Grindstone Lake

Comprehensive Lake Management Plan

September 2023

Sponsored by:

Grindstone Lake Association

Sawyer County, Wisconsin

With Grant Support from:

WISCONSIN DEPT. OF NATURAL RESOURCES

Consulting Partners:

Harmony Environmental

Finding a balance

People Land Water

Ecosystem Society Economy

Ecological Integrity Service, LLC

Advisory Committee Members

Dr. Debra Anderson, Faculty, Lac Courte Oreilles Ojibwe College
Steve Borchart, Member, Grindstone Lake Association
Donna Carlson, President, Grindstone Lake Association
Cheryl Contant, Board Member, Grindstone Lake Association
Christie Dundee, Clean Boats, Clean Waters, Grindstone Lake Association
Bob Hammond, Board Supervisor, Town of Bass Lake
Sean Humphreys, Board Member, Grindstone Lake Association
Karen Mumford, Board Member, Grindstone Lake Association
Cindy Parker, President, Grindstone Lake Foundation
Dan Tyrolt, Lac Courte Oreilles Conservation (also Advisor)
Tony Wescott, Board Member, Grindstone Lake Foundation

Advisors

Natalie Erler, Sawyer County Aquatic Invasive Species Coordinator
Lindsey Ketchel, Executive Director, Landmark Conservancy
Jay Kozlowski, Sawyer County Zoning and Conservation Department Administrator
Steve Schieffer, Ecological Integrity Service
Scott Van Egeren, Wisconsin Department of Natural Resources
Max Wolter, Wisconsin Department of Natural Resources Fisheries
Jane Getting, Whitefish Lake Property Owners

Contents

Figures

Tables

Introduction

This Comprehensive Lake Management Plan for Grindstone Lake, Sawyer County Wisconsin (WBIC: 2391200) provides a blueprint for preserving lake water quality and native habitats, preventing introductions of invasive species, and supporting long-term ecological health of the lake. The plan presents data about water quality, land cover within the watershed, shoreland conditions, and the aquatic plant community of Grindstone Lake. To engage the Grindstone Lake community in plan development, property owners on the lake completed a survey to share their concerns, perspectives, priorities, and management recommendations. The results from this survey are summarized in the report. Finally, an implementation action plan is provided to direct future management actions.

This plan will guide the Grindstone Lake Association, the Town of Bass Lake, Sawyer County, the Lac Courte Oreilles Conservation Department, and the Wisconsin Department of Natural Resources in lake management from 2023 - 2033.

The Grindstone Lake Association (GLA) initiated the planning process by securing a Wisconsin Department of Natural Resources (WDNR) grant early in 2021. The grant funded data gathering and the resulting reports used in plan development including:

Water Quality Analysis/Nutrient Budget. Grindstone Lake, Sawyer County Wisconsin (WBIC: 2391200) (Schieffer, 2022).

Lake Shoreland & Shallows Habitat Survey. Grindstone Lake WBIC: 2391200 Sawyer County, Wisconsin (Schieffer, 2021).

Aquatic Macrophyte Survey-Point Intercept Method Grindstone Lake (WBIC: 2391200) Sawyer County Wisconsin June/August 2021 (Schieffer, 2021).

Grindstone Lake Association Shoreland Property Owners Survey Report (Mumford, 2022).

"Little Grindstone" Early-season AIS Survey Summary (Schieffer, 2023).

These reports are available on the GLA website.[1]

[1] Lake Studies and Reports – Grindstone Lake Association

Institutional Framework for Planning

Lake Management Goals

I. Preserve excellent lake water quality.
II. Prevent the introduction of aquatic invasive species.
III. Respond rapidly to new introductions of aquatic invasive species and reduce the impacts of established AIS.
IV. Support a healthy and diverse fishery as guided by the Grindstone Lake Fishery Management Plan.
V. Support healthy native aquatic plant communities.
VI. Support the efforts of the Grindstone Lake Association with an engaged lake community.

Plan Stakeholders Input

Advisory Committee

Five meetings of the Grindstone Lake Comprehensive Lake Management Plan Advisory Committee were held to gather input, review and discuss data, identify lake concerns, and develop strategies to mitigate these concerns. The advisory committee was composed of board members from the Grindstone Lake Association (GLA), the Grindstone Lake Foundation (GLF), officials with the Lac Courte Oreilles Conservation Department, and a Board Supervisor with the Town of Bass Lake. Additional advisory assistance was provided by staff from Sawyer County Zoning and Conservation, the Wisconsin Department of Natural Resources (WDNR), Ecological Integrity Services, the Executive Director of Landmark Conservancy, and the President of the Board of Whitefish Lake Property Owners. The first meeting was held in person in July 2022. The remaining meetings were held virtually from July through October 2022.

Committee Lake Management Concerns

This Comprehensive Lake Management Plan addresses the top concerns identified by the advisory committee.

- Invasive species prevention
- Impacts of climate change
- Maintaining two-story, coldwater fishery
- Maintaining good water quality
- Impacts of near shore development
- The importance of engaging the lake community

Public Review and Comment

A draft plan was made available to the public by posting on the GLA website[2] with notification sent to lake residents and published in the Sawyer County Record in early February 2023. The public review period ended March 13, 2023. Two comments were received which supported plan contents. Public comments are available from the GLA by request.

Property Owner Survey

A survey of lake residents was conducted to understand lake resident concerns, experiences, and perceptions to: (1) inform the development of the Comprehensive Lake Management Plan; (2) further our understanding of the Grindstone Lake community; and, (3) identify ways to improve resident involvement in lake protection activities and the Grindstone Lake Association (Mumford, 2022).

The survey link and instructions were emailed or mailed to 365 Grindstone Lake property owners. A total of 189 surveys were completed with a final survey response rate of 52%. A summary report of survey results is included as Appendix A. Results from a few of the approximately 50 questions are highlighted below. Additional results were used in plan development and implementation.

Respondents were asked about the importance of characteristics or elements that contributed to their enjoyment of Grindstone Lake. The top four characteristics that were indicated as very important included: water clarity (97.3% very important), scenery (83.6% very important), healthy fish populations (74.9%), and nearby forests (71.6%). Socializing was not considered as important.

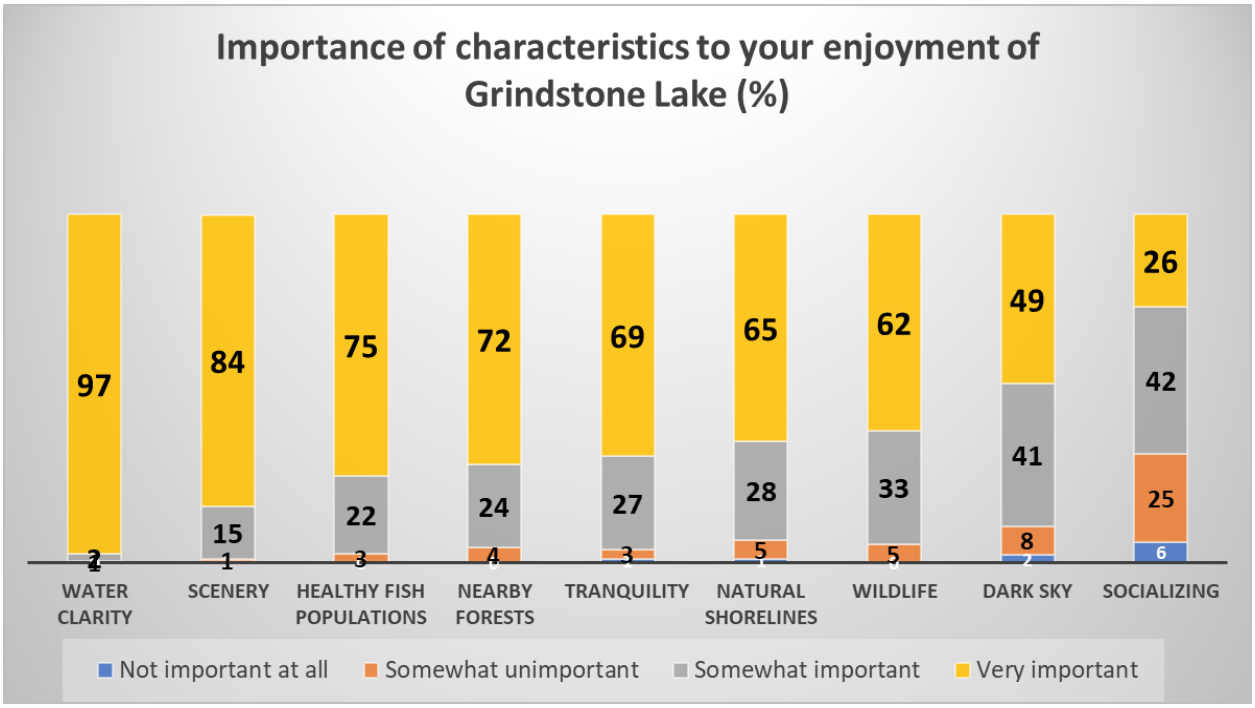


FIGURE 1. IMPORTANCE OF LAKE CHARACTERISTICS TO YOUR ENJOYMENT OF GRINDSTONE LAKE

[2] Home – Grindstone Lake Association

Respondents were asked to indicate their level of concern regarding potential challenges to the lake and their experiences. The three issues that garnered the most concerns were swimmers itch, non-native species, and use of lawn fertilizers and pesticides.

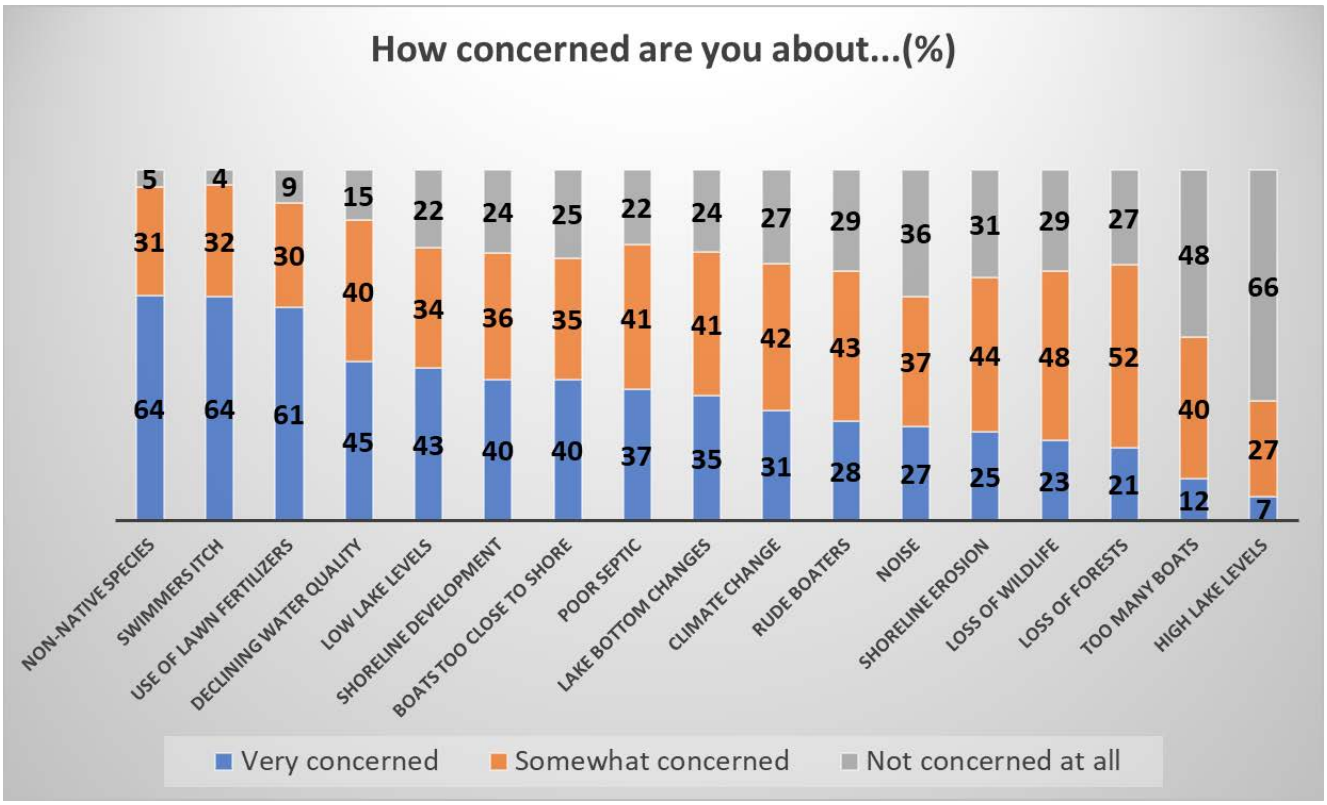


FIGURE 2. LAKE PROPERTY OWNER CONCERNS

To provide input on lake management, survey participants were asked to indicate the level of importance of various management priorities. Although there was broad support across most of the management priorities, four priorities garnered the strongest levels of importance: (1) preventing invasive species from entering the lake; (2) educating residents on lake protection efforts; (3) reporting water quality information annually; and (4) reducing or eliminating use of lawn fertilizers and pesticides.

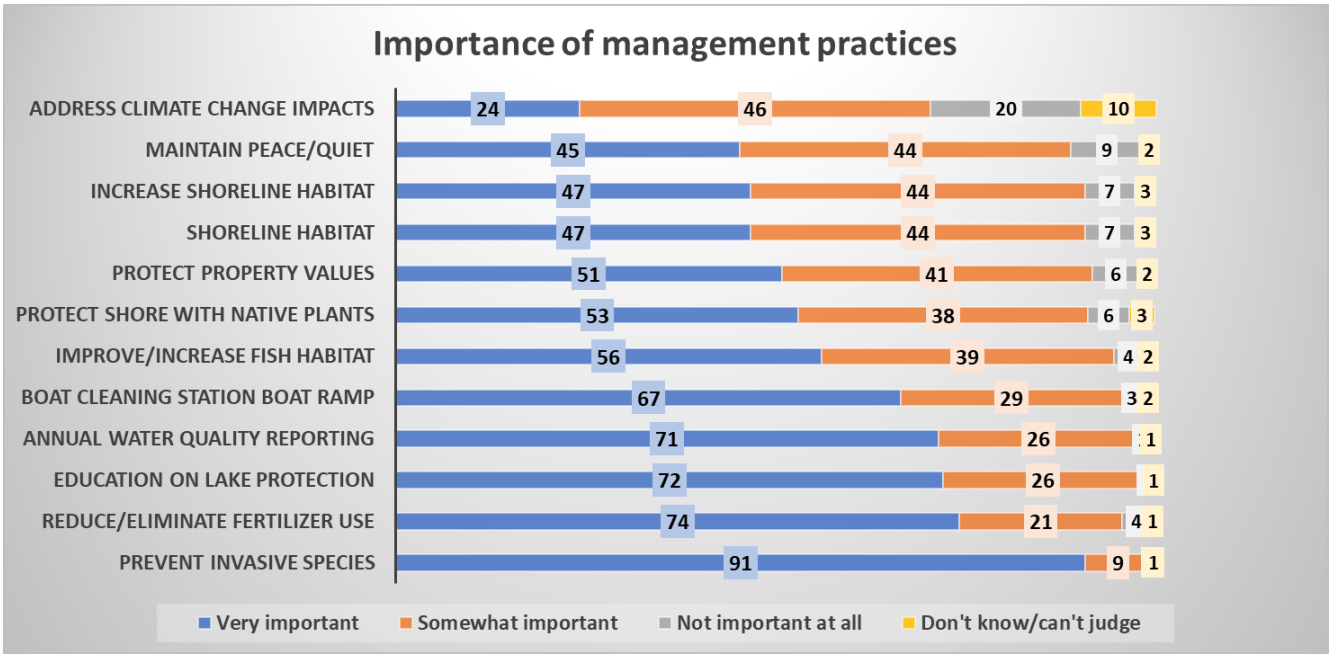


FIGURE 3. IMPORTANCE OF LAKE MANAGEMENT PRIORITIES

Previous Grindstone Lake Association Public Input

Grindstone 2019 Lake Capacity Building Workshop

Participants in a capacity building workshop held in 2019 by the GLA, with support from a WDNR Small Lake Planning Grant, identified similar priorities to those from the 2022 survey of lake property owners. During the workshop, presentations on water quality, fisheries, and aquatic invasive species led to identification of the following three key challenges for Grindstone Lake:

1. Greater engagement of lake property owners in efforts to protect the lake,
2. Prevention of aquatic invasive species, and
3. Mitigation of phosphorus in the lake.

Organizational Capacity

The Grindstone Lake Association (GLA) was founded in 1994. The GLA has 501(c)(3) status which allows for tax deductions of contributions made to the organization. GLA members provide contributions and volunteer support. The GLA actively partners with the Lac Courte Oreilles (LCO) Conservation Department, University of Wisconsin Extension, Sawyer County, Wisconsin Lakes, Sawyer County Lakes Forum, and the Wisconsin DNR.

Grindstone Lake Association Mission

- To Inform
- To Enhance the Community
- To Protect the Environment Around Grindstone Lake

Grindstone Lake Association Achievements

Aquatic Invasive Species Prevention and Management

- Conducted Clean Boats Clean Waters inspection program at the Wisconsin DNR Landing on County Road K (2011 – 2022, except 2012 and 2017).

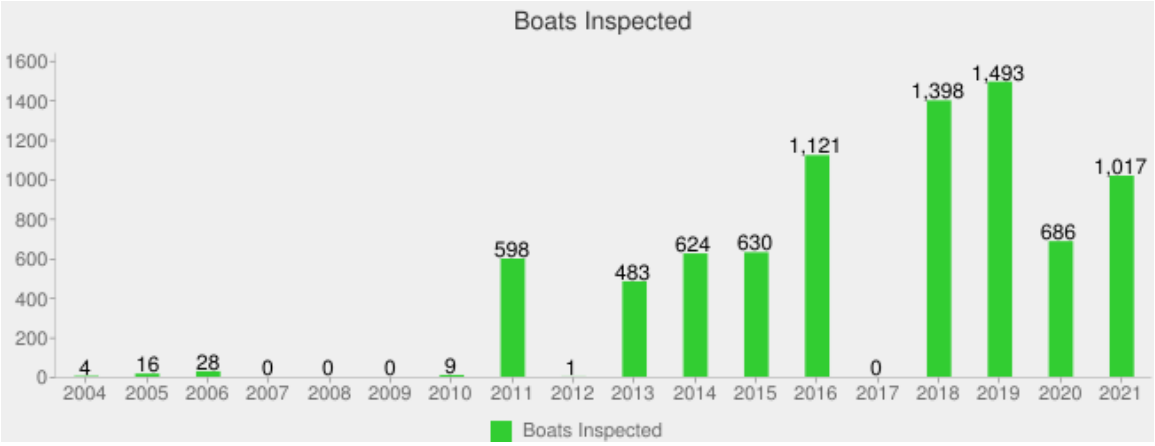


FIGURE 4. CLEAN BOATS, CLEAN WATERS BOATS INSPECTED ON GRINDSTONE LAKE THROUGH 2021

- Coordinated a multi-year treatment of Curly-leaf pondweed in Little Grindstone Lake (2011 - 2013).
- Conducted a survey for rusty crayfish (2007). None were found.

Lake Study

- Completed a water quality study and shoreland habitat inventory in preparation for this plan (2021).
- Partnered with LCO Conservation Department on a core sediment study (2008).

- Completed critical habitat survey of the lake in conjunction with the University of Wisconsin — Stevens Point and volunteer observers (2010).
- Conducted an aquatic plant survey (2006) and a related aquatic plant management plan (2007). Updated the aquatic plant survey (2021).
- Partnered with the LCO Conservation Department to assess lake water quality (2010).
- Completed a survey of lake property owners and other stakeholders to quantify concerns, identify problems, and help set the direction of the lake management plan (2006, updated in 2022).
- Sponsored a septic system inspection of all lake front property through Sawyer County Sanitation (2006). As of January 2009, all but one septic system was in compliance with state and county requirements.

Fisheries

- Partnered with the Wisconsin DNR to hold a fisheries visioning meeting. The process involved public input for a fisheries management plan for the lake (2008).
- Placed over 250 fish cribs in the lake.
- Funded the stocking of extended growth walleyes in the lake.

Lake Management

- Led the effort to dredge the WDNR public boat landing on the lake (2005). The GLA obtained the dredging permit and contributed $4,300 towards the $9,100 total cost of the project.
- Coordinate annual scuba diving events to remove junk and debris from the lake bottom.

Plan Partners and Related Ordinances and Plans

Grindstone Lake Foundation

The Grindstone Lake Foundation (GLF) was founded in 2018 for the purpose of acquiring and rehabilitating a 57-acre tract of land comprised predominantly of a cranberry bog on the Grindstone Lake shoreland.

The mission of the GLF is to steward the protection, restoration, and preservation of the tract of wetlands and create a community-supported nature area that is publicly accessible to Grindstone Lake residents and visitors.

Prior to purchase, the property operated as a cranberry farm, but it had been inactive for some time. The GLF secured the land to ensure it was not developed. The GLF seeks funding to sustain ownership of the land, restore the area to wetlands, and create an educational ecological reserve to ensure the protection of Grindstone Lake and downstream lakes.

Lac Courte Oreilles Conservation Department

The Lac Courte Oreilles (LCO) Tribal Conservation Department protects the resources within the Lac Courte Oreilles reservation including Grindstone Lake. LCO Conservation projects include: water quality monitoring and reporting, stocking of walleye, fish habitat restoration, and purple loosestrife eradication.

Sawyer County Zoning and Conservation Department

The Land and Water Conservation branch is responsible for promoting, protecting and enhancing the land and waters of Sawyer County. Working in conjunction with federal, state, and county agencies and programs, activities include a tree planting program, guidance for shoreland restoration, a lakes information database, design and implementation of erosion control practices, and administration of the state Wildlife Damage and Farmland Preservation Programs. Support is also provided for prevention and control efforts related to aquatic invasive species including plant identification questions and advice. Educational information to lake associations, schools, and other interested organizations is provided as requested. Activities are guided by the Sawyer County Land and Water Resource Management Plan 2017-2026 (Sawyer County, 2017).

Sawyer County Zoning is the enforcement branch for county regulations that regulate land use. The Zoning & Conservation Department provides assistance for mitigation of development impacts for shoreland properties. Sanitary and grading permits are issued by Sawyer County Zoning.

Town of Bass Lake

The Town of Bass Lake passed a boating ordinance in 1996 which established a no-wake zone in the channel between Grindstone Lake and Lac Courte Oreilles. The ordinance states that the area will be indicated by buoys placed at each end of the restricted area. An enhanced wake boating ordinance that applies to Grindstone Lake became effective in November 2018.

> "No person shall operate a motorboat … on the waters within the Town of Bass Lake, Sawyer County in a manner to enhance an elevated wake for over 50 feet in length closer than 700 feet from any shoreline, dock, pier, raft or other restricted area(s) within the Town of Bass Lake, Sawyer County. An elevated wake is a trail of disturbed water left by the passage of a watercraft in excess of 24 inches. Such prohibited operation shall apply to wake enhancement watercraft by the use of ballast, mechanical hydrofoil(s), uneven loading or operation at transition speed. Transition speed means the speed at which the boat is operating at greater than slow-no-wake speed, but not fast enough so the boat is planing."

Town of Bass Lake building inspectors enforce the construction site erosion control provisions within the state Uniform Dwelling Code. These provisions apply to one and two family dwellings. Towns contract with building inspectors for on-site inspections.

Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources provides support to the GLA for many functions including technical and financial assistance for the development of this plan and support for programs including the Citizen Lake Monitoring Network, the Clean Boats, Clean Waters Program, standardized inventory and monitoring methods, regulatory permitting and enforcement, and fisheries management.

The Wisconsin Department of Natural Resources also regulates boating in the state:[3]

Slow, no wake speed is required for a vessel operating within 100 feet of the shoreline, a swimmer, dock, raft, or pier. *Slow-no wake speed means a speed at which a vessel moves as slowly as possible while still maintaining steerage control.* In addition, personal watercraft may not be operated at faster than slow, no wake speed within:

- 100 feet of any vessel on any waterbody
- 200 feet of shore on any lake.

Related Ordinances and Plans are summarized in Appendix B.

[3] *The Handbook of Boating Laws and Responsibilities.* Approved by the Wisconsin Department of Natural Resources. Boat Ed – a Division of Kalkomey Enterprises, LLC. 2020.

Baseline Data and Assessments

Lakes Description

Grindstone Lake is located in Sawyer County, Wisconsin in the Town of Bass Lake (T40N R08W S29) WBIC: 2391200. It is a hard-water drainage lake with the main inflow from Grindstone Creek and outflow through Little Grindstone Lake into Lac Courte Oreilles. Lake characteristics are described in Table 1. The maximum depth is 60 feet, and the mean depth of 30 feet. The watershed area that drains directly to the lake is 2,122.5 acres. Additional land drains to Grindstone Creek.

The lake is further classified as a stratified, two-story fishery lake.[4,5] The Wisconsin DNR sets water quality standards based on lakes classification. Standards for a stratified, two-story fishery lake are listed in Table 2. Grindstone Lake meets phosphorus and chlorophyll-a standards for this lakes classification (Table 3).

A more stringent site-specific phosphorus criterion is proposed for Lac Courte Oreilles. The revision, which would change the lake's total phosphorus criterion from 15 µg/L to 10 µg/L, is proposed to support the lake's coldwater fish community.[6] The Courte Oreilles Lakes Association and the Lac Courte Oreilles Band of the Lake Superior Chippewa Indians filed the rulemaking petition for the changes with the Wisconsin Department of Natural Resources (WDNR, 2022). It was approved by the Wisconsin Natural Resources Board in June 2023. The standard is pending legislative and governor's approval as of September 2023.

Grindstone Lake and Grindstone Creek are each classified as an Outstanding Resource Water by the Wisconsin DNR (NR102.10). An Outstanding Resource Water (ORW) is defined as a lake or stream which has excellent water quality, high recreational and aesthetic value, high-quality fishing, and is free from point source and nonpoint source pollution (NR 102.11, Wis. Adm. Code).

Grindstone Lake is further classified by WDNR Healthy Watersheds, High-Quality Waters modeling and assessment as a high-quality water. Its watershed is a statewide protection priority in the top 30% healthiest watersheds.[7]

TABLE 1. GRINDSTONE LAKE CHARACTERISTICS

Area (acres)	**Maximum Depth** (ft.)	**Mean Depth** (ft.)	**Trophic State** (2021)
3,111	60	30	Oligotrophic to Mesotrophic

[4] Wisconsin Two-Story Fishery List. March 2021. https://dnr.wi.gov/water/waterDetail.aspx?key=15369

[5] "Stratified two−story fishery lake" means a stratified lake which has supported a cold water fishery in its lower depths within the last 50 years (NR012.06(2)(i)).

[6] https://dnr.wisconsin.gov/topic/SurfaceWater/RuleUpdates.html

[7] https://dnr.wisconsin.gov/topic/SurfaceWater/HQW.html

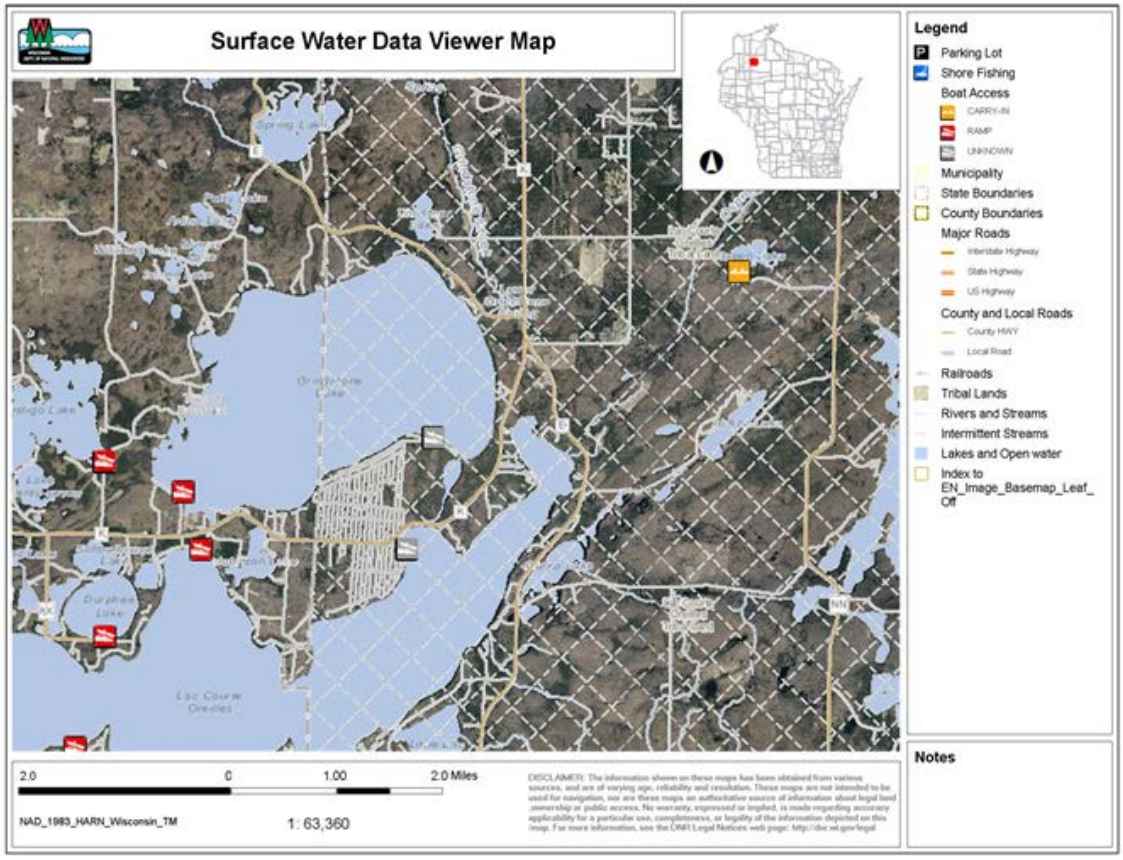
TABLE 2. WDNR LAKES CLASS IMPAIRMENT THRESHOLDS TWO-STORY FISHERY[8]

	Recreation Threshold	Aquatic Life Threshold
Total Phosphorus	≥15 µg/L	≥15 µg/L
Chlorophyll-a	>5% of days with moderate algae levels (20 µg/L)	≥10 µg/L

TABLE 3. WDNR LAKES CLASSIFICATION AND STATUS[9]

Lake Classification	Recreation	Fish and Aquatic Life
Two-Story Fishery	May Meet (TP) Good - Clearly Meets (Chl-a)	Good - Clearly Meets

Little Grindstone is a 24-acre lake which connects Grindstone Lake and Lac Courte Oreilles. Little Grindstone Lake has a maximum depth of 4 feet and a mean depth of 2 feet.



[8] For more information, see Wisconsin Consolidated Assessment and Listing Methodology (WDNR, 2022).

[9] Wisconsin Department of Natural Resources Comprehensive 2020 Water Quality Assessment Spreadsheet.

FIGURE 5. GRINDSTONE LAKE

Public Use

The lake supports two public access boat landings with up to 30 parking locations for vehicle-trailers. The WDNR-owned landing near County Highway K has a paved boat ramp and parking with 25 vehicle and trailer stalls. The Town of Bass Lake owns a second less developed gravel boat ramp at Grindstone Shallows Community Park on W Poplar Avenue. In addition, there are at least 7 access points to the south end of the lake where road right-of-way extends to the lake shore. Grindstone Lake Association landing monitors recorded 1,017 boats entering at the WDNR public landing when monitors were present in 2021.

A contour map of lake depth and a substrate map are presented in Figures 6 and 7.

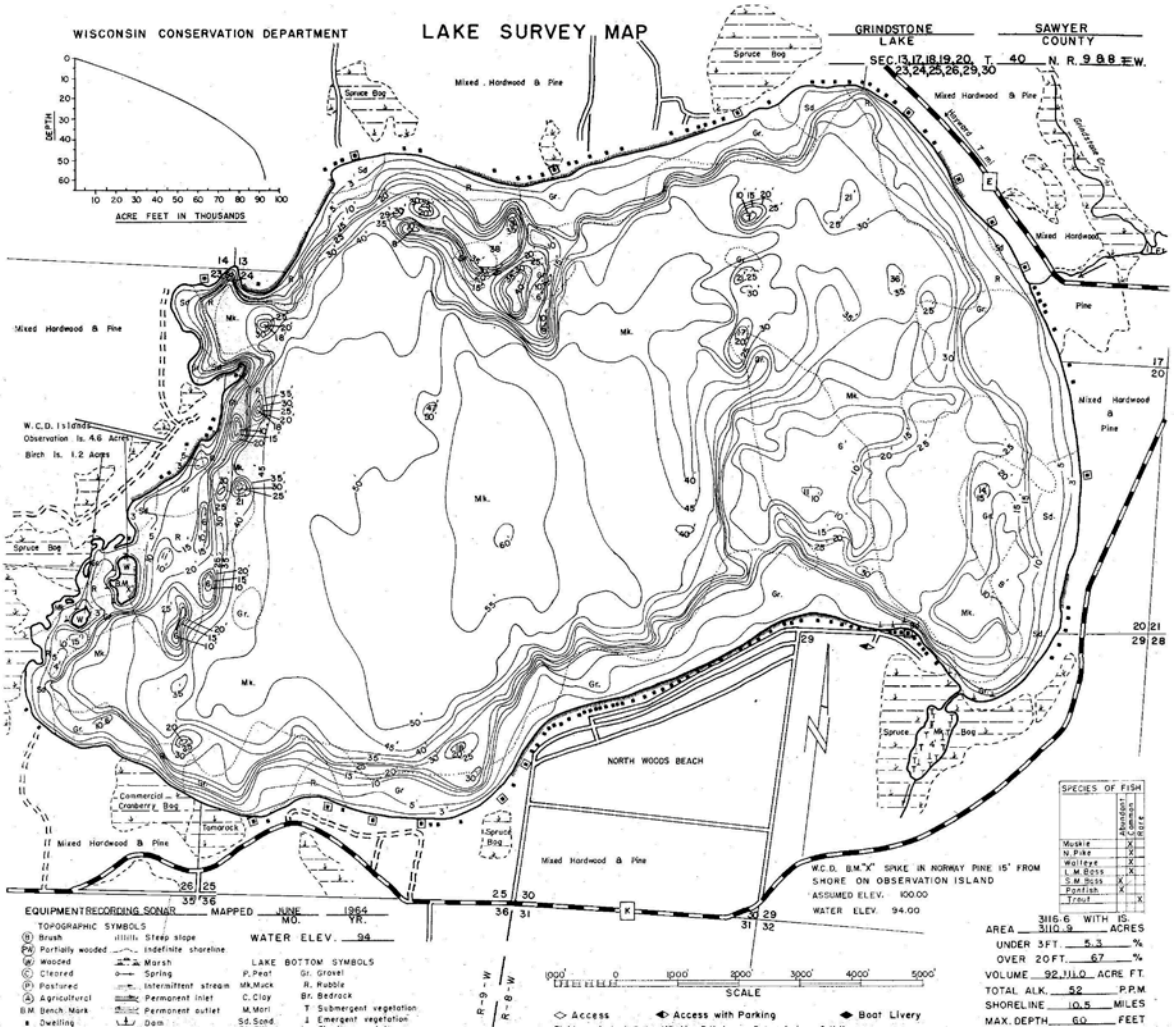


FIGURE 6. GRINDSTONE LAKE SURVEY MAP (WDNR, 1964)

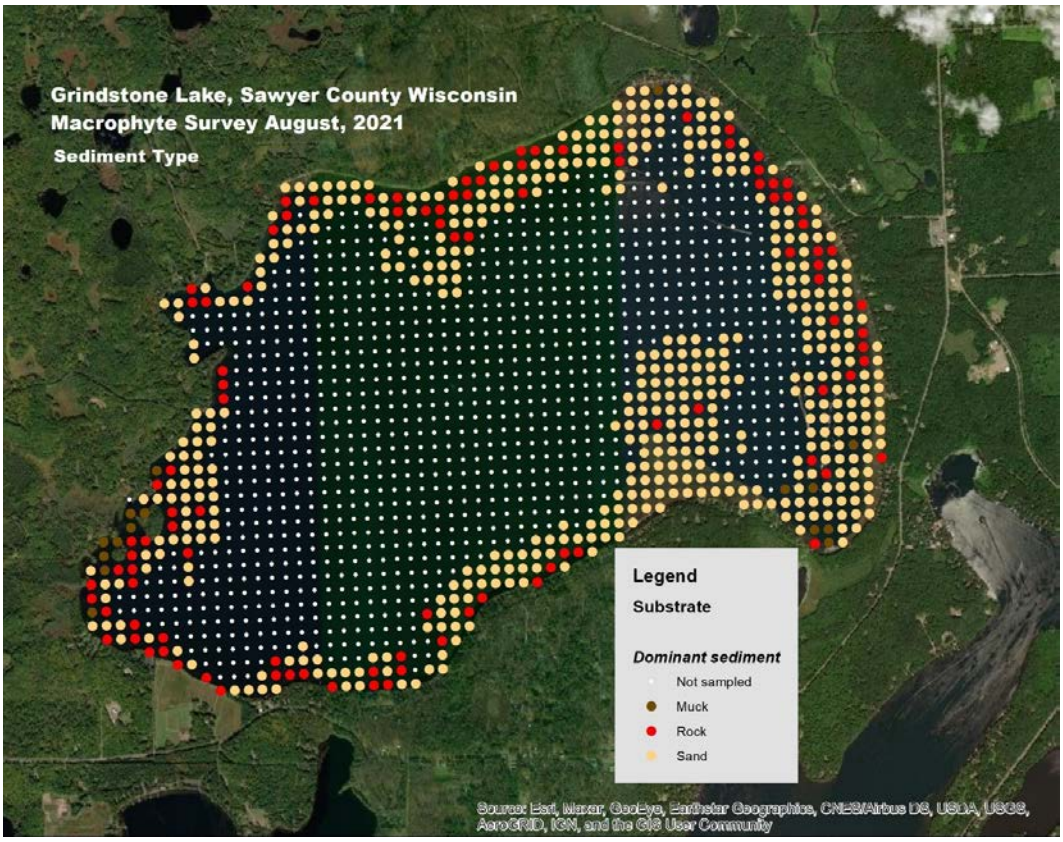


FIGURE 7. GRINDSTONE LAKE SUBSTRATE

Grindstone Lake Water Levels

Water Levels in Grindstone Lake are regulated by the Billy Boy Dam at the outflow of the Billy Boy Flowage just north of HWY 27/70. Grindstone flows into Little Grindstone which flows into Lac Courte Oreilles then to Little Lac Courte Oreilles to the Billy Boy Flowage. The Billy Boy Dam is owned and managed by Sawyer County and regulated by the Wisconsin Department of Natural Resources. It was built in 1936. [10]

The water level for the system is regulated by a 1953 Public Service Commission order which established an official water level elevation. Over the last 20+ years the gauge reading was taken from the control structure. It was only recently discovered that the official reading was to be measured at the George Hess Resort which is no longer present. The gauge was moved upstream to the upstream side of the Thoroughfare Bridge on Lac Courte Oreilles, thus reducing the total pool elevation by over 12 inches. Water level regulation is an important issue for the lakes and is under discussion between the WDNR, Sawyer County, Courte Oreilles Lakes Association, and the LCO Tribe.[11] The GLA installed an additional gauge near where the County Highway K Bridge crosses over Little Grindstone in 2019.

[10] https://nationaldams.com/dams/billy-boy-dam

[11] Email communication with Jay Kozlowski. July 12, 2022 and October 17, 2022.

Trophic State Index (TSI)

The Carlson Trophic State Index (TSI) is a measure of lake productivity or nutrient level. Higher trophic state index values indicate the lake has more nutrients which results in more algae growth. Various parameters (total phosphorus, chlorophyll-a, and Secchi depth) are used to calculate a TSI, and ranges of TSI value represent a particular trophic state. A lower TSI reflects low nutrient levels and less algae growth.

30-40	Oligotrophic = very low nutrients and productivity
40-50	Mesotrophic = moderate nutrients and productivity
50-60	Mild Eutrophic =moderately high nutrients and productivity
60-70	Eutrophic = high nutrients and productivity
70-80	Hyper Eutrophic = very high nutrients and productivity

Figures 8 and 9 graph the trophic state in Grindstone Lake since 1995.[12] Historical data[13] indicate that Grindstone Lake is low-mesotrophic to oligotrophic, with results varying by parameter used in the calculation.

The North American Lake Management Society recommends focusing on chlorophyll-a TSI to evaluate the trophic state of a lake, because this variable is the most accurate of the three at predicting algal biomass. According to Carlson (1977), transparency (Secchi depth) should only be used if there are no better methods available.[14]

The total phosphorus TSI is in the mesotrophic range. Using chlorophyll-a concentration, the lake is low-mesotrophic to oligotrophic. Secchi depth values lead to an oligotrophic TSI desigination. When the TSI for phosphorus is higher than the chlorophyll TSI and higher than the Secchi depth TSI, zooplankton grazing may be robust in the lake, reducing algae and increasing water clarity.[15] This situation occurs in Grindstone Lake as illustrated in Figure 8.

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[12] The mean TSI shown for each parameter was calculated using data from dates following Wisconsin's Consolidated Assessment and Listing Methodology (WISCALM) as follows: total phosphorus —June 1 to September 15, chlorophyll-a— July 15 to September 15. The Secchi depth TSI calculation used data from June 1 to September 15 of each year.

[13] Data is from the Wisconsin DNR (1995-2006) and the Lac Courte Oreilles Conservation Department (after 2006). Some years have missing data throughout the monitoring period.

[14] https://www.nalms.org/secchidipin/monitoring-methods/trophic-state-equations/

[15] There is also a potential for inaccurate phosphorus readings based on the type of test phosphorus used for Citizen Lake Monitoring at the State Laboratory of Hygiene which may not be accurate at low TP levels.

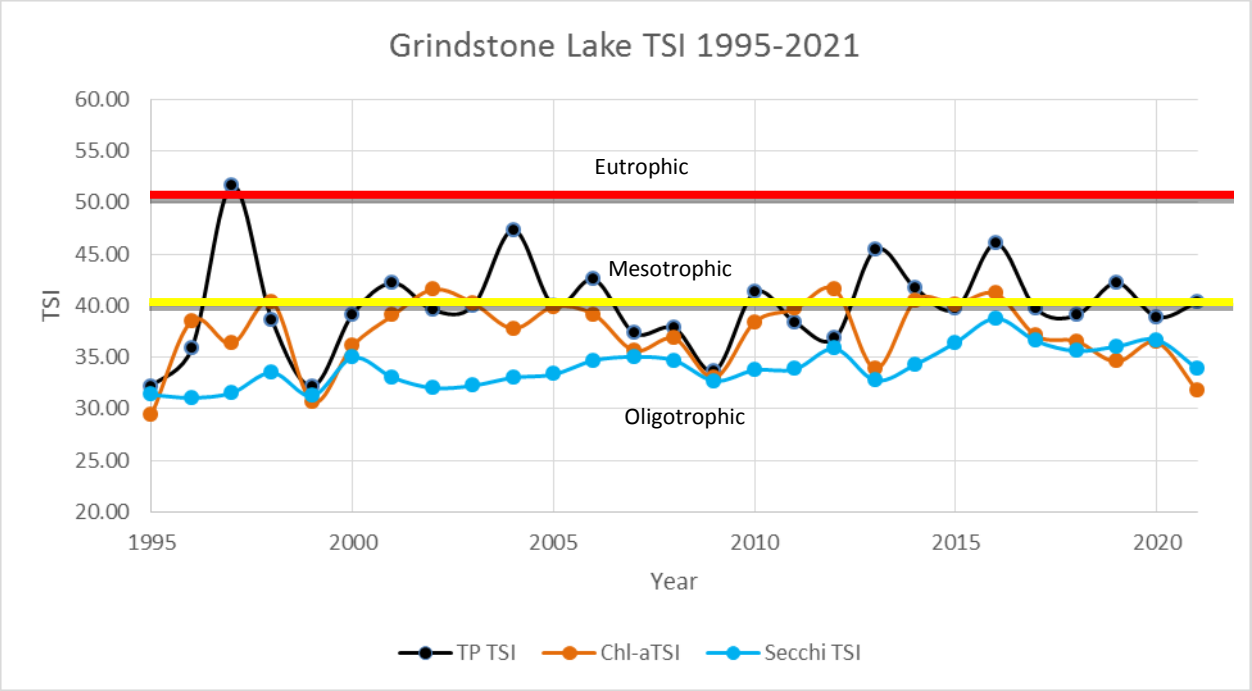

FIGURE 8. ANNUAL GRINDSTONE LAKE TSI 1995 – 2021 (WISCALM DATES)

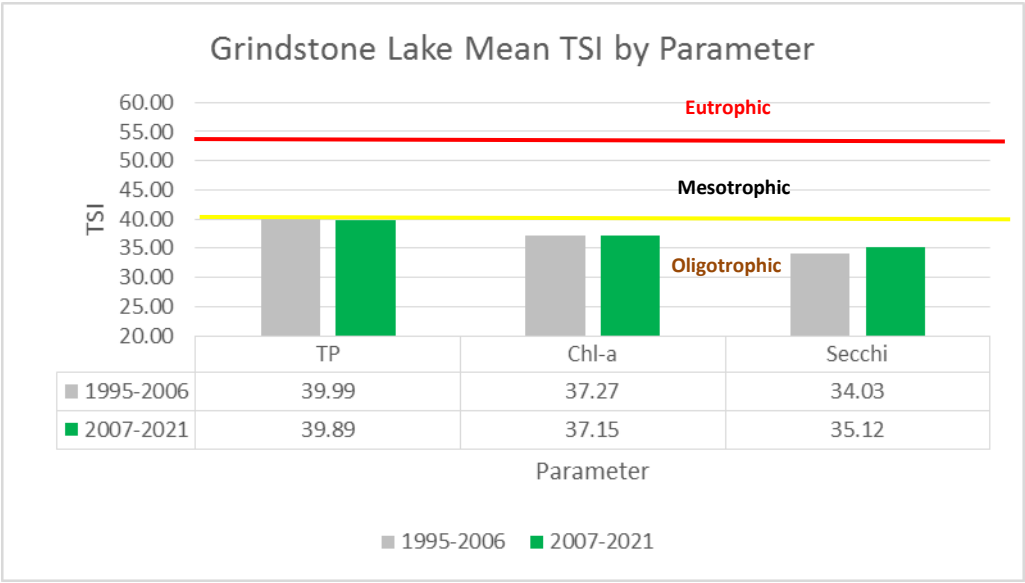

FIGURE 9. MEAN GRINDSTONE LAKE TSI 1995–2006 AND 2007 – 2021 (WISCALM DATES)

Water Quality Study

The 2021 lake study conducted by Ecological Integrity Service examined lake water quality, developed a water and nutrient budget, and looked at the influence of various factors on water quality including watershed areas draining to the lake. Detailed descriptions of study methods and results are found in the report (Schieffer, 2021).

Water Quality Trends

The Wisconsin DNR completed a paleolimnologic analysis of Grindstone Lake sediments in 2004. Grindstone Lake had one of the lowest sedimentation rates measured in Wisconsin. Analysis of the diatoms in sediment deposited over 150 years indicated that nutrients had increased slightly in the lake beginning in about 1995 (Garrison, 2008). However, recent data do not verify this trend.

The 2021 water quality study examined trends in historical water quality data[16] and did not find evidence of declining or improving water quality based on measurements of total phosphorus or chlorophyll-a (algae growth). A weak trend of decreasing Secchi depth (water clarity) was evident. However, the trend line explained variations in data points less than 60 percent of the time.

Nutrient and Water Budget

Phosphorus was the nutrient of focus for the water quality study. Phosphorus is usually considered the "limiting nutrient" in aquatic ecosystems, meaning that the available quantity of this nutrient controls the pace at which algae and aquatic plants are produced. In appropriate quantities, phosphorus can be used by vegetation and soil microbes for normal growth. However, in excess quantities, phosphorus can lead to water quality problems such as eutrophication and harmful algal growth.[17] Phosphorus is considered the limiting nutrient when the total nitrogen to total phosphorus ratio is greater than 10:1. Water sample results from 2000 and 2001 verified nitrogen to phosphorus ratios exceeded 15:1.[18] Grindstone Lake is therefore phosphorus limited.

The Grindstone Lake 2021 growing season (May – Sept.) total phosphorus mean was 12.5 µg/L, and the historical growing season mean was 12.6 µg/L (June – Sept.). The 2021 mean chlorophyll-a concentration was 2.4 µg/L (2.0 µg/L was observed historically) and the mean Secchi depth was 6.3 meters (5.9 meters was observed historically).[19] These measures all indicated excellent water quality and confirm clearly meeting WDNR impairment thresholds for two-story fishery (Table 3). The water budget estimate found that 37% of the inflowing water was from precipitation onto the lake, 31% was

[16] Data is from the Wisconsin DNR (1995-2006) and the Lac Courte Oreilles Conservation Department (after 2006). Some years have missing data throughout the monitoring period.

[17] https://www.epa.gov/national-aquatic-resource-surveys/indicators-phosphorus

[18] Email communication. Dan Tyrolt, Lac Courte Oreilles Conservation Department.

[19] Growing season mean data for 2021 was collected from May – September. Historical GSM data was generally collected from June – September.

from groundwater, 29% was from the Grindstone Creek inlet, and 3% was from overland runoff from the watershed (Figure 10). The estimated hydraulic residence time for an average precipitation year was 6 years.

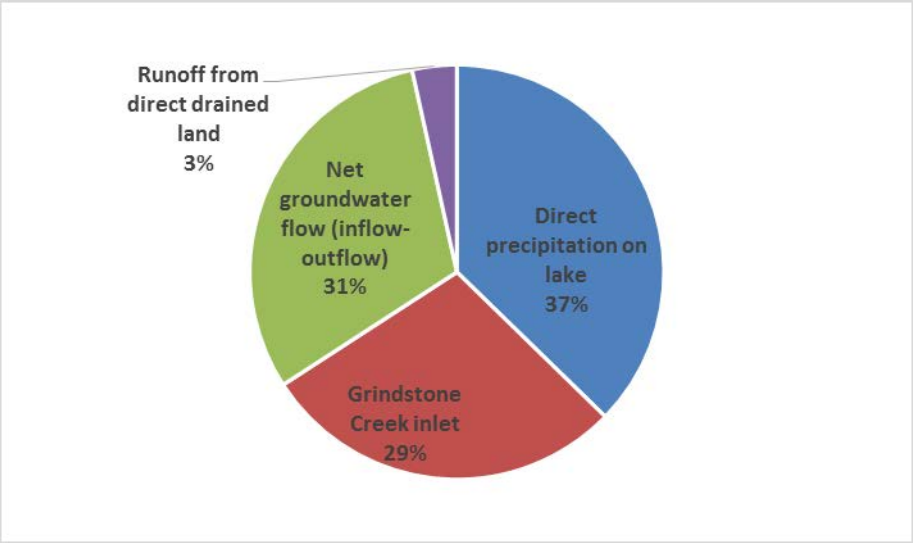

FIGURE 10. GRINDSTONE LAKE WATER BUDGET – INFLOWS

Sources of phosphorus to Grindstone Lake are illustrated in Figure 11. Atmospheric deposition is the largest source (28%), followed by Grindstone Creek (28%), and the direct-drainage watershed (24%). Atmospheric phosphorus loading is due to both dry and wet deposition. Dry deposition is estimated to be relatively high in Grindstone Lake, due to high amounts of conifer pollen likely released in the growing season. Mitigation of this deposition is unlikely.

It is possible to control the loading from Grindstone Creek and the direct-drainage watershed through management practices. Management practices would most likely be implemented in the direct-drainage watershed where the phosphorus load comes primarily from developed land. Developed areas have relatively high runoff from impervious surfaces when compared with forested and wetland areas.

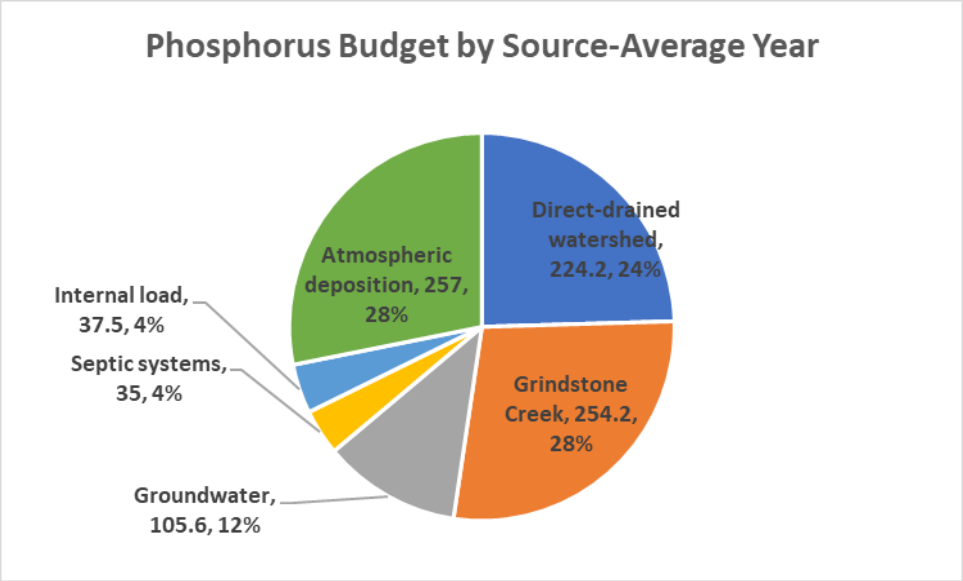

FIGURE 11. PHOSPHORUS LOAD BY SOURCE AVERAGE YEAR

Watershed

The Wisconsin Department of Natural Resources watershed boundary was divided into catchments in the water quality study. The catchments that appeared to drain into low elevations or other bodies of surface water rather than directly to Grindstone Lake were eliminated in the calculation of watershed loading. The remaining direct-drainage watershed around Grindstone Lake measured 2,122 acres. The direct-drainage watershed does not include the Grindstone Springs/Creek watershed. Flow and phosphorus were measured directly from the creek, so the creek watershed area was not included in the watershed estimates of loading. Watershed areas are illustrated in Figure 12. The map shows the direct-drainage (red line) and Grindstone Creek watershed (blue shaded).

FIGURE 12. WATERSHED BOUNDARIES: DIRECT-DRAINAGE AND GRINDSTONE CREEK

The land cover information used to estimate the runoff from the direct-drainage watershed was obtained from the Wisconsin DNR.[20] Land cover is illustrated in Figure 13 and summarized in Table 4. The watershed area to lake area ratio is low for Grindstone Lake, which results in low nutrient loading from the watershed.

[20] National Land Cover Database, 2011.

FIGURE 13. GRINDSTONE LAKE WATERSHED LAND COVER MAP

TABLE 4. DIRECT-DRAINAGE WATERSHED LAND COVER

Land Cover	Area (acres)	Area (km^2)	Percent of Total Area
Forested (includes deciduous, mixed, and evergreen)	1,388.7	5.62	65.4%
Developed/residential	415.1	1.68	19.5%
Wetlands	269.3	1.09	12.7%
Grassland	39.5	0.16	1.9%
Commercial	9.9	0.04	0.5%
Total	**2,122.5**	**8.59**	100%

Forest is the predominant watershed land cover, followed by developed/residential. Forest land cover yields lower runoff and nutrient loading than developed/residential land cover.

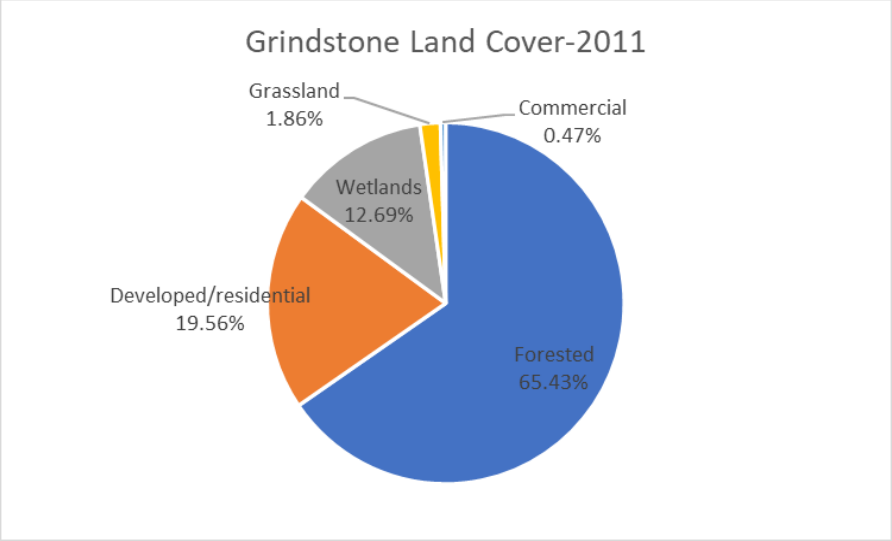

FIGURE 14. LAND COVER TYPES IN THE GRINDSTONE LAKE WATERSHED

The percent of the phosphorus load estimated from land cover type and area is displayed in Figure 15 and Table 5. Although forest lands make up 65% of the direct-drainage watershed, these areas were estimated to contribute only 27% of the phosphorus load. Conversely, residential lands make of only 20% of the direct-drainage watershed and were estimated to contribute 65% of the phosphorus load. Developed areas have much higher phosphorus loading per unit area because of increased runoff from impervious surfaces and lawns.

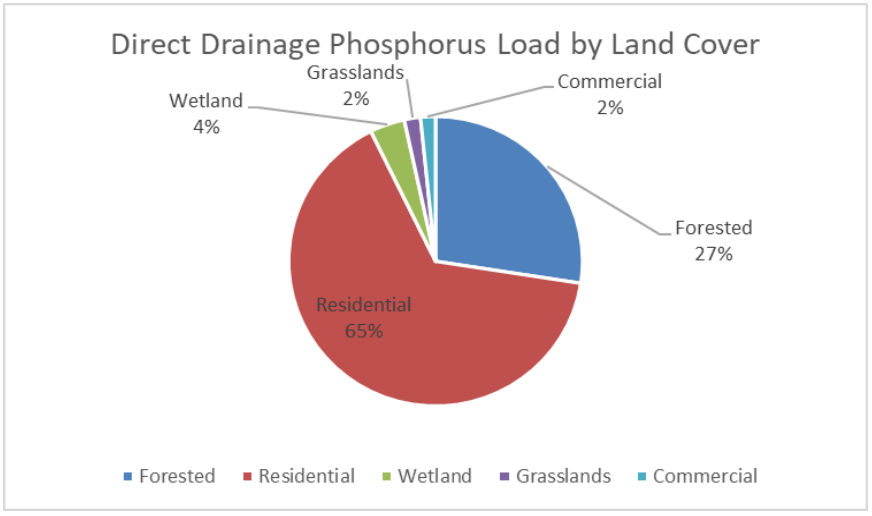

FIGURE 15. PHOSPHORUS LOADING BY LAND COVER DIRECT-DRAINAGE WATERSHED

TABLE 5. ESTIMATED DIRECT-DRAINAGE PHOSPHORUS LOAD BY LAND COVER

Land use	Total P Load (kg)	Percent of Direct-Drainage Total
Forested (all forms)	61.5	27.4
Residential	146.4	65.3
Wetland	8.6	3.8
Grasslands	4	1.8
Commercial	3.7	1.7
Total direct drainage	224.2	100.0

Phosphorus loading from the direct-drainage area was estimated based on the area and predicted loading from various land covers. In reality, intensity and phosphorus concentration in runoff can vary greatly within a given land cover because of various factors such as slope, amount of impervious surface and lawn, and timing and intensity of precipitation. Evaluation of these specific factors was outside the scope of the water quality study.

Predicting Water Quality Changes

The lake water quality mathematical model allows prediction of water quality impacts with changes in phosphorus loading. The model is calibrated to a long-term lake water quality data set to increase accuracy of predictions. The data set from 2007 – 2021[21] was used for this analysis with dates consistent with the Wisconsin Consolidated Assessment and Listing Methodology (WISCALM).[22] Because sources of phosphorus from the atmosphere and groundwater are not readily managed and watershed loads can be, the influences of changes in watershed loads were examined.

The load analysis examined increases and decreases in the probable average year phosphorus load in 20% increments. The resulting output predicts the in-lake total phosphorus and chlorophyll-a concentrations and the Secchi depth during the WISCALM periods. Chlorophyll-a is a measure of algae growth in the lake, and Secchi depth measures water clarity.

As Table 6 shows, the in-lake total phosphorus concentration will respond with changes to the total phosphorus load. A 20% reduction in phosphorus is predicted to result in a most likely in-lake concentration of 11.5 µg/L. When compared to the historical average of 12.6 µg/L, this is a decrease of about 8.7%. Conversely, a 20% increase in total phosphorus load would increase phosphorus concentration from 12.6 µg/L to 13.7 µg/L, an 8.7% increase. This concentration of 15 µg/L is the threshold for an impaired waters listed for a two-story fishery lake classification.

[21] From Lac Courte Oreilles Conservation Department.

[22] Total phosphorus —June 1 to September 15, chlorophyll-a— July 15 to September 15. The Secchi depth TSI calculation used data from June 1 to September 15 of each year.

The most likely potential for phosphorus mitigation is in the direct-drainage watershed, especially in developed areas near the lakeshore. Load analysis of only the direct-drainage watershed shows less change in the in-lake phosphorus concentration. With a 20% decrease in loading from the direct-drainage watershed, the in-lake concentration is estimated at 12.2 µg/L, a decrease of only 3.2%. A 20% increase is predicted to result in an in-lake concentration of 13.0 µg/L, an increase of 3.2%. In general decreases result in phosphorus TSI values in the oligotrophic range. Current values and increases are in the mesotrophic TSI range.

TABLE 6. ESTIMATED IN-LAKE TOTAL PHOSPHORUS CONCENTRATION WITH VARIOUS PHOSPHORUS LOADS

	Estimated Growing Season Mean Total Phosphorus (µg/L)	
Total P load factor (1.0 is present load)	**Results with changes to total watershed load**	**Results with changes to the direct-drainage watershed only**
0.6 (40% reduction)	10.2	11.8
0.8 (20% reduction)	11.5	12.2
1.0 (current)	12.6	12.6
1.2 (20% increase)	13.7	13.0
1.4 (40% increase)	14.8	13.4

A similar analysis was completed for chlorophyll-a to predict resulting changes in algae growth. The load analysis shows that a 20% reduction in overall phosphorus loading would result in a 0.3 µg/L change in chlorophyll-a concentration (from 2.1 µg/L to 1.8 µg/L). Reducing the direct-drainage phosphorus load by 20% is predicted to lower the chlorophyll-a concentration from 2.1 µg/L to 2.0 µg/L. All predicted values (increases and decreases) result in TSI values in the oligotrophic range.

Since algae growth can significantly affect the Secchi depth (water clarity), changing the phosphorus load into Grindstone Lake can be expected to result in a change in Secchi depth. The load analysis from the calibrated average year model predicts an increase in the growing season mean Secchi depth from 5.7 meters (18.7 feet) to 6.3 meters (20.7) with a 20% reduction in phosphorus loading overall. A 20% reduction in phosphorus loading from just the direct-drainage watershed would increase the Secchi depth from 5.7 meters (18.7 feet) to 5.9 meters (19.4 feet). All predicted values (increases and decreases) result in TSI values in the oligotrophic range.

TABLE 7. ESTIMATED IN-LAKE TOTAL CHLOROPHYLL-A CONCENTRATION WITH VARIOUS PHOSPHORUS LOADS

	Estimated Growing Season Mean Chlorophyll-a (µg/L)	
Total P load factor (1.0 is current load)	**Results with changes to total watershed load**	**Results with changes to the direct-drainage watershed only**
0.6 (40% reduction)	1.5	1.9
0.8 (20% reduction)	1.8	2.0
1.0 (current)	2.1	2.1
1.2 (20% increase)	2.4	2.2
1.4 (40% increase)	2.6	2.3

TABLE 8. ESTIMATED IN-LAKE SECCHI DEPTH WITH VARIOUS PHOSPHORUS LOADS

	Estimated Growing Season Mean Secchi Depth (meters)	
Total P load factor (1.0 is present load)	**Results with changes to total watershed load**	**Results with changes to the direct-drainage watershed only**
0.6 (40% reduction)	7.1	6.1
0.8 (20% reduction)	6.3	5.9
1.0 (current)	5.7	5.7
1.2 (20% increase)	5.3	5.5
1.4 (40% increase)	4.9	5.4

Discussion

Management should focus on preserving existing water quality and preventing future negative impacts. Grindstone Lake has very high-water quality. Historical data indicate that the total phosphorus concentration is typically in the low-mesotrophic Trophic State Index (TSI) range, and the chlorophyll-a and Secchi TSI's are in the oligotrophic range.

The most effective and practical management efforts would occur in the direct-drainage watershed. There is limited nutrient loading from the Grindstone Creek watershed, and much of the Grindstone Creek flow is from groundwater (springs) and wetland drainage. Of the direct-drainage watershed, 19.6% of the land cover is developed, with the majority forested. Because developed land cover creates the most runoff and nutrient loading (65% of the phosphorus from the direct-drainage watershed is estimated to come from residential land), mitigation and prevention measures should be focused here.

Potential sources of increased future loading should be examined because increases in phosphorus loading are predicted to lead to water quality declines. Negative changes would result from conversion of forested land to developed lands unless effective mitigation measures are installed. New residential and commercial development often leads to increases in impervious surfaces and manicured lawn cover, which increases runoff and nutrients that flow to the lake. Increases in the density of existing commercial and residential development would also have negative impacts.

The acquisition of the commercial cranberry bog has likely significantly reduced the phosphorus loading from that portion of the direct-drainage watershed. Keeping this area out of cranberry production or residential or commercial development and restoring it to a natural landscape will continue to help preserve the water quality in Grindstone Lake.

The internal load of phosphorus from lake sediments is currently low, and no related management is recommended.

Climate change, which is bringing more intense storms events, could increase runoff significantly. Furthermore, more intense storm systems and greater heating of Grindstone Lake could lead to lake mixing and higher internal loading. Both could result in degradation in water quality with more nutrients and potential algae growth. Since residents and lake users cannot directly control these potential changes, the implementation of management practices to reduce runoff could mitigate climate change impacts.

Water Quality Management Recommendations

- ***Implement best management practices (BMPs) in the near-shore areas.*** *Review and identify locations with high potential loading. The focus for mitigation should be areas with large impervious surfaces, buildings, and manicured lawns. The shoreland survey (discussed in the following section) can be used to identify priority areas to implement best management practices. Potential best management practices include infiltration devices (especially adjacent to impervious surfaces), rain gardens, and/or shoreline buffers.*

1. ***Identify methods to mitigate loading from future development.*** *Future development might include conversion of forest land to residential or commercial land or increased density of existing commercial and residential development. Logging best management practices might also be considered on public and private lands.*

2. ***Establish a long-term water quality monitoring program.*** *Consistent monitoring will help to identify trends and evaluate management practices. Minimum data collection should include near-surface total phosphorus, chlorophyll-a, and Secchi depth (at least monthly during the growing season). Dissolved oxygen and temperature profiles in the deep hole are also recommended to assess if the lake is periodically mixing. Profiles will also assess whether or not the lake continues to meet oxythermal habitat WisCALM standards for a two-story fishery (WDNR, 2023). Monitoring of Grindstone Creek water quality and flow would also be beneficial.*

POTENTIAL ACTIONS TO IMPLEMENT RECOMMENDATIONS

1. **Install best management practices (BMPs) in near shore areas**

    - Education regarding shoreline restoration and best management practices for infiltration
    - Technical assistance
    - Financial assistance (WDNR Healthy Lakes Program)
    - Implementation of Sawyer County Shoreland Zoning land use permit mitigation requirements

2. **Mitigate loading from development**

    - Identify and prioritize areas for conservation set aside
    - Support effective development of and compliance with local ordinances and state regulations that limit impacts of shoreline development
    - Implement BMPs in near-shore areas (see #1)
    - Restore historical wetland areas to functioning wetlands

3. **Establish a long-term monitoring program**

    - Participate in WDNR expanded self-help monitoring or support ongoing LCO Conservation Department monitoring
    - Seek partners to assist with Grindstone Creek monitoring

Shoreland

Bay Area Environmental Consulting and Ecological Integrity Service conducted and analyzed a comprehensive inventory of Grindstone Lake shorelines (Schieffer, 2021). The inventory was conducted according to standardized WDNR methods which are described in the report. The methodology involved surveying, assessing, and mapping habitat in the riparian zone (shoreline buffer extending back 35 feet from the ordinary high water mark), along the bank, and in the littoral zone (in the lake along the lake shoreline). The data collected include the following: percent tree cover, percent ground cover by type (impervious surfaces, manicured lawns, and natural), erosion concerns, length of modified banks, density of human structures, presence of floating/emergent plants, and coarse woody habitat. Data was collected by parcel rather than shoreline length. Therefore, summaries provide data as a percentage of parcels and not by percentage of the entire shoreline length for each lake.

A previous shoreland survey was completed in 2006. However, it is difficult to readily compare results because different data collection methods were used. The 2006 survey compiled information by length of shoreline and area of riparian zone rather than by parcel, and different data was collected. However, some comparison of 2006 and 2021 survey data can be made as shown in Table 9 and Table 10.

The comparison shows increases in riprap along the shoreline and increases in lawn and impervious surfaces in the riparian zone (first 35 feet from the ordinary high water mark). In 2006 95% of the shoreline length was found to be in natural vegetation, while in 2021, 93% of the shoreline was in natural vegetation. The riparian area was 73% natural in 2006 and 67.4% natural in 2021.

TABLE 9. COMPARISON BETWEEN 2006 AND 2021 SHORELINE SURVEYS: SHORELINE LENGTH

Survey Year	Rip Rap: % of total shoreline length	Structures: % of total shoreline length	Natural Vegetation: % of total shoreline length
2006	2.3%	0.2%	95%
2021	6.5%	0.2%	93%
Change from 2006 to 2021	+4.2%	0.0%	- 2.0%

TABLE 10. COMPARISON BETWEEN 2006 AND 2021 SHORELINE SURVEYS: RIPARIAN AREA

Survey Year	Lawn: % of total riparian area	Impervious Surface: % of total riparian area	Natural: % of total riparian area
2006	9.4%	2.2%	73.0%
2021	15.5%	5.0%	67.4%
Change from 2006 to 2021	+6.1%	+2.8%	-5.6%

The data presented in the 2021 shoreland survey report is extensive. The report includes an overview of results followed by maps showing the presence and magnitude of various parameters. Because the data is extensive and difficult to summarize, few results are reported here. Instead, the report is incorporated by reference, and results will be considered to prioritize activities and implement programming as needed.

Maps are generated for a variety of measurements. The example map in Figure 16 illustrates percent of manicured lawn in the riparian zone. A list of all parameters examined and maps provided is included below the map.

The GLA can access the maps to focus on specific concerns. For example, maps that record bank erosion are available if the GLA decides to address shoreline erosion through education or management efforts.

GRINDSTONE LAKE SHORELINE

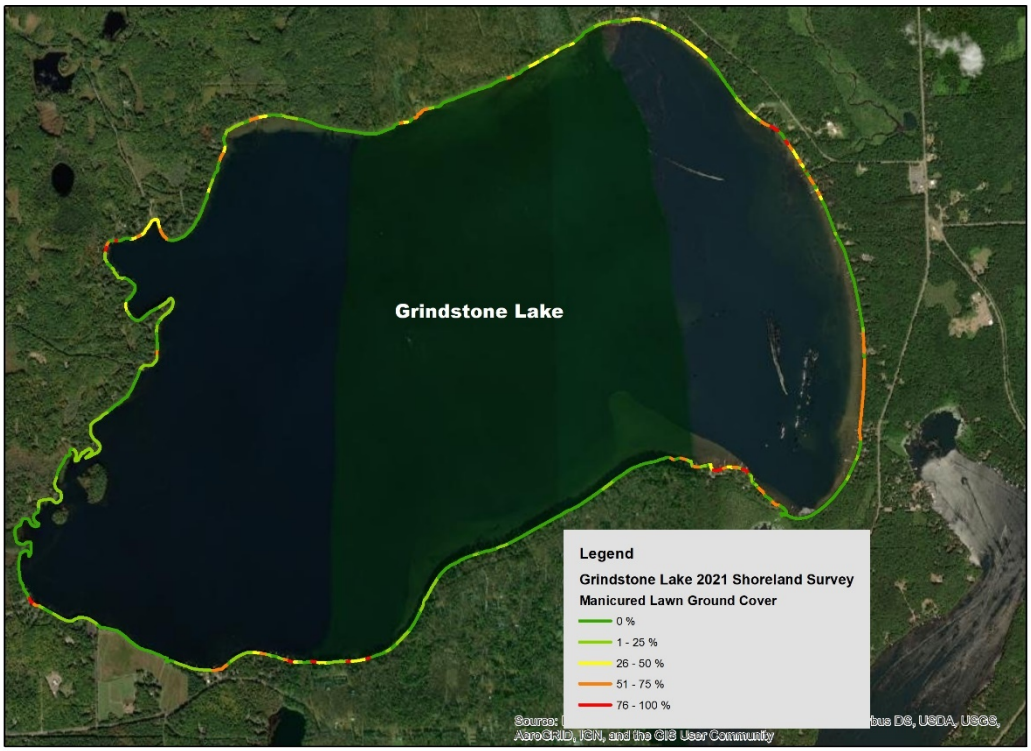

FIGURE 16. EXAMPLE MAP: GRINDSTONE LAKE MANICURED LAWN GROUND COVER

Shoreland Inventory Maps by Parameter Measured

Tree canopy

Ground cover-shrub/herbaceous

Ground cover-impervious surfaces

Ground cover-manicured lawn

Ground cover-agriculture

Ground cover-other (duff, mulch, etc.)

Riparian structures-buildings

Runoff potential-lawn/soil slopes to lake

Runoff potential-bare soil

Bank modification-rip rap

Bank erosion > 1 foot face

Bank erosion < 1foot face

Aquatic plants-emergent plants present

Aquatic plants-floating plants present

Invasive species observed

Coarse woody habitat branches, in water, touches shore

Watershed and Shoreland Recommendations[23]

Watershed protection measures should concentrate on areas where phosphorus loading potential is the highest and runoff to the lake is most direct. Recommendations mirror those from the water quality study.

The GLA is encouraged to work with property owners, the Lac Courte Oreilles Tribe, the Sawyer County Zoning and Conservation Department, the Department of Natural Resources, and other partners to further assess pollutant loading concerns and options for management.

Residential development

a. Encourage lakeshore residents to preserve and restore shoreline buffers and install runoff mitigation measures.
b. Discourage use of phosphorus fertilizer on lawns.[24]
c. Monitor and follow stormwater permitting and erosion control requirements for new development.

The GLA should encourage residents to protect water quality by installing infiltration practices such as rain gardens and infiltration pits and trenches. These practices capture water from roofs and paved areas allowing water to soak into the ground rather than flowing to the lake. Buffers of natural vegetation along the shoreline also help to slow runoff water and allow infiltration and should be encouraged. Use of phosphorus fertilizers should be discouraged. Residents may be encouraged to follow the practices described above through education and incentive programs.

Grindstone Lake has a well-preserved shoreline buffer zone for much of the lake shoreline. In 2006 95% of the shoreline length was found to be in natural vegetation, while in 2021, 93% of the shoreline was in natural vegetation. The shoreline riparian area, extending back 35 feet from the ordinary high water mark, was 73% natural in 2006.[25] The riparian area was 67.4% natural in 2021 (Schieffer, 2021).

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[23] Watershed recommendations prepared in 2007 by Dale Olson, Sawyer County Conservationist and Dan Tyrolt, Environmental Engineer, Lac Courte Oreilles Conservation Department and listed in the aquatic plant management plan were reviewed by Sawyer County zoning staff and Dan Tyrolt and updated with recommended changes in 2022.

[24] A Wisconsin law, which took effect as of 1 April 2010, restricts the use, sale, and display of lawn and turf fertilizer which contains phosphorus or available phosphate. **Use of this type of fertilizer is prohibited on lawns and turf in Wisconsin, except under certain exemptions**. A similar law is in place in Minnesota, where many property owners have permanent residences.

[25] Grindstone Lake Association Shoreline Survey. Summer 2006.

Runoff may still channelize to the lake from homes, driveways, and other impervious surfaces through cleared areas to the lake. Limiting cutting in a pathway even narrower than the allowed (35 feet per 100 feet of shoreline length) corridor is highly recommended to preserve lake water quality and habitat.

Cropland

Look for opportunities to support the Sawyer County Land and Water Conservation Branch as they develop conservation practices for agricultural landowners.

Future commercial and residential development

- Be aware of stormwater and erosion control requirements and monitor development in the watershed.
- Identify and preserve critical areas for watershed protection.

Stormwater runoff from future commercial and residential development is a concern. Erosion control during construction is also critical The Department of Natural Resources regulates stormwater and erosion control through required plans and permits.

A **stormwater plan** describes how runoff water will be contained and treated when development is complete.

An **erosion control plan** specifies how soil erosion will be limited during construction.

A landowner is required to obtain a construction site stormwater runoff permit from the WDNR[26] when there will be one acre or more of disturbance. The Towns are responsible to enforce the construction site erosion control provisions within the state Uniform Dwelling Code. These provisions apply to one and two family dwellings. Towns contract with building inspectors for on-site inspections. The Sawyer County Shoreland Zoning Ordinance regulates development within the one thousand feet of the lake and three hundred feet of Grindstone Creek. When Sawyer County grading permits are required due to steep slopes, construction site erosion control requirements are also included.[27] The GLA can help to ensure that the requirements of these programs are carried out by informing the WDNR or Town about new construction and potential stormwater and erosion control violations.

An investigation of ownership of currently undeveloped parcels and identification of those parcels that are critical for watershed protection is recommended. The GLA should take an active role in the purchase of title or conservation easements to preserve such properties. [Added note: The Grindstone Lake Foundation, Inc. was formed for this purpose, and coordinates with the GLA.][28]

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[26] The current WDNR stormwater contact for Sawyer County is Matthew Jacobson (Matthew.Jacobson@wisconsin.gov, 715-928-0485).

[27] Personal communication Jay Koslowski, Sawyer County Zoning and Conservation Administrator, September 5, 2023.

[28] Personal communication Cindy Parker, President Grindstone Lake Foundation, November 18, 2022.

Aquatic Habitats

Grindstone Lake Fisheries

A fisheries management plan was completed for Grindstone Lake in 2008 and information is presented here from that report (Wolter, 2008).

TABLE 11. FISH SPECIES OF GRINDSTONE LAKE

Species (Common name)	**Scientific name**	**Abundance**
Walleye	*Sander vitreus*	2.1 per acre
Muskellunge	*Esox masquinongy*	1 per 5-10 acres
Northern pike	*Esox lucius*	1 per 5-10 acres
Smallmouth bass	*Micropterus dolomieu*	Common
Largemouth bass	*Micropterus salmoides*	Rare
Bluegill	*Lepomis macrochirus*	Common
Black crappie	*Pomoxis nigromaculatus*	Present
Yellow perch	*Perca flavescens*	Common
Cisco	*Coregonus artedi*	Present
Rock bass	*Ambloplites rupestris*	Common

Other species present (or suspected): white sucker, shorthead redhorse, greater redhorse, bluntnose minnows, spottail shiner, blacknose shiner, golden shiner, common shiner, and other small cyprinid species, trout perch, log perch, johnny darter, rainbow darter, and other small darter species, pumpkinseed, rock bass, longear sunfish, tadpole madtom and black, yellow, and brown bullheads, longnose gar; slimy sculpin, and brook trout (from Grindstone Creek and Springs).

Besides walleye, the other species that appears to be dominant or increasing is smallmouth bass. Largemouth and smallmouth bass have exploded statewide since the late 1980s, thanks in part to more restrictive harvest magnified by some exceptional strong year classes. Grindstone Lake once was a trophy crappie lake. In the late 1970s this lake produced several state record crappies. Then the population crashed due to poor recruitment. The most recent Grindstone Lake fishery management plan noted some signs of recovery in the crappie population.

Regular walleye stocking commenced in Grindstone Lake 1977 and continued through 1985. The population became self-sustaining by 1984. The 1976 population estimate showed a remnant population of less than 1,000 extremely old and extremely large walleyes. Lac Courte Oreilles (LCO) went through the same transition but it took another 20 years for natural reproduction to assert itself there. There is evidence of a cisco-natural walleye relationship in both lakes. When cisco populations are high, walleye seem to have a hard time self-sustaining. In the early 80s, Grindstone's cisco population declined as walleye reproduction took over. In LCO, cisco declined and walleye have shown natural reproduction more recently. As natural reproduction increased in Grindstone and population densities increased, walleye growth rates declined. The growth rates have been average and stable here, since the mid-1990s. On average, 15 inches was attained in five summers of growth.

TABLE 12. WI DNR WALLEYE STOCKING IN GRINDSTONE LAKE

Year	Age Class	Number Stocked	Average Length (Inches)
2000	FRY	100000	0.3
1985	FINGERLING	50040	3
1983	FINGERLING	45135	3
1981	FINGERLING	50000	3
1979	FRY	5000000	
1978	FINGERLING	100003	1
1977	FINGERLING	129564	1.55
1977	FRY	6000000	

FISHING BY THE CRANBERRY BOG

TABLE 13. WI DNR MUSKELLUNGE STOCKING IN GRINDSTONE LAKE

Year	Age Class	Number Stocked	Average Length (Inches)
2021	LARGE FINGERLING	1773	14.03
2017	LARGE FINGERLING	736	11.9
2014	LARGE FINGERLING	3108	10.97
2011	LARGE FINGERLING	2991	10.13
2009	LARGE FINGERLING	2499	9.4
2007	LARGE FINGERLING	1755	12.1
2005	LARGE FINGERLING	1881	11.9
2003	LARGE FINGERLING	2499	11.48
2001	LARGE FINGERLING	3011	11
2000	LARGE FINGERLING	1500	12.2
1997	LARGE FINGERLING	1380	12.2
1996	FINGERLING	1501	11.7
1993	FINGERLING	1500	11.9
1992	FINGERLING	1500	9
1991	FINGERLING	3300	10.6
1990	FINGERLING	1000	11
1989	FINGERLING	1000	9
1988	FINGERLING	4510	10.14
1987	FINGERLING	3000	9
1986	FINGERLING	2000	10.5
1985	FINGERLING	4490	11
1984	FINGERLING	1300	8
1983	FINGERLING	1250	11
1982	FINGERLING	1000	12
1981	FINGERLING	700	7
1980	FINGERLING	970	9
1979	FINGERLING	2748	11.4
1978	FINGERLING	3000	7.5
1977	FINGERLING	3500	3
1976	FINGERLING	3012	9.4
1975	FINGERLING	986	13
1973	FINGERLING	600	13
1972	FINGERLING	1650	14

Plant Community

Functions and Values of Native Aquatic Plants

Naturally occurring native plants are extremely beneficial to lakes. They provide a diversity of habitats, help maintain water quality, sustain fish populations, and support common lakeshore wildlife such as loons and frogs.

Water Quality

Aquatic plants can improve water quality by absorbing phosphorus, nitrogen, and other nutrients from the water that could otherwise fuel nuisance algal growth. Some plants can even filter and break down pollutants. Plant roots and underground stems help to prevent re-suspension of sediments from the lake bottom. Stands of emergent plants (whose stems protrude above the water surface) and floating plants help to blunt wave action and prevent erosion of the shoreline.

Fishing

Habitat created by aquatic plants provides food and shelter for both young and adult fish. Invertebrates living on or beneath plants are a primary food source for many species of fish. Other fish such as bluegills graze directly on the plants themselves. Plant beds in shallow water provide important spawning habitat for many fish species.

Waterfowl

Plants offer food, shelter, and nesting material for waterfowl. Birds eat both the invertebrates that live on plants and the plants themselves.[29]

Protection against Invasive Species

Non-native invasive species threaten native plants in Northern Wisconsin. The most common are Eurasian water milfoil (EWM) and Curly-leaf pondweed (CLP). These species are described as opportunistic invaders. This means that they take over openings in the lake bottom where native plants have been removed. Without competition from other plants, these invasive species may successfully become established and spread in the lake. This concept of opportunistic invasion can also be observed on land in areas where bare soil is quickly taken over by weeds.

Removal of native vegetation not only diminishes the natural qualities of a lake, but it increases the risk of non-native species invasion and establishment. The presence of invasive species can change many of the natural features of a lake and often leads to expensive annual control plans. Allowing native plants to grow may not guarantee protection against invasive plants, but it can discourage their establishment. Native plants may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.[30]

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[29] Above paragraphs summarized from *Through the Looking Glass*. Borman et al. 1997.

[30] *Aquatic Plant Management Strategy*. DNR Northern Region. Summer 2007.

Aquatic Plant Survey

Grindstone Lake aquatic plant inventories were completed in 2006 (Schieffer, 2006) and 2021 (Schieffer, 2021) using the WDNR-specified point intercept method. Early season surveys were conducted in June to identify the locations of Curly-leaf pondweed and other aquatic invasive species. Warm water native plant surveys were conducted in July (2006) and August (2021). An early season survey was conducted in Little Grindstone Lake in 2023 (Schieffer, 2023). The survey and data analysis methods and detailed results for the aquatic plant survey are found in the reports.

A brief summary of the results most relevant to aquatic plant management are presented in this plan. While there were some significant increases and decreases in native plant species frequency of occurrence and rake fullness, these were most likely attributed to natural variation rather than human influence.

Definitions

Rake Fullness: Is a measure of the quantity of plants found at a sample point when pulled up by a rake as shown in Figure 17. The rake fullness ranges from 0 to 3. Total rake fullness and rake fullness for individual species are recorded for each sample point.

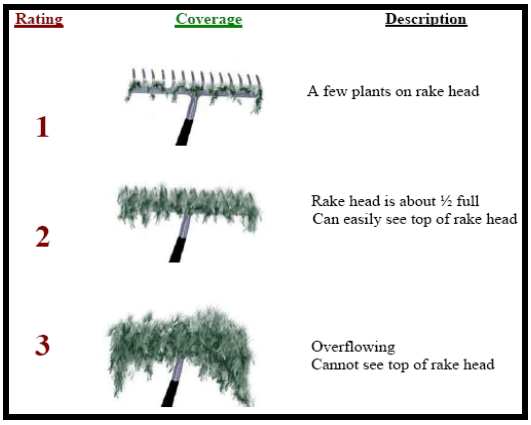


FIGURE 17. RAKE FULLNESS RATINGS

Littoral Zone: The area of the lake that extends to the deepest point at which plants will grow. Not all sample points in the littoral zone have vegetation. In clear lakes, such as Grindstone Lake, plants may be found at depths of over 20 feet, while in stained or turbid locations, they may only be found in up to a few feet of water. While some species can tolerate very low light conditions, others are only found near the surface.

Simpson's Diversity Index: The Simpson's Diversity Index value represents the probability that two randomly selected, individual plants will be different species. The index values range from 0 to 1 where 0 indicates that all the plants sampled are the same species, to 1 where none of the plants sampled are the same species. The greater the index value, the higher the diversity in a given location. Although many natural variables like lake size, depth, dissolved minerals, water clarity, mean temperature, etc.

can affect diversity, in general, a more diverse lake indicates a healthier ecosystem. Perhaps most importantly, plant communities with high diversity also tend to be more resistant to invasion by exotic species.

Floristic Quality Index (FQI): This index measures the impact of human development on a lake's aquatic plants. The 124 species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1 to 10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and they often exploit these changes to the point where they may crowd out other species. The higher the index value, the healthier the lake's macrophyte community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, North Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. Grindstone Lake is in the Northern Lakes and Forests Ecoregion.

Aquatic Plant Survey Results

The 2021 Grindstone Lake Aquatic Macrophyte Survey revealed a healthy and diverse plant community. Thirty-four species of native aquatic plants were sampled. The Simpson's diversity index was high at 0.92. The aquatic plant coverage was limited with plants present at only 48.8% of the sample points within the littoral zone (the area in depths at which plants grow in the lake). This was only 16.9% of the entire lake. Plants grew in depths up to 25.6 feet in 2021. In 2006, plants grew on 53% of the then 29.2 foot deep littoral zone, or 17.3% of the entire lake.

Numerous sensitive plants were sampled, resulting in a Floristic Quality Index of 39.2. This FQI is substantially higher than the median for lakes studied in the same eco-region. The Northern Lakes and Forests median FQI is 24. There were no endangered, threatened, or species of special concern sampled or viewed in Grindstone Lake. There were no invasive plant species sampled or viewed at the sample points. Three invasive species were observed when boating around the lake. These were: aquatic forget me not (*Myosotis scorpioides*), reed canary grass (*Phalaris arundinacea*), and purple loosestrife (*Lythrum salicaria*). All three of these plants can spread in wetlands and become dominant.

A chi-square analysis comparing the frequency in 2006 vs. 2021 showed a statistically significant increase in 12 species. Five species had a statistically significant decrease between 2006 and 2021. The number of species sampled increased from 24 to 34 between 2006 and 2021. No known plant management activities have occurred on Grindstone Lake, so changes could result from natural variability in the plant community or other human activity that negatively affects more sensitive plants.

The most common plants sampled in Grindstone Lake are common plants found in Wisconsin lakes, and all serve essential roles in the lake ecosystem.

Most Common Aquatic Plant Species (2021)

Variable pondweed (*Potamogeton gramineus*)
Slender naiad (*Najas flexilis*)
Coontail (*Ceratophyllum demersum*)
Flat-stem pondweed (*Potamogeton zosteriformis*)

Since Grindstone Lake has limited plant coverage, the areas with plants present are critical. Areas with high species richness, floating and emergent vegetation, and sensitive plants should be considered essential plant habitats. These areas, circled in Figure 18 below, should be monitored for changes and scrutinized in a broader critical habitat analysis.

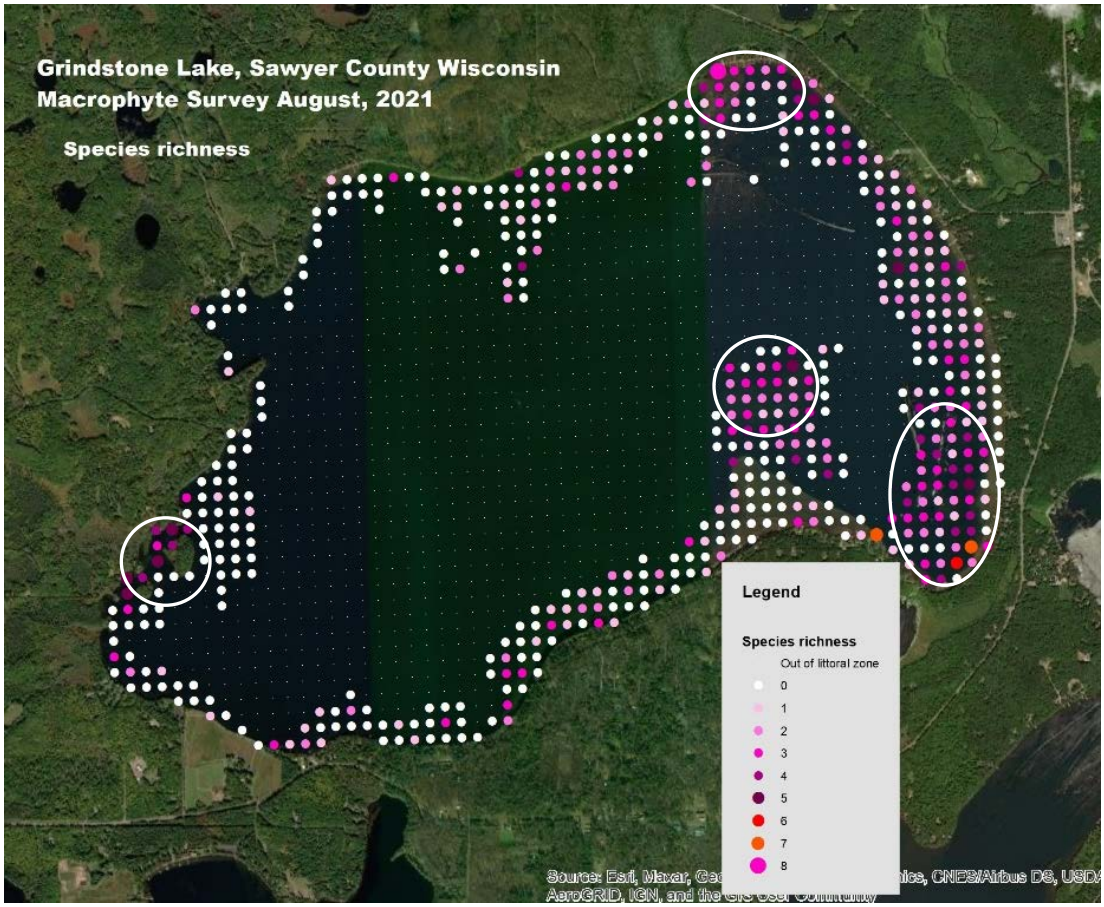


FIGURE 18. SPECIES RICHNESS 2021 AQUATIC PLANT SURVEY

Little Grindstone Aquatic Invasive Species

Eurasian water milfoil and curly-leaf pondweed were observed in the 2023 early season aquatic plant survey. Curly-leaf pondweed, found in low density in both the point intercept and meander survey, was previously known to be present. Eurasian water milfoil was discovered for the first time in Little Grindstone during the 2023 early season meander survey. Although EWM density was low, hand removal was recommended to prevent introduction into Grindstone Lake (Schieffer, 2023).

Discussion

The 2021 Grindstone Lake aquatic macrophyte survey results show a healthy, diverse aquatic plant community with numerous sensitive plants present. The coverage of aquatic plants in Grindstone Lake is limited, so preserving native aquatic plants in Grindstone Lake is paramount. Numerous aquatic organisms rely on these plants for food and habitat, and if the plant coverage decreases, it could be detrimental to the lake ecosystem.

Three aquatic invasive species (AIS) were observed. There was only one location each where aquatic forget me not and purple loosestrife was observed. There may be additional locations of these plants that were not observed in the survey. Reed canary grass is more common around the lake. However, reed canary grass is typically not mitigated due to its common occurrence (unless infesting a restoration area). Additional invasive species: banded mystery snail, curly-leaf pondweed, and rusty crayfish are noted as present in the lake in the DNR Lakes Pages.[32] The mystery snails and rusty crayfish are typically not managed actively and do not present any known risks to the Grindstone Lake ecosystem or recreational capacity (Wolter, 2008). Curly-leaf pondweed (CLP) was not found in Grindstone Lake in the June 2021 point intercept survey. The Little Grindstone 2023 early season survey confirmed the presence of CLP (Schieffer, 2023). More significantly, Eurasian water milfoil (EWM) was found in four locations in Little Grindstone Lake for the first time. No beds were observed, with only individual plants or tiny clumps of EWM plants present.

The susceptibility of Grindstone Lake to AIS, such as Eurasian water-milfoil, is likely lower than that of many other lakes. This is because there are limited high nutrient sediments in shallow water regions for AIS to thrive. However, confirmation of EWM in Little Grindstone increases the chance of introduction into Grindstone Lake. And, since the vast majority of plant growth in Grindstone Lake occurs on high nutrient sediments, introducing AIS into these limited plant areas would be detrimental to the lake ecosystem. Existing native plant cover can reduce the likelihood of AIS taking hold in the lake. Therefore, it is essential to maintain a diverse, native plant community in Grindstone Lake. Figure 19 designates areas of greatest concern for AIS introduction due to present plant growth, sediment type, boat traffic, and proximity to boat launches.

[32] https://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2391200&page=facts

FIGURE 19. GRINDSTONE LAKE AIS RISK AREAS

Aquatic Plant Management Recommendations

1. ***Preserve existing native plant communities.***

2. ***Conduct an AIS survey*** *of Grindstone Lake and Little Grindstone Lake at least one each year during the growing season. Since invasive species can spread quickly, regular AIS surveys are important. Surveys may be conducted by trained volunteers or professional staff or contractor.*

3. ***Continue AIS prevention activities*** *including the Clean Boats, Clean Waters program.*

4. ***Examine options to expand AIS prevention efforts.***

5. ***Consider control measures for curly-leaf pondweed and Eurasian water milfoil.***

Lake Management Planning

Goals and Objectives

The Grindstone Lake Advisory Committee discussed priority concerns and desired results at the first meeting, and additional guidance was provided by the property owner survey. This information was used to develop plan goals and objectives.

Lake Management Alternatives

Alternative actions that were considered as means to meet goals and objectives were provided by committee members and recommended by consultants and advisors. Alternatives included current actions of the GLA. Committee members refined the description of each alternative and selected those that remain in the plan.

Alternatives/Actions Analysis

In some cases, actions included in the Grindstone Lake Comprehensive Lake Management Plan (CLMP) lack detail for implementation or are listed for consideration only. Alternatives will be evaluated for inclusion in more detailed implementation plans and updates to this plan with the following in mind:

1) Does the action fit under one of the CLMP goals?
2) Does the action fulfill one of the CLMP objectives? If not, is the result to be obtained from the action important, and does it necessitate a new plan objective?
3) How will the action's progress toward plan objectives be evaluated?
4) What alternatives are available to reaching the objective?
    a. Is this action more likely to produce results compared with other alternatives?
    b. Is this action more cost effective when compared with other alternatives?
    c. Does the risk of no action outweigh the risk of uncertainty of success?
5) Does the GLA and/or its partners have the resources available to implement the action? Volunteers? Advisors? Funding for consultants or construction?
6) Is grant funding available to support the action?
7) Who (what committee, board member, volunteer) is responsible to lead the action?

Plan Implementation

This section of the plan lists goals and objectives for lake management for Grindstone Lake. It also presents a list of actions that will be used to reach plan goals and objectives.

Goals are broad statements of desired results. Goals are listed in order of priority established by the advisory committee.

Objectives are the measurable accomplishments toward achieving a goal. Methods to evaluate progress toward plan objectives are listed below the objectives and are included in the implementation plan as "Evaluation Actions."

Actions are the steps taken to accomplish objectives and ultimately goals.

The Grindstone Lake Association (GLA) board and committees will track implementation of plan actions and evaluate progress toward reaching plan goals and objectives. An action plan spreadsheet will be used as a planning and tracking tool.

Plan Guiding Principles

Grindstone Lake management activities are guided by best available science and practice and adaptive management.

Adaptive management is a systematic approach for improving resource management by learning from management outcomes. Adaptive management uses results of monitoring, evaluation of project activities, and updated information to modify and guide future project implementation.

Management Plan Goals

I. Preserve excellent lake water quality.

II. Prevent the introduction of aquatic invasive species.

III. Respond rapidly to new introductions of aquatic invasive species and reduce the impacts of established AIS.

IV. Support a healthy and diverse fishery as guided by the Grindstone Lake Fishery Management Plan.

V. Support healthy native aquatic plant communities.

VI. Support the efforts of the Grindstone Lake Association with an engaged lake community.

Goals, Objectives, and Actions

Goal 1. Preserve excellent lake water quality.

Objectives

A. Preserve two-story fishery with no degradation in water quality.

   a. Maintain mean total phosphorus at or below 12.6 µg/L (historic June 15 to September 15 levels).

   b. Maintain chlorophyll a at or below 2.1 µg/L (historic July 15 to September 15) with no results above 20 µg/L..

   c. Support a lower DNR two-story fishery impaired waters site specific threshold for total phosphorus for Grindstone Lake as justified by lake quality monitoring and modeling.[33]

B. Maintain trophic state index (TSI) based on chlorophyll-a and water clarity (Secchi depth) at oligotrophic levels.

C. Improve trophic state index (TSI) based on total phosphorus levels from mesotrophic to oligotrophic levels.

> ***Trophic State Index***
>
> *The Carlson Trophic State Index (TSI) is a measure of lake productivity or nutrient level. Higher trophic state index values indicate the lake has more nutrients which results in more algae growth. Various parameters (total phosphorus, chlorophyll-a, and Secchi depth) are used to calculate a TSI, and ranges of TSI value represent a particular trophic state. A lower TSI reflects low nutrient levels and less algae growth. Oligotrophic TSI values are below 40. Historic Grindstone Lake TSI values are shown in Figure 8 and 9. For this plan, WISCALM dates of June 1 to September 15 are used for TP and Secchi TSI calculations, and June 15 to September 15 are used for chlorophyll a TSI Calculations.*

D. Minimize sediment inputs to Grindstone Lake.

E. Preserve functioning wetlands and restore wetland functions in priority areas.

[33] Current WDNR two-story fisheries impaired waters thresholds are shown in Table 3. A lower total phosphorus criterion of 10 µg/L was approved by the Wisconsin Natural Resources Board for Lac Courte Oreilles in June 2023. Final legislative and governor's approvals are pending as of September 5, 2023.

Evaluation

Support the LCO Conservation Department long-term monitoring program (Objectives A, B, C**).** *Consistent monitoring will help to identify trends and evaluate management practices. Minimum data collection should include near-surface total phosphorus, chlorophyll-a, and Secchi depth (at least monthly during the growing season). Dissolved oxygen and temperature profiles in the deep hole are also recommended to assess if the lake is periodically mixing and maintaining oxythermal habitat standards for a two-story fishery.*

- Coordinate with and support LCO Conservation Department monitoring.
- Consider automated temperature and oxygen probes and thermistor string.
- LCO Conservation Department will provide written annual water quality reports to the GLA.

Actions

1. Install best management practices (BMPs) in near shore areas (Objectives A, B, C and D).
    a. Identify areas with high potential for nutrient and sediment loading. *The focus for mitigation will be areas with large impervious surfaces, buildings, and manicured lawns. The shoreland survey can be used to identify priority areas to implement best management practices. New development and redevelopment are also a priority because of high potential for erosion during and just after construction. Priority areas for minimizing sediment input will be identified to protect rocky walleye spawning areas.*
    b. Establish demonstration sites for various BMPs and locations around the lake.
    c. Provide technical assistance to design or support homeowner installation of BMPs. *Consider WDNR grant for county or another partner to provide technical assistance. Potential best management practices include infiltration devices (especially adjacent to impervious surfaces), rain gardens, and shoreline buffers.*
    d. Provide financial assistance for BMP installation (WDNR Healthy Lakes and/or Surface Water grant).
2. Identify and prioritize areas for land protection. Use available tools to prevent land development in priority areas (Objectives A, B, C and D).
3. Identify and restore or preserve priority wetland areas (Objective E).
    a. Identify priority wetland areas.
    b. Restore wetland functions and prevent drainage from the former cranberry bog owned by the Grindstone Lake Foundation.

4. Educate and inform property owners regarding methods to preserve Grindstone Lake water quality (Objectives A, B, C and D).

WATER QUALITY EDUCATION AND OUTREACH

Target audiences

Shoreline property owners (especially new owners and those who are remodeling or re-developing property)

Outreach messages

- Importance/benefits of natural shoreline vegetation and functioning wetlands.
- Guidance on shoreline restoration and best management practices for infiltration.
- Lawn care practices for a healthy lake.
- Example photos of "good" vs "bad" practices.

Outreach methods

- Annual meeting presentations
- Newsletters
- Brochures and other written materials

ACTIONS FOR POTENTIAL FUTURE IMPLEMENTATION

- Support effective development of and compliance with local ordinances and state regulations that limit impacts of shoreline development including stormwater permitting and erosion control requirements for new development (Objectives A, B, C and D).
    a. Ask to be notified by Sawyer County of permits/variances in shoreland areas, and monitor violations and enforcement actions.
    b. Provide design support for mitigation required by land use and grading permits.
    c. Facilitate coordination between Town of Bass Lake and Sawyer County for land use activities.

- Support the Sawyer County Land and Water Conservation Branch as they design and install conservation practices (Objectives A, B, C and D).

- Investigate and potentially pursue development and approval of an EPA Nine-key element plan (Objectives A, B, C and D).

Goal II. Prevent the introduction of aquatic invasive species (AIS).

Objectives

A. No new AIS become established in Grindstone Lake.

B. Lake visitors and property owners are aware of the threats of AIS and take action to prevent their introduction.

C. AIS prevention actions address most likely invaders with potentially large ecological, recreational, and/or economic impacts.

Evaluation

Monitoring results: see Goal III action 1, 2, 3 (volunteer and professional AIS monitoring and early season point intercept survey).

Actions address priority AIS including Eurasian water milfoil and its hybrids, zebra mussels, purple loosestrife, and curly-leaf pondweed.

Collect and analyze CBCW data annually.

Property owner surveys

Actions

1. Continue and enhance the Clean Boats, Clean Waters Program:
   a. increase hours of coverage,
   b. provide effective training, and
   c. provide outreach at the County K Bridge between Little Grindstone Lake and Lac Courte Oreilles, (Objectives A, B, C).

2. Provide self-service resources for AIS prevention at the boat landings
   a. tools for plant and debris removal
   b. mild bleach solution for decontaminating equipment (Objectives A, B, C).

3. Install AIS prevention methods, such as cameras, that don't require staffing (Objectives A, B, C).

4. Gather and disseminate public information materials about AIS prevention for Grindstone Lake residents and visitors (Objectives A, B, C).

AIS PREVENTION EDUCATION AND OUTREACH

Target audiences

Lake property owners

Lake visitors: highest priority from nearby likely AIS sources (Lac Courte Oreilles, Little Grindstone), out-of-state, guides

Outreach messages

- For travel between lakes:
    1. Lift motors and anchors
    2. Clean off weeds and debris
    3. Back thrust motor
    4. Identify infested areas

- Less AIS, results in higher property values.
- Follow AIS prevention and decontamination procedures – it's the law.
- It is your duty to clean boats and trailers and drain live wells to prevent invasive plant and animal spread. Do not dump bait buckets in the lake. All may contain invasive species that are not visible to the naked eye.
- It is illegal to transport aquatic plants on boats, trailers, and equipment in Wisconsin.
- Decontamination is required in Sawyer County if an AIS decontamination method is provided at a landing
- We are surrounded by lakes with AIS.
- Once AIS have arrived, they are hard or impossible to eradicate.

Outreach methods

- Annual meeting presentations
- Newsletters
- Signs (such as on both sides of the County Rd K bridge over stream connection to Lac Courte Oreilles)

ACTIONS FOR POTENTIAL FUTURE IMPLEMENTATION

- Encourage enforcement of state AIS regulations and local ordinances (Objectives A, B, C).

Goal III. Respond rapidly to new introductions of aquatic invasive species (AIS) and reduce impacts of established AIS.

Objectives

A. A clear process is outlined for AIS monitoring, confirmation, and reaction to AIS introduction.

B. AIS monitoring is focused on areas of highest risk of introduction when resources are limited (see Figure 19).

C. AIS do not create nuisance conditions or impair native aquatic communities.

D. Control measures are effective in removing AIS.

Evaluation

An AIS rapid response protocol is updated and available.

Curly-leaf pondweed is not present in Grindstone Lake and is very limited in Little Grindstone Lake.

Eurasian water milfoil is not present in Grindstone Lake or Little Grindstone Lake.

Actions

1. Provide professional monitoring with an AIS meander survey at least annually. Two surveys, one in early June and the second in mid- July to August, are recommended. (Objective A and B).

2. Follow procedures outlined in the Grindstone Lake AIS Rapid Response Protocol. Review and update the protocol at least annually (Objective A and B). The protocol is included as Appendix C.

3. Conduct volunteer monitoring for aquatic invasive species: support training, establish monitoring zones and appoint zone representatives, coordinate volunteers, provide contacts for ID verification (Objective A and B).

4. Conduct an early season point intercept survey of Grindstone and Little Grindstone Lake to assess growth of Curly-leaf pondweed (CLP) and Eurasian water milfoil when warm season point intercept survey is completed every 5-7 years (Objective B).

5. Consider control measures where CLP and EWM are found. Control measures might include hand pulling in shallow water, SCUBA removal in deeper water, planting native aquatic plants, and early season herbicide use. Conduct appropriate plant surveys to evaluate the effectiveness of control measures used (Objective D).

6. Gather, assemble, and distribute public information materials about AIS monitoring and control measures (Objective A, B, and C).

AIS RESPONSE EDUCATION AND OUTREACH

Target audiences

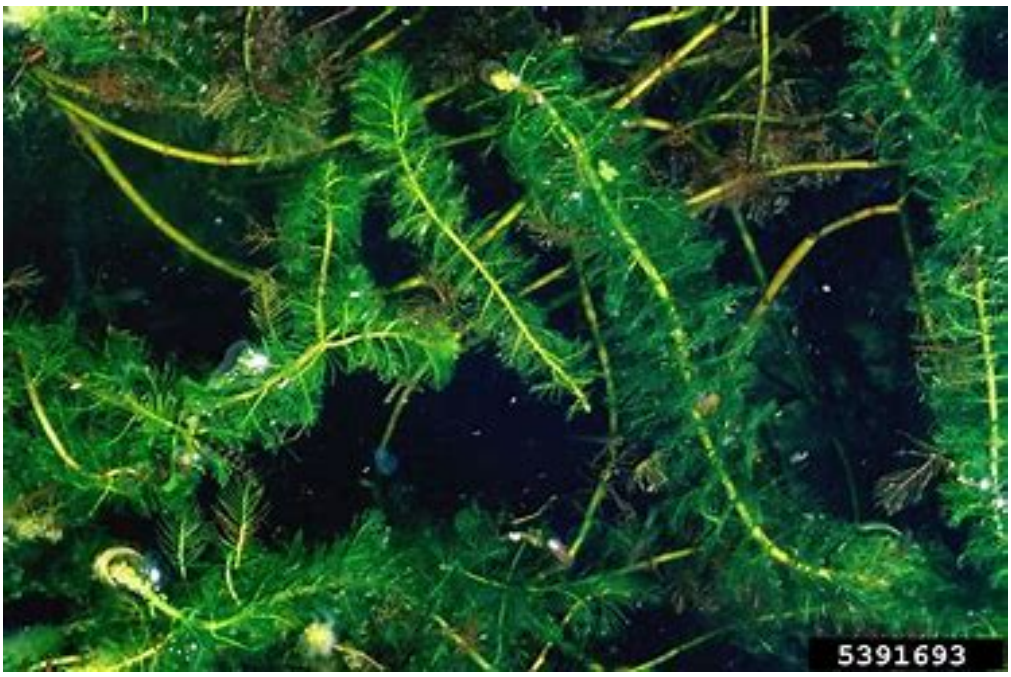
Lake residents

Outreach messages

- Provide identification information for curly-leaf pondweed (CLP) and Eurasian water milfoil (EWM), encourage hand pulling and removal of plant fragments.
- Provide identification information for additional AIS and contacts for suspected AIS in the lake.

Outreach methods

- Annual meeting presentations
- Newsletters



EURASIAN WATER MILFOIL

Goal IV. Support a healthy and diverse fishery as guided by the Grindstone Lake Fishery Management Plan.

Objectives

A. Ensure that residential and commercial development results in minimal nutrient input and associated eutrophication and minimal sediment input to preserve rocky spawning habitat (esp. for walleye).
   - Preserve undeveloped shorelines.
   - Protect and restore shoreline buffer zones.
   - Minimize runoff and erosion from developed shoreland lots.

B. Maintain oxythermal habitat for a two-story fishery.

C. Protect spawning and nursery habitats to support natural reproduction:
   - Increase shallow woody habitat in the form of "tree-drops" or "fish sticks" (benefit yellow perch, crappie, muskellunge, smallmouth bass).
   - Promote healthy stands of native aquatic plants (yellow perch), especially emergent vegetation (muskellunge)

D. Support non-game fish and other aquatic organisms that are an important link in the food chain.

Evaluation

WDNR fisheries surveys and onsite creel surveys (Objective A, C, and D)

Temperature and dissolved oxygen profile results (Objective B)

Actions

1. See Goal I for actions related to minimizing nutrient and sediment inputs to the lake (Objective A, B, C and D).

2. Identify important fisheries habitat/spawning areas (use aquatic macrophtye point intercept survey, shoreland survey, 2010 sensitive area survey, WDNR fish surveys, spotlight observations, and tribal harvesting records as a guide). Use the results to prioritize protection measures such as runoff prevention, shoreline buffer restoration, land protection, and woody habitat installation (Objective A, B, C and D).

3. Promote installation of woody habitat by providing technical assistance and cost sharing (Objective C).

4. Establish and implement a water quality sampling protocol to measure dissolved oxygen and temperature at multiple depths and locations to determine whether the oxythermal habitat requirements are met for a two-story fishery (Objective B). Also, see Goal I - Evaluation.

5. See Goal V for actions related to preserving native plant communities (Objective A and D).

ACTIONS FOR POTENTIAL FUTURE IMPLEMENTATION

- Consider supplementing WDNR and LCO fish stocking when the need is identified such as in low natural production years (as guided by fishery management plans).
- Participate in WDNR fisheries planning sessions, and provide input in other ways as requested (Objective A, B, C and D).

Goal V. Preserve native aquatic plant communities.

Objectives

A. Minimize disturbance from boating and plant removal in near-shore areas.

B. Preserve emergent and floating aquatic vegetation. Areas with high species richness, floating and emergent vegetation, and sensitive plants should be considered important plant habitats (See Figure 18).

C. Reduce sedimentation of aquatic habitats.

Evaluation

Conduct an aquatic plant point intercept survey in Grindstone Lake and Little Grindstone Lake every 5 to 7 years to assess aquatic plant changes.

Actions

1. Investigate options to encourage enforcement of no-wake ordinances and regulations (Objectives A, B, and C).

2. See Goal I for actions related to minimizing sediment inputs to the lake (Objective C).

AQUATIC PLANTS **PHOTO BY ED RONKOWSKI**

Provide outreach to lake residents to encourage preservation of native aquatic plant communities (Objectives A, B, and C).

NATIVE PLANT PRESERVATION OUTREACH AND EDUCATION

Target audiences

Lake residents

Owners of short-term rentals

Outreach messages

Limit impacts to native aquatic plants. They play a very important role in the lake ecosystem. Aquatic plant growth is limited to a few small areas and a very narrow littoral zone in other parts of the lake. A property owner who removes plants could have a significant negative impact on the limited Grindstone Lake plant community.

- Observe no-wake restrictions (describe requirements and benefits e.g., protecting shoreline habitat).
- Boats may uproot native plants and break aquatic plants into fragments.
- Bare substrate is more likely to be colonized by non-native species.
- Plant fragments contribute phosphorus to the water as they decay.
- Curly-leaf pondweed and Eurasian water milfoil fragments broken up by boat propellers may root and encourage uncontrolled spread of these invasive plants.
- Regular waterfront use like boating, swimming, and clearing removes native aquatic plants.
- Healthy native plant populations prevent colonization by invasive plants.
- Erosion and runoff from waterfront property may alter sediment characteristics and encourage spread of invasive plants.
- Discourage introduction of non-native invasive species.

Outreach methods

- Annual meeting presentations
- Newsletters
- Signs
- Grindstone Lake Courtesy Code

Goal VI. Support the efforts of the Grindstone Lake Association with an engaged lake community.

Objectives

A. Organization efforts focus on identified priorities and projects especially where multiple goals and objectives are accomplished.

B. Volunteer efforts are encouraged, supported, and recognized.

C. The Grindstone Lake Association (GLA) has the financial and human resources needed to accomplish plan goals and objectives.

D. A high percentage (80%) of Grindstone Lake residents are members of the GLA.[34]

Evaluation

Evaluation measures are used to track progress toward meeting plan goals and objectives (see other plan goals).

Residents are surveyed on a variety of lake topics at least every five years (Action).

Evaluation Measures

Number of GLA members

Achieving fundraising goals

Number of active committees

Number of active volunteers

Actions

1. Develop a "*Keep Grindstone Clean,*" "*Preserve Pure Grindstone,*" or similar campaign. Acknowledge the over-arching importance of maintaining clean water and preventing foreign substances and organisms from entering Grindstone Lake (Objective A).

    a. Use outreach audience, messages, and methods listed for each goal. Stress "hot topics" (Objectives A, B, C and D). Communicate with lake residents via e-communication (including president's quarterly report), website, newsletter, and Facebook.

[34] As of December 2022, 43% of Grindstone Lake Owners are members of the GLA. Personal Communication, Donna Carlson, President, Grindstone Lake Association. December 7, 2022.

b. Organize outreach efforts by neighborhood zones surrounding Grindstone Lake for outreach, monitoring, etc. Assign neighborhood leaders. Reach new owners within neighborhoods early (Objectives B, C, and D).

2. Establish and support a committee structure for plan implementation including seeking technical assistance. Assign clear responsibilities and leads. Committees report to the GLA board of directors (Objectives B and C).

    a. Seek professional support for mapping and Geographic Information System (GIS) services (Objectives A and C).

3. Recognize, support, and coordinate partner involvement and support of the Grindstone Lake Comprehensive Lake Management Plan. Host a partner meeting at least once each year (Objectives A and C).

4. Engage lake residents by offering activities that encourage lake protection (such as litter pick-up, demonstration site events, etc.) (Objectives B, C and D).

GLA GRANT WORKSHOP 2019

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Appendix A. Property Owner Survey Results

Grindstone Lake Resident Survey Summary Results
July 7, 2022

The Grindstone Lake Association is in the process of developing a comprehensive lake management plan to address water quality, aquatic plant management, lake habitat, human land development activities and other considerations designed to protect the long-term ecological health of Grindstone Lake.

Problem Statement

Historically, Grindstone Lake has exhibited excellent water quality. The lake has supported a two-story fishery and excellent water clarity. However, during the past 20 years, water clarity has declined by 4 inches of Secchi depth per year according to water quality analyses conducted by the LCO Conservation Department (Tyrolt, 2020). Higher phosphorus levels have also been detected (Tyrolt, 2020).

The Grindstone Lake Association needs to better understand the current conditions of Grindstone Lake and its watershed in order to engage citizens in its protection. Past studies of the lake and its environs include: 2006 aquatic plant management plan; 2008 sediment core study; 2010 critical habitats and priority shorelines study; and a 2010 water quality report. In 2019, WDNR and UW-Extension facilitated a WDNR-funded capacity building workshop of Grindstone Lake Association members and agency partners who identified 3 priority areas: (1) mitigate phosphorus loads to the lake; (2) engage lake property owners in lake protection efforts and, (3) prevent aquatic invasive species from entering the lake (especially Eurasian milfoil from LCO and Curly leaf pondweed from Little Grindstone). Results from past studies have guided the efforts of the GLA, LCO Conservation Dept, and WDNR to protect Grindstone Lake.

To inform the development of a comprehensive lake management plan for Grindstone Lake, the following data were collected during 2021-2022:

- Watershed land cover and associated nutrient loading
- Lake water quality
- Aquatic plant survey
- Shoreland activities
- Lake resident survey of experiences, concerns, and perspectives

This section of the report presents findings from the Grindstone Lake Resident Survey

Purpose

A survey of lake residents was conducted to understand lake resident concerns, experiences and perceptions to: (1) inform the development of the Comprehensive Lake Management Plan; (2) further our understanding of the Grindstone Lake community; and, (3) identify ways to improve resident involvement in lake protection activities and the Grindstone Lake Association.

Methods

<u>Survey Development</u>

The Grindstone Lake Resident Survey was developed based on reviews of survey questions provided by the WDNR questionnaire database and survey instruments used by other lake associations in the area (Spider Chain of Lakes and Lac Courte Orielles). Survey questions were drafted and then reviewed by Grindstone Lake Association board members. After discussions and recommended edits, a final draft survey was then sent to Lauren Bradshaw, WDNR, for final review and edits. The survey includes both closed-ended (questions with specific response categories) and open-ended questions.
The survey questions were then entered into the online survey software program, Qualtrics. The online version of the survey was then sent out to GLA board members for testing and to make any final edits and modifications.

Survey Questions

Survey questions addressed the following:

- Demographic and residency information
- Residence characteristics
    - General location of lake property/residence on Grindstone
    - Annual use of lake property or residence and timing of use
    - Location of permanent residence (state)
    - Number of years of ownership of lake property and age of cabin or home
    - Property ownership structure and whether a previous family member owned the property
- Lake-based activities
    - Major purpose of use of cabin and types of recreational activities of residents
    - Ownership of lake-based amenities
    - Fishing
        - Whether residents fish and if so, types of fish caught
        - Perceptions about the Grindstone lake fishery
        - Whether residents fish on other lakes
- Importance of specific characteristics or elements to the enjoyment of Grindstone Lake (e.g. water clarity, scenery, etc.)
- Perceptions of the quality of or changes in Grindstone Lake
- Concerns associated Grindstone Lake
- Importance of management strategies
- Grindstone Lake Association
    - Involvement
    - Activities
    - Efforts the association should pursue

Survey Dissemination

A list of all Grindstone Lake property owners was generated from the Sawyer County land records. The list from Sawyer county was then cross-referenced with the Grindstone Lake Association member database to identify those property owners for which email addresses were available. The link for the survey was then sent out directly by email to Grindstone Lake property owners. Property owners in which email addresses were not available were sent a

postcard asking them to take the survey. The postcard then directed them to go to the Grindstone Lake Association website, select the survey link, and then take the survey.

The survey was available to residents from mid-April to mid-May. A follow-up email was sent to those for whom email addresses were available. Follow-up postcards were not sent out. Survey data were downloaded from Qualtrics into an Excel spreadsheet and then into SPSS, a data analysis software, to be reviewed, cleaned, coded and analyzed. Surveys in which less than 30% of questions were answered were eliminated from the analysis.

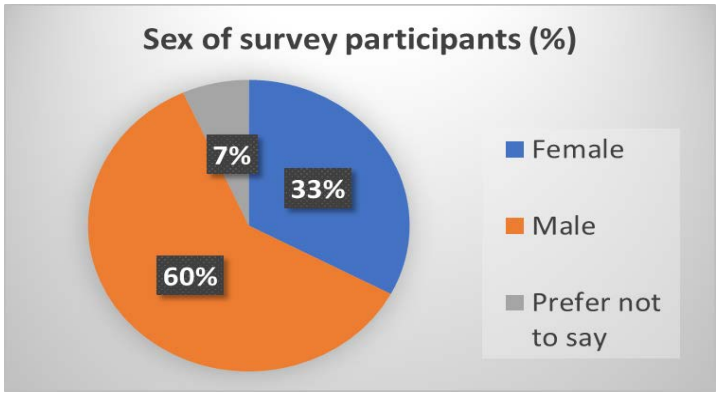
Survey Response Rate

The survey link and instructions on how to take the survey were sent to 243 email addresses and by postcard to 131 residential addresses for a total of 365 contacts. Of the residents who were sent information to take the survey, 211 responses were received. Of the 211 surveys, 22 surveys were eliminated due to low completion rates (less than 30% of the survey questions were answered) for a total of 189 surveys. The final survey response rate is 52%.

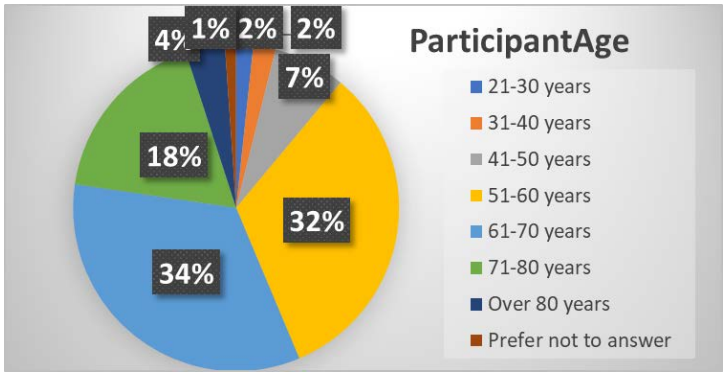
RESULTS

Characteristics of Survey Respondents

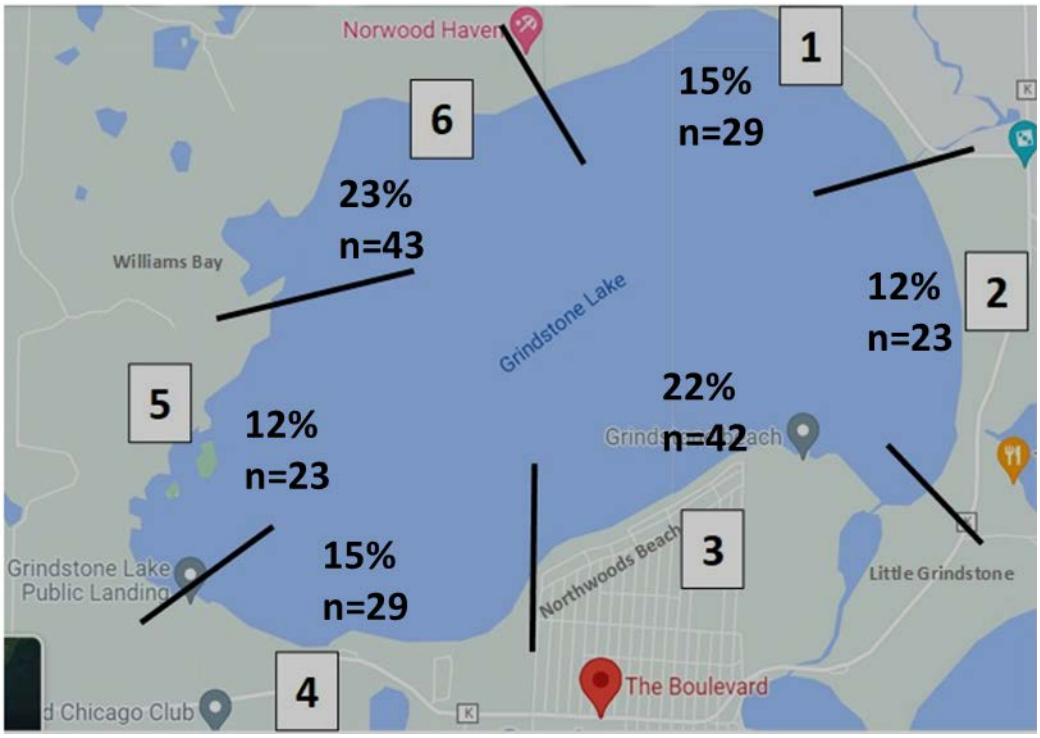
Of the 189 survey respondents, 60% identified as male, 33% as female, and 7% preferred not to self-identify.



Respondents tended to be older with the largest proportions between the ages of 51-60 years (32.7%) and 61-70 years (33%).

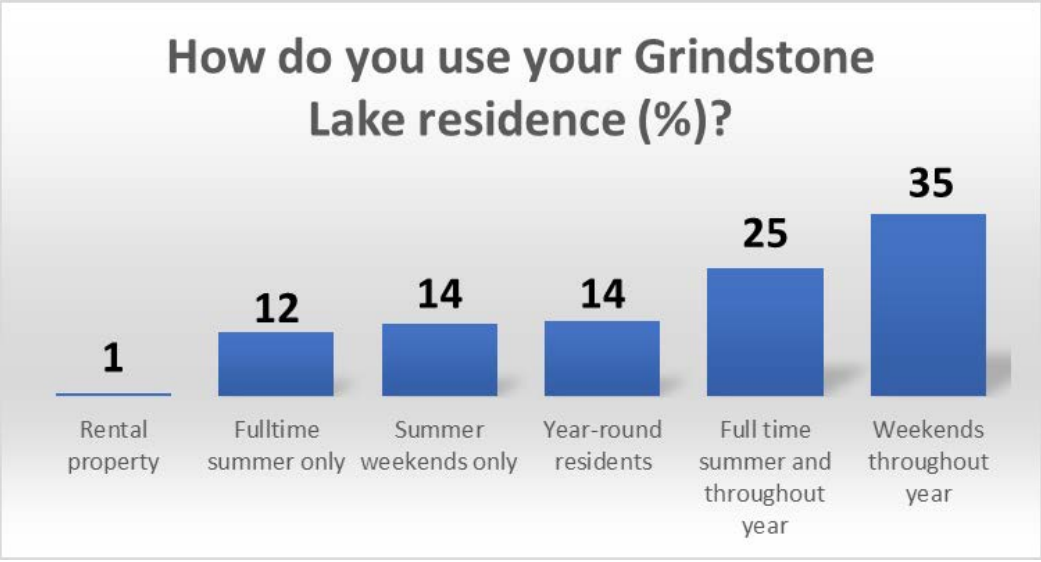


We also asked respondents to indicate their general location on the lake to ensure geographical representation. This may be particularly important if different parts of the lake vary in terms of issues or concerns. As indicated below, we had relatively even distribution of respondents around the lake, with somewhat higher numbers among those in the northwest (n= 43) and in the southeast (n=42) zones. These differences may also represent differences in numbers of properties in each zone.

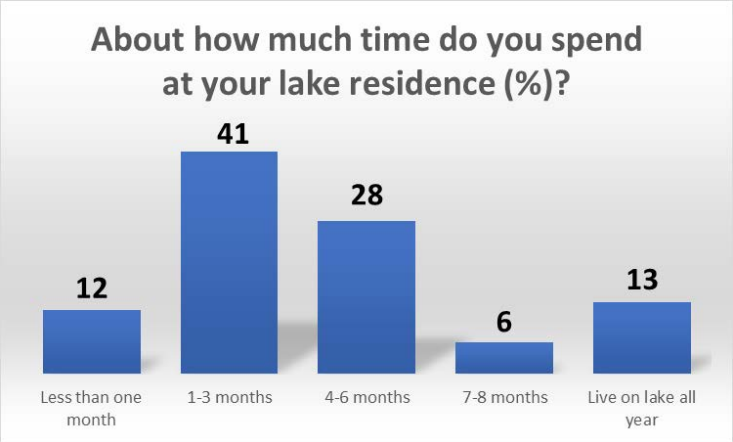


Lake Property and Residence Use Characteristics

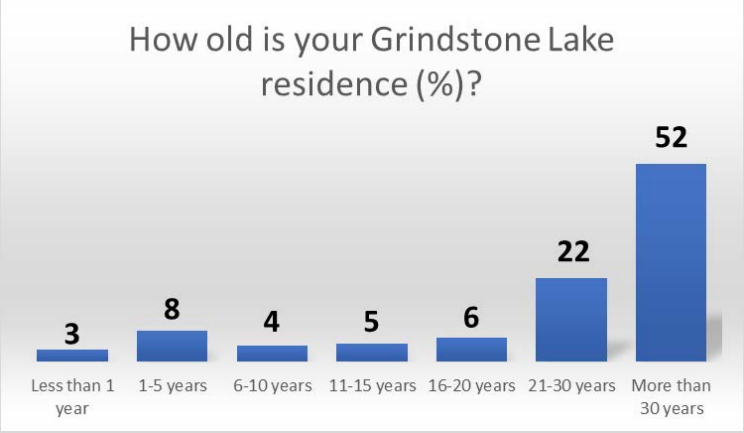
The largest proportion of survey respondents use their property only on weekends throughout the year (34.6%) or full-time in the summer and at times throughout the year (24.5%). About 14% of respondents live year-round on the lake.



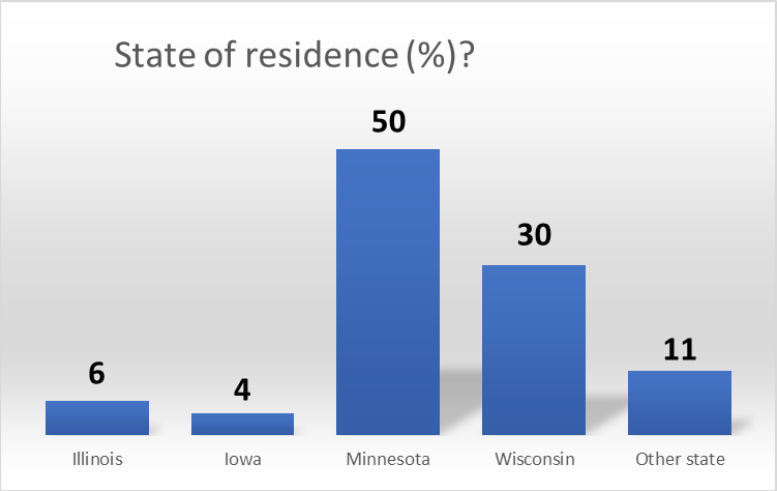
When asked specifically about the amount of time participants use their properties, most spend half a year or less (41% 1-3 months/year; 28.2% 4-6 months/year). Responses to the previous two questions suggests that educational and outreach activities may need to employ shorter-term engagement activities or more virtual engagement options.



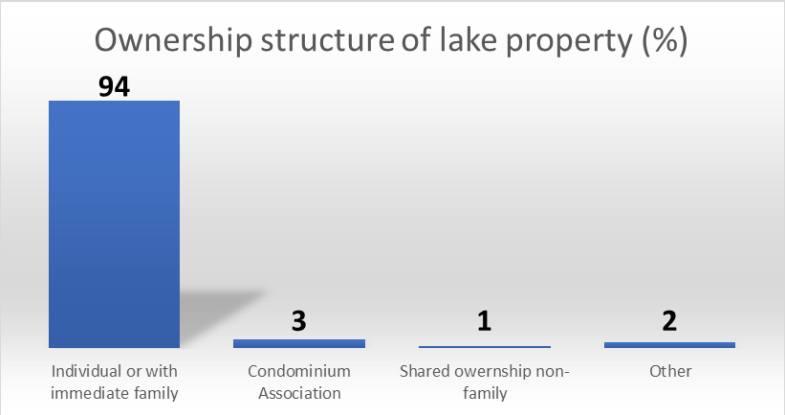
Despite many residents using their properties for less than 6 months, the greatest proportion of respondents indicated owning their properties for more than 30 years (38%); with the next highest proportion having owned their properties for 21-30 years (21.8%). In terms of the age of cabins, 51.6% of respondents indicated that their cabins or homes were more than 30 years old.

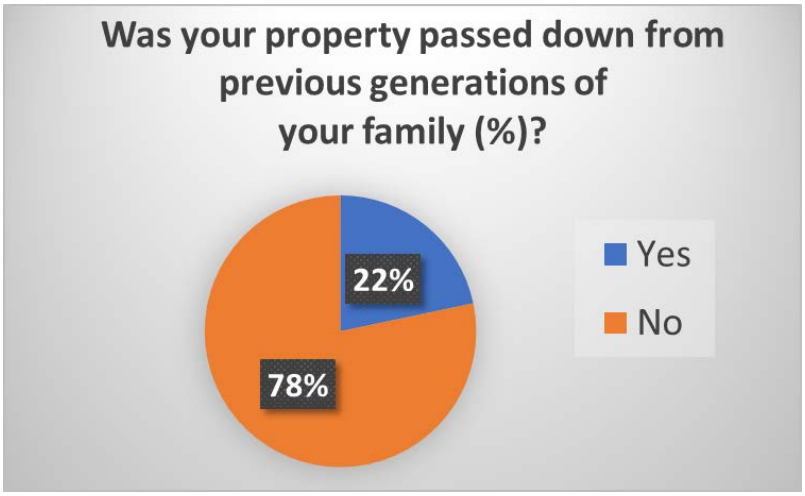


The largest proportion of respondents indicated Minnesota as the location of their permanent residence (49.7%), while 29.6% indicated Wisconsin.



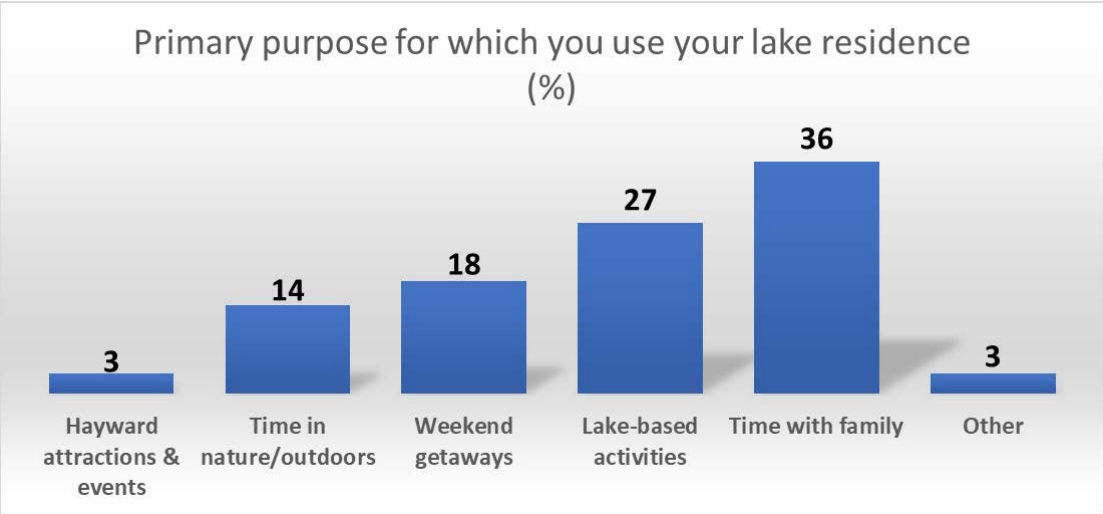
When asked about the structure of property ownership, almost all respondents indicated individual or family-shared ownership (94.2%), with about 22% owning a property that was passed down from the previous generation.



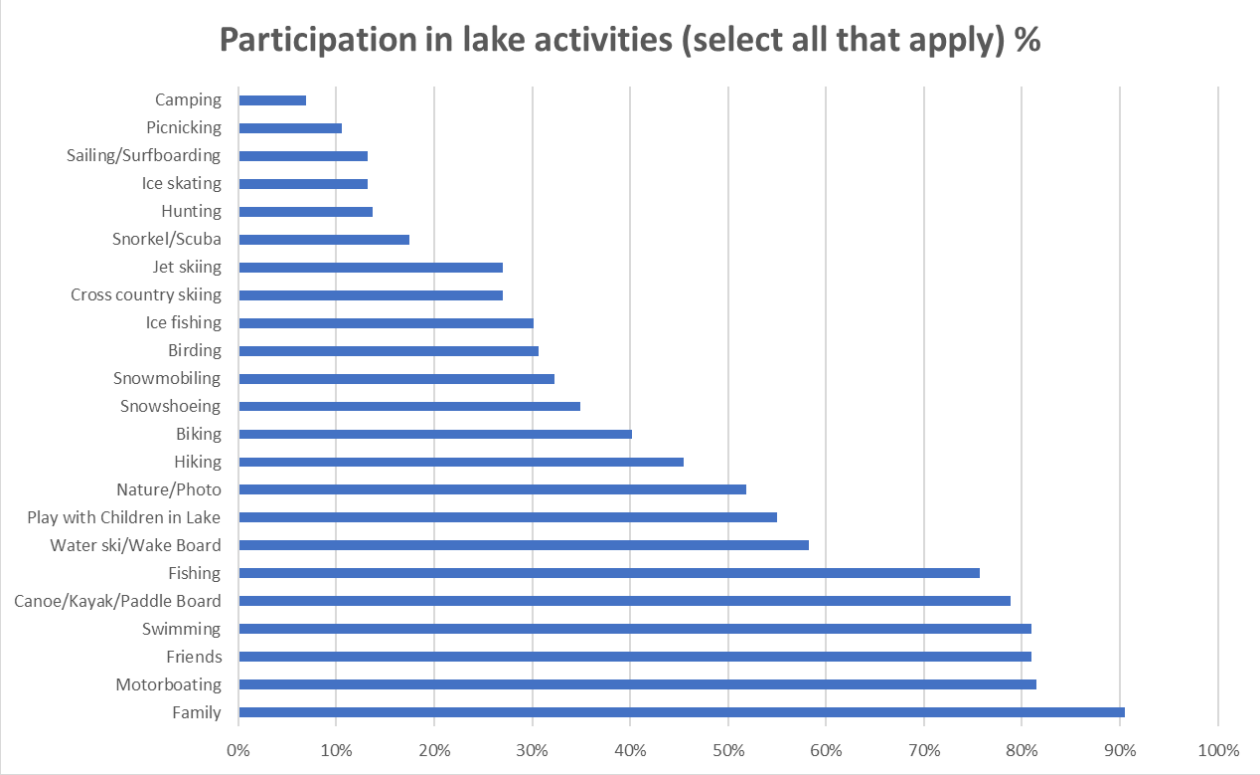


Lake-Based Activities

When asked about the primary purpose for which respondents used their lake property, time with family and lake-based activities were the most common responses.

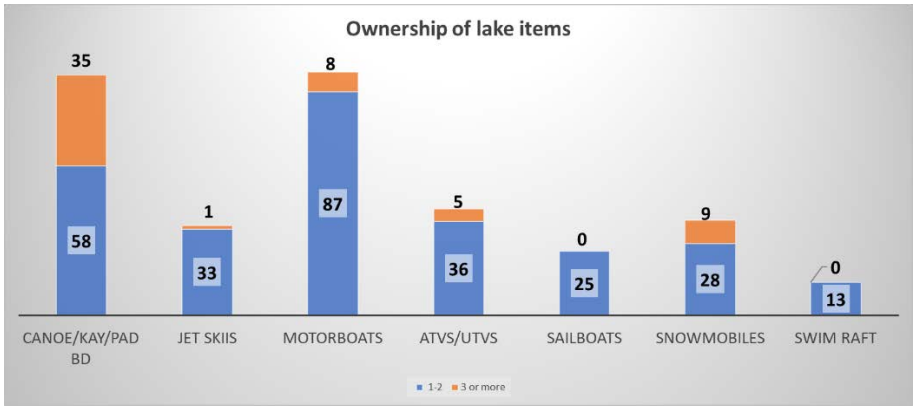


Respondents were also given a list of activities to select the activities that they and their family members engage in while at their property. In addition to time with family, those that were selected by the most respondents included summer-based activities such as motorboating, swimming, canoe/kayak/paddleboard, and fishing as well as sharing time with friends.



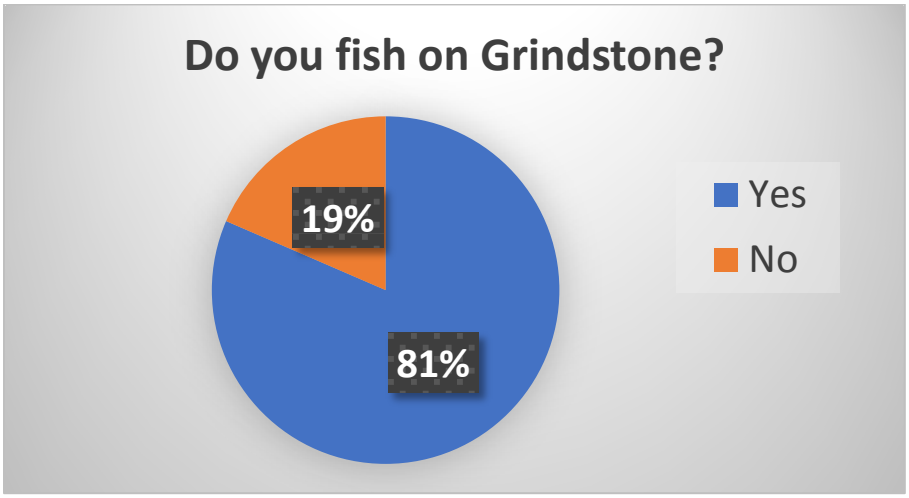
The focus on motorboating and canoe/kayak/paddleboarding activities above were reflected in the types of lake-based amenities owned by residents. Approximately 95% indicated owning at least one or more motorboats and 93% of respondents indicated owning at least one canoe,

kayak, or paddleboard. It is interesting to note that jet skis, which receive a significant amount of complaints during GLA meetings, were not as numerous as other motorized vehicles.

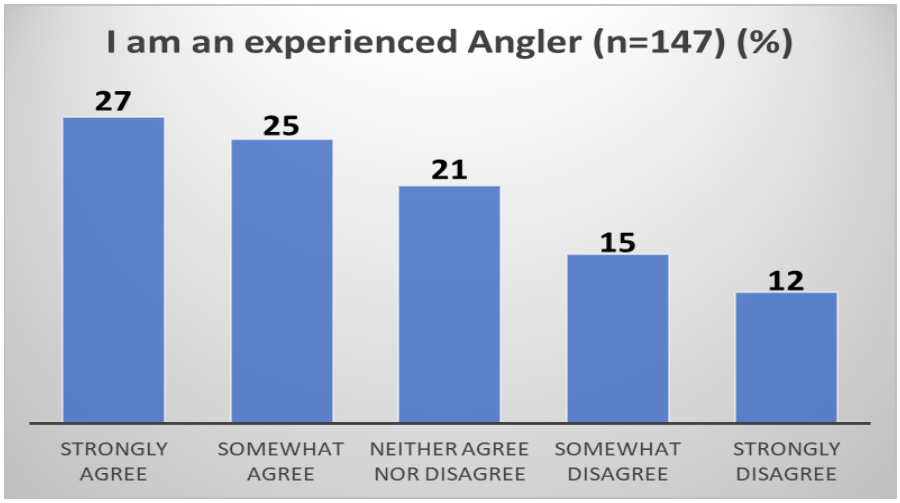


Fishing

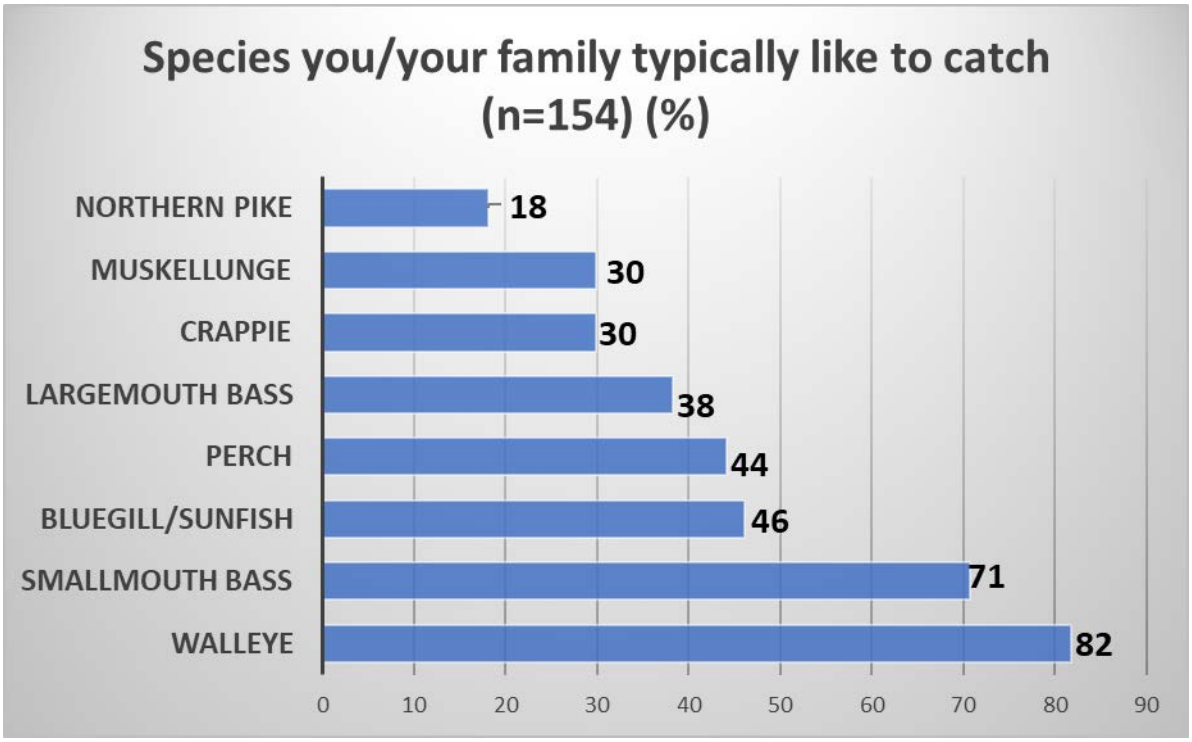
Over 80% of respondents indicated that they fished on Grindstone Lake.



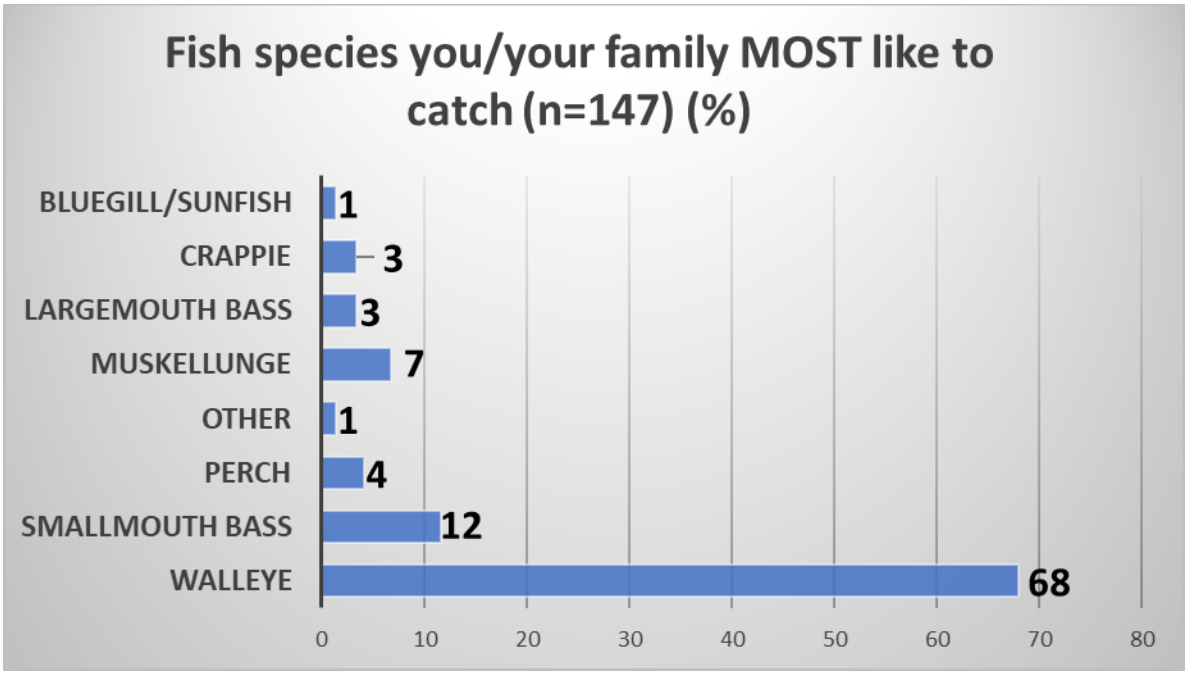
The greatest proportion of respondents who fished indicated that they either strongly agreed (27.2%) or somewhat agreed (25.2%) with the statement about being an experienced angler.



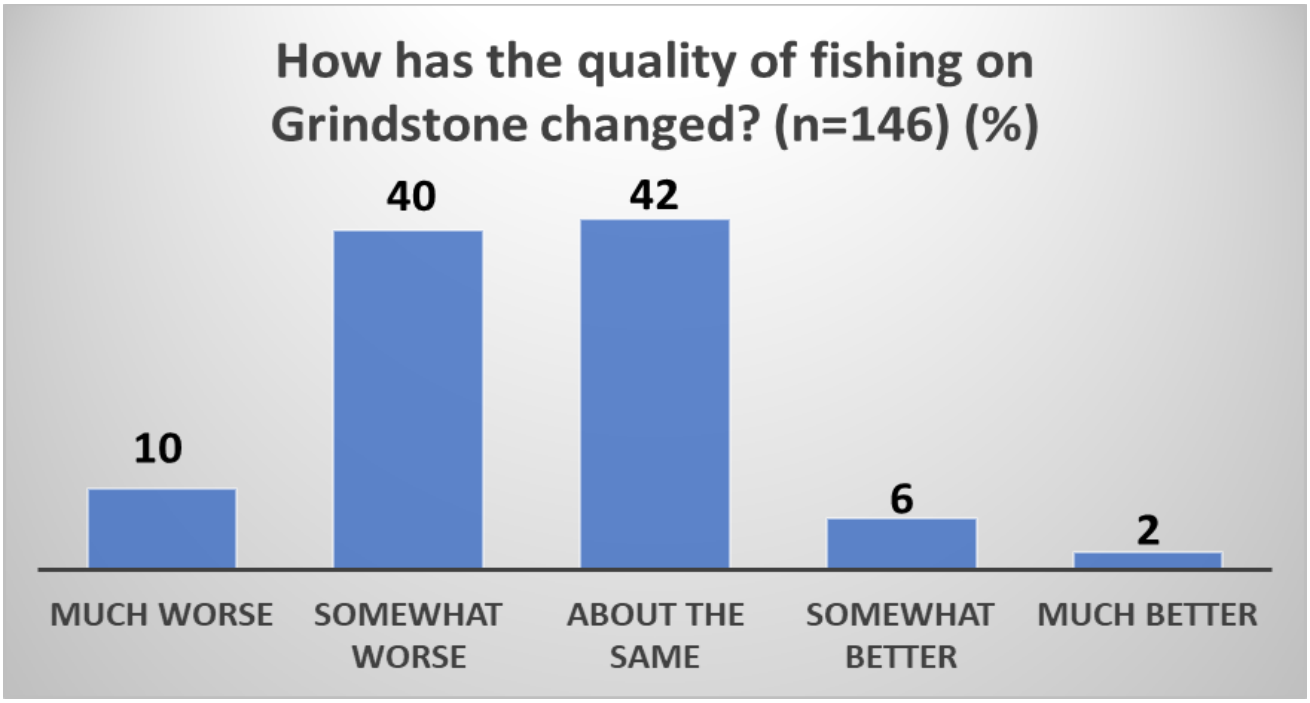
When asked about the different species of fish they like to catch, the highest responses were walleye (82%) small mouth bass (71%).



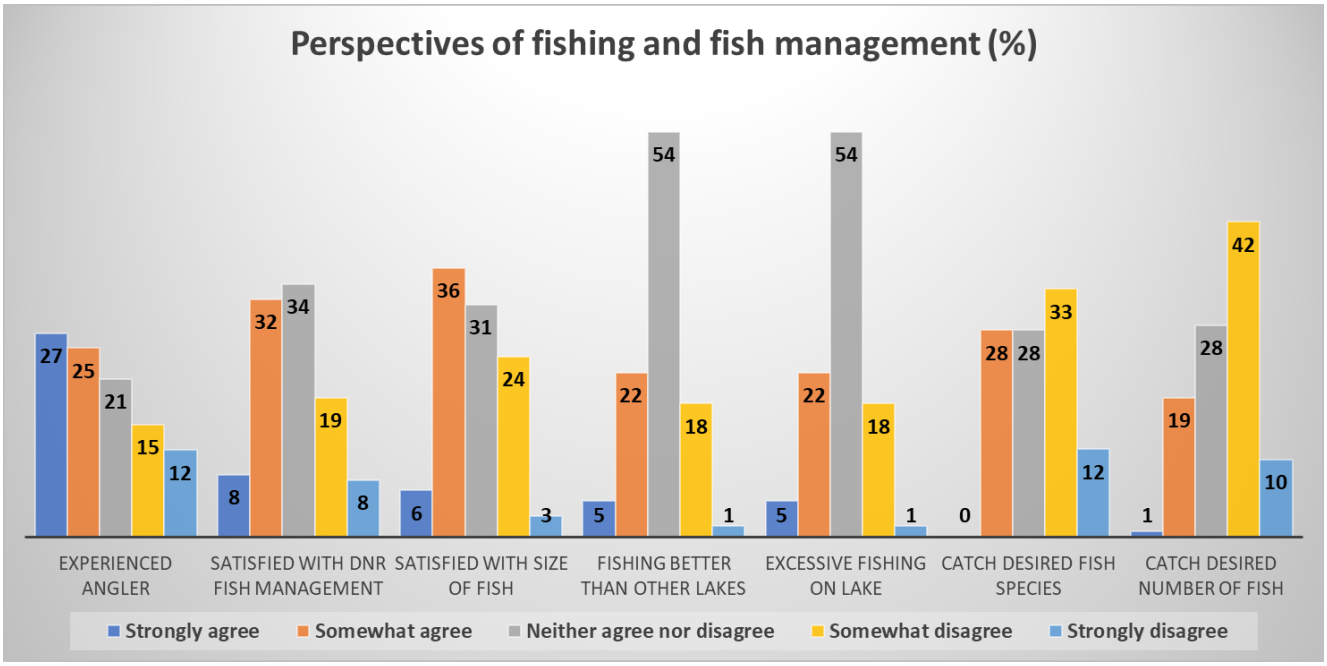
When asked about the one species of fish respondents and their families **MOST** liked to catch, walleye was the dominant response (68%).



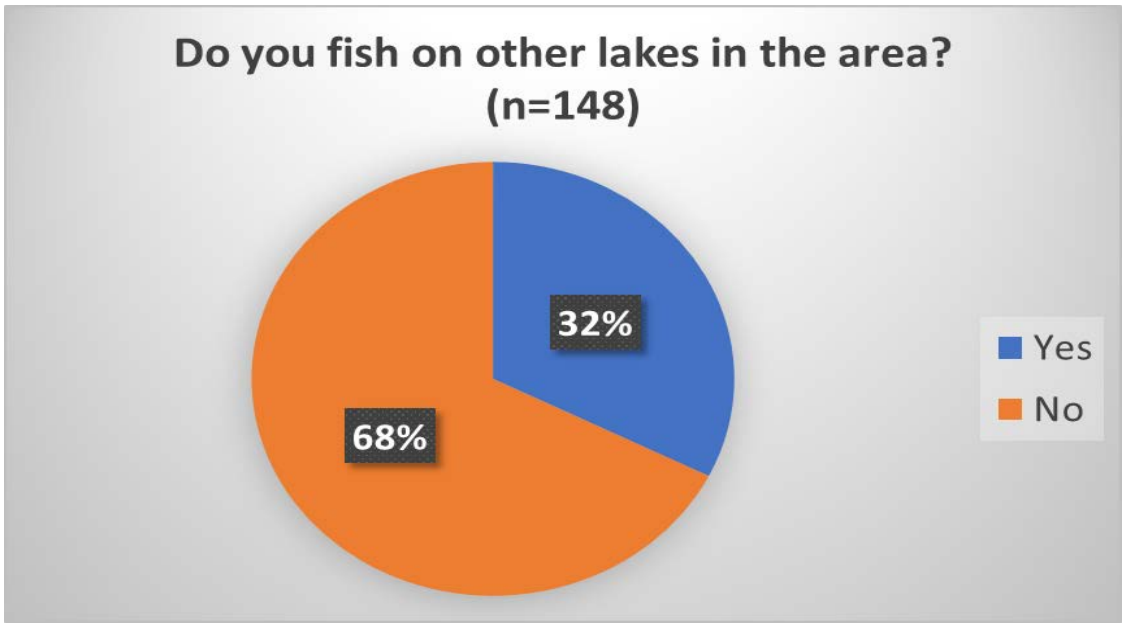
When asked how the quality of fishing has changed since respondents started to fish on Grindstone, 41.8% indicated the fishing was about the same, while 40.8% indicated the fishing was somewhat worse.

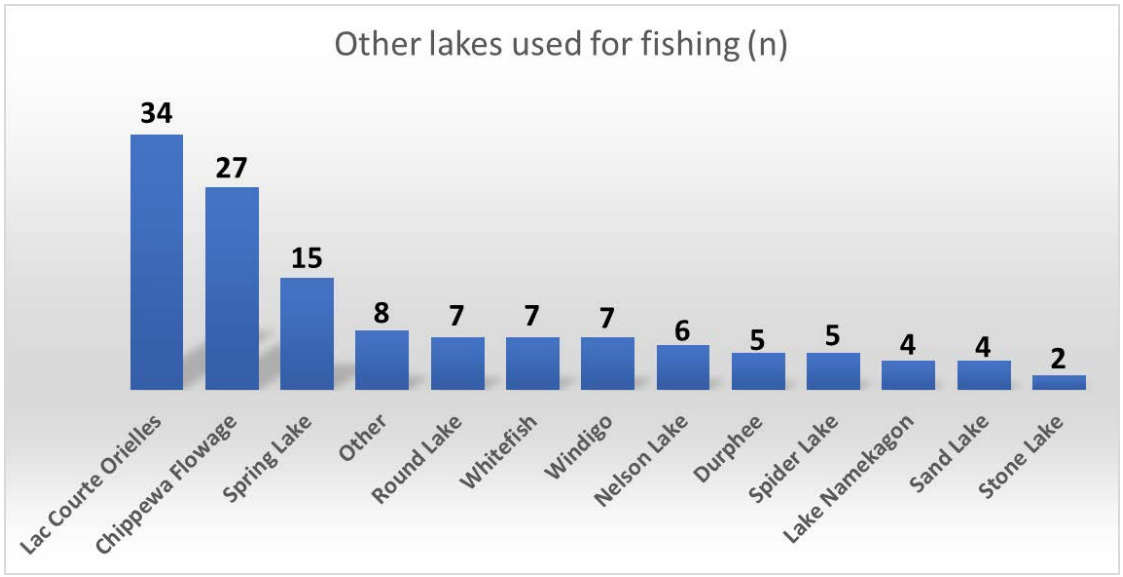


When asked about the level of agreement regarding fishing activities and management of the fishery, satisfaction was relatively strong except for questions about satisfaction with the size of fish, desired species, and number of fish caught.



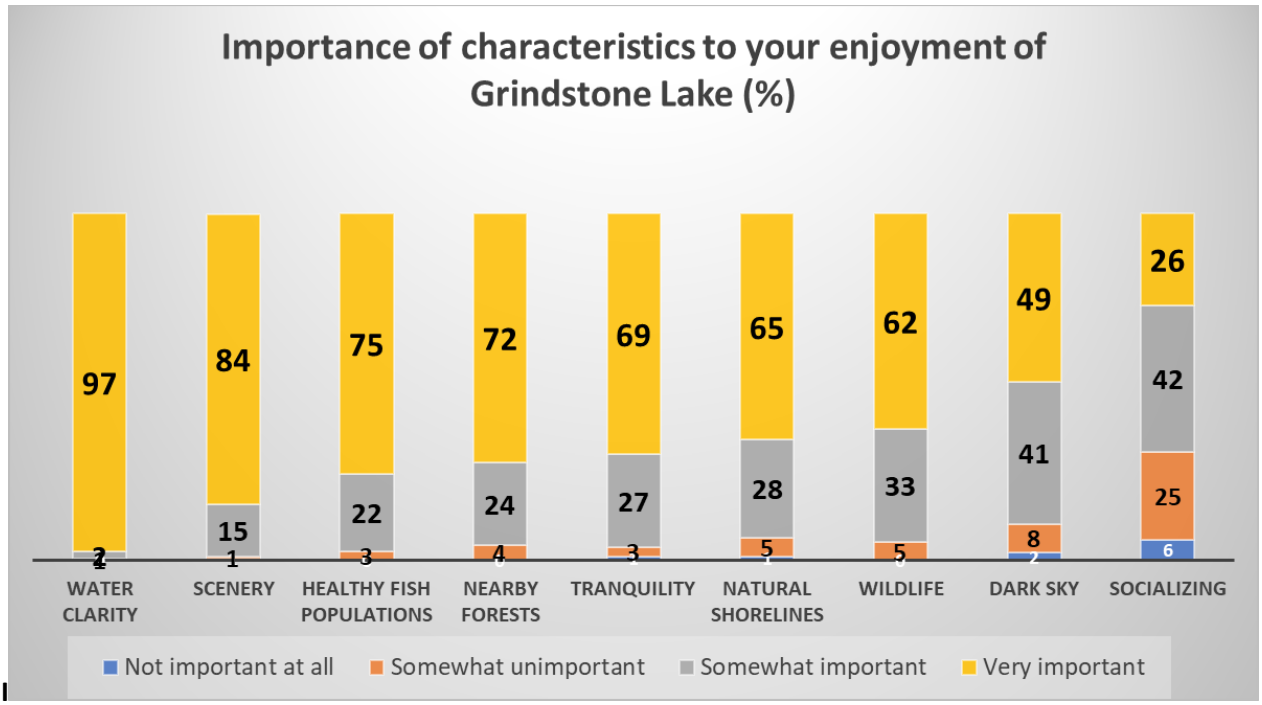
Approximately 32% of respondents who fish indicated that they fish on other lakes in the area. The more commonly indicated lakes that respondents fished included: Lac Courte Orielles, the Chippewa Flowage, and Spring Lake. Other lakes indicated were Ham Lake, Tigercat Flowage, and Crystal Lake. (NOTE: connect to implications for invasive species monitoring—our challenges likely more related to non-residents fishing on Grindstone than residents fishing on a lot of other lakes).





Important Characteristics of Grindstone Lake

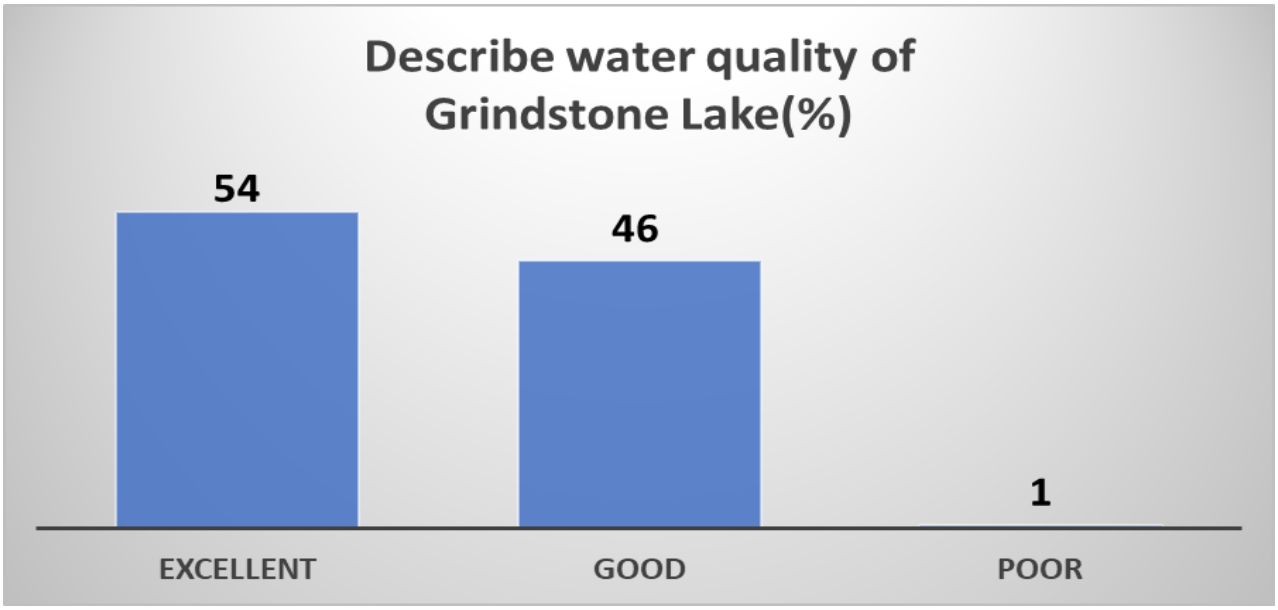
Respondents were then asked about the importance of characteristics or elements that contributed to their enjoyment of Grindstone Lake. The top four characteristics that were indicated as very important included: water clarity (97.3% very important), scenery (83.6% very important), healthy fish populations (74.9%, and nearby forests (71.6%). Socializing was not considered as important.



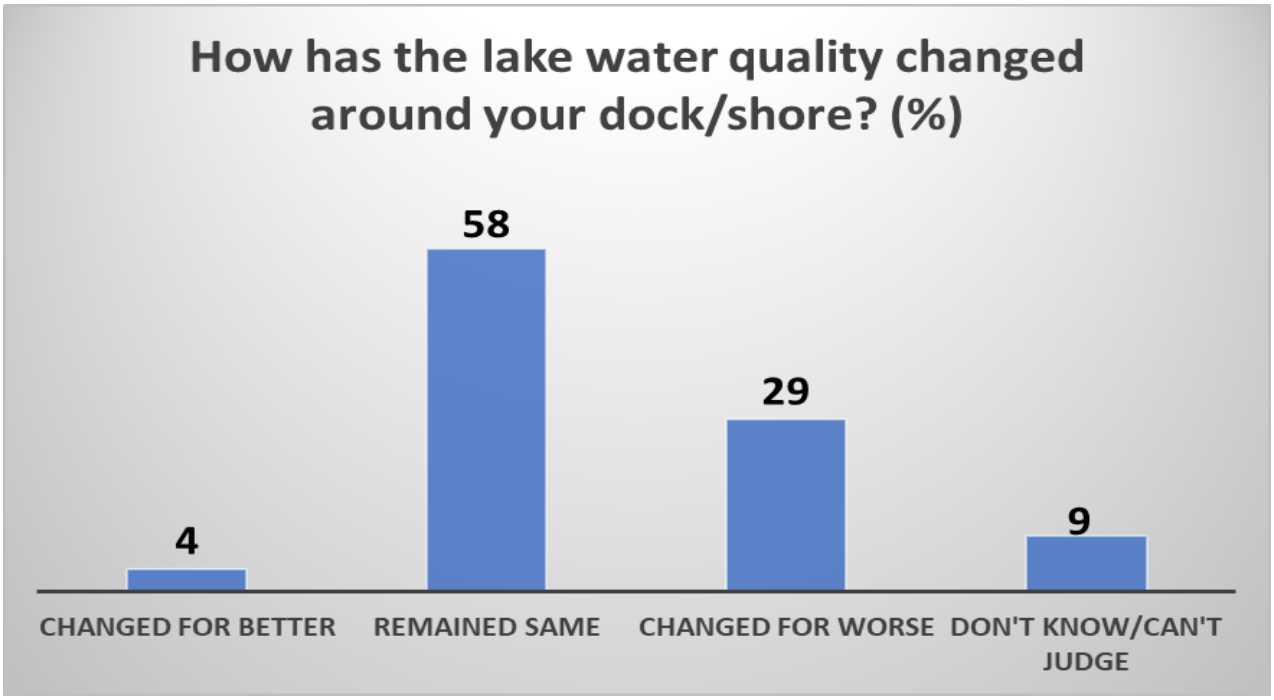
Survey participants were then asked to describe in their own words two or three things they value most about Grindstone Lake. The most common descriptions indicated align with the response from the question above. Most of the respondents indicated the clearness of the lake water as most valued using terns such as *water clarity*, *clear waters*, and *water quality*. After water clarity, *fishing* and *tranquility/peacefulness* were emphasized.

Water Quality

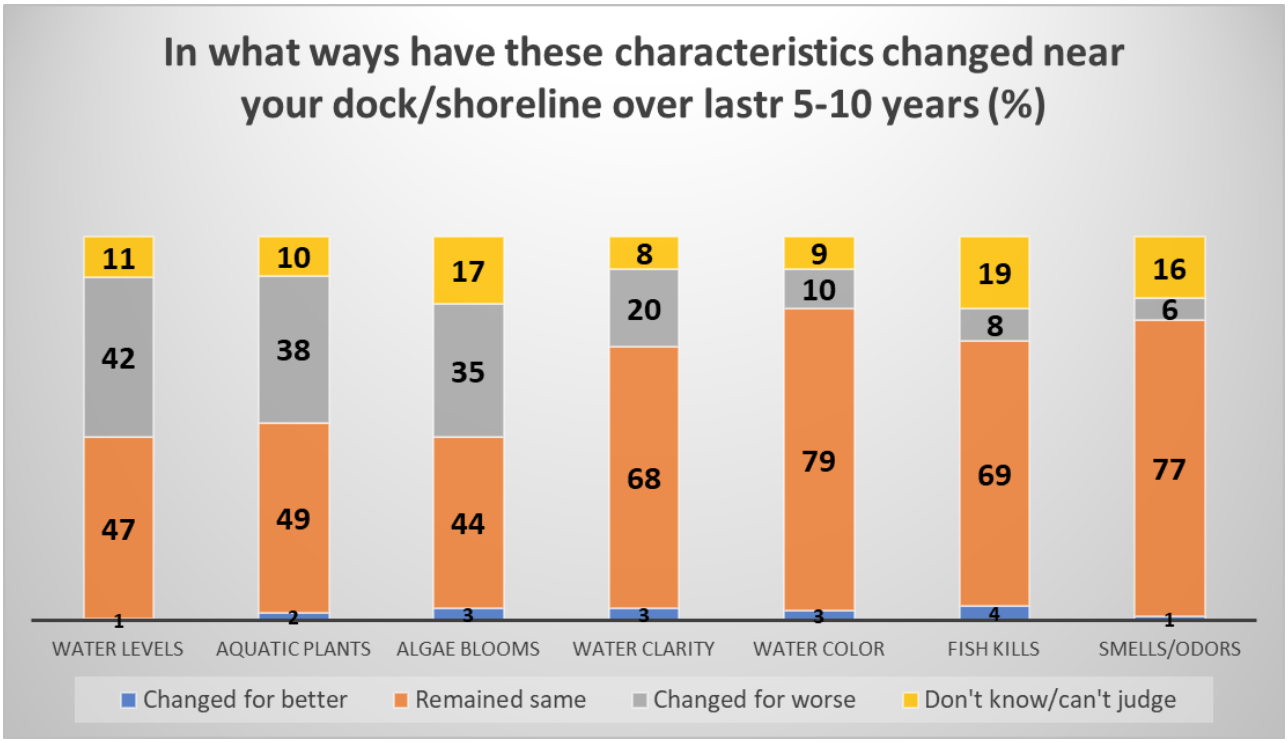
Respondents were very positive about the water quality of Grindstone Lake, with 99% reporting the water quality as excellent or good.



When asked if the water quality had changed near their dock or shoreline over the last 5-10 years, the majority felt that the water quality had remained the same (57.7%) while 29.9% indicated water quality had changed for the worse.

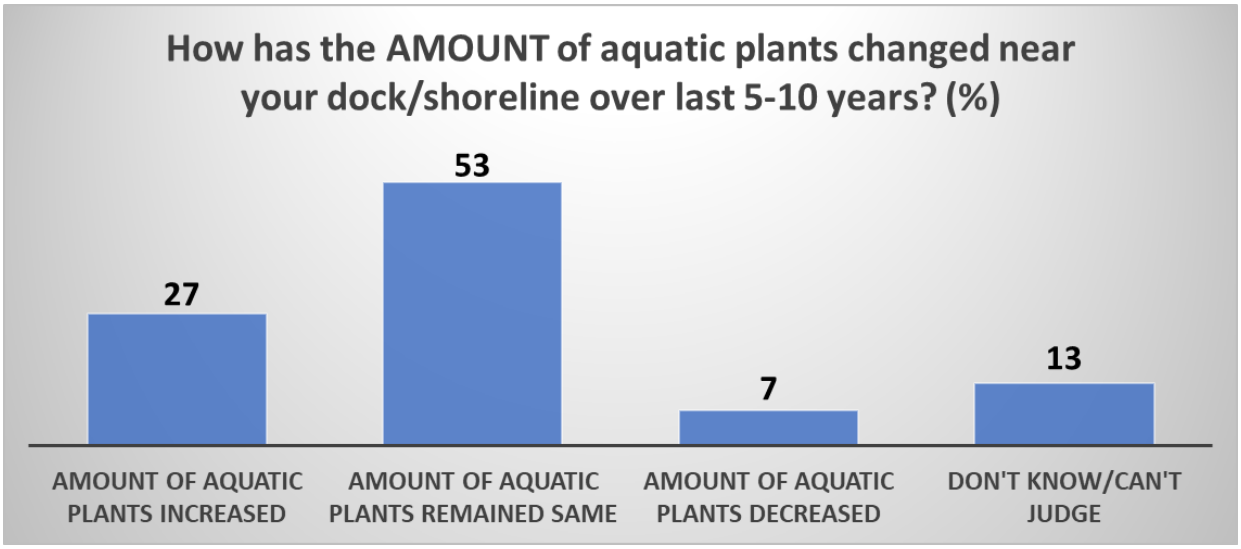


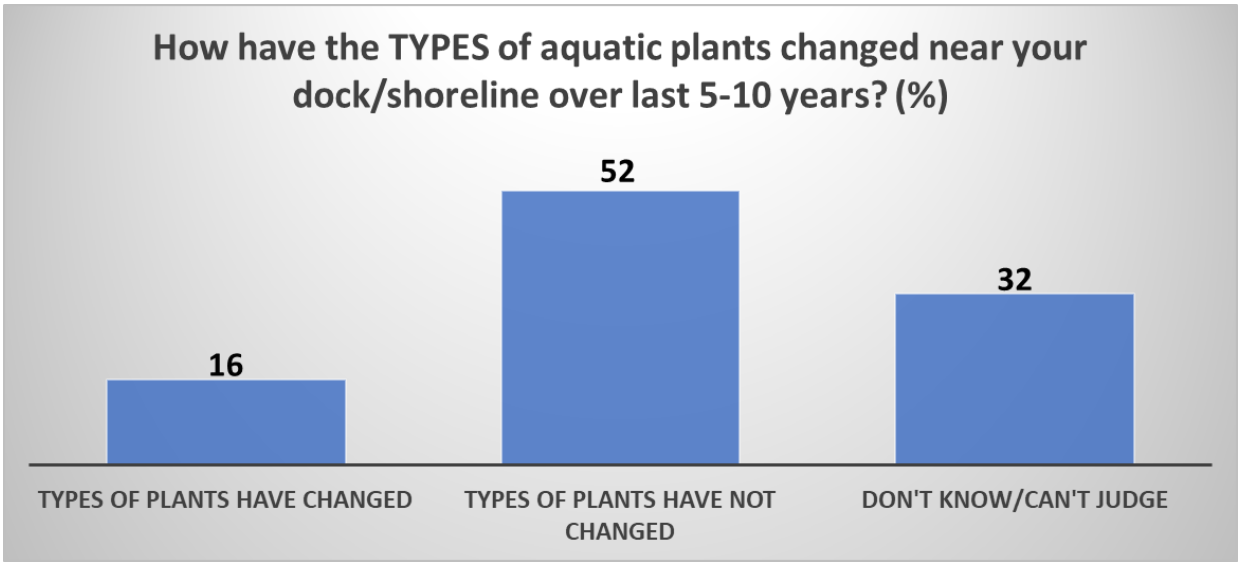
Few respondents indicated that characteristics of the lake had changed for the better. Characteristics in which at least 30% of respondents felt had changed for the worse included water levels, aquatic plants, and algae blooms.



Aquatic Plants

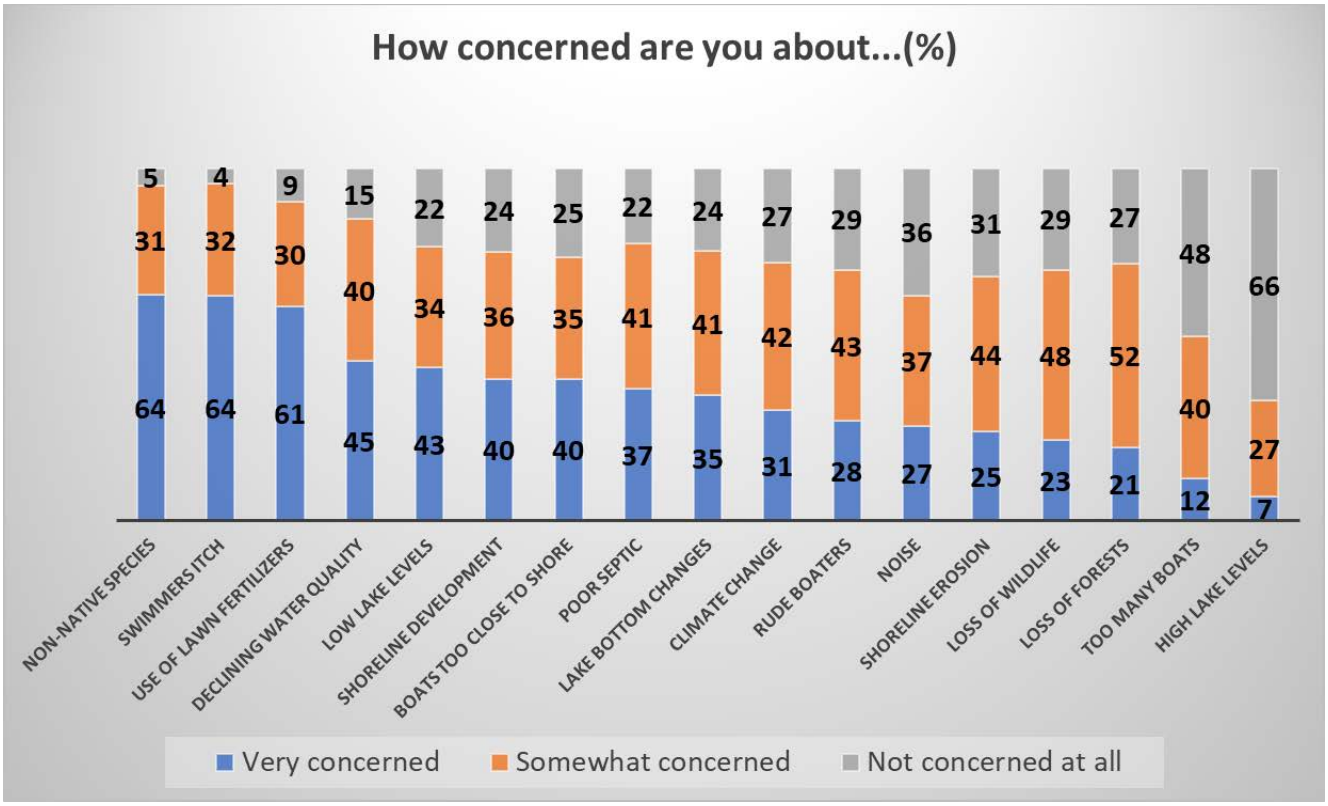
Specific questions were then asked about whether the amount or types of aquatic plants had changed near respondent docks or shoreline over the last 5-10 years. Most respondents indicated that neither of these characteristics had changed. However, about one-third of respondents indicated that they did not know or could not judge whether the types of aquatic plants had changed [note: this could suggest that educational efforts on plant identification might be valuable).



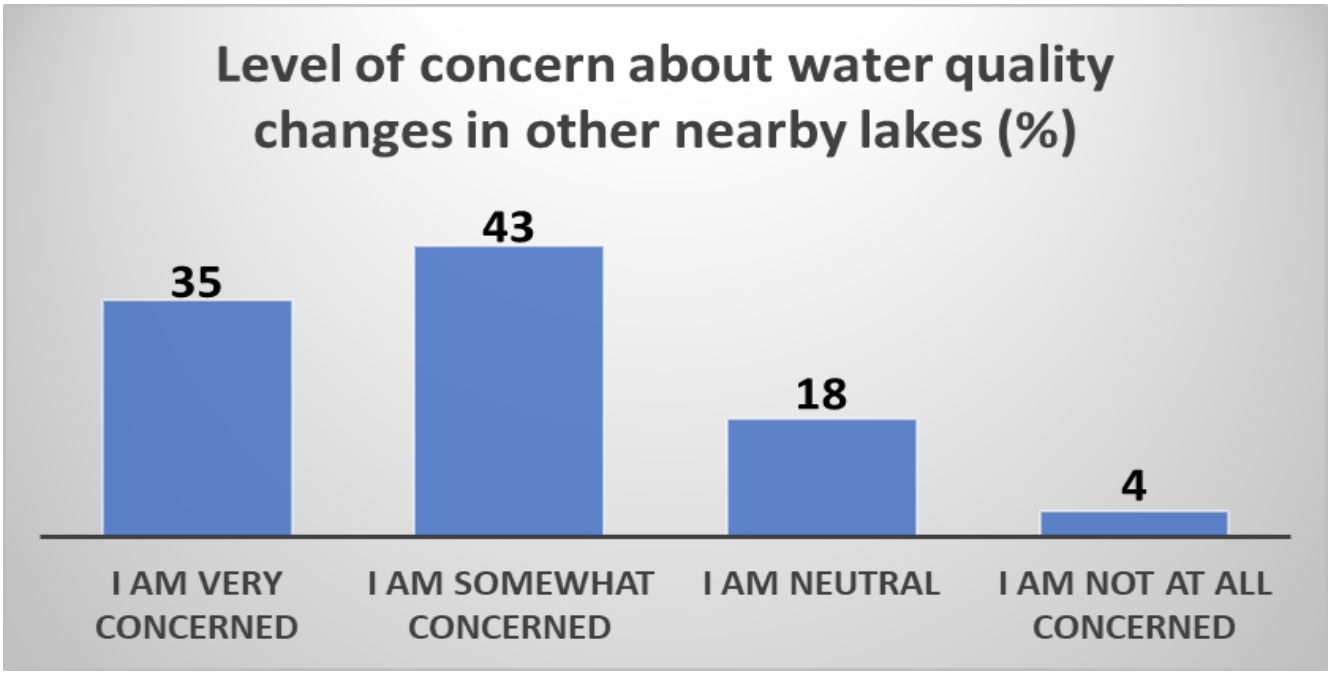


Concerns About Lake Challenges

Respondents were asked to indicate their level of concern regarding potential challenges to the lake and their experiences. The three issues the garnered the most concerns were swimmers itch, non-native species, and use of lawn fertilizers. There was stronger concern about low lake water levels than high lake water levels.

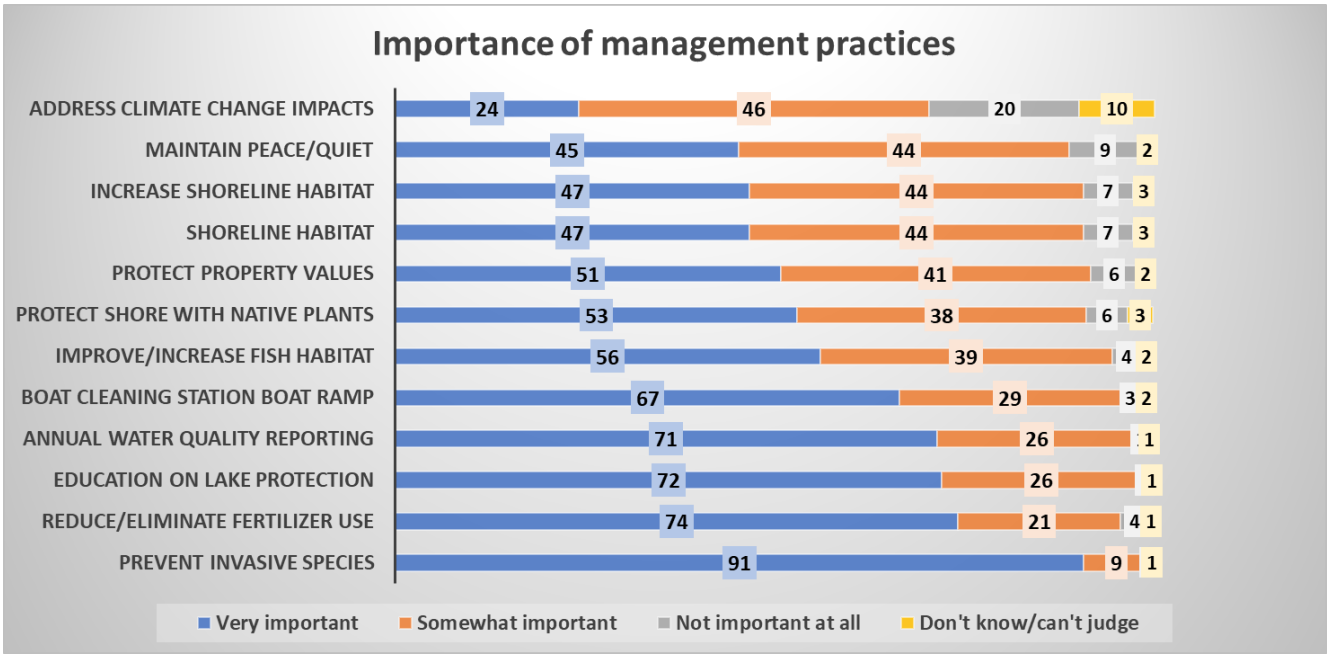


Over 78% of respondents indicated they were very or somewhat concerned about declining water quality in other lakes in the area. Survey participants were then asked to describe in their own words two or three things that need to happen to protect the future of Grindstone Lake. The top issues respondents listed as important to address included *water quality, invasive species, swimmers itch, water levels*, and *fertilizers*. These top issues correspond with the question below about the importance of various lake management practices.



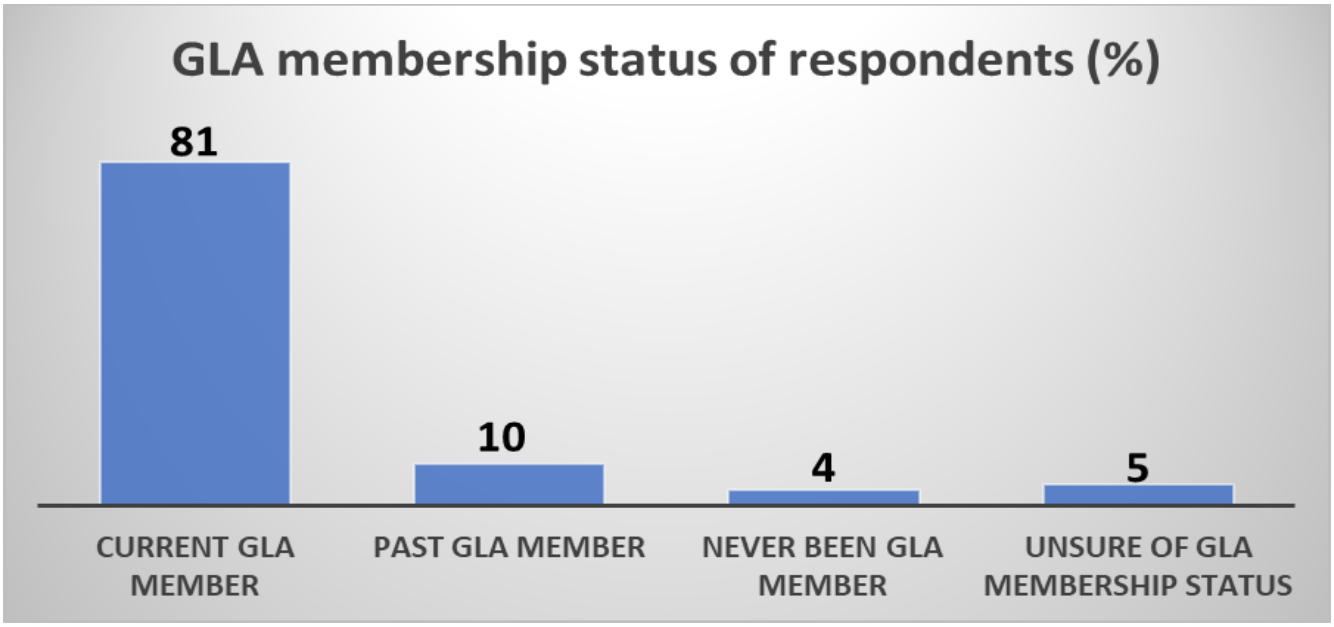
Lake Management

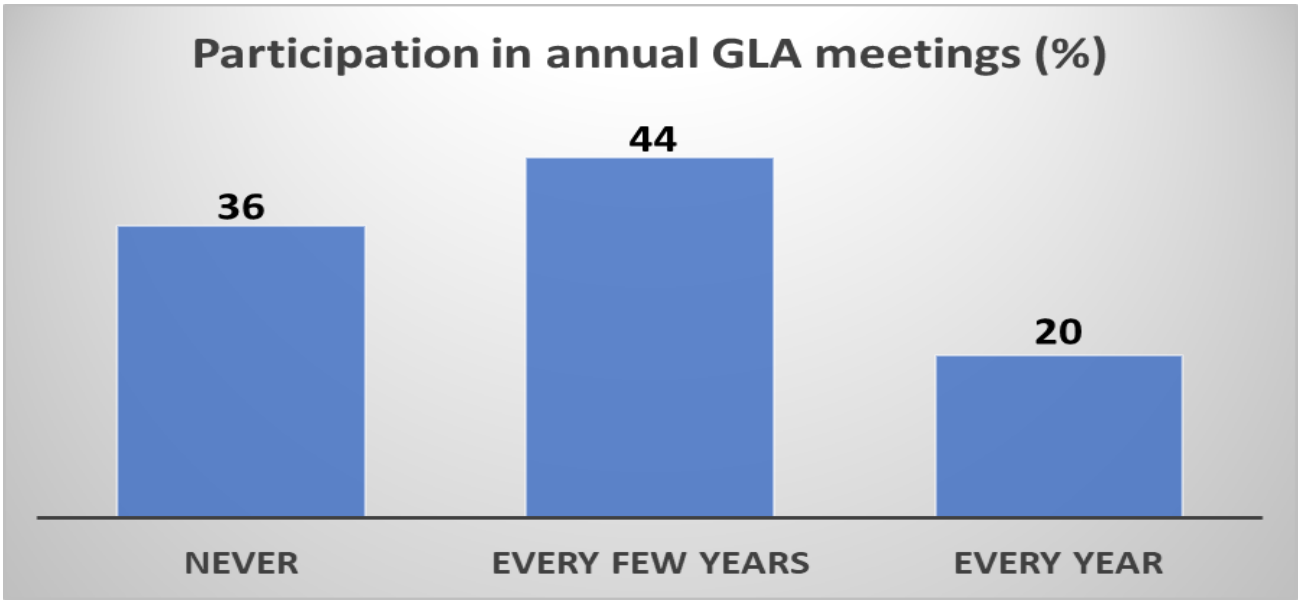
To provide input on lake management, survey participants were asked to indicate the level of importance of various management priorities. Although there was broad support across most of the management priorities, four priorities garnered the strongest levels of importance: (1) preventing invasive species from entering the lake; (2) educating residents on lake protection efforts; (3) reporting water quality information annually; and (4) reducing or eliminating use of lawn fertilizers.



Grindstone Lake Association Awareness and Activities

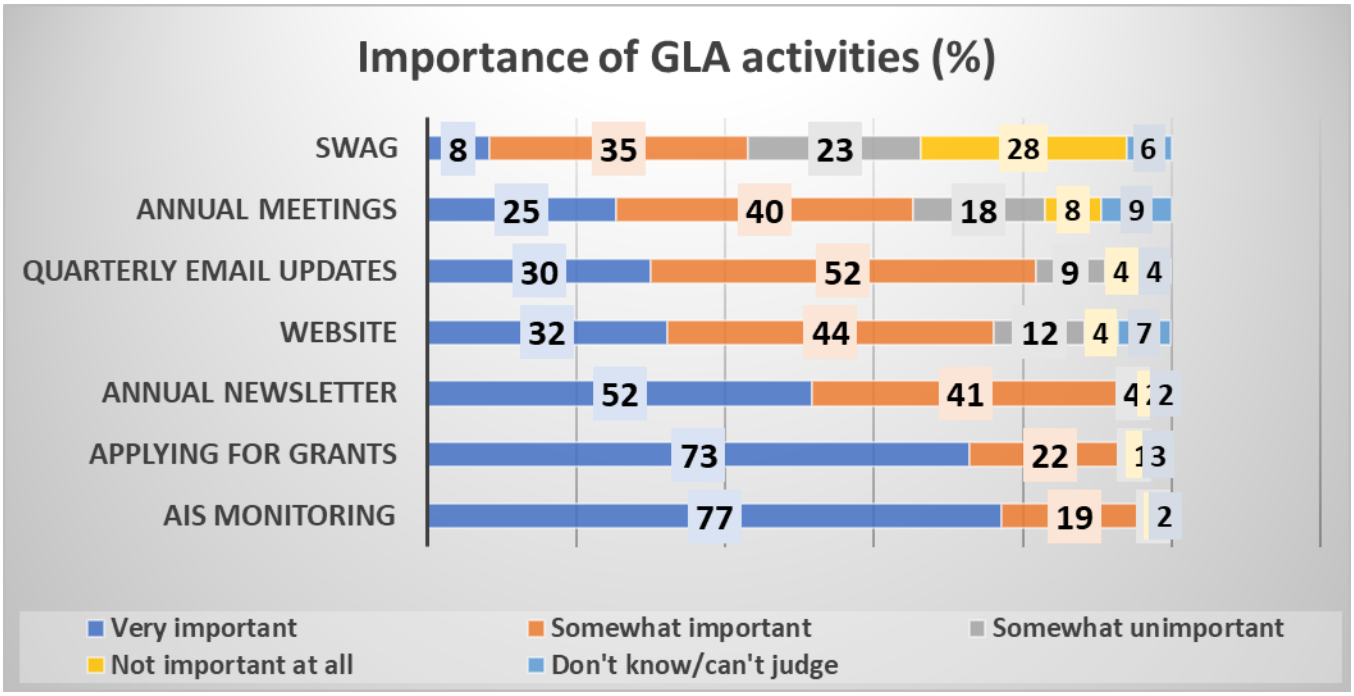
Most of the respondents indicated that they were current GLA members (81.2%) and attended GLA meetings every few years (44.2%) or every year 19.9%).





The majority of survey respondents indicated that they had visited the GLA website (68%).

Respondents were also asked the degree of importance of activities of the GLA. Four activities of the GLA that were viewed as highly important included: (1) aquatic Invasive Species (AIS) monitoring; (2) applying for grants; (3) providing the annual newsletter; and, (4) quarterly email updates.



When asked about initiatives that the Grindstone Lake Association should pursue, the top responses included *education of lake users*, *water quality monitoring*, and *shoreline protection*.

Summary

Results from the Grindstone Lake Resident Survey were summarized in this draft report. Findings from the survey will be shared with the Lake Management Planning Committee for discussion and use in the final Comprehensive Lake management Plan. Further analyses may be conducted based on committee discussions and recommendations.

Appendix B. Local and State Requirements for Watershed Protection

Sawyer County Shoreland Zoning Ordinance[35]

The shoreland zoning ordinance applies within 1000 feet of the ordinary high water mark (OHWM) of lakes, ponds, or flowages and within 300 feet of the OHWM of navigable rivers or streams. The shoreland zoning provisions establish minimum lot sizes, structure setbacks, controls for excavation and earth moving, and restrictions on removal of shoreline cover. Unsewered lots require a minimum lot size of 20,000 square feet, a minimum average 100-foot lot width, and a 75-foot minimum structure setback from the ordinary high water mark.

For all Sawyer County lakes, shoreline clearing is limited to preserve a minimum thirty-five foot shoreline buffer zone of natural shoreline vegetation yet allow shoreline property owners access to the waters abutting their property. For every 100 feet of shoreline, a property owner may create an area up to thirty-five feet wide more or less perpendicular to the shore through mowing, pruning and selective removal of trees, stumps, and shrubbery.

Impervious surface limits are established for construction, reconstruction, expansion, and relocation of impervious surfaces within 300 feet of the ordinary high water mark. In this area, impervious surfaces are limited to 15% or to 30% with a mitigation plan that meets specific standards.

Permits are required for filling and grading within 300 feet of the ordinary high water mark with a minimum disturbance area that triggers a permit dependent upon slope. Erosion control measures are required for these permits.

Sawyer County Subdivision Ordinance[36]

The Sawyer County Zoning Committee reviews subdivisions for compliance with the ordinance. Subdivisions may be rejected because of flooding, inadequate drainage, severe erosion potential, or unfavorable topography. There are no specific erosion control or stormwater requirements in the ordinance, nor is there a separate ordinance for either.

[35] As amended January 17, 2019

[36] As amended June 20, 2013

Stormwater and Erosion Control Permit (WDNR)

The landowner of a construction site where one acre or more of land will be disturbed must apply for and obtain coverage under the WPDES General Permit for Storm Water Associated with Land Disturbing Construction Activity (Permit No. WI-S067831-6) from the Wisconsin Department of Natural Resources (WDNR). This general permit regulates the discharges of pollutants to waters of the state as provided in S. 283.33, Wis. Stats., and Subch. III of Ch. NR 216, Wis. Adm. Code.

The general permit requires the permittee to implement best management practices to control storm water runoff in accordance with site-specific erosion control and storm water management plans to reduce sediment and other pollutants from entering waters of the state. Waters of the state include surface waters, groundwater, and wetlands. The general permit requires landowners of regulated construction sites to develop and implement erosion control and post-construction storm water management plans in accordance with Subch. III of Ch. NR 216, Wis. Adm. Code, and the applicable performance standards of Ch. NR 151, Wis. Adm. Code (among other requirements). The erosion control plan details how sediment and other pollutants will be controlled on the site. The storm water management plan includes practices such as wet ponds, infiltration structures, grass swales, vegetation filter strips, and vegetative buffers to control runoff from the site after construction is completed.

NR151 Non-Agricultural Performance Standards

Construction Sites >1 acre – must control 80% of sediment load from sites

Stormwater management plans (>1 acre)

- Total suspended solids
- Peak discharge rate
- Infiltration
- Buffers around water

Developed urban areas (>1,000 persons/square mile)

- Public education
- Yard waste management
- Nutrient management
- Reduction of suspended solids

The general permit will not be used to provide permit coverage to a storm water discharge within Indian Country. Permit coverage is required from the USEPA for construction site storm water discharges within Indian County. Information on such permitting is available at: https://www.epa.gov/npdes/stormwaterdischarges-construction-activities.

(Wisconsin Department of Natural Resources, 2021)

Construction Site Erosion Control

The Wisconsin Department of Safety and Professional Services, Division of Industry Services has authority and responsibility for construction site erosion control for building sites for public buildings and places of employment and one and two-family dwellings. The department may delegate authority under this section to a county, city, village or town.

If a one- or two-family construction site disturbs less than one acre, the specific erosion control requirements in SPS 321.125 (Erosion and sediment control) must be met. Erosion control requirements for construction of public buildings and buildings that are places of employment are found in Wis. Stats. Chapter 101.1206. Standard erosion control plan sheets and a checklist are available from the WDNR and UWEX.

Appendix C. Grindstone Lake AIS Rapid Response Protocol