

Sand Lake and Little Sand Lake Project Summary

Aquatic Plant/Lake Management and Education Project

Barron County, Wisconsin

WDNR No. AEPP-203-10
SEH No. SLKMD 111066

February 15, 2011

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RE: Aquatic Plant/Lake Management and
Education Project
Sand Lake and Little Sand Lake Project
Summary
Barron County, Wisconsin
WDNR Project No. AEPP-203-10
SEH No. SLKMD 111066

Mr. Jerry Schliemann
Sand Lake Management District
9369 Tewsbury Bend
Maple Grove, MN 55311

Dear Jerry:

The following document is a summary of the Sand Lake and Little Sand Lake Aquatic Plant/Lake Management and Education Project, funded in part by the WDNR AIS Grant AEPP-203-10. This project evaluated activities undertaken as part of an existing Aquatic Plant Management (APM) Plan from which a new APM Plan for Sand Lake was developed with a focus on controlling Eurasian watermilfoil. Aquatic plant point-intercept surveys and reports have been completed by Endangered Resources Services, LLC for both lakes. Sociological surveys were conducted to evaluate lake use and user perceptions and identify educational opportunities. A shoreline status survey and nearshore land use inventory has been completed and the Barron County Soil and Water Conservation Department completed a watershed-scale land use evaluation. Basic nonpoint source modeling was completed using the WiLMS to estimate the phosphorus load contributed by the nearshore area. The information collected was used to make recommendations for plant and lake management, assessment, and monitoring to begin in 2011.

Please contact me if you have any questions or concerns.

Sincerely,

David L. Blumer
Lake Scientist

jam

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Aquatic Plant/Lake Management and Education Project
Barron County, Wisconsin

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Sand Lake and Little Sand Lake Project Summary

Aquatic Plant/Lake Management and Education Project

Prepared for the Sand Lake Management District

1.0 Introduction

Sand Lake (WBIC 2661100) is a hard water drainage lake in northwestern Barron County, about seven miles northwest of Cumberland, Wisconsin (Figure 1). Sand Lake, which is the headwaters to Sand Creek, is fed by intermittent streams at the north and south ends of the lake. The water level is controlled by a 2 foot dam owned by the Town of Maple Plain at the Sand Creek outlet. According to the 2005 Wisconsin Lakes bulletin, Sand Lake is 322 acres and up to 57 feet deep. Using GIS and 2008 6-inch resolution orthophotos, the lake area was recalculated to be 342 acres.

Eurasian watermilfoil (EWM) was discovered in Sand Lake in 2002 near the public boat access. The infested area was relatively small and it was thought that scuba diving and physical removal would provide sufficient containment of EWM. In 2004 it became evident that scuba diving was not the solution to the problem; EWM had spread to cover more than 30 acres. In response to the expansion of EWM, the Sand Lake Management District (SLMD) was formed specifically to address current and future EWM management needs. Formal Aquatic Plant Management (APM) planning was initiated in 2005 and an APM Plan was completed in 2006. Since that time, EWM management in Sand Lake has focused on a great deal of spot treatment combined with limited larger-scale treatment with granular 2,4-D. Although this routine was not specifically laid out in the 2006 APM Plan, this management method has been effective in Sand Lake as the total area of EWM has declined to about 10 acres in 2010.

The SLMD applied for and was awarded an Aquatic Invasive Species Education, Prevention and Planning Grant in the fall of 2009. The Little Sand Lakeshore Association (LSLA) was a key partner in this project. The project tasks included updating the Sand Lake Aquatic Plant Management Plan and gaining a better understanding of the watershed. The APM Plan was due for a recommended five-year update. The update was required to include applied management activities not covered in the 2005 plan (i.e., spot treatments). Information about the watershed was collected to begin exploring the possibility of expanding lake management activities to include watershed management.

The specific tasks for this project were as follows:

1. Spring and summer aquatic plant point-intercept surveys on both lakes and Eurasian watermilfoil bed mapping on Sand Lake;
2. Expanded water quality monitoring on both lakes and DO/temp meter purchase;
3. Shoreline inventory survey and determining corresponding near-shore runoff coefficients;

-
4. Watershed evaluation in partnership with Barron County SWCD;
 5. Lake user education, including implementation of Clean Boats Clean Waters, AIS monitoring, a lake fair, and new boat landing signage;
 6. Sociological survey of riparians and local community.

This document serves as an end of project summary and includes recommendations for expanding management activities to encompass the entire watershed.

2.0 Aquatic Plant Surveys

A number of plant surveys were conducted during this project in both Sand Lake and Little Sand Lake. The surveys were completed by Endangered Resource Services, LLC (St. Croix Falls, WI) following established WDNR protocols. In Sand Lake, pre- and post-treatment and a whole-lake point intercept surveys were completed. In Little Sand Lake, an early season (spring) curly-leaf pondweed survey and mid-season (summer) whole-lake point intercept survey were completed. Both lakes were found to have Coefficients of Conservatism and Floristic Quality Indices above the North Central Hardwood Forest Ecoregion averages. Brief summaries of each survey are presented below, and copies of the full survey reports have been submitted to the SLMD, the LSLA, and the WDNR.

2.1 Sand Lake 2010 Pre- and Post-Treatment Surveys (Berg, 2010a)

An initial assessment of the proposed EWM treatment areas and a pre herbicide treatment survey were conducted on May 16, 2010. A post herbicide treatment survey was conducted on July 16, 2010. The surveys were conducted at 133 sample points located throughout the treatment areas. All sample points with plants occurred in areas between 1.0 and 15.5 feet of water with the mean depth of 7.25 feet and a median depth of 7.00 feet in the pre-treatment survey. Plants were found in slightly shallower water during the July post-treatment survey. The mean depth of plant growth decreased slightly to 7.18 feet and the median dropped to 6.50 feet. Most EWM was established over organic muck in sheltered bays, but was also found on sandy-muck and sand in more open parts of the lake. Diversity within the areas was moderately high with an initial Simpson's Index of 0.86 and a similar post treatment value of 0.88. Mean native species richness was 2.75 per site pre-treatment, and increased to 2.95 per site post-treatment. Total rake fullness also increased slightly from 2.02 pre-treatment to 2.22 post-treatment.

A fall EWM bed mapping survey was conducted on October 2, 2010 and the resulting maps and bed descriptions were used to determine spring 2011 treatment areas and rates. The spring 2011 treatment is contingent upon a pre-treatment bed survey.

2.2 Sand Lake 2010 Warm Water Aquatic Plant Survey (Berg, 2010b)

ERS conducted a warm water aquatic plant survey on July 21-22, 2010 using the WDNR point intercept survey protocol. The established protocol allows for the spatial and temporal comparison of data within and between lakes. The survey provided benchmark data to measure possible impacts of EWM and subsequent management on the lake's native macrophyte populations. The survey found macrophytes at 221 of the 931 total survey sites. Forty-five total species were found growing in and immediately adjacent to the lake. The average Coefficient of Conservatism for the 29 native index species found in the lake was 5.9, which resulted in a Floristic Quality Index of 31.8. Coontail (*Ceratophyllum demersum*), flat-stem pondweed (*Potamogeton zosteriformis*), northern watermilfoil (*Myriophyllum sibiricum*) and small pondweed (*Potamogeton pusillus*) were the most common species and were found at 56.56%, 47.96%, 38.46% and 28.05% of survey points with vegetation,

respectively. Three exotic invasive species, Eurasian watermilfoil (*Myriophyllum spicatum*), purple loosestrife (*Lythrum salicaria*), and reed canary grass (*Phalaris arundinacea*), were also found in the lake, although none were common. EWM was identified at five survey points and had a relative frequency of 0.65 and a mean rake fullness of 1.60.

2.3 Little Sand Lake 2010 Curly-Leaf Pondweed and Warm Water Surveys (Berg, 2010c)

The LSLA began assembling the information required to develop an APM Plan for Little Sand Lake as part of this project. A CLP survey was completed on May 19, 2010 and a whole-lake point intercept survey from July 14-16, 2010. The surveys were completed to determine if AIS had invaded Little Sand Lake and to establish baseline data on the richness, diversity, abundance, and distribution of native aquatic plant populations. Neither survey found evidence of CLP, EWM or any other exotic species with the exception of reed canary grass (*Phalaris arundinacea*) which was scattered along the margin of the lake.

The full point intercept survey found aquatic macrophytes at 121 of the 351 survey points (34.5%) and identified a total of 45 plants to species growing in and immediately adjacent to the lake. During the May survey, the littoral zone was to depths of 12 feet, and by the July survey had extended to depths up to 13.5 feet. The 28 native index species found in the lake produced a mean Coefficient of Conservatism of 6.9 and resulted in a Floristic Quality Index of 36.7. *Nitella* (*Nitella* sp.), northern naiad (*Najas gracillima*), slender waterweed (*Elodea nuttallii*), and watershield (*Brasenia schreberi*) were the most common species and were found at 38.02%, 33.06%, 28.93%, and 28.10% of survey points with vegetation, respectively.

3.0 Sociological Lake User Survey

In July 2010, a lake user survey was distributed to property owners on Sand Lake and Little Sand Lake. The surveys were reviewed and approved by the WDNR before being initiated. The Sand Lake survey focused on management activities that have been completed since 2005 (when a previous survey was conducted) with an objective of determining management and educational priorities and opportunities. The response rate for the Sand Lake survey was 42.6% (81/190), somewhat lower than the 53% (81/153) response rate of the 2005 survey. The survey collected information regarding lake stewardship, aquatic plants and AIS, and determined lake user and property owner awareness of current and potential EWM management efforts. A summary of the Sand Lake survey results and a comparison with the 2005 survey can be found in Appendix B of the 2010 Sand Lake APM Plan.

The Little Sand Lake survey focused on current lake use preferences and perceptions, and knowledge of lake regulations and aquatic invasive species. The survey was delivered to 16 property owners and nine (56%) were returned. A summary of the Little Sand Lake survey can be found in Appendix B of this document.

4.0 Shoreline Inventory

Although residential areas only make up a small percentage of the total land use in the Sand Lake watershed, the residential areas are concentrated around the lake. Development replaces the natural landscape with buildings, roads, driveways and lawns which prevent rainwater and snowmelt from slowly infiltrating into the ground. The increased runoff carries with it sediment, pollutants, and nutrients which can lead to poor water quality and can fuel algae growth. Nutrients and pollutants are also supplied by the fertilizers, pesticides and septic systems associated with development.

The condition of the shoreline and the nearshore (within 200 feet of the lake) land uses were assessed to evaluate the impact the nearshore area has on water quality in Sand Lake. The surveys also located those areas where conservation and restoration activities should be implemented. The immediate shoreline was visually inspected via boat during the summer of 2010. A GPS was used to mark the location of severe to moderate erosion and to delimit the extent of different types of shoreline cover (e.g. lawn, forest, herbaceous). The presence of riprap, shoreland buffers, and emergent aquatic vegetation was also recorded.

The land use in the nearshore area was assessed using recent high resolution (6-inch) orthophotos and GIS. Land use was classified as disturbed (lawn, impervious surface) or natural (forest, wetland). The land use data was input into the Wisconsin Lake Modeling Suite (WiLMS) (Panuska and Kreider, 2002) to estimate the nutrient loading to Sand Lake from the nearshore area. Loading from septic systems in the nearshore area was estimated from the septic system usage data, which was collected for both permanent and seasonal dwellings as part of the sociological survey, and from the number of nearshore dwellings, which were identified during the nearshore analysis.

The annual loading coefficients used in the WiLMS analysis were 0.52 kilograms per hectare (kg/ha) for developed lands, 0.10 kg/ha for wetlands, and 0.09 kg/ha forests. Septic tank output was estimated at 0.50 kg per capita-year and the total capita-years was estimated to be 116.1 (32 year-round dwellings with 3 people for 272 days and 100 seasonal dwellings with 3.7 people for 79 days). It was assumed that 80% of the septic system load was retained by the nearshore soils which are primarily well-drained sandy loams.

There has been an increase in development around the lake since a survey was completed in 1996 when 137 dwellings, 35 lawns, and 17 shoreland protection structures were identified around Sand Lake. In 2010, 223 structures were identified in the nearshore area, of which 147 appear to be dwellings and the remaining 76 appear to be garages, boathouses and other outbuildings. The number of lawns along the shoreline and shoreland protection structures increased to 42 continuous lawns and 29 protection structures (riprap). A summary of the shoreline condition found around Sand Lake in 2010 is presented in Table 1.

**Table 1
Shoreline Conditions of Sand Lake in 2010**

Shoreline Condition	Length (feet)	Length (miles)	Percent of Total Shoreline
Lawn bare	7,486	1.4	20.7
Lawn buffered	1,310	.2	3.6
Impervious	40	.01	.1
Forest	25,632	4.9	71.0
Shrub/wetland	1,652	.3	4.6
TOTAL	36,120	6.8	100.0
Other shoreline features			
Erosion	413	.1	1.1
Emergent Aquatic Veg.	8,956	1.7	24.8
Riprap	4,671	.9	12.9

Erosion is prevalent around Sand Lake (Figure 2). This is primarily due to steep shorelines but is compounded by the presence of lawns and impervious surfaces. Photographs of severe

gully erosion in the northwest part of the lake (marked with an arrow in Figure 2) can be found in Appendix C. The erosion occurred during large rain events in July and August 2010 and led to the infilling of the nearshore area. Due to the severity of this erosion, stabilization and mitigation techniques should be implemented immediately.

Nearly 25% (1.6 miles) of the 6.8-mile shoreline consists of lawns, and less than 15% of that (0.2 mile) is buffered lawn. The 11 buffers identified during the survey averaged about 10 feet wide, far smaller than the recommended 35-foot shoreland buffer between the lake and lawn, and the widest buffer was estimated to be only 25 feet wide. Lawns lacking buffers are shown in Figure 2. Emergent aquatic vegetation was more common adjacent to natural and buffered shorelines than shorelines comprised of bare lawn.

Developed landscapes (lawns and impervious surfaces) make up approximately 14% (22 acres) of the 161-acre nearshore area (Figure 2). This value is considered conservative because driveways and lawns are often obscured by tree cover in aerial photography. The majority of the nearshore area is forested (85.6% or 138 acres) and there are two wetlands covering a total of 1.2 acres (less than 1%) of the nearshore area along the northern part of the lake.

According to a WiLMS analysis, the most likely annual phosphorus contribution to the lake from the nearshore area is estimated to be 49 pounds. The majority of the nearshore phosphorus load is from septic systems, which account for 54.5% (26 pounds) of the total phosphorus load. Although developed lands only cover 22 acres of the nearshore area and forest lands cover 138 acres, each land use contributes 22.7% (11 pounds) of the phosphorus load. The contribution of phosphorus to the lake by wetlands was estimated to be insignificant.

The phosphorus load from septic systems may be over-estimated. Muldoon and others (1999) identified a perched water-table in the uplands around Sand Lake. Because of the perched water-table, it is possible that some of the on-site waste water treatment systems are not hydrologically connected to the lake and therefore have no impact on lake water quality. At this time, the groundwater system of the Sand Lake area is not well understood.

5.0 Watershed Evaluation

According to a land use evaluation by the Barron County Soil & Water Conservation Department (SWCD), the land cover in the Sand Lake watershed is primarily forests which make up 61% of the 6,763-acre watershed, followed by agricultural (row crops, pasture, etc.) which cover 15% of the land surface (Table 2). The remainder of the land use is classified as lakes, streams and wetlands (20%), and residential areas (4%). Figure 3 shows the distribution of land uses in the watershed. Note the concentration of residential areas around Sand Lake and Little Sand Lake and that although agricultural land use has decreased from 22% of the watershed in 1964, the agricultural areas are generally located adjacent to stream channels draining to the lakes.

The SWCD also identified over 30 acres of agricultural land where buffers and (or) grassed waterways would be beneficial to water quality in the watershed (Figure 4). These areas are primarily located at the edge of field or act as waterways for spring runoff and during large rain events. Best management practices in these areas will not only slow runoff and increase infiltration, but will also utilize excess nutrients carried by the runoff.

Table 2
Land Use Distribution in the Sand Lake Watershed

Land Use	Little Sand Lake Subbasin		Sand Lake Subbasin		Entire Watershed ^a	
	Area (acres)	Percent	Area (acres)	Percent	Area (acres)	Percent
Developed	70	3.0	218	5.0	288	4.3
Agriculture	454	19.2	554	12.6	1,008	14.9
Forest	1,400	59.1	2,747	62.5	4,147	61.3
Wetland	297	12.5	336	7.6	633	9.4
Open Water	147	6.2	541 ^b	12.3	688	10.2
TOTAL	2,368	100.0	4,395	100.0	6,763	100.0

^a Not including area draining to Little Bass Lake (283 acres).

^b Including Sand Lake (342 acres).

6.0 Lake Water Quality Monitoring

Volunteers on Sand Lake and Little Sand Lake collected water quality samples and measured water clarity (Secchi depth) along with temperature and dissolved oxygen profiles on both lakes throughout this project. A Hach HQ30d water quality sonde was purchased for the SLMD and the LSLA to collect temperature and dissolved oxygen profiles. Water quality samples were sent to the Wisconsin State Lab of Hygiene (SLOH) for analysis. All lab and field data were entered into the SWIMS database.

Samples were collected from three sites on Sand Lake (Deep Hole, North Basin, Central Basin) and analyzed for concentrations of total phosphorus, dissolved reactive phosphorus, total Kjeldahl nitrogen, nitrate + nitrite, ammonia, and chlorophyll *a* (Figure 1). Samples were collected from the Deep Hole site in Little Sand Lake and were analyzed for total phosphorus, total Kjeldahl nitrogen, and chlorophyll *a* (Figure 1). Secchi depths were measured at the Deep Hole sites on each lake and temperature and dissolved oxygen profiles were measured at all sites.

These water quality parameters provide information on lake trophic status, the nutrient limiting production in the lake, potential sources of nutrients, and in-lake nutrient release and dynamics. The information further develops datasets that can be used for analysis trends and establishment of baseline conditions. In 2010, phosphorus appeared to be the nutrient likely limiting plant growth in both Sand Lake and Little Sand Lakes with N:P ratios of approximately 18:1 and 26:1, respectively. The summer chlorophyll *a* Trophic State Index for Sand Lake is often in the mid to upper 40s, which is near eutrophic levels and in the upper 50s for Little Sand Lake, indicating eutrophic conditions. A summary of water quality conditions in Sand Lake can be found in the 2010 Sand Lake APM Plan and Citizen Lake Monitoring Network water quality reports can be found in Appendix A.

7.0 Sand Lake Aquatic Plant Management Plan Update

The previous Sand Lake APM Plan was written in 2005 and approved by the state at that time, but did not include what the WDNR considers adequate detail about the spot treatment management strategy. The WDNR indicated that a revised APM plan that includes the spot treatment approach is needed to continue with this management strategy. The Sand Lake

APM Plan was updated during this project and submitted to the WDNR for review in December 2010. The APM Plan covers aquatic plant management activities in Sand Lake for the next five years and will be implemented beginning in 2011 following WDNR approval.

There are seven management goals outlined and described in the APM Plan:

- Manage Eurasian watermilfoil in the lake;
- Control and manage other AIS in and around the lake;
- Provide AIS education and prevention planning;
- Monitor water quality in the lake;
- Promote shoreland best management practices;
- Preserve, enhance and protect native species in and around the lake;
- Continue to evaluate aquatic plant and lake management activities.

The Sand Lake APM Plan includes a comparison of the 2003 through 2009 and 2010 aquatic plant survey data, an AIS management plan for EWM, purple loosestrife, Japanese knotweed, and other potential threats, an evaluation of existing lake and watershed characteristics, including water quality, fishery and wildlife information, a review of all possible EWM management alternatives, and a review of past, current, and future management activities.

The APM Plan provides a five-year timeline of recommended activities and is intended to be a fluid document that may be modified following annual review, subsequent of approval by the SLMD and WDNR.

8.0 Recommendations

Recommendations primarily focused on plant management can be found in the 2010 APM Plan. Based on information collected during this project, there are also a number of activities throughout the watershed that can be done to protect and improve water quality in Sand Lake. The SLMD should complete a Comprehensive Lake Management Plan that will cover management activities throughout the Sand Lake watershed. To complete such a plan, more information on the hydrology and water quality in the watershed is required as only a basic understanding currently exists. The SLMD should work closely with the Little Sand Lakeshore Association and other partners when developing and implementing a Comprehensive Management Plan.

Recommendations for future activities include:

1. Limit the impact of riparian properties on the lake. This can be accomplished by maintaining a natural landscape with native plants in the nearshore area, leaving or maintaining at least 35 feet of buffer strips, limiting the amount of impervious areas (e.g. driveways, sidewalks, and rooftops), installing rain gardens and leaving woody vegetation and debris in the nearshore area. Locations lacking shoreland buffers can be found in Figure 2.
2. Enforce shoreland zoning regulations for all future development and alert new residents of local laws to prevent violations and conflict. Establish new lawns in areas that will have the least impact on water quality (e.g., on slopes that do not terminate at the lake, in locations with flat areas or buffer zones between the lawn and lake). Runoff Best Management Practices (BMPs) should be implemented throughout the watershed.
3. The SLMD should inventory woody debris present along and near the shoreline of the lake. Coarse woody debris (CWD), such as trees and logs, are an important but often

neglected component of lake ecosystems. Due to lakeshore development, CWD in lakes has been in decline, which is known to have negative impacts on fisheries and other wildlife. Riparian landowners should be presented with information on the importance of CWD to the lake ecosystem. Following the survey, the management actions regarding CWD should be evaluated. Partnerships to be pursued for this activity include the WDNR and Walleyes Forever.

4. Areas of severe erosion along the shoreline should be restored and (or) Best Management Practices implemented to mitigate erosion. These areas include gullies along the nearshore area due to steep topography and shoreline erosion due to the absence of buffers and aquatic vegetation (Figure 2). Of particular note is gully erosion causing in-filling of the nearshore area in the northwest part of the lake.
5. Due to the proximity of agricultural land use to tributaries of Sand Lake (Figure 3), BMPs, such as grassed waterways and buffer strips, should be implemented. The SLMD should work with the Barron County SWCD to provide education and information to agricultural landowners in the watershed. Nutrient management planning should be pursued if not already in action. Some areas of special concern were identified during this project (Figure 4) and can be expanded upon during plan development.
6. Monitor the water quality of the lake and of the streams, wetlands, and intermittent/ephemeral channels tributary to the lake to gain a better understanding of the hydrology and water quality of the watershed. Correspond the sampling with flow monitoring so the data can be used to develop hydrologic and nutrient budgets for the Sand Lake system. To identify baseline conditions in the watershed, streamflow and water quality monitoring should be completed over a two-year period. During that time, sample tributaries and the lake outflow twice a month and during runoff events throughout the ice-free period for major nutrients, chloride, and total suspended solids. Measure daily flow using continuous stage recorders and stage-discharge relationships.
7. Nearly 80% of the property owners around Sand Lake have on-site waste water treatment (either drain field or septic tank), but there is only a very basic understanding of groundwater in the Sand Lake system. Conduct investigations to determine the hydrogeology of the system, including groundwater quality and flow, and surface water-groundwater interactions in the Sand Lake watershed. Practice preventative care and encourage riparian landowners to test and update septic systems.
8. Identify target nutrient concentrations through paleocore analysis and lake nutrient response modeling.
9. Develop a watershed hydrologic model to evaluate management options. A watershed-scale model such as the Soil and Water Assessment Tool can be developed from the information collected above and used to quantify the impact of land management in the watershed.

Implementation of these recommendations should begin as soon as possible. Items 1 through 4 above can be implemented with little or no cost to the SLMD and items 5 through 9 will require a source of funding and resource professionals to complete. Funding for all of the recommendations listed above and for many of the recommendations in the 2010 APM plan is available through the WDNR Lake Management and AIS Control Grant Programs, funding to control erosion and install runoff BMPs can be sought from the Targeted Runoff Management Grant programs, and the SLMD, as a lake district, can pursue funding via fees or a tax levy.

9.0 References

- Berg, M.S., 2010a. Eurasian water milfoil (*Myriophyllum spicatum*) Pre/Post Herbicide Surveys and Fall Bed Mapping Sand Lake - Barron County, Wisconsin WBIC: 2661100. 95 p.
- Berg, M.S., 2010b. Warm Water Point Intercept Aquatic Macrophyte Survey Sand Lake - WBIC: 2661100 Barron County, Wisconsin. 96 p.
- Berg, M.S., 2010c. Curly-leaf Pondweed and Full Warm Water Point/Intercept Macrophyte Surveys Little Sand Lake (WBIC: 2661600) Barron County, Wisconsin. 96 p.
- Panuska, J.C., and Kreider, J.C., 2002, Wisconsin lake modeling suite program documentation and user's manual, Version 3.3 for Windows: Wisconsin Department of Natural Resources PUBL-WR-363-94, 32 p. Available at: <http://www.dnr.state.wi.us/lakes/model/> (accessed February 8, 2011).

List of Figures

Figure 1 – Project Location and Sample Sites

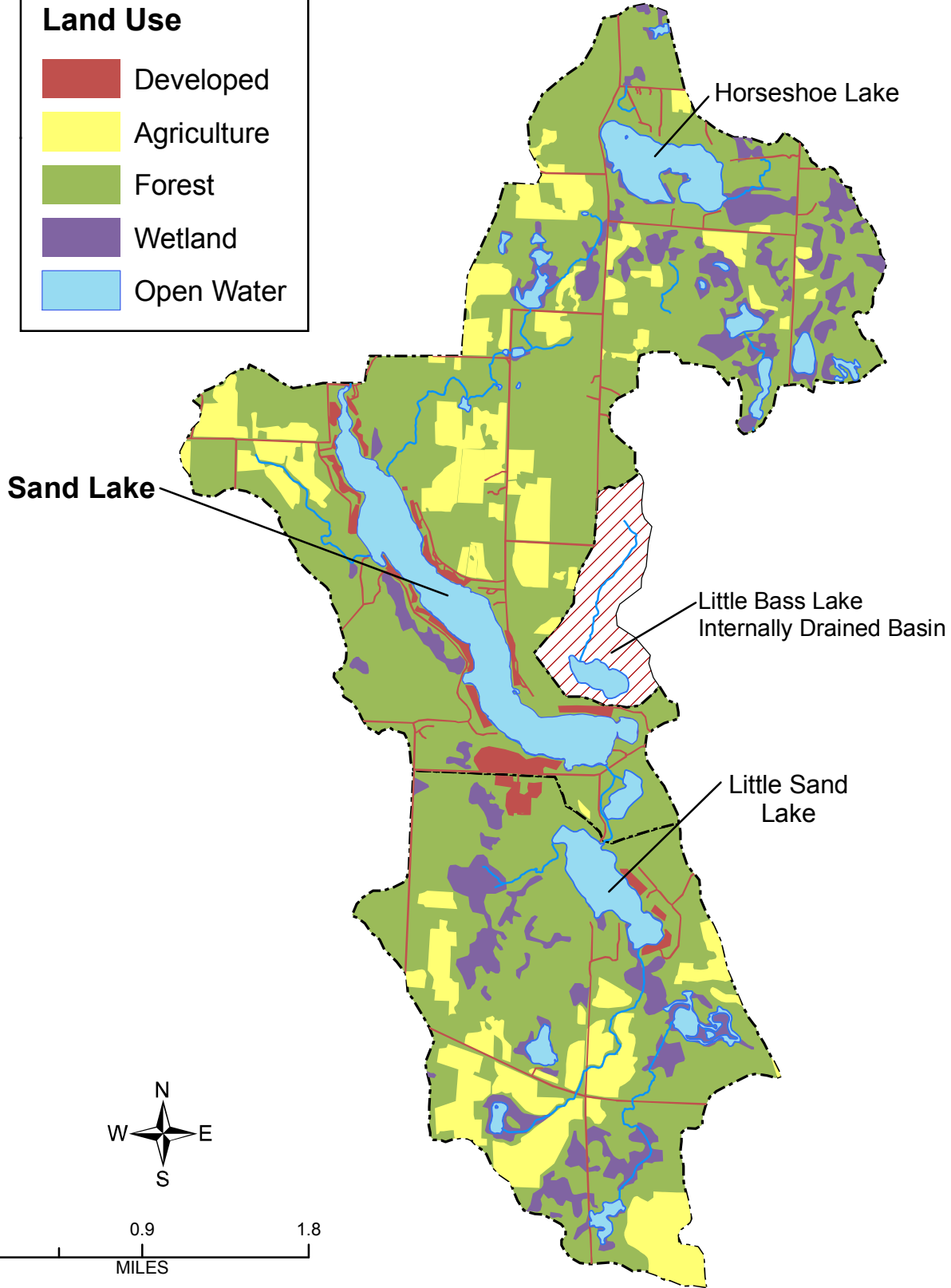
Figure 2 – 2010 Nearshore Land Use

Figure 3 – Sand Lake Watershed Land Use, 2010

Figure 4 – Potential Agricultural BMPs

**EXPLANATION
Land Use**

- Developed
- Agriculture
- Forest
- Wetland
- Open Water



Map Document P:\PT\GIS\kmd\Common\ArcGIS\ArcMaps\Sand Lake 2010 Nearshore Land Use.mxd
2/4/2011 -- 11:14 AM



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Project: SLKMD 111066
Print Date: 2/4/2011
Map by: JAM
Projection: NAD 83 Wisconsin TM
Source: Barron County SWCD

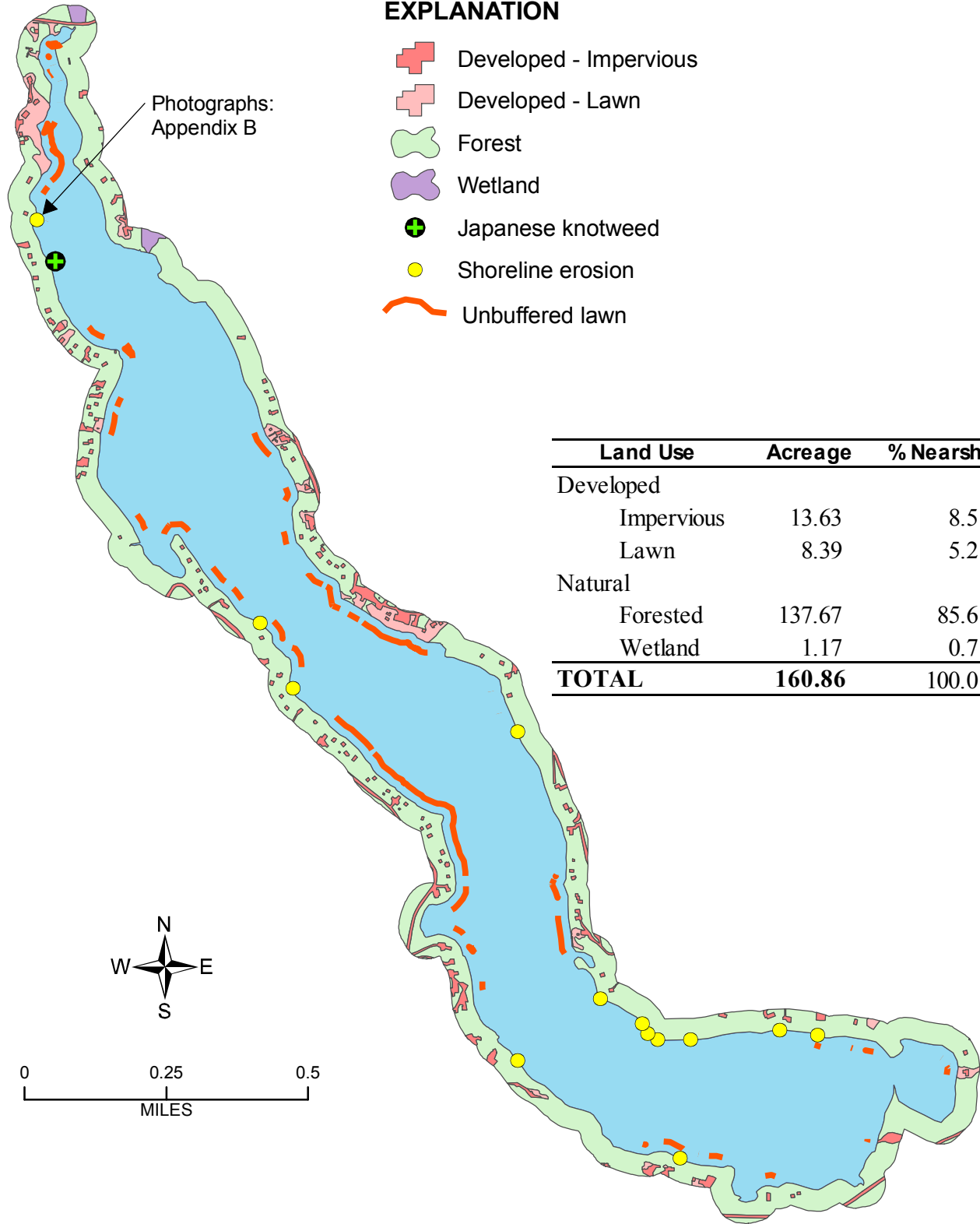
Sand Lake Watershed Land Use, 2010
Sand Lake
Barron County, Wisconsin

Figure
3

This map is neither a legally recorded map nor a survey map and is not intended to be used as one. This map is a compilation of records, information, and data gathered from various sources listed on this map and is to be used for reference purposes only. SEH does not warrant that the Geographic Information System (GIS) Data used to prepare this map are error free, and SEH does not represent that the GIS Data can be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features. The user of this map acknowledges that SEH shall not be liable for any damages which arise out of the user's access or use of data provided.

EXPLANATION

-  Developed - Impervious
-  Developed - Lawn
-  Forest
-  Wetland
-  Japanese knotweed
- Shoreline erosion
-  Unbuffered lawn



Land Use	Acreeage	% Nearshore
Developed		
Impervious	13.63	8.5
Lawn	8.39	5.2
Natural		
Forested	137.67	85.6
Wetland	1.17	0.7
TOTAL	160.86	100.0

Map Document P:\PT\GIS\kmd\Common\ArcGIS\Map\Sand Lake 2010 Nearshore Land Use.mxd
2/4/2011 -- 11:14 AM



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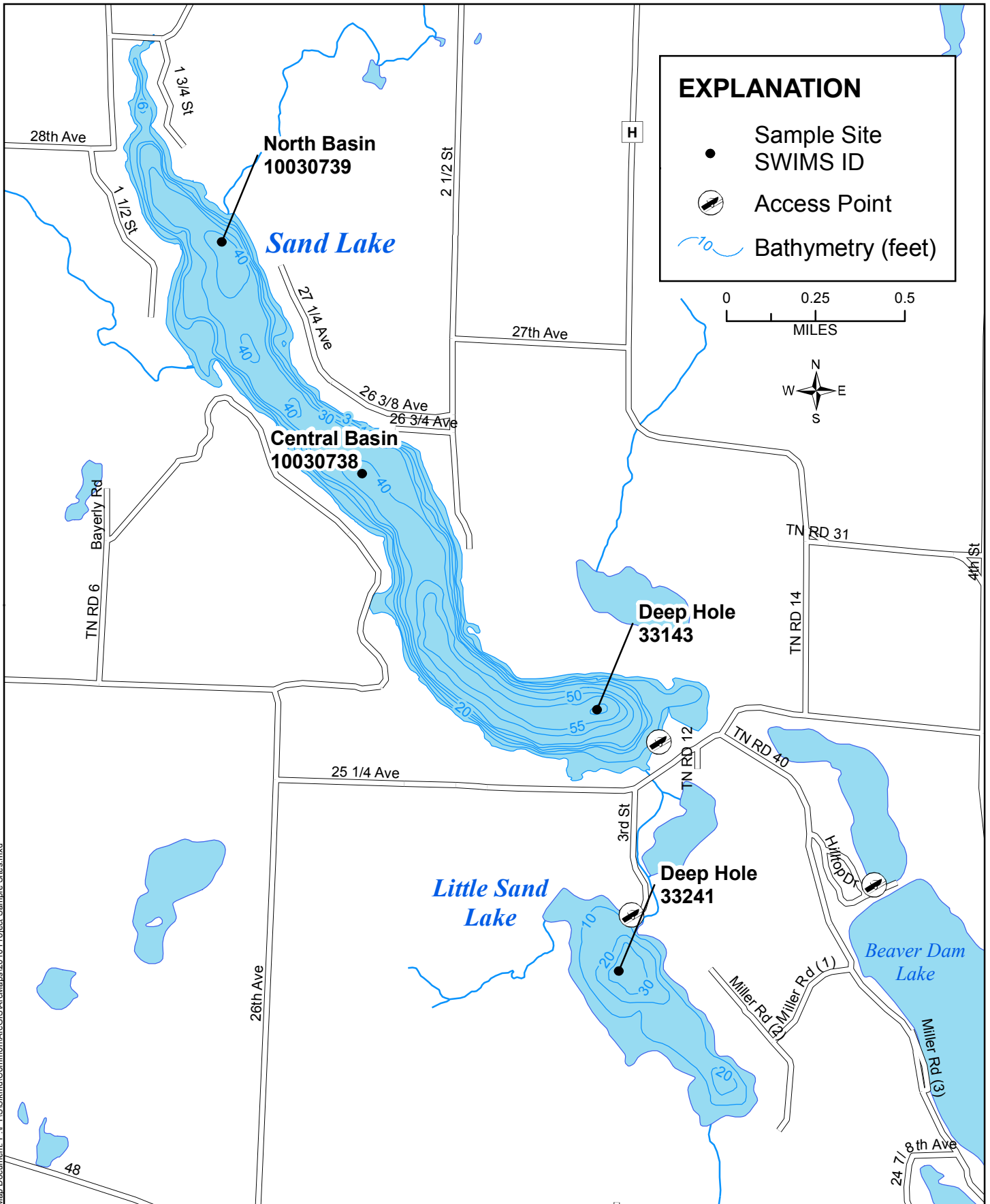
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Projection: NAD 83 Wisconsin TM
Source: Barron County



2010 Nearshore Land Use
Sand Lake
Barron County, Wisconsin

Figure
2

This map is neither a legally recorded map nor a survey map and is not intended to be used as one. This map is a compilation of records, information, and data gathered from various sources listed on this map and is to be used for reference purposes only. SEH does not warrant that the Geographic Information System (GIS) Data used to prepare this map are error free, and SEH does not represent that the GIS Data can be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features. The user of this map acknowledges that SEH shall not be liable for any damages which arise out of the user's access or use of data provided.



Map Document: P:\PT\S\slkmdl\Common\ArcGIS\ArcMaps\2010 Project Sample Sites.mxd

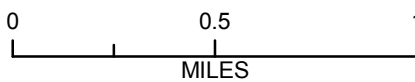
	1701 W. KNAPP ST., SUITE B RICE LAKE, WI 54868 PHONE: 715.236.4000 FAX: 715.234.4069 WATTS: 800.903.6970 www.sehinc.com	Project: SLKMD 111066 Print Date: 2/8/2011 Map by: JAM Projection: NAD 83 Wisconsin TM Source: WDNR, U.S. Census Bureau	<h3>Figure 1</h3> <h2>Sand Lake & Little Sand Lake</h2> <h3>Project Location and 2010 Sample Sites</h3> <h3>Barron County, Wisconsin</h3>	Location 
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This map is neither a legally recorded map nor a survey map and is not intended to be used as one. This map is a compilation of records, information, and data gathered from various sources listed on this map and is to be used for reference purposes only. SEH does not warrant that the Geographic Information System (GIS) Data used to prepare this map are error free, and SEH does not represent that the GIS Data can be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features. The user of this map acknowledges that SEH shall not be liable for any damages which arise out of the user's access or use of data provided.



EXPLANATION

-  Potential Ag Best Management Practice (buffer, grassed waterway, etc.)



1701 WEST KNAPP STREET, SUITE B
RICE LAKE, WI 54868
PHONE: 715.236.4000
FAX: 715.234.4069
WATTS: 800.903.6970
www.sehinc.com

Project: SLKMD 111066
Print Date: 2/7/2011

Map by: JAM
Projection: NAD 83 Wisconsin TM
Source: Barron County SWCD,
WDNR

Potential Agricultural BMPs
Sand Lake
Barron County, Wisconsin

Figure
4

Appendix A

2010 Citizen Lake Monitoring Water Quality Reports

A-1 – Little Sand Lake: Deep Hole

A-2 – Sand Lake: North Basin

A-3 – Sand Lake: Central Basin

A-4 – Sand Lake: Deep Hole

Lake Water Quality 2010 Annual Report

Sand Lake
Barron County
Waterbody ID Number: 2661100

Lake Type: DRAINAGE
DNR Region: NO
GEO Region: NW

Site Name	Station ID
Sand Lake - Central Basin	10030738

Date	SD (feet)	SD (meters)	Hit Bottom?	CHL	TP	TSI (SD)	TSI (Chl)	TSI (TP)	Lake Level	Staff Gauge	Clarity	Color	Perception
05/01/2010					24			53					
06/14/2010				12.6	25		54	53					
07/11/2010				3.23	19		44	51					
08/09/2010				6.25	19		49	51					
10/25/2010				7.8	28		50	54					

07/11/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	78.3	9.85
3	78.5	9.87
6	78.4	9.81
9	78.2	9.76
12	78.1	9.71
15	75.4	11.36
18	68.8	11.23
21	59.8	7.69
24	54.7	1.84
27	52.7	.22
30	51.8	.1
33	51	.07
36	50.2	.05
39	49.7	.03

07/14/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	65.4	10.59
3	65.4	10.61
6	65.3	10.6
9	65.3	10.57
12	65.3	10.54
15	65.2	10.44
18	63.3	8.76
21	57.2	7.41
24	53.3	5.56
27	51.8	3.15
30	50.8	1.5
33	50	.15
36	49.8	.09
39	49.3	.05

08/09/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	82.5	10.13
3	81.1	10.42
6	79.5	10.44
9	78.6	10.37
12	78.1	9.94
15	77	8.4
18	72	5.4
21	65.1	2.63
24	58.3	.2
27	55.8	.14
30	53.2	.06
33	51	.04
36	50.8	.03
39	50.2	.02

10/25/2010		
Depth	Temp.	D.O.
0	54.2	7.47
3	54.2	7.38

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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10/25/2010		
Depth	Temp.	D.O.
6	54.2	7.33
9	54.1	7.29
12	54.2	7.28
15	54.1	7.25
18	54.1	7.23
21	54.1	7.21
24	54.1	7.22
27	54.1	7.2
30	54.1	7.16
33	54.1	7.14
36	54	6.81
39	52.3	.14

Date	Lab Comment
05/01/2010	HOLD TIME EXC'D BY 4 DAYS; NOT ICED OR ICE MELTED
05/01/2010	MATRIX DUPLICATE EXCEEDED; NOT ICED OR ICE MELTED
05/01/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
06/14/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
07/11/2010	MATRIX DUPLICATE QC EXCEEDED
07/11/2010	NOT ICED OR ICE MELTED; HOLD TIME EXC'D BY 2 DAYS
07/11/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
08/09/2010	QC SAMPLE (2ND SOURCE) EXCEEDED QC LIMITS BY 1.0%
08/09/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
10/25/2010	DUPLICATE QC EXCEEDED- RESULT AVG OF 7.11 + 8.48

Date	Data Collectors	Project
05/01/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
06/14/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
07/11/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
07/11/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake - Central Basin
07/14/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake - Central Basin
08/09/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
08/09/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake - Central Basin

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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Date	Data Collectors	Project
10/25/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
10/25/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake - Central Basin

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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Lake Water Quality 2010 Annual Report

Sand Lake
Barron County
Waterbody ID Number: 2661100

Lake Type: DRAINAGE
DNR Region: NO
GEO Region: NW

Site Name	Station ID
Sand Lake - North Basin	10030739

Date	SD (feet)	SD (meters)	Hit Bottom?	CHL	TP	TSI (SD)	TSI (Chl)	TSI (TP)	Lake Level	Staff Gauge	Clarity	Color	Perception
05/01/2010					23			52					
06/14/2010				9.81	22		52	52					
06/14/2010					33			55					
07/11/2010				3.01	16		43	50					
08/09/2010				7.53	18		50	51					
10/25/2010				8.33	25		51	53					

06/14/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	65	10.51
3	65.1	10.51
6	65.2	10.48
9	65.2	10.45
12	65.2	10.38
15	65.2	10.34
18	65.2	10.3
21	59.4	7.03
24	54.4	5.72
27	52.3	3.4
30	50.9	1.27
33	50.1	.11
36	49.7	.06
39	49.2	.05

07/11/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	77	9.91
3	78.3	9.85
6	78.3	9.84
9	78.3	9.78
12	78.1	9.54
15	72.8	11.37
18	67.6	11.17
21	60.9	7.91
24	55	.73
27	53	.18
30	51.8	.1
33	51.1	.09
36	50.4	.09
39	50	.05

08/09/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	83.7	10.17
3	82	10.32
6	79.8	10.35
9	78.4	9.94
12	77.9	9.5
15	77.5	9.1
18	74.6	6.6
21	65.3	2.09
24	59.1	.22
27	56.1	.13
30	53.1	.06
33	51.4	.04
36	50.6	.03
39	50.4	.01

10/25/2010		
Depth	Temp.	D.O.
0	54.1	7.57

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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10/25/2010		
Depth	Temp.	D.O.
3	54.1	7.51
6	54.2	7.45
9	54.2	7.39
12	54.2	7.39
15	54.1	7.33
18	54.1	7.24
21	54.1	7.21
24	54.1	7.19
27	54.1	7.19
30	54.1	7.16
33	54.1	6.92
36	53.9	6.37
39	54	4.99

Date	Lab Comment
05/01/2010	HOLD TIME EXC'D BY 4 DAYS; NOT ICED OR ICE MELTED
05/01/2010	MATRIX DUPLICATE EXCEEDED; NOT ICED OR ICE MELTED
05/01/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
06/14/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
07/11/2010	MATRIX DUPLICATE QC EXCEEDED
07/11/2010	NOT ICED OR ICE MELTED; HOLD TIME EXC'D BY 2 DAYS
07/11/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
08/09/2010	QC SAMPLE (2ND SOURCE) EXCEEDED QC LIMITS BY 1.0%
08/09/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED

Date	Data Collectors	Project
05/01/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
06/14/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
06/14/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake - North Basin
07/11/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
07/11/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake - North Basin
08/09/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
08/09/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake - North Basin

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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Date	Data Collectors	Project
10/25/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
10/25/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake - North Basin

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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Report Generated: 02/09/2011**

Lake Water Quality 2010 Annual Report

Little Sand Lake
 Barron County
 Waterbody ID Number: 2661600

Lake Type: SEEPAGE
 DNR Region: NO
 GEO Region: NW

Site Name	Station ID
Little Sand Lake, Deepest Hole	033241

Date	SD (feet)	SD (meters)	Hit Bottom?	CHL	TP	TSI (SD)	TSI (Chl)	TSI (TP)	Lake Level	Staff Gauge	Clarity	Color	Perception
04/17/2010					38			56					
04/17/2010	5.25	1.6	NO			53			LOW	low	CLEAR	BROWN	2-Very minor aesthetic problems
05/09/2010	5.75	1.7				52			LOW			BROWN	2-Very minor aesthetic problems
05/14/2010	8.75	2.7	NO			46			LOW		CLEAR	BROWN	2-Very minor aesthetic problems
06/09/2010				6.7	24		49	53					
06/09/2010	6.2	1.9				51			LOW		CLEAR	BROWN	2-Very minor aesthetic problems
07/06/2010				15.8	22		56	52					
07/06/2010	5	1.5	NO			54			LOW		MURKY	BROWN	2-Very minor aesthetic problems
08/22/2010				27.3	35		60	56					
08/22/2010	3	.9				61			LOW		MURKY	BROWN	3-Enjoyment somewhat impaired (algae)
10/10/2010				42.9	54		63	59					

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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Report Generated: 02/09/2011

04/17/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	55.1	9.94
3	54.4	10.08
6	54	10.11
9	53.8	10.1
12	53.5	10.08
15	53.4	10.05
18	53.3	10.01
21	51.7	8.43
24	51.2	7.82
27	49.4	6.12
29	48.9	5.71

05/14/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
3	55.7	9.31
6	54.3	9.46
9	54.2	9.43
12	54.7	9.46
15	54.1	9.39
18	54.1	9.37
21	54.1	9.32
24	53.9	9.15

06/09/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
3	68.3	8.68
6	68.5	8.59
9	68.4	8.46
12	63.3	6.28
15	57	4.55
18	55.3	2.01
21	54.2	.84
24	53.4	.43
27	52.2	.09
30	50.5	.04
33	49.6	.03
36	49.2	.02

07/06/2010		
Depth	Temp.	D.O.
3	77.9	9.54
6	77.9	9.43
9	76.6	8.4
12	71.8	3.69
15	64.1	.019
18	59.9	.11
21	56.3	.05
24	54.5	.04
27	52.9	.03
30	52	.02
33	51	.01
36	50.5	.01

08/22/2010		
Depth	Temp.	D.O.
3	75.9	8.88
6	75.8	8.86
9	75.3	8.43
12	73.5	4.86
15	71.6	.15
18	68.6	.09
21	62.2	.05
23	57.7	.03
26	55.4	.02
30	53.2	.02
33	52.4	.01

Date	Fieldwork Comment
04/17/2010	don cook bob carlson dan hollihan kevin larson dave blumer
05/09/2010	Temp 55 F Wind calm.
06/09/2010	1.5 inches of rain in the last 3 days

Date	Lab Comment
04/17/2010	REC'D ICE MELTED- MATRIX DUPLICATE Q.C. EXCEEDED
04/17/2010	SAMPLE RECEIVED WITH ICE MELTED

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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Date	Lab Comment
06/09/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
07/06/2010	NOT ICED OR ICE MELTED; LRB EXCEEDED BY 0.03
07/06/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
08/22/2010	NOT ICED OR ICE MELTED; HOLD TIME EXC'D BY 2 DAYS
08/22/2010	NOT ICED OR ICE MELTED; HOLD TIME EXC'D BY 3 DAYS
08/22/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
10/10/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED

Date	Data Collectors	Project
04/17/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
04/17/2010	Dave Christensen	Citizen Lake Monitoring - Water Quality - Little Sand Lake; Deep Hole
05/09/2010	Robert Carlson	Citizen Lake Monitoring - Water Quality - Little Sand Lake; Deep Hole
05/14/2010	Dave Christensen	Citizen Lake Monitoring - Water Quality - Little Sand Lake; Deep Hole
06/09/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
06/09/2010	Dave Christensen	Citizen Lake Monitoring - Water Quality - Little Sand Lake; Deep Hole
07/06/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
07/06/2010	Dave Christensen	Citizen Lake Monitoring - Water Quality - Little Sand Lake; Deep Hole
08/22/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
08/22/2010	Dave Christensen	Citizen Lake Monitoring - Water Quality - Little Sand Lake; Deep Hole
10/10/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

**Wisconsin Department of Natural Resources * Wisconsin Lakes Partnership
Report Generated: 02/09/2011**

Lake Water Quality 2010 Annual Report

Sand Lake
Barron County
Waterbody ID Number: 2661100

Lake Type: DRAINAGE
DNR Region: NO
GEO Region: NW

Site Name	Station ID
Sand Lake - Near Deepest Pt	033143

Date	SD (feet)	SD (meters)	Hit Bottom?	CHL	TP	TSI (SD)	TSI (Chl)	TSI (TP)	Lake Level	Staff Gauge	Clarity	Color	Perception
04/15/2010	7.5	2.3	NO			48			NORMAL		MURKY	GREEN	3-Enjoyment somewhat impaired (algae)
05/09/2010	9	2.7	NO			45			NORMAL		MURKY	BROWN	3-Enjoyment somewhat impaired (algae)
05/19/2010	11	3.3	NO		22	43		52	NORMAL		MURKY	BROWN	3-Enjoyment somewhat impaired (algae)
05/27/2010	13	4	NO			40			NORMAL		MURKY	GREEN	3-Enjoyment somewhat impaired (algae)
06/02/2010	12	3.6	NO			41			NORMAL		MURKY	GREEN	3-Enjoyment somewhat impaired (algae)
06/07/2010	14	4.3	NO			39			NORMAL		MURKY	GREEN	2-Very minor aesthetic problems
06/14/2010				7.44	19		50	51					
06/22/2010	17	5.2	NO			36			NORMAL		CLEAR	GREEN	2-Very minor aesthetic problems
06/30/2010	16	4.9	NO			37			NORMAL		CLEAR	GREEN	2-Very minor aesthetic problems

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

Wisconsin Department of Natural Resources * Wisconsin Lakes Partnership
Report Generated: 02/09/2011

Date	SD (feet)	SD (meters)	Hit Bottom?	CHL	TP	TSI (SD)	TSI (Chl)	TSI (TP)	Lake Level	Staff Gauge	Clarity	Color	Perception
07/06/2010	15	4.6	NO			38			HIGH		CLEAR	GREEN	2-Very minor aesthetic problems
07/11/2010				5.55	21		48	52					
07/23/2010	9	2.7	NO			45			HIGH		MURKY	GREEN	3-Enjoyment somewhat impaired (algae)
08/07/2010	8.5	2.6	NO			46			HIGH		MURKY	GREEN	3-Enjoyment somewhat impaired (algae)
08/08/2010	8.5	2.6	NO			46			HIGH		MURKY	GREEN	3-Enjoyment somewhat impaired (algae)
08/09/2010				6.98	20		49	51					
08/22/2010	10	3	NO			44			HIGH		MURKY	GREEN	3-Enjoyment somewhat impaired (algae)
09/18/2010	10	3	NO			44			HIGH		MURKY	GREEN	3-Enjoyment somewhat impaired (algae)

06/14/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	66.3	10.53
3	66.1	10.6
6	65.9	10.63
9	65.6	10.48
12	63.9	9.21
15	61.6	9.11
18	59.8	9.19
21	56.3	8.68
24	53.9	7.77
27	52.4	5.6
30	51.1	2.11
33	50.3	1.35

06/22/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	66.3	10.53
5	65.9	10.63
10	65.6	10.45
15	61.6	10.34
20	56.3	8.68
25	53.9	7.77
30	51.1	2.11
35	49.8	1.27
40	49.2	.64
45	48	.06
50	47.1	.04
55	46.6	.03

07/06/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
0	79	9.75
5	78.8	9.79
10	78.6	9.82
15	76.6	10.94
20	64.6	11.61
25	57	5.51
30	52.3	.32
35	50.3	.06
40	49	.02
45	48	.01
50	46.9	0
55	46.3	0

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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06/14/2010		
Depth	Temp.	D.O.
FEET	DEGREES F	MG/L
36	49.8	1.27
39	49.2	.64
42	48.6	.11
45	48	.06
48	47.5	.04
51	47.1	.04
54	46.6	.03
57	45.8	.01

07/11/2010		
Depth	Temp.	D.O.
0	79	9.75
3	78.9	9.77
6	78.9	9.81
9	78.6	9.82
12	78.5	9.82
15	76.6	10.94
18	69.4	11.8
21	61.6	11.46
24	57	5.51
27	53.9	1.7
30	52.3	.32
33	50.6	.09
36	49.8	.04
39	49.3	.03
42	48.7	.02
45	48	.01
48	47.2	0
51	46.9	0
54	46.4	0
57	46.1	0

08/09/2010		
Depth	Temp.	D.O.
0	82.8	10
5	81.5	10.25
10	79.4	10.48
15	77.3	7.62
20	64.6	3.54
25	58	.4
30	52.9	.08
35	50.7	.03
40	49.9	.02
45	48.6	.02
50	47.6	.01
55	47	0

10/25/2010		
Depth	Temp.	D.O.
0	54.3	7.39
3	54.2	7.33
6	54.2	7.27
9	54.2	7.24
12	54.2	7.22
15	54.2	7.19
18	54.2	7.17
21	54.1	6.99
24	54	6.95
27	54	6.85
30	54	6.82
33	54	6.7
36	52.9	1.81
39	51.3	.13
42	50.3	.07
45	49.5	.05
48	48.6	.04
51	48	.03
54	47.5	.02
57	47.3	.01

Date	Fieldwork Comment
05/19/2010	last four days were warm and calm after two cold and windy weeks
05/27/2010	sunny- warm- lite breeze
06/22/2010	sunny- lite breeze

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD),TSI(CHL),TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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Date	Fieldwork Comment
07/23/2010	5 inches rain last week- breezy sunny
08/07/2010	cloudy lite wind cloudy lite wind
08/08/2010	cloudy lite wind

Date	Lab Comment
05/01/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
06/14/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
07/11/2010	MATRIX DUPLICATE QC EXCEEDED
07/11/2010	NOT ICED OR ICE MELTED; HOLD TIME EXC'D BY 2 DAYS
07/11/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED
08/09/2010	QC SAMPLE (2ND SOURCE) EXCEEDED QC LIMITS BY 1.0%
08/09/2010	SAMPLE RECEIVED WAS NOT ICED OR ICE MELTED

Date	Data Collectors	Project
04/15/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
05/01/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
05/09/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
05/19/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
05/27/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
06/02/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
06/07/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
06/14/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
06/14/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
06/22/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
06/30/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
07/06/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
07/11/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
07/11/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
07/23/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
08/07/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
08/08/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
08/09/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
08/09/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
08/22/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt
09/18/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt

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Date	Data Collectors	Project
10/25/2010	Data Collectors Unknown or Specified in Comments	SAND LAKE MANAGEMENT DISTRICT: Sand + Little Sand Lake Aquatic Plant/Lake Mgt. + Education Project
10/25/2010	Gary Klund	Citizen Lake Monitoring - Water Quality - Sand Lake; Near Deepest Pt

SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter (ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet; Temp = Temperature in degrees Fahrenheit; D.O. = Dissolved Oxygen in parts per million.

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Appendix B

Little Sand Lake Sociological Survey Summary

Lake User's Survey

Little Sand Lake

Prepared for Little Sand Lake, Barron County, WI

In July 2010, the Little Sand Lake Association, in cooperation with SEH Inc., delivered 16 surveys to property owners around Little Sand Lake. Nine (56%) were returned. The results were used to identify current lake use preferences and perceptions, and knowledge of lake regulations and aquatic invasive species. The surveys are not intended to be definitive, but are valuable as background information for lake planning purposes.

Respondent Profile

- All respondents were property owners on Little Sand Lake.
- 44.4% (4) of the respondents were seasonal residents, 22.2% (2) were permanent residents, 22% owned undeveloped land, and 11.1% (1) self-identified as less than seasonal; there were an average of 3 persons per property.
- Respondents spent an average of 108 days a year at the lake.
- The majority of respondents, 77.8%, have used the property for 3 to 5 years, and ownership ranged from 3 to 35 years.

Findings of Fact

- The three most frequent uses of Little Sand Lake are fishing, pontoon boating, and rest/relaxation.
- 66.7% of respondents feel a managed natural shoreline is most desirable and 33.3% prefer unmanaged natural vegetation. No respondents most desire a mowed or manicured lawn to the shoreline or beach.
- Respondents are most concerned about water quality, the introduction of non-native species and undesirable weed growth, and poor fishing.
- 55.5 % of respondents have pontoon boats.
- 66.7% of respondents have canoes or kayaks, but canoeing and kayaking are tied for one of the least participated in activities.
- 8 out of 9 respondents say they use the lake at least 3-4 times a month when there.
- A majority of respondents are aware of Eurasian Water Milfoil (EWM) and purple loosestrife in Sand Lake, but would probably not recognize purple loosestrife on the shore.
- Respondents support EWM control through herbicide application and physical or mechanical removal, but would also like more information about the practices.
- The most common water quality/landscaping practices in place are: not fertilizing (77.8%), using zero-phosphorus fertilizers (44%), and maintaining shoreline buffers (44.4%).
- The majority of respondents knew lake regulations and feel that most lake users do their best to follow regulations.

Findings of Observation

- The majority of respondents, 66%, feel that water quality has decreased but is still good to fair throughout the summer.

- The majority of respondents, 78% feel that aquatic plant growth has decreased since they began using the lake.
- Responses indicate that no wake rules within 100 ft of the shoreline for boats and within 200 ft for personal water craft are the most frequently violated boating regulations.
- The majority of respondents, 44%, believe enforcement of regulations is mostly not adequate.

Respondents ranked participation in activities on the lake in the following order:

Activity	Rank
Fishing	1
Pontoon boating	2
Rest/relaxation	3
Swimming/wading	4
Wildlife viewing	5
Other (monitoring, maintaining property)	6
Jet skiing	7
Water skiing/tubing	8 (tie)
Canoe/Kayak/Paddle boat	8 (tie)
Speed boating	none
Sailing	none

According to anglers, the primary users on Little Sand Lake, bass are pursued the most (26.1%) followed by musky (21.7%).

General comments included increasing the legal length of muskies in the lake, and decreasing the bag limit for crappies or at least instituting a size limit on crappies.

Another comment was made pertaining to increasing enforcement of existing boating regulations, rather than pursuing “no wake” restrictions on Little Sand.

Eight of the nine respondents are willing to contribute time to protect the lake.

The most popular volunteer activities are watercraft inspection and water quality monitoring, followed by aquatic plant monitoring and identification, and wildlife monitoring.

Appendix C

Photographs of Gully Erosion in Northwest Part of Sand Lake



Photo 1



Photo 2

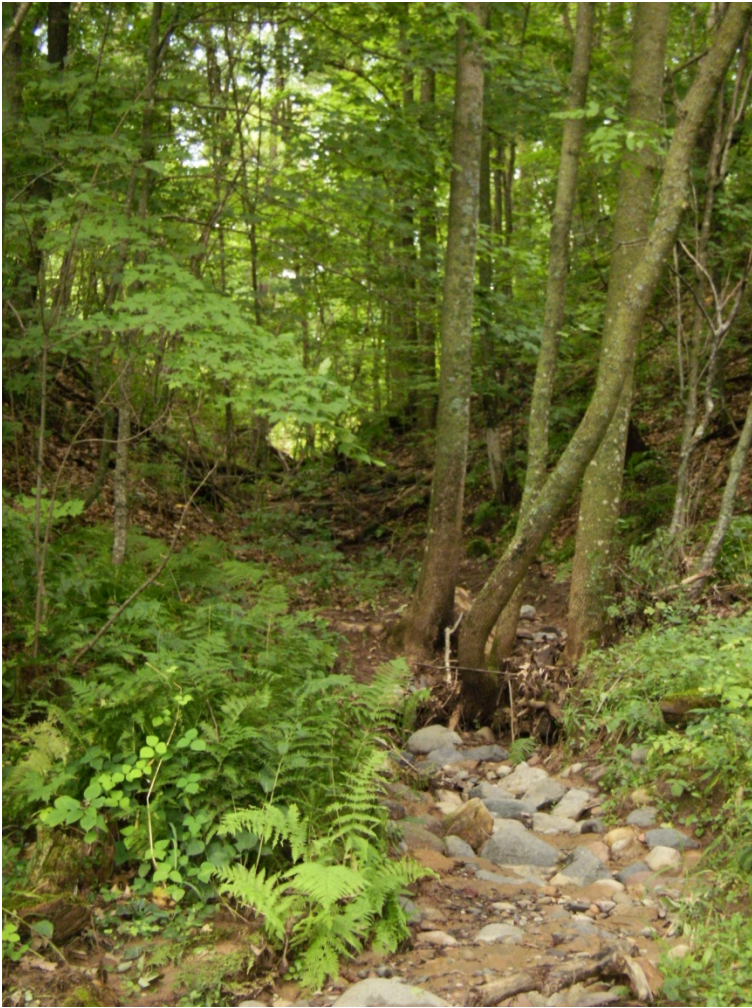


Photo 3



Photo 4



Photo 5



Photo 6



Photo 7



Photo 8



Photo 9