control and in cases of very small infestations, possibly even eradication. This technique has proven successful for Seven Island Lake in the past, as early detection of Eurasian water milfoil was seemingly eradicated this species after a prompt control strategy was initiated consisting of herbicide treatment and manual removal.

Currently, a single person undergoes the task of surveying the area of initial infestation using scuba methods. Additional volunteers will be needed to continue this monitoring effort into the future. Volunteers would monitor the entire area of the lake in which plants grow (littoral zone) annually to locate new occurrences of Eurasian water milfoil as well as other non-native plant species. Using an "adopt-a-shoreline" approach, volunteers would be responsible for surveying specified areas of their lake.

Action Steps:

1. Volunteers from SILA attend training session conducted by WDNR/UW-Extension through the AIS Coordinator for Lincoln County (Chris Hamerla – 715.362.5972).
2. Trained volunteers recruit and train additional association members.
3. Complete lake surveys following protocols.
4. Report results to WDNR and SILA.

Management Action: Control recurring Eurasian water milfoil infestation on Seven Island Lake

Timeframe: Initiate upon exotic infestation

Facilitator: Planning Committee with professional help as needed

Description: As described in the Aquatic Plant section and elaborated upon within the Summary and Conclusions, Seven Island Lake is not believed to contain Eurasian water milfoil. Eradication of a species such as Eurasian water milfoil is widely thought of as an impossible task and there still remains a chance that this species occurs within the lake, albeit at undetectable levels. Therefore, a control strategy needs to be devised to align the SILA in the event that Eurasian water milfoil infestation reestablishes or a new population becomes introduced to the system.

In the event that Eurasian water milfoil is located by the trained volunteers, the areas would be marked using GPS and would serve as *focus areas* for professional ecologists. Those focus areas would be surveyed by professionals during late summer (likely August or early September) and the results would be used to create a prospective treatment strategy for the following year.

Small isolated infestations of Eurasian water milfoil can most appropriately controlled using manual removal methods, likely through scuba or snorkeling efforts. In order for this technique to be successful, the entire plant (including the root) needs to be removed from the lake. During manual extraction, careful attention would need to be paid to all plant fragments that may detach during the control effort.

Please Note: Hand removal activities have occurred in 2011 and are scheduled for 2012 to control the Eurasian water milfoil locations discovered after finalization of this document (Map 4).

At this time, the most feasible method to control larger infestations is through herbicide applications, specifically, early-spring treatments with 2,4-D. The responsible use of this technique is well supported by Seven Island Lake stakeholders as indicated by approximately 71% of stakeholder survey respondents indicating that they are at least moderately supportive of an herbicide control program (Appendix B, Question #22). Likely as a condition of the WDNR herbicide application permit, a spring refinement and verification survey by professionals would precede the treatment as well as post treatment surveys to evaluate the control action.

If large populations of Eurasian water milfoil are located, a formal monitoring strategy consistent with the WDNR document, Aquatic Plant Community Evaluation with Chemical Manipulation (Draft), would need to accompany the herbicide application. This form of monitoring is required by the WDNR for all large scale herbicide applications (exceeding 10 acres in size or 10% of the area of the water body that is 10 feet or less in depth and treatment areas that are more than 150 feet from shore) and grant-funded projects where scientific and financial accountability are required.

Action Steps:

1. Retain consultant to map new Eurasian water milfoil occurrences.
2. Determine control strategy based upon professional findings.
3. Association obtains a permit to implement management action. The UW Extension Lake List is a great resource for locating an herbicide applicator or a company that can conduct removal of Eurasian water milfoil using scuba methods (www.uwsp.edu/cnr/uwexlakes/lakelist/businessSearch.asp).
4. Association updates management plant to reflect changes in control strategy.

Management Goal 4: Minimize User Conflicts on Seven Island Lake

Management Action: Investigate creation of slow-no-wake hours on Seven Island Lake.
Timeframe: Begin 2009
Facilitator: Planning Committee
Description: Like most lakes, Seven Island 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 Seven Island Lake. This would include the collection of stakeholder opinions regarding the idea and preliminary discussions with the Town of Harrison regarding the development of ordinances. Within the stakeholder survey, this implementation of slow-no-wake hours was supported by over 71% of respondents (Appendix B, Question #12).

Action Steps:

See description above.

<u>Management Action:</u> Investigate creation of slow-no-wake areas on Seven Island Lake.
Timeframe: Begin 2009
Facilitator: Planning Committee
Description: Seven Island Lake consists of an irregularly shaped shoreline including multiple islands. Within the stakeholder survey sent out as a part of the current management planning process, a series of questions were presented to understand stakeholder's support of the creation of slow-no-wake areas on Seven Island Lake. Approximately 87% of respondents were in favor of a permanent slow-no-wake zone extending from the public boat landing to the two nearest islands and over 90% were in favor of extending the slow no wake zone between the two islands closest to the public boat landing (Appendix B, Question #10 and 11).

Current state law requires a slow-no-wake zone for personal watercraft (jet skiis) within 200 feet of the shoreline. This law was enacted for personal safety reasons as well as to reduce the impacts of personal watercrafts (PWCs), which can negatively affect near-shore ecosystems due to their ability to navigate in relatively shallow water. These areas are displayed in hatching on Map 5. Please note that this restrict PWC use to the central part of the two main basins of Seven Island Lake.

A slow-no-wake bill (enacted as 2009 Wisconsin Act 31) has recently passed and will take effect February 24, 2010 that would establish a slow-no-wake zone within 100 feet of the shoreline for all watercraft. Boating close to the shoreline can cause shoreline erosion, stir up lake bottom sediments causing turbidity, and release nutrients such as phosphorus which can contribute to algal growth. In addition, boating in these areas can be harmful to fish habitat as propellers uproot emergent plant populations. These areas are also displayed in pink on Map 5.

This bill provides the ability for local units of government to balance the sociological needs of the lake users by creating local ordinances to allow high-speed boating within these areas if specified in a local ordinance. Currently, water skiing actively occurs around the large island (locally referred to as the 'swimming island') near the constriction between the two large basins of the lake. If this bill is to be signed by the governor and less-restrictive local ordinances are not created, these activities would be against the law.

Action Steps:

1. Solicit information from lake stakeholders referring to establishing slow-no-wake zones on Seven Island Lake.
2. Establish communication with Town of Harrison for implementation of slow-no-wake zones and/or less restrictive boating ordinances for the lake.
3. Determine if signage and/or buoy placement is needed to educate stakeholders on regulations.

Management Goal 5: Improve Fishery Resource and Fishing

Management Action: Work with WDNR fisheries managers to promote development of balanced fishery on Seven Island Lake

Timeframe: Currently

Facilitator: Education Committee

Description: As stated within the Fisheries Section, numerous Seven Island Lake stakeholders would like to see an increased walleye fishery. Dave Siebel, WDNR regional fisheries biologist, states that while the lake contains naturally reproducing muskellunge populations, the data shows that little or no walleye reproduction occurs in the system.

Walleye were stocked in 2009 for the first time since 1996. Some riparians feel that the large muskellunge population is competing for resources (food and space) with walleye. While simply adding more walleye may seem like the most appropriate action, the cause of the reduced walleye population has not been removed. Dave Siebel believes that the best way to encourage the balance between these two apex predator species is to reduce the current muskellunge population by harvesting this species within the current WDNR regulations. According to Dave Seibel, the current muskellunge population is not at a level in which lowering of size limits is warranted.

The SILA would like to continue its relationship with the WDNR, stocking walleye when resources are available. The SILA would also like to foster a continued dialogue with the WDNR to discuss additional and alternative methods to enhance the lake's fishery.

Action Steps:

1. See description above.

6.0 METHODS

Lake Water Quality

Baseline water quality conditions were studied to assist in identifying potential water quality problems in Seven Island Lake (e.g., elevated phosphorus levels, anaerobic conditions, etc.). Water quality was monitored at the deepest point on the lake that would most accurately depict the conditions of the lake (Map 1). Samples were collected using WDNR Citizen Lake Monitoring Network (CLMN) protocols which occurred once in spring and three times during the summer. In addition to the samples collected by Seven Island Lake Association members, professional water quality samples were collected at subsurface (S) and near bottom (B) depths once in spring, winter, and fall. Although Seven Island Lake Association members collected a spring total phosphorus sample, professionals also collected a near bottom sample to coincide with the bottom total phosphorus sample. Winter dissolved oxygen was determined with a calibrated probe and all samples were collected with a 3-liter Van Dorn bottle. Secchi disk transparency was also included during each visit.

All samples that required laboratory analysis were processed through the Wisconsin State Laboratory of Hygiene (SLOH). The parameters measured, sample collection timing, and designated collector are contained in the table below.

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

♦ indicates samples collected as a part of the Citizen Lake Monitoring Network.
● indicates additional samples collected as a part of the grant funded project.

Aquatic Vegetation

Curly-leaf Pondweed Survey

Surveys of curly-leaf pondweed were completed on Seven Island Lake during a June 6, 2007 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 Seven Island 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 in the summer of 2007. A point spacing of 40 meters was used resulting in approximately 331 points.

Community Mapping

During the species inventory work, the aquatic vegetation community types within Seven Island 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.

Watershed Analysis

The watershed analysis began with an accurate delineation of Seven Island 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)

7.0 LITERATURE CITED

Asplund, T.R. and C.M. Cook. 1997. Effects of motor boats on submerged aquatic macrophytes. Lake and Reservoir Management 13(1): 1-12.

Becker, G.C. 1983. Fishes of Wisconsin. The University of Wisconsin Press. London, England.

Boston, H.L., M.S. Adams. 1987. Productivity, growth, and photosynthesis of two small 'Isoetid' plants, Littorella uniflora and Isoetes macrospora. Journal of Ecology 75: 333-350.

Carlson, R.E. 1977 A trophic state index for lakes. Limnology and Oceanography 22: 361-369.

Elias, J.E. and M.W. Meyer. 2003. Comparisons of Undeveloped and Developed Shorelands, Northern Wisconsin, and Recommendations of Restoration. Wetlands 23(4):800-816. 2003.

Great Lakes Indian Fish and Wildlife Service. 2009. Interactive Mapping Website. Available at http://www.glifwc-maps.org. Last accessed December 2009.

Jennings, M. J., E. E. Emmons, G. R. Hatzenbeler, C. Edwards and M. A. Bozek. 2001. Is littoral habitat affected by residential development and land use in watersheds of Wisconsin lakes? Lake and Reservoir Management. 19(3):272-279.

Lillie, R.A., and J.W. Mason. 1983. Limnological characteristics of Wisconsin lakes. Technical Bulletin No. 138. Wisconsin Department of Natural Resources.

Lillie, R.A., S. Graham, and P. Rasmussen. 1993. Trophic state index equations and regional predictive equations for Wisconsin lakes. Research Management Findings 35. Wisconsin Department of Natural Resources.

Mumma, M.T., C.E. Cichra, and J.T. Sowards. 1996 Effects of recreation the submersed aquatic plant community of Rainbow River, Florida. Journal of Aquatic Plant Management 34: 53-56.

Murphy, K.J. and J.W. Eaton. 1983 Effects of pleasure-boat traffic on macrophyte growth in canals. Journal of Applied Ecology 20: 713-729.

Nichols, S.A. 1999. Floristic quality assessment of Wisconsin lake plant communities with example applications. Journal of Lake and Reservoir Management 15(2): 133-141

Omernick, J.M. and A.L. Gallant. 1988. Ecoregions of the Upper Midwest states. U.S. Environmental Protection Agency Report EPA/600/3-88/037. Corvallis, OR. 56p.

Panuska, J.C., and J.C. Kreider. 2003 Wisconsin Lake Modeling Suite Program Documentation and User's Manual Version 3.3. WDNR Publication PUBL-WR-363-94.

Radomski, P. and T.J. Goeman. 2001. Consequences of human lakeshore development on emergent and floating-leaf vegetation abundance. North American Journal of Fisheries Management 21: 46-61.

Scheuerell M.D. and D.E. Schindler. Changes in the Spatial Distribution of Fishes in Lakes Along a Residential Development Gradient. Ecosystems (2004) 7: 98–106.

Shaw, B., C. Mechenich and L. Klessig. Understanding Lake Data. 1996. UW-Extension Publication G3582.

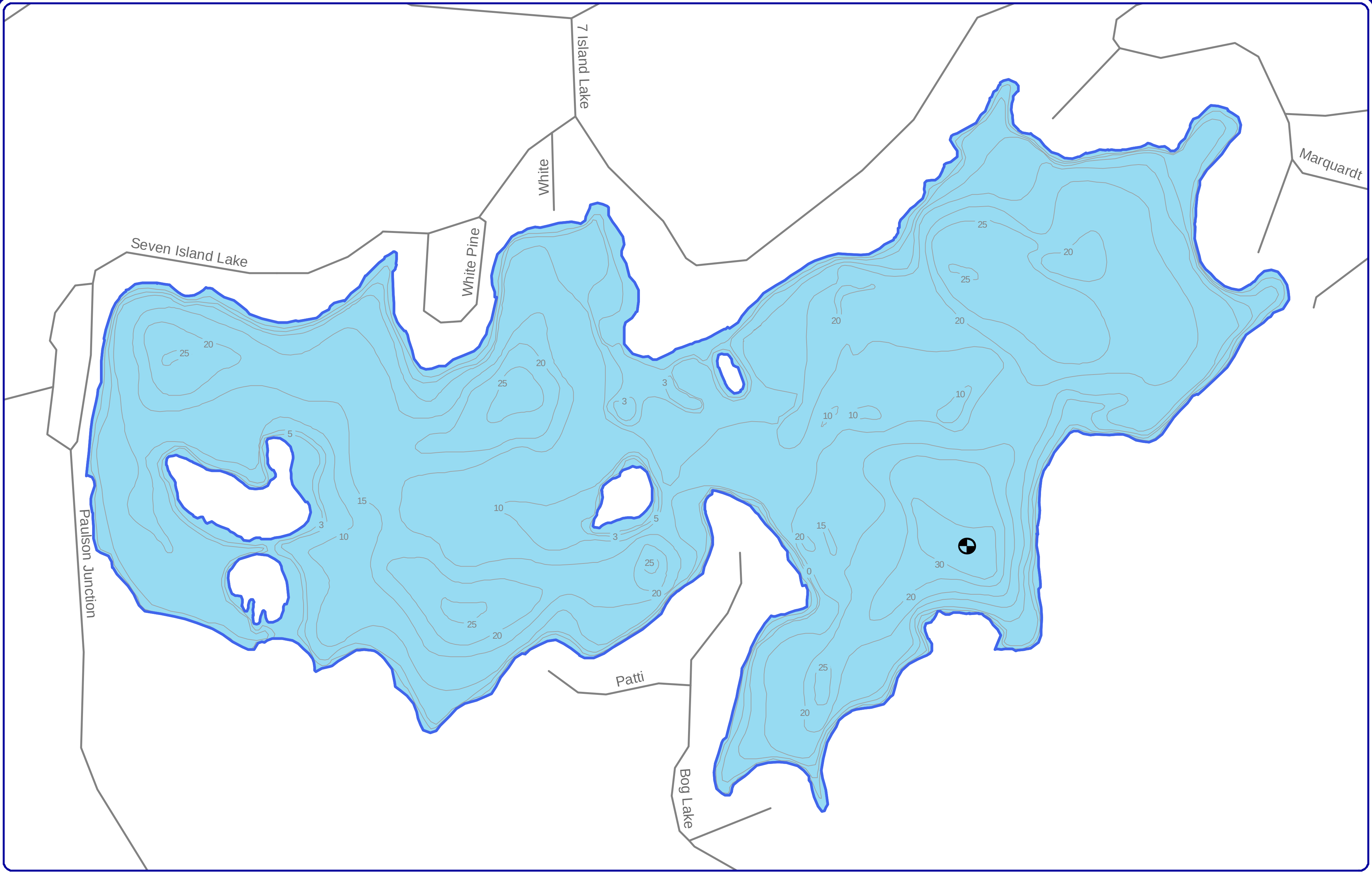
Vermatt, J.E., and R.J. de Bruyne. 1993. Factors limiting the distribution of submerged waterplants in the lowland river Vecht (The Netherlands). Freshwater Biology 30: 147-157.

Vestergaard, O. and K. Sand-Jensen. Alkalinity and trophic state regulate aquatic plant distribution in Danish lakes. 2000. Aquatic Botany 67: 85-107.

United States Department of the Interior – Bureau of Indian Affairs. 2007. Fishery Status Update in the Wisconsin Treaty Ceded Waters. Fourth Edition.

Wisconsin Department of Natural Resources. 2008. Department of Natural Resources Annual Spring Fish and Wildlife Rule Hearings. WDNR Publication PUB-LS-003 2008.

Wisconsin Department of Natural Resources – Bureau of Fisheries Management. 2009. Fish Stocking Summaries. Available at: http://infotrek.er.usgs.gov/wdnr_public. Last accessed December 2009.



N
W E
S

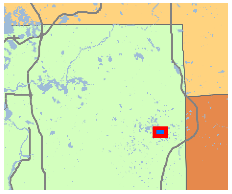
500

Feet

Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR

Map Date: August 1, 2009
\MgmtPlan\Map1_ProjectLocation.mxd



Extent of large map shown in red.

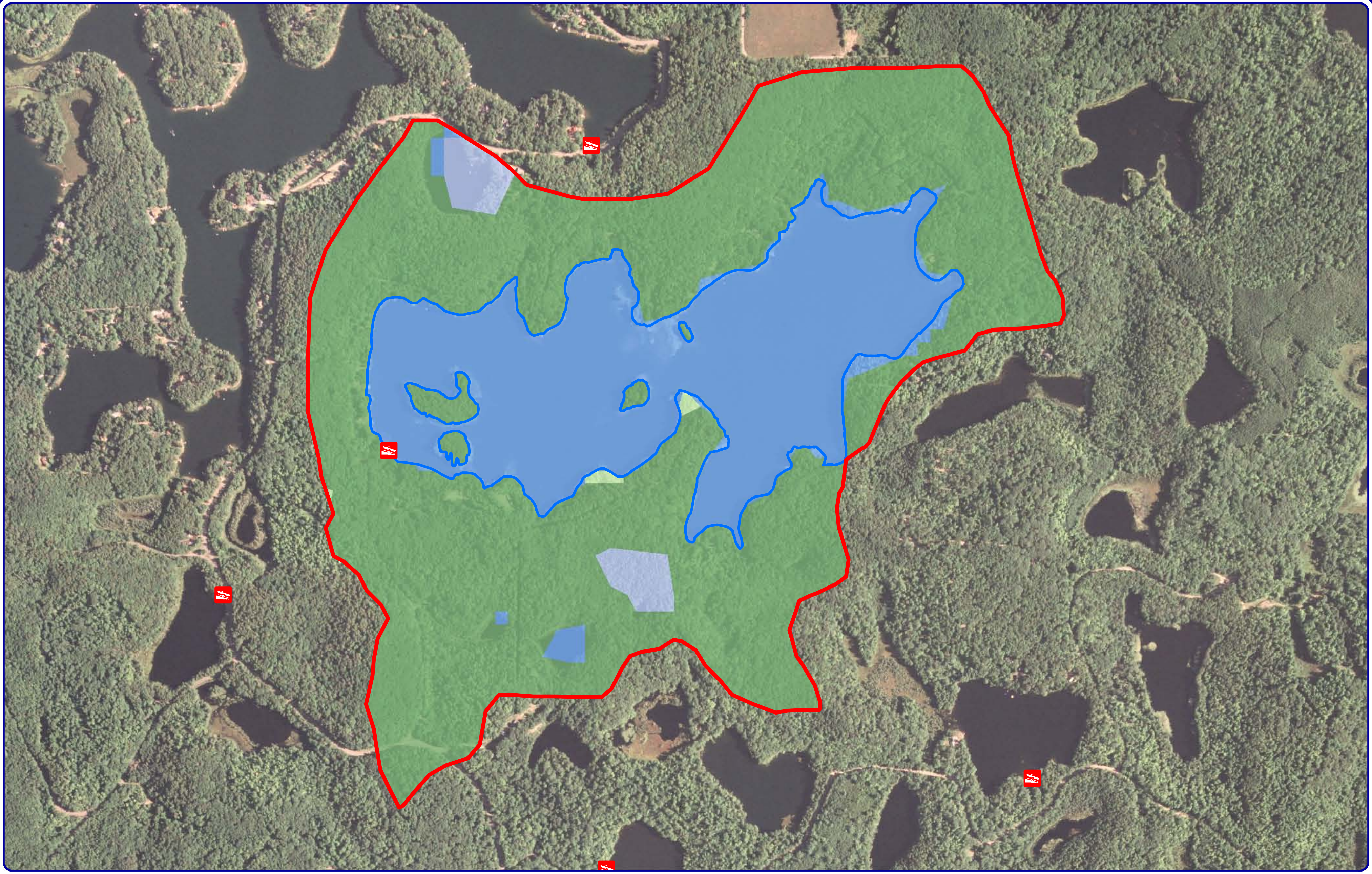
Legend

Seven Island Lake ~ 138 acres
WDNR Definition

Water Quality Sample Location

Map 1
Seven Island Lake
Lincoln County, Wisconsin

Project Location and Water Quality Sampling Site



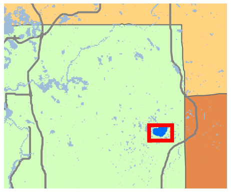
N
W E
S

1,000

Feet

Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Point-intercept Data: WDNR
Map Date: August 1, 2009
\MgmtPlan\Map2_SvnIsland_watershed.mxd



Extent of large map shown in red.

Legend

Land Cover Types
- Forest
- Pasture/Grass
- Wetland
- Open Water

- Watershed Boundary
- Public Boat Landing

Map 2
Seven Island Lake
Lincoln County, Wisconsin

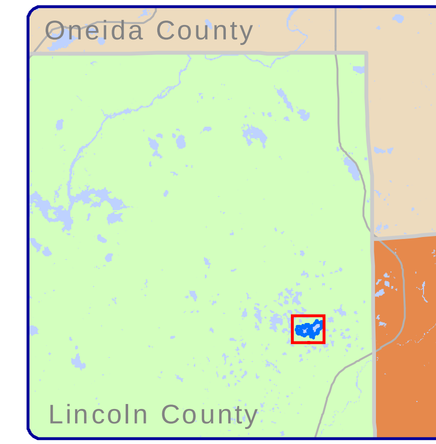
Watershed and Land Cover Types

Map 3

Seven Island Lake

Lincoln County, Wisconsin

Aquatic Plant Communities



Extent of large map shown in red.

Legend

Small Plant Communities

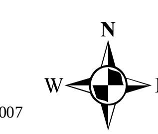
- Emergent
- Floating-leaf
- Mixed Floating-leaf & Emergent

Large Plant Communities

- Emergent
- Floating-leaf
- Mixed Floating-leaf & Emergent

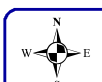
Public Boat Landing

Sources:
Roads & Hydro: WDNR
Orthophotography: NAIP 2005
Aquatic Plant Survey: Onterra, 2007
Map Date: April 8, 2007



450
Feet

Onterra, LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com



200

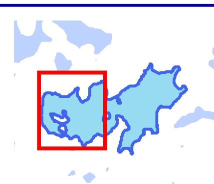
Feet

Onterra LLC

Lake Management Planning

135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Hydro and Roads: WDNR
Orthophotograpy: NAIP, 2010
2005 Treatment Area: Schmidt's Aquatic Plant Control
Aquatic Plant Survey: WDNR, 2005
Map Date: April 21, 2009



Extent of large map shown in red.

Legend

- EWM Location
  SILA and Lumberjack, 2011
- EWM Location
  WDNR PI Survey, 2005
- 2005 EWM Treatment Area
  ~8 acres of Navigate (150 lbs/acre) on 9/20/05

Map 4

Seven Island Lake

Lincoln County, Wisconsin

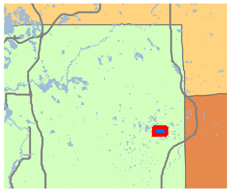
EWM Locations

N
W E
S

500
Feet

Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Othophotography: NAIP, 2005
Slow-no-wake Zones: Onterra
Map Date: December 28, 2009
\MgmtPlan\Map5_SvnIsland_WatercraftRegs.mxd



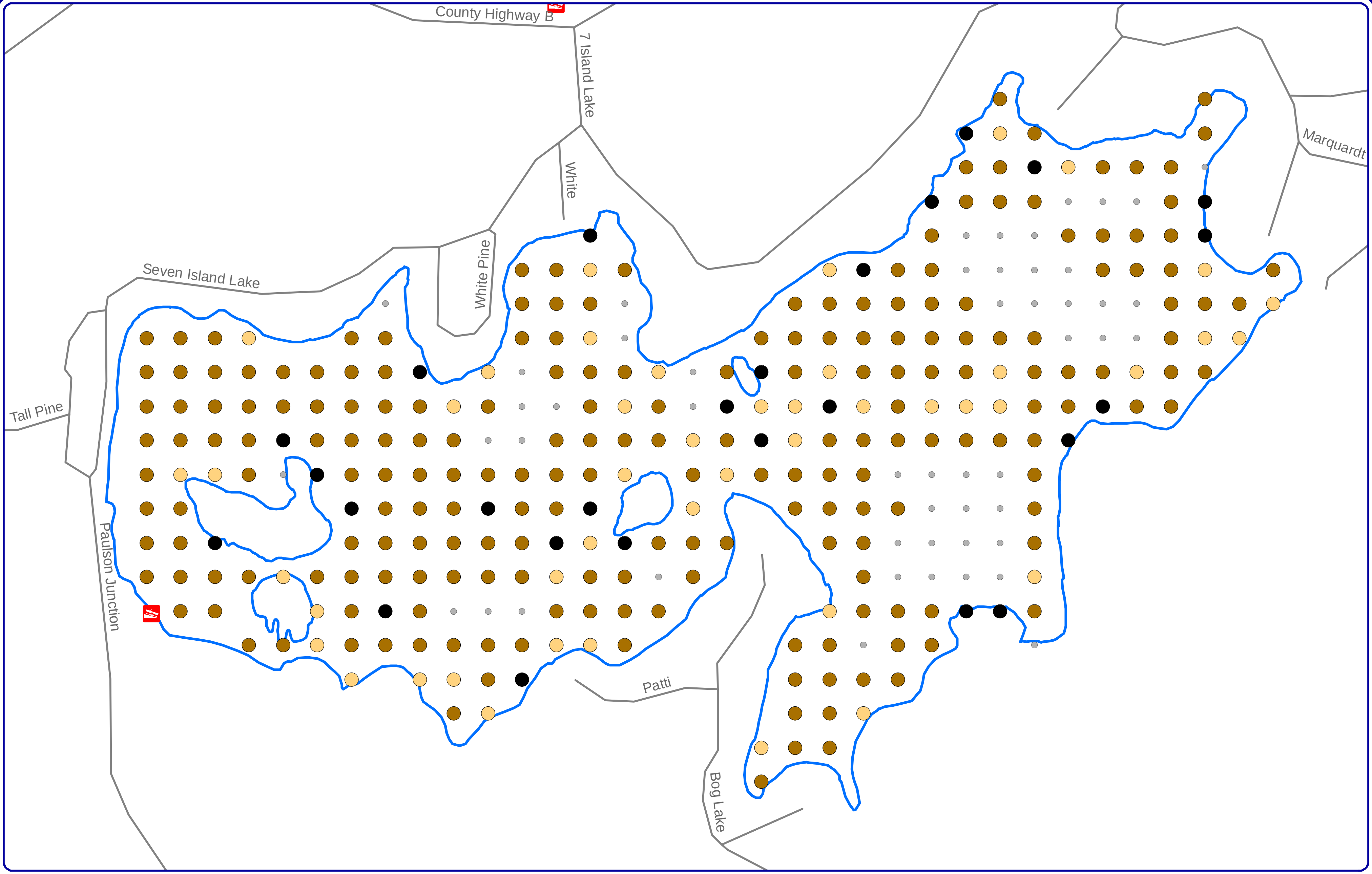
Extent of large map shown in red.

Legend

Motorized Boat
Slow-No-Wake Area (100-ft)

Personal Watercraft
Slow-No-Wake Area (200-ft)

Map 5
Seven Island Lake
Lincoln County, Wisconsin
Watercraft Regulation Areas

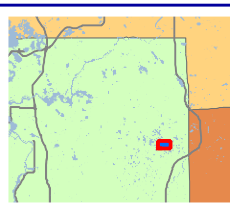


N
W E
S

500
Feet

Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Point-intercept Data: WDNR
Map Date: August 1, 2009
\MgmtPlan\Map6_SvnIsland_substrate_PI.mxd



Extent of large map shown in red.

Legend

Substrate

- Muck
- Rock
- Sand
- Too Deep or No Data

Map 6
Seven Island Lake
Lincoln County, Wisconsin

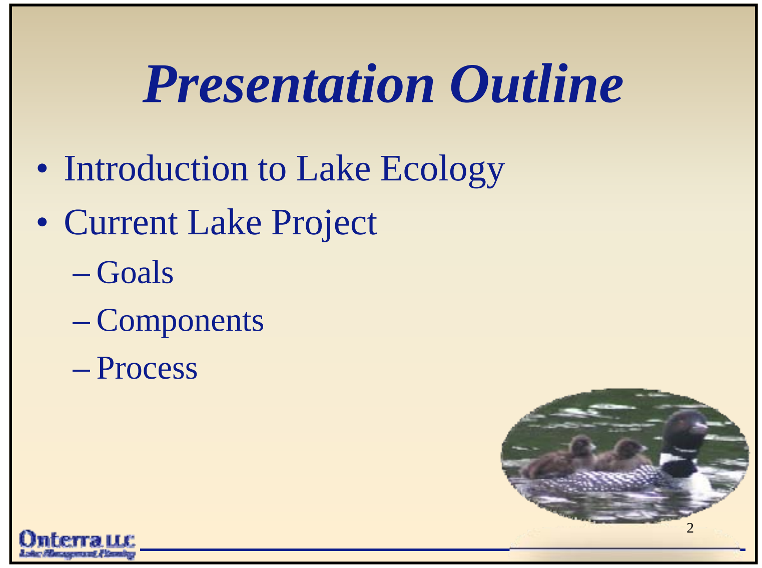
2007 P-I Survey: Substrate Types

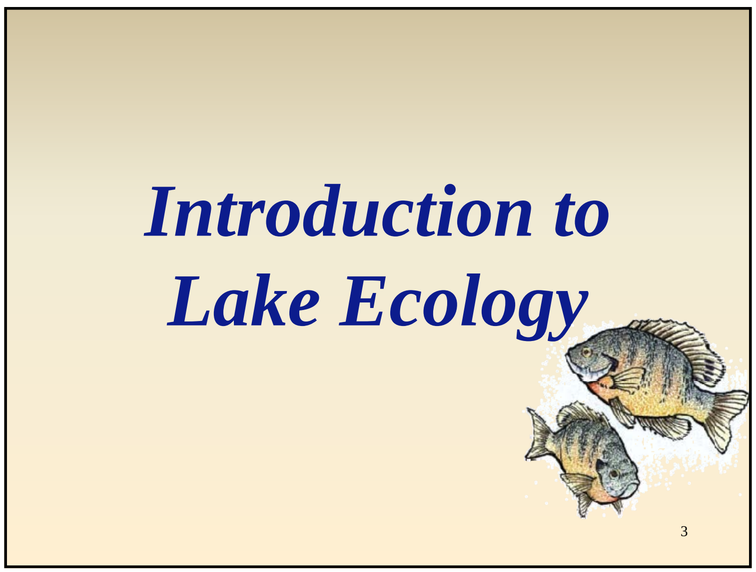
A

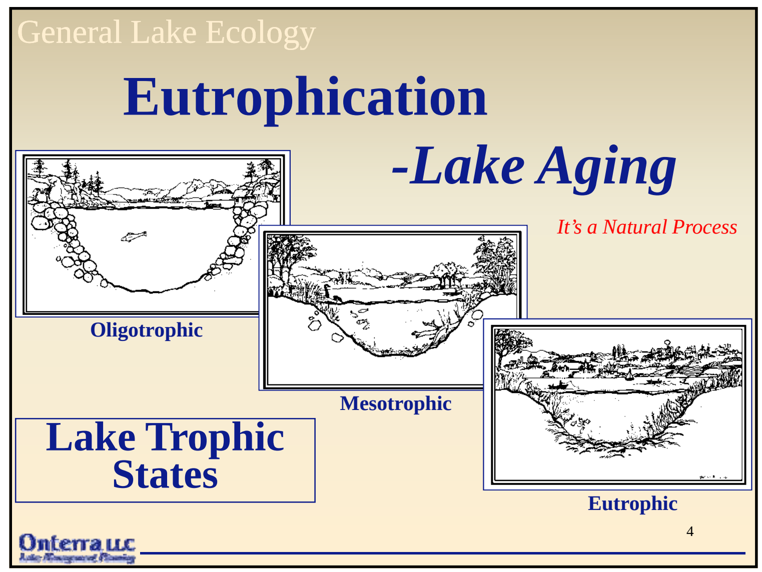
APPENDIX A

Public Participation Materials


Seven Island
Lake Association
Seven Island Lake
Mangement Planning Project
Kick-off Meeting
July 28, 2007
Eddie J. Heath
Aquatic Ecologist
Onterra LLC
1


Presentation Outline
• Introduction to Lake Ecology
• Current Lake Project
– Goals
– Components
– Process
Onterra LLC
2


Introduction to
Lake Ecology
3


General Lake Ecology
Eutrophication
-Lake Aging
It's a Natural Process
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic
States
Onterra LLC
4

General Lake Ecology

Cultural Eutrophication

Accelerated eutrophication caused by human activity.

Onterra LLC

5

General Lake Ecology

Limiting Ingredient (Nutrient)

8 Cups Water, 8 Cups Four, 8 Cups Sugar, 6 Eggs

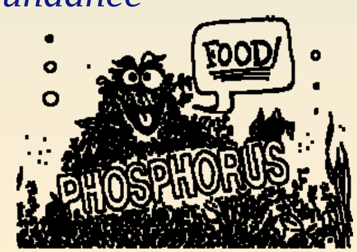
2 Cups Water 2 Cups Flour 2 Cups Sugar 2 Eggs	2 Cups Water 2 Cups Flour 2 Cups Sugar 2 Eggs
2 Cups Water 2 Cups Flour 2 Cups Sugar 2 Cups Eggs	2 Cups Water 2 Cups Flour 2 Cups Sugar 2 Eggs

6

General Lake Ecology

Phosphorus

- *Limiting Nutrient*
- *Controls Plant Abundance (Productivity)*
  - *Algae*
  - *Macrophytes*



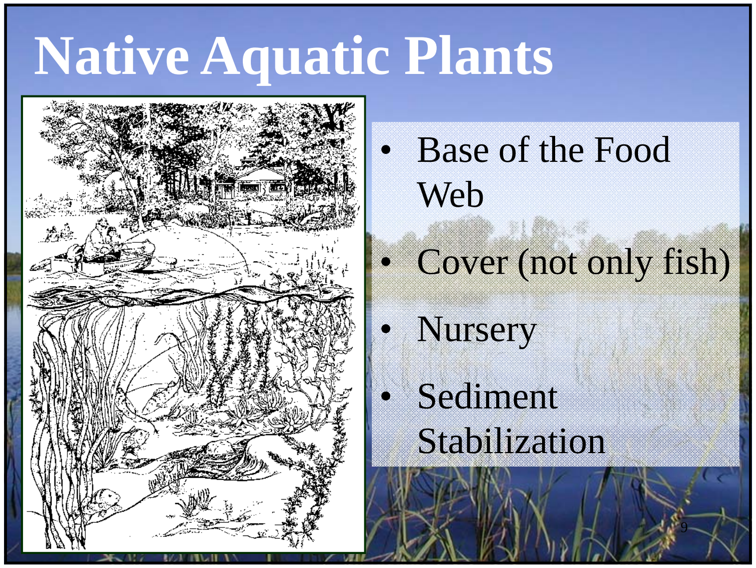
7

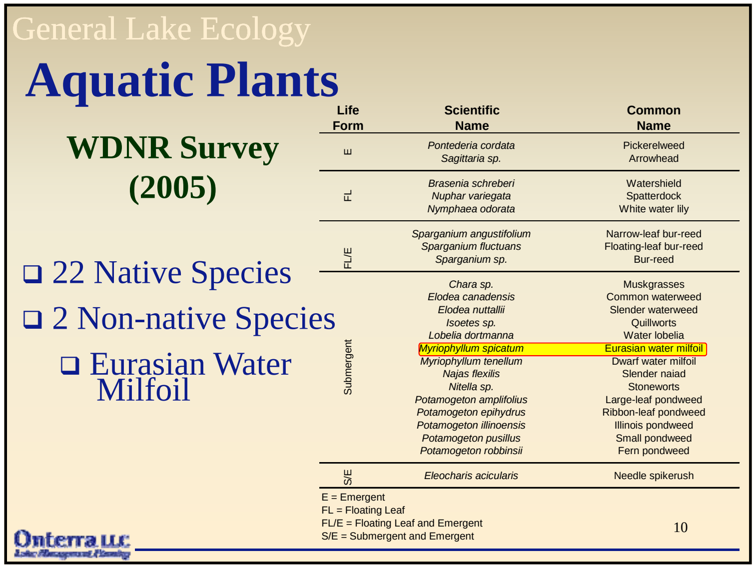
General Lake Ecology

Aquatic Plants (macrophytes)

- *Native Plants*
- *Exotic Plants (non-native)*

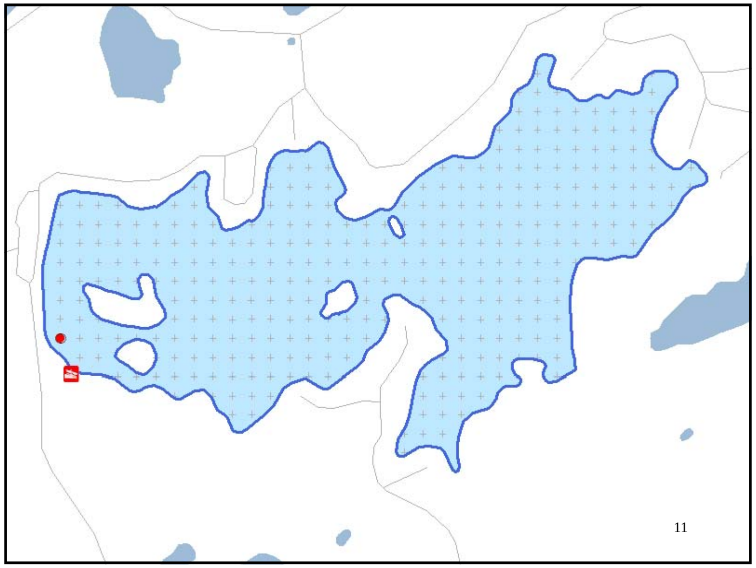
8





Life Form	Scientific Name	Common Name
E	*Pontederia cordata*	Pickerelweed
	Sagittaria sp.	Arrowhead
FL	*Brasenia schreberi*	Watershield
	Nuphar variegata	Spatterdock
	Nymphaea odorata	White water lily
FL/E	*Sparganium angustifolium*	Narrow-leaf bur-reed
	Sparganium fluctuans	Floating-leaf bur-reed
	Sparganium sp.	Bur-reed
Submergent	*Chara sp.*	Muskgrasses
	Elodea canadensis	Common waterweed
	Elodea nuttallii	Slender waterweed
	Isoetes sp.	Quillworts
	Lobelia dortmanna	Water lobelia
	Myriophyllum spicatum	Eurasian water milfoil
	Myriophyllum tenellum	Dwarf water milfoil
	Najas flexilis	Slender naiad
	Nitella sp.	Stoneworts
	Potamogeton amplifolius	Large-leaf pondweed
	Potamogeton epihydrus	Ribbon-leaf pondweed
	Potamogeton illinoensis	Illinois pondweed
	Potamogeton pusillus	Small pondweed
	Potamogeton robbinsii	Fern pondweed
S/E	*Eleocharis acicularis*	Needle spikerush

E = Emergent
FL = Floating Leaf
FL/E = Floating Leaf and Emergent
S/E = Submergent and Emergent



General Lake Ecology

Non-native Aquatic Plants

Curly-leaf Pondweed

Onterra LLC
Lake Management Planning
13

General Lake Ecology

Non-native Aquatic Plants

Eurasian Water Milfoil

Onterra LLC
Lake Management Planning
14

General Lake Ecology

Consequences of Exotics

- Competition with Natives
  - Monotypic Community
- Decreased Recreational Value
- Decreased Property Value

Onterra LLC
Lake Management Planning
15

Current Project

Study and Plan Goals

•Collect & Analyze Data

•Construct Long-Term & Useable Plan

A goal without a plan is nothing more than a wish.

Onterra LLC
Lake Management Planning

17

Current Project

Study Components

•Public Participation
•Watershed Modeling
•Water Quality *Citizens Lake Monitoring Network*
•Aquatic Vegetation
  •Curly-leaf Survey *Completed – Results Pending*
  •Comprehensive Survey *P-I Completed (WDNR)*
  •Eurasian Water Milfoil *Scuba Survey*
•Plan Development

Onterra LLC
Lake Management Planning

18

Current Project

Planning Process

Planning Committee Meetings

•Study Results (including a stakeholder survey)
•Conclusions & Initial Recommendations
•Management Goals
•Management Actions
  •Timeframe
  •Facilitator(s)

Implementation Plan

Onterra LLC
Lake Management Planning

19

Thank You

Eddie J. Heath **eheath@onterra-eco.com**

Many of the graphics used in this presentation were supplied by:

Wisconsin Lakes Partnership

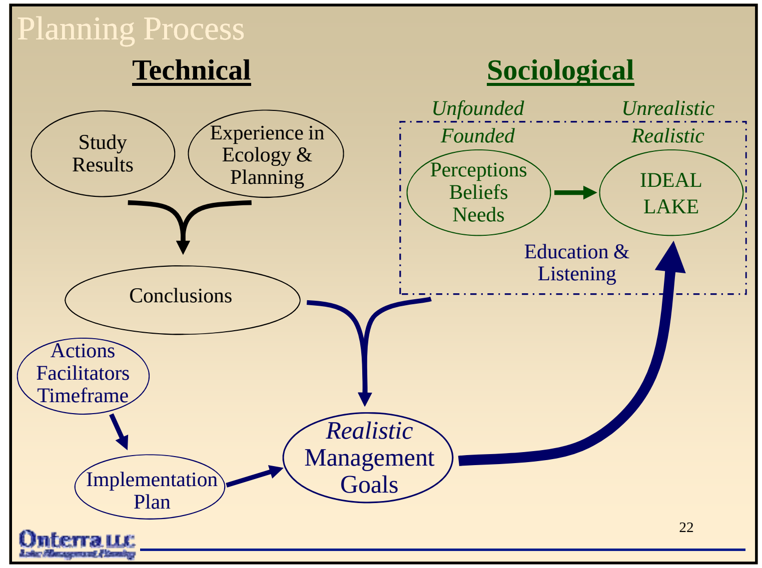
UW Extension

Wisconsin Dept. of Natural Resources

Onterra LLC
Lake Management Planning

20


The Planning Process
…it’s not as easy as you may think.
21


Planning Process
Technical
Sociological
Study Results
Experience in Ecology & Planning
Conclusions
Unfounded
Unrealistic
Founded
Realistic
Perceptions Beliefs Needs
IDEAL LAKE
Education & Listening
Actions Facilitators Timeframe
Implementation Plan
Realistic Management Goals
22
Onterra LLC

Seven Island Lake Management Planning Project Update – September 2007

Submitted by:
Tim Hoyman
Aquatic Ecologist
Onterra, LLC

As the summer winds down, sadly, so does our field season. Fortunately, we had the chance to visit Seven Island Lake a few times as a part of our studies. The first trip to the lake was completed in mid April when Eddie Heath, the manager of the Seven Island Lake planning project, met with Dan Nordall to discuss the water quality sampling needs of project. Dan has been sampling Seven Island Lake for many years, but as a part of this project we have requested that Dan collect some additional samples during his normal lake visits. Those extra samples will be analyzed for parameters that are not normally part of the Wisconsin DNR's citizen monitoring program, but are important in helping us understand the water quality of Seven Island Lake.

In early June, Eddie and our intern, Brenton, visited the lake in search of curly-leaf pondweed. Curly-leaf pondweed as a potentially harmful exotic plant that has been accidentally introduced to many Wisconsin lakes and much like Eurasian water milfoil, it can displace important native aquatic plants leading to decreased habitat and aesthetics. Fortunately, their scouring of the lake found no curly-leaf pondweed plants, or Eurasian water milfoil for that matter. This is of course very good news for the lake.

During the last week in August, Eddie and I visited the lake in order to map native and exotic plant communities that occur within its waters. During a visit such as this, we use a highly accurate Global Positioning System (GPS) to map native emergent and floating-leaf communities and any exotic plants we come across. As with the curly-leaf pondweed study, we search the entire area of the lake that supports plant growth, also known as the littoral zone. The map that will be created with the results of the survey will stand as a "snapshot" of the Seven Island Lake aquatic plant community as it appeared during the summer of 2007. This type of information is important because emergent and floating-leaf species are often the first plants to react, either by occurring more or less frequently, as a lake changes. Unfortunately, without some sort of baseline data, these changes occur so slowly that they may go unnoticed for years or even decades. However, having this documentation as a part of the management plan will decrease the chance of that occurring to Seven Island Lake by allowing comparisons of this current information with similar information collected in the future.

Eddie and I also completed a scuba-survey of the bay the public boat landing is in during our August visit. Once again, we did not find Eurasian water milfoil, which is truly incredible. Although we cannot say that Eurasian water milfoil absolutely does not occur in Seven Island Lake, it is very apparent that the fine efforts of the Seven Island Lake Association and its many volunteers have reduced this nasty plant to truly undetectable levels.

The next major step in the planning effort will be to create and disburse a questionnaire to the property owners around the lake. The stakeholder survey is important in this type of project because it assures that the lake group's thoughts and needs are incorporated within the plan. The plan will be created with the assistance of the Seven Island Lake Association Planning Committee and will likely be mailed out in October. Please take the time to complete the survey and return it, so your concerns and comments can be heard.

On a more personal note, I just want everyone to know that Eddie and I have enjoyed our time on the lake immensely and have found the lake to be beautiful and a truly special resource. I have spent a great deal of my like enjoying and studying lakes in Wisconsin, so please do not take that comment lightly. The greatest challenge of the management plan and the Seven Island Lake Association will be to preserve the lake as it is today; a task that I can ensure you will take the dedication and efforts of everyone that enjoys that little jewel in the Lincoln County landscape.

Seven Island Lake Management Planning Project
Update – June 2008
Submitted by: Tim Hoyman, Onterra, LLC

The Seven Island Lake management planning project is moving forward and will be completed by the end of the summer. To date, all of the field surveys have been completed, including the collection of water quality samples, and multiple plant surveys. The final plant survey that was completed last summer included a SCUBA survey searching for Eurasian water milfoil. After about 45 minutes of searching by two divers, no Eurasian water milfoil was located. Although it is incredibly uncommon, it appears that the hard work of the Seven Island Lake Association has paid off and the Eurasian water milfoil has been eradicated from the lake - at least is well below detectable levels. This is great news for the lake.

Much of the data analysis has also been completed for the project including the work up of the aquatic plant survey data from our visits and those of the WDNR, the delineation of the lake's watershed, and the compilation of fisheries and water quality data. The stakeholder survey data has been entered by association volunteers and our analysis of it has begun.

The next step in the completion of the plan will be a meeting between Onterra ecologists and the Seven Island Lake Planning Committee. At this meeting we will present the study results and our initial conclusions and recommendations. An additional meeting will be held later in the summer where the Planning Committee will develop the management plan's goals and the actions that will lead the Seven Island Lake Association in meeting those goals.

Presentation Outline

- Lake Management Planning Project Overview
- Study Results
  - Water Quality
  - Watershed
  - Aquatic Plants
  - Miscellaneous
- "Big Picture"
- Goals and Actions Discussion

Onterra LLC

Planning Project

Study and Plan Goals

- Collect & Analyze Data
- Construct Long-Term & Useable Plan

Onterra LLC

Lillie Mason Regions

Onterra LLC

Planning Project

Water Quality

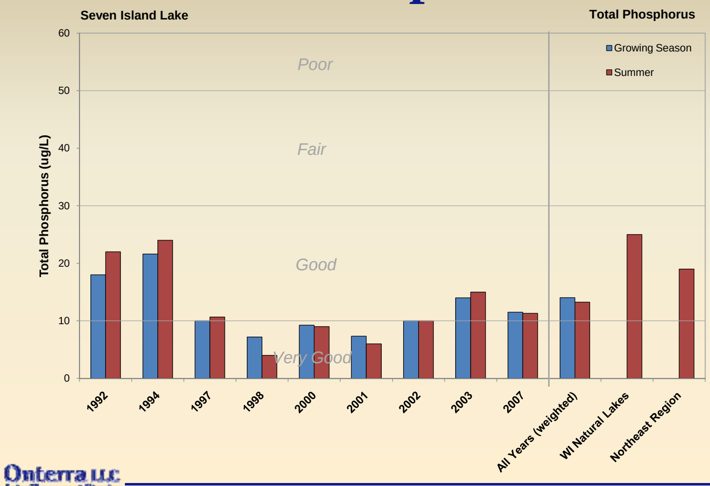
↑ Phosphorus (Limiting Plant Nutrient)

↑ Chlorophyll-*a* (Algal Abundance)

↓ Water Clarity (Secchi Disk)

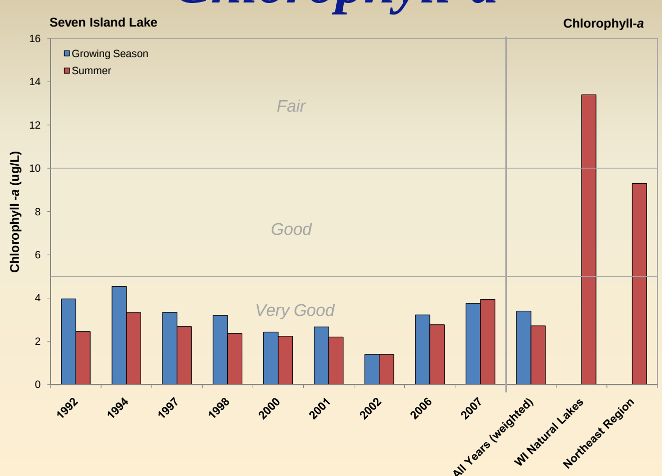
Onterra LLC

Total Phosphorus



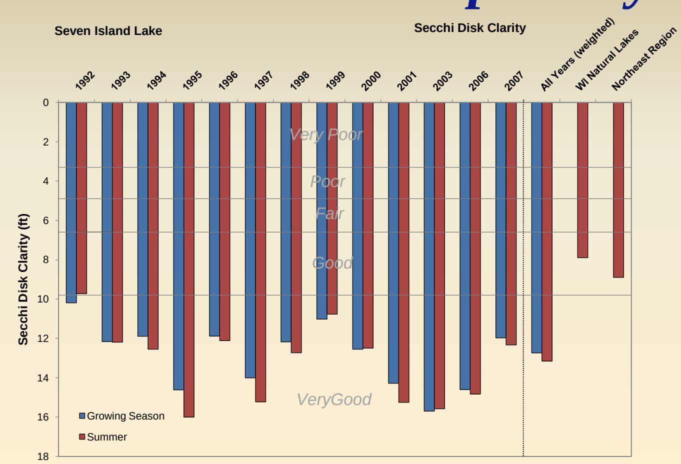
Onterra LLC

Chlorophyll-a

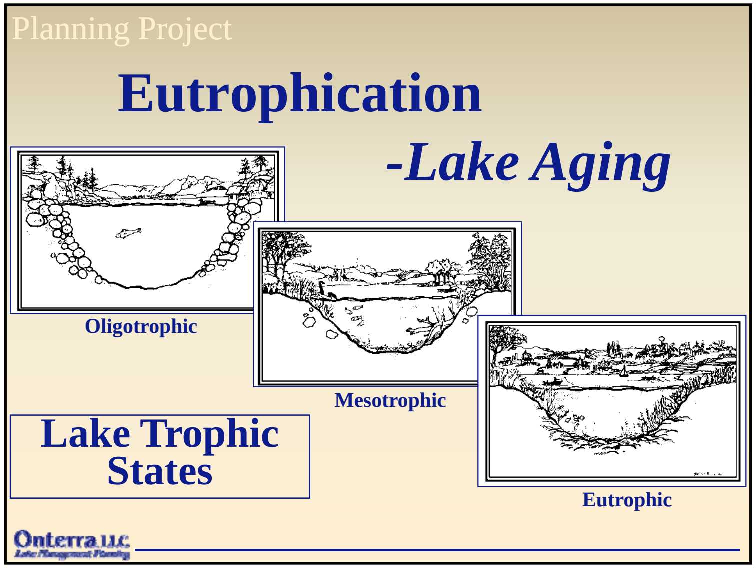


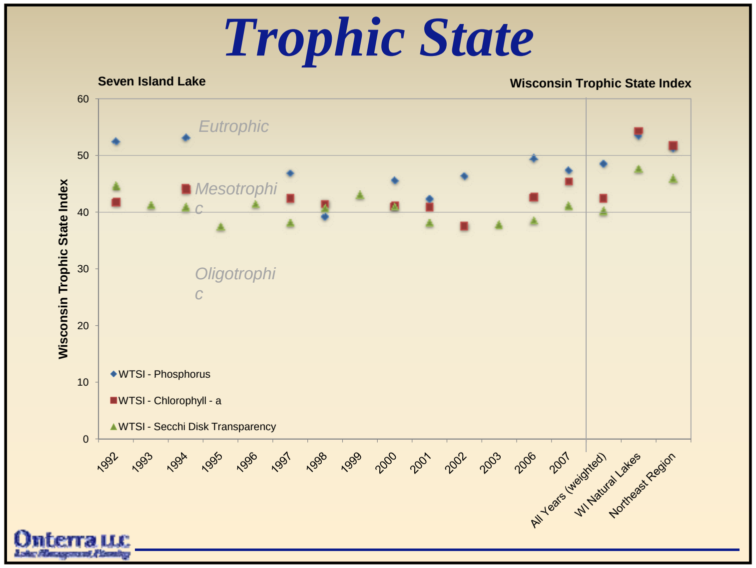
Onterra LLC

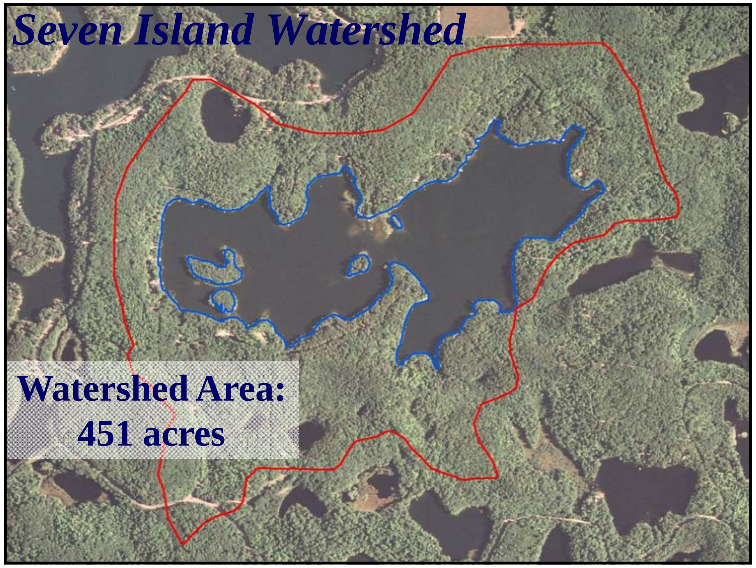
Secchi Disk Transparency

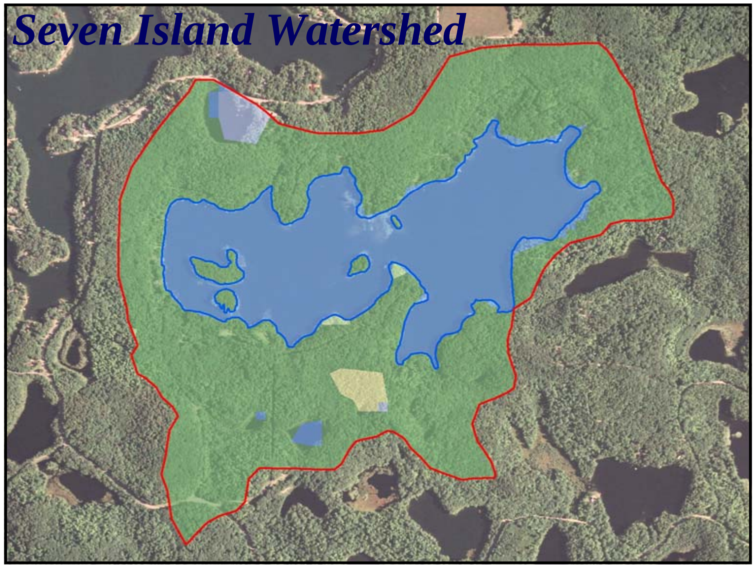


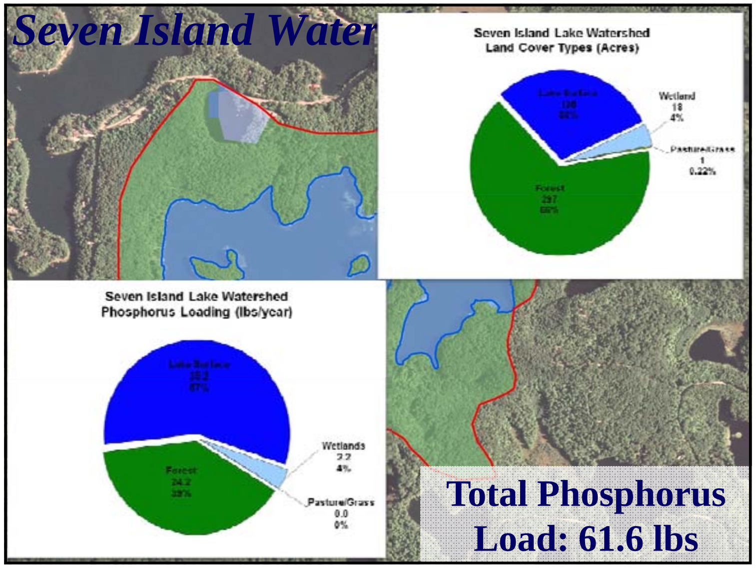
Onterra LLC

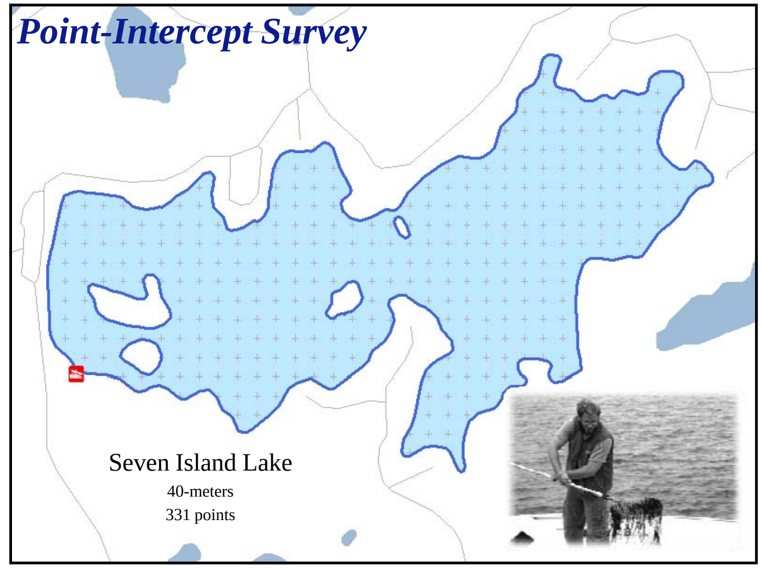

Planning Project
Eutrophication
-Lake Aging
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic States
Onterra LLC
Lake Management Planning


Trophic State
Seven Island Lake
Wisconsin Trophic State Index
Wisconsin Trophic State Index
Eutrophic
Mesotrophic
Oligotrophic
WTSI - Phosphorus
WTSI - Chlorophyll - a
WTSI - Secchi Disk Transparency
0
10
20
30
40
50
60
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2006
2007
All Years (weighted)
WI Natural Lakes
Northeast Region
Onterra LLC
Lake Management Planning


Seven Island Watershed
Watershed Area:
451 acres


Seven Island Watershed





Species List

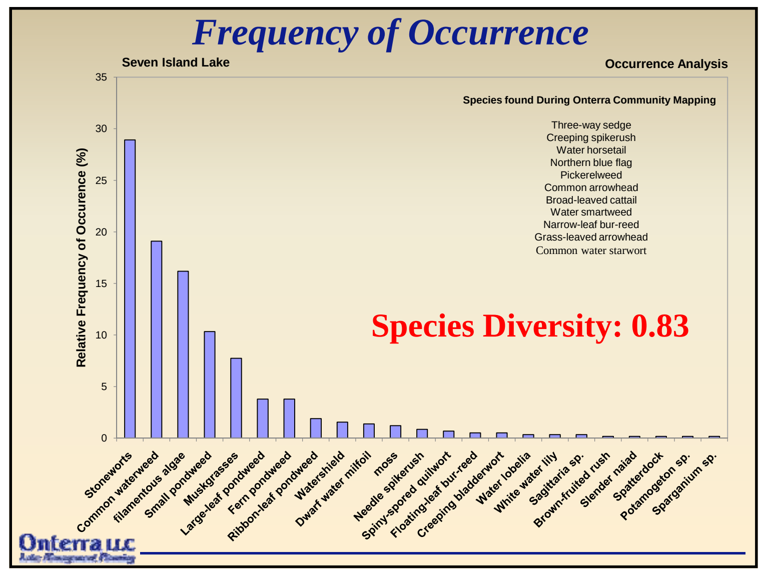
- 29 Total Species
  - All Native
    - No Curly-leaf Pondweed
    - No Eurasian water milfoil

Seven Island Lake

Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)
E	*Sagittaria sp.*	Arrowhead Sp.	NA
	*Dulichium arundinaceum**	Three-way sedge	9
	*Eleocharis palustris**	Creeping spikerush	6
	*Equisetum fluviatile**	Water horsetail	7
	*Iris versicolor**	Northern blue flag	5
	*Pontederia cordata**	Pickerelweed	9
	*Sagittaria latifolia**	Common arrowhead	3
	Sparganium sp.	Bur-Reed Sp.	NA
	*Typha latifolia**	Broad-leaved cattail	1
FL	*Brasenia schreberi*	Watershield	7
	Nuphar variegata	Spatterdock	6
	Nymphaea odorata	White water lily	6
	*Polygonum amphibium**	Water smartweed	5
FL/E	*Sparganium angustifolium**	Narrow-leaf bur-reed	9
	*Sagittaria graminea**	Grass-leaved arrowhead	9
	Sparganium fluctuans	Floating-leaf bur-reed	10
Submergent	*Callitriche palustris**	Common water starwort	8
	Chara sp.	Muskgrasses	7
	Elodea canadensis	Common waterweed	3
	filamentous algae	filamentous algae	NA
	Isoetes echinospora	Spiny-spored quilwort	8
	Lobelia dortmanna	Water lobelia	10
	Moss	moss	NA
	Myriophyllum tenellum	Dwarf water milfoil	10
	Najas flexilis	Slender naiad	6
	Nitella sp.	Stoneworts	7
	Potamogeton amplifolius	Large-leaf pondweed	7
	Potamogeton epihydrus	Ribbon-leaf pondweed	8
	Potamogeton pusillus	Small pondweed	7
	Potamogeton robbinsii	Fern pondweed	8
	Potamogeton sp.	Pondweed Sp.	NA
	Utricularia gibba	Creeping bladderwort	9
SE	*Eleocharis acicularis*	Needle spikerush	5
	Juncus pelocarpus	Brown-fruited rush	8

E = Emergent
FL = Floating Leaf
FL/E = Floating Leaf and Emergent
S/E = Submergent and Emergent
* = Species found during community mapping

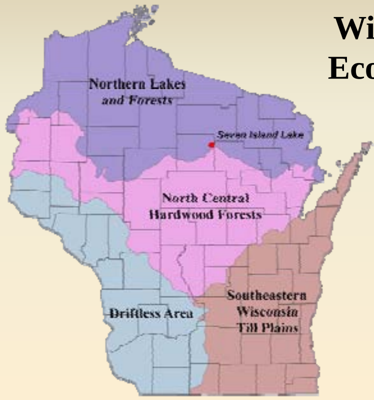
Onterra LLC
Lake Management Planning



Planning Project

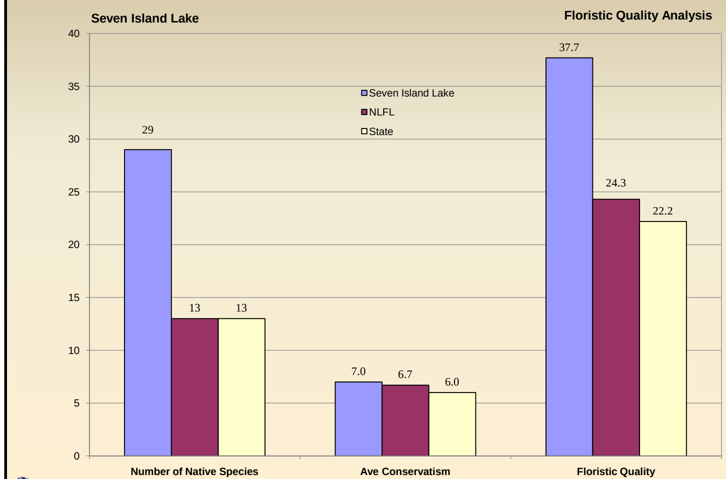
Aquatic Plants

Wisconsin Ecoregions



Onterra LLC
Lake Management Planning

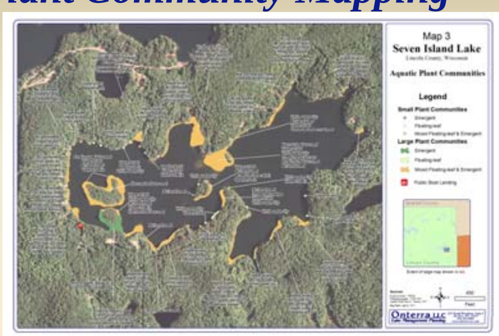
Floristic Quality Assessment



Onterra LLC
Lake Management Planning

Aquatic Plant Community Mapping

- Mapped Communities
  - Floating-leaf
  - Emergent
- Important Indicators
  - Vulnerable to ecosystem changes
    - Loss of species
    - Expansion or recession



Onterra LLC
Lake Management Planning

Additional Results

- EWM Surveys
  - Onterra scuba survey during 2007 found no EWM
- Fisheries Data Summary
  - Compilation completed
  - Analysis will be completed for report
- Zebra Mussel Monitoring
  - No veligers (larval mussels) found
- Stakeholder Survey
  - Tabulation completed (Thanks Tim!)
  - Charts are completed
  - Full analysis completed as report is compiled

Onterra LLC
Lake Management Planning

Conclusions

- Water Quality is excellent.
  - Limited historic data indicates that water quality has remained the same over the past decade.
- Watershed is in great condition.
  - Land cover exports minimal phosphorus.
- Aquatic plant community of Seven Island Lake is outstanding.
  - The plants provide excellent habitat for fish and other wildlife.

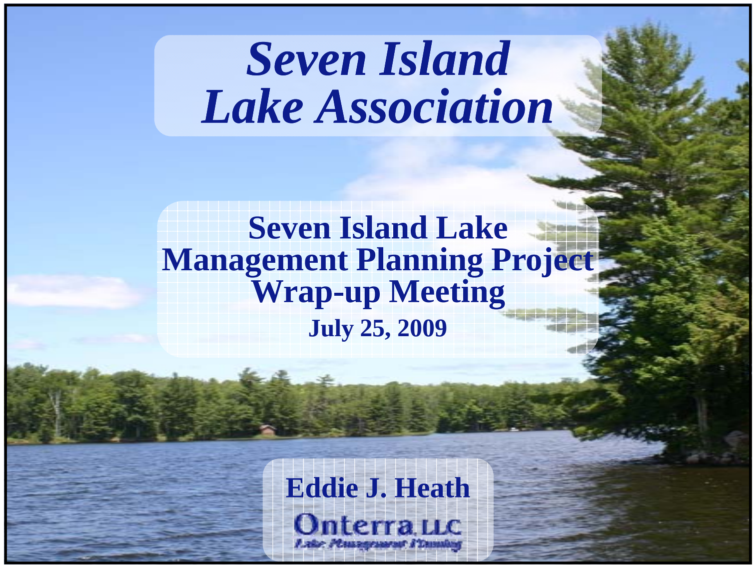
Concerns

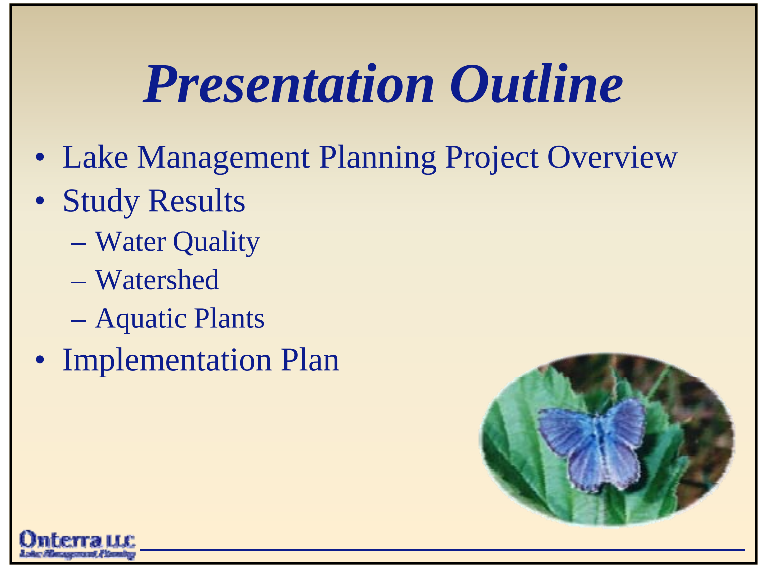
- Reoccurrence of Eurasian Water Milfoil
  - Threat to native aquatic plant community
  - Monitoring must continue
- Shoreland Development Impacts
  - Runoff from developed properties
  - Septic systems?

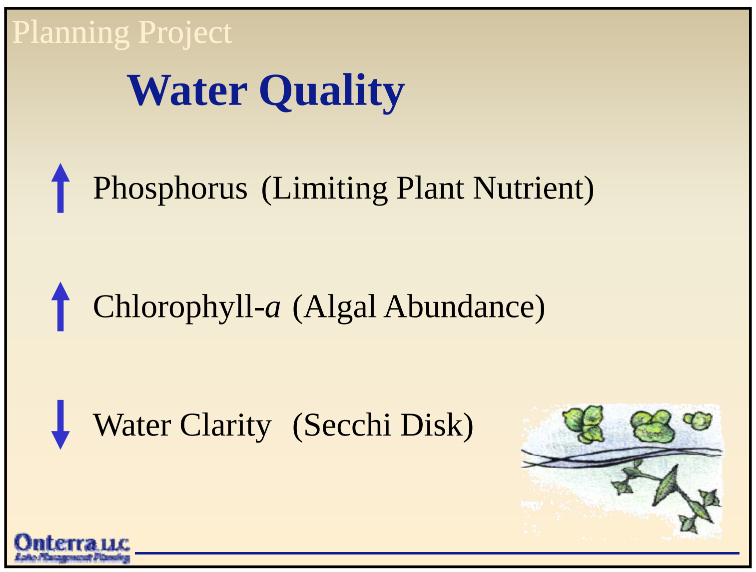
Thank You

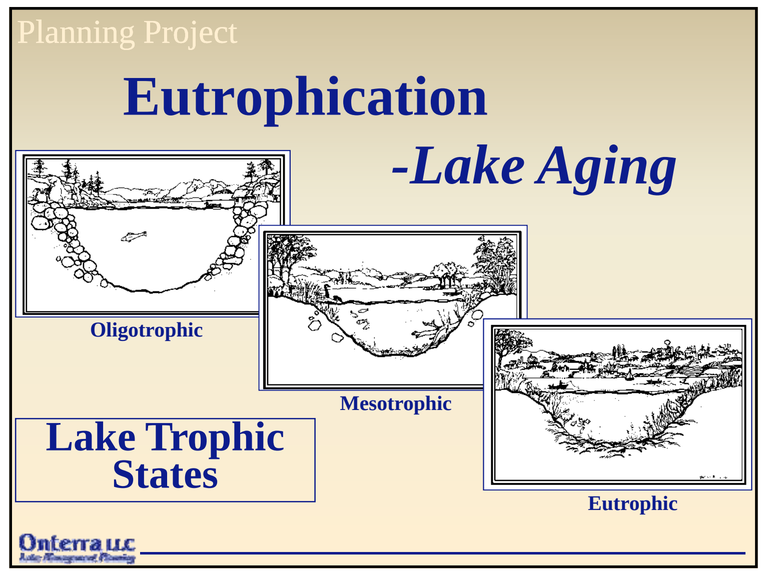
Many of the graphics used in this presentation were supplied by:

Wisconsin Lakes Partnership

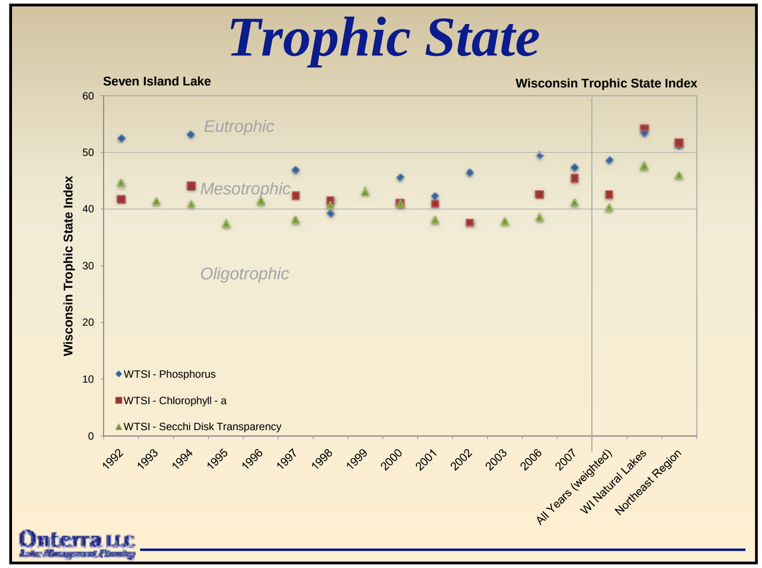

Seven Island
Lake Association
Seven Island Lake
Management Planning Project
Wrap-up Meeting
July 25, 2009
Eddie J. Heath
Onterra LLC

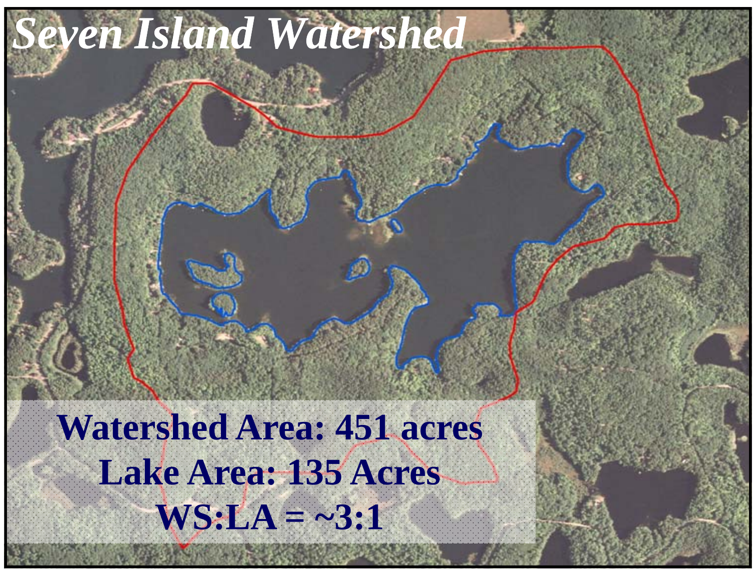

Presentation Outline
• Lake Management Planning Project Overview
• Study Results
– Water Quality
– Watershed
– Aquatic Plants
• Implementation Plan
Onterra LLC

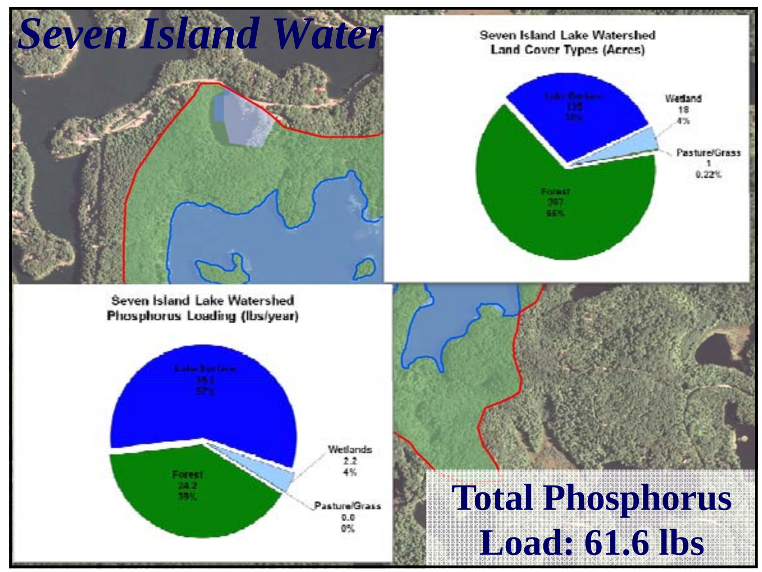

Planning Project
Water Quality
Phosphorus (Limiting Plant Nutrient)
Chlorophyll-a (Algal Abundance)
Water Clarity (Secchi Disk)
Onterra LLC

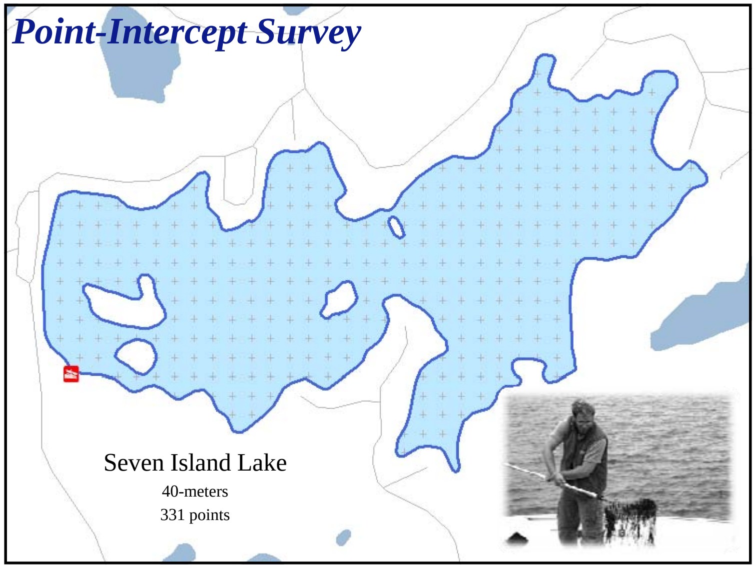

Planning Project
Eutrophication
-Lake Aging
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic
States
Onterra LLC

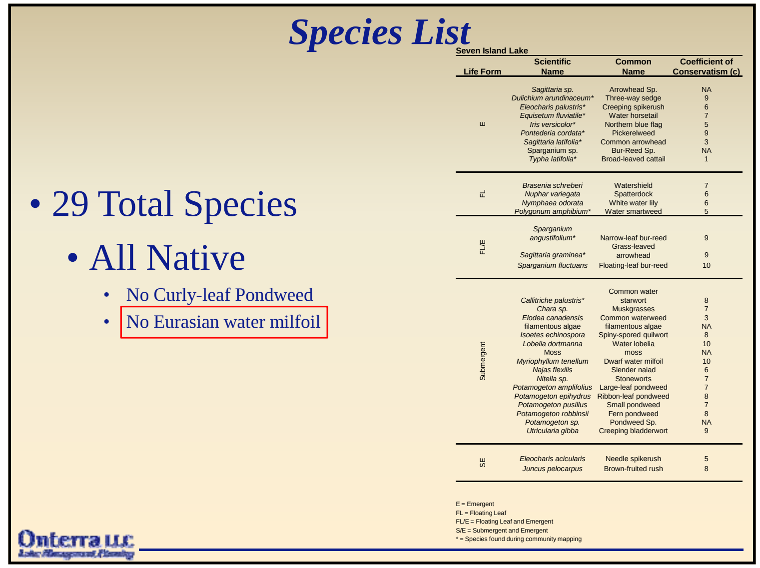

Lillie Mason Regions
Northwest
Northeast
Seven Island Lake
Southwest
Central
Southeast
Onterra LLC
Lake Management Planning


Trophic State
Seven Island Lake
Wisconsin Trophic State Index
Wisconsin Trophic State Index
0
10
20
30
40
50
60
Eutrophic
Mesotrophic
Oligotrophic
WTSI - Phosphorus
WTSI - Chlorophyll - a
WTSI - Secchi Disk Transparency
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2006
2007
All Years (weighted)
WI Natural Lakes
Northeast Region
Onterra LLC
Lake Management Planning


Seven Island Watershed
Watershed Area: 451 acres
Lake Area: 135 Acres
WS:LA = ~3:1


Seven Island Water
Seven Island Lake Watershed
Land Cover Types (Acres)
Wetland
18
4%
Pasture/Grass
1
0.22%
Forest
Seven Island Lake Watershed
Phosphorus Loading (lbs/year)
Wetlands
2.2
4%
Forest
24.2
39%
Pasture/Grass
0.0
0%
Total Phosphorus
Load: 61.6 lbs

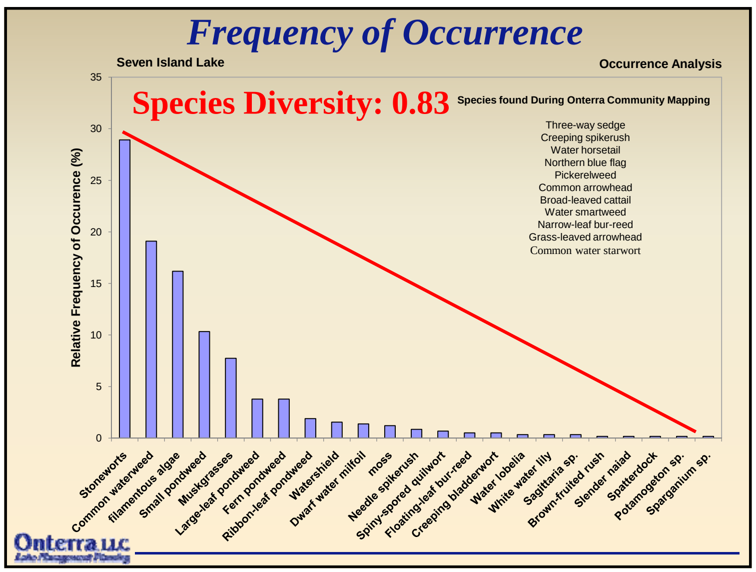


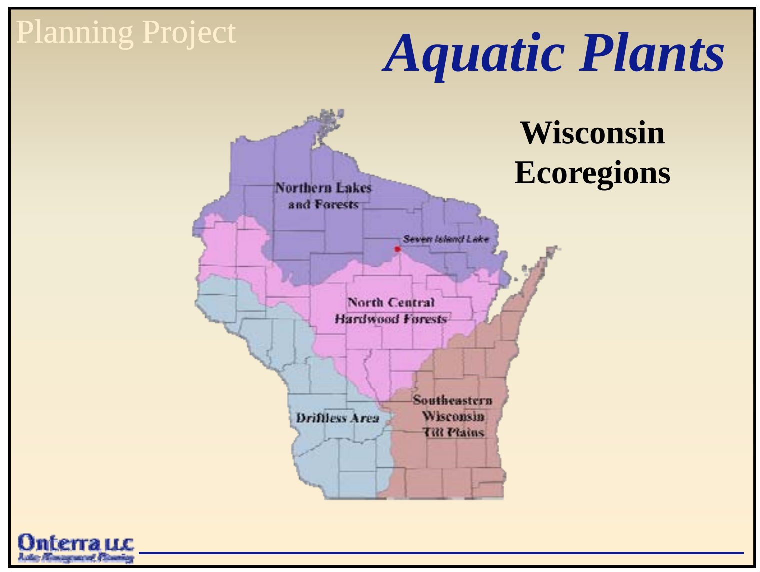


Seven Island Lake

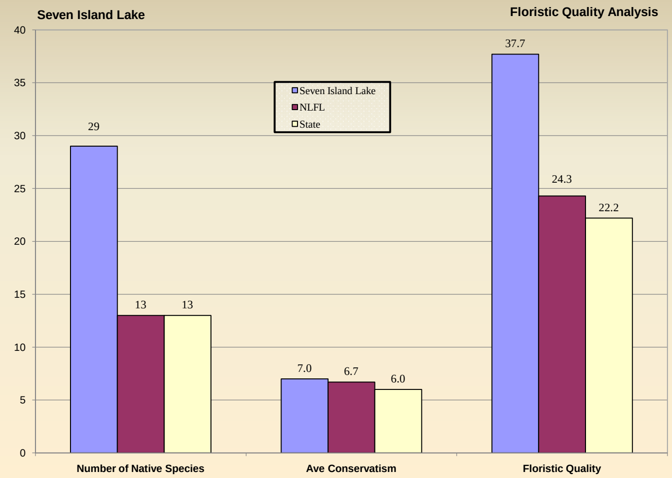
Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)
E	*Sagittaria sp.*	Arrowhead Sp.	NA
	*Dulichium arundinaceum**	Three-way sedge	9
	*Eleocharis palustris**	Creeping spikerush	6
	*Equisetum fluviatile**	Water horsetail	7
	*Iris versicolor**	Northern blue flag	5
	*Pontederia cordata**	Pickerelweed	9
	*Sagittaria latifolia**	Common arrowhead	3
	Sparganium sp.	Bur-Reed Sp.	NA
	*Typha latifolia**	Broad-leaved cattail	1
FL	*Brasenia schreberi*	Watershield	7
	Nuphar variegata	Spatterdock	6
	Nymphaea odorata	White water lily	6
	*Polygonum amphibium**	Water smartweed	5
FL/E	*Sparganium angustifolium**	Narrow-leaf bur-reed	9
	*Sagittaria graminea**	Grass-leaved arrowhead	9
	Sparganium fluctuans	Floating-leaf bur-reed	10
Submergent	*Callitriche palustris**	Common water starwort	8
	Chara sp.	Muskgrasses	7
	Elodea canadensis	Common waterweed	3
	filamentous algae	filamentous algae	NA
	Isoetes echinospora	Spiny-spored quilwort	8
	Lobelia dortmanna	Water lobelia	10
	Moss	moss	NA
	Myriophyllum tenellum	Dwarf water milfoil	10
	Najas flexilis	Slender naiad	6
	Nitella sp.	Stoneworts	7
	Potamogeton amplifolius	Large-leaf pondweed	7
	Potamogeton epihydrus	Ribbon-leaf pondweed	8
	Potamogeton pusillus	Small pondweed	7
	Potamogeton robbinsii	Fern pondweed	8
	Potamogeton sp.	Pondweed Sp.	NA
	Utricularia gibba	Creeping bladderwort	9
SE	*Eleocharis acicularis*	Needle spikerush	5
	Juncus pelocarpus	Brown-fruited rush	8

E = Emergent
FL = Floating Leaf
FL/E = Floating Leaf and Emergent
S/E = Submergent and Emergent
* = Species found during community mapping





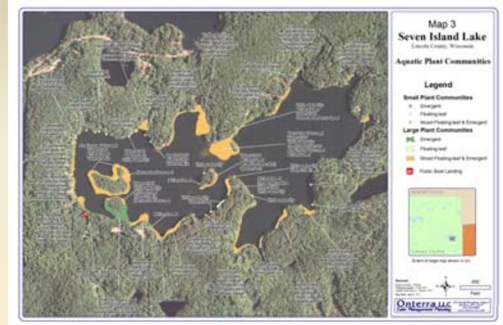
Floristic Quality Assessment



Onterra LLC Lake Management Planning

Aquatic Plant Community Mapping

- Mapped Communities
  - Floating-leaf
  - Emergent
- Important Indicators
  - Vulnerable to ecosystem changes
    - Loss of species
    - Expansion or recession



Onterra LLC Lake Management Planning

Conclusions

- Water Quality is excellent.
  - Limited historic data indicates that water quality has remained the same over the past decade.
- Watershed is in great condition.
  - Land cover exports minimal phosphorus.
- Aquatic plant community of Seven Island Lake is outstanding.
  - The plants provide excellent habitat for fish and other wildlife.

Onterra LLC Lake Management Planning

Concerns

- Reoccurrence of Eurasian Water Milfoil
  - Threat to native aquatic plant community
  - Monitoring must continue
- Shoreland Development Impacts
  - Runoff from developed properties
  - Septic systems?

Onterra LLC Lake Management Planning

Planning Project

Goal 1: Increase Seven Island Lake Association's Capacity to Communicate with Lake Stakeholders

Management Actions

1. Support an Education & Communication Committee to promote clean boating, water quality, public safety, and quality of life on Seven Island Lake.

Example Educational Topics:
Aquatic Invasive Species Updates
Specific topics brought forth in other management actions
Boating safety
Catch and release fishing
Noise, air, and light pollution
Shoreland restoration and protection
Septic system maintenance

Onterra LLC
Lake Management Planning

Planning Project

Goal 2: Maintain Current Water Quality Conditions

Management Actions

1. Water quality through WDNR Citizens Lake Monitoring Network (Facilitator?).
2. Reduce phosphorus and sediment loads from shoreland watershed to Seven Island Lake.
3. Complete Shoreland Condition Assessment as a part of next management plan update.

Onterra LLC
Lake Management Planning

Planning Project

Goal 3: Control Aquatic Invasive Species within Seven Island Lake

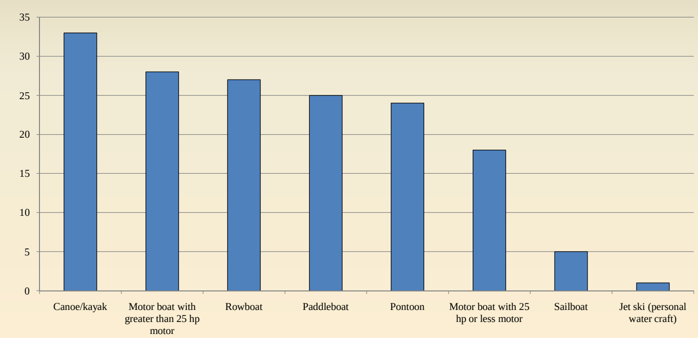
Management Actions

1. Initiate *modified* Clean Boats Clean Waters watercraft inspections at Seven Island Lake public access.
2. Coordinate annual volunteer monitoring of Aquatic Invasive Species.
3. Control recurring Eurasian water milfoil infestation on Seven Island Lake.

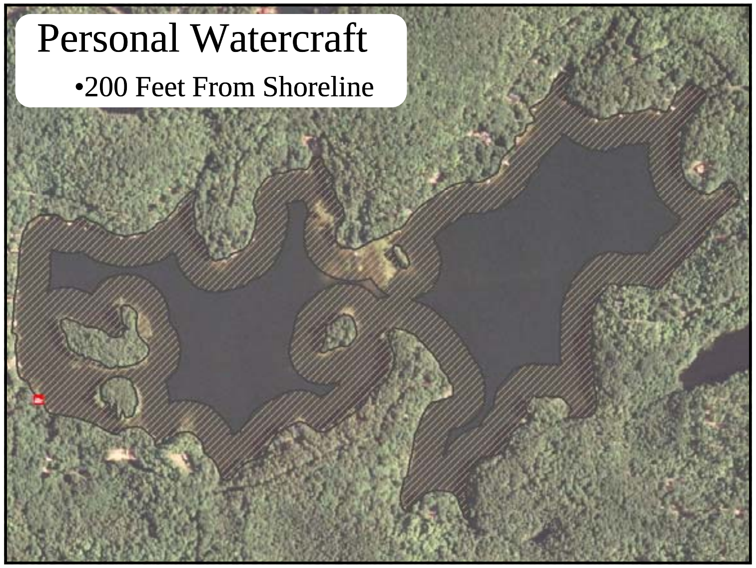
Onterra LLC
Lake Management Planning

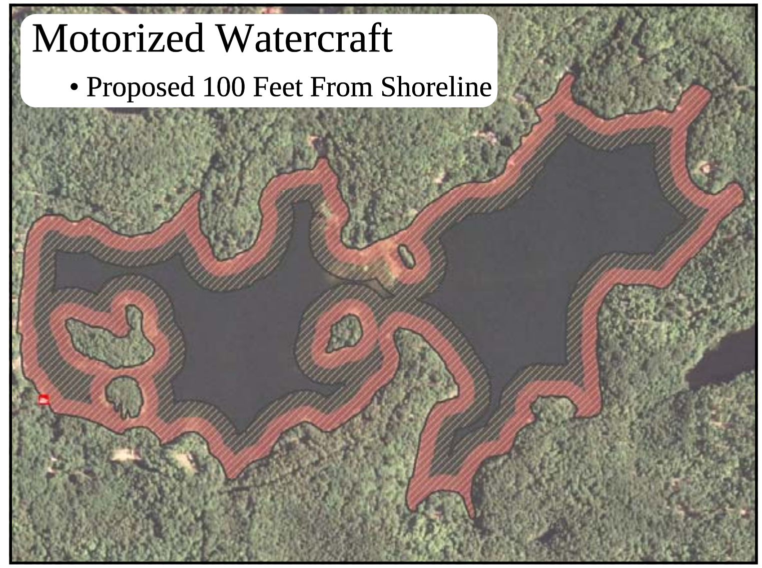
Planning Project

Goal 4: Minimize User Conflicts on Seven Island Lake



Onterra LLC
Lake Management Planning





Planning Project

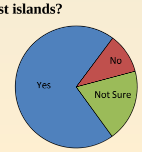
Goal 4: Minimize User Conflicts on Seven Island Lake

Management Actions

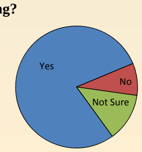
1. Investigate creation of slow-no-wake hours on Seven Island Lake.
2. Investigate creation of slow-no-wake areas (or less-restrictive ordinances) on Seven Island Lake.

Would you support lake wide, daily slow-no-wake hours between 7:00 pm and 10:00 am?

Would you support a permanent slow-no-wake zone extending from the public boat landing to the two nearest islands?



Would you support a permanent slow-no-wake zone between the two islands closest to the public boat landing?



Onterra LLC

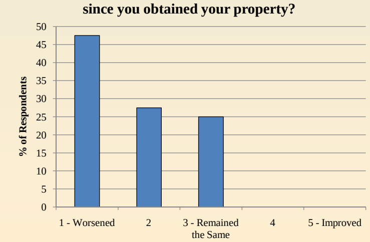
Planning Project

Goal 4: Improve Fishery Resource and Fishing

Management Actions

1. Work with WDNR fisheries managers to promote development of balanced fishery on Seven Island Lake.

How has the quality of fishing changed on Seven Island Lake since you obtained your property?



Onterra LLC

B

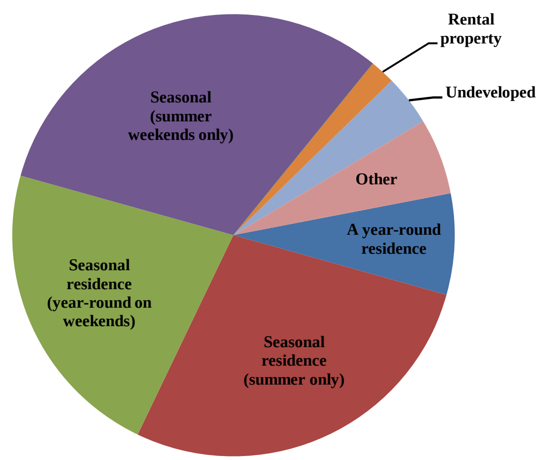
APPENDIX B

Stakeholder Survey Response Charts and Comments

Returned Surveys	47
Sent Surveys	82
Response Rate	57.3

#1 What type of property do you own on Seven Island Lake?

	Total	*%*
A year-round residence	4	*7.4*
Seasonal residence (summer only)	15	*27.8*
Seasonal residence (year-round on weekends)	12	*22.2*
Seasonal (summer weekends only)	17	*31.5*
Resort	0	*0.0*
Rental property	1	*1.9*
Undeveloped	2	*3.7*
Other	3	*5.6*
	54	***100.0***



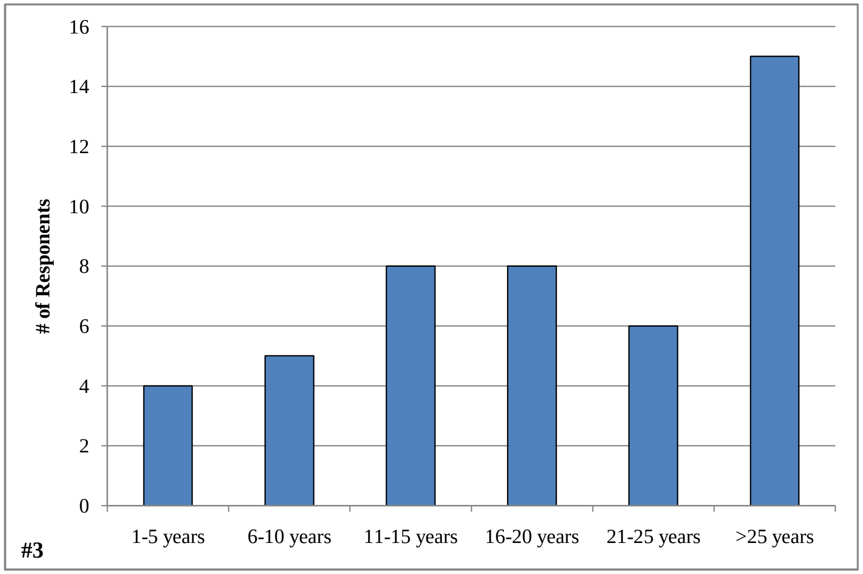
#1

#2 If you are not a year-round resident, how many days each year is your property used by you or others?

Answered Question	42
Average	77.3
Standard deviation	68.5

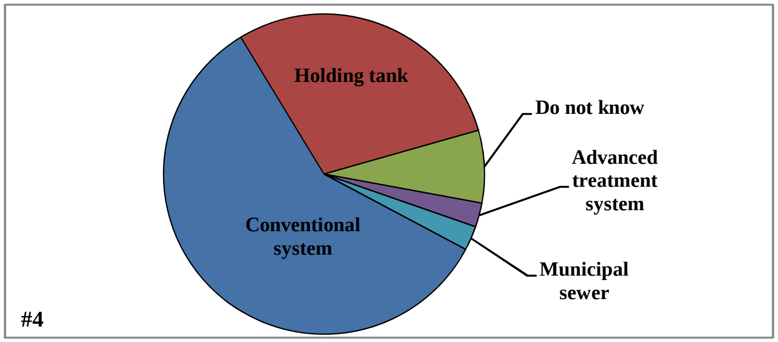
#3 How many years have you owned property on Seven Island Lake?

Answered Question	46	%
1-5 years	4	*8.7*
6-10 years	5	*10.9*
11-15 years	8	*17.4*
16-20 years	8	*17.4*
21-25 years	6	*13.0*
>25 years	15	*32.6*
	46	*100.0*



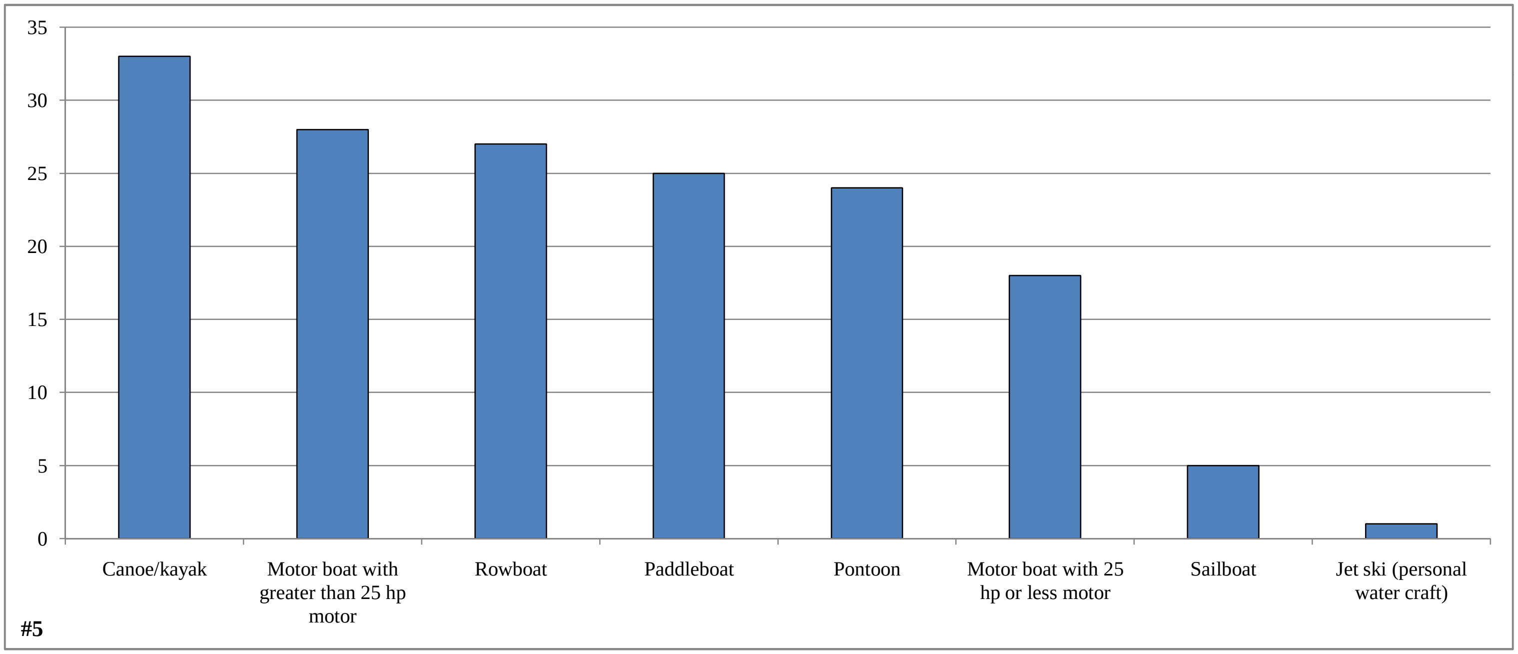
#4 What type of septic system does your property utilize?

	Total	%
Conventional system	24	*58.5*
Holding tank	12	*29.3*
Do not know	3	*7.3*
Advanced treatment system	1	*2.4*
Municipal sewer	1	*2.4*
Mound	0	*0.0*
	41	*100.0*



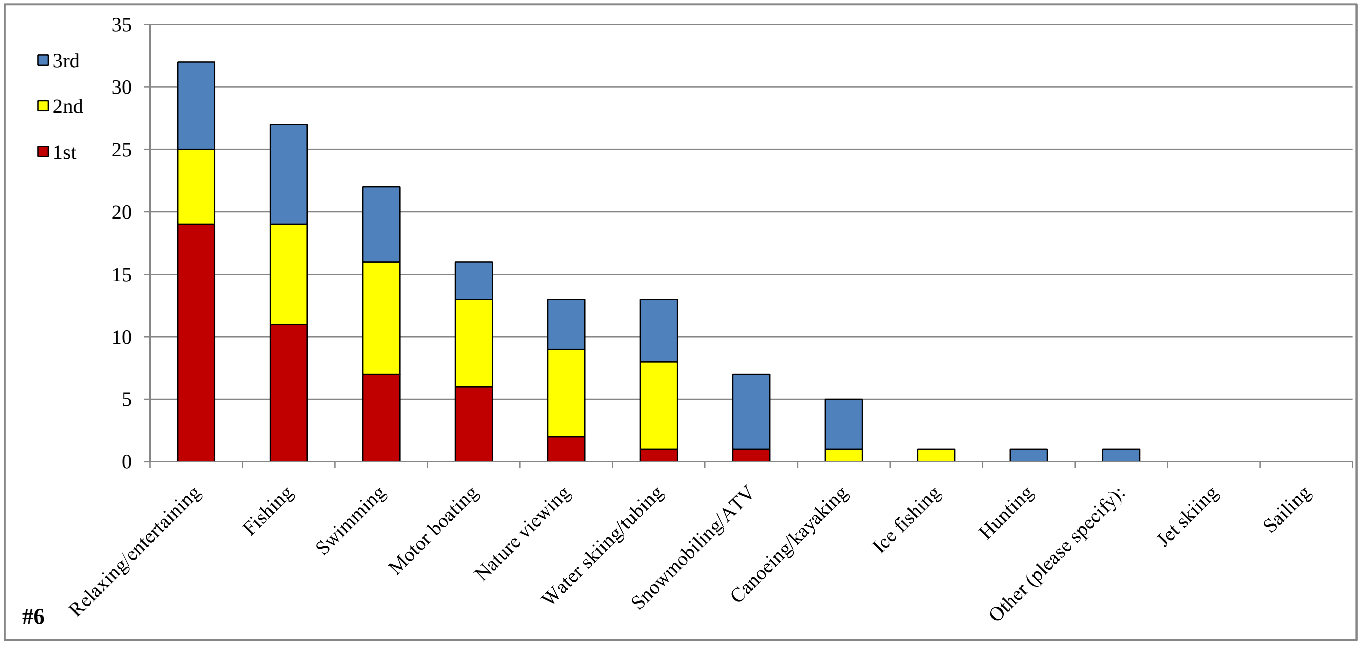
#5 What types of watercraft do you or others that use your property, currently use on Seven Island Lake?

	Total	%
Canoe/kayak	33	*20.5*
Motor boat with greater than 25 hp motor	28	*17.4*
Rowboat	27	*16.8*
Paddleboat	25	*15.5*
Pontoon	24	*14.9*
Motor boat with 25 hp or less motor	18	*11.2*
Sailboat	5	*3.1*
Jet ski (personal water craft)	1	*0.6*
	161	*100.0*



#6 Please rank the activities below that are the most important or enjoyable to you on Seven Island Lake?

	1st	2nd	3rd	*% ranked*
Relaxing/entertaining	19	6	7	*68.1*
Fishing	11	8	8	*57.4*
Swimming	7	9	6	*46.8*
Motor boating	6	7	3	*34.0*
Nature viewing	2	7	4	*27.7*
Water skiing/tubing	1	7	5	*27.7*
Snowmobiling/ATV	1	0	6	*14.9*
Canoeing/kayaking	0	1	4	*10.6*
Ice fishing	0	1	0	*2.1*
Hunting	0	0	1	*2.1*
Other (please specify):	0	0	1	*2.1*
Jet skiing	0	0	0	*0.0*
Sailing	0	0	0	*0.0*
	47	46	45	*293.6*

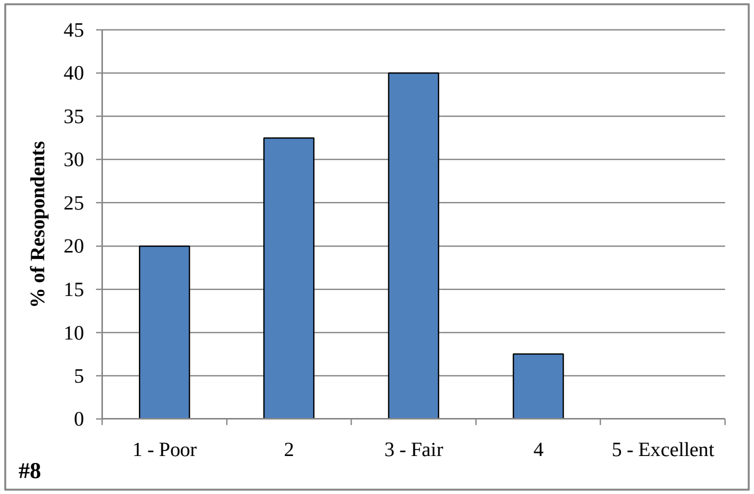


#7 Have you fished on Seven Island Lake in the past 3 years?

		%
Yes	39	*83.0*
No	8	*17.0*
	47	*100.0*

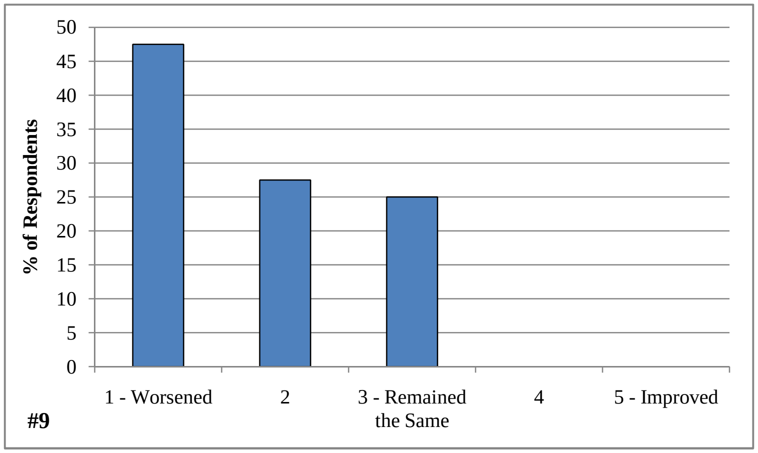
#8 How would you describe the current quality of fishing on Seven Island Lake?

	Total	%
1 - Poor	8	*20.0*
2	13	*32.5*
3 - Fair	16	*40.0*
4	3	*7.5*
5 - Excellent	0	*0.0*
	40	*100.0*



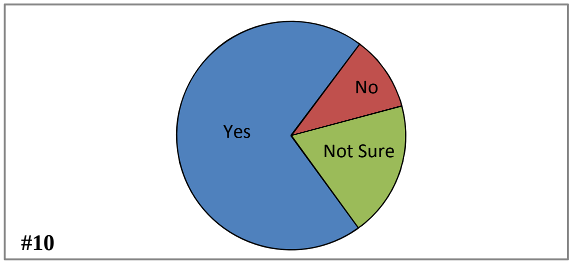
#9 How has the quality of fishing changed on Seven Island Lake since you obtained your property?

	Total	%
1 - Worsened	19	*47.5*
2	11	*27.5*
3 - Remained the Same	10	*25.0*
4	0	*0.0*
5 - Improved	0	*0.0*
	40	*100.0*



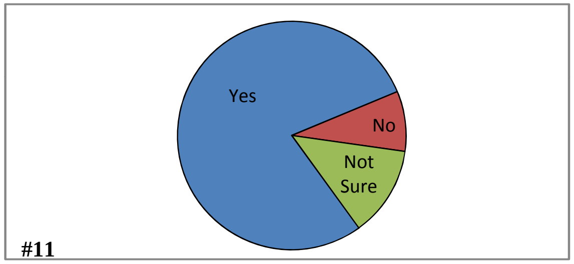
#10 Would you support a permanent slow-no-wake zone extending from the public boat landing to the two nearest islands?

		%
Yes	33	*86.8*
No	5	*13.2*
Not Sure	9	*23.7*
	38	*100.0*



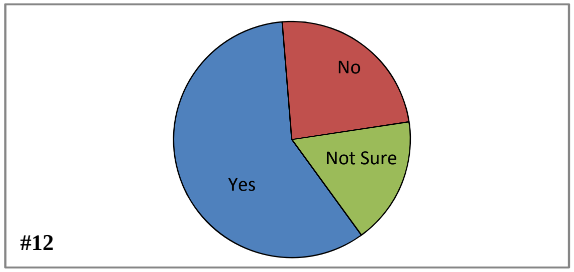
#11 Would you support a permanent slow-no-wake zone between the two islands closest to the public boat landing?

		%
Yes	37	*90.2*
No	4	*9.8*
Not Sure	6	*14.6*
	41	*100.0*



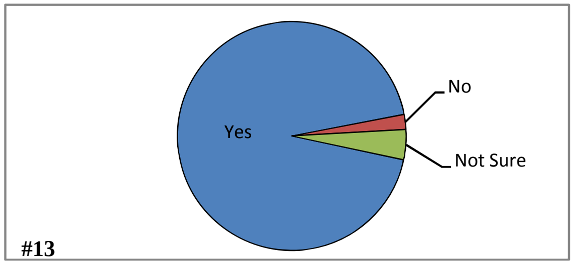
#12 Would you support lake wide, daily slow-no-wake hours between 7:00 pm and 10:00 am?

		%
Yes	27	*71.1*
No	11	*28.9*
Not Sure	8	*21.1*
	38	*100.0*



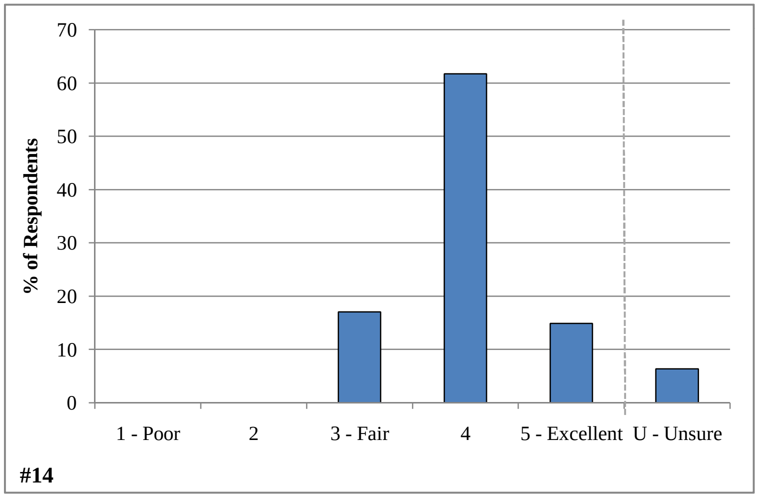
#13 Would you support a temporary slow-no-wake zone extending from the public boat landing to the two nearest islands if a potentially harmful plant species, such as Eurasian water milfoil, was found in the area?

		%
Yes	44	*93.6*
No	1	*2.1*
Not Sure	2	*4.3*
	47	*100.0*



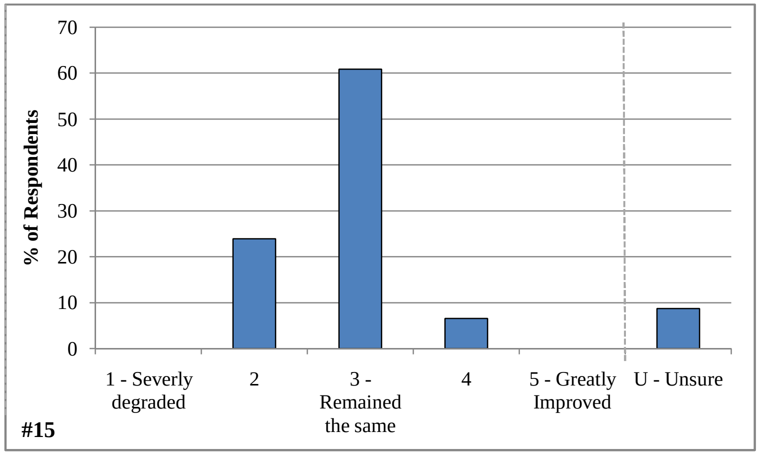
#14 How would you describe the current water quality of Seven Island Lake?

	Total	%
1 - Poor	0	*0.0*
2	0	*0.0*
3 - Fair	8	*17.0*
4	29	*61.7*
5 - Excellent	7	*14.9*
U - Unsure	3	*6.4*
	47	*100.0*



#15 How has the water quality changed in Seven Island Lake since you obtained your property?

	Total	%
1 - Severly degraded	0	*0.0*
2	11	*23.9*
3 - Remained the same	28	*60.9*
4	3	*6.5*
5 - Greatly Improved	0	*0.0*
U - Unsure	4	*8.7*
	46	*100.0*



#16 Have you ever heard of aquatic invasive species?

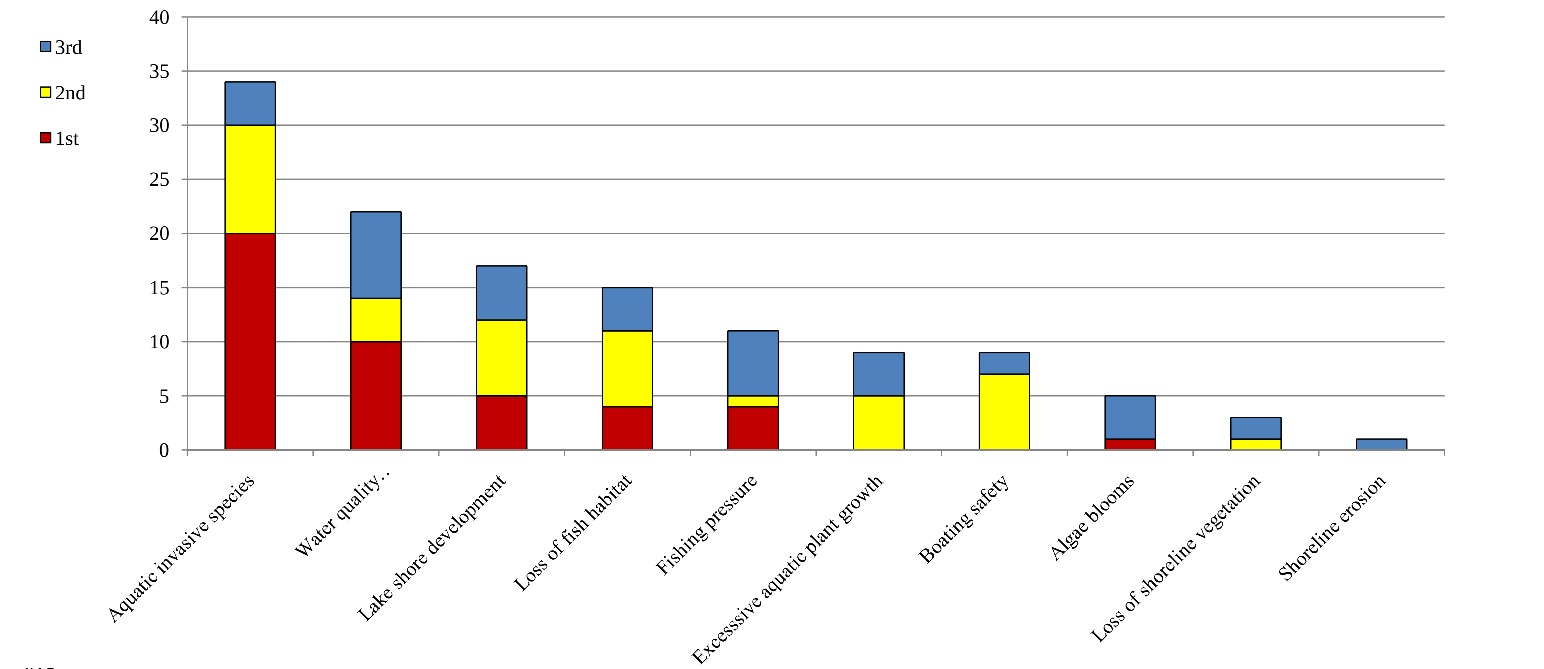
		%
Yes	45	*95.7*
No	2	*4.3*
	47	*100.0*

#17 Are you aware of aquatic invasive species on Seven Island Lake?

		%
Yes	44	*93.6*
No	3	*6.4*
	47	*100.0*

#18 From the list below, please rank your top three concerns regarding Seven Island Lake?

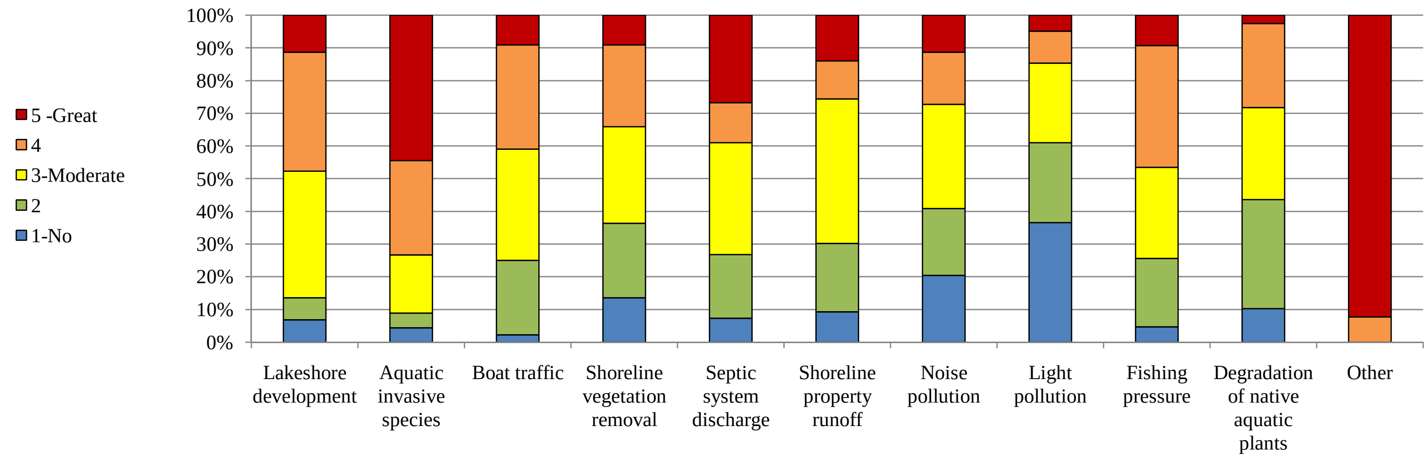
	1st	2nd	3rd	*% Ranked*
Aquatic invasive species	20	10	4	*27.0*
Water quality degradation/pollution	10	4	8	*17.5*
Lake shore development	5	7	5	*13.5*
Loss of fish habitat	4	7	4	*11.9*
Fishing pressure	4	1	6	*8.7*
Excesssive aquatic plant growth	0	5	4	*7.1*
Boating safety	0	7	2	*7.1*
Algae blooms	1	0	4	*4.0*
Loss of shoreline vegetation	0	1	2	*2.4*
Shoreline erosion	0	0	1	*0.8*
	44	42	40	*100.0*



#18

#19 To what level do you believe each the following factors are negatively impacting Seven Island Lake?

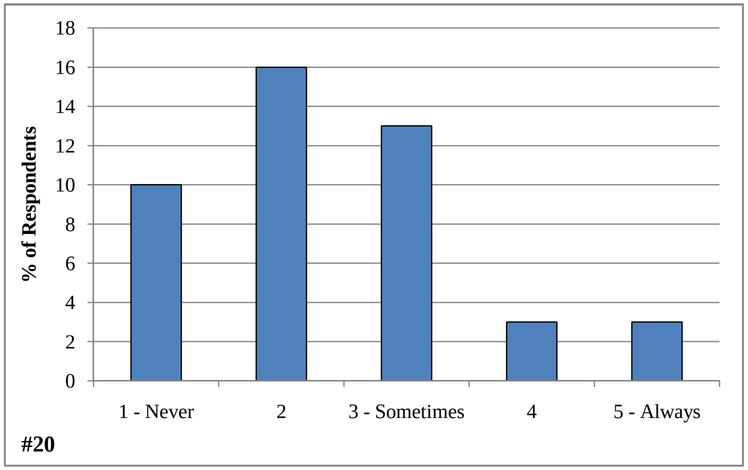
	1-No	2	3-Moderate	4	5 -Great	*Total*	*Average*
Lakeshore development	3	3	17	16	5	*44*	*3.4*
Aquatic invasive species	2	2	8	13	20	*45*	*4.0*
Boat traffic	1	10	15	14	4	*44*	*3.2*
Shoreline vegetation removal	6	10	13	11	4	*44*	*2.9*
Septic system discharge	3	8	14	5	11	*41*	*3.3*
Shoreline property runoff	4	9	19	5	6	*43*	*3.0*
Noise pollution	9	9	14	7	5	*44*	*2.8*
Light pollution	15	10	10	4	2	*41*	*2.2*
Fishing pressure	2	9	12	16	4	*43*	*3.3*
Degradation of native aquatic plants	4	13	11	10	1	*39*	*2.8*
Other	0	0	0	1	12	*13*	*4.9*



#19

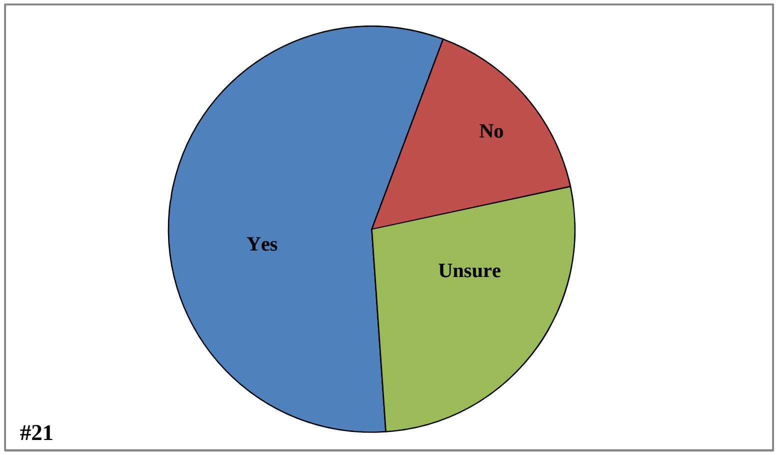
#20 **How often does aquatic plant growth impact your recreational use of Seven Island Lake?**

	Total	%
1 - Never	10	*22.2*
2	16	*35.6*
3 - Sometimes	13	*28.9*
4	3	*6.7*
5 - Always	3	*6.7*
	45	*100.0*



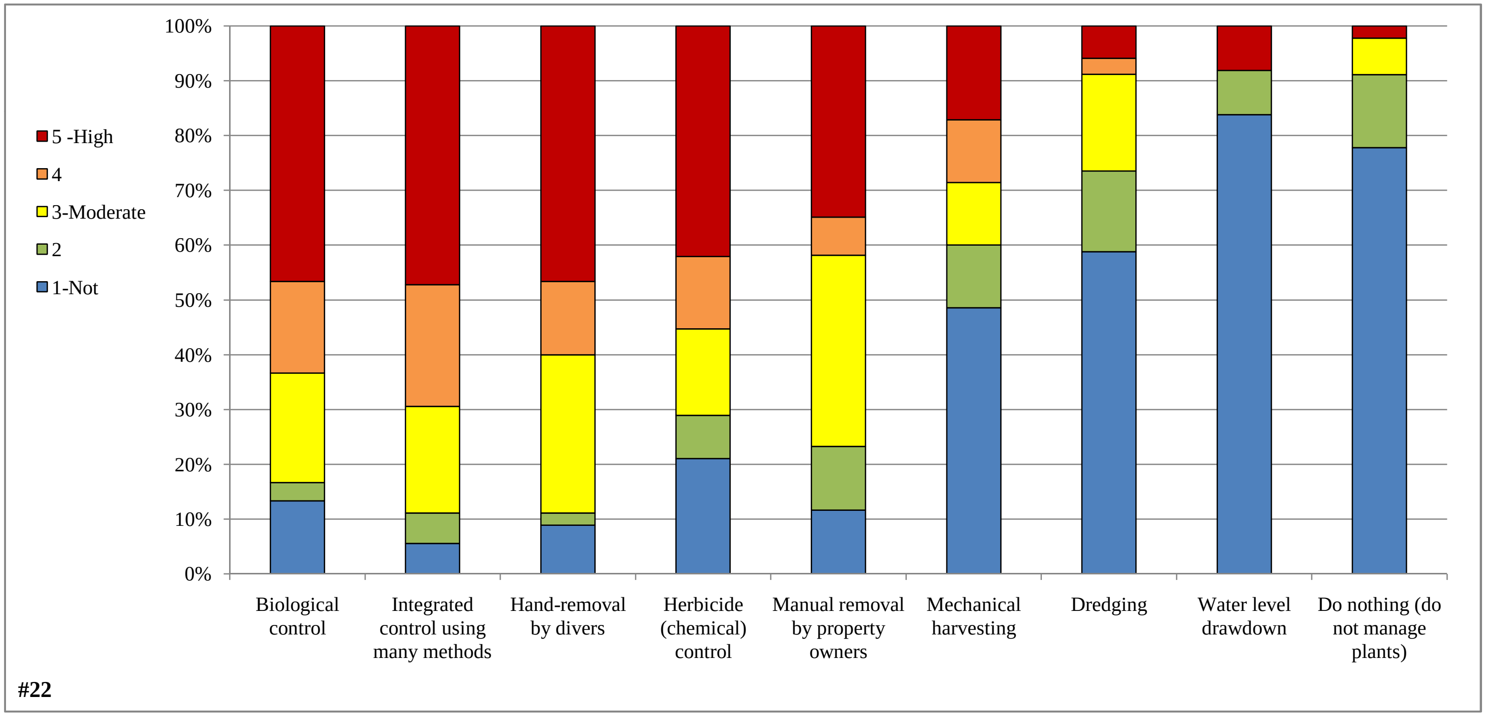
#21 **Considering your answer to the question above, do you believe aquatic plant control is needed on Seven Island Lake?**

		%
Yes	25	*56.8*
No	7	*15.9*
Unsure	12	*27.3*
	44	*100.0*



#22 What is your level of support for the responsible use of the following techniques on Seven Island Lake?

	1-Not	2	3-Moderate	4	5 -High	*Total*	*Average*
Biological control	4	1	6	5	14	*30*	*4.5*
Integrated control using many methods	2	2	7	8	17	*36*	*4.4*
Hand-removal by divers	4	1	13	6	21	*45*	*3.9*
Herbicide (chemical) control	8	3	6	5	16	*38*	*3.9*
Manual removal by property owners	5	5	15	3	15	*43*	*3.5*
Mechanical harvesting	17	4	4	4	6	*35*	*3.2*
Dredging	20	5	6	1	2	*34*	*2.8*
Water level drawdown	31	3	0	0	3	*37*	*2.3*
Do nothing (do not manage plants)	35	6	3	0	1	*45*	*1.5*



#23 Before receiving this mailing, have you ever heard of the Seven Island Lake P&R District?

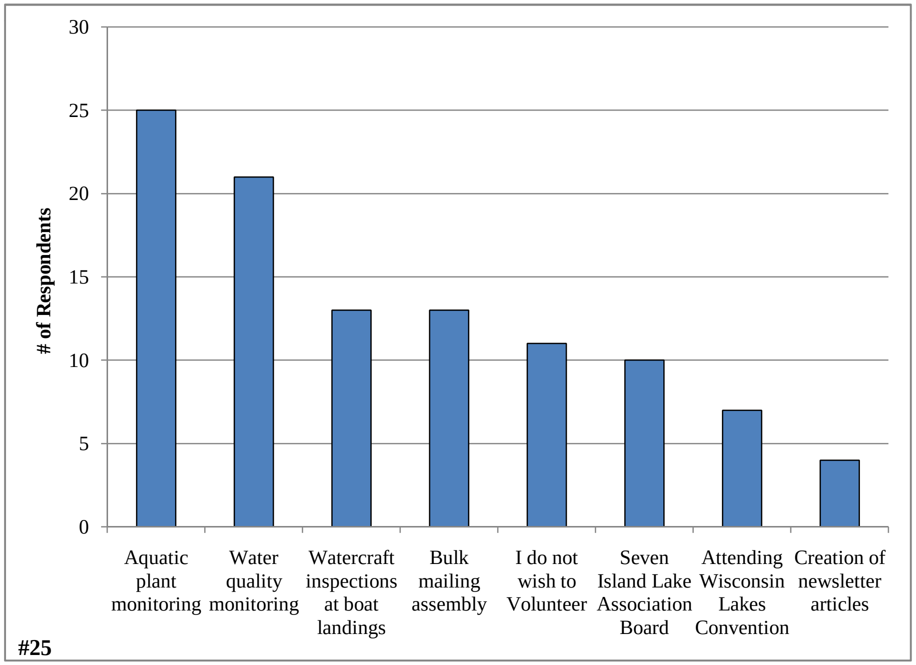
		%
Yes	46	*100.0*
No	0	*0.0*
	46	*100.0*

#24 Are you currently a member of the Seven Island Lake Association?

		%
Yes	43	*93.5*
No	3	*6.5*
	46	*100.0*

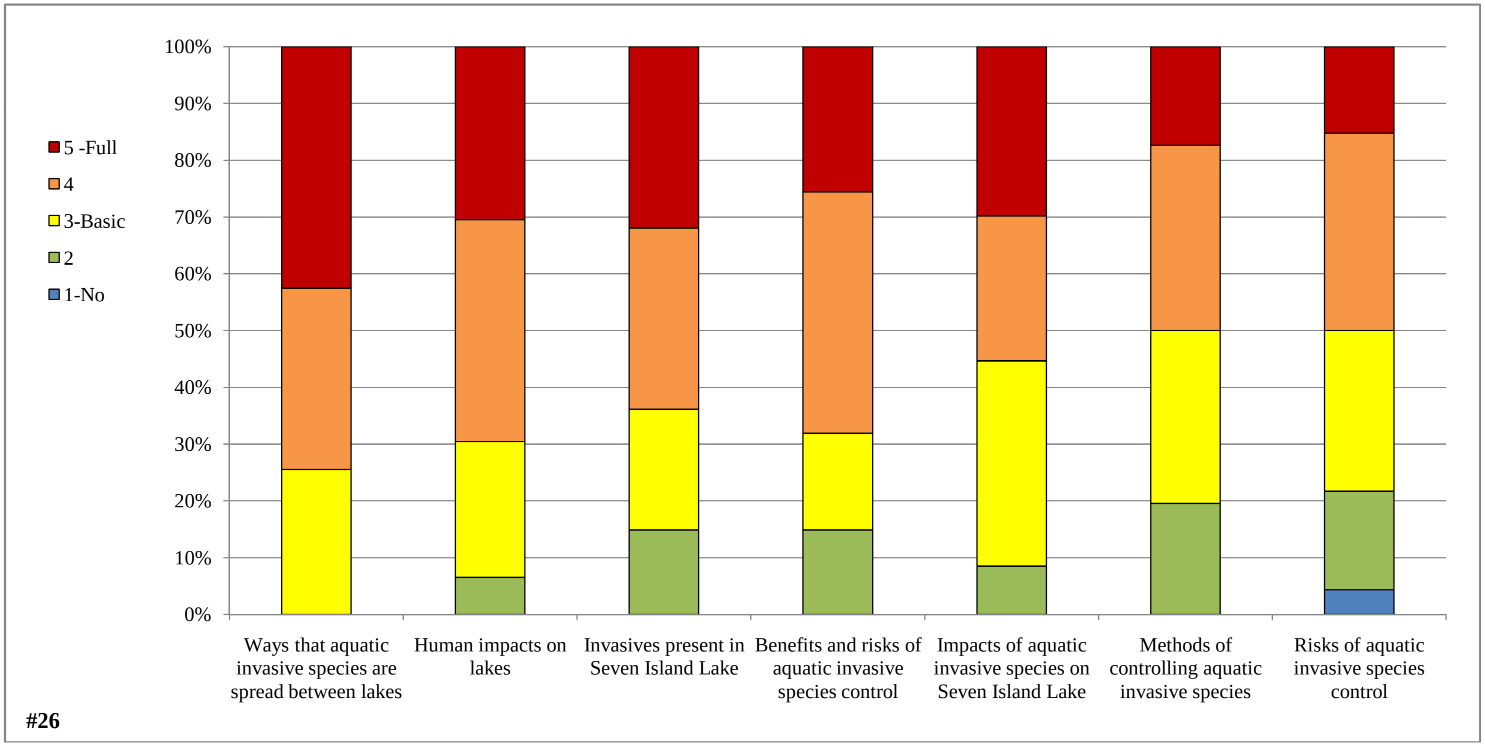
#25 Please circle the activities you would be willing to participate in if called upon.

	Total
Aquatic plant monitoring	25
Water quality monitoring	21
Watercraft inspections at boat landings	13
Bulk mailing assembly	13
I do not wish to Volunteer	11
Seven Island Lake Association Board	10
Attending Wisconsin Lakes Convention	7
Creation of newsletter articles	4
	104



#26 Please describe your level of understanding of each of the following lake management issues.

	1-No	2	3-Basic	4	5 -Full	*Total*	*Average*
Ways that aquatic invasive species are spread between lakes	0	0	12	15	20	*47*	*4.2*
Human impacts on lakes	0	3	11	18	14	*46*	*3.9*
Invasives present in Seven Island Lake	0	7	10	15	15	*47*	*3.8*
Benefits and risks of aquatic invasive species control	0	7	8	20	12	*47*	*3.8*
Island Lake	0	4	17	12	14	*47*	*3.8*
Methods of controlling aquatic invasive species	0	9	14	15	8	*46*	*3.5*
Risks of aquatic invasive species control	2	8	13	16	7	*46*	*3.4*



Survey Number	Comment	Additional Comments
1	Low water level is a problem that did not exist 10 years ago	#1h: Seasonal: Spring, summer, fall #4 g: outhouse #19 k: Water level increase
2	Never caught leagal size bass…all too small. Need more structures for fish growth. Time to eliminate some muskies. If worried about lake pollution, attack obvious culprit and erect privy. Waterskiing to close to piers causes to much wake, erosion, pier instability	
3		# 22 reflects ansers only to AIS
4	I support the lake association in its continuing effort to control potentila harmful plant species. I am also frustrated that thre are owners on the lake that do not join the association, do nothing to help the lake, and basically ingnore the problems such as milfoil. They come to their cottage, abuse the lake, act rowdy bothering their neighbors and then leave until next time. I do understand that this behaviour is difficult to address.	#4. g represemts outhouse
5		
6	Seven Island Board is doing an excellent job overall. DNR needs to reduce muskie population	#19 k: Camping
7	I believe that people catching fish and throwing them onshore for eagles to eat is totally unethical. When members of some of 7 island lake committees do this and brag about it, this leaves a bad taste in the mouth of anyone that believes in conservation. What a wonderful example for the future. I applaud the way that oure board aggressively went after the milfoil problem. Also, regarding question number 12 - Isn't this already posted on the sign at the boat landing.	#19 k: People Killing fish because they don't like the species
8	I support the eradication of invasive species using all methods in #22	# 22 reflects ansers only to AIS
9	& Island is a small lake that used to have size appropriate cottages. It now has year round homes that belong in a developed subdivision. They do not fit the look or size of a small lake. What has happened is that a few wealthy people have driven up the property values to the point that the average family soon will not be able to afford to keep the family cottage or pass it on to their children. These large fancy homes fertilize their lawns regularly which contributes to algae growth. Natural trees, flowers and vegitation is waht should have been left. Good example is Sherwood and Camelot (town of Rome, Adams Count) constant weed problem.	
10		
11	#12 I thought that there is a slow wake from 6-10 am. #10 would this be because of the harmful plant problem. #14 I understand that water samples have been taken for years. Do you have any results from this?	
12		
13		#22 Manage invasive species (non-native only)
14	Who authorized the expense of $500 dollars for fish stocking in 2007. Was there a vote, a quorum present. Has anyone one beside the fish chairman contacted the DNR fish management group regarding the removal of muskies from our lake. Fish stocking in our lake has not been successful except for muskie. I think we need a new approach to increasing walleye in our lake. The present group has failed.	#22 Invasive species (non-native only)
15		
16	How can we control the no parking at the boat landing.	#4. g represemts outhouse
17	We (my family) has owned property on 7 island for 51 years. We never had any problems until the association got involved. We use the cottage only in the summer and I don't feel that we need to be told what we can or cannot do as long as we are not endangering any people. Boating safety is the major concern. The weather is only good a few weekends during the summer ofr water skiing. but the rules are always made for fishing which can be done many, many more days of the year. If the weather is good for skiing then we should be able to ski. #17. There are none there. #11 Absolutely not...You cannot waterski then. #24 I don't like people telling me what I can do with my cottage. #25 I volunteer many hours for good causes such as 4H and kids' activities. Close the public landing to the public. Save for the lake owners only.	#19k: People who panic over nothing. Loss of lake rights such as no wake zone.
18	Our family has a long history on the lake. I married into the lake in the late 60s and our children grew up their. Three things have negatively impacted the lake. Two were mentioned in the rest of this survey 1. The lake changed significantly when muskies were introduced into the lake. The bullfrogs disappeared. There was a great increase of people from the outside coming on to the lake. 2. The amount of fireworks has increased alot during the past few years. This is okay on July 4th but it has gotten to be many more days than that. Can anything be done? 3. The increased number of outside people coming onto the lake has increased the danger between two of the middle islands. Legally, when waterskiing, only one of the channels can be used. With the increased number of people swimming off the middle island, it makes it very dangerous for swimmers, boaters and skiiers. Can this island be closed to boaters and swimmers.	#22 Invasive species (non-native only) #19k: Planting non-native fish not native to the lake

Survey Number	Comment	Additional Comments
19		
20	Protect habitat more emphjasis on protecting habitat and wildlife (fish, minnows, and frogs) in the 1950s and 60s the lake population consisted of walleye, large mouthed bass, perch bluegill, crayfish, frogs, bullfrogs, and many,many minnows and pollywogs. The addition of muskie (planted by DNR), rock bass, crappie, and bullhead changed the ecosystem.	
21	I wuld like to see the muskie size limit raised to 40 or 42" long. I would also like to see the bass limit lowered to 10" opr 12" long. That way kids could keep some of the fish they catch. I would like to see some enforcement of barking dogs. The Barking carries a long way across the water	#19k: Boat landing traffic
22	Many septic systems on 7 island lake are very old and close to the lake. We should have an inspection of all systems on the lake by outside people. The annual meeting should be more condensed and a cookout held at the meeting not a picnic later. A small charge could be assessed for food and refreshments. Maybe have Nutzees do the work	
23		
24	Would support efforts to establish wash area for watercraft going in and out of boat landing to reduce risk of AIS. Also, need to make its use mandatory once it is set up. An ounce of prevention is worth a poind of cure.	#19k: Outside public use bringing in AIS
25	We (and others) don't really know much about these topics. I do not like chemicals. I do not think dirty 2 cycle engines are good to be exhausted into the water. Builders almost take no steps to control erosion from excavating. The builder and homeowner both play dumb when tons of dirt and other stuff go into the lake. Contractors and builders use stupid subcontractors to do the building then blame the stupid subs. (then they act shocked) should be more fines/enforcment. All homeowners should do more for their lake. Outsiders should be busted for their piggishness. These lakes are being abused by too many people and they all act shocked when you confront them. If you were to pee in their water, I bet they would be offended. Lakes are a valuable resource.	#19k: Two stroke old and oily boat engines
26	I believe we have a problem with the muskie population in the lake. Personally, I think the lake is too small to support both muskie and a healthy bass/walleye population. The DNR introduced the muskies and I believe they should be responsible for rectifying the problem.	#19k: Boats not inspected for AIS at landing.
27		
28		
29		
30	My family has been on th elake ofr over 60 years. Aquatic species have been active on our lake all that time, from muskie weeds in the public landing area, to other parts of the lake, south side and east. Lily pads were even more abundant then than now. The fish were very abundant in those areas. Muskie, walleye, bass, and even lake suckers which are gone now. Now milfoil is not a good plant to have and should be kept in control, but fish do need plant life. Since the public landing came in, we have experienced many problems from the milfoil to too much boat traffic. Possibly charging to land boats there could discourage some of this extra boat traffic. Plus the money would be helpful for milfoil expenses. Marathon county charges $3 I believe. I think $5 would be fair. enforcement could be challenging. We all want a clean lake with quality fishing. I worry about all the negative things I see with the public boat landing...pollution, overfishing the lake, some toonoisy with too big boats. A motor size limit would be nice. It isn't that big of a lake 100 hp is plenty. Most of our resident show great restraint and devotion to our lake. I appreciate your help. Thank you!	#19k: Boat landing use by non-property owners.
31	#25 Would volunteer for road maintenance	
32	the trees that were felled to be used as fish cribs are nonbeneficial and are an eyesore. They should be removed. They also cause problems with boating close shore.	
33	We just took possession of our home in Oct. of 2006. A lot of this in new to us so some of my answers may be suspect. However, I believe the association is doing a great job. The future of our lake depends on our efforts.	
34	The fishing quality has been going down yearly. The few perch that are caught are wormy.	#1h: Now building year-round residence #19k: No fish
35	My place on the lake has always been like a little bit of paradise for me. When the children were younger, they and their friends loved every spent there. They are now grown and busy with their own lives so it has become my private place to retreat to during the summer. I really appreciate all the time and effort that the association directors and volunteers put into association activities.	
36	I hope the board is monitoring the activities of the treasurer, Pat Haskin. She has had that post for many years and I hope that funds aren't being mishandled. I am especially concerned about the funds collected specifically for the milfoil weed. I have been told that the monies collected are not kept in a separate account. If combined with other association funds it is easy to lose track of what dollars are used for what purposes. Hopefully someone else is monitoring the books. Perhaps there should be a term limit as far as how long someone can be in a position on the board.	#4. g represemts outhouse #19k: Should check all cottage septic tanks are up to date.
37	Thank you for all of your efforts. We have a great association and board.	

Survey Number	Comment	Additional Comments
38		
39		
40	When are we closing camping overnight on all islands?	
41		
42	I have been using the lake for over 35 years. I have seen fish numbers and quality steadily decline. We have a great deal of non-property owners using the lake…which is great that the opportunity is there…but we have a lot of those people practicing catch and keep. Is there a way we can charge a fee for boat launching and put this money toward boat launching. A lot of areas are charging 3 to 7 dollars per launch. Possibly issue property owners a pass to launch free. I would also like to see a no size limit placed on large mouth bass and a two fish a day limit to thin the herd of runts and look into stocking small mouth bass. The lake is supporting nice size smallies now. Also, stock hybrid bluegills if this is allowed by the DNR	
43		Answers refer to NATIVE plants would be different if talking AIS

C

APPENDIX C

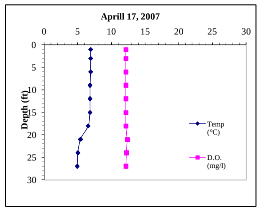
Water Quality Data

Seven Island

Date: 04-17-07
Time: 15:00
Weather: 100% Clouds, 57° F, windy
Ent: BTB **Verf:**

Max Depth (ft): 31.2
SILS Depth (ft): 3.0
SILB Depth (ft): 27.0
Secchi Depth (ft): 10.6

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	6.9	12.1	7.8	37
3.0	6.9	12.1	7.7	37
6.0	6.9	12.1	7.8	37
9.0	6.8	12.1	7.8	37
12.0	6.8	12.1	7.7	37
15.0	6.8	12.1	7.7	37
18.0	6.5	12.1	7.7	37
21.0	5.4	12.3	7.6	37
24.0	5.0	12.2	7.6	37
27.0	4.9	12.1	7.6	37



Parameter	SILS	SILB
Total P (µg/L)	NA	NA
Dissolved P (µg/L)	ND	NA
Chl a (µg/L)	3.49	NA
TKN (µg/L	420.00	NA
NO3+NO2-N (µg/L)	ND	NA
NH3-N (µg/L)	ND	NA
Total N (µg/L)	420.00	NA
Lab Cond. (µS/cm)	41	NA
Lab pH	7.25	NA
Alkal (mg/l CaCO3)	15	NA
Total Susp Sol (mg/l)	ND	NA
Calcium (mg/l)	3.9	NA

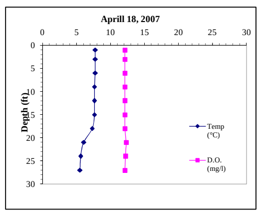
Samples collected by EJH and DN

Seven Island

Date: 04-18-07
Time: NA
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): 27.0
SILS Depth (ft): 6.0
SILB Depth (ft): 27.0
Secchi Depth (ft): 10.5

Depth (ft)	Temp (°C)	Temp (°F)	D.O. (mg/l)
1.0	7.8	44.4	12.1
3.0	7.8	44.4	12.1
6.0	7.8	44.4	12.1
9.0	7.6	44.2	12.1
12.0	7.6	44.2	12.1
15.0	7.6	44.2	12.1
18.0	7.3	43.7	12.1
21.0	6.1	41.7	12.3
24.0	5.6	41.0	12.2
27.0	5.5	40.8	12.1



Parameter	SILS	SILB
Total P (µg/L)	NA	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	**	
TKN (µg/L	NA	NA
NO3+NO2-N (µg/L)	NA	NA
NH3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	NA	NA
Calcium (mg/l)	NA	NA

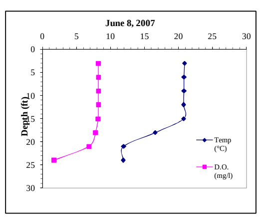
Data collected by Dan Nordall (Seven Island CLMN)

Seven Island

Date: 06-08-07
Time: NA
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): 24.0
SILS Depth (ft): 6.0
SILB Depth (ft): 24.0
Secchi Depth (ft): 12.5

Depth (ft)	Temp (°C)	Temp (°F)	D.O. (mg/l)
3.0	20.9	65.4	8.2
6.0	20.8	65.3	8.2
9.0	20.8	65.3	8.2
12.0	20.8	65.2	8.2
15.0	20.8	65.2	8.2
18.0	16.6	58.5	7.8
21.0	11.9	51.1	6.8
24.0	11.9	51.0	1.7



Parameter	SILS	SILB
Total P (µg/L)	NA	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	NA	NA
TKN (µg/L	NA	NA
NO3+NO2-N (µg/L)	NA	NA
NH3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	NA	NA
Calcium (mg/l)	NA	NA

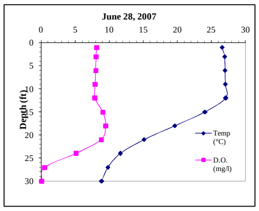
Data collected by Dan Nordall (Seven Island CLMN)

Seven Island

Date: 06-28-07
Time: NA
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): 30.0
SILS Depth (ft): 6.0
SILB Depth (ft): 30.0
Secchi Depth (ft): 11.8

Depth (ft)	Temp (°C)	Temp (°F)	D.O. (mg/l)
1.0	26.6	74.5	8.2
3.0	26.9	75.1	8.1
6.0	27.0	75.2	8.0
9.0	27.1	75.3	7.9
12.0	27.1	75.4	7.9
15.0	24.1	70.5	9.0
18.0	19.6	63.4	9.5
21.0	15.1	56.2	8.8
24.0	11.6	50.6	5.1
27.0	9.8	47.7	0.5
30.0	8.9	46.2	0.1



Parameter	SILS	SILB
Total P (µg/L)	12.000	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	3.51	NA
TKN (µg/L	**	NA
NO3+NO2-N (µg/L)	**	NA
NH3-N (µg/L)	**	NA
Total N (µg/L)	**	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	2.000	NA
Calcium (mg/l)	NA	NA

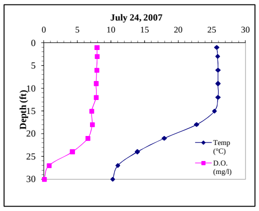
Data collected by Dan Nordall (Seven Island CLMN)

Seven Island

Date: 07-24-07
Time: NA
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): 30.0
SILS Depth (ft): 6.0
SILB Depth (ft): 30.0
Secchi Depth (ft): 12.8

Depth (ft)	Temp (°C)	Temp (°F)	D.O. (mg/l)
1.0	25.8	73.2	7.9
3.0	25.9	73.4	7.9
6.0	25.9	73.5	7.9
9.0	25.9	73.5	7.8
12.0	25.9	73.5	7.8
15.0	25.4	72.6	7.1
18.0	22.8	68.4	7.2
21.0	17.9	60.7	6.5
24.0	13.9	54.3	4.3
27.0	11.0	49.6	0.8
30.0	10.3	48.4	0.0



Parameter	SILS	SILB
Total P (µg/L)	13.000	NA
Dissolved P (µg/L)	ND	NA
Chl a (µg/L)	3.28	NA
TKN (µg/L	**	NA
NO3+NO2-N (µg/L)	**	NA
NH3-N (µg/L)	**	NA
Total N (µg/L)	**	NA
Lab Cond. (µS/cm)	40.000	NA
Lab pH	7.320	NA
Alkal (mg/l CaCO3)	14.800	NA
Total Susp Sol (mg/l)	2.000	NA
Calcium (mg/l)	NA	NA

Data collected by Dan Nordall (Seven Island CLMN)

Seven Island

Date: 08-29-07
Time: NA
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): NA
SILS Depth (ft): NA
SILB Depth (ft): NA
Secchi Depth (ft): NA

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
NA	NA	NA	NA	NA
NA	NA	NA	NA	NA
NA	NA	NA	NA	NA
NA	NA	NA	NA	NA
NA	NA	NA	NA	NA
NA	NA	NA	NA	NA
NA	NA	NA	NA	NA
NA	NA	NA	NA	NA

Parameter	SILS	SILB
Total P (µg/L)	9.000	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	5.01	NA
TKN (µg/L	470.000	NA
NO3+NO2-N (µg/L)	ND	NA
NH3-N (µg/L)	ND	NA
Total N (µg/L)	470.000	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	ND	NA
Calcium (mg/l)	NA	NA

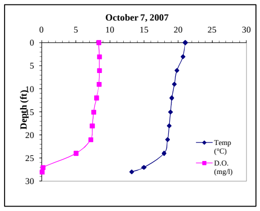
Data collected by Dan Nordall (Seven Island CLMN)

Seven Island

Date: **10-07-08**
Time: NA
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): 28.0
SILS Depth (ft): 6.0
SILB Depth (ft): 28.0
Secchi Depth (ft): 13.8

Depth (ft)	Temp (°C)	Temp (°F)	D.O. (mg/l)
0.0	21.1	65.7	8.3
3.0	20.7	65.1	8.4
6.0	19.8	63.7	8.4
9.0	19.4	63.1	8.4
12.0	19.1	62.5	8.0
15.0	18.9	62.2	7.6
18.0	18.7	61.9	7.4
21.0	18.4	61.5	7.2
24.0	17.9	60.7	5.0
27.0	15.0	56.0	0.2
28.0	13.2	53.1	0.0



Parameter	SILS	SILB
Total P (µg/L)	NA	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	NA	NA
TKN (µg/L	NA	NA
NO3+NO2-N (µg/L)	NA	NA
NH3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	NA	NA
Calcium (mg/l)	NA	NA

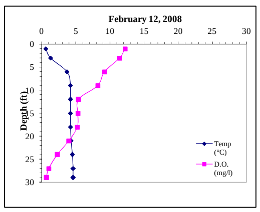
Data collected by Dan Nordall (Seven Island CLMN)

Seven Island

Date: **02-12-08**
Time: 9:50
Weather: Hazy Sun, 5 F
Ent: BTB **Verf:**

Max Depth (ft): 30.5
SILS Depth (ft): 3.0
SILB Depth (ft): 29.0
Secchi Depth (ft): 9.7

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	0.6	12.2	7.5	42
3.0	1.3	11.4	8.5	40
6.0	3.7	9.2	8.0	39
9.0	4.2	8.2	7.5	41
12.0	4.2	5.4	7.3	41
15.0	4.2	5.3	7.1	41
18.0	4.2	5.2	6.9	41
21.0	4.3	4.0	6.7	42
24.0	4.5	2.3	6.3	44
27.0	4.6	1.0	6.2	45
29.0	4.6	0.7	6.0	37



Parameter	SILS	SILB
Total P (µg/L)	14.000	NA
Dissolved P (µg/L)	4.000	NA
Chl a (µg/L)	NA	NA
TKN (µg/L	630.000	NA
NO3+NO2-N (µg/L)	ND	NA
NH3-N (µg/L)	23.000	NA
Total N (µg/L)	630.000	NA
Lab Cond. (µS/cm)	37.100	NA
Lab pH	8.500	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	ND	NA
Calcium (mg/l)	NA	NA

Data collected by TAH & EJH (Onterra)

Water Quality Data

2007/2008	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	7	11.7	NA	NA
Total P (µg/L)	4	12.000	NA	NA
Dissolved P (µg/L)	1	4.000	NA	NA
Chl a (µg/L)	4	3.823	NA	NA
TKN (µg/L	3	506.667	NA	NA
NO3+NO2-N (µg/L)	0	**	NA	NA
NH3-N (µg/L)	1	23.000	NA	NA
Total N (µg/L)	3	506.667	NA	NA
Lab Cond. (µS/cm)	3	39.367	NA	NA
Lab pH	3	7.690	NA	NA
Alkal (mg/l CaCO3)	2	14.750	NA	NA
Total Susp Sol (mg/l)	2	2.000	NA	NA
Calcium (µg/L)	1	3.900	NA	NA

Wisconsin Trophic State Index (WTSI)				
Year		TP	Chla	SD
1992		52.19	41.49	44.34
1993				41.08
1994		52.87	43.78	40.66
1995				37.15
1996				41.17
1997		46.56	42.16	37.87
1998		38.92	41.22	40.45
1999				42.86
2000		45.24	40.79	40.72
2001		42.08	40.68	37.85
2002		46.06	37.24	
2003				37.54
2004				
2005				
2006		49.21	42.41	38.25
2007		47.01	45.04	40.91
All Years (weighted)		48.25	42.27	40.07
WI Natural Lakes		53.19	54.23	47.33
Northeast Region		51.05	51.49	45.61

Morphological / Geographical Data

Parameter	Value
Acreage	135
Volume (acre-feet)	1916
Perimeter (miles)	3.36
Shoreland Development	
Maximum Depth (feet)	31
County	Lincoln County
WBIC	1490300
Lillie Mason Region(1983)	Northeast Region
Nichols Ecoregion(1999)	NLFL

Watershed Data

WiLMS Class	Acreage	kg/yr	lbs/yr
Forest	297.0	11	5.0
Open Water	135.0	16	7.3
Pasture/Grass	1.0	0	0.0
Row Crops	0.0	0	0.0
Urban - Rural Residential	0.0	0	0.0
Wetland	18.0	1	0.5

Watershed to Lake Area 4.5 :1

	Secchi (feet)				Chlorophyll a (µg/L)				Phosphorus (µg/L)			
	Growing Season		Summer		Growing Season		Summer		Growing Season		Summer	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
1992	8	10.19	4	9.72	4	3.96	2	2.45	8	18.000	4	22
1993	14	12.16	9	12.19								
1994	11	11.89	5	12.55	5	4.54	3	3.33	10	21.6	6	24
1995	13	14.62	6	16								
1996	13	11.88	7	12.11								
1997	22	14.01	12	15.23	4	3.34	3	2.68	5	10	3	10.67
1998	22	12.18	13	12.73	4	3.20	3	2.36	5	7.2	3	4
1999	16	11.01	10	10.77								
2000	12	12.55	8	12.49	4	2.43	3	2.23	4	9.25	3	9
2001	7	14.28	4	15.25	3	2.67	2	2.20	3	7.33	2	6
2002					1	1.39	1	1.39	1	10	1	10
2003	5	15.7	3	15.58								
2004												
2005												
2006	4	14.6	3	14.83	3	3.22	2	2.77	3	14	2	15
2007	6	11.98	3	12.33	5	3.76	3	3.93	4	11.50	3	11.30
All Years (weighted)		12.7		13.1		3.4		2.7		14.0		13.3
WI Natural Lakes				7.9				13.4				25
Northeast Region				8.9				9.3				19

	Phosphorus (µg/L)				Nitrogen (µg/L)			
	Spring Turnover		Fall Turnover		Spring Turnover		Fall Turnover	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean
2007	1	12.0	0	NA	1	420.0	0	NA

Summer 2007 N: 470
Summer 2007 P: 11

Summer 2007 N:P 43 :1

D

APPENDIX D

Watershed Analysis WiLMS Results

Date: 7/9/2008 Scenario: Seven Island Lake

Lake Id: Seven Island Lake
Watershed Id: Seven Island

Hydrologic and Morphometric Data

Tributary Drainage Area: 316.0 acre
Total Unit Runoff: 11.7 in.
Annual Runoff Volume: 308.1 acre-ft
Lake Surface Area <As>: 135 acre
Lake Volume <V>: 1916 acre-ft
Lake Mean Depth <z>: 14.2 ft
Precipitation - Evaporation: 5.2 in.
Hydraulic Loading: 366.6 acre-ft/year
Areal Water Load <qs>: 2.7 ft/year
Lake Flushing Rate <p>: 0.19 1/year
Water Residence Time: 5.23 year
Observed spring overturn total phosphorus (SPO): 12 mg/m^3
Observed growing season mean phosphorus (GSM): 11.5 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	0.0	0.50	1.00	3.00	0.0	0	0	0
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	1	0.10	0.30	0.50	0.4	0	0	0
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	0.0	0.05	0.10	0.25	0.0	0	0	0
Wetlands	18	0.10	0.10	0.10	2.6	1	1	1
Forest	297	0.05	0.09	0.18	38.6	6	11	22
Lake Surface	135.0	0.10	0.30	1.00	58.4	5	16	55

POINT SOURCE DATA

Point Sources	Water Load (m^3/year)	Low (kg/year)	Most Likely (kg/year)	High (kg/year)	Loading %

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.3	0.5	0.8	
# capita-years	0.0				
% Phosphorus Retained by Soil		98	90	80	
Septic Tank Loading (kg/year)		0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	27.0	61.9	170.2	100.0
Total Loading (kg)	12.2	28.1	77.2	100.0
Areal Loading (lb/ac-year)	0.20	0.46	1.26	0.0
Areal Loading (mg/m^2-year)	22.41	51.36	141.31	0.0
Total PS Loading (lb)	0.0	0.0	0.0	0.0
Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	14.9	25.7	49.7	100.0
Total NPS Loading (kg)	6.8	11.7	22.6	100.0

Phosphorus Prediction and Uncertainty Analysis Module

Date: 7/9/2008   Scenario: Seven Island Lake
Observed spring overturn total phosphorus (SPO): 12.0 mg/m^3
Observed growing season mean phosphorus (GSM): 11.5 mg/m^3
Back calculation for SPO total phosphorus: 0.0 mg/m^3
Back calculation GSM phosphorus: 0.0 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 0 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	11	26	72	15	130
Canfield-Bachmann, 1981 Natural Lake	10	17	33	6	52
Canfield-Bachmann, 1981 Artificial Lake	11	17	30	6	52
Rechow, 1979 General	2	4	11	-8	-70
Rechow, 1977 Anoxic	13	31	85	20	174
Rechow, 1977 water load<50m/year	4	8	22	-4	-35
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	10	23	62	11	92
Vollenweider, 1982 Combined OECD	9	17	40	5	43
Dillon-Rigler-Kirchner	6	15	40	3	25
Vollenweider, 1982 Shallow Lake/Res.	7	14	33	2	17
Larsen-Mercier, 1976	8	19	52	7	58
Nurnberg, 1984 Oxic	6	13	35	2	17

Lake Phosphorus Model	**Confidence** Lower Bound	**Confidence** Upper Bound	**Parameter** Fit?	**Back** Calculation (kg/year)	**Model** Type
Walker, 1987 Reservoir	14	56	Tw	0	GSM
Canfield-Bachmann, 1981 Natural Lake	5	49	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	5	49	FIT	1	GSM
Rechow, 1979 General	2	9	L	0	GSM
Rechow, 1977 Anoxic	17	65	FIT	0	GSM
Rechow, 1977 water load<50m/year	5	17	FIT	0	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	11	50	FIT	0	SPO
Vollenweider, 1982 Combined OECD	8	35	FIT	0	ANN
Dillon-Rigler-Kirchner	8	31	L qs p	0	SPO
Vollenweider, 1982 Shallow Lake/Res.	7	29	FIT	0	ANN
Larsen-Mercier, 1976	11	40	P Pin	0	SPO
Nurnberg, 1984 Oxic	7	28	FIT	0	ANN

Water and Nutrient Outflow Module

Date: 7/9/2008   Scenario: Seven Island Lake
Average Annual Surface Total Phosphorus: 11.5mg/m^3
Annual Discharge: 3.67E+002 AF => 4.52E+005 m^3
Annual Outflow Loading: 11.0 LB =>   5.0 kg

E

APPENDIX E

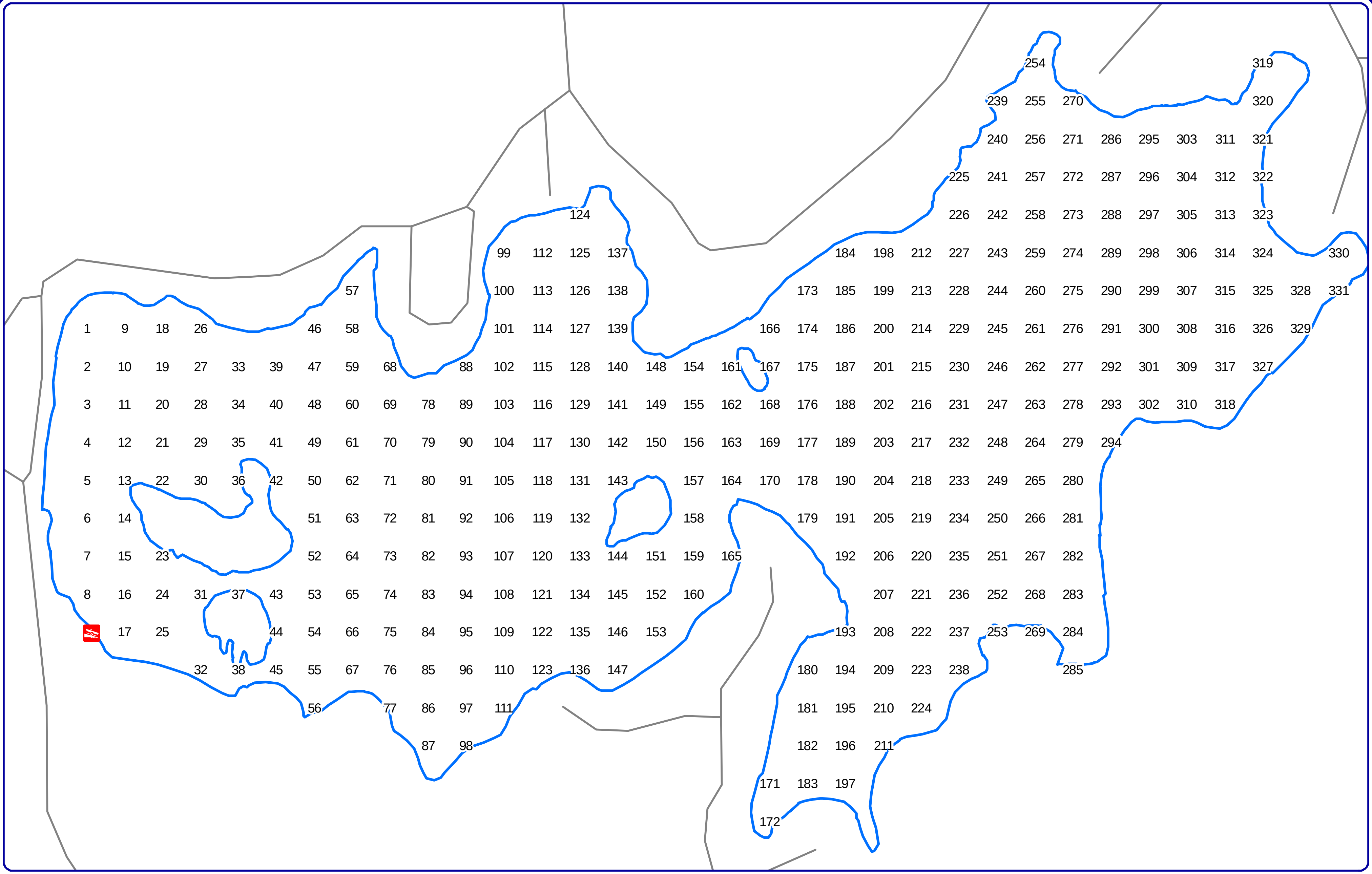
2007 Aquatic Plant Survey Data

Sampling Point	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Brasenia schreberi, Watershield*	*Chara, Muskgrasses*	*Eleocharis acicularis, Needle spikerush*	*Elodea canadensis, Common waterweed*	*filamentous algae*	*Juncus pelocarpus f. submersus, Brown-fruited rush*	Lobelia dortmanna, Water lobelia	*moss*	*Myriophyllum tenellum, Dwarf water milfoil*	*Najas flexilis, Bushy pondweed*	*Nitella sp., Nitella*	*Nuphar variegata, Spatterdock*	*Nymphaea odorata, White water lily*	*Potamogeton amplifolius, Large-leaf pondweed*	Potamogeton epihydrus, Ribbon-leaf pondweed	Potamogeton pusillus, Small pondweed	Potamogeton robbinsii, Robbins pondweed	Sagittaria sp.	sp1 - Isoetes echinospora, Spiny-spored quillwort	sp2 - Potamogeton sp., Pondweed (stolon only)	sp3 - Sparganium sp., Thick leaved floating bur-reed	Sparganium fluctuans, Floating-leaved bur-reed	Utricularia gibba, Creeping bladderwort
1	45.42586188	-89.47557074	10.5	M	P							1	1												2						
2	45.42550184	-89.47557407	16	M	P					2		1							1					1							
3	45.42514181	-89.4755774	13	M	P							2																			1
4	45.42478177	-89.47558074	13	M	P							2							1												
5	45.42442174	-89.47558407	11	M	P							2	1																		
6	45.4240617	-89.4755874	9	M	P							2	1									1									
7	45.42370167	-89.47559074	8	M	P								1						1			V	2								
8	45.42334163	-89.47559407	5	M	P				1			2	1												1						
9	45.42585953	-89.47505944	15.5	M	P							2	1						1					1							
10	45.42549949	-89.47506278	23.5	M	R																										
11	45.42513946	-89.47506611	23	M	R																										
12	45.42477942	-89.47506945	15	M	P					1		1							2												
13	45.42441939	-89.47507279	3.5	S	P									1							V						1				
14	45.42405935	-89.47507612	4	M	P				3												V	1									
15	45.42369932	-89.47507946	7	M	P														1												
16	45.42333928	-89.4750828	9	M	P							1	1									1									
17	45.42297925	-89.47508613	7	M	P								1						1						2						
18	45.42585718	-89.47454814	12	M	P							2																			
19	45.42549714	-89.47455148	21.5	M	R																										
20	45.42513711	-89.47455482	22.5	M	R																										
21	45.42477707	-89.47455816	14.5	M	P					2		1							1					1							
22	45.42441704	-89.4745615	7	S	P				V																						
23	45.42369697	-89.47456818	1	R	P				2																		V				
24	45.42333693	-89.47457152	7.5	M	P							1	1										2								
25	45.4229769	-89.47457486	9	M	P								1						1												
26	45.42585482	-89.47403685	11	S	P																										
27	45.42549479	-89.47404019	16.5	M	R							1							1					1							
28	45.42513475	-89.47404353	13	M	P							2							1			2									
29	45.42477472	-89.47404688	10	M	P							1	1						1						2						
30	45.42441468	-89.47405022	10	M	P							2	1						1					1							
31	45.42333458	-89.47406025	4.5	M	P				V																	V					
32	45.42261451	-89.47406694	6.5	M	P								1																		
33	45.42549243	-89.4735289	16.5	M	P														1					2							
34	45.4251324	-89.47353225	14	M	P					3		1												1							
35	45.42477236	-89.47353559	8	R	P							2	1						1					1							
36	45.42441233	-89.47353894				TERRESTRIAL																									
37	45.42333222	-89.47354898	2	S	P				V			1									V		1				V				
38	45.42261215	-89.47355567	1.5	M	P				2												V		1								
39	45.42549007	-89.47301761	14.5	M	P					2														1							
40	45.42513004	-89.47302096	14.5	M	P					2														1							
41	45.42477001	-89.47302431	11	M	P							1	1											1	1						
42	45.42440997	-89.47302766	2	R	P																1										
43	45.42332987	-89.4730377	7	M	P								1						1						1						
44	45.42296983	-89.47304105	1	S	P										1												1				
45	45.4226098	-89.4730444	3	S	P				V																						
46	45.42584775	-89.47250296	11	M	P								1						1												
47	45.42548771	-89.47250631	15.5	M	P								1						1												
48	45.42512768	-89.47250967	14	M	P					3																					
49	45.42476765	-89.47251302	14.5	M	P								1						2												
50	45.42440761	-89.47251637	13	M	P							2	1						1			2									
51	45.42404758	-89.47251973	7	R	P														1												
52	45.42368754	-89.47252308	10	M	P							2							1												
53	45.42332751	-89.47252643	11	M	P							1	1										1								
54	45.42296747	-89.47252978	10.5	M	P														1						1						
55	45.42260744	-89.47253314	10.5	M	P							2	1										2		1						
56	45.4222474	-89.47253649	1.5	S	P																V		V			V					
57	45.42620542	-89.47198831	6		P																										
58	45.42584539	-89.47199166	12	M	P								1												1						
59	45.42548535	-89.47199502	15.5	M	P							1	1						1					1							
60	45.42512532	-89.47199838	16	M	P							1							1					2							
61	45.42476528	-89.47200173	15	M	P					3		1	1																		
62	45.42440525	-89.47200509	15	M	P					2		1	1						1			1									
63	45.42404521	-89.47200845	15	M	P														1												
64	45.42368518	-89.4720118	14	M	P							1	1						2												
65	45.42332514	-89.47201516	14.5	M	P								1						2												
66	45.42296511	-89.47201851	8.5	R	P								1						1												
67	45.42260507	-89.47202187	4	M	P				2			1					1														
68	45.42548299	-89.47148373	3	R	P																										
69	45.42512295	-89.47148709	12	M	P							1							1			2									
70	45.42476292	-89.47149045	17.5	M	R					2																					
71	45.42440288	-89.47149381	17	M	R														1					1							
72	45.42404285	-89.47149717	15	M	P														1												
73	45.42368281	-89.47150053	16	M	P					2														1							
74	45.42332278	-89.47150389	21	M	R																										
75	45.42296274	-89.47150725	13	M	P														2												
76	45.42260271	-89.4715106	12.5	M	P														2												
77	45.42224267	-89.47151396	9	S	P														1												
78	45.42512059	-89.4709758	7.5	S	P												1						1								
79	45.42476055	-89.47097916	20	M	R																										
80	45.42440052	-89.47098253	14	M	P					3																					
81	45.42404048	-89.47098589	11	M	P					2									1												
82	45.42368045	-89.47098925	14	M	P					2		1	1											1							
83	45.42332041	-89.47099261	20	M	R								1						1												
84	45.42296038	-89.47099598	22.5			DEEP																									
85	45.42260034	-89.47099934	20	M	R														2												
86	45.42224031	-89.4710027	9.5	S	P							1							1												
87	45.42188027	-89.47100606	7	M	P							1							1				1								
88	45.42547825	-89.47046114	7	S	P																										
89	45.42511822	-89.47046451	19	M	R														1												
90	45.42475818	-89.47046788	23			DEEP																									
91	45.42439815	-89.47047124	12.5	M	P														1			2									
92	45.42403811	-89.47047461	11	R	P					1		1							2					1							1
93	45.42367808	-89.47047797	13	M	P							2	1						2			2		1							1
94	45.42331804	-89.47048134	16.5	M	R					2			1						1												
95	45.42295801	-89.47048471	25			DEEP																									
96	45.42259797	-89.47048807	22	M	R																										
97	45.42223794	-89.47049144	12	M	P							2	1						1			2									
98	45.4218779	-89.4704948	4	S	P				1			1																		1	
99	45.42655598	-89.46993974	8	M	P																										
100	45.42619595	-89.46994311	12	M	P							2	1																		
101	45.42583591	-89.46994648	12	M	P							1	1						1												
102	45.42547588	-89.46994985	23			DEEP																									
103	45.42511585	-89.46995322	25			DEEP																									

Sampling Point	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Brasenia schreberi*, Watershield	*Chara*, Muskgrasses	*Eleocharis acicularis*, Needle spikerush	*Elodea canadensis*, Common waterweed	*filamentous algae*	*Juncus pelocarpus f. submersus*, Brown-fruited rush	Lobelia dortmanna, Water lobelia	*moss*	*Myriophyllum tenellum*, Dwarf water milfoil	*Najas flexilis*, Bushy pondweed	*Nitella sp.*, Nitella	*Nuphar variegata*, Spatterdock	*Nymphaea odorata*, White water lily	*Potamogeton amplifolius*, Large-leaf pondweed	Potamogeton epihydrus, Ribbon-leaf pondweed	Potamogeton pusillus, Small pondweed	Potamogeton robbinsii, Robbins pondweed	Sagittaria sp.	sp1 - Isoetes echinospora, Spiny-spored quillwort	sp2 - Potamogeton sp., Pondweed (stolon only)	sp3 - Sparganium sp., Thick leaved floating bur-reed	Sparganium fluctuans, Floating-leaved bur-reed	Utricularia gibba, Creeping bladderwort
104	45.42475581	-89.46995659	22			DEEP																									
105	45.42439578	-89.46995996	13	M	P							2	1						1												
106	45.42403574	-89.46996333	11	M	P							1	1						2			2									
107	45.42367571	-89.4699667	11	M	P							1							2			1									
108	45.42331567	-89.46997007	14.5	M	P														2												
109	45.42295564	-89.46997344	23.5			DEEP																									
110	45.4225956	-89.46997681	15	M	P					1		1	1						1												
111	45.42223557	-89.46998017	4	R	P				2																						
112	45.42655361	-89.46942844	12	M	P							2																			
113	45.42619358	-89.46943181	13	M	P							2																			
114	45.42583354	-89.46943519	15	M	P					1									1					1				1			
115	45.42547351	-89.46943856	19	M	R														1												
116	45.42511347	-89.46944193	24			DEEP																									
117	45.42475344	-89.46944531	18.5	M	R														1												
118	45.4243934	-89.46944868	14.5	M	P					2		1							1												
119	45.42403337	-89.46945205	11	M	P							1	1						2												
120	45.42367333	-89.46945542	9	R	P								1						1			1		1							
121	45.4233133	-89.46945879	13	S	P														2												
122	45.42295326	-89.46946217	17	M	R					3									1												
123	45.42259323	-89.46946554	11	S	P														2												
124	45.42691127	-89.46891376	2	R	P																										
125	45.42655123	-89.46891714	7	S	P												2														
126	45.4261912	-89.46892052	4	M	P												2														
127	45.42583116	-89.46892389	9	S	P																										
128	45.42547113	-89.46892727	10	M	P																		2								
129	45.4251111	-89.46893064	10	M	P								1						2												
130	45.42475106	-89.46893402	14	M	P					1		1																			
131	45.42439103	-89.4689374	13.5	M	P								1						2												
132	45.42403099	-89.46894077	9	R	P							1	1						1					1							
133	45.42367096	-89.46894415	8	S	P														1					1							
134	45.42331092	-89.46894752	15	M	P					1			1						2												
135	45.42295089	-89.4689509	14.5	M	P					1			1			1			2			2									
136	45.42259085	-89.46895427	6	S	P				V																						
137	45.42654886	-89.46840584	3	M	P				V															1		1					
138	45.42618882	-89.46840922				NONNAVIGABLE (PLANTS)			V												V										
139	45.42582879	-89.4684126				ROCKS																									
140	45.42546875	-89.46841598	8	M	P																										
141	45.42510872	-89.46841935	2	S	P																										
142	45.42474868	-89.46842273	11	M	P							1							1			2									
143	45.42438865	-89.46842611	8.5	S	P							1	1						2					1							
144	45.42366858	-89.46843287	5.5	R	P				V																						
145	45.42330854	-89.46843625	16.5	M	R																										
146	45.42294851	-89.46843963	14	M	P							1	1						2												
147	45.42258847	-89.46844301	10.5	M	P																										
148	45.42546637	-89.46790468	1.5	S	P																										
149	45.42510634	-89.46790807	4.5	M	P						2																				
150	45.4247463	-89.46791145	9	M	P							1	1						1	1											
151	45.4236662	-89.4679216	19.5	M	R																										
152	45.42330616	-89.46792498	24.5			DEEP																									
153	45.42294613	-89.46792836	12.5	M	P							1	1																		
154	45.42546399	-89.46739339				NONNAVIGABLE (PLANTS)																									
155	45.42510395	-89.46739678				NONNAVIGABLE (PLANTS)																									
156	45.42474392	-89.46740016	5	S	P						1		1						1												
157	45.42438388	-89.46740355	9	M	P							1												1							
158	45.42402385	-89.46740693	10	S	P								1					1	1												
159	45.42366382	-89.46741032	20	M	R																										
160	45.42330378	-89.46741371	21	M	R																										
161	45.4254616	-89.4668821	2	M	P				2								1				1										
162	45.42510157	-89.46688549	2	R	P				V								1												2		
163	45.42474153	-89.46688888	8	M	P																		1	2							
164	45.4243815	-89.46689227	7	S	P								1						2			V									
165	45.42366143	-89.46689904	8.5	M	P							1																			
166	45.42581925	-89.46636742	12	M	P							2	1						1					1							
167	45.42545922	-89.46637081	4	R	P				V																						
168	45.42509918	-89.4663742	3.5	S	P						1																				
169	45.42473915	-89.46637759	10.5	R	P							1	1						1												
170	45.42437911	-89.46638098	12	M	P								1						2												
171	45.42149883	-89.46640812	9	S	P																										
172	45.4211388	-89.46641151	4	M	P				V																						
173	45.42617689	-89.46585273	12	M	P								1						2												
174	45.42581686	-89.46585612	18	M	R							2	1						2					2							
175	45.42545683	-89.46585952	15	M	P							1	1						2												
176	45.42509679	-89.46586291	12	S	P														1						3						
177	45.42473676	-89.46586631	14	S	P							1	1						2												
178	45.42437672	-89.4658697	15	M	P					3									1												
179	45.42401669	-89.4658731	13.5	M	P														1						2						
180	45.42257655	-89.46588668	16	M	P																										
181	45.42221651	-89.46589007	15.5	M	P														1												
182	45.42185648	-89.46589347	17	M	R					1																					
183	45.42149644	-89.46589686	14	M	P							2							1												
184	45.42653454	-89.46533803	9	S	P														1												
185	45.4261745	-89.46534143	20	M	R														2												
186	45.42581447	-89.46534483	16.5	M	P							2							1					1							
187	45.42545443	-89.46534822	11	S	P							1	2						3												
188	45.4250944	-89.46535162	12	R	P							1	1						2												
189	45.42473436	-89.46535502	16.5	M	P					2									1					1							
190	45.42437433	-89.46535842	16	M	P														2					1	2						
191	45.4240143	-89.46536182	14	M	P							2	1						2					1							
192	45.42365426	-89.46536522	13	M	P							2	1																		
193	45.42293419	-89.46537201	14	S	P														1												
194	45.42257416	-89.46537541	20.5	M	R														2												
195	45.42221412	-89.46537881	17.5	M	R								1						2												
196	45.42185409	-89.46538221	16	M	P					1									2												
197	45.42149405	-89.46538561	13	M	P							2	1																		
198	45.42653214	-89.46482673	11	R	P																										
199	45.42617211	-89.46483013	17	M	R							2							1												
200	45.42581207	-89.46483353	15.5	M	P					2									1					1							
201	45.42545204	-89.46483693	13.5	M	P					1		1	1						2												
202	45.425092	-89.46484034	10	S	P							1							1			2		1							
203	45.42473197	-89.46484374	16.5	M	R					3									1												
204	45.42437194	-89.46484714	17.5	M	R					2									1												
205	45.4240119	-89.46485054	16	M	R							1				1			1					1	2						
206	45.42365187	-89.46485394	16.5	M	R														1												

Sampling Point	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Brasenia schreberi*, Watershield	*Chara*, Muskgrasses	*Eleocharis acicularis*, Needle spikerush	*Elodea canadensis*, Common waterweed	*filamentous algae*	*Juncus pelocarpus f. submersus*, Brown-fruited rush	Lobelia dortmanna, Water lobelia	*moss*	*Myriophyllum tenellum*, Dwarf water milfoil	*Najas flexilis*, Bushy pondweed	*Nitella sp.*, *Nitella*	*Nuphar variegata*, Spatterdock	*Nymphaea odorata*, White water lily	*Potamogeton amplifolius*, Large-leaf pondweed	Potamogeton epihydrus, Ribbon-leaf pondweed	Potamogeton pusillus, Small pondweed	Potamogeton robbinsii, Robbins pondweed	Sagittaria sp.	sp1 - Isoetes echinospora, Spiny-spored quillwort	sp2 - Potamogeton sp., Pondweed (stolon only)	sp3 - Sparganium sp., Thick leaved floating bur-reed	Sparganium fluctuans, Floating-leaved bur-reed	Utricularia gibba, Creeping bladderwort
207	45.42329183	-89.46485734	16	M	R														1					1							
208	45.4229318	-89.46486075	19	M	P														2												
209	45.42257176	-89.46486415	24			DEEP																									
210	45.42221173	-89.46486755	20	M	R														2												
211	45.42185169	-89.46487095	12	S	P																										
212	45.42652975	-89.46431543	13.5	M	P							2	1																		
213	45.42616971	-89.46431883	17.5	M	R														1					1							
214	45.42580968	-89.46432224	14.5	M	P					2		1	1						1					1							
215	45.42544964	-89.46432564	13	M	P					2		1	1																		
216	45.42508961	-89.46432905	12	M	P							2	1						2			2									
217	45.42472957	-89.46433245	18.5	M	R					3																					
218	45.42436954	-89.46433586	22			DEEP																									
219	45.4240095	-89.46433926	20	M	R														1					1							
220	45.42364947	-89.46434267	22			DEEP																									
221	45.42328944	-89.46434607	26.5			DEEP																									
222	45.4229294	-89.46434948	19.5	M	R														2												
223	45.42256937	-89.46435288	19	M	R																										
224	45.42220933	-89.46435629	15	M	P							2	1																		
225	45.42724741	-89.46379731	6.5	R	P																						1				
226	45.42688738	-89.46380072	16.5	M	P							2							1					1							
227	45.42652735	-89.46380412	16.5	M	R							1												1							
228	45.42616731	-89.46380753	17.5	M	R														1												
229	45.42580728	-89.46381094	14.5	M	P							2	1						1												
230	45.42544724	-89.46381435	14.5	M	P							1																			
231	45.42508721	-89.46381776	12	S	P					1		1	1						1												
232	45.42472717	-89.46382117	17.5	M	R					2									1												
233	45.42436714	-89.46382458	28.5			DEEP																									
234	45.42400711	-89.46382798	30			DEEP																									
235	45.42364707	-89.46383139	29			DEEP																									
236	45.42328704	-89.4638348	25.5			DEEP																									
237	45.422927	-89.46383821	16.5	M	P							1							1						1						
238	45.42256697	-89.46384162	11	M	P																										
239	45.42796508	-89.46327918	3	R	P								1		1																
240	45.42760505	-89.46328259	4	M	P				2				1													1				1	
241	45.42724501	-89.463286	17.5	M	R														1												
242	45.42688498	-89.46328941	27			DEEP																									
243	45.42652494	-89.46329282	22.5			DEEP																									
244	45.42616491	-89.46329624	17.5	M	R					1			1						2												
245	45.42580488	-89.46329965	14	M	P							1	1						1												
246	45.42544484	-89.46330306	13	M	P							1	1						1			2		1							
247	45.42508481	-89.46330647	9	S	P							1	1						1			1		1							
248	45.42472477	-89.46330988	18.5	M	R											1			1												
249	45.42436474	-89.46331329	27			DEEP																									
250	45.4240047	-89.46331671	31			DEEP																									
251	45.42364467	-89.46332012	31			DEEP																									
252	45.42328464	-89.46332353	25.5			DEEP																									
253	45.4229246	-89.46332694	5	R	P										V												V				
254	45.42832271	-89.46276445	5	M	P						2	1	1						1												
255	45.42796268	-89.46276786	6	S	P												2														
256	45.42760264	-89.46277128	11	M	P							2	1						1												
257	45.42724261	-89.46277469	17	M	R														1												
258	45.42688258	-89.46277811	26			DEEP																									
259	45.42652254	-89.46278152	26.5			DEEP																									
260	45.42616251	-89.46278494	23			DEEP																									
261	45.42580247	-89.46278835	17.5	M	R					2			1						1												
262	45.42544244	-89.46279177	12.5	S	P							2							1					1							
263	45.4250824	-89.46279518	11	S	P							2	1						1			2		1							
264	45.42472237	-89.4627986	18.5	M	R											1			1					2							
265	45.42436234	-89.46280201	26			DEEP																									
266	45.4240023	-89.46280543	28			DEEP																									
267	45.42364227	-89.46280884	31.5			DEEP																									
268	45.42328223	-89.46281226	28			DEEP																									
269	45.4229222	-89.46281567	0.5	R	P																										
270	45.42796027	-89.46225655	9.5	M	P																				1						
271	45.42760024	-89.46225997	9	R	P														1					1							
272	45.4272402	-89.46226338	17.5	M	P					2			1						1												
273	45.42688017	-89.4622668	24			DEEP																									
274	45.42652014	-89.46227022	29.5			DEEP																									
275	45.4261601	-89.46227364	26			DEEP																									
276	45.42580007	-89.46227706	18.5	M	R											1			1					1							
277	45.42544003	-89.46228048	15.5	M	P					1			1						1												
278	45.42508	-89.46228389	18	M	R							1							1					2							
279	45.42471996	-89.46228731	17	M	R														1					1							
280	45.42435993	-89.46229073	16.5	M	R							2							1												
281	45.4239999	-89.46229415	15	M	P														1												
282	45.42363986	-89.46229757	17	M	R														2					2							
283	45.42327983	-89.46230098	13.5	S	P							2	1						1					1							
284	45.42291979	-89.4623044	7	M	P														1					1							
285	45.42255976	-89.46230782	2.5		P														1		V									1	
286	45.42759783	-89.46174866	12	S	P							2	1						1												
287	45.4272378	-89.46175208	22.5			DEEP																									
288	45.42687776	-89.4617555	17.5	M	R											1			1					1							
289	45.42651773	-89.46175892	23			DEEP																									
290	45.42615769	-89.46176234	26			DEEP																									
291	45.42579766	-89.46176576	26			DEEP																									
292	45.42543762	-89.46176919	21.5	M	R														2												
293	45.42507759	-89.46177261	16	M	R														1					1							
294	45.42471756	-89.46177603	3	R	P																										
295	45.42759542	-89.46123734	15	M	P							1							1												
296	45.42723538	-89.46124077	23.5			DEEP																									
297	45.42687535	-89.46124419	17.5	M	R								1						2					2							
298	45.42651532	-89.46124762	18.5	M	R											1			2					1							
299	45.42615528	-89.46125104	24.5			DEEP																									
300	45.42579525	-89.46125447	27			DEEP																									
301	45.42543521	-89.46125789	19	M	R								1						1						1						
302	45.42507518	-89.46126132	7	R	P																										
303	45.42759301	-89.46072603	16	M	R					1									2												
304	45.42723297	-89.46072946	23			DEEP																									
305	45.42687294	-89.46073289	21.5	M	R								1						2												
306	45.4265129	-89.46073632	21	M	R														1												
307	45.42615287	-89.46073975	22			DEEP																									
308	45.42579284	-89.46074318	25.5			DEEP																									
309	45.4254328	-89.4607466	16	S	P							1	1						1												

Sampling Point	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Brasenia schreberi, Watershield*	*Chara, Muskgrasses*	*Eleocharis acicularis, Needle spikerush*	*Elodea canadensis, Common waterweed*	*filamentous algae*	*Juncus pelocarpus f. submersus, Brown-fruited rush*	Lobelia dortmanna, Water lobelia	*moss*	*Myriophyllum tenellum, Dwarf water milfoil*	*Najas flexilis, Bushy pondweed*	*Nitella sp., Nitella*	*Nuphar variegata, Spatterdock*	*Nymphaea odorata, White water lily*	*Potamogeton amplifolius, Large-leaf pondweed*	Potamogeton epihydrus, Ribbon-leaf pondweed	Potamogeton pusillus, Small pondweed	Potamogeton robbinsii, Robbins pondweed	Sagittaria sp.	sp1 - Isoetes echinospora, Spiny-spored quillwort	sp2 - Potamogeton sp., Pondweed (stolon only)	sp3 - Sparganium sp., Thick leaved floating bur-reed	Sparganium fluctuans, Floating-leaved bur-reed	Utricularia gibba, Creeping bladderwort
310	45.42507277	-89.46075003	15.5	M	P							2										1			2						
311	45.42759059	-89.46021472	12	M	P							1							1												
312	45.42723056	-89.46021816	13.5	M	P							1										2									
313	45.42687052	-89.46022159	16.5	M	R					2		1	1																		
314	45.42651049	-89.46022502	18	M	R					1		1	1						2												
315	45.42615045	-89.46022845	16.5	M	R														1					2	1						
316	45.42579042	-89.46023188	21	M	R														2												
317	45.42543039	-89.46023531	16	M	R					2														2							
318	45.42507035	-89.46023874	16.5	M	R							1																			
319	45.42830824	-89.45969654	3	M	P							1							1				3		3						
320	45.42794821	-89.45969998	6	M	P							1							1						1						
321	45.42758817	-89.45970341				ROCKS																									
322	45.42722814	-89.45970685	0.5	R	P										V																
323	45.42686811	-89.45971028	1	R	P																										
324	45.42650807	-89.45971372	14	S	P							1							1												
325	45.42614804	-89.45971715	16	M	R					3		1							1												
326	45.425788	-89.45972059	18	S	R							1							1												
327	45.42542797	-89.45972402	16	M	R							2							1					1							
328	45.42614562	-89.45920585	11	M	P																				2						
329	45.42578558	-89.45920929	7	S	P																										
330	45.42650323	-89.45869112	3	M	P						1	1									V	V			1		1				
331	45.4261432	-89.45869456	3	S	P												1														



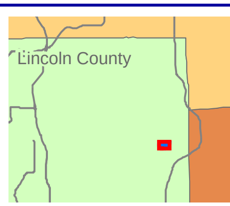
N
W E
S

450

Feet

Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Point-intercept Data: WDNR
Map Date: August 1, 2009
\maps\SvnIsland_substrate_PI.mxd



Extent of large map shown in red.

Legend

Point-intercept Sample Location

Appendix E

Seven Island Lake

Lincoln County, Wisconsin

Point-intercept Sample Locations