Big Blake Lake Aquatic Plant and Lake Management Plan, 2016-2021

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Big Blake Lake Protection and Rehabilitation District

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Table of Contents

Purpose of the Study 3
Background Information on Lakes, Studies, and Management Plans 4
Introduction to Big Blake Lake 5
Lake Classification 6
Big Blake Lake Characteristics 7
Designated Waters and Sensitive Areas 8
Impaired Waters 10
Previous Lake Studies 11
Fisheries 18
Lake Resident Survey 19
Lake Level and Precipitation Monitoring 25
Lake Mixing and Stratification: Background Information 26
Deep Hole Sampling Procedure 28
Dissolved Oxygen 29
Temperature 31
Specific Conductance (Conductivity) 32
pH 33
Secchi Depth 35
Phosphorus 38
Tributary and Outlet Phosphorus 43
Tributary and Outlet Phosphorus Budget 45
Nitrogen 46
Tributary and Outlet Nitrogen 48
Total Nitrogen to Total Phosphorus Ratio 50
Total Suspended Solids 51
Tributary and Outlet Total Suspended Solids 52
Chlorophyll 53
Trophic State Index 54
Phytoplankton 57
Blue Green Algae 60

Zooplankton 62
Harvesting and Curly-leaf Pondweed 64
Curly-leaf Pondweed Biomass and Turion Sampling 65
Point Intercept Aquatic Macrophyte Surveys 68
Land Use and Water Quality 81
Historical Land Use in the Big Blake Lake Watershed 83
Historic Land Use and Nutrient Loading in the Big Blake Lake Watershed 84
Watershed and Lake Modeling 89
Paleolimnoligical Study of Big Blake Lake 95
Areas Providing Water Quality Benefits to Big Blake Lake 97
Information and Education 98
Summary of Rules and Legislation 101
Aquatic Plant Laws and Rules 107
Management Options for Aquatic Plants 108
Lake Management Plan 109

Appendix Files

Appendix A: Lake Resident Survey and Results
Appendix B: Lake Level and Precipitation Monitoring
Appendix C: Deep Hole Chemical and Physical Data
Appendix D: Tributary and Outlet Chemical and Physical Data
Appendix E: Algae Data
Appendix F: Zooplankton Data and Report
Appendix G: Curly Leaf Pondweed Biomass and Turion Data
Appendix H: Point Intercept Aquatic Macrophyte Survey Data
Appendix I: Modeling Data
Appendix J: Sediment Core Data and Paleolimnoligical Study of Big Blake Lake Report
Appendix K: Newsletters, Presentations, and Handouts
Appendix L: Management Options for Aquatic Plants
Appendix M: Meeting Agendas and Materials

Purpose of the Study

In 2012, the Big Blake Lake Protection and Rehabilitation District applied for a Wisconsin Department of Natural Resources Aquatic Invasive Species Education, Prevention, and Planning Grant. The grant was awarded and data collection occurred in 2013, 2014, and 2015.

The main purpose of the grant was to address the following problems: aquatic invasive species, nuisance aquatic plant growth, algae blooms, impaired water clarity, and a lack of education and data.

Methods and activities completed through this grant award include:

- ✓ Lake resident survey
- ✓ In-lake physical and chemical monitoring
- ✓ Tributary monitoring
- ✓ Phytoplankton
- ✓ Zooplankton
- ✓ Aquatic plant point intercept surveys
- ✓ Curly-leaf pondweed biomass and turion monitoring
- ✓ Watershed delineation, land use determination, and modeling
- ✓ Participation in aquatic invasive species statewide programs: Citizen Lake Monitoring Network for AIS and Water Quality, Bait Dealer Initiative, and Clean Boats, Clean Waters
- ✓ Communication of information: the Blake Lake Bugle Newsletter, pontoon classrooms, and distribution of AIS flyers
- ✓ Development of Aquatic Plant Management Plan

In 2013, the Big Blake Lake Protection and Rehabilitation District applied for a Wisconsin Department of Natural Resources Large Scale Lake Management Planning Grant to collect a sediment core on Big Blake Lake.

Methods and activities completed through this grant award include:

- ✓ Sediment core collection
- ✓ Sediment phosphorus
- ✓ Diatom analysis
- ✓ Macrofossils
- ✓ Zooplankton
- ✓ Pigments
- ✓ Biogenic silica analysis
- ✓ Historical land use determination and modeling
- ✓ Development of a Lake Management Plan

The following report details the methods and activities completed through both grant awards.

Background Information on Lakes, Studies, and Management Plans

Lakes are a product of the landscape they are situated in and of the actions that take place on the land which surrounds them. Factors such as lake size, lake depth, water sources, and geology all cause inherent differences in lake quality. As a result, lakes situated within feet of others can differ profoundly in the uses they support.

A landscape can be divided into watersheds and subwatersheds. These areas define the land that drains to a particular lake, flowage, stream, or river. Watersheds that preserve native vegetation and minimize impervious surfaces (cement, concrete, and other materials that water can't permeate) are less likely to cause negative impacts on lakes, rivers, and streams. This arises because rain and melting snow eventually end up in lakes and streams through surface runoff or groundwater infiltration. Rain and melting snow entering a waterbody is not inherently problematic. However, water has the ability to carry nutrients, bacteria, sediments, and chemicals into a waterbody. These inputs can impact aquatic organisms such as insects, fish, and wildlife and—especially in the case of the nutrient phosphorus—fuel problematic algae blooms.

Lake studies often examine the underlying factors that impact a lake's health, such as lake size, depth, water sources, and the land use in a lake's watershed. Many forms of data can be collected and analyzed to gauge a lake's health including: physical data (oxygen, temperature, etc.), chemical data (including nutrients such a phosphorus and nitrogen), biological data (algae, zooplankton, and aquatic plants), and land use within a lake's watershed. Additionally, sediment cores can be used to determine how a lake has changed over the course of hundreds of years

Lake studies identify challenges and threats to a lake's health along with opportunities for improvement. These studies identify practices already being implemented by watershed residents to improve water quality and areas providing benefits to a lake's ecosystem. Additionally, these studies quantify practices or areas on the landscape that have the potential to negatively impact the health of a lake and identify best management practices for improvement.

The end product of a lake study is a **Lake Management Plan** which identifies goals, objectives, and action items to either maintain or improve the health of a lake. These goals should be realistic based on inherent lake characteristics (lake size, depth, etc.) and should align with the goals of watershed residents.

An **Aquatic Plant Management Plan** is similar to a Lake Management Plan, although the goals, objectives, and action items pertain specifically to aquatic plants.

Both types of management plans are designed to be working documents that are used to guide the actions which take place to manage a specific lake.

Introduction to Big Blake Lake

Big Blake Lake[1] is a 208 acre lake located in the Town of Georgetown[2] in Polk County, Wisconsin, approximately 80 miles northeast of the Twin Cities metropolitan area. The area of land that drains to a lake is called a watershed. Big Blake Lake is situated within the Upper Apple River Watershed, which is part of the St. Croix River Basin. The Upper Apple River Watershed is the largest watershed in Polk County, totaling approximately 125,074 acres in size.

On a smaller scale, the area of land that drains to Big Blake Lake, or the Big Blake Lake watershed, is 15,369 acres in size. The drainage basin: lake area ratio (DB: LA) compares the size of a lake's watershed to the size of a lake. If a lake has a relatively large DB: LA then surface water inflow (containing nutrients and sediments) occurs from a large area of land relative to the area of the lake. The DB: LA for Big Blake Lake is approximately 61:1.[3]

The main inlet for Big Blake Lake is a channel flowing directly from Little Blake Lake on the southeast end of the lake. Additionally, Big Blake Lake receives water from an inlet located on the north side of the lake. This tributary flows from Lost Lake and is called Lost Creek. The lake's outlet is located on the northwest side of Big Blake Lake and flows to the Apple River via Fox Creek.

Lakes are classified according to their primary source of water and how that water enters and leaves the system. Big Blake Lake is defined as a drainage lake, or a lake with an inlet and an outlet. Drainage lakes receive most of their water from the surrounding watershed in the form of stream drainage, have a prominent inlet and outlet that move water through the system, and commonly have high nutrient levels due to inputs from the watershed.

The residence time is the average amount of time water remains in a body of water. The residence time for Big Blake Lake is 0.10 year, meaning that water is replaced approximately every 36 days.[4]

There are two ramp public access sites on Big Blake Lake located on the northeast and southwest sides of the lake.

The Big Blake Lake Protection and Rehabilitation District was formed in 1976 in response to concerns about algae blooms and aquatic plant problems. The District includes two hundred twenty-two residences. The majority of the shoreline property on Big Blake Lake is parceled into 100 foot lots, although a moderate tract of forested land remains on the east side of the lake.

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[1] Waterbody ID (WBIC) 2627000
[2] T35N, R16 W, Sec. 22, 26, 27
[3] Blake Lake Polk County Feasibility Study Results: Management Alternatives; Wisconsin Department of Natural Resources Office of Inland Lakes Renewal, 1981
[4] Ibid

Lake Classification

Lake classification in Polk County is a relatively simple model that considers:

- ✓ Lake surface area
- ✓ Maximum depth
- ✓ Lake type
- ✓ Watershed area
- ✓ Shoreline irregularity
- ✓ Existing level of shoreline development

These parameters are used to classify lakes as class one, class two, or class three lakes. Big Blake Lake is classified as a class one lake.

Class one lakes are large and highly developed.
Class two lakes are less developed and more sensitive to development pressure.
Class three lakes are usually small, have little or no development, and are very sensitive to development pressure.

Big Blake Lake Characteristics

Big Blake Lake [5]

Area: 208 Acres
Maximum depth: 14 feet
Mean depth: 9 feet
Bottom: 55% sand, 0% gravel, 0% rock, and 45% muck
Hydrologic lake type: Drainage [6]
Total shoreline: 6.65 miles
Invasive species: Curly-leaf pondweed, Chinese mystery snail, and banded mystery snail
Fish: Musky, panfish, largemouth bass, northern pike, and walleye
Boat landings: 2
Trophic Status: Eutrophic

Oligotrophic lakes are generally clear, deep, and free of plants and large algae blooms.

Mesotrophic lakes lie between oligotrophic and eutrophic lakes. They usually have productive fisheries, healthy plant life, and occasional algae blooms.

Eutrophic lakes are generally high in nutrients and support a large number of plant and animal populations. They are usually very productive and subject to frequent algae blooms. Lakes can also be hypereutrophic. Hypereutrophic lakes are characterized by dense algae communities and can experience heavy blooms throughout the summer.

[5] http://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2627000&page=more
[6] A drainage lake is fed by streams, groundwater, precipitation, and runoff and drained by a stream

Designated Waters and Sensitive Areas

A designated water is a waterbody with special designations that affect permit requirements.

Big Blake Lake is designated as an Area of Special Natural Resource Interest (ASNRI) Endangered, Threatened, or Special Concern Lake. The Natural Heritage Inventory Program identifies waters or portions of waters inhabited by any endangered, threatened, special concern species, or unique ecological community identified in the Natural Heritage Inventory.

An Integrated Sensitive Area Survey Report was completed for Big Blake Lake in August, 2000. This survey identified three areas of Big Blake Lake that merit special protection of aquatic habitat. Sensitive area A is located on the northern end of Big Blake Lake and covers approximately 400 feet of shoreline and extends out as far as 100 feet, sensitive area B is located at the northeastern end of Big Blake Lake and covers approximately 400 feet of shoreline and extends out as far as 150 feet, and sensitive area C is located at the southeastern end of Big Blake Lake and the southwestern end of Little Blake Lake and encompasses the channel between the two lakes. [7]

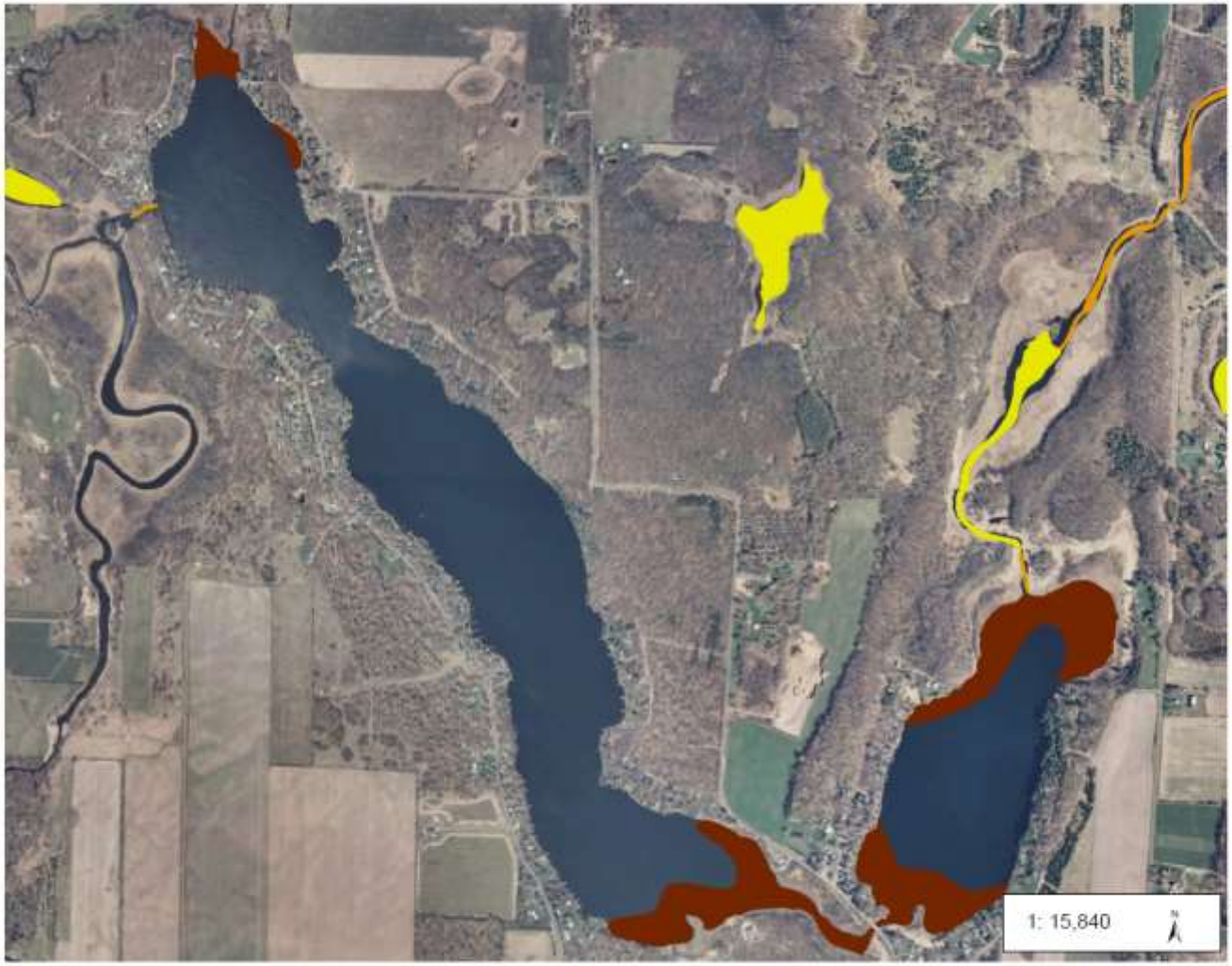
Wild rice was documented in sensitive areas A and C. Big Blake Lake is recognized as a wild rice water in the Wisconsin Ceded Territory.[8]

Wild rice, white water lily, and yellow water lily in sensitive area A

[7] Blake and Little Blake Lake Sensitive Area Survey Report and Management Guidelines, Wisconsin Department of Natural Resources, 2000

[8] Wisconsin Ceded Territory Manoomin Inventory, GLIFWC Project Report, Peter David, 2010

Surface Water Data Viewer Map



Legend

- PRF Sensitive Areas of Lakes
- PRF Other Public Rights Featu
- ASNRI Wild and Scenic Rivers
- ASNRI Outstanding and Excep
- ASNRI Trout Streams
- ASNRI Wild Rice Streams
- ASNRI Quality Wetland Strean
- ASNRI Endangered Threatene Concern Streams
- ASNRI Outstanding and Excep
- ASNRI Quality Wetland Areas
- ASNRI Wild Rice Areas
- ASNRI Trout Spring Ponds
- ASNRI Endangered Threatene Concern Areas
- ASNRI State Natural Areas
- PNW Musky Streams
- PNW Sturgeon Streams
- PNW Musky Areas
- PNW Sturgeon Areas
- PNW Walleye Areas
- PNW Lakes Less Than 50 Acr

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

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Impaired Waters

Wisconsin lakes, rivers, and streams are managed to determine if their conditions are meeting state and federal water quality standards. Water samples are collected through monitoring studies and results are compared to guidelines designed to evaluate conditions as compared to state standards. General assessments place waters in four different categories: poor, fair, good, and excellent. The results of assessments can be used to determine which actions will ensure that water quality standards are being met (anti-degradation, maintenance, or restoration).

If a waterbody does not meet water quality standards, it is placed on Wisconsin's Impaired Waters List under the Federal Clean Water Act, Section 303(d). Every two years, the State of Wisconsin is required to submit list updates to the United States Environmental Protection Agency for approval.

Waterbodies can be listed as impaired based on pollutants such as total phosphorus, total suspended solids, and metals. Wisconsin waters are each assigned four uses (fish and aquatic life, recreation, public health and welfare, and wildlife) that carry with them a set of goals.

Impairment thresholds vary for each use and vary based on lake characteristics such as whether a waterbody is shallow versus deep and whether a waterbody is a drainage lake versus a seepage lake. Big Blake Lake is classified as a shallow drainage lake that does not stratify. [9]

Big Blake Lake was assessed during the 2016 listing cycle and proposed for listing for the pollutant total phosphorus and the impairment of excess algal growth. The general condition is suspected poor.

Total phosphorus sample data exceeded the 2016 Wisconsin's Consolidated Assessment and Listing Methodology (WisCALM) listing thresholds for recreational use (40 µg/L) but not for fish and aquatic life use (100 µg/L). Chlorophyll sample data exceeded the 2016 WisCALM listing thresholds for recreational use (30% of days in the sampling season have nuisance algal blooms with chlorophyll values greater than 20 µg/L) and fish and aquatic life use (60 µg/L).[10]

[9] Listing thresholds can be found in: Wisconsin 2014 Consolidated Assessment and Listing Methodology (WisCALM) Clean Water Act Section 305(b), 314, and 303(d) Integrated Reporting, Wisconsin Department of Natural Resources, September 2013

[10] http://dnr.wi.gov/water/waterDetail.aspx?key=16558

Previous Lake Studies

Past studies on Big Blake Lake include:

- ✓ Blake Lake Polk County Feasibility Study Results: Management Alternatives, Wisconsin Department of Natural Resources Office of Inland Lake Renewal, 1981
- ✓ Blake Lake Macrophyte Surveys and Management Plan, Barr Engineering, 1998
- ✓ Blake and Little Blake Lake Sensitive Area Survey Report and Management Guidelines, Wisconsin Department of Natural Resources, 2000
- ✓ 2004 Big Blake Lake Water Quality and Technical Report, Aquatic Engineering, Inc., 2005
- ✓ 2004 Big Blake Lake Aquatic Plant Survey Technical Report and Management Plan, Aquatic Engineering, Inc., 2005
- ✓ Aquatic Macrophyte Surveys, Polk County Land and Water Resources Department, 2006-2012

Blake Lake Polk County Feasibility Study Results: Management Alternatives, 1981

Office of Inland Lake Renewal, Wisconsin Department of Natural Resources

The Big Blake Lake Protection and Rehabilitation District was formed in 1976. In response, a study of Big Blake Lake and its watershed was initiated by the Office of Inland Lake Renewal, Wisconsin Department of Natural Resources (November 1978-October 1979).

The three main objectives of this study were to: define a nutrient budget, define a water budget, and characterize in-lake chemistry and biological processes for Big Blake Lake.

The following sources of phosphorus loading were identified and used to develop a nutrient budget:

- ✓ Surface runoff: 1,190 kg/yr, 90%
    - *Approximately 70% of this loading originated from the Straight River Watershed*
- ✓ Groundwater: 72 kg/yr, 5%
- ✓ Septic system leachate: 38 kg/yr, 3%
- ✓ Atmospheric deposition: 30 kg/yr, 2%

Additionally, the study determined that the net release of phosphorus from sediments was 149 kg during the study period. Data indicated that Big Blake Lake was over half full of sediment, with a maximum sediment thickness of 25 feet.

The study classified Big Blake Lake as a productive, eutrophic body of water based on total phosphorus, secchi depth, and chlorophyll a. Dissolved oxygen remained adequate throughout the winter months and thermal stratification was not recorded during the summer months. The nitrogen to phosphorus ratio was 13:1, indicating that phosphorus is the most important nutrient for limiting algae populations.

At the time of this study, Big Blake Lake contained a diverse group of macrophytes including eight submerged species, three emergent species, and six floating leaf species. With the exception of dense curly-leaf pondweed in the northwest portion of the lake, macrophyte densities were light to moderate through June. However, by August macrophyte densities were elevated in many areas of the lake with

curly-leaf pondweed beds being replaced with coontail. Approximately 10% (25 acres) of Big Blake Lake was covered with aquatic macrophytes during the study.

Management alternatives suggested in this study include: improving the water quality of Big Round Lake, chemically removing phosphorus from the Straight River, diverting the Straight River south to White Ash Lake, controlling weeds with herbicides or harvesting, and dredging.

Blake Lake Macrophyte Surveys and Management Plan, 1998

Barr Engineering

In 1996 the Big Blake Lake District approached the Wisconsin DNR to discuss options for plant management. In response, the DNR suggested that the District complete a macrophyte survey and a macrophyte management plan for the lake. As a result, Barr Engineering completed macrophyte surveys during June and July 1997.

Macrophytes were surveyed using a series of 29 transects at approximately 500 foot intervals along the shoreline. Each transect was divided into depth categories of 0-1.5 feet, 1.5-5 feet, and 5-10 feet (or the maximum rooting depth), with four rake samples taken at each depth category.

The study determined that the total area of macrophyte growth was 122 acres (49% of the lake surface area) in June and 120 acres (49% of the lake surface area) in July. This compares with macrophyte growth covering only 25 acres (10% of the lake surface area) in 1979. In the 18 years between the two surveys, macrophyte coverage in Big Blake Lake increased by nearly 100 acres.

A total of 21 species were found in Big Blake Lake with approximately 8-9 species being found in each transect. In general, each plant had a low individual density, but because there were a large number of species found at each site, overall plant growth was moderate to high. The study determined that diversity was similar when comparing 1979 and 1997 data. In both June and July 1997, the diversity index was 0.89.

Curly-leaf pondweed, the only invasive plant located in the survey, was found in approximately 52% of the sample transects during June and approximately 48% of the sample transects during July. In general, densities remained low, although occasionally curly-leaf pondweed was found at higher densities. The study indicated that native species were relatively successful in competing with curly-leaf pondweed.

Barr Engineering also surveyed members of the Big Blake Lake District to determine: resident understanding of functions and values of aquatic plants, uses of the lake, perceived impairment of lake uses by aquatic plants, and aquatic plant management preferences. Seventy-seven responses were received (31% response rate).

The primary uses for Big Blake Lake were fishing (94%), viewing (82%), swimming (70%), powerboating (47%), and canoeing (43%). The primary use impairments caused by plants were swimming (62%) and fishing (60%). Over half of respondents (56%) had removed or attempted to remove plants around their docks or along their shorelines. More respondents were opposed to the use of chemicals to remove aquatic plants from the lake (39%) as compared to mechanical harvesting of plants (23%). Over half of respondents (57%) indicated that the District should not own and operate a weed harvester. Most

respondents (88%) recognized that aquatic plants have value, with high levels of importance for fish shelter and high to medium levels of importance for fish food.

The six aquatic plant management goals developed for Blake Lake included:

- Improve navigation within the lake through areas containing dense plant beds
- Remove or limit current exotic plants (i.e. curly-leaf pondweed)
- Preserve native species and prevent introduction of additional exotic species
- Preserve and/or improve fish and wildlife habitat
- Protect and/or improve quality of the resources for all to enjoy (i.e., people, fish, wildlife)
- Minimize disturbance of sensitive areas (i.e. fish and wildlife)

The management plan developed for Big Blake Lake was based upon the need to: provide reasonable access to the lake for residents living adjacent to very dense plant growth, control curly-leaf pondweed growth, preserve the current macrophyte community, and prevent the introduction of additional invasive species to Big Blake Lake.

The resulting management plan included:

- A harvesting plan for approximately 5 acres, with channel width restricted to 20 feet
- Herbicide treatment for approximately 60 acres of curly-leaf pondweed
- Education programs to increase understanding of the function and roles of native plant communities and the threat that invasive species pose
- A plan to control the introduction of invasive species including: boat inspections; littoral area inspections; informational meetings; and boat launch signage, bulletin boards and brochures with educational information
- Evaluation program to monitor the effectiveness of the plan and resurvey the plant community every five years

Blake and Little Blake Lake Sensitive Area Survey Report and Management Guidelines, 2000
Wisconsin Department of Natural Resources
A lake sensitive area survey was completed on Big Blake Lake on August 17th, 2000. The report indicated three sensitive areas in Big Blake Lake.

Sensitive area A is located at the northern end of Big Blake Lake and covers approximately 400 feet of shoreline and extends out as far as 100 feet. The area encompasses the alder thicket and open/shallow water wetland area north of the boat launch. The majority of the shoreline in this area is considered "wild" with little or no development and high scenic beauty.

Sensitive area B is located at the northeastern end of Big Blake Lake and covers approximately 400 feet of shoreline and extends out as far as 150 feet. The majority of the length is dominated by a shallow or open water wetland which has protected the area from the negative impacts of improperly developed shorelines.

Sensitive area C is located at the southeastern end of Big Blake Lake and the southwestern end of Little Blake Lake and encompasses the channel between the two lakes. The majority of the length is dominated by deep marsh and shallow or open water wetland which has protected the area from the negative impacts of improperly developed shorelines. However, some developed shorelines with minimal buffers do exist in the area. It is recommended that these shorelines should create suitable vegetative buffers for approximately 35 feet.

Sensitive Area A, north end of Big Blake Lake

All three sensitive areas provide important habitat for bass, panfish, and northern pike spawning and nursery areas; forage species; and wildlife. Additionally, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from the valuable habitat in these sensitive areas.

Wild rice was documented in sensitive areas A and C and should be allowed to proliferate.

The report recommended that chemical treatment and mechanical harvesting not be allowed in sensitive area A, and that these actions be limited to navigational channels in sensitive areas B and C.

2004 Big Blake Lake Water Quality and Technical Report, 2005

Aquatic Engineering, Inc.

In 2004, the District received a WDNR grant to collect physical and chemical water quality data, algae data, zooplankton data, and develop a phosphorus budget for Big Blake Lake. The final report was prepared by Aquatic Engineering, Inc.

Data indicated that Big Blake Lake was eutrophic and did not thermally stratify. The TN:TP ratio was approximately 12.5:1. In July and September the most common algae division was cyanophyta, or blue green algae. In August and September the zooplankton community was dominated by rotifers.

The Big Blake Lake watershed was determined as 798.37 acres and summed for each functional category. This study determined the largest land uses in the Big Blake Lake Watershed as forest (385.8 acres) and grassland (144.6 acres).[11]

Using the Wisconsin Lake Modeling Suite (WiLMS), it was determined that the most likely total annual phosphorus load to Big Blake Lake was 808 kg. This value includes 712 kg/year as point source load and 96 kg/year as non-point source load, but does not include internal loading or groundwater interactions. The study determined that the single largest load in 2004 came from the Straight River (85% of the total load or 703.7 kg/year).

[11] This study indicated that the Big Blake Lake Watershed was 798.37 acres in size. However, when all the land uses in the watershed are added the total equals 895.3 acres. Removing the lake surface area of 230 acres does not alleviate the discrepancy in acreage.

To improve the water quality of Big Blake Lake, the study recommended: public education and implementation of buffer strips and shoreline restoration, creating a committee to improve the Straight River Watershed, working with Polk County and towns as they create land use and zoning regulations, collecting in-lake data, reducing curly-leaf pondweed biomass, and adopting and implementing the 2005 Aquatic Plant Management Plan goals and recommendations.

2004 Big Blake Lake Aquatic Plant Survey Technical Report and Management Plan, 2005
Aquatic Engineering, Inc.
A second grant was awarded to the District to assess aquatic macrophytes and macroinvertebrates in conjunction with the water quality study. Project activities included an assessment of riparian land use, a lake resident survey, and updates to the current Lake Management Plan. The final report was prepared by Aquatic Engineering, Inc.

Macrophytes were surveyed in spring and summer using a series of thirty-four transects along the shoreline. Each transect was divided into depth categories of 0-1.5 feet, 1.5-5 feet, 5-10 feet, and 10 feet to the maximum rooting depth. Each sample area was divided into quadrants and sampled with a rake.

Seventeen species were identified in Big Blake Lake with 14 present in the spring and 12 present in the summer. The most common species found in the spring were curly-leaf pondweed (56.9%), coontail (16.9%), and flat stemmed pondweed (12.1%). The most common species in the summer were coontail (32%), flat stemmed pondweed (20.3%), and najas (13.1%).[12] The diversity value was 62.82 in the spring and 81.2 in the summer.

Curly-leaf pondweed was found at 87% of the sites sampled in the spring and 20% of the sites sampled in the summer.

Macroinvertebrates were collected in June and July at three different site conditions: curly-leaf pondweed dominated communities, moderate curly-leaf pondweed communities, and native plant communities. In general, diversity and richness did not differ significantly across sites.

At each point where the macrophyte transect intersected the shoreline, the riparian area was classified as natural or disturbed. Approximately three-fourths (79%) of the shoreline was classified as disturbed as compared to natural (21%).

A survey was distributed to all members of the District in the spring of 2005 to engage public participation and determine resident opinions and concerns. The survey had a 40% response rate (87 surveys completed out of 218). Over two-thirds of respondents (69%) were seasonal/part time residents. Respondents most frequently described their property immediately adjacent to the lake as mowed lawn leading to a pier. Over half (60%) of respondents felt that fertilizers and weed killer were not necessary to maintain lawns around the lake. Clear water received the most rankings as the issue of greatest importance. In the time since respondents have lived on Big Blake Lake, over half perceived the following conditions to have worsened: nuisance weed growth, algae growth, noise, personal watercraft traffic, motor boat traffic, and muckiness of lake bottom.

[12] Percentages for frequency of occurrence, relative percent

The vast majority of respondents felt that overall there were too many plants in Big Blake Lake (87%), that there are areas in the lake where aquatic plants became especially problematic (86%), and that the current weed management program was not effectively controlling nuisance plant growth (89%).

Over half of respondents believed that recreational activities and lake uses were occurring that were seriously jeopardizing the health and safety of Big Blake Lake (52%) and were in favor of expanding slow-no-wake times and/or locations to promote safety and protect sensitive habitat areas (56%).

The study outlined an implementation plan for Big Blake Lake with immediate, short range, and long-range actions. Immediate actions included education campaigns to inform residents about the value of aquatic plants and what they can do to help improve water quality. Short-range actions included harvesting curly-leaf pondweed throughout the lake in the spring and native plants in designated navigational channels in the summer. Long range actions included improving water quality by implementing best management practices in the Straight River Watershed and promoting the growth of native plants in sensitive areas.

Aquatic Macrophyte Surveys, 2006-2012

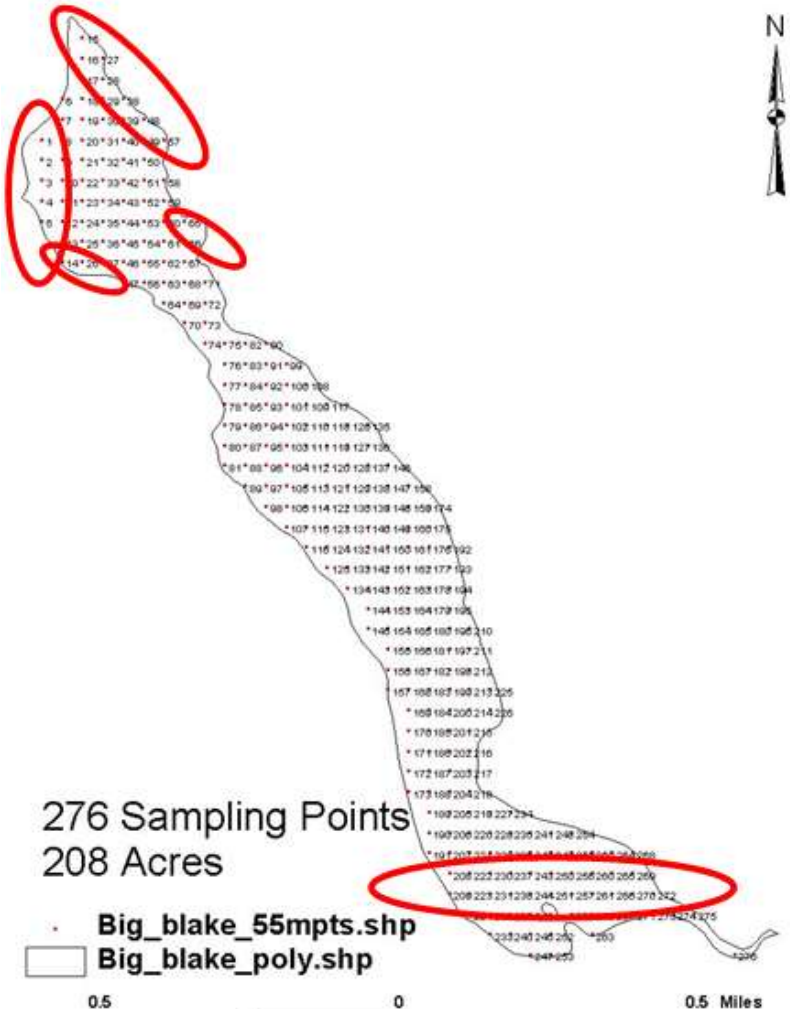
Polk County Land and Water Resources Department

The Polk County Land and Water Resources Department has completed aquatic plant surveys on Big Blake Lake since 2006. The surveys completed in 2006 sampled 40 points with early establishment of curly-leaf pondweed and the surveys completed in 2008-2010 occurred in two intensive management areas. Full spring and fall point intercept surveys were completed in 2007, 2011, and 2012 with data being summarized in the "Point Intercept Aquatic Macrophyte Surveys" section of this report.

May 2008 plant survey, rake shows curly leaf pondweed and coontail

In 2006, 2008, 2009, and 2010 curly-leaf pondweed was the dominant species in the spring being found at 98%, 100%, 95%, and 88% (respectively) of the sites sampled. Coontail was the only other common species found in all three years. Flat stem pondweed was fairly common in spring and fall 2006 and small pondweed was fairly common in spring 2010. The dominance of curly-leaf pondweed is not surprising given that the sampling points were chosen based on the presence of this species.

From 2008-2010, the Simpsons Diversity Index ranged from a high of 0.79 in October 2009 to a low of 0.53 in August 2008. Species richness, or the number of species found (including visuals), ranged from a high of 14 species in June 2010 to a low of 6 species in June 2009.



2006 sampling points

2008-2010 sampling points

Fisheries

The most recent fisheries survey on Big Blake Lake was completed in 2009 and included netting and shocking surveys.

Over a time period of 13 net nights, the total catch was highest for bluegill (103 fish, average length of 6.86 inches) followed by pumpkinseed (31 fish, average length of 7.25 inches). Fewer numbers of black crappie (13 fish, average length of 6.90 inches), northern pike (11 fish, average length of 22.34 inches), muskellunge (8 fish, average length of 37.31 inches), walleye (4 fish, average length of 23.13 inches), largemouth bass (3 fish, average length of 11.75 inches), and yellow perch (2 fish, average length of 6.50 inches) were caught.

Electroshocking occurred over one mile of shoreline on Big Blake Lake. The total catch was highest for bluegill (394 fish, average length of 6.36 inches) and largemouth bass (254 fish, average length of 11.53 inches). Fewer numbers of pumpkinseed (38 fish, average length of 7.24 inches), black crappie (8 fish, average length of 8.88 inches), northern pike (8 fish, average length of 23.63 inches), green sunfish (7 fish, average length of 6.68 inches), muskellunge (2 fish, average length of 35.00 inches), and yellow perch (1 fish, average length of 8.75 inches) were shocked.

Lake Resident Survey

A Wisconsin Department of Natural Resources approved survey was mailed to two hundred seventeen property owners on Big Blake Lake in May 2014. One hundred twenty-six surveys were returned (58% response rate) and data was entered by volunteers and analyzed.

Survey respondents have owned their property on Big Blake Lake for an average of 21 years. One third of survey respondents (33%) use their property as a year-round residence. The majority of respondents use their property part time, either as a weekend, vacation, and/or holiday residence (56%) or as a seasonal residence (continued occupancy months at a time) (10%). On average, properties on Big Blake Lake are used 148 days per year and occupied by 3.6 people.

The survey asked respondents to describe the area measuring 35 feet inland (beginning at the water's edge, shoreland towards the road). Survey respondents indicated that the vast majority of properties (91%) on Big Blake Lake contain mowed lawn in the 35 foot buffer area. Fewer respondents indicated that this area of their property contained shrubs/trees (44%), un-mowed vegetation (38%), and undisturbed woods (15%). A small minority of property owners have installed best management practices such as shoreline restorations (9%) and rain gardens (3%) in this area. Around half of respondents indicated their property has a dock/pier (48%) and stabilizing rock/rip rap (42%).

The survey asked respondents which activities they enjoy on Big Blake Lake. Activities enjoyed by over three-fourths of respondents include: enjoying peace and tranquility (93%), enjoying the scenic view (89%), open water fishing (83%), motorized boating (80%), and observing birds and wildlife (79%). Swimming is enjoyed by nearly three-fourths of respondents (70%), non-motorized boating (canoe/kayak) and ice fishing are enjoyed by around half of respondents (47% and 45%, respectively), and jet skiing/wakeboarding/waterskiing are enjoyed by one-fourth of respondents (27%). Fewer respondents enjoy cross country skiing/snowshoeing (17%), snowmobiling (16%), hunting/trapping (8%), and sailing/wind surfing (1%).

Most respondents keep watercraft on their property for use on Big Blake Lake, with only 7% of respondents noting that they do not have watercraft. Most survey respondents keep motorboats/pontoons on their property for use on Big Blake Lake. Nearly half of respondents keep

motorboats/pontoons that are 21-50 HP (46%), approximately one-third keep motorboats/pontoons that are more than 50 HP (36%), and approximately one-fourth keep motorboats/pontoons that are 1-21 HP (26%). Nearly half of survey respondents keep canoes/kayaks and paddleboats/rowboats on their property (46% and 44% respectively). Fewer respondents keep jet skis (12%) and sailboats (3%) on their property for use on Big Blake Lake.

In an effort to quantify risk of spreading aquatic invasive species, survey respondents were asked if the watercrafts they use on Big Blake Lake are used on other waterbodies. Approximately one-fourth (23%) of boats kept on Big Blake Lake are used on other waterbodies.

Respondents were asked to rank their degree of concern with fifteen issues as high, medium, low, issue exists but isn't a concern, and issue doesn't exist. Responses for this question were analyzed using a point system. Each issue ranked as high received 4 points, as medium received 3 points, as low received 2 points, as exists but not a concern 1 point, and as not an issue received 0 points. Total points were averaged to determine a final rank.

Issues with a final ranking of medium concern included: excessive aquatic plant growth, expansion of current invasive species (curly-leaf pondweed), excessive algae blooms, decrease in overall lake health, lack of water clarity or quality, new invasive species entering the lake, and increased nutrient pollution. The remaining issues ranked as low concerns.

What is your degree of concern with each issue listed below?	**Rank**
Excessive aquatic plant growth	3.4
Expansion of current invasive species (curly-leaf pondweed)	3.4
Excessive algae blooms	3.4
Decrease in overall lake health	3.3
Lack of water clarity or quality	3.3
New invasive species entering the lake	3.3
Increased nutrient pollution	3.2
Decreased property values	2.9
Decreased fisheries	2.7
Unsafe use of motorized water craft	2.6
Loss of natural scenery/beauty	2.5
Disregard for slow-no-wake zones	2.4
Increased development	2.3
Decreased wildlife populations	2.2
Excessive noise level on the lake	2.1

The survey was mailed out to members of the Big Blake Lake Protection and Rehabilitation District just after the dam on the outlet blew out in May 2014. As a result, when the survey was mailed out water levels on Big Blake Lake were below average. Not surprisingly, at the time of the survey the majority of respondents (81%) described the lake level as too low.

Over half of respondents described the current water quality of Big Blake Lake as fair (54%). More respondents described the current water quality as good (26%) compared to poor (14%). Respondents were more divided in describing how the water quality has changed since they've lived on Big Blake

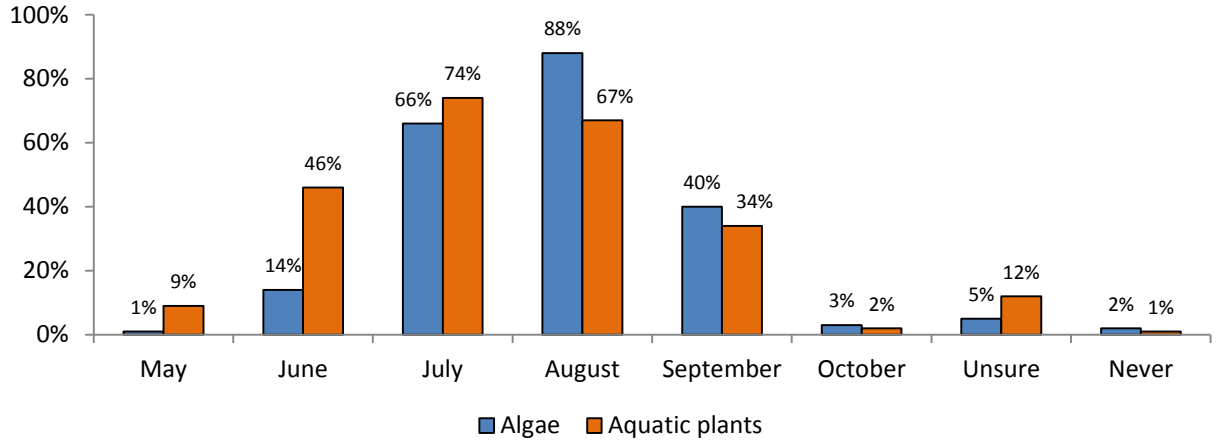
Lake. In general, more respondents described water quality as degrading in the time they'd lived on the lake (42%) as compared to improving (27%). However, approximately one-third of respondents (31%) were unsure how to describe the change or described the lake as unchanged.

The survey also asked a variety of questions regarding algae and aquatic plants. Respondents were asked to describe the amount of aquatic plants in Big Blake Lake, what months during the open water season algae and aquatic plants are a problem, and what uses are impaired as a result of algae and aquatic plants.

Algae are considered problematic by over three-fourths of respondents in August (88%), by two-thirds of respondents in July (66%), and by less than half of respondents in September (40%). A large majority of respondents indicated that swimming (92%) and overall enjoyment of the lake (84%) are limited by algae. Around half of respondents indicated that fishing (57%), boating (52%), and dogs/animals using the water (46%) were limited by algae.

The majority of respondents described the amount of aquatic plants as too many (69%). Fewer respondents described a healthy amount of plants (29%) and too few plants (2%). Aquatic plants are considered problematic by three-fourths of respondents in July (74%), by two-thirds of respondents in August (67%), by half of respondents in June (46%), and by one-third of respondents in September (34%). Approximately three-fourths of respondents indicated that swimming (83%), overall enjoyment of the lake (72%), and boating (71%) were limited by aquatic plants. Fewer respondents felt that fishing (63%) and navigation (43%) were limited.

Which months of the open water season do you consider algae and aquatic plants to be a problem on Big Blake Lake?



Curly-leaf pondweed is an invasive species that creates nuisance conditions in Big Blake Lake by forming dense beds of vegetation that interfere with lake uses in the spring. Nearly half of respondents (49%)

indicated that they would definitely recognize this invasive species and nearly one-fourth of respondents (20%) indicated that they would probably recognize this species.

Survey respondents were divided in describing if the current aquatic plant management program is effectively controlling nuisance aquatic plant growth (not including algae). More respondents felt that the program was effective (40%) as compared to ineffective (27%), although a third of respondents (33%) weren't sure how to describe the program. In a related question, the survey asked how satisfied residents were with the current aquatic plant harvesting program. Nearly two-thirds of respondents were satisfied with the program (63%), one-fourth of respondents were unsure or neutral (25%), and a minority were dissatisfied with the program (12%).

Earlier in the survey, 91% of respondents indicated that the area 35 feet back from their shoreline contained mowed lawn. Later, the survey asked respondents to describe the current amount of mowed lawn across the entire shoreline of Big Blake Lake. Nearly half of respondents described the amount of lawn as just right (47%), one-fourth described the amount of lawn as too much (24%), and another one-fourth were unsure (27%). Only 2% of respondents described the amount of lawn as not enough.

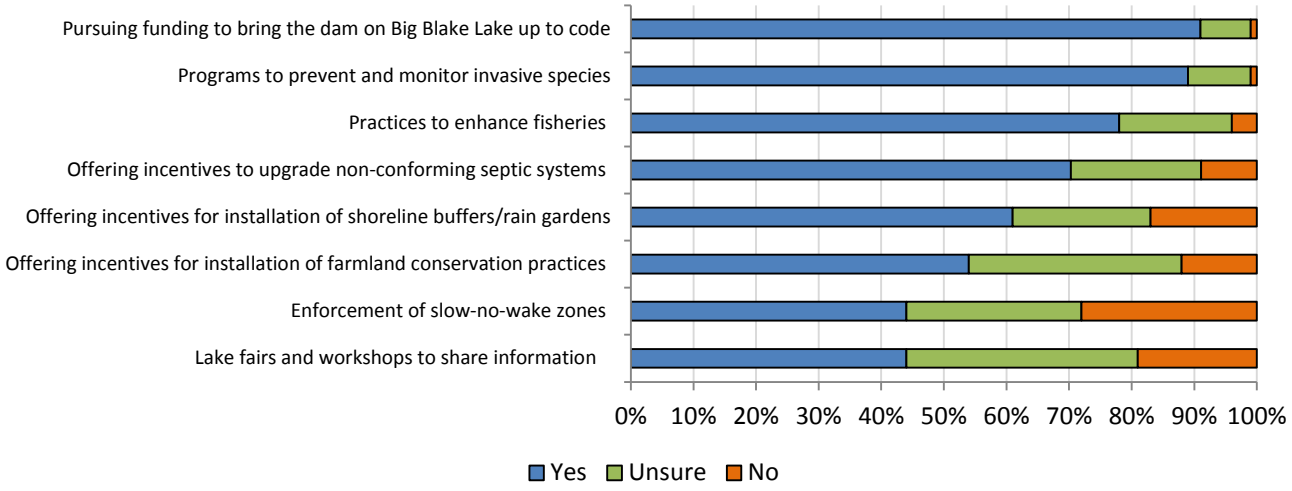
Overall the majority of respondents felt that shoreline buffers, rain gardens, and native plants were very important (37%) or somewhat important (34%) to the water quality of Big Blake Lake. A minority described them as not too important (10%) and not at all important (7%). However, earlier in the survey it was indicated that very few shoreline property owners had installed shoreline restorations and rain gardens (9% and 3%, respectively).

On a positive note, over half of respondents do not use fertilizer on their property (60%) and another one-third use zero phosphorus fertilizer (38%). A very small minority of respondents use fertilizer but are unsure of its phosphorus content (2%) or use multiple types of fertilizer that contain varying amounts of phosphorus (1%).

The survey asked respondents to indicate which actions should be completed by the District to manage Big Blake Lake. Over three-fourths of respondents supported: pursuing funding to bring the dam on Big

Blake Lake up to code (91%), programs to prevent and monitor invasive species (89%), and practices to enhance fisheries (78%). Over half of respondents supported offering incentives for: upgrades to non-conforming septic systems (71%), installation of shoreline buffers/rain gardens (61%), and installation of farmland conservation practices (54%). Fewer respondents supported the enforcement of slow-no-wake-zones (44%) and lake fairs and workshops to share information (44%).

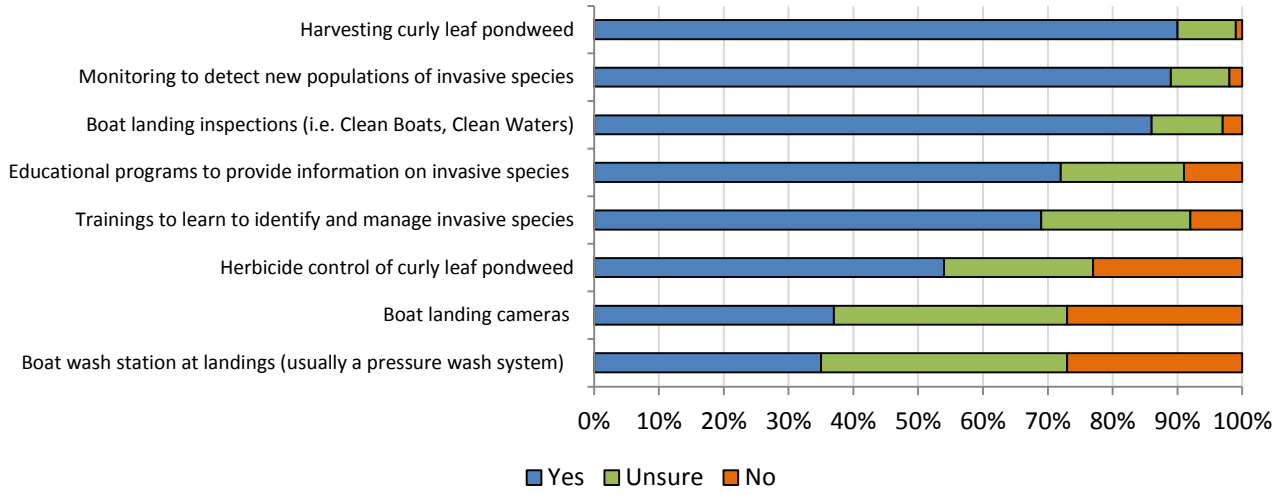
Which activities should be completed by the District to manage Big Blake Lake?



The survey also asked respondents to indicate which actions should be completed by the District to manage aquatic invasive species. Over three-fourths of respondents supported: harvesting curly-leaf pondweed (90%), monitoring to detect new populations of invasive species (89%), and boat landing inspections (86%). Over half of respondents supported: educational programs to provide information on invasive species (72%), trainings to learn to identify and manage invasive species (69%), and herbicide control of curly-leaf pondweed (54%).

Fewer respondents supported boat landing cameras (37%) and boat wash stations at landings (35%). However, over one-third of respondents were unsure if the District should pursue these opportunities, indicating a potential need for information and education regarding these management practices.

Which activities should be completed by the District to manage aquatic invasive species?



Survey respondents were asked how they prefer to receive information from the Big Blake Lake District. Respondents indicated that the most preferred method of communication was the newsletter (85%), followed by email (51%), and the annual meeting (40%). Only one-fourth of respondents preferred to receive information through websites (24%) and a small minority preferred Facebook (6%).

Over half of survey respondents were not aware of the Big Blake Lake District Facebook page (55%) and one-third of respondents never visit the page (32%). Fewer respondents rarely (9%), and sometimes (4%) visit the page.

The survey asked respondents which activities they were interested in participating in to improve Big Blake Lake. Around one-third of respondents were interested in learning to identify invasive species (36%), installing a shoreline buffer on their property (32%), and learning how to monitor for aquatic invasive species (29%). Approximately one-fourth of respondents were interested in learning how to monitor water quality (28%) and installing a rain garden on their property (28%). Fewer respondents were interested in serving on a committee to develop an action plan for improving Big Blake Lake (12%).

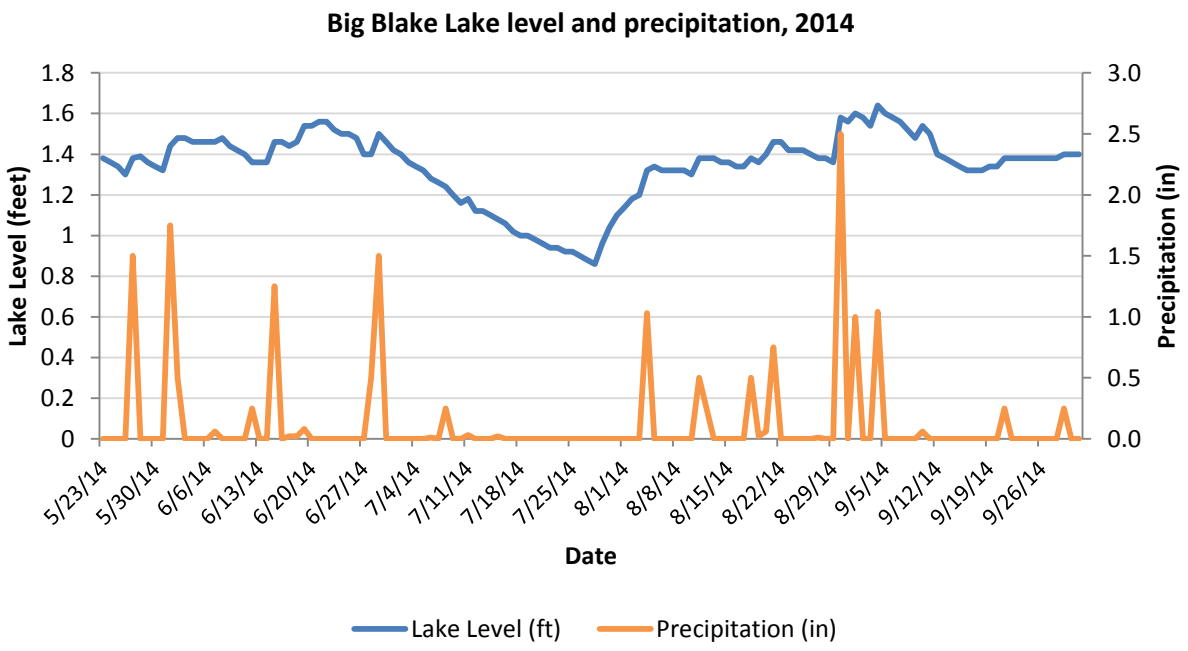
Lake Level and Precipitation Monitoring

Lake water-level fluctuations are important to lake managers, lakeshore property owners, developers, and recreational users because they can have significant impacts on lake water quality and usability. Although lake levels naturally change from year to year, extreme high or low levels can present problems such as restricted water access, flooding, shoreline and structure damage, and changes in near shore vegetation.

Records of lake water elevations can be very useful in understanding changes that may occur in lakes. While some lakes respond almost immediately to precipitation, other lakes do not reflect changes in precipitation until months later.

Volunteers monitored lake level and precipitation on Big Blake Lake in 2014 in response to the dam failure. Polk County Land and Water Resources Department provided training on data collection methods and installed staff and rain gauges. Monitoring began on May 23rd and continued through October 10th.

Seasonal precipitation on Big Blake Lake totaled 17.71 inches. Lake level did respond to precipitation events, with levels increasing following rainfall events. Lake levels were lowest on July 28th and highest on September 4th, with a variation of 0.78 feet.



Lake Mixing and Stratification: Background Information

Water quality is affected by the degree to which the water in a lake mixes. Within a lake, mixing is most directly impacted by the temperature-density relationship of water. When comparing why certain lakes mix differently than others, lake area, depth, shape, and position in the landscape become important factors to consider.

Water reaches its greatest density at 3.9^{o}C (39°F) and becomes less dense as temperatures increase and decrease. Compared to other liquids, the temperature-density relationship of water is unusual: liquid water is more dense than water in its solid form (ice). As a result, ice floats on liquid water.

When ice melts in the early spring, the temperature and density of the water will be constant from the top to the bottom of the lake. This uniformity in density allows a lake to completely mix. As a result, oxygen is brought to the bottom of a lake, and nutrients are re-suspended from the sediments. This event is termed **spring turnover**.

As the sun's rays warm the surface waters in the spring, the water becomes less dense and remains at the surface. Warmer water is mixed deeper into the water column through wind and wave action. However, these forces can only mix water to a depth of approximately twenty to thirty feet. Generally, in a shallow lake, the water may remain mixed all summer. However, a deeper lake usually experiences layering based on temperature differences, called **stratification**.

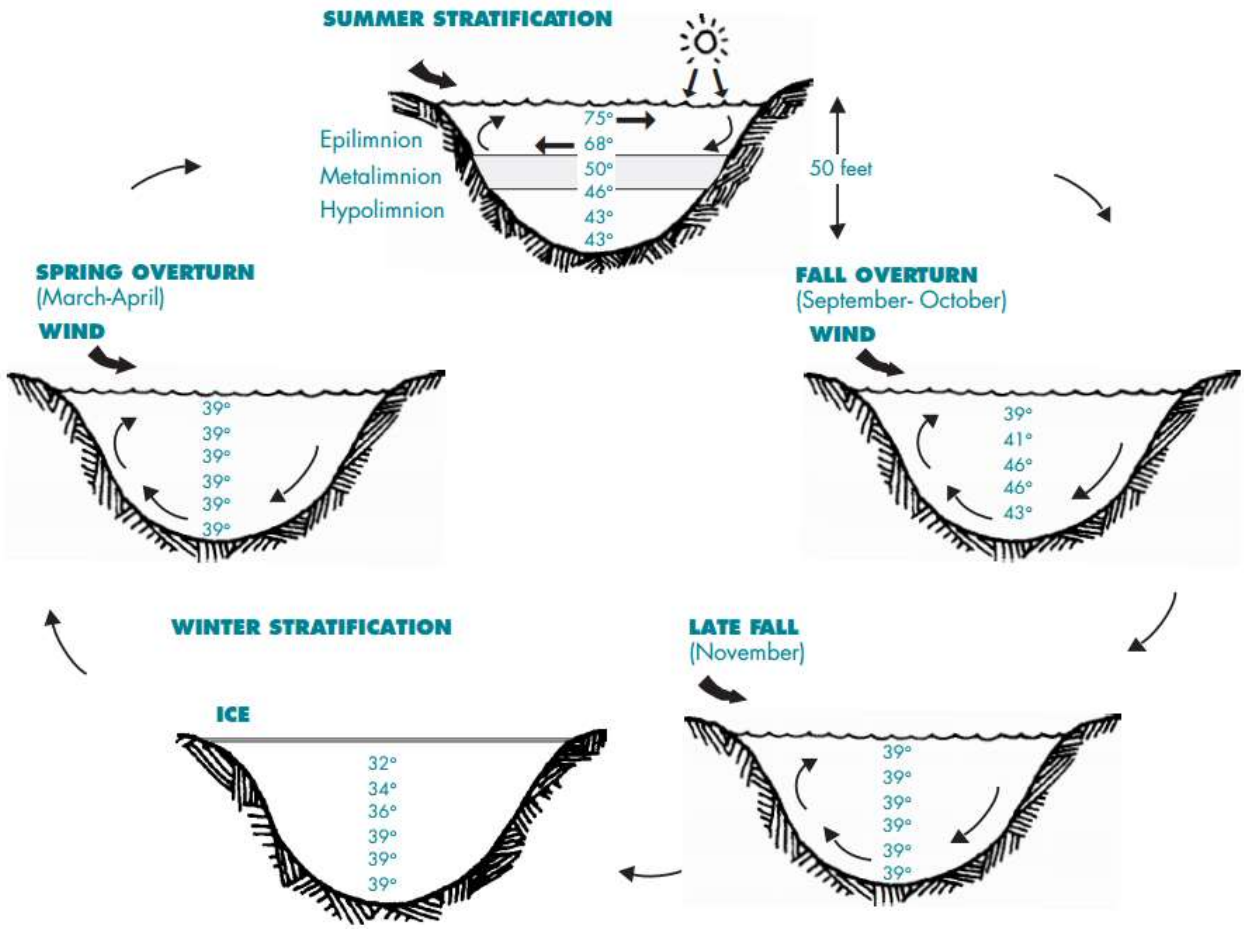
During the summer, lakes have the potential to divide into three distinct zones: the **epilimnion**, **thermocline** or **metalimnion**, and the **hypolimnion**. The epilimnion describes the warmer surface layer of a lake and the hypolimnion describes the cooler bottom area of a lake. The thermocline, or metalimnion, describes the transition area between the epilimnion and hypolimnion.

As surface waters cool in the fall, they become more dense and sink until the water temperature evens out from top to bottom. This process is called **fall turnover** and allows for a second mixing event to occur. Occasionally, algae blooms can occur at fall overturn when nutrients from the hypolimnion are made available throughout the water column.

Variations in density arising from differences in water temperatures can prevent warmer water from mixing with cooler water. As a result, nutrients released from the sediments can become trapped in the hypolimnion of a lake that stratifies. Additionally, since mixing is one of the main ways oxygen is distributed throughout a lake, lakes that don't mix have the potential to have very low levels of oxygen in the hypolimnion.

The absence of oxygen in the hypolimnion can have adverse effects on fisheries. Species of cold water fishes require the cooler waters that result from stratification. Cold water holds more oxygen as compared to warm water. As a result, the cooler waters of the hypolimnion can provide a refuge for cold water fisheries in the summer as long as oxygen is present. Respiration by plants, animals, and especially bacteria is the primary way oxygen is removed from the hypolimnion. A large algae bloom can cause oxygen depletion in the hypolimnion as algae die, sink, and decay.

In the winter, stratification remains constant because ice cover prevents mixing by wind action.



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[13] Figure from Understanding Lake Data (G3582), UW-Extension, Byron Shaw, Christine Mechenich, and Lowell Klessig, 2004

Deep Hole Sampling Procedure

In-lake data were collected by the Polk County Land and Water Resources Department at the deep hole of Big Blake Lake at spring and fall turnover events and bi-weekly between the months of May through September from 2013-2015.

Lake profile monitoring

Dissolved oxygen, temperature, conductivity, specific conductance, and pH were recorded at meter increments with a Hanna Instruments 9828 multi-parameter probe.

Secchi depth

Secchi depth was recorded with an eight inch diameter round disk with alternating black and white quadrants called a secchi disk. To record secchi depth, the disk was lowered into the lake on the shady side of a boat until just before it disappeared from sight. This depth was measured in feet and recorded as the secchi depth. Data were collected biweekly to correspond with lake profile monitoring readings.

Chemistry and chlorophyll a

Top and bottom samples were collected once monthly with a Van Dorn sampler and analyzed at the Wisconsin State Lab of Hygiene. Top samples were analyzed for total phosphorus, soluble reactive phosphorus, nitrate/nitrite, ammonium, total Kjeldahl nitrogen, sulfate, total suspended solids, and chlorophyll a. Bottom samples were analyzed for total phosphorus and soluble reactive phosphorus.

Dissolved Oxygen

Oxygen is required by all aquatic organisms for survival. The amount of oxygen dissolved in water depends on temperature, the amount of wind mixing that brings water into contact with the atmosphere, the biological activity that consumes or produces oxygen within a lake, and the composition of groundwater and surface water entering a lake.

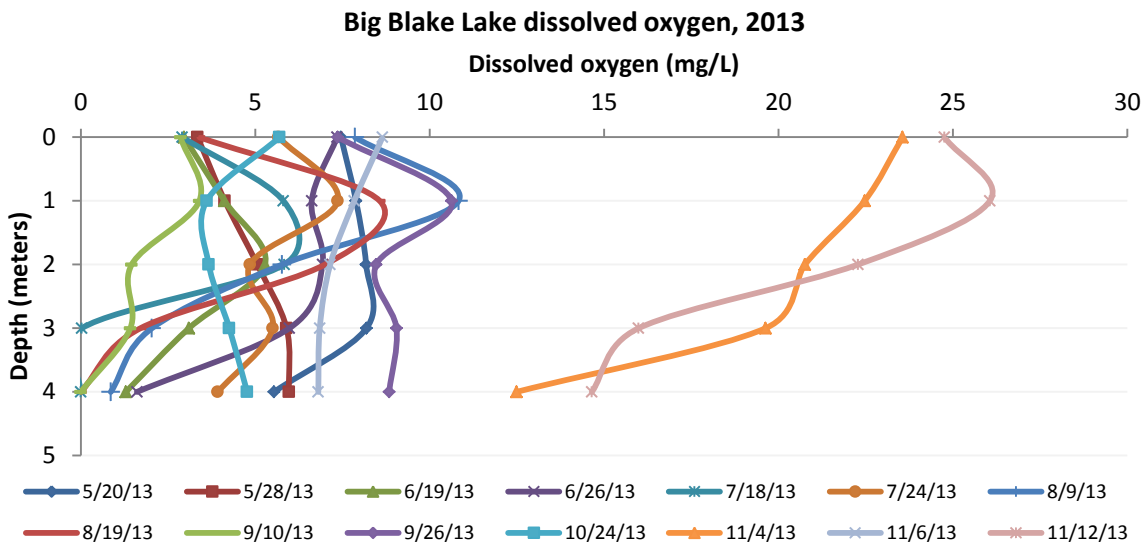
In a process called photosynthesis, plants use carbon, water, and the sun's energy to produce simple sugars and oxygen. Chlorophyll, the pigment in plants that captures the light energy necessary for photosynthesis, is the site where oxygen is produced. Since photosynthesis requires light, the oxygen producing process only occurs during the daylight hours and only at depths where sunlight can penetrate. Plants and animals also use oxygen in a process called respiration. During respiration, sugar and oxygen are used by plants and animals to produce carbon dioxide and water.

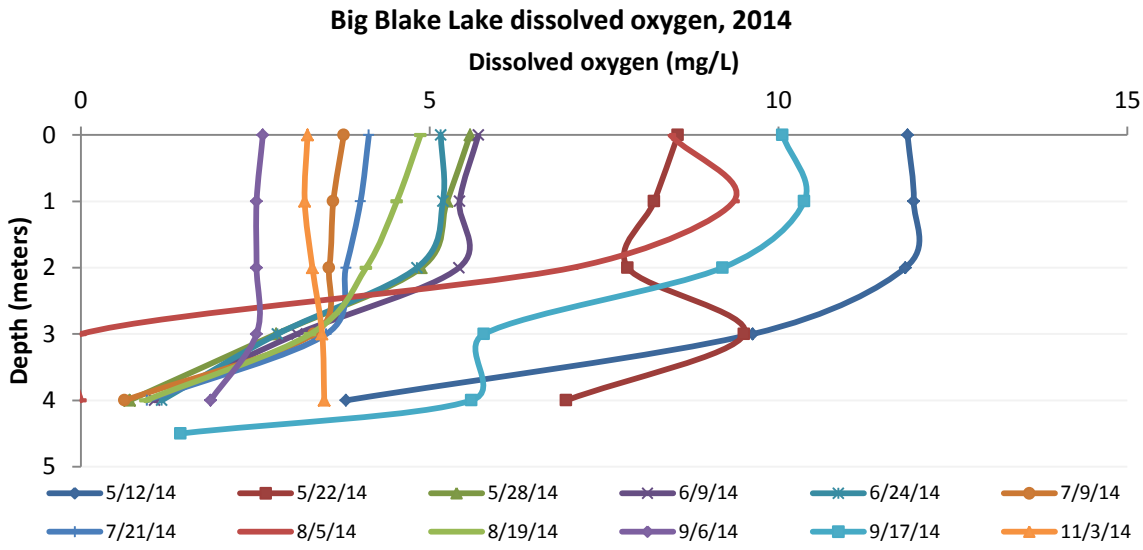
Cold water has a higher capacity for oxygen than warm water. However, although temperatures are coolest in the deepest part of a lake, these waters often do not contain the most oxygen. This arises because in the deepest parts of lakes, oxygen producing photosynthesis is not occurring, mixing is unable to introduce oxygen, and the only reaction occurring is oxygen consuming respiration. Therefore, it is not uncommon for oxygen depletion to occur in the hypolimnion.

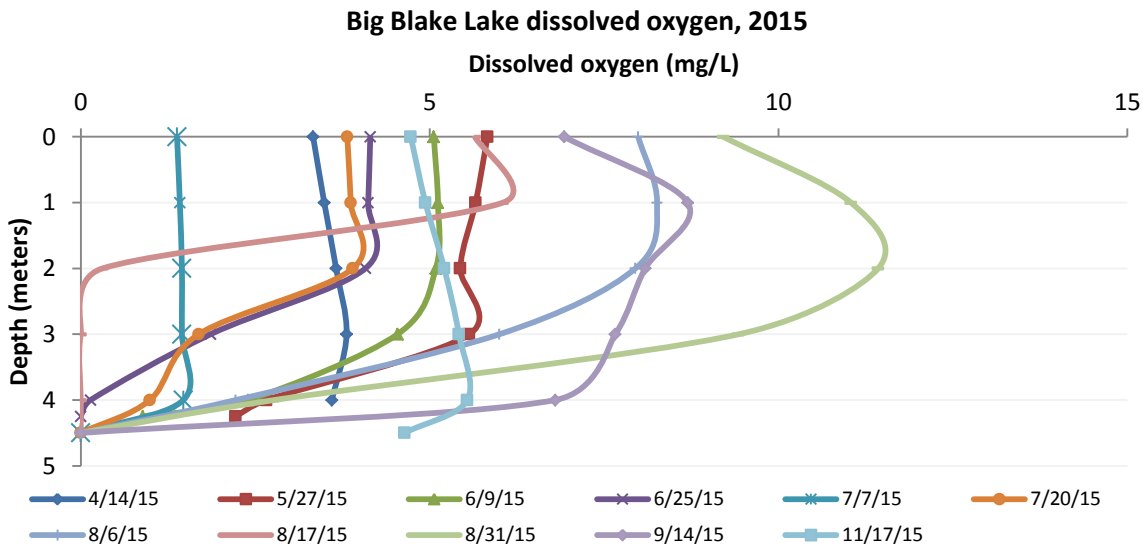
During the sunlight hours, when photosynthesis is occurring, dissolved oxygen levels at a lake's surface may be quite high. Conversely, at night or early in the morning (when photosynthesis is not occurring), the dissolved oxygen values can be expected to be lower.

A water quality standard for dissolved oxygen in warm water lakes and streams is set at 5 mg/L. This standard is based on the minimum amount of oxygen required by fish for survival and growth. For cold water lakes supporting trout, the standard is set even higher at 7 mg/L.

Dissolved oxygen levels at the surface of Big Blake Lake were below 5 mg/L on 15 of the 37 days data was collected. Dissolved oxygen levels at the surface were below 5 mg/L in July and July in 2013, 2014, and 2015.


Big Blake Lake dissolved oxygen, 2013
Dissolved oxygen (mg/L)
0
5
10
15
20
25
30
Depth (meters)
0
1
2
3
4
5
5/20/13
5/28/13
6/19/13
6/26/13
7/18/13
7/24/13
8/9/13
8/19/13
9/10/13
9/26/13
10/24/13
11/4/13
11/6/13
11/12/13

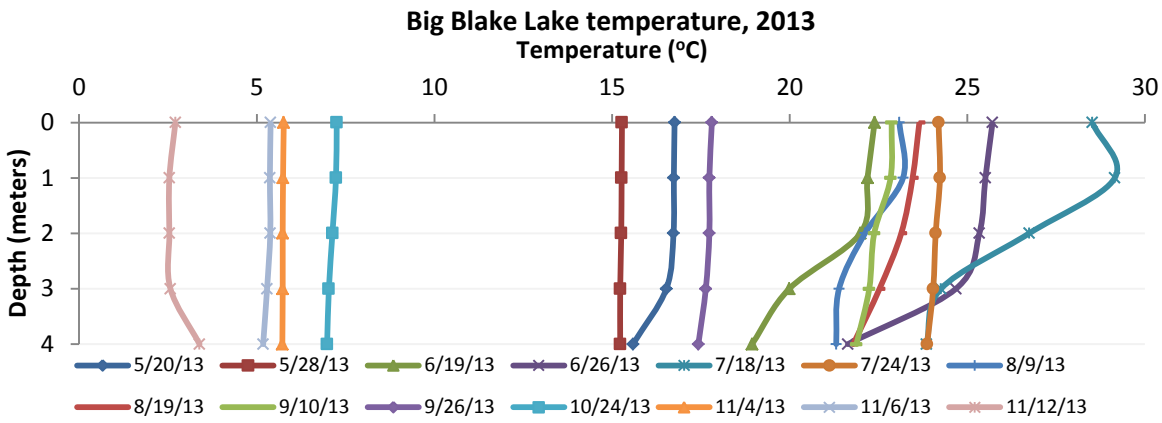

Big Blake Lake dissolved oxygen, 2014
Dissolved oxygen (mg/L)
0
5
10
15
Depth (meters)
0
1
2
3
4
5
5/12/14
5/22/14
5/28/14
6/9/14
6/24/14
7/9/14
7/21/14
8/5/14
8/19/14
9/6/14
9/17/14
11/3/14

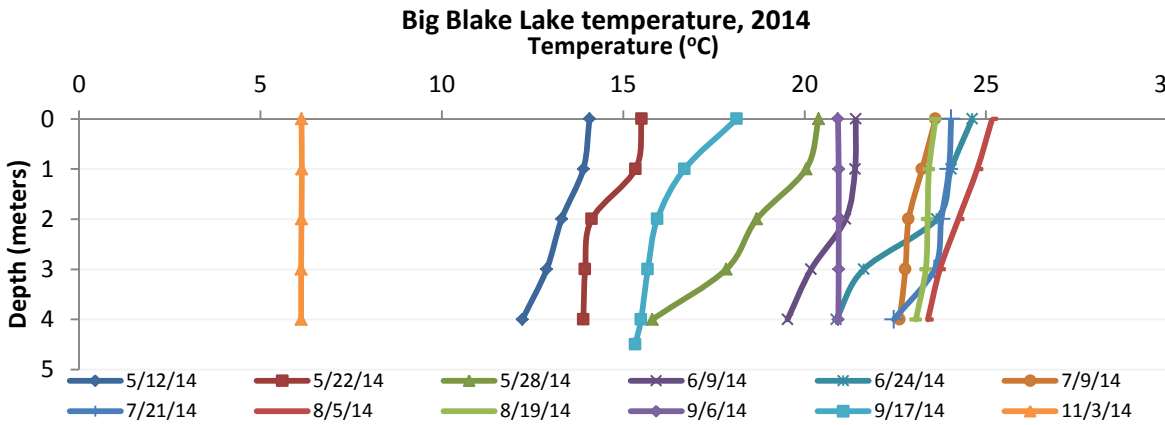

Big Blake Lake dissolved oxygen, 2015
Dissolved oxygen (mg/L)
0
5
10
15
Depth (meters)
0
1
2
3
4
5
4/14/15
5/27/15
6/9/15
6/25/15
7/7/15
7/20/15
8/6/15
8/17/15
8/31/15
9/14/15
11/17/15

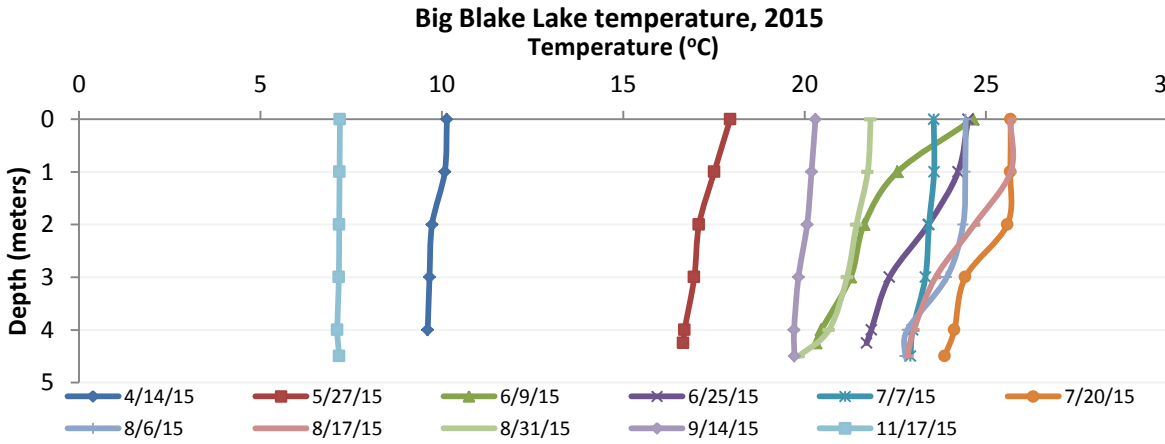
Temperature

Big Blake Lake reached its warmest surface temperature (28.52°C) on July 18th, 2013. In 2014, the warmest surface temperature recorded was 25.17°C on August 5th and in 2015 the warmest surface temperature recorded was 25.68°C on July 20th.

Big Blake Lake did weakly stratify, or set up density dependent layers, in all three sampling years. Generally stratification occurred in May, June, and July.



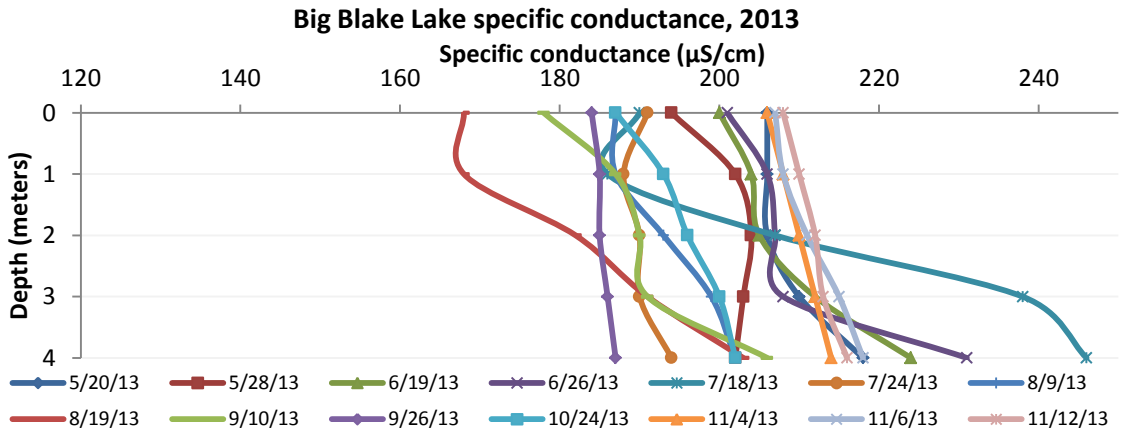


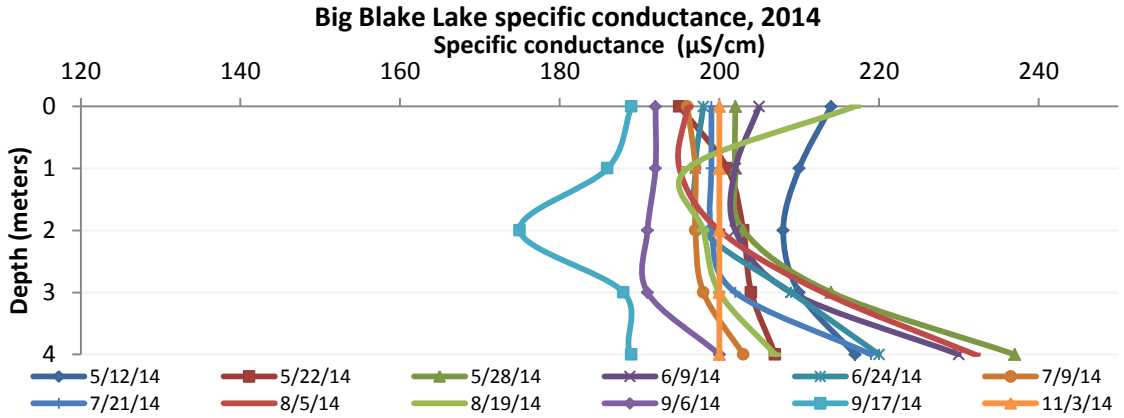


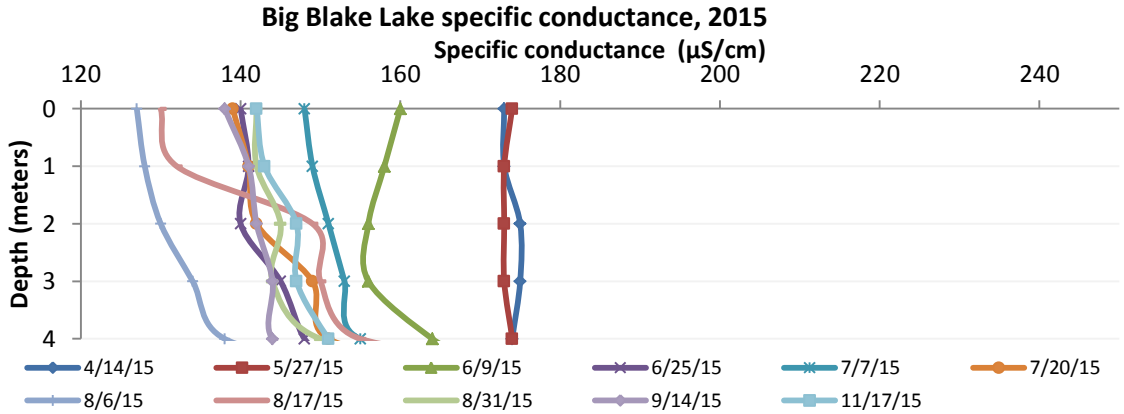
Specific Conductance (Conductivity)

Conductivity is the measure of the ability of water to conduct an electrical current and serves as an indicator of the concentration of total dissolved inorganic chemicals in the water. Since conductivity is temperature related, reported values are normalized at 25°C and termed specific conductance. Specific conductance increases as the concentration of dissolved minerals in a lake increase.

In general, specific conductance values were between 160 and 240 µS/cm in 2013 and 2014. However, in 2015 specific conductance values were much lower, falling between 130 and 180 µS/cm. Values generally increased towards the bottom of the lake and were highest in the spring/early summer.







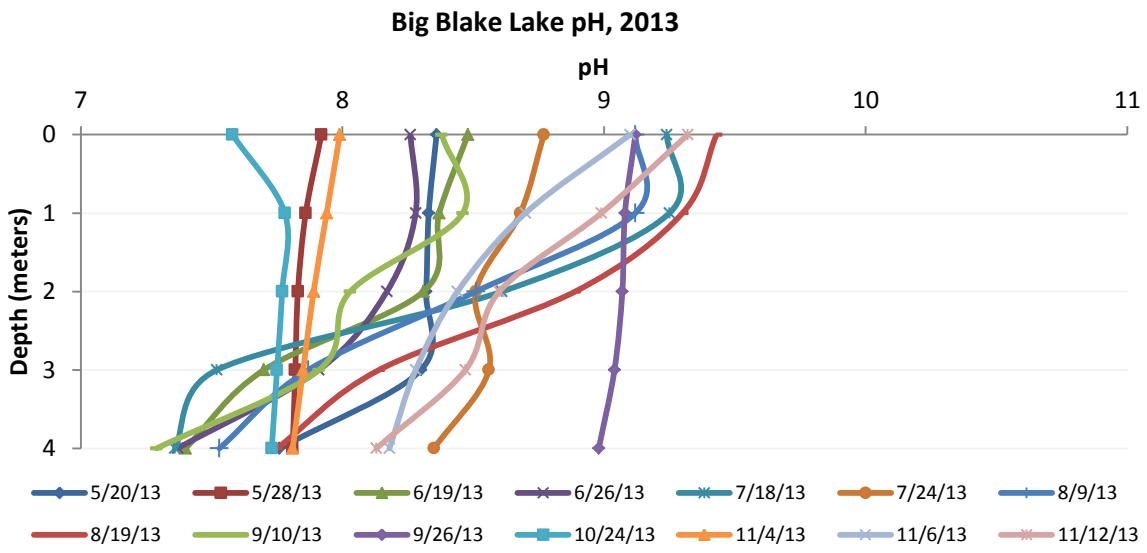
pH

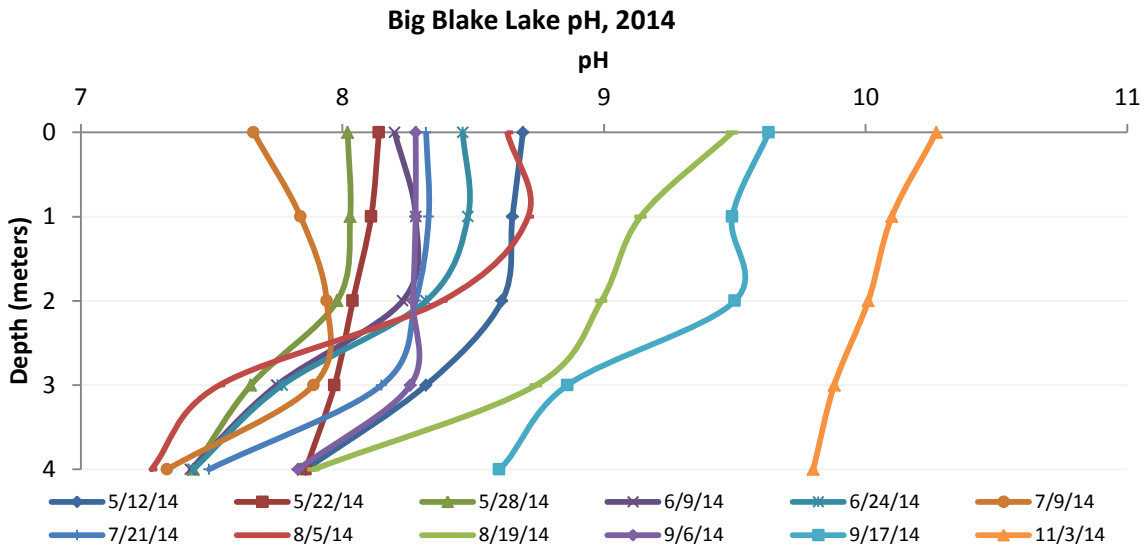
An indicator of acidity, pH is the negative logarithm of the hydrogen ion (H+) concentration. Lower pH waters have more hydrogen ions and are more acidic, and high pH waters have less hydrogen ions and are less acidic.

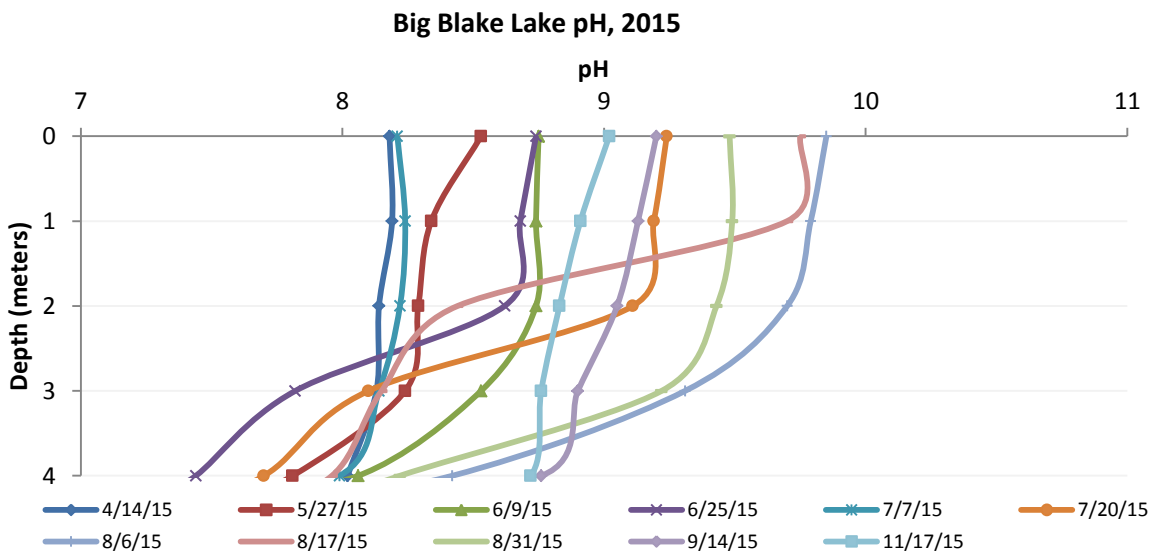
A pH value of seven is considered neutral. Values less than seven indicate acidic conditions; whereas, values greater than seven indicate alkaline conditions. A single pH unit change represents a tenfold change in the concentration of hydrogen ions. As a result, a lake with a pH value of eight is ten times less acidic than a lake with a pH value of seven. Across Wisconsin lakes, pH values can range from 4.5 (acid bog lakes) to 8.4 (hard water, marl lakes).

Through the removal of CO_2 from the water column, photosynthesis has the effect of increasing pH. As a result, pH generally increases during the day and decreases at night. Under conditions such as high temperature, high nutrients, and dense algae blooms, pH levels can increase.

In general pH levels on Big Blake Lake were between 8 and 10, with values decreasing towards the bottom of the lake. Values for pH were highest in the late summer and early fall.


Big Blake Lake pH, 2013
pH
7
8
9
10
11
Depth (meters)
0
1
2
3
4
5/20/13
5/28/13
6/19/13
6/26/13
7/18/13
7/24/13
8/9/13
8/19/13
9/10/13
9/26/13
10/24/13
11/4/13
11/6/13
11/12/13


Big Blake Lake pH, 2014
pH
7
8
9
10
11
Depth (meters)
0
1
2
3
4
5/12/14
5/22/14
5/28/14
6/9/14
6/24/14
7/9/14
7/21/14
8/5/14
8/19/14
9/6/14
9/17/14
11/3/14


Big Blake Lake pH, 2015
pH
7
8
9
10
11
Depth (meters)
0
1
2
3
4
4/14/15
5/27/15
6/9/15
6/25/15
7/7/15
7/20/15
8/6/15
8/17/15
8/31/15
9/14/15
11/17/15

Secchi Depth

The depth which light can penetrate into lakes is affected by suspended particles, dissolved pigments, and absorbance by water. Often, the ability of light to penetrate the water column is determined by the abundance of algae or other photosynthetic organisms in a lake.

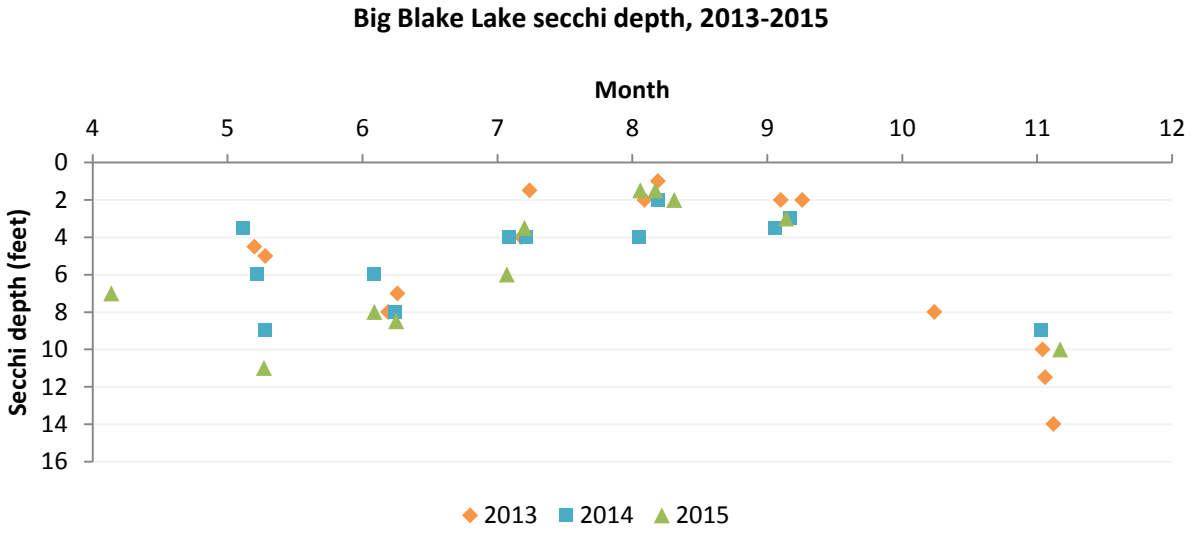
One method of measuring light penetration is with a secchi disk. A secchi disk is an eight inch diameter round disk with alternating black and white quadrants that is used to provide a rough estimate of water clarity. The depth at which the secchi disk is just visible is defined as the secchi depth. A greater secchi depth indicates greater water clarity.

For the majority of the summer months (July through September) secchi depth was below 4 feet.

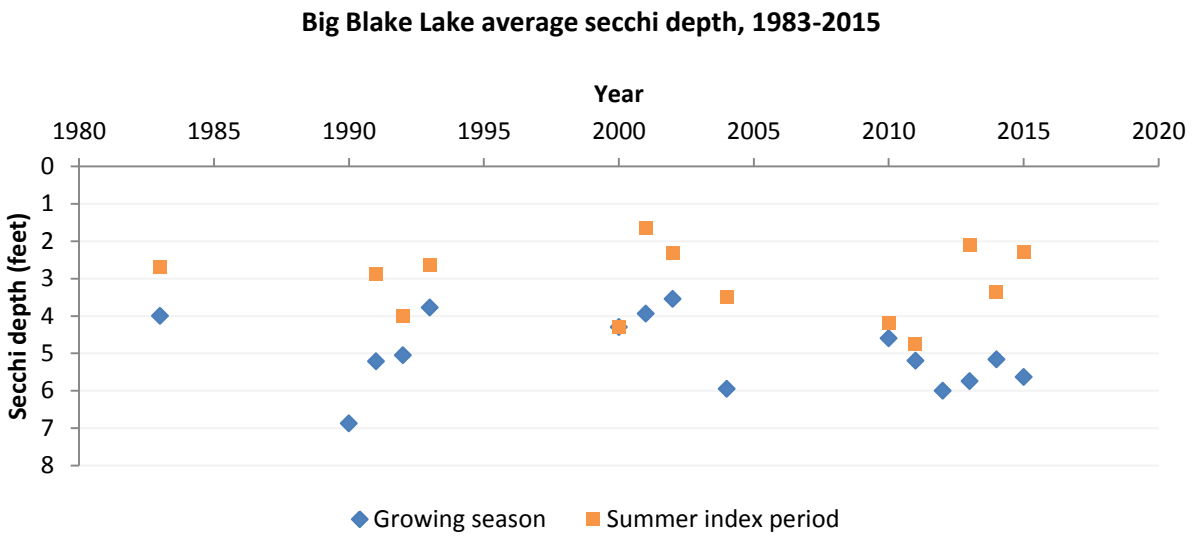
Secchi depth ranged from a low of one foot on August 19th, 2013 to a high of fourteen feet on November 12th, 2013.

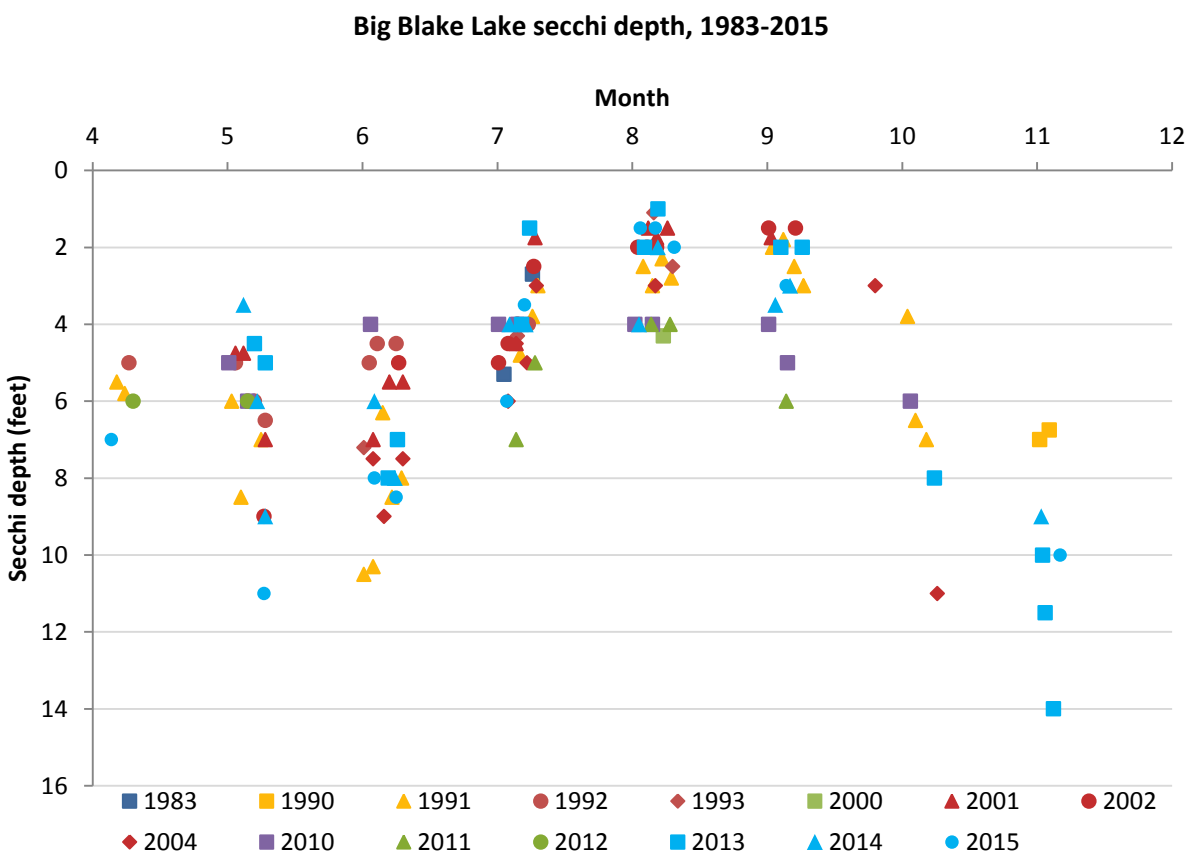
Growing season average secchi depth (April-November) was between five and six feet in all three sampling years (6 feet in 2013, 5 feet in 2014, and 6 feet in 2015).

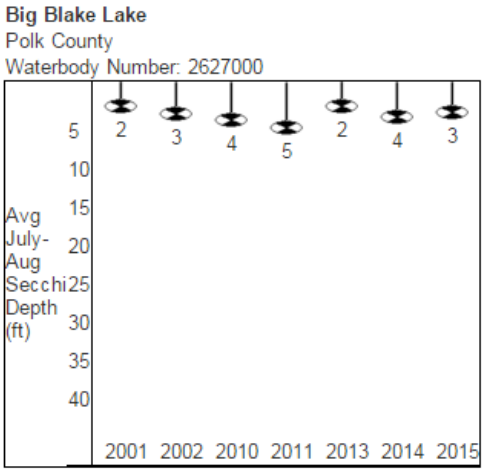
Summer index period average secchi depth (July 15-September 15) ranged from two to three feet in all three sampling years (2 feet in 2013, 3 feet in 2014, and 2 feet in 2015).



Average growing season and summer index period secchi depth has varied since 1983. In most years, the summer index period secchi depth was less than four feet. Over this same time period, secchi depth has been lowest in the months of July, August, and September.







Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
2001	2.2	1.5	4.5	5
2002	3.14	2	5	7
2010	4	4	4	4
2011	5	4	7	4
2013	2.13	1	4	4
2014	3.5	2	4	4
2015	2.9	1.5	6	5

The Wisconsin Department of Natural Resources website provides historic secchi depth averages for the months of July and August. This data exists for Big Blake Lake for 2001, 2002, and 2010-2015. Averages over this time period range from a low of 2 feet to a high of 5 feet.

Over the three years this study took place, average summer secchi depth (July-August) was 2.1 feet in 2013, 3.5 feet in 2014, and 2.9 feet in 2015.

The average summer secchi depth (July and August) for the Northwest geo-region was 8.6 feet in 2013, 8.5 feet in 2014, and 8.4 feet in 2015.

In all three years, secchi depth for Big Blake Lake was well below the Northwest georegion average.

Phosphorus

Phosphorus is an element present in lakes which is necessary for plant and algae growth. It occurs naturally in soil and rocks and in the atmosphere in the form of dust. Phosphorus can make its way into lakes through groundwater and human induced disturbances such as soil erosion. Additional sources of phosphorus inputs into a lake can include external sources such as fertilizer runoff from urban and agricultural settings and internal sources such as release from lake bottom sediments.

Phosphorus does not readily dissolve in water, instead it forms insoluble precipitates with calcium, iron, manganese, sulfur, and aluminum. If oxygen is available in the hypolimnion, iron forms sediment particles that store phosphorus in the sediments. However, when lakes lose oxygen in the winter or when the hypolimnion becomes anoxic in the summer, these particles dissolve and phosphorus is redistributed throughout the water column with strong wind action or turnover events.

Phosphorus is necessary for plant and animal growth. Excessive amounts can lead to an overabundance of growth which can decrease water clarity and lead to nutrient pollution in lakes.

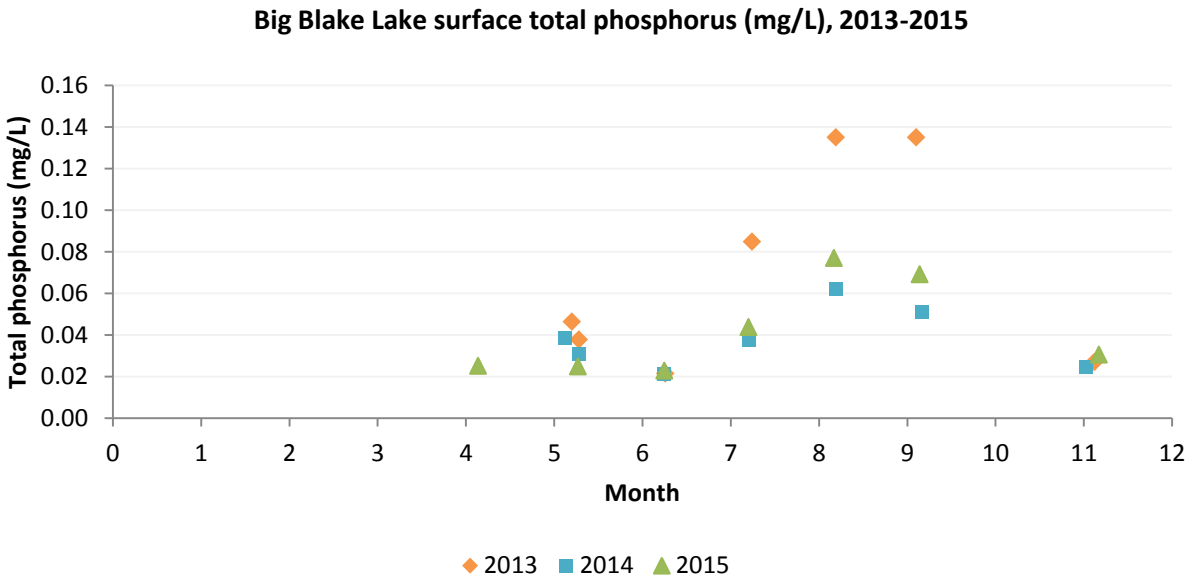
Total phosphorus (TP) is a measure of all the phosphorus in a sample of water. In many cases total phosphorus is the preferred indicator of a lake's nutrient status because it remains more stable than other forms over an annual cycle.

In lakes, a "healthy" limit of total phosphorus is set at 0.02 mg/L. If a value is above the healthy limit, it is more likely that a lake could support nuisance algae blooms. Total phosphorus concentrations were above 0.02 mg/L on all twenty-one sampling dates.

Growing season average[14] surface total phosphorus exceeded the healthy limit in 2013 (0.08 mg/L), 2014 (0.04mg/L), and 2015 (0.05mg/L).

Summer index period average surface total phosphorus (July 15-September 15) exceeded the healthy limit in 2013 (0.12 mg/L), 2014 (0.05 mg/L), and 2015 (0.06mg/L).

Surface total phosphorus concentrations were approximately twice as high in 2013 as compared to 2014 and 2015. As the growing season progressed, a general trend of increasing phosphorus was evident through September. By November (fall turnover), total phosphorus levels had returned to what they had been in April/May (spring turnover). However, in 2013 and 2014 total phosphorus levels exhibited a slight decrease in June as compared to May, which would align with the time that harvesting of curly-leaf pondweed occurred. With warmers temperatures in 2015, harvesting began earlier (May) which may explain why total phosphorus levels remained fairly constant from April through June.



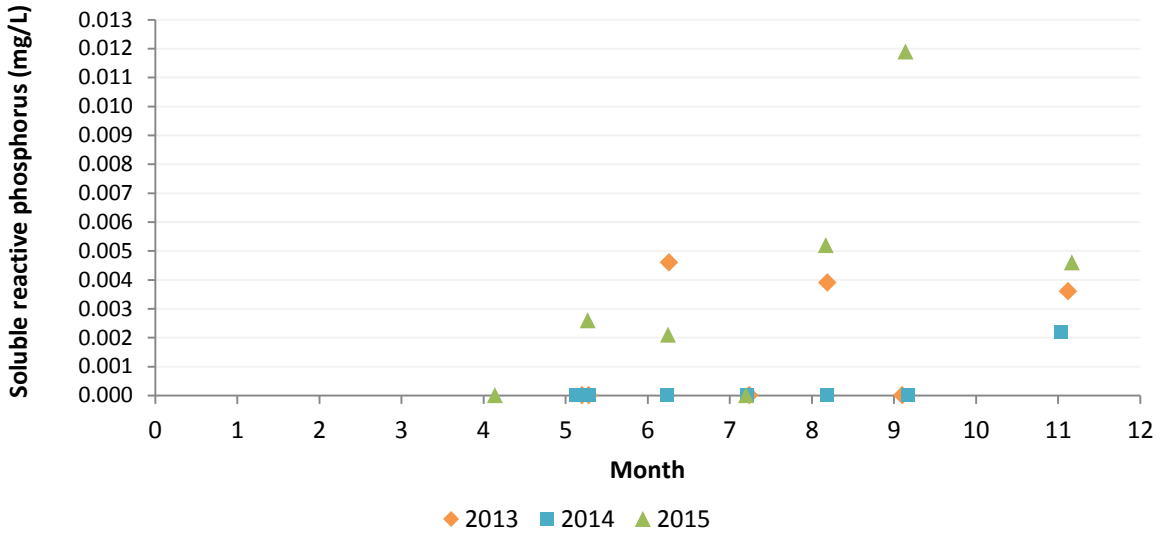
[14] Excludes turnover

Soluble reactive phosphorus (SRP) includes forms of phosphorus that are dissolved in the water and are readily available for uptake by algae and aquatic macrophytes (plants).

In lakes, a "healthy" limit of soluble reactive phosphorus is set at 0.01 mg/L. If a value is above the healthy limit it is more likely that a lake could support nuisance algae blooms.

Surface soluble reactive phosphorus concentrations were below 0.01 mg/L on all sampling dates with the exception of September 14th, 2015. On twelve of the twenty-one dates where samples were taken (57%), soluble reactive phosphorus was below the limit of detection.[15] Soluble reactive phosphorus concentrations were the highest in 2015, with only one of the seven samples being below the limit of detection. Soluble reactive phosphorus concentrations were lowest in 2014, with only one of the seven samples being above the limit of detection.

Big Blake Lake surface soluble reactive phosphorus (mg/L), 2013-2015



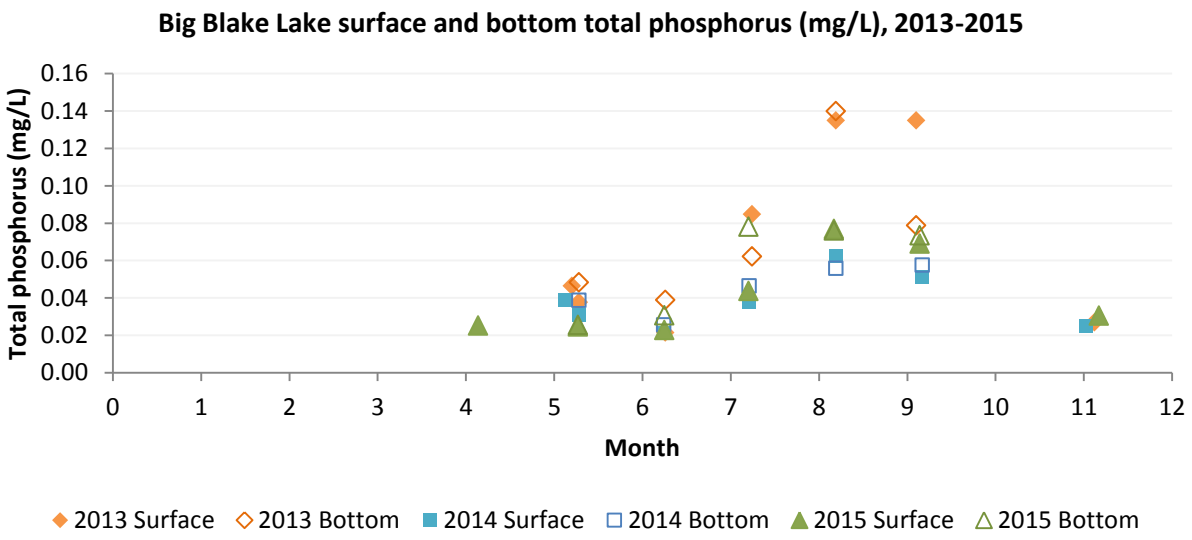
[16]

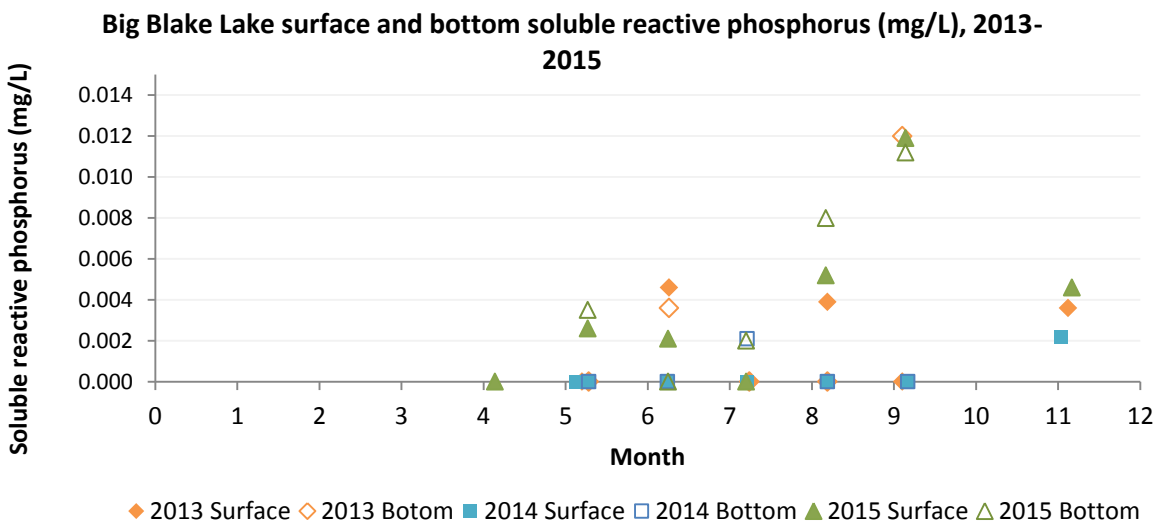
[15] Averages were not calculated for surface soluble reactive phosphorus because over half the samples were below the limit of detection

[16] Values of zero represent sample dates were soluble reactive phosphorus was below the limit of detection

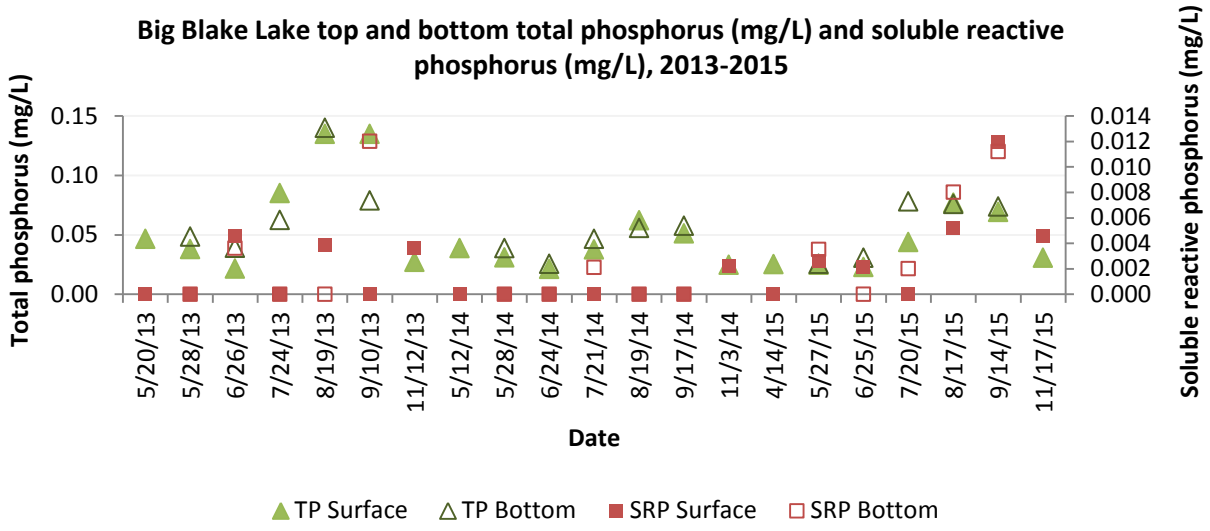
Bottom samples were also collected and analyzed for total phosphorus and soluble reactive phosphorus. Surface and bottom total phosphorus and soluble reactive phosphorus levels were fairly consistent, suggesting that Big Blake Lake is fairly well mixed.

Similar to the top samples, bottom samples for soluble reactive phosphorus were below the limit of detection on eight of the fifteen days where samples were taken (53%). On all but two sampling dates soluble reactive phosphorus concentrations were below 0.01 mg/L (September 10th, 2013 and September 14th, 2015).[17]





[17] Averages were not calculated for bottom soluble reactive phosphorus because over half the samples were below the limit of detection

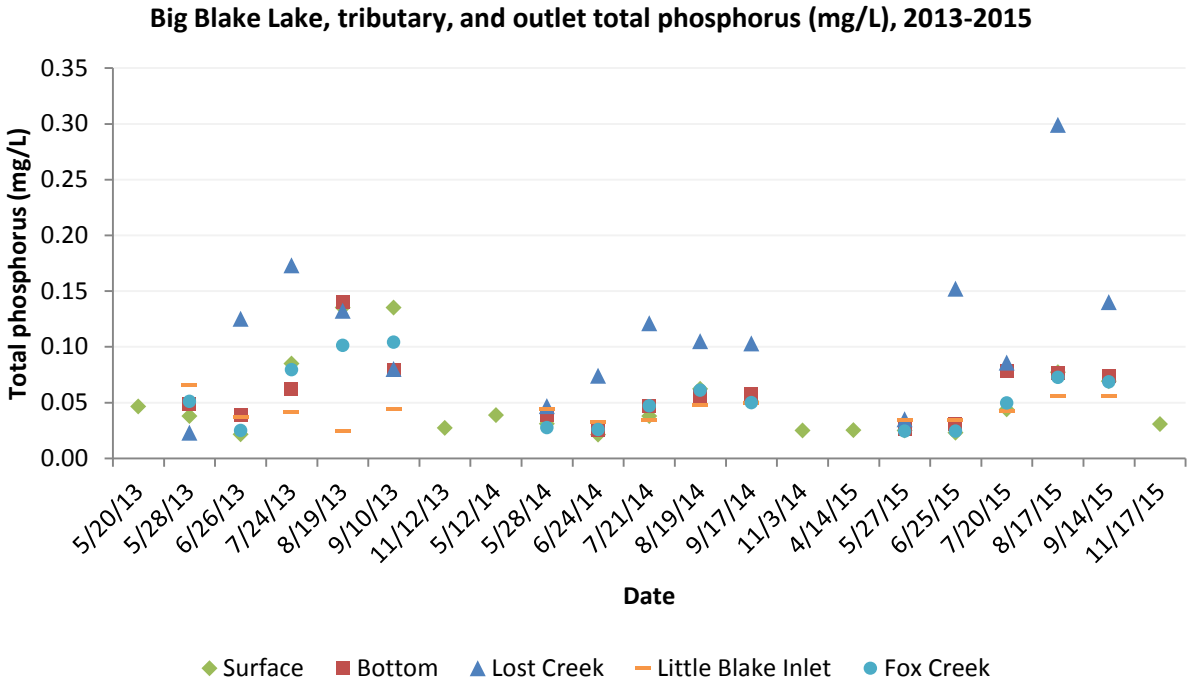

Big Blake Lake top and bottom total phosphorus (mg/L) and soluble reactive phosphorus (mg/L), 2013-2015
Total phosphorus (mg/L)
0.15
0.10
0.05
0.00
Soluble reactive phosphorus (mg/L)
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
5/20/13
5/28/13
6/26/13
7/24/13
8/19/13
9/10/13
11/12/13
5/12/14
5/28/14
6/24/14
7/21/14
8/19/14
9/17/14
11/3/14
4/14/15
5/27/15
6/25/15
7/20/15
8/17/15
9/14/15
11/17/15
Date
TP Surface
TP Bottom
SRP Surface
SRP Bottom

Tributary and Outlet Phosphorus

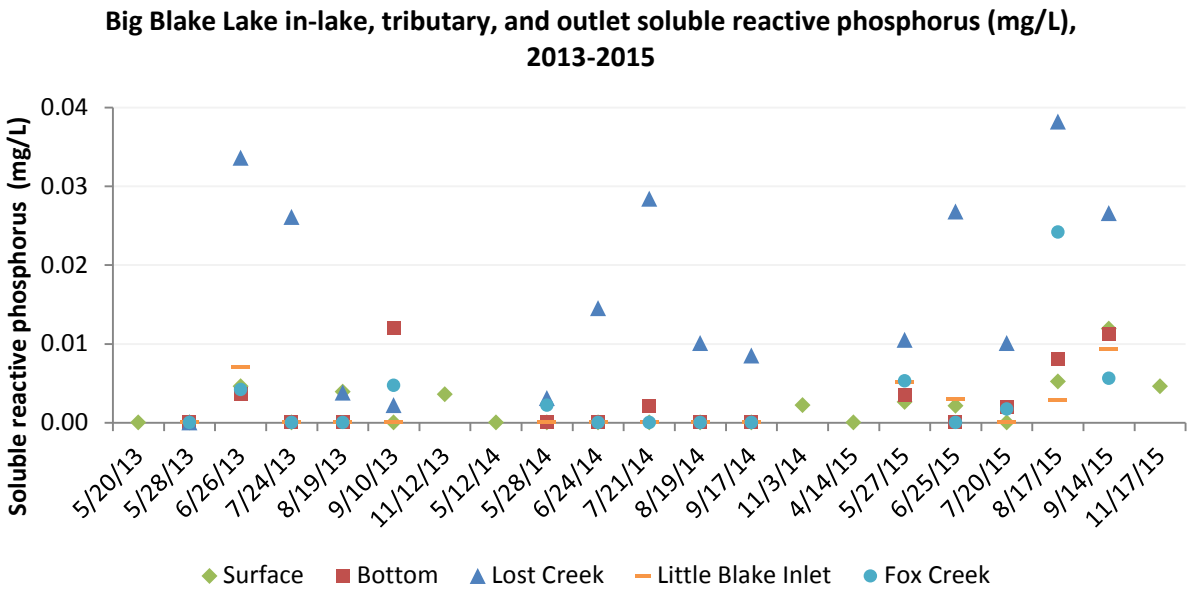
Data was collected on the two tributaries to Big Blake Lake and the outlet: Lost Creek, the inlet from Little Blake Lake, and Fox Creek. Flow data was collected bi-weekly at each tributary with a March McBirney Flo-Mate ™ velocity flowmeter. At each foot interval across each of the streams, depth (ft) and velocity (m/s) were measured. Grab samples were collected once monthly at each site. Samples were analyzed at the State Lab of Hygiene for total phosphorus, soluble reactive phosphorus, nitrate/nitrite, ammonium, total Kjeldahl nitrogen, and total suspended solids.

Average total phosphorus concentrations were always greater in Lost Creek as compared to the Little Blake Lake inlet. The average total phosphorus concentration in the water leaving Big Blake Lake through Fox Creek was similar to the average total phosphorus concentration of Big Blake Lake.

Average total phosphorus (mg/L)			
	2013	**2014**	**2015**
Surface of Big Blake Lake	0.08	0.04	0.05
Bottom of Big Blake Lake	0.07	0.04	0.06
Lost Creek	0.11	0.09	0.14
Little Blake Lake Inlet	0.04	0.04	0.04
Fox Creek	0.07	0.04	0.05



Tributary and outlet soluble reactive phosphorus followed the same general trend as in-lake soluble reactive phosphorus, with the majority of 2013 and 2014 sampling dates being below the limit of detection. Lost Creek was the exception, with all but one sampling date being above the limit of detection over the same time period. In 2015 soluble reactive phosphorus was above the limit of detection at all sites on the majority of sampling dates, with concentrations being highest in Lost Creek.



Tributary and Outlet Phosphorus Budget

The phosphorus data collected on Lost Creek, the inlet from Little Blake Lake, and Fox Creek is specific to date and location and can be used to theoretically determine how much phosphorus is entering and leaving Big Blake Lake through inlets and outlets. Values for phosphorus influxes are established by multiplying the phosphorus concentration at a specific location by the volume of water that moves through a specific location, or the discharge in cubic feet per second. To determine the average instantaneous load of phosphorus (in mg/s), the average phosphorus concentration is multiplied by the average seasonal discharge. Units are then converted and expressed as lb/yr.

The analysis of this data allows for areas of highest phosphorus loading to be identified. Once areas of highest phosphorus loading are identified, the land use and geology of these areas can be investigated for their total phosphorus contribution and best management recommendations can be made.

On average, Little Blake Lake contributes nearly three times the amount of phosphorus to Big Blake Lake as compared to Lost Creek (17,335 pounds/year as compared to 5,955 pounds/year). On an annual basis, an average of 26,545 pounds of phosphorus leaves Big Blake Lake through the outlet at Fox Creek.[18]

Site	TP (mg/L)	Area (m^2)	Discharge (l/s)	Phosphorus (lb/yr)
2013 Fox Creek	0.0720	4.11	4,942	24,755
2014 Fox Creek	0.0422	5.72	10,696	31,402
2015 Fox Creek	0.0477	4.08	7,075	23,479
2013 Lost Creek	0.1065	5.90	360	2,667
2014 Lost Creek	0.0899	7.22	1,227	7,674
2015 Lost Creek	0.1423	8.26	760	7,524
2013 Little Blake Inlet	0.0424	10.37	4,571	13,484
2014 Little Blake Inlet	0.0415	8.17	7,487	21,616
2015 Little Blake Inlet	0.0445	8.21	5,460	16,904

In all three years discharge, or the amount of water flowing through each stream, was substantially elevated in 2014 as compared to 2013 and 2015. This increase could be partly explained by the dam failure that occurred in May 2014. Discharge was also substantially lower in all three tributaries in 2013 which could be a result of climate. In 2013 only 25-30 inches of rain fell near Big Blake Lake as compared to 35-40 inches in 2014 and 2015.[19]

[18] Values are averages for 2013, 2014, and 2015

[19] National Weather Service precipitation data at http://water.weather.gov/precip/#

Nitrogen

Nitrogen, like phosphorus, is an element necessary for plant growth. Nitrogen sources in a lake can vary widely. Nitrogen does not occur naturally in soil minerals; however, it is a major component of all plant and animal matter. The decomposition of plant and animal matter releases ammonia, which is converted to nitrate in the presence of oxygen. This reaction accelerates when water temperatures increase. Nitrogen can also be introduced to a lake through rainfall, in the form of nitrate and ammonium, and through groundwater in the form of nitrate.

In most instances, the amount of nitrogen in a lake corresponds to land use. Nitrogen can enter a lake from surface runoff or groundwater sources as a result of fertilization of lawns and agricultural fields, animal waste, or human waste from septic systems or sewage treatment plants. During spring and fall turnover events, nitrogen is recycled back into the water column, which can cause spikes in ammonia levels. Under low oxygen circumstances, nitrogen can be lost from a lake system through a process called denitrification. Under these conditions nitrate is converted to nitrogen gas. Additionally, nitrogen can be lost through permanent sedimentation.

Nitrogen comprises the majority (78%) of the gases in the Earth's atmosphere. As with other gases, nitrogen is more soluble in cooler water as compared to warmer water. Nitrogen gas is not readily available to most aquatic plants, with the exception of blue green algae.

Similar to phosphorus, nitrogen is divided into many components. In this study nitrate/nitrite (NO_3 and NO_2), ammonium (NH_4), and total Kjeldahl nitrogen (TKN) were analyzed.

Nitrate/nitrite and ammonium are all inorganic forms of nitrogen which can be used by aquatic plants and algae. Inorganic nitrogen concentrations above 0.3 mg/L can support summer algae blooms.

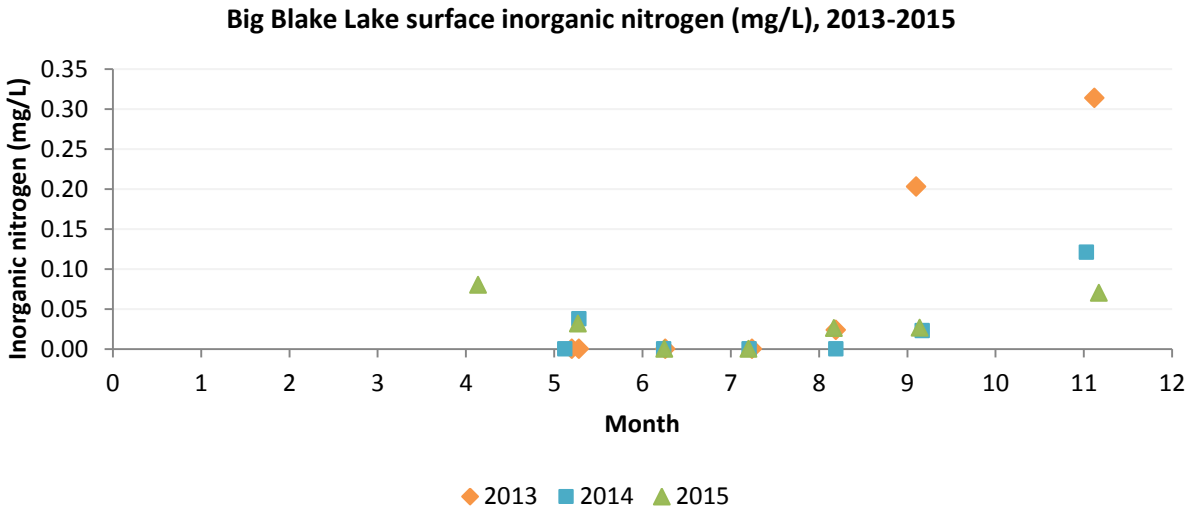
Total Kjeldahl nitrogen (TKN) is a measure of organic nitrogen plus ammonium. By subtracting the ammonium concentration from TKN, the organic nitrogen concentration found in plants and algal material can be found.

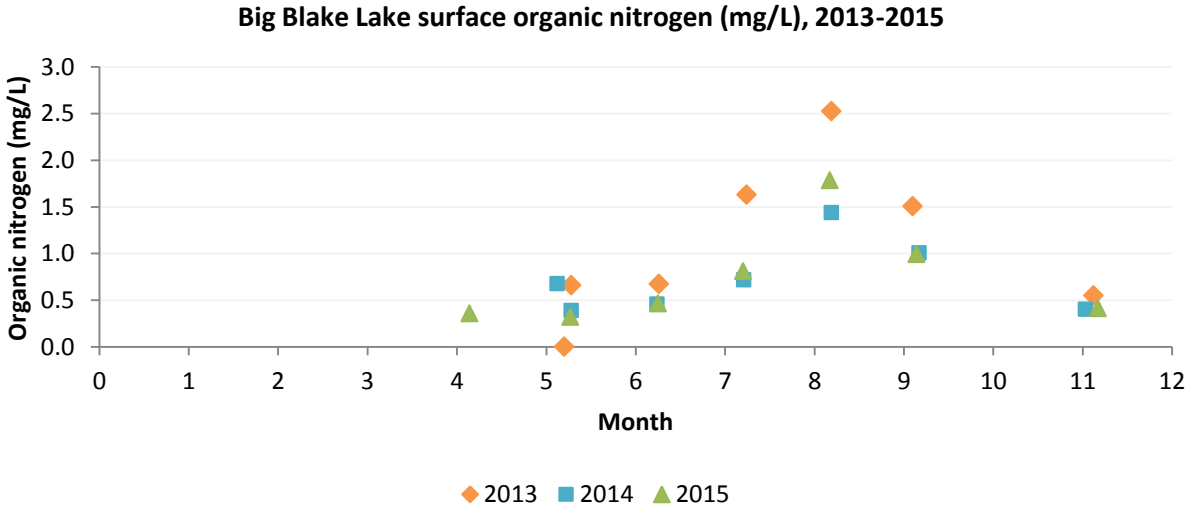
Nitrate/nitrite concentrations were below the limit of detection on all sampling dates with the exception of fall turnover (2013-2015) and spring turnover (2015). Ammonium concentrations were below the limit of detection in ten of the twenty-one sampling dates (47%). Inorganic nitrogen was below the healthy limit of 0.3 mg/L on all sampling dates with the exception of November 12th, 2013.[20] In all three sampling years, inorganic nitrogen was below the limit of detection in June and July.

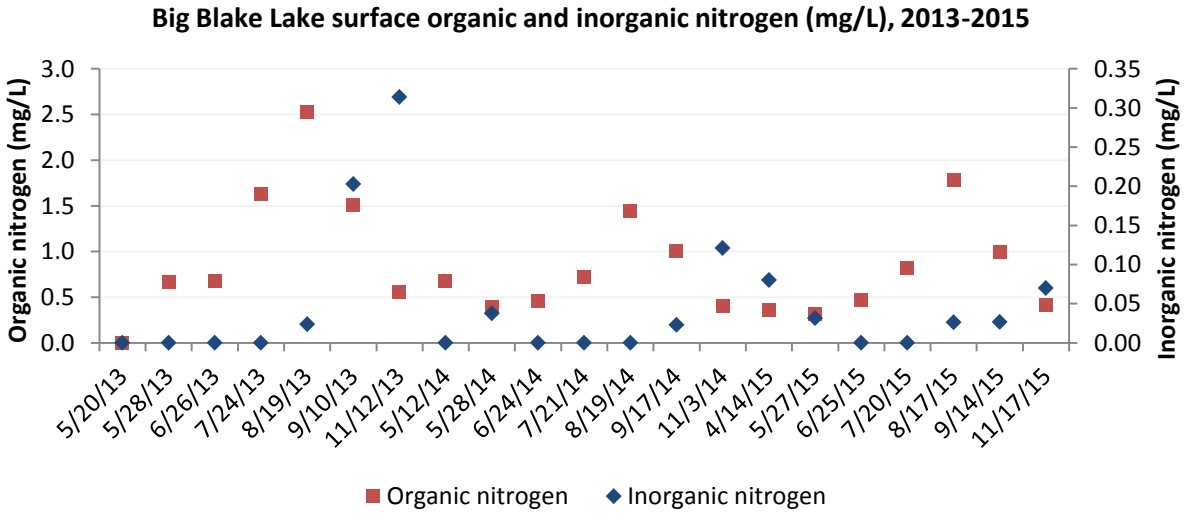
Growing season average[21] surface organic nitrogen was highest in 2013 (1.40mg/L) as compared to 2014 (0.80 mg/L) and 2015 (0.88 mg/L). Summer index period average surface organic nitrogen (July 15-September 15) was also highest in 2013 (1.89 mg/L) as compared to 2014 (1.08 mg/L) and 2015 (1.20 mg/L). In general, organic nitrogen levels in Big Blake Lake increased through August, after which time they began to decrease.

[20] Averages were not calculated for surface inorganic nitrogen because nearly half the samples were below the limit of detection

[21] Excludes turnover


Big Blake Lake surface inorganic nitrogen (mg/L), 2013-2015
Inorganic nitrogen (mg/L)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
1
2
3
4
5
6
7
8
9
10
11
12
Month
2013
2014
2015


Big Blake Lake surface organic nitrogen (mg/L), 2013-2015
Organic nitrogen (mg/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
5
6
7
8
9
10
11
12
Month
2013
2014
2015


Big Blake Lake surface organic and inorganic nitrogen (mg/L), 2013-2015
Organic nitrogen (mg/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Inorganic nitrogen (mg/L)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
5/20/13
5/28/13
6/26/13
7/24/13
8/19/13
9/10/13
11/12/13
5/12/14
5/28/14
6/24/14
7/21/14
8/19/14
9/17/14
11/3/14
4/14/15
5/27/15
6/25/15
7/20/15
8/17/15
9/14/15
11/17/15
Organic nitrogen
Inorganic nitrogen

Tributary and Outlet Nitrogen

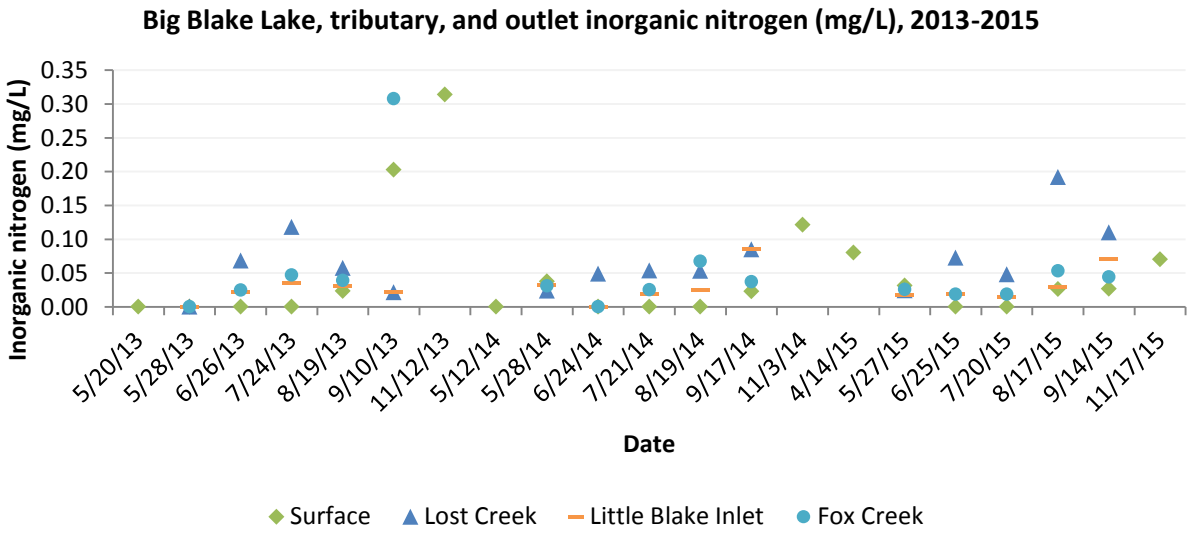
Nitrate/nitrite concentrations were below the limit of detection on all sampling dates in all tributaries with the exception of the Little Blake Lake Inlet on September 17th, 2014.

Growing season average inorganic nitrogen and organic nitrogen were greater in Lost Creek as compared to the Little Blake Lake Inlet in all three sampling years. The concentration of inorganic and organic nitrogen leaving Big Blake Lake via Fox Creek was similar to the in-lake concentration in 2014 and 2015. However, in 2013, the concentration of inorganic and organic nitrogen leaving Big Blake Lake via Fox Creek was less than the in-lake concentration.

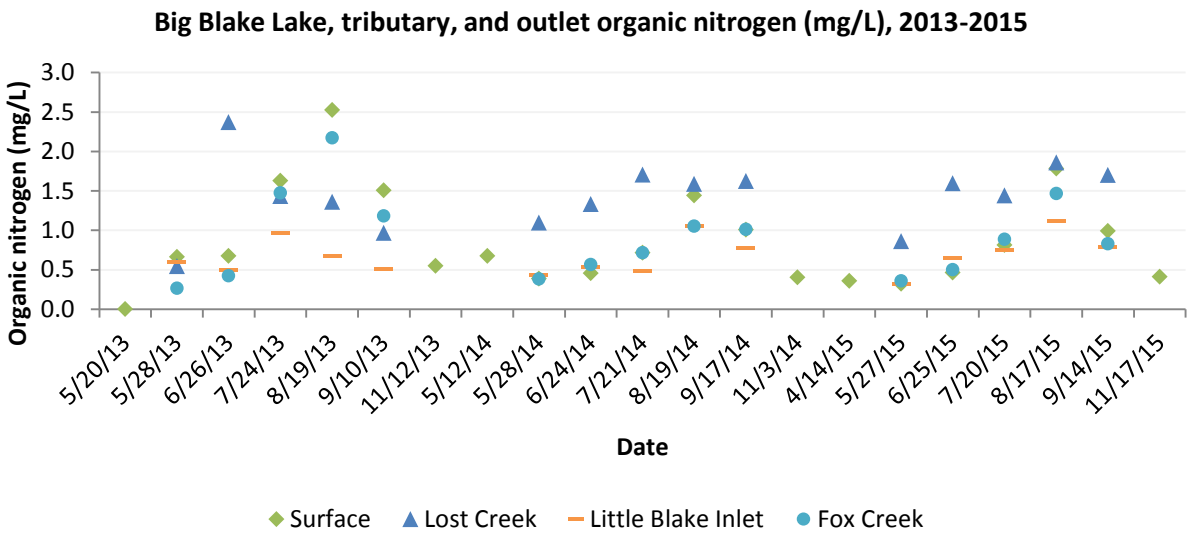
Average inorganic nitrogen (mg/L)			
	2013	**2014**	**2015**
Surface of Big Blake Lake	0.113	0.030	0.028
Lost Creek	0.053	0.053	0.089
Little Blake Lake Inlet	0.022	0.032	0.030
Fox Creek	0.084	0.032	0.032

Average organic nitrogen (mg/L)			
	2013	**2014**	**2015**
Surface of Big Blake Lake	1.40	0.80	0.88
Lost Creek	1.34	1.47	1.49
Little Blake Lake Inlet	0.64	0.66	0.72
Fox Creek	1.10	0.75	0.81

Inorganic nitrogen, or the nitrogen available for plants and algae, was below the healthy limit of 0.3 mg/L on all sampling dates at all sites with the exception of September 10, 2013 in Fox Creek and November 12th, 2013 at the surface of Big Blake Lake. In general inorganic nitrogen concentrations were lowest in the spring and increased towards the end of the growing season.



Growing season average organic nitrogen, or the amount of nitrogen in plants and algae, was highest in Lost Creek followed by Fox Creek and the Little Blake Lake Inlet in all three sampling years. In general, organic nitrogen increased over the course of the growing season through August in all three sampling years.



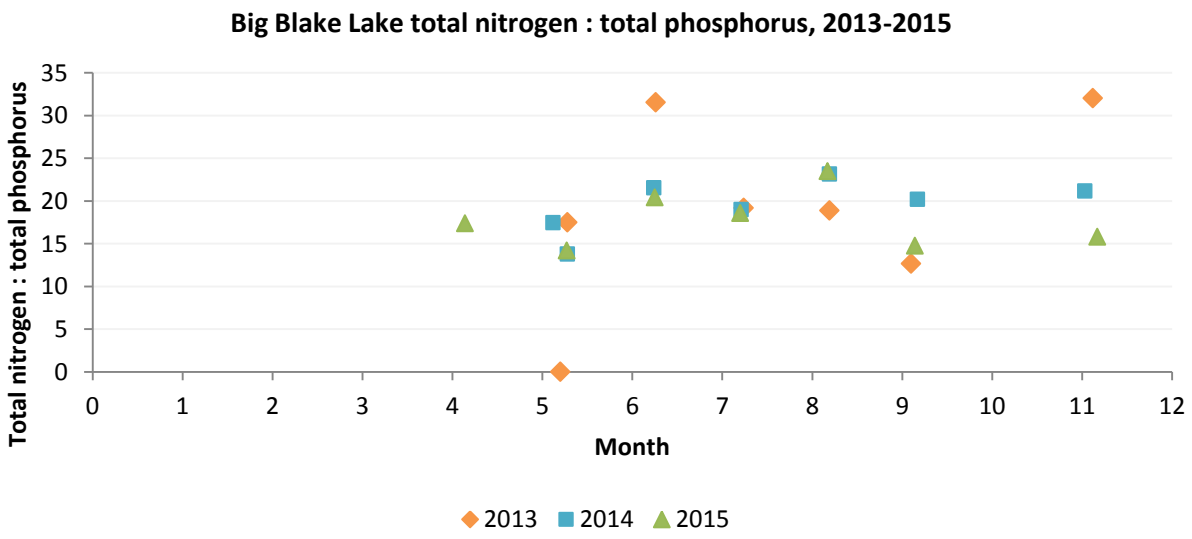
Total Nitrogen to Total Phosphorus Ratio

The total nitrogen to total phosphorus ratio (TN: TP) is a calculation that depicts which nutrient limits algae growth in a lake.

Lakes are considered nitrogen limited, or sensitive to the amount of nitrogen inputs, when TN: TP ratios are less than 10. Only about 10% of Wisconsin lakes are limited by nitrogen. In contrast, lakes are considered phosphorus limited, or sensitive to the amount of phosphorus inputs into a lake, when the TN: TP ratio is above 15. Lakes with values between 10 and 15 are considered transitional. In transitional lakes it is impossible to determine which nutrient, either nitrogen or phosphorus, is limiting algae growth.

Total nitrogen is found by adding nitrate/nitrite to total Kjeldahl nitrogen. As previously mentioned, nitrate/nitrite concentrations were below the limit of detection on all sampling dates with the exception of fall turnover (2013-2015) and spring turnover (2015). As a result, total nitrogen is largely reflective of TKN.

With the exception of spring turnover in 2013, data indicate that overall Big Blake Lake is phosphorus limited. In May of 2014 and 2015 and September of 2013 and 2015, data indicate a transitional state. In May of 2013, total nitrogen was below the limit of detection, resulting in a ratio of zero.

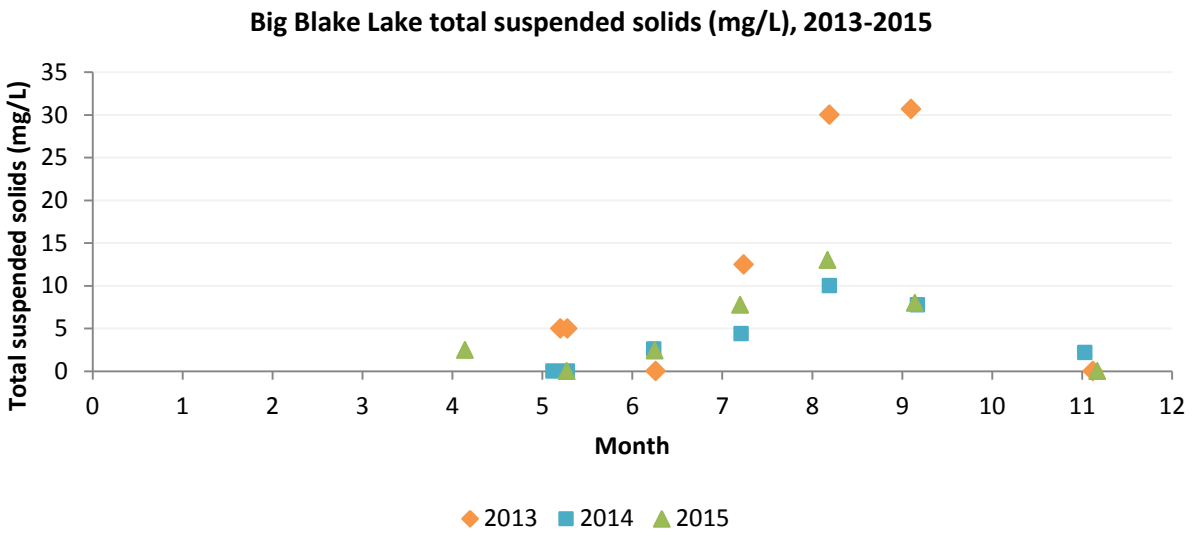


Total Suspended Solids

Total suspended solids (TSS) quantify the amount of inorganic matter that is floating in the water column. Wind, waves, boats, and even some fish species can stir up sediments from the lake bottom re-suspending them in the water column. Fine sediments, especially clay, can remain suspended in the water column for weeks. These particles scatter light and decrease water transparency.

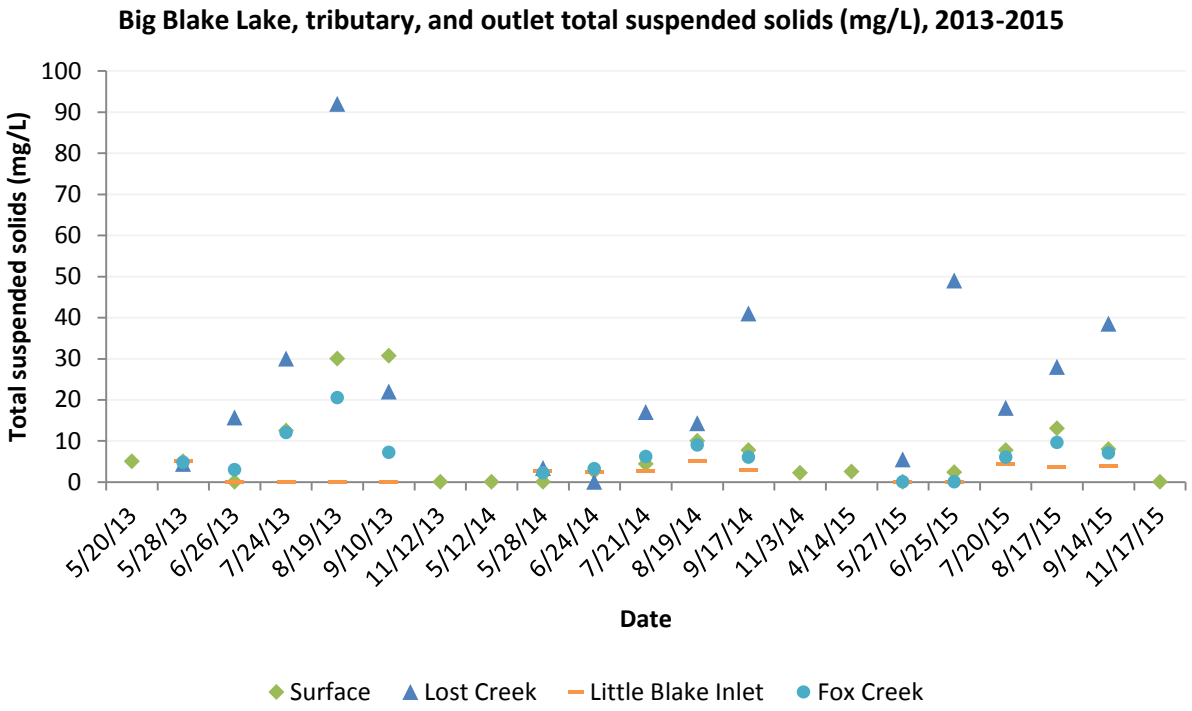
Summer index period average surface total suspended solids (July 15-September 15) were highest in 2013 (24.4 mg/L) as compared to 2014 (7.20 mg/L) and 2015 (9.6 mg/L).

Total suspended solids remained fairly low through June and increased in July and August in all three years data was collected. By November (fall turnover), total suspended solids had returned to what they had been in April/May (spring turnover).



Tributary and Outlet Total Suspended Solids

In all three sampling years, average total suspended solids were highest in Lost Creek, followed by Fox Creek and the Little Blake Inlet. Total suspended solids increased through the growing season through August and September. In all three sampling years average total suspended solids were highest in 2013, followed by 2015 and 2014 in each tributary and the outlet.



Chlorophyll

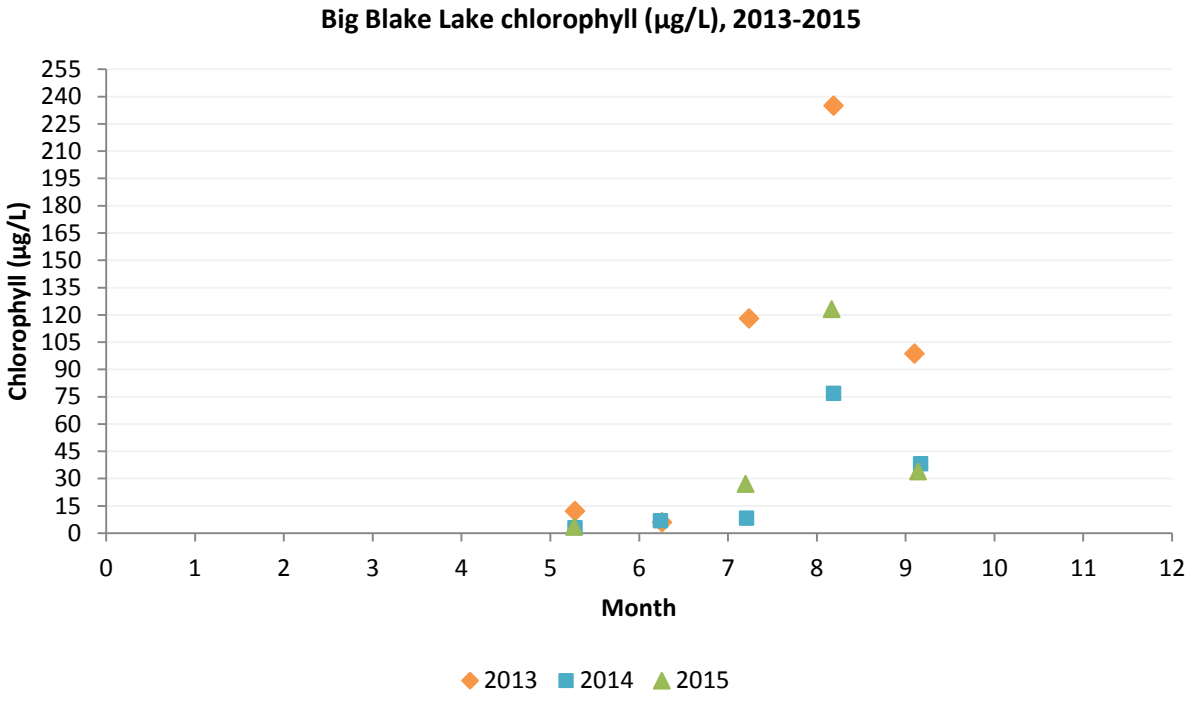
Chlorophyll is a pigment in plants and algae that is necessary for photosynthesis and is an indicator of water quality in a lake. Chlorophyll gives a general indication of the amount of algae growth in a lake, with greater values for chlorophyll indicating greater amounts of algae. However, since chlorophyll is present in sources other than algae— such as decaying plants— it does not serve as a direct indicator of algae biomass.

Chlorophyll seems to have the greatest impact on water clarity when levels exceed 30 µg/L. Lakes which appear clear generally have chlorophyll levels less than 15 µg/L.

Growing season average[22] surface chlorophyll exceeded the healthy limit in 2013 (94 µg/L) and 2015 (47 µg/L). Growing season average surface chlorophyll was just below the threshold in 2014 (27 µg/L).

Summer index period average surface chlorophyll (July 15-September 15) exceeded the healthy limit in 2013 (151 µg/L), 2014 (42 µg/L) and 2015 (61 µg/L).

In 2013 chlorophyll levels remained below 15 µg/L through June and in 2014 they remained below 15 µg/L through July. In 2015 chlorophyll levels remained below 15 µg/L through May and below 30 µg/L through July. [23]



[22] Excludes turnover

[23] The lab did not run the chlorophyll sample for June 25th, 2015 so a data point does not exist for this date

Trophic State Index

Lakes are divided into three categories based on their trophic states: oligotrophic, eutrophic, and mesotrophic. These categories reflect a lake's nutrient and clarity level and serve as an indicator of water quality. Each category is designed to serve as an overall interpretation of a lake's primary productivity.

Oligotrophic lakes are generally clear, deep, and free of weeds and large algae blooms. These types of lakes are often poor in nutrients and are unable to support large populations of fish. However, oligotrophic lakes can develop a food chain capable of supporting a desirable population of large game fish.

Eutrophic lakes are generally high in nutrients and support a large number of plants and animals. They are usually very productive and subject to frequent algae blooms. Eutrophic lakes often support large fish populations, but are susceptible to oxygen depletion.

Mesotrophic lakes lie between oligotrophic and eutrophic lakes. They usually have good fisheries and occasional algae blooms.

All lakes experience a natural aging process which causes a change from an oligotrophic to a eutrophic state. Human influences that introduce nutrients into a lake (agriculture, lawn fertilizers, and septic systems) can accelerate the process by which lakes age and become eutrophic.

[24]

A common method of determining a lake's trophic state is to compare total phosphorus (important for algae growth), chlorophyll (an indicator of the amount of algae present), and secchi disk readings (an indicator of water clarity). Although many factors influence these relationships, the link between total phosphorus, chlorophyll, and secchi disk readings is the basis of comparison for the trophic state index (TSI).

TSI is determined using a mathematic formula and ranges from 0 to 110. Lakes with the lowest numbers are oligotrophic and lakes with the highest values are eutrophic.

[24] Figure from Understanding Lake Data (G3582), UW-Extension, Byron Shaw, Christine Mechenich, and Lowell Klessig, 2004

Three equations for summer index period TSI were examined for Big Blake Lake.

TSI (P) = 14.42 * Ln [TP] + 4.15 (where TP is in µg/L)
TSI (C) = 30.6 + 9.81 Ln [Chlor-a] (where the chlorophyll is in µg/L)
TSI (S) = 60-14.41 * Ln [Secchi] (where the secchi depth is in meters)

Big Blake Lake 2013
Average summer index period TSI (total phosphorus) = 73
Average summer index period TSI (chlorophyll) = 80
Average summer index period TSI (secchi depth) = 66
Average summer index period TSI = 73 = hypereutrophic

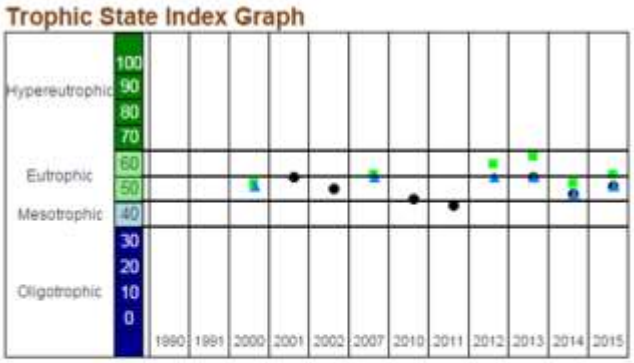
Big Blake Lake 2014
Average summer index period TSI (total phosphorus) = 61
Average summer index period TSI (chlorophyll) = 67
Average summer index period TSI (secchi depth) = 59
Average summer index period TSI = 62 = eutrophic

Big Blake Lake 2015
Average summer index period TSI (total phosphorus) = 64
Average summer index period TSI (chlorophyll) = 71
Average summer index period TSI (secchi depth) = 65
Average summer index period TSI = 67 = eutrophic

TSI	General Description
<30	Oligotrophic; clear water, high dissolved oxygen throughout the year/lake
30-40	Oligotrophic; clear water, possible periods of oxygen depletion in the lower depths of the lake
40-50	Mesotrophic; moderately clear water, increasing chance of anoxia near the bottom of the lake in summer, fully acceptable for all recreation/aesthetic uses
50-60	Mildly eutrophic; decreased water clarity, anoxic near the bottom, may have macrophyte problem, warm-water fisheries only
60-70	Eutrophic; blue-green algae dominance, scums possible, prolific aquatic plant growth, full body recreation may be decreased
70-80	Hypereutrophic; heavy algal blooms possible throughout the summer, dense algae and macrophytes
>80	Algal scums, summer fish kills, few aquatic plants due to algal shading, rough fish dominate

Monitoring the trophic state index of a lake gives stakeholders a method by which to gauge lake productivity over time. TSI data for phosphorus and chlorophyll exist for 2000, 2007, and 2012 and TSI data for secchi exist for 2001, 2002, 2010, and 2011. Complete TSI data exist for 2013-2015.

The majority of the historic TSI data falls between 50 and 70, indicating a eutrophic state. TSI secchi data for 2010 and 2011 indicate a mesotrophic state.



Monitoring Station: Big Blake Lake - Deep Hole/Main Basin, Polk County
Past Summer (July-August) Trophic State Index (TSI) averages.

● = Secchi ■ = Chlorophyll ▲ = Total Phosphorus

TSI(Chl) = TSI(TP) = TSI(Sec)	It is likely that algae dominate light attenuation.
TSI(Chl) > TSI(Sec)	Large particulates, such as Aphanizomenon flakes dominate
TSI(TP) = TSI(Sec) > TSI(Chl)	Non-algal particulate or color dominate light attenuation
TSI(Sec) = TSI(Chl) >= TSI(TP)	The algae biomass in your lake is limited by phosphorus
TSI(TP) > TSI(Chl) = TSI(Sec)	Zooplankton grazing, nitrogen, or some factor other than phosphorus is limiting algae biomass

TSI	TSI Description
TSI < 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
TSI 40-50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 70-80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI > 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Trophic state index (TSI) is determined using a mathematical formula (Wisconsin has its own version). The TSI is a score from 0 to 110, with lakes that are less fertile having a low TSI. We base the overall TSI on the Chlorophyll TSI when we have Chlorophyll data. If we don't have chemistry data, we use TSI Secchi. We do this rather than averaging, because the TSI is used to predict biomass. This makes chlorophyll the best indicator. Visit Bob Carlson's website, dipin.kent.edu/tsi.htm, for more info.
[25]

[25] https://dnrx.wisconsin.gov/swims/public/reporting.do?type=33&action=post&format=html&stationNo=493144

Phytoplankton

Algae, also called phytoplankton, are microscopic plants that convert sunlight and nutrients into biomass. They can live on bottom sediments and substrate, in the water column, and on plants and leaves. Algae are the primary producers in an aquatic ecosystem and can vary in form. Zooplankton, are small aquatic organisms that feed on algae. The size and shape of algae determine which types of zooplankton—if any—can consume them.

Algae have short life cycles. As a result, changes in water quality are often reflected by changes in the algal community within a few days or weeks. The number and types of algae in a waterbody can provide useful information for environmental monitoring programs, impairment assessments, and the identification of best management strategies.

The types of algae in a lake will change over the course of a year. Typically, there is less algae in winter and spring because of ice cover and cold temperatures. As a lake warms up and sunlight increases, algae communities begin to increase. Their short life span quickly cycles the nutrients in a lake and affects nutrient dynamics.

The types of algae present in a lake are influenced by environmental factors like climate, phosphorus, nitrogen, silica and other nutrient content, carbon dioxide, grazing, substrate, and other factors in the lake. When high levels of nutrients are available, blue green algae often become predominant.

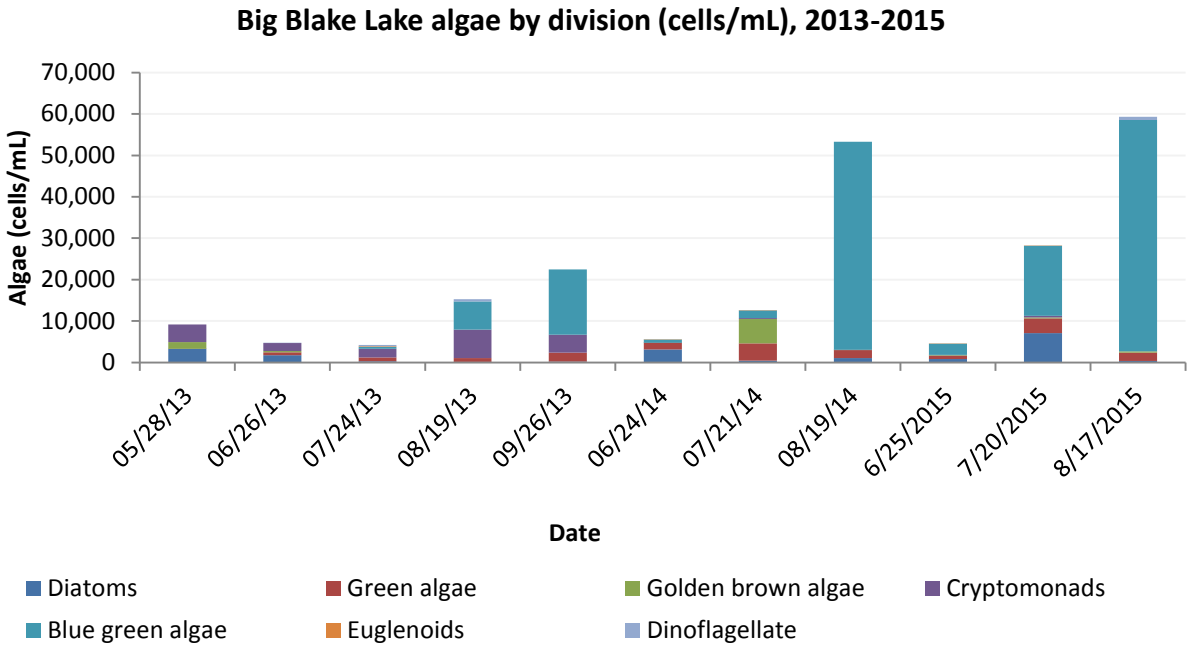
Chlorophyll is a pigment in plants and algae that is necessary for photosynthesis. Chlorophyll gives a general indication of the amount of algae growth in the water column; however, it is not directly correlated with algae biomass. To obtain accurate algae data, composite samples from a two meter water column were collected monthly, preserved with glutaraldehyde, placed on ice, and sent to the State Lab of Hygiene (2013) and UW-Oshkosh (2014 and 2015) for identification and enumeration of algae species.

Algae were identified to genus, and a relative concentration and natural unit count was made to describe the algae community throughout the growing season. This method of sampling also allows the identification of any species of concern which might be present.

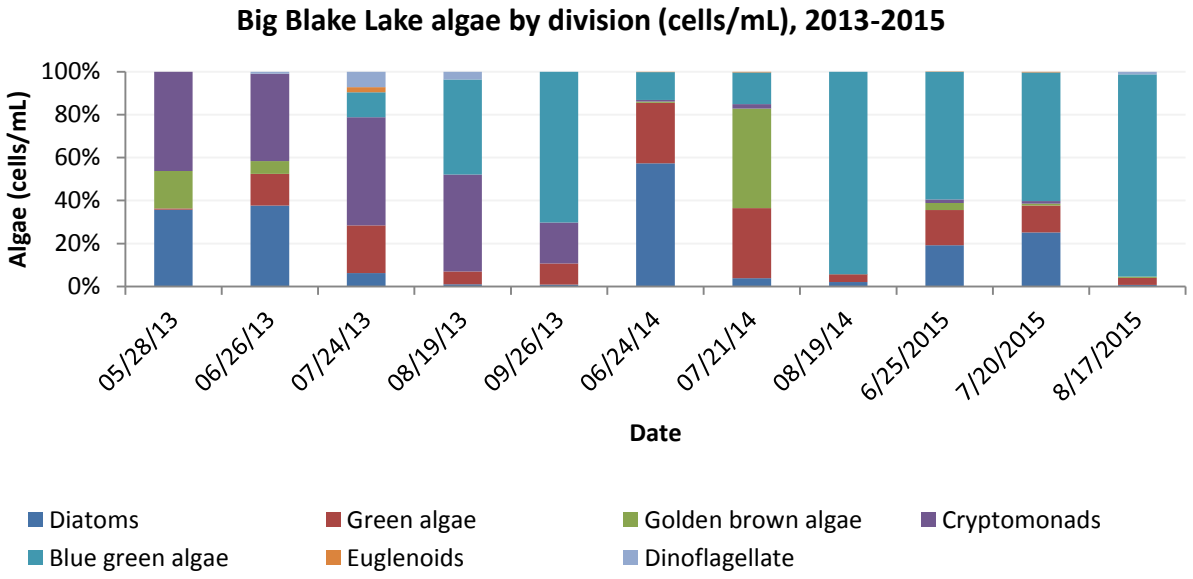
There are twelve divisions of algae found in typical lakes of Wisconsin. Seven divisions were found in Big Blake Lake.

Algal Division	Common Name	Characteristics
Bacillariophyta	Diatoms	Have a siliceous frustule that makes up the external covering. Sensitive to chloride, pH, color, and total phosphorus (TP) in water. As TP increases, see a decrease in diatoms. Generally larger in size. Tend to be highly present in spring and late spring. Can be benthic or planktonic.
Chlorophyta	Green algae	Have a true starch and provide high nutritional value to consumers. Can be filamentous and intermingle with macrophytes.
Chrysophyta	Golden brown algae	Organisms which bear two unequal flagella. A genus of single-celled algae in which the cells are ovoid. Contain chlorophyll a, c_1 and c_2, generally masked by abundant accessory pigment, fucoxanthin, imparting distinctive golden color to cells.
Cryptophyta	Cryptomonads	Have a true starch. Planktonic. Bloom forming, are not known to produce any toxins and are used to feed small zooplankton. Cryptomonads frequently dominate the phytoplankton assemblages of the Great Lakes.
Cyanophyta	Blue green algae	Prevail in nutrient-rich standing waters. Blooms can be toxic to zooplankton, fish, livestock, and humans. Can be unicellular, colonial, planktonic, or filamentous. Can live on almost any substrate. More prevalent in late to mid-summer.
Euglenophyta	Euglenoids	One of the best-know groups of flagellates, commonly found in freshwater that is rich in organic materials. Most are unicellular.
Pyrrhophyta	Dinoflagellate	A large group of protists with brownish pigments. Cells are single and large and can be toxic. Red tides, which occur in marine waters, are explosions of dinoflagellates. In freshwater systems, blooms are more brown than red.

In general, algae populations increased over the course of the sampling season in all three years of the study. Algae populations were greatest in August and September of 2013, August of 2014, and July and August of 2015. On these sampling dates, blue green algae began to dominate the algal community making up 44% of the algal community in August 2013, 70% of the algal community in September 2013, and 94% of the algal community in August 2014. In 2015, blue green algae dominated the algal community on all three sampling dates, making up 59% of the algal community in June, 60% of the algal community in July and 94% of the algal community in August.



Diatoms were present across the growing season in all three years of the study, making up a larger percentage of the algal community in May and June of 2013, June of 2014, and June and July of 2015. In 2013 (with the exception of September) cryptomonads made up nearly 40% of the algal community. However, in 2014 and 2015 cryptomonads were a very minimal component of the algal community. Golden brown algae were fairly absent in the algal community with the exception of May 2013 and July 2014 when they made up 17% and 47%of the algal community, respectively. Blue green algae became a dominant component of the algae community beginning in August of 2013 and 2014 and were dominant during the entire 2015 growing season.



Blue Green Algae

Blue green algae, or cyanobacteria, have been around for billions of years and typically bloom during the summer months. However, blue-green algae blooms become more frequent as a result of increased nutrient concentrations.

Blue green algae are of specific concern because of their ability to produce toxins, that when ingested or inhaled, can cause short and long term health effects. Effects range from tingling, burning, numbness, drowsiness, and dermatitis to liver or respiratory failure possibly leading to death.

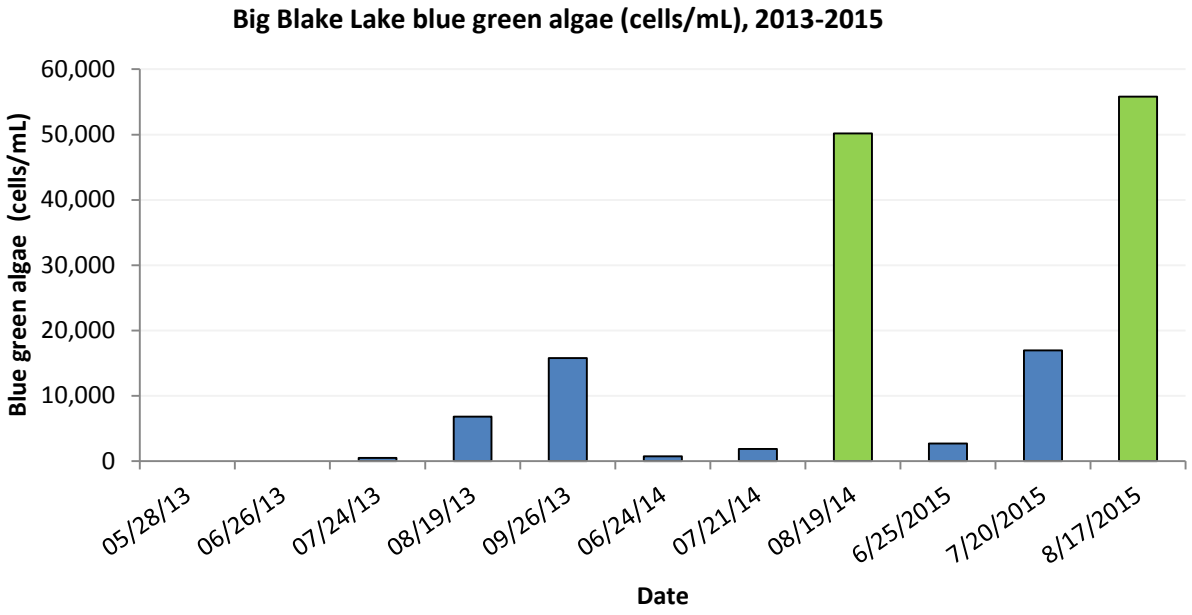
It is not known which environmental conditions cause the production of cyanotoxins, but scientists have found that when blue green algae is present at concentrations over 100,000 cells/mL toxin production is more likely to occur.

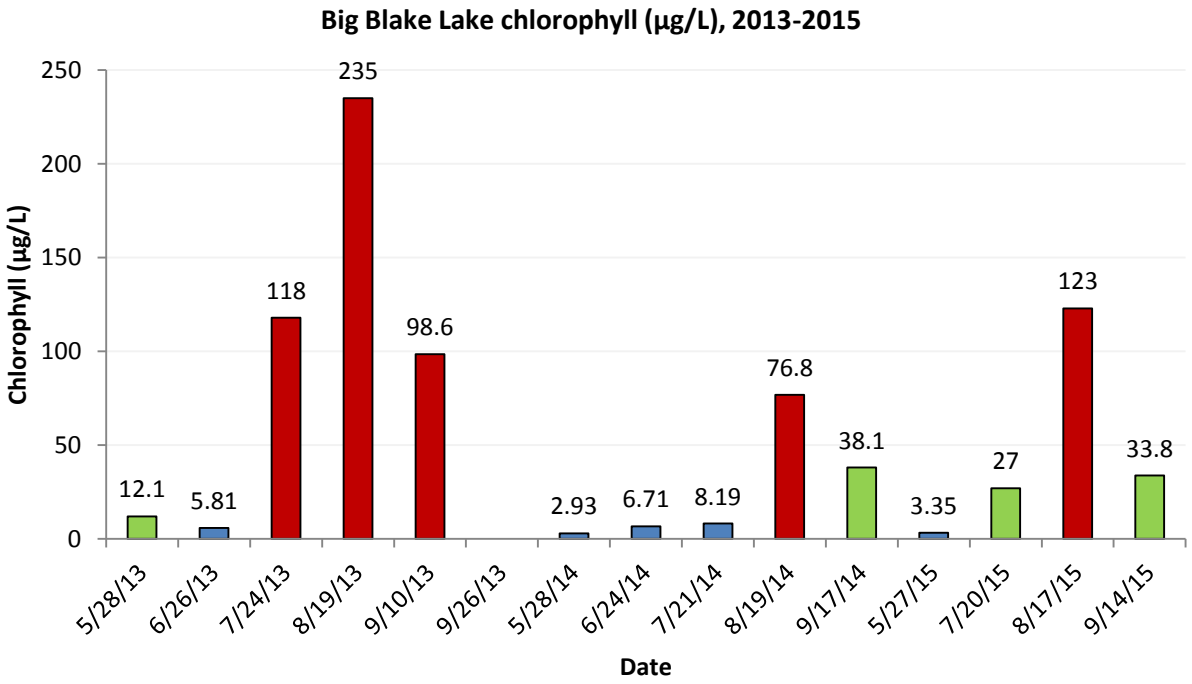
Federal guidelines for blue green algae cell densities and chlorophyll concentrations do not exist. The Wisconsin Harmful Algal Bloom (HAB) Surveillance Program uses guidelines of the World Health Organization to determine risks from blue green algae.

Blue green algae cell density (cells/mL)	Chlorophyll (µg/L)	Risk
Less than 20,000	Less than 10	**Low**
20,000 to 100,000	10 to 50	**Moderate**
Greater than 100,000	Greater than 50	**High**

Based on blue green algae cell density, the risks from blue green algae were low on all sampling dates with the exception of August 2014 and August 2015, when the risk increased to moderate.

Based on chlorophyll, the risk from blue green algae was high in July, August, and September of 2013, July of 2014, and August of 2015. Additionally, the risk was moderate in May 2013, September 2014, and July and September 2015.


Big Blake Lake blue green algae (cells/mL), 2013-2015
Blue green algae (cells/mL)
60,000
50,000
40,000
30,000
20,000
10,000
0
05/28/13
06/26/13
07/24/13
08/19/13
09/26/13
06/24/14
07/21/14
08/19/14
6/25/2015
7/20/2015
8/17/2015
Date


Big Blake Lake chlorophyll (µg/L), 2013-2015
Chlorophyll (µg/L)
250
200
150
100
50
0
12.1
5.81
118
235
98.6
2.93
6.71
8.19
76.8
38.1
3.35
27
123
33.8
5/28/13
6/26/13
7/24/13
8/19/13
9/10/13
9/26/13
5/28/14
6/24/14
7/21/14
8/19/14
9/17/14
5/27/15
7/20/15
8/17/15
9/14/15
Date

Zooplankton

Zooplankton are small aquatic animals that feed on algae and are eaten by fish. They are divided into three main components: rotifers, copepods, and cladocerans.

Rotifers eat algae, other zooplankton, and sometimes each other. Due to their small size, rotifers are not capable of significantly reducing algal biomass although they are able to shift the algae community to favor larger species.

Copepods feed on algae and other plankton. They are eaten by larger plankton and are preyed heavily upon by pan fish, minnows, and the fry of larger fish.

Cladocerans are filter feeders that play an important part in the food web. Species of cladocerans (particularly Daphnia) are well known for their ability to reduce algal biomass and help maintain clear water in lake ecosystems.

Zooplankton are often overlooked as a component of aquatic systems, but their role in a lake is extremely important. Lake systems are valued primarily for water clarity, fishing, or other recreation, all of which are strongly linked to water quality and ecosystem health. Zooplankton are the primary link between the "bottom up" processes and "top down" processes of the lake ecosystem.

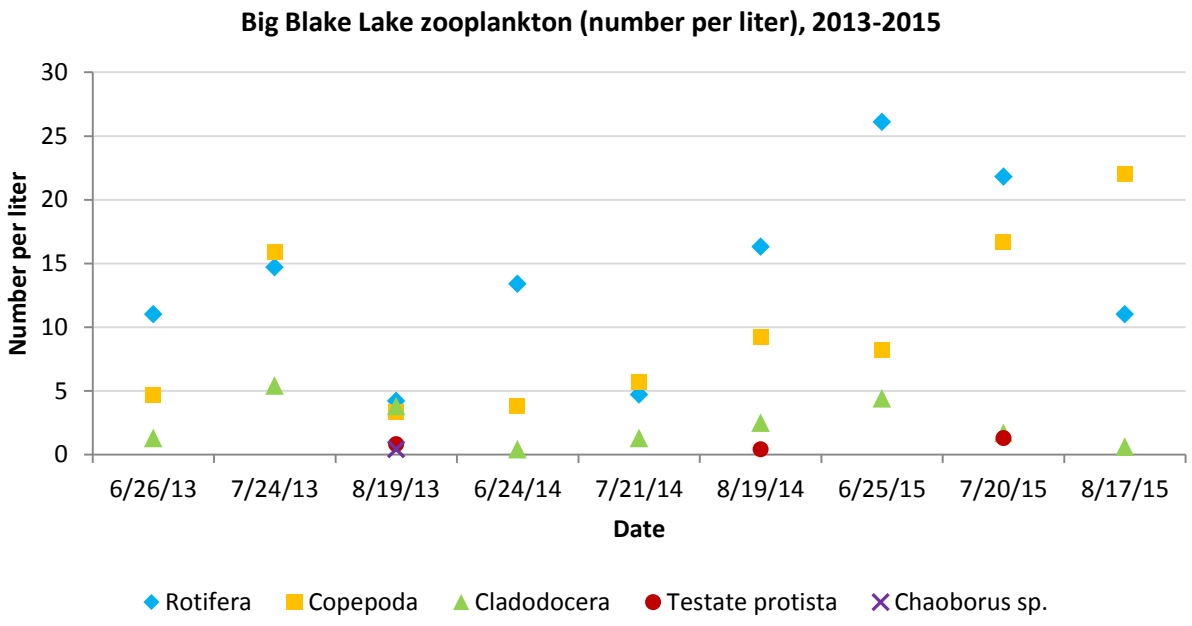
"Bottom up" processes include factors such as increased nutrients, which can cause noxious algal blooms. Zooplankton have the ability to mediate algae blooms by heavy grazing. Conversely, shifts in algal composition, which can be caused by increased nutrients, can change the composition of the zooplankton community. If the composition shifts to favor smaller species of zooplankton, for example, algal blooms can be intensified, planktivorous fish can become stressed, and the development of fry can be negatively impacted.

"Top down" processes include factors such as increased fish predation. Increases in planktivorous fishes (pan fish) can dramatically reduce zooplankton populations and lead to algal blooms. In some lakes, biomanipulation is utilized to manage this effect and improve water clarity. Piscivorous fish (fish that eat other fish) are used to reduce planktivorous fish. This in turn increases zooplankton populations and ultimately reduces algae populations.

Changes in the aquatic plant community and shoreland habitat can impact zooplankton populations. This occurs especially in shallow lakes where zooplankton are more likely to have the ability to migrate horizontally to avoid predation from fish and other invertebrates. In general, a diverse shoreland habitat (substrate, plant species, and woody debris) will support a diverse zooplankton community.

Composite samples from a two meter water column were collected monthly, preserved with denatured ethanol, placed on ice, and sent to Dr. Toben Lafrancois for identification and enumeration of zooplankton species. This analysis shows the abundance of the major zooplankton groups—cladocera, copepoda, and rotifer—in Big Blake Lake. The analysis also includes the abundance of Chaoborus (phantom midge) and protozoa in Big Blake Lake. Protists are single celled organisms living either as

single cells or as simple colonies of cells that are divided into animal like organisms (protozoa) and photosynthetic organisms (algae). Protozoans provide a critical link in returning energy and nutrients from bacteria and detritus to higher trophic levels.



"Big Blake Lake shows some interesting patterns in 2013, where a typical phenological pattern appears in June and July with a crash in August. This crash is someone unexpected since August tends to be a very productive year. Environmental factors need to be analyzed to explain this change, which would typically occur later in October or November. The 2014 trends show a more typical response with an unexpected drop in rotifers in July but otherwise a slow increase into the most productive months. In 2015 there was a major increase in copepods over the summer, with a decline in rotifers that could be associated with copepod predation, and a decrease in cladocerans. The cladoceran decrease could be due to either fish pressure or a change in algal community structure. The concurrent increase in copepods suggests that a bottom-up mechanism is more likely, since planktivorous fish tend to favor cladocerans but also enjoy copepods, being mostly size selective." [26]

[26] Excerpted directly from: Lafrançois, T. 2016. Zooplankton of Big Blake and Lotus Lakes, Polk County (WI) 2013-2016. Final report to Polk County Land & Water Resources Department, Polk Co. WI.

Harvesting and Curly-leaf Pondweed

The Big Blake Lake Protection and Rehabilitation District formed in 1976 in response to concerns about algae blooms and aquatic plants. In the 1980's and 1990's aquatic plants were managed with harvesting (contracted) and chemical treatments by individual property owners.

Efforts to address curly-leaf pondweed, an aquatic invasive species, began in earnest in 1997. Barr Engineering completed a macrophyte survey and Macrophyte Management Plan in 1998 and The Limnological Institute (TLI) completed a macrophyte survey in 2004 that helped the District develop a Lake Management Plan. TLI's plan led to the obtainment of an ACEI Aquatic Invasives Control grant through the WDNR which provided a fifty-percent match for aquatic plant management through harvesting. The District has used harvesting to manage curly-leaf pondweed since 2007.

Curly-leaf pondweed is an exotic plant present in many Wisconsin lakes. Curly-leaf pondweed begins growing in the fall as native plants die off for the year. Curly-leaf pondweed tolerates cold water and low light conditions and continues to grow throughout the winter months under ice cover. It completes its reproductive cycle with the formation of turions, or seeds, in the early summer and dies off in late June through mid-July.

Since curly-leaf pondweed die off occurs when water temperatures are relatively high, biological organisms are very active. As curly-leaf pondweed decays, nutrients released into the water column are available for uptake by algae.

Later in the growing season, coontail reaches nuisance levels in Big Blake Lake. Coontail is a free floating native aquatic plant.

During the course of this study, aquatic plant growth was the most robust in 2015, with 143 total loads of curly-leaf pondweed and 28 loads of coontail being removed from Big Blake Lake. Additionally, due to a warm spring, harvesting for curly-leaf pondweed began about a month earlier in 2015 as compared to 2013 and 2014. In 2012, (prior to this study) 85 loads of curly-leaf pondweed were harvested.

Curly-leaf pondweed harvesting information

	Harvesting start date	Harvesting end date	Loads of curly-leaf pondweed removed
2013	June 16	July 3	8
2014	June 8	July 14	30
2015	May 19	July 1	143

Coontail harvesting information

	Harvesting start date	Harvesting end date	Loads of coontail removed
2013	July 18	September 17	14
2014	August 14	September 18	6
2015	July 22	September 3	28

Curly-leaf Pondweed Biomass and Turion Sampling

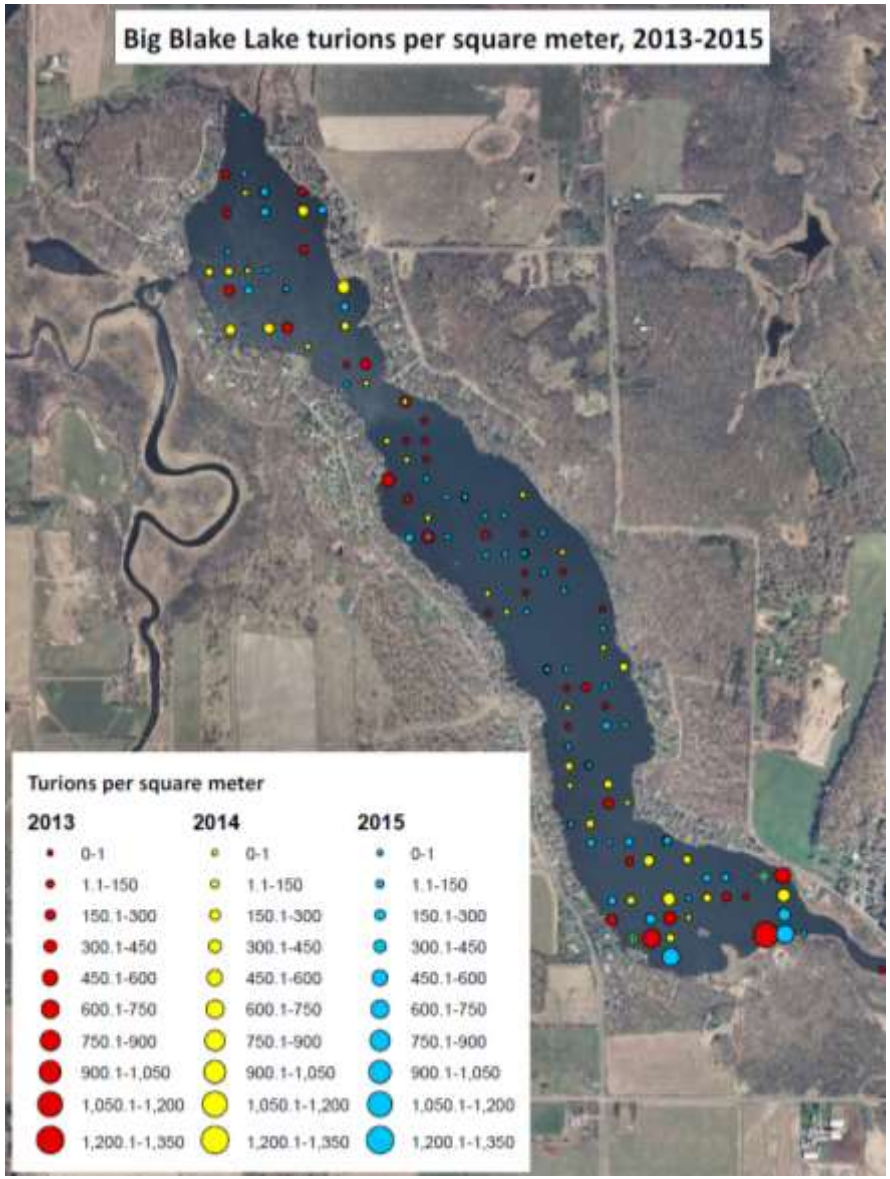
A Petite Ponar Grab Sampler was used to sample the surface sediments at fifty randomly selected points on the point intercept grid. The number of viable turions in the surface sediments were counted at each site. Numbers were extrapolated to determine number of turions per square meter.

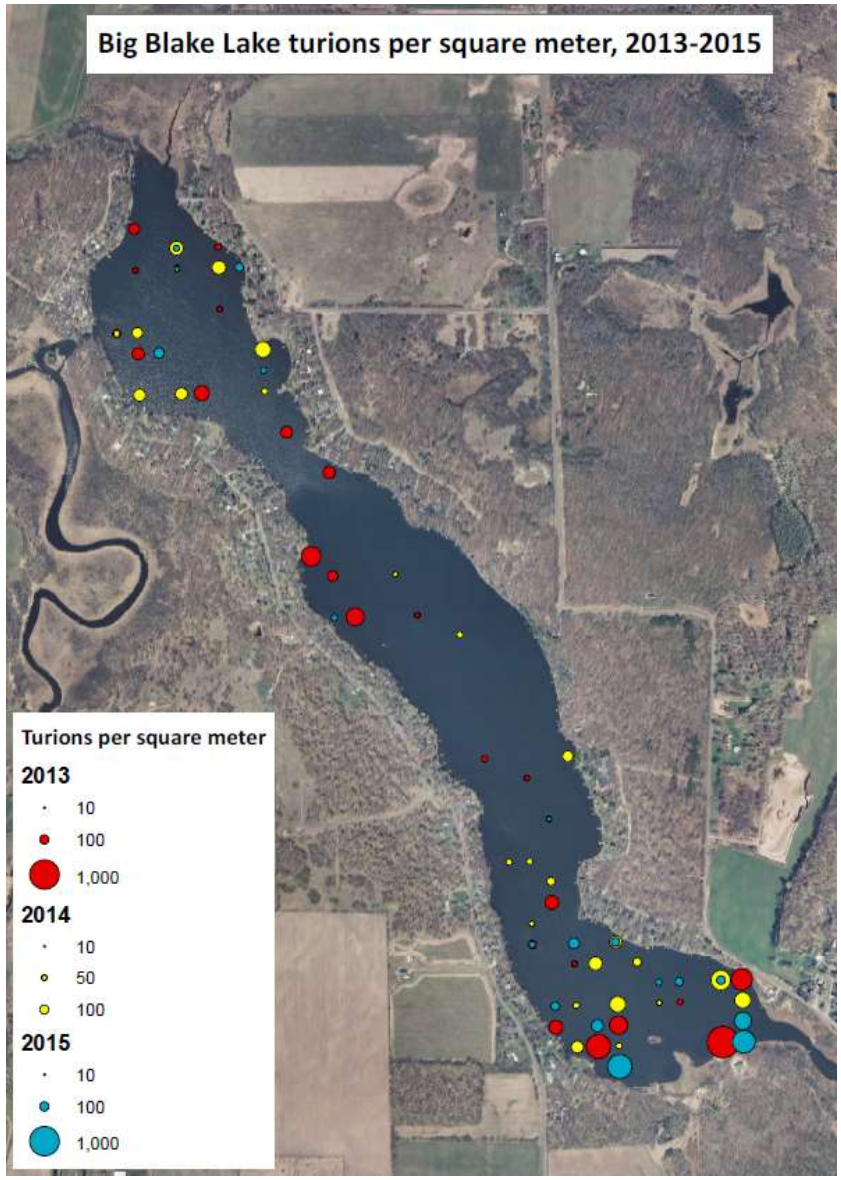
Average number of turions per dredge sample and number of turions per square meter decreased each year of the study. However, at many of the sites on the south end where points were revisited, the number of turions per square meter increased in 2015 as compared to 2013 and 2014.

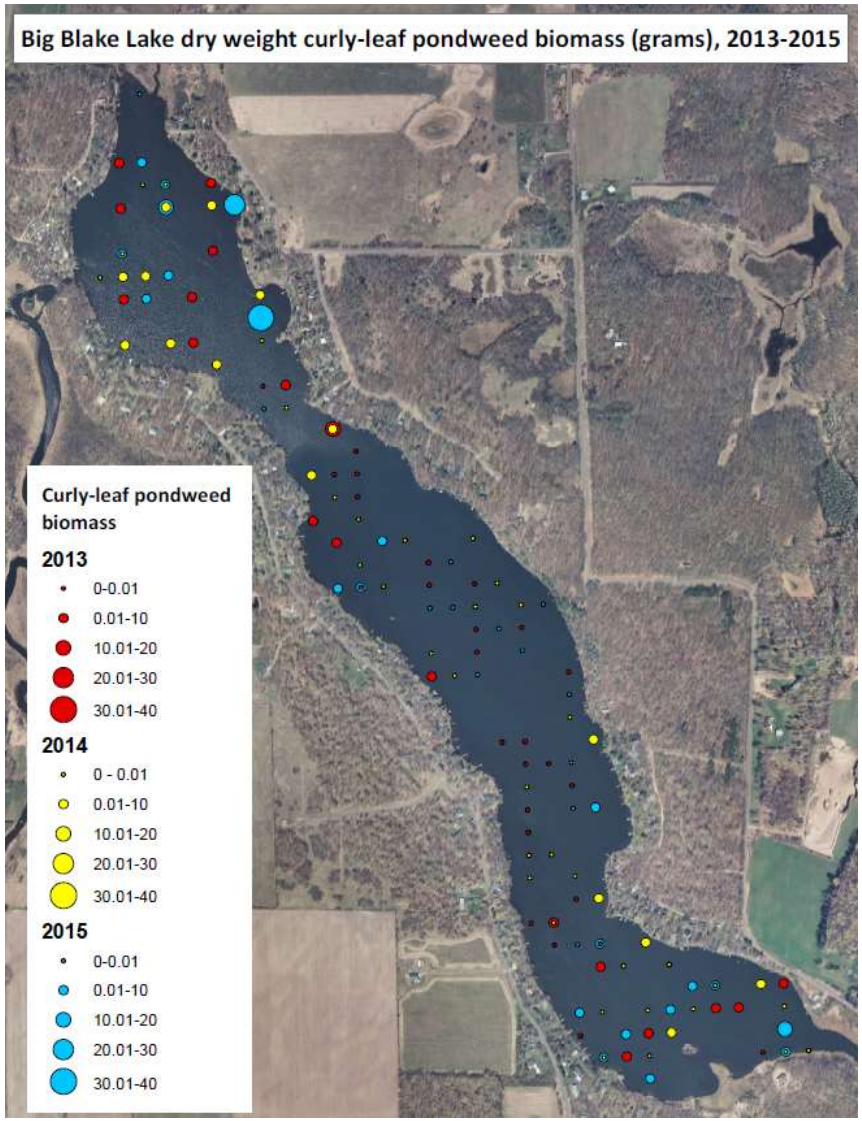
Number of turions per site was greatest on the south end of Big Blake Lake. Turions were not present in the sediments of many of the sites in the middle of Big Blake Lake.

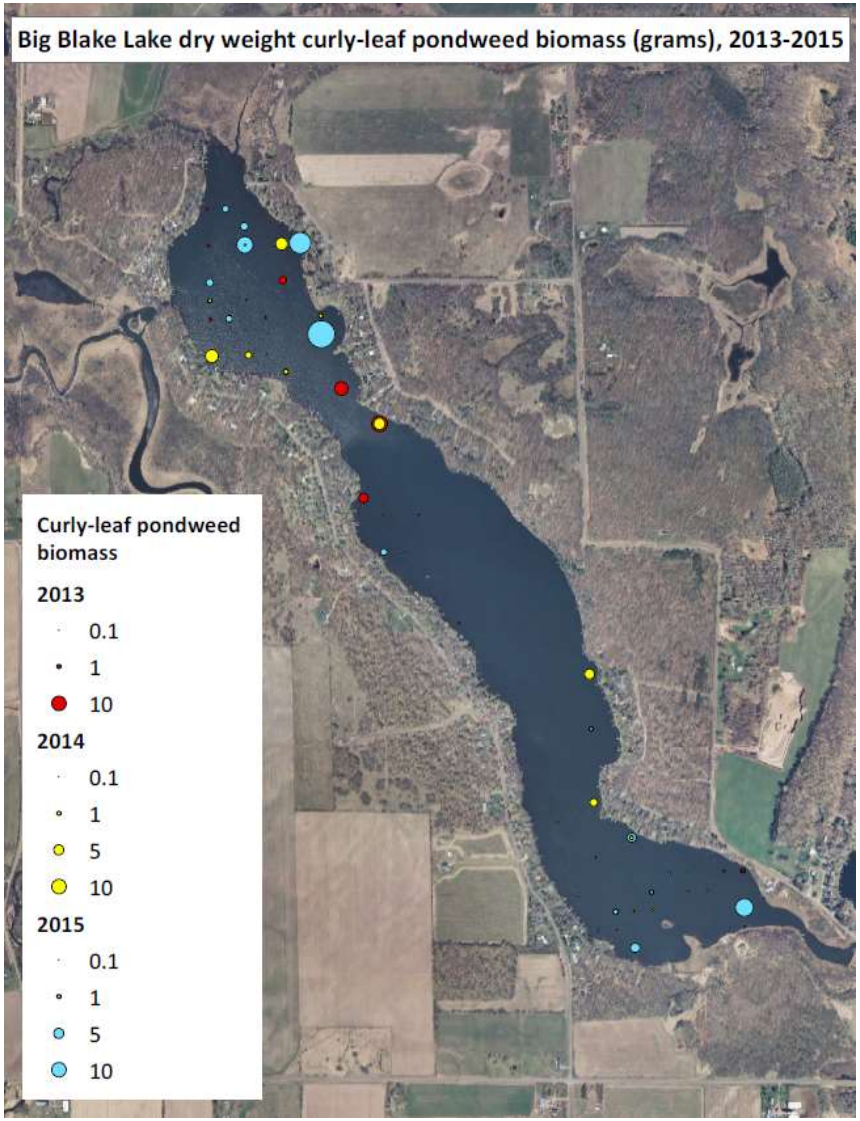
At each of the fifty randomly selected points, a rake was used to sample biomass. Biomass samples were dried and weighed. Average dry weight biomass was greatest in 2015 followed by 2014 and 2013. In general, biomass was greatest in the north and south ends of the lake with much less curly-leaf pondweed being found in the middle of the lake.

Year	Turions per dredge sample	Turions per square meter	Curly-leaf pondweed biomass (grams)
2013	2.7	117	0.656
2014	1.9	83	0.768
2015	1.3	56	2.272


Big Blake Lake turions per square meter, 2013-2015
Turions per square meter
2013
0-1
1.1-150
150.1-300
300.1-450
450.1-600
600.1-750
750.1-900
900.1-1,050
1,050.1-1,200
1,200.1-1,350
2014
0-1
1.1-150
150.1-300
300.1-450
450.1-600
600.1-750
750.1-900
900.1-1,050
1,050.1-1,200
1,200.1-1,350
2015
0-1
1.1-150
150.1-300
300.1-450
450.1-600
600.1-750
750.1-900
900.1-1,050
1,050.1-1,200
1,200.1-1,350


Big Blake Lake turions per square meter, 2013-2015
Turions per square meter
2013
10
100
1,000
2014
10
50
100
2015
10
100
1,000


Big Blake Lake dry weight curly-leaf pondweed biomass (grams), 2013-2015
Curly-leaf pondweed biomass
2013
0-0.01
0.01-10
10.01-20
20.01-30
30.01-40
2014
0 - 0.01
0.01-10
10.01-20
20.01-30
30.01-40
2015
0-0.01
0.01-10
10.01-20
20.01-30
30.01-40


Big Blake Lake dry weight curly-leaf pondweed biomass (grams), 2013-2015
Curly-leaf pondweed biomass
2013
0.1
1
10
2014
0.1
1
5
10
2015
0.1
1
5
10

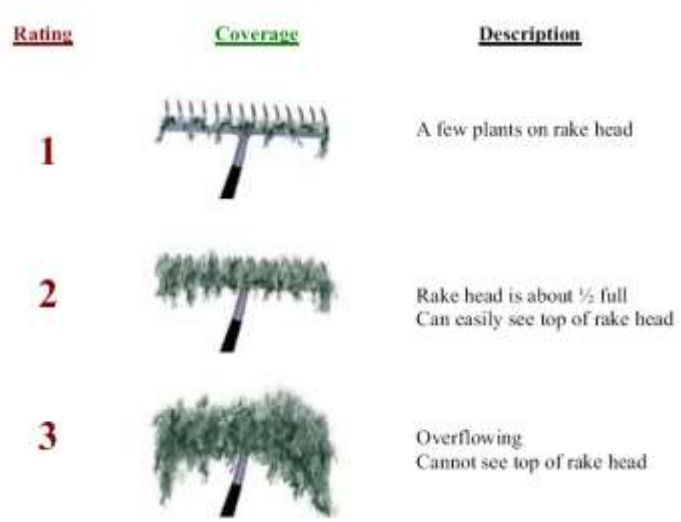
Point Intercept Aquatic Macrophyte Surveys

Spring and fall aquatic macrophyte surveys were conducted on Big Blake Lake in 2013, 2014, and 2015 using the Jessen and Lound Rake Method.

Two hundred seventy six sampling points were established in and around the lake using a standard formula that takes into account the shoreline shape and distance, islands, water clarity, depth, and total lake acres. Points were generated in ArcView and downloading to a GPS unit. These points were then sampled in field.

During the aquatic macrophyte survey, each sampling point was located using a handheld mapping GPS unit. The depth at each sampling point was recorded using a depth finder. At each sampling point a pole rake was used to sample the plant community of an approximately 1 meter section of the benthos.

All plants on the rake, as well as any that were dislodged by the rake, were identified to species and assigned a rake fullness value of 1 to 3 to estimate abundance. Visual sightings of plants within six feet of the sample point were also recorded. The lake bottom type, or substrate, was also assigned at each sampling point where the bottom was visible or it could be reliably determined using the rake. Data was collected at each sampling point, with the exception of those that were too shallow or terrestrial. Shallow communities were characterized visually.



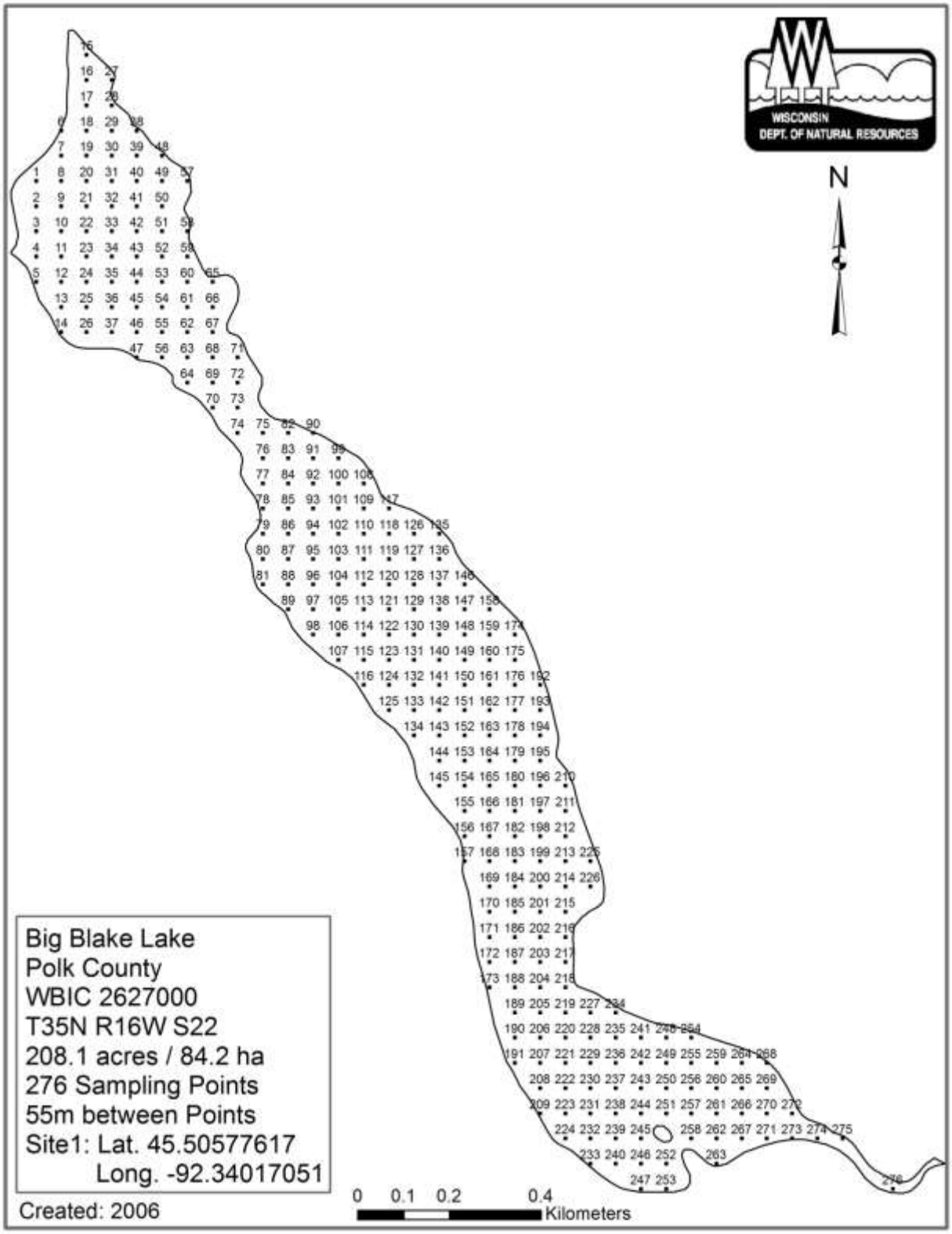
Although two hundred seventy six sampling points were established in Big Blake Lake, it was not possible to reach all sampling points (some were terrestrial).

Twice annual aquatic macrophyte surveys were conducted on Big Blake Lake in 2007 and 2011 and a fall point intercept survey was conducted in 2012. Surveys completed in 2008-2010 represented two intensive management units rather than the full point intercept grid. This summary will include data from 2007 and 2011-2015.

Data collected was entered into a spreadsheet for analysis. The following statistics were generated from the spreadsheet:

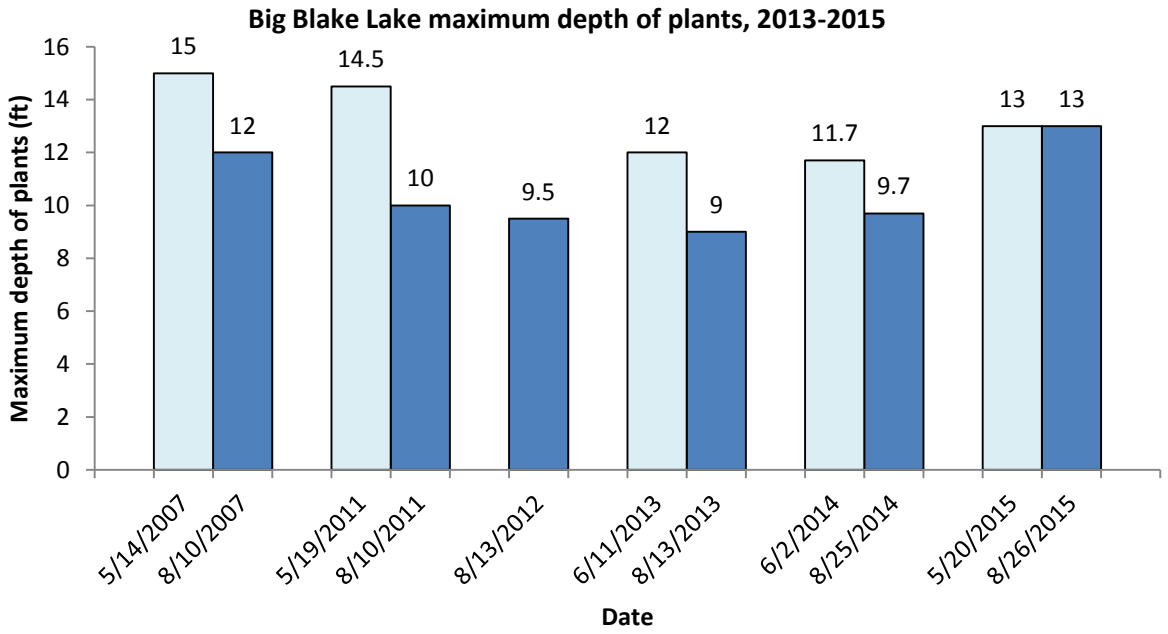
- Maximum depth of plants
- Frequency of occurrence
- Relative frequency
- Sample points with vegetation
- Species richness
- Simpson's Diversity Index
- Floristic Quality Index

Following are explanations of the various analysis values with data from Big Blake Lake.



Maximum Depth of Plants

In lakes, plant growth is limited to certain depths based on availability of light. With greater water clarity, light can penetrate to greater depths and be used by plants for growth. In Big Blake Lake the maximum depth of plants was generally greater in the spring as compared to the fall (12 versus 9 feet in 2013 and 11.7 versus 9.7 feet in 2014, respectively). In 2015, the maximum depth of plants (13 feet) was the same in both spring and fall.



Frequency of Occurrence

Two values are computed for frequency of occurrence: the frequency of occurrence within vegetated areas and the frequency of occurrence at sites shallower than the maximum depth of plants. The maximum depth of plants is the depth of the deepest site sampled at which vegetation was present (maximum depth of plants).

<u>Frequency of occurrence within vegetated areas</u> is defined as the number of times a species was seen in a vegetated area divided by the total number of vegetated sites. This value shows how often the plant would be encountered everywhere vegetation was found in the lake. The greater the value, the more frequently the plant would be encountered in the lake.

In the spring, within vegetated areas, curly-leaf pondweed was the most frequently encountered plant species being found at 100% of sites in 2007, 93% of sites in 2011, 73% of sites in 2013, 59% of sites in 2014, and 93% of sites in 2015. Other frequent species included small pondweed, coontail, forked duckweed, and flat-stem pondweed.

In the fall, within vegetated areas, coontail was the most frequently encountered plant species being found at 86% of sites in 2007, 92% of sites in 2011, 86% of sites in 2012, 82% of sites in 2013, 73% of sites in 2014, and 85% of sites in 2015. Other frequent species included flat-stem pondweed, forked duckweed, and small pondweed.

Spring frequency of occurrence within vegetated areas, 2007, 2011, and 2013-2015					
	5/14/07	5/19/11	6/11/13	6/2/14	5/20/15
Ceratophyllum demersum, coontail	19.52	25.64	34.11	31.6	19.44
Filamentous algae	8.37	5.13	3.88	17.39	4.86
Heteranthera dubia, water star-grass			1.55		0.69
Lemna minor, small duckweed			2.33		
Lemna trisulca, forked duckweed	1.99	12.31	15.5	29.57	5.56
Myriophyllum sibiricum, northern water milfoil		2.05	0.78	2.61	4.17
Nitella sp., nitella					0.69
Nuphar variegata, spatterdock		1.03	0.78	3.48	1.39
Nymphaea odorata, white water lily		0.51	2.33	1.74	0.69
Potamogeton crispus, curly-leaf pondweed	100.00	93.33	72.87	59.13	93.06
Potamogeton praelongis, white-stem pondweed		0.51	3.1	1.74	1.39
Potamogeton pulcher, spotted pondweed		0.51			
Potamogeton pusillus, small pondweed	1.20	13.85	35.66	39.13	18.75
Potamogeton zosteriformis, flat-stem pondweed	2.39	4.10	16.28	13.04	5.56
Ranunculus aquatilis, white water crowfoot			3.1		1.39
Vallisneria americana, wild celery			0.78		
Wolffia columbiana, common watermeal			1.55		
Zizania palustris, northern wild rice			0.78	1.74	1.39

Fall frequency of occurrence within vegetated areas, 2007 and 2011-2015						
	8/10/07	8/10/11	8/13/12	8/13/13	8/25/14	8/26/15
Ceratophyllum demersum, coontail	85.87	91.89	85.71	82.14	73.24	85.29
Chara sp., Muskgrasses						1.47
Elodea canadensis, common waterweed	1.09					4.41
Filamentous algae	8.70		5.36	8.93	9.86	11.76
Heteranthera dubia, water star-grass	1.09	2.70		3.57	7.04	2.94
Lemna minor, small duckweed	3.26	6.76		1.79	5.63	4.41
Lemna trisulca, forked duckweed	14.13	43.24	30.36	28.57	38.03	44.12
Myriophyllum sibiricum, northern water milfoil	3.26	8.11	14.29	8.93	12.68	11.76
Najas flexilis, bushy pondweed	1.09	4.05		1.79	8.45	
Nitella sp., nitella	1.09					
Nuphar variegata, spatterdock		6.76	1.79		4.23	1.47
Nymphaea odorata, white water lily	2.17	4.05	7.14	8.93	5.63	7.35
Potamogeton amplifolius, large-leaf pondweed					1.41	
Potamogeton crispus, curly-leaf pondweed	1.09	1.35	1.79	1.79	1.41	1.47
Potamogeton illinoensis, Illinois pondweed	3.26					
Potamogeton praelongis, white-stem pondweed		2.70		3.57		4.41
Potamogeton pusillus, small pondweed	1.09	8.11		17.86	11.27	2.94
Potamogeton richardsonii, clasping-leaf pondweed	2.17	2.70	1.79	8.93	1.41	4.41
Potamogeton zosteriformis, flat-stem pondweed	15.22	31.08	26.79	48.21	28.17	35.29
Ranunculus aquatilis, white water crowfoot		1.35		1.79	1.41	2.94
Sparganium angustifolium, narrow-leaved bur-reed			8.93			
Spirodela polyrhiza, large duckweed	1.09	6.76		1.79		
Stuckenia pectinata, sago pondweed	1.09					
Vallisneria americana, wild celery		1.35	3.57	5.36		2.94
Wolffia columbiana, common watermeal		1.35		1.79	1.41	4.41
Zizania palustris, northern wild rice		1.35				

Frequency of occurrence at sites shallower than the maximum depth of plants is defined as the number of times a species was seen divided by the total number of sites shallower than the maximum depth of plants. This value shows how often the plant would be encountered within the depths plants can potentially grow (maximum depth of plants). The greater the value, the more frequently the plant would be encountered in the lake.

In the spring, at sites shallower than the maximum depth of plants, curly-leaf pondweed was the most frequently encountered plant species being found at 97% of sites in 2007, 67% of sites in 2011, 53% of sites in 2013, 32% of sites in 2014, and 51% of sites in 2015. Other frequent species included small pondweed, coontail, and forked duckweed.

In the fall, at sites shallower than the maximum depth of plants, coontail was the most frequently encountered plant species being found at 31% of sites in 2007, 52% of sites in 2011, 44% of sites in 2012, 51% of sites in 2013, 42% of sites in 2014, and 22% of sites in 2015. Other frequent species included flat-stem pondweed and forked duckweed.

[27]

[27] Rake of coontail, August 10th, 2007

Spring frequency of occurrence at sites shallower than the maximum depth of plants, 2007, 2011, and 2013-2015					
	5/14/07	5/19/11	6/11/13	6/2/14	5/20/15
Ceratophyllum demersum, coontail	18.85	18.38	25.00	16.74	10.73
Filamentous algae	8.08	3.68	2.84	9.30	2.68
Heteranthera dubia, water star-grass			1.14		0.38
Lemna minor, small duckweed			1.70		
Lemna trisulca, forked duckweed	1.92	8.82	11.36	15.81	3.07
Myriophyllum sibiricum, northern water milfoil		1.47	0.57	1.40	2.30
Nitella sp., nitella					0.38
Nuphar variegata, spatterdock		0.74	0.57	1.86	0.77
Nymphaea odorata, white water lily		0.37	1.70	0.93	0.38
Potamogeton crispus, curly-leaf pondweed	96.54	66.91	53.41	31.63	51.34
Potamogeton praelongis, white-stem pondweed		0.37	2.27	0.93	0.77
Potamogeton pulcher, spotted pondweed		0.37			
Potamogeton pusillus, small pondweed	1.15	9.93	26.14	20.93	10.34
Potamogeton zosteriformis, flat-stem pondweed	2.31	2.94	11.93	6.98	3.07
Ranunculus aquatilis, white water crowfoot			2.27		0.77
Vallisneria americana, wild celery			0.57		
Wolffia columbiana, common watermeal			1.14		
Zizania palustris, northern wild rice			0.57	0.93	0.77

Fall frequency of occurrence at sites shallower than the maximum depth of plants, 2007 and 2011-2015						
	8/10/07	8/10/11	8/13/12	8/13/13	8/25/14	8/26/15
Ceratophyllum demersum, coontail	31.10	52.31	43.64	51.11	41.94	22.22
Chara sp., Muskgrasses						0.38
Elodea canadensis, common waterweed	0.39					1.15
Filamentous algae	3.15		2.73	5.56	5.65	3.07
Heteranthera dubia, water star-grass	0.39	1.54		2.22	4.03	0.77
Lemna minor, small duckweed	1.18	3.85		1.11	3.23	1.15
Lemna trisulca, forked duckweed	5.12	24.62	15.45	17.78	21.77	11.49
Myriophyllum sibiricum, northern water milfoil	1.18	4.62	7.27	5.56	7.26	3.07
Najas flexilis, bushy pondweed	0.39	2.31		1.11	4.84	
Nitella sp., nitella	0.39					
Nuphar variegata, spatterdock		3.85	0.91		2.42	0.38
Nymphaea odorata, white water lily	0.79	2.31	3.64	5.56	3.23	1.92
Potamogeton amplifolius, large-leaf pondweed					0.81	
Potamogeton crispus, curly-leaf pondweed	0.39	0.77	0.91	1.11	0.81	0.38
Potamogeton illinoensis, Illinois pondweed	1.18					
Potamogeton praelongis, white-stem pondweed		1.54		2.22		1.15
Potamogeton pusillus, small pondweed	0.39	4.62		11.11	6.45	0.77
Potamogeton richardsonii, clasping-leaf pondweed	0.79	1.54	0.91	5.56	0.81	1.15
Potamogeton zosteriformis, flat-stem pondweed	5.51	17.69	13.64	30.00	16.13	9.20
Ranunculus aquatilis, white water crowfoot		0.77		1.11	0.81	0.77
Sparganium angustifolium, narrow-leaved bur-reed			4.55			
Spirodela polyrhiza, large duckweed	0.39	3.85		1.11		
Stuckenia pectinata, sago pondweed	0.39					
Vallisneria americana, wild celery		0.77	1.82	3.33		0.77
Wolffia columbiana, common watermeal		0.77		1.11	0.81	1.15
Zizania palustris, northern wild rice		0.77				

Relative Frequency

Relative frequency is the frequency of a particular plant species relative to other plant species. This value is independent of the number of points sampled. Relative frequency can be used to show which plants are the dominant species in a lake. The higher the value a species has for relative frequency, the more common the species is compared to others. The relative frequency of all plants will always add up to 100%. If species A had a relative frequency of 30%, this species occurred 30% of the time compared to all the species sampled or makes up 30% of all species sampled.

Relative frequency example:
Suppose we were sampling 10 points in a very small lake and got the following results:
Plant A present at 3 of 10 sites
Plant B present at 5 of 10 sites
Plant C present at 2 of 10 sites
Plant D present at 6 of 10 sites

Plant D is the most frequently sampled at all points, with 60% (6/10) of the sites having plant D. However, the relative frequency allows us to see what the frequency of Plant D is compared to other plants, without taking into account the number of sites. This value is calculated by dividing the number of times a plant is sampled by the total of all plants sampled. If we add all frequencies (3+5+2+6), we get a sum of 16. We can calculate the relative frequency by dividing by the individual frequency.

Plant A = 3/16 = 0.1875 or 18.75%
Plant B = 5/16 = 0.3125 or 31.25%
Plant C = 2/16 = 0.125 or 12.5%
Plant D = 6/16 = 0.375 or 37.5%

Now we can compare the plants to one another. Plant D is still the most frequent, but the relative frequency tells us that of all plants sampled at those 10 sites, 37.5% of them are Plant D. This is much lower than the frequency of occurrence (60%) because, although we sampled Plant D at 6 of 10 sites, we were sampling many other plants too, thereby giving a lower frequency when compared to those other plants. This then gives a true measure of the dominant plants present.

In the spring, the most dominant plant in Big Blake Lake as indicated by relative frequency was curly-leaf pondweed. Curly-leaf pondweed made up 75% of the plant community in 2007, 61% in 2011, 38% in 2013, 32% in 2014, and 60% in 2015. Other dominant plants, as indicated by relative frequency included small pondweed, coontail, and forked duckweed.

In the fall, the most dominant plant in Big Blake Lake as indicated by relative frequency was coontail. Coontail made up 59% of the plant community in 2007, 41% in 2011, 46% in 2012, 36% in 2013, 36% in 2014, and 38% in 2015. Other dominant plants, as indicated by relative frequency included flat-stem pondweed and forked duckweed.

Spring relative frequency, 2007, 2011, and 2013-2015					
	5/14/07	5/19/11	6/11/13	6/2/14	5/20/15
Ceratophyllum demersum, coontail	14.6	16.7	17.8	17.1	12.6
Filamentous algae	6.3				
Heteranthera dubia, water star-grass			0.8		0.5
Lemna minor, small duckweed			1.2		
Lemna trisulca, forked duckweed	1.5	8.0	8.1	16.1	3.6
Myriophyllum sibiricum, northern water milfoil		1.3	0.4	1.4	2.7
Nitella sp., nitella					0.5
Nuphar variegata, spatterdock		0.7	0.4	1.9	0.9
Nymphaea odorata, white water lily		0.3	1.2	0.9	0.5
Potamogeton crispus, curly-leaf pondweed	74.9	60.7	38.1	32.2	60.4
Potamogeton praelongis, white-stem pondweed		0.3	1.6	0.9	0.9
Potamogeton pulcher, spotted pondweed		0.3			
Potamogeton pusillus, small pondweed	0.9	9.0	18.6	21.3	12.2
Potamogeton zosteriformis, flat-stem pondweed	1.8	2.7	8.5	7.1	3.6
Ranunculus aquatilis, white water crowfoot			1.6		0.9
Vallisneria americana, wild celery			0.4		
Wolffia columbiana, common watermeal			0.8		
Zizania palustris, northern wild rice			0.4	0.9	0.9

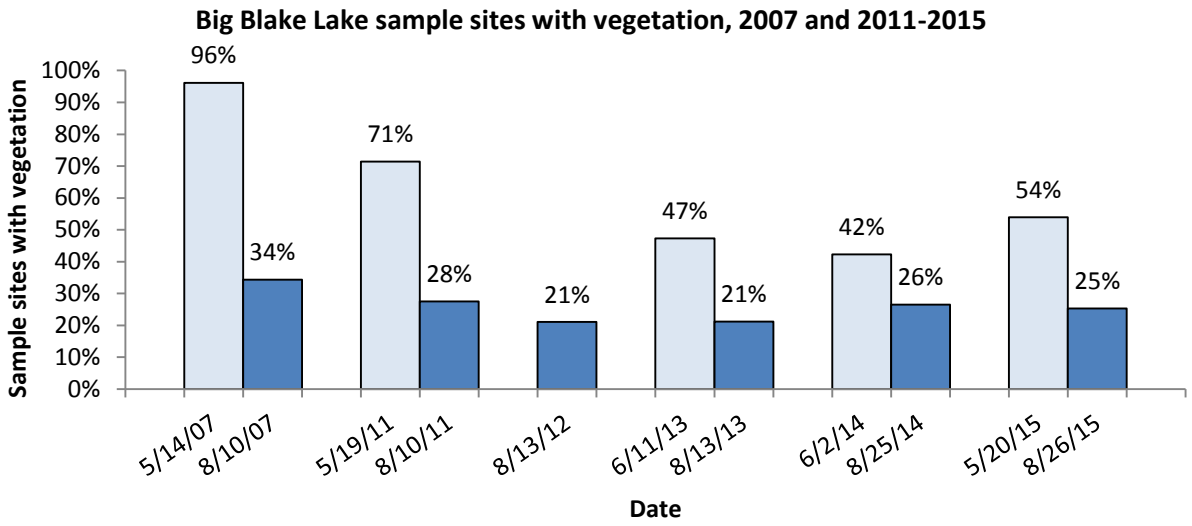
Fall relative frequency, 2007, 2011, and 2013-2015						
	8/10/07	8/10/11	8/13/12	8/13/13	8/25/14	8/26/15
Ceratophyllum demersum, coontail	58.5	40.7	45.7	36.2	36.4	38.4
Chara sp., Muskgrasses						0.7
Elodea canadensis, common waterweed	0.7					2.0
Filamentous algae	5.9		2.9			
Heteranthera dubia, water star-grass	0.7	1.2		1.6	3.5	1.3
Lemna minor, small duckweed	2.2	3.0		0.8	2.8	2.0
Lemna trisulca, forked duckweed	9.6	19.2	16.2	12.6	18.9	19.9
Myriophyllum sibiricum, northern water milfoil	2.2	3.6	7.6	3.9	6.3	5.3
Najas flexilis, bushy pondweed	0.7	1.8		0.8	4.2	
Nitella sp., nitella	0.7					
Nuphar variegata, spatterdock		3.0	1.0		2.1	0.7
Nymphaea odorata, white water lily	1.5	1.8	3.8	3.9	2.8	3.3
Potamogeton amplifolius, large-leaf pondweed					0.7	
Potamogeton crispus, curly-leaf pondweed	0.7	0.6	1.0	0.8	0.7	0.7
Potamogeton illinoensis, Illinois pondweed	2.2					
Potamogeton praelongis, white-stem pondweed		1.2		1.6		2.0
Potamogeton pusillus, small pondweed	0.7	3.6		7.9	5.6	1.3
Potamogeton richardsonii, clasping-leaf pondweed	1.5	1.2	1.0	3.9	0.7	2.0
Potamogeton zosteriformis, flat-stem pondweed	10.4	13.8	14.3	21.3	14.0	15.9
Ranunculus aquatilis, white water crowfoot		0.6		0.8	0.7	1.3
Sparganium angustifolium, narrow-leaved burreed			4.8			
Spirodela polyrhiza, large duckweed	0.7	3.0		0.8		
Stuckenia pectinata, sago pondweed	0.7					
Vallisneria americana, wild celery		0.6	1.9	2.4		1.3
Wolffia columbiana, common watermeal		0.6		0.8	0.7	2.0
Zizania palustris, northern wild rice		0.6				

Sample Points with Vegetation

This value shows the number of sites where plants were actually collected and gives an approximation of the plant coverage of a lake. If 10% of all sample points had vegetation, then it is implied that approximately 10% of the lake is covered with plants.

In all sample years the percent of Big Blake Lake that is covered with plants was greater in spring as compared to fall. Overall, plant coverage has decreased when comparing the earliest sampling years (2007 and 2011) to the later sampling years. The decrease is much more pronounced in the spring sampling period.

In the years with the most dense curly-leaf pondweed growth (2007, 2011, and 2015), the percent of the lake covered with plants in the spring was also the greatest. This arises because the majority of the plants sampled in these years were curly-leaf pondweed.

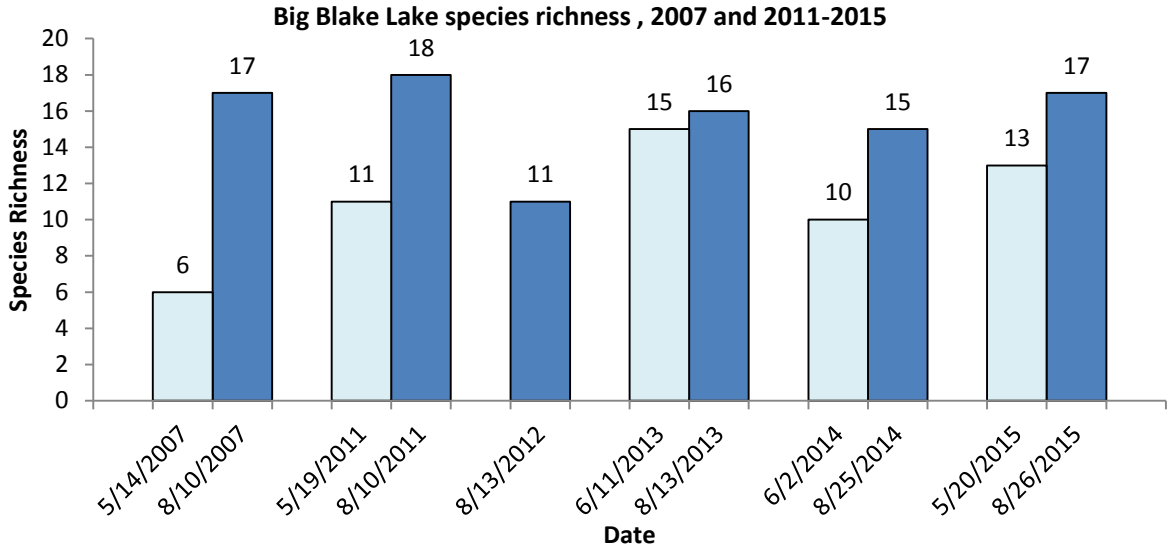


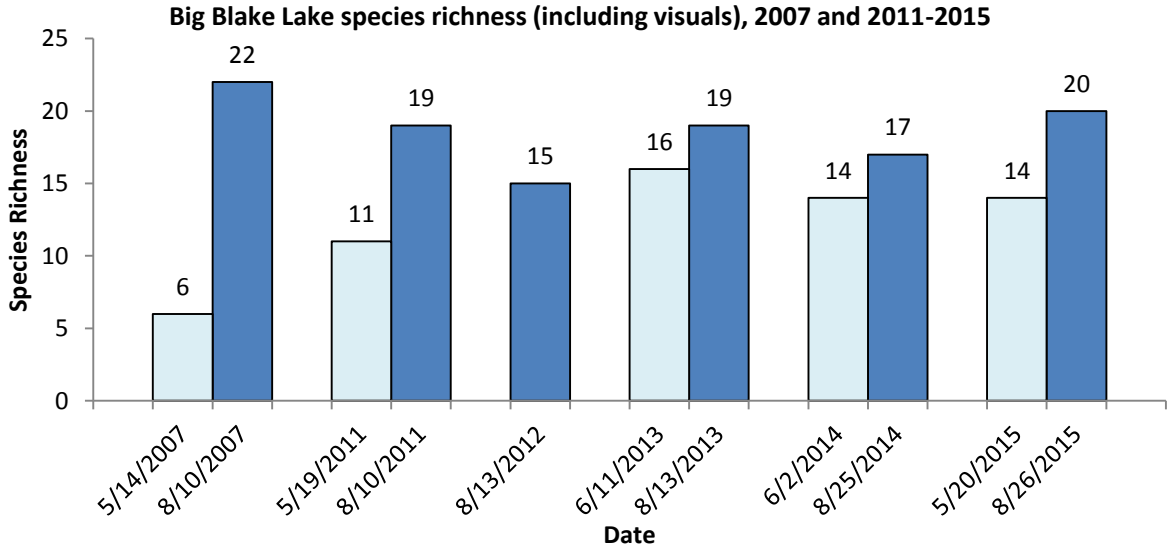
Species Richness

Species richness is a measure of the number of different individual species found in a lake. Species richness can be computed based on plants sampled or based on plants sampled/visually seen during the survey.

In all sampling years, species richness was greater in the fall as compared to the spring.

Species richness was notably lower in spring 2007 as compared with all other sampling years. This was the year curly-leaf pondweed growth was the most prolific. However, across all other years species richness has remained fairly constant, with the exception of fall 2012.





Simpson's Diversity Index

Simpson's Diversity Index (D) is used to determine how diverse the plant community in a lake is by measuring the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species). This value ranges from zero to one, with greater values representing more diverse plant communities. In theory, the value for Simpson's Diversity Index is the chance that two species that are sampled will be different. An Index of one means that the two plants sampled will *always* be different (very diverse) and an Index of zero means that the two plants sampled will *never* be different. Simpson's Diversity Index can be calculated by using the equation

$$D = \frac{\sum n(n-1)}{N(N-1)} \; ;$$

Where: D = Simpson's Diversity Index;
n= the total number of organisms of a particular species; and
N=the total number of organisms of all species.

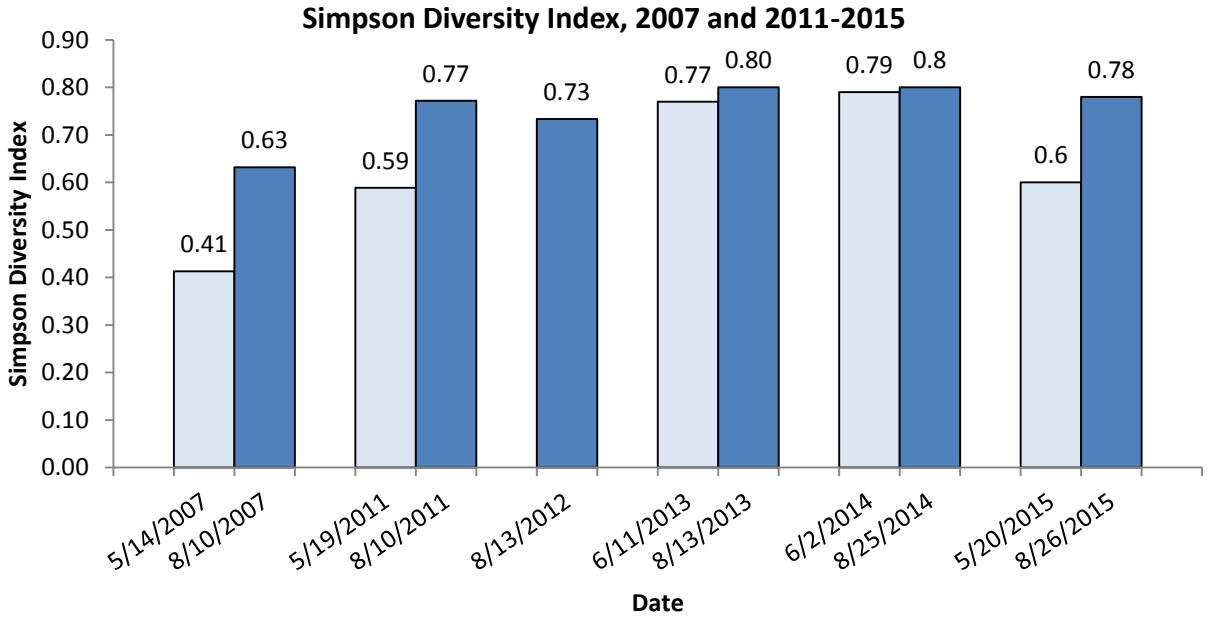
Simpson's Diversity Index example:

If one went into a lake and found just one plant, the Simpson's Diversity Index would be "0." This is because if two plants were sampled randomly, there would be a 0% chance of them being different, since there is only one plant.

If every plant sampled were different, then the Simpson's Diversity Index would be "1." This is because if two plants were sampled randomly, there would be a 100% chance they would be different since every plant is different.

These are extreme and theoretical scenarios, but they do make the point. The greater the Simpson's Diversity Index is for a lake, the greater the diversity since it represents a greater chance of two randomly sampled plants being different.

Diversity in Big Blake Lake has remained relatively constant since 2012. In 2007 spring and fall diversity values were notably lower as compared to all other sampling years. Additionally, low spring diversity values occurred in the years curly-leaf pondweed growth was the most prolific.



Floristic Quality Index

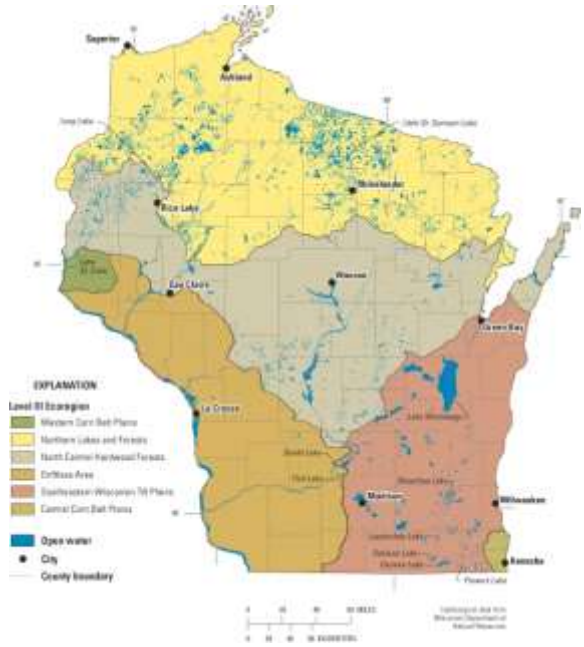
The Floristic Quality Index (FQI) is designed to evaluate the closeness of the flora in an area to that of an undisturbed condition. It can be used to identify natural areas, compare the quality of different sites or locations within a single lake, monitor long-term floristic trends, and monitor habitat restoration efforts. This is an important assessment in Wisconsin because of the demand by the Department of Natural

Resources (DNR), local governments, and riparian landowners to consider the integrity of lake plant communities for planning, zoning, sensitive area designation, and aquatic plant management decisions.

The FQI takes into account the species of aquatic plants found and their tolerance for changing water quality and habitat modification using the equation $I = \overline{C}\sqrt{N}$

Where I is the Floristic Quality Index;
$\overline{C}$ is the average coefficient of conservation (http://www.botany.wisc.edu/wisflora/FloristicR.asp);
and $\sqrt{N}$ is the square root of the number of species.

The Index uses a conservatism value assigned to various plants ranging from 1 to 10. A high conservatism value indicates that a plant is intolerant of change while a lower value indicates a plant is tolerant of change. Those plants with higher values are more apt to respond adversely to water quality and habitat changes. The FQI is calculated using the number of species and the average conservatism value of all species used in the Index. Therefore, a higher FQI indicates a healthier lake plant community. It should be noted that invasive species have a conservatism value of 0.



Summary of North Central Hardwood Forest values for Floristic Quality Index

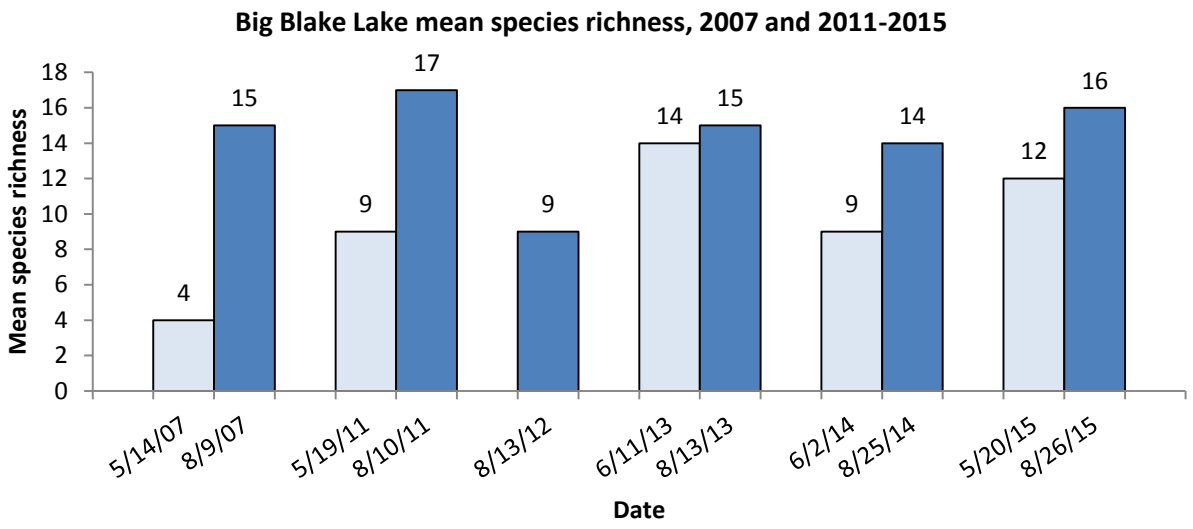
Mean species richness = 14
Mean average conservatism = 5.6
Mean Floristic Quality = 20.9*

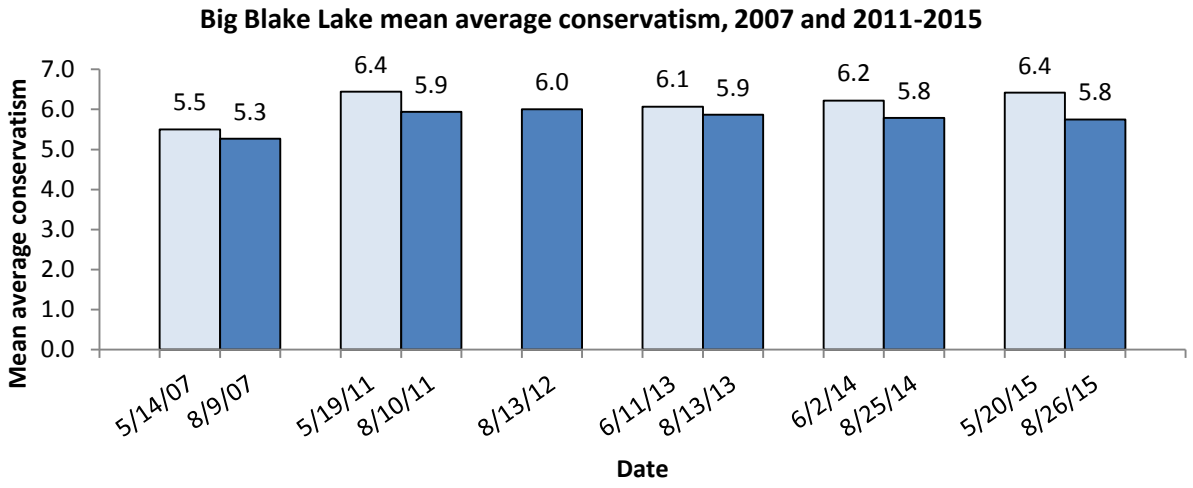
**Floristic Quality has a significant correlation with area of lake (+), alkalinity (-), conductivity (-), pH (-) and secchi depth (+). With a positive correlation, as that value rises so will FQI. With a negative correlation, as a value rises, the FQI will decrease.*

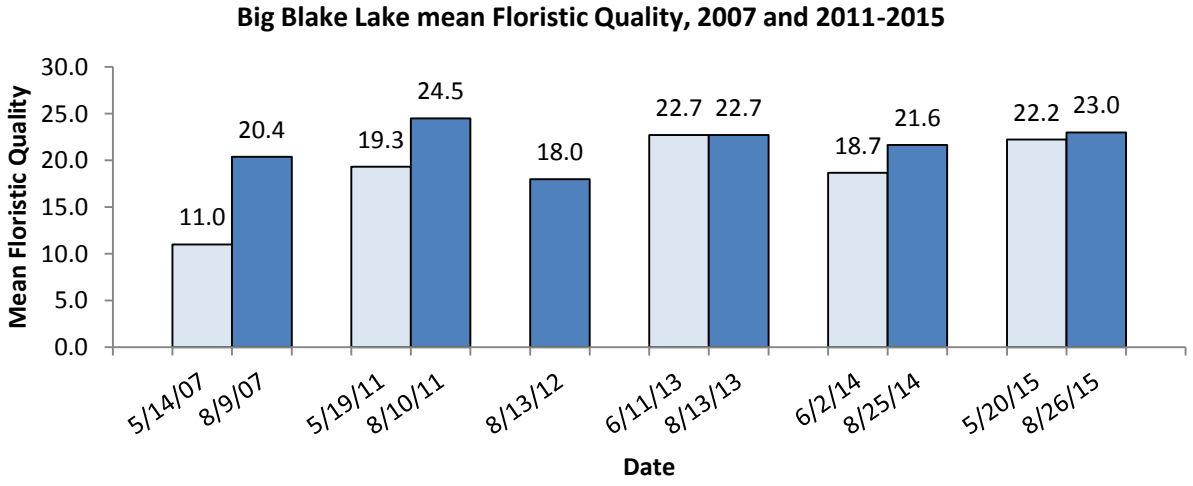
Using data from 2007 and 2011-2015, the mean species richness for Big Blake Lake is 12, which is below the mean value for the North Central Hardwood Forest. The mean average conservatism value for Big Blake Lake is 5.9, which is above the mean value for the North Central Hardwood Forest. The mean Floristic Quality value for Big Blake Lake is 20.4 which is just below the mean value for the North Central Hardwood Forest.

Using data from only the past three years during which the study took place (2013-2015), the mean species richness for Big Blake Lake is 13, which remains below the mean value for the North Central Hardwood Forest. However, the mean average conservatism value (6.0) and the mean Floristic Quality (21.8) are both above the value for the North Central Hardwood Forest.

Mean species richness, mean average conservatism, and mean floristic quality for spring of 2007 were substantially lower as compared with spring 2011-2015.


Big Blake Lake mean species richness, 2007 and 2011-2015
Mean species richness
18
16
14
12
10
8
6
4
2
0
4
15
9
17
9
14
15
9
14
12
16
5/14/07
8/9/07
5/19/11
8/10/11
8/13/12
6/11/13
8/13/13
6/2/14
8/25/14
5/20/15
8/26/15
Date


Big Blake Lake mean average conservatism, 2007 and 2011-2015
Mean average conservatism
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
5.5
5.3
6.4
5.9
6.0
6.1
5.9
6.2
5.8
6.4
5.8
5/14/07
8/9/07
5/19/11
8/10/11
8/13/12
6/11/13
8/13/13
6/2/14
8/25/14
5/20/15
8/26/15
Date


Big Blake Lake mean Floristic Quality, 2007 and 2011-2015
Mean Floristic Quality
30.0
25.0
20.0
15.0
10.0
5.0
0.0
11.0
20.4
19.3
24.5
18.0
22.7
22.7
18.7
21.6
22.2
23.0
5/14/07
8/9/07
5/19/11
8/10/11
8/13/12
6/11/13
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Date

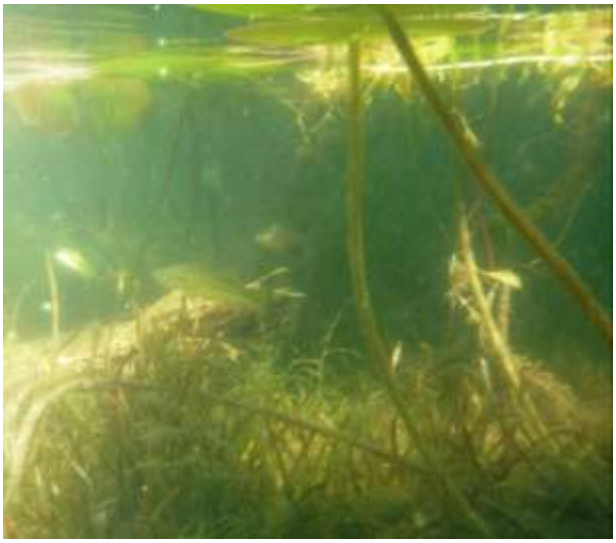
Land Use and Water Quality

The health of water resources depends largely on the decisions that landowners make on their properties. When waterfront lots are developed, a shift from native plants and trees to impervious surfaces and lawn often occurs. Impervious surfaces are hard, man-made surfaces such as rooftops, paved driveways, and concreate patios that make it impossible for rain to infiltrate into the ground.

By making it impossible for rainwater to infiltrate into the soil, impervious surfaces increase the volume of rainwater that washes over the soil surface and runs off directly into lakes and streams. Rainwater runoff can carry pollutants such as sediment, lawn fertilizers, and car oils directly into a lake. Native vegetation can slow the speed of rainwater, giving it time to soak into the soil where it is filtered by soil microbes.

In extreme precipitation events, erosion and gullies can result. The signs of erosion are unattractive and can cause decreases in property values. Sediment can also have negative impacts on aquatic life: fish eggs will die when covered with sediment and sediment influxes to a lake can decrease water clarity making it difficult for predator fish species to locate food.

Increases in impervious surfaces and lawns cause a loss of habitat for birds and other wildlife. Over ninety percent of all lake life is born, raised, and fed in the area where land and water meet. Overdeveloped shorelines remove critical habitat which species such as loons, frogs, songbirds, ducks, otters, and mink depend on. Impervious surfaces and lawns can be thought of as biological desserts which lack food and shelter for birds and wildlife. Nuisance species such as Canada geese favor lawns over taller native grasses and flowers. Lawns provide geese with a ready food source (grass) and a sense of security from predators (open views).



Additionally, fish species depend on the area where land and water meet for spawning. The removal of coarse woody habitat, or trees and braches that fall into a lake, cause decreases in fisheries habitat.

Common lawn species, such as Kentucky bluegrass, are often dependent on chemical fertilizers and require mowing. Excess chemical fertilizers are washed directly into the adjacent water during precipitation events. The phosphorus and other nutrients in fertilizers, which produce lush vegetative growth on land, are the same nutrients which fuel algae blooms and

decrease water clarity in a lake. Additionally, since common lawn species have very shallow root systems, when lawns are located on steep slopes, soil capacity is reduced and the impacts of erosion can be intensified.

Avoiding establishing lawns can provide direct positive impacts on lake water quality. The creation of a buffer zone of native grasses, wildflowers, shrubs, and trees where the land meets the water can provide numerous benefits for water quality and restore valuable bird and wildlife habitat.

In Polk County, all new constructions on lakeshore properties require that a shoreland protection area be in place. A shoreland protection area is required to be 35 feet in depth as measured from the ordinary high water mark, which is defined as the point on the bank or shore up to which the water leaves a distinct mark (erosion, change in vegetation, etc.). These rules are in place largely to protect water quality and also provide benefits in terms of natural beauty and bird and wildlife viewing opportunities. Additionally, shoreline protection areas allow for a 35 foot maximum viewing corridor (per 100 feet of frontage).

Historical Land Use in the Big Blake Lake Watershed

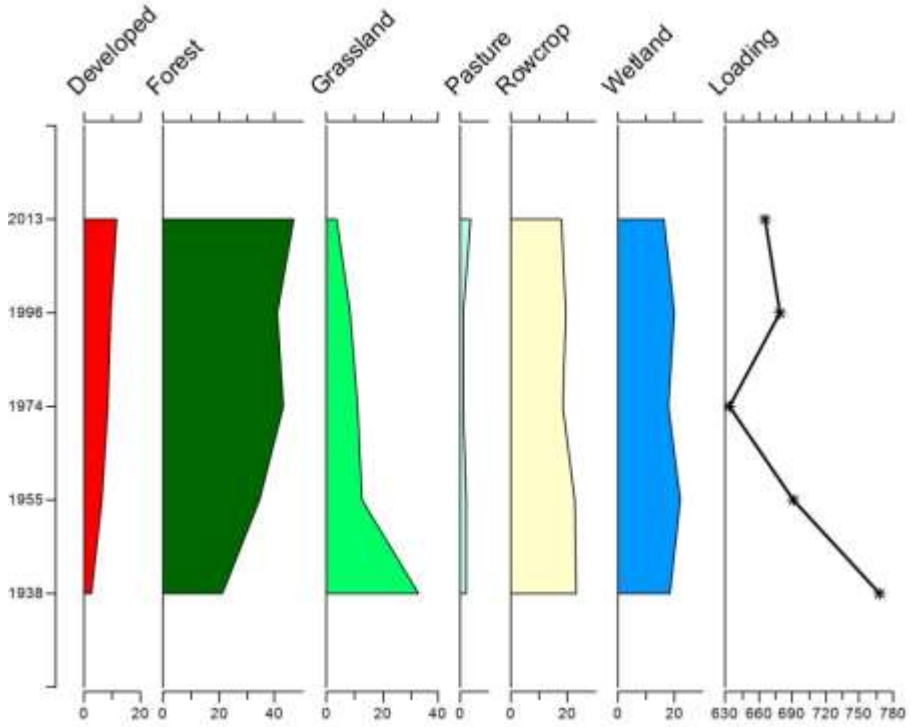
The area of land that drains to a lake is called a watershed. A student from the University of Wisconsin-River Falls delineated the land use in the Big Blake Lake watershed for the years 1938, 1955, 1974, 1996, and 2013. Land use was categorized as developed, forest, grassland, pasture, row crop, and wetland.

Over this timeframe, the amount of pasture, row crop, and wetland has remained fairly consistent; the amount of grassland has decreased (33% to 4%); and the amount of forest and developed land has increased (21% to 47% and 3% to 12%, respectively).

The Wisconsin Lakes Modeling Suite (WiLMS) was used to model conditions for Big Blake Lake each year and estimate land use nutrient loading for the watershed. Phosphorus is the key parameter in the modeling scenarios used in WiLMS because it is the limiting nutrient for algae growth in most waterbodies.

This data indicated that based on land use, phosphorus loading was greatest in 1938 (769 lbs/yr), followed by 1955 (691 lbs/yr), 1996 (679 lbs/yr), 2013 (666 lbs/yr), and 1974 (634 lbs/yr).

Date	Developed (acres)	Forest (acres)	Grassland (acres)	Pasture (acres)	Row crop (acres)	Wetland (acres)	Phosphorus loading (lbs/yr)
1938	57, (3%)	451, (21%)	705, (33%)	40, (2%)	490, (23%)	391, (18%)	769
1955	132, (6%)	753, (35%)	279, (13%)	40, (2%)	489, (23%)	474, (22%)	691
1974	179, (8%)	922, (43%)	244, (11%)	26, (1%)	392, (18%)	379, (18%)	634
1996	204, (10%)	873, (41%)	177, (8%)	28, (1%)	417, (20%)	421, (20%)	679
2013	250, (12%)	1004, (47%)	80, (4%)	80, (4%)	390, (18%)	348, (16%)	666

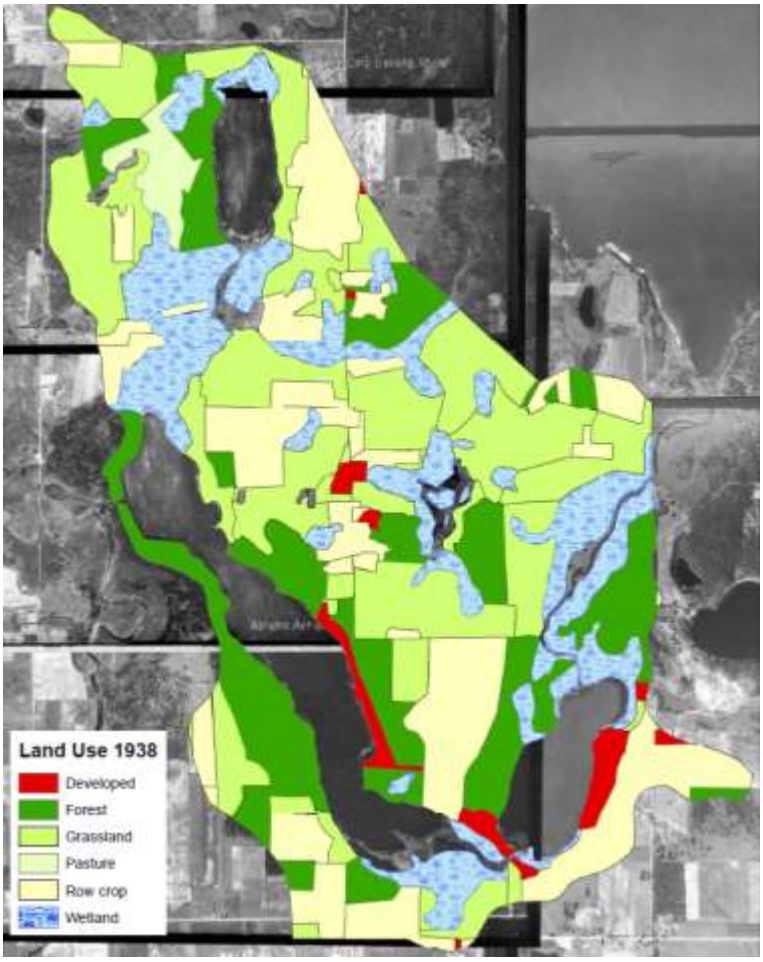


Historic Land Use and Nutrient Loading in the Big Blake Lake Watershed

The area of land that drains towards a lake is called a watershed. The Wisconsin Lakes Modeling Suite (WiLMS) was used to model historic and current conditions for Big Blake Lake, verify monitoring, and estimate land use nutrient loading for the watershed. Phosphorus is the key parameter in the modeling scenarios used in WiLMS because it is the limiting nutrient for algal growth in most lakes.

Land Use and Nutrient Loading – 1938

In 1938 the watershed for Big Blake was delineated at 2133.4 acres with a total watershed phosphorus load of 769 pounds.



The most common land use in 1938 was pasture/grass (32%) followed by row crop (21%), forest (19%), and wetland (17%). At this point in time, rural residential development accounted for only 2% of the land use in the Big Blake Lake watershed.

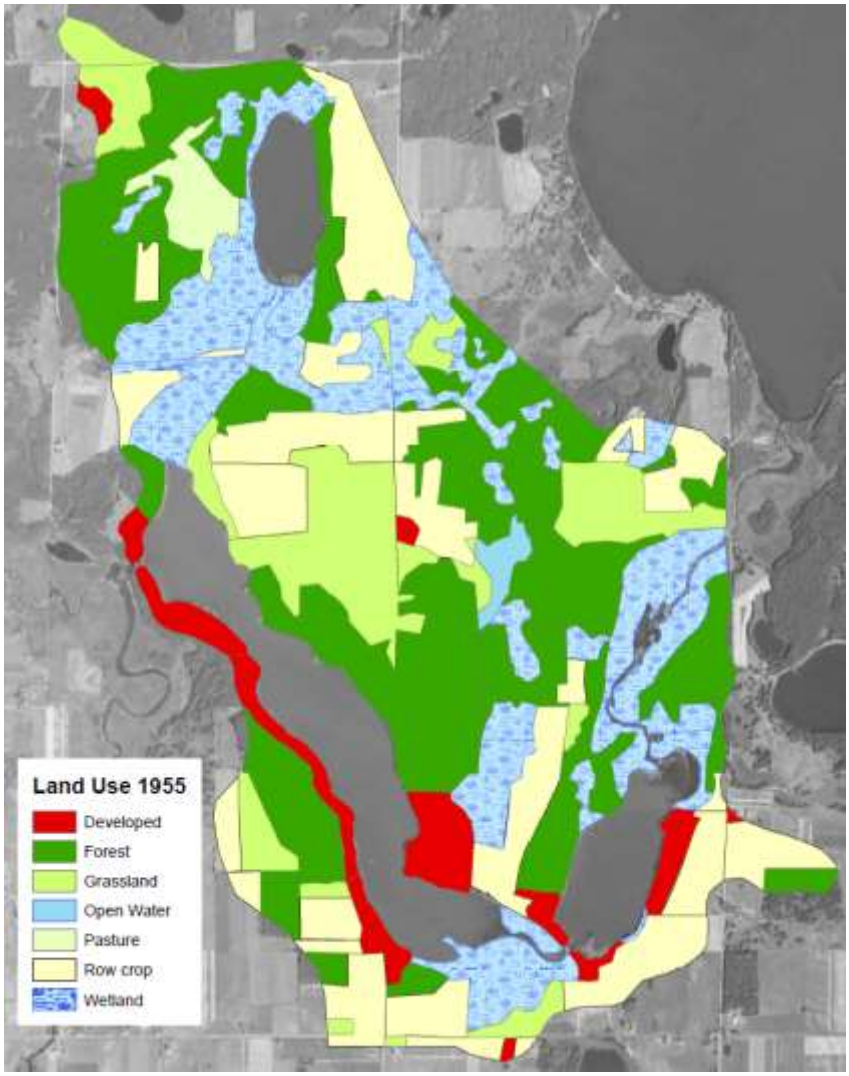
The largest contributor of phosphorus to Big Blake Lake was row crop (57%) followed by pasture/grass (26%). Precipitation to the surface of the lake contributed 7% of the total phosphorus load and natural state land uses such as forest and wetlands each contributed 5% of the total phosphorus load. Residential contributed only 1% of the total watershed phosphorus load.

1938 Land Use and Nutrient Loading

	Total Acres	Percent Acres (%)	Total Loading (lb P/yr)	Loading %
Row crop	490.1	21%	437	57%
Pasture/grass	744.7	32%	198	26%
Rural residential	56.9	2%	4	1%
Wetlands	391.1	17%	35	5%
Forest	450.6	19%	35	5%
Lake surface	208	9%	55	7%

Land Use and Nutrient Loading – 1955

In 1955 the watershed for Big Blake was delineated at 2165.5 acres with a total watershed phosphorus load of 691 pounds.



The most common land use in 1955 was forest (32%) followed by row crop (21%), wetland (20%), and pasture/grass (13%). At this point in time, residential development accounted for 6% of the land use in the Big Blake Lake watershed.

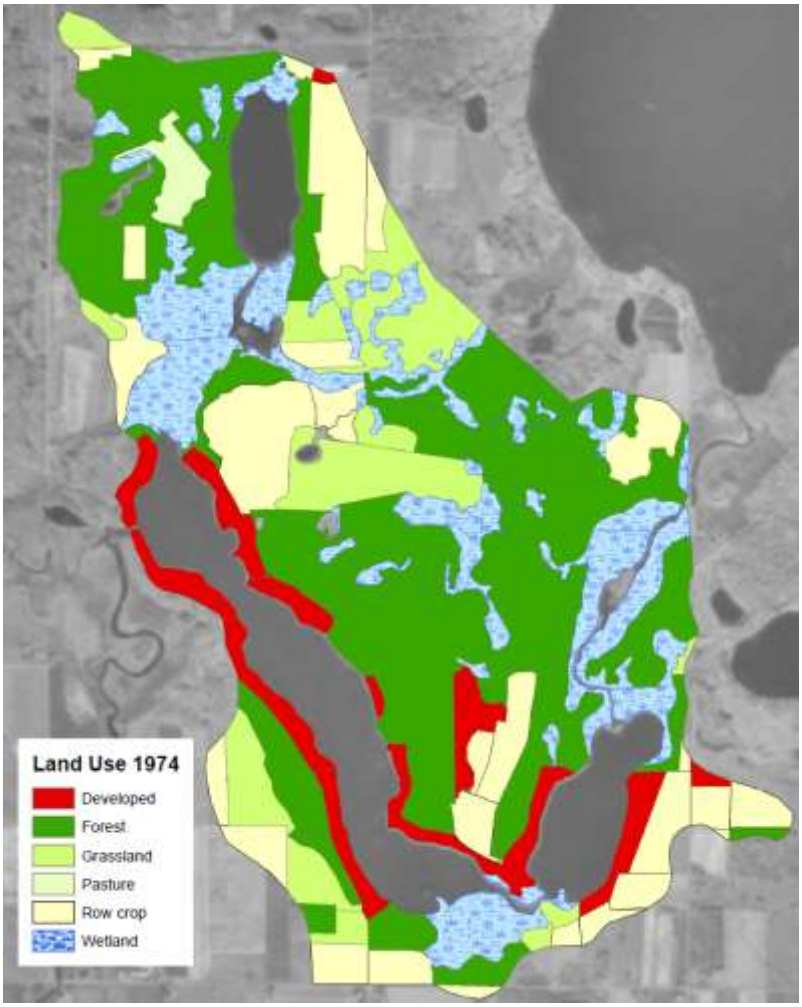
The largest contributor of phosphorus to Big Blake Lake was row crop (63%) followed by pasture/grass (12%). Precipitation to the surface of the lake contributed 8% of the total phosphorus load and natural state land uses such as forest and wetlands contributed 9% and 6% of the total phosphorus load, respectively. Rural residential contributed only 2% of the total watershed phosphorus load.

1955 Land Use and Nutrient Loading

	Total Acres	Percent Acres (%)	Total Loading (lb P/yr)	Loading %
Row crop	488.5	21%	437	63%
Pasture/grass	318.5	13%	86	12%
Rural residential	131.7	6%	11	2%
Wetlands	474.1	20%	42	6%
Forest	752.7	32%	60	9%
Lake surface	208	9%	55	8%

Land Use and Nutrient Loading – 1974

In 1974 the watershed for Big Blake was delineated at 2142.3 acres with a total watershed phosphorus load of 634 pounds.



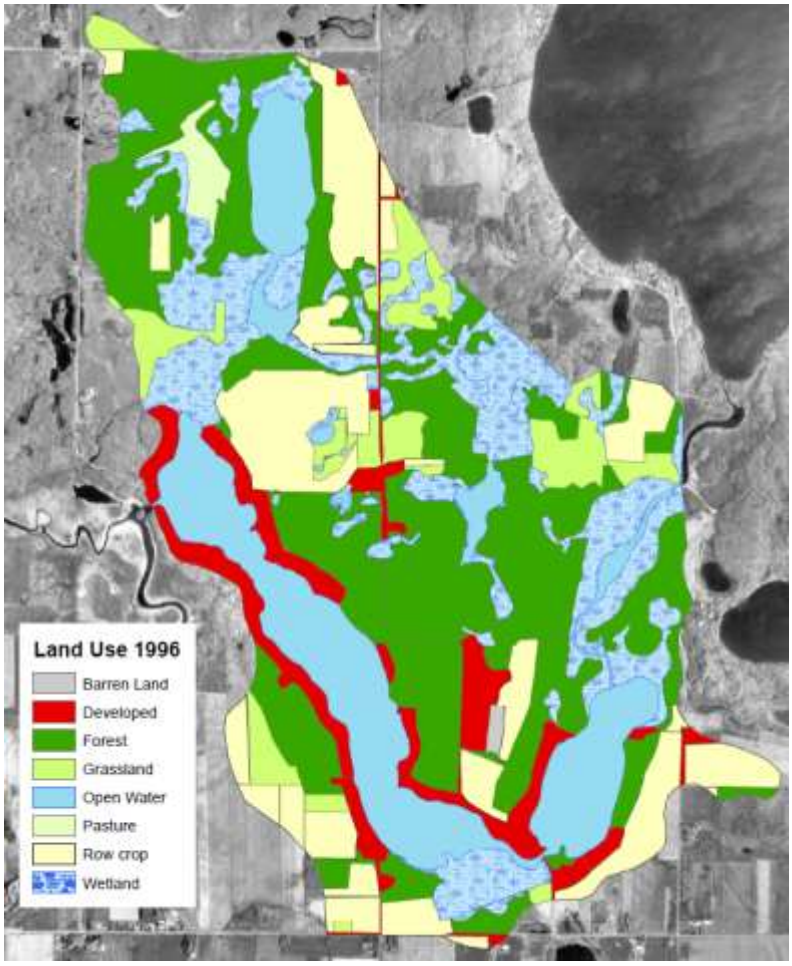
The most common land use in 1974 was forest (39%) followed by row crop (17%), wetland (16%), and pasture/grass (12%). At this point in time, residential development accounted for 8% of the land use in the Big Blake Lake watershed.

The largest contributor of phosphorus to Big Blake Lake was row crop (55%) followed by forest (12%), and pasture/grass (11%). Precipitation to the surface of the lake contributed 9% of the total phosphorus load. Wetlands contributed 5% of the total phosphorus load. By 1974, residential contributed 7% of the total watershed phosphorus load.

1974 Land Use and Nutrient Loading				
	Total Acres	Percent Acres (%)	Total Loading (lb P/yr)	Loading %
Row crop	392.2	17%	351	55
Pasture/grass	270.4	12%	73	11
Medium density residential	89.7	4%	40	6
Rural residential	89.7	4%	9	1
Wetlands	378.9	16%	33	5
Forest	921.6	39%	75	12
Lake surface	208	9%	55	9

Land Use and Nutrient Loading – 1996

In 1996 the watershed for Big Blake was delineated at 2119.1 acres with a total watershed phosphorus load of 679 pounds.



The most common land use in 1996 was forest (37%) followed by row crop (18%), and wetland (18%). Pasture/grass made up 9% of the land use in the Big Blake Lake watershed. At this point in time, residential development accounted for 9% of the land use in the Big Blake Lake watershed.

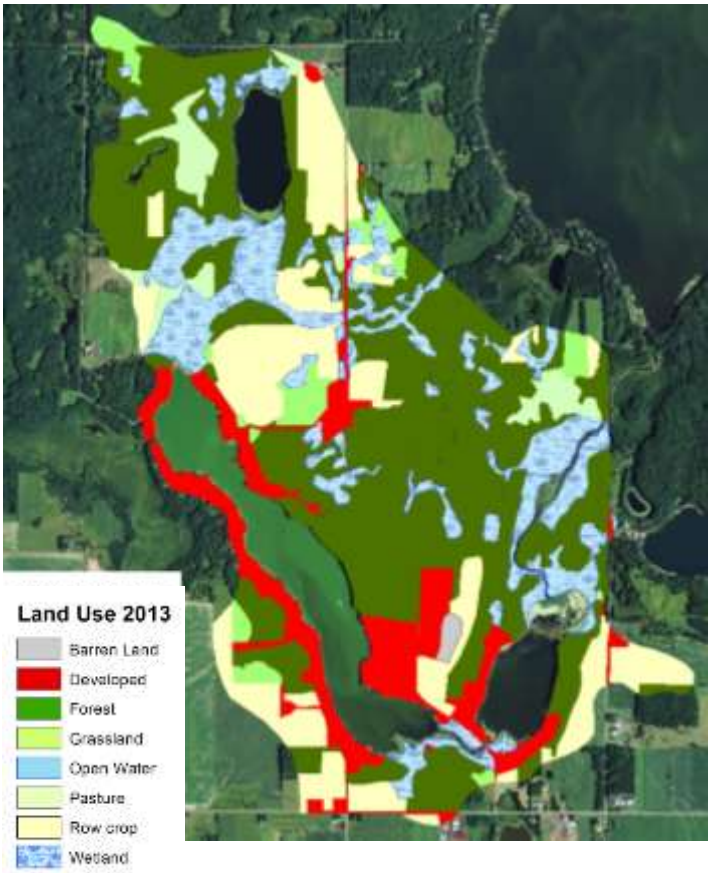
The largest contributor of phosphorus to Big Blake Lake was row crop (55%) followed by forest (10%), and pasture/grass (8%). Precipitation to the surface of the lake contributed 8% of the total phosphorus load and wetlands contributed 5% of the total phosphorus load. By 1996, residential contributed 13% of the total watershed phosphorus load.

1996 Land Use and Nutrient Loading

	Total Acres	Percent Acres (%)	Total Loading (lb P/yr)	Loading %
Row crop	416.6	18%	373	54.7
Pasture/grass	204.5	9%	55	8.1
Medium density residential	200	9%	88	13.1
Rural residential	4.2	0%	0	0.1
Wetlands	421.1	18%	37	5.5
Forest	872.6	37%	71	10.3
Lake surface	208	9%	55	8.2

Land Use and Nutrient Loading – 2013

In 2013 the watershed for Big Blake was delineated at 2150.7 acres with a total watershed phosphorus load of 666 pounds.



The most common land use in 2013 was forest (43%) followed by row crop (17%), and wetland (15%). Pasture/grass made up 7% of the land use in the Big Blake Lake watershed. At this point in time, residential development accounted for 10% of the land use in the Big Blake Lake watershed.

The largest contributor of phosphorus to Big Blake Lake was row crop (52%) followed by residential (16%), and forest (12%). Precipitation to the surface of the lake contributed 8% of the total phosphorus load, pasture/grass contributed 6% of the total phosphorus load, and wetlands contributed 5% of the total phosphorus load.

2013 Land Use and Nutrient Loading

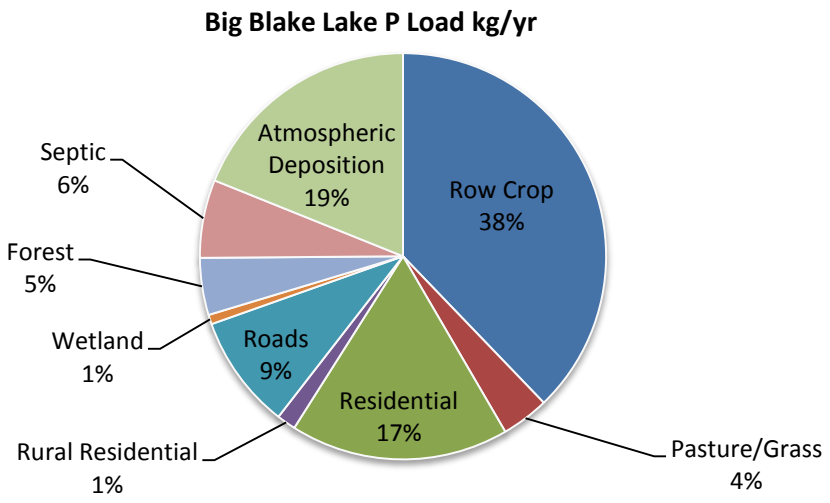
	Total Acres	Percent Acres (%)	Total Loading (lb P/yr)	Loading %
Row crop	390.5	17%	348	52%
Pasture/grass	159.2	7%	42	6%
Medium density residential	240	10%	108	16%
Rural residential	9.7	0%	0	0.1%
Wetlands	347.8	15%	31	5%
Forest	1003.6	43%	82	12%
Lake surface	208	9%	55	8%

Watershed and Lake Modeling

The Wisconsin Lake Modeling Suite (WiLMS) was used to model current conditions for Big Blake Lake, verify monitoring, and estimate land use nutrient loading for the watershed. Phosphorus is the key parameter in the modeling scenarios used in WiLMS because it is the limiting nutrient for algal growth in most lakes.

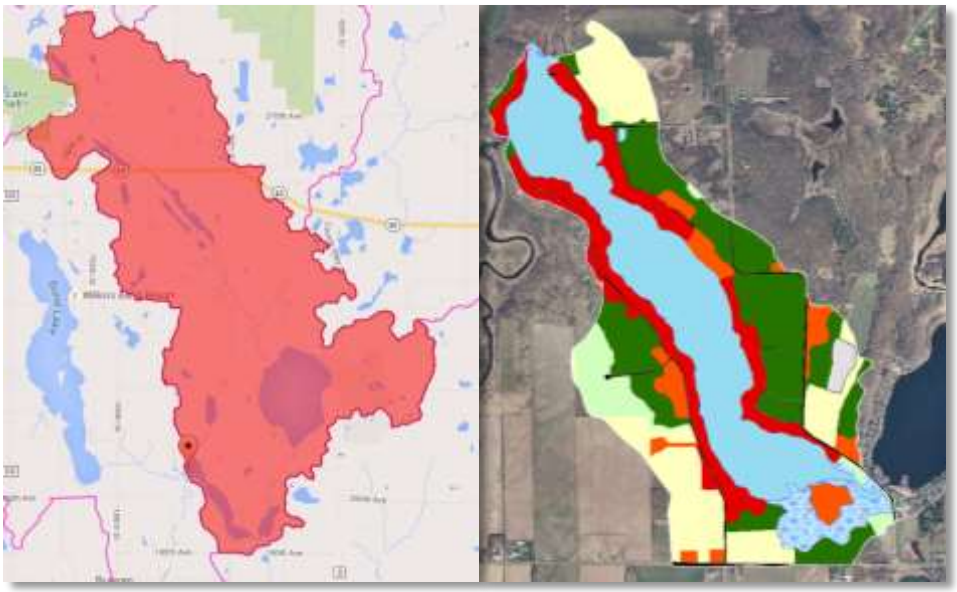
Based on average evaporation, precipitation, and runoff coefficients for Polk County soils and land use, WiLMS determined the annual nonpoint source load of phosphorus to Big Blake Lake as 7,432 kilograms per year (16,380 pounds), the direct drainage to the lake minus the tributaries was calculated to be 132 kilograms per year (291 pounds).

Big Blake Lake Nutrient Budget	
Source	**Phosphorus load (kg/yr)**
Row Crop	50
Pasture/Grass	5
Residential	23
Rural Residential	2
Roads	12
Wetland	1
Forest	6
Septic	8.22
Atmospheric Deposition	25
Lost Creek	1218.5
Straight River	6081.2



The land use for the entire watershed was obtained from Purdue University Agricultural Biological Engineering Department's Long Term Hydrologic Impact Analysis (L-THIA). ArcGIS was then used to clip the subwatersheds of the basin and the direct drainage to the lake was modeled using in-situ

phosphorus loading from the tributaries modeled as a point sources and the direct drainage land use. Because the outlet of the lake was breeched in 2014, scenarios were modeled for the three years of the study with several different scenarios.



L-THIA watershed vs. the direct drainage to Big Blake Lake

The internal load for Big Blake Lake was estimated using in-situ data and four methods were used to estimate internal loading.

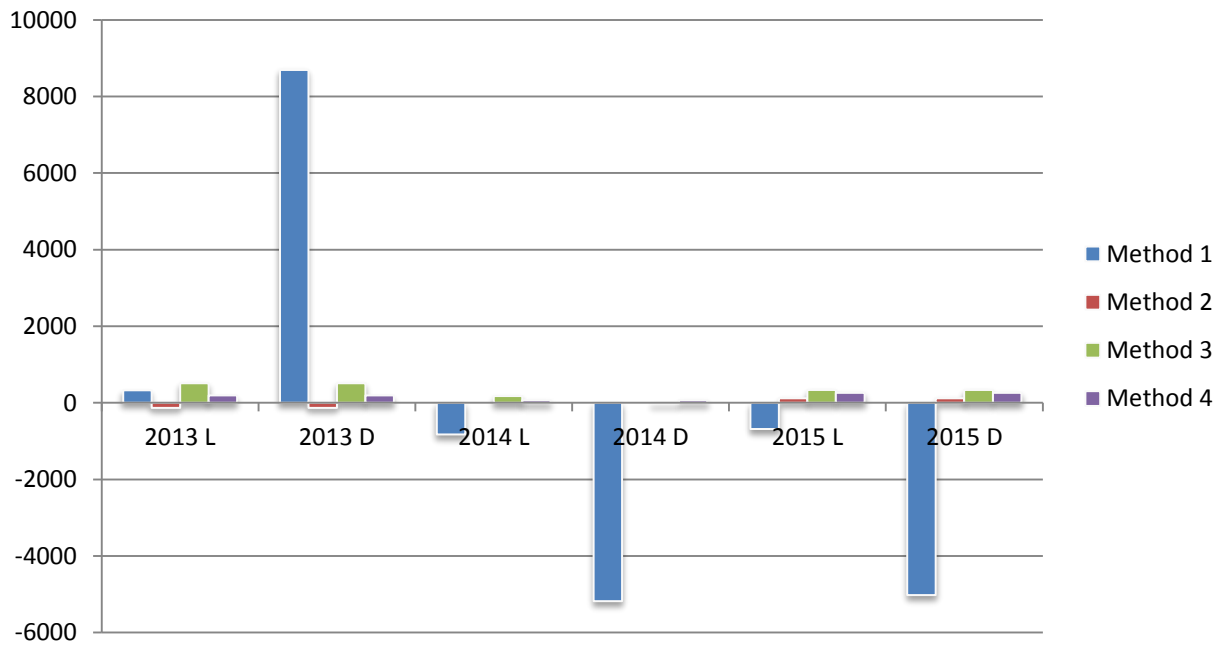
The first method was a complete total phosphorus mass budget. This method calculated the annual internal phosphorus load under the L-THIA scenario to be 149 kg (327 lbs.) in 2013, -375 kg (-827 lbs) in 2014, and -311 kg (-686 lbs.) in 2015. The annual internal phosphorus load under the direct drainage scenario was estimated to be 3,943 kg (8,649 lbs.) in 2013, -2,350 kg (-5,181 lbs.) in 2014, and -2,275 kg (-5,016 lbs.) in 2015.

In the second method the internal load was estimated from growing season *in situ* phosphorus increases. This method estimated a sediment release rate of -2.8 mg/m^2-day in 2013, 0.00 mg/m^2-day in 2014, and 1.9 mg/m^2-day in 2015. The internal load was calculated annually in both the L-THIA and direct drainage scenarios to be -57 kg (-127 lbs.) in 2013, 0 kg (0 lbs) in 2014, and 53 kg (117 lbs.) in 2015.

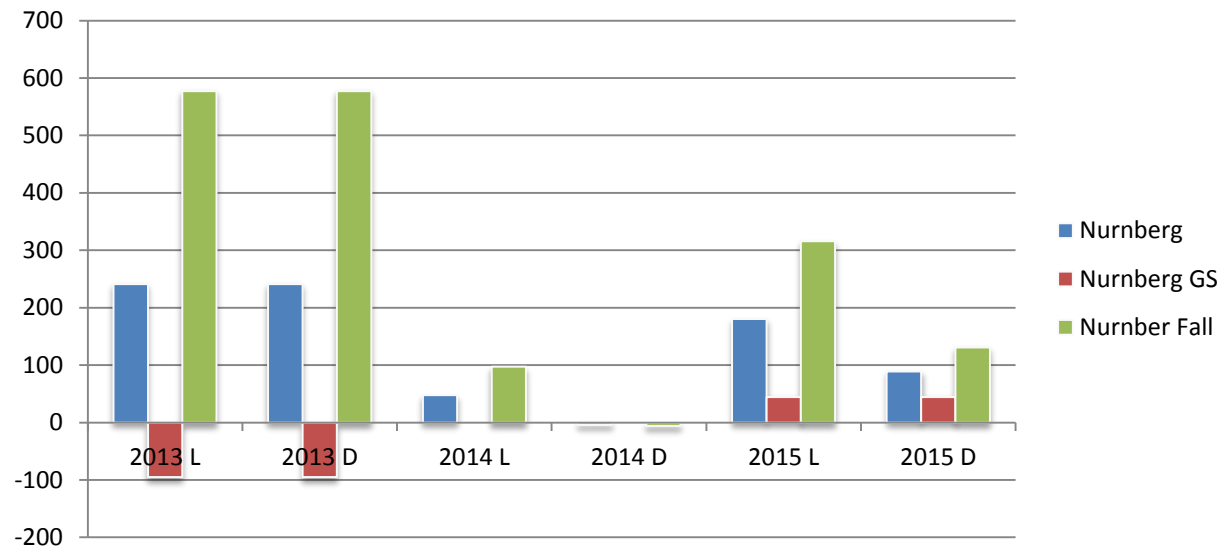
The third method estimated the internal load from in situ phosphorus increases in the fall. The annual load was calculated to be 233 kg (513 lbs.) with a sediment release rate of 17 mg/m^2-day in both the 2013 L-THIA and direct drainage scenarios. In 2014 the L-THIA scenario estimated the sediment phosphorus release rate to be 4.9 mg/m^2-day with an annual internal load of 82 kg (180 lbs.) annually. In the 2014 direct drainage scenario the sediment release rate was calculated to be -0.3 mg/m^2-day with an annual loading rate of -5 kg (-11 lbs.). The 2015 L-THIA model calculated a sediment phosphorus release rate of 13.5 mg/m^2-day with an annual load of 153 kg (337 lbs.), while the 2015 direct drainage

model predicted an annual internal load of 64 kg (140 lbs.) with a sediment release rate of 5.6 mg/m^2-day.

The fourth method used the average of the calculated phosphorus release rates (7.1 mg/m^2-day) and anoxic sediment area. This calculated the internal load to be 87 kg (193 lbs.) of phosphorus annually in both 2013 scenarios. The release rate for the 2014 L-THIA model was calculated to be 2.4 mg/m^2-day with a loading rate of 33 kg (73 lbs.) annually. In the 2014 direct drainage scenario the sediment release rate was calculated to be -0.2 mg/m^2-day, however, the model predicted the annual loading rate to be the same. The release rate for the 2015 L-THIA model was calculated to be 7.7 mg/m^2-day with a loading rate of 119 kg (263 lbs.) annually. In the 2015 direct drainage scenario the sediment release rate was calculated to be 3.8 mg/m^2-day and also predicted the annual loading rate to be the same. This is unlikely an invalid method for Big Blake Lake.



The 1984 Nurnberg model is commonly used to estimate the effects of the internal load for a lake. The Nurnberg total phosphorus model is ($P = \frac{L_{Ext}}{q_s}(1 - R) + \frac{L_{Int}}{q_s}$ where $R = \frac{15}{18+q_s}$) where P is the predicted mixed lake total phosphorus concentration, L is the areal total phosphorus load (mg/m^2-yr.), R is the fraction of inflow total phosphorus retained in the lake, and q_s is the areal water loading or surface overflow rate. The model predicts the internal load to be between 577 kg to -95 kg (or burying phosphorus in the sediment), these numbers were derived by using annual, growing season, and fall increases in water column phosphorus concentrations.



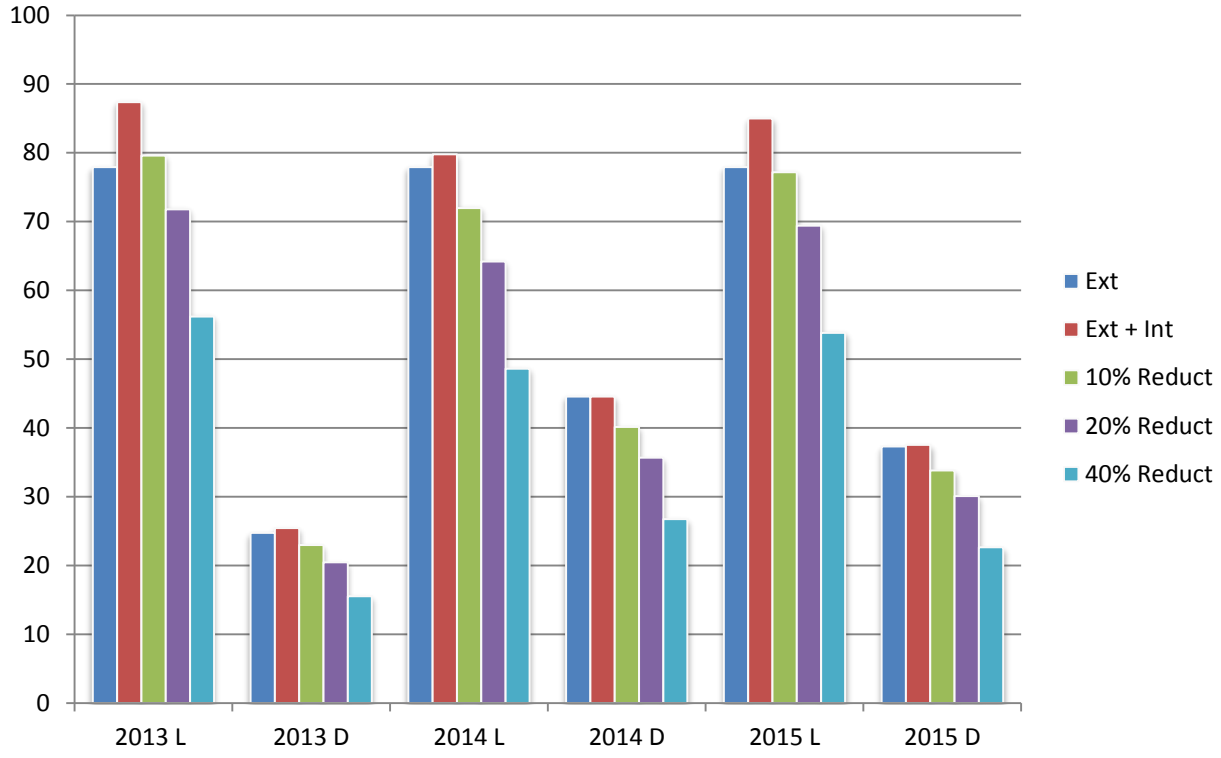
The Osgood Index of mixing $I = z/\sqrt{km^2}$ (where z is mean depth) is a measure of the lake volume in relation to wind fetch. The chance for mixing hypolimnetic (bottom water) with epilimnetic (surface water) increases as the ratio of volume to fetch decreases. Lakes with an Osgood Index of less than 6-7 usually have a summer surface water total phosphorus that exceeds the concentration predicted from external loading. Big Blake Lake has an Osgood Index of 3.

The likely scenario is that the internal loading varies both seasonally and annually depending on growth of curly-leaf pondweed (*Potamogeton crispus)* and residence time of the water. Because the outlet was breached and the lake stratified at different depths and different times the internal loading calculations proved to be problematic. However, taking all calculations and scenarios into account, the internal load on Big Blake Lake likely is between 40-120 kg on an annual basis.

The data derived from the different loading scenarios can be used to predict the average concentration of phosphorus in the lake's water column.

The model that fit every scenario was the 1977 Reckhow model $P = \frac{L}{0.17z+1.13z/T_w}$ where P is the predicted mixed lake total phosphorus concentration, L is the areal total phosphorus load (mg/m^2-yr.), T_w is the lakes hydraulic retention time, and *z* is the lakes mean depth. The model fit best in the 2014 direct drainage scenario, likely because the hydraulic retention time was greatly reduced and there was less mixing. The model was used to run several scenarios across all three of the lake study years using the nonpoint and point source loading to the lake and 10, 20, and 40 % reductions in total phosphorus inputs to the water column.

	2013 L	2013 D	2014 L	2014 D	2015 L	2015 D
External	77.91	24.76	77.91	44.57	77.91	37.3
External + Internal	87.37	25.43	79.78	44.57	84.98	37.55
10% Reduction	79.58	22.96	71.98	40.12	77.19	33.82
20% Reduction	71.79	20.48	64.19	35.66	69.4	30.09
40% Reduction	56.21	15.53	48.61	26.74	53.81	22.63



Because the water chemistry and hydraulic loading and retention time were so different from 2013-2015 combined models were put together and run for both the direct drainage scenario and the L-THIA scenario. It was determined that the combined L-THIA model would be used to address nutrient reductions and management scenarios as the hydraulic loading was normalized.

In the combined L-THIA scenario the 1979 Reckhow general lake model fit best. The general lake model is $P = \frac{1000L}{11.6+1.2q_s}$ where L is the areal loading in mg/m^2-yr. and q_s is the annual areal water loading or surface overflow rate.

The internal load using this scenario was determined to be 68.9 kg (151.8 lbs). When this value was input into the model and phosphorus values were back calculated there was a 2% difference between the predicted versus the observed phosphorus values (57 µg/l vs. 56 µg/l). This can be used to determine appropriate nutrient reduction scenarios.

When there is a 15% nonpoint source phosphorus reduction the water column total phosphorus is predicted to be reduced to 48 µg/l. When a 20% nonpoint source reduction is achieved, the model predicts the water column total phosphorus concentration to be 45 µg/l. Finally with a 30% reduction the predicted water column concentration is 40 µg/l. Phosphorus values under 45 would reduce both chlorophyll *a* and the presence of cyanobacteria blooms based on in-situ data collected and paleolimnological analysis.

Calculations from the 2003 Long Lake Barr Engineering report were used to calculate reductions in the internal phosphorus load from curly-leaf pondweed senescence in Big Blake Lake. This report estimated that the internal load attributed to curly leaf pondweed senescence is 3.73 pounds of phosphorus per acre of curly leaf pondweed.

Using this value it was determined that pre harvesting internal load attributed to curly leaf pondweed senescence was 744.81 pounds of phosphorus. Using 2015 curly leaf pondweed acreage, the post harvesting internal load attributed to curly leaf pondweed senescence was estimated at 462 pounds of phosphorus. This would indicate a reduction of nearly 300 pounds of phosphorus as a result of harvesting.

Calculations from the 2010 Bone Lake Ecological Integrity Service, LLC report were also used to calculate reductions in the internal phosphorus load from curly-leaf pondweed senescence in Big Blake Lake.

This report estimated that 21.3% of the phosphorus in curly-leaf pondweed is released into the water column at senescence. Using these calculations it was determined that 158.64 pounds of phosphorus were released into the water column under pre harvesting conditions in Big Blake Lake. Using 2015 post harvesting curly leaf pondweed acreage, it was determined that 98.52 pounds of phosphorus were released into the water column. This would indicate a reduction of approximately 60 pounds of phosphorus due to harvesting.

Paleolimnoligical Study of Big Blake Lake

A pair of sediment cores were recovered from the north basin of Big Blake Lake on September 12th, 2013. The full report "A Paleolimnoligical Study of Big Blake Lake, Polk County, Wisconsin" can be found in Appendix J. The executive summary follows.

Paired sediment cores were recovered from the northern basin of Big Blake Lake, Polk County, Wisconsin, in September 2013 and analyzed to reconstruct a historical record of sedimentation, ecological change, and water quality from the early 1800s to present. Management concerns for Big Blake Lake are centered on the prevalence of *Potamogeton crispus*, cyanobacterial blooms, elevated nutrient levels, response to and prevention of aquatic invasive species, and sustaining high quality recreational and fishing opportunities in the lake.

Sediment cores were subjected to multiple analyses including radioisotopic dating with Pb-210 to establish a date-depth relationship and sedimentation rates for the core site, loss-on-ignition to determine major sediment constituents, biogenic silica to estimate historical diatom productivity, diatom communities to identify ecological changes and estimate historical water column phosphorus, extraction and determination of sediment phosphorus fractions to determine past nutrient loading and threat of internal loading, and analysis of macrofossils including chironomid head capsules, zooplankton fossils, aquatic macrophyte remains to identify ecological shifts that have occurred in Big Blake Lake.

Sedimentation rates in the lake increased following Euroamerican settlement, and current sedimentation rates are approximately five times greater than pre-settlement levels.

Loss-on-ignition analysis showed that inorganics are the predominant fraction of Big Blake Lake sediments followed by organic components and then carbonates. Inorganic components show increased accumulation after 1900, likely reflecting changes in sediment loading following logging, land clearance, and development of the shoreline, while organic constituents decreased.

Biogenic silica concentrations in the cores, a marker of diatom algae abundance, are high compared to most lakes in the Midwest and represent 8-14% of the dry weight of Big Blake Lake sediment. Accumulation rates of biogenic silica show diatom growth has increased in the last two decades.

The concentration and accumulation rates of phosphorus fractions in the Big Blake Lake sediment core show general increases toward the top of the core. Mobile (labile) forms of phosphorus including exchangeable and NaOH-extractable forms of phosphorus are most abundant in the top few cm of sediment. This provides a readily available source of phosphorus during period of internal loading. Internal loading appears to be more significant in recent decades when bottom water go anoxic during *Potamogeton crispus* senescence and periodic breakdowns of stratification throughout the summer months which can initiate cyanobacteria blooms.

The diatom communities preserved in Big Blake Lake's sediment are dominated by six species. A significant diatom community shift occurs in the 1920-30s, a time when cottage and resort communities were expanding and agricultural practices were likely shifting in the region. This time period shows a decrease in the planktonic mesotrophic indicator *Aulacoseira ambigua* and benthic diatoms *Staurosira*

construens and *S. venter* coincident with an increase in the dominance of the eutrophic species *Aulacoseira granulata*.

Estimates of historical total phosphorus were generated using a diatom-total phosphorus model based on species environmental relationships in 89 Minnesota lakes. The model suggests that Big Blake Lake has shifted from a mesotrophic lake to a eutrophic system. Diatom-inferred total phosphorus estimates increase following European settlement, increase further in the 1940s to peak levels in the 1960s through present day. Modeled total phosphorus estimates for the last ten years (49-52 µg/l) are similar to monitored values taken during the growing season (40-80 µg/l total phosphorus) when cyanobacterial blooms can occur. Diatom reconstructed total phosphorus values are almost identical to the mean annual total phosphorus levels based on a comprehensive monitoring program from 2013-2015 (49.9 µg/l), and predictions modeled using the Wisconsin Lakes Modeling Suite (43-50 µg/l).

Pigment analysis of different algae groups showed that algae, including cyanobacteria, have increased in recent decades. Evidence suggests that nitrogen-fixing, and possibly toxic, forms of cyanobacteria (via aphanizophyll), have increased dramatically over the last three decades.

Analysis of zooplankton remains shows a general decrease in cladocerans since the 1960s and 1970s. There is a sharp reduction in both *Eurycercus sp*. and *Alona sp*. since the 1960s. These species are often associated with aquatic plants in the littoral zones of ponds and lakes in North America and Europe and their decline corresponds to decline of the native aquatic plant community in Big Blake Lake since the 1960s.

Chironomid head capsules shows sharp decrease in littoral species after the 1950s similar to changes in zooplankton composition, again reflecting changes in ecosystem quality associated with the loss of the native aquatic plant community.

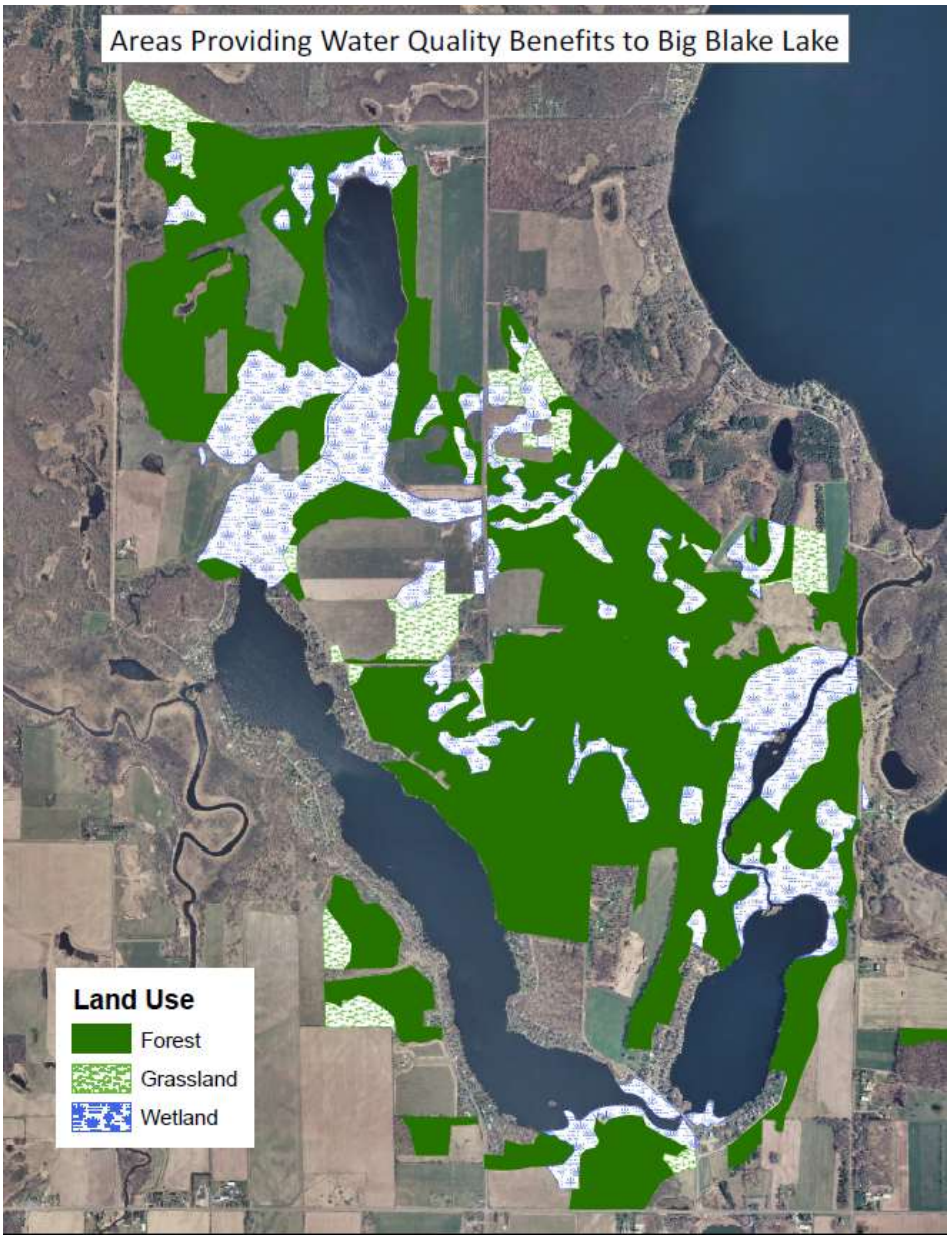
Aquatic macrophyte fossils show a loss in both species richness and total number of indigenous species since the 1960s. Fossils of the aquatic invasive species *Potamogeton crispus* appear in the 1980s.

Paleolimnology-based management recommendations and additional analysis are provided in the Big Blake Lake comprehensive Lake Management Plan.

Areas Providing Water Quality Benefits to Big Blake Lake

Natural areas such as forests, grasslands, and wetlands allow for more infiltration of precipitation when compared with row cropped fields and developed residential sites containing lawns, rooftops, sidewalks, and driveways. This occurs because dense vegetation lessens the impact of raindrops on the soil surface, thereby reducing erosion and allowing for greater infiltration of water. Additionally, wetlands provide extensive benefits through their ability to filter nutrients and allow sediments to settle out before reaching lakes and rivers.

Forests make up the largest land use in the Big Blake Lake watershed (47%) and wetlands make up the third largest land use (16%). Grasslands make up only 4% of the land use in the Big Blake Lake watershed. These areas should be considered sensitive areas and preserved for the benefits they provide to the lake.



Information and Education[28]

The Big Blake Lake Protection and Rehabilitation District is actively providing information and education opportunities to their membership. The District communicates with their membership during their spring and fall meetings, through their newsletter and mailings, and through direct contact with their volunteers. Additionally, Polk County Land and Water Resources Department staff attended the District Spring and Fall meetings in 2013, 2014, and 2015 and communicated grant updates to attendees.

2013 Information and Education Summary

A total of 42 volunteers signed up to assist with the Big Blake Lake Clean Boats, Clean Waters program in 2013. New supplies were ordered for volunteers and current literature, forms, shirts, and supplies were refreshed and distributed. Weekly contact was made with each volunteer through email or phone in June and July. Volunteers spent 379 hours at the north access and inspected 45 boats and contacted 93 people. Volunteers spent 38 hours at the west access and inspected 11 boats and contacted 17 people.

A volunteer cookout was organized to coordinate with the July 4th Landing Blitz. Sixteen volunteers attended. Photo opportunities for a press release were organized in June to promote the Landing Blitz. A press release for the Landing Blitz was distributed to 5 media outlets. The press release and photo were published in the Polk County Leader and a county-wide release which mentioned Big Blake Lake was published in the Amery Free Press.

All 212 members of the District received two direct mailings which included AIS information. The Blake Lake Bugle Newsletter contained one page of information on Clean Boats, Clean Waters and AIS. Another mailing included: the Wisconsin Boating Regulations pamphlet and the Clean Boats, Clean Waters flyer. Additionally, AIS flyers and brochures were distributed at area bait shops and places where bait is sold.

[28] Information and photos provided by Peggy Lauritsen, Clean Boats, Clean Waters Volunteer Coordinator

2014 Information and Education Summary

A total of 52 volunteers signed up to assist with the Big Blake Lake Clean Boats, Clean Waters program in 2014, which was a 20% increase from the previous year. New supplies were ordered for volunteers and current literature, forms, shirts, and supplies were refreshed and distributed. Contact was made with each volunteer through email or phone in June and July. Volunteers spent 202 hours at the north access and inspected 38 boats and contacted 75 people over the course of the boating season. Volunteers spent 205 hours at the west access and inspected 42 boats and contacted 70 people over the course of the boating season.

At the May 17th Spring District Meeting, a Clean Boats, Clean Waters display was set up and a flyer was circulated to all attendees. The Drain Campaign was also announced to attendees. Approximately 150 people attended the meeting.

For the first time, the District participated in the statewide Drain Campaign which took place on June 14th and 15th. On June 14th, Katelin Holm with the Polk County Land and Water Resources Department provided a special AIS training session for members of the Big Blake Lake District. Ten people attended this supplementary training.

The District participated in the 2014 statewide Landing Blitz over the 4th of July weekend. A press release for the Landing Blitz was distributed to 3 media outlets and was published in The Leader. A county-wide press release which mentioned Big Blake Lake was also published in area newspapers.

Similar to 2013, the Big Blake Lake Bugle Newsletter contained one page of information on Clean Boats, Clean Waters and AIS.

Three volunteers of the Big Blake Lake Protection and Rehabilitation District attended a county-wide Aquatic Invasive Species Citizen Lake Monitoring Network Training on June 11th, 2014. The training included a hands-on session to view specimens of AIS with a focus on native as well and invasive plants.

Additionally, AIS flyers and brochures were distributed at area bait shops and places where bait is sold.

2015 Information and Education Summary

A total of 40 volunteers signed up to assist with the Big Blake Lake Clean Boats, Clean Waters program in 2015. New supplies were ordered for volunteers and current literature, forms, shirts, and supplies were refreshed and distributed. Weekly contact was made with each volunteer through email or phone in June and July. Clean Boats, Clean Waters volunteers spent 276 hours at the north access and inspected 24 boats and contacted 35 people over the course of the boating season. Volunteers spent 132 hours at the west access and inspected 8 boats and contacted 13 people over the course of the boating season.

At the Spring and Fall District Meetings, a Clean Boats, Clean Waters display was set up and a packet of AIS information, including the Big Blake Lake waterproof AIS flyer was circulated to all attendees. The latest information from state and county sources was also provided.

A total of seventeen volunteers attended trainings on Saturday, June 6th and Saturday, June 13th as part of the WDNR Drain Campaign. Polk County Land and Water Resources Department staff attended the June 13th training and provided supplemental AIS information. As in years past, the District also participated in the statewide Landing Blitz and authored a press release which was published in the Inter-County Leader.

Additionally, AIS flyers and brochures were distributed at area bait shops and places where bait is sold.

On Thursday, July 2nd a pontoon classroom was held by the Polk County Land and Water Resources Department for members of the Big Blake Lake Protection and Rehabilitation District. The classroom was attended by eight members of the District. During the pontoon classroom participants had the opportunity to collect physical and chemical data, zooplankton samples, algae samples, sediment samples, and plant samples. Data were explained and participants saw zooplankton and examined aquatic plants (native and invasive). Preserved specimens of common aquatic invasive species were also shown to attendees. A brief overview of all the projects included in the grant was also provided. Topics of conversation included aquatic plants, wild rice, and lake sediments.

Summary of Rules and Legislation

Comprehensive Land Use Planning

The Polk County Comprehensive Land Use Plan was adopted in 2009. The plan includes an analysis of population, economy, housing, transportation, recreation, and land use trends. It also reports the physical features of Polk County. The purpose of the land use plan is to provide general guidance to achieve the desired future development of the county and direction for development decisions. The lakes classification outlines restriction on development according to lake features.

Plan information is available online at http://www.co.polk.wi.us <Departments < Land Information < Comprehensive Plan

Town, City and Village Comprehensive Plans are available at:
http://www.co.polk.wi.us < Departments < Land Information < Comprehensive Plan < City, Village, and Town Comprehensive Plans

Smart growth is a state mandated planning requirement to guide land use decisions and facilitate communication between municipalities. Wisconsin's Comprehensive Planning Law (Statute 66.1001, Wis. Stats.) was passed as part of the 1999 Budget Act. The law requires that if a local government engages in zoning, subdivision regulations, or official mapping, those local land use regulations must be consistent with that unit of local government's comprehensive plan beginning on January 1, 2010. The law defines a comprehensive plan as having at least the following nine elements:

- ✓ Issues and opportunities
- ✓ Housing
- ✓ Transportation
- ✓ Utilities and community facilities
- ✓ Agricultural, natural, and cultural resources
- ✓ Economic development
- ✓ Intergovernmental cooperation
- ✓ Land use
- ✓ Implementation
- ✓ Polk County added "Energy and Sustainability"

Polk County Comprehensive Land Use Ordinance

Polk County's oldest portions of the current zoning code are over 40 years old. Over the years, there have been numerous revisions to the original code. However, the current zoning code is in need of a comprehensive rewrite in order to address current and future issues in Polk County and to implement the vision set forth in the County's adopted comprehensive plan. Recognizing this, the County began a rewrite process in March 2010. A Zoning Citizen Advisory Committee (CAC) met to review the existing ordinances and make suggestions on how to appropriately rewrite them for the past 3+ years.

The State of Wisconsin's Administrative Rule NR115 dictates that counties must regulate lands within 1,000 feet of a lake, pond or flowage and 300 feet of a river or stream. The Shoreland Protection Zoning

Ordinance is also currently being rewritten as a part of the Comprehensive Land Use Ordinance due to the Comprehensive Plan and the State of Wisconsin passing a new version of NR 115 in 2010.

After reviewing the input of the advisory committees, public hearings and other changes, the Conservation, Development, Recreation and Education (CDRE) Committee, at their September 2, 2015 meeting, recommended that the ordinance be moved on to the County Board's agenda for consideration of passage at the September 15, 2015 meeting. At the September 15th, 2015 Polk County Board of Supervisors Meeting, the ordinance below was adopted.

Now that the ordinance has been passed, each Town within Polk County will have one calendar year to decide if they want to adopt county zoning or not. Each town participating in county zoning will be responsible for developing the zoning map for their town. Staff from the Land Information Department will be assisting the towns in this process over the next year.

The current Comprehensive Zoning Ordinance is available at:
http://www.co.polk.wi.us < Departments < Land Information < Ordinances (Zoning)

Subdivision Ordinance

The subdivision ordinance, adopted in 1996 and updated in 2005, requires a recorded certified survey map for any parcel less than 19 acres. The ordinance requires most new plats to incorporate storm water management practices with no net increase in runoff from development.

The ordinance is available online at:
http://www.co.polk.wi.us < Departments < Land Information < Ordinances (Zoning)

Animal Waste

The Polk County Manure and Water Quality Management Ordinance was revised in January 2000. A policy manual established minimum standards and specifications for animal waste storage facilities, feedlots, degraded pastures, and active livestock operations greater than 300 animal units for livestock producers regulated by the ordinances. The Land and Water Resource Department's objective was to have countywide compliance with the ordinance by 2006.

The ordinance is available online at:
http://www.co.polk.wi.us < Departments < Land & Water Resources < Ordinances.

Storm Water and Erosion Control

This ordinance, passed in December 2005, establishes planning and permitting requirements for erosion control on disturbed sites greater than 3,000 square feet, where more than 400 cubic yards of material is cut or filled, or where channels are used for 300 feet more of utility installation (with some exceptions). Storm water plans and implementation of best management practices are required for subdivisions, survey plats, and roads where more than ½ acre of impervious surface will result. The Polk County Land and Water Resources Department administers the ordinance. The ordinance is a local

mechanism to implement the Wisconsin Non-agricultural Runoff Performance Standards found in NR 151.

The ordinance is available online at:
http://www.co.polk.wi.us < Departments < Land & Water Resources < Ordinances.

WI Non-Agricultural Performance Standards (NR 151)

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

Storm water management plans (>1 acre)
- Total suspended solids
- Peak discharge rate
- Infiltration
- Buffers around water

Developed urban areas (>1000 persons/square mile)
- Public education
- Yard waste management
- Nutrient management
- Reduction of suspended solids

Polk County Land and Water Resources Management Plan

The Polk County Land and Water Resources Management Plan describes the strategy the Land and Water Resources Department (LWRD) will employ from 2010-2018 to address agriculture and non-agriculture runoff management, stormwater discharge, shoreline management, soil conservation, invasive species and other environmental degradation that affects the natural resources of Polk County. The plan specifies how LWRD will implement NR 151 (Runoff Management). It involves identifying critical sites, offering cost-share and other programs, identifying BMP's monitoring and evaluating projects for compliance, conducting enforcement activities, tracking progress, and providing information and education.

Polk County has local shoreland protection, zoning, subdivision, animal waste, and non-metallic mining ordinances. Enforcing these rules and assisting other agencies with programs are part of LWRD's ongoing activities. Other activities to implement the NR 151 Standards include information and education strategies, write nutrient management plans, provide technical assistance to landowners and lakeshore owners, perform lake studies, collaborate with other agencies, work on a rivers classification system, set up demonstration sites of proper BMP's, control invasive species, and revise ordinances to offer better protection of resources.

WI Agricultural Performance Standards (NR 151)

For farmers who grow agricultural crops

- ✓ Meet "T" on cropped fields
- ✓ Starting in 2005 for high priority areas such as impaired or exceptional waters, and 2008 for all other areas, follow a nutrient management plan designed to limit entry of nutrients into waters of the state

For farmers who raise, feed, or house livestock

- ✓ No direct runoff from feedlots or stored manure into state waters
- ✓ No unlimited livestock access to waters of the state where high concentrations of animals prevent the maintenance of adequate or self-sustaining sod cover
- ✓ Starting in 2005 for high priority areas, and 2008 for all other areas, follow a nutrient management plan when applying or contracting to apply manure to limit entry of nutrients into waters of the state

For farmers who have or plan to build a manure storage structure

- ✓ Maintain a structure to prevent overflow, leakage, and structural failure
- ✓ Repair or upgrade a failing or leaking structure that poses an imminent health threat or violates groundwater standards
- ✓ Close a structure according to accepted standards
- ✓ Meet technical standards for a newly constructed or substantially-altered structure

For farmers with land in a water quality management area (defined as 300 feet from a stream, or 1,000 feet from a lake or areas susceptible to groundwater contamination)

- ✓ Do not stack manure in unconfined piles
- ✓ Divert clean water away from feedlots, manure storage areas, and barnyards located within this area

Boating Regulations

The Department of Natural Resources regulates boating in the state of Wisconsin.[29] Wisconsin conservation wardens enforce boating regulations. A few highlights of boating regulations are:

- ✓ Personal watercrafts (PWCs) may not operate from sunset to sunrise.
- ✓ PWC operators must be at least 12 years old.
- ✓ There are 100-foot restrictions between boats or PWCs and water skiers, towropes, and boats towing skiers.
- ✓ It is unlawful to operate within 100 feet of shore or of any dock, raft, pier, or buoyed restricted area at a speed in excess of "slow-no-wake."
- ✓ Speed must be reasonable and prudent under existing conditions to avoid colliding with any object or person.

A town or village <u>may</u> delegate the authority to adopt lake use regulations to a lake district. These may include regulation of boating equipment, use, or operation; aircraft; and travel on ice-bound lakes.[30] Local ordinances may now extend the slow-no-wake zone to within 200 feet of shore with passage of WI Act 31.

Dredging Regulations (Sec 30.20 Wis. Stats.) [31]

A general permit or an individual permit is required to dredge material from the bed of a navigable waterway. Local zoning permits and U.S. Army Corps of Engineers permits may also be required.

Wisconsin Transport Laws for Boaters and Anglers

In 2001, the Wisconsin Legislature directed the Department of Natural Resources to establish a statewide program to control invasive species and to promulgate rules to identify, classify, and control invasive species for purposes of the program. By 2004, the Wisconsin Council on Invasive Species formed to assist WDNR with this task.

As a result, on September 1, 2009 the WDNR created Wisconsin's Invasive Species Identification, Classification, and Control Rule, Chapter NR 40, Wisconsin Administrative Code. The rule helps citizens learn to identify and minimize the spread of plants, animals and diseases that can invade our lands and waters and cause significant damage.

The invasive species rule creates a comprehensive, science-based system with criteria to classify invasive species into two categories: prohibited and restricted. With certain exceptions, the transport, possession, transfer, and introduction of prohibited species is banned. Restricted species are also subject to a ban on transport, transfer, and introduction, although possession is allowed, with the exception of fish and crayfish.

Wisconsin has various laws in place to prevent the introduction and control the spread of AIS and diseases in Wisconsin.

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[29] Boating regulations may be found online at www.dnr.wi.us/org/es/enforcement/docs/boating regs.pdf.
[30] Chapter 33. Wisconsin State Statutes.
[31] Information from http://dnr.wi.gov.org/water/fhp/waterway/dredging.

Wisconsin Transport Laws for Boaters and Anglers

- ✓ INSPECT your boat, trailer and equipment.
- ✓ REMOVE any attached aquatic plants or animals (before launching, after loading and before transporting on a public highway).
- ✓ DRAIN all water from boats, motors, and all equipment.
- ✓ NEVER MOVE live fish away from a waterbody.
- ✓ DISPOSE of unwanted bait in the trash.
- ✓ BUY minnows from a Wisconsin bait dealer. You may take leftover minnows away from any state water and use them again on that same water. You may use leftover minnows on other waters only if no lake or river water, or other fish were added to their container.

Amended Illegal Transport of Aquatic Plants and Invasive Animals

In 2008, the Polk County Illegal Transport of Aquatic Plants and Invasive Animals Ordinance was adopted, making it illegal to operate or transport equipment with aquatic plants or invasive animals attached. Public input into the decision making process was sought through public meetings which were advertised in local papers. The Ordinance was amended in 2011 to include language regarding liability of a vehicle, watercraft, trailer, or equipment of the owner or lessor.

The ordinance is available online at:
http://www.co.polk.wi.us < Departments < Land & Water Resources < Ordinances.

Aquatic Plant Laws and Rules

[32] [33]

Nearly all aquatic plant management options require a permit from the Wisconsin Department of Natural Resources. Permits are needed to protect diverse communities of native aquatic plants and limit the spread of aquatic invasive plants. The two primary permit programs regulating aquatic plant management in Wisconsin include cutting and harvesting [34] and chemical treatment. [35]

Permits for aquatic plant management are needed when:

- ✓ Chemicals are used
- ✓ Biological controls are used[36]
- ✓ Physical techniques such as drawdowns or bottom plant barriers are used
- ✓ Wild rice is involved
- ✓ Plants are removed mechanically
- ✓ Plants are removed manually from an area greater than 30 feet in width along the shoreline

There are two circumstances when aquatic plant management activities are exempt from permit requirements. The first is when individuals manually remove vegetation from an area no wider than 30 feet directly out from a use area (dock or swim area). Manual removal requires a person's muscle power to remove plants and could include tools such as rakes or hand cutting tools. The second circumstance allows for manual removal of aquatic invasive plants as long as native species are not damaged or eliminated. In both circumstances, any plants cut or raked must be removed from the lake and shoreline.

[32] http://dnr.wi.gov/lakes/plants/

[33] Aquatic Plant Management in Wisconsin http://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/ecology/Aquatic%20Plants/APMguideFull2010.pdf

[34] Administrative Code Chapter NR 109, Aquatic Plants: Introduction, Manual Removal, and Mechanical Control Regulations

[35] Administrative Code Chapter NR 107, Aquatic Plant Management

[36] The use of grass carp and rusty crayfish is prohibited as a biocontrol

Management Options for Aquatic Plants

A number of management options exist for aquatic plants. These options are summarized in a Wisconsin Department of Natural Resources handout which includes the option, if a permit is needed, how the options works, and the pros and cons of each option. The handout can be found in Appendix L or online. [37]

Options summarized include:

- ✓ No management
- ✓ Mechanical control
  - Handpulling/manual raking
  - Harvesting
- ✓ Biological control
  - Weevils on EWM
  - Pathogens
  - Allelopathy
  - Native plantings
- ✓ Physical control
  - Fabrics/bottom barriers
  - Drawdown
  - Dredging
  - Dyes
  - Non-point source nutrient control
- ✓ Chemical control
  - 2,4-D
  - Endothall
  - Diquat
  - Fluridone
  - Glyphosate
  - Triclopyr
  - Copper compounds

[37] http://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/ecology/Aquatic%20Plants/Appendix-E.pdf

Lake Management Plan

Lake management plans help protect natural resource systems by encouraging partnerships between concerned citizens, lakeshore residents, watershed residents, agency staff, and diverse organizations. Lake management plans identify concerns of importance and set realistic goals, objectives, and action items to address each concern. Additionally, lake management plans identify roles and responsibilities for meeting each goal and provide a timeline for implementation.

Lake management plans are living documents which are under constant review and adjustment depending on the condition of a lake, available funding, level of volunteer commitments, and the needs of lake stakeholders.

The vision statement, guiding principles, and lake management plan goals presented below were created through collaborative efforts using current and past water quality data, a 2014 sociological survey regarding the needs of Big Blake Lake residents, and a series of four meetings by the Big Blake Lake Management Plan Committee. Key findings of the study and draft goals were presented at the 2013, 2014, and 2015 District Spring and Annual Meetings.

The draft plan was posted on the Big Blake Lake and Polk County Land and Water Resources websites and opened for a 30 day public comment period ending on November 21st, 2016. A notice of public comment was published in the Polk County Leader on October 19th and 26th, 2016. No public comments were received. The plan was approved by the Big Blake Lake Protection and Rehabilitation Board on *** and by the Wisconsin Department of Natural Resources on ***.

One objective of the plan is to form teams to ensure that the goals of the plan are met. The first task given to each team will be to complete the lake management plan chart for each goal.

Vision: ***an overall statement for what you want Big Blake Lake to look like***

> Big Blake Lake is a sustainable, healthy environment for people, recreation, wildlife, and native plants. Engaged and informed stakeholders protect the lake and its watershed.

Guiding Principles: ***provide guidance on how the lake management plan will be implemented***

> Lake management decisions are data driven and evidence-based to incorporate an analysis of past, present, and future data and are implemented in a manner that will limit unintended negative environmental impacts.
>
> Member education, engagement, and neighbor-to-neighbor communications for all generations are important to meet the vision of and manage the future of Big Blake Lake.
>
> Clear and concise multi-channel communications to members express the ever evolving nature of lake management and the complexity of issues.

Goal 1: Reduce nuisance algae and plant growth by reducing watershed and internal sources of phosphorus

Big Blake Lake is currently on Wisconsin's Impaired Waters List under the Federal Clean Water Act, Section 303(d). Watershed and internal sources of phosphorus should be reduced such that Big Blake Lake is removed from the Impaired Waters List as indicated by an in-lake average seasonal total phosphorus concentration of 40 µg/L and in-lake chlorophyll value of less than 20 µg/L for 30% of the days in the sampling season. Harvesting of curly leaf pondweed removes nutrients from Big Blake Lake which would otherwise contribute to internal sources of phosphorus.

Objective 1. Support harvesting of curly leaf pondweed to remove nutrients from Big Blake Lake

- *Develop and deliver an educational message to explain the relationship between harvesting and phosphorus removal from Big Blake Lake*
- *Review and update the Big Blake Lake harvesting plan on an annual basis*
- *Complete and submit Form 3200-113:Mechanical/Manual Aquatic Plant Control Application*

Objective 2. Install at least 10 shoreline native plantings/restorations, diversion practices, rock infiltration practices or rain gardens per year

- *Provide an educational message regarding the importance of native vegetation, diversion practices, and rock infiltration practices to reduce watershed sources of phosphorus*
- *Organize an educational session highlighting simple changes to properties that will improve Big Blake Lake*
- *Offer free annual Healthy Lakes property audits to identify property owners interested in installing practices*
- *Prepare a Healthy Lakes Grant application to provide technical assistance and cost sharing to fund practices by 75%*
- *Determine a 25% match for the Healthy Lakes Grant (District on behalf of individual property owners or individual property owners)*
- *Recognize shoreline property owners who have installed practices*
- *Organize a tour of properties where successful practices have been installed*

Objective 3. Evaluate the purchase of highly erodible/ecologically sensitive land if option arises

- *Research and explore the formation of a conservancy*
- *Research and explore grant opportunities for acquiring land*
- *Form a subteam to oversee the purchase of high erodible/ecologically sensitive land*
- *If possible, provide recreational uses if land is purchased*

Objective 4. Engage the agricultural community as a partner in reducing watershed runoff

- *Work with the Polk County Land and Water Resources Department to identify agricultural producers in the Big Blake Lake watershed*

- *Develop a program to incentivize the installation of farmland best management practices*
- *Develop and deliver an educational message to explain the need and purpose of the program*
- *Recognize agricultural producers who have participated in the program*
- *Prepare a Lake Planning Grant application to fund soil sampling on agricultural fields in the watershed and determine a match for the grant*

Objective 5. Ensure that stakeholders understand the relationship between boat traffic and phosphorus release from the sediment

- *Develop and deliver an educational message to members of the District*
- *Develop and deliver an educational message to anglers in fishing tournaments*

Objective 6. Upgrade non-compliant septic systems by engaging and educating 100% of shoreline property owners

- *Develop and deliver an educational message regarding the relationship between failing septic systems and increased watershed sources of phosphorus*
- *Conduct a septic survey to determine the impact of septic systems on the lake and identify non-compliant septic systems*
- *Identify shoreline property owners willing to upgrade their septic system*
- *Prepare a Lake Protection Grant to fund upgrades to septic systems*
- *Determine a match for a Lake Protection Grant (District or individual property owners)*
- *Recognize shoreline property owners who have participated in the program*

Goal 2: Reduce curly-leaf pondweed coverage and density to restore reasonable uses of the lake while promoting the recovery of the beneficial native plant community and protecting sensitive areas from disturbances

The current harvesting program should be continued with the goal of reducing curly-leaf pondweed sample site frequency of occurrence at sites shallower than the maximum depth of plants to 60% in harvested areas or an average density of 1. As a measure of the recovery of the native plant community, FQI should be maintained at 20 or greater.

The harvesting program will follow the guidelines of the Big Blake Lake Aquatic Invasive Species Management Plan, 2007-2011. At the time this plan was written, harvesting was not allowed within 100 feet of the shoreline. In 2008, the Big Blake Lake Aquatic Plant Management Plan was amended as a result of concerns regarding navigational issues. At this time the change was made to allow harvesting towards the shore to a minimum depth of 36 inches, with no minimum distance from shore. Additionally, in allowing harvesting near shore, no chemical herbicide permits will be considered as harvesting to minimum depths of 36 inches should allow adequate navigational opportunities.

Objective 1. Ensure that the timing and location of harvesting is appropriate

- *Complete and submit Form 3200-113:Mechanical/Manual Aquatic Plant Control Application*
- *Notify Aquatic Plant Specialist, Mark Sundeen at 715-635-4074, 4 working days prior to anticipated start of the harvesting operation, or provide a schedule of harvesting on request*
- *Mechanical harvesting is only allowed in the areas specified and approved in the annual permit letter from WDNR and as they appear on the map submitted in the permit application*
- *Harvesting does not include sensitive areas and areas with a water depth of less than 36 inches*
- *Harvesting should occur before turion formation and deposition*
- *Harvesting will occur in the intensive management sites designated in the 2007 study regardless of apparent extend of CLP as a basis to measure progress of the program*
- *All late season cutting (that allowed in the permit after June 15th) should be allowed only at a depth greater than 5-feet of the lake nearest the rice beds.*
- *During or after the spring CLP harvesting is completed, harvesting will be allowed in navigation channels to be selected and agreed on by the Lake District, its' plant monitoring consultant, and the DNR.*
- *Nuisance mid-summer native plant coverage, primarily coontail, may be harvested*
- *All aquatic plants cut must be removed immediately from the water and disposal of the harvested aquatic plants must be located in department approved areas and must be in accordance with any applicable county and local regulations.*

Objective 2. Allow individual riparian owners to manually remove vegetation if adequate navigational opportunities are not provided with the harvester

- *Manual removal will be done by hand or hand-held devices without the use or aid of external or auxiliary power*

- *Manual removal cannot exceed 30 feet in width and can only be done where the shore is being used for a dock or swim raft*
- *The 30 foot wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed*
- *Wild rice may not be manually removed*

Objective 3. Monitor the success of the harvesting program

- *The WDNR harvesting permit, all maps of sensitive areas, identified navigation channels, and of the intensive management sites will be carried on board the harvester while operating at all times.*
- *GPS coordinates will be established to delineate all harvesting sites, and the harvesting record will be maintained and provided or made available at the end of the season.*
- *Annual spring and summer point intercept surveys and a turion study will be completed to determine if CLP reduction goals are being met and to assess improvements in the native plant community*
- *If goals aren't being met, a committee will convene and adapt the goals and objectives as necessary*

Objective 4. Plant control will prevent harm to important fish spawning and nursery habitat and prevent direct removal or indirect harm to wild rice

- *Sensitive area A will have no active management*
- *Sensitive area B may have a primary navigation channel cut into it (4 finger channels branching from a primary channel to 4 properties, 25 feet wide at maximum) after Memorial Day when fish have completed spawning*
- *Sensitive area C includes vegetation that may include wild rice and will have no active management until after a site survey is made to determine what if any effects management may have on wild rice and after a consultation about the effects of management on wild rice is done with the Voigt Task Force*
- *Inspection of Sensitive Area C will take place in June by DNR and St. Croix Tribal DNR to determine potential impacts on wild rice growing in that area if harvesting of navigational lanes to riparian areas were permitted*
- *Harvesting will not take place in areas with water depth of less than 36 inches*

Goal 3: Provide information and education with the intent of changing stakeholder behaviors to protect Big Blake Lake

Objective 1. Use existing channels to deliver at least one focused educational message per year to meet the goals of this plan

- *Articles in the Big Blake Lake Bugle*
- *Webpages on the Big Blake Lake website*
- *Emails to the Big Blake Lake list serve*
- *Presentations and brochures at the Big Blake Lake Spring and Annual Meeting*
- *Press releases in local newspapers*
- *Special educational sessions such as pontoon classrooms, Healthy Lakes workshops, and CBCW trainings*
- *Posts on the Big Blake Lake Facebook page*

Objective 2. Explore new and innovative methods to provide information and education

- *For each focused educational message, develop at least one new method to communicate information*
    - *Example: Tour of properties that have installed shoreline buffers and rain gardens*
    - *Example: Stickers or signs to symbolize participation in a program as a way to start a conversation with neighbors*

Goal 4: Prevent the introduction of new invasive species and eradicate newly introduced invasive species

Objective 1. Ensure that lake residents and users understand the steps necessary to prevent invasive species

- *Continue a successful Clean Boats, Clean Water monitoring and education program at each boat landing using volunteers and paid inspectors*
- *Participate in additional WDNR statewide programs including the Landing Blitz and Drain Campaign*
- *Ensure that signage at the boat landings is in place each year and updated as necessary*
- *Distribute brochures and the waterproof Big Blake Lake map with aquatic invasive species information*
- *Work with the Polk County Sheriff's Department to encourage enforcement of the Do Not Transport Ordinance*

Objective 2. Implement an annual monitoring program to quickly identify the introduction of new invasive species

- *Attend the Polk County Citizen Lake Monitoring Network Training for invasive species which trains volunteers to identify and monitor for aquatic invasive species*
- *Provide training for harvester operators regarding new aquatic invasive species identification*
- *Form a committee of volunteers to monitor for invasive species over the course of the growing season with a focus on boat landings and other areas with high potential for introduction*
- *Contract with professionals to implement a monitoring program for aquatic invasive species*
- *Develop and implement a rapid response plan so that new populations are addressed quickly and efficiently*

Goal 5: Evaluate the progress of lake management efforts and needs through monitoring

Objective 1. Continue current data collection efforts to evaluate progress

- *Ensure that Citizen Lake Monitoring Volunteer is in place each year to collect phosphorus, chlorophyll, and secchi data*
- *Conduct yearly spring and summer aquatic plant point intercept surveys to determine if CLP reduction goals are being met and if the native plant community is improving*

Objective 2. Expand data collection efforts depending on needs

- *Monitor culverts to determine phosphorus loads and identify the need for sediment basins*
- *Conduct a shoreline inventory to document areas of natural vegetation, lawn, and erosion along the shoreline of Big Blake Lake*
- *Repeat the 2013-15 water quality study in five to ten years*
- *Collect a sediment core in the south basin*
- *Implement a turion study to document effectiveness of reducing CLP with harvesting*
- *Implement a septic survey on all septic systems on the lake*

Goal 6: Protect, maintain, and enhance fish and wildlife habitat

Objective 1. Maintain and enhance desirable populations of game fish in Big Blake Lake by installing 5 habitat improvements such as fish sticks

- *Work with fisheries biologist to determine locations for fish sticks and other habitat improvements*
- *Identify property owners interested in installing fish sticks and other habitat improvements*
- *Prepare a Healthy Lakes Grant application to fund the installation of fish sticks*
- *Recognize shoreline property owners who have installed fish sticks and other habitat improvements*
- *Develop and deliver an educational message regarding the importance of leaving trees and branches that fall into the lake for the habitat they provide to fish*
- *Promote the growth of native aquatic plants*
- *Explore stocking options for Big Blake Lake*

Objective 2. Restore 10 developed shorelines to more native habitats per year

- *Provide an educational message regarding the importance of native vegetation for fish and wildlife habitat*
- *Conduct a shoreline inventory to document areas of natural vegetation, lawn, and erosion along the shoreline of Big Blake Lake and prioritize sites for projects*
- *Develop a program to provide incentives to property owners who quit mowing a portion of their shoreline*
- *See actions under Goal 1, Objective 2*

Goal 7: Sustain the implementation of the plan

Objective 1. Form teams to ensure that the goals of the plan are met

- *Water quality team*
    - *Land acquisition subteam*
    - *Healthy Lakes subteam*
- *Fish and wildlife team*
- *Information and education team*
- *Aquatic invasive species team*
- *Aquatic plant team*

Objective 2. Continue to seek funding to implement the Big Blake Lake Management Plan

- *Apply for WDNR Lake Planning, Lake Protection, and Aquatic Invasive Species Grants*
- *Leverage current partner efforts to strengthen grant applications*
- *Identify additional funding*

	Timeline	$ Estimate	Volunteer hours (annual)	Responsible parties and partners	Funding sources
<u>Goal 1: Reduce nuisance algae and plant growth by reducing watershed and internal sources of phosphorus</u>					
Objective 1. Support harvesting of curly leaf pondweed to remove nutrients from Big Blake Lake	Ongoing, annual				
Develop and deliver an educational message to explain the relationship between harvesting and phosphorus removal from Big Blake Lake				Information and education team	
Review and update the Big Blake Lake harvesting plan on an annual basis				Aquatic plant team	
Complete and submit Form 3200-113:Mechanical/Manual Aquatic Plant Control Application				Aquatic plant team	
Objective 2. Install at least 10 shoreline native plantings/restorations, diversion practices, rock infiltration practices or rain gardens per year				Healthy lakes subteam	
Provide an educational message regarding the importance of native vegetation, diversion practices, and rock infiltration practices to reduce watershed sources of phosphorus	2016				
Organize an educational session highlighting simple changes to properties that will improve Big Blake Lake	2016				
Offer free annual Healthy Lakes property audits to identify property owners interested in installing practices	2016				
Prepare a Healthy Lakes Grant application to provide technical assistance and cost sharing to fund practices by 75%	Due Feb 1, 2017				Healthy Lakes Grant
Determine a 25% match for the Healthy Lakes Grant (District on behalf of individual property owners or individual property owners)	2016				
Recognize shoreline property owners who have installed practices	2017/2018				
Organize a tour of properties where successful practices have been installed	2017/2018				

Objective 3. Evaluate the purchase of highly erodible/ecologically sensitive land if option arises	As opportunity arises			Land acquisition subteam	
Research and explore the formation of a conservancy					
Research and explore grant opportunities for acquiring land					
Form a subteam to oversee the purchase of high erodible/ecologically sensitive land					
If possible, provide recreational uses if land is purchased					
Objective 4. Engage the agricultural community as a partner in reducing watershed runoff				Water quality team	
Work with the Polk County Land and Water Resources Department to identify agricultural producers in the Big Blake Lake watershed				Polk County LWRD	
Develop a program to incentivize the installation of farmland best management practices					
Develop and deliver an educational message to explain the need and purpose of the program					
Recognize agricultural producers who have participated in the program					
Prepare a Lake Planning Grant application to fund soil sampling on agricultural fields in the watershed and determine a match for the grant	2018				Lake Planning Grant
Objective 5. Ensure that stakeholders understand the relationship between boat traffic and phosphorus release from the sediment	Ongoing, annual			Information and education team	
Develop and deliver an educational message to members of the District					
Develop and deliver an educational message to anglers in fishing tournaments					
Objective 6. Upgrade non-compliant septic systems by engaging and educating 100% of shoreline property owners				Water quality team	

Develop and deliver an educational message regarding the relationship between failing septic systems and increased watershed sources of phosphorus	Ongoing, annual			Information and education team	
Conduct a septic survey to determine the impact of septic systems on the lake and identify non-compliant septic systems using lake water testing	2021				Lake Planning Grant
Identify shoreline property owners willing to upgrade their septic system	2021				
Prepare a Lake Protection Grant to fund upgrades to septic systems	2021				Lake Protection Grant
Determine a match for a Lake Protection Grant (District or individual property owners)	2021				
Recognize shoreline property owners who have participated in the program	2022				

	Timeline	$ Estimate	Volunteer hours (annual)	Responsible parties and partners	Funding sources
<u>Goal 2: Reduce curly-leaf pondweed coverage and density to restore reasonable uses of the lake while promoting the recovery of the beneficial native plant community and protecting sensitive areas from disturbances</u>					
Objective 1. Ensure that the timing and location of harvesting is appropriate	Ongoing, annual			Aquatic plant team	
Complete and submit Form 3200-113:Mechanical/Manual Aquatic Plant Control Application	Winter prior to harvesting				
Notify Aquatic Plant Specialist, Mark Sundeen at 715-635-4074, 4 working days prior to anticipated start of the harvesting operation, or provide a schedule of harvesting on request	4 days prior to harvesting				
Mechanical harvesting is only allowed in the areas specified and approved in the annual permit letter from WDNR and as they appear on the map submitted in the permit application					
Harvesting does not include sensitive areas and areas with a water depth of less than 36 inches					
Harvesting should occur before turion formation and deposition					
Harvesting will occur in the intensive management sites designated in the 2007 study regardless of apparent extend of CLP as a basis to measure progress of the program					
All late season cutting (that allowed in the permit after June 15th) should be allowed only at a depth greater than 5-feet of the lake nearest the rice beds.					
During or after the spring CLP harvesting is completed, harvesting will be allowed in navigation channels to be selected and agreed on by the Lake District, its' plant monitoring consultant, and the DNR.					
Nuisance mid-summer native plant coverage, primarily coontail, may be harvested					

All aquatic plants cut must be removed immediately from the water and disposal of the harvested aquatic plants must be located in department approved areas and must be in accordance with any applicable county and local regulations.					
Objective 2. Allow individual riparian owners to manually remove vegetation if adequate navigational opportunities are not provided with the harvester	Ongoing, annual			Aquatic plant team	
Manual removal will be done by hand or hand-held devices without the use or aid of external or auxiliary power					
Manual removal cannot exceed 30 feet in width and can only be done where the shore is being used for a dock or swim raft					
The 30 foot wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed					
Wild rice may not be manually removed					
Objective 3. Monitor the success of the harvesting program	Ongoing, annual			Aquatic plant team	
The WDNR harvesting permit, all maps of sensitive areas, identified navigation channels, and of the intensive management sites will be carried on board the harvester while operating at all times.					
GPS coordinates will be established to delineate all harvesting sites, and the harvesting record will be maintained and provided or made available at the end of the season.					
Annual spring and summer point intercept surveys and a turion study will be completed to determine if CLP reduction goals are being met and to assess improvements in the native plant community	Spring and summer, yearly				Lake Planning Grant
If goals aren't being met, a committee will convene and adapt the goals and objectives as necessary	Fall/winter, as needed				
Objective 4. Plant control will prevent harm to important fish spawning and nursery habitat and prevent direct removal or indirect harm to wild rice	Ongoing, annual			Aquatic plant team	

Sensitive area A will have no active management					
Sensitive area B may have a primary navigation channel cut into it (4 finger channels branching from a primary channel to 4 properties, 25 feet wide at maximum) after Memorial Day when fish have completed spawning					
Sensitive area C includes vegetation that may include wild rice and will have no active management until after a site survey is made to determine what if any effects management may have on wild rice and after a consultation about the effects of management on wild rice is done with the Voigt Task Force					
Inspection of Sensitive Area C will take place in June by DNR and St. Croix Tribal DNR to determine potential impacts on wild rice growing in that area if harvesting of navigational lanes to riparian areas were permitted	June, annually				
Harvesting will not take place in areas with water depth of less than 36 inches					

	Timeline	$ Estimate	Volunteer hours (annual)	Responsible parties and partners	Funding sources
<u>Goal 3: Provide information and education with the intent of changing stakeholder behaviors to protect Big Blake Lake</u>					
Objective 1. Use existing channels to deliver at least one focused educational message per year to meet the goals of this plan	Ongoing, annual			Information and education team	
Articles in the Big Blake Lake Bugle					
Webpages on the Big Blake Lake website					
Emails to the Big Blake Lake list serve					
Presentations and brochures at the Big Blake Lake Spring and Annual Meeting					
Press releases in local newspapers					
Special educational sessions such as pontoon classrooms, Healthy Lakes workshops, and CBCW trainings					
Posts on the Big Blake Lake Facebook page					
Objective 2. Explore new and innovative methods to provide information and education	Ongoing, annual			Information and education team	
For each focused educational message, develop at least one new method to communicate information					
Example: Tour of properties that have installed shoreline buffers and rain gardens					
Example: Stickers or signs to symbolize participation in a program as a way to start a conversation with neighbors					

	Timeline	$ Estimate	Volunteer hours (annual)	Responsible parties and partners	Funding sources
<u>Goal 4: Prevent the introduction of new invasive species and eradicate newly introduced invasive species</u>					
Objective 1. Ensure that lake residents and users understand the steps necessary to prevent invasive species	Yearly, ongoing			Aquatic invasive species team	AIS Education, Prevention, & Planning Grant
Continue a successful Clean Boats, Clean Water monitoring and education program at each boat landing using volunteers and paid inspectors					Clean Boats, Clean Waters Grant
Participate in additional WDNR statewide programs including the Landing Blitz and Drain Campaign					
Ensure that signage at the boat landings is in place each year and updated as necessary					
Distribute brochures and the waterproof Big Blake Lake map with aquatic invasive species information					
Work with the Polk County Sheriff's Department to encourage enforcement of the Do Not Transport Ordinance	2017				
Objective 2. Implement an annual monitoring program to quickly identify the introduction of new invasive species				Aquatic invasive species team	AIS Education, Prevention, & Planning Grant
Attend the Polk County Citizen Lake Monitoring Network Training for invasive species which trains volunteers to identify and monitor for aquatic invasive species	Yearly, ongoing				
Provide training for harvester operators regarding new aquatic invasive species identification	2017, annually				

Form a committee of volunteers to monitor for invasive species over the course of the growing season with a focus on boat landings and other areas with high potential for introduction	After AIS team forms				
Contract with professionals to implement a monitoring program for aquatic invasive species	2017, annually				
Develop and implement a rapid response plan so that new populations are addressed quickly and efficiently	2017				

	Timeline	$ Estimate	Volunteer hours (annual)	Responsible parties and partners	Funding sources
<u>Goal 5: Evaluate the progress of lake management efforts and needs through monitoring</u>					
Objective 1. Continue current data collection efforts to evaluate progress	Ongoing, annual			Water quality team	Lake Planning Grant
Ensure that Citizen Lake Monitoring Volunteer is in place each year to collect phosphorus, chlorophyll, and secchi data	Annual				Citizen Lake Monitoring Network Program
Conduct yearly spring and summer aquatic plant point intercept surveys to determine if CLP reduction goals are being met and if the native plant community is improving	Spring and summer, annual			Polk County LWRD or consultant	Lake Planning Grant
Objective 2. Expand data collection efforts depending on needs				Water quality team	Lake Planning Grant
Monitor culverts to determine phosphorus loads and identify the need for sediment basins	2017-2018				
Conduct a shoreline inventory to document areas of natural vegetation, lawn, and erosion along the shoreline of Big Blake Lake	2017-2018				
Repeat the 2013-15 water quality study in five to ten years	2021-2026				
Collect a sediment core in the south basin					
Implement a turion study to document effectiveness of reducing CLP with harvesting	2017-2018				
Implement a septic survey on all septic systems on the lake	2021				

	Timeline	$ Estimate	Volunteer hours (annual)	Responsible parties and partners	Funding sources
<u>Goal 6: Protect, maintain, and enhance fish and wildlife habitat</u>					
Objective 1. Maintain and enhance desirable populations of game fish in Big Blake Lake by installing 5 habitat improvements such as fish sticks				Fish and wildlife team	
Work with fisheries biologist to determine locations for fish sticks and other habitat improvements					
Identify property owners interested in installing fish sticks and other habitat improvements	2016				
Prepare a Healthy Lakes Grant application to fund the installation of fish sticks	Due February 1, 2017				
Recognize shoreline property owners who have installed fish sticks and other habitat improvements					
Develop and deliver an educational message regarding the importance of leaving trees and branches that fall into the lake for the habitat they provide to fish	Ongoing				
Promote the growth of native aquatic plants					
Explore stocking options for Big Blake Lake					
Objective 2. Restore 10 developed shorelines to more native habitats per year				Healthy lakes team	
Provide an educational message regarding the importance of native vegetation for fish and wildlife habitat	2016			Information and education team	
Conduct a shoreline inventory to document areas of natural vegetation, lawn, and erosion along the shoreline of Big Blake Lake and prioritize sites for projects	2017-2018				
Develop a program to provide incentives to property owners who quit mowing a portion of their shoreline					
See actions under Goal 1, Objective 2					

	Timeline	$ Estimate	Volunteer hours (annual)	Responsible parties and partners	Funding sources
<u>Goal 7: Sustain the implementation of the plan</u>					
Objective 1. Form teams to ensure that the goals of the plan are met	Annual meeting 2016, ongoing			District Board	
Water quality team					
-Land acquisition subteam					
-Healthy Lakes subteam					
Fish and wildlife team					
Information and education team					
Aquatic invasive species team					
Aquatic plant team					
Objective 2. Continue to seek funding to implement the Big Blake Lake Management Plan	As needed, ongoing			District Board	
Apply for WDNR Lake Planning, Lake Protection, and Aquatic Invasive Species Grants					
Leverage current partner efforts to strengthen grant applications					
Identify additional funding sources and partners to expand opportunities for action					

Appendix A

Lake Resident Survey and Results

Big Blake Lake Resident Survey

The following survey is a component of a grant which was received to study Big Blake Lake. The survey should take approximately 5-10 minutes to complete. Responses will remain confidential. Final results will be compiled and used to guide management decisions for Big Blake Lake. Feel free to contact the Polk County Land and Water Resources Department with any questions at 715-485-8699. Surveys should be returned by June 1st to:

LWRD
100 Polk County Plaza- Suite 120
Balsam Lake, WI 54810

Thank you again for your participation!

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1. How many years have you owned property on Big Blake Lake? Note: If you own more than one property, please answer all questions for the property you have owned the longest.

   _____years

2. Which of the following best describes how you use your property?
   ___Year-round residence
   ___Seasonal residence (continued occupancy for months at a time)
   ___Weekend, vacation, and/or holiday residence
   ___Rental property/resort
   ___Other, please specify_____

3. How many days in a typical year is your property used by you or others? Just provide your best estimate.
   _____days per year

4. On the average day that your property is occupied, how many people occupy the property?
   _____people

5. Do you own shoreline property (including shared access points) on Big Blake Lake?
   ___No, please skip to question 7 ___Yes

6. Beginning at the water's edge, how would you describe the area measuring 35 feet inland (shoreline towards the road)? If you don't own shoreline property, please skip this question. Please check all that apply.
   ___Mowed lawn
   ___Un-mowed vegetation
   ___Shrubs/trees
   ___Undisturbed woods
   ___Stabilizing rock/rip rap
   ___Pier/dock
   ___Buffer zone/shoreline restoration
   ___Rain garden

7. What activities do you enjoy on Big Blake Lake? Please check all that apply.

___Swimming
___Peace and tranquility
___Scenic view
___Jet skiing/wakeboarding/waterskiing
___Non-motorized boating (canoe/kayak)
___Motorized boating
___Sailing or wind surfing
___Hunting/trapping
___Observing birds/wildlife
___Open water fishing
___Ice fishing
___Snowmobiling
___Cross country skiing/snowshoeing
___Other, please list_____

8. Which of the following watercraft are kept on your property for use on Big Blake Lake? Please check all that apply.

___Jet skis
___Motorboats/pontoons (1-20 HP)
___Motorboats/pontoons (21-50 HP)
___Motorboats/pontoons (more than 50 HP)
___Canoes/kayaks
___Paddleboats/rowboats
___Sailboat
___Seaplane
___No watercrafts are kept at my property, skip to question 10

9. Are the watercrafts that you use on Big Blake Lake used on other waterbodies?

___Yes ___No

10. What is your degree of concern with each issue listed below? If you believe the issue doesn't exist check the first column; if you believe the issue exists but is not a concern check the second column; and if the issue concerns you please rank your concern as low, medium, or high.

	Issue doesn't exist	Exists, but not a concern	Low concern	Medium concern	High concern
New invasive species entering the lake					
Expansion of current invasive species (curly leaf pondweed)					
Excessive aquatic plant growth					
Excessive algae blooms					
Lack of water clarity or quality					
Loss of natural scenery/beauty					
Excessive noise level on the lake					
Decreased wildlife populations					
Decreased fisheries					
Unsafe use of motorized water craft					
Disregard for slow-no-wake zones					
Decreased property values					
Increased development					
Increased nutrient pollution					
Decrease in overall lake health					

11. How would you describe the current lake level of Big Blake Lake?
    ____Too high
    ____Just right
    ____Too Low
    ____Unsure

12. How would you describe the current water quality of Big Blake Lake?
    ____Poor
    ____Fair
    ____Good
    ____Excellent
    ____Unsure

13. How has the water quality changed in Big Blake Lake in the time you've lived on the lake?
    ____Severely degraded
    ____Somewhat degraded
    ____Remained unchanged
    ____Somewhat improved
    ____Greatly improved
    ____Unsure

14. Algae growth varies through the open water season. Which month(s) of the open water season do you consider algae growth (not including plants) to be a problem on Big Blake Lake. Please check all that apply.
    ____May
    ____June
    ____July
    ____August
    ____September
    ____October
    ____Unsure
    ____Algae growth is never a problem, please skip to question 16

15. Please indicate which of the following uses you believe are impaired by algae (not including plants) on Big Blake Lake. If you are unsure, please check the last column.

	Yes	No	Unsure
Swimming			
Fishing			
Boating			
Navigation			
Dogs/animals using the water			
Overall enjoyment of the lake			

16. Overall, how would you describe the amount of aquatic plants (not including algae) in Big Blake Lake?
    ____Too few plants ____Healthy amount of plants ____Too many plants

17. Aquatic plant growth varies throughout the open water season. Which month(s) of the open water season do you consider aquatic plant growth (not including algae) to be a problem in Big Blake Lake? Please check all that apply.
    ____May
    ____June
    ____July
    ____August
    ____September
    ____October
    ____Unsure
    ____Aquatic plants are never a problem, please skip to question 20

18. On the map (right), please mark the areas where aquatic plants (not including algae) are a problem in Big Blake Lake. Additionally, feel free to use the space below to describe where aquatic plants are a problem in Big Blake Lake.

_____

_____

_____

_____

_____

_____

19. Please indicate which of the following uses you believe are limited by aquatic plants (not including algae) on Big Blake Lake. If you are unsure, please check the last column.

	Yes	No	Unsure
Swimming			
Fishing			
Boating			
Navigation			
Overall enjoyment of the lake			

20. Curly leaf pondweed is an invasive species that creates nuisance conditions in Big Blake Lake by forming dense beds of vegetation that interfere with lake uses in the spring. Do you think you would recognize curly leaf pondweed if you saw it?

____Definitely yes
____Probably yes
____Unsure
____Probably no
____Definitely no

21. Do you feel the current aquatic plant management program is effectively controlling nuisance aquatic plant growth (not including algae)? If no, please explain.

____Yes
____No, please use the space below to explain
____Unsure

_____

_____

_____

22. How satisfied are you with the current aquatic plant harvesting program?

____Very satisfied
____Somewhat satisfied
____Neutral
____Somewhat dissatisfied
____Very dissatisfied
____Unsure

23. How would you describe the current amount of mowed lawn across the entire shoreline of Big Blake Lake?
    ____Too much
    ____Not enough
    ____Just right
    ____Unsure

24. How would you describe the importance of shoreline buffers, rain gardens, and native plants to the water quality of Big Blake Lake?
    ____Not at all important
    ____Very important
    ____Not too important
    ____Unsure
    ____Somewhat important

25. How would you describe the use of fertilizer on your property?
    ____I don't use any fertilizer on my property
    ____I use zero phosphorus fertilizer on my property
    ____I use fertilizer on my property but I'm unsure of its phosphorus content
    ____I use fertilizer on my property that contains phosphorus
    ____I use multiple types of fertilizers on my property that contain varying amounts of phosphorus

26. Please indicate which of the following actions should be completed by the District to manage Big Blake Lake. Most activities are eligible for grant funding.

	Yes	No	Unsure
Offering incentives for installation of shoreline buffers and rain gardens			
Offering incentives for installation of farmland conservation practices			
Lake fairs and workshops to share information			
Enforcement of slow-no-wake zones			
Practices to enhance fisheries			
Offering incentives to upgrade non-conforming septic systems			
Pursuing funding to bring the dam on Big Blake Lake up to code			
Programs to prevent and monitor invasive species			

27. Please indicate which of the following activities should be completed by the District to manage aquatic invasive species.

	Yes	No	Unsure
Harvesting curly leaf pondweed			
Herbicide control of curly leaf pondweed			
Boat landing inspections (i.e. Clean Boats, Clean Waters)			
Boat landing cameras (Big Round, Bone, Half Moon, and Church Pine are Polk County lakes that currently have cameras)			
Monitoring to detect new populations of invasive species			
Boat wash station at landings (usually a pressure wash system)			
Educational programs to provide information on invasive species			
Trainings to learn to identify and manage invasive species			

28. How would you prefer to receive information from the Big Blake Lake District? Please check all that apply.

___Newsletter
___Email
___Website
___Facebook
___Annual Meeting
___Prefer not to receive information
___Other, please specify_____

29. How often do you visit the Big Blake Lake District Facebook page?

___I wasn't aware of the Facebook page
___Never
___Rarely
___Sometimes
___Often

30. From the list below, which activities are you interested in participating in to improve Big Blake Lake? Responses will be considered as a measure of interest rather than a commitment.

___Learning to identify aquatic invasive species
___Learning how to monitor for aquatic invasive species
___Learning how to monitor water quality
___Serving on a committee to develop an action plan for improving Big Blake Lake
___Installing a shoreline buffer on your property
___Installing a rain garden on your property
___None of the above

If you're interested in participating in any of the above activities and would like more information, please list your contact information below. This information will be kept separate from your responses to ensure confidentiality.

_____

If you have any comments you would like to make, please use the space below.

Thank you for your time and your answers!

Big Blake Lake Resident Survey

Surveys mailed: 217
Surveys returned: 126
Response rate: 58%

1. How many years have you owned property on Big Blake Lake? Note: If you own more than one property, please answer all questions for the property you have owned the longest.

   124 respondents, 98% **Average years: 21**

2. Which of the following best describes how you use your property?

   125 respondents, 99%

___Year-round residence	**41 respondents, 33%**
___Seasonal residence (continued occupancy for months at a time)	**13 respondents, 10%**
___Weekend, vacation, and/or holiday residence	**70 respondents, 56%**
___Rental property/resort	**1 respondent, 1%**
___Other, please specify_____	**9 respondents, 7%**

- *Occasionally during the week*
- *Family owned for 74 years, personally owned for 3*
- *20-30 days occupied by family/visitors*
- *Occasional visits*
- *One of our sons lives there full time*
- *Only own land - no residence*
- *Land only*
- *Personally owned for 3 years, family owned for 60*
- *Just retired, will stay longer*

3. How many days in a typical year is your property used by you or others? Just provide your best estimate.

   123 respondents, 98% **Average days per year: 147.8**

4. On the average day that your property is occupied, how many people occupy the property?

   125 respondents, 99% **Average people: 3.6**

5. Do you own shoreline property (including shared access points) on Big Blake Lake?

   124 respondents, 98%

___No, please skip to question 7	**7 respondents, 6%**
___ Yes	**117 respondents, 94%**

6. Beginning at the water's edge, how would you describe the area measuring 35 feet inland (shoreline towards the road)? If you don't own shoreline property, please skip this question. Please check all that apply.

117 respondents, 93%

___Mowed lawn	**106 respondents, 91%**
___Un-mowed vegetation	**44 respondents, 38%**
___Shrubs/trees	**52 respondents, 44%**
___Undisturbed woods	**17 respondents, 15%**
___Stabilizing rock/rip rap	**49 respondents, 42%**
___Pier/dock	**57 respondents, 49%**
___Buffer zone/shoreline restoration	**11 respondents, 9%**
___Rain garden	**4 respondents, 3%**

7. What activities do you enjoy on Big Blake Lake? Please check all that apply.

122 respondents, 97%

___Swimming	**85 respondents, 70%**
___Peace and tranquility	**113 respondents, 93%**
___Scenic view	**108 respondents, 89%**
___Jet skiing/wakeboarding/waterskiing	**33 respondents, 27%**
___Non-motorized boating (canoe/kayak)	**57 respondents, 47%**
___Motorized boating	**97 respondents, 80%**
___Sailing or wind surfing	**1 respondent, 1%**
___Hunting/trapping	**10 respondents, 8%**
___Observing birds/wildlife	**96 respondents, 79%**
___Open water fishing	**101 respondents, 83%**
___Ice fishing	**55 respondents, 45%**
___Snowmobiling	**20 respondents, 16%**
___Cross country skiing/snowshoeing	**21 respondents, 17%**
___Other, please list_____	**3 respondents, 2%**

- *I simply live on my 12 acre backlot. I do not, at present, use the lake. I just live here. No longer use the boat, not useable.*
- *Ice Skating*
- *Tubing*

8. Which of the following watercraft are kept on your property for use on Big Blake Lake? Please check all that apply.

123 respondents, 98%

___Jet skis	**15 respondents, 12%**
___Motorboats/pontoons (1-20 HP)	**32 respondents, 26%**
___Motorboats/pontoons (21-50 HP)	**57 respondents, 46%**
___Motorboats/pontoons (more than 50 HP)	**44 respondents, 36%**
___Canoes/kayaks	**56 respondents, 46%**
___Paddleboats/rowboats	**54 respondents, 44%**
___Sailboat	**4 respondents, 3%**
___Seaplane	**0 respondents, 0%**
___No watercrafts are kept at my property, skip to question 10	**9 respondents, 7%**

9. Are the watercrafts that you use on Big Blake Lake used on other waterbodies?

116 respondents, 92%

___Yes	**27 respondents, 23%**
___No	**89 respondents, 77%**

10. What is your degree of concern with each issue listed below? If you believe the issue doesn't exist check the first column; if you believe the issue exists but is not a concern check the second column; and if the issue concerns you please rank your concern as low, medium, or high.
113 respondents, 90%

	Issue doesn't exist	Exists, but not a concern	Low concern	Medium concern	High concern
New invasive species entering the lake **113, 90%**	2, 2%	4, 4%	13, 12%	33, 29%	61, 54%
Expansion of current invasive species (curly leaf pondweed) **120, 100%**	2, 2%	5, 4%	7, 6%	32, 25%	74, 59%
Excessive aquatic plant growth **117, 93%**	2, 2%	3, 3%	8, 7%	34, 29%	70, 60%
Excessive algae blooms **120, 95%**	2, 2%	2, 2%	13, 11%	34, 28%	69, 58%
Lack of water clarity or quality **119, 94%**	3, 3%	4, 3%	12, 10%	34, 29%	66, 55%
Loss of natural scenery/beauty **112, 89%**	12, 11%	11, 10%	28, 25%	36, 32%	25, 22%
Excessive noise level on the lake **117,93%**	16, 14%	18, 15%	37, 32%	27, 23%	19, 16%
Decreased wildlife populations **115. 91%**	21, 18%	11, 10%	36, 31%	23, 20%	24, 21%
Decreased fisheries **114, 90%**	13, 11%	5, 4%	24, 21%	37, 32%	35, 31%
Unsafe use of motorized water craft **117, 93%**	7, 6%	12, 10%	39, 33%	23, 20%	36, 31%
Disregard for slow-no-wake zones **119, 94%**	10, 8%	15, 13%	40, 34%	23, 19%	31, 26%
Decreased property values **115, 91%**	8, 7%	7, 6%	22, 19%	27, 23%	51, 44%
Increased development **115, 91%**	13, 11%	22, 19%	29, 25%	25, 22%	26, 23%
Increased nutrient pollution **111, 88%**	1, 1%	7, 6%	20, 18%	29, 26%	54, 49%
Decrease in overall lake health **116, 92%**	2, 2%	5, 4%	8, 7%	37, 22%	64, 55%

11. How would you describe the current lake level of Big Blake Lake?

120 respondents, 95%

___Too high	**1 respondent, 1%**
___Just right	**11 respondents, 9%**
___Too Low	**97 respondents, 81%**
___Unsure	**11 respondents, 9%**

12. How would you describe the current water quality of Big Blake Lake?

116 respondents, 92%

___Poor	**16 respondents, 14%**
___Fair	**63 respondents, 54%**
___Good	**30 respondents, 26%**
___Excellent	**0 respondents, 0%**
___Unsure	**7 respondents, 6%**

13. How has the water quality changed in Big Blake Lake in the time you've lived on the lake?

119 respondents, 94%

___Severely degraded	**14 respondents, 12%**
___Somewhat degraded	**36 respondents, 30%**
___Remained unchanged	**25 respondents, 21%**
___Somewhat improved	**26 respondents, 22%**
___Greatly improved	**6 respondents, 5%**
___Unsure	**12 respondents, 10%**

14. Algae growth varies through the open water season. Which month(s) of the open water season do you consider <u>algae growth</u> (not including plants) to be a problem on Big Blake Lake. Please check all that apply.

121 respondents, 96%

___May	**1 respondent, 1%**
___June	**17 respondents, 14%**
___July	**80 respondents, 66%**
___August	**107 respondents, 88%**
___September	**49 respondents, 40%**
___October	**4 respondents, 3%**
___Unsure	**6 respondents, 5%**
___Algae growth is never a problem, please skip to question 16	**3 respondents, 2%**

15. Please indicate which of the following uses you believe are impaired by algae (not including plants) on Big Blake Lake. If you are unsure, please check the last column.

	Yes	No	Unsure
Swimming **114, 90%**	105, 92%	2, 2%	7, 6%
Fishing **101, 80%**	58, 57%	16, 16%	27, 27%
Boating **100, 79%**	52, 52%	35, 35%	13, 13%
Navigation **94, 75%**	19, 20%	53, 56%	22, 23%
Dogs/animals using the water **106, 84%**	49, 46%	21, 20%	36, 34%
Overall enjoyment of the lake **108, 86%**	91, 84%	5, 5%	12, 11%

16. Overall, how would you describe the amount of aquatic plants (not including algae) in Big Blake Lake?
114 respondents, 90%

___Too few plants **2 respondents, 2%**
___Healthy amount of plants **33 respondents, 29%**
___Too many plants **79 respondents, 69%**

17. Aquatic plant growth varies throughout the open water season. Which month(s) of the open water season do you consider aquatic plant growth (not including algae) to be a problem in Big Blake Lake? Please check all that apply.

118 respondents, 94%
___May **11 respondents, 9%**
___June **54 respondents, 46%**
___July **87 respondents, 74%**
___August **79 respondents, 67%**
___September **40 respondents, 34%**
___October **2 respondents, 2%**
___Unsure **14 respondents, 12%**
___Aquatic plants are never a problem, please skip to question 20 **1 respondent, 1%**

18. On the map (right), please mark the areas where aquatic plants (not including algae) are a problem in Big Blake Lake. Additionally, feel free to use the space below to describe where aquatic plants are a problem in Big Blake Lake.

89 respondents, 71%

- *Shorelines and both ends of lake*
- *Northeast shoreline, north by Richardson Court, southeast corner of lake*
- *Southeast corner*
- *Center of lake – 2*
- *N and S bays – 15*
- *NW end center, NW area of center lake, center lake, SE end center*
- *NW area of center of lake towards western shore*
- *NW end center and western shore, SE end center*
- *W shore of center lake*
- *NW by N bay. E bays N of the narrows*
- *All of lake*
- *NW bay, SE bay - 2*
- *SE bay, entire W shore*

- *W shore of the S bay*
- *NW bay, NW of center of lake near W shore, SE bay*
- *E and W shores, center lake, NW bay, SE bay*
- *Lower SE bay, Blake Lake Court*
- *Near the narrows of N end of lake and both bays*
- *We see them mainly on the North end. Once you get through the narrows, it's not so bad*
- *NW bay just off shore, SE bay*
- *W shore between center lake and N bay*
- *Whole N & S bays*
- *Northern most shore of N bay, W & E shores of S bay*
- *Lower end of the North bay*
- *N and S bays. "North end of lake quick sand like sediment much where boats get stuck"*
- *Entire length of the center of the lake. "Mouth at straight river (fox creek), west end of lake"*
- *Western half of the North bay*
- *Worst areas are the N and S ends. The entire lake can have an excessive amount of aquatic plants. Mowing has been good.*
- *N and S bays, NE area of center lake*
- *E and W banks of the lower portion of North bay*
- *Western shore of S bay, SE shore of center lake*
- *Nearly entire shoreline where depth is 5 ft. of less*
- *Outlet gets plugged by cut plants*
- *Most of the lake during June and July*
- *By Bystrom Lake boat landing and W shoreline; bay just N of Baker Lane landing; Channel by and bay by inlet from L Blake*
- *All bays*
- *N shore of N bay. W shore of center lake, entire S bay*
- *NE end*
- *West shore of the north bay*
- *All along the shoreline on the west side; unsure about east side*
- *Mouth of the S bay*
- *NE area of N bay; E and W shore of S bay*
- *Whole length of western shore*
- *N and S bays trailing towards center lake*
- *N and S bays; center lake*
- *South bay -2*
- *N and S bays, "It's a lot better since harvesting."*
- *N and S bays; esp. SE shore of S bay. "I have observed water flowing across road that has flowed from a farmer's field. I have taken pictures at that time."*
- *N and S bays, "Bystrom. Richardson Ct."*
- *"The entire lake is prone to curly leaf. Without the harvester it would be a major problem"*
- *Western shore of North bay*
- *NW corner*
- *N and S bays – eastern shore of center lake*
- *"South East end of lake and the channel between Big + Little Blake Lakes. Both ends of lake get very weedy"*
- *S bay - 2*
- *Whole lake has problems. Especially the north end*
- *Eastern shore of North bay*
- *North bay, NW and SE shores of center lake*
- *Ends of lake. Richardson Bay. Beyond ledge, Blake Lake Ct.*
- *S bay extending into Little Blake Lake*
- *Northern shore of North bay, NW + SE shores of center lake. Eastern area of South bay*
- *South bay. NW center lake. "Actually the whole lake if we didn't harvest them"*
- *"Mostly on west side of lake and in the two ends – shallow areas"*
- *SE shore center lake*
- *North and NW shore of North bay extending to western shore towards center lake*
- *N and S bays. Northern center lake*
- *NW area of North bay, South bay, "Cove that empties Big into Little Blake. Area by Sherards dam site*
- *N and S bays, eastern shore center lake*
- *Least problem seems to be along East side (least developed) (least of bogus septic operations). Shallow far south is pretty bad too*
- *N and S bays, western shore b/t N bay and center lake*
- *Unsure*
- *All the areas less than 6' deep, then floating plants go where the current and wind takes it. All the lake is a problem sometimes*

19. Please indicate which of the following uses you believe are limited by aquatic plants (not including algae) on Big Blake Lake. If you are unsure, please check the last column.

	Yes	No	Unsure
Swimming **109, 87%**	90, 83%	8, 7%	11, 10%
Fishing **104, 83%**	65, 63%	20, 19%	19, 18%
Boating **106, 84%**	75, 71%	17, 16%	14, 13%
Navigation **100, 79%**	43, 43%	27, 27%	30, 30%
Overall enjoyment of the lake **105, 85%**	76, 72%	15, 14%	14, 13%

20. Curly leaf pondweed is an invasive species that creates nuisance conditions in Big Blake Lake by forming dense beds of vegetation that interfere with lake uses in the spring. Do you think you would recognize curly leaf pondweed if you saw it?
114 respondents, 90%

___Definitely yes **56 respondents, 49%**
___Probably yes **23 respondents, 20%**
___Unsure **15 respondents, 13%**
___Probably no **13 respondents, 11%**
___Definitely no **7 respondents, 6%**

21. Do you feel the current aquatic plant management program is effectively controlling nuisance aquatic plant growth (not including algae)? If no, please explain.

111 respondents, 88%

___Yes **44 respondents, 40%**
___No, please use the space below to explain **30 respondents, 27%**
___Unsure **37 respondents, 33%**

- *Not exactly sure what plan is currently. Would be nice if lake weed harvesting could be done by county more often by shoreline as opposed to citizens having to private pay. Taxes very high, should provide for more exclusive lake services.*
- *No significant difference.*
- *Helps, but problem still exists*
- *The harvesting cleans it up but does nothing to get rid of it or limit it's growth.*
- *Yes! Harvester made a big difference!*
- *This are better with Harvey the harvester than without, HOWEVER, way too little is done at North end along Breezy Road cabins to catch floating cut plants before they wash up on shore. TONS! Operators need to be aware of what they miss & not dawdle to catch floaters. Harvey the machine was a great purchase.*

22. How satisfied are you with the current aquatic plant harvesting program?

115 respondents, 91%

___Very satisfied **22 respondents, 19%**
___Somewhat satisfied **51 respondents, 44%**
___Neutral **19 respondents, 17%**
___Somewhat dissatisfied **12 respondents, 10%**
___Very dissatisfied **2 respondents, 2%**
___Unsure **9 respondents, 8%**

23. How would you describe the current amount of mowed lawn across the entire shoreline of Big Blake Lake?

115 respondents, 91%

___Too much **28 respondents, 24%**
___Just right **54 respondents, 47%**
___Not enough **2 respondents, 2%**
___Unsure **31 respondents, 27%**

24. How would you describe the importance of shoreline buffers, rain gardens, and native plants to the water quality of Big Blake Lake?

115 respondents, 91%

___Not at all important **8 respondents, 7%**
___Not too important **12 respondents, 10%**
___Somewhat important **39 respondents, 34%**
___Very important **42 respondents, 37%**
___Unsure **14 respondents, 12%**

25. How would you describe the use of fertilizer on your property?

114 respondents, 90%

___I don't use any fertilizer on my property **68 respondents, 60%**
___I use zero phosphorus fertilizer on my property **43 respondents, 38%**
___I use fertilizer on my property but I'm unsure of its phosphorus content **2 respondents, 2%**
___I use fertilizer on my property that contains phosphorus **0 respondents, 0%**
___I use multiple types of fertilizers on my property that contain varying amounts of phosphorus **1 respondent, 1%**

26. Please indicate which of the following actions should be completed by the District to manage Big Blake Lake. Most activities are eligible for grant funding.

	Yes	No	Unsure
Offering incentives for installation of shoreline buffers and rain gardens **109, 87%**	66, 61%	19, 17%	24, 22%
Offering incentives for installation of farmland conservation practices **109, 87%**	59, 54%	13, 12%	37, 34%
Lake fairs and workshops to share information **106, 84%**	47, 44%	20, 19%	39, 37%
Enforcement of slow-no-wake zones **109, 87%**	48, 44%	31, 28%	30, 28%
Practices to enhance fisheries **109, 87%**	85, 78%	4, 4%	20, 18%
Offering incentives to upgrade non-conforming septic systems **112, 89%**	79, 71%	10, 9%	23, 21%
Pursuing funding to bring the dam on Big Blake Lake up to code **115, 91%**	105, 91%	1, 1%	9, 8%
Programs to prevent and monitor invasive species **113, 1%**	101, 89%	1, 1%	11, 10%

27. Please indicate which of the following activities should be completed by the District to manage aquatic invasive species.

	Yes	No	Unsure
Harvesting curly leaf pondweed **115, 91%**	104, 90%	1, 1%	10, 9%
Herbicide control of curly leaf pondweed **111, 88%**	60, 54%	25, 23%	26, 23%
Boat landing inspections (i.e. Clean Boats, Clean Waters) **114, 90%**	98, 86%	3, 3%	13, 11%
Boat landing cameras (Big Round, Bone, Half Moon, and Church Pine are Polk County lakes that currently have cameras) **107, 85%**	40, 37%	29, 27%	38, 36%
Monitoring to detect new populations of invasive species **114, 90%**	102, 89%	2, 2%	10, 9%
Boat wash station at landings (usually a pressure wash system) **113, 90%**	39, 35%	31, 27%	43, 38%
Educational programs to provide information on invasive species **114, 90%**	82, 72%	10, 9%	22, 19%
Trainings to learn to identify and manage invasive species **114, 90%**	79, 69%	9, 8%	26, 23%

28. How would you prefer to receive information from the Big Blake Lake District? Please check all that apply.
122 respondents, 97%

___Newsletter **104 respondents, 85%**
___Email **62 respondents, 51%**
___Website **29 respondents, 24%**
___Facebook **7 respondents, 6%**
___Annual Meeting **49 respondents, 40%**
___Prefer not to receive information **1 respondent, 1%**
___Other, please specify_____ **0 respondents, 0%**

29. How often do you visit the Big Blake Lake District Facebook page?

120 respondents, 95%

___I wasn't aware of the Facebook page **66 respondents, 55%**
___Never **38 respondents, 32%**
___Rarely **11 respondents, 9%**
___Sometimes **5 respondents, 4%**
___Often **0 respondents, 0%**

30. From the list below, which activities are you interested in participating in to improve Big Blake Lake? Responses will be considered as a measure of interest rather than a commitment.

109 respondents, 87%

___Learning to identify aquatic invasive species **39 respondents, 36%**
___Learning how to monitor for aquatic invasive species **32 respondents, 29%**
___Learning how to monitor water quality **30 respondents, 28%**
___Serving on a committee to develop an action plan for improving Big Blake Lake **13, 12%**
___Installing a shoreline buffer on your property **35 respondents, 32%**
___Installing a rain garden on your property **30 respondents, 28%**
___None of the above **38 respondents, 35%**

If you have any comments you would like to make, please use the space below.

Thank you for your time and your answers!

- *Most important issue is rebuilding the dam*
- *As a lake resident, the lake is most important. All actions to help lake Me good! We support it even if tax increase or Lake Association dues*
- *I'd like to do the pontoon classroom and the class at the government center*
- *Anyone looking to buy I'm selling!*
- *Take culvert out that feeds run off from the field on 78th St.*
- *Better inspection of boats coming from other waters. Closer monitoring of boat speed, jet ski operations, young people operating boats/jet skis.*
- *Do not understand why the DNR thinks it's such a big deal to throw a few rocks on the dam for a temporary fix to hold the water level until a new dam can be put in place. It has only been done this way for 100 years. A safety issue. REALLY!! What a bunch of bullshit.*
- *Fix the dam, if not let the people fix it!*
- *I am very concerned about the dam washout at Fox Creek. We need to make sure this gets rebuilt or we will have nothing but a mud puddle.*
- *I believe the lake has too much traffic for its size compared to other lakes in the area. Jet skis are changing the shore line by too much use.*
- *Is there a list somewhere of who lives where around the lake?*
- *Limit jet ski hours. We do not need a no wake zone.*
- *Live too far away to participate*
- *We are 1000 ft. back from Blake Lake! None of these questions apply to us!*
- *Re: #7 Jet skiing - forbid #22 Just before holidays don't come up to shoreline to cut & harvest weeds! #30 Get rid of harvester. Use spray. Ones that want swimming and fishing negotiate treatment to their property on the subject. It's hard to do manually for older residents. Get a contact person to run Harvester all summer/year*
- *Re: #25 My neighbors do and I'm not sure if it's the right product #26 re: Dam funding - if water keeps flowing where dam use to be we will have a dry lake bed. #30 I'm selling my cabin because of all the problems with the Lake Association.*
- *Lake is "way too low". Poor condition all summer, good condition in spring and winter. The lake "smells really bad"*
- *Re #10: No one adheres to [the no wake zones] re #25: Never use fertilizers. Would rather have good water conditions than green grass. re #30: I have this [buffer] now for the last 25 years*
- *Re #12: water quality poor in summer, good spring to July re #23: [Mown lawn] is too much, but is less concern than failed/ failing / borderline septics. re#26: [Offering incentives to upgrade septic systems] is the most important question on entire survey. [Pursuing funding to repair dam] 2nd most important although most urgent re#27: Not persuaded herbicide is safe.*
- *Re:#12: Natural, same as in the 50's, 60's, 70's, 80's, 90's. re #14: It happens every year, it's normal. re #30: Keep cutting the weeds and leave the lake alone. It's been fine for the 70 years I've been there.*
- *Re: #1: Develop stewardship group that includes 2 generations. Favor involvement of area student groups paired with adults. Engagement program.*
- *Emphatic #11 & #26 (Funding)*
- *Re: #30 "Too old!"*

Appendix B

Lake Level and Precipitation Monitoring

Date	Lake Level (ft)	Precipitation (in)	Comments
5/23/14	138	0	
5/24/14	136	0	
5/25/14	134	0	
5/26/14	130	0	
5/27/14	138	1.5	
5/28/14	139	0	
5/29/14	136	0	
5/30/14	134	0	
5/31/14	132	0	
6/1/14	144	1.75	
6/2/14	148	0.5	
6/3/14	148	0	
6/4/14	146	0	
6/5/14	146	0	
6/6/14	146	0	
6/7/14	146	0.06	
6/8/14	148	0	
6/9/14	144	0	
6/10/14	142	0	
6/11/14	140	0	
6/12/14	136	0.25	
6/13/14	136	0	
6/14/14	136	0	
6/15/14	146	1.25	
6/16/14	146	0	
6/17/14	144	0.02	
6/18/14	146	0.02	
6/19/14	154	0.08	
6/20/14	154	0	
6/21/14	156	0	
6/22/14	156	0	
6/23/14	152	0	
6/24/14	150	0	
6/25/14	150	0	
6/26/14	148	0	
6/27/14	140	0	
6/28/14	140	0.5	
6/29/14	150	1.5	
6/30/14	146	0	
7/1/14	142	0	
7/2/14	140	0	
7/3/14	136	0	
7/4/14	134	0	
7/5/14	132	0	
7/6/14	128	0.01	
7/7/14	126	0	
7/8/14	124	0.25	
7/9/14	120	0	
7/10/14	116	0	
7/11/14	118	0.03	
7/12/14	112	0	
7/13/14	112	0	
7/14/14	110	0	
7/15/14	108	0.02	
7/16/14	106	0	
7/17/14	102	0	
7/18/14	100	0	
7/19/14	100	0	
7/20/14	98	0	
7/21/14	96	0	
7/22/14	94	0	
7/23/14	94	0	
7/24/14	92	0	
7/25/14	92	0	
7/26/14	90	0	
7/27/14	88	0	
7/28/14	86	0	
7/29/14	96	0	
7/30/14	104	0	
7/31/14	110	0	rocks placed
8/1/14	114	0	
8/2/14	118	0	
8/3/14	120	0	
8/4/14	132	1.03	
8/5/14	134	0	
8/6/14	132	0	
8/7/14	132	0	
8/8/14	132	0	
8/9/14	132	0	
8/10/14	130	0	
8/11/14	138	0.5	
8/12/14	138	0.25	
8/13/14	138	0	
8/14/14	136	0	
8/15/14	136	0	
8/16/14	134	0	
8/17/14	134	0	
8/18/14	138	0.5	

8/19/14	136	0.02	
8/20/14	140	0.06	
8/21/14	146	0.75	
8/22/14	146	0	
8/23/14	142	0	
8/24/14	142	0	
8/25/14	142	0	
8/26/14	140	0	
8/27/14	138	0.01	
8/28/14	138	0	
8/29/14	136	0	
8/30/14	158	2.5	
8/31/14	156	0	
9/1/14	160	1	
9/2/14	158	0	
9/3/14	154	0	
9/4/14	164	1.04	
9/5/14	160	0	
9/6/14	158	0	
9/7/14	156	0	
9/8/14	152	0	
9/9/14	148	0	
9/10/14	154	0.06	
9/11/14	150	0	
9/12/14	140	0	
9/13/14	138	0	
9/14/14	136	0	
9/15/14	134	0	
9/16/14	132	0	
9/17/14	132	0	
9/18/14	132	0	
9/19/14	134	0	
9/20/14	134	0	
9/21/14	138	0.25	
9/22/14	138	0	
9/23/14	138	0	
9/24/14	138	0	
9/25/14	138	0	
9/26/14	138	0	
9/27/14	138	0	
9/28/14	138	0	
9/29/14	140	0.25	
9/30/14	140	0	
10/1/14	140	0	
10/2/14	146	0.75	

10/3/14	146	0.25	
10/4/14	150	0.75	
10/5/14	152	0	
10/6/14	150	0	
10/7/14	150	0	
10/8/14	150	0	
10/9/14	148	0	
10/10/14	146	0	

Appendix C

Deep Hole Chemical and Physical Data

Big Blake Lake Surface, all units mg/L unless otherwise noted								
Date	Phosphate Ortho Diss	Total Phosphorus	Nitrogen NO3+NO2 Diss	Nitrogen Kjeldahl Total	Nitrogen NH3-N Diss	Total Suspended Solids	Total Sulfate	Chlorophyll a (ug/L)
5/20/13	ND	0.0464	ND	ND	ND	5.00	ND	
5/28/13	ND	0.0378	ND	0.661	ND	5.00	ND	12.1
6/26/13	0.00460	0.0214	ND	0.675	ND	ND	ND	5.81
7/24/13	ND	0.0849	ND	1.63	ND	12.5	ND	118
8/19/13	0.0039	0.135	ND	2.55	0.0236	30.00	ND	235
9/10/13	ND	0.135	ND	1.71	0.203	30.70	ND	98.6
11/12/13	0.0036	0.027	0.182	0.683	0.132	ND		
5/12/14	ND	0.0387	ND	0.676	ND	ND	ND	
5/28/14	ND	0.0308	ND	0.425	0.0377	ND	ND	2.93
6/24/14	ND	0.0212	ND	0.457	ND	2.60	ND	6.71
7/21/14	ND	0.0377	ND	0.717	ND	4.40	ND	8.19
8/19/14	ND	0.0622	ND	1.44	ND	10.00	ND	76.8
9/17/14	ND	0.051	ND	1.03	0.023	7.75	ND	38.1
11/3/14	0.0022	0.0247	0.103	0.42	0.0182	2.20	ND	
4/14/15	ND	0.0252	0.0644	0.374	0.0157	2.50	4.84	
5/27/15	0.0026	0.0248	ND	0.352	0.0316	ND	5.28	3.35
6/25/15	0.0021	0.0228	ND	0.466	ND	2.40	ND	
7/20/15	ND	0.0437	ND	0.812	ND	7.8	ND	27
8/17/15	0.0052	0.077	ND	1.81	0.0262	13.00	4.72	123
9/14/15	0.0119	0.0691	ND	1.02	0.0265	8.00	ND	33.8
11/17/15	0.0046	0.0305	0.051	0.431	0.0191	ND	5.33	

Big Blake Lake Bottom, units mg/L		
Date	Phosphate Ortho Diss	Phosphorus Total
5/28/13	ND	0.0484
6/26/13	0.00360	0.0389
7/24/13	ND	0.0623
8/19/13	ND	0.14
9/10/13	0.012	0.0788
5/28/14	ND	0.0388
6/24/14	ND	0.0255
7/21/14	0.0021	0.0464
8/19/14	ND	0.0558
9/17/14	ND	0.0576
5/27/15	0.0035	0.0256
6/25/15	ND	0.0307
7/20/15	0.002	0.0781
8/17/15	0.00800	0.076
9/14/15	0.0112	0.0736

Big Blake Lake, deep hole

Date	Depth (m)	DO (mg/l)	SpCond (ms/s)	Conduct (ms/s)	Temp (oC)	Salinity (ppt)	pH	ORP	TDS	Secchi (ft)	Comments
5/20/13	0	7.46	206	173	16.76	0.10	8.36	-44.1		4.5	Turnover, 11:44 am
	1	7.89	206	173	16.74	0.10	8.33	-43.2			cloudy, breezy, humid
	2	8.18	206	173	16.73	0.10	8.32	-43.7			storms over weekend
	3	8.19	210	177	16.53	0.10	8.30	-44.3			CLP immature, loon
	4	5.54	218	179	15.59	0.10	7.76	-43.7			depth 16 feet
5/28/13	0	3.35	194	159	15.28	0.09	7.92	-72.8		5	overcast, calm
	1	4.13	202	164	15.27	0.10	7.86	-71.0			low/mid 60's, slight breeze
	2	5.06	204	167	15.26	0.10	7.83	-70.7			bottom: 13 ft, top: 1 ft
	3	5.90	203	165	15.23	0.10	7.82	-70.8			zooplankton: 13 ft
	4	5.97	202	164	15.23	0.10	7.81	-70.9			algae: 2 meter composite
6/19/13	0	2.96	200	191	22.39	0.09	8.48	-97.9		8	clear, calm breeze, 70's
	1	4.12	204	193	22.19	0.10	8.37	-93.1			
	2	5.28	205	193	21.99	0.10	8.31	-92.3			
	3	3.10	212	191	19.99	0.10	7.70	-92.8			
	4	1.29	224	199	18.94	0.11	7.40	-94.9			
6/26/13	0	7.35	201	204	25.71	0.09	8.26	-78.9		7	calm, humid, then storm arrived
	1	6.62	206	208	25.51	0.10	8.28	-78.9			top at 2 PM bottom at 2:07 PM
	2	6.93	207	209	25.34	0.10	8.17	-75.2			
	3	5.98	208	207	24.68	0.10	7.91	-75.7			
	4	1.61	231	216	21.64	0.11	7.37	-83.1			
7/18/13	0	2.91	190	201	28.52	0.09	9.24	-95.7		4	90's, sunny, light breeze 11:55 AM
	1	5.81	186	201	29.15	0.09	9.25	-95.1			
	2	5.83	207	214	26.74	0.10	8.61	-88.8			
	3	0.03	238	234	24.26	0.11	7.52	-105.9			
	4	0.00	246	240	23.85	0.12	7.36	-115.6			
7/24/13	0	5.67	191	188	24.19	0.09	8.77	-88.4		1.5	blue-green alage bloom

	1	7.37	188	185	24.23	0.09	8.68	-86.7		overcast, calm, high 60's
	2	4.85	190	187	24.11	0.09	8.51	-89.0		10:10AM
	3	5.50	190	187	24.04	0.09	8.56	-88.7		
	4	3.93	194	190	23.87	0.09	8.35	-89.6		
8/9/13	0	7.86	187	181	23.09	0.09	9.12	-81.0	2	sunny, partly cloudy, light breeze
	1	10.83	187	181	23.19	0.09	9.12	-78.0		low 70's, 1:40 PM
	2	5.77	193	182	22.12	0.09	8.51	-73.9		
	3	2.04	199	185	21.39	0.09	7.87	-75.7		
	4	0.86	202	188	21.31	0.10	7.53	-83.3		
8/19/13	0	3.40	168	163	23.65	0.08	9.43	-66.0	1	overcast, calm, slight breeze
	1	8.57	168	163	23.46	0.08	9.30	-64.6		10:16 AM
	2	7.00	182	176	23.14	0.09	8.89	-62.7		
	3	1.71	191	182	22.53	0.09	8.14	-64.0		
	4	0.00	203	191	21.79	0.10	7.75	-65.0		
9/10/13	0	2.86	178	170	22.87	0.09	8.38	-43.2	2	raining, calm, 12:05 PM
	1	3.40	187	180	22.84	0.09	8.46	-44.1		
	2	1.46	190	181	22.38	0.09	8.03	-44.7		
	3	1.42	191	181	22.24	0.09	7.91	-45.1		
	4	0.00	206	194	21.88	0.10	7.29	-50.7		
9/26/13	0	7.37	184	159	17.81	0.09	9.12	-14.9	2	very windy, sunny, high 70's
	1	10.63	185	159	17.74	0.09	9.08	-14.5		12:20 PM
	2	8.47	185	160	17.74	0.09	9.07	-15.1		
	3	9.05	186	160	17.64	0.09	9.04	-15.0		
	4	8.84	187	160	17.43	0.09	8.98	-15.2		
10/24/13	0	5.70	187	124	7.25	0.09	7.58	-2.5	8	crisp breeze, overcast
	1	3.61	193	128	7.23	0.09	7.78	-2.5		flurries earlier in day
	2	3.67	196	129	7.13	0.09	7.77	-3.3		
	3	4.26	200	132	7.03	0.10	7.75	-5.4		
	4	4.77	202	133	6.98	0.10	7.73	-6.2		

11/4/13	0	23.56	206	131	5.76	0.10	7.99	-46.9		10	drizzle, gusty, overcast
	1	22.47	208	132	5.74	0.10	7.94	-45.1			
	2	20.76	210	133	5.73	0.10	7.89	-43.1			
	3	19.63	212	134	5.73	0.10	7.85	-41.2			
	4	12.49	214	136	5.72	0.10	7.81	-39.4			
11/6/13	0	8.65	207	130	5.39	0.10	9.10	-23.1		11.5	lake fairly calm, chill breeze
	1	7.84	208	130	5.37	0.10	8.70	-22.9			sunny, snow last night
	2	7.15	211	132	5.38	0.10	8.44	-22.8			
	3	6.85	215	135	5.29	0.10	8.28	-23.1			
	4	6.81	218	136	5.18	0.10	8.18	-23.0			
11/12/13	0	24.76	208	119	2.71	0.10	9.32	-50.8		14	sunny, calm
	1	26.06	210	120	2.54	0.10	8.99	-50.3			secchi touched bottom
	2	22.28	212	122	2.54	0.10	8.60	-47.4			Turnover chemistry
	3	15.99	213	122	2.57	0.10	8.47	-46.8			
	4	14.65	216	128	3.39	0.10	8.13	-51.2			
5/12/14	0	11.85	214	170	14.07	0.10	8.69	20.5		3.5	Turnover
	1	11.94	210	165	13.9	0.10	8.65	21.0			Slight breeze, overcast
	2	11.82	208	162	13.3	0.10	8.61	21.4			Storm previous night
	3	9.63	210	161	12.89	0.10	8.32	21.9			Dam blew in spring
	4	3.80	217	164	12.22	0.10	7.86	21.6			
5/22/14	0	8.56	195	159	15.51	0.09	8.14	28.9	97	6	Sunny, calm, beautiful day
	1	8.22	201	164	15.34	0.10	8.11	29.0	100		Installed staff gauge at Denny's
	2	7.84	203	161	14.13	0.10	8.04	29.6	102		
	3	9.51	204	161	13.95	0.10	7.97	29.7	102		
	4	6.96	207	163	13.9	0.10	7.86	29.1	103		
5/28/14	0	5.58	202	185	20.39	0.10	8.02	-23.7	101	9	Large rain on 5/27/14
	1	5.25	202	183	20.04	0.10	8.03	-23.4	101		Sunny, calm, beautiful day
	2	4.88	203	178	18.68	0.10	7.98	-23.0	101		Chemistry
	3	2.80	214	185	17.84	0.10	7.65	-21.8	107		11AM

	4	0.70	237	196	15.8	0.11	7.43	-20.0	119		
6/9/14	0	5.70	205	191	21.41	0.10	8.20	-25.8	102	6	overcast, calm
	1	5.43	202	189	21.39	0.10	8.28	-24.7	101		
	2	5.42	202	187	21.13	0.10	8.23	-23.4	101		
	3	3.10	209	190	20.18	0.10	7.75	-23.4	105		
	4	1.06	230	207	19.53	0.11	7.42	-24.8	105		
6/24/14	0	5.16	198	197	24.62	0.09	8.46	-18.5	99	8	Beautiful day, calm, sunny
	1	5.19	197	194	24.04	0.09	8.48	-18.5	99		Harvesting
	2	4.82	198	193	23.64	0.09	8.32	-18.5	99		Chemistry, algae, zooplankton
	3	2.82	209	196	21.63	0.10	7.77	-19.1	105		
	4	1.16	220	203	20.87	0.10	7.43	-21.8	110		
7/9/14	0	3.77	196	191	23.61	0.09	7.66	-18.2	99	4	Sunny, calm, 70's, perfect day
	1	3.62	197	191	23.24	0.09	7.84	-17.3	99		10:46AM
	2	3.56	197	189	22.87	0.09	7.94	-17.0	99		
	3	3.34	198	189	22.78	0.09	7.89	-15.1	99		
	4	0.63	203	194	22.62	0.10	7.33	-25.0	102		
7/21/14	0	4.13	199	195	24.04	0.09	8.32	-54.1	99	4	Sunny, light breeze
	1	4.01	199	195	23.98	0.09	8.33	-53.1	99		Heat advisory
	2	3.80	199	195	23.77	0.09	8.28	-52.1	100		10:33AM
	3	3.52	202	196	23.58	0.09	8.15	-50.8	101		Chemistry, algae, zooplankton
	4	0.95	219	208	22.46	0.10	7.49	-63.0	110		
8/5/14	0	8.45	196	197	25.17	0.09	8.63	-32.6	98	4	Partly cloudy, mostly calm
	1	9.36	195	194	24.76	0.09	8.71	-32.7	97		
	2	7.05	200	198	24.24	0.09	8.38	-31.3	100		
	3	0.00	213	208	23.73	0.10	7.53	-33.0	107		
	4	0.00	232	219	23.4	0.11	7.27	-44.4	112		
8/19/14	0	4.87	217	206	23.61	0.10	9.49	8.2	102	2	Overcast, slight breeze
	1	4.53	196	190	23.43	0.09	9.14	6.4	98		
	2	4.09	198	192	23.39	0.09	8.99	5.3	99		

	3	3.29	200	194	23.34	0.09	8.74	5.8	100		
	4	0.93	207	200	23.07	0.10	7.89	-6.8	106		
9/6/14	0	2.61	192	177	20.92	0.09	8.28	-55.8	96	3.5	Overcast, windy, cold
	1	2.52	192	177	20.94	0.09	8.28	-57.7	96		
	2	2.52	191	177	20.94	0.09	8.27	-57.9	96		
	3	2.52	191	176	20.94	0.09	8.26	-58.9	96		
	4	1.86	200	185	20.93	0.09	7.83	-73.2	99		
9/17/14	0	10.06	189	164	18.13	0.09	9.63	-63.2	94	3	Mostly sunny, calm, beautiful
	1	10.37	186	156	16.69	0.09	9.49	-64.0	93		
	2	9.20	175	145	15.94	0.09	9.50	-64.1	91		
	3	5.78	188	154	15.68	0.09	8.86	-63.6	94		
	4	5.60	189	155	15.49	0.09	8.60	-64.2	94		
	4.5	1.43	196	160	15.33	0.09	8.34	-65.3	98		
11/3/14	0	3.25	200	128	6.13	0.10	10.27	-57.0	100	9	Turnover, slight breeze
	1	3.21	200	128	6.14	0.10	10.10	-58.0	100		Overcast, cold
	2	3.32	200	129	6.13	0.10	10.01	-59.1	100		
	3	3.46	200	128	6.12	0.10	9.88	-58.3	100		
	4	3.49	200	128	6.12	0.10	9.80	-59.3	100		
4/14/15	0	3.33	173	124	10.14	0.08	8.18	52.0	86	7	Clear, calm breeze, sunny
	1	3.49	173	124	10.08	0.08	8.19	53.1	86		Turnover
	2	3.66	175	125	9.73	0.08	8.14	54.4	88		
	3	3.81	175	124	9.66	0.08	8.13	55.7	87		
	4	3.60	174	123	9.61	0.08	8.02	56.3	87		
5/27/15	0	5.83	174	151	17.95	0.08	8.53	10.0	87	11	
	1	5.66	173	149	17.51	0.08	8.34	13.3	87		
	2	5.44	173	147	17.09	0.08	8.29	16.9	87		
	3	5.57	173	147	16.96	0.08	8.24	19.5	87		
	4	2.66	174	146	16.69	0.08	7.81	16.5	87		
	4 1/4	2.22	174	146	16.66	0.08	7.57	15.0	87		

6/9/15	0	5.06	160	159	24.65	0.07	8.75	15.0	80	8	harvesting
	1	5.12	158	151	22.56	0.07	8.74	17.6	78		
	2	5.09	156	146	21.64	0.07	8.74	19.6	78		
	3	4.54	156	145	21.27	0.07	8.53	21.4	78		
	4	2.40	164	150	20.46	0.08	8.06	18.9	82		
	4 1/4	0.89	168	153	20.32	0.08	7.45	11.4	84		
6/25/15	0	4.15	140	139	24.51	0.07	8.74	21.4	70	8.5	breezy, cloudy, warm
	1	4.12	141	139	24.23	0.07	8.68	23.3	70		
	2	4.08	140	136	23.41	0.07	8.62	27.5	70		
	3	1.86	145	138	22.34	0.07	7.82	22.9	73		
	4	0.14	148	139	21.84	0.07	7.44	14.7	74		
	4 1/4	0.00	151	142	21.71	0.07	7.28	12.3	75		
7/7/15	0	1.38	148	144	23.56	0.07	8.21	29.2	74	6	breezy, partly cloudy
	1	1.42	149	145	23.57	0.07	8.24	30.6	75		Close to 3" rain Sunday night to Monday
	2	1.45	151	147	23.43	0.07	8.22	32.0	76		
	3	1.45	153	148	23.33	0.07	8.14	35.2	77		
	4	1.47	155	149	22.98	0.07	7.99	36.1	78		
	4.5	0.00	179	172	22.92	0.08	7.31	9.1	80		
7/20/15	0	3.82	139	141	25.68	0.06	9.24	22.7	70	3.5	windy, partly cloudy
	1	3.87	141	143	25.67	0.07	9.19	25.6	70		
	2	3.90	142	143	25.59	0.07	9.11	28.7	70		
	3	1.69	149	148	24.43	0.07	8.10	22.4	74		
	4	0.99	151	149	24.13	0.07	7.70	17.0	76		
	4.5	0.00	168	165	23.86	0.08	7.27	29.5	83		
8/6/15	0	7.99	127	126	24.44	0.06	9.85	49.5	63	1.5	breezy, overcast, water - green - bloom
	1	8.26	128	127	24.43	0.06	9.79	49.4	64		
	2	7.95	130	129	24.37	0.06	9.70	52.4	65		
	3	6.00	134	131	23.92	0.06	9.31	56.9	67		
	4	2.22	138	132	22.83	0.06	8.42	60.9	69		

	4.5	0.00	154	148	22.77	0.07	7.46	51.5	77		
8/17/15	0	5.65	130	132	25.67	0.06	9.75	-25.7	65	1.5	mostly cloudy, slight breeze
	1	6.05	132	133	25.68	0.06	9.70	-29.2	66		
	2	0.31	149	148	24.68	0.07	8.44	-43.5	74		
	3	0.00	150	146	23.61	0.07	8.15	-54.9	75		
	4	0.00	155	149	23.01	0.07	7.96	-96.8	77		
	4.5	0.00	184	176	22.83	0.09	7.58	-113.9	92		
8/31/15	0	9.21	142	133	21.82	0.07	9.48	-49.6	71	2	windy, breezy, cloudy, partly sunny
	1	11.04	142	133	21.74	0.07	9.49	-42.3	71		
	2	11.43	145	135	21.43	0.07	9.43	-37.8	72		
	3	9.43	144	134	21.17	0.07	9.22	-36.6	72		
	4	2.77	150	138	20.67	0.07	8.22	-45.9	75		
	4.5	0.00	172	156	19.84	0.08	7.76	-92.5	86		
9/14/15	0	6.93	138	125	20.3	0.06	9.20	-74.1	69	3	breezy, sunny
	1	8.70	141	129	20.19	0.07	9.13	-64.6	71		
	2	8.09	142	129	20.07	0.07	9.05	-60.8	71		
	3	7.66	144	129	19.83	0.07	8.90	-59.7	72		
	4	6.80	144	129	19.71	0.07	8.76	-58.9	72		
	4.5	0.00	152	137	19.72	0.07	7.59	-192.7	76		
11/17/15	0	4.73	142	94	7.19	0.07	9.02	-13.4	71	10	
	1	4.94	143	95	7.18	0.07	8.91	-9.9	72		
	2	5.21	147	97	7.17	0.07	8.83	-5.8	73		
	3	5.42	147	97	7.16	0.07	8.76	-2.8	74		
	4	5.54	151	100	7.12	0.07	8.72	0.1	75		
	4.5	4.64	154	102	7.17	0.07	8.42	3.3	77		

Appendix D

Tributary and Outlet Chemical and Physical Data

Fox Creek, all units mg/L unless otherwise noted

Date	Phosphate Ortho Diss	Total Phosphorus	Nitrogen NO3+NO2 Diss	Nitrogen Kjeldahl Total	Nitrogen NH3-N Diss	Total Suspended Solids	Chlorophyll a (ug/L)
5/28/13	ND	0.0510	ND	0.266	ND	4.80	
6/26/13	0.00420	0.0247	ND	0.449	0.0250	3.00	
7/24/13	ND	0.0794	ND	1.52	0.0470	12.0	91.9
8/19/13	ND	0.101	ND	2.21	0.039	20.50	
9/10/13	0.0047	0.104	ND	1.49	0.308	7.20	
5/28/14	0.0022	0.0274	ND	0.412	0.0311	2.20	
6/24/14	ND	0.0257	ND	0.564	ND	3.20	
7/21/14	ND	0.047	ND	0.742	0.0251	6.20	
8/19/14	ND	0.0611	ND	1.12	0.0674	9.0	
9/17/14	ND	0.0498	ND	1.05	0.0372	6.00	
5/27/15	0.0053	0.0241	ND	0.385	0.0257	ND	
6/25/15	ND	0.0242	ND	0.518	0.0186	ND	
7/20/15	0.0017	0.0496	ND	0.903	0.0187	6.00	
8/17/15	0.0242	0.0723	ND	1.52	0.0532	9.60	
9/14/15	0.0056	0.0685	ND	0.872	0.0442	7.00	

Lost Creek, all units mg/L unless otherwise noted

Date	Phosphate Ortho Diss	Total Phosphorus	Nitrogen NO3+NO2 Diss	Nitrogen Kjeldahl Total	Nitrogen NH3-N Diss	Total Suspended Solids	Chlorophyll a (ug/L)
5/28/13	ND	0.0227	ND	0.545	ND	4.4	
6/26/13	0.0336	0.125	ND	2.44	0.0682	15.7	
7/24/13	0.0261	0.173	ND	1.55	0.118	30.0	29.1
8/19/13	0.0038	0.132	ND	1.42	0.0576	92.0	
9/10/13	0.0022	0.0799	ND	0.989	0.0217	22.0	
5/28/14	0.0031	0.0467	ND	1.12	0.0237	3.4	
6/24/14	0.0145	0.0738	ND	1.38	0.0487	ND	
7/21/14	0.0284	0.121	ND	1.76	0.0539	17.0	
8/19/14	0.0101	0.105	ND	1.64	0.0532	14.3	
9/17/14	0.0085	0.103	ND	1.71	0.0849	41.0	
5/27/15	0.0105	0.0349	ND	0.886	0.0245	5.5	
6/25/15	0.0268	0.152	ND	1.67	0.0726	49.0	
7/20/15	0.0101	0.0855	ND	1.49	0.0479	18.0	
8/17/15	0.0382	0.299	ND	2.05	0.192	28.0	
9/14/15	0.0266	0.14	ND	1.81	0.11	38.5	

Little Blake Inlet, all units mg/L unless otherwise noted

Date	Phosphate Ortho Diss	Total Phosphorus	Nitrogen NO3+NO2 Diss	Nitrogen Kjeldahl Total	Nitrogen NH3-N Diss	Total Suspended Solids	Chlorophyll a (ug/L)
5/28/13	ND	0.0652	ND	0.595	ND	5.00	
6/26/13	0.00700	0.0370	ND	0.516	0.0214	ND	
7/24/13	ND	0.0415	ND	0.992	0.0345	ND	17.6
8/19/13	ND	0.0240	ND	0.698	0.0309	ND	
9/10/13	ND	0.0441	ND	0.53	0.0225	ND	
5/28/14	ND	0.0436	ND	0.469	0.0325	2.60	
6/24/14	ND	0.0319	ND	0.537	ND	2.40	
7/21/14	ND	0.0343	ND	0.507	0.018	2.60	
8/19/14	ND	0.0481	ND	1.08	0.0254	5.00	
9/17/14	ND	0.0494	0.0383	0.822	0.0464	3.00	
5/27/15	0.00510	0.0345	ND	0.337	0.0176	ND	
6/25/15	0.00300	0.0340	ND	0.668	0.0182	ND	
7/20/15	ND	0.0419	ND	0.764	0.015	4.20	
8/17/15	0.00280	0.0560	ND	1.14	0.0288	3.67	
9/14/15	0.00930	0.0559	ND	0.859	0.0714	3.80	

Little Blake Inlet

Date	Foot	Depth (ft)	Flow (m/s)
5/28/13	0	0.7	0.02
	1	1.0	0.05
	2	1.1	0.07
	3	1.1	0.11
	4	1.5	0.20
	5	1.7	0.25
	6	2.4	0.23
	7	2.5	0.19
	8	2.6	0.24
	9	2.5	0.27
	10	2.7	0.26
	11	2.7	0.21
	12	2.5	0.21
	13	2.6	0.27
	14	2.5	0.24
	15	2.3	0.18
	16	2.2	0.17
	17	2.0	0.15
	18	2.1	0.12
	19	1.9	0.08
	20	1.7	0.01
	21	1.4	0.00
	22	1.4	0.00
	23	0.7	0.00
	24	0.4	0.00
6/19/13	0	0.8	0.00
	1	1.0	0.00
	2	1.0	0.13
	3	0.8	0.22
	4	1.6	0.41
	5	2.3	0.69
	6	2.1	1.03
	7	2.5	1.02
	8	2.6	1.14
	9	2.6	1.20
	10	2.6	1.13
	11	2.5	1.18
	12	2.4	1.13
	13	2.4	0.99
	14	2.2	0.81
	15	2.1	0.62
	16	2.0	0.58
	17	2.0	0.55
	18	1.7	0.23
	19	1.6	0.05
	20	1.4	0.01
	21	1.2	0.01
	22	0.5	0.00
	23	0.2	0.00
6/26/13	0	0.8	0.00
	1	0.7	0.03
	2	0.8	0.10
	3	0.9	0.16
	4	1.6	0.44
	5	2.1	0.61
	6	2.3	0.75
	7	2.4	1.05
	8	2.5	1.05
	9	2.3	0.92
	10	2.5	0.77
	11	2.5	0.83
	12	2.5	0.86
	13	2.4	0.89
	14	2.3	0.80
	15	2.2	0.69
	16	2.0	0.52
	17	2.0	0.43
	18	2.0	0.24
	19	1.7	0.10
	20	1.5	0.03
	21	1.3	0.01
	22	1.0	0.01
	23	0.5	0.02
7/18/13	0	0.5	0.06
	1	0.4	0.02
	2	0.6	0.04
	3	1.1	0.06
	4	1.1	0.18
	5	0.9	0.21
	6	2.0	0.40
	7	2.1	0.49
	8	2.2	0.49
	9	2.2	0.64
	10	2.4	0.42
	11	2.2	0.41
	12	2.1	0.47
	13	1.6	0.60
	14	2.1	0.46
	15	2.0	0.39
	16	1.9	0.23
	17	1.7	0.20
	18	1.7	0.09
	19	1.6	0.09
	20	1.4	0.01
	21	1.3	0.00
	22	0.9	0.00
	23	0.3	0.00
	24	0.1	0.00
7/24/13	0	0.3	0.00
	1	0.5	0.00
	2	0.6	0.02
	3	1.4	0.04
	4	1.1	0.19
	5	1.3	0.32
	6	1.9	0.34
	7	2.1	0.42
	8	2.2	0.33
	9	2.0	0.48
	10	2.2	0.36
	11	2.2	0.37
	12	2.1	0.35
	13	2.1	0.38
	14	2.0	0.37
	15	2.0	0.35
	16	1.8	0.20
	17	1.7	0.09
	18	1.5	0.14
	19	1.4	0.04
	20	1.4	0.00
	21	1.2	0.03
	22	0.8	0.00
	23	0.2	0.00
8/9/13	0	0.2	0.98
	1	0.3	0.81
	2	0.3	0.80
	3	0.2	1.34
	4	0.2	1.16
	5	0.2	0.75
	6	0.2	1.24
	7	0.2	1.13
	8	0.1	0.00
	9	0.0	0.00
	10	0.1	0.01
	11	0.3	0.57
	12	0.3	0.88

	13	0.3	1.12
	14	0.3	1.85
	15	0.4	1.45
	16	0.4	2.54
	17	0.5	2.17
	18	0.3	2.44
	19	0.4	0.88
	20	0.5	1.65
	21	0.5	1.60
	22	0.4	1.00
	23	0.5	1.22
	24	0.5	2.95
	25	0.5	3.10
	26	0.4	1.88
8/19/13	0	0.4	0.07
	1	0.2	0.04
	2	0.6	0.09
	3	0.6	0.07
	4	1.2	0.24
	5	1.2	0.41
	6	2.0	0.44
	7	1.8	0.44
	8	2.3	0.80
	9	2.3	0.54
	10	2.4	0.56
	11	2.4	0.68
	12	2.1	0.76
	13	2.2	0.71
	14	2.2	0.72
	15	2.1	0.63
	16	1.9	0.45
	17	1.7	0.54
	18	1.7	0.36
	19	1.7	0.26
	20	1.4	0.14
	21	1.0	0.06
	22	1.0	0.05
	23	0.4	0.04
	24	0.1	0.00
9/10/13	0	0.4	0.02
	1	0.3	0.00
	2	1.2	0.10
	3	1.3	0.11
	4	1.0	0.20
	5	1.1	0.25
	6	1.8	0.29
	7	2.1	0.57
	8	1.2	0.28
	9	2.0	0.50
	10	2.2	0.37
	11	2.2	0.44
	12	2.0	0.36
	13	2.0	0.40
	14	2.0	0.46
	15	1.9	0.38
	16	1.7	0.32
	17	1.6	0.30
	18	1.6	0.36
	19	1.3	0.18
	20	1.0	0.11
	21	1.0	0.07
	22	0.2	0.00
	23	0.1	0.00
9/26/13	0	0.2	0.04
	1	0.4	0.05
	2	0.6	0.11
	3	0.5	0.17
	4	1.1	0.36
	5	1.1	0.45
	6	1.9	0.46
	7	2.1	0.62
	8	1.9	0.86
	9	2.1	0.82
	10	2.0	0.65
	11	2.1	0.82
	12	2.1	0.63
	13	2.1	0.63
	14	2.1	0.57
	15	1.9	0.41
	16	1.8	0.32
	17	1.8	0.26
	18	1.7	0.18
	19	1.3	0.19
	20	1.4	0.16
	21	1.0	0.14
	22	0.3	0.07
	23	0.2	0.00
	24	0.1	0.00
5/22/14	0	0.5	0.11
	1	0.5	0.12
	2	1.0	0.09
	3	1.2	0.15
	4	1.2	0.19
	5	1.3	0.66
	6	1.5	1.18
	7	1.5	2.15
	8	1.6	2.70
	9	1.6	2.95
	10	1.5	2.85
	11	1.9	2.77
	12	2.0	1.01
	13	1.9	2.83
	14	1.9	2.88
	15	1.8	2.10
	16	1.5	1.04
	17	0.4	0.54
	18	0.6	0.20
	19	0.4	0.15
	20	0.3	0.01
5/28/14	0	0.1	0.04
	1	0.1	0.00
	2	0.3	0.05
	3	0.2	0.31
	4	0.8	0.11
	5	0.9	0.78
	6	1.5	0.84
	7	1.7	2.35
	8	1.9	2.27
	9	1.9	2.86
	10	1.9	2.87
	11	1.8	3.01
	12	1.5	2.96
	13	1.7	2.40
	14	1.6	1.10
	15	1.4	0.59
	16	1.2	0.32
	17	1.1	0.04
	18	1.0	0.02
	19	0.5	0.07
	20	0.4	0.09
6/9/14	0	0.2	0.11
	1	0.2	0.03
	2	0.4	0.20
	3	0.5	0.35
	4	0.7	0.79
	5	1.2	1.18
	6	1.8	1.87
	7	1.8	2.43

	8	1.9	2.83
	9	2.1	2.41
	10	2.1	2.52
	11	2.1	3.02
	12	1.7	3.59
	13	2.0	2.28
	14	1.8	3.05
	15	1.8	2.28
	16	1.6	1.97
	17	1.4	0.99
	18	1.4	0.67
	19	1.0	0.18
	20	1.0	0.03
	21	0.9	0.10
	22	0.5	0.11
	23	0.1	0.00
6/24/14	0	0.3	0.09
	1	0.4	0.05
	2	0.6	0.09
	3	0.5	0.18
	4	0.0	0.00
	5	1.6	0.40
	6	1.8	0.43
	7	1.8	1.52
	8	1.9	2.59
	9	2.0	2.06
	10	2.1	2.12
	11	2.1	2.42
	12	2.1	2.38
	13	2.1	1.96
	14	2.1	2.53
	15	2.0	2.12
	16	1.5	2.29
	17	1.5	1.68
	18	1.5	1.22
	19	1.2	0.80
	20	1.2	0.43
	21	1.2	0.18
	22	0.7	0.05
	23	0.4	0.10
	24	0.1	0.00
7/9/14	0	0.1	0.00
	1	0.1	0.00
	2	0.2	0.01
	3	0.2	0.10
	4	0.6	0.12

	5	1.4	0.17
	6	1.1	0.63
	7	1.6	1.15
	8	1.8	1.81
	9	2.0	2.12
	10	2.0	1.60
	11	1.9	1.85
	12	1.9	2.03
	13	1.8	2.35
	14	1.9	2.04
	15	1.6	1.81
	16	1.5	1.47
	17	1.2	1.27
	18	1.2	0.97
	19	0.9	0.50
	20	1.0	0.22
	21	1.0	0.02
	22	0.5	0.11
	23	0.0	0.00
7/21/14	0	0.2	0.07
	1	0.8	0.92
	2	0.6	0.22
	3	1.0	0.24
	4	1.4	0.75
	5	1.5	1.07
	6	1.7	1.36
	7	1.7	1.73
	8	1.7	1.35
	9	1.7	1.81
	10	1.6	2.05
	11	1.5	1.87
	12	1.5	1.69
	13	1.4	1.23
	14	1.3	0.90
	15	1.2	0.63
	16	1.2	0.37
	17	1.0	0.14
	18	0.9	0.06
	19	0.5	0.13
	20	0.4	0.06
	21	0.2	0.03
8/5/14	0	0.1	0.00
	1	0.1	0.00
	2	0.4	0.11
	3	0.5	0.15
	4	0.6	0.14

	5	1.0	0.36
	6	1.6	0.38
	7	1.8	0.62
	8	1.8	0.70
	9	1.9	1.11
	10	2.0	1.18
	11	1.9	1.32
	12	1.5	1.41
	13	1.9	1.12
	14	1.8	1.11
	15	1.6	0.95
	16	1.7	0.83
	17	1.3	0.54
	18	1.3	0.47
	19	0.9	0.26
	20	1.0	0.09
	21	0.6	0.10
	22	0.4	0.04
	23	0.1	0.00
8/19/14	0	0.2	0.12
	1	0.05	0.00
	2	0.5	0.08
	3	0.5	0.24
	4	0.0	0.00
	5	1.5	0.46
	6	1.2	0.50
	7	1.7	0.70
	8	1.9	1.16
	9	2.0	0.99
	10	2.0	0.96
	11	2.0	1.04
	12	2.1	1.19
	13	1.6	1.15
	14	1.7	1.12
	15	1.8	1.02
	16	1.7	0.69
	17	1.4	0.46
	18	1.4	0.26
	19	1.3	0.25
	20	1.1	0.08
	21	1.1	0.06
	22	0.4	0.07
	23	0.05	0.00
9/6/14	0	0.4	0.03
	1	0.2	0.01
	2	0.8	0.10

	3	0.9	0.37
	4	1.4	1.20
	5	1.9	1.48
	6	2.0	1.85
	7	2.1	2.13
	8	2.2	1.58
	9	2.2	1.84
	10	2.2	2.08
	11	2.1	2.32
	12	2.2	1.83
	13	2.1	1.47
	14	2.0	1.53
	15	2.0	1.32
	16	1.6	1.19
	17	1.6	0.80
	18	1.6	0.34
	19	1.4	0.02
	20	0.9	0.12
	21	0.7	0.03
	22	0.2	0.00
9/17/14	0	0.05	0.00
	1	0.05	0.00
	2	0.1	0.01
	3	0.1	0.02
	4	0.8	0.09
	5	0.8	0.19
	6	1.0	0.30
	7	1.3	0.60
	8	1.8	0.73
	9	1.8	0.90
	10	1.8	1.06
	11	1.9	1.04
	12	1.7	1.35
	13	1.8	0.87
	14	1.6	0.91
	15	1.6	0.65
	16	1.2	0.71
	17	1.2	0.29
	18	1.0	0.10
	19	0.6	0.07
	20	0.6	0.07
	21	0.05	0.00
5/27/15	0	0.02	0.07
	1	0.3	0.12
	2	0.3	0.15
	3	0.4	0.35

	4	0.5	0.16
	5	0.2	0.76
	6	1.5	1.08
	7	1.6	1.50
	8	1.8	1.61
	9	1.8	1.55
	10	1.9	0.99
	11	1.8	1.55
	12	1.9	1.74
	13	1.5	1.35
	14	1.7	1.44
	15	1.7	1.16
	16	1.5	0.82
	17	1.3	0.50
	18	1.3	0.28
	19	1.3	0.09
	20	1.0	0.07
	21	0.9	0.05
	22	0.5	0.05
	23	0.1	0.00
6/9/15	0	0.1	0.00
	1	0.1	0.00
	2	0.2	0.05
	3	0.3	0.20
	4	0.8	0.28
	5	1.1	0.46
	6	1.7	1.16
	7	1.9	1.53
	8	1.9	1.44
	9	1.9	1.59
	10	2.0	1.60
	11	1.8	1.66
	12	1.8	1.57
	13	1.9	1.41
	14	1.7	1.27
	15	1.6	0.99
	16	1.5	0.81
	17	1.4	0.37
	18	1.4	0.20
	19	1.4	0.06
	20	0.6	0.04
	21	0.3	0.03
	22	0.0	0.00
6/25/15	0	0.1	0.01
	1	0.2	0.01
	2	0.7	0.02

	3	1.2	0.08
	4	1.3	0.34
	5	1.4	0.63
	6	1.4	0.55
	7	1.6	0.47
	8	1.8	1.28
	9	1.8	1.29
	10	1.8	1.35
	11	1.9	1.46
	12	1.9	1.38
	13	2.0	1.57
	14	1.7	1.27
	15	1.9	1.12
	16	1.7	0.99
	17	1.5	0.46
	18	0.8	0.17
	19	0.6	0.11
	20	0.3	0.11
	21	0.2	0.00
	22	0.5	0.06
7/7/15	0	0.6	0.10
	1	0.3	0.06
	2	0.4	0.10
	3	0.7	0.18
	4	0.9	0.17
	5	1.5	0.72
	6	1.6	1.43
	7	1.9	1.26
	8	2.0	1.54
	9	2.0	1.50
	10	2.1	1.89
	11	2.1	1.56
	12	1.9	1.86
	13	1.9	1.88
	14	1.9	1.57
	15	1.8	1.48
	16	1.6	1.36
	17	1.5	0.77
	18	1.5	0.35
	19	1.4	0.28
	20	1.2	0.01
	21	0.3	0.03
	22	0.5	0.03
	23	0.1	0.00
7/20/15	0	0.1	0.00
	1	0.5	0.00

	2	0.7	0.07
	3	1.0	0.19
	4	1.4	0.42
	5	1.3	0.62
	6	1.4	0.95
	7	1.6	1.22
	8	1.7	1.47
	9	1.9	1.74
	10	1.9	1.96
	11	1.9	1.66
	12	2.0	1.87
	13	1.8	1.61
	14	2.1	1.40
	15	1.8	1.28
	16	1.8	1.49
	17	1.7	1.75
	18	1.4	0.21
	19	0.8	0.11
	20	0.9	0.06
	21	0.1	0.00
	22	0.2	0.00
	23	0.1	0.00
8/6/15	0	0.3	0.03
	1	0.1	0.00
	2	0.0	0.00
	3	0.2	0.00
	4	0.7	0.05
	5	0.9	0.32
	6	1.5	0.59
	7	1.5	1.08
	8	1.5	0.96
	9	1.5	0.95
	10	1.8	1.16
	11	1.7	1.13
	12	1.6	1.25
	13	1.6	1.15
	14	1.6	0.86
	15	1.5	0.81
	16	1.2	0.47
	17	1.1	0.40
	18	1.1	0.22
	19	1.1	0.08
	20	0.9	0.08
	21	0.6	0.05
	22	0.4	0.06
8/17/15	0	0.5	0.08
	1	3.0	0.02
	2	0.0	0.00
	3	0.1	0.00
	4	0.7	0.24
	5	1.0	0.26
	6	1.7	0.55
	7	1.7	0.90
	8	1.7	0.74
	9	1.7	1.15
	10	1.9	1.01
	11	1.8	1.06
	12	1.7	1.04
	13	1.7	1.06
	14	1.7	0.90
	15	1.6	0.48
	16	1.4	0.58
	17	1.3	0.30
	18	1.2	0.15
	19	1.2	0.11
	20	0.7	0.14
	21	0.2	0.00
	22	0.2	0.02
	23	0.1	0.00
8/31/15	0	0.1	0.00
	1	0.4	0.05
	2	0.3	0.00
	3	0.3	0.01
	4	0.8	0.10
	5	1.4	0.32
	6	1.7	0.66
	7	1.8	1.04
	8	1.9	1.64
	9	1.9	1.31
	10	2.1	1.34
	11	2.0	1.64
	12	1.9	1.36
	13	1.8	1.73
	14	1.8	1.44
	15	1.7	1.29
	16	1.5	0.71
	17	1.4	0.60
	18	1.3	0.61
	19	1.4	0.26
	20	1.3	0.15
	21	0.7	0.08
	22	0.5	0.00
	23	0.1	0.00
9/14/15	0	0.1	0.00
	1	0.3	0.04
	2	0.0	0.00
	3	0.2	0.07
	4	0.2	0.00
	5	1.3	0.12
	6	1.4	0.57
	7	1.6	0.90
	8	1.8	1.09
	9	1.7	0.96
	10	1.9	1.11
	11	1.8	1.29
	12	1.8	1.32
	13	1.6	1.60
	14	1.7	1.36
	15	1.6	1.08
	16	1.5	1.03
	17	1.3	0.68
	18	1.3	0.34
	19	1.2	0.12
	20	1.2	0.04
	21	0.5	0.02
	22	0.3	0.00
	23	0.1	0.00

Lost Creek

Date	Foot	Depth (ft)	Flow (m/s)
5/28/13	0	2.0	0.03
	1	2.5	0.00
	2	3.0	0.03
	3	2.9	0.03
	4	3.4	0.01
	5	3.5	0.03
	6	3.0	0.03
	7	3.0	0.02
	8	2.8	0.03
	9	2.5	0.01
	10	2.4	0.03
	11	2.2	0.01
	12	2.2	0.01
	13	2.2	0.01
	14	2.1	0.01
	15	2.5	0.01
	16	2.7	0.01

	17	2.2	0.01
6/19/13	0	2.2	0.04
	1	1.3	0.06
	2	1.0	0.06
	3	0.7	0.02
	4	0.8	0.10
	5	0.9	0.04
	6	1.0	0.05
	7	1.2	0.06
	8	1.5	0.08
	9	1.3	0.06
	10	1.2	0.02
	11	1.2	0.08
6/26/13	0	2.9	0.02
	1	1.6	0.03
	2	1.0	0.07
	3	0.6	0.03
	4	0.7	0.04
	5	0.7	0.03
	6	0.9	0.04
	7	1.0	0.04
	8	1.7	0.03
	9	1.7	0.04
	10	2.9	0.01
	11	1.4	0.02
	12	1.0	0.02
	13	0.8	0.02
7/18/13	0	1.5	0.02
	1	1.0	0.04
	2	0.7	0.03
	3	0.5	0.01
	4	0.6	0.01
	5	1.0	0.00
	6	0.9	0.02
	7	1.2	0.02
	8	1.3	0.03
	9	1.9	0.02
	10	1.2	0.03
	11	1.3	0.03
	12	1.0	0.02
7/24/13	0	2.7	0.06
	1	1.5	0.06
	2	1.1	0.06
	3	0.9	0.03
	4	0.8	0.03
	5	0.6	0.04
	6	0.6	0.00
	7	0.7	0.03
	8	0.9	0.02
	9	1.5	0.04
	10	1.5	0.03
	11	2.0	0.02
	12	1.4	0.06
	13	0.6	0.03
	14	2.1	0.06
8/9/13	0	3.3	0.09
	1	1.1	0.07
	2	0.9	0.07
	3	0.7	0.06
	4	0.9	0.06
	5	0.7	0.05
	6	0.9	0.07
	7	0.8	0.12
	8	1.1	0.08
	9	1.1	0.10
	10	1.0	0.10
	11	1.2	0.09
	12	1.2	0.09
	13	3.5	0.10
	14	1.0	0.09
8/19/13	0	2.8	0.07
	1	2.6	0.12
	2	1.2	0.09
	3	0.7	0.11
	4	0.6	0.11
	5	0.8	0.09
	6	1.1	0.10
	7	1.0	0.11
	8	1.2	0.11
	9	1.8	0.09
	10	1.8	0.09
	11	1.5	0.09
	12	1.0	0.11
	13	1.4	0.09
	14	2.0	0.10
9/10/13	0	2.8	0.07
	1	1.7	0.08
	2	1.0	0.10
	3	0.6	0.08
	4	0.6	0.07
	5	0.7	0.09
	6	1.0	0.09
	7	1.2	0.10
	8	1.3	0.10
	9	1.5	0.07
	10	1.3	0.11
	11	1.3	0.09
	12	1.0	0.10
	13	1.0	0.12
9/26/13	0	2.6	0.14
	1	1.2	0.12
	2	0.7	0.11
	3	0.8	0.12
	4	1.0	0.13
	5	0.8	0.12
	6	0.9	0.13
	7	1.0	0.11
	8	1.3	0.14
	9	1.3	0.11
	10	1.2	0.13
	11	1.4	0.14
	12	0.7	0.12
	13	1.0	0.10
5/22/14	0	0.5	0.05
	1	0.9	0.24
	2	1.1	0.60
	3	1.2	0.65
	4	1.3	0.47
	5	1.3	0.74
	6	1.4	0.75
	7	1.5	0.56
	8	1.2	0.41
	9	1.1	0.33
	10	1.1	0.27
	11	0.8	0.22
	12	0.3	0.11
	13	0.3	0.14
	14	0.3	0.01
5/28/14	0	1.4	0.21
	1	1.6	0.22
	2	2.0	0.26
	3	2.0	0.34
	4	2.1	0.31
	5	2.6	0.35
	6	2.2	0.13
	7	2.3	0.22
	8	2.5	0.44
	9	2.7	0.75

	10	2.7	0.52
	11	2.2	0.16
	12	2.2	0.24
	13	0.9	0.18
	14	0.5	0.09
6/9/14	0	2.5	0.12
	1	2.6	0.13
	2	2.6	0.10
	3	2.2	0.14
	4	2.2	0.12
	5	1.5	0.11
	6	1.5	0.14
	7	1.5	0.14
	8	1.9	0.19
	9	2.0	0.17
	10	1.7	0.19
	11	1.5	0.17
	12	1.0	0.14
	13	0.8	0.13
	14	1.0	0.15
	15	1.0	0.13
6/24/14	0	1.4	1.03
	1	1.2	0.20
	2	1.7	0.16
	3	1.7	0.13
	4	2.0	0.12
	5	2.3	0.19
	6	2.3	0.16
	7	2.3	0.13
	8	2.3	0.18
	9	2.4	0.35
	10	2.1	0.19
	11	1.9	0.13
	12	1.0	0.28
	13	1.9	0.10
	14	0.7	0.09
	15	1.2	0.07
7/9/14	0	1.5	0.12
	1	2.5	0.12
	2	2.2	0.13
	3	2.2	0.13
	4	2.2	0.10
	5	2.1	0.12
	6	2.4	0.12
	7	2.3	0.18
	8	2.2	0.13

	9	1.9	0.17
	10	1.3	0.12
	11	0.7	0.13
	12	0.5	0.15
	13	0.4	0.11
	14	0.2	0.00
7/21/14	0	1.2	0.13
	1	1.4	0.11
	2	1.3	0.16
	3	1.2	0.18
	4	1.3	0.12
	5	1.2	0.12
	6	1.5	0.29
	7	1.3	0.13
	8	1.7	0.14
	9	2.0	0.14
	10	1.8	0.13
	11	1.8	0.14
	12	1.3	0.11
	13	0.5	0.10
8/5/14	0	1.6	0.13
	1	1.3	0.11
	2	1.5	0.09
	3	1.3	0.11
	4	1.7	0.15
	5	1.9	0.12
	6	2.0	0.12
	7	2.3	0.12
	8	2.4	0.11
	9	2.3	0.13
	10	2.0	0.10
	11	1.7	0.12
	12	0.5	0.13
	13	0.7	0.12
	14	0.9	0.11
	15	0.1	0.00
8/19/14	0	1.9	0.11
	1	2.0	0.11
	2	1.8	0.10
	3	1.9	0.14
	4	1.7	0.13
	5	2.0	0.13
	6	2.8	0.11
	7	2.5	0.11
	8	2.8	0.12
	9	2.9	0.10

	10	2.5	0.11
	11	1.9	0.12
	12	0.8	0.11
	13	0.8	0.08
	14	0.8	0.09
	15	0.8	0.07
9/6/14	0	2.3	0.12
	1	1.3	0.07
	2	1.5	0.09
	3	2.1	0.10
	4	2.2	0.10
	5	2.5	0.08
	6	2.6	0.15
	7	2.6	0.13
	8	2.9	0.12
	9	2.5	0.12
	10	2.4	0.12
	11	1.1	0.08
	12	1.0	0.09
	13	0.9	0.05
	14	1.2	0.12
	15	0.2	0.00
9/17/14	0	3.0	0.10
	1	1.0	0.11
	2	1.4	0.10
	3	1.6	0.08
	4	1.8	0.09
	5	1.8	0.08
	6	1.7	0.11
	7	2.2	0.12
	8	2.5	0.11
	9	2.0	0.13
	10	2.0	0.16
	11	1.6	0.12
	12	1.0	0.10
	13	0.6	0.10
	14	0.8	0.11
5/27/15	0	1.8	0.12
	1	1.6	0.12
	2	1.6	0.08
	3	1.4	0.12
	4	1.2	0.10
	5	1.3	0.12
	6	1.3	0.11
	7	0.2	0.04
	8	1.0	0.04

	9	1.3	0.10
	10	1.1	0.09
	11	1.6	0.11
	12	1.6	0.09
	13	1.3	0.04
	14	1.0	0.11
6/9/15	0	1.9	0.14
	1	2.5	0.17
	2	1.3	0.15
	3	1.3	0.04
	4	2.0	0.06
	5	2.2	0.11
	6	2.4	0.10
	7	2.4	0.12
	8	2.5	0.10
	9	2.8	0.10
	10	2.1	0.08
	11	1.3	0.13
	12	1.1	0.13
	13	1.0	0.11
	14	1.0	0.11
	15	1.0	0.10
6/25/15	0	2.4	0.13
	1	2.2	0.13
	2	1.2	0.10
	3	1.5	0.12
	4	1.6	0.09
	5	2.2	0.11
	6	2.4	0.11
	7	2.4	0.13
	8	2.5	0.11
	9	2.4	0.13
	10	2.4	0.12
	11	2.4	0.12
	12	2.0	0.19
	13	1.2	0.13
	14	0.8	0.10
	15	0.8	0.13
	16	1.0	0.14
	17	1.1	0.13
	18	1.1	0.13
7/7/15	0	3.0	0.08
	1	1.5	0.09
	2	1.5	0.13
	3	1.7	0.10
	4	1.7	0.08

	5	2.4	0.11
	6	2.4	0.12
	7	2.4	0.15
	8	2.7	0.08
	9	2.4	0.09
	10	2.4	0.06
	11	2.3	0.11
	12	1.9	0.10
	13	1.1	0.09
	14	0.8	0.11
	15	0.9	0.11
	16	0.8	0.12
	17	0.9	0.09
	18	0.9	0.02
	19	0.5	0.08
7/20/15	0	2.5	0.08
	1	1.0	0.09
	2	1.6	0.10
	3	1.3	0.08
	4	1.6	0.09
	5	2.0	0.09
	6	2.1	0.09
	7	2.4	0.09
	8	2.1	0.10
	9	1.9	0.08
	10	1.9	0.10
	11	1.0	0.07
	12	0.7	0.08
	13	0.6	0.10
	14	0.8	0.10
	15	1.0	0.07
	16	0.1	0.09
	17	0.6	0.08
8/6/15	0	3.0	0.10
	1	2.3	0.11
	2	2.0	0.07
	3	2.3	0.08
	4	1.8	0.06
	5	1.9	0.10
	6	2.2	0.07
	7	2.3	0.08
	8	2.1	0.03
	9	1.9	0.09
	10	1.9	0.09
	11	1.9	0.08
	12	1.6	0.09

	13	0.8	0.08
	14	0.8	0.08
	15	0.8	0.10
8/17/15	0	2.8	0.06
	1	0.6	0.14
	2	1.7	0.06
	3	1.8	0.08
	4	1.8	0.08
	5	2.0	0.04
	6	2.0	0.07
	7	2.2	0.08
	8	2.2	0.07
	9	2.0	0.03
	10	2.0	0.09
	11	2.0	0.10
	12	1.0	0.08
	13	1.0	0.09
	14	1.3	0.09
	15	1.0	0.08
8/31/15	0	0.8	0.10
	1	1.9	0.08
	2	1.8	0.11
	3	2.0	0.07
	4	2.0	0.09
	5	2.4	0.09
	6	2.4	0.09
	7	2.5	0.10
	8	2.4	0.08
	9	2.4	0.07
	10	2.2	0.09
	11	2.0	0.07
	12	1.7	0.06
	13	1.7	0.11
	14	2.5	0.10
9/14/15	0	1.8	0.07
	1	1.8	0.09
	2	1.9	0.06
	3	1.8	0.07
	4	1.8	0.06
	5	2.2	0.04
	6	2.3	0.09
	7	2.3	0.07
	8	2.4	0.04
	9	2.0	0.06
	10	2.0	0.05
	11	1.4	0.05

	12	1.7	0.06
	13	1.7	0.03
	14	1.7	0.07

Fox Creek

Date	Foot	Depth (ft)	Flow (m/s)
5/28/13	0	0.2	0.04
	1	0.4	0.06
	2	0.5	0.10
	3	0.4	0.15
	4	0.3	0.46
	5	0.3	0.56
	6	0.4	0.87
	7	0.3	0.77
	8	0.3	0.57
	9	0.3	0.80
	10	0.3	0.70
	11	0.3	0.56
	12	0.3	0.45
	13	0.6	0.69
	14	0.6	0.48
	15	0.6	0.63
	16	0.6	0.73
	17	0.7	0.85
	18	0.8	0.84
	19	0.8	0.80
	20	0.9	0.86
	21	0.8	0.74
	22	0.9	0.63
	23	0.9	0.54
	24	0.6	0.39
	25	0.8	0.48
	26	0.8	0.74
	27	0.7	0.65
	28	0.7	0.49
6/19/13	0	0.7	2.13
	1	0.8	2.30
	2	0.9	2.59
	3	0.6	1.97
	4	0.7	1.25
	5	0.8	1.99
	6	0.9	2.16
	7	0.9	1.82
	8	0.9	2.83
	9	0.8	2.91
	10	0.6	3.06
	11	0.8	2.68
	12	0.7	2.13
	13	0.6	1.49
	14	0.6	2.54
	15	0.5	1.42
	16	0.4	2.23
	17	0.3	2.70
	18	0.3	2.57
	19	0.5	2.45
	20	0.5	2.55
	21	0.4	2.25
	22	0.4	2.50
	23	0.5	1.62
	24	0.5	1.25
	25	0.5	0.88
	26	0.4	0.22
6/26/13	0	0.3	0.45
	1	0.5	0.44
	2	0.5	0.83
	3	0.5	2.01
	4	0.5	2.15
	5	0.5	2.04
	6	0.4	1.75
	7	0.4	2.29
	8	0.3	2.00
	9	0.3	1.29
	10	0.3	0.95
	11	0.5	1.80
	12	0.6	2.39
	13	0.6	1.59
	14	0.6	2.36
	15	0.7	2.29
	16	0.7	3.01
	17	0.7	3.00
	18	0.6	3.32
	19	0.7	2.76
	20	0.8	2.51
	21	0.8	1.29
	22	0.7	1.47
	23	0.8	2.05
	24	0.9	3.05
	25	0.7	2.48
	26	0.6	0.52
7/18/13	0	0.4	1.48
	1	0.4	2.43
	2	0.6	1.57
	3	0.3	1.39
	4	0.4	1.35
	5	0.4	1.43
	6	0.6	1.32
	7	0.5	2.53
	8	0.5	2.43
	9	0.4	1.32
	10	0.4	2.07
	11	0.3	1.88
	12	0.2	1.22
	13	0.2	0.53
	14	0.2	0.17
	15	0.2	0.05
	16	0	0.00
	17	0	0.00
	18	0.2	0.90
	19	0.2	1.52
	20	0.2	0.91
	21	0.3	0.78
	22	0.2	0.32
	23	0.3	0.89
	24	0.2	0.95
	25	0.3	0.91
	26	0.2	0.79
7/24/13	0	0.3	0.97
	1	0.4	0.87
	2	0.4	2.15
	3	0.4	0.65
	4	0.3	0.85
	5	0.4	1.73
	6	0.4	1.52
	7	0.3	1.48
	8	0.3	1.45
	9	0.4	1.55
	10	0.3	1.52
	11	0.3	0.12
	12	0.2	1.30
	13	0.2	1.06
	14	0.2	0.54
	15	0.2	0.40
	16	0.0	0.00
	17	0.0	0.00
	18	0.0	0.00
	19	0.2	1.03
	20	0.2	1.07

	21	0.3	0.51
	22	0.3	0.99
	23	0.2	1.21
	24	0.3	0.70
	25	0.3	0.96
	26	0.2	0.81
8/9/13	0	0.5	0.08
	1	0.4	0.05
	2	0.6	0.10
	3	0.5	0.24
	4	1.2	0.27
	5	1.2	0.28
	6	2.0	0.36
	7	2.1	0.53
	8	2.2	0.56
	9	2.3	0.45
	10	2.4	0.53
	11	2.2	0.60
	12	2.1	0.55
	13	1.6	0.54
	14	2.1	0.33
	15	2.0	0.47
	16	1.9	0.41
	17	1.7	0.37
	18	1.7	0.22
	19	1.6	0.23
	20	1.4	0.22
	21	1.2	0.15
	22	0.9	0.06
	23	0.3	0.08
	24	0.1	0.00
8/19/13	0	0.2	0.83
	1	0.3	0.76
	2	0.3	1.05
	3	0.3	1.02
	4	0.3	1.07
	5	0.2	1.22
	6	0.2	1.42
	7	0.0	0.00
	8	0.1	0.12
	9	0.2	0.28
	10	0.2	0.82
	11	0.3	0.70
	12	0.4	1.78
	13	0.4	2.45
	14	0.4	1.84

	15	0.5	2.77
	16	0.5	1.98
	17	0.5	2.71
	18	0.5	1.73
	19	0.5	1.86
	20	0.6	1.91
	21	0.5	0.80
	22	0.6	1.11
	23	0.6	2.43
	24	0.5	1.51
	25	0.3	1.21
9/10/13	0	0.2	0.92
	1	0.3	1.17
	2	0.2	1.02
	3	0.2	0.45
	4	0.2	0.40
	5	0.2	1.10
	6	0.1	0.92
	7	0.0	0.00
	8	0.2	0.22
	9	0.1	0.22
	10	0.2	0.46
	11	0.2	0.71
	12	0.3	0.64
	13	0.3	1.53
	14	0.3	1.89
	15	0.4	2.15
	16	0.3	2.79
	17	0.3	1.89
	18	0.4	1.36
	19	0.5	1.62
	20	0.5	1.85
	21	0.4	0.66
	22	0.5	1.31
	23	0.5	2.47
	24	0.4	1.93
	25	0.3	1.68
9/26/13	0	0.2	0.58
	1	0.3	0.76
	2	0.3	0.80
	3	0.3	0.50
	4	0.2	0.66
	5	0.2	0.76
	6	0.2	1.42
	7	0.2	0.95
	8	0.1	0.00

	9	0.2	0.92
	10	0.2	0.04
	11	0.3	0.70
	12	0.3	1.15
	13	0.3	1.06
	14	0.4	2.24
	15	0.4	0.61
	16	0.4	1.83
	17	0.4	3.30
	18	0.4	2.00
	19	0.5	1.96
	20	0.6	1.71
	21	0.5	1.39
	22	0.5	0.65
	23	0.6	1.96
	24	0.6	2.35
	25	0.5	1.64
	26	0.4	1.66
5/22/14	0	1.4	2.65
	1	1.3	3.27
	2	1.4	3.27
	3	1.2	2.70
	4	1.1	1.68
	5	1.0	2.36
	6	1.1	1.95
	7	1.1	2.81
	8	1.1	3.20
	9	1.0	3.02
	10	1.0	3.77
	11	0.9	3.16
	12	0.8	3.42
	13	0.6	2.58
	14	0.8	2.97
	15	0.8	1.82
	16	0.8	2.26
	17	0.6	2.54
	18	0.6	2.38
	19	0.6	1.94
	20	0.6	2.38
	21	0.5	2.00
	22	0.5	1.82
	23	0.5	1.98
	24	0.6	2.19
	25	0.5	2.15
	26	0.2	1.80
	27	0.4	1.30

	28	0.4	1.16
	29	0.3	0.42
5/28/14	0	0.3	0.20
	1	0.3	0.52
	2	0.5	0.73
	3	0.6	1.29
	4	0.5	2.00
	5	0.6	1.95
	6	0.5	2.14
	7	0.5	1.71
	8	0.5	2.03
	9	0.5	2.78
	10	0.6	2.10
	11	0.6	1.94
	12	0.5	2.47
	13	0.3	2.66
	14	0.8	2.02
	15	0.5	2.37
	16	0.5	3.17
	17	0.7	3.09
	18	1.0	2.60
	19	1.0	2.36
	20	1.0	3.12
	21	1.0	3.41
	22	1.0	2.85
	23	1.0	2.76
	24	0.6	4.07
	25	1.1	2.92
	26	1.2	0.87
	27	1.3	2.46
	28	1.4	2.89
	29	1.4	2.45
6/9/14	0	1.4	2.68
	1	1.4	2.66
	2	1.4	2.97
	3	1.2	2.35
	4	1.1	2.32
	5	1.1	1.73
	6	1.1	2.33
	7	1.0	2.71
	8	1.0	3.07
	9	1.0	3.51
	10	0.9	2.74
	11	0.6	2.63
	12	0.9	3.51
	13	0.7	2.98

	14	0.7	2.74
	15	0.5	2.39
	16	0.5	2.28
	17	0.6	2.18
	18	0.5	2.25
	19	0.6	2.85
	20	0.5	2.36
	21	0.5	2.29
	22	0.6	2.24
	23	0.5	2.23
	24	0.5	2.60
	25	0.5	0.86
	26	0.4	1.02
	27	0.3	0.82
6/24/14	0	1.3	1.33
	1	1.3	2.66
	2	1.4	3.59
	3	1.1	2.08
	4	1.2	2.56
	5	1.1	2.56
	6	1.1	2.34
	7	1.0	3.59
	8	1.1	3.56
	9	1.1	3.31
	10	1.0	2.92
	11	1.0	3.41
	12	0.9	2.77
	13	0.8	2.67
	14	0.8	2.69
	15	0.6	2.72
	16	0.8	2.49
	17	0.7	1.91
	18	0.7	2.34
	19	0.6	1.78
	20	0.6	1.72
	21	0.6	1.74
	22	0.7	1.76
	23	0.7	1.53
	24	0.7	1.56
	25	0.6	1.76
	26	0.6	0.81
	27	0.6	0.87
	28	0.4	0.48
	29	0.2	0.31
7/9/14	0	1.1	1.13
	1	1.2	1.66

	2	1.2	2.24
	3	1.2	2.35
	4	1.1	1.45
	5	1.1	2.08
	6	1.0	0.81
	7	1.0	2.31
	8	1.0	2.85
	9	1.0	2.93
	10	0.8	3.06
	11	0.8	2.31
	12	0.8	2.20
	13	0.7	1.91
	14	0.7	2.08
	15	0.7	1.98
	16	0.7	1.74
	17	0.6	0.79
	18	0.6	1.66
	19	0.5	1.54
	20	0.5	1.54
	21	0.5	1.33
	22	0.4	1.28
	23	0.5	1.23
	24	0.5	1.41
	25	0.5	1.30
	26	0.5	1.50
	27	0.5	0.97
	28	0.4	1.03
	29	0.3	0.64
	30	0.3	0.32
7/21/14	0	1.0	1.20
	1	1.0	1.95
	2	0.8	2.29
	3	1.0	2.15
	4	0.8	1.02
	5	0.8	2.63
	6	0.8	0.47
	7	0.8	2.25
	8	0.6	2.44
	9	0.5	3.13
	10	0.8	2.64
	11	0.7	2.22
	12	0.6	1.78
	13	0.5	2.05
	14	0.4	1.22
	15	0.5	1.05
	16	0.5	0.80

	17	0.4	0.06
	18	0.3	1.87
	19	0.3	1.45
	20	0.3	1.45
	21	0.3	1.04
	22	0.2	0.74
	23	0.3	0.92
	24	0.3	1.00
	25	0.2	1.04
	26	0.3	1.27
	27	0.2	1.07
	28	0.2	0.61
	29	0.1	0.51
	30	0.1	0.12
8/5/14	0	0.9	1.35
	1	1.0	1.53
	2	0.9	1.81
	3	0.9	1.91
	4	0.8	1.34
	5	0.7	1.64
	6	0.7	0.14
	7	0.5	2.15
	8	0.6	2.52
	9	0.4	2.52
	10	0.5	2.25
	11	0.5	2.04
	12	0.5	2.01
	13	0.4	1.63
	14	0.4	1.35
	15	0.4	1.15
	16	0.4	0.91
	17	0.3	1.27
	18	0.2	1.49
	19	0.2	1.21
	20	0.2	1.14
	21	0.2	0.94
	22	0.2	0.97
	23	0.3	0.87
	24	0.3	0.87
	25	0.3	1.09
	26	0.3	0.86
	27	0.2	0.42
	28	0.1	0.47
	29	0.05	0.00
8/19/14	0	1.0	1.54
	1	1.0	2.02
	2	1.0	2.14
	3	0.9	1.87
	4	0.8	0.84
	5	0.7	1.86
	6	0.7	0.02
	7	0.7	2.02
	8	0.5	2.34
	9	0.4	2.74
	10	0.6	2.18
	11	0.6	2.43
	12	0.5	2.19
	13	0.4	2.11
	14	0.4	1.75
	15	0.4	1.51
	16	0.4	1.01
	17	0.1	0.23
	18	0.3	2.07
	19	0.2	1.20
	20	0.2	1.13
	21	0.2	0.90
	22	0.2	0.87
	23	0.3	0.81
	24	0.3	1.09
	25	0.3	1.32
	26	0.3	1.26
	27	0.2	0.29
	28	0.1	0.51
	29	0.05	0.00
9/6/14	0	1.3	2.12
	1	1.3	2.68
	2	1.3	3.05
	3	1.2	2.75
	4	1.1	3.48
	5	0.9	3.39
	6	1.0	3.54
	7	1.0	2.77
	8	0.9	2.94
	9	0.8	4.03
	10	0.9	2.40
	11	0.9	3.32
	12	0.7	2.48
	13	0.6	3.53
	14	0.5	2.62
	15	0.7	2.69
	16	0.7	2.36
	17	0.5	1.80
	18	0.5	2.07
	19	0.5	1.98
	20	0.5	1.24
	21	0.5	1.31
	22	0.5	1.49
	23	0.5	1.78
	24	0.5	1.77
	25	0.5	1.72
	26	0.5	1.50
	27	0.5	1.10
	28	0.3	0.60
	29	0.3	0.70
9/17/14	0	0.9	1.17
	1	0.7	2.14
	2	1.0	1.68
	3	0.7	1.90
	4	0.8	1.29
	5	0.7	1.67
	6	0.6	0.74
	7	0.7	2.28
	8	0.7	2.70
	9	0.5	2.93
	10	0.6	2.11
	11	0.5	1.94
	12	0.4	1.86
	13	0.4	1.40
	14	0.4	1.33
	15	0.3	1.27
	16	0.4	1.19
	17	0.2	0.89
	18	0.2	0.89
	19	0.2	1.84
	20	0.2	0.72
	21	0.1	0.84
	22	0.2	0.69
	23	0.2	0.59
	24	0.3	0.99
	25	0.2	1.03
	26	0.2	0.88
	27	0.2	0.56
	28	0.1	0.19
5/27/15	0	0.7	1.40
	1	0.8	1.19
	2	0.9	3.30
	3	0.9	2.93
	4	0.8	1.44

	5	0.8	3.04
	6	0.8	1.13
	7	0.7	2.76
	8	0.6	3.02
	9	0.6	3.31
	10	0.8	3.00
	11	0.6	2.34
	12	0.6	1.96
	13	0.4	1.54
	14	0.4	0.87
	15	0.4	0.87
	16	0.3	0.53
	17	0.1	2.23
	18	0.3	1.13
	19	0.3	1.37
	20	0.2	1.02
	21	0.2	0.94
	22	0.2	0.06
	23	0.3	0.99
	24	0.3	1.12
	25	0.2	1.06
	26	0.2	0.78
	27	0.2	0.99
	28	0.2	0.28
6/9/15	0	0.8	0.92
	1	1.0	3.12
	2	1.0	3.06
	3	1.0	2.72
	4	0.9	2.94
	5	0.8	3.14
	6	0.8	2.66
	7	0.6	3.67
	8	0.8	4.25
	9	0.7	2.25
	10	0.7	3.30
	11	0.8	2.84
	12	0.7	2.54
	13	0.5	2.62
	14	0.5	1.52
	15	0.4	1.12
	16	0.4	1.69
	17	0.3	0.90
	18	0.3	1.34
	19	0.3	1.04
	20	0.3	1.14
	21	0.3	1.14

	22	0.3	1.11
	23	0.3	1.39
	24	0.3	1.23
	25	0.3	1.29
	26	0.3	1.67
	27	0.3	1.12
	28	0.2	0.44
6/25/15	0	0.8	1.18
	1	0.9	2.54
	2	0.9	2.69
	3	0.9	2.68
	4	0.6	1.55
	5	0.6	3.05
	6	0.6	1.68
	7	0.7	2.58
	8	0.7	3.82
	9	0.5	3.67
	10	0.6	3.43
	11	0.5	2.48
	12	0.6	2.03
	13	0.4	1.91
	14	0.4	1.69
	15	0.3	1.38
	16	0.3	1.54
	17	0.3	0.59
	18	0.3	1.90
	19	0.2	0.75
	20	0.3	0.93
	21	0.2	1.11
	22	0.2	0.90
	23	0.2	0.66
	24	0.3	1.18
	25	0.3	1.45
	26	0.3	1.21
	27	0.3	1.06
	28	0.2	0.30
7/7/15	0	0.9	1.85
	1	0.9	2.55
	2	1.0	2.50
	3	0.9	1.49
	4	0.9	2.51
	5	0.9	0.85
	6	0.8	3.11
	7	0.8	3.48
	8	0.8	3.71
	9	0.8	3.51

	10	0.7	2.97
	11	0.7	3.03
	12	0.7	2.35
	13	0.6	2.58
	14	0.5	2.41
	15	0.6	2.53
	16	0.5	2.65
	17	0.5	1.89
	18	0.5	2.10
	19	0.4	1.67
	20	0.4	1.53
	21	0.4	1.52
	22	0.4	1.84
	23	0.4	1.79
	24	0.4	1.92
	25	0.4	1.81
	26	0.4	1.80
	27	0.3	1.09
	28	0.2	0.12
	29	0.1	0.08
7/20/15	0	0.9	0.42
	1	1.0	2.51
	2	1.0	2.90
	3	0.9	2.84
	4	0.7	0.35
	5	0.8	2.35
	6	0.7	2.32
	7	0.6	4.11
	8	0.7	3.93
	9	0.7	2.50
	10	0.7	2.80
	11	0.7	2.49
	12	0.7	2.48
	13	0.6	2.06
	14	0.5	3.22
	15	0.5	2.58
	16	0.4	1.74
	17	0.4	1.50
	18	0.3	0.02
	19	0.4	1.41
	20	0.3	0.58
	21	0.3	0.91
	22	0.4	2.02
	23	0.4	1.60
	24	0.4	1.77
	25	0.4	1.94

	26	0.4	2.12
	27	0.3	0.85
	28	0.1	0.03
8/6/15	0	0.6	0.62
	1	0.8	2.39
	2	0.9	2.63
	3	0.5	1.76
	4	0.6	2.23
	5	0.6	0.06
	6	0.5	2.31
	7	0.5	2.16
	8	0.5	3.52
	9	0.5	2.99
	10	0.4	2.38
	11	0.5	1.72
	12	0.4	1.99
	13	0.3	1.18
	14	0.1	1.07
	15	0.3	0.24
	16	0.2	1.27
	17	0.1	1.70
	18	0.1	0.58
	19	0.2	0.67
	20	0.1	0.61
	21	0.1	0.02
	22	0.2	0.44
	23	0.2	0.90
	24	0.2	0.74
	25	0.1	0.72
	26	0.1	0.96
	27	0.1	0.27
	28	0.1	0.13
8/17/15	0	0.6	0.24
	1	0.6	2.63
	2	0.8	2.73
	3	0.6	1.92
	4	0.6	1.98
	5	0.6	0.68
	6	0.5	0.10
	7	0.3	2.77
	8	0.5	3.23
	9	0.3	3.20
	10	0.5	2.29
	11	0.5	2.32
	12	0.4	2.07
	13	0.4	1.44
	14	0.2	0.91
	15	0.3	0.96
	16	0.2	1.39
	17	0.2	0.55
	18	0.2	0.18
	19	0.2	0.69
	20	0.1	0.61
	21	0.1	0.00
	22	0.1	0.53
	23	0.2	0.97
	24	0.1	0.76
	25	0.2	0.24
	26	0.2	1.21
	27	0.1	0.59
	28	0.1	0.22
8/31/15	0	1.1	1.48
	1	1.0	2.31
	2	1.0	2.34
	3	0.7	1.06
	4	0.7	2.04
	5	0.6	2.34
	6	0.7	2.20
	7	0.6	3.36
	8	0.6	3.17
	9	0.7	2.57
	10	0.7	2.25
	11	0.6	2.33
	12	0.5	2.59
	13	0.5	1.94
	14	0.5	1.05
	15	0.5	2.68
	16	0.2	0.50
	17	0.3	1.81
	18	0.3	1.55
	19	0.3	2.02
	20	0.3	1.84
	21	0.3	1.61
	22	0.3	1.26
	23	0.3	1.31
	24	0.3	1.11
	25	0.3	1.56
	26	0.3	1.87
	27	0.2	1.74
9/14/15	0	0.8	0.29
	1	0.8	2.47
	2	1.0	2.81
	3	0.7	0.32
	4	0.7	2.94
	5	0.6	0.14
	6	0.6	2.73
	7	0.6	2.97
	8	0.6	3.28
	9	0.7	2.70
	10	0.6	2.11
	11	0.7	2.15
	12	0.6	2.60
	13	0.5	1.52
	14	0.3	1.23
	15	0.3	1.86
	16	0.4	1.39
	17	0.3	1.08
	18	0.2	1.88
	19	0.2	1.32
	20	0.2	1.06
	21	0.1	1.00
	22	0.3	1.22
	23	0.2	1.15
	24	0.2	0.67
	25	0.3	1.55
	26	0.2	1.02
	27	0.2	0.83
	28	0.1	0.38

Appendix E

Algae Data and Report

Wisconsin State Laboratory of Hygiene
2601 Agriculture Drive, PO Box 7996
Madison, WI 53707-7996
(800)442-4618 • FAX (608)224-6213
http://www.slh.wisc.edu

Laboratory Report

D.F. Kurtycz, M.D., Medical Director • Charles D. Brokopp, Dr.P.H., Director

Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000225

POLK COUNTY LAND & WATER RESOU

100 POLK CO. PLAZA, STE 120

BALSAM LAKE WI 54810

Bill To

Customer ID: 336949

POLK COUNTY LAND & WATER RESOURCES DEPARTMENT
100 POLK CO. PLAZA, STE 120
BALSAM LAKE WI 54810

ID#: 493144

Waterbody/Outfall ID: 2627000

Point/Well:

Account #: PP001

Project No:

Date Received: 02/19/2014 08:28:00

Date Reported: 03/10/2014

Sample Reason:

Field #:

Collection Start: 05/28/2013

Collection End:

Collected By: JEREMY WILLIAMSON

County:

Sample Source: SURFACE WATER

Sample Depth: 2 Meters

Sample Information: ; COMPOSITE SAMPLER

Sample Location: BIG BLAKE LAKE

Sample Description: MID LAKE

Analyses and Results:

Taxa	Division	Result	Unit	Percentage
ASTERIONELLA FORMOSA	BACILLARIOPHYTA	131.	CELLS/ML	1.4 %
AULACOSEIRA SP.	BACILLARIOPHYTA	341.	CELLS/ML	3.7 %
FRAGILARIA CROTONENSIS	BACILLARIOPHYTA	2804.	CELLS/ML	30.6 %
DYSMORPHOCOCCUS SP.	CHLOROPHYTA	26.	CELLS/ML	0.3 %
STAURASTRUM SP.	CHLOROPHYTA	26.	CELLS/ML	0.3 %
DINOBRYON SP.	CHRYSOPHYTA	1598.	CELLS/ML	17.4 %
CRYPTOMONAS SP.	CRYPTOPHYTA	970.	CELLS/ML	10.6 %
KOMMA CAUDATA	CRYPTOPHYTA	3275.	CELLS/ML	35.7 %

Wisconsin State Laboratory of Hygiene
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http://www.slh.wisc.edu

Laboratory Report

D.F. Kurtycz, M.D., Medical Director • Charles D. Brokopp, Dr.P.H., Director

Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000225

Test results for NELAP accredited tests are certified to meet the requirements of the NELAC standards. For a list of accredited analytes see http://www.slh.wisc.edu/nelap/

List of Abbreviations:

Natural Unit = Unicell, Colony or Filament Equals 1 Unit
LOD = Level of detection
LOQ = Level of quantification
ND = None detected. Results are less than the LOD

Responsible Party: _____ Steve Geis, Chemist Supervisor

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Report #: 9567392

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Laboratory Report

D.F. Kurtycz, M.D., Medical Director • Charles D. Brokopp, Dr.P.H., Director

Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000226

POLK COUNTY LAND & WATER RESOU
100 POLK CO. PLAZA, STE 120
BALSAM LAKE WI 54810

Bill To

Customer ID: 336949
POLK COUNTY LAND & WATER RESOURCES DEPARTMENT
100 POLK CO. PLAZA, STE 120
BALSAM LAKE WI 54810

ID#: 493144
Waterbody/Outfall ID: 2627000
Point/Well:
Account #: PP001
Project No:
Date Received: 02/19/2014 08:28:00
Date Reported: 03/10/2014
Sample Reason:

Field #:
Collection Start: 06/26/2013
Collection End:
Collected By: JEREMY WILLIAMSON
County:
Sample Source: SURFACE WATER
Sample Depth: 2 Meters
Sample Information: ; COMPOSITE SAMPLER
Sample Location: BIG BLAKE LAKE
Sample Description: MID LAKE
Analyses and Results:

Taxa	Division	Result	Unit	Percentage
AULACOSEIRA SP.	BACILLARIOPHYTA	454.	CELLS/ML	9.6 %
CAVINULA SP.	BACILLARIOPHYTA	14.	CELLS/ML	0.3 %
FRAGILARIA CROTONENSIS	BACILLARIOPHYTA	1306.	CELLS/ML	27.7 %
SCHROEDERIA SP.	CHLOROPHYTA	695.	CELLS/ML	14.7 %
DINOBRYON SP.	CHRYSOPHYTA	284.	CELLS/ML	6.0 %
CRYPTOMONAS SP.	CRYPTOPHYTA	199.	CELLS/ML	4.2 %
KOMMA CAUDATA	CRYPTOPHYTA	1717.	CELLS/ML	36.4 %
CERATIUM HIRUNDINELLA	PYRRHOPHYTA	43.	CELLS/ML	0.9 %

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Laboratory Report

D.F. Kurtycz, M.D., Medical Director • Charles D. Brokopp, Dr.P.H., Director

Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000226

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List of Abbreviations:

Natural Unit = Unicell, Colony or Filament Equals 1 Unit
LOD = Level of detection
LOQ = Level of quantification
ND = None detected. Results are less than the LOD

Responsible Party: _____ Steve Geis, Chemist Supervisor

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Report #: 9567393

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Laboratory Report

D.F. Kurtycz, M.D., Medical Director • Charles D. Brokopp, Dr.P.H., Director

Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000227

POLK COUNTY LAND & WATER RESOU

100 POLK CO. PLAZA, STE 120

BALSAM LAKE WI 54810

Bill To

Customer ID: 336949

POLK COUNTY LAND & WATER RESOURCES DEPARTMENT
100 POLK CO. PLAZA, STE 120
BALSAM LAKE WI 54810

ID#: 493144

Waterbody/Outfall ID: 2627000

Point/Well:

Account #: PP001

Project No:

Date Received: 02/19/2014 08:28:00

Date Reported: 03/10/2014

Sample Reason:

Field #:

Collection Start: 07/24/2013

Collection End:

Collected By: JEREMY WILLIAMSON

County:

Sample Source: SURFACE WATER

Sample Depth: 2 Meters

Sample Information: ; COMPOSITE SAMPLER

Sample Location: BIG BLAKE LAKE

Sample Description: MID LAKE

Analyses and Results:

Wisconsin State Laboratory of Hygiene
2601 Agriculture Drive, PO Box 7996
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Laboratory Report

D.F. Kurtycz, M.D., Medical Director • Charles D. Brokopp, Dr.P.H., Director

Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000227

Taxa	Division	Result	Unit	Percentage
AULACOSEIRA SP.	BACILLARIOPHYTA	30.	CELLS/ML	0.7 %
CAVINULA SP.	BACILLARIOPHYTA	30.	CELLS/ML	0.7 %
FRAGILARIA CROTONENSIS	BACILLARIOPHYTA	180.	CELLS/ML	4.3 %
SYNEDRA SP.	BACILLARIOPHYTA	20.	CELLS/ML	0.5 %
DICTYOSPHAERIUM SP.	CHLOROPHYTA	220.	CELLS/ML	5.2 %
DYSMORPHOCOCCUS SP.	CHLOROPHYTA	30.	CELLS/ML	0.7 %
MICRACTINIUM SP.	CHLOROPHYTA	220.	CELLS/ML	5.2 %
OOCYSTIS SP.	CHLOROPHYTA	40.	CELLS/ML	1.0 %
PEDIASTRUM SP.	CHLOROPHYTA	10.	CELLS/ML	0.2 %
SCENEDESMUS SP.	CHLOROPHYTA	40.	CELLS/ML	1.0 %
SCHROEDERIA SP.	CHLOROPHYTA	80.	CELLS/ML	1.9 %
SPHAEROCYSTIS SP.	CHLOROPHYTA	210.	CELLS/ML	5.0 %
STAURASTRUM SP.	CHLOROPHYTA	20.	CELLS/ML	0.5 %
TETRAEDRON SP.	CHLOROPHYTA	20.	CELLS/ML	0.5 %
TETRASELMIS SP.	CHLOROPHYTA	40.	CELLS/ML	1.0 %
CRYPTOMONAS SP.	CRYPTOPHYTA	391.	CELLS/ML	9.3 %
KOMMA CAUDATA	CRYPTOPHYTA	1723.	CELLS/ML	41.1 %
ANABAENA SP.	CYANOPHYTA	491.	CELLS/ML	11.7 %
TRACHELOMONAS SP.	EUGLENOPHYTA	100.	CELLS/ML	2.4 %
CERATIUM HIRUNDINELLA	PYRRHOPHYTA	281.	CELLS/ML	6.7 %
PERIDINIUM SP.	PYRRHOPHYTA	20.	CELLS/ML	0.5 %

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List of Abbreviations:

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Responsible Party: Steve Geis, Chemist Supervisor

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Report #: 9567394

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Laboratory Report

D.F. Kurtycz, M.D., Medical Director • Charles D. Brokopp, Dr.P.H., Director

Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000228

POLK COUNTY LAND & WATER RESOU

100 POLK CO. PLAZA, STE 120

BALSAM LAKE WI 54810

Bill To

Customer ID: 336949

POLK COUNTY LAND & WATER RESOURCES DEPARTMENT
100 POLK CO. PLAZA, STE 120
BALSAM LAKE WI 54810

ID#: 493144

Waterbody/Outfall ID: 2627000

Point/Well:

Account #: PP001

Project No:

Date Received: 02/19/2014 08:28:00

Date Reported: 03/10/2014

Sample Reason:

Field #:

Collection Start: 08/19/2013

Collection End:

Collected By: JEREMY WILLIAMSON

County:

Sample Source: SURFACE WATER

Sample Depth: 2 Meters

Sample Information: ; COMPOSITE SAMPLER

Sample Location: BIG BLAKE LAKE

Sample Description: MID LAKE

Analyses and Results:

Wisconsin State Laboratory of Hygiene
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Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000228

Taxa	Division	Result	Unit	Percentage
AULACOSEIRA SP.	BACILLARIOPHYTA	136.	CELLS/ML	0.9 %
CAVINULA SP.	BACILLARIOPHYTA	27.	CELLS/ML	0.2 %
CHODATELLA SP.	CHLOROPHYTA	82.	CELLS/ML	0.5 %
DYSMORPHOCOCCUS SP.	CHLOROPHYTA	164.	CELLS/ML	1.1 %
EUDORINA SP.	CHLOROPHYTA	409.	CELLS/ML	2.7 %
OOCYSTIS SP.	CHLOROPHYTA	164.	CELLS/ML	1.1 %
PEDIASTRUM SP.	CHLOROPHYTA	27.	CELLS/ML	0.2 %
SCHROEDERIA SP.	CHLOROPHYTA	27.	CELLS/ML	0.2 %
TETRASELMIS SP.	CHLOROPHYTA	27.	CELLS/ML	0.2 %
CRYPTOMONAS SP.	CRYPTOPHYTA	2889.	CELLS/ML	18.9 %
KOMMA CAUDATA	CRYPTOPHYTA	4006.	CELLS/ML	26.2 %
ANABAENA SP.	CYANOPHYTA	1744.	CELLS/ML	11.4 %
APHANIZOMENON FLOS-AQUAE	CYANOPHYTA	2861.	CELLS/ML	18.7 %
COELOSPHAERIUM SP.	CYANOPHYTA	1690.	CELLS/ML	11.1 %
MICROCYSTIS AERUGINOSA	CYANOPHYTA	491.	CELLS/ML	3.2 %
CERATIUM HIRUNDINELLA	PYRRHOPHYTA	545.	CELLS/ML	3.6 %

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Report #: 9567395

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Laboratory Report

D.F. Kurtycz, M.D., Medical Director • Charles D. Brokopp, Dr.P.H., Director

Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000229

POLK COUNTY LAND & WATER RESOU

100 POLK CO. PLAZA, STE 120

BALSAM LAKE WI 54810

Bill To

Customer ID: 336949

POLK COUNTY LAND & WATER RESOURCES DEPARTMENT
100 POLK CO. PLAZA, STE 120
BALSAM LAKE WI 54810

ID#: 493144

Waterbody/Outfall ID: 2627000

Point/Well:

Account #: PP001

Project No:

Date Received: 02/19/2014 08:28:00

Date Reported: 03/10/2014

Sample Reason:

Field #:

Collection Start: 09/26/2013

Collection End:

Collected By: JEREMY WILLIAMSON

County:

Sample Source: SURFACE WATER

Sample Depth: 2 Meters

Sample Information: ; COMPOSITE SAMPLER

Sample Location: BIG BLAKE LAKE

Sample Description: MID LAKE

Analyses and Results:

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Environmental Health Division Environmental Toxicology

WDNR LAB ID: 113133790 NELAP LAB ID: E37658 EPA LAB WI00007 WI DATCP ID: 105-415

WSLH Sample: FY000229

Taxa	Division	Result	Unit	Percentage
AULACOSEIRA SP.	BACILLARIOPHYTA	40.	CELLS/ML	0.2 %
CAVINULA SP.	BACILLARIOPHYTA	140.	CELLS/ML	0.6 %
CLOSTERIUM SP.	CHLOROPHYTA	20.	CELLS/ML	0.1 %
DYSMORPHOCOCCUS SP.	CHLOROPHYTA	60.	CELLS/ML	0.3 %
OOCYSTIS SP.	CHLOROPHYTA	301.	CELLS/ML	1.3 %
SCENEDESMUS SP.	CHLOROPHYTA	160.	CELLS/ML	0.7 %
SCHROEDERIA SP.	CHLOROPHYTA	341.	CELLS/ML	1.5 %
SPHAEROCYSTIS SP.	CHLOROPHYTA	1242.	CELLS/ML	5.5 %
STAURASTRUM SP.	CHLOROPHYTA	20.	CELLS/ML	0.1 %
TETRAEDRON SP.	CHLOROPHYTA	40.	CELLS/ML	0.2 %
TETRASELMIS SP.	CHLOROPHYTA	40.	CELLS/ML	0.2 %
CRYPTOMONAS SP.	CRYPTOPHYTA	2645.	CELLS/ML	11.8 %
KOMMA CAUDATA	CRYPTOPHYTA	1643.	CELLS/ML	7.3 %
ANABAENA SP.	CYANOPHYTA	260.	CELLS/ML	1.2 %
APHANIZOMENON FLOS-AQUAE	CYANOPHYTA	561.	CELLS/ML	2.5 %
COELOSPHAERIUM SP.	CYANOPHYTA	9518.	CELLS/ML	42.4 %
MICROCYSTIS AERUGINOSA	CYANOPHYTA	1703.	CELLS/ML	7.6 %
PSEUDANABAENA SP.	CYANOPHYTA	3707.	CELLS/ML	16.5 %

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Report #: 9567396

Lake		Big Blake	Big Blake	Big Blake
Date		**6/24/14**	**7/21/14**	**8/19/14**
Division	**Taxa**	**cells/ml**	**cells/ml**	**cells/ml**
Bacillariiophyta	Aulacoseira	186.39	0.00	0.00
Bacillariiophyta	centric sm	0.00	0.00	0.00
Bacillariiophyta	Cocconeis	11.65	22.02	0.00
Bacillariiophyta	Fragilaria crotonensis	2912.39	352.24	1033.26
Bacillariiophyta	Gomhonema	23.30	0.00	0.00
Bacillariiophyta	Naviculoid	11.65	0.00	0.00
Bacillariiophyta	Stephanodiscus	0.00	88.06	32.29
Bacillariiophyta	Synedra	34.95	22.02	0.00
Chlorophyta	Ankistrodesmus	11.65	44.03	0.00
Chlorophyta	Chlamydomonas	104.85	44.03	0.00
Chlorophyta	Coccoid greens	139.79	110.08	581.21
Chlorophyta	Cosmarion	0.00	0.00	0.00
Chlorophyta	Dictyosphaerium	1071.76	3148.18	161.45
Chlorophyta	Eudorina	0.00	154.11	0.00
Chlorophyta	Franceia	0.00	0.00	0.00
Chlorophyta	Gloeocystis	0.00	88.06	129.16
Chlorophyta	Lagerheimia	0.00	0.00	32.29
Chlorophyta	Mougeotia	0.00	0.00	32.29
Chlorophyta	Nephrocytium	93.20	0.00	0.00
Chlorophyta	Oedogonium	0.00	0.00	193.74
Chlorophyta	Oocystis	46.60	66.05	742.65
Chlorophyta	Pandorina	93.20	0.00	0.00
Chlorophyta	Pediastrum	0.00	88.06	32.29
Chlorophyta	Scenedesmus	0.00	352.24	0.00
Chlorophyta	Schroederia	0.00	0.00	0.00
Chlorophyta	Staurastrum	0.00	44.03	32.29
Chlorophyta	Tetraedron	0.00	0.00	0.00
Chrysophyta	Dinobryon	34.95	0.00	0.00
Chrysophyta	Komma Caudata	34.95	132.09	0.00
Chrysophyta	Mallomonas	0.00	286.20	0.00
Chrysophyta	Synura	0.00	5569.87	32.29
Cryptophyta	Cryptomonas	0.00	132.09	64.58
Cyanophyta	Anabaena	349.49	1871.30	5650.63
Cyanophyta	Aphanizomenon flos-aquae	0.00	0.00	30416.53
Cyanophyta	Aphanocapsa	0.00	0.00	0.00
Cyanophyta	Aphanothece	0.00	0.00	0.00
Cyanophyta	Chroococcus	69.90	0.00	1162.42
Cyanophyta	Coelospharium	151.44	0.00	0.00
Cyanophyta	Gloeocystis	0.00	0.00	0.00

Cyanophyta	Gomphosphaeria	151.44	0.00	2098.81
Cyanophyta	Microcystis	0.00	0.00	10849.21
Cyanophyta	Planktolyngbya	0.00	0.00	0.00
Cyanophyta	Schizothrix	0.00	0.00	0.00
Euglenophyta	Euglena	0.00	44.03	0.00
Euglenophyta	Trachelomonas	11.65	0.00	0.00
Pyrrhophyta	Ceritum	0.00	0.00	0.00
Pyrrhophyta	Peridinium	0.00	0.00	0.00

From:
Dr Robert Pillsbury
Biology Department
University of Wisconsin Oshkosh
800 Algoma Blvd.
Oshkosh, WI 54901
920-424-3069
pillsbur@uwosh.edu

Date: Dec 10, 2015

To:
Jeremy Williamson
Polk County Land and Water Resource Department
100 Polk County Plaza, Suite 120
Balsam Lake, WI 54810

Project Overview

Wisconsin Lakes Report: Analysis of phytoplankton samples from Big Blake Lake and Lotus Lake during June-August 2014.

Methods

This set of lake samples was received in the spring of 2015.
Lake samples were concentrated when necessary in glass funnels. Samples were then enumerated using a Palmer-Maloney nanoplankton counting chamber and a Olympus BX40 research microscope at 400x magnification. This allows for the calculations of cell densities (cells/ml) At least 400 cells were counted and identified to genus using Prescot (1952), Taft and Taft (1971) Wehr and Sheath (2003) as the main taxonomic guides. All samples were counted within 5 weeks of receiving them.

Results

Cell densities for each sample are reported in Table 1. The data is grouped by lake and algal division. An electronic version will be included.

-The taxa labeled "centric sm" refers to small (<8 um) centric diatoms which most likely belong to the genus *Cyclotella* but distinguishing details important to taxonomic resolution could not be resolved.

-The Taxa labeled "Naviculoid" represents diatoms that resembled the genus *Navicula* but lack any taxonomic features resolvable at 400x with uncleaned samples.

-The taxa labeled “Coccoid greens” represent small (3-6um), coccoid, green algae (phylum Chlorophyta) cells that lack characteristics to distinguish among several genera from the order Chlorococcales.

Discussion

In both Big Blake and Lotus lakes, there is a general increase in blue-green taxa (Cyanobacteria) from June to August which is typical of many mesotrophic and eutrophic lakes. For each month, Big Blake Lake has high cell densities compared to Lotus Lake.

In general there seems to be a good agreement with both the cell densities and taxonomic composition when these samples are compared with past analyses conducted by the Wisconsin State laboratory of Hygiene from these same lakes. Those reports noted the presence of the diatom genus *Cavinula* was recently split off from the genus *Navicula*. In the cells counts presented in this report those cells would have been labeled as “Naviculoid”. At the magnification used for this report, I did not believe that I could consistently and accurately keep that two taxa separate.

References:

Prescott, G.W. 1952. Algae of the western great lakes area. Otto Koeltz Science Publishers. Koenigstein. Germany.

Taft, C.E., and Taft, C.W. 1971. The algae of western Lake Erie. Bulletin of Ohio Biological survey. 4(1). College of Biological sciences, Ohio State University. Columbus, OH.

Wehr, J.E., and Sheath, R.G. (eds) 2003. Freshwater algae of North America. Ecology and Classification. Academic Press. New York, NY.

Lake	Big Blake	Big Blake	Big Blake
Date	**6/25/15**	**7/20/15**	**8/17/15**
units	**cells/ml**	**cells/ml**	**cells/ml**
Taxa			
Amphora	6	0	0
Asterionella	0	442	0
Aulacoseira granulata	0	1567	0
centric sm	11	241	136
Cocconeis	0	0	0
Cymbella	0	40	34
Fragilaria crotonensis	841	4621	0
Gomhonema	0	0	0
Naviculoid	0	40	102
Nitzschia	0	0	0
Stephanodiscus	0	0	0
Synedra	17	161	136
Tabellaria	0	0	0
Actinastrum	0	0	816
Ankistrodesmus	0	40	0
Arthrodesmus	0	0	0
Characium	0	0	0
Chlamydomonas	105	80	714
Closterium	0	0	0
Coccoid greens	0	0	0
Coelastrum	44	0	0
Cosmarion	0	0	0
Crucigenia	0	0	0
Cylindrocapsa	0	0	0
Dictyosphaerium	144	2049	68
Elactothrix	11	0	0
Euastrum	0	0	0
Eudorina	160	0	0
Franceia	0	80	0
Gloeocystis	33	241	0
Kirchneriella	0	0	0
Lagerheimia	0	40	0
Mougeotia	0	0	0
Nephrocytium	0	0	0
Oedogonium	0	0	0
Oocystis	183	643	136
Pandorina	44	0	0
Pediastrum	0	0	34
Quadrigula	0	0	0

Scenedesmus	0	321	136
Schroederia	17	0	34
Sphaerocystis	0	0	0
Spondylosium	0	0	0
Staurastrum	0	40	0
Tetraedron	0	0	0
Dinobryon	6	0	0
Mallomonas	55	0	136
Synura	0	0	0
Uroglenopsis	0	0	0
Cryptomonas	71	362	714
Komma Caudata	94	241	238
Anabaena	0	6028	40311
Aphanizomenon flos-aquae	0	5063	7348
Aphanocapsa	1681	3215	0
Aphanothece	0	0	0
Chroococcus	44	723	0
Coelospharium	0	0	0
Gloeocystis	0	0	102
Gomphosphaeria	72	1567	0
Merismopedia	0	0	0
Microcystis	0	0	442
Planktolyngbya	548	362	4899
Planktothrix	354	0	2721
Schizothrix	0	0	0
Euglena	0	0	0
Trachelomonas	6	80	0
Ceratium	0	0	0
Euglena	0	0	0
Peridinium	0	0	34
total	4546	28290	59293

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Project Overview

Wisconsin Lakes Report: Analysis of phytoplankton samples from:
Big Blake Lake – June to August 2015 (3 samples)
Bone Lake –April to September 2015 (5 samples
Lotus Lake - June to August 2015 (3 samples)
North Pipe Lake- June to August 2015 (4 samples)
Pipe Lake- June to September 2015 (5 samples)

Methods

This set of lake samples was received in the spring of 2016.
Lake samples were concentrated when necessary in glass funnels to increase cell densities. Samples were then enumerated using a Palmer-Maloney nanoplankton counting chamber and a Olympus BX40 research microscope at 400x magnification. This allows for the calculations of cell densities (cells/ml, back-calculating to the original cell densities). At least 400 cells were counted and identified to genus using Prescot (1952), Taft and Taft (1971), Wehr et al. (2015) as the main taxonomic guides. All samples were counted within 5 weeks of receiving them.

Results

Cell densities for each sample are reported in Table 1. The data is grouped by lake and algal division and presented both as cells/ml and % of total cells counted. An electronic version will be included.

-The taxa labeled “centric sm” refers to small (<8 um) centric diatoms which most likely belong to the genus *Cyclotella* but distinguishing details important to taxonomic resolution could not be resolved. Larger centric diatoms, where it was possible to note genus distinctions, were identified to genera.

-The Taxa labeled “Naviculoid” represents diatoms that resembled the genus *Navicula* but lack any taxonomic features resolvable at 400x with uncleaned samples.

-The taxa labeled “Coccoid greens” represent small (3-6um), coccoid, green algae (phylum Chlorophyta) cells that lack characteristics to distinguish among several genera from the order Chlorococcales.

Discussion

Since I also counted the 2014 for both Big Blake Lake and Lotus Lake, we can compare the phytoplankton samples from these lakes from 2014 and 2015. The cell densities, largely driven by Cyanobacteria, are comparable between 2014 and 2015 with Lotus lake, at any given time, having a higher densities. In 2014, both lakes had their highest sampled densities in August. But in 2015, while Big Blake Lake still peaked in August, Lotus had peak cell densities in July which was also the highest cell densities of the 2015 sampled (over 272,000 cells/ml). This high density sample consisted mostly (71%) of *Planktolyngbia*. This genus is a Cyanobacteria that grows in filaments composed of very small cells. Therefore, even with high cell densities, other lakes may have had more turbid conditions. The second most common taxa (9%) from this sample as *Planktothrix*, a slightly larger filamentous Cyanobacteria. It is interesting to note that while Planktothrix is fairly distinct and was present in all sampled lakes in 2015, it was absent from the 2014 samples.

Bone Lake was sampled across the largest range of months (April to September) and seems to show a spring algal bloom in April which is gone by June. This vernal peak was mostly driven by small-celled Cyanobacteria (*Planktolyngbia* and *Aphanocapsa*). A late summer/fall peak was also observed (mainly caused by a bloom of *Aphanizomenon*) which significantly diminished by late September.

North Pipe Lake exhibited high densities of blue-green algae (*Anabaena* and *Aphanizomenon*) in August. Both of these taxa are “nitrogen fixers” so their dominance might indicate the system was Nitrogen limited during this time. Pipe Lake, however, had relatively low algal densities throughout the sampling season (June to September). This lack of a summer plankton bloom suggests that Pipe Lake might be considered oligotrophic compared to the other sampled lakes which seemed more typical of mesotrophic to eutrophic conditions. Pipe Lake exhibited a spring (June) flora consisting of the diatom *Asterionella*, the green alga *Gloeosystis*, and the flagellated chrysophyte Dinobryon. For the rest of the sampling period (July to September) the algal community was dominated by *Aphanizomenon* and *Anabaena*, which may indicate that the system is also limited by Nitrogen.

References:

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Appendix F

Zooplankton Data and Report

Big Blake Lake Zooplankton (number per liter)

Month	Year	Rotifera	Copepoda	Cladodocera	testate protista	*Chaoborus sp.*
June	2013	11.0	4.7	1.3	0.0	*0.0*
July	2013	14.7	15.9	5.4	0.0	*0.0*
Aug	2013	4.2	3.3	3.8	0.8	*0.4*
June	2014	13.4	3.8	0.4	0.0	*0.0*
July	2014	4.7	5.7	1.3	0.0	*0.0*
Aug	2014	16.3	9.2	2.5	0.4	*0.0*
June	2015	26.1	8.2	4.4	0.0	*0.0*
July	2015	21.8	16.7	1.7	1.3	*0.0*
Aug	2015	11.0	22.0	0.6	0.0	*0.0*

Big Blake Lake Zooplankton (number per liter)

	June	July	Aug	June	July	Aug	June	July	Aug
	2013	2013	2013	2014	2014	2014	2015	2015	2015
Adineta sp.	0	0	1.674937	0	0.314051	0	0	0	0
Anuraeopsis fissa	0	0	0	0	0	0	0	0	0
Ascomorpha sp.	0	0	0	0	0	0	0.628101	0	0.314051
Asplanchna brightwelli	0	0	0	0	0	0	0	0	0
Asplanchna herricki	0	0	0	0	0	0	0	0	0
Aplanchna priodonta	0	0	0	0	0	0	0	0	0
Brachionus angularis	0	0	0	0	0	0	0	0	0
Brachionus quadridentatus	0	0	0	0	0	0	0	0	0
Collotheca sp.	0	0	0.418734	0	0	0	0	0	0
Colurella sp.	0	0	0	0	0	0	0	0	0
Conochilus unicornis	0	0	0	0	0	0.418734	9.421519	0	0.628101
Euchlanis sp.	0	0	0	0	0	0	0	0	0
Filinia longiseta	0	1.256202	0	0	0	2.093671	0	0.418734	1.256202
Filinia terminalis	0	0	0.837468	0	0	0	0	0	0
Gastropus sp.	0	0	0	1.674937	0	0	0	0	0
Hexarthra mira	0	0	0	0	0	0	0	0	0
Kellicottia bostoniensis	0	0	0	0	0	0	0	0	0
Kellicottia longispina	0	0	0	0	0	0	0	0	0
Keratella crassa	0	0	0	0	0	0	0	0	0
Keratella cochlearis cochlearis	7.851266	8.374683	1.256202	4.606076	0.314051	5.02481	2.826456	13.81823	5.966962
Keratella cochlearis hispida	0	0	0	0	0	0	0	0	0
Keratella cochlearis robusta	0.314051	0.837468	0	0	0	7.118481	0.628101	1.256202	1.256202
Keratella cochlearis tecta	0	0	0	0	0	0	0	0	0
Keratella earlinae	0	0	0	0	0	0	0	0	0
Lecane luna	0	0	0	0	0	0	0	0	0
Monostyla bulla	0	0	0	0	0	0.418734	0	0	0
Monostyla closterocerca	0	0	0	0	0	0	0	0	0

Monostyla lunaris	0	0	0	0	0	0	0	0	0
Monostyla quadridentata	0	0	0	0	0	0	0	0	0
Notholca squamula	0	0	0	0	0	0	0	0	0
Notholca acuminata var extensa	0	0	0	0	0	0	0	0	0
Notomata sp.	0	0	0	0	0	0	0	0	0
Polyarthra sp.	0.314051	0	0	0	0.314051	0	0	0	0
Polyarthra dolichoptera	1.570253	0	0	0.837468	0	0	0	0	0
Polyarthra euryptera	0.628101	0.837468	0	0.837468	0	0	1.884304	0	0.628101
Polyarthra major	0	0	0	0	0	0	0	0	0
Polyarthra remata	0	1.256202	0	3.349873	0	1.256202	10.36367	3.349873	0.942152
Polyarthra vulgaris	0	0	0	0	0	0	0	0	0
Pompholyx sulcata	0	0	0	0	0.628101	0	0	0	0
Proales sp.	0	0	0	0	0	0	0	0	0
Synchaeta sp.	0	0	0	0	3.140506	0	0	0	0
Trichocerca (bicristata)	0	0	0	0	0	0	0	0	0
Trichocerca cylindrica	0.314051	0.837468	0	0	0	0	0	0.418734	0
Trichocerca elongata	0	0	0	0	0	0	0	0	0
Trichocerca pusilla	0	1.256202	0	2.093671	0	0	0	0.837468	0
Trichocerca lata	0	0	0	0	0	0	0	0	0
Trichocerca longiseta	0	0	0	0	0	0	0.314051	0	0
Trichocerca multicrinis	0	0	0	0	0	0	0	0	0
Trichocerca similis	0	0	0	0	0	0	0	0	0
Trichotria tetractis	0	0	0	0	0	0	0	0	0
Trocosphaera sp.	0	0	0	0	0	0	0	0	0
unidentified rotifer	0	0	0	0	0	0	0	1.674937	0
cyclopoid nauplius	2.512405	6.281012	2.093671	1.256202	2.198354	5.02481	4.396709	6.281012	8.165316
cyclopoid copepodid	0.628101	7.537215	1.256202	2.512405	0.628101	1.674937	1.570253	7.118481	10.99177
calanoid nauplius	0.628101	0	0	0	0.628101	0	0.942152	0	0
calanoid copepodid	0.314051	1.256202	0	0	0.628101	1.256202	0.628101	1.256202	0
Acanthocyclops sp.	0	0	0	0	0	0	0	0	0

Cyclops sp.	0	0	0	0	0	0	0	0	0
Diacyclops spp.	0.314051	0.837468	0	0	1.570253	0	0	1.256202	1.570253
Megacyclops viridis	0	0	0	0	0	0.418734	0	0	0.314051
Mesocyclops sp.	0.314051	0	0	0	0	0	0	0	0.314051
(Metacyclops sp.)	0	0	0	0	0	0	0	0	0
Microcyclops sp.	0	0	0	0	0	0	0	0	0
Paracyclops chiltoni	0	0	0	0	0	0	0	0	0
[Thermocyclops crassus]	0	0	0	0	0	0	0	0	0
Diaptomidae	0	0	0	0	0	0	0	0	0.628101
(Arctodiaptomus arapahoensis)	0	0	0	0	0	0	0	0	0
Heterocope septeptrionalis	0	0	0	0	0	0	0	0	0
(Limnocalanus sp.)	0	0	0	0	0	0	0	0	0
(Osphrantium sp.)	0	0	0	0	0	0	0	0	0
Skistodiaptomus oregonensis	0	0	0	0	0	0.837468	0.628101	0.837468	0
(Senecella calanoides)	0	0	0	0	0	0	0	0	0
Bosmina coregoni	0	0	0	0	0	0	0.314051	0	0
Bosmina leideri	0	0	0	0	0	0	0	0	0
Bosmina longirostris	0	0	0	0	0	0	1.570253	0	0
Bosmina longispina	0	0	0	0	0	0	0	0	0
Ceriodaphnia sp.	0	0	0	0.418734	0	0	0	0	0
Ceriodaphnia lacustris	0	0	0	0	0	0	0	0	0
Ceriodaphnia laticaudata	0	0	0	0	0	0	0	0	0
Ceriodaphnia pulchella	0	0	0	0	0	0	0	0	0
Ceriodaphnia quadrangula	0	0	0	0	0	0	0.628101	0	0
Chydorus sp.	0	0.418734	0	0	0	0.418734	0	0	0
Chydorus faviformis	0	0	0	0	0	0	0	0	0
Chydorus sphaericus	0	0	0	0	0	0	0	0	0
Diaphanosoma sp.	0	0.837468	0	0	0.314051	0	1.256202	1.674937	0.314051
Daphnia ambigua	0	0.837468	0	0	0	0	0.314051	0	0
Daphnia mendotae	1.256202	2.931139	1.256202	0	0.942152	2.093671	0.314051	0	0.314051

Daphnia parvula	0	0	0	0	0	0	0	0	0
Daphnia pulex	0	0	0	0	0	0	0	0	0
Daphnia retrocurva	0	0	2.512405	0	0	0	0	0	0
Holopedium gibberum	0	0.418734	0	0	0	0	0	0	0
Leptodora kindtii	0	0	0	0	0	0	0	0	0
Acroperus harpae	0	0	0	0	0	0	0	0	0
Camptocercus sp.	0	0	0	0	0	0	0	0	0
Paralona pigra	0	0	0	0	0	0	0	0	0
Sida sp.	0	0	0	0	0	0	0	0	0
Simocephalus mirabilis	0	0	0	0	0	0	0	0	0
Arcella gibbosa	0	0	0	0	0	0	0	0	0
Centropyxis aerophila	0	0	0	0	0	0	0	0	0
Codonella sp.	0	0	0	0	0	0	0	0	0
Cyclopyxis arcelloides	0	0	0	0	0	0	0	0	0
Difflugia globosa	0	0	0.837468	0	0	0	0	0	0
Difflugia oblonga	0	0	0	0	0	0	0	0	0
Difflugia lobostoma	0	0	0	0	0	0.418734	0	1.256202	0
Trinema sp.	0	0	0	0	0	0	0	0	0
unidentified protist	0	0	0	0	0	0	0	0	0

Zooplankton of Big Blake and Lotus Lakes, Polk County (WI) 2013-2016.

Toben Lafrançois, PhD
November 2016

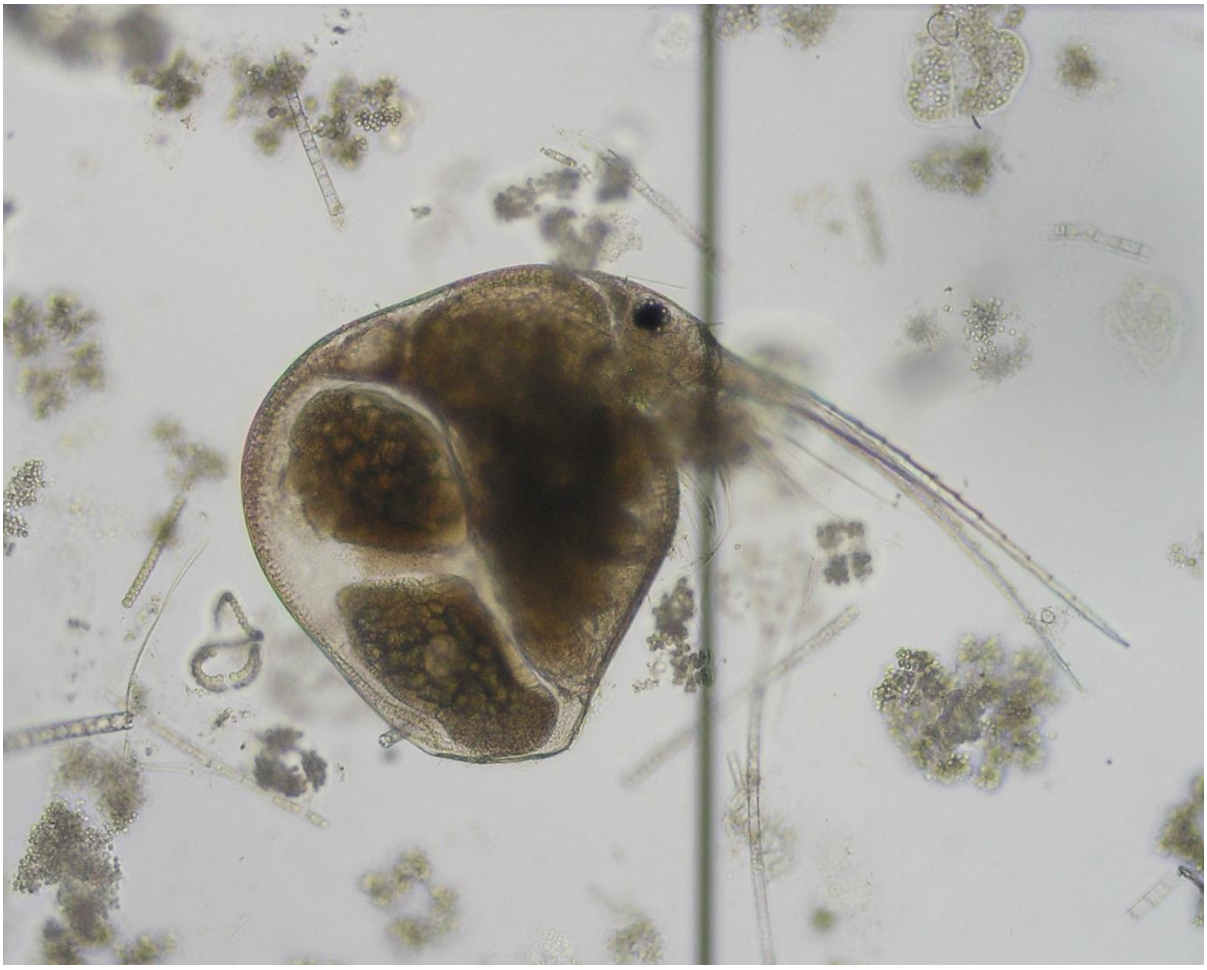

Figure 1. *Bosmina coregoni* from Big Blake Lake, Polk Co., WI, 2015. Field of view = 0.65 mm. Photo T. Lafrançois.

Suggested citation: Lafrançois, T. 2016. Zooplankton of Big Blake and Lotus Lakes, Polk County (WI) 2013-2016. Final report to Polk County Land & Water Resources Department, Polk Co. WI.

Eighteen samples from Big Blake and Lotus Lakes in Polk County were examined for zooplankton species abundances. Final data and basic community analyses have been sent with this report as an attachment in Microsoft Excel.

Methods

Zooplankton samples were collected by Polk Co. with WI plankton nets using known depths for volumetric calculation and preserved in ETOH. Laboratory methods used a dual counting technique for different size fractions modified from Chick et al. 2006 and Chick et al. 2010. This process has been found to be cost-effective and statistically robust in nearby systems (Lafrancois 2009, Lafrancois 2013, Lafrancois *et al*. 2016). Samples were condensed on a 20 µm filter, transferred to 40 mL centrifuge tubes and diluted to between 20 and 40 ml depending on sample density. This volume was rigorously agitated, sub-sampled with a 1mL Hensen-Stempel pipette, and transferred to a 1mL Sedgwick Rafter counting slide. Organisms of all size fractions were counted on a compound microscope at magnifications of 40x to 100x using an Olympus CX41 compound microscope. Counts of rotifers and protists were tallied row by row (1/20 ml increments) on the Sedgwick Rafter cell until stable variance in taxa diversity was achieved (Colwell & Coddington 1994). Stable variance in taxonomic diversity and total number for these samples was achieved when at least 50 individuals of smaller species were counted (with volume counted between 0.6 and 2 ml out of 20-40 ml). The larger organisms (copepods and cladocerans) were then counted for the entire cell and checked against the entire sample. Insecta were counted from the entire sample, but in this case only one *Chaoborus* sp. was found in one sample. At least two aliquots were counted in this manner for each sample. Standard identification keys were used from Thorp & Covich (2010) to allow cross study comparison. Zooplankton counts were converted from numbers per subsample to number per liter (n/l).

Results and Summary

Thirty-eight species / lowest practically identifiable taxa from Big Blake Lake and thirty seven from Lotus Lake were identified from samples reported here (2013 to 2016), Tables 1 and 2 respectively. Basic diversity measures are presented in Table 3.

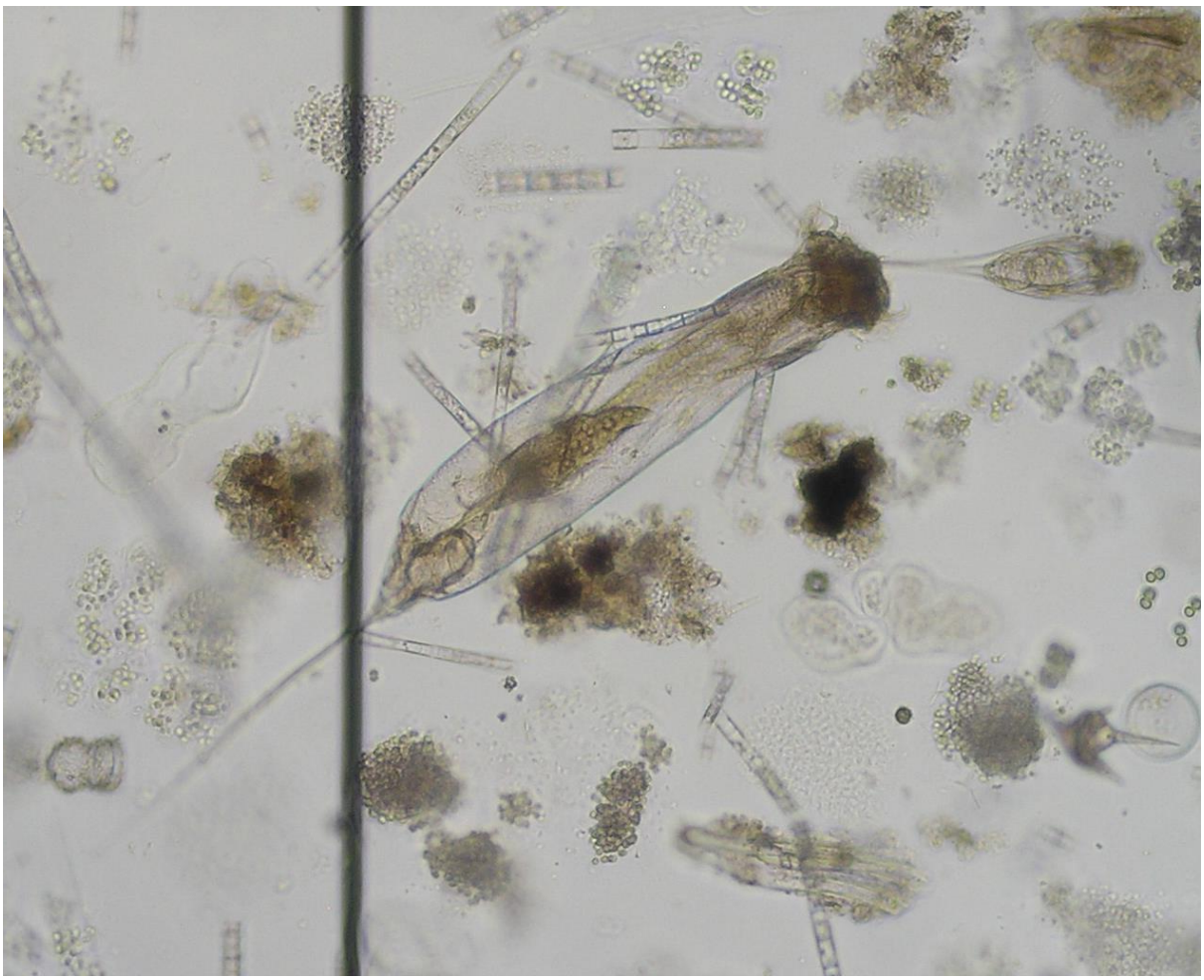

Figure 2. *Trichocerca elongata* and *Filinia longiseta* from Lotus Lake, Polk Co., WI (field of view 1mm across).

Community composition baselines are shown in Figures 3 and 4, with numbers per liter of four primary taxonomic groups. Rotifera are small multicellular organisms that generally feed on bacteria and algae. Cladocerans are crustacean plankton that are typically grazers, and copepods are crustacean often size selective omnivores or predators. Testate protozoa are single celled organisms that leave behind a shell used for identification and counting. It is unclear whether testate protozoa correlate to the total protozoan community, or perhaps are inverse (increasing at the expense of other soft protozoa that leave no trace in preserved samples). They are included because they may indicate run-off events and could be important to long term monitoring as knowledge of this group's ecology develops.

Zooplankton occupy an ecologically critical position between top-down (e.g., fish predation) and bottom-up (e.g., eutrophication) processes. Typically zooplankton will increase in abundance over the summer, and peak in August or September, tracking overall productivity. However, patterns can change

as the community responds to fish stocking and growth, temperature, algal growth and community change – particularly due to nutrients and eutrophication, and other factors. Looking *just* at the community patterns over time gives some insight into these processes but is most meaningful when coupled with environmental and fish stocking data. That said, some general patterns stick out.

Big Blake Lake shows some interesting patterns in 2013, where a typical phenological pattern appears in June and July with a crash in August (Fig. 3). This crash is someone unexpected since August tends to be a very productive year. Environmental factors need to be analyzed to explain this change, which would typically occur later in October or November. The 2014 trends show a more typical response with an unexpected drop in rotifers in July but otherwise a slow increase into the most productive months. In 2015 there was a major increase in copepods over the summer, with a decline in rotifers that could be associated with copepod predation, and a decrease in cladocerans. The cladoceran decrease could be due to either fish pressure or a change in algal community structure. The concurrent increase in copepods suggests that a bottom-up mechanism is more likely, since planktivorous fish tend to favor cladocerans but also enjoy copepods, being mostly size selective.

Lotus Lake produced an order of magnitude greater density of zooplankton than Big Blake in 2014 and 2015 with a curious crash in 2016 for all groups except rotifers in June (Fig. 4). In 2014 and 2015 there was a bump in zooplankton populations, all groups, in July. One particularly notable spike of rotifers in June 2016, Lotus Lake, is primarily due to *B. angularis*, *F. longiseta*, and *Collotheca* sp. (probably *C. mutabilis*). The first two rotifer specie are indicators of eutrophic conditions, combined with *Collotheca* sp. in this spike it would appear to relate to a bacterial bloom related to high nutrients and/or high temperatures (Pejler 1983, Walz 1993, Mola 2011).

A simple principle components ordination based on Bray-Curtis similarities helps sort out the complex of species level community composition. Environmental factors were not tested at this time. The ordination shows community similarity between lakes and sample periods, both month and year (Figure 5). This ordination confirms that there are differences between the zooplankton communities in Big Blake and Lotus Lake across the x-axis, which explains 66.2% of variation in community similarity. Samples from Lotus Lake also spread out a bit more, showing what look to be important groups of different community patters. All of the patterns pointed out here between and within Big Blake and Lotus Lake will be best explained when these results are compared to the larger data set of all factors from these lakes.

Table 1. Lowest identified taxa from Big Blake Lake, Polk County (WI) 2013-2015 with total percent occurrence.

Rotifera		**Cladocera**	
Adineta sp.	0.77%	*Bosmina coregoni*	0.15%
Ascomorpha sp.	0.46%	*Bosmina longirostris*	0.77%
Collotheca sp.	0.15%	*Ceriodaphnia* sp.	0.15%
Conochilus unicornis	5.11%	*Ceriodaphnia quadrangula*	0.31%
Filinia longiseta	2.01%	*Chydorus* sp.	0.31%
Filinia terminalis	0.31%	*Diaphanosoma* sp.	1.86%
Gastropus sp.	0.62%	*Daphnia ambigua*	0.46%
Keratella cochlearis	20.59%	*Daphnia mendotae*	3.72%
Keratella cochlearis robusta	4.49%	*Daphnia retrocurva*	0.93%
Monostyla bulla	0.15%	*Holopedium gibberum*	0.15%
Polyarthra sp.	0.31%		
Polyarthra dolichoptera	1.08%	**Copepoda**	
Polyarthra euryptera	2.17%	cyclopoid nauplius	16.25%
Polyarthra remata	8.98%	cyclopoid copepodid	14.24%
Pompholyx sulcata	0.31%	calanoid nauplius	1.08%
Synchaeta sp.	1.55%	calanoid copepodid	2.17%
Trichocerca cylindrica	0.62%	*Diacyclops* spp.	2.48%
Trichocerca pusilla	1.55%	*Megacyclops viridis*	0.31%
Trichocerca longiseta	0.15%	*Mesocyclops* sp.	0.31%
unidentified rotifer	0.62%	Diaptomidae	0.31%
		Skistodiaptomus oregonensis	0.93%
testate Protista			
Difflugia globosa	0.31%		
Difflugia lobostoma	0.62%		
Insecta			
Chaoborus sp.	0.15%		

Table 2. Lowest identified taxa from Lotus Lake, Polk County (WI) 2013-2016 with total percent occurrence.

Rotifera		**Copepoda**	
Anuraeopsis fissa	4.58%	cyclopoid nauplius	4.84%
Aplanchna priodonta	0.52%	cyclopoid copepodid	3.79%
Brachionus angularis	6.15%	calanoid nauplius	0.52%
Collotheca sp.	3.01%	calanoid copepodid	0.16%
Conochilus unicornis	0.13%	*Diacyclops* spp.	1.44%
Filinia longiseta	8.50%	*Paracyclops chiltoni*	1.18%
Kellicottia longispina	0.78%	Diaptomidae	0.02%
Keratella cochlearis cochlearis	30.09%	*Skistodiaptomus oregonensis*	0.03%
Keratella cochlearis hispida	0.13%		
Keratella cochlearis robusta	0.26%	**Cladocera**	
Polyarthra euryptera	0.13%	*Bosmina coregoni*	0.78%
Polyarthra remata	0.92%	*Bosmina leideri*	0.52%
Pompholyx sulcata	8.37%	*Chydorus sphaericus*	1.45%
Trichocerca (bicristata)	0.92%	*Daphnia ambigua*	0.92%
Trichocerca cylindrica	0.65%	*Daphnia mendotae*	3.01%
Trichocerca elongata	0.13%	*Daphnia retrocurva*	1.80%
Trichocerca pusilla	0.26%	*Sida* sp.	0.01%
Trichocerca multicrinis	0.13%		
Trichocerca similis	0.26%		
unidentified rotifer	0.52%		

testate protista	
Arcella gibbosa	0.65%
Centropyxis aerophila	0.26%
Codonella sp.	1.57%
Difflugia oblonga	0.13%
Difflugia lobostoma	10.33%
unidentified protist	0.13%

Table 3. Diversity indices for Big Blake and Lotus Lakes, 2013 to 2016, Polk Co., WI including S (raw number of species or lowest identified taxa), d (Margaleff Diversity), J' (Pielou's index), Brillouin and Fisher indices, H' (Shannon index, natural log) and in the last column the inverse Simpson index.

Sample	S	d	J'	Brillouin	Fisher	H'(loge)	1-Lambda'
BBlakeJune2013	13	4.24	0.73	1.20	25.49	1.86	0.79
BBlakeJuly2013	16	4.19	0.82	1.84	11.03	2.27	0.88
BBlakeAug2013	9	3.20	0.95	1.40	15.74	2.09	0.94
BBlakeJune2014	9	2.79	0.91	1.48	7.39	1.99	0.89
BBlakeJuly2014	12	4.49	0.87	1.40	****	2.16	0.93
BBlakeAug2014	14	3.88	0.83	1.70	10.90	2.20	0.89
BBlakeJune2015	18	4.65	0.77	1.84	13.11	2.24	0.86
BBlakeJuly2015	14	3.49	0.79	1.72	7.43	2.09	0.84
BBlakeAug2015	15	3.98	0.72	1.57	10.40	1.95	0.82
LotusJune2014	10	1.77	0.67	1.43	2.36	1.54	0.66
LotusJuly2014	19	2.70	0.75	2.19	3.51	2.22	0.86
LotusAug2014	14	2.50	0.85	2.11	3.53	2.23	0.86
LotusJune2015	21	3.94	0.83	2.35	6.47	2.53	0.90
LotusJuly2015	14	2.44	0.88	2.22	3.40	2.32	0.88
LotusAug2015	14	3.08	0.88	2.00	5.35	2.32	0.88
LotusJune2016	11	1.48	0.57	1.34	1.78	1.36	0.59
LotusJuly2016	12	2.91	0.90	1.92	5.45	2.23	0.89
LotusAug2016	11	2.81	0.78	1.59	5.50	1.86	0.77

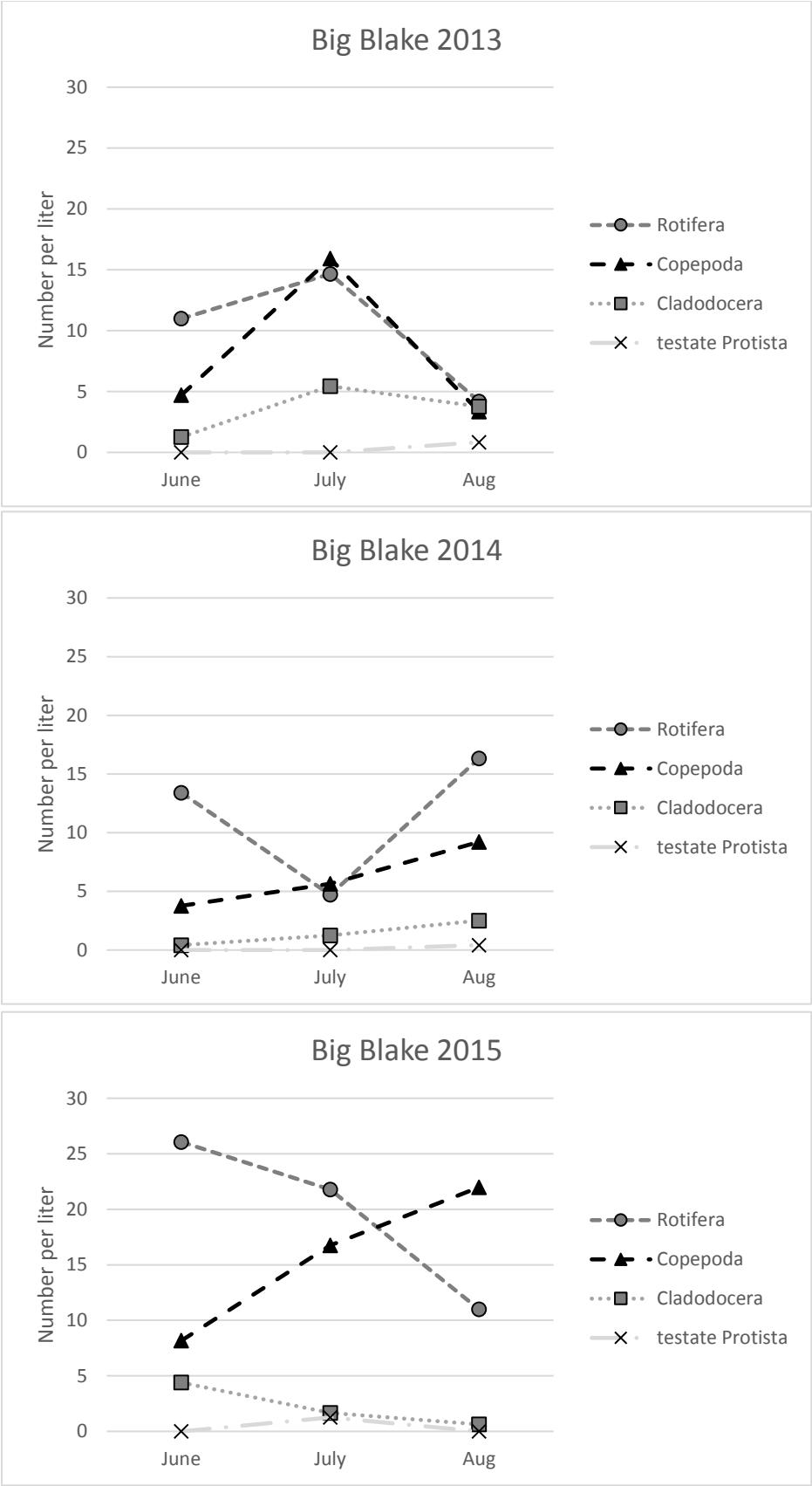

Figure 3. Zooplankton community composition (as total numbers per liter of four primary taxonomic groups) of samples from Big Blake Lake, Polk Co. (WI), 2013 to 2015.

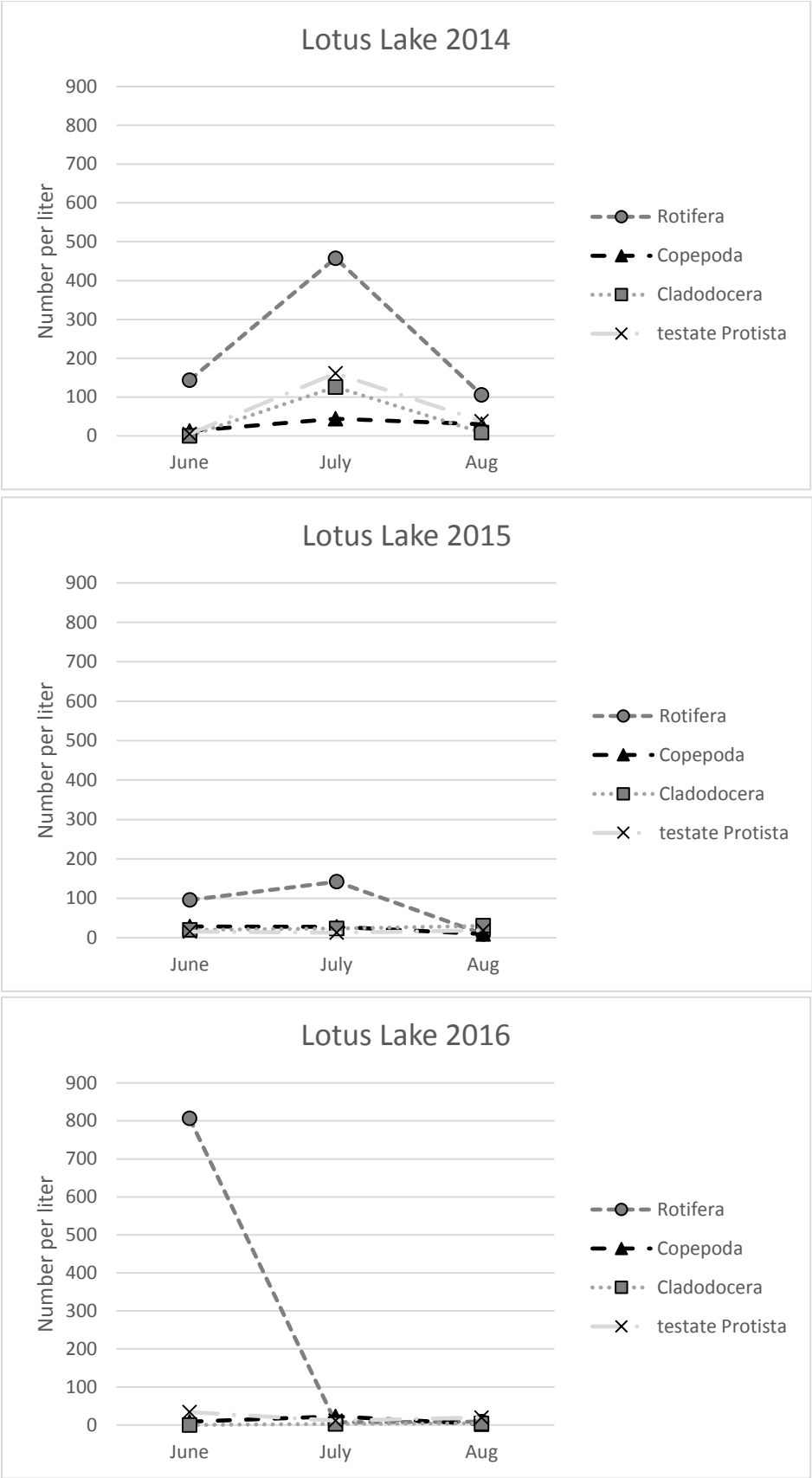

Figure 4. Zooplankton community composition (as total numbers per liter of four primary taxonomic groups) from Lotus Lake, Polk Co. (WI), 2014-2016.

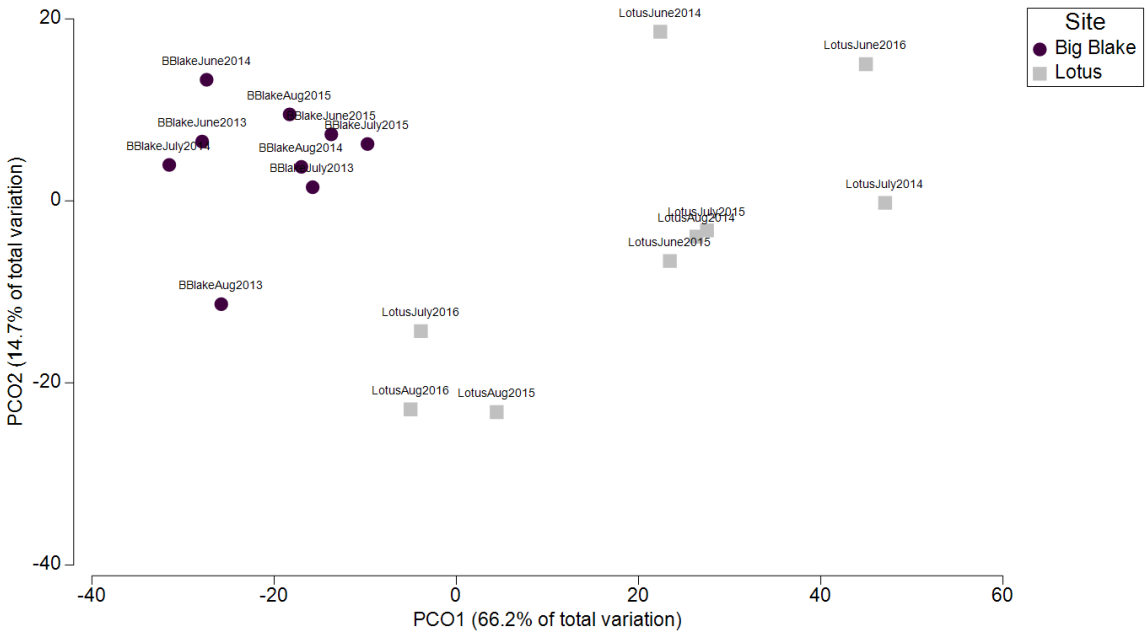

Figure 5. Principal components analysis of zooplankton community composition. Abundances (numbers per liter) were square root transformed before calculating Bray-Curtis resemblance for the ordination. This plot lumped species into major groups to weight the differences between the lakes to show major composition shifts over the more local variations in species. Plot was run in Primer 7 software.

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Appendix G

Curly-leaf Pondweed Biomass and Turion Data

Date	Site	Dredge turion (#)	Turions/m^2	Biomass (grams)	Turion # attached to biomass
6/19/13	4	2	86.95652174	0	0
	8	1	43.47826087	0.5	0
	6	3	130.4347826	0.6	0
	12	4	173.9130435	0.7	0
	44	0	0	0.3	0
	46	6	260.8695652	0.1	0
	48	1	43.47826087	0.1	0
	51	1	43.47826087	2.8	0
6/20/13	69	0	0	0	0
	72	4	173.9130435	9	0
	82	4	173.9130435	12.3	0
	84	0	0	0	0
	79	10	434.7826087	4.2	0
	87	3	130.4347826	0.1	0
	97	9	391.3043478	0	0
	93	0	0	0	0
	92	0	0	0	0
	91	0	0	0	0
	120	0	0	0	0
	121	1	43.47826087	0	0
	125	0	0	0.3	0
	141	0	0	0	0
	140	0	0	0	0
	138	0	0	0	0
	160	0	0	0	0
	154	1	43.47826087	0	0
	165	0	0	0	0
	166	0	0	0	0
	168	0	0	0	0
	169	0	0	0	0
	173	0	0	0	0
9/25/13	181	1	43.47826087	0	0
	188	0	0	0.1	0
	189	2	86.95652174	0	0
	209	5	217.3913043	0	0
	203	5	217.3913043	0	0
	198	0	0	0	0
	193	0	0	0	0
	219	2	86.95652174	0	0
	220	1	43.47826087	0.2	0
	228	3	130.4347826	0	0
	232	15	652.173913	0.1	1
	238	9	391.3043478	0.3	0
	241	2	86.95652174	0	0

	255	1	43.47826087	0	0
	256	1	43.47826087	0.1	0
	260	0	0	0.1	0
	268	12	521.7391304	0.9	0
	267	26	1130.434783	0	0
	276	0	0	0	0

Date	Site	Dredge turion (#)	Turions/m^2	Biomass (grams)	Turion # attached to biomass
6/2/14-6/4/14	4	1	43.47826087	0	0
	10	0	0	0	0
	11	3	130.4347826	0.9	0
	14	4	173.9130435	8.1	1
	37	4	173.9130435	2.4	3
	30	5	217.3913043	0	0
	19	0	0	0	0
	31	2	86.95652174	0.3	0
	49	5	217.3913043	7.3	12
	23	0	0	0.1	0
	56	0	0	1.7	0
	65	7	304.3478261	0.9	1
	67	1	43.47826087	0	0
	73	0	0	0	0
	77	0	0	0.1	0
	82	0	0	6.6	2
	85	0	0	0	0
	94	0	0	0	0
	96	0	0	0	0
	105	0	0	0	0
	111	1	43.47826087	0	0
	124	0	0	0	0
	133	0	0	0	0
	136	0	0	0	0
	139	1	43.47826087	0	0
	147	0	0	0	0
	159	0	0	0	0
	167	0	0	0	0
	170	1	43.47826087	0	0
	171	0	0	0	0
	185	1	43.47826087	0	0
	188	1	43.47826087	0	0
	195	0	0	0	0
	202	2	86.95652174	0	0
	210	3	130.4347826	4.8	2
	217	0	0	3.3	0

	222	1	43.47826087	0	0
	224	4	173.9130435	0	0
	228	5	217.3913043	0	0
	234	4	173.9130435	1.2	1
	237	7	304.3478261	0	0
	239	1	43.47826087	0	0
	241	2	86.95652174	0	0
	244	0	0	0.5	1
	250	1	43.47826087	0	0
	255	1	43.47826087	0	0
	264	10	434.7826087	0.2	0
	269	7	304.3478261	0	0
	271	10	434.7826087	0	0
	273	0	0	0	0

Date	Site	Dredge turion (#)	Turions/m^2	Biomass (grams)	Turion # attached to biomass
6/16/15	10	0	0	2.7	0
	15	0	0	0	0
	18	0	0	2.3	0
	24	3	130.4347826	2.2	1
	30	1	43.47826087	3.3	0
	31	1	43.47826087	12.5	0
	34	0	0	0.2	0
	44	0	0	0.2	0
	57	2	86.95652174	21.8	0
	66	1	43.47826087	35.2	0
	70	0	0	0	0
	89	1	43.47826087	2.2	1
	94	0	0	0	0
	97	0	0	0.5	0
	103	0	0	0.2	0
	105	0	0	0	0
	111	0	0	0	0
	120	0	0	0	0
	122	0	0	0	0
	128	0	0	0	0
	130	0	0	0	0
	139	0	0	0	0
	142	0	0	0	0
	147	0	0	0	0
	149	0	0	0	0
	154	0	0	0	0
	161	0	0	0	0
	165	0	0	0	0

	169	0	0	0	0
	174	0	0	0	0
	185	0	0	0	0
	189	1	43.47826087	0	0
	194	0	0	0	0
	197	0	0	0	0
	199	1	43.47826087	0	0
	205	0	0	0	0
	208	2	86.95652174	0.6	0
	213	0	0	1.1	0
	219	3	130.4347826	0.1	0
	224	0	0	0.4	1
	231	4	173.9130435	1.9	0
	234	2	86.95652174	4.2	0
	240	15	652.173913	4.2	0
	243	0	0	1.1	0
	249	1	43.47826087	0.6	0
	255	2	86.95652174	0.1	0
	264	2	86.95652174	0.7	0
	270	8	347.826087	15	0
	271	14	608.6956522	0.3	1
	273	0	0	0	0

Appendix H

Point Intercept Aquatic Macrophyte Survey Data

9:00AM - 11:30 EW, JW, KH

cool spring, ~~lake~~ record lake ice OFF

Observers for this page: names and hours worked by each:

Lake: Big Blake **WBIC** **County** Polk **Date:** 6/11/13 Tuesday psl

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 POTPU POTCR	2 CERDE	3 POTZO	4 POTIL	5 POTPR	6 ZIZAQ	7 LEMTR	8 VAL AMER.	9 Wolffia	10 Lem mi	11	12	13	14	15
1	8.5	M				1 ✓	1														
2	10	M				1 ✓	1														
3	9.5	M				1	1	1													
4	9	M					1		1												
5	9	M				1	1			V											
6	8	S				V	1 ✓														
7	10	M				1	1 ✓														
8	11	M				1	✓														
9	10.5	M				1	✓														
10	10	M				1	1 ✓														
11	9.5	M				1	1 ✓														
12	9	M				1		1 ✓													
13	8	M				1	✓														
14	5	M				2	✓	1			1										
15	3	M				1 ✓		2	1			V	1								
16	7	S				1 ✓															
17	8	M					1 ✓						1								
18	10	M					1 ✓	1													
19	10.5	M					1 ✓														
20	11	M				1	1 ✓														
21	11	M					1 ✓														
22	11	M					1 ✓				1										
23	10	M				1 ✓															
24	10	M				1 ✓															
25	10	M				1 ✓															
26	8.5	M				2 ✓		1													
27	8	M				1 ✓		1				1			V	V					
28	7	S				2 ✓		1													
29	10	M				1 ✓	1	1						1							
30	10.5	M					✓														

Observers for this page: names and hours worked by each:

Lake: **WBIC** **County** **Date:**

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 POTCR	2 CERDE	3 POTZO	4 POTIL	5 POTPR	6 ZIZAQ	7 LEMTR	8 VALAM	9 WOLFA	10 LEMMI	11 NAJAQ	12 HETCU	13 FIL ALG	14 MYR SI	15
31	11	m				1	1														
32	11			Ø																	
33	11					1															
34	11					1															
35	10					1															
36	10						1														
37	9.5					1	1	1													
38	5	S				1	1						1		1	1	1				
39	9	m				2															
40	10.5	m					1														
41	11	m					1														
42	11	m				1															
43	11	m					1														
44	11	m		Ø			1														
45	10.5	m				1															
46	10.5	m				1															
47	9.5	m				1															
56	10	m				2															
55	11	m				1															
54	11	m					1														
53	11	m		Ø		1															
52	11	m				1															
51	11	m				1	1														
50	11	m					1														
49	10	m				1															
48	3	R				1	1						1			1	1	2	1	1	
57	4.5	m				3										V					
58	4.5	S				1	1												1		
59	3	S				2	1														
60	3	S				2	1			V							1			1	

Observers for this page: names and hours worked by each:

Lake: **WBIC** **County** **Date:**

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 Pot Ru	2 Curt de	3 Pot Zo	4 Pot IL	5 Pot Pr	6 ZIZAQ	7 Lemna Tr	8 Val Am	9 Walla	10 Lem mi	11 RAN AQ	12 HET Du	13 Fi Al	14 Myr Si	15 Nup Va
61	12	M																			
62	12	M																			
63	12.5																				
64	11	M				1✓															
65	3.5	M				2✓		1✓												2✓	
66	10	M				1✓															
67	12					1✓															
68	13																				
69	15																				
70	15																				
71	9					1✓															
72	13.5																				
73	15.5																				
74	16																				
75	10	M																			
76	16																				
77	13.5																				
78	9.5	S/M				1✓	1✓														
79	7	R				1✓															
80	7.5	M				1✓															
81	9.5	M				2✓															
82	7	R				2✓															
83	12.5	M																			
84	14																				
85	13.5																				
86	12	M																			
87	11.5	M				1✓															
88	10	M				V✓															
89	5.5	M				1✓	1✓														
90	Shore																				

Observers for this page: names and hours worked by each:

Lake: **WBIC** **County** **Date:**

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 Pot pu	2 cert de	3 Pot zo	4 Pot IL	5 Pot Pr	6 Zis Aq	7 Lemna To	8 Val Am	9 wolfia	10 Lemna Mi	11 Ran Aa	12 Het Du	13 Tri Ala	14 Myr Si	15 Nur Va
91	12.5																				
92	13.5																				
93	14																				
94	13																				
95	12																				
96	12	M																			
97	12	M				1															
98	15	R				2	1										1				
99	7	R				1															
100	13.5																				
101	13.5																				
102	14																				
103	13																				
104	12																				
105	12																				
106	12					1															
107	10					1															
108	11.5																				
109	14																				
110	13																				
111	12.5																				
112	12.5																				
113	12.5																				
114	12	M																			
115	13																				
116	7	R				1															
117	10	R																			
118	14																				
119	13																				
120	12.5																				

135 - start point for 6/13/13 10:30-12:30

PS 4

Observers for this page: names and hours worked by each:

Lake: WBIC County Date:

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 Pot Pu	2 Cer de	3 Pot zo	4 Pot Il	5 Pot Pr	6 Zis Am	7 Lemna Tr	8 Var Am	9 Wolfia	10 Lemna Mi	11 Ran Ac	12 Hot Du	13 Tri Ala	14 Myr Si	15 Nup Va
121	12.5																				
122	12.5																				
123	13																				
124	13																				
125	11	M																			
126	15																				
127	13.5																				
128	13.5																				
129	12.5																				
130	13																				
131	13																				
132	13																				
133	12	M																			
134	12																				
135	11	R																			
136	14																				
137	14																				
138	12.5																				
139	12.5																				
140	13																				
141	13																				
142	12.5																				
143	12	M				1/															
144	18	M				1/															
145	8.5	M				1/															
146	15																				
147	14																				
148	13.5																				
149	13																				
150	13																				

Observers for this page: names and hours worked by each:

Lake: **WBIC** **County** **Date:**

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 Pot pu	2 Cerde	3 Pot ro	4 Pot Tl	5 Pot pr	6 Biz Aq	7 Lemna Tr	8 Val Am	9 Wolffia	10 Lemna Mi	11 Ran Aq	12 Het pu	13 Fil Aque	14 Nym Si	15 Nup Va
151	12.5																				
152	12.5																				
153	12.5																				
154	12	M				1 ✓															
155	11.5	M																			
156	9	R				1 ✓	1 ✓	1 ✓													
157	8.5	MS																			
158	16																				
159	15																				
160	14																				
161	13																				
162	12																				
163	13.5																				
164	13.5																				
165	13.5																				
166	14																				
167	13																				
168	13																				
169	13																				
170	13																				
171	13																				
172	12.5																				
173	11.5	M																			
174	13.5																				
175	14.5																				
176	14																				
177	13.5																				
178	13.5																				
179	13.5																				
180	14																				

Observers for this page: names and hours worked by each:

Lake: **WBIC** **County** **Date:**

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 Pot Pu	2 Cer de	3 Pot 20	4 Pot 11	5 Pot Pr	6 Ziz Aq	7 Lemna Tr	8 Val Am	9 Wolfia	10 Lemna Mi	11 Ran Aq	12 Hel Pu	13 Hi Atla	14 Myr Sp	15 Nup Va	Nym Od	Meg
181	13.5																						
182	13																						
183	13																						
184	12.5																						
185	13																						
186	12.5																						
187	12.5																						
188	12.5																						
189	12	M																					
190	11	M																					
191	11	M																					
192	12.5																						
193	13.5																						
194	13.5																						
195	15																						
196	13																						
197	12.5																						
198	12	M																					
199	12.5																						
200	13																						
201	12.5																						
202	12	M																					
203	11.5	M																					
204	12.5																						
205	12	M						1/															
206	11	M																					
207	~~10.5~~	10.5 M																					
208	10.5	M																					
209	10	M																					
210	~~10.5~~	6 M				2/			1/											V-		V-	

Observers for this page: names and hours worked by each:

Lake: **WBIC** **County** **Date:**

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 Pot pu	2 Cer de	3 Pot 20	4 Pot 12	5 pot pr	6 212 Aa	7 Lemna Tc	8 Vat Am	9 Wolffia	10 Lemna Mi	11 Rau Ag	12 Hot ocu	13 Fri Al	14 Myr Sp	15 Nup Va	Nym Od
211	10	R				2✓																
212	12	M																				
213	11	M																				
214	12	M																				
215	13																					
216	8.5	M				2✓	1✓															
217	9.5	M				V✓																
218	11.9	M				V✓	1✓						1✓									
219	11.5	M																				
220	11	M																				
221	10	M				1✓																
222	10	M				1✓																
223	10	M				1✓																
224	9	M						1✓														
225	5.5	R				2✓																
226	5	R				2✓																
227	10.5	M																				
228	10.5	M							1✓													
229	10	M				1✓																
230	10	M																				
231	10	M																				
232	9	M																				
233	4	M				1✓	1✓	V✓					1✓								V✓	
234	4	M				2✓	1✓	1✓	V✓													
235	10.5	M																				
236	9.5	M				1✓																
237	9	M				1✓																
238	9.5	M																				
239	9.5	M				1✓																
240	8	M				1✓		1✓	V✓				1✓									

Observers for this page: names and hours worked by each:

Lake: **WBIC** **County** **Date:**

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 Pot pu	2 Cer de	3 Pot zo	4 Pot il	5 Pot pr	6 Ziz aq	7 Lem tr	8 Val am	9 Wolf co	10 Lemna mi	11 Ran fa	12 Het du	13 Fil algae	14 Myr sp	15 Nup va	Nym od
241	10.5	M										1										
242	9.5	M				1	1															
243	9.5	M																				
244	7	MR				1		1														
245	6	R				1		3														
246	8	M				1	V															
247	2	M				1		2	V				2							V	V	
248	10	M																				
249	8	M						1														
250	9	M					1															
251	8	M				V		2														
252	5	M						3	1				1							V		
253	1.5	M				V		2	1				2				1		1	V	1	
254	8	M				1		1	1													
255	9	M					1	1	1													
256	8.5	M						1			2											
257	8	M						2	1													
258	4.5	M				V		2	1			V	1								V	
259	8	M				1	1	1	1		2											
260	8	M						1	1		V											
261	8	M						2	1													
262	5	M				1	1	2	1		V		1									
263	2	M				V	1	1	1			V	1							V	1	
264	6	M				1		1	1				1									
265	7	M						2	1													
266	6.5	M						3	1				1									
267	4.5	M						3	V			V	1								V	
268	3	M						2	1				1								V	
269	4.5	M				V		3	1				1									
270	3	M				V		1										1				

Observers for this page: names and hours worked by each:

Lake: **WBIC** **County** **Date:**

Site #	Depth (ft)	Dominant sediment type Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	comments	EWM	CLP	1 Pot pu	2 Cer de	3 Pot zo	4 Pot il	5 Pot pe	6 Zizi aq	7 Lemna mi	8 Val am	9 Worsa	10 Lemna mi	11 Ran ac	12 Hot bu	13 Fil al	14 Myr si	15 Nuv va	Nym od
271	2.5	M				1✓		2✓					1✓									V✓
272	1.5	M				1✓	1✓	1✓	1✓						1✓	1✓		1✓				1✓
273	1.5	M				1✓		2✓					1✓		V✓	V✓						V✓
274	2.5	M				V✓	1✓	1✓							V✓	V✓			1✓			V✓
275																						
276																						

Big Blake Polk WBIC 2627000 **Date:** 8/13/13

Observer 1: name and hours: KH | Observer 2: name and hours: EW | Observer 3: name and hours: JW | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 NymOd	4 PotZo	5 LemTr	6 LemMi	7 WolFi	8 SpiPo	9 Filamentous algae	10 ZizAq	11 NupVa	12 SchTa	13 HetPe	14 ValAm	15 PotRi	16 RanAq	17 MyrSi	18 PotPec	19 NajFl	20	21	22	23
1	8.5																												
2	9																												
3	9																												
4	8.5																												
5	8						1	1																					
6	8																												
7	9																												
8	9.5																												
9	9.5																												
10	9																												
11	9																												
12	8.5						1																						
13	7.5																												
14	6.5						1																						
15	3						2		1	1	1	1	1	1	V	V													
16	5						2			1																			
17	8						1																						
18	9																												
19	9.5																												
20	9.5																												
21	9.5																												
22	9.5																												
23	9						3			1																			
24	9						V																						
25	9						1																						
26	8.5																												
27	rice																												
28	7						1		V																				
29	9						1			1																			

Big Blake Polk WBIC 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 NymOd	4 PotZo	5 LemTr	6 LemMi	7 WolBi	8 SprPo	9 Filalg	10 ZizAq	11 NupVa	12 SenTa	13 HetPu	14 ValAm	15 PotFl	16 RanAq	17 MyrSi	18 NajFl	19	20	21	22	23
30	9.5																												
31	9.5																												
32	9.5																												
33	9.5																												
34	9.5																												
35	9.5																												
36	9																												
37	8.5																												
38	shore																												
39	9	S																											
40	10																												
41	10																												
42	10																												
43	10																												
44	10																												
45	9.5																												
46	9																												
47	6.5						1										V	V											
48	4									2									1										
49	9						2																						
50	10																												
51	10																												
52	10																												
53	10																												
54	10																												
55	10																												
56	7	R						1			1				1														
57	3						1		1																				
58	2						2			1										1	1	1		1					

Big Blake Polk WBIC 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 NymOd	4 PotZa	5 LemTr	6 LemMi	7 WolFi	8 SprPo	9 Filalgae	10 ZizAq	11 NupVa	12 SchTa	13 HetDu	14 ValAm	15 PotRi	16 RanAq	17 MyrSi	18	19	20	21	22	23
59	5.5						1	1																					
60	9.5																												
61	10.5																												
62	10.5																												
63	11.5																												
64	11.5																												
65	2						2		1		1						V				1		1						
66	8.5																												
67	10.5																												
68	11																												
69	13																												
70	13.5																												
71	9										1																		
72	11.5																												
73	13.5																												
74	15																												
75	12																												
76	13																												
77	12.5																												
78	5	R						1																					
79	6.5										1																		
80	8	S																											
81	6.5	S					1	1							1														
82	12																												
83	12																												
84	12																												
85	12																												
86	10.5																												
87	10																												

Big Blake Polk WBIC 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cerbe	2 PotPu	3 NymOd	4 PotZo	5 LemTr	6 LemMi	7 WolFa	8 SprPo	9 fil algae	10 ZizAq	11 NupVa	12 SchTa	13 HetDu	14 ValAm	15 PotPi	16 RanAq	17 MyrSi	18	19	20	21	22	23
88	9.5																												
89	4	R															V												
90	shore																												
91	12																												
92	12																												
93	12																												
94	11																												
95	11																												
96	10.5																												
97	9.5																												
98	9	R						I		I	I				I		V												
99	11.5																												
100	12.5																												
101	12.5																												
102	11.5																												
103	11.5																												
104	11																												
105	12																												
106	12																												
107	8																												
108	11																												
109	14																												
110	12.5																												
111	12																												
112	11																												
113	11.5																												
114	11.5																												
115	12.5																												
116	4	R							V	I					I		V						I						

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 NymOd	4 PotZo	5 LemTr	6 LemMi	7 WolFi	8 SprPo	9 FlAlg	10 ZizAq	11 NupVa	12 SchTa	13 HetDu	14 ValAm	15 PotKi	16 RanAq	17 MyrSi	18	19	20	21	22	23
117	13																												
118	12.5																												
119	12																												
120	12																												
121	12																												
122	12																												
123	12																												
124	13																												
125	11																												
126	13.5																												
127	13																												
128	12																												
129	12.5																												
130	12																												
131	12																												
132	12																												
133	12																												
134	10.5																												
135	8.5																												
136	14																												
137	13																												
138	12.5																												
139	12.5																												
140	12																												
141	12																												
142	12																												
143	12																												
144	11																												
145	9						1			1																			

Big Blake Polk WBIC 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 NymOd	4 PotZo	5 LemTr	6 LemMi	7 WolFa	8 SprPo	9 fil algae	10 ZizAq	11 NupVa	12 SchTa	13 HetDu	14 ValAm	15 PotRi	16 RanAq	17 MyrSi	18	19	20	21	22	23
146	13																												
147	14																												
148	13																												
149	12.5																												
150	12.5																												
151	12																												
152	12																												
153	12																												
154	12.5																												
155	12.5																												
156	10.5																												
157	10																												
158	15																												
159	13.5																												
160	13																												
161	13																												
162	12.5																												
163	12.5																												
164	12.5																												
165	12.5																												
166	12.5																												
167	13																												
168	12.5																												
169	12.5																												
170	12.5																												
171	12																												
172	12																												
173	10																												
174	11																												

Big Blake Polk WBIC 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cerde	2 PotPu	3 Nymod	4 Potzo	5 LeWTr	6 LemMi	7 WolFi	8 SprPo	9 fil algae	10 ZizAq	11 NupVa	12 SchTa	13 HetDu	14 ValAm	15 PotRi	16 RanAq	17 MyrSi	18	19	20	21	22	23
175	14.5																												
176	13																												
177	13																												
178	12.5																												
179	12.5																												
180	12.5																												
181	12.5																												
182	12																												
183	11.5																												
184	12																												
185	12																												
186	12																												
187	11.5																												
188	11.5																												
189	10.5																												
190	10																												
191	10.5																												
192	11																												
193	12.5																												
194	13																												
195	14																												
196	13																												
197	13																												
198	12.5																												
199	12																												
200	11.5																												
201	11																												
202	11																												
203	11																												

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 NymOd	4 PotZo	5 LemTr	6 LemMi	7 WolFa	8 SprPo	9 fil algae	10 ZizAq	11 NupVa	12 SchTa	13 HetDu	14 ValAm	15 PotRi	16 RanAq	17 MysSi	18	19	20	21	22	23
204	11																												
205	10.5																												
206	10																												
207	10																												
208	10																												
209	8																												
210	7	R																				V							
211	9.5	R																											
212	12																												
213	12																												
214	11																												
215	11																												
216	7.5	R						1																					
217	7	S				1		1		1												2							
218	8					1				3												1							
219	11																												
220	10																												
221	9.5																												
222	9.5																												
223	9					2														1									
224	9																												
225	5							1		V																			
226	5.5					1																1							
227	10																												
228	9.5																												
229	9.5																												
230	9																												
231	9																												
232	9					V																							

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 NymOd	4 PotZo	5 LemTr	6 LemMi	7 WolFia	8 SpiPo	9 fil algae	10 BizAq	11 NupVa	12 SchTa	13 HetPu	14 ValAm	15 PotKi	16 RanAq	17 MyrSi	18	19	20	21	22	23
233	2						1		1		1						V		1	1	1								
234	5						3		V	1	1																		
235	10																												
236	9																												
237	9						1																						
238	9																												
239	7.5																												
240	8						2				1																		
241	10																												
242	9																												
243	9						1																						
244	8																												
245	6.5	R				1	1																						
246	7						V																						
247	Nym	bed																											
248	9.5																												
249	8.5						1			1																			
250	8.5																												
251	6						2			1					1														
252	4						3			1	1																		
253	rice	bed																											
254	7						1		V	1	1																		
255	8.5						1																						
256	8						2			1																			
257	7						1														1								
258	4						3		V	2	1																		
259	7.5						1			1																			
260	8									1																			
261	7						1			1																			

Big Blake Polk WBIC 2627000 **Date:**

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 NymOd	4 PotZo	5 LemTr	6 LemMi	7 WolFia	8 SprPo	9 filam algae	10 ZizAq	11 NupVa	12 SchTa	13 HetDu	14 ValAm	15 PotRi	16 RanAq	17 MyrSi	18 PotPr	19	20	21	22	23
262	5						2			1	1													1					
263	Nym bed																												
264	6						3		V	1																			
265	7						1			1	1																		
266	4.5						1			1	1																		
267	4						1		V																				
268	shore																												
269	4						1			1																			
270	3						2		V																				
271	3						3	1	1	2	1					V			1					1					
272	Nymp bed																												
273																													
274																													
275																													
276																													
277																													
278																													
279																													
280																													
281																													
282																													
283																													
284																													
285																													
286																													
287																													
288																													
289																													
290																													

6/2/14 JW KH
6/3/14 JW KH GW

X

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Pot pu	2 Pot pf	3 Lem tr	4 Lem mi	5 Wolfia	6 Cer de	7 Fil	8 Potzo	9 Ziz aq	10	11	12	13	14	15	16	17	18	19	20	21
1	8.0	M	P				1																				
2	8.2	M	P			1	1																				
3	7.6	M	P			1	1																				
4	8.0	M	P	1		V	1	V																			
5	6.0	M	P			3	1																				
6	7.2	M	P				1																				
7	8.5	M	P				1					1															
8	8.9	M	P																								
9	8.3	M	P																								
10	9.3	M	P	1			1																				
11	8.3	M	P	1		1	1																				
12	6.9	M	P				1					1															
13	7.0	M	P			2	1					1															
14	3.9	M	P	3		2	2		1	V	V	1	V														
15	1.5	M	P				1		V	V	V	V		1	1												
16	5.8	M	P				1																				
17	9.6	M	P				2																				
18	8.3	M	P				1																				
19	4.3	M	P	—																							
20	8.1	M	P			1																					
21	8.4	M	P			2																					
22	8.6	M	P																								
23	8.6	M	P	1		1																					
24	7.7	M																									
25	7.4	M	P			1	1																				
26	7.2	M	P			1	1																				
27	shallow																										
28	4.0	R	P				1					1			1												
29	8.3	M	P				1																				
30	9.5	M	P	—	Nothing																						

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Pot pu	2 Pot pr	3 Lem tr	4 Lem mi	5 Wolffia	6 Ceratde	7 Fil.	8 Potzo	9 Zizpa	10 Nymod	11 SpAeu	12 Schta	13 NupVa	14	15	16	17	18	19	20	21
31	8.2	M	P	1		1	1																				
32	7.3	M	P				1																				
33	8.4	M	P			1																					
34	8.1	M	P			1																					
35	8.1	M	P			1																					
36	8.5	M	P			1		V																			
37	8.5	M	P	1		1	1																				
38	2.5	M	P				1		1			1				V	V										
39	8.7	M	P																								
40	9.0	M	P			1																					
41	9.2	M	P			1																					
42	8.5	M	P				1																				
43	8.0	M	P																								
44	8.3	M	P			1																					
45	8.6	M	P			1																					
46	9.9	M	P			1																					
47	2.5	M	P			1	1		1			1					V	3									
48	3	S	P			1	1		1				1														
49	8.2	M	P	1		2	1																				
50	10.5	M	P			1																					
51	11.1	M	P			1																					
52	10.5	M	P																								
53	11	M	P																								
54	10.5	M	P			1																					
55	8.3	M	P			1																					
56	4.8	M	P			1	1																				
57	1.5	M	P			1	1		1				2	V				1									
58	2.7	M	P			1	1																				
59	6.5	M	P			2	1																				
60	10.5	M	P			1																					

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPu	2 PotPr	3 LemTr	4 LemMi	5 ValHe	6 CerDe	7 Fil	8 PotZo	9 ZiPan	10 NymOd	11 SpAqu	12 SchTa	13 NupVa	14	15	16	17	18	19	20	21
61	9.5	M	P			1																					
62	10.0	M	P																								
63	9.2	R	P																								
64	8.5	M	P			1																					
65	2.5	M	P			1	1		1			1						1									
66	8.6	M	P			1																					
67	10.1	M	P																								
68	11.7	M	R			1																					
69	13.7	M	R																								
70	12	M	P																								
71	9.8	M	P			1																					
72	12.4	M	P																								
73	14.5	\																									
74	15	\																									
75	11.5	M	R																								
76	13.5	\																									
77	11.5	M	R			1																					
78	2.7	R	P																								
79	5.0	R	P			V																					
80	7.7	M	P			1																					
81	5.5	M	P			1																					
82	7.0	M	P			2																					
83	11.2	M	R																								
84	12	M	R																								
85	11.2	M	R																								
86	10.5	M	P																								
87	10.0	M	P																								
88	9.6	M	P																								
89	3.0	R	P			1	1																				
90	1.0	R	P																								

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPu	2 PotPr	3 LemTr	4 LemMi	5 WolBra	6 CerDe	7 Fil	8 PotZo	9 ZizAq	10 NymOd	11 SpAeu	12 SchTa	13 NupVa	14	15	16	17	18	19	20	21
91	10.8	M	R																								
92	12.8	'	'																								
93	12.2	'	'																								
94	11.7	M	R																								
95	10.2	M	P																								
96	10.3	M	P																								
97	10.4	M	P																								
98	3.0	M	P			1	1											V									
99	9	S	P																								
100	12.4	'	'																								
101	12.7	'	'																								
102	12.1	'	'																								
103	11.5	M	R																								
104	11.2	M	R																								
105	10.5	M	P																								
106	10.5	M	P																								
107	7	R	P			1																					
108	9.5	M	P																								
109	12.8	-	-																								
110	11.9	M	R																								
111	11.2	M	R																								
112	11.4	M	R																								
113	11.3	M	R																								
114	11.0	M	R																								
115	11.0	M	P			1																					
116	4.5	R	P			2	1						1														
117	5.5	R	P										1														
118	12.7	-	-																								
119	10.5	M	P																								
120	11.0	M	R																								

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotFu	2 PotPr	3 LemTr	4 LemMi	5 WolFig	6 CerDe	7 Fil	8 PotZo	9 ZiPam	10 NymOd	11 SpaRu	12 SchTa	13 NupVa	14	15	16	17	18	19	20	21
121	11.2	M	R																								
122	11.0	M	R																								
123	11.3	M	R																								
124	11.0	M	R																								
125	9.8	M	P																								
126	12.5	-	-																								
127	12.2	-	-																								
128	11.5	M	R																								
129	11.7	M	R																								
130	11.5	M	R																								
131	11.3	M	R																								
132	11.4	M	R																								
133	10.5	M	P																								
134	10.2	M	P																								
135	5.5	R	P			1																					
136	12.9	-	-																								
137	13.5	-	-																								
138	12.1	-	-																								
139	11.3	M	R																								
140	11.8	M	R																								
141	12.4	-	-																								
142	11.5	M	R																								
143	10.8	M	R																								
144	10.7	M	P																								
145	4.5	R	P									1															
146	14.2	-	-																								
147	13.9	-	-																								
148	12.0	-	-																								
149	11.4	-	-																								
150	12.0	-	-																								

X

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Pot Pu	2 Pot Pr	3 Lem Tr	4 Lem Mi	5 Wolf Ra	6 Cerpe	7 Fi	8 Pot Zo	9 Zizpa	10 Nym od	11 Spar	12 Schta	13 Nup Va	14	15	16	17	18	19	20	21
151	11.7	-	-																								
152	11.5	-	-																								
153	11.7	-	-																								
154	11.3	-	-																								
155	10.8	M	P																								
156	9.6	S	P																								
157	6.8	R	P			1																					
158	14.5	-	-																								
159	13.5	-	R																								
160	12	-	-																								
161	11.4	-	-																								
162	12.7	-	-																								
163	12.5	-	-																								
164	12.5	-	-																								
165	12.7	-	-																								
166	12.5	-	-																								
167	11.5	-	-																								
168	11.7	-	-																								
169	11.5	-	-																								
170	12.0	-	-																								
171	11.4	M	R																								
172	10.6	M	P																								
173	11.5	M	R							V	V																
174	9.8	R	P																								
175	13	-	-																								
176	12.5	-	-																								
177	12.0	-	-																								
178	12.5	-	-																								
179	12.5	-	-																								
180	12.6	-	-																								

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPu	2 PotPr	3 LemTr	4 LemMi	5 WolRa	6 CerDe	7 Fil	8 PotZe	9 ZizAq	10 NymOd	11 SpAru	12 SchTa	13 NupVa	14	15	16	17	18	19	20	21
181	12.4	-	-																								
182	12.2	-	-																								
183	12.3	-	-																								
184	12.1	-	-																								
185	11.9	-	-																								
186	11.8	-	-																								
187	12.2	-	-																								
188	11.9	-	-																								
189	11.5	-	-																								
190	10.7	M	P						1																		
191	9.5	M	P																								
192	12.3	-	-																								
193	11.7	-	-																								
194	12.3	-	-																								
195	13.2	-	-																								
196	12.2	-	-																								
197	11.6	-	-																								
198	11.2	-	-																								
199	11.7	-	-																								
200	12.1	-	-																								
201	12.0	-	-																								
202	11.1	-	-																								
203	11.6	-	-																								
204	12.0	-	-																								
205	11.5	-	-																								
206	11.1	-	-																								
207	10.1	M	P																								
208	9.2	M	P									1															
209	7.0	M	P			1			1			1															
210	5.0	M	P			1																					

Observer 1: name and hours: Observer 2: name and hours: Observer 3: name and hours: Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPu	2 PotPe	3 CerDi	4 LemMi	5 NymOd	6 CerDe	7 FiRi	8 PotZo	9 ZizAq	10 NymOd	11 SpAeu	12 SchTa	13 NupVa	14 MyrSi	15	16	17	18	19	20	21
211	8.5	R	P			2																					
212	12.5	–	–																								
213	10.4	M	P																								
214	10.5	M	P																								
215	7.0	M	P			1																					
216	5.0	R	P			1	1						1						1								
217	5.0	M	P			1	1		1				3														
218	4.5	M	P			1						1							1								
219	11.5	–	–																								
220	10.5	M	P																								
221	9.2	M	P							V	V																
222	9.0	M	P					V																			
223	9.5	M	P				1					1															
224	8.5	M	P																								
225	8.2	M	P			1																					
226	5.0	M	P			3						2							1								
227	10.0	M	P						1																		
228	10.0	M	P																								
229	9.2	M	P											1													
230	9.0	M	P						1			1															
231	8.5	M	P			1			1																		
232	8.5	M	P																								
233	5.0	M	P			1	1	V	1																		
234	6.2	R	P			1			1																		
235	10.0	M	P						1																		
236	9.0	M	P						1																		
237	8.5	M	P																								
238	8.4	M	P							V	V		1														
239	9.0	M	P											1													
240	7.0	M	P					V	1																		

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPu	2 PotFr	3 LouTr	4 LemMi	5 WolRi	6 CerDe	7 Fil	8 PotZo	9 ZizAq	10 NymOd	11 SpaEu	12 SchTa	13 NupVa	14 MyrSp	15	16	17	18	19	20	21
241	9.5	M	P																								
242	9.0	M	P			1																					
243	8.7	M	P																								
244	6.9	R	P			1																					
245	3.0	R	P			2			1			1		1													
246	6.8	M	P						1			1	1														
247	2.0	M	P						2			2		1		1			1								
248	8.4	M	P																								
249	8.0	M	P					1																			
250	8.5	M	P																								
251	7.8	M	P						1			1	1														
252	4.0	M	P			1			1			2		1													
253	Shallow - terrestrial																										
254	6.0	M	P				1		1			1	2	1													
255	8.3	M	P						1			1															
256	7.5	M	P				1						1														
257	7.0	M	P						1			1															
258	4.0	M	P					1	1	V	V	1	1	1													
259	8.0	M	P						1			1		1													
260	7.8	M	P									1		1													
261	7.2	M	P									1		1													
262	5.8	M	P									1															
263	Shallow - terrestrial																										
264	6.0	M	P			1	1					1		1													
265	7.3	M	P									1		1													
266	5.5	M	P						1			2	1	1													
267	3.0	M	P						1			3	1														
268	1.8	M	P				2		1			1				1											
269	4.2	M	P									1															
270	2.6	M	P						1			3	3														

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPu	2 PotPr	3 LemTr	4 LemMi	5 WolRi	6 CerDe	7 SpI	8 PotZo	9 ZiAqu	10 NymOd	11 SpAev	12 SchTa	13 NupVa	14 MyrSi	15	16	17	18	19	20	21
271	2.0	M	P						1			2		1	V												
272	1.5	M	P						1			3	2														
273	1.5	M	P				1		1			1	1														
274	2.7	S	P									1															
275	1.5	M	P				V						V			V											
276																											
277																											
278																											
279																											
280																											
281																											
282																											
283																											
284																											
285																											
286																											
287																											
288																											
289																											
290																											
291																											
292																											
293																											
294																											
295																											
296																											
297																											
298																											
299																											
300																											

KH JW 8/25/14

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cer De	2 Pot Pu	3 Ziz Pa	4 FL	5 Lem Tr	6 Myr Si	7	8 Nym od	9 Pot zo	10	11	12	13	14	15	16	17	18	19	20	21
1	7.3	M	P								1																
2	7.8	M	P				V	1																			
3	7.6	M	P				V																				
4	7.3	M	P				V	1																			
5	6.8	M	P				1	1																			
6	6.9	R	P				V					1	V	1													
7	8.2	M	P				1																				
8	8.4	M	P				1																				
9	8.8	M	P				1																				
10	8.5	M	P				1																				
11	8.3	M	P				1																				
12	7.8	M	P				2																				
13	6.3	M	P				1																				
14	5.4	M	P				1				1																
15	Rice						1																				
16	4.0	M	P				2	1	V		1			1													
17	7.3	M	P				1																				
18	7.8	M	P				1																				
19	8.6	M	P				1																				
20	9.1	M	P				1																				
21	10.2	M	P				1																				
22	8.2	M	P				1																				
23	9.2	M	P				1																				
24	8.3	M	P				1																				
25	7.0	M	P			1	1							V													
26	6.9	M	P			1	1																				
27	RICE																										
28	6.1	M	P				1				1																
29	8.1	M	P				1																				
30	8.2	M	P				1																				

JW KH

Big Blake Lake Polk County WBIC 2627000 **Date:** 8/25/14

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cer pe	2 Pot pu	3 Zizpa	4 Fil	5 Nym de	6	7 Myr si	8 Het da	9 Lem tr	10 Pot ri	11 Val am	12 Pot am	13 Nai fl	14 Nup va	15 Sag i	16	17	18	19	20	21
31	9.0	M	P				1																				
32	9.6	M	P				1																				
33	10.4	M	P				1																				
34	10.0	M	P				1																				
35	10.0	M	P				1																				
36	8.6	M	P				1																				
* 37	7.8	M	P				1																				
38	2.8	R	P				1				V	V	1														
39	8.5	M	P										1														
40	9.0	M	P				1																				
41	9.9	M	P				1																				
42	10.9	M	P				1																				
43	10.5	M	P				1																				
44	10.1	M	P				1																				
45	9.8	M	P				1																				
46	8.4	M	P				V							1													
47	6.8	R	P											1													
48	1.3	R	P					1	V		V		1	1	1		1	1									
49	8.1	M	P				1																				
50	8.7	M	P				1																				
51	9.4	M	P				1																				
52	9.3	M	P				1																				
53	9.4	M	P				1																				
54	9.2	M	P				1																				
55	9.9	M	P				1																				
* 56	8.2	M	P				1																				
57	1.0	R	P				1				V		1					1	V	V							
58	6.9	M	P				1																				
59	8.5	M	P				1																				
60	9.7	M	P				1																				

Big Blake Lake Polk County WBIC 2627000 JW KM Date: 8/25/19

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 ZizAq	4 fil	5 Pot zo	6 Lem tri	7 NupVa	8 NymOd	9 Lem mi	10 Wol fil	11 Ran aq	12 MyrSi	13	14	15	16	17	18	19	20	21
61	10.9	Deep																									
62	10.6	Deep																									
63	11.5	Deep																									
64	9.7	M	P				—																				
65	2.7						1			1		1	1	1	1	1	1										
66	8.5	M	P								1	1															
67	10.6	Deep																									
68	10.9	Deep																									
69	13.3	Deep																									
* 70	13.7	Deep																									
71	7.3						—																				
72	11.2	Deep																									
73	14.3	Deep																									
74	15.0	Deep																									
75	8.7	R	P				—																				
76	14.1	Deep																									
77	12.1	Deep																									
78	7.1	R	P				—																				
79	3.0	R	P								V	1				1	1										
80	7.4	M	P				V																				
81	5.0	R	P				1					1															
82	6.0	R	P				1							V				1									
83	12.5	Deep																									
84	12.9	Deep																									
85	12.8	Deep																									
86	11.7	Deep																									
87	10.3	M					—																				
88	9.7	M	P								1																
* 89	4.3	R	P				—					1															
90	8.2	R	P				—																				

JW KH

Big Blake Lake Polk County WBIC 2627000 Date: 8-25-14

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cerde	2 Potpy	3 Zizta	4 fil	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
91	11.8	Deep					1																				
92	12.9	Deep																									
93	12.9	Deep																									
94	11.8	Deep																									
95	12.9	Deep																									
96	11.7	Deep																									
97	11.4	Deep																									
98	4.2	R	P		1		1																				
99	9.0	R	P		1		1																				
100	12.2	Deep																									
101	11.0	Deep																									
102	12.3	Deep																									
103	11.4	Deep																									
104	11.8	Deep																									
105	11.9	Deep																									
106	12.3	Deep																									
*107	6.5	R	P				2																				
108	9.8	M	P																								
109	14.3	Deep																									
110	12.7	Deep																									
111	10.4	Deep																									
112	11.4	Deep																									
113	11.4	Deep																									
114	12.3	Deep																									
115	12.5	Deep																									
116	4.9	R	P				1																				
117	7.2	R	P				1																				
118	13.5	Deep																									
119	12.5	Deep																									
120	12.3	Deep																									

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cer De	2 Post Pu	3 Zaz Ag	4 Fil	5 Pot zo	6 Myr Sp	7 Nyp od	8	9	10	11	12	13	14	15	16	17	18	19	20	21
121	11.9	Deep					—																				
122	11.6	Deep																									
123	12.1	Deep																									
124	12.6	Deep																									
*125	11.9	M	P				—																				
126	11.6	Deep																									
127	13.2	Deep																									
128	12.7	Deep																									
129	12.2	Deep																									
130	12.2	Deep																									
131	11.7	Deep																									
132	12.1	Deep																									
133	12.1	Deep																									
134	10.9	Deep																									
135	8.4	R	P								1	1	V														
136	13.8	Deep																									
137	13.4	Deep																									
138	12.5	Deep																									
139	11.2	Deep																									
140	11.6	Deep																									
141	11.9	Deep																									
142	11.5	Deep																									
143	11.9	Deep																									
144	11.2	Deep																									
*145	4.8	R	P				—	—																			
146	14.6	Deep																									
147	13.6	Deep																									
148	12.8	Deep																									
149	12.3	Deep																									
150	12.2	Deep																									

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cerdo	2 Potpu	3 Zizaq	4 Fil	5 Nai fl	6 Nym od	7 Pot zo	8 Het du	9 Myr si	10	11	12	13	14	15	16	17	18	19	20	21
151	11.8	Deep																									
152	11.7	Deep																									
153	12.4	Deep																									
154	12.8	Deep																									
155	12.2	Deep																									
156	9.1	R	P																								
157	3.7	R	P			1	1	1			2	V	1	1	1												
158	12.5	Deep																									
159	13.4	Deep																									
160	13.1	Deep																									
161	11.8	Deep																									
162	12.1	Deep																									
163	11.9	Deep																									
164	12.2	Deep																									
165	12.2	Deep																									
166	12.5	Deep																									
167	11.7	Deep																									
168	12.2	Deep																									
169	11.8	Deep																									
170	11.7	Deep																									
171	11.8	Deep																									
172	11.4	Deep																									
173	11.0	S	P				—																				
174	12.1	Deep																									
175	13.3	Deep																									
176	12.7	Deep																									
177	12.4	Deep																									
178	12.3	Deep																									
179	12.2	Deep																									
180	12.3	Deep																									

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cer De	2 Pot Pu	3 Zat Ra	4 Fil	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
181	12.3	Deep																									
182	12.0	Deep																									
183	11.7	Deep																									
184	12.0	Deep																									
185	11.7	Deep																									
186	11.7	Deep																									
187	11.4	Deep																									
188	11.2	Deep																									
189	10.9	Deep																									
190	10.6	Deep																									
191	9.5	S	P				—																				
192	11.7	Deep																									
193	13.0	Deep																									
194	13.2	Deep																									
195	13.6	Deep																									
196	13.3	Deep																									
197	11.8	Deep																									
198	12.2	Deep																									
199	11.3	Deep																									
200	11.8	Deep																									
201	10.9	Deep																									
202	11.1	Deep																									
203	10.7	Deep																									
204	11.6	Deep																									
205	11.0	Deep																									
206	10.6	Deep																									
207	9.8	M	P				—																				
208	9.8	M	P				—																				
*209	9.1	M	P				—																				
210	7.2	M	P				—																				

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Ceroe	2 Potpu	3 Zizpa	4 AFL	5 Lem ta	6 Wolf	7 Lem mi	8 Nym ad	9 Nuph va	10 Pot zo	11 Myr sp	12	13	14	15	16	17	18	19	20	21
241	9.2	M	P				1																				
242	8.2	M	P P				1																				
243	8.1	M	P P				1																				
244	7.5	P	P								1																
245	2.4	P	P				3			1	1					1											
246	5.7	M	P				2																				
* 247	2.5	P	P P			V																					
248	7.8	M	P P				3			1	1	1	1	1	1	V											
249	7.7	M	P				2									1											
250	7.7	M	P				1																				
251	7.4	M	P P				4										1										
252	3.0	M	P				3				1			V		2	1										
253	Rice																										
254	6.8	M	P				1			2	1			V		1											
255	7.7	M	P P				1																				
256	7.6	M	P P				1						1														
257	5.8	M	P P				1				1																
* 258	2.8	M	P P				3				1	V	V	V		1	V										
259	6.0	M	P P				1																				
260	7.2	M	P				1									1											
261	6.6	M	P P				1				1																
262	4.8	M	P P				2				1					1											
263	Rice																										
264	5.7						2									1											
265	6.1	M	P				1									2											
266	4.6	M	P P				3				1					1											
267	3.7	M	P				1																				
268	Terrestrial																										
269	3.4	M	P				3				1					1	V										
270	3.8	M	P				2			1																	

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotPu	3 ZizAq	4 FiU	5 Lem Tr	6 Pot zo	7 Wolf	8 Lem m	9	10 Allyn ud	11	12	13	14	15	16	17	18	19	20	21
271	2.2	M	P				2			1	2	1	V	U													
272	2.2	M	P				1			V			V	1	1												
273	2.2	M	P				3	1		1	1																
274																											
275																											
276																											
277																											
278																											
279																											
280																											
281																											
282																											
283																											
284																											
285																											
286																											
287																											
288																											
289																											
290																											
291																											
292																											
293																											
294																											
295																											
296																											
297																											
298																											
299																											
300																											

Lakes Database / Big Blake / WiAPMs files / BB_Polk_262700 2015

Big Blake Lake Polk County WBIC 2627000 Date: 5/20/15 11:05

Observer 1: name and hours: KH | Observer 2: name and hours: JW | Observer 3: name and hours: EW | Total hours worked: 2:40

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Pot Pr	2 Pot Pu	3 Cer De	4 ~~Ctenia~~ Nitella	5 fil algae	6 Pot ZO	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 H	7	M	P			3	1																				
2 H	9	↓	↓			2																					
3	8					3		1																			
4	6					2		1																			
5	6					2		2																			
6	5					3		1	1																		
7	8					2		1																			
8	10					2																					
9	8.5					2																					
* 10 H	9					1																					
11 H	9					1		1																			
12 H	8					3		1																			
13	7					2		1		1																	
↑ 14	6					3		1	1																		
* 15	shallow/shore																										
16	3								3		1																
17	8					1		2																			
* 18	8					1																					
19	10					1																					
20	10					3																					
21	10.5					2																					
22	11					1																					
* 23	11					1																					
G 24	7.5					1																					
25	7					2		1																			
26	6.5					3																					
27	Shallow/Shore																										
28	5					3		1	~~1~~			1															
29	8.5					3																					
* 30	8.5					1																					

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

	Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Pot Pr	2 Pot Pu	3 Cerpe	4 Nitella	5 fil algae	6 Potzo	7 Hetpu	8 Nymod	9 RanAq	10	11	12	13	14	15	16	17	18	19	20	21
*	31	9					2																					
	32	10					2																					
	33	8.5					1																					
*	34	9					1																					
	35	10.5					1																					
	36	8					1		1	1																		
↑	37	7					3																					
	38	1					1							1														
↓	39	8	S				3																					
	40	9					1																					
	41	10					1																					
	42	10.5					1																					
	43	9					1																					
*	44	10					1																					
	45	9.5					1																					
	46	8					3																					
	47	6					3		1																			
	48	shallow terrestrial																										
	49				8		3																					
	50				9.5		2																					
	51				9		2																					
	52				9		2																					
	53				10		1																					
	54				10		1																					
	55				9.5		1																					
↑	56				8		2																					
*	57				2.5		2		1	1					V													
	58				3		1		1	1						1												
	59				5.5		3		1																			
	60				8		2																					

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPr	2 PotPu	3 CerDe	4 NitUl	5 Fil	6 PotZo	7 HetBu	8 NymOd	9 RanAq	10 NupVa	11 MyrSi	12 PotRi	13 LemTr	14	15	16	17	18	19	20	21
61	8					2																					
62	10					1																					
63	10	R							1																		
64	10					1					1																
65	2.5					1		1	1					V		1	1										
66	9					3																					
67	10					1																					
68	11					1																					
69	13																										
70	12																										
71	7.5					2																					
72	12																										
73	14																										
74	15																										
75	9	R									1																
76	13.5																										
77	8	S				1																					
78	5	R																									
79	5	R/S				1											V										
80	5					1		1																			
81	3					1					1							1									
82	10					1												1									
83	12																										
84	12																										
85	11					1																					
86	10																										
87	10					1																					
88	9.5					1																					
89	4					1		1																			
90	shore																										

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

	Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPr	2 PotPu	3 CerDe	4 NitUlg	5 FiL	6 PotZo	7 HetOu	8 NymOd	9 RanAq	10 NupVa	11 MyrSi	12 PotRi	13 LemTr	14	15	16	17	18	19	20	21
	91	11																										
	92	12.5																										
	93	12.5																										
*	94	11.5																										
	95	10																										
	96	10																										
*	97	9					1																					
	98	4	R				1		1																			
	99	8					1																					
	100	12																										
	101	12																										
	102	12																										
*	103	11					1																					
	104	10																										
*	105	10.5																										
	106	10																										
	107	8					1																					
	108	9																										
	109	12.5																										
	110	12																										
*	111	12																										
	112	12																										
	113	12																										
	114	10	S																									
	115	10																										
	116	4	R				2		1			1																
	117	13																										
	118	12																										
	119	12																										
*	120	11																										

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPr	2 PotPu	3 CerDe	4 Nitella	5 fil	6 PotZo	7 HydDu	8 NymOd	9 RanAq	10 NupVa	11 MyrSi	12 PotRi	13 CanTr	14	15	16	17	18	19	20	21
121	11.5																										
* 122	12																										
123	10.5																										
124	10.5					1																					
↑ 125	10					1																					
126	13																										
127	12																										
* 128	11																										
129	11.5																										
* 130	12																										
131	11.5																										
132	11.5																										
133	10																										
134	9					1																					
135	8	S				1																					
136	13																										
137	13																										
138	12.5																										
* 139	12																										
140	12																										
141	11.5																										
* 142	10.5																										
143	10.5																										
144	9.5																										
↑ 145	5	R																									
↓ 146	13																										
* 147	14																										
148	13																										
* 149	11.5																										
150	12																										

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPe	2 PotPu	3 CuDe	4 NitFle	5 FR	6 PotZo	7 HydPy	8 NymOd	9 RanPa	10 NupVa	11 MyrSi	12 PotRi	13 LemTr	14	15	16	17	18	19	20	21
151	12																										
152	11.5																										
153	12																										
* 154	11.5																										
155	11.5																										
156	9.5																										
157	4.5					1			1																		
158	14																										
159	13																										
160	12																										
* 161	12.5																										
162	12.5																										
163	12.5																										
164	12.5																										
* 165	12.5																										
166	13																										
167	11.5																										
168	11.5																										
* 169	11																										
170	11.5																										
171	10.5																										
172	11																										
173	11																										
* 174	10	R																									
175	14																										
176	13																										
177	13																										
178	13																										
179	12.5																										
180	12.5																										

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPr	2 PotPu	3 Canpe	4 Nitella	5 AL	6 PotZo	7 HetDy	8 NymOd	9 RorAt	10 MyPa	11 MyrS	12 PotRi	13 CenT	14	15	16	17	18	19	20	21
181	12.5																										
182	12.5																										
183	12																										
184	12																										
185	11.5																										
186	11.5																										
187	12																										
188	11.5																										
189	11.5																										
190	10																										
191	9.5					1																					
192	13																										
193	12																										
194	13																										
195	13																										
196	12																										
197	12																										
198	11.5																										
199	11.5																										
200	12																										
201	12																										
202	11																										
203	11																										
204	11.5																										
205	11.5																										
206	10.5					V																					
207	8.5					1																					
208	9.5					1																					
209	8.5					V																					
210	6					3						1															

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPr	2 PotPu	3 CerDe	4 NitFlex	5 fl	6 Pot zo	7 HydPu	8 NymOd	9 RanPa	10 NupVa	11 MyrSi	12 PotRi	13 CerTr	14	15	16	17	18	19	20	21
211	8					2											1										
212	10.5					1																					
213	10					1																					
214	10					1																					
215	9.5					1																					
216	6					2		2																			
217	4	S				1		1									1										
218	8					1																					
219	10.5					1																					
220	10					1																					
221	9					1																					
222	8.5					1																					
223	7					1																					
224	8.5					1																					
225	3					1						1					1										
226	5					2		1									1										
227	10																										
228	9.5																										
229	9																										
230	9					1																					
231	8.5					1																					
232	8.5					1																					
233	3.5					3						1		V		V											
234	3					1		1	2								1										
235	9.5																										
236	8.5					2																					
237	8.5					1																					
238	8.5					1																					
239	7					2																					
240	6					1	1											1									

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Pot Pr	2 Pot Pu	3 Lem Mi	4 Vi Ella	5 FL	6 Pot Zo	7 Het Pu	8 Nym Od	9 Ran Aq	10 Nup Va	11 Myr Si	12 Pot Ri	13 Cen Ts	14 Zi Aq	15	16	17	18	19	20	21
241	11.5																										
242	10.5																										
243	10					1																					
244	7	R				1																					
245	2					1			3																		
246	5					1			3																		
247	1								1					V		V		V	1	1							
248	10.5					1																					
249	9					1																					
250	6					2																					
251	7					3			2																		
252	3						V		3					V													
253	shallow																										
254	7					1			1																		
255	10					1																					
256	10								1			1															
257	8					1			1																		
258	3.5					V	V		2			1						1									
259	9					1			1																		
260	9								1			1															
261	9					1																					
262	6					V			3																		
263	shallow																										
264	5					1			3																		
265	7					1	V		2									1									
266	7.5								3			1															
267	3					3																					
268	shallow																										
269	5					1			2																		
270	4					2					1																

Big Blake Lake Polk County WBIC 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 PotPr	2 PotPu	3 Cerde	4 Utrlla	5 AL	6 PotFo	7 HydDu	8 NymOd	9 PanAq	10 MypKa	11 MyrVs	12 PotRi	13 LemTr	14 ZizAq	15	16	17	18	19	20	21
271	2					1		1	1										1	✓							
272	1					1					1			1	1	1			1								
273	1								1											1							
274	2																										
275	shallow																										
276																											
277																											
278																											
279																											
280																											
281																											
282																											
283																											
284																											
285																											
286																											
287																											
288																											
289																											
290																											
291																											
292																											
293																											
294																											
295																											
296																											
297																											
298																											
299																											
300																											

KHJW, DC algae bloom

Big Blake Lake Polk County 2627000 9:00 AM – **Date:** 8/20/15

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cerde	2 PotZo	3 EloCa	4 PotPu	5 LemMi	6 LemTr	7 PotPr	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	7.5						3	1																			
2	7.8						1																				
3	7.7						1	1	1																		
4	7.3									1																	
5	6.9									1																	
6	6.9											1															
7	8.4										V																
8	8.5										V																
9	8.4										V																
10	8.2						V																				
11	7.9																										
12	7.4																										
13	7.0						V																				
14	5.6						1																				
15	shallow																										
16	2.8						3	1																			
17	7.1																										
18	8.3																										
19	8.9																										
20	9.0						1	1																			
21	9.1										V																
22	8.8						V				V		V														
23	8.8						1	1																			
24	8.6										V																
25	8.1						1				V																
26	7.0						V						V														
27	shallow																										
28	6.5						3	1				1															
29	8.3						1					1															
30	9.0						1	1																			

Big Blake Lake Polk County 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cerde	2 Potzo	3 Eloca	4 Potpu	5 LemMi	6 LemTr	7 PotPr	8 NymOd	9 SpEx	10 MyrSi	11 WolFia	12 SagGr	13 HetDu	14 VaMam	15 Fil	16 RanTa	17	18	19	20	21
31	9.2																										
32	9.1										V																
33	10.4																										
34	9.5						1																				
35	9.4										V																
36	8.2										V																
37	7.8																										
38	2.5						1				V	1		1	V	1											
39	8.9	S					2	1				1															
40	9.1						1				V																
41	9.3																										
42	9.6										V																
43	9.8																										
44	9.5						1				V																
45	9.3										V						V										
46	8.7																										
47	7.5										V						V										
48	2.2	S					3	1			V	1				V	V	V									
49	8.8										V																
50	9.1										V																
51	9.3										V						V										
52	9.5																										
53	9.7										V						V										
54	9.6										V						V										
55	9.3										V						V										
56	7.5	S									V						V										
57	4.6						1	1				1		1					1	1	1	1					
58	6.3						1							V								1					
59	3.7	R									V																
60	8.5	S														V											

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotZo	3 ElaCa	4 PotPu	5 LemMi	6 LemTr	7 PotPr	8 NymOd	9 SpEu	10 MyrSi	11 WolFia	12 SagSf	13 HetDu	14 ValAm	15 Fil	16 RanAq	17 NupVa	18	19	20	21
61	9.6										V																
62	9.8																										
63	10.6										V																
64	10.4										V																
65	5.9																										
66	8.3										V																
67	10.1																										
68	10.8										V																
69	12.2										V																
70	13.0										V	1		1		V						V					
71	7.6						V				V																
72	11										V						V										
73	12.8										V																
74	14.5																										
75	8.0																										
76	13.2																										
77	11.8																										
78	8.0	S																									
79	5.3	S																									
80	8.0						1																				
81	6.2																										
82	10.8										V						V										
83	11.8																										
84	11.9										V																
85	11.4										V						V										
86	10.3																V										
87	9.3																										
88	8.7																										
89	4.2	R																									
90	shore																										

Big Blake Lake Polk County 2627000 **Date:**

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotZo	3 EloCa	4 PotPu	5 LemMi	6 LemTr	7 PotPr	8 NymOd	9 SpEu	10 MyrSi	11 WolFia	12 SagGr	13 HetPu	14 ValAm	15 Fil	16 RanAq	17 NupVa	18	19	20	21
91	11.2																										
92	11.9																										
93	11.2																										
94	11.1																										
95	10.8																										
96	10.1																										
97	10.3																										
98	5.5	R										1															
99	10.2																										
100	11.6																										
101	11.5																										
102	10.9																										
103	10.7																										
104	10.6																										
105	10.9																										
106	10.8																										
107	6.6	R						1								1											
108	9.9																										
109	13.0																										
110	11.7																										
111	11.1																										
112	10.5																										
113	10.8																										
114	11.0																										
115	11.2																										
116	8.7	S																									
117	12.8																										
118	12.2																										
119	11.3																										
120	11.1																										

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotZo	3 EloCa	4 PotPu	5 LemMi	6 LemTr	7 PotPr	8 NymOd	9 SpEy	10 MyrSi	11 WolRh	12 SagGr	13 HetPu	14 ValAm	15 Al	16 RanAq	17	18	19	20	21
121	10.9																										
122	11.1																										
123	11.4																										
124	[illegible].7																										
125	10.6																										
126	12.2																										
127	12.6																										
128	11.9																										
129	11.3																										
130	11.4																										
131	11.5																										
132	11.2																										
133	11.5																										
134	11.0																										
135	10.1																										
136	13.4																										
137	12.7																										
138	11.8																										
139	11.7																										
140	11.3																										
141	11.5																										
142	11.2																										
143	11.2																										
144	9.0	R																									
145	8.3	R					1	1																			
146	12.8																										
147	13.8																										
148	12.2																										
149	11.7																										
150	11.6																										

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerOe	2 PotZo	3 EloCa	4 PotPu	5 LemMi	6 LemTr	7 PotPr	8 NymOd	9 SpTd	10 MyrSi	11 WolFa	12 SagGr	13 HydPu	14 ValAm	15 FiI	16 RanAq	17	18	19	20	21
151	11.5																										
152	11.2																										
153	11.8																										
154	12.2																										
155	11.2																										
156	10.3																										
157	10.0																										
158	14.5																										
159	13.0																										
160	12.1																										
161	11.6																										
162	11.8																										
163	11.6																										
164	11.9																										
165	12.2																										
166	12.2																										
167	12.0																										
168	12.0																										
169	11.8																										
170	12.2																										
171	11.8																										
172	11.2																										
173	10.8																										
174	11.1																										
175	13.5																										
176	12.5																										
177	12.1																										
178	12.2																										
179	12.1																										
180	11.8																										

Observer 1: name and hours:	Observer 2: name and hours:	Observer 3: name and hours:	Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 Cerde	2 Potfo	3 Elodca	4 Potpu	5 Lemmi	6 Lemtr	7 Potpr	8 Nymod	9 Spatu	10 Myrsi	11 Wolfis	12 Sagfr	13 Hetdu	14 Valam	15 Fl	16 Ranaq	17	18	19	20	21
181	11.8																										
182	11.5																										
183	11.3																										
184	11.3																										
185	11.0																										
186	11.1																										
187	10.7																										
188	10.6																										
189	10.2																										
190	10.0																										
191	10.0																										
192	12.8																										
193	13.0																										
194	13.2																										
195	13.5																										
196	12.2																										
197	12.1																										
198	11.5																										
199	11.1																										
200	11.0																										
201	10.8																										
202	10.6																										
203	10.4																										
204	10.6																										
205	10.0																										
206	9.8																										
207	9.4																										
208	9.3																										
209	8.5							V																			
210	4.8	S						I																			

Observer 1: name and hours: Observer 2: name and hours: Observer 3: name and hours: Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotZo	3 ElOCa	4 PotPu	5 LemMi	6 LemTr	7 PotPr	8 NymOd	9 SpaEn	10 MyrSi	11 WolFi	12 SagGr	13 HetDe	14 ValAm	15 Fl	16 RanFa	17 NupVa	18 PotRi	19 ChaFa	20	21
211	7.8	R																									
212	11.3																										
213	11.0																										
214	10.5																										
215	11.0																										
216	6.5						1					1				1											
217	7.3																										
218	5.0															1			1	1				1	1		
219	10.3																										
220	9.8																										
221	9.3											1															
222	9.0						1																				
223	8.9					1																					
224	8.5						1																				
225	6.1	R					V																				
226	5.7						1									1											
227	9.8																										
228	9.0						1				V	1															
229	8.6																										
230	8.5																										
231	8.5																										
232	8.4																										
233	7.8						2	1				1				V											
234	5.2						V							V		1					1						
235	9.7																										
236	8.6																										
237	8.5																										
238	8.4						1																				
239	8.4						1						V														
240	7.6						3	1			1	1															

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotZo	3 HloCa	4 PotPu	5 LemMi	6 LemTr	7 PotPr	8 NymOd	9 SpiEq	10 MyrSi	11 WolFa	12 SagGr	13 HetPu	14 IlaAm	15 FIL	16 RanAq	17 NupVa	18 PotNa	19 ZizPa	20	21
241	10.1																										
242	9.1																										
243	8.8																										
244	8.2						1					1															
245	4.6	R					1									V											
246	7.6						3					1															
247	2.0						3					1		1			V						1				
248	9.4																										
249	8.5						2	1																			
250	7.8																										
251	5.5						1																				
252	4.5						3	1				1				1											
253	shallow																										
254	7.0						1														1						
255	7.3						1	1				1															
256	6.2						1	1				1	1														
257	6.5						1	1				1															
258	5.0						2	2				1				V								1			
259	5.5						1					1															
260	7.1						1					1															
261	7.5						2	1				1															
262	5.0						3	1				1	1														
263	shallow																										
264	5.0						3																				
265	7.0						3	1				1															
266	7.0						1																				
267	4.6						3					1		V										V			
268	shallow																										
269	4.5						2				1	1					1				1						
270	2.5						1		1												1						

Observer 1: name and hours: | Observer 2: name and hours: | Observer 3: name and hours: | Total hours worked:

Site #	Depth (ft)	Dominant sediment type (M, S, R)	Rake pole (P) or rake rope (R)?	Total Rake Fullness	EWM 1,2,3	CLP 1,2,3	1 CerDe	2 PotZo	3 ElaCa	4 PotPu	5 LemMi	6 LemTr	7 PotPr	8 NymOd	9 SpiEu	10 MyrSi	11 WolBra	12 SagGr	13 HetDu	14 ValAm	15 Til	16 PanAn	17 [illegible]	18 PotPg	19 ZizAq	20 [illegible]	21
271	2.5						3	1				1									1						
272	2.0						2				1		1	1		1	1				2				V		
273	2.0						1				1			V			1				2						
274	2.0						1							V													
275	Shore																										
276	2.0						V		1		V			V										1			
277																											
278																											
279																											
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Appendix I

Modeling Data

Date: 7/12/2016 Scenario: 1938 Diatom Inferred TP Reconstruction
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 2133.4 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 1422.3 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 1479.5 acre-ft/year
Areal Water Load <qs>: 7.1 ft/year
Lake Flushing Rate <p>: 0.79 1/year
Water Residence Time: 1.27 year
Observed spring overturn total phosphorus (SPO): 0.0 mg/m^3
Observed growing season mean phosphorus (GSM): 36.05 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	490.1	0.50	1.00	3.00	56.9	99	198	595
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	744.7	0.10	0.30	0.50	25.9	30	90	151
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	56.9	0.05	0.10	0.25	0.7	1	2	6
Wetlands	391.1	0.10	0.10	0.10	4.5	16	16	16
Forest	450.6	0.05	0.09	0.18	4.7	9	16	33
Lake Surface	208.0	0.10	0.30	1.00	7.2	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	0.0				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	361.2	768.5	1949.6	100.0
Total Loading (kg)	163.8	348.6	884.3	100.0
Areal Loading (lb/ac-year)	1.74	3.69	9.37	
Areal Loading (mg/m^2-year)	194.63	414.10	1050.61	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	342.6	712.8	1764.0	100.0
Total NPS Loading (kg)	155.4	323.3	800.2	100.0

Wisconsin Internal Load Estimator
Date: 7/12/2016 Scenario: 19
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 36.05 mg/m^3
Phosphorus Inflow Concentration: 191.0 mg/m^3
Areal External Loading: 414.1 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.74
Observed Phosphorus Retention Coefficient: 0.81
Internal Load: -52 Lb -24 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 0 mg/m^3
Hypolimnetic Volume: 0.0 acre-ft
Anoxia Sediment Area: 0.0 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 0 mg/m^3
Hypolimnetic Volume: 0.0 acre-ft
Anoxia Sediment Area: 0.0 acres
Time Period of Stratification: 1 days
Sediment Phosphorus Release Rate: 0 mg/m^2-day 0 lb/acre-day
Internal Load: 0 Lb 0 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 0 mg/m^3
Hypolimnetic Volume: 0 acre-ft
Anoxia Sediment Area: 0 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 0 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 0 acres
Time Period Between Observations: 1 days
Sediment Phosphorus Release Rate: 0 mg/m^2-day 0 lb/acre-day
Internal Load: 0 Lb 0 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 0 acre
End of Anoxia Anoxic Sediment Area: 0 acre
Phosphorus Release Rate As Calculated In Method 2: 0 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 0 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 0.0 mg/m^2-day
Period of Anoxia: 0 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	0	0	0

Internal Load: (kg)	0	0	0

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 769 Lb 349 kg

	Lb	kg	%
From A Complete Mass Budget:	-52	-24	-7.2
From Growing Season In Situ Phosphorus Increases:	0	0	0
From In Situ Phosphorus Increases In The Fall:	0	0	0.0
From Phosphorus Release Rate and Anoxic Area:	0	0	0

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	10	49	124

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	-52	0.0	0
Internal Load (kg):	-24	0.0	0
External Load (Lb):	361	769	1950
External Load (kg):	164	349	884
Total Load (Lb):	309	769	1950
Total Load (kg):	140	349	884

Phosphorus Prediction and Uncertainty Analysis Module

Date: 7/12/2016 Scenario: 15

Observed spring overturn total phosphorus (SPO): 0.0 mg/m^3

Observed growing season mean phosphorus (GSM): 36.0 mg/m^3

Back calculation for SPO total phosphorus: 0.53 mg/m^3

Back calculation GSM phosphorus: 0.53 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 49 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	30	65	164	29	81
Canfield-Bachmann, 1981 Natural Lake	37	63	117	27	75
Canfield-Bachmann, 1981 Artificial Lake	32	51	84	15	42
Rechow, 1979 General	14	29	74	-7	-19
Rechow, 1977 Anoxic	67	142	360	106	294
Rechow, 1977 water load<50m/year	31	67	169	31	86
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	N/A	N/A	N/A	N/A	N/A
Vollenweider, 1982 Combined OECD	33	62	133	44	244
Dillon-Rigler-Kirchner	N/A	N/A	N/A	N/A	N/A
Vollenweider, 1982 Shallow Lake/Res.	27	53	121	35	194
Larsen-Mercier, 1976	N/A	N/A	N/A	N/A	N/A
Nurnberg, 1984 Oxic	50	76	151	40	111

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	37	130	FIT	3	GSM
Canfield-Bachmann, 1981 Natural Lake	20	181	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	16	147	FIT	1	GSM
Rechow, 1979 General	16	59	FIT	6	GSM
Rechow, 1977 Anoxic	83	283	FIT	1	GSM
Rechow, 1977 water load<50m/year	37	135	P	3	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	N/A	N/A	N/A	N/A	N/A
Vollenweider, 1982 Combined OECD	30	122	FIT	1	ANN
Dillon-Rigler-Kirchner	N/A	N/A	N/A	N/A	N/A
Vollenweider, 1982 Shallow Lake/Res.	26	107	FIT	2	ANN
Larsen-Mercier, 1976	N/A	N/A	N/A	N/A	N/A
Nurnberg, 1984 Oxic	44	136	P	-187	ANN

Date: 3/4/2016 Scenario: 1938
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

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Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 1422.3 acre-ft
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Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 1479.5 acre-ft/year
Areal Water Load <qs>: 7.1 ft/year
Lake Flushing Rate <p>: 0.79 1/year
Water Residence Time: 1.27 year
Observed spring overturn total phosphorus (SPO): 0.0 mg/m^3
Observed growing season mean phosphorus (GSM): 0.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|	
Row Crop AG	490.1	0.50	1.00	3.00	56.9	99	198	595
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	744.7	0.10	0.30	0.50	25.9	30	90	151
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	56.9	0.05	0.10	0.25	0.7	1	2	6
Wetlands	391.1	0.10	0.10	0.10	4.5	16	16	16
Forest	450.6	0.05	0.09	0.18	4.7	9	16	33
Lake Surface	208.0	0.10	0.30	1.00	7.2	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description	Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)	0.30	0.50	0.80	
# capita-years	0.0			
% Phosphorus Retained by Soil	98.0	90.0	80.0	
Septic Tank Loading (kg/year)	0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	361.2	768.5	1949.6	100.0
Total Loading (kg)	163.8	348.6	884.3	100.0
Areal Loading (lb/ac-year)	1.74	3.69	9.37	
Areal Loading (mg/m^2-year)	194.63	414.10	1050.61	
Total PS Loading (lb)	0.0	0.0	0.0	0.0
Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	342.6	712.8	1764.0	100.0
Total NPS Loading (kg)	155.4	323.3	800.2	100.0

Date: 7/12/2016 Scenario: 1955 Diatom Inferred TP
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 2165.5 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 1443.7 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 1500.9 acre-ft/year
Areal Water Load <qs>: 7.2 ft/year
Lake Flushing Rate <p>: 0.80 1/year
Water Residence Time: 1.25 year
Observed spring overturn total phosphorus (SPO): 54.9 mg/m^3
Observed growing season mean phosphorus (GSM): 54.9 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	488.5	0.50	1.00	3.00	63.1	99	198	593
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	318.5	0.10	0.30	0.50	12.3	13	39	64
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	131.7	0.05	0.10	0.25	1.7	3	5	13
Wetlands	474.1	0.10	0.10	0.10	6.1	19	19	19
Forest	752.7	0.05	0.09	0.18	8.7	15	27	55
Lake Surface	208.0	0.10	0.30	1.00	8.1	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description	Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)	0.30	0.50	0.80	
# capita-years	0.0			
% Phosphorus Retained by Soil	98.0	90.0	80.0	
Septic Tank Loading (kg/year)	0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	346.6	691.3	1827.7	100.0
Total Loading (kg)	157.2	313.5	829.1	100.0
Areal Loading (lb/ac-year)	1.67	3.32	8.79	
Areal Loading (mg/m^2-year)	186.80	372.50	984.92	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	328.1	635.6	1642.2	100.0
Total NPS Loading (kg)	148.8	288.3	744.9	100.0

Wisconsin Internal Load Estimator
Date: 7/12/2016 Scenario: 22
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 54.87 mg/m^3
Phosphorus Inflow Concentration: 169.4 mg/m^3
Areal External Loading: 372.5 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.74
Observed Phosphorus Retention Coefficient: 0.68
Internal Load: 46 Lb 21 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 0 mg/m^3
Hypolimnetic Volume: 0.0 acre-ft
Anoxia Sediment Area: 0.0 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 0 mg/m^3
Hypolimnetic Volume: 0.0 acre-ft
Anoxia Sediment Area: 0.0 acres
Time Period of Stratification: 1 days
Sediment Phosphorus Release Rate: 0 mg/m^2-day 0 lb/acre-day
Internal Load: 0 Lb 0 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 0 mg/m^3
Hypolimnetic Volume: 0 acre-ft
Anoxia Sediment Area: 0 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 0 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 0 acres
Time Period Between Observations: 1 days
Sediment Phosphorus Release Rate: 0 mg/m^2-day 0 lb/acre-day
Internal Load: 0 Lb 0 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 0 acre
End of Anoxia Anoxic Sediment Area: 0 acre
Phosphorus Release Rate As Calculated In Method 2: 0 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 0 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 0.0 mg/m^2-day
Period of Anoxia: 0 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	0	0	0

Internal Load: (kg)	0	0	0

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 691 Lb 314 kg

	Lb	kg	%
From A Complete Mass Budget:	46	21	6.2
From Growing Season In Situ Phosphorus Increases:	0	0	0
From In Situ Phosphorus Increases In The Fall:	0	0	0.0
From Phosphorus Release Rate and Anoxic Area:	0	0	0

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	33	44	115

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	46	0.0	0
Internal Load (kg):	21	0.0	0
External Load (Lb):	347	691	1828
External Load (kg):	157	314	829
Total Load (Lb):	393	691	1828
Total Load (kg):	178	314	829

Phosphorus Prediction and Uncertainty Analysis Module

Date: 7/12/2016 Scenario: 16

Observed spring overturn total phosphorus (SPO): 54.9 mg/m^3

Observed growing season mean phosphorus (GSM): 54.9 mg/m^3

Back calculation for SPO total phosphorus: 0.47 mg/m^3

Back calculation GSM phosphorus: 0.47 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 44 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	30	60	159	5	9
Canfield-Bachmann, 1981 Natural Lake	35	58	112	3	5
Canfield-Bachmann, 1981 Artificial Lake	31	48	81	-7	-13
Rechow, 1979 General	13	26	69	-29	-53
Rechow, 1977 Anoxic	63	126	334	71	129
Rechow, 1977 water load<50m/year	30	60	158	5	9
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	44	89	234	34	62
Vollenweider, 1982 Combined OECD	32	56	125	1	2
Dillon-Rigler-Kirchner	22	43	114	-12	-22
Vollenweider, 1982 Shallow Lake/Res.	26	48	113	-7	-13
Larsen-Mercier, 1976	40	80	212	25	46
Nurnberg, 1984 Oxic	46	67	139	12	22

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	35	124	FIT	2	GSM
Canfield-Bachmann, 1981 Natural Lake	18	167	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	15	138	FIT	1	GSM
Rechow, 1979 General	15	54	FIT	6	GSM
Rechow, 1977 Anoxic	75	259	FIT	1	GSM
Rechow, 1977 water load<50m/year	34	124	FIT	2	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	44	192	FIT	2	SPO
Vollenweider, 1982 Combined OECD	28	113	FIT	1	ANN
Dillon-Rigler-Kirchner	26	89	P	3	SPO
Vollenweider, 1982 Shallow Lake/Res.	24	98	FIT	2	ANN
Larsen-Mercier, 1976	49	164	P Pin	2	SPO
Nurnberg, 1984 Oxic	39	123	P	-168	ANN

Date: 3/4/2016 Scenario: 1955
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 2165.5 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 1443.7 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 1500.9 acre-ft/year
Areal Water Load <qs>: 7.2 ft/year
Lake Flushing Rate <p>: 0.80 1/year
Water Residence Time: 1.25 year
Observed spring overturn total phosphorus (SPO): 0.0 mg/m^3
Observed growing season mean phosphorus (GSM): 0.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	488.5	0.50	1.00	3.00	63.1	99	198	593
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	318.5	0.10	0.30	0.50	12.3	13	39	64
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	131.7	0.05	0.10	0.25	1.7	3	5	13
Wetlands	474.1	0.10	0.10	0.10	6.1	19	19	19
Forest	752.7	0.05	0.09	0.18	8.7	15	27	55
Lake Surface	208.0	0.10	0.30	1.00	8.1	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description	Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)	0.30	0.50	0.80	
# capita-years	0.0			
% Phosphorus Retained by Soil	98.0	90.0	80.0	
Septic Tank Loading (kg/year)	0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	346.6	691.3	1827.7	100.0
Total Loading (kg)	157.2	313.5	829.1	100.0
Areal Loading (lb/ac-year)	1.67	3.32	8.79	
Areal Loading (mg/m^2-year)	186.80	372.50	984.92	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	328.1	635.6	1642.2	100.0
Total NPS Loading (kg)	148.8	288.3	744.9	100.0

Date: 3/4/2016 Scenario: 1974
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 2142.3 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 1428.2 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 1485.4 acre-ft/year
Areal Water Load <qs>: 7.1 ft/year
Lake Flushing Rate <p>: 0.79 1/year
Water Residence Time: 1.26 year
Observed spring overturn total phosphorus (SPO): 0.0 mg/m^3
Observed growing season mean phosphorus (GSM): 0.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	392.2	0.50	1.00	3.00	55.2	79	159	476
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	270.4	0.10	0.30	0.50	11.4	11	33	55
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	89.7	0.30	0.50	0.80	6.3	11	18	29
Rural Res (>1 Ac)	89.7	0.05	0.10	0.25	1.3	2	4	9
Wetlands	378.9	0.10	0.10	0.10	5.3	15	15	15
Forest	921.6	0.05	0.09	0.18	11.7	19	34	67
Lake Surface	208.0	0.10	0.30	1.00	8.8	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	0.0				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	320.6	633.8	1621.7	100.0
Total Loading (kg)	145.4	287.5	735.6	100.0
Areal Loading (lb/ac-year)	1.54	3.05	7.80	
Areal Loading (mg/m^2-year)	172.74	341.52	873.92	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	302.0	578.1	1436.2	100.0
Total NPS Loading (kg)	137.0	262.2	651.4	100.0

Date: 3/4/2016 Scenario: 1996
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 2119.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 1412.7 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 1469.9 acre-ft/year
Areal Water Load <qs>: 7.1 ft/year
Lake Flushing Rate <p>: 0.79 1/year
Water Residence Time: 1.27 year
Observed spring overturn total phosphorus (SPO): 0.0 mg/m^3
Observed growing season mean phosphorus (GSM): 0.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	416.6	0.50	1.00	3.00	54.7	84	169	506
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	204.5	0.10	0.30	0.50	8.1	8	25	41
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	200.0	0.30	0.50	0.80	13.1	24	40	65
Rural Res (>1 Ac)	4.2	0.05	0.10	0.25	0.1	0	0	0
Wetlands	421.1	0.10	0.10	0.10	5.5	17	17	17
Forest	872.6	0.05	0.09	0.18	10.3	18	32	64
Lake Surface	208.0	0.10	0.30	1.00	8.2	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	0.0				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	352.9	679.3	1713.3	100.0
Total Loading (kg)	160.1	308.1	777.1	100.0
Areal Loading (lb/ac-year)	1.70	3.27	8.24	
Areal Loading (mg/m^2-year)	190.15	366.08	923.25	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	334.3	623.7	1527.7	100.0
Total NPS Loading (kg)	151.6	282.9	693.0	100.0

Date: 3/28/2016 Scenario: BBL 2013 Direct Drainage
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 550.0 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 366.7 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 126018.4 acre-ft/year
Areal Water Load <qs>: 605.9 ft/year
Lake Flushing Rate <p>: 67.32 1/year
Water Residence Time: 0.01 year
Observed spring overturn total phosphorus (SPO): 46.4 mg/m^3
Observed growing season mean phosphorus (GSM): 80 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	123	0.50	1.00	3.00	0.7	25	50	149
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	38	0.10	0.30	0.50	0.1	2	5	8
HD Urban (1/8 Ac)	19	1.00	1.50	2.00	0.2	8	12	15
MD Urban (1/4 Ac)	113	0.30	0.50	0.80	0.3	14	23	37
Rural Res (>1 Ac)	46	0.05	0.10	0.25	0.0	1	2	5
Wetlands	35	0.10	0.10	0.10	0.0	1	1	1
Forest	176	0.05	0.09	0.18	0.1	4	6	13
Lake Surface	208.0	0.10	0.30	1.00	0.3	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.1

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	139.2	16383.7	745.9	100.0
Total Loading (kg)	63.1	7431.6	338.4	100.0
Areal Loading (lb/ac-year)	0.67	78.77	3.59	
Areal Loading (mg/m^2-year)	75.02	8828.81	401.97	
Total PS Loading (lb)	0.0	16092.8	0.0	98.2

Total PS Loading (kg)	0.0	7299.7	0.0	98.2
Total NPS Loading (lb)	118.5	217.1	502.4	1.7
Total NPS Loading (kg)	53.7	98.5	227.9	1.7

Wisconsin Internal Load Estimator
Date: 3/28/2016 Scenario: 5
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 69.64 mg/m^3
Phosphorus Inflow Concentration: 47.8 mg/m^3
Areal External Loading: 8828.8 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.07
Observed Phosphorus Retention Coefficient: -0.46
Internal Load: 8694 Lb 3943 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 84.9 mg/m^3
Hypolimnetic Volume: 1175.95 acre-ft
Anoxia Sediment Area: 97.12 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 135 mg/m^3
Hypolimnetic Volume: 1175 acre-ft
Anoxia Sediment Area: 97.12 acres
Time Period of Stratification: 90 days
Sediment Phosphorus Release Rate: 2.0 mg/m^2-day 5.57E-003 lb/acre-day
Internal Load: 160 Lb 73 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 84.9 mg/m^3
Hypolimnetic Volume: 1175.95 acre-ft
Anoxia Sediment Area: 97.12 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 135 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 97.12 acres
Time Period Between Observations: 14 days
Sediment Phosphorus Release Rate: 34.3 mg/m^2-day 9.32E-002 lb/acre-day
Internal Load: 416 Lb 189 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 97.12 acre
End of Anoxia Anoxic Sediment Area: 97.12 acre
Phosphorus Release Rate As Calculated In Method 2: 2.0 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 2.0 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 18.2 mg/m^2-day
Period of Anoxia: 90 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	143	333	570

Internal Load: (kg) 65 151 259

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 16384 Lb 7432 kg

	Lb	kg	%
From A Complete Mass Budget:	8694	3943	34.7
From Growing Season In Situ Phosphorus Increases:	160	73	1.0
From In Situ Phosphorus Increases In The Fall:	416	189	2.5
From Phosphorus Release Rate and Anoxic Area:	333	151	2.0

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	26	45	3

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	8694	287.8	333
Internal Load (kg):	3943	130.5	151
External Load (Lb):	139	16384	746
External Load (kg):	63	7432	338
Total Load (Lb):	8833	16671	1079
Total Load (kg):	4006	7562	489

Phosphorus Prediction and Uncertainty Analysis Module

Date: 3/28/2016 Scenario: 5

Observed spring overturn total phosphorus (SPO): 46.4 mg/m^3

Observed growing season mean phosphorus (GSM): 80.0 mg/m^3

Back calculation for SPO total phosphorus: 46.87 mg/m^3

Back calculation GSM phosphorus: 80.81 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 45 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	0	43	2	-37	-46
Canfield-Bachmann, 1981 Natural Lake	0	44	2	-36	-45
Canfield-Bachmann, 1981 Artificial Lake	0	40	2	-40	-50
Rechow, 1979 General	0	38	2	-42	-53
Rechow, 1977 Anoxic	0	42	2	-38	-48
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	0	36	2	-44	-55
Walker, 1977 General	0	43	2	-3	-6
Vollenweider, 1982 Combined OECD	1	34	3	-29	-46
Dillon-Rigler-Kirchner	0	43	2	-3	-6
Vollenweider, 1982 Shallow Lake/Res.	0	28	2	-35	-55
Larsen-Mercier, 1976	0	43	2	-3	-6
Nurnberg, 1984 Oxic	1	45	2	-35	-44

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	14	72	Tw	13845	GSM
Canfield-Bachmann, 1981 Natural Lake	14	127	L	14021	GSM
Canfield-Bachmann, 1981 Artificial Lake	12	115	FIT	16290	GSM
Rechow, 1979 General	12	65	FIT	15863	GSM
Rechow, 1977 Anoxic	14	70	FIT	14226	GSM
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	14	57	FIT	16677	GSM
Walker, 1977 General	12	79	FIT	8174	SPO
Vollenweider, 1982 Combined OECD	9	64	Tw	16275	ANN
Dillon-Rigler-Kirchner	14	72	P L p	8091	SPO
Vollenweider, 1982 Shallow Lake/Res.	7	52	Tw	19477	ANN
Larsen-Mercier, 1976	15	71	P Pin p	8174	SPO
Nurnberg, 1984 Oxic	14	80	L	13517	ANN

Water and Nutrient Outflow Module
Date: 3/28/2016 Scenario: 3
Average Annual Surface Total Phosphorus: 69.64mg/m^3
Annual Discharge: 1.26E+005 AF => 1.55E+008 m^3
Annual Outflow Loading: 22749.9 LB => 10319.3 kg

Expanded Trophic Response Module
Date: 3/28/2016 Scenario: 4
Total Phosphorus: 69.64 mg/m^3
Growing Season
Chlorophyll a: 93.9 mg/m^3
Secchi Disk Depth: 1.75 m
Chlorophyll a Nuisance Frequency
Chla Mean Min: 5
Chla Mean Max: 100
Chla Mean Increment: 5
Chla Temporal CV: 0.62
Chla Nuisance Criterion: 20

Mean	Freq %	ml	z	v	w	x
5	0.5	1.4	2.546	0.016	0.541	0.005
10	7.7	2.1	1.428	0.144	0.678	0.077
15	21.9	2.5	0.774	0.296	0.795	0.219
20	37.8	2.8	0.310	0.380	0.907	0.378
25	52.0	3.0	-0.050	0.398	0.984	0.480
30	63.5	3.2	-0.344	0.376	0.897	0.365
35	72.3	3.4	-0.593	0.335	0.835	0.277
40	79.0	3.5	-0.808	0.288	0.788	0.210
45	84.1	3.6	-0.998	0.242	0.751	0.159
50	87.9	3.7	-1.168	0.202	0.720	0.121
55	90.7	3.8	-1.322	0.167	0.695	0.093
60	92.8	3.9	-1.462	0.137	0.673	0.072
65	94.4	4.0	-1.591	0.112	0.654	0.056
70	95.6	4.1	-1.711	0.092	0.637	0.044
75	96.6	4.1	-1.822	0.076	0.623	0.034
80	97.3	4.2	-1.926	0.062	0.609	0.027

85	97.8	4.3	-2.024	0.051	0.598	0.022
90	98.3	4.3	-2.116	0.043	0.587	0.017
95	98.6	4.4	-2.203	0.035	0.577	0.014
100	98.9	4.4	-2.286	0.029	0.568	0.011

Expanded Trophic Response Module
Date: 3/28/2016 Scenario: 5
Total Phosphorus: 69.64 mg/m^3
Growing Season
Chlorophyll a: 93.9 mg/m^3
Secchi Disk Depth: 1.75 m
Carlson TSI Equations:
TSI (Total Phosphorus): 65 TSI (Chlorophyll a): 75 TSI (Secchi Disk Depth): 52

Expanded Trophic Response Module
Date: 3/28/2016 Scenario: 6
Total Phosphorus: 69.64 mg/m^3
Growing Season
Chlorophyll a: 93.9 mg/m^3
Secchi Disk Depth: 1.75 m
Wisconsin Statewide Prediction Equations:

	Natural Lakes		Impoundments	
	Stratified	Mixed	Stratified	Mixed
Secchi Disk Depth using Chlorophyll a:	0.7	0.5	0.9	0.5
Secchi Disk Depth using Total Phosphorus:	1.3	0.8	0.9	0.9
Chlorophyll a using Total Phosphorus:	14.6	20.7	36.9	22.4

Expanded Trophic Response Module
Date: 3/28/2016 Scenario: 7
Total Phosphorus: 69.64 mg/m^3
Growing Season
Chlorophyll a: 93.9 mg/m^3
Secchi Disk Depth: 1.75 m
Wisconsin Regional Prediction Equations:

		Stratified		Mixed	
	Region	Seepage	Drainage	Seepage	Drainage
Use Chlorophyll a To Predict	South	0.6	0.6	0.5	0.4
Secchi Disk Depth (m)	Central	1.2	0.5	0.1	No Data
	North	0.9	0.6	0.7	0.9
Use Total Phosphorus To	South	1.2	0.8	0.6	0.6
Predict Secchi Disk Depth (m)	Central	2.7	0.4	0.6	No Data
	North	1.8	1.0	1.1	0.8
Use Total Phosphorus To	South	15.0	44.8	22.2	28.8
Predict Chlorophyll a (mg/m^3))	Central	13.5	120.6	21.2	No Data
	North	8.2	19.8	16.3	12.3

Date: 4/4/2016 Scenario: Big Blake 2013 Direct Drainage
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 550.0 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 366.7 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 126018.4 acre-ft/year
Areal Water Load <qs>: 605.9 ft/year
Lake Flushing Rate <p>: 67.32 1/year
Water Residence Time: 0.01 year
Observed spring overturn total phosphorus (SPO): 46.4 mg/m^3
Observed growing season mean phosphorus (GSM): 80.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	123.0	0.50	1.00	3.00	0.7	25	50	149
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	38.0	0.10	0.30	0.50	0.1	2	5	8
HD Urban (1/8 Ac)	19.0	1.00	1.50	2.00	0.2	8	12	15
MD Urban (1/4 Ac)	113.0	0.30	0.50	0.80	0.3	14	23	37
Rural Res (>1 Ac)	46.0	0.05	0.10	0.25	0.0	1	2	5
Wetlands	35.0	0.10	0.10	0.10	0.0	1	1	1
Forest	176.0	0.05	0.09	0.18	0.1	4	6	13
Lake Surface	208.0	0.10	0.30	1.00	0.3	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.1

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	139.2	16383.7	745.9	100.0
Total Loading (kg)	63.1	7431.6	338.4	100.0
Areal Loading (lb/ac-year)	0.67	78.77	3.59	
Areal Loading (mg/m^2-year)	75.02	8828.81	401.97	
Total PS Loading (lb)	0.0	16092.8	0.0	98.2

Total PS Loading (kg)	0.0	7299.7	0.0	98.2
Total NPS Loading (lb)	118.5	217.1	502.4	1.7
Total NPS Loading (kg)	53.7	98.5	227.9	1.7

Wisconsin Internal Load Estimator
Date: 4/4/2016 Scenario: 11
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 69.64 mg/m^3
Phosphorus Inflow Concentration: 47.8 mg/m^3
Areal External Loading: 8828.8 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.07
Observed Phosphorus Retention Coefficient: -0.46
Internal Load: 8694 Lb 3943 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 1029.20 acre-ft
Anoxia Sediment Area: 156.89 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 78.8 mg/m^3
Hypolimnetic Volume: 223.01 acre-ft
Anoxia Sediment Area: 67.99 acres
Time Period of Stratification: 45 days
Sediment Phosphorus Release Rate: -2.8 mg/m^2-day -7.62E-003 lb/acre-day
Internal Load: -127 Lb -57 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 1029.20 acre-ft
Anoxia Sediment Area: 156.89 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 135 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 67.99 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 17.0 mg/m^2-day 4.63E-002 lb/acre-day
Internal Load: 513 Lb 233 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 156.89 acre
End of Anoxia Anoxic Sediment Area: 67.99 acre
Phosphorus Release Rate As Calculated In Method 2: -2.8 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: -2.8 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 7.1 mg/m^2-day
Period of Anoxia: 45 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	83	193	330

Internal Load: (kg) 37 87 150

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 16384 Lb 7432 kg

	Lb	kg	%
From A Complete Mass Budget:	8694	3943	34.7
From Growing Season In Situ Phosphorus Increases:	-127	-57	-0.8
From In Situ Phosphorus Increases In The Fall:	513	233	3.0
From Phosphorus Release Rate and Anoxic Area:	193	87	1.2

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	0	0	0

Osgood, 1988 Lake Mixing Index: 0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	0	0	0
Internal Load (kg):	0	0	0
External Load (Lb):	0	0	0
External Load (kg):	0	0	0
Total Load (Lb):	0	0	0
Total Load (kg):	0	0	0

Wisconsin Internal Load Estimator

Date: 4/4/2016 Scenario: 12

Method 1 - A Complete Total Phosphorus Mass Budget

Method 1 - A Complete Total Phosphorus Mass Budget 69.64 mg/m^3
Phosphorus Inflow Concentration: 47.8 mg/m^3
Areal External Loading: 8828.8 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.07
Observed Phosphorus Retention Coefficient: -0.46
Internal Load: 8694 Lb 3943 kg

Method 2 - From Growing Season In Situ Phosphorus Increases

Start of Anoxia

Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 1029.20 acre-ft
Anoxia Sediment Area: 156.89 acres

Just Prior To The End of Stratification

Average Hypolimnetic Phosphorus Concentration: 78.8 mg/m^3
Hypolimnetic Volume: 223.01 acre-ft
Anoxia Sediment Area: 67.99 acres
Time Period of Stratification: 45 days
Sediment Phosphorus Release Rate: -2.8 mg/m^2-day -7.62E-003 lb/acre-day
Internal Load: -127 Lb -57 kg

Method 3 - From In Situ Phosphorus Increases In The Fall

Start of Anoxia

Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 1029.20 acre-ft
Anoxia Sediment Area: 156.89 acres

Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 135 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 67.99 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 17.0 mg/m^2-day 4.63E-002 lb/acre-day
Internal Load: 513 Lb 233 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 156.89 acre
End of Anoxia Anoxic Sediment Area: 67.99 acre
Phosphorus Release Rate As Calculated In Method 2: -2.8 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: -2.8 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 7.1 mg/m^2-day
Period of Anoxia: 45 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	83	193	330
Internal Load: (kg)	37	87	150

Internal Load Comparison (Percentages are of the Total Estimate Load)
Total External Load: 16384 Lb 7432 kg

	Lb	kg	%
From A Complete Mass Budget:	8694	3943	34.7
From Growing Season In Situ Phosphorus Increases:	-127	-57	-0.8
From In Situ Phosphorus Increases In The Fall:	513	233	3.0
From Phosphorus Release Rate and Anoxic Area:	193	87	1.2

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	26	45	3

Osgood, 1988 Lake Mixing Index: 3.0
Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	8694	193.1	193
Internal Load (kg):	3943	87.6	87
External Load (Lb):	139	16384	746
External Load (kg):	63	7432	338
Total Load (Lb):	8833	16577	939
Total Load (kg):	4006	7519	426

Phosphorus Prediction and Uncertainty Analysis Module
Date: 4/4/2016 Scenario: 9
Observed spring overturn total phosphorus (SPO): 46.4 mg/m^3
Observed growing season mean phosphorus (GSM): 80.0 mg/m^3
Back calculation for SPO total phosphorus: 46.87 mg/m^3
Back calculation GSM phosphorus: 80.81 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 45 kg

Lake Phosphorus Model	Low Total P (mg/m^3)	Most Likely Total P (mg/m^3)	High Total P (mg/m^3)	Predicted -Observed (mg/m^3)	% Dif.
Walker, 1987 Reservoir	0	43	2	-37	-46
Canfield-Bachmann, 1981 Natural Lake	0	44	2	-36	-45
Canfield-Bachmann, 1981 Artificial Lake	0	40	2	-40	-50
Rechow, 1979 General	0	38	2	-42	-53
Rechow, 1977 Anoxic	0	42	2	-38	-48
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	0	36	2	-44	-55
Walker, 1977 General	0	43	2	-3	-6
Vollenweider, 1982 Combined OECD	1	34	3	-29	-46
Dillon-Rigler-Kirchner	0	43	2	-3	-6
Vollenweider, 1982 Shallow Lake/Res.	0	28	2	-35	-55
Larsen-Mercier, 1976	0	43	2	-3	-6
Nurnberg, 1984 Oxic	1	45	2	-35	-44

Lake Phosphorus Model	Confidence Lower Bound	Confidence Upper Bound	Parameter Fit?	Back Calculation (kg/year)	Model Type
Walker, 1987 Reservoir	14	72	Tw	13845	GSM
Canfield-Bachmann, 1981 Natural Lake	14	127	L	14021	GSM
Canfield-Bachmann, 1981 Artificial Lake	12	115	FIT	16290	GSM
Rechow, 1979 General	12	65	FIT	15863	GSM
Rechow, 1977 Anoxic	14	70	FIT	14226	GSM
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	14	57	FIT	16677	GSM
Walker, 1977 General	12	79	FIT	8174	SPO
Vollenweider, 1982 Combined OECD	9	64	Tw	16275	ANN
Dillon-Rigler-Kirchner	14	72	P L p	8091	SPO
Vollenweider, 1982 Shallow Lake/Res.	7	52	Tw	19477	ANN
Larsen-Mercier, 1976	15	71	P Pin p	8174	SPO
Nurnberg, 1984 Oxic	14	80	L	13517	ANN

Water and Nutrient Outflow Module
Date: 4/4/2016 Scenario: 7
Average Annual Surface Total Phosphorus: 69.64mg/m^3
Annual Discharge: 1.26E+005 AF => 1.55E+008 m^3
Annual Outflow Loading: 22749.9 LB => 10319.3 kg

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 21
Total Phosphorus: 69.64 mg/m^3
Growing Season
Chlorophyll a: 93.90 mg/m^3
Secchi Disk Depth: 1.75 m
Carlson TSI Equations:
TSI (Total Phosphorus): 65 TSI (Chlorophyll a): 75 TSI (Secchi Disk Depth): 52

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 22

Total Phosphorus: 69.64 mg/m^3
Growing Season
Chlorophyll a: 93.90 mg/m^3
Secchi Disk Depth: 1.75 m

Wisconsin Statewide Prediction Equations:

	Natural Lakes		Impoundments	
	Stratified	Mixed	Stratified	Mixed
Secchi Disk Depth using Chlorophyll a:	0.7	0.5	0.9	0.5
Secchi Disk Depth using Total Phosphorus:	1.3	0.8	0.9	0.9
Chlorophyll a using Total Phosphorus:	14.6	20.7	36.9	22.4

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 23
Total Phosphorus: 69.64 mg/m^3
Growing Season
Chlorophyll a: 93.90 mg/m^3
Secchi Disk Depth: 1.75 m

Wisconsin Regional Prediction Equations:

		Stratified		Mixed	
	Region	Seepage	Drainage	Seepage	Drainage
Use Chlorophyll a To Predict	South	0.6	0.6	0.5	0.4
Secchi Disk Depth (m)	Central	1.2	0.5	0.1	No Data
	North	0.9	0.6	0.7	0.9
Use Total Phosphorus To	South	1.2	0.8	0.6	0.6
Predict Secchi Disk Depth (m)	Central	2.7	0.4	0.6	No Data
	North	1.8	1.0	1.1	0.8
Use Total Phosphorus To	South	15.0	44.8	22.2	28.8
Predict Chlorophyll a (mg/m^3))	Central	13.5	120.6	21.2	No Data
	North	8.2	19.8	16.3	12.3

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 24
Total Phosphorus: 69.64 mg/m^3
Growing Season
Chlorophyll a: 93.90 mg/m^3
Secchi Disk Depth: 1.75 m

Chlorophyll a Nuisance Frequency
Chla Mean Min: 5
Chla Mean Max: 100
Chla Mean Increment: 5
Chla Temporal CV: 0.62
Chla Nuisance Criterion: 20

Mean	Freq %	ml	z	v	w	x
5	0.5	1.4	2.546	0.016	0.541	0.005
10	7.7	2.1	1.428	0.144	0.678	0.077
15	21.9	2.5	0.774	0.296	0.795	0.219
20	37.8	2.8	0.310	0.380	0.907	0.378
25	52.0	3.0	-0.050	0.398	0.984	0.480
30	63.5	3.2	-0.344	0.376	0.897	0.365
35	72.3	3.4	-0.593	0.335	0.835	0.277

40	79.0	3.5	-0.808	0.288	0.788	0.210
45	84.1	3.6	-0.998	0.242	0.751	0.159
50	87.9	3.7	-1.168	0.202	0.720	0.121
55	90.7	3.8	-1.322	0.167	0.695	0.093
60	92.8	3.9	-1.462	0.137	0.673	0.072
65	94.4	4.0	-1.591	0.112	0.654	0.056
70	95.6	4.1	-1.711	0.092	0.637	0.044
75	96.6	4.1	-1.822	0.076	0.623	0.034
80	97.3	4.2	-1.926	0.062	0.609	0.027
85	97.8	4.3	-2.024	0.051	0.598	0.022
90	98.3	4.3	-2.116	0.043	0.587	0.017
95	98.6	4.4	-2.203	0.035	0.577	0.014
100	98.9	4.4	-2.286	0.029	0.568	0.011

Date: 3/16/2016 Scenario: 2013 LTHIA
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 46.4 mg/m^3
Observed growing season mean phosphorus (GSM): 82.8 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|		
Row Crop AG	1023.8	0.50	1.00	3.00	24.8	207	414	1243
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.8	194	582	969
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	2	3	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	14	28	70
Wetlands	1496.3	0.10	0.10	0.10	3.6	61	61	61
Forest	10759.2	0.05	0.09	0.18	23.5	218	392	784
Lake Surface	208.0	0.10	0.30	1.00	1.5	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.5

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1669.0	3682.4	8304.2	100.0
Total Loading (kg)	757.1	1670.3	3766.8	100.0
Areal Loading (lb/ac-year)	8.02	17.70	39.92	
Areal Loading (mg/m^2-year)	899.40	1984.34	4474.95	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1648.3	3608.6	8060.6	99.5
Total NPS Loading (kg)	747.7	1636.8	3656.3	99.5

Wisconsin Internal Load Estimator
Date: 3/16/2016 Scenario: 1
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 69.64 mg/m^3
Phosphorus Inflow Concentration: 100.8 mg/m^3
Areal External Loading: 1984.3 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.40
Observed Phosphorus Retention Coefficient: 0.31
Internal Load: 327 Lb 149 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 73.68 mg/m^3
Hypolimnetic Volume: 1175.95 acre-ft
Anoxia Sediment Area: 97.12 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 73.68 mg/m^3
Hypolimnetic Volume: 1175.95 acre-ft
Anoxia Sediment Area: 97.12 acres
Time Period of Stratification: 90 days
Sediment Phosphorus Release Rate: 0.0 mg/m^2-day 0.00E+000 lb/acre-day
Internal Load: 0 Lb 0 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 73.68 mg/m^3
Hypolimnetic Volume: 1175.95 acre-ft
Anoxia Sediment Area: 97.12 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 78.8 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 97.12 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 6.4 mg/m^2-day 1.73E-002 lb/acre-day
Internal Load: 166 Lb 75 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 97.12 acre
End of Anoxia Anoxic Sediment Area: 97.12 acre
Phosphorus Release Rate As Calculated In Method 2: 0.0 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 0.0 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 3.2 mg/m^2-day
Period of Anoxia: 90 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	143	333	570

Internal Load: (kg) 65 151 259

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 3682 Lb 1670 kg

	Lb	kg	%
From A Complete Mass Budget:	327	149	8.2
From Growing Season In Situ Phosphorus Increases:	0	0	0.0
From In Situ Phosphorus Increases In The Fall:	166	75	4.3
From Phosphorus Release Rate and Anoxic Area:	333	151	8.3

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	36	63	146

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	327	82.8	333
Internal Load (kg):	149	37.5	151
External Load (Lb):	1669	3682	8304
External Load (kg):	757	1670	3767
Total Load (Lb):	1996	3765	8637
Total Load (kg):	906	1708	3918

Phosphorus Prediction and Uncertainty Analysis Module

Date: 3/16/2016 Scenario: 2

Observed spring overturn total phosphorus (SPO): 46.4 mg/m^3

Observed growing season mean phosphorus (GSM): 82.8 mg/m^3

Back calculation for SPO total phosphorus: 70.34 mg/m^3

Back calculation GSM phosphorus: 70.48 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 63 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	25	56	127	-27	-33
Canfield-Bachmann, 1981 Natural Lake	35	69	136	-14	-17
Canfield-Bachmann, 1981 Artificial Lake	31	57	102	-26	-31
Rechow, 1979 General	26	56	127	-27	-33
Rechow, 1977 Anoxic	40	87	197	4	5
Rechow, 1977 water load<50m/year	30	66	149	-17	-21
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	34	75	170	29	63
Vollenweider, 1982 Combined OECD	27	53	102	-12	-19
Dillon-Rigler-Kirchner	24	53	119	7	15
Vollenweider, 1982 Shallow Lake/Res.	22	45	91	-20	-31
Larsen-Mercier, 1976	33	73	166	27	58
Nurnberg, 1984 Oxic	31	64	141	-19	-23

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	32	104	FIT	2096	GSM
Canfield-Bachmann, 1981 Natural Lake	21	199	FIT	1685	GSM
Canfield-Bachmann, 1981 Artificial Lake	18	164	FIT	2189	GSM
Rechow, 1979 General	31	105	FIT	2090	GSM
Rechow, 1977 Anoxic	50	160	FIT	1347	GSM
Rechow, 1977 water load<50m/year	36	123	P	1783	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	36	148	FIT	1558	SPO
Vollenweider, 1982 Combined OECD	25	100	FIT	2393	ANN
Dillon-Rigler-Kirchner	30	97	P	2234	SPO
Vollenweider, 1982 Shallow Lake/Res.	21	85	FIT	2842	ANN
Larsen-Mercier, 1976	43	134	P Pin	1601	SPO
Nurnberg, 1984 Oxic	33	122	P	1836	ANN

Water and Nutrient Outflow Module
Date: 3/16/2016 Scenario: 1
Average Annual Surface Total Phosphorus: 69.64mg/m^3
Annual Discharge: 1.34E+004 AF => 1.66E+007 m^3
Annual Outflow Loading: 2436.5 LB => 1105.2 kg

Expanded Trophic Response Module
Date: 3/16/2016 Scenario: 1
Total Phosphorus: 69.78 mg/m^3
Growing Season
Chlorophyll a: 93.90 mg/m^3
Secchi Disk Depth: 1.75 m
Chlorophyll a Nuisance Frequency
Chla Mean Min: 5
Chla Mean Max: 100
Chla Mean Increment: 5
Chla Temporal CV: 0.62
Chla Nuisance Criterion: 20

Mean	Freq %	ml	z	v	w	x
5	0.5	1.4	2.546	0.016	0.541	0.005
10	7.7	2.1	1.428	0.144	0.678	0.077
15	21.9	2.5	0.774	0.296	0.795	0.219
20	37.8	2.8	0.310	0.380	0.907	0.378
25	52.0	3.0	-0.050	0.398	0.984	0.480
30	63.5	3.2	-0.344	0.376	0.897	0.365
35	72.3	3.4	-0.593	0.335	0.835	0.277
40	79.0	3.5	-0.808	0.288	0.788	0.210
45	84.1	3.6	-0.998	0.242	0.751	0.159
50	87.9	3.7	-1.168	0.202	0.720	0.121
55	90.7	3.8	-1.322	0.167	0.695	0.093
60	92.8	3.9	-1.462	0.137	0.673	0.072
65	94.4	4.0	-1.591	0.112	0.654	0.056
70	95.6	4.1	-1.711	0.092	0.637	0.044
75	96.6	4.1	-1.822	0.076	0.623	0.034
80	97.3	4.2	-1.926	0.062	0.609	0.027

85	97.8	4.3	-2.024	0.051	0.598	0.022
90	98.3	4.3	-2.116	0.043	0.587	0.017
95	98.6	4.4	-2.203	0.035	0.577	0.014
100	98.9	4.4	-2.286	0.029	0.568	0.011

Date: 4/4/2016 Scenario: Big Blake 2013 L-THIA
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 46.4 mg/m^3
Observed growing season mean phosphorus (GSM): 80 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|		
Row Crop AG	1023.8	0.50	1.00	3.00	24.8	207	414	1243
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.8	194	582	969
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	2	3	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	14	28	70
Wetlands	1496.3	0.10	0.10	0.10	3.6	61	61	61
Forest	10759.2	0.05	0.09	0.18	23.5	218	392	784
Lake Surface	208.0	0.10	0.30	1.00	1.5	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.5

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1669.0	3682.4	8304.2	100.0
Total Loading (kg)	757.1	1670.3	3766.8	100.0
Areal Loading (lb/ac-year)	8.02	17.70	39.92	
Areal Loading (mg/m^2-year)	899.40	1984.34	4474.95	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1648.3	3608.6	8060.6	99.5
Total NPS Loading (kg)	747.7	1636.8	3656.3	99.5

Wisconsin Internal Load Estimator
Date: 4/4/2016 Scenario: 13
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 69.64 mg/m^3
Phosphorus Inflow Concentration: 100.8 mg/m^3
Areal External Loading: 1984.3 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.40
Observed Phosphorus Retention Coefficient: 0.31
Internal Load: 327 Lb 149 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 1029.20 acre-ft
Anoxia Sediment Area: 156.89 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 78.8 mg/m^3
Hypolimnetic Volume: 223.01 acre-ft
Anoxia Sediment Area: 67.99 acres
Time Period of Stratification: 45 days
Sediment Phosphorus Release Rate: -2.8 mg/m^2-day -7.62E-003 lb/acre-day
Internal Load: -127 Lb -57 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 1029.20 acre-ft
Anoxia Sediment Area: 156.89 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 135 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 67.99 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 17.0 mg/m^2-day 4.63E-002 lb/acre-day
Internal Load: 513 Lb 233 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 156.89 acre
End of Anoxia Anoxic Sediment Area: 67.99 acre
Phosphorus Release Rate As Calculated In Method 2: -2.8 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: -2.8 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 7.1 mg/m^2-day
Period of Anoxia: 45 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	83	193	330

Internal Load: (kg) 37 87 150

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 3682 Lb 1670 kg

	Lb	kg	%
From A Complete Mass Budget:	327	149	8.2
From Growing Season In Situ Phosphorus Increases:	-127	-57	-3.6
From In Situ Phosphorus Increases In The Fall:	513	233	12.2
From Phosphorus Release Rate and Anoxic Area:	193	87	5.0

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	0	0	0

Osgood, 1988 Lake Mixing Index: 0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	0	0	0
Internal Load (kg):	0	0	0
External Load (Lb):	0	0	0
External Load (kg):	0	0	0
Total Load (Lb):	0	0	0
Total Load (kg):	0	0	0

Wisconsin Internal Load Estimator

Date: 4/4/2016 Scenario: 14

Method 1 - A Complete Total Phosphorus Mass Budget

Method 1 - A Complete Total Phosphorus Mass Budget 69.64 mg/m^3
Phosphorus Inflow Concentration: 100.8 mg/m^3
Areal External Loading: 1984.3 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.40
Observed Phosphorus Retention Coefficient: 0.31
Internal Load: 327 Lb 149 kg

Method 2 - From Growing Season In Situ Phosphorus Increases

Start of Anoxia

Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 1029.20 acre-ft
Anoxia Sediment Area: 156.89 acres

Just Prior To The End of Stratification

Average Hypolimnetic Phosphorus Concentration: 78.8 mg/m^3
Hypolimnetic Volume: 223.01 acre-ft
Anoxia Sediment Area: 67.99 acres
Time Period of Stratification: 45 days
Sediment Phosphorus Release Rate: -2.8 mg/m^2-day -7.62E-003 lb/acre-day
Internal Load: -127 Lb -57 kg

Method 3 - From In Situ Phosphorus Increases In The Fall

Start of Anoxia

Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 1029.20 acre-ft
Anoxia Sediment Area: 156.89 acres

Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 135 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 67.99 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 17.0 mg/m^2-day 4.63E-002 lb/acre-day
Internal Load: 513 Lb 233 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 156.89 acre
End of Anoxia Anoxic Sediment Area: 67.99 acre
Phosphorus Release Rate As Calculated In Method 2: -2.8 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: -2.8 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 7.1 mg/m^2-day
Period of Anoxia: 45 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	83	193	330
Internal Load: (kg)	37	87	150

Internal Load Comparison (Percentages are of the Total Estimate Load)
Total External Load: 3682 Lb 1670 kg

	Lb	kg	%
From A Complete Mass Budget:	327	149	8.2
From Growing Season In Situ Phosphorus Increases:	-127	-57	-3.6
From In Situ Phosphorus Increases In The Fall:	513	233	12.2
From Phosphorus Release Rate and Anoxic Area:	193	87	5.0

Predicted Water Column Total Phosphorus Concentration (ug/l)

	Low	Most Likely	High
Nurnberg+ 1984 Total Phosphorus Model:	36	66	142

Osgood, 1988 Lake Mixing Index: 3.0
Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	327	193.1	193
Internal Load (kg):	149	87.6	87
External Load (Lb):	1669	3682	8304
External Load (kg):	757	1670	3767
Total Load (Lb):	1996	3876	8497
Total Load (kg):	906	1758	3854

Phosphorus Prediction and Uncertainty Analysis Module
Date: 4/4/2016 Scenario: 10
Observed spring overturn total phosphorus (SPO): 46.4 mg/m^3
Observed growing season mean phosphorus (GSM): 80.0 mg/m^3
Back calculation for SPO total phosphorus: 46.87 mg/m^3
Back calculation GSM phosphorus: 80.81 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 66 kg

Lake Phosphorus Model	Low Total P (mg/m^3)	Most Likely Total P (mg/m^3)	High Total P (mg/m^3)	Predicted -Observed (mg/m^3)	% Dif.
Walker, 1987 Reservoir	25	56	127	-24	-30
Canfield-Bachmann, 1981 Natural Lake	35	69	136	-11	-14
Canfield-Bachmann, 1981 Artificial Lake	31	57	102	-23	-29
Rechow, 1979 General	26	56	127	-24	-30
Rechow, 1977 Anoxic	40	87	197	7	9
Rechow, 1977 water load<50m/year	30	66	149	-14	-18
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	34	75	170	29	63
Vollenweider, 1982 Combined OECD	27	53	102	-10	-16
Dillon-Rigler-Kirchner	24	53	119	7	15
Vollenweider, 1982 Shallow Lake/Res.	22	45	91	-18	-28
Larsen-Mercier, 1976	33	73	166	27	58
Nurnberg, 1984 Oxic	31	65	141	-15	-19

Lake Phosphorus Model	Confidence Lower Bound	Confidence Upper Bound	Parameter Fit?	Back Calculation (kg/year)	Model Type
Walker, 1987 Reservoir	32	104	FIT	2403	GSM
Canfield-Bachmann, 1981 Natural Lake	21	199	FIT	1983	GSM
Canfield-Bachmann, 1981 Artificial Lake	18	164	FIT	2659	GSM
Rechow, 1979 General	31	105	FIT	2396	GSM
Rechow, 1977 Anoxic	50	160	FIT	1545	GSM
Rechow, 1977 water load<50m/year	36	123	P	2044	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	36	148	FIT	1038	SPO
Vollenweider, 1982 Combined OECD	25	100	FIT	2124	ANN
Dillon-Rigler-Kirchner	30	97	P	1489	SPO
Vollenweider, 1982 Shallow Lake/Res.	21	85	FIT	2542	ANN
Larsen-Mercier, 1976	43	134	P Pin	1067	SPO
Nurnberg, 1984 Oxic	34	122	P	2115	ANN

Water and Nutrient Outflow Module

Date: 4/4/2016 Scenario: 8

Average Annual Surface Total Phosphorus: 69.64mg/m^3

Annual Discharge: 1.34E+004 AF => 1.66E+007 m^3

Annual Outflow Loading: 2436.5 LB => 1105.2 kg

Date: 3/4/2016 Scenario: 2013
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 2150.7 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 1433.8 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 1491.0 acre-ft/year
Areal Water Load <qs>: 7.2 ft/year
Lake Flushing Rate <p>: 0.80 1/year
Water Residence Time: 1.26 year
Observed spring overturn total phosphorus (SPO): 0.0 mg/m^3
Observed growing season mean phosphorus (GSM): 0.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|		
Row Crop AG	390.5	0.50	1.00	3.00	52.3	79	158	474
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	159.2	0.10	0.30	0.50	6.4	6	19	32
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	240.0	0.30	0.50	0.80	16.1	29	49	78
Rural Res (>1 Ac)	9.7	0.05	0.10	0.25	0.1	0	0	1
Wetlands	347.8	0.10	0.10	0.10	4.7	14	14	14
Forest	1003.6	0.05	0.09	0.18	12.1	20	37	73
Lake Surface	208.0	0.10	0.30	1.00	8.4	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	0.0				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.00	0.00	0.00	0.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	347.4	666.2	1667.4	100.0
Total Loading (kg)	157.6	302.2	756.3	100.0
Areal Loading (lb/ac-year)	1.67	3.20	8.02	
Areal Loading (mg/m^2-year)	187.22	359.01	898.54	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	328.9	610.5	1481.9	100.0
Total NPS Loading (kg)	149.2	276.9	672.2	100.0

Date: 3/17/2016 Scenario: 2014 Bloom
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 46.4 mg/m^3
Observed growing season mean phosphorus (GSM): 82.8 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|	
Row Crop AG	1023.8	0.50	1.00	3.00	24.8	207	414	1243
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.8	194	582	969
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	2	3	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	14	28	70
Wetlands	1496.3	0.10	0.10	0.10	3.6	61	61	61
Forest	10759.2	0.05	0.09	0.18	23.5	218	392	784
Lake Surface	208.0	0.10	0.30	1.00	1.5	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.5

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1669.0	3682.4	8304.2	100.0
Total Loading (kg)	757.1	1670.3	3766.8	100.0
Areal Loading (lb/ac-year)	8.02	17.70	39.92	
Areal Loading (mg/m^2-year)	899.40	1984.34	4474.95	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1648.3	3608.6	8060.6	99.5
Total NPS Loading (kg)	747.7	1636.8	3656.3	99.5

Wisconsin Internal Load Estimator
Date: 3/17/2016 Scenario: 3
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 69.64 mg/m^3
Phosphorus Inflow Concentration: 100.8 mg/m^3
Areal External Loading: 1984.3 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.40
Observed Phosphorus Retention Coefficient: 0.31
Internal Load: 327 Lb 149 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 73.68 mg/m^3
Hypolimnetic Volume: 1175.95 acre-ft
Anoxia Sediment Area: 97.12 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 78.8 mg/m^3
Hypolimnetic Volume: 1175.95 acre-ft
Anoxia Sediment Area: 97.12 acres
Time Period of Stratification: 90 days
Sediment Phosphorus Release Rate: 0.2 mg/m^2-day 5.71E-004 lb/acre-day
Internal Load: 16 Lb 7 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 73.68 mg/m^3
Hypolimnetic Volume: 1175.95 acre-ft
Anoxia Sediment Area: 97.12 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 140 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 97.12 acres
Time Period Between Observations: 14 days
Sediment Phosphorus Release Rate: 39.3 mg/m^2-day 1.07E-001 lb/acre-day
Internal Load: 477 Lb 216 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 97.12 acre
End of Anoxia Anoxic Sediment Area: 97.12 acre
Phosphorus Release Rate As Calculated In Method 2: 0.2 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 0.2 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 19.8 mg/m^2-day
Period of Anoxia: 90 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	143	333	570

Internal Load: (kg)	65	151	259

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 3682 Lb 1670 kg

	Lb	kg	%
From A Complete Mass Budget:	327	149	8.2
From Growing Season In Situ Phosphorus Increases:	16	7	0.4
From In Situ Phosphorus Increases In The Fall:	477	216	11.5
From Phosphorus Release Rate and Anoxic Area:	333	151	8.3

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	0	0	0

Osgood, 1988 Lake Mixing Index: 0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	0	0	0
Internal Load (kg):	0	0	0
External Load (Lb):	0	0	0
External Load (kg):	0	0	0
Total Load (Lb):	0	0	0
Total Load (kg):	0	0	0

Date: 3/29/2016 Scenario: 2014 direct drainage
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 550.0 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 366.7 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 222649.0 acre-ft/year
Areal Water Load <qs>: 1070.4 ft/year
Lake Flushing Rate <p>: 118.94 1/year
Water Residence Time: 0.01 year
Observed spring overturn total phosphorus (SPO): 38.7 mg/m^3
Observed growing season mean phosphorus (GSM): 40 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	123.0	0.50	1.00	3.00	0.4	25	50	149
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	38.0	0.10	0.30	0.50	0.0	2	5	8
HD Urban (1/8 Ac)	19.0	1.00	1.50	2.00	0.1	8	12	15
MD Urban (1/4 Ac)	113.0	0.30	0.50	0.80	0.2	14	23	37
Rural Res (>1 Ac)	46.0	0.05	0.10	0.25	0.0	1	2	5
Wetlands	35.0	0.10	0.10	0.10	0.0	1	1	1
Forest	176.0	0.05	0.09	0.18	0.0	4	6	13
Lake Surface	208.0	0.10	0.30	1.00	0.2	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.1

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	139.2	29497.6	745.9	100.0
Total Loading (kg)	63.1	13380.0	338.4	100.0
Areal Loading (lb/ac-year)	0.67	141.82	3.59	
Areal Loading (mg/m^2-year)	75.02	15895.57	401.97	
Total PS Loading (lb)	0.0	29206.7	0.0	99.0

Total PS Loading (kg)	0.0	13248.1	0.0	99.0
Total NPS Loading (lb)	118.5	217.1	502.4	0.9
Total NPS Loading (kg)	53.7	98.5	227.9	0.9

Wisconsin Internal Load Estimator
Date: 3/29/2016 Scenario: 6
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 38.04 mg/m^3
Phosphorus Inflow Concentration: 48.7 mg/m^3
Areal External Loading: 15895.6 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.04
Observed Phosphorus Retention Coefficient: 0.22
Internal Load: -5181 Lb -2350 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 37.7 mg/m^3
Hypolimnetic Volume: 44.08 acre-ft
Anoxia Sediment Area: 13.44 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 51.0 mg/m^3
Hypolimnetic Volume: 44.08 acre-ft
Anoxia Sediment Area: 13.44 acres
Time Period of Stratification: 60 days
Sediment Phosphorus Release Rate: 0.2 mg/m^2-day 6.03E-004 lb/acre-day
Internal Load: 2 Lb 1 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 37.7 mg/m^3
Hypolimnetic Volume: 44.08 acre-ft
Anoxia Sediment Area: 13.44 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 24.7 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 13.44 acres
Time Period Between Observations: 14 days
Sediment Phosphorus Release Rate: 72.2 mg/m^2-day 1.96E-001 lb/acre-day
Internal Load: 121 Lb 55 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 13.44 acre
End of Anoxia Anoxic Sediment Area: 13.44 acre
Phosphorus Release Rate As Calculated In Method 2: 0.2 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 0.2 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 36.2 mg/m^2-day
Period of Anoxia: 60 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	13	31	53

Internal Load: (kg) 6 14 24

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 29498 Lb 13380 kg

	Lb	kg	%
From A Complete Mass Budget:	-5181	-2350	-21.3
From Growing Season In Situ Phosphorus Increases:	2	1	0.0
From In Situ Phosphorus Increases In The Fall:	121	55	0.4
From Phosphorus Release Rate and Anoxic Area:	31	14	0.1

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	0	0	0

Osgood, 1988 Lake Mixing Index: 0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	0	0	0
Internal Load (kg):	0	0	0
External Load (Lb):	0	0	0
External Load (kg):	0	0	0
Total Load (Lb):	0	0	0
Total Load (kg):	0	0	0

Phosphorus Prediction and Uncertainty Analysis Module

Date: 3/29/2016 Scenario: 6

Observed spring overturn total phosphorus (SPO): 38.7 mg/m^3

Observed growing season mean phosphorus (GSM): 40.0 mg/m^3

Back calculation for SPO total phosphorus: 39.1 mg/m^3

Back calculation GSM phosphorus: 40.4 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 0 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	0	46	1	6	15
Canfield-Bachmann, 1981 Natural Lake	0	45	1	5	13
Canfield-Bachmann, 1981 Artificial Lake	0	42	1	2	5
Rechow, 1979 General	0	39	1	-1	-3
Rechow, 1977 Anoxic	0	43	1	3	8
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	0	32	1	-8	-20
Walker, 1977 General	0	45	1	6	16
Vollenweider, 1982 Combined OECD	0	35	2	-4	-10
Dillon-Rigler-Kirchner	0	47	1	8	21
Vollenweider, 1982 Shallow Lake/Res.	0	29	1	-10	-25
Larsen-Mercier, 1976	0	45	1	6	16
Nurnberg, 1984 Oxic	0	47	1	7	18

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	15	78	Tw	11794	GSM
Canfield-Bachmann, 1981 Natural Lake	14	130	L	11551	GSM
Canfield-Bachmann, 1981 Artificial Lake	13	121	FIT	12459	GSM
Rechow, 1979 General	12	67	qs	13709	GSM
Rechow, 1977 Anoxic	15	72	FIT	12553	GSM
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	13	51	FIT	16938	GSM
Walker, 1977 General	12	83	FIT	11749	SPO
Vollenweider, 1982 Combined OECD	9	66	Tw	15698	ANN
Dillon-Rigler-Kirchner	16	79	P L qs p	11024	SPO
Vollenweider, 1982 Shallow Lake/Res.	8	54	Tw	19512	ANN
Larsen-Mercier, 1976	16	75	P Pin p	11723	SPO
Nurnberg, 1984 Oxic	14	84	L qs	11601	ANN

Water and Nutrient Outflow Module
Date: 3/29/2016 Scenario: 4
Average Annual Surface Total Phosphorus: 38.04mg/m^3
Annual Discharge: 2.23E+005 AF => 2.75E+008 m^3
Annual Outflow Loading: 22047.5 LB => 10000.7 kg actual discharge 3.35e+8

Expanded Trophic Response Module
Date: 3/29/2016 Scenario: 8
Total Phosphorus: 38.04 mg/m^3
Growing Season
Chlorophyll a: 26.55 mg/m^3
Secchi Disk Depth: 1.57 m
Carlson TSI Equations:
TSI (Total Phosphorus): 57 TSI (Chlorophyll a): 63 TSI (Secchi Disk Depth): 53

Expanded Trophic Response Module
Date: 3/29/2016 Scenario: 9
Total Phosphorus: 38.04 mg/m^3
Growing Season
Chlorophyll a: 26.55 mg/m^3
Secchi Disk Depth: 1.57 m
Wisconsin Statewide Prediction Equations:

	Natural Lakes		Impoundments	
	Stratified	Mixed	Stratified	Mixed
Secchi Disk Depth using Chlorophyll a:	1.3	0.9	1.3	0.9
Secchi Disk Depth using Total Phosphorus:	1.6	1.1	1.3	1.0
Chlorophyll a using Total Phosphorus:	10.5	13.9	19.9	14.7

Expanded Trophic Response Module
Date: 3/29/2016 Scenario: 10
Total Phosphorus: 38.04 mg/m^3
Growing Season
Chlorophyll a: 26.55 mg/m^3
Secchi Disk Depth: 1.57 m
Wisconsin Regional Prediction Equations:

		Stratified		Mixed	
	Region	Seepage	Drainage	Seepage	Drainage
Use Chlorophyll a To Predict Secchi Disk Depth (m)	South	1.1	1.0	0.7	0.7
	Central	1.8	1.1	0.5	No Data
	North	1.5	1.1	1.2	1.1
Use Total Phosphorus To Predict Secchi Disk Depth (m)	South	1.6	1.2	0.7	0.8
	Central	2.8	0.7	0.9	No Data
	North	2.1	1.5	1.4	1.1
Use Total Phosphorus To Predict Chlorophyll a (mg/m^3))	South	10.2	21.7	13.8	17.1
	Central	9.4	49.0	14.4	No Data
	North	7.4	12.2	11.8	11.2

Expanded Trophic Response Module
Date: 3/29/2016 Scenario: 11
Total Phosphorus: 38.04 mg/m^3
Growing Season
Chlorophyll a: 26.55 mg/m^3
Secchi Disk Depth: 1.57 m
Chlorophyll a Nuisance Frequency
Chla Mean Min: 5
Chla Mean Max: 100
Chla Mean Increment: 5
Chla Temporal CV: 0.62
Chla Nuisance Criterion: 20

Mean	Freq %	ml	z	v	w	x
5	0.5	1.4	2.546	0.016	0.541	0.005
10	7.7	2.1	1.428	0.144	0.678	0.077
15	21.9	2.5	0.774	0.296	0.795	0.219
20	37.8	2.8	0.310	0.380	0.907	0.378
25	52.0	3.0	-0.050	0.398	0.984	0.480
30	63.5	3.2	-0.344	0.376	0.897	0.365
35	72.3	3.4	-0.593	0.335	0.835	0.277
40	79.0	3.5	-0.808	0.288	0.788	0.210
45	84.1	3.6	-0.998	0.242	0.751	0.159
50	87.9	3.7	-1.168	0.202	0.720	0.121
55	90.7	3.8	-1.322	0.167	0.695	0.093
60	92.8	3.9	-1.462	0.137	0.673	0.072
65	94.4	4.0	-1.591	0.112	0.654	0.056
70	95.6	4.1	-1.711	0.092	0.637	0.044
75	96.6	4.1	-1.822	0.076	0.623	0.034
80	97.3	4.2	-1.926	0.062	0.609	0.027
85	97.8	4.3	-2.024	0.051	0.598	0.022
90	98.3	4.3	-2.116	0.043	0.587	0.017
95	98.6	4.4	-2.203	0.035	0.577	0.014
100	98.9	4.4	-2.286	0.029	0.568	0.011

Date: 4/4/2016 Scenario: Big Blake 2014 Direct Drainage
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 550.0 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 366.7 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 222649.0 acre-ft/year
Areal Water Load <qs>: 1070.4 ft/year
Lake Flushing Rate <p>: 118.94 1/year
Water Residence Time: 0.01 year
Observed spring overturn total phosphorus (SPO): 38.7 mg/m^3
Observed growing season mean phosphorus (GSM): 40.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	123.0	0.50	1.00	3.00	0.4	25	50	149
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	38.0	0.10	0.30	0.50	0.0	2	5	8
HD Urban (1/8 Ac)	19.0	1.00	1.50	2.00	0.1	8	12	15
MD Urban (1/4 Ac)	113.0	0.30	0.50	0.80	0.2	14	23	37
Rural Res (>1 Ac)	46.0	0.05	0.10	0.25	0.0	1	2	5
Wetlands	35.0	0.10	0.10	0.10	0.0	1	1	1
Forest	176.0	0.05	0.09	0.18	0.0	4	6	13
Lake Surface	208.0	0.10	0.30	1.00	0.2	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.1

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	139.2	29497.6	745.9	100.0
Total Loading (kg)	63.1	13380.0	338.4	100.0
Areal Loading (lb/ac-year)	0.67	141.82	3.59	
Areal Loading (mg/m^2-year)	75.02	15895.57	401.97	
Total PS Loading (lb)	0.0	29206.7	0.0	99.0

Total PS Loading (kg)	0.0	13248.1	0.0	99.0
Total NPS Loading (lb)	118.5	217.1	502.4	0.9
Total NPS Loading (kg)	53.7	98.5	227.9	0.9

Wisconsin Internal Load Estimator
Date: 4/4/2016 Scenario: 9
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 38.04 mg/m^3
Phosphorus Inflow Concentration: 48.7 mg/m^3
Areal External Loading: 15895.6 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.04
Observed Phosphorus Retention Coefficient: 0.22
Internal Load: -5181 Lb -2350 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 901.8 acre-ft
Anoxia Sediment Area: 137.47 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 901.8 acre-ft
Anoxia Sediment Area: 137.47 acres
Time Period of Stratification: 30 days
Sediment Phosphorus Release Rate: 0.0 mg/m^2-day 0.00E+000 lb/acre-day
Internal Load: 0 Lb 0 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 901.8 acre-ft
Anoxia Sediment Area: 137.47 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 24.7 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 137.47 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: -0.3 mg/m^2-day -8.20E-004 lb/acre-day
Internal Load: -11 Lb -5 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 137.47 acre
End of Anoxia Anoxic Sediment Area: 137.47 acre
Phosphorus Release Rate As Calculated In Method 2: 0.0 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 0.0 mg/m^2-day
Average of Methods 2 and 3 Release Rates: -0.2 mg/m^2-day
Period of Anoxia: 14 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	31	73	126

Internal Load: (kg) 14 33 57

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 29498 Lb 13380 kg

	Lb	kg	%
From A Complete Mass Budget:	-5181	-2350	-21.3
From Growing Season In Situ Phosphorus Increases:	0	0	0.0
From In Situ Phosphorus Increases In The Fall:	-11	-5	0.0
From Phosphorus Release Rate and Anoxic Area:	73	33	0.2

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	0	0	0

Osgood, 1988 Lake Mixing Index: 0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	0	0	0
Internal Load (kg):	0	0	0
External Load (Lb):	0	0	0
External Load (kg):	0	0	0
Total Load (Lb):	0	0	0
Total Load (kg):	0	0	0

Wisconsin Internal Load Estimator

Date: 4/4/2016 Scenario: 10

Method 1 - A Complete Total Phosphorus Mass Budget

Method 1 - A Complete Total Phosphorus Mass Budget 38.04 mg/m^3
Phosphorus Inflow Concentration: 48.7 mg/m^3
Areal External Loading: 15895.6 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.04
Observed Phosphorus Retention Coefficient: 0.22
Internal Load: -5181 Lb -2350 kg

Method 2 - From Growing Season In Situ Phosphorus Increases

Start of Anoxia

Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 901.8 acre-ft
Anoxia Sediment Area: 137.47 acres

Just Prior To The End of Stratification

Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 901.8 acre-ft
Anoxia Sediment Area: 137.47 acres
Time Period of Stratification: 30 days
Sediment Phosphorus Release Rate: 0.0 mg/m^2-day 0.00E+000 lb/acre-day
Internal Load: 0 Lb 0 kg

Method 3 - From In Situ Phosphorus Increases In The Fall

Start of Anoxia

Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 901.8 acre-ft
Anoxia Sediment Area: 137.47 acres

Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 24.7 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 137.47 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: -0.3 mg/m^2-day -8.20E-004 lb/acre-day
Internal Load: -11 Lb -5 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 137.47 acre
End of Anoxia Anoxic Sediment Area: 137.47 acre
Phosphorus Release Rate As Calculated In Method 2: 0.0 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 0.0 mg/m^2-day
Average of Methods 2 and 3 Release Rates: -0.2 mg/m^2-day
Period of Anoxia: 14 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	31	73	126
Internal Load: (kg)	14	33	57

Internal Load Comparison (Percentages are of the Total Estimate Load)
Total External Load: 29498 Lb 13380 kg

	Lb	kg	%
From A Complete Mass Budget:	-5181	-2350	-21.3
From Growing Season In Situ Phosphorus Increases:	0	0	0.0
From In Situ Phosphorus Increases In The Fall:	-11	-5	0.0
From Phosphorus Release Rate and Anoxic Area:	73	33	0.2

Predicted Water Column Total Phosphorus Concentration (ug/l)

	Low	Most Likely	High
Nurnberg+ 1984 Total Phosphorus Model:	-8	47	1

Osgood, 1988 Lake Mixing Index: 3.0
Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	-5181	-5.6	73
Internal Load (kg):	-2350	-2.5	33
External Load (Lb):	139	29498	746
External Load (kg):	63	13380	338
Total Load (Lb):	-5042	29492	819
Total Load (kg):	-2287	13377	372

Phosphorus Prediction and Uncertainty Analysis Module
Date: 4/4/2016 Scenario: 8
Observed spring overturn total phosphorus (SPO): 38.7 mg/m^3
Observed growing season mean phosphorus (GSM): 40.0 mg/m^3
Back calculation for SPO total phosphorus: 39.1 mg/m^3
Back calculation GSM phosphorus: 40.4 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 47 kg

Lake Phosphorus Model	Low Total P (mg/m^3)	Most Likely Total P (mg/m^3)	High Total P (mg/m^3)	Predicted -Observed (mg/m^3)	% Dif.
Walker, 1987 Reservoir	0	46	1	6	15
Canfield-Bachmann, 1981 Natural Lake	0	45	1	5	13
Canfield-Bachmann, 1981 Artificial Lake	0	42	1	2	5
Rechow, 1979 General	0	39	1	-1	-3
Rechow, 1977 Anoxic	0	43	1	3	8
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	0	32	1	-8	-20
Walker, 1977 General	0	45	1	6	16
Vollenweider, 1982 Combined OECD	0	35	2	-4	-10
Dillon-Rigler-Kirchner	0	47	1	8	21
Vollenweider, 1982 Shallow Lake/Res.	0	29	1	-10	-25
Larsen-Mercier, 1976	0	45	1	6	16
Nurnberg, 1984 Oxic	0	47	1	7	18

Lake Phosphorus Model	Confidence Lower Bound	Confidence Upper Bound	Parameter Fit?	Back Calculation (kg/year)	Model Type
Walker, 1987 Reservoir	15	78	Tw	11794	GSM
Canfield-Bachmann, 1981 Natural Lake	14	130	L	11551	GSM
Canfield-Bachmann, 1981 Artificial Lake	13	121	FIT	12459	GSM
Rechow, 1979 General	12	67	qs	13709	GSM
Rechow, 1977 Anoxic	15	72	FIT	12553	GSM
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	13	51	FIT	16938	GSM
Walker, 1977 General	12	83	FIT	11749	SPO
Vollenweider, 1982 Combined OECD	9	66	Tw	15698	ANN
Dillon-Rigler-Kirchner	16	79	P L qs p	11024	SPO
Vollenweider, 1982 Shallow Lake/Res.	8	54	Tw	19512	ANN
Larsen-Mercier, 1976	16	75	P Pin p	11723	SPO
Nurnberg, 1984 Oxic	14	84	L qs	11552	ANN

Water and Nutrient Outflow Module
Date: 4/4/2016 Scenario: 6
Average Annual Surface Total Phosphorus: 38.04mg/m^3
Annual Discharge: 2.23E+005 AF => 2.75E+008 m^3
Annual Outflow Loading: 22047.5 LB => 10000.7 kg

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 16
Total Phosphorus: 38.04 mg/m^3
Growing Season
Chlorophyll a: 26.54 mg/m^3
Secchi Disk Depth: 1.57 m
Carlson TSI Equations:
TSI (Total Phosphorus): 57 TSI (Chlorophyll a): 63 TSI (Secchi Disk Depth): 53

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 17

Total Phosphorus: 38.04 mg/m^3
Growing Season
Chlorophyll a: 26.54 mg/m^3
Secchi Disk Depth: 1.57 m

Wisconsin Statewide Prediction Equations:

	Natural Lakes		Impoundments	
	Stratified	Mixed	Stratified	Mixed
Secchi Disk Depth using Chlorophyll a:	1.3	0.9	1.3	0.9
Secchi Disk Depth using Total Phosphorus:	1.6	1.1	1.3	1.0
Chlorophyll a using Total Phosphorus:	10.5	13.9	19.9	14.7

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 18
Total Phosphorus: 38.04 mg/m^3
Growing Season
Chlorophyll a: 26.54 mg/m^3
Secchi Disk Depth: 1.57 m

Wisconsin Regional Prediction Equations:

		Stratified		Mixed	
	Region	Seepage	Drainage	Seepage	Drainage
Use Chlorophyll a To Predict	South	1.1	1.0	0.7	0.7
Secchi Disk Depth (m)	Central	1.8	1.1	0.5	No Data
	North	1.5	1.1	1.2	1.1
Use Total Phosphorus To	South	1.6	1.2	0.7	0.8
Predict Secchi Disk Depth (m)	Central	2.8	0.7	0.9	No Data
	North	2.1	1.5	1.4	1.1
Use Total Phosphorus To	South	10.2	21.7	13.8	17.1
Predict Chlorophyll a (mg/m^3))	Central	9.4	49.0	14.4	No Data
	North	7.4	12.2	11.8	11.2

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 19
Total Phosphorus: 38.04 mg/m^3
Growing Season
Chlorophyll a: 26.54 mg/m^3
Secchi Disk Depth: 1.57 m

Other Prediction Equations:
Rast and Lee, 1978:: Chlorophyll a = 8.7 mg/m^3 Secchi Disk Depth = 1.3 m
Bartsch and Gaksatter, 1978:: Chlorophyll a = 12.1 mg/m^3

User Defined: Chlorophyll a - Total Phosphorus Regression::
Use Total Phosphorus To Predict Chlorophyll a = 0.0 x 38.04^0.0 = 0.0 mg/m^3
Use Chlorophyll a To Predict Secchi Disk Depth = 0.0 x 26.54^0.0 = 0.0 m

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 20
Total Phosphorus: 38.04 mg/m^3
Growing Season
Chlorophyll a: 26.54 mg/m^3
Secchi Disk Depth: 1.57 m

Chlorophyll a Nuisance Frequency

Chla Mean Min: 5
Chla Mean Max: 100
Chla Mean Increment: 5
Chla Temporal CV: 0.62
Chla Nuisance Criterion: 20

Mean	Freq %	ml	z	v	w	x
5	0.5	1.4	2.546	0.016	0.541	0.005
10	7.7	2.1	1.428	0.144	0.678	0.077
15	21.9	2.5	0.774	0.296	0.795	0.219
20	37.8	2.8	0.310	0.380	0.907	0.378
25	52.0	3.0	-0.050	0.398	0.984	0.480
30	63.5	3.2	-0.344	0.376	0.897	0.365
35	72.3	3.4	-0.593	0.335	0.835	0.277
40	79.0	3.5	-0.808	0.288	0.788	0.210
45	84.1	3.6	-0.998	0.242	0.751	0.159
50	87.9	3.7	-1.168	0.202	0.720	0.121
55	90.7	3.8	-1.322	0.167	0.695	0.093
60	92.8	3.9	-1.462	0.137	0.673	0.072
65	94.4	4.0	-1.591	0.112	0.654	0.056
70	95.6	4.1	-1.711	0.092	0.637	0.044
75	96.6	4.1	-1.822	0.076	0.623	0.034
80	97.3	4.2	-1.926	0.062	0.609	0.027
85	97.8	4.3	-2.024	0.051	0.598	0.022
90	98.3	4.3	-2.116	0.043	0.587	0.017
95	98.6	4.4	-2.203	0.035	0.577	0.014
100	98.9	4.4	-2.286	0.029	0.568	0.011

Date: 3/17/2016 Scenario: 2014L-THIA
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 38.7 mg/m^3
Observed growing season mean phosphorus (GSM): 40.6 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|	
Row Crop AG	1023.8	0.50	1.00	3.00	24.8	207	414	1243
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.8	194	582	969
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	2	3	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	14	28	70
Wetlands	1496.3	0.10	0.10	0.10	3.6	61	61	61
Forest	10759.2	0.05	0.09	0.18	23.5	218	392	784
Lake Surface	208.0	0.10	0.30	1.00	1.5	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.5

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1669.0	3682.4	8304.2	100.0
Total Loading (kg)	757.1	1670.3	3766.8	100.0
Areal Loading (lb/ac-year)	8.02	17.70	39.92	
Areal Loading (mg/m^2-year)	899.40	1984.34	4474.95	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1648.3	3608.6	8060.6	99.5
Total NPS Loading (kg)	747.7	1636.8	3656.3	99.5

Wisconsin Internal Load Estimator
Date: 3/17/2016 Scenario: 2
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 40.58 mg/m^3
Phosphorus Inflow Concentration: 100.8 mg/m^3
Areal External Loading: 1984.3 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.40
Observed Phosphorus Retention Coefficient: 0.60
Internal Load: -734 Lb -333 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 44.82 mg/m^3
Hypolimnetic Volume: 44.08 acre-ft
Anoxia Sediment Area: 13.44 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 44.08 acre-ft
Anoxia Sediment Area: 13.44 acres
Time Period of Stratification: 60 days
Sediment Phosphorus Release Rate: 0.2 mg/m^2-day 4.97E-004 lb/acre-day
Internal Load: 1 Lb 1 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 44.82 mg/m^3
Hypolimnetic Volume: 44.08 acre-ft
Anoxia Sediment Area: 13.44 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 57.6 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 13.44 acres
Time Period Between Observations: 14 days
Sediment Phosphorus Release Rate: 171.5 mg/m^2-day 4.66E-001 lb/acre-day
Internal Load: 288 Lb 131 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 13.44 acre
End of Anoxia Anoxic Sediment Area: 13.44 acre
Phosphorus Release Rate As Calculated In Method 2: 0.2 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 0.2 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 85.8 mg/m^2-day
Period of Anoxia: 60 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	13	31	53

Internal Load: (kg) 6 14 24

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 3682 Lb 1670 kg

	Lb	kg	%
From A Complete Mass Budget:	-734	-333	-24.9
From Growing Season In Situ Phosphorus Increases:	1	1	0.0
From In Situ Phosphorus Increases In The Fall:	288	131	7.3
From Phosphorus Release Rate and Anoxic Area:	31	14	0.8

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	7	65	138

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	-734	144.6	31
Internal Load (kg):	-333	65.6	14
External Load (Lb):	1669	3682	8304
External Load (kg):	757	1670	3767
Total Load (Lb):	935	3827	8335
Total Load (kg):	424	1736	3781

Phosphorus Prediction and Uncertainty Analysis Module

Date: 3/17/2016 Scenario: 3

Observed spring overturn total phosphorus (SPO): 38.7 mg/m^3

Observed growing season mean phosphorus (GSM): 40.6 mg/m^3

Back calculation for SPO total phosphorus: 39.09 mg/m^3

Back calculation GSM phosphorus: 40.99 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 65 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	25	56	127	15	37
Canfield-Bachmann, 1981 Natural Lake	35	69	136	28	69
Canfield-Bachmann, 1981 Artificial Lake	31	57	102	16	39
Rechow, 1979 General	26	56	127	15	37
Rechow, 1977 Anoxic	40	87	197	46	113
Rechow, 1977 water load<50m/year	30	66	149	25	62
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	34	75	170	36	93
Vollenweider, 1982 Combined OECD	27	53	102	13	33
Dillon-Rigler-Kirchner	24	53	119	14	36
Vollenweider, 1982 Shallow Lake/Res.	22	45	91	5	13
Larsen-Mercier, 1976	33	73	166	34	88
Nurnberg, 1984 Oxic	31	65	141	24	59

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	32	104	FIT	1219	GSM
Canfield-Bachmann, 1981 Natural Lake	21	199	FIT	893	GSM
Canfield-Bachmann, 1981 Artificial Lake	18	164	FIT	1051	GSM
Rechow, 1979 General	31	105	FIT	1215	GSM
Rechow, 1977 Anoxic	50	160	FIT	784	GSM
Rechow, 1977 water load<50m/year	36	123	P	1037	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	36	148	FIT	866	SPO
Vollenweider, 1982 Combined OECD	25	100	FIT	1202	ANN
Dillon-Rigler-Kirchner	30	97	P	1242	SPO
Vollenweider, 1982 Shallow Lake/Res.	21	85	FIT	1493	ANN
Larsen-Mercier, 1976	43	134	P Pin	890	SPO
Nurnberg, 1984 Oxic	34	122	P	1020	ANN

Expanded Trophic Response Module
Date: 3/17/2016 Scenario: 2
Total Phosphorus: 40.58 mg/m^3
Growing Season
Chlorophyll a: 26.55 mg/m^3
Secchi Disk Depth: 1.58 m
Chlorophyll a Nuisance Frequency
Chla Mean Min: 5
Chla Mean Max: 100
Chla Mean Increment: 5
Chla Temporal CV: 0.62
Chla Nuisance Criterion: 20

Mean	Freq %	ml	z	v	w	x
5	0.5	1.4	2.546	0.016	0.541	0.005
10	7.7	2.1	1.428	0.144	0.678	0.077
15	21.9	2.5	0.774	0.296	0.795	0.219
20	37.8	2.8	0.310	0.380	0.907	0.378
25	52.0	3.0	-0.050	0.398	0.984	0.480
30	63.5	3.2	-0.344	0.376	0.897	0.365
35	72.3	3.4	-0.593	0.335	0.835	0.277
40	79.0	3.5	-0.808	0.288	0.788	0.210
45	84.1	3.6	-0.998	0.242	0.751	0.159
50	87.9	3.7	-1.168	0.202	0.720	0.121
55	90.7	3.8	-1.322	0.167	0.695	0.093
60	92.8	3.9	-1.462	0.137	0.673	0.072
65	94.4	4.0	-1.591	0.112	0.654	0.056
70	95.6	4.1	-1.711	0.092	0.637	0.044
75	96.6	4.1	-1.822	0.076	0.623	0.034
80	97.3	4.2	-1.926	0.062	0.609	0.027
85	97.8	4.3	-2.024	0.051	0.598	0.022
90	98.3	4.3	-2.116	0.043	0.587	0.017
95	98.6	4.4	-2.203	0.035	0.577	0.014
100	98.9	4.4	-2.286	0.029	0.568	0.011

Date: 4/4/2016 Scenario: Big Blake 2014 L-THIA
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 38.7 mg/m^3
Observed growing season mean phosphorus (GSM): 40.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|		
Row Crop AG	1023.8	0.50	1.00	3.00	24.8	207	414	1243
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.8	194	582	969
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	2	3	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	14	28	70
Wetlands	1496.3	0.10	0.10	0.10	3.6	61	61	61
Forest	10759.2	0.05	0.09	0.18	23.5	218	392	784
Lake Surface	208.0	0.10	0.30	1.00	1.5	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.5

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1669.0	3682.4	8304.2	100.0
Total Loading (kg)	757.1	1670.3	3766.8	100.0
Areal Loading (lb/ac-year)	8.02	17.70	39.92	
Areal Loading (mg/m^2-year)	899.40	1984.34	4474.95	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1648.3	3608.6	8060.6	99.5
Total NPS Loading (kg)	747.7	1636.8	3656.3	99.5

Wisconsin Internal Load Estimator
Date: 4/4/2016 Scenario: 15
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 38.04 mg/m^3
Phosphorus Inflow Concentration: 100.8 mg/m^3
Areal External Loading: 1984.3 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.40
Observed Phosphorus Retention Coefficient: 0.62
Internal Load: -827 Lb -375 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 901.8 acre-ft
Anoxia Sediment Area: 137.47 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 901.8 acre-ft
Anoxia Sediment Area: 137.47 acres
Time Period of Stratification: 30 days
Sediment Phosphorus Release Rate: 0.0 mg/m^2-day 0.00E+000 lb/acre-day
Internal Load: 0 Lb 0 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 55.8 mg/m^3
Hypolimnetic Volume: 901.8 acre-ft
Anoxia Sediment Area: 137.47 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 62.2 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 137.47 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 4.9 mg/m^2-day 1.33E-002 lb/acre-day
Internal Load: 180 Lb 82 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 137.47 acre
End of Anoxia Anoxic Sediment Area: 137.47 acre
Phosphorus Release Rate As Calculated In Method 2: 0.0 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 0.0 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 2.4 mg/m^2-day
Period of Anoxia: 14 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	31	73	126

Internal Load: (kg)	14	33	57

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 3682 Lb 1670 kg

	Lb	kg	%
From A Complete Mass Budget:	-827	-375	-29.0
From Growing Season In Situ Phosphorus Increases:	0	0	0.0
From In Situ Phosphorus Increases In The Fall:	180	82	4.7
From Phosphorus Release Rate and Anoxic Area:	73	33	2.0

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	5	63	139

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	-827	89.9	73
Internal Load (kg):	-375	40.8	33
External Load (Lb):	1669	3682	8304
External Load (kg):	757	1670	3767
Total Load (Lb):	842	3772	8377
Total Load (kg):	382	1711	3800

Phosphorus Prediction and Uncertainty Analysis Module

Date: 4/4/2016 Scenario: 11

Observed spring overturn total phosphorus (SPO): 38.7 mg/m^3

Observed growing season mean phosphorus (GSM): 40.0 mg/m^3

Back calculation for SPO total phosphorus: 39.1 mg/m^3

Back calculation GSM phosphorus: 40.4 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 63 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	25	56	127	16	40
Canfield-Bachmann, 1981 Natural Lake	35	69	136	29	73
Canfield-Bachmann, 1981 Artificial Lake	31	57	102	17	43
Rechow, 1979 General	26	56	127	16	40
Rechow, 1977 Anoxic	40	87	197	47	118
Rechow, 1977 water load<50m/year	30	66	149	26	65
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	34	75	170	36	93
Vollenweider, 1982 Combined OECD	27	53	102	14	36
Dillon-Rigler-Kirchner	24	53	119	14	36
Vollenweider, 1982 Shallow Lake/Res.	22	45	91	6	15
Larsen-Mercier, 1976	33	73	166	34	88
Nurnberg, 1984 Oxic	31	64	141	24	60

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	32	104	FIT	1201	GSM
Canfield-Bachmann, 1981 Natural Lake	21	199	FIT	878	GSM
Canfield-Bachmann, 1981 Artificial Lake	18	164	FIT	1031	GSM
Rechow, 1979 General	31	105	FIT	1198	GSM
Rechow, 1977 Anoxic	50	160	FIT	772	GSM
Rechow, 1977 water load<50m/year	36	123	P	1022	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	36	148	FIT	866	SPO
Vollenweider, 1982 Combined OECD	25	100	FIT	1192	ANN
Dillon-Rigler-Kirchner	30	97	P	1242	SPO
Vollenweider, 1982 Shallow Lake/Res.	21	85	FIT	1481	ANN
Larsen-Mercier, 1976	43	134	P Pin	890	SPO
Nurnberg, 1984 Oxic	33	122	P	1007	ANN

Water and Nutrient Outflow Module

Date: 4/4/2016 Scenario: 9

Average Annual Surface Total Phosphorus: 30.04mg/m^3

Annual Discharge: 1.34E+004 AF => 1.66E+007 m^3

Annual Outflow Loading: 1050.9 LB => 476.7 kg

Date: 4/4/2016 Scenario: 2015 Direct Drainage
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 550.0 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 366.7 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 159737.5 acre-ft/year
Areal Water Load <qs>: 768.0 ft/year
Lake Flushing Rate <p>: 85.33 1/year
Water Residence Time: 0.01 year
Observed spring overturn total phosphorus (SPO): 25.2 mg/m^3
Observed growing season mean phosphorus (GSM): 50 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	123.0	0.50	1.00	3.00	0.4	25	50	149
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	38.0	0.10	0.30	0.50	0.0	2	5	8
HD Urban (1/8 Ac)	19.0	1.00	1.50	2.00	0.1	8	12	15
MD Urban (1/4 Ac)	113.0	0.30	0.50	0.80	0.2	14	23	37
Rural Res (>1 Ac)	46.0	0.05	0.10	0.25	0.0	1	2	5
Wetlands	35.0	0.10	0.10	0.10	0.0	1	1	1
Forest	176.0	0.05	0.09	0.18	0.1	4	6	13
Lake Surface	208.0	0.10	0.30	1.00	0.2	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.1

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	139.2	24685.4	745.9	100.0
Total Loading (kg)	63.1	11197.2	338.4	100.0
Areal Loading (lb/ac-year)	0.67	118.68	3.59	
Areal Loading (mg/m^2-year)	75.02	13302.36	401.97	
Total PS Loading (lb)	0.0	24394.5	0.0	98.8

Total PS Loading (kg)	0.0	11065.3	0.0	98.8
Total NPS Loading (lb)	118.5	217.1	502.4	1.1
Total NPS Loading (kg)	53.7	98.5	227.9	1.1

Wisconsin Internal Load Estimator
Date: 4/4/2016 Scenario: 7
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 41.9 mg/m^3
Phosphorus Inflow Concentration: 56.8 mg/m^3
Areal External Loading: 13302.4 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.06
Observed Phosphorus Retention Coefficient: 0.26
Internal Load: -5016 Lb -2275 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 25.6 mg/m^3
Hypolimnetic Volume: 215.66 acre-ft
Anoxia Sediment Area: 65.75 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 73.6 mg/m^3
Hypolimnetic Volume: 662.03 acre-ft
Anoxia Sediment Area: 121.03 acres
Time Period of Stratification: 74 days
Sediment Phosphorus Release Rate: 1.9 mg/m^2-day 5.18E-003 lb/acre-day
Internal Load: 117 Lb 53 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 25.6 mg/m^3
Hypolimnetic Volume: 215.66 acre-ft
Anoxia Sediment Area: 65.75 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 30.5 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 121.03 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 5.6 mg/m^2-day 1.53E-002 lb/acre-day
Internal Load: 140 Lb 64 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 65.75 acre
End of Anoxia Anoxic Sediment Area: 121.03 acre
Phosphorus Release Rate As Calculated In Method 2: 1.9 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 1.9 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 3.8 mg/m^2-day
Period of Anoxia: 74 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	113	263	451

Internal Load: (kg) 51 119 205

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 24685 Lb 11197 kg

	Lb	kg	%
From A Complete Mass Budget:	-5016	-2275	-25.5
From Growing Season In Situ Phosphorus Increases:	117	53	0.5
From In Situ Phosphorus Increases In The Fall:	140	64	0.6
From Phosphorus Release Rate and Anoxic Area:	263	119	1.1

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	0	0	0

Osgood, 1988 Lake Mixing Index: 0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	0	0	0
Internal Load (kg):	0	0	0
External Load (Lb):	0	0	0
External Load (kg):	0	0	0
Total Load (Lb):	0	0	0
Total Load (kg):	0	0	0

Wisconsin Internal Load Estimator

Date: 4/4/2016 Scenario: 8

Method 1 - A Complete Total Phosphorus Mass Budget

Method 1 - A Complete Total Phosphorus Mass Budget 41.9 mg/m^3
Phosphorus Inflow Concentration: 56.8 mg/m^3
Areal External Loading: 13302.4 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.06
Observed Phosphorus Retention Coefficient: 0.26
Internal Load: -5016 Lb -2275 kg

Method 2 - From Growing Season In Situ Phosphorus Increases

Start of Anoxia

Average Hypolimnetic Phosphorus Concentration: 25.6 mg/m^3
Hypolimnetic Volume: 215.66 acre-ft
Anoxia Sediment Area: 65.75 acres

Just Prior To The End of Stratification

Average Hypolimnetic Phosphorus Concentration: 73.6 mg/m^3
Hypolimnetic Volume: 662.03 acre-ft
Anoxia Sediment Area: 121.03 acres
Time Period of Stratification: 74 days
Sediment Phosphorus Release Rate: 1.9 mg/m^2-day 5.18E-003 lb/acre-day
Internal Load: 117 Lb 53 kg

Method 3 - From In Situ Phosphorus Increases In The Fall

Start of Anoxia

Average Hypolimnetic Phosphorus Concentration: 25.6 mg/m^3
Hypolimnetic Volume: 215.66 acre-ft
Anoxia Sediment Area: 65.75 acres

Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 69.1 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 121.03 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 13.5 mg/m^2-day 3.66E-002 lb/acre-day
Internal Load: 337 Lb 153 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 65.75 acre
End of Anoxia Anoxic Sediment Area: 121.03 acre
Phosphorus Release Rate As Calculated In Method 2: 1.9 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 1.9 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 7.7 mg/m^2-day
Period of Anoxia: 74 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	113	263	451
Internal Load: (kg)	51	119	205

Internal Load Comparison (Percentages are of the Total Estimate Load)
Total External Load: 24685 Lb 11197 kg

	Lb	kg	%
From A Complete Mass Budget:	-5016	-2275	-25.5
From Growing Season In Situ Phosphorus Increases:	117	53	0.5
From In Situ Phosphorus Increases In The Fall:	337	153	1.3
From Phosphorus Release Rate and Anoxic Area:	263	119	1.1

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	-11	54	2

Osgood, 1988 Lake Mixing Index: 3.0
Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	-5016	227.1	263
Internal Load (kg):	-2275	103.0	119
External Load (Lb):	139	24685	746
External Load (kg):	63	11197	338
Total Load (Lb):	-4877	24913	1009
Total Load (kg):	-2212	11300	458

Phosphorus Prediction and Uncertainty Analysis Module
Date: 4/4/2016 Scenario: 7
Observed spring overturn total phosphorus (SPO): 25.2 mg/m^3
Observed growing season mean phosphorus (GSM): 50.0 mg/m^3
Back calculation for SPO total phosphorus: 25.45 mg/m^3
Back calculation GSM phosphorus: 50.51 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 54 kg

Lake Phosphorus Model	Low Total P (mg/m^3)	Most Likely Total P (mg/m^3)	High Total P (mg/m^3)	Predicted -Observed (mg/m^3)	% Dif.
Walker, 1987 Reservoir	0	52	2	2	4
Canfield-Bachmann, 1981 Natural Lake	0	52	2	2	4
Canfield-Bachmann, 1981 Artificial Lake	0	47	2	-3	-6
Rechow, 1979 General	0	45	1	-5	-10
Rechow, 1977 Anoxic	0	50	2	0	0
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	0	41	1	-9	-18
Walker, 1977 General	0	51	2	26	103
Vollenweider, 1982 Combined OECD	1	39	2	1	3
Dillon-Rigler-Kirchner	0	53	2	28	111
Vollenweider, 1982 Shallow Lake/Res.	0	33	1	-5	-13
Larsen-Mercier, 1976	0	51	2	26	103
Nurnberg, 1984 Oxic	1	54	2	4	8

Lake Phosphorus Model	Confidence Lower Bound	Confidence Upper Bound	Parameter Fit?	Back Calculation (kg/year)	Model Type
Walker, 1987 Reservoir	17	88	Tw	10924	GSM
Canfield-Bachmann, 1981 Natural Lake	16	150	L	10639	GSM
Canfield-Bachmann, 1981 Artificial Lake	15	135	FIT	11743	GSM
Rechow, 1979 General	14	78	qs	12436	GSM
Rechow, 1977 Anoxic	17	84	FIT	11266	GSM
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	16	65	FIT	13842	GSM
Walker, 1977 General	14	93	FIT	5563	SPO
Vollenweider, 1982 Combined OECD	10	74	Tw	10815	ANN
Dillon-Rigler-Kirchner	18	89	P L qs p	5347	SPO
Vollenweider, 1982 Shallow Lake/Res.	9	62	Tw	13492	ANN
Larsen-Mercier, 1976	18	84	P Pin p	5557	SPO
Nurnberg, 1984 Oxic	16	96	L qs	10524	ANN

Water and Nutrient Outflow Module
Date: 4/4/2016 Scenario: 5
Average Annual Surface Total Phosphorus: 41.87mg/m^3
Annual Discharge: 1.60E+005 AF => 1.97E+008 m^3
Annual Outflow Loading: 17384.4 LB => 7885.5 kg

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 12
Total Phosphorus: 41.8 mg/m^3
Growing Season
Chlorophyll a: 46.78 mg/m^3
Secchi Disk Depth: 1.72 m
Carlson TSI Equations:
TSI (Total Phosphorus): 58 TSI (Chlorophyll a): 68 TSI (Secchi Disk Depth): 52

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 13

Total Phosphorus: 41.8 mg/m^3
Growing Season
Chlorophyll a: 46.78 mg/m^3
Secchi Disk Depth: 1.72 m

Wisconsin Statewide Prediction Equations:

	Natural Lakes		Impoundments	
	Stratified	Mixed	Stratified	Mixed
Secchi Disk Depth using Chlorophyll a:	1.0	0.7	1.1	0.7
Secchi Disk Depth using Total Phosphorus:	1.6	1.0	1.2	1.0
Chlorophyll a using Total Phosphorus:	11.1	14.8	21.9	15.7

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 14
Total Phosphorus: 41.8 mg/m^3
Growing Season
Chlorophyll a: 46.78 mg/m^3
Secchi Disk Depth: 1.72 m

Wisconsin Regional Prediction Equations:

		Stratified		Mixed	
	Region	Seepage	Drainage	Seepage	Drainage
Use Chlorophyll a To Predict	South	0.9	0.8	0.6	0.6
Secchi Disk Depth (m)	Central	1.5	0.8	0.2	No Data
	North	1.2	0.8	0.9	1.0
Use Total Phosphorus To	South	1.5	1.1	0.7	0.7
Predict Secchi Disk Depth (m)	Central	2.8	0.6	0.8	No Data
	North	2.0	1.4	1.4	1.0
Use Total Phosphorus To	South	10.8	24.3	14.9	18.5
Predict Chlorophyll a (mg/m^3))	Central	10.0	56.4	15.3	No Data
	North	7.5	13.1	12.4	11.4

Expanded Trophic Response Module
Date: 4/4/2016 Scenario: 15
Total Phosphorus: 41.8 mg/m^3
Growing Season
Chlorophyll a: 46.78 mg/m^3
Secchi Disk Depth: 1.72 m

Chlorophyll a Nuisance Frequency
Chla Mean Min: 5
Chla Mean Max: 100
Chla Mean Increment: 5
Chla Temporal CV: 0.62
Chla Nuisance Criterion: 20

Mean	Freq %	ml	z	v	w	x
5	0.5	1.4	2.546	0.016	0.541	0.005
10	7.7	2.1	1.428	0.144	0.678	0.077
15	21.9	2.5	0.774	0.296	0.795	0.219
20	37.8	2.8	0.310	0.380	0.907	0.378
25	52.0	3.0	-0.050	0.398	0.984	0.480
30	63.5	3.2	-0.344	0.376	0.897	0.365
35	72.3	3.4	-0.593	0.335	0.835	0.277

40	79.0	3.5	-0.808	0.288	0.788	0.210
45	84.1	3.6	-0.998	0.242	0.751	0.159
50	87.9	3.7	-1.168	0.202	0.720	0.121
55	90.7	3.8	-1.322	0.167	0.695	0.093
60	92.8	3.9	-1.462	0.137	0.673	0.072
65	94.4	4.0	-1.591	0.112	0.654	0.056
70	95.6	4.1	-1.711	0.092	0.637	0.044
75	96.6	4.1	-1.822	0.076	0.623	0.034
80	97.3	4.2	-1.926	0.062	0.609	0.027
85	97.8	4.3	-2.024	0.051	0.598	0.022
90	98.3	4.3	-2.116	0.043	0.587	0.017
95	98.6	4.4	-2.203	0.035	0.577	0.014
100	98.9	4.4	-2.286	0.029	0.568	0.011

Date: 3/18/2016 Scenario: 2015 L-THIA
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 25.2 mg/m^3
Observed growing season mean phosphorus (GSM): 50 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|		
Row Crop AG	1023.8	0.50	1.00	3.00	24.8	207	414	1243
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.8	194	582	969
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	2	3	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	14	28	70
Wetlands	1496.3	0.10	0.10	0.10	3.6	61	61	61
Forest	10759.2	0.05	0.09	0.18	23.5	218	392	784
Lake Surface	208.0	0.10	0.30	1.00	1.5	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.5

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1669.0	3682.4	8304.2	100.0
Total Loading (kg)	757.1	1670.3	3766.8	100.0
Areal Loading (lb/ac-year)	8.02	17.70	39.92	
Areal Loading (mg/m^2-year)	899.40	1984.34	4474.95	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1648.3	3608.6	8060.6	99.5
Total NPS Loading (kg)	747.7	1636.8	3656.3	99.5

Wisconsin Internal Load Estimator
Date: 3/18/2016 Scenario: 4
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 41.87 mg/m^3
Phosphorus Inflow Concentration: 100.8 mg/m^3
Areal External Loading: 1984.3 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.40
Observed Phosphorus Retention Coefficient: 0.58
Internal Load: -687 Lb -312 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 56.8 mg/m^3
Hypolimnetic Volume: 31.72 acre-ft
Anoxia Sediment Area: 8.96 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 73.6 mg/m^3
Hypolimnetic Volume: 7.46 acre-ft
Anoxia Sediment Area: 8.96 acres
Time Period of Stratification: 95 days
Sediment Phosphorus Release Rate: -0.4 mg/m^2-day -1.22E-003 lb/acre-day
Internal Load: -3 Lb -2 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 56.8 mg/m^3
Hypolimnetic Volume: 31.72 acre-ft
Anoxia Sediment Area: 8.96 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 30.5 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 8.96 acres
Time Period Between Observations: 14 days
Sediment Phosphorus Release Rate: 134.4 mg/m^2-day 3.65E-001 lb/acre-day
Internal Load: 150 Lb 68 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 8.96 acre
End of Anoxia Anoxic Sediment Area: 8.96 acre
Phosphorus Release Rate As Calculated In Method 2: -0.4 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: -0.4 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 67.0 mg/m^2-day
Period of Anoxia: 95 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	14	32	56

Internal Load: (kg) 6 15 25

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 3682 Lb 1670 kg

	Lb	kg	%
From A Complete Mass Budget:	-687	-312	-22.9
From Growing Season In Situ Phosphorus Increases:	-3	-2	-0.1
From In Situ Phosphorus Increases In The Fall:	150	68	3.9
From Phosphorus Release Rate and Anoxic Area:	32	15	0.9

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	9	63	138

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	-687	73.5	32
Internal Load (kg):	-312	33.3	15
External Load (Lb):	1669	3682	8304
External Load (kg):	757	1670	3767
Total Load (Lb):	982	3756	8337
Total Load (kg):	445	1704	3781

Phosphorus Prediction and Uncertainty Analysis Module

Date: 3/18/2016 Scenario: 4

Observed spring overturn total phosphorus (SPO): 25.2 mg/m^3

Observed growing season mean phosphorus (GSM): 50.0 mg/m^3

Back calculation for SPO total phosphorus: 25.45 mg/m^3

Back calculation GSM phosphorus: 50.51 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 63 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	25	56	127	6	12
Canfield-Bachmann, 1981 Natural Lake	35	69	136	19	38
Canfield-Bachmann, 1981 Artificial Lake	31	57	102	7	14
Rechow, 1979 General	26	56	127	6	12
Rechow, 1977 Anoxic	40	87	197	37	74
Rechow, 1977 water load<50m/year	30	66	149	16	32
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	34	75	170	50	198
Vollenweider, 1982 Combined OECD	27	53	102	15	40
Dillon-Rigler-Kirchner	24	53	119	28	111
Vollenweider, 1982 Shallow Lake/Res.	22	45	91	7	19
Larsen-Mercier, 1976	33	73	166	48	190
Nurnberg, 1984 Oxic	31	64	141	14	28

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	32	104	FIT	1502	GSM
Canfield-Bachmann, 1981 Natural Lake	21	199	FIT	1139	GSM
Canfield-Bachmann, 1981 Artificial Lake	18	164	FIT	1386	GSM
Rechow, 1979 General	31	105	FIT	1498	GSM
Rechow, 1977 Anoxic	50	160	FIT	966	GSM
Rechow, 1977 water load<50m/year	36	123	P	1278	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	36	148	FIT	564	SPO
Vollenweider, 1982 Combined OECD	25	100	FIT	1127	ANN
Dillon-Rigler-Kirchner	30	97	P	808	SPO
Vollenweider, 1982 Shallow Lake/Res.	21	85	FIT	1406	ANN
Larsen-Mercier, 1976	43	134	P Pin	579	SPO
Nurnberg, 1984 Oxic	33	122	P	1286	ANN

Water and Nutrient Outflow Module
Date: 3/18/2016 Scenario: 2
Average Annual Surface Total Phosphorus: 41.87mg/m^3
Annual Discharge: 1.34E+004 AF => 1.66E+007 m^3
Annual Outflow Loading: 1465.0 LB => 664.5 kg

Expanded Trophic Response Module
Date: 3/18/2016 Scenario: 3
Total Phosphorus: 41.87 mg/m^3
Growing Season
Chlorophyll a: 46.79 mg/m^3
Secchi Disk Depth: 1.52 m
Chlorophyll a Nuisance Frequency
Chla Mean Min: 5
Chla Mean Max: 100
Chla Mean Increment: 5
Chla Temporal CV: 0.62
Chla Nuisance Criterion: 20

Mean	Freq %	ml	z	v	w	x
5	0.5	1.4	2.546	0.016	0.541	0.005
10	7.7	2.1	1.428	0.144	0.678	0.077
15	21.9	2.5	0.774	0.296	0.795	0.219
20	37.8	2.8	0.310	0.380	0.907	0.378
25	52.0	3.0	-0.050	0.398	0.984	0.480
30	63.5	3.2	-0.344	0.376	0.897	0.365
35	72.3	3.4	-0.593	0.335	0.835	0.277
40	79.0	3.5	-0.808	0.288	0.788	0.210
45	84.1	3.6	-0.998	0.242	0.751	0.159
50	87.9	3.7	-1.168	0.202	0.720	0.121
55	90.7	3.8	-1.322	0.167	0.695	0.093
60	92.8	3.9	-1.462	0.137	0.673	0.072
65	94.4	4.0	-1.591	0.112	0.654	0.056
70	95.6	4.1	-1.711	0.092	0.637	0.044
75	96.6	4.1	-1.822	0.076	0.623	0.034
80	97.3	4.2	-1.926	0.062	0.609	0.027

85	97.8	4.3	-2.024	0.051	0.598	0.022
90	98.3	4.3	-2.116	0.043	0.587	0.017
95	98.6	4.4	-2.203	0.035	0.577	0.014
100	98.9	4.4	-2.286	0.029	0.568	0.011

Date: 4/4/2016 Scenario: Big Blake 2015 L-THIA
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 25.2 mg/m^3
Observed growing season mean phosphorus (GSM): 50.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|	
Row Crop AG	1023.8	0.50	1.00	3.00	24.8	207	414	1243
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.8	194	582	969
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	2	3	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	14	28	70
Wetlands	1496.3	0.10	0.10	0.10	3.6	61	61	61
Forest	10759.2	0.05	0.09	0.18	23.5	218	392	784
Lake Surface	208.0	0.10	0.30	1.00	1.5	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.5

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1669.0	3682.4	8304.2	100.0
Total Loading (kg)	757.1	1670.3	3766.8	100.0
Areal Loading (lb/ac-year)	8.02	17.70	39.92	
Areal Loading (mg/m^2-year)	899.40	1984.34	4474.95	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1648.3	3608.6	8060.6	99.5
Total NPS Loading (kg)	747.7	1636.8	3656.3	99.5

Wisconsin Internal Load Estimator
Date: 4/4/2016 Scenario: 16
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 41.9 mg/m^3
Phosphorus Inflow Concentration: 100.8 mg/m^3
Areal External Loading: 1984.3 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.40
Observed Phosphorus Retention Coefficient: 0.58
Internal Load: -686 Lb -311 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 25.6 mg/m^3
Hypolimnetic Volume: 215.66 acre-ft
Anoxia Sediment Area: 65.75 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 73.6 mg/m^3
Hypolimnetic Volume: 662.03 acre-ft
Anoxia Sediment Area: 121 acres
Time Period of Stratification: 74 days
Sediment Phosphorus Release Rate: 1.9 mg/m^2-day 5.18E-003 lb/acre-day
Internal Load: 117 Lb 53 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 25.6 mg/m^3
Hypolimnetic Volume: 215.66 acre-ft
Anoxia Sediment Area: 65.75 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 69.1 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 121 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 13.5 mg/m^2-day 3.66E-002 lb/acre-day
Internal Load: 337 Lb 153 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 65.75 acre
End of Anoxia Anoxic Sediment Area: 121 acre
Phosphorus Release Rate As Calculated In Method 2: 1.9 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: 1.9 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 7.7 mg/m^2-day
Period of Anoxia: 74 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	113	263	451

Internal Load: (kg) 51 119 205

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 3682 Lb 1670 kg

	Lb	kg	%
From A Complete Mass Budget:	-686	-311	-22.9
From Growing Season In Situ Phosphorus Increases:	117	53	3.1
From In Situ Phosphorus Increases In The Fall:	337	153	8.4
From Phosphorus Release Rate and Anoxic Area:	263	119	6.7

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	9	67	144

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	-686	227.1	263
Internal Load (kg):	-311	103.0	119
External Load (Lb):	1669	3682	8304
External Load (kg):	757	1670	3767
Total Load (Lb):	983	3910	8567
Total Load (kg):	446	1773	3886

Phosphorus Prediction and Uncertainty Analysis Module

Date: 4/4/2016 Scenario: 12

Observed spring overturn total phosphorus (SPO): 25.2 mg/m^3

Observed growing season mean phosphorus (GSM): 50.0 mg/m^3

Back calculation for SPO total phosphorus: 25.45 mg/m^3

Back calculation GSM phosphorus: 50.51 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 67 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	25	56	127	6	12
Canfield-Bachmann, 1981 Natural Lake	35	69	136	19	38
Canfield-Bachmann, 1981 Artificial Lake	31	57	102	7	14
Rechow, 1979 General	26	56	127	6	12
Rechow, 1977 Anoxic	40	87	197	37	74
Rechow, 1977 water load<50m/year	30	66	149	16	32
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	34	75	170	50	198
Vollenweider, 1982 Combined OECD	27	53	102	15	40
Dillon-Rigler-Kirchner	24	53	119	28	111
Vollenweider, 1982 Shallow Lake/Res.	22	45	91	7	19
Larsen-Mercier, 1976	33	73	166	48	190
Nurnberg, 1984 Oxic	32	65	141	15	30

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	32	104	FIT	1502	GSM
Canfield-Bachmann, 1981 Natural Lake	21	199	FIT	1139	GSM
Canfield-Bachmann, 1981 Artificial Lake	18	164	FIT	1386	GSM
Rechow, 1979 General	31	105	FIT	1498	GSM
Rechow, 1977 Anoxic	50	160	FIT	966	GSM
Rechow, 1977 water load<50m/year	36	123	P	1278	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	36	148	FIT	564	SPO
Vollenweider, 1982 Combined OECD	25	100	FIT	1127	ANN
Dillon-Rigler-Kirchner	30	97	P	808	SPO
Vollenweider, 1982 Shallow Lake/Res.	21	85	FIT	1406	ANN
Larsen-Mercier, 1976	43	134	P Pin	579	SPO
Nurnberg, 1984 Oxic	34	122	P	1279	ANN

Water and Nutrient Outflow Module

Date: 4/4/2016 Scenario: 10

Average Annual Surface Total Phosphorus: 41.87mg/m^3

Annual Discharge: 1.34E+004 AF => 1.66E+007 m^3

Annual Outflow Loading: 1465.0 LB => 664.5 kg

Date: 7/26/2016 Scenario: Big Blake Lake combined direct drainage
Lake Id: Big Blake Lake
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 550.0 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 366.7 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 169846.7 acre-ft/year
Areal Water Load <qs>: 816.6 ft/year
Lake Flushing Rate <p>: 90.73 1/year
Water Residence Time: 0.01 year
Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3
Observed growing season mean phosphorus (GSM): 57.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	123.0	0.50	1.00	3.00	0.5	25	50	149
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	38.0	0.10	0.30	0.50	0.0	2	5	8
HD Urban (1/8 Ac)	19.0	1.00	1.50	2.00	0.1	8	12	15
MD Urban (1/4 Ac)	113.0	0.30	0.50	0.80	0.2	14	23	37
Rural Res (>1 Ac)	46.0	0.05	0.10	0.25	0.0	1	2	5
Wetlands	35.0	0.10	0.10	0.10	0.0	1	1	1
Forest	176.0	0.05	0.09	0.18	0.1	4	6	13
Lake Surface	208.0	0.10	0.30	1.00	0.2	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.1

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	139.2	23580.3	745.9	100.0
Total Loading (kg)	63.1	10696.0	338.4	100.0
Areal Loading (lb/ac-year)	0.67	113.37	3.59	
Areal Loading (mg/m^2-year)	75.02	12706.86	401.97	
Total PS Loading (lb)	0.0	23289.4	0.0	98.8

Total PS Loading (kg)	0.0	10564.0	0.0	98.8
Total NPS Loading (lb)	118.5	217.1	502.4	1.2
Total NPS Loading (kg)	53.7	98.5	227.9	1.2

Wisconsin Internal Load Estimator
Date: 7/26/2016 Scenario: 24
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 49.85 mg/m^3
Phosphorus Inflow Concentration: 51.1 mg/m^3
Areal External Loading: 12706.9 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.06
Observed Phosphorus Retention Coefficient: 0.02
Internal Load: 769 Lb 349 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 715.6 acre-ft
Anoxia Sediment Area: 120.4 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 70 mg/m^3
Hypolimnetic Volume: 595.61 acre-ft
Anoxia Sediment Area: 108.82 acres
Time Period of Stratification: 50 days
Sediment Phosphorus Release Rate: -0.2 mg/m^2-day -4.18E-004 lb/acre-day
Internal Load: -8 Lb -4 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 715.6 acre-ft
Anoxia Sediment Area: 120.4 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 62.3 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 108.82 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 6.4 mg/m^2-day 1.74E-002 lb/acre-day
Internal Load: 196 Lb 89 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 120.4 acre
End of Anoxia Anoxic Sediment Area: 108.82 acre
Phosphorus Release Rate As Calculated In Method 2: -0.2 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: -0.2 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 3.1 mg/m^2-day
Period of Anoxia: 50 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	93	218	374

Internal Load: (kg) 42 99 170

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 23580 Lb 10696 kg

	Lb	kg	%
From A Complete Mass Budget:	769	349	3.2
From Growing Season In Situ Phosphorus Increases:	-8	-4	0.0
From In Situ Phosphorus Increases In The Fall:	196	89	0.8
From Phosphorus Release Rate and Anoxic Area:	218	99	0.9

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	2	48	2

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	769	94.0	218
Internal Load (kg):	349	42.7	99
External Load (Lb):	139	23580	746
External Load (kg):	63	10696	338
Total Load (Lb):	908	23674	964
Total Load (kg):	412	10739	437

Phosphorus Prediction and Uncertainty Analysis Module

Date: 7/26/2016 Scenario: 18

Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3

Observed growing season mean phosphorus (GSM): 57.0 mg/m^3

Back calculation for SPO total phosphorus: 37.14 mg/m^3

Back calculation GSM phosphorus: 57.24 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 48 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	0	47	1	-10	-18
Canfield-Bachmann, 1981 Natural Lake	0	47	2	-10	-18
Canfield-Bachmann, 1981 Artificial Lake	0	43	2	-14	-25
Rechow, 1979 General	0	41	1	-16	-28
Rechow, 1977 Anoxic	0	45	1	-12	-21
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	0	36	1	-21	-37
Walker, 1977 General	0	46	1	9	24
Vollenweider, 1982 Combined OECD	1	36	2	-11	-23
Dillon-Rigler-Kirchner	0	48	2	11	30
Vollenweider, 1982 Shallow Lake/Res.	0	30	1	-17	-36
Larsen-Mercier, 1976	0	46	1	9	24
Nurnberg, 1984 Oxic	1	48	2	-9	-16

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	16	80	Tw	12997	GSM
Canfield-Bachmann, 1981 Natural Lake	15	135	L	12877	GSM
Canfield-Bachmann, 1981 Artificial Lake	13	124	FIT	14320	GSM
Rechow, 1979 General	13	71	qs	14949	GSM
Rechow, 1977 Anoxic	15	76	FIT	13573	GSM
Rechow, 1977 water load<50m/year	N/A	N/A	N/A	N/A	N/A
Rechow, 1977 water load>50m/year	14	57	FIT	16923	GSM
Walker, 1977 General	13	84	FIT	8609	SPO
Vollenweider, 1982 Combined OECD	10	68	Tw	14943	ANN
Dillon-Rigler-Kirchner	16	81	P L qs p	8226	SPO
Vollenweider, 1982 Shallow Lake/Res.	8	56	Tw	18320	ANN
Larsen-Mercier, 1976	16	77	P Pin p	8598	SPO
Nurnberg, 1984 Oxic	14	86	L qs	12655	ANN

Date: 7/26/2016 Scenario: Big Blake Lake combined L-THIA
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3
Observed growing season mean phosphorus (GSM): 57.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|		
Row Crop AG	1023.8	0.50	1.00	3.00	24.8	207	414	1243
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.8	194	582	969
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	2	3	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	14	28	70
Wetlands	1496.3	0.10	0.10	0.10	3.6	61	61	61
Forest	10759.2	0.05	0.09	0.18	23.5	218	392	784
Lake Surface	208.0	0.10	0.30	1.00	1.5	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.5

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1669.0	3682.4	8304.2	100.0
Total Loading (kg)	757.1	1670.3	3766.8	100.0
Areal Loading (lb/ac-year)	8.02	17.70	39.92	
Areal Loading (mg/m^2-year)	899.40	1984.34	4474.95	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1648.3	3608.6	8060.6	99.5
Total NPS Loading (kg)	747.7	1636.8	3656.3	99.5

Wisconsin Internal Load Estimator
Date: 7/26/2016 Scenario: 23
Method 1 - A Complete Total Phosphorus Mass Budget
Method 1 - A Complete Total Phosphorus Mass Budget 49.85 mg/m^3
Phosphorus Inflow Concentration: 100.8 mg/m^3
Areal External Loading: 1984.3 mg/m^2-year
Predicted Phosphorus Retention Coefficient: 0.40
Observed Phosphorus Retention Coefficient: 0.51
Internal Load: -396 Lb -179 kg

Method 2 - From Growing Season In Situ Phosphorus Increases
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 715.6 acre-ft
Anoxia Sediment Area: 120.04 acres
Just Prior To The End of Stratification
Average Hypolimnetic Phosphorus Concentration: 70.0 mg/m^3
Hypolimnetic Volume: 595.61 acre-ft
Anoxia Sediment Area: 108.82 acres
Time Period of Stratification: 50 days
Sediment Phosphorus Release Rate: -0.2 mg/m^2-day -4.19E-004 lb/acre-day
Internal Load: -8 Lb -4 kg

Method 3 - From In Situ Phosphorus Increases In The Fall
Start of Anoxia
Average Hypolimnetic Phosphorus Concentration: 62.3 mg/m^3
Hypolimnetic Volume: 715.6 acre-ft
Anoxia Sediment Area: 120.04 acres
Just Prior To The End of Stratification
Average Water Column Phosphorus Concentration: 85 mg/m^3
Lake Volume: 1872.0 acre-ft
Anoxia Sediment Area Just Before Turnover: 108.82 acres
Time Period Between Observations: 30 days
Sediment Phosphorus Release Rate: 10.2 mg/m^2-day 2.77E-002 lb/acre-day
Internal Load: 311 Lb 141 kg

Method 4 - From Phosphorus Release Rate and Anoxic Area
Start of Anoxia Anoxic Sediment Area: 120.04 acre
End of Anoxia Anoxic Sediment Area: 108.82 acre
Phosphorus Release Rate As Calculated In Method 2: -0.2 mg/m^2-day
Phosphorus Release Rate As Calculated In Method 3: -0.2 mg/m^2-day
Average of Methods 2 and 3 Release Rates: 5.0 mg/m^2-day
Period of Anoxia: 50 days
Default Areal Sediment Phosphorus Release Rates:

	Low	Most Likely	High
	6	14	24
Internal Load: (Lb)	93	218	373

Internal Load: (kg) 42 99 169

Internal Load Comparison (Percentages are of the Total Estimate Load)

Total External Load: 3682 Lb 1670 kg

	Lb	kg	%
From A Complete Mass Budget:	-396	-179	-12.0
From Growing Season In Situ Phosphorus Increases:	-8	-4	-0.2
From In Situ Phosphorus Increases In The Fall:	311	141	7.8
From Phosphorus Release Rate and Anoxic Area:	218	99	5.6

Predicted Water Column Total Phosphorus Concentration (ug/l)

Nurnberg+ 1984 Total Phosphorus Model:	Low	Most Likely	High
	17	65	143

Osgood, 1988 Lake Mixing Index: 3.0

Phosphorus Loading Summary:

	Low	Most Likely	High
Internal Load (Lb):	-396	151.8	218
Internal Load (kg):	-179	68.9	99
External Load (Lb):	1669	3682	8304
External Load (kg):	757	1670	3767
Total Load (Lb):	1273	3834	8522
Total Load (kg):	578	1739	3866

Phosphorus Prediction and Uncertainty Analysis Module

Date: 7/26/2016 Scenario: 17

Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3

Observed growing season mean phosphorus (GSM): 57.0 mg/m^3

Back calculation for SPO total phosphorus: 37.14 mg/m^3

Back calculation GSM phosphorus: 57.24 mg/m^3

% Confidence Range: 70%

Nurenberg Model Input - Est. Gross Int. Loading: 65 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	25	56	127	-1	-2
Canfield-Bachmann, 1981 Natural Lake	35	69	136	12	21
Canfield-Bachmann, 1981 Artificial Lake	31	57	102	0	0
Rechow, 1979 General	26	56	127	-1	-2
Rechow, 1977 Anoxic	40	87	197	30	53
Rechow, 1977 water load<50m/year	30	66	149	9	16
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	34	75	170	38	103
Vollenweider, 1982 Combined OECD	27	53	102	6	13
Dillon-Rigler-Kirchner	24	53	119	16	43
Vollenweider, 1982 Shallow Lake/Res.	22	45	91	-2	-4
Larsen-Mercier, 1976	33	73	166	36	98
Nurnberg, 1984 Oxic	31	65	141	8	14

Lake Phosphorus Model	**Confidence** Lower	**Confidence** Upper	**Parameter** Fit?	**Back** Calculation	**Model** Type

	Bound	Bound		(kg/year)	
Walker, 1987 Reservoir	32	104	FIT	1702	GSM
Canfield-Bachmann, 1981 Natural Lake	21	199	FIT	1318	GSM
Canfield-Bachmann, 1981 Artificial Lake	18	164	FIT	1641	GSM
Rechow, 1979 General	31	105	FIT	1697	GSM
Rechow, 1977 Anoxic	50	160	FIT	1094	GSM
Rechow, 1977 water load<50m/year	36	123	P	1448	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	36	148	FIT	823	SPO
Vollenweider, 1982 Combined OECD	25	100	FIT	1469	ANN
Dillon-Rigler-Kirchner	30	97	P	1180	SPO
Vollenweider, 1982 Shallow Lake/Res.	21	85	FIT	1801	ANN
Larsen-Mercier, 1976	43	134	P Pin	845	SPO
Nurnberg, 1984 Oxic	34	122	P	1468	ANN

Water and Nutrient Outflow Module

Date: 7/26/2016 Scenario: 13

Average Annual Surface Total Phosphorus: 49.8mg/m^3

Annual Discharge: 1.34E+004 AF => 1.66E+007 m^3

Annual Outflow Loading: 1742.3 LB => 790.3 kg

Date: 7/26/2016 Scenario: L-THIA combined 15% reduction
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3
Observed growing season mean phosphorus (GSM): 57.0 mg/m^3
% NPS Change: -15%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|	
Row Crop AG	1023.8	0.50	1.00	3.00	24.7	176	352	1057
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.7	165	494	824
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	1	2	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	12	24	60
Wetlands	1496.3	0.10	0.10	0.10	3.6	51	51	51
Forest	10759.2	0.05	0.09	0.18	23.4	185	333	666
Lake Surface	208.0	0.10	0.30	1.00	1.8	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.6

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1421.8	3141.1	7095.1	100.0
Total Loading (kg)	644.9	1424.8	3218.3	100.0
Areal Loading (lb/ac-year)	6.84	15.10	34.11	
Areal Loading (mg/m^2-year)	766.16	1692.66	3823.39	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1401.0	3067.3	6851.6	99.4
Total NPS Loading (kg)	635.5	1391.3	3107.8	99.4

Phosphorus Prediction and Uncertainty Analysis Module
Date: 7/26/2016 Scenario: 21
Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3
Observed growing season mean phosphorus (GSM): 57.0 mg/m^3
Back calculation for SPO total phosphorus: 37.14 mg/m^3
Back calculation GSM phosphorus: 57.24 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 65 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	23	50	114	-7	-12
Canfield-Bachmann, 1981 Natural Lake	30	60	120	3	5
Canfield-Bachmann, 1981 Artificial Lake	27	51	91	-6	-11
Rechow, 1979 General	22	48	109	-9	-16
Rechow, 1977 Anoxic	34	75	168	18	32
Rechow, 1977 water load<50m/year	25	56	127	-1	-2
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	29	64	145	27	73
Vollenweider, 1982 Combined OECD	24	46	90	-1	-2
Dillon-Rigler-Kirchner	20	45	101	8	22
Vollenweider, 1982 Shallow Lake/Res.	19	39	80	-8	-17
Larsen-Mercier, 1976	28	63	141	26	71
Nurnberg, 1984 Oxic	27	56	121	-1	-2

Lake Phosphorus Model	**Confidence** Lower Bound	**Confidence** Upper Bound	**Parameter** Fit?	**Back** Calculation (kg/year)	**Model** Type
Walker, 1987 Reservoir	28	93	FIT	1623	GSM
Canfield-Bachmann, 1981 Natural Lake	19	173	FIT	1318	GSM
Canfield-Bachmann, 1981 Artificial Lake	16	147	FIT	1641	GSM
Rechow, 1979 General	26	90	FIT	1697	GSM
Rechow, 1977 Anoxic	43	137	FIT	1094	GSM
Rechow, 1977 water load<50m/year	31	105	FIT	1448	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	31	126	FIT	823	SPO
Vollenweider, 1982 Combined OECD	22	87	FIT	1469	ANN
Dillon-Rigler-Kirchner	26	82	P	1180	SPO
Vollenweider, 1982 Shallow Lake/Res.	19	74	FIT	1801	ANN
Larsen-Mercier, 1976	37	114	P Pin	845	SPO
Nurnberg, 1984 Oxic	29	105	FIT	1468	ANN

Date: 7/26/2016 Scenario: L-THIA combined 20% reduction
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3
Observed growing season mean phosphorus (GSM): 57.0 mg/m^3
% NPS Change: -20%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|		
Row Crop AG	1023.8	0.50	1.00	3.00	24.7	166	331	994
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.6	155	465	776
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	1	2	3
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	11	22	56
Wetlands	1496.3	0.10	0.10	0.10	3.6	48	48	48
Forest	10759.2	0.05	0.09	0.18	23.3	174	314	627
Lake Surface	208.0	0.10	0.30	1.00	1.9	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.6

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1339.4	2960.7	6692.1	100.0
Total Loading (kg)	607.5	1342.9	3035.5	100.0
Areal Loading (lb/ac-year)	6.44	14.23	32.17	
Areal Loading (mg/m^2-year)	721.75	1595.43	3606.21	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1318.6	2886.9	6448.5	99.4
Total NPS Loading (kg)	598.1	1309.5	2925.0	99.4

Phosphorus Prediction and Uncertainty Analysis Module
Date: 7/26/2016 Scenario: 22
Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3
Observed growing season mean phosphorus (GSM): 57.0 mg/m^3
Back calculation for SPO total phosphorus: 37.14 mg/m^3
Back calculation GSM phosphorus: 57.24 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 65 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	22	48	109	-9	-16
Canfield-Bachmann, 1981 Natural Lake	28	57	114	0	0
Canfield-Bachmann, 1981 Artificial Lake	26	48	88	-9	-16
Rechow, 1979 General	20	45	102	-12	-21
Rechow, 1977 Anoxic	32	70	159	13	23
Rechow, 1977 water load<50m/year	24	53	120	-4	-7
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	27	61	137	24	65
Vollenweider, 1982 Combined OECD	23	44	86	-3	-6
Dillon-Rigler-Kirchner	19	42	96	5	14
Vollenweider, 1982 Shallow Lake/Res.	18	37	76	-10	-21
Larsen-Mercier, 1976	27	59	133	22	60
Nurnberg, 1984 Oxic	26	53	114	-4	-7

Lake Phosphorus Model	**Confidence** Lower Bound	**Confidence** Upper Bound	**Parameter** Fit?	**Back** Calculation (kg/year)	**Model** Type
Walker, 1987 Reservoir	27	89	FIT	1595	GSM
Canfield-Bachmann, 1981 Natural Lake	18	164	FIT	1318	GSM
Canfield-Bachmann, 1981 Artificial Lake	15	138	FIT	1641	GSM
Rechow, 1979 General	24	84	FIT	1697	GSM
Rechow, 1977 Anoxic	41	129	FIT	1094	GSM
Rechow, 1977 water load<50m/year	29	99	FIT	1448	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	29	120	FIT	823	SPO
Vollenweider, 1982 Combined OECD	21	83	FIT	1469	ANN
Dillon-Rigler-Kirchner	24	78	P	1180	SPO
Vollenweider, 1982 Shallow Lake/Res.	18	71	FIT	1801	ANN
Larsen-Mercier, 1976	35	107	P Pin	845	SPO
Nurnberg, 1984 Oxic	28	99	FIT	1468	ANN

Date: 7/26/2016 Scenario: L-THIA direct 30% reduction
Lake Id: Big Blake Lake
Watershed Id: 1

Hydrologic and Morphometric Data

Tributary Drainage Area: 20066.1 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 13377.4 acre-ft
Lake Surface Area <As>: 208.0 acre
Lake Volume <V>: 1872.0 acre-ft
Lake Mean Depth <z>: 9.0 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 13434.6 acre-ft/year
Areal Water Load <qs>: 64.6 ft/year
Lake Flushing Rate <p>: 7.18 1/year
Water Residence Time: 0.14 year
Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3
Observed growing season mean phosphorus (GSM): 57.0 mg/m^3
% NPS Change: -30%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|	
Row Crop AG	1023.8	0.50	1.00	3.00	24.6	145	290	870
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	4790.6	0.10	0.30	0.50	34.5	136	407	679
HD Urban (1/8 Ac)	4.3	1.00	1.50	2.00	0.2	1	2	2
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	691.9	0.05	0.10	0.25	1.7	10	20	49
Wetlands	1496.3	0.10	0.10	0.10	3.6	42	42	42
Forest	10759.2	0.05	0.09	0.18	23.3	152	274	549
Lake Surface	208.0	0.10	0.30	1.00	2.1	8	25	84

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	164.4				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.99	8.22	26.30	0.7

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	1174.5	2599.8	5886.0	100.0
Total Loading (kg)	532.8	1179.3	2669.9	100.0
Areal Loading (lb/ac-year)	5.65	12.50	28.30	
Areal Loading (mg/m^2-year)	632.93	1400.97	3171.84	
Total PS Loading (lb)	0.0	0.0	0.0	0.0

Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	1153.8	2526.0	5642.5	99.3
Total NPS Loading (kg)	523.4	1145.8	2559.4	99.3

Phosphorus Prediction and Uncertainty Analysis Module
Date: 7/26/2016 Scenario: 23
Observed spring overturn total phosphorus (SPO): 36.8 mg/m^3
Observed growing season mean phosphorus (GSM): 57.0 mg/m^3
Back calculation for SPO total phosphorus: 37.14 mg/m^3
Back calculation GSM phosphorus: 57.24 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 65 kg

Lake Phosphorus Model	**Low** Total P (mg/m^3)	**Most Likely** Total P (mg/m^3)	**High** Total P (mg/m^3)	**Predicted** -Observed (mg/m^3)	**% Dif.**
Walker, 1987 Reservoir	20	44	99	-13	-23
Canfield-Bachmann, 1981 Natural Lake	25	51	103	-6	-11
Canfield-Bachmann, 1981 Artificial Lake	23	44	80	-13	-23
Rechow, 1979 General	18	40	90	-17	-30
Rechow, 1977 Anoxic	28	62	140	5	9
Rechow, 1977 water load<50m/year	21	47	106	-10	-18
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	24	53	121	16	43
Vollenweider, 1982 Combined OECD	21	39	77	-8	-17
Dillon-Rigler-Kirchner	17	37	84	0	0
Vollenweider, 1982 Shallow Lake/Res.	16	33	68	-14	-30
Larsen-Mercier, 1976	23	52	117	15	41
Nurnberg, 1984 Oxic	23	47	101	-10	-18

Lake Phosphorus Model	**Confidence** Lower Bound	**Confidence** Upper Bound	**Parameter** Fit?	**Back** Calculation (kg/year)	**Model** Type
Walker, 1987 Reservoir	25	81	FIT	1537	GSM
Canfield-Bachmann, 1981 Natural Lake	16	147	FIT	1318	GSM
Canfield-Bachmann, 1981 Artificial Lake	14	127	FIT	1641	GSM
Rechow, 1979 General	22	75	FIT	1697	GSM
Rechow, 1977 Anoxic	36	114	FIT	1094	GSM
Rechow, 1977 water load<50m/year	26	87	FIT	1448	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	26	105	FIT	823	SPO
Vollenweider, 1982 Combined OECD	19	74	FIT	1469	ANN
Dillon-Rigler-Kirchner	21	68	P	1180	SPO
Vollenweider, 1982 Shallow Lake/Res.	16	63	FIT	1801	ANN
Larsen-Mercier, 1976	30	94	P Pin	845	SPO
Nurnberg, 1984 Oxic	24	88	FIT	1468	ANN

Appendix J

Sediment Core Data and Paleolimnoligical Study of Big Blake Lake Report

Total Phosphorus Results Pink = air spike

Sample ID	Raw Result (mg P/L)	Dilution Factor	Final Result (mg P/L)
DI Blank	-0.005		
Chk Stnd 0.096 ppm P	0.084		
Chk Stnd 0.288 ppm P	0.260		
Cal Stnd 0.50 ppm P	0.449		
DI Blank	-0.006		
21 Dup Blake 1A - 10 cm TP	0.342	5373.48	1.84
22 Blake 1A - 13 cm TP	0.293	5809.08	1.70
23 Blake 1A - 16 cm TP	0.257	5749.28	1.48
24 Blake 1A - 19 cm TP	0.261	5465.21	1.43
25 Blake 1A - 21 cm TP	0.271	5303.36	1.44
26 Blake 1A - 23 cm TP	0.230	5522.54	1.27
27 Blake 1A - 25 cm TP	0.240	5233.57	1.26
28 Blake 1A - 27 cm TP	0.224	5597.01	1.25
29 Blake 1A - 29 cm TP	0.260	5737.58	1.49
30 Dup Blake 1A - 29 cm TP	0.317	5750.04	1.82
31 Blake 1A - 31 cm TP	0.220	5699.87	1.26
32 Blake 1A - 33 cm TP	0.248	5541.35	1.37
33 Blake 1A - 37 cm TP	0.231	5633.14	1.30
34 Blake 1A - 39 cm TP	0.233	5571.53	1.30
35 Blank 2 Blake TP	0.019		
LFB 3 - Blake	0.181		
Spike 29 Blake 1A - 29 cm TP	0.429		
rep 35 Blank 2 Blake TP	0.020		
DI Blank	-0.006		
Chk Stnd 0.096 ppm P	0.0835		
Chk Stnd 0.288 ppm P	0.2577		
Cal Stnd 0.50 ppm P	0.4498		
DI Blank	-0.0058		
inst rep 28 Blake 1A - 27 cm TP	0.2233	5597.01	1.25
inst rep 34 Blake 1A - 39 cm TP	0.2361	5571.53	1.32
AS 25 Blake 1A - 21 cm TP	0.2518	5303.36	1.34
DI Blank	-0.0053		

Sample ID	Result (mg P/g)	Instrument Rep
18 Blake 1A - 1 cm TP	2.29	
19 Blake 1A - 7 cm TP	1.80	
20 Blake 1A - 10 cm TP	1.88	
22 Blake 1A - 13 cm TP	1.70	
23 Blake 1A - 16 cm TP	1.48	
24 Blake 1A - 19 cm TP	1.43	
25 Blake 1A - 21 cm TP	1.34	
26 Blake 1A - 23 cm TP	1.27	
27 Blake 1A - 25 cm TP	1.26	
28 Blake 1A - 27 cm TP	1.25	1.25
29 Blake 1A - 29 cm TP	1.49	
30 Dup Blake 1A - 29 cm TP	1.82	
31 Blake 1A - 31 cm TP	1.26	

32 Blake 1A - 33 cm TP	1.37	
33 Blake 1A - 37 cm TP	1.30	
34 Blake 1A - 39 cm TP	1.30	1.32

Extractable Phosphorus

Sample ID	Result mg P/L	Dilution Factor	Final Result mg P/g
DI Blank	0.0027		
Chk Stnd 0.096 ppm P	0.0850		
Cal Stnd 0.20 ppm P	0.1628		
Chk Stnd 0.288 ppm P	0.2534		
DI Blank	0.0039		
21 Blake Lake 9-10 cm Ex-P	0.0312	2236.07	0.07
22 Blake Lake 12-13 cm Ex-P	0.0197	2197.26	0.04
23 Blake Lake 15-16 cm Ex-P	0.0213	2227.42	0.05
24 Blake Lake 18-19 cm Ex-P	0.0216	2149.48	0.05
25 Blake Lake 20-21 cm Ex-P	0.0228	2039.90	0.05
26 Blake Lake 22-23 cm Ex-P	0.0235	2094.91	0.05
27 Blake Lake 24-25 cm Ex-P	0.0233	2026.10	0.05
28 Blake Lake 26-27 cm Ex-P	0.0216	2239.91	0.05
29 Blake Lake 28-29 cm Ex-P	0.0483	1945.69	0.09
30 DUP Blake Lake 28-29 cm Ex-P	0.0516	2073.20	0.11
31 Blake Lake 30-31 cm Ex-P	0.0222	2220.26	0.05
32 Blake Lake 32-33 cm Ex-P	0.0215	2101.00	0.05
33 Blake Lake 36-37 cm Ex-P	0.0208	2201.19	0.05
34 Blake Lake 38-39 cm Ex-P	0.0201	2336.21	0.05
35 DUP Blake Lake 38-39 cm Ex-P	0.0198	2207.05	0.04
1 Blank - Bone Ex-P	0.0251		0.00
LFB 2	0.1831		0.00
Spike 22 Blake 12-13 cm Ex-P	0.1929		0.00
DI Blank	0.0039		0.00
Chk Stnd 0.096 ppm P	0.0865		0.00
Cal Stnd 0.20 ppm P	0.1640		0.00
Chk Stnd 0.288 ppm P	0.2552		0.00
DI Blank	0.0043		0.00
inst rep 23 Blake Lake 15-16 cm Ex-P	0.0217	2227.42	0.05
inst rep 32 Blake Lake 32-33 cm Ex-P	0.0207	2101.00	0.04
AS 28 Blake Lake 26-27 cm Ex-P	0.0219	2239.91	0.05

Sample ID	Result mg P/g	Instrument Replicate
19 Blake Lake 0-1 cm Ex-P	0.06	
20 Blake Lake 6-7 cm Ex-P	0.04	
21 Blake Lake 9-10 cm Ex-P	0.07	
22 Blake Lake 12-13 cm Ex-P	0.04	
23 Blake Lake 15-16 cm Ex-P	0.05	0.05
24 Blake Lake 18-19 cm Ex-P	0.05	

25 Blake Lake 20-21 cm Ex-P	0.05	
26 Blake Lake 22-23 cm Ex-P	0.05	
27 Blake Lake 24-25 cm Ex-P	0.05	
28 Blake Lake 26-27 cm Ex-P	0.05	
29 Blake Lake 28-29 cm Ex-P	0.09	
31 Blake Lake 30-31 cm Ex-P	0.05	
32 Blake Lake 32-33 cm Ex-P	0.05	0.04
33 Blake Lake 36-37 cm Ex-P	0.05	
34 Blake Lake 38-39 cm Ex-P	0.05	

NaOH Phosphorus

Sample ID	Raw Result	Background Color	Raw Result	Dilution Factor	Final Result
	mg P/L	(file 140813z.fdt)	minus color		mg P/g
			mg P/L		
DI Blank	0.00				
1 Blank 1 - Bone NaOH-P	0.00	0.00	0.00		
Chk Stnd 0.096 ppm P	0.08				
Cal Stnd 0.20 ppm P	0.19				
Chk Stnd 0.288 ppm P	0.26				
DI Blank	0.00				
21 Blake Lake 9-10 cm NaOH-P	0.10	0.00	0.10	2736.77	0.28
22 Blake Lake 12-13 cm NaOH-P	0.06	0.00	0.06	2786.77	0.16
23 Blake Lake 15-16 cm NaOH-P	0.05	0.00	0.05	2803.92	0.13
24 Blake Lake 18-19 cm NaOH-P	0.05	0.00	0.05	2698.74	0.13
25 Blake Lake 20-21 cm NaOH-P	0.05	0.00	0.05	2585.90	0.13
26 Blake Lake 22-23 cm NaOH-P	0.05	0.00	0.05	2635.45	0.14
27 Blake Lake 24-25 cm NaOH-P	0.05	0.00	0.05	2594.24	0.12
28 Blake Lake 26-27 cm NaOH-P	0.05	0.00	0.05	2822.99	0.14
29 Blake Lake 28-29 cm NaOH-P	0.20	0.00	0.20	2430.87	0.49
30 DUP Blake Lake 28-29 cm NaOH-P	0.19	0.00	0.19	2646.08	0.50
31 Blake Lake 30-31 cm NaOH-P	0.05	0.00	0.05	2823.75	0.13
32 Blake Lake 32-33 cm NaOH-P	0.05	0.00	0.05	2658.78	0.13
33 Blake Lake 36-37 cm NaOH-P	0.05	0.00	0.05	2806.63	0.15
34 Blake Lake 38-39 cm NaOH-P	0.05	0.00	0.05	3054.09	0.15
35 DUP Blake Lake 38-39 cm NaOH-P	0.05	0.00	0.05	2807.89	0.15
DI Blank	0.00				
Chk Stnd 0.096 ppm P	0.09				
Cal Stnd 0.20 ppm P	0.20				
Chk Stnd 0.288 ppm P	0.27				
DI Blank	0.00				
inst rep 26 Blake Lake 22-23 cm NaOH-P	0.05	0.00	0.05	2635.45	0.14

Sample ID	Final Result mg P/g	Inst dup
19 Blake Lake 0-1 cm NaOH-P	0.42	
20 Blake Lake 6-7 cm NaOH-P	0.19	
21 Blake Lake 9-10 cm NaOH-P	0.28	
22 Blake Lake 12-13 cm NaOH-P	0.16	
23 Blake Lake 15-16 cm NaOH-P	0.13	
24 Blake Lake 18-19 cm NaOH-P	0.13	
25 Blake Lake 20-21 cm NaOH-P	0.13	
26 Blake Lake 22-23 cm NaOH-P	0.14	0.14
27 Blake Lake 24-25 cm NaOH-P	0.12	
28 Blake Lake 26-27 cm NaOH-P	0.14	
29 Blake Lake 28-29 cm NaOH-P	0.49	
31 Blake Lake 30-31 cm NaOH-P	0.13	
32 Blake Lake 32-33 cm NaOH-P	0.13	
33 Blake Lake 36-37 cm NaOH-P	0.15	
34 Blake Lake 38-39 cm NaOH-P	0.15	

HCL Phosphorus

Sample ID	Raw Result	Dilution Factor	Final Result
	mg P/L		mg P/g
DI Blank	0.00	X	X
1 Blank 1 HCl-P	0.00	X	X
Chk Stnd 0.096 ppm P	0.09	X	X
Cal Stnd 0.20 ppm P	0.20	X	X
Chk Stnd 0.288 ppm P	0.27	X	X
DI Blank	0.00	X	X
21 Blake Lake 9-10 cm HCl-P	0.21	2948.70	0.63
22 Blake Lake 12-13 cm HCl-P	0.04	2926.27	0.13
23 Blake Lake 15-16 cm HCl-P	0.04	2954.14	0.12
24 Blake Lake 18-19 cm HCl-P	0.04	2884.81	0.12
25 Blake Lake 20-21 cm HCl-P	0.05	2662.21	0.12
26 Blake Lake 22-23 cm HCl-P	0.05	2641.00	0.13
27 Blake Lake 24-25 cm HCl-P	0.05	2555.17	0.12
28 Blake Lake 26-27 cm HCl-P	0.04	2942.36	0.13
29 Blake Lake 28-29 cm HCl-P	0.07	2556.33	0.17
30 DUP Blake Lake 28-29 cm HCl-P	0.05	2712.10	0.14
31 Blake Lake 30-31 cm HCl-P	0.04	2951.18	0.11
32 Blake Lake 32-33 cm HCl-P	0.04	2761.52	0.10
33 Blake Lake 36-37 cm HCl-P	0.04	2877.07	0.10
34 Blake Lake 38-39 cm HCl-P	0.03	3334.41	0.11
35 DUP Blake Lake 38-39 cm HCl-P	0.04	2797.93	0.11
LFB 2	0.17	X	X
Spike 33 Blake 36-37 cm HCl-P	0.21	X	X
DI Blank	0.00	X	X
DI Blank	0.00	X	X

Chk Stnd 0.096 ppm P	0.09	X	X
Cal Stnd 0.20 ppm P	0.20	X	X
Chk Stnd 0.288 ppm P	0.27	X	X
DI Blank	0.00	X	X
inst rep 26 Blake Lake 22-23 cm HCl-P	0.05	2641.00	0.13
inst rep 33 Blake Lake 36-37 cm HCl-P	0.04	2877.07	0.11

Sample ID	Final Result	Inst dup
	mg P/g	
19 Blake Lake 0-1 cm HCl-P	0.13	
20 Blake Lake 6-7 cm HCl-P	0.11	
21 Blake Lake 9-10 cm HCl-P	0.63	
22 Blake Lake 12-13 cm HCl-P	0.13	
23 Blake Lake 15-16 cm HCl-P	0.12	
24 Blake Lake 18-19 cm HCl-P	0.12	
25 Blake Lake 20-21 cm HCl-P	0.12	
26 Blake Lake 22-23 cm HCl-P	0.13	0.13
27 Blake Lake 24-25 cm HCl-P	0.12	
28 Blake Lake 26-27 cm HCl-P	0.13	
29 Blake Lake 28-29 cm HCl-P	0.17	
31 Blake Lake 30-31 cm HCl-P	0.11	
32 Blake Lake 32-33 cm HCl-P	0.10	
33 Blake Lake 36-37 cm HCl-P	0.10	0.11
34 Blake Lake 38-39 cm HCl-P	0.11	

Loss on Ignition

NOTE: perform LOI starting with deepest sample first, then work your way up the core to prevent sample contamination

Project:	Polk County	**Core:**	Blake Lake 1A**	**Collection:**	Sep-13	**Analysis:**	25-Mar-14	**Analyst:**
	MBE		Blake Lake 1B				3-Apr-14	E. Mittag
Sample ID	**Interval Top**	**Interval Bottom**	**Crucible #**	**Crucible Wt.**	**Wet Wt.**	**Dry Wt.**	**550 °C Wt.**	**1000 °C Wt.**
Blake Lake 1A	0.0	1.0	J-54	4.7136	7.7048	4.8009	4.7648	4.7611
Blake Lake 1A	1.0	2.0	J-52	4.9470	8.0229	5.0519	5.0092	5.0044
Blake Lake 1A	2.0	3.0	J-51	4.7555	7.7065	4.8654	4.8215	4.8157
Blake Lake 1A	3.0	4.0	J-48	4.6109	7.6625	4.7265	4.6798	4.6741
Blake Lake 1A	4.0	5.0	J-47	4.7787	7.7108	4.8974	4.8469	4.8422
Blake Lake 1A	5.0	6.0	J-44	4.7551	7.7185	4.8776	4.8255	4.8205
Blake Lake 1A	6.0	7.0	J-42	4.6789	7.6768	4.8128	4.7548	4.7502
Blake Lake 1A	7.0	8.0	J-41	5.0405	8.0750	5.1779	5.1178	5.1143
Blake Lake 1A	8.0	9.0	J-40	4.9132	8.0192	5.0517	4.9896	4.9862
Blake Lake 1A	9.0	10.0	J-39	5.1117	8.1889	5.2550	5.1920	5.1885
Blake Lake 1A	10.0	11.0	J-38	5.4476	8.4442	5.5871	5.5257	5.5222

Blake Lake 1A	11.0	12.0	J-37	4.9481	7.9976	5.0953	5.0294	5.0259
Blake Lake 1A	12.0	13.0	J-33	4.6898	7.7308	4.8311	4.7670	4.7637
Blake Lake 1A	13.0	14.0	J-32	5.2260	8.2856	5.3738	5.3103	5.3066
Blake Lake 1A	14.0	15.0	J-31	4.7909	7.7088	4.9411	4.8789	4.8751
Blake Lake 1A	15.0	16.0	J-30	4.8975	7.8849	5.0527	4.9905	4.9865
Blake Lake 1A	16.0	17.0	J-29	5.0841	8.0633	5.2465	5.1823	5.1780
Blake Lake 1A	17.0	18.0	J-25	5.3197	8.3695	5.4899	5.4243	5.4197
Blake Lake 1A	18.0	19.0	J-24	4.4116	7.4483	4.5855	4.5193	4.5145
Blake Lake 1A	19.0	20.0	J-22	5.0919	8.0854	5.2605	5.1963	5.1917
Blake Lake 1A	20.0	21.0	J-20	5.2462	8.2754	5.4184	5.3529	5.3481
Blake Lake 1A	21.0	22.0	J-19	5.1120	8.1591	5.2901	5.2227	5.2176
Blake Lake 1A	22.0	23.0	J-18	4.8268	7.7119	4.9970	4.9325	4.9279
Blake Lake 1A	23.0	24.0	J-17	4.7822	7.7319	4.9530	4.8877	4.8830
Blake Lake 1A	24.0	25.0	J-15	4.4877	7.4792	4.6646	4.5966	4.5922
Blake Lake 1A	25.0	26.0	J-14	4.5932	7.5065	4.7654	4.6984	4.6942
Blake Lake 1A	26.0	27.0	J-13	4.7927	7.7868	4.9668	4.8980	4.8938
Blake Lake 1A	27.0	28.0	J-5	4.8564	7.8067	5.0234	4.9554	4.9511
Blake Lake 1A	28.0	29.0	S-36	4.9589	7.9997	5.1286	5.0580	5.0531
Blake Lake 1A	29.0	30.0	S-35	4.6747	7.6412	4.8384	4.7687	4.7637
Blake Lake 1A	30.0	31.0	S-34	5.2051	8.2079	5.3697	5.2984	5.2938
Blake Lake 1A	31.0	32.0	S-29	4.8526	7.8019	5.0081	4.9386	4.9344
Blake Lake 1A	32.0	33.0	S-26	5.1389	8.1274	5.2926	5.2208	5.2164
Blake Lake 1A	33.0	34.0	S-25	4.9443	7.9798	5.0940	5.0207	5.0164
Blake Lake 1A	34.0	35.0	S-24	4.9494	7.9313	5.0913	5.0190	5.0149
Blake Lake 1A	35.0	36.0	S-23	5.0792	8.0265	5.2120	5.1406	5.1373
Blake Lake 1A	36.0	37.0	S-21	4.6429	7.6725	4.7768	4.7042	4.7004
Blake Lake 1A	37.0	38.0	S-20	4.9967	7.9396	5.1272	5.0579	5.0540
Blake Lake 1A	38.0	39.0	S-17	4.9566	7.9827	5.0894	5.0185	5.0143
Blake Lake 1A	39.0	40.0	S-16	5.0162	8.0097	5.1482	5.0782	5.0744
Blake Lake 1A	40.0	41.0	S-13	5.1001	8.1485	5.2329	5.1614	5.1574
Blake Lake 1A	41.0	42.0	S-12	5.1588	8.1543	5.2885	5.2182	5.2144
Blake Lake 1A	42.0	43.0	S-11	5.1106	8.1251	5.2450	5.1717	5.1681
Blake Lake 1A	43.0	44.0	S-7	5.0386	7.9983	5.1680	5.0969	5.0934
Blake Lake 1A	44.0	45.0	S-5	4.8530	7.8725	4.9905	4.9152	4.9116
Blake Lake 1A	46.0	47.0	S-34	5.2051	8.2765	5.3767	5.2815	5.2767
Blake Lake 1A	48.0	49.0	S-29	4.8527	7.9009	5.0196	4.9275	4.9226
Blake Lake 1A	50.0	51.0	Z-52	4.6798	7.6408	4.8427	4.7535	4.7492
Blake Lake 1A	52.0	53.0	S-26	5.1389	8.1716	5.3002	5.2149	5.2103
Blake Lake 1A	54.0	55.0	S-25	4.9444	7.9169	5.1081	5.0227	5.0181
Blake Lake 1A	56.0	57.0	Z-29	5.3850	8.2815	5.5437	5.4581	5.4542
Blake Lake 1A	58.0	59.0	S-24	4.9495	7.9046	5.1158	5.0294	5.0253
Blake Lake 1A	60.0	61.0	S-23	5.0790	8.0071	5.2490	5.1624	5.1580
Blake Lake 1A	62.0	63.0	Z-37	4.8189	7.8538	5.0078	4.9146	4.9100
Blake Lake 1A	64.0	65.0	S-21	4.6429	7.6384	4.8275	4.7390	4.7343
Blake Lake 1A	66.0	67.0	S-20	4.9966	7.9651	5.1826	5.0943	5.0895
Blake Lake 1A	68.0	69.0	Z-27	4.9684	7.9441	5.1591	5.0661	5.0612
Blake Lake 1A	70.0	71.0	S-16	5.0164	8.0806	5.2091	5.1158	5.1108
Blake Lake 1A	72.0	73.0	S-13	5.1001	8.1430	5.2895	5.1982	5.1934
Blake Lake 1A	74.0	75.0	Z-26	4.8084	7.8514	5.0025	4.9092	4.9044
Blake Lake 1A	76.0	77.0	S-12	5.1589	8.2109	5.3630	5.2695	5.2646

Blake Lake 1A	78.0	79.0	S-7	5.0387	8.0460	5.2378	5.1476	5.1425
Blake Lake 1A	80.0	81.0	Z-39	4.6828	7.6358	4.8679	4.7825	4.7774
Blake Lake 1A	82.0	83.0	S-5	4.8530	7.8650	5.0490	4.9633	4.9584
Blake Lake 1A	84.0	85.0	Z-55	4.8741	7.8325	5.0712	4.9856	4.9806
Blake Lake 1A	86.0	87.0	Z-59	4.7860	7.7288	4.9901	4.9009	4.8960
Blake Lake 1A	88.0	89.0	Z-24	4.8646	7.8962	5.0658	4.9771	4.9721
Blake Lake 1A	90.0	91.0	Z-47	5.2157	8.2468	5.4250	5.3327	5.3275
Blake Lake 1A	92.0	93.0	Z-44	4.9861	7.9505	5.2050	5.1146	5.1088
Blake Lake 1A	94.0	95.0	Z-10	4.9096	7.9547	5.1431	5.0508	5.0444
Blake Lake 1A	96.0	97.0	Z-43	4.9438	7.9804	5.1770	5.0846	5.0784
Blake Lake 1A	98.0	99.0	Z-34	4.9366	7.9912	5.1616	5.0648	5.0592
Blake Lake 1A	100.0	101.0	Z-60	4.9902	7.9320	5.2148	5.1228	5.1169
Blake Lake 1A	102.0	103.0	Z-9	4.6881	7.7483	4.9322	4.8359	4.8297
Blake Lake 1A	104.0	105.0	Z-51	5.0863	8.0602	5.3239	5.2292	5.2231
Blake Lake 1A	106.0	107.0	Z-11	4.9071	7.9330	5.1297	5.0375	5.0323
Blake Lake 1A	108.0	109.0	Z-38	4.9131	7.9457	5.1384	5.0463	5.0405
Blake Lake 1A	110.0	111.0	Z-6	5.0461	8.0197	5.2729	5.1820	5.1762
Blake Lake 1A	112.0	113.0	Z-16	4.6458	7.6271	4.8712	4.7813	4.7754
Blake Lake 1A	114.0	115.0	Z-8	4.7436	7.7185	4.9638	4.8745	4.8685
Blake Lake 1A	116.0	117.0	Z-56	4.7358	7.7388	4.9464	4.8555	4.8495
Blake Lake 1A	118.0	119.0	Z-49	4.8541	7.8241	5.0638	4.9729	4.9668
Blake Lake 1A	120.0	121.0	Z-53	4.8660	7.7489	5.0584	4.9686	4.9638
Blake Lake 1A	122.0	123.0	Z-21	5.0237	8.0362	5.2249	5.1332	5.1284
Blake Lake 1A	124.0	125.0	Z-23	4.9936	7.9917	5.1936	5.1038	5.0987
Blake Lake 1A	126.0	127.0	Z-57	4.8729	7.8889	5.0843	4.9928	4.9872
Blake Lake 1A	128.0	129.0	Z-4	4.6124	7.5957	4.8148	4.7234	4.7181
Blake Lake 1A	130.0	131.0	Z-42	4.8919	7.7758	5.0854	4.9992	4.9940
Blake Lake 1A	132.0	133.0	B-44	4.8007	7.8049	5.0009	4.9097	4.9045
Blake Lake 1A	134.0	135.0	B-52	4.6251	7.5928	4.8326	4.7424	4.7368
Blake Lake 1A	136.0	137.0	B-36	4.5418	7.5242	4.7473	4.6582	4.6528
Blake Lake 1A	138.0	139.0	B-53	5.4701	8.4113	5.6742	5.5858	5.5804
Blake Lake 1A	140.0	141.0	B-43	5.3801	8.2951	5.5780	5.4868	5.4815
Blake Lake 1A	142.0	143.0	B-15	5.3245	8.2453	5.5304	5.4389	5.4336
Blake Lake 1A	144.0	145.0	B-26	4.7378	7.6670	4.9559	4.8646	4.8589
Blake Lake 1A	146.0	147.0	B-17	5.5182	8.4741	5.7412	5.6471	5.6412
Blake Lake 1A	148.0	149.0	B-11	5.0749	7.9484	5.3038	5.2125	5.2067
Blake Lake 1A	150.0	151.0	B-33	5.0259	8.0486	5.2695	5.1687	5.1628
Blake Lake 1A	152.0	153.0	B-5	4.8944	7.8585	5.1414	5.0384	5.0319
Blake Lake 1B	1.0	2.0	B-53	5.4697	8.5233	5.5736	5.5338	5.5265
Blake Lake 1B	3.0	4.0	B-50	5.3828	8.3420	5.4932	5.4504	5.4436
Blake Lake 1B	5.0	6.0	B-48	5.3359	8.3911	5.4527	5.4032	5.3996
Blake Lake 1B	7.0	8.0	B-44	4.8000	7.8795	4.9395	4.8796	4.8746
Blake Lake 1B	9.0	10.0	B-43	5.3803	8.3482	5.5223	5.4633	5.4575
Blake Lake 1B	11.0	12.0	B-41	4.9919	7.9732	5.1350	5.0747	5.0710
Blake Lake 1B	13.0	14.0	B-36	4.5412	7.5066	4.6881	4.6259	4.6223
Blake Lake 1B	15.0	16.0	B-35	4.9763	7.9756	5.1249	5.0627	5.0591
Blake Lake 1B	17.0	18.0	B-24	4.7888	7.7446	4.9462	4.8848	4.8806
Blake Lake 1B	19.0	20.0	B-33	5.0255	8.0913	5.1945	5.1306	5.1259
Blake Lake 1B	21.0	22.0	B-31	5.6499	8.6976	5.8232	5.7577	5.7530
Blake Lake 1B	23.0	24.0	B-30	5.3380	8.3906	5.5153	5.4485	5.4430

Blake Lake 1B	25.0	26.0	B-28	5.5218	8.5645	5.7010	5.6319	5.6272
Blake Lake 1B	27.0	28.0	B-26	4.7378	7.7571	4.9102	4.8423	4.8378
Blake Lake 1B	29.0	30.0	B-17	5.5180	8.5475	5.6805	5.6098	5.6053
Blake Lake 1B	31.0	32.0	B-16	5.4115	8.4835	5.5596	5.4871	5.4831
Blake Lake 1B	33.0	34.0	B-15	5.3243	8.3185	5.4578	5.3878	5.3842
Blake Lake 1B	35.0	36.0	B-11	5.0746	8.0154	5.2102	5.1409	5.1369
Blake Lake 1B	37.0	38.0	B-9	4.6847	7.6344	4.8151	4.7461	4.7420
Blake Lake 1B	39.0	40.0	B-5	4.8939	7.8904	5.0244	4.9563	4.9523
Blake Lake 1B	41.0	42.0	B-3	5.0986	8.0344	5.2366	5.1689	5.1652
Blake Lake 1B	43.0	44.0	B-2	4.7288	7.7329	4.8576	4.7872	4.7836

** Every other interval of core 1A subsectioned for pigments, starting with interval 1-2 cm. Every other interval of second half of core also subsectioned for pigments (i.e. every interval that is LOI'ed)

** Core extended to reach background. LOI for these intervals started on 4/3/2014

Core	Top	Base	Wt. Cruc.	Wt. Wet	Wt. 100	Wt. 500	Wt. 1000	Volume	Wet (g/cc)	Dry (g/cc)	Dry/ Wet	Org/ Wet	% Organic	% CaCO3	% Inorg.
Blake 1A	0.0	1.0	4.714	7.705	4.801	4.765	4.761	2.949	1.014	0.030	0.029	0.012	41.352	9.638	49.011
Blake 1A	1.0	2.0	4.947	8.023	5.052	5.009	5.004	3.025	1.017	0.035	0.034	0.014	40.705	10.405	48.889
Blake 1A	2.0	3.0	4.756	7.707	4.865	4.822	4.816	2.898	1.018	0.038	0.037	0.015	39.945	12.001	48.054
Blake 1A	3.0	4.0	4.611	7.663	4.727	4.680	4.674	2.996	1.019	0.039	0.038	0.015	40.398	11.213	48.389
Blake 1A	4.0	5.0	4.779	7.711	4.897	4.847	4.842	2.876	1.020	0.041	0.040	0.017	42.544	9.004	48.452
Blake 1A	5.0	6.0	4.755	7.719	4.878	4.826	4.821	2.905	1.020	0.042	0.041	0.018	42.531	9.282	48.188
Blake 1A	6.0	7.0	4.679	7.677	4.813	4.755	4.750	2.934	1.022	0.046	0.045	0.019	43.316	7.812	48.872
Blake 1A	7.0	8.0	5.041	8.075	5.178	5.118	5.114	2.970	1.022	0.046	0.045	0.020	43.741	5.793	50.467
Blake 1A	8.0	9.0	4.913	8.019	5.052	4.990	4.986	3.041	1.021	0.046	0.045	0.020	44.838	5.582	49.580
Blake 1A	9.0	10.0	5.112	8.189	5.255	5.192	5.189	3.010	1.022	0.048	0.047	0.020	43.964	5.554	50.482
Blake 1A	10.0	11.0	5.448	8.444	5.587	5.526	5.522	2.931	1.022	0.048	0.047	0.020	44.014	5.705	50.280
Blake 1A	11.0	12.0	4.948	7.998	5.095	5.029	5.026	2.981	1.023	0.049	0.048	0.022	44.769	5.407	49.824
Blake 1A	12.0	13.0	4.690	7.731	4.831	4.767	4.764	2.975	1.022	0.047	0.046	0.021	45.364	5.311	49.325
Blake 1A	13.0	14.0	5.226	8.286	5.374	5.310	5.307	2.989	1.024	0.049	0.048	0.021	42.963	5.693	51.344
Blake 1A	14.0	15.0	4.791	7.709	4.941	4.879	4.875	2.846	1.025	0.053	0.051	0.021	41.411	5.753	52.835
Blake 1A	15.0	16.0	4.898	7.885	5.053	4.991	4.987	2.912	1.026	0.053	0.052	0.021	40.077	5.861	54.062
Blake 1A	16.0	17.0	5.084	8.063	5.247	5.182	5.178	2.900	1.027	0.056	0.055	0.022	39.532	6.021	54.447
Blake 1A	17.0	18.0	5.320	8.370	5.490	5.424	5.420	2.967	1.028	0.057	0.056	0.022	38.543	6.146	55.311
Blake 1A	18.0	19.0	4.412	7.448	4.586	4.519	4.515	2.951	1.029	0.059	0.057	0.022	38.068	6.277	55.655
Blake 1A	19.0	20.0	5.092	8.085	5.261	5.196	5.192	2.911	1.028	0.058	0.056	0.021	38.078	6.204	55.717
Blake 1A	20.0	21.0	5.246	8.275	5.418	5.353	5.348	2.945	1.029	0.058	0.057	0.022	38.037	6.339	55.624
Blake 1A	21.0	22.0	5.112	8.159	5.290	5.223	5.218	2.960	1.029	0.060	0.058	0.022	37.844	6.512	55.644
Blake 1A	22.0	23.0	4.827	7.712	4.997	4.933	4.928	2.801	1.030	0.061	0.059	0.022	37.897	6.146	55.957
Blake 1A	23.0	24.0	4.782	7.732	4.953	4.888	4.883	2.866	1.029	0.060	0.058	0.022	38.232	6.257	55.511
Blake 1A	24.0	25.0	4.488	7.479	4.665	4.597	4.592	2.905	1.030	0.061	0.059	0.023	38.440	5.656	55.904
Blake 1A	25.0	26.0	4.593	7.507	4.765	4.698	4.694	2.829	1.030	0.061	0.059	0.023	38.908	5.546	55.545
Blake 1A	26.0	27.0	4.793	7.787	4.967	4.898	4.894	2.910	1.029	0.060	0.058	0.023	39.518	5.486	54.997
Blake 1A	27.0	28.0	4.856	7.807	5.023	4.955	4.951	2.870	1.028	0.058	0.057	0.023	40.719	5.855	53.426
Blake 1A	28.0	29.0	4.959	8.000	5.129	5.058	5.053	2.959	1.028	0.057	0.056	0.023	41.603	6.566	51.831
Blake 1A	29.0	30.0	4.675	7.641	4.838	4.769	4.764	2.889	1.027	0.057	0.055	0.023	42.578	6.946	50.476
Blake 1A	30.0	31.0	5.205	8.208	5.370	5.298	5.294	2.925	1.027	0.056	0.055	0.024	43.317	6.355	50.328
Blake 1A	31.0	32.0	4.853	7.802	5.008	4.939	4.934	2.876	1.025	0.054	0.053	0.024	44.695	6.142	49.163
Blake 1A	32.0	33.0	5.139	8.127	5.293	5.221	5.216	2.917	1.025	0.053	0.051	0.024	46.714	6.510	46.776
Blake 1A	33.0	34.0	4.944	7.980	5.094	5.021	5.016	2.967	1.023	0.050	0.049	0.024	48.965	6.532	44.504
Blake 1A	34.0	35.0	4.949	7.931	5.091	5.019	5.015	2.918	1.022	0.049	0.048	0.024	50.951	6.570	42.478
Blake 1A	35.0	36.0	5.079	8.027	5.212	5.141	5.137	2.889	1.020	0.046	0.045	0.024	53.765	5.651	40.584
Blake 1A	36.0	37.0	4.643	7.673	4.777	4.704	4.700	2.971	1.020	0.045	0.044	0.024	54.220	6.453	39.327
Blake 1A	37.0	38.0	4.997	7.940	5.127	5.058	5.054	2.885	1.020	0.045	0.044	0.024	53.103	6.796	40.101
Blake 1A	38.0	39.0	4.957	7.983	5.089	5.019	5.014	2.968	1.020	0.045	0.044	0.023	53.389	7.192	39.420
Blake 1A	39.0	40.0	5.016	8.010	5.148	5.078	5.074	2.935	1.020	0.045	0.044	0.023	53.030	6.546	40.423
Blake 1A	40.0	41.0	5.100	8.149	5.233	5.161	5.157	2.990	1.020	0.044	0.044	0.023	53.840	6.849	39.310

Blake 1A	41.0	42.0	5.159	8.154	5.289	5.218	5.214	2.939	1.019	0.044	0.043	0.023	54.202	6.662	39.136
Blake 1A	42.0	43.0	5.111	8.125	5.245	5.172	5.168	2.956	1.020	0.045	0.045	0.024	54.539	6.091	39.370
Blake 1A	43.0	44.0	5.039	7.998	5.168	5.097	5.093	2.903	1.020	0.045	0.044	0.024	54.946	6.151	38.903
Blake 1A	44.0	45.0	4.853	7.873	4.991	4.915	4.912	2.960	1.020	0.046	0.046	0.025	54.764	5.954	39.283
Blake 1A	46.0	47.0	5.205	8.277	5.377	5.282	5.277	2.997	1.025	0.057	0.056	0.031	55.478	6.361	38.161
Blake 1A	48.0	49.0	4.853	7.901	5.020	4.928	4.923	2.976	1.024	0.056	0.055	0.030	55.183	6.676	38.141
Blake 1A	50.0	51.0	4.680	7.641	4.843	4.754	4.749	2.890	1.025	0.056	0.055	0.030	54.758	6.003	39.240
Blake 1A	52.0	53.0	5.139	8.172	5.300	5.215	5.210	2.961	1.024	0.054	0.053	0.028	52.883	6.485	40.632
Blake 1A	54.0	55.0	4.944	7.917	5.108	5.023	5.018	2.900	1.025	0.056	0.055	0.029	52.169	6.390	41.441
Blake 1A	56.0	57.0	5.385	8.282	5.544	5.458	5.454	2.827	1.025	0.056	0.055	0.030	53.938	5.588	40.473
Blake 1A	58.0	59.0	4.950	7.905	5.116	5.029	5.025	2.881	1.026	0.058	0.056	0.029	51.954	5.606	42.439
Blake 1A	60.0	61.0	5.079	8.007	5.249	5.162	5.158	2.852	1.027	0.060	0.058	0.030	50.941	5.886	43.173
Blake 1A	62.0	63.0	4.819	7.854	5.008	4.915	4.910	2.949	1.029	0.064	0.062	0.031	49.338	5.538	45.124
Blake 1A	64.0	65.0	4.643	7.638	4.828	4.739	4.734	2.911	1.029	0.063	0.062	0.030	47.941	5.790	46.269
Blake 1A	66.0	67.0	4.997	7.965	5.183	5.094	5.090	2.883	1.030	0.065	0.063	0.030	47.473	5.868	46.658
Blake 1A	68.0	69.0	4.968	7.944	5.159	5.066	5.061	2.889	1.030	0.066	0.064	0.031	48.768	5.843	45.389
Blake 1A	70.0	71.0	5.016	8.081	5.209	5.116	5.111	2.976	1.030	0.065	0.063	0.030	48.417	5.900	45.682
Blake 1A	72.0	73.0	5.100	8.143	5.290	5.198	5.193	2.956	1.029	0.064	0.062	0.030	48.205	5.763	46.032
Blake 1A	74.0	75.0	4.808	7.851	5.003	4.909	4.904	2.954	1.030	0.066	0.064	0.031	48.068	5.623	46.309
Blake 1A	76.0	77.0	5.159	8.211	5.363	5.270	5.265	2.957	1.032	0.069	0.067	0.031	45.811	5.459	48.730
Blake 1A	78.0	79.0	5.039	8.046	5.238	5.148	5.143	2.914	1.032	0.068	0.066	0.030	45.304	5.825	48.871
Blake 1A	80.0	81.0	4.683	7.636	4.868	4.783	4.777	2.867	1.030	0.065	0.063	0.029	46.137	6.265	47.597
Blake 1A	82.0	83.0	4.853	7.865	5.049	4.963	4.958	2.919	1.032	0.067	0.065	0.028	43.724	5.685	50.591
Blake 1A	84.0	85.0	4.874	7.833	5.071	4.986	4.981	2.865	1.033	0.069	0.067	0.029	43.430	5.769	50.802
Blake 1A	86.0	87.0	4.786	7.729	4.990	4.901	4.896	2.846	1.034	0.072	0.069	0.030	43.704	5.459	50.837
Blake 1A	88.0	89.0	4.865	7.896	5.066	4.977	4.972	2.937	1.032	0.069	0.066	0.029	44.085	5.651	50.263
Blake 1A	90.0	91.0	5.216	8.247	5.425	5.333	5.328	2.933	1.033	0.071	0.069	0.030	44.099	5.650	50.251
Blake 1A	92.0	93.0	4.986	7.951	5.205	5.115	5.109	2.859	1.037	0.077	0.074	0.030	41.297	6.025	52.677
Blake 1A	94.0	95.0	4.910	7.955	5.143	5.051	5.044	2.932	1.039	0.080	0.077	0.030	39.529	6.233	54.238
Blake 1A	96.0	97.0	4.944	7.980	5.177	5.085	5.078	2.923	1.039	0.080	0.077	0.030	39.623	6.046	54.332
Blake 1A	98.0	99.0	4.937	7.991	5.162	5.065	5.059	2.948	1.036	0.076	0.074	0.032	43.022	5.660	51.318
Blake 1A	100.0	101.0	4.990	7.932	5.215	5.123	5.117	2.834	1.038	0.079	0.076	0.031	40.962	5.974	53.065
Blake 1A	102.0	103.0	4.688	7.748	4.932	4.836	4.830	2.942	1.040	0.083	0.080	0.031	39.451	5.776	54.773
Blake 1A	104.0	105.0	5.086	8.060	5.324	5.229	5.223	2.859	1.040	0.083	0.080	0.032	39.857	5.838	54.305
Blake 1A	106.0	107.0	4.907	7.933	5.130	5.038	5.032	2.919	1.037	0.076	0.074	0.030	41.420	5.312	53.268
Blake 1A	108.0	109.0	4.913	7.946	5.138	5.046	5.041	2.924	1.037	0.077	0.074	0.030	40.879	5.854	53.267
Blake 1A	110.0	111.0	5.046	8.020	5.273	5.182	5.176	2.864	1.038	0.079	0.076	0.031	40.079	5.815	54.105
Blake 1A	112.0	113.0	4.646	7.627	4.871	4.781	4.775	2.872	1.038	0.078	0.076	0.030	39.885	5.952	54.163
Blake 1A	114.0	115.0	4.744	7.719	4.964	4.875	4.869	2.869	1.037	0.077	0.074	0.030	40.554	6.196	53.250
Blake 1A	116.0	117.0	4.736	7.739	4.946	4.856	4.850	2.903	1.034	0.073	0.070	0.030	43.162	6.479	50.359
Blake 1A	118.0	119.0	4.854	7.824	5.064	4.973	4.967	2.871	1.034	0.073	0.071	0.031	43.348	6.615	50.037
Blake 1A	120.0	121.0	4.866	7.749	5.058	4.969	4.964	2.794	1.032	0.069	0.067	0.031	46.674	5.673	47.653
Blake 1A	122.0	123.0	5.024	8.036	5.225	5.133	5.128	2.919	1.032	0.069	0.067	0.030	45.577	5.425	48.998
Blake 1A	124.0	125.0	4.994	7.992	5.194	5.104	5.099	2.904	1.032	0.069	0.067	0.030	44.900	5.799	49.301
Blake 1A	126.0	127.0	4.873	7.889	5.084	4.993	4.987	2.916	1.034	0.072	0.070	0.030	43.283	6.024	50.693
Blake 1A	128.0	129.0	4.612	7.596	4.815	4.723	4.718	2.889	1.033	0.070	0.068	0.031	45.158	5.955	48.887
Blake 1A	130.0	131.0	4.892	7.776	5.085	4.999	4.994	2.793	1.033	0.069	0.067	0.030	44.548	6.111	49.341
Blake 1A	132.0	133.0	4.801	7.805	5.001	4.910	4.905	2.911	1.032	0.069	0.067	0.030	45.554	5.906	48.539
Blake 1A	134.0	135.0	4.625	7.593	4.833	4.742	4.737	2.870	1.034	0.072	0.070	0.030	43.470	6.137	50.393
Blake 1A	136.0	137.0	4.542	7.524	4.747	4.658	4.653	2.885	1.034	0.071	0.069	0.030	43.358	5.975	50.667
Blake 1A	138.0	139.0	5.470	8.411	5.674	5.586	5.580	2.845	1.034	0.072	0.069	0.030	43.312	6.016	50.671
Blake 1A	140.0	141.0	5.380	8.295	5.578	5.487	5.482	2.823	1.033	0.070	0.068	0.031	46.084	6.090	47.826
Blake 1A	142.0	143.0	5.325	8.245	5.530	5.439	5.434	2.824	1.034	0.073	0.070	0.031	44.439	5.853	49.708
Blake 1A	144.0	145.0	4.738	7.667	4.956	4.865	4.859	2.825	1.037	0.077	0.074	0.031	41.862	5.943	52.195
Blake 1A	146.0	147.0	5.518	8.474	5.741	5.647	5.641	2.850	1.037	0.078	0.075	0.032	42.197	6.016	51.786
Blake 1A	148.0	149.0	5.075	7.948	5.304	5.213	5.207	2.763	1.040	0.083	0.080	0.032	39.886	5.762	54.352
Blake 1A	150.0	151.0	5.026	8.049	5.270	5.169	5.163	2.906	1.040	0.084	0.081	0.033	41.379	5.508	53.113
Blake 1A	152.0	153.0	4.894	7.859	5.141	5.038	5.032	2.846	1.041	0.087	0.083	0.035	41.700	5.984	52.315
Blake 1B	1.0	2.0	5.4697	8.5233	5.5736	5.5338	5.5265	3.003	1.0168	0.0346	0.0340	0.0130	38.31	15.98	45.72

Blake 1B	3.0	4.0	5.3828	8.3420	5.4932	5.4504	5.4436	2.905	1.0187	0.0380	0.0373	0.0145	38.77	14.01	47.23
Blake 1B	5.0	6.0	5.3359	8.3911	5.4527	5.4032	5.3996	3.000	1.0184	0.0389	0.0382	0.0162	42.38	7.01	50.61
Blake 1B	7.0	8.0	4.8000	7.8795	4.9395	4.8796	4.8746	3.013	1.0221	0.0463	0.0453	0.0195	42.94	8.15	48.91
Blake 1B	9.0	10.0	5.3803	8.3482	5.5223	5.4633	5.4575	2.900	1.0234	0.0490	0.0478	0.0199	41.55	9.29	49.16
Blake 1B	11.0	12.0	4.9919	7.9732	5.1350	5.0747	5.0710	2.913	1.0234	0.0491	0.0480	0.0202	42.14	5.88	51.98
Blake 1B	13.0	14.0	4.5412	7.5066	4.6881	4.6259	4.6223	2.895	1.0243	0.0507	0.0495	0.0210	42.34	5.57	52.09
Blake 1B	15.0	16.0	4.9763	7.9756	5.1249	5.0627	5.0591	2.928	1.0244	0.0508	0.0495	0.0207	41.86	5.51	52.63
Blake 1B	17.0	18.0	4.7888	7.7446	4.9462	4.8848	4.8806	2.879	1.0267	0.0547	0.0533	0.0208	39.01	6.07	54.92
Blake 1B	19.0	20.0	5.0255	8.0913	5.1945	5.1306	5.1259	2.983	1.0278	0.0567	0.0551	0.0208	37.81	6.32	55.87
Blake 1B	21.0	22.0	5.6499	8.6976	5.8232	5.7577	5.7530	2.962	1.0289	0.0585	0.0569	0.0215	37.80	6.17	56.04
Blake 1B	23.0	24.0	5.3380	8.3906	5.5153	5.4485	5.4430	2.965	1.0295	0.0598	0.0581	0.0219	37.68	7.05	55.27
Blake 1B	25.0	26.0	5.5218	8.5645	5.7010	5.6319	5.6272	2.955	1.0297	0.0606	0.0589	0.0227	38.56	5.96	55.48
Blake 1B	27.0	28.0	4.7378	7.7571	4.9102	4.8423	4.8378	2.935	1.0287	0.0587	0.0571	0.0225	39.39	5.94	54.68
Blake 1B	29.0	30.0	5.5180	8.5475	5.6805	5.6098	5.6053	2.953	1.0259	0.0550	0.0536	0.0233	43.51	6.30	50.20
Blake 1B	31.0	32.0	5.4115	8.4835	5.5596	5.4871	5.4831	3.005	1.0223	0.0493	0.0482	0.0236	48.95	6.14	44.90
Blake 1B	33.0	34.0	5.3243	8.3185	5.4578	5.3878	5.3842	2.935	1.0202	0.0455	0.0446	0.0234	52.43	6.13	41.43
Blake 1B	35.0	36.0	5.0746	8.0154	5.2102	5.1409	5.1369	2.880	1.0211	0.0471	0.0461	0.0236	51.11	6.71	42.19
Blake 1B	37.0	38.0	4.6847	7.6344	4.8151	4.7461	4.7420	2.892	1.0200	0.0451	0.0442	0.0234	52.91	7.15	39.94
Blake 1B	39.0	40.0	4.8939	7.8904	5.0244	4.9563	4.9523	2.939	1.0196	0.0444	0.0436	0.0227	52.18	6.97	40.85
Blake 1B	41.0	42.0	5.0986	8.0344	5.2366	5.1689	5.1652	2.873	1.0219	0.0480	0.0470	0.0231	49.06	6.10	44.85
Blake 1B	43.0	44.0	4.7288	7.7329	4.8576	4.7872	4.7836	2.948	1.0190	0.0437	0.0429	0.0234	54.66	6.36	38.99

Blake SiO2

Blue = no consistent increase in concentration

Sample ID	mg/g SiO2	mg/g SiO2	mg/g SiO2
	3 hour	4 hour	5 hour
Blake Lake 1A 1 cm	99.09	99.65	101.35
Blake Lake 1A 7 cm	89.91	92.29	94.30
Blake Lake 1A 10 cm	93.27	95.28	96.35
Blake Lake 1A 13 cm	116.23	118.17	119.82
Blake Lake 1A 16 cm	131.21	140.97	140.85
Blake Lake 1A 19 cm	133.50	141.50	142.50
Blake Lake 1A 21 cm	127.82	133.27	132.29
Blake Lake 1A 23 cm	114.55	117.63	121.05
Blake Lake 1A 25 cm	106.83	109.85	111.21
Blake Lake 1A 27 cm	115.05	119.39	121.19
Blake Lake 1A 29 cm	130.91	133.19	136.68
Blake Lake 1A 31 cm	126.67	130.39	132.32
Blake Lake 1A 33 cm	138.38	141.57	141.76
Blake Lake 1A 37 cm	124.18	126.04	128.21
Blake Lake 1A 39 cm	129.64	131.11	132.34

Conc Method				mg/g SiO2	Depth		g/cm2 yr	g/cm2 yr		wt % BSi	mg/cm2 yr
(1)-slope, (0)-mean	slope	int	ave	conc	0.00	Date	sed rate	flux SiO2	Adj depth	wt % BSi	flux SiO2
1.00	1.129723	95.50967	100.03	95.51	1	2012.6	0.0271	0.0026		9.5510	2.5883
1.00	2.194486	83.38963	92.17	83.39	7	2003.0	0.0203	0.0017		8.3390	1.6928
1.00	1.539541	88.81138	94.97	88.81	10	1995.3	0.0174	0.0015		8.8811	1.5453
1.00	1.795961	110.8926	118.08	110.89	13	1986.7	0.0159	0.0018		11.0893	1.7632
0.00	4.819435	118.3968	137.67	137.67	16	1976.0	0.0137	0.0019		13.7675	1.8861

1.00	4.502345	121.1578	139.17	121.16	19	1963.4	0.0133	0.0016		12.1158	1.6114
0.00	2.237543	122.1749	131.13	131.13	21	1954.3	0.0128	0.0017		13.1125	1.6784
1.00	3.249714	104.742	117.74	104.74	23	1944.6	0.0123	0.0013		10.4742	1.2883
1.00	2.191588	100.5315	109.30	100.53	25	1933.8	0.0110	0.0011		10.0532	1.1058
1.00	3.066938	106.2773	118.55	106.28	27	1922.5	0.0105	0.0011		10.6277	1.1159
1.00	2.885729	122.0546	133.60	122.05	29	1910.7	0.0097	0.0012		12.2055	1.1839
1.00	2.823704	118.4994	129.79	118.50	31	1897.5	0.0081	0.0010		11.8499	0.9598
1.00	1.689403	133.8121	140.57	133.81	33	1882.3	0.0067	0.0009		13.3812	0.8965
1.00	2.015708	118.0819	126.14	118.08	37	1852.5	0.0080	0.0009		11.8082	0.9447
1.00	1.345813	125.648	131.03	125.65	39	1838.1	0.0057	0.0007		12.5648	0.7162
										g/100g sed	

Blake Isotopes

Sample	$d^{15}N_{AIR}$	$d^{13}C_{VPDB}$	mgN	mgC	%N	%C	C/N
BL2009	1.0	-27.9	236.68	1960.28	2.55	21.13	9.7
BL2003	1.0	-28.6	230.84	1862.27	2.75	22.15	9.4
BL1995	0.9	-29.2	231.26	1845.85	2.85	22.72	9.3
BL1987	0.7	-28.9	264.97	2142.73	2.74	22.12	9.4
BL1976	0.5	-28.7	228.16	1831.74	2.58	20.72	9.4
BL1963	0.4	-29.1	228.33	1828.88	2.61	20.89	9.3
BL1954	0.5	-29.6	220.84	1758.54	2.48	19.75	9.3
BL1945	0.8	-29.3	219.59	1782.76	2.44	19.82	9.5
BL1934	2.0	-29.3	222.68	1813.73	2.46	20.08	9.5
BL1923	-0.5	-28.3	229.58	1906.88	2.41	20.01	9.7
BL1911	-0.6	-28.5	211.69	1753.87	2.44	20.24	9.7
BL1898	-0.7	-28.7	237.83	1995.70	2.65	22.27	9.8
BL1882	-0.8	-29.3	219.72	1859.64	2.65	22.40	9.9
BL1866	-0.8	-29.1	243.54	2080.46	2.90	24.77	10.0
BL1853	-0.8	-29.3	245.61	2103.34	2.97	25.41	10.0
BL1838	-1.1	-28.8	306.54	2636.81	3.22	27.71	10.0
BL1815	-1.1	-28.8	303.54	2611.37	3.36	28.87	10.0

Pigment Concentrations

Pigment Concentration Calculation

Section Depth (cm)	Fuco	Sed_A	Sed_B	Sed_C	Aphan	Sudan	Myxo	Allo	Diato	Lut_Zea
3--4	31.05304689	0	0	0	31.0671932	2033.642	0	165.2800014	145.0380153	346.3910559
7--8	16.23168075	0	0	0	15.95638466	2279.2495	0	150.825612	109.0869187	305.9735523
9--10	14.93172187	0	0	0	20.86694268	2188.342	0	152.3186126	125.5025163	298.3519497
13-14	14.79421133	0	0	0	0	2503.256	0	140.5416088	128.8175258	334.7567215
15-16	8.576819604	0	0	0	0	1990.8615	0	107.7368038	108.4051535	267.7994922
19-20	9.785285356	0	0	0	0	1765.331	0	74.24860318	92.19123306	165.257122
21-22	7.713588821	0	0	0	0	1931.0385	0	64.64289253	75.26281473	119.5296858
23-24	7.653929162	0	0	0	0	1877.7605	0	73.68978982	95.85646179	168.0574846
25-26	6.749317382	0	0	0	0	2258.229	0	71.23994882	96.26756804	165.2329143

27-28	6.639704746	0	0	0	0	1866.0985	0	58.10296324	81.80850198	140.6015416
29-30	6.239291583	0	0	0	0	1938.6375	0	58.01942953	86.710069	153.1762884
31-32	6.898390742	0	0	0	0	2349.456	0	68.62846661	97.56205971	170.2668582
33-34	5.465112021	0	0	0	0	2418.328	0	66.74730412	102.6774829	187.4170604
37-38	7.105396212	0	0	0	0	2507.8765	0	79.02034796	110.0501576	277.1742728
39-40	5.487616739	0	0	0	0	2506.572	0	75.64882819	112.9473764	291.3088454

Section Depth (cm)	Cantha	Chl_b	Chl_a	Chl_ap	Echine	Phaeo_B	Pheo_A	B-car
3--4	101.8612939	86.8640816	193.6905125	58.58793327	133.1891678	255.4396553	503.4950594	234.8576189
7--8	93.10083593	85.88730042	146.6324351	65.65988627	89.12257651	302.3738112	399.0457666	161.3827107
9--10	98.31300553	79.15388796	122.441363	77.37080592	69.59611006	354.0516822	359.9081981	173.1601279
13-14	86.66311399	62.14422556	104.800885	56.2767122	66.68149547	393.0385042	321.6619958	149.5933369
15-16	66.17696647	40.1859009	70.81229185	51.2343688	60.23659518	295.3423489	276.6241978	126.5623428
19-20	55.28773154	25.50968018	49.59990873	48.76496941	29.50491039	190.3890077	196.8961091	77.65956031
21-22	40.62700188	0	34.65839533	35.8544822	24.90395851	156.2175323	175.0488962	63.59606489
23-24	48.78952408	0	43.54428829	52.64894407	32.39957365	210.4559294	208.5989589	85.44994708
25-26	48.86675133	0	41.12949395	50.11976977	22.47298516	198.4478955	195.4768151	69.78222721
27-28	37.93632252	0	41.43544861	46.49472402	18.06183909	201.2163641	196.9350825	63.65618219
29-30	34.14198586	0	39.19820728	43.83912933	12.04124915	144.5142112	164.7173782	44.21560043
31-32	40.70779296	0	47.71767378	48.38472006	9.9627709	182.4068577	210.6088148	53.76543482
33-34	36.67238291	0	44.4178075	48.59760953	13.71828112	151.2010145	208.4274376	56.81158176
37-38	37.1481098	0	45.9015381	48.29368851	11.81837933	119.1250108	148.8755486	40.86214023
39-40	33.15764724	0	44.2585933	50.74563444	11.55359655	114.6740602	184.6214742	56.80870491

Blake Final Dating

Detector	209Po (dpm)	210Po (dpm)	Bkg Date	% Efficiency	Eff Date
1	0.0025	0.0004	2/4/2014	16.9	2/10/2014
2	0.0022	0.0002	1/8/2014	17.1	1/13/2014
3	0.0057	0.0003	1/8/2014	16.7	1/13/2014
4	0.0009	0.0003	1/8/2014	17.1	1/13/2014
5	0.0022	0.0003	1/8/2014	17.6	1/16/2014
6	0.0007	0.0004	1/8/2014	17.5	1/16/2014
7	0.0026	0.0001	1/8/2014	17.4	1/16/2014
8	0.0042	0.0002	1/8/2014	17.2	1/16/2014
9	0.0011	0.0003	12/29/2013	17.1	1/2/2014
10	0.0049	0.0005	12/29/2013	16.3	1/2/2014
11	0.0022	0.0003	12/29/2013	16.9	1/2/2014
12	0.0012	0.0003	12/29/2013	17.3	1/2/2014
13	0.0041	0.0003	12/29/2013	17.4	1/2/2014
14	0.0059	0.0002	12/29/2013	17.5	1/3/2014
15	0.0028	0.0002	12/29/2013	15.0	1/3/2014
16	0.0025	0.0002	12/29/2013	17.4	1/3/2014
17	0.0005	0.0001	12/29/2013	17.2	1/3/2014
18	0.0002	0.0002	12/29/2013	17.6	1/3/2014
19	0.0005	0.0003	12/29/2013	17.3	1/3/2014
20	0.0005	0.0002	12/29/2013	16.9	1/3/2014
21	0.0005	0.0001	12/29/2013	16.7	1/13/2014
22	0.0003	0.0004	2/14/2014	16.2	2/17/2014
23	0.0006	0.0002	12/29/2013	17.1	1/13/2014
24	0.0007	0.0003	12/29/2013	17.0	1/13/2014

Top of Interval (cm)	Base of Interval (cm)	Cum. Dry Mass (g/cm2)	Unsup. Activity (pCi/g)	Error of Unsup. Act. (±s.d.)	Cum. Act. below Int. (pCi/cm2)	Age: Base of Int. (yr)	Error of Age (±s.d.)	Date A.D.	Sediment Accum. (g/cm2 yr)	Error of Sed. Accum. (±s.d.)
0	1	0.0296	20.0457	0.7845	17.1822	1.09	0.95	2012.6	0.0271	0.00119
3	4	0.1364	17.4268	0.6574	15.2353	4.95	0.99	2008.7	0.0278	0.00120
6	7	0.2662	20.1816	0.7332	12.7348	10.71	1.06	2003.0	0.0203	0.00087
9	10	0.4070	18.7028	0.6766	10.0328	18.37	1.20	1995.3	0.0174	0.00080
12	13	0.5496	15.6833	0.5364	7.6589	27.04	1.33	1986.7	0.0159	0.00076
15	16	0.7037	13.2561	0.4966	5.4990	37.68	1.57	1976.0	0.0137	0.00075
18	19	0.8748	9.2778	0.3524	3.7070	50.34	1.11	1963.4	0.0133	0.00059
20	21	0.9920	7.3179	0.3012	2.7952	59.41	1.16	1954.3	0.0128	0.00061
22	23	1.1124	5.6695	0.2491	2.0665	69.11	1.20	1944.6	0.0123	0.00061
24	25	1.2341	4.5804	0.1613	1.4775	79.88	1.35	1933.8	0.0110	0.00051
26	27	1.3543	3.3771	0.1172	1.0378	91.22	1.41	1922.5	0.0105	0.00050
28	29	1.4703	2.5410	0.1025	0.7202	102.96	1.53	1910.7	0.0097	0.00052
30	31	1.5834	2.0331	0.0903	0.4765	116.22	1.92	1897.5	0.0081	0.00052
32	33	1.6906	1.5572	0.0635	0.2973	131.37	2.58	1882.3	0.0067	0.00052
34	35	1.7899	1.1132	0.0435	0.1763	148.15	3.72	1865.5	0.0057	0.00060
36	37	1.8818	0.5042	0.0307	0.1175	161.18	4.04	1852.5	0.0080	0.00102
38	39	1.9714	0.4655	0.0333	0.0749	175.64	6.23	1838.1	0.0057	0.00104
41	42	2.1044	0.2113	0.0255	0.0365	198.72	8.01	1815.0	0.0061	0.00151
44	45	2.2415	0.0967	0.0226	0.0183	220.90	12.62	1792.8	0.0066	0.00270
Supported Pb-210: 0.438 ± 0.0144 pCi/g							Cum. Unsup. Pb-210: 17.7756 pCi/cm2			
Number of Supported Samples: 5							Unsup. Pb-210 Flux: 0.5736 pCi/cm2 yr			

Diatom Data

			slide		
Nr	P(1) or B (0)	Code		# > 1%	max abund
7	1		Aulacoseira ambigua	15	0.170
8	1		Aulacoseira granulata	15	0.278
37	1		Fragilaria crotonensis	8	0.090
93			Staurosira construens	15	0.418
98			Staurosira venter	15	0.198
103			Staurosirella pinnata	15	0.135
			% planktonic		

Blake-10001a	Blake-10003a	Blake-10004	Blake-10004a	Blake-10005a	Blake-10006a	Blake-10007a
1	7	10	13	16	19	21
2012.6	2003.0	1995.3	1986.7	1976.0	1963.4	1954.3

0.0700	0.0850	0.0325	0.0450	0.0725	0.0950	0.1325
0.2425	0.1725	0.1400	0.2150	0.2775	0.2475	0.2025
0.0900	0.0100	0.0500	0.0175	0.0200	0.0100	0.0025
0.0950	0.1600	0.1475	0.1200	0.1250	0.1125	0.0975
0.0875	0.1150	0.0675	0.1275	0.1025	0.1025	0.1625
0.0500	0.0500	0.1350	0.0350	0.0450	0.0425	0.0400
0.508	0.370	0.375	0.395	0.465	0.485	0.468

Blake-10008a	Blake-10009a	Blake-10010a	Blake-10011a	Blake-10012a	Blake-10013a	Blake-10014	Blake-10015
23	25	27	29	31	33	37	39
1944.6	1933.8	1922.5	1910.7	1897.5	1882.3	1852.5	1838.1
0.0900	0.1000	0.1150	0.1700	0.1275	0.1250	0.0250	0.0400
0.1925	0.1000	0.0875	0.0800	0.0775	0.0550	0.0175	0.0350
0.0050	0.0125	0.0025	0.0200	0.0000	0.0025	0.0000	0.0000
0.1850	0.2075	0.3350	0.2675	0.3150	0.3625	0.4025	0.4175
0.1150	0.1625	0.1825	0.1425	0.1475	0.1425	0.1975	0.1800
0.0700	0.0650	0.0300	0.0675	0.0625	0.0825	0.0825	0.0600
0.405	0.283	0.263	0.318	0.248	0.213	0.065	0.093

Reconstructed Phosphorus

Name	WA_Inv	WA_Cla	WAT_Inv	WAT_Cla	WA_Inv_X	WA_Cla_X	WAT_Inv_X	WAT_Cla_X	log TP	TP (ug/l)	RMSEP
2013	1.71794	1.73872	1.78557	1.81006	1.72061	1.73961	1.76717	1.78316	1.71794	52.23240223	0.206927
2003	1.69103	1.70636	1.76425	1.78568	1.69415	1.7082	1.7415	1.7546	1.69103	49.0941788	
1995	1.56788	1.55834	1.65234	1.65768	1.57452	1.56669	1.61293	1.61216	1.56788	36.97260066	
1987	1.73153	1.75505	1.80181	1.82864	1.73397	1.7554	1.77721	1.7942	1.73153	53.89270719	
1976	1.79057	1.82602	1.85156	1.88553	1.79205	1.82416	1.83569	1.85909	1.79057	61.74047978	
1963	1.78058	1.81401	1.83531	1.86694	1.78252	1.81288	1.81561	1.83682	1.78058	60.33648416	
1954	1.73937	1.76448	1.79023	1.81538	1.74311	1.76624	1.77038	1.78664	1.73937	54.87442721	
1945	1.68066	1.69391	1.75385	1.77378	1.6843	1.69653	1.72347	1.73472	1.68066	47.93580224	
1934	1.55687	1.54509	1.61219	1.61176	1.56195	1.55163	1.58546	1.58177	1.55687	36.0470725	
1923	1.53859	1.52312	1.6005	1.59839	1.54346	1.5296	1.5795	1.57505	1.53859	34.56129444	
1911	1.53368	1.51722	1.57774	1.57237	1.53943	1.52491	1.54437	1.53626	1.53368	34.17275556	
1898	1.49003	1.46475	1.54771	1.53802	1.498	1.47584	1.50347	1.4909	1.49003	30.9050891	
1882	1.46273	1.43194	1.50611	1.49044	1.46861	1.44098	1.48307	1.46831	1.46273	29.02217791	
1853	1.35137	1.29808	1.41002	1.38054	1.36126	1.31388	1.37803	1.35181	1.35137	22.45794428	
1838	1.38529	1.33884	1.44375	1.41913	1.39402	1.35267	1.41018	1.38744	1.38529	24.28231004	

Sediment Total Phosphorus

Depth (cm)	Date (AD)	total Sed P Result (mg P/g)	sed rate (g/cm2 yr)	Total sed P flux (mg/cm2 yr)
1	2012.6	2.29	0.0271	0.0621
7	2003.0	1.80	0.0203	0.0366
10	1995.3	1.88	0.0174	0.0327
13	1986.7	1.70	0.0159	0.0271
16	1976.0	1.48	0.0137	0.0202
19	1963.4	1.43	0.0133	0.0190
21	1954.3	1.34	0.0128	0.0171
23	1944.6	1.27	0.0123	0.0156
25	1933.8	1.26	0.0110	0.0138
27	1922.5	1.25	0.0105	0.0131
29	1910.7	1.49	0.0097	0.0145

29 dup	1910.7	1.82	0.0097	0.0177
31	1897.5	1.26	0.0081	0.0102
33	1882.3	1.37	0.0067	0.0092
37	1852.5	1.30	0.0080	0.0104
39	1838.1	1.30	0.0057	0.0074

Sediment Phosphorus Flux

Phosphorus Fractions

Date	mg Ex-P/g	mg TP/g	mg NaOH-P/g	mg HCl P/g	mg Organic P/g
2013	0.06	2.29	0.42	0.13	1.68
2003	0.04	1.80	0.19	0.11	1.46
1995	0.07	1.88	0.28	0.63	0.90
1987	0.04	1.70	0.16	0.13	1.37
1976	0.05	1.48	0.13	0.12	1.18
1963	0.05	1.43	0.13	0.12	1.13
1954	0.05	1.34	0.13	0.12	1.03
1945	0.05	1.27	0.14	0.13	0.96
1934	0.05	1.26	0.12	0.12	0.97
1923	0.05	1.25	0.14	0.13	0.93
1911	0.09	1.49	0.49	0.17	0.74
1898	0.05	1.26	0.13	0.11	0.97
1882	0.05	1.37	0.13	0.10	1.10
1853	0.05	1.30	0.15	0.10	1.01
1838	0.05	1.30	0.15	0.11	1.00

Sediment Phosphorus Flux

Phosphorus Flux

Date	mg Ex-P/g	mg TP/g	mg NaOH-P/g	mg HCl P/g	mg Organic P/g	sed rate g/cm2 yr
2013	0.06	2.29	0.42	0.13	1.68	0.0271
2003	0.04	1.80	0.19	0.11	1.46	0.0203
1995	0.07	1.88	0.28	0.63	0.90	0.0174
1987	0.04	1.70	0.16	0.13	1.37	0.0159
1976	0.05	1.48	0.13	0.12	1.18	0.0137
1963	0.05	1.43	0.13	0.12	1.13	0.0133
1954	0.05	1.34	0.13	0.12	1.03	0.0128
1945	0.05	1.27	0.14	0.13	0.96	0.0123
1934	0.05	1.26	0.12	0.12	0.97	0.0110
1923	0.05	1.25	0.14	0.13	0.93	0.0105
1911	0.09	1.49	0.49	0.17	0.74	0.0097
1898	0.05	1.26	0.13	0.11	0.97	0.0081
1882	0.05	1.37	0.13	0.10	1.10	0.0067
1853	0.05	1.30	0.15	0.10	1.01	0.0080
1838	0.05	1.30	0.15	0.11	1.00	0.0057

Date	flux Ex-P g/cm2 yr	flux TP g/cm2 yr	flux NaOH-P g/cm2 yr	flux HCl-P g/cm2 yr	flux Organic-P g/cm2 yr
2013	1.60985E-06	6.20845E-05	1.13356E-05	3.62876E-06	4.55103E-05
2003	8.33204E-07	3.66147E-05	3.8756E-06	2.26136E-06	2.96446E-05
1995	1.21431E-06	3.27099E-05	4.85584E-06	1.09253E-05	1.57145E-05
1987	6.88806E-07	2.70982E-05	2.60204E-06	2.04452E-06	2.17629E-05
1976	6.49159E-07	2.02421E-05	1.77583E-06	1.65198E-06	1.61651E-05
1963	6.16475E-07	1.89774E-05	1.7419E-06	1.54669E-06	1.50723E-05
1954	5.95872E-07	1.70957E-05	1.71068E-06	1.55197E-06	1.32372E-05
1945	6.04683E-07	1.5643E-05	1.66152E-06	1.53842E-06	1.18383E-05
1934	5.20291E-07	1.38423E-05	1.36234E-06	1.31549E-06	1.06442E-05
1923	5.13961E-07	1.31442E-05	1.44206E-06	1.37887E-06	9.80931E-06
1911	9.12385E-07	1.44812E-05	4.74094E-06	1.61563E-06	7.21223E-06
1898	3.99642E-07	1.01781E-05	1.03484E-06	8.64029E-07	7.87957E-06
1882	3.02142E-07	9.20172E-06	9.03535E-07	6.49814E-07	7.34623E-06
1853	3.66912E-07	1.04178E-05	1.16046E-06	8.16765E-07	8.07361E-06
1838	2.67713E-07	7.40679E-06	8.53338E-07	6.04681E-07	5.68106E-06

Zooplankton

Date	*Chydorus brevilabris*	*Bosmina longirostris* complex	*Camptocercus sp.*	*Alona sp*	*Acropersus harpae*	*Daphnia longirostris* complex	*Daphnia* ephippium	*Eurycecus sp.*	*Alonella pulchella*	*Total Cladocera*
2012	193	12	2	27			4			238
2003	189	9	2	14	1		1		1	217
1995	85	4		5			3			97
1986	292	13		28	1			1		335
1976	157	2	1	17	9		9	4		199
1963	370	63		15	1			13	16	478
1954	258	3		40	5		8	6		320
1944	298	11	1	49	1		8	6		374
1933	169	5	4	18	4		7		2	209
1922	287	9		24	5		6	2	5	338
1910	276	15	8	58	11		5	8		381
1897	89	26	1	22		3	3	18	1	163
1882	189	14	7	59	10		3	8	3	293
1852	116	13	4	32			1	6		172
1838	239	25	16	31	10	4	9	6	3	343

Macrophytes

Date	*Ceratophyllum demersum*	*Potamogeton sp*	*Najas flexilis*	*Potamogeton pusillus*	*Vallisneria americana*	*Chara sp*	*Potamogeton crispus*	*Total Native Macrophytes*
2012	2						4	2
2003	5						5	5
1995	1						6	1
1986	5	7					2	12
1976	24	2						26
1963	40		3					43
1954	14	2						16
1944	11	3				1		15
1933	28	7	2	1				38
1922	18	4	2					24

1910	35	26	1	3	2			67
1897	41	5						46
1882	38	11						49
1852	26	3						29
1838	33	4	1					38

Chironomids

Date	Chironomus	Procladius	Cryptochironomus	Crictopus/Orthocladius	Dicrotendipes	Cladotanytarsus mancus gr.	Endochironomus tendens-type	Glyptotendipes	Microtendipes pedellus-type	Tanystarsus s. lat.	Chaoborus manible	Total Littoral Chironomids	Total Profundal Chironomids
2012												0	0
2003	4	1										0	5
1995	5	2								1		1	7
1986	1	1			1					1		2	2
1976	5							2				2	5
1963	2	1		1	2			3		1		6	3
1954	7	2	2		5			2		2		9	11
1944	2				2	2					1	4	2
1933	1	2						2				2	3
1922	2	3				3	2	4				9	5
1910	1					2						2	1
1897	3	9		1	7	5			1		2	13	12
1882												0	0
1852	2	6		1	1	2		1	4			8	8
1838	7	9		1	3	2	4				5	9	16

A Paleolimnological Study of Big Blake Lake, Polk County, Wisconsin

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Executive Summary

1. Paired sediment cores were recovered from the northern basin of Big Blake Lake, Polk County, Wisconsin, in September 2013 and analyzed to reconstruct a historical record of sedimentation, ecological change, and water quality from the early 1800s to present. Management concerns for Big Blake Lake are centered on the prevalence of *Potamogeton crispus*, cyanobacterial blooms, elevated nutrient levels, response to and prevention of aquatic invasives, and sustaining high quality recreational and fishing opportunities in the lake.
2. Sediment cores were subjected to multiple analyses including radioisotopic dating with Pb-210 to establish a date-depth relationship and sedimentation rates for the core site, loss-on-ignition to determine major sediment constituents, biogenic silica to estimate historical diatom productivity, diatom communities to identify ecological changes and estimate historical water column phosphorus, extraction and determination of sediment phosphorus fractions to determine past nutrient loading and threat of internal loading, and analysis of macrofossils including chironomid head capsules, zooplankton fossils, aquatic macrophyte remains to identify ecological shifts that have occurred in Big Blake Lake.
3. Sedimentation rates in the lake increased following Euroamerican settlement, and current sedimentation rates are approximately five times greater than pre-settlement levels.
4. Loss-on-ignition analysis showed that inorganics are the predominant fraction of Big Blake Lake sediments followed by organic components and then carbonates. Inorganic components show increased accumulation after 1900, likely reflecting changes in sediment loading following logging, land clearance, and development of the shoreline, while organic constituents decreased.
5. Biogenic silica concentrations in the cores, a marker of diatom algae abundance, are high compared to most lakes in the Midwest and represent 8-14% of the dry weight of Big Blake Lake sediment. Accumulation rates of biogenic silica show diatom growth has increased in the last two decades.
6. The concentration and accumulation rates of phosphorus (P) fractions in the Big Blake Lake sediment core show general increases toward the top of the core. Organic P is the most abundant in the top few cm of sediment. NaOH-extractable P and exchangeable P also increase in the top few centimeters of the core providing a readily available source of P during period of internal loading. Internal loading appears to be more significant in recent decades when bottom water go anoxic during *Potamogeton crispus* senescence and periodic breakdowns of stratification throughout the summer months which can initiate cyanobacteria blooms.
7. The diatom communities preserved in Big Blake Lake's sediment are dominated by six species. A significant diatom community shift occurs in the 1920-30s, a time when cottage and resort communities were expanding and agricultural practices were likely shifting in the region. This time period shows a decrease in the planktonic mesotrophic indicator *Aulacoseira ambigua* and benthic diatoms *Staurosira construens* and *S. venter* coincident with an increase in the dominance of the eutrophic species *Aulacoseira granulata*.
8. Estimates of historical total phosphorus (TP) were generated using a diatom-TP model based on species environmental relationships in 89 Minnesota lakes. The model suggests that Big Blake Lake has shifted from a mesotrophic lake to a eutrophic system. Diatom-

inferred TP estimates increase following European settlement, increase further in the 1940s to peak levels in the 1960s through present day. Modeled TP estimates for the last ten years (49-52 µg/l) are similar to monitored values taken during the growing season (40-80 µg/l TP) when cyanobacterial blooms can occur. Diatom reconstructed TP values are almost identical to the mean annual TP levels based on a comprehensive monitoring program from 2013-2015 (49.9 µg/l), and predictions modeled using the Wisconsin Lakes Modeling Suite (43-50 µg/l).

9. Pigment analysis of different algae groups showed that algae, including cyanobacteria, have increased in recent decades. Evidence suggests that nitrogen-fixing, and possibly toxic, forms of cyanobacteria (via aphanizophyll), have increased dramatically over the last three decades.
10. Analysis of zooplankton remains shows a general decrease in cladocerans since the 1960s and 1970s. There is a sharp reduction in both *Eurycercus sp*. and *Alona sp*. since the 1960s. These species are often associated with aquatic plants in the littoral zones of ponds and lakes in North America and Europe and their decline corresponds to decline of the native aquatic plant community in Big Blake Lake since the 1960s.
11. Chironomid head capsules shows sharp decrease in littoral species after the 1950s similar to changes in zooplankton composition, again reflecting changes in ecosystem quality associated with the loss of the native aquatic plant community.
12. Aquatic macrophyte fossils show a loss in both species richness and total number of indigenous species since the 1960s. Fossils of the aquatic invasive species *Potamogeton crispus* appear in the 1980s.
13. Paleolimnology-based management recommendations and additional analysis are provided in the Big Blake Lake comprehensive Lake Management Plan.

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Introduction

Lakes are prominent features in the glaciated landscape of the Upper Midwest. They are valued resources for recreation, fisheries, wildlife, and leisure for lakeshore owners. Water management concerns have been raised about the state of lakes and how to best manage them due to current, historical, and future land and resource use that is certain to see further change. To develop effective management plans it is important to determine the natural state of a lake and have an understanding of the timing and magnitude of historical ecological changes that have occurred. We can estimate past conditions and natural variability through the use of paleolimnological techniques to identify the timing of ecological change, and determine the rates of change and recovery. Linking this information to historical land-use changes and known environmental impacts helps target management options.

Big Blake Lake (WBIC 2627000) is located in the Town of Georgetown in central Polk County, Wisconsin (T35N, R16W, S22, 26, and 27, Fig. 1). The lake has a surface area of 217 acres, a maximum depth of 4.3 meters (14 feet), and a mean depth of 2.7 meters (9 feet). The Big Blake Lake watershed is part of the Upper Apple River watershed in the St. Croix River Basin. The watershed (or drainage area) of Big Blake Lake is approximately 15,369 acres. The watershed to lake area ratio is approximately 70:1. The lake is classified as a drainage lake, meaning that it is fed primarily by inflowing streams or rivers. The Straight River flows in from the southeast via Big Round and Little Blake Lake and an unnamed creek that drains from Lost Lake flows in on the north side of the lake. Fox Creek flows out of the lake at the northwest end. Big Blake Lake is also designated as an Area of Special Natural Resource Interest (ASNRI) and as a Public Rights Feature (PRF). Significant public access and use opportunities are available on Big Blake Lake. There is a resort located on Big Blake Lake on the northwest side (Sherrards Resort). Big Blake Lake has two public boat landings, one which provides parking for seven car-trailer units and a carry-in launch.

With any lake management plan it is important to have a basic understanding of natural fluctuations within the system. Long-term water quality data sets on the order of 30 to 50 years are generally not available for most of the country and Big Blake Lake is no exception. Incomplete water quality data have been collected intermittently from Big Blake Lake since 2000. Most of the data sets do not include chlorophyll a or total phosphorus TSI averages and there are large stretches of time where no data have been collected. The most recent data suggest that Big Blake Lake is eutrophic; however, the large lag times between sampling events make these data inconclusive. The most recent water quality study on Big Blake Lake was completed in 2004 by Aquatic Engineering, Inc. to determine management recommendations to protect and improve water quality on Big Blake Lake. Northern Lake Service, Inc. also completed a study in 1979 and the DNR Office of Inland Lake Renewal completed a study in 1981. The Wisconsin

state phosphorus standard of 30 µg/L was exceeded in both of these reports. The highest readings of total phosphorus in the reports were 69 µg/L and 95 µg/L. The highest reading for chlorophyll a concentrations was 55 µg/L (Williamson, unpublished data). The 1981 DNR Office of Inland Lake Renewal study further concluded that sediment was a major source of the total phosphorus load to Big Blake Lake.

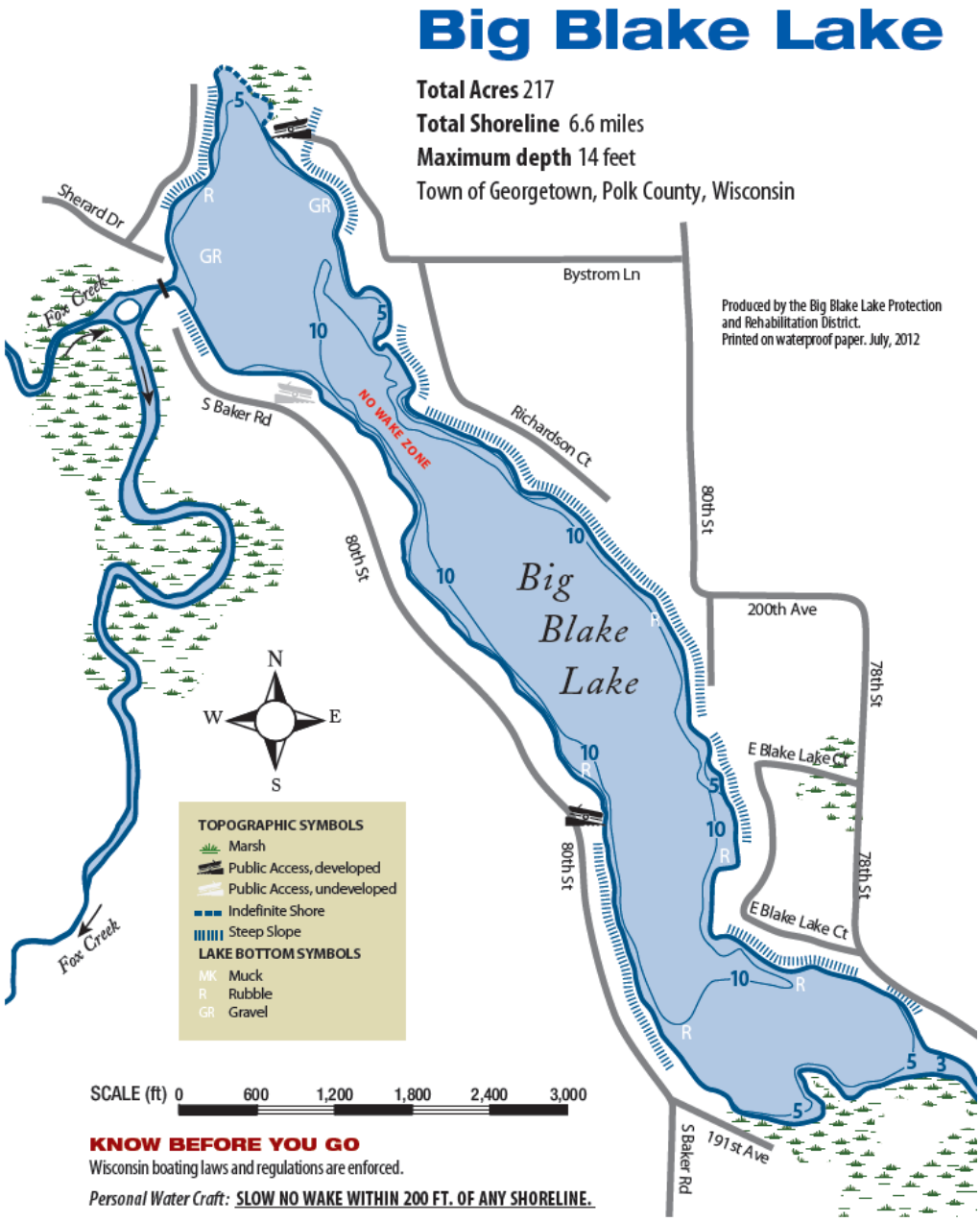


Figure 1. Map of Big Blake Lake.

In addition to inadequate water quality data, there is a lack of ecological data and biological monitoring for the lake, a problem that is not unique to Blake Lake. Monitoring of aquatic

macrophytes has been carried out since 2006 by the Polk County Land & Water Resources Department (LWRD), and two of the three main goals in the Blake Lake Aquatic Invasive Species Management Plan address preserving and protecting native plant functions and reducing curly-leaf pondweed. Algae and zooplankton data are absent.

The primary aim of this project was to use paleolimnological analysis of a dated sediment core to reconstruct changes in the lake condition over the last 150-200 years using multiple lines of evidence including biogeochemistry, sediment accumulation, zooplankton fossils, chironomid head capsules, aquatic macrophyte remains, and diatom remains as biological indicators. In an effort to further understand presettlement conditions, and historical lake response to land use and past management, the paleolimnological study uses diatom remains to model changes in water column TP. Diatoms often make up the main types of algae in a lake and therefore changes in diatom community structure are symptomatic of algal changes in response to water quality. Diatoms have been widely used to interpret environmental conditions in lakes (Dixit et al., 1992). Many species are sensitive to specific water conditions and are useful as bioindicators. Over the past 25 years, statistical methods have been developed to estimate quantitative environmental parameters from diatom assemblages. These methods are statistically robust and ecologically sound. In the states of Minnesota and Wisconsin, diatom analysis has been used as one line of evidence for developing nutrient criteria (Heiskary and Wilson 2008), lake-specific nutrient standards (Edlund and Ramstack 2007), and prioritizing management actions (Edlund et al. 2008).

In addition, we further characterize changes in algal productivity and nutrient availability using biogeochemical analyses of the cores. Biogenic silica (BSi) is a component of two major algal groups—the diatoms and chrysophytes. The amount of BSi preserved in sediments and its accumulation rate represent a straightforward measure of algal productivity through time that is particularly responsive to nutrient inputs (Edlund et al. 2009). Fossilized algae pigments were analyzed in order to investigate changes in the composition of algae as well as total algae production. Zooplankton fossils, chironomid head capsules, and aquatic macrophyte remains were analyzed to characterized habitat changes and the faunal and food web response to such changes. We also characterized the total phosphorus and phosphorus fractions in the core to understand the historical sources of P to the lake, the distribution of P and P fractions within the cores, and to assess the relative capability (or lack of capability, i.e. internal loading) of the lake to sequester phosphorus in its sediments.

Figure 2. Sediment core recovered from Big Blake Lake in September 2013

Methods

Coring

A pair of sediment cores, each measuring approximately 1.6 m in length, was recovered from the north basin of Big Blake Lake (45°30'11.68"N, 92°20'10.24"W) on 12 September 2013 (Fig. 2). The cores were recovered from 3 meters of water using a piston corer consisting of a 6.5 cm diameter polycarbonate tube outfitted with a piston and operated with rigid drive rods working from an anchored boat on the lake surface (Wright 1991). The core was transported to shore where the uppermost 45 cm of the core were vertically extruded and sectioned in 1.0-cm increments. The remaining core material was stabilized, transported back to the laboratory and further sectioned in 2-cm increments to 154 cm core depth for core one and 155 cm core depth for core two. Paired cores were taken to ensure we had sufficient material for all planned analyses.

Isotopic Dating and Geochemistry

The sediment core was analyzed for ^{210}Pb activity to determine age and sediment accumulation rates for the past 150 to 200 years. Lead-210 activity was measured from its daughter product, ^{210}Po, which is considered to be in secular equilibrium with the parent isotope. Aliquots of freeze-dried sediment were spiked with a known quantity of ^{209}Po as an internal yield tracer and the isotopes distilled at 550°C after treatment with concentrated HCl. Polonium isotopes were then directly plated onto silver planchets from a 0.5 N HCl solution. Activity was measured for 1-3 x 10^5 s using an Ortec alpha spectrometry system. Supported ^{210}Pb was estimated by mean activity in the lowest core samples and subtracted from upcore activity to calculate unsupported ^{210}Pb. Core dates and sedimentation rates were calculated using the constant rate of supply model (Appleby and Oldfield 1978, Appleby 2001). Dating and sedimentation errors represented first-order propagation of counting uncertainty (Binford 1990).

Bulk-density (dry mass per volume of fresh sediment), water content, organic content, and carbonate content of sediments were determined by standard loss-on-ignition techniques (Dean 1974). Weighed sediment subsamples were dried at 105°C for 24 hr to determine water content and dry bulk density, then heated at 550°C and 1000°C to calculate organic and carbonate content from post-ignition weight loss, respectively. These data were used in combination with ^{210}Pb dating to calculate sedimentation rates (mg cm^{-2} yr^{-1}) for each core and its sediment constituents.

Sediment phosphorus fractions were analyzed following the sequential extraction procedures in Engstrom (2005) and Engstrom and Wright (1984). Extracts were analyzed colorimetrically on a Lachat QuikChem 8000 flow injection autoanalyzer. Measured sediment P concentrations were also converted to flux using bulk sedimentation rates in each core. In addition to total phosphorus in cores, sediment fractions include the refractory forms HCl-P and Organic-P and the labile or readily exchangeable forms of NaOH-P and "exchangeable P (Ex-P)."

Biogenic silica (BSi), a proxy for historical diatom and chrysophyte algal productivity, was measured using weighed subsamples (30 mg) from each primary core, which were digested for BSi analysis using 40 mL of 1% (w/v) Na_2CO_3 solution heated at 85°C in a reciprocating water bath for five hours (DeMaster 1979, Conley and Schelske 2001). A 0.5 g aliquot of supernatant was removed from each sample at 3, 4, and 5 hr. After cooling and neutralization with 4.5 g of 0.021N HCl solution, dissolved silica was measured colorimetrically on a Lachat QuikChem 8000 flow injection autoanalyzer as molybdate reactive silica (McKnight 1991).

Diatom Analysis

Diatoms were used in this study to provide a timeline of changes in the Big Blake Lake algal community and estimates of historical water column total phosphorus concentrations. The analytical steps are as follows: Diatoms and chrysophyte cysts were prepared by placing approximately 50 mg freeze dried core material in a 50 cm^3 polycarbonate centrifuge tube and adding 2-5 drops of 10% v/v HCl solution to dissolve carbonates. Organic material was subsequently oxidized by adding 10 ml of 30% H_2O_2 and heating for 3 hr in an 85°C water bath. After cooling the samples were centrifuged and rinsed 4-6 times with deionized water to remove oxidation byproducts. Material was then transferred to 22x22 mm square #1 coverglasses. Coverglasses were permanently attached to microscope slides using Zrax mounting medium (Ramstack et al. 2008). Diatoms were identified along measured random transects to the lowest taxonomic level under 1000-1250X magnification (full immersion optics of NA>1.3). A minimum of 400 valves was counted in each sample. Identification of diatoms relied on floras and monographs such as Hustedt (1927-1966, 1930), Patrick and Reimer (1966, 1975), Krammer and Lange-Bertalot (1986-1991), Reavie and Smol (1998), Camburn and Charles (2000), and Fallu et al. (2000). All diatom counts were converted to percentage abundances by species or taxon; abundances are reported relative to total diatom counts in each sample.

A stratigraphy of predominant diatoms (species with greater than or equal to 5% relative abundance in one or more core depths) was plotted against core date. Relationships among diatom communities within the sediment core were explored using constrained cluster analysis (CONISS) and the unconstrained ordination method of Detrended Correspondence Analysis (DCA), in the software package R (R Core Team 2014). Core depths/dates were plotted in

ordinate space and their relationships and variability used to identify periods of change, sample groups, and ecological variability among core samples. A general rule for interpreting a DCA is that samples that plot closer to one another have more similar diatom assemblages.

Downcore diatom communities were also used to reconstruct historical epilimnetic phosphorus levels. A transfer function for reconstructing historical logTP was developed earlier based on the relationship between modern diatom communities and modern environmental variables in 89 Minnesota lakes (Ramstack et al. 2003, Edlund and Ramstack 2006) using weighted averaging (WA) regression with inverse deshrinking and bootstrap error estimation (C2 software; Juggins 2003). Reconstructed estimates of logTP (diatom-inferred TP, or DI-TP) for each downcore sample were determined by taking the logTP optimum of each species, weighting it by its abundance in that sample, and determining the average of the combined weighted species optima. Data are presented as both logTP values and as backtransformed values, to TP in µg/l or ppb.

Analysis of Chitinous and Vegetative Remains

Chironomid head capsules and zooplankton remains were analyzed along with aquatic macrophyte remains to assess ecosystem level changes in Big Blake Lake such as habitat loss, changes in fisheries, and colonization by invasive species. Wet sediment samples (2 cm^3) were first disaggregated in hot water. Samples were then sieved through a 125 µm (no.120) standard soil test sieve and specimens picked out using a fine forceps under a stereo microscope at 25X magnification. Samples were either slide mounted or identified in a Borgorov counting chamber under magnification appropriate for each taxon. All specimens picked from the samples were identified to the lowest taxonomic using available taxonomic literature (e.g., Brooks et al. 2007, Crow and Hellquist 2000, Korosi and Smol 2012). Predominant species were stratigraphically plotted against core date. Autecology of individual taxa was investigated, and species groups with similar ecological niches were used to infer ecological change.

Algal Pigment Analysis

Carotenoids, chlorophylls, and derivatives were extracted (4°C, dark, N2) from freeze-dried sediments according to Leavitt et al. (1989), measured on a Hewlett-Packard model 1050 high performance liquid chromatography system, and are reported relative to total organic carbon (TOC; Hall et al. 1999).

Results and Discussion

Core Dating and Sedimentation Rates

The Big Blake Lake core showed a monotonic decrease in Pb-210 inventory to supported levels below 45 cm core depth. Using the date-depth relationship, 20 cm down the core represents approximately 1960 and sediments deposited deeper than 33 cm are dated before 1880. Sedimentation rates in Big Blake Lake began increasing immediately after European settlement

and continue to increase upcore. Modern sedimentation rates are approximately four times greater than pre-1900 rates (Figure 3). Pre-settlement sedimentation rates in Big Blake Lake were approximately 0.007 g/cm^2 yr compared to 0.028 g/cm^2 yr since the 1990s. Increases in sedimentation rates are common in Midwestern lakes following logging, land clearance for agriculture, and changes in land use/cover.

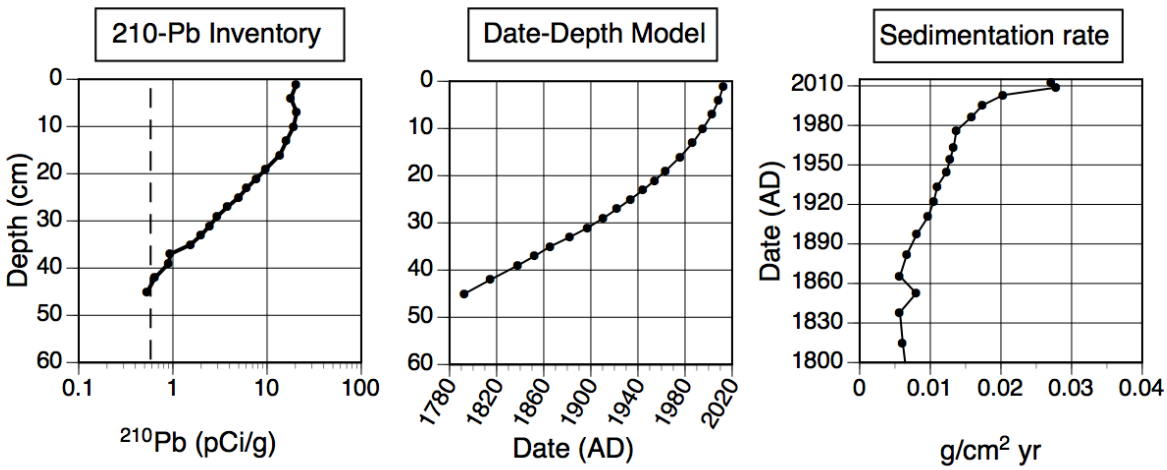


Fig. 3 Pb-210 inventory, date-depth model, and historical sedimentation rates for Big Blake Lake.

Loss-on-ignition

Sediments in Big Blake Lake have shifted from being dominated by the organic fraction (pre-settlement; 54.7% organic matter) to being dominated by the inorganic fraction (present day; 45.7% inorganic matter) (Figure 4). Carbonates rise from 6.4% of the sediment fraction in pre-settlement and increase to 16% in recent sediments; carbonates commonly increase in sediments as a consequence of greater plant and algae production in a lake (carbonates are precipitated as a result of photosynthesis). Inorganics notably increased in accumulation to a peak in the 1940s before dropping slightly until 1980 before increasing in most recent times. Increases in inorganics around 1900 are generally an erosional signal of logging and land clearance associated with settlement in the region.

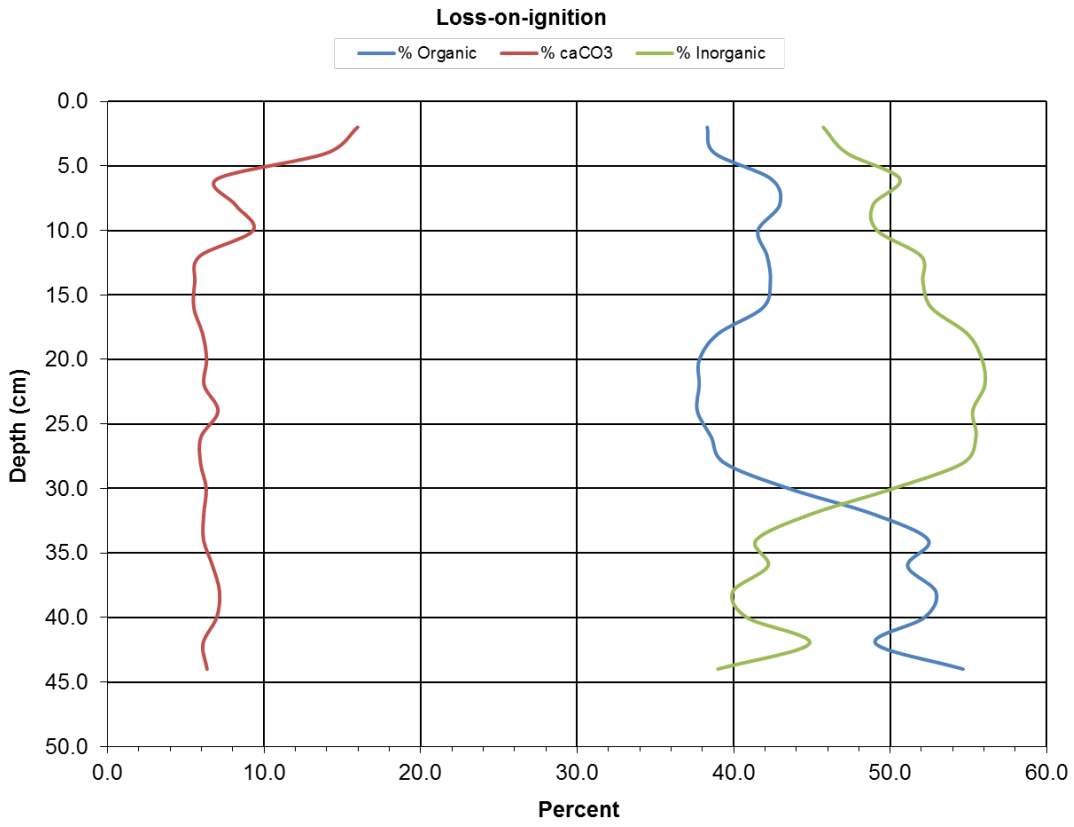


Fig. 4. Loss-on-ignition

Biogenic Silica (BSi)

Biogenic silica composed 8.3-13.7% of the dry weight of Big Blake Lake sediment, with the lowest values in the 1990s to present day (as BSi content is diluted by carbonates) and the highest values from pre-settlement to the 1880s (Figure 5). Upcore decreases in BSi were noted in the top 6 cm of sediment. Big Blake Lake has relatively high levels of BSi, most lakes have from 2-4% biogenic silica by weight. When BSi is presented as accumulation rates, the flux of BSi increases in the 1930s to the top of the Big Blake Lake core. Modern accumulation rates of biogenic silica are almost 70% greater than in pre-European settlement times likely reflecting greater diatom algae productivity in recent decades.

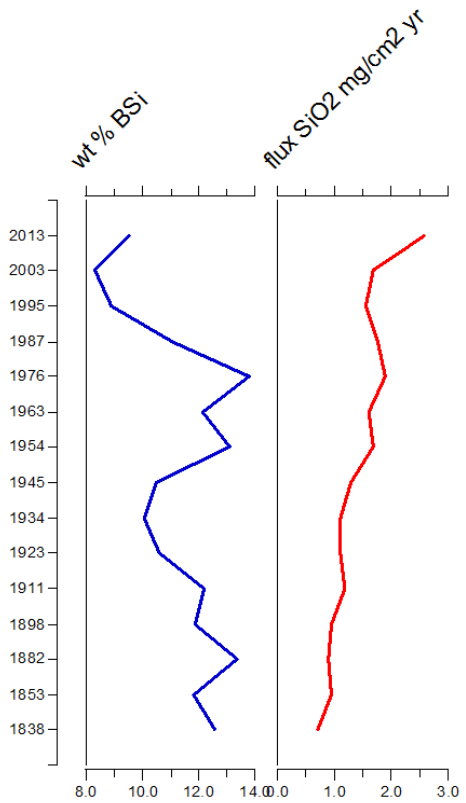
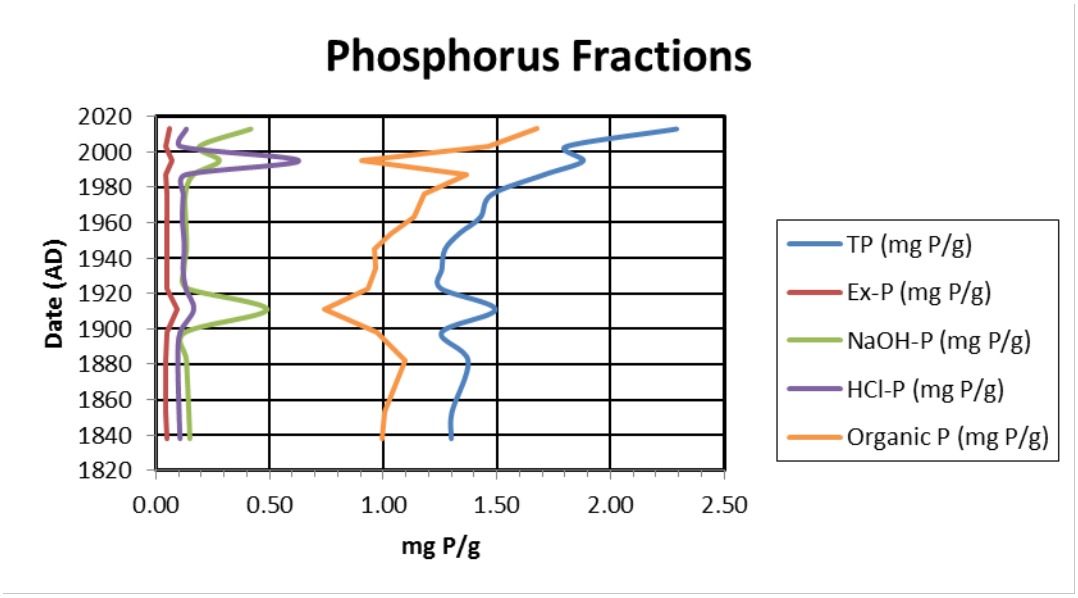


Fig. 5 Biogenic silica content (percent dry weight) and accumulation rate ($mg/cm^2\ yr^{-1}$)

Sediment Phosphorus Fractions

Total phosphorus in Big Blake Lake sediment ranged from 1.3 to 2.3 mg P/g with increasing amounts moving upcore and the highest values at the core top (Figure 6). The organic-P made up the largest proportion of the fractions followed by NaOH-P and HCl-P fractions. We must consider the potential mobility and possibility of exchange of P with the water column in the distribution and abundance of the refractory (HCl-P, Org-P) and labile/exchangeable P (Ex-P, NaOH-P). In Big Blake Lake, an active pool of labile P forms is strongly distributed in the top 4 cm of the core suggesting that while Big Blake Lake can efficiently bury P in its sediments (one of only two ways for a lake to rid itself of excess P burdens—the other being the outflow), there is a ready pool of P to fuel internal loading during certain times of the year.



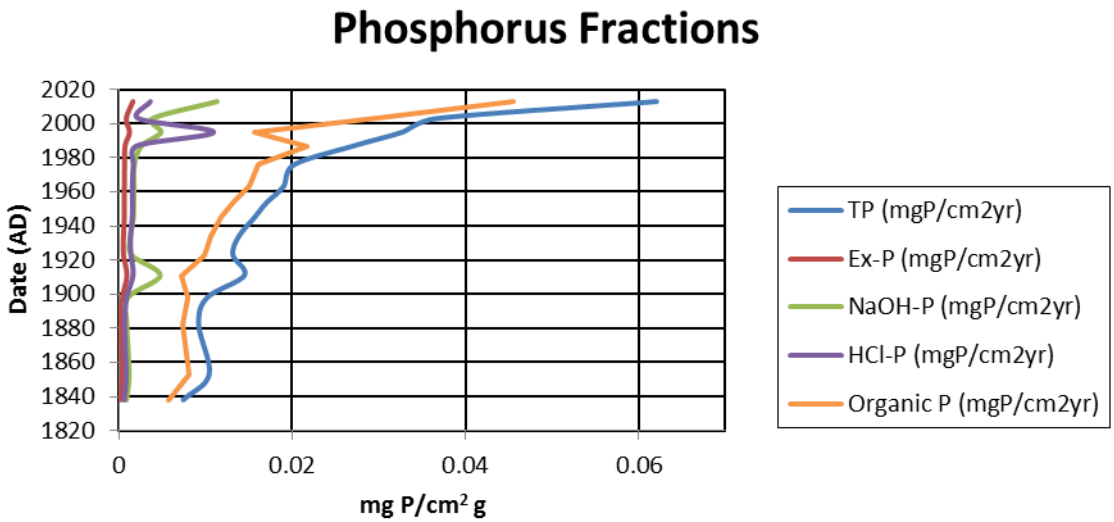


Fig. 6 Sediment phosphorus fractions in Big Blake Lake core including total phosphorus (TP), exchangeable P (Ex-P, NaOH extractable P (NaOH-P), HCl extractable P (HCl-P), and organic P (Org-P)

Accumulation rates of organic P and total P in the cores increase after 1900 to levels that are almost five-fold higher than pre-European settlement (Figure 6). There are less dramatic increases in the other fractions of P; however, NaOH-P and Ex-P may be a limited but active pool of P available to the water column. The greatest flux of labile P occurs in the top few centimeters of the core. This pool of P is important given the propensity for the lake to have anoxic bottom waters in mid-summer following senescence of *Potamogeton crispus* by early summer, which releases additional labile P from the sediments to fuel frequent cyanobacterial blooms.

Diatom Communities and TP reconstructions

In the Big Blake Lake core there were over 110 diatom species noted. In pre-European settlement samples, benthic or epiphytic (living on the bottom or on plants) species such as *Staurosira construens* and *S. venter* were dominant. After the 1940s planktonic species that live in the water column such as *Aulacoseira granulata* and *Fragilaria crotonensis* dominate the samples.

Several analyses were run to determine how the diatom communities in each level were related to each other and develop stratigraphic groupings. The first shows an ordination biplot from detrended correspondence analysis (DCA) that shows how the core samples cluster based on similarity of diatom assemblage (Figure 7). Note that the presettlement samples are grouped on the left of axis 1, undergo a rapid shift to the right on axis 1 between 1923 and 1954, and then remain to the right on axis 1, but vary more on axis 2 from 1954 to present.

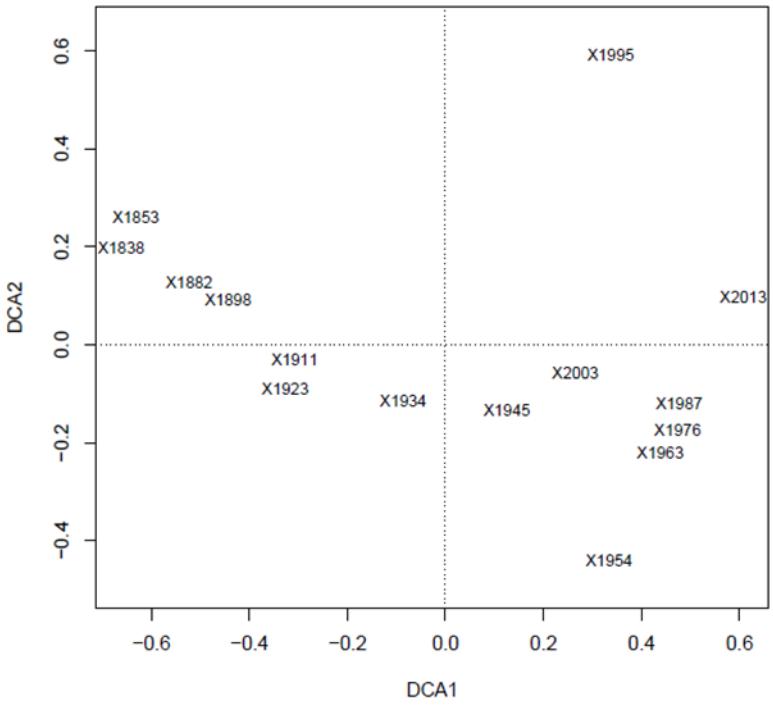


Fig. 7 Detrended Correspondence Analysis (DCA) of the diatom community from the Big Blake Lake sediment core by dated core level. Core levels that plot closer together are generally more similar.

A constrained cluster analysis was also run and confirms the DCA results (Figure 8). These results suggest that the major significant breaks among diatom assemblages occur between 1924 and 1934, 1945 to 1954, and 1987 to present day. Similarly, the diatom community show major changes from the 1890s to the 1960s along Axis 1 of the DCA plot; and change over the last sixty years along Axis 2. This may suggest that the lake has been experiencing multiple stressors over many decades.

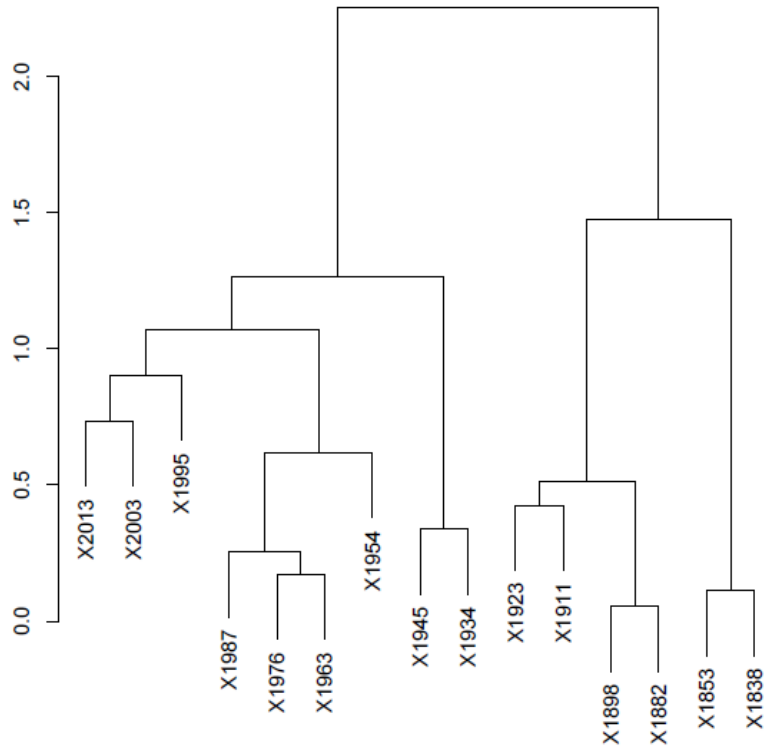


Fig. 8 Constrained Cluster Analysis of diatom communities by dated core level from the Big Blake Lake sediment core based on Euclidean distance.

Changes in the abundance of predominant diatoms can be seen in a stratigraphic diagram of the core (Figure 9). The shifts in diatoms communities can clearly be seen in the increases in *Aulacoseira granulata*, *Fragilaria crotonensis*, and the benthic *Staurosirella pinnata* and decreases in *Staurosira construens*, *S. venter*, and the mesotrophic species *Aulacoseira ambigua*. The sharp increase in *Fragilaria crotonensis* sets the very top of the core apart from the rest of the core, but there has clearly been changes thoughout the modern history of Big Blake Lake.

The common diatoms near the bottom of the Big Blake Lake core are indicative of a mesotrophic midwestern lake, while diatom communities at the top imply a eutrophic condition (Figure 10). The two *Staurosira* species, abundant in the bottom of the core, are both non-motile species that are likely benthic or epiphytic species that often form small colonies. The two *Aulacoseira* species are indicative of strong mixing of the lake. *Aulacoseira ambigua*, which decreases towards the top of the core, is more indicative of a mesotrophic lake; while *A. granulata*, which increases towards the top of the core, is more indicative of a shallow eutrophic lake. The sharp increase in *Fragilaria crotonensis* near the top of the core is an indication that the lake has continued to eutrophy over time.

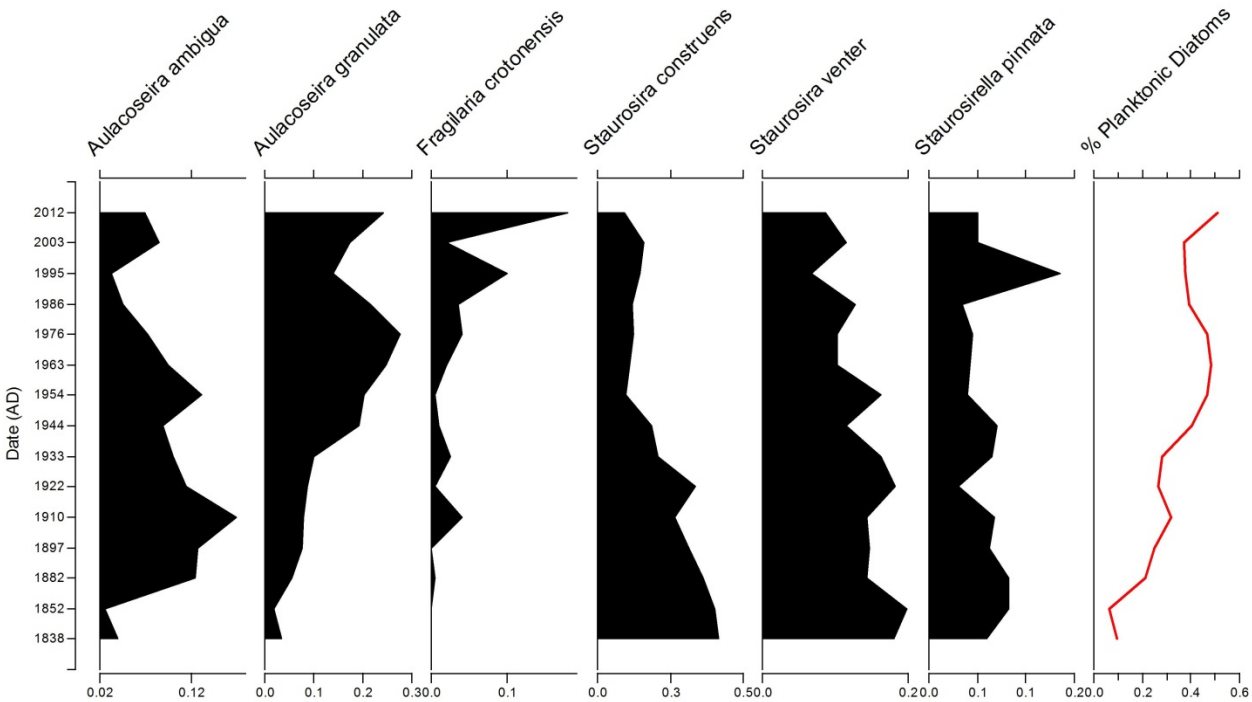


Fig. 9 Downcore distribution by core date of predominant diatoms in the Big Blake Lake sediment core. Diatom abundances are given relative to total diatom count.

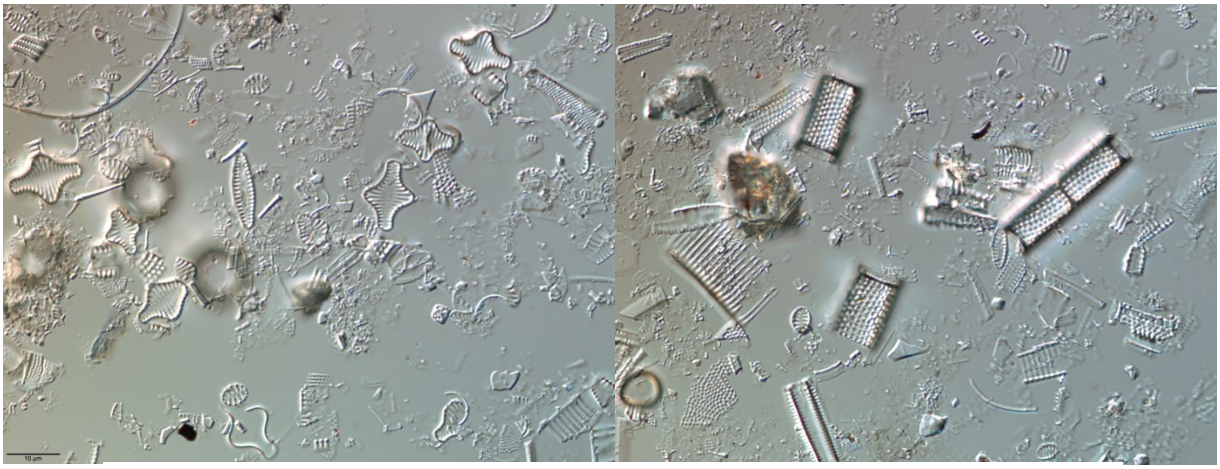
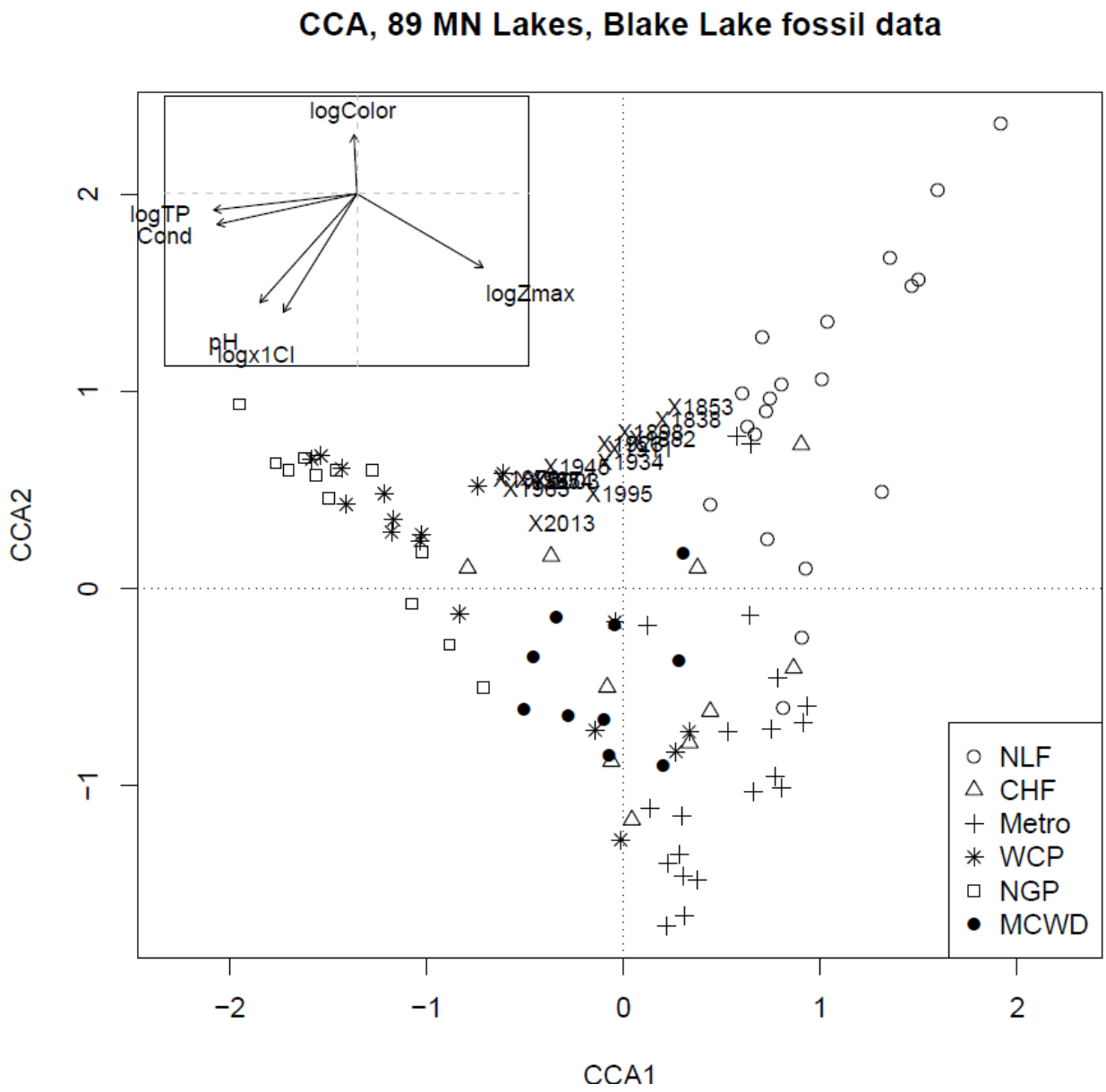


Fig. 10 Diatom communities for the Big Blake Lake sediment core circa 1852 (left) and 2012 (right).

The diatom communities were also used to reconstruct historical TP levels in Big Blake Lake. Many factors can contribute to changes in diatom communities (pH, light penetration, and habitat availability), and in order for a diatom-inferred total phosphorus (TP) reconstruction to be meaningful, changes in the diatom community assemblage over time should be primarily driven by changes in TP concentrations. One way to evaluate TP as a driver of change in Big Blake Lake is to project the core sections on the MN calibration set that we used to reconstruct TP to

determine if changes in the diatom assemblage in the core correlate with the TP gradient in the model (Figure 11; Juggins et al. 2013).

Another way to evaluate the strength of a TP reconstruction is to determine the amount of variance in the diatom data that can be accounted for by the TP reconstruction. This can be calculated by the variance explained by the first axis of an ordination of the sediment assemblages constrained to diatom-inferred TP, divided by the variation explained by an unconstrained ordination of the sediment assemblages (known as the lambda r/lambda p score; Juggins et al. 2013). In Big Blake Lake, this analysis shows that the fraction of the maximum explainable variation in the diatom data that can be explained by TP is very high (= 0.9291). The high score from this analysis, coupled with the strong correlation with the logTP axis in the passive plot (Figure 11), suggests that TP has been a significant driver of diatom community change in this lake and therefore therefore we can be confident in the TP reconstruction.



The TP reconstruction on Big Blake Lake suggests that the lake has gone from a mesotrophic state to a eutrophic state, with levels starting to increase immediately after Euroamerican settlement (Figure 12). Diatom-inferred TP also suggests a sharp increase in TP after 1940. A final way to evaluate the strength of the TP reconstructions is to compare TP results with measured TP levels generated through regular lake monitoring programs. Monitored TP from 2012 to 2015 ranged from 23 to 135 ppb TP with notably higher levels in late summer and fall that were associated with cyanobacterial blooms.

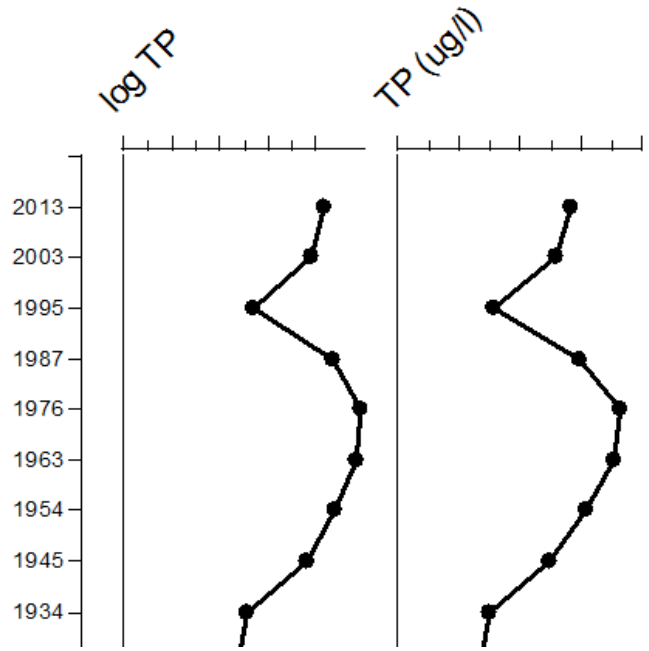


Fig. 11. Diatom communities in dated Big Blake Lake core sections passively plotted onto the calibration set of 89 Minnesota lakes. The inset shows the strength and direction of environmental gradients that significantly explain diatom abundance in the calibration set lakes. The historical diatom communities in Big Blake Lake were responding strongly to changes in TP, and are aligned with the logTP axis.

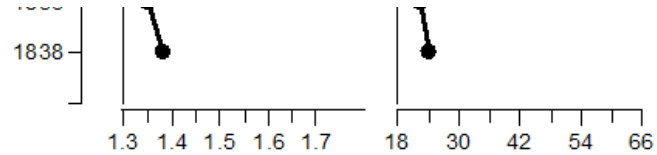


Fig. 12. Historical diatom-inferred TP levels for Big Blake Lake. Model reconstructions (left panel) are in log TP units (model error estimate is 0.2069 logTP units; RMSEP). The back transformed diatom-inferred TP levels are given in the right panel in the more commonly reported units of µg/l or ppb.

Historical Algal Communities

The algae consist of many biological groups of organisms that do not represent a single lineage on the evolutionary tree of life, but are linked by function—the algae generally are small, photosynthetic, and do not have organized tissues similar to higher plants (flowers and trees). From an ecological perspective the algae are critical to the functioning of the earth (algae account for about 50% of the photosynthesis—hence the oxygen we breathe) and form the base of the food web in most lake and river systems. The different algal groups are separated based on their cell structure (bacterial type or prokaryotes—the Cyanobacteria; or true cells or eukaryotes—the rest of the algal groups), storage products (starch, lipids, proteins), pigments, cell wall or membrane structure, cellular organization, and life history types. The types of algae present in a lake are influenced by environmental and biogeographical factors like climate, phosphorus, nitrogen, and silica concentrations and ratios, pH, grazing, substrate, and other factors in the lake basin. Lakes that have been heavily impacted with nutrients most often are dominated by blue-green algae for the greater part of the open water season with spring and winter the only periods where other algal groups might dominate.

Algal pigments were quantified in fifteen core sections to determine the historical concentration or production of different algal groups (Figure 13). Total algal production, as measured by betacarotene and chlorophyll *a*, showed that overall production was relatively low until the 1940s with sharp increases after the 1960s. The diatoms and most of the cyanobacterial groups followed this same pattern, with the exception of aphanizophyll which was not present until the 1980s.

Cyanobacterial groups were present throughout the length of the core, dating back to the 1800s. Cyanobacteria or blue-green algae are a natural and normal part of the algal flora in all lakes, but they tend to flourish in nutrient-rich waters, and may cause nuisance or harmful algal blooms. Pigments from the cyanobacteria are differentiated into various types that are associated with specific subgroups of blue-green algae (e.g., canthaxanthin, lutein-zeaxanthin, etc.), and there is evidence that pigments associated with potentially toxic, nitrogen-fixing forms (aphanizophyll) have become much more abundant in the lake in recent times. The recent dramatic increase in abundance of aphanizophyll in Big Blake Lake suggests that conditions were not conducive to support nuisance blooms of cyanobacteria until late in the 20th century. Evidence would also

support that recent nutrient increases due to watershed development and the introduction of *Potamogeton crispus* have exacerbated cyanobacteria growth so that blooms are more prevalent than in the past.

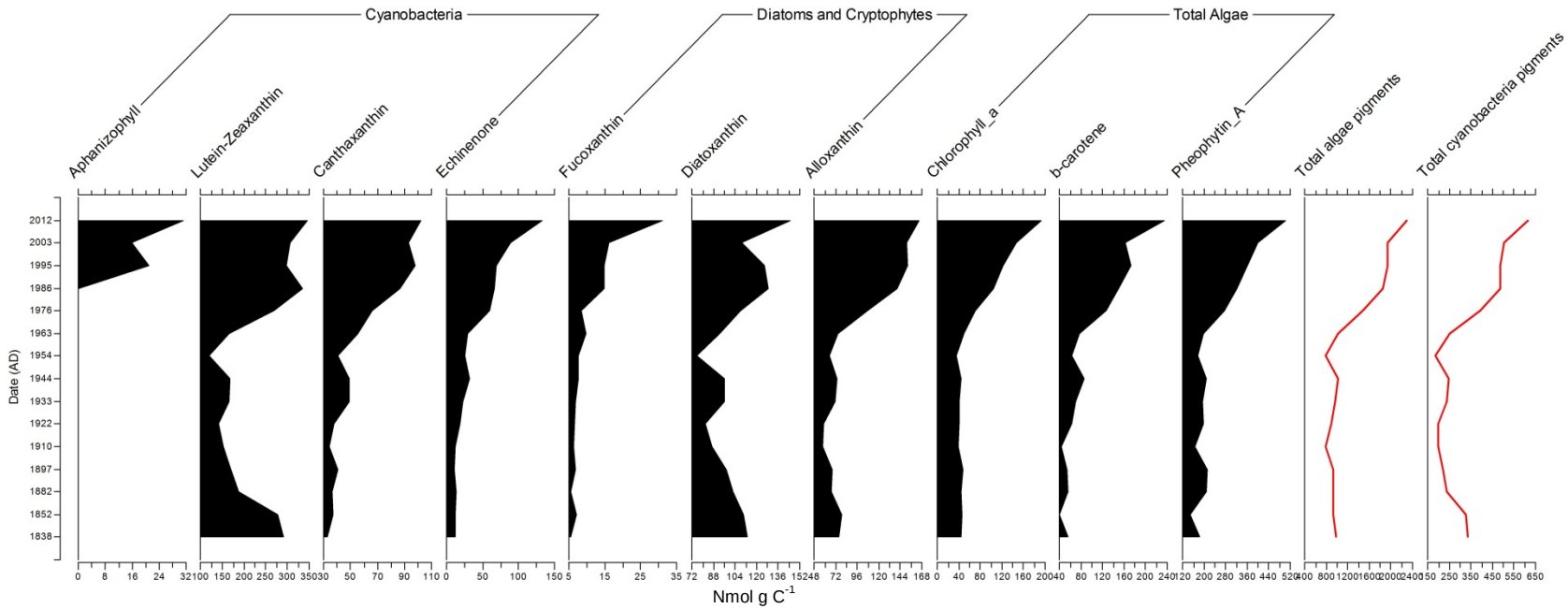


Fig. 13. The sediment algal pigments quantified in fifteen core sections from Big Blake Lake. The group of algae associated with each pigment is also shown along the x-axis.

Historical Zooplankton Communities

Cladoceran subfossils were quantified in fifteen core sections to determine the historical concentration or production of different zooplankton species (Figure 14). Total zooplankton, as measured by subfossil count, showed that overall abundance was high until the 1960s when sharp decreases in littoral species began. Other species followed this same pattern, with a small increase of production in the most recent two decades.

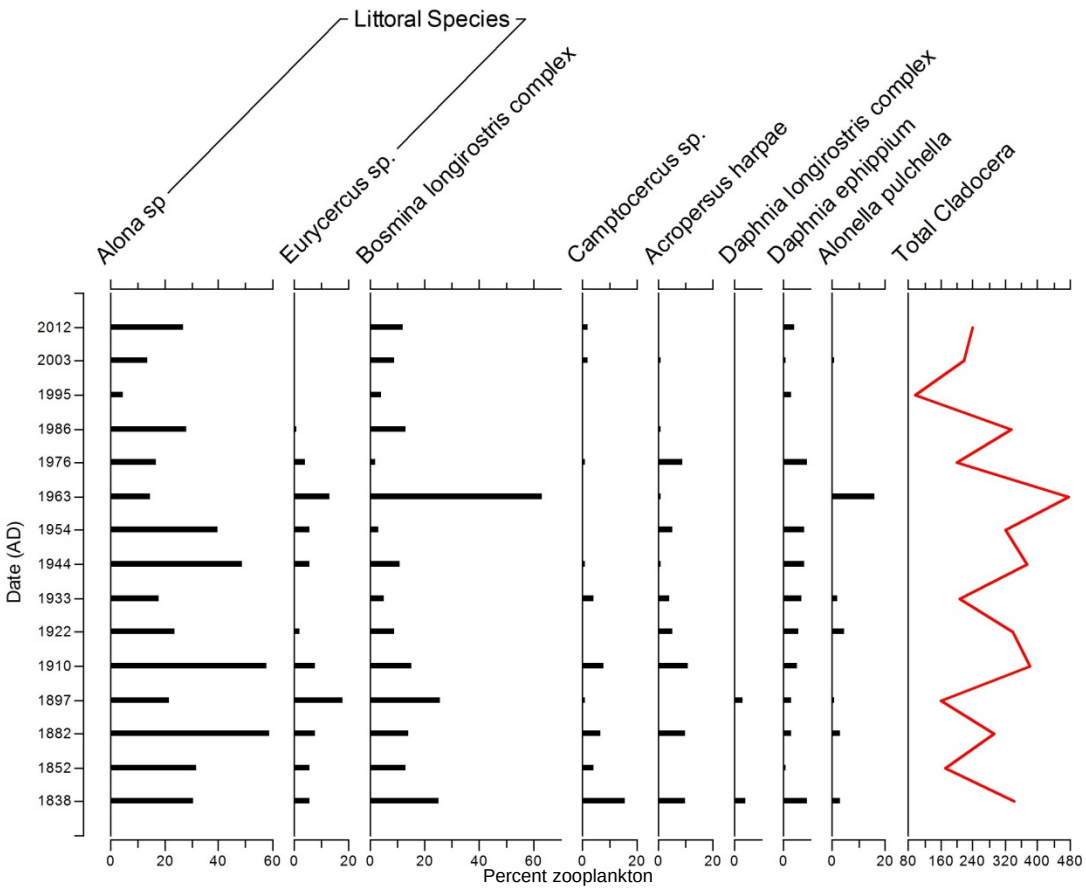


Fig. 14. The sediment cladoceran subfossils quantified in fifteen core sections from Big Blake Lake.

Zooplankton is often overlooked in paleolimnological studies, but their role in a lake is influential in structuring the algal and fish communities. Lake systems are valued primarily for water clarity, fishing, or other recreation, all of which are strongly linked to water quality and ecosystem health. Zooplankton is the primary link between the “bottom up” processes (through grazing) and “top down” processes (as a food source for fish) of the lake ecosystem.

Changes in the aquatic plant community and shoreland habitat can impact zooplankton populations. This occurs especially in shallow lakes where zooplankton are more likely to have the ability to migrate horizontally in and out of macrophyte (aquatic plant) beds to avoid

predation from fish and other invertebrates, as is likely the case in Big Blake Lake. The loss of littoral taxa such as *Alona sp.* and *Eurycercus sp.* indicates changes in littoral habitat have occurred in Big Blake Lake, either from increased sedimentation, loss of the native aquatic plant diversity, or the introduction of invasive species such as *Potamogeton crispus*. The general decline in cladocera is likely due to multiple stressors such as sedimentation, aquatic invasive species, and the increasing prevalence of cyanobacteria in the system.

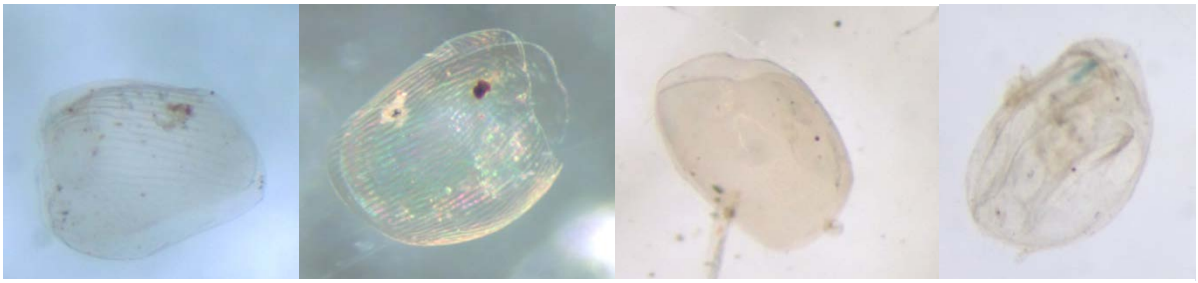


Fig. 15. Examples of subfossil cladocerans from Big Blake Lake recovered from various core depths.

Historical Chironomidae communities

Head capsules of larval chironomids, or the non-biting midges, have several attributes that make them useful as environmental indicators. They are stenotopic or able to tolerate only a restricted range of habitats or ecological conditions**,** but as a group are ubiquitous and abundant. In addition they are readily identifiable, species-rich, sensitive to change, and inferences drawn from chironomid assemblages can complement other paleoecological proxies (Brooks et al. 2007).

All head capsules from each sediment sample were identified to the lowest taxonomic level. Eleven taxa from five major groups were identified in the sediment samples (Figures 16 & 17). Some diagnostic characteristics that are used to separate taxonomic groups within the Chironomidae include: 1. the head capsule of the Tanypodinae looks very different than other chironomids as they do not have a distinctive row of teeth on the mentum, but have a hand-shaped ligula, 2. the Chironomini often have a large head capsule with fan-shaped striated ventromental plates and the mentum can have a variable number of teeth 3. Tanytarsini head capsules have sausage-shaped ventromental plates that are striated, and the mentum has one median tooth and five lateral teeth, and 4. the Orthocladiinae head capsule has a mentum that is very strongly arched (usually with 4-6 pairs of lateral teeth), with narrow, inconspicuous, unstriated ventromental plates, and sometimes has a beard. Another dipteran group that can be found in sediment is the phantom midges or Chaoboridae; for this group it is the mandibles rather than the head capsule that are preserved in lake sediment.

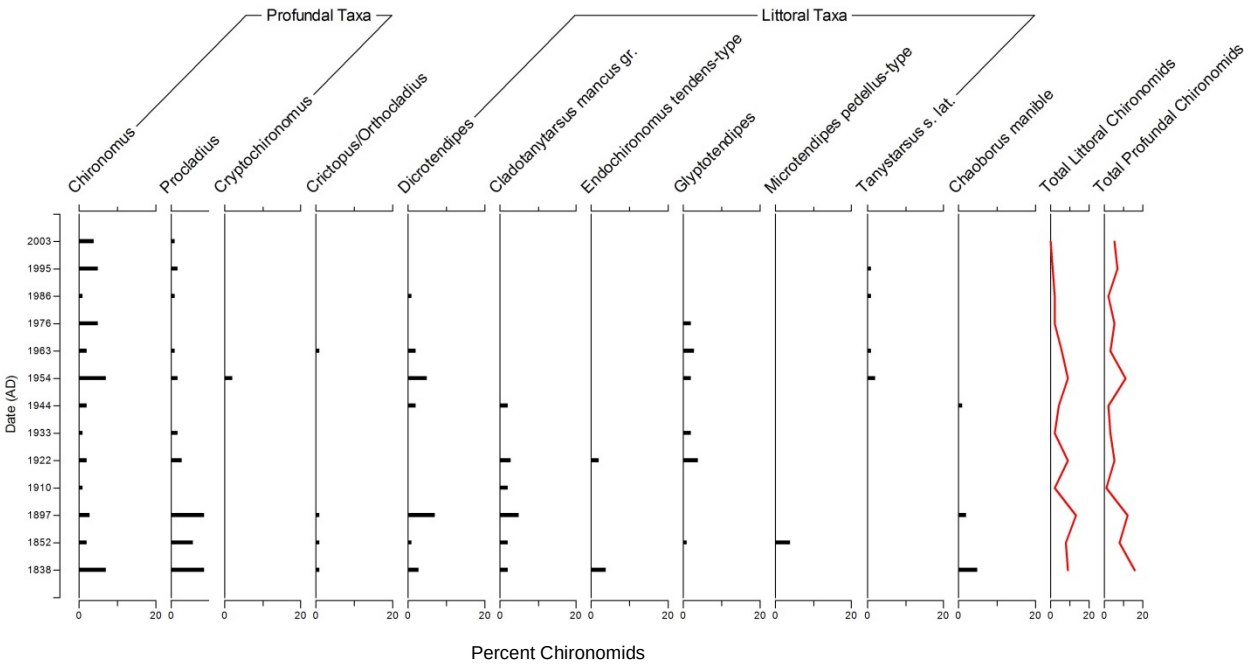


Fig. 16. The sediment chironomid head capsules and *Chaoborus* mandibles quantified in fifteen core sections from Big Blake Lake.

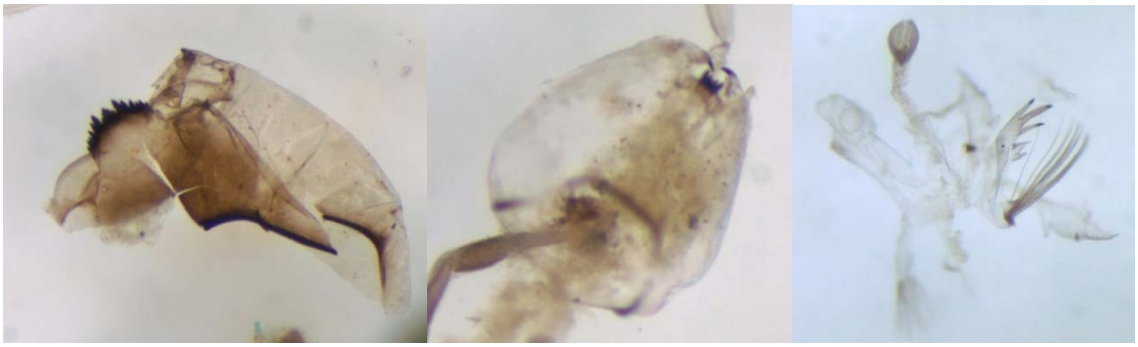


Fig. 17. Chironomid head capsules and a *Chaoborus* mandible from Big Blake Lake recovered from various core depths

Even with a low abundance of head capsules, differences in the chironomid community can be seen through time (Figure 16). There is a decline in *Procladius* starting in the early 1900s, while there is an increase in *Chironomus* in the 1950s. There is also a decline in *Chaoborus* in the early 1900s, and *Chaoborus* mandibles did not occur in the core after the 1940s. *Procladius* is carnivorous, and lives in fine sediments and may be eliminated during periods of anoxia; however, it can survive a long time in an anoxic environment. *Procladius* is most abundant in mesotrophic and eutrophic lakes. *Chironomus* is abundant in warm eutrophic lakes usually in the profundal zone. Due to the hemoglobin in their bodies, *Chironomus* is tolerant of low oxygen conditions and even anoxia for a few weeks. *Chironomus* is opportunistic and is often an early colonizer after environmental change. They are detritivores and filter feeders. *Chaoborus* are often referred to as phantom midges. A high abundance of remains can be indicative of

anoxic conditions (Brooks et al., 2007). However, *Chaoborus* abundance is strongly influenced by fish predation, and remains can aid reconstructions of past fish population (Tolonen et al. 2012). There is also an increase of species of indicative of eutrophic conditions such as *Glyptotendipes, Dicrotendipes,* and *Chironomus* (Francis, 2001) beginning around the 1920s. *Glyptotendipes* and *Dicrotendipes* are large tube-building larvae that depend on a rain of plankton and detritus as food.

Chironomid head capsules have been used to model many facets of environmental change ranging from mean July air temperature and hypolimnetic oxygen to chlorophyll *a*. In this study chironomids where used to augment plant macrofossils and cladoceran subfossils to assess habitat alteration due to increased sedimentation and the introduction of *Potamogeton crispus* into Big Blake Lake. There is a sharp decrease in littoral species in the 1950s and there were none found in the most recently deposited sediment whereas profundal taxa generally did not decrease over time (Figure 16). This would suggest that habitat alteration due to increased sedimentation, aquatic plant management, and the introduction of *Potamogeton crispus* has had a profound effect on chironomid taxa in Big Blake Lake.

Historical Aquatic Macrophyte Communities

Rich aquatic plant communities in midwestern lakes are an invaluable part of the lake's ecosystem, particularly to invertebrates and fish. In lakes, plant growth is limited to certain depths based on availability of light. With greater water clarity, light can penetrate to greater depths and be used by plants for growth. In Big Blake Lake the maximum depth of plants is generally around 2.7 meters. In the spring and early summer, within vegetated areas, *Potamogeton crispus* (curly-leaf pondweed) is the most frequently encountered plant while *Ceratophyllum demersum* (coontail) is the most frequent plant in the late summer and early fall (Figure 18).

Fig. 18 *Ceratophyllum demersum* (coontail) macrofossil. Big Blake Lake core, 31 cm.

Potamogeton crispus can have a particularly negative impact on aquatic macrophyte communities because of its life cycle; germinating in the fall, lying dormant throughout the ice covered season, then actively growing in early spring before indigenous macrophytes have a chance to become established. Because of early germination, *Potamogeton crispus* also senescences early with the potential to release large pools of phosphorus from plant tissues and the sediment, and further reducing littoral coverage of indigenous species.

Because aquatic macrophytes play such an important role in lake ecosystems (especially shallow lakes) macrofossils were identified from 15 different core sections. All plant remains with

diagnostic features where picked and identified to the lowest taxonomic resolution possible (Figure 19).

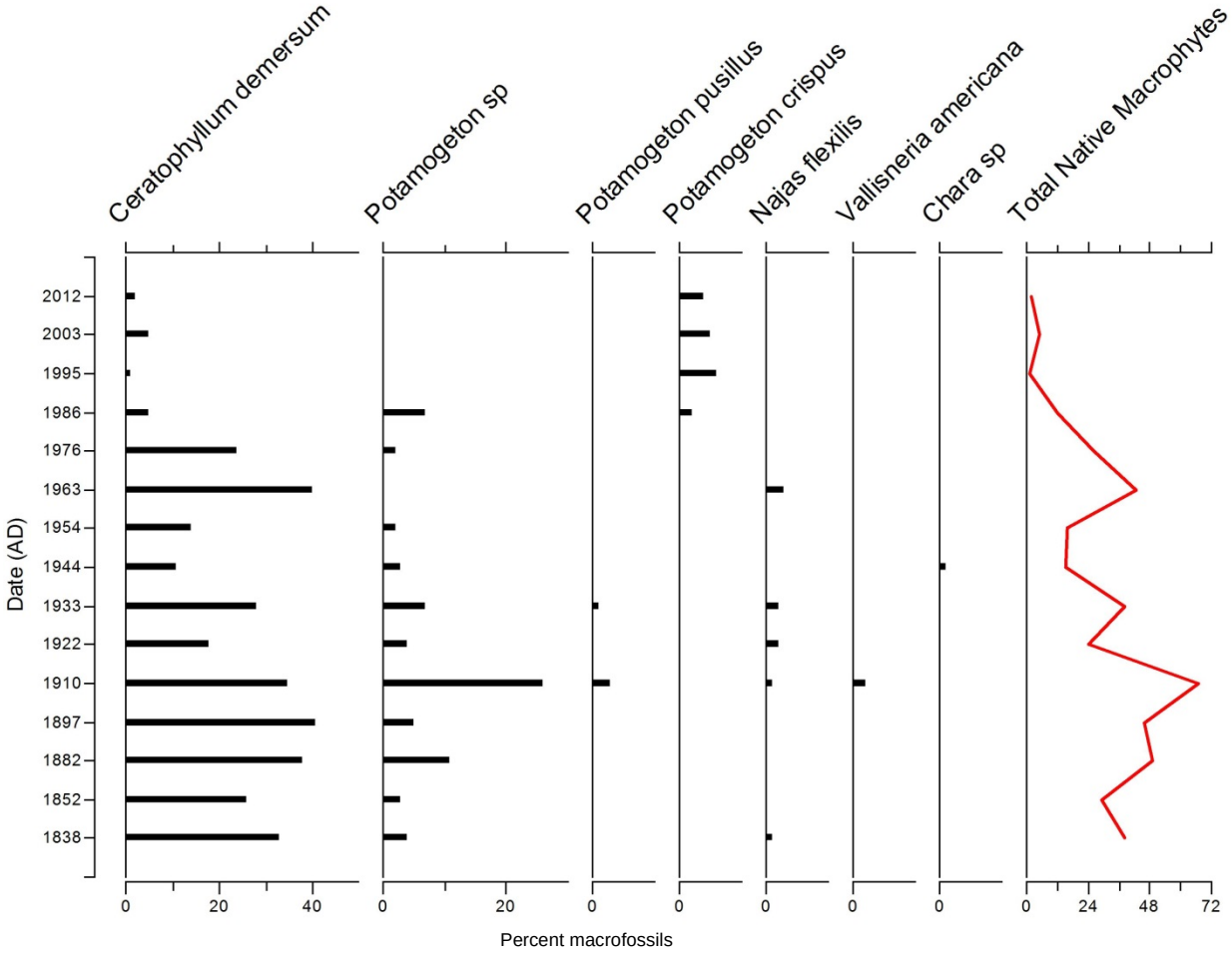


Fig. 19. The sediment aquatic plant remains quantified in fifteen core sections from Big Blake Lake.

Macrofossils of indigenous aquatic plants begin to decrease around 1910. This is likely to do land clearance on conversion in the watershed. There is a sharp decline in native macrophytes after the 1960s. This is likely due to additional watershed disturbances, the increase in nutrients, and the expansion of lake shore development, and eventually the introduction of *Potamogeton crispus* in the 1980s. The most recent decades have very few indigenous fossils but there is a higher occurrence of *Potamogeton cripus* beginning in the 1980s. Multiple stressors have severely altered littoral habitat in Big Blake Lake.

Conclusions

There have been dramatic changes in Big Blake Lake since pre-Euroamerican settlement. Sedimentation had a peak in 1910 and continued increasing in the 1940s to present day levels almost four times as high as historical sedimentation rates. The composition of the sediment has shifted from mostly organic to inorganic portions. Sediment phosphorus and biogenic silica also see significant increases over the period that this study examined.

Overall, the sediment record shows multiple lines of correlated biological evidence of a shift in Big Blake Lake to its current eutrophic condition (Figure 20). For example, there were major changes in the diatom community of Big Blake Lake. The diatom flora was dominated by benthic and mesotrophic taxa from pre-settlement until the 1930s. By the 1940s the lake became dominated by eutrophic, planktonic taxa likely due to phosphorus enrichment. Indeed, diatom inferred TP concentrations show an increase to phosphorus levels considered eutrophic by the 1940s. A sharp increase in *Fragilaria crotonensis* accompanied a period when small seasonal cottages were being replaced with year-round lake homes. The algal pigment analysis showed that cyanobacteria have significantly increased since the 1960s with nitrogen fixing, possibly toxic forms appearing by the 1980s.

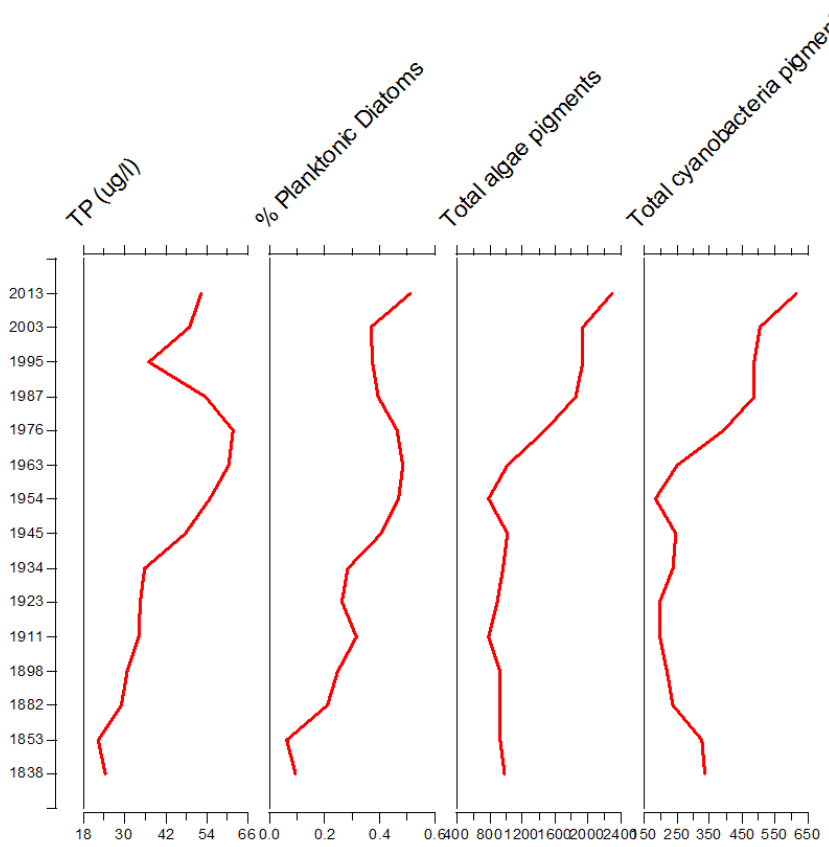
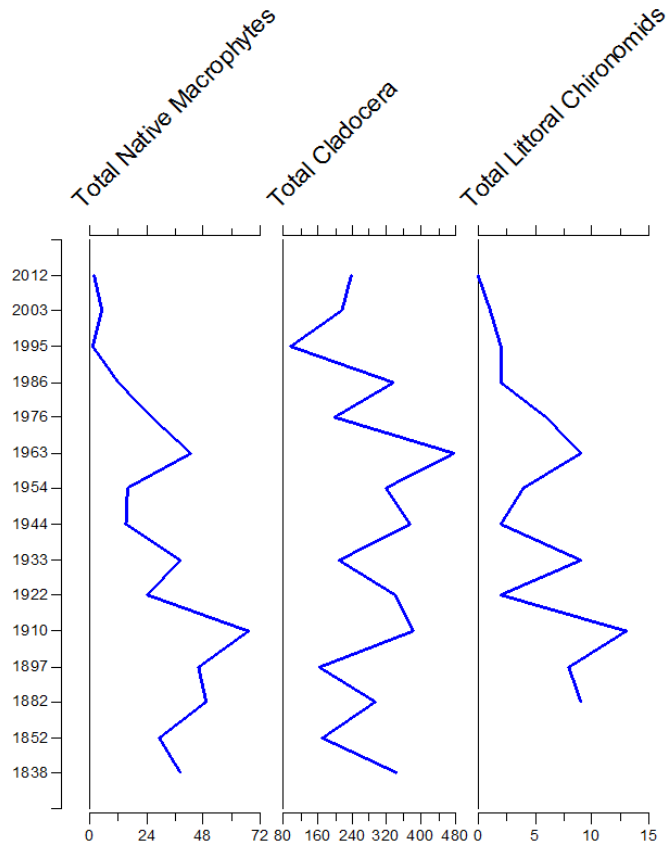


Fig. 20 Indicators for Big Blake Lake core showing a shift to a eutrophic state

Other biological indicators show how in-lake habitats have changed in Big Blake Lake (Figure 21). Cladoceran and littoral Chironomidae are greatly reduced after the 1960s indicating that there have been major habitat alterations in Big Blake Lake. This is like due to multiple factors

such as sedimentation and changes in sediment composition, nutrient enrichment, loss of native plants, and the introduction of *Potamogeton crispus*. Aquatic plant remains of indigenous species decline sharply during this same time period as well. The absence of *Chaoborus* mandibles would indicate that habitat alterations also led to a change in the lake's fisheries.

Fig. 21 Indicators of littoral and mesotrophic state showing decline from the Big Blake Lake core



Big Blake Lake has seen significant changes over the period of this study. The lake has shifted from a mesotrophic lake with a healthy aquatic plant community and associated fauna to a nutirent-rich eutrophic lake dominated by *Potamogeton crispus* in the spring and early summer (Figures 20 & 21). The Big Blake Lake Protection and Rehabilitation District should continue control efforts by harvesting and removing *Potamogeton crispus* biomass. Wider control efforts in the watershed should emphasize working collaboratively with other districts in the Straight River watershed. Efforts should be made on Big Blake Lake to install best management practices for nutrient control around the lake, including nearshore and littoral habitat protection along with other management strategies. The district should maintain monitoring efforts that are in place to detect further changes in lake condition.

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Appendix K

Newsletters, Presentations, and Handouts

BLAKE LAKE BUGLE

Future District Meetings:

Spring Meeting 2015: May 16
Annual Meeting 2015: August 15

Invasive Species Prevention & Clean Boats, Clean Waters
page 4

District Meetings Minutes 2013–2014
pages 5–7

Current dam condition Sept. 1, 2014

UPDATE: Reconstruction of the Big Blake Lake Dam

What happened? Why did the dam break?

In late April three things happened to create "the perfect storm". Days of heavy, soaking rains saturated the soil and strong winds during "ice-out" pushed ice chunks into the old logging dam. Rip-rapped boulders and the old logs constituted the dam and it gave way to the elements.

New dam in 2015

The Lake District Board has been very busy figuring out all that needs to be done to replace the dam as quickly as possible.

The Sherrard family estate has owned the dam. They are working closely with the District to transfer ownership of the dam (and needed adjoining property) to the District. Also, there was some concern that the DNR may require us to completely remove what is left of the existing dam at some point this year. The folks from the DNR said that they did not feel it would need to be removed — as long as it poses no danger. The current plan is to remove the old dam 'after' the new dam is in place. The District received approval to place rip-rap where the dam breached this past Spring to prevent additional erosion. The work was professionally done by Marv Pass (see photo above). This is not intended to repair the existing dam structure nor is expected to help retain any additional water in the lake. *Continued on next page.*

On July 18th, members of the board and APM Coordinator Jim Maxwell, met at the dam site along with members of the Sherrard family, the DNR, a Polk County surveyor and our contracted engineer — Larry Gotham. All parties agreed on the placement of the reconstructed dam. This would be downstream of the existing structure which will allow us to complete construction of the new dam without lowering the current lake levels any further. The final survey is almost complete.

We have a preliminary project plan pulled together. We are looking to have all paperwork, engineering work and approvals completed by the Spring of 2015. The current estimate is May 1st, 2015 and we are seeing if we can move that date up any further. Once everything has been approved, contractors identified and construction begins, our engineering team is estimating 30 days to complete the construction of the dam.

New Dam: "Rip-Rap Rock Chute Dam"

Overview:

- This type of dam is simple, economical and can be built without dewatering
- Virtually Maintenance Free
- Rip-Rap Rock Chute Dam can be built in about thirty days after all the red tape
- Red tape takes about ten-twelve months (survey map, deed transfer, draft and final agreement, plans to WDNR, bidding/ negotiations, build)
- Preliminary Estimate $100k - $150k

Above: This is a typical rip-rap rock chute dam for a high head. The steel sheet pile can be seen under the bridge. This dam will look very natural and in keeping with

Dam Costs Assessment: calculate what you own

How many parcels?
Do any parcels have lake access / lakeshore?
If so, how many feet of shoreline do you own?
For example:
1 parcel, shoreline, 100'
1 parcel, backlot
1 parcel, backlot w/access, 6' (easement is not considered access)

Riparian v non-Riparian 84% / 16% split	Unique: Flat Fee v Non: Flat Fee 91% / 9% split
193 parcels x $434=$83,762	**"Unique"** Owners own at least one property with lake access
75 parcels x $217 = $16,275	**"Non"** owners have no property with lake access
Riparian = $434 ea non-Riparian = $217ea	176 Unique Owners x $518 = $91,168 34 Non x $260 = $8,840
per Parcel based on $100,000 dam Riparian means you have deeded access to the lake or lakeshore property	**per Owner** based on $100,000 dam

Otter Sighting — Keep Your Distance

This family of river otters with a baby was spotted on a dock and boat lift on the west side of the lake in the narrows on September 7. Be careful around otters. Keep your distance. They are fun to watch, but are capable of aggressive behavior. Males can be 25 lbs., females 19 lbs.

Volunteers Active!

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Join Us! If you would like to volunteer for next year please contact Peggy Lauritsen at plauritsen@pldg.com or 612–940–2006.

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Some of the 52 CBCW volunteers, pictured left to right: Judy Hall, Katelin Holm/Water Quality Specialist, Polk County Land and Water Resources Department, Mike Rogge, Naomi Anderson, Tom Borden, Diane Borden, Sue

Call to Order at 9:05 by Sam Weber.

Welcome and Introductions

Board Members Present: Sam Weber, Tom Borden, Jim Filkins, Joan Maxwell, Polk Co Designee Cedric Solland.

Board Members Absent: Adam Elliott, Ron Ogren

Approval of meeting minutes (handout)

Motion to accept/approve minutes from 2013 Annual meeting by Stephanie Hinrichs; Second by Sue Ogren. Motion carries.

Approval of Treasurer's report (handout)

Motion to approve Treasurer's report by Char Dunst; Second by Stephanie Hinrichs. Motion carries

Introduction of Guests and Presentations

Jeremy Williamson, Polk Co LWRD

re: Core Sediment Sampling

Jeremy Williamson presented an update on the findings for the core sampling collected in September 2013. Jeremy has been doing studies on our lake since 2006. He is currently doing top and bottom water chemistry, algae and zooplankton sampling and reconstructing the history of Blake Lake through the core sampling.

They took two core samples and have 195cm of mud, essentially. From this core, they are extracting a lot of geo-chemical data looking at what phosphorus is bound to, finding out how much erosion has occurred in the entire watershed, etc. They date the core, calibrate it, then pull out the diatoms, zooplankton fossils, fish flies, pigments, and all sorts of things to measure and observe.

Blake Lake is really interesting because it has changed significantly over time. We have a low sedimentation rate. They took 2 meters of "mud" and they were able to go back to pre-settlement within 40cm... back to around the 1300s. Our geo-chemical analysis so far seems to indicate that our lake really began changing in the 1970s. In looking back to where we've been, to where our lake has been historically, we will be able to more accurately develop an aquatic plant management plan that is realistic and is based on evidence from where our lake has been in the past.

At the end of this core sampling data analysis, Blake Lake will develop a plan that will outline where we are going with respect to aquatic plant management. This will involve forming a committee to look at the data and present a plan to the District. This will also involve continued citizen lake monitoring participants. Clean Boats Clean Waters will also play a huge role in preventing the spread of aquatic invasive species and protecting our lake water and ecosystem.

Old Business

Slow-no-wake Zone (Tom Borden)

Commissioner Tom Borden updated the District

WDNR and we are m
for buoys to mark the
on Big Blake Lake. W
for the 2015 boating

Email List

The District would li
member in order to c
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District info, CBCW
address to Peggy Lau

Standing Committe

Clean Boats Clean W
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complete our goal.

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Three CBCW volunt
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training.

Polk Co LWRD expe
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Marge Filkins, Jim Fi

APM Harvey Report
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e engineer is

reconstruct the Dam, to assess the District for the costs of this project, and to borrow funds to get things rolling on this with a cap of $175k. If Dam costs go above $175k, the District will hold a special meeting to discuss the project costs and seek approval for additional funding. We do not anticipate this happening, and feel comfortable with the $175k borrowing approval at this time.

VOTE: Funding for Dam Reconstruction: Approved

Motion approving the Dam Reconstruction project by Sue Ogren/ Ford Elliott. Motion carried unanimously.

VOTE: Borrowing Funds for Dam Reconstruction: Approved unanimously. Three methods of assessment were presented to the District:

1) Riparian v Non-Riparian

2) Unique Flat Fee v non-Unique Flat Fee

3) Flat Fee for all plus Riparian cost per foot of shoreline

*Riparian means you have deeded access to the lake or you own lakeshore property. The Board will determine the method of assessment; thank you for your input.

Announcements - Save the Dates

1) Spring Meeting: May 16, 2015 (3rd Saturday in May)

2) 2015 Annual Meeting: August 15 (3rd Saturday in August)

3) 2015 Pontoon Parade: July 4, 4:00 p.m.

Adjourn: Sue Ogren/Gail Rustad, unanimous. Adjourned 11:10.

78 District Members attendees; 6 non-District attendees.

Minutes Submitted by: Sam Weber, Co-Chair

Common Acronyms:

APM:	Aquatic Plant Management
AIS:	Aquatic Invasive Species
BBLP&RD:	Big Blake Lake Protection & Rehabilitation District
CBCW:	Clean Boats Clean Waters
CLMN:	Citizen's Lake Monitoring Network
EPP:	Education, Prevention, & Planning
LWRD:	Polk Co. Land & Water Resources Department
PCALR:	Polk Co. Association of Lakes and Rivers
SWIMS:	Surface Water Integrated Monitoring System
WAL:	Wisconsin Area Lakes (now: WI Lakes Partnership)
WDNR:	Wisconsin Department of Natural Resources

Call to Order: Tom Borden, 9:00 AM

Motion to approve minutes: Jim Thorn/Sue Ogren. Unanimous.

Treasurer's Report: Jim Filkins presented the Treasurer's report and spoke about the need to approve a 50K Reserve account for Harvey as a Capital Expense Acct. Something that never was officially approved in the past. Sue Ogren motioned to approve capital exp acct and Peggy Lauritsen seconded, motion carried. Ogren/Lauritsen motion to approve Treasurer's report carries.

Presentation:

Jeremy Williamson: Core Sediment Sampling:

Jeremy and Katelin from Polk Co LWRD did point intercept surveys on the lake this summer and spoke about gathering extensive data and entering into the mapping program. Curly leaf way behind this year. Native plants are growing where curly leaf used to be abundant, and that's a good thing. Taking chemistry samples at inlet and outlet and using a flow meter to gain critical information. Also is interested in doing sediment core samples – working with science museum – doing Geo chemical analysis also and looking at historical land use, going back 150 years or so. Lessening curly leaf makes us eligible for more grants.

Old Business:

Slow – No-wake:

DNR needed comments and feedback from residents on the lake who have been impacted by the land erosion and lack of a slow wake zone.

Jack Belisle who doesn't live in the narrows commented on the boaters. Gerry Smith remarked about possibly having an on-line survey for our residents to give feedback regarding the need for a slow-no-wake zone. He thought it might be a danger to boaters to hit the buoy with their boat. He was told that it is the boaters responsibility if he does. This was a quote from Mark Little @ DNR. Gale Rustad lives in the narrows and has seen rip-rap totally washed away and seen people spin their watercraft in narrows. Peggy Lauritsen has seen a lot of traffic right by their dock. She commented that in her line of work they do surveys on-line often and if you get a 30% response on the survey is good. Ford Elliott says that 200 feet North of narrows gets hammered with wake. Says buoys are in the water at Balsam. On our lake we would be placing two buoys at each end. They are made of covered foam. Adam Elliott had a question regarding clarity on what kind of buoy. Sue Ogren says boaters are still coming too close to property. Suggested reminding boaters. Jerry Belisle has seen boaters going between his float and his shoreline. Vincent Tueber asked about the number of feet from shore and other boaters. Gail Rustad says people are asking "Where does the no wake zone start and end?" Says they need to see the signs.

Trash can vs. Signage at landings:

Tom Borden reported that trash cans rent for $55 a month and two would be required if we go that route. It was decided – no trash barrels. Signage is better to encourage people to take home their trash and dispose of it properly.

Standing Comm

CBCW: Peggy Laurit
signed up this year. S
literature at Bait Shop
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APM: Jim Maxwell s
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On 6/30/2013 Jim Ma
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EPP Grant (AIS): Sa
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Pontoon Classroom.

Core Sampling Gran

The total for District'
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Elliott seconded. Mo

New Business:

Annual budget: Jim
up significantly. The
Budget remains at $2
motion to approve ca

WAL Convention: St
strongly recommend
Borden and Peggy La

4th of July Parade: F

Spring Meeting 2014

Annual meeting: Au

Adam Elliott volunte
motion carried.

Adjourn: Ford Elli

Paleolimnology of Blake Lake Using Sediment

Paleolimnology is the study of ancient lakes from their sediments and fossils. Jeremy Williamson, Water Quality Specialist, Polk Co. LWRD collected core sediment samples in September, 2013. Since 2006, he has been studying water chemistry, algae and zooplankton to reconstruct the history of the lake. This core data analysis will be the foundation of an aquatic plant management plan for the future.

Read more on page 5. See August 16 District Meeting minutes.

Contacts

Waterfront Property, Polk Co., WI

Alterations to shoreline? Cutting Trees? Building, remodeling, boathouses, driveways, garages, fire numbers?

Polk County Zoning:
(715) 485-9111
http://www.co.polk.wi.us/

Burning permits and restrictions? WDNR or town, village or city:

1-888-947-2876
http://dnr.wi.gov/topic/forestfire/restrictions.html

More resources at:
Polk County Association of Lakes and Rivers (PCALR)
http://pcalr.org/our-lakes-and-rivers/

BLAKE LAKE BUGLE

1988 S. Baker Road
Balsam Lake, WI 54810

Photo by Sam Weber

SAVE THESE DATES

2015 Spring Meeting: May 16 (3rd Saturday in May)
2015 Annual Meeting: August 15 (3rd Saturday in August)
2015 Pontoon Parade: July 4, 4:00 p.m.

BLAKE LAKE BUGLE

Save the Dates!

May 16: Spring Meeting, 9am

June 6 and 13: CBCW season kickoff training

June 13: Pontoon Classroom

July 4: Pontoon Parade, 4pm

August 15: Annual Meeting, 9am

Invasive Species Prevention
Clean Boats, Clean Waters page 4

County and State Resources for Property Owners
page 5

Spring Meeting Agenda
page 7

Current dam image

UPDATE: Blake Lake Dam Reconstruction

We are actively working on the dam reconstruction project and making progress. Working with the DNR and the Sherrard Family/estate, extra time has been needed to finalize legal agreements to get the project into reconstruction. We are moving as fast as we can while being mindful of the real estate issues inherent with the Sherrard family's recent loss. That being said, we are making progress.

We have been fielding questions in the past couple of weeks regarding the dam project. Yes - there are lots of discussions and rumors flying around, too. Our goal is to bring you up to date on our progress and answer some of the questions you may have. We will have more updates during the **Spring Meeting on Saturday, May 16, 9am.**

Questions & Answers

Q: How will the costs for the dam reconstruction at $100,000-$150,000 be assessed to members?
A: After careful consideration of the will of the District members who weighed in at the 2014 Annual Meeting, the value of the Sherrard Family deeded land to reconstruct the dam, and the loan terms offered by the BCPL State Trust Fund Loan Program, the Board has resolved that the dam may be assessed as follows:

$100,000 Dam reconstruction cost @ 3% interest rate*
Riparians: $111.50 per year x 5 yrs = $557.50
Non-Riparians: $57.10 per year x 5 yrs = 285.50

$150,000 Dam reconstruction cost @ 3% interest rate*
Riparians: $167.25 per year x 5 yrs = $836.25
Non-Riparians: $85.60 per year x 5 yrs = $428

Continued on page 3

Lake Management Plan Update

By Sam Rivers Weber

Ice out on April 2nd, 2015, kicked-off our final year of significant data collection, which will inform our Aquatic Plant Management (APM) plan slated to be developed in late 2015 to early 2016 through the efforts of our district members forming an APM committee to look at all the results of the biological reports, core sample findings, the data collected by our Citizen Lake Monitors, our District-wide sociological survey results, and our CBCW data.

As you plan your seasonal activities, please consider becoming a part of these salient ventures designed to educate our members, protect our lake and what we value most about it, and prevent permanent and future damage from destroying this beauty, this goodness, this sanctuary of relaxation, recreation, and precious memories.

For more information, attend our Spring Meeting on May 16 and our Annual meeting on August 15 where some of the experts will present the findings of our grant-sponsored projects. Also, our first ever Pontoon Classroom will be held June 13; a wonderful opportunity to educate yourselves and your family members, and to become supportive stewards of Big Blake Lake.

Blake Lake: We Live It, We Love It, We Mean It!

Two District Board Positions Open, Fall 2015

Two current board members will be completing their term of office this year, Jim Filkens and Tom Borden. We will be electing new board members at our Annual Meeting on Saturday, August 15. Now is the time to think about serving on the board. For more information contact Sam Rivers Weber at 2cherokeerivers@gmail.com or (715) 554-1054.

Contacts

Waterfront Property, Polk Co., WI

Alterations to shoreline? Cutting Trees? Building, remodeling, boathouses, driveways, garages, fire numbers?

Polk County Zoning:
(715) 485-9111
http://www.co.polk.wi.us/

Burning permits and restrictions?
WDNR or town, village or city:

1-888-947-2876
http://dnr.wi.gov/topic/forestfire/restrictions.html

More resources at:
Polk County Association of Lakes and Rivers (PCALR)
http://pcalr.org/our-lakes-and-rivers/

BLPR District Leadership

Sam Rivers Weber Co-Chair
2cherokeerivers@gmail.com | (715) 554-1054

Adam Elliott Co-Chair
adam.elliott@idinsight.com | (651) 343-5380

Tom Borden Commissioner
trborden@msn.com | (651) 335-3895

Jim Filkins Treasurer
mmafilkins@hotmail.com | (715) 307-0873

Peggy Lauritsen
Communications Commissioner / Secretary
plauritsen@pldg.com | (612) 940-2006

The *Blake Lake Bugle* is a publication of the Big Blake Lake Protection and Rehabilitation District. The *Bugle* is published seasonally for friends and members of the district. To receive lake news, send your email address to Peggy at plauritsen@pldg.com or mail to the address below.

Dam Reconstruction Update, cont.

Q: How are you managing the dam project?
A: After conferring with other lake districts and the DNR, we have hired a highly recommended engineer to oversee all aspects of the dam reconstruction project. He is working on all aspects of the project from surveying the property, helping secure all necessary agreements, creating the plan and submitting to the DNR as well as being responsible for the construction phase. It is our intent that this will allow us to complete the project in the most effective way possible.

Q: What is the current status of the dam project and what is the estimated timeline?
A: We have been working diligently on the dam reconstruction project and are currently working on all needed land transfer and easement agreements. Once complete, this will allow us to finalize our plans that will then be submitted to the DNR for final approval. We do not fully control these agreements or the DNR approval process so it is difficult right now to estimate the date when the dam reconstructed will be complete. While we are hopeful that everything will be completed in 2015, there are no assurances that this will be the case.

Q: How long will it take to reconstruct the dam once the plan is approved.
A: The actual construction of the dam is expected to take days and weeks, not months.

Q: What are the anticipated water levels this Summer before the reconstructed dam is complete?
A: Because Big Blake Lake is on a flowage, the water levels can fluctuate based on many factors, including Spring run-offs, overall precipitation and other factors. At the end of last Summer, the water levels were manageable with the existing dam. We are working closely with the DNR to do what we can to maintain the existing water levels until the dam project is complete.

Q: Should I be putting in our docks and boats this Spring, or wait until the dam project is complete?
A: As mentioned above, the water levels can fluctuate, especially with the current state of the dam. While we do not anticipate water levels dropping to levels that may impact your dock and boat placement, your decision is personal preference and may depend on the shoreline water depth near your property.

Q: If I am selling my property, what do I need to disclose to a potential buyer?
A: Please consult your realtor or real estate professional about what you need to disclose. The Board is doing our best to be transparent and update all members about the costs, the timelines, risks and process as we move forward.

Q: How long will it take to reconstruct the dam once the plan is approved.
A: The actual construction of the dam is expected to take days and weeks, not months.

Q: When the old dam is removed, will lake levels drop significantly?
A: The engineers have told us that this is not the expectation. The plan calls for placing the new dam West of the old dam and then to remove the old dam after placement of the new dam.

Q: Will there be a bridge over the new dam and will this be accessible by Big Blake Lake residents?
A: The current plan calls for a foot bridge to go over the dam that can be accessed by residents. The final bridge design is not yet complete.

Q: Will maintenance be required on the new dam?
A: Yes. Periodic inspections will be required and we will have secured the necessary easements and rights to inspect, maintain and repair (if necessary) the dam. We do not anticipate significant incremental costs to perform inspection, maintenance and repairs. We are anticipating any incremental costs to be covered in our annual budget.

Q: Is it possible that the new dam could also fail?
A: While this is certainly always a possibility, the new dam will have all of the latest technology and engineering that our 100 year old dam did not have. The DNR is requiring us to build a dam that is appropriate for a lake of our size and configuration. ¶

Respectfully,

Adam Elliott, Sam Weber, Tom Borden, Jim Filkins and Peggy Lauritsen | *Board Members, BBLPRD*

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* Our interest rate is not locked in yet, so assessments may vary slightly from these numbers. This answer is intended to give you the best information we have at this time from the BCPL Loan Program. Our rate will be locked in upon our loan approval, which is anticipated to take place by mid/end-of May 2015. All loan documents have been filed and are pending final approval. Dam costs have not been determined yet.

June is Invasive Species Awareness Month/WDNR!

Get Involved! Lake Monitoring

The Citizen Lake Monitoring Network is a 1000+ citizen volunteers statewide who gather and monitor lake data, supported by the Wisconsin Lakes Partnership. Volunteers provide their time, expertise, energy, and a willingness to share information with their fellow lake residents or other lake users. The information gathered by these monitoring programs is used by WDNR and university biologists and researchers, UW-Extension, and other interested individuals.

Clean Boats, Clean Waters, is a statewide program. Volunteers are trained to organize and conduct boater education in their community. Adults and youth teams educate boaters on how and where invasive species are most likely to hitch a ride into lakes. Volunteers perform boat and trailer checks for invasives, distribute brochures and collect and report any new lake infestations.

Join Us! To volunteer on Blake Lake, contact Peggy Lauritsen at plauritsen@pldg.com or 612–940–2006.

NEW Volunteers and Veteran Volunteers Welcome! Join us again this year!

There will be training on two Saturday mornings to refresh CBCW volunteers in June as part of the **WDNR "Drain Campaign" June 12-14**, a statewide initiative to make sure anglers know about Wisconsin's invasive species laws. Campaign posters, ice packs and flyers will be available for volunteers to give anglers at the landings again this year. Photos will be taken on all three dates for local media.

Clean Boats, Clean Waters - refresher basics and training at the landing
Saturday, June 6, 10am to noon
Blake Lake, east landing/north end of lake /Bystrom Lane
Come have a cup of coffee and kick off the boating season by volunteering with other CBCW volunteers. All new volunteers will be paired up with veteran volunteers this year. We will go over the basics of boat inspections and what is needed to educate the public about invasives. Supplies and t-shirts will be available for all volunteers Coffee, tea and treats provided.

Clean Boats, Clean Waters - refresher basics and training at the landing
Saturday, June 13, 10am to noon
Blake Lake, east landing/north end of lake /Bystrom Lane
Come have a cup of coffee and kick off the boating season by volunteering with other CBCW volunteers. All new volunteers will be paired up with veteran volunteers this year. Training will be done by Katelin Holmes, Water Quality Specialist, Polk County Land and Water Resources Department. We will go over the basics of boat inspections and what is needed to educate the public about invasives. Supplies and t-shirts will be available for all volunteers. Coffee, tea and treats provided.

New! Pontoon Classroom
Saturday, June 13, Noon to 2pm
Blake Lake, east landing/north end of lake /Bystrom Lane
Join the Polk County Land and Water Resources Department for an on the water experience to learn how water samples, algae samples, and sediment samples are collected and analyzed on Big Blake Lake. This is your opportunity to learn how to find wild rice, how water samples work, learn more about Big Blake Lake and ask any questions you have regarding the lake. There is no cost to attend the classroom, but please RSVP to Katelin Holm at katelin.holm@co.polk.wi.us or (715) 485-8637. Kids over 7 years are welcome, everyone bring a life jacket.

What's needed to be a CBCW volunteer?
Requires: 2 hours of reading orientation material, watch a 7 minute video about boat inspections, perform first boat inspection with a veteran volunteer, and do up to 4 hours per month alone or with others monthly (June, July, Aug., Sept.).

New CBCW Coordinator wanted for 2016
At the end of this season, Peggy Lauritsen will complete her fourth year and retire as CBCW Coordinator. We are looking for a new volunteer to step up and train this Summer to take her place next year. Could that be you? Let's talk. Contact Peggy at plauritsen@pldg.com or call 612-940-2006.

Contacts & Resources

Polk County Assoc. of Lakes and Rivers (PCALR)

Manage, promote, protect and preserve our lakes, rivers and streams

PCALR provides a forum for county lake and river groups to share information, ideas and resources for managing, protecting and restoring their lake, river or stream. The organization works in concert with Polk County Land and Water Resources Department to provide information and education to the public on rules, regulations and ways to help preserve the vitality of our waters.

Here are just a few reasons to visit their website resources: **http://pcalr.org/management-protection/frequently-asked-questions/**

- Lake protection plans, who benefits?
- Maintaining your lake lot, FAQs great questions!
- Shoreline ordinances you need to know

Library resources (just a sampling):

http://pcalr.org/library/

- Lake science basics
- Land use and watershed impact
- Blue-green algae effects on humans and pets
- Free tools for owners to self-assess habitat on your lakeshore
- Lakeshore property values and water quality

UW-Extension Lakes, College of Natural Resources

http://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/default.aspx

A sampling of what you will find on their site:

- Wisconsin Lake Organizations
- Clean Boats Clean Waters
- Citizen Lake Monitoring Network
- Lake Leaders

Wisconsin Lakes Partnership

Since the early 1970s, the Wisconsin Lakes Partnership has been recognized as a national model of collaboration. Three groups form the core of this team:

1. UW- Extension Lakes (UWEX-Lakes), builds connections among stakeholders and provides supporting educational materials and programs;
2. The Wisconsin Department of Natural Resources (WDNR) supplies the technical expertise and regulatory authority;
3. Local lake people make up the third group, represented by Wisconsin Lakes. Citizen volunteers from around the state — lake organizations, property owners, and local governments — provide the political will and hard work to accomplish watershed restoration and lake protection goals.

We are all concerned with the future of our lakes and have joined together in active cooperation and conscientious planning for lake protection. Partnership activities include citizen volunteer monitoring, research, youth and adult training and education, aquatic plant protection, pollution prevention, invasive species education, water recreation planning, land and water regulation, and community assistance grants.

Source: UW-Extension Lakes http://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/default.aspx

Subscribe to a FREE *Lake Tides* newsletter for people interested in Wisconsin lakes

http://www.uwsp.edu/cnrap/UWEXLakes/Pages/resources/newsletter/default.aspx

Amended Annual Meeting Minutes | August 16, 2014

Big Blake Lake Protection And Rehabilitation District

Note: to follow are amended minutes from the annual meeting on 8-16-14, that add detail to the minutes published previously. For a complete set of annual meeting minutes, see the September 2014 issue of the Bugle newsletter.

Annual Business

DAM Discussion

The preliminary figure we've been given by the engineer is between $100k-150k.

Therefore, the board is seeking approval from the District to reconstruct the Dam, to assess the District for the costs of this project, and to borrow funds to get things rolling on this with a cap of $175k. If Dam costs go above $175k, the District will hold a special meeting to discuss the project costs and seek approval for additional funding. We do not anticipate this happening, and feel comfortable with the $175k borrowing approval at this time.

VOTE: Funding for Dam Reconstruction: Approved

Motion approving the Dam Reconstruction project by Sue Ogren/Ford Elliott. Motion carried unanimously.

VOTE: Borrowing Funds for Dam Reconstruction:

Treasurer Filkins explained how BBLPRD can apply to the Board of Commissioners of Public Lands in order to borrow money and establish a line of credit for a District such as ours. General obligation moneys can be borrowed with interest, which will vary but today's rates are 1-2 yrs 2.5%; 3-5 yrs 3%; or 6-10 3.5%.

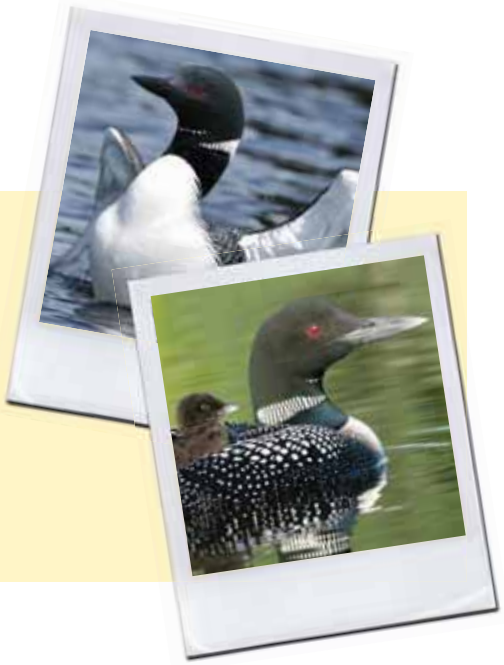
We would be looking at 60-90 days to get the public application approved. This will result in an assessment that will appear on our property tax statement, which will be financed over a number of years so people will have options to break up the payment plus interest over time. Also, the assessment will appear on your tax statement so that Polk Co Treasurer can track the transactions and payments from each property.

Common Acronyms:

APM:	Aquatic Plant Management
AIS:	Aquatic Invasive Species
BBLP&RD:	Big Blake Lake Protection & Rehabilitation District
CBCW:	Clean Boats Clean Waters
CLMN:	Citizen's Lake Monitoring Network
EPP:	Education, Prevention, & Planning
LWRD:	Polk Co. Land & Water Resources Department
PCALR:	Polk Co. Association of Lakes and Rivers
SWIMS:	Surface Water Integrated Monitoring System
WAL:	Wisconsin Area Lakes (now: WI Lakes Partnership)
WDNR:	Wisconsin Department of Natural Resources

Monitoring Opportunities: 2015 loon population survey

Northland College is looking for volunteers to assist with a one-day loon survey that has been conducted every five years since 1985 to estimate the state's loon population. 250 lakes across Wisconsin have been pre-selected, and many lakes still need a volunteer for this event. The survey takes place on **July 18 this year, from 5:00-10:00am**. Read more about this fun opportunity at **http://www.northland.edu/loon-population-survey.htm**



Spring Meeting Agenda | May 16, 2015

9:00am | Georgetown Town Hall, 1847 100th St. County Rd. H,
Balsam Lake, WI 54810

Approval of minutes

Treasurer's report

Guest Presentation
2014 Member Survey results and Pontoon Classroom; by Katelin Holm, Polk County Land & Water Resources Dept. and Adam Elliott

Old Business
1) Dam Update: (Tom Borden and Adam Elliott)
2) Slow-no-wake Zone (Tom Borden)

Committee Reports
1) Clean Boats Clean Waters (Peggy Lauritsen)
2) APM Harvey Report (Jim Maxwell)
3) EPP Grant Update (Sam Weber)
4) WAL Conference report (Peggy Lauritsen)

New Business

Announcements

August 15	Annual Meeting (3rd Saturday in August)
July 4	Boat Parade 4pm

Save the Dates!

Spring Meeting,
Saturday, May 16, 9am,
Georgetown Town Hall

July 4: Boat Parade (4:00 pm)

August 15: Annual Meeting

What can you do to improve water quality?

Restore your shore. Maintain a strip of native trees, shrubs, wildflowers, grasses and sedges 35 ft. wide back from the ordinary high water mark. Shoreland buffers help protect our lake from nutrients, pollutants and sediments in runoff from the land. Deep-rooted native plants can limit erosion while offering a place for wildlife.

Don't use products containing phosphorus. If you use fertilizer, the middle number in the formula on the package must be zero. Also, choose phosphorus-free soaps for laundry, dish washing and household cleaning.

Verify your septic system is working properly. Bacteria as well as nutrients can enter the water from improperly functioning septic systems.

Think about your role as shoreland owner. The way you manage your property affects the entire lake ecosystem.

Reprinted from: *Who's Who…Contacts for Your Waterfront Property*, published by PCALR.

BLAKE LAKE BUGLE

1988 S. Baker Road
Balsam Lake, WI 54810

SAVE THESE DATES

Spring Meeting: May 16 (3rd Saturday in May)
Annual Meeting: August 15 (3rd Saturday in August)
Pontoon Parade: July 4, 4:00 p.m.

BLAKE LAKE
BUGLE
AUGUST 2015

ANNUAL MEETING, SATURDAY, AUGUST 15, 2015

9am to 12pm at Georgetown Town Hall,
1847 100th Street,Balsam Lake, WI 54810

Board Members: Sam Rivers Weber/Co-Chair, Adam Elliott/ Co-Chair, Tom Borden/ Commissioner, Jim Filkins/ Treasurer, Peggy Lauritsen/Secretary, Ken Sample/Polk County Board, and Ron Ogren/Georgetown Chair.

AGENDA (AGENDA WITH FLEXIBILITY)

Call to order, welcome and introductions, approval of minutes

Treasurer's Report
Guest Presentation: Reconstructing the History of Blake Lake -Results of Core Sediment Sampling, presented by Jeremy Williamson, Polk County Land & Water Resources Dept.

Old Business
1. Dam Update: Adam Elliott
2. Slow-no-wake Zone (Tom Borden)

Committee Reports
1. Clean Boats Clean Waters (Peggy Lauritsen)
2. APM Harvey Report (Jim Maxwell)
3. EPP Grant Update (Sam Weber)

New Business
- Polk County Updates, Georgetown Updates WLP
- (WI Lakes Partnership) Convention Delegates for April 20-23, 2016

Annual Business
Approval of 2016 Annual Budget (Jim Filkins)
Vote: Election of 2 new commissioners – 3-year term currently held by Tom Borden and Jim Filkins

Announcements
- May 21, 2016 — Spring Meeting, 9am-noon (3rd Saturday in May)
- August 20, 2016 — Annual Meeting (3rd Saturday in August)
- July 4, 2016 — Boat Parade (July 4th is on Monday), 4pm

BLPRD 2016 ANNUAL BUDGET
August 1, 2015 to July 31, 2016

Category	Budget
EPP Grant	$2500
APM Coord	$2500
WAL Convention	$1500
Dues	$355
Harvey Pay/Exp	$7000
Insurance	$4500
Admin	$1645
TOTAL	$20,000

SPRING MEETING MINUTES

Meeting Date: 5-16-15

Meeting at Georgetown Town Hall called to order by Co-Chair Sam Rivers Weber at 9:01 am.

Board Members present: Sam Rivers Weber/Co-Chair, Adam Elliott/ Co-Chair, Tom Borden/ Commissioner, Jim Filkins/Treasurer, and Peggy Lauritsen/Secretary.

AGENDA

Welcome and Introductions
Co-Chair Rivers Weber proposed to approve the agenda with flexibility. Motion was made to approve agenda with flexibility by Jack Belisle, second by Mike Rogge. Unanimous. Motion carries.

Approval of Minutes
Co-Chair Rivers Weber explained the amended minutes from the 2014 Annual Meeting, published on page 6 in the Spring 2015 newsletter. Motion to approve minutes by Jim Seifert, second by Sheila Monson. Unanimous. Motion carries.

Treasurer's Report
Jim Filkins reported account balances as of 4-30-15 as follows: Checking $6363.99; Savings $5.00; and Money market $65,704.88. Anticipated taxes are $8000-$9000.

Introduction of Guest Presentation
Presenter: Katelin Holm, Information and Education Coordinator/Water Quality Specialist, Polk County Land & Water Resources Dept.

Grants ending
We have 2 grants that are ending in 2015, EPP Grant (Education/prevention/planning) and the Sediment Core Grant. Blake Lake is the only lake in Wisconsin that has a state harvesting grant to control invasive weeds, and not use a chemical treatment. Because of this we have a flagship program in the state.

2014 District Member Survey Results
The survey was mailed to 217 district members in May, 2014. There were 126 responses, or 58% response, which is excellent given that a 30% response is considered good or acceptable. The survey results will inform our lake management plan going forward.

- Top concerns by 75% of members: new invasives, more curly leaf, excessive plant growth, excess algae, water clarity, increased nutrient pollution and decrease on overall lake health.
- Low or no concern: 60% believe there is no concern about excessive noise or decreased wildlife.
- The average number of years owned property on the lake: 21 years. 50% living on the lake seasonally, which is common in Polk County; 56% are weekend residents and 33% are full-time residents. 148 days per year property is used. This data can helps with modeling and septic systems.

Continued on next page

Spring Meeting minutes continued from page one

- Shoreline buffer zone of 35 feet is ideal that includes plants, shrubs and trees. 91% of properties have mowed lawns; 38% unmowed section, 50% have shrubs in this area; and 15% have woods on shoreline.
- 49% of properties have piers/docks
- Amount of lawns: 50% of members said its just right; 25% said too much; and 25% were not sure.
- Interest in shoreline improvement: 75% interested
- Use phosphorous on property: 98% don't use or use phosphorous-free fertilizer.
- What activities members enjoy most: 93% value views and peaceful enjoyment.
- Watercraft used: 46% use canoes, kayaks and other non-motorized; 46% use watercraft with 21-50HP; 25% use boats on other lakes.
- Water Quality: 54% rated it fair; 26% rated it good. More people thought water quality had degraded rather than improved. What month algae a problem: 66% said July and 88% August.
- Impairments: 92% algae impairs swimming; 57% fishing; 52% boating/pets & animals. Boating not impaired by algae.
- Impairments by plants /Curly leaf identification: 50% could recognize it.
- Plant Harvesting/ how satisfied?: 44% somewhat; 19% very satisfied
- Key Actions and Priorities to Manage Big Blake Lake: 91% of members want the dam up to code; 89% believe AIS (invasives) is a top priority; 78% enhance fisheries, 71% upgrade non-conforming septic systems; 61% install shoreline buffers and rain gardens; 54% install farmland conservation practices; 44% want lake fairs and workshops and 44% want enforcement in slow-no-wake-zones; 90% want harvesting of lake weeds; 89% want monitoring of new AIS; 86% want Clean Boats, Clean Waters; 72% want educational programs; 54% want to use herbicides to control curly leaf; 37% want landing cameras; and 35% want washing stations at landings (not in Polk Co. now).

Katelin will email the full 10-page report summary to anyone who wants it. Contact her at katelin.holm@co.polk.wi.us.

APP Grant Expiration in 2015: Blake Lake has a 3-year AIS (aquatic invasive species) grant that ends in 2015. Every other week samples are collected from the lake including pH, temperature. Once a month nutrient samples are sent to the lab. Algae and zooplankton are measured once a year. The Spring and Fall plant survey is measured at 276 GPS points on the lake and three people rake samples of plants. Once-a-year dredge samples taken. In the Spring, curly leaf pondweed turions are sampled. Nutrient levels are sampled at inlets and outlets.

There is a county and state emphasis on AIS prevention via the June Drain Campaign (focused on anglers) and the July Landing Blitz (focused on all boaters). A key component of prevention is educating members, and all boaters. She handed out a list of AIS training and classes in June. Again this year she will be leading several of the trainings at the east landing including a new class "Pontoon Classroom" on June 13 from noon to 2pm. Details were published in the Spring newsletter.

Katelin advised us to think about the development of a lake management plan with a sightline of the next 20 years. How do we want the lake to be in the future? Everyone is invited to contribute to this coming effort.

Katelin reported on the Sediment Core Grant. Samples are taken from the deepest part of the lake to see how the lake is changing and has changed over the past 150-200 years. Samples identify what the state of the original lake was. Jeremy Williamson will be reporting updates at the Annual Meeting in August.

Old Business

Dam Update by Adam Elliott/Co-chair

We hired a good engineer Larry Gotham, early in the process to manage the project and keep things moving. The DNR advised that we had good timing for fast-tracking the project. We are approved for the loan of $150,000 as of May 5. We have 4 months, until September 5, to draw down the funds. We are expecting a 3% interest rate upon drawn down with a 5-year term. The funding source, BCPL (Board of Commissioners of Public Lands), funds schools and libraries in the state. We are in the process of getting the outlot transferred from the property owners/Sherrards. Once we get the ownership of the outlot the district takes over to start the reconstruction. There will be a permanent easement for maintenance and temporary easements for construction. Legal agreements are being processed, and with that we can get approval from the DNR. In all, the process is going well and going down the right path. Once all agreements are in place to the DNR, the reconstruction can start. Regarding the timeline, we do not know at this date if the project will be done in 2015. We are moving forward as much as we can and with respect to the Sherrard family dealing with estate issues. The new dam will be a rip-rap-rock-chute dam style. When the new construction goes in the old dam comes out. Members were encouraged to contact any district board member with questions. Board member contacts are listed on page 2 of the newsletter. A question and answer period followed the presentation.

Slow-no-wake zone update by Tom Borden/Commissioner

The 6 buoys are arriving within a week and will be installed by June. Signs will be posted at the landings. The buoys will identify the slow-no-wake zone through the narrows on Big Blake Lake.

Standing Committee Reports

Clean Boats, Clean Waters (CBCW) by Peggy Lauritsen/ AIS Coordinator

There are three seasonal goals: 1) volunteers perform 400 hours of CBCW monitoring (200 hours per each of two landings); 2) educate boaters and the public to avoid the accidental spreading of invasives; and 3) increase awareness with district members that our grant requires volunteer hours.

Peggy thanked all past CBCW volunteers who have helped to meet our goals year after year. Thanks to Vicky Dorner for representing our lake, attending the Annual CBCW training April 29 presented by Katelin Holm, Polk Co. Land and Water Resources Dept. Highlights are included in our display at the meeting.

CBCW Training Dates and Activities

There will be training on two June Saturday mornings to refresh CBCW volunteers in June as part of the WDNR "Drain Campaign" June 12-14, a statewide initiative to make sure anglers know about Wisconsin's invasive species laws. Dates are June 6 and 13. Posters, ice packs and flyers will be available for volunteers to give anglers at the landings again this year. Training on June 13 will be lead by Katelin Holmes.

New CBCW Coordinator Wanted

Peggy announced that she will complete her fourth year and retire as CBCW Coordinator. We are looking for a new coordinator for 2016. She suggested that a committee approach of several volunteers could be considered instead of having just one person coordinate all efforts.

APM Harvey Report by Jim Maxwell, APM Coordinator

There are lots of weeds already this year. This is the ninth year of studies done on our lake by the research team. This team needs to complete samples of the weed population before cutting can start. As soon as that happens cutting will be aggressive.

EPP Grant Update by Sam Rivers Weber
The EPP Grant (Education, Prevention, and Planning) is a 3 year grant that is ending in 2015. It is a $66,000 project designed to educate District members about the lake and about aquatic invasive species (AIS). Katelin Holm's report today is the detailed update on where we are at currently with the grant. District members are forming a committee to study the results of all the studies and surveys to inform our APM committee at the annual meeting in August.

WLP Convention by Peggy Lauritsen
The Wisconsin Lakes Partnership Convention (WLP) is an annual, statewide convention that she attended on April 23-25 in Stevens Point. Wisconsin Lakes Partnership consists of 3 core groups: 1) Wisconsin DNR (technical, financial, regulatory); 2) University of WI extension Lakes (educational materials) and 3) Wisconsin Lakes (advocates statewide for local lake people and lakes). The Wisconsin Lakes Partnership brings science, education, and citizens together to empower people to work together to care for our lakes. Six educational tracks included "Watersheds, Groundwater and Water Levels", AIS, Ecology, "People Policy and Politics", "Nutrients in our Lakes" and Public Health.

Conference highlights and value we can bring to our district include:
Networking with attendees: AIS leaders in our area attending from Balsam Lake, Deer Lake, Bone Lake, Amery Lakes, Round Lake and White Ash Lake.

Takeaways: literature in the display today is the latest and some "just published", many statewide contacts to experts in many areas.

Leadership training: all day workshop for "Beginner and Advanced Lake District Commissioner Training".

The latest information on key topics:

1. "Long term EW Milfoil research and long term effects of herbicide on native plants". Learnings: there are 100 plant species in Wisconsin lakes. After herbicide treatment some plant species NEVER COME BACK after treatment. As was the case in Sandbar Lake and Tomahawk Lake.
2. "Learning from our Neighbors: What's new in Minnesota AIS prevention and management". Tina Wolbers-AIS (Aquatic Invasive Species) Prevention Planner, Minnesota DNR.
   - MN has a 21- day dry time for docks/lifts
   - Citation: transport or possess prohibited species; and launch into non-infested waters with AIS attached MN=$500; WI=$295
   - Since 2013 MN using dogs to detect zebra mussels
   - MN increased the use of roadway checkpoints by 300% in last 3 years. Violation rate is 17%, down from 31% three years ago.
3. Greater awareness of impacts to the watershed that effects our lake district.
4. Invasive species are a very big threat: Increased education and strategies to fight Eurasian milfoil, zebra mussels, and purple loosestrife are top priorities.
5. County alliances forming for lakes and rivers: Eau Claire area watershed creating a coalition to qualify for federal grants. Polk County has 14 lake districts, with increased talk about collaborations to improve shorelines and buffer zones. Special sessions at the conference in 2016 to support new alliances.
6. 50% of Polk County revenue comes from waterfront property taxes. Important economically to protect our lakes and rivers.

New Business

Communications
Peggy Lauritsen reported that the results of the 2014 Member Survey will help to shape communications to members going forward. We are currently sending the newsletter to 226 members 2x per year; our email list is sent almost monthly to 92 members with an open rate of 65-70%; social media using Facebook has grown from 10 fans in 2013 to 77 fans in 2014 to 165 fans as of May 2015.

Announcements

- 2015 Annual Meeting will be held August 15th (3rd Saturday in August)
- 2015 Boat Parade July 4 at 4pm. (July 4th falls on a Saturday)
- A motion was made by Jim Sieffert to adjourn the meeting and second by Marge Kabis. Meeting adjourned 12:01 pm. A total of 68 district members attended the Spring Meeting.
- Minutes respectfully submitted by Peggy Lauritsen, Communications Commissioner/Secretary, plauritsen@pldg.com

PONTOON CLASSROOM ATTENDEES ON JULY 2

Instructor Katelin Holm/Information and Education Coordinator & Water Quality Specialist, Polk County Land and Water Resources Dept., Tommy Budd, Vicky Dorner, Lisa Denne, Joe Norby, Sue Budd, instructor Jeremy Williamson/ Polk County Land and Water Resources Dept. and not pictured, Peggy Lauritsen.

TWO DISTRICT BOARD POSITIONS OPEN FALL 2015

Two current board members will be completing their term of office this year, Jim Filkens and Tom Borden. We will be electing new board members at our Annual Meeting on Saturday, August 15. Now is the time to think about serving on the board. For more information contact Sam Rivers Weber at 2cherokeerivers@gmail.com or (715) 554-1054.

VOLUNTEERS DEFEND AGAINST INVASIVES

Thanks to the volunteers on our lake who contribute 400 hours each season to check boats at the landings and educate boaters about invasive species.

June 13 Clean Boats, Clean Waters Training and Volunteers on Blake Lake. Pictured (left to right) are AIS (Aquatic Invasive Species) experts Jeremy Williamson and Katelin Holm, water quality specialists, Polk County Land and Water Resources; Volunteer boat inspectors Mike Rogge, Judy Hall, Vince and Mary Teuber, Vicky Dorner, Sue Ogren, and Diane Borden. Not pictured: Peggy Lauritsen, Tom Borden, Jim and Marge Filkins and Joyce Booth.

June 6 Clean Boats, Clean Waters
Volunteers on Blake Lake, (left to right): Mike Foley, Ann Foley and Shelley Rodriguez.

About Clean Boats, Clean Water Program

With the growing concern over the spread of aquatic invasive species to Wisconsin's inland lakes, many lake association members and other concerned citizens are looking for ways to get involved. The Clean Boats, Clean Waters volunteer watercraft inspection program is an opportunity to take a front line defense against the spread of aquatic invasive species. **If you want to get involved on Blake Lake contact Peggy at plauritsen@pldg.com or 612-940-2006.**

Save the Dates!

May 21, 2016 — Spring Meeting, 9am-noon (3rd Saturday in May)

August 20, 2016 — Annual Meeting (3rd Saturday in August)

July 4, 2016 — Boat Parade (July 4th is on Monday), 4pm

BLAKE LAKE BUGLE

1988 S. Baker Road
Balsam Lake, WI 54810

BLAKE LAKE BUGLE

FALL 2015

Annual Meeting Minutes

Meeting Date: 8-15-15

Annual meeting at Georgetown Town Hall called to order by Co-Chair Adam Elliott at 9:00 am.

Board Members present: Sam Rivers Weber/Co-Chair, Adam Elliott/ Co-Chair, Tom Borden/ Commissioner, Jim Filkins/Treasurer, and Peggy Lauritsen/Secretary, Communications. Also present Ken Sample/Polk County Board.

AGENDA

WELCOME AND INTRODUCTIONS

After Board introductions, Co-Chair Elliott proposed to approve the agenda with flexibility. Motion was made to approve agenda with flexibility by Allen Moe, second by Jerry Smith. Unanimous. Motion carries.

APPROVAL OF MINUTES

Minutes of the Spring Meeting were printed in the Bugle newsletter and mailed to members, received on August 10. An email with the Spring Meeting minutes was sent on August 13. Copies of the minutes were also handed out at the meeting. A motion was made to approve the minutes by Steve Paul, second by Sue Ogren. Unanimous. Motion carries.

TREASURER'S REPORT

Jim Filkins reported account balances as of 7-31-15 as follows: Checking $633.25, Dam Project checking $1034.50; Savings $5.00; and Money Market $45,276.97.

GUEST PRESENTATION

Presenter: Jeremy Williamson, Water Quality Specialist and Aquatic Invasive Species Biologist, Polk County Land & Water Resources Department, presented "A History of Blake Lake – Results of Core Sediment Sampling". Since 2006 plant studies have been done on Blake Lake. Over the last 3 years a comprehensive water quality study has been done. A sediment core sampling was done to reconstruct the ecological history of the lake. Water quality has changed substantially over the past 50 years, and not in a healthy direction. Now with the data collected, a comprehensive lake management plan can be created. What do members want the lake water quality, plant life and fishing to be over the next 20 years? A Lake Management Committee (LMC) will be formed of 5-10 people/members. A sign-up sheet was passed around and approximately 15 people signed up to be a part of this committee. There will be 3-5 meetings over the Winter at a Balsam Lake location in the evening. At the 2016 Annual Meeting, the LMC committee will present the new lake management plan for approval to district members. If members want to sign up who were not at the meeting contact Sam Rivers Weber at 715-554-1054 or 2cherokeerivers@gmail.com.

Jeremy went on to explain the findings from the sediment core samples collected. Sediment reveals atmospheric nuclear testing done in the 50s. He used historic photos of Blake Lake for a geographic reference and overlaid the watershed area. From that he is able to see a timeline of historic loading, the amount of phosphorus in water. Jeremy talked about changes in property and housing development over time. From 1938 to 1974 there was very little buildings around the lake. Since 1974 there has been dramatically more development. Originally, the

Continued on next page

Annual Meeting minutes continued from page one

lake land around the lake was logged off, it reforested and row cropping dramatically reduced loading. "The good news is…we can get our house in order with very little effort".

Jeremy has analyzed loading rates for phosphorus in the mud of other Polk County lakes near the size of Blake Lake at 250 acres. Mud can have a lot of nutrients collect and it's an easy fix to get phosphorus to move. This corrolates with when curly leaf pondweed really took off. Since the 60s and 70s pigments increased and drastically changed. Much greener due to algae. Blue-green algae pigment increased possibly due to internal load or curly leaf.

Jeremy went on to say that he is reconstructing the fish history from the 1800s. The lake was 10 feet deeper at one time before logging and the dam. Jeremy is one of four in North America working on plant microphossils. Part of his mission is to find ways to restore good native plants. From 1800s to 1990s the lake plant community completely changed, sediment and water quality also changed. Changes in sediment changes the plants.

In Blake Lake the curly leaf has been reduced, but the challenge is to get back to native plants that provide clear water quality and good fish habitat. He sited Deer Lake has done many best practices to achieve significantly clearer water. Deer Lake and Bone Lake used grants to help pay for 75% of the costs.

A question and answer period followed the presentation.

OLD BUSINESS

Dam Update by Adam Elliott/Co-chair

We have spent $15,000 to date on the Dam Project. While there are still aspects of the project still out of our control, here are the latest projections after conferring with our Engineer.

1. **Land Transfer:** DNR approval of Transfer is expected to occur in early September. Upon DNR approval, the Deed can be signed and recorded. The property will then be transferred to the District at that point in time.
2. **Planning:** Our engineers will be working on the overall dam design this Fall and early Winter.
3. **DNR Approval:** We are expecting approval of dam plans in the Spring of 2016.
4. **Contractor:** Upon DNR approval, our engineer will help us select a contractor as soon as possible — expected in early Summer of 2016.
5. **Construction:** Our engineering team is expecting to commence work in late Summer or early Fall of 2016. Late Summer or early Fall is generally a time of lower stream flows.
6. **Completion:** Project completion and certification to the DNR is expected in the Fall of 2016.

The BLPRD Board applied for and was granted a $150,000 loan. Here is a summary of the financing terms:

- On August 26th, 2015 a check for the entire loan amount ($150,000) will be sent to BLPRD.
- The term of the loan is 5 years.
- The interest rate on the loan is 3%.
- The total finance charge is approximately $12,000.
- We have the ability to pay the loan off early.

Jim Filkins, Treasurer, confirmed we are receiving the loan on 8-26-15 and reminded members that we have locked in an interest rate of 3% for a 5-year term. The style of the dam will be a rip-rap-rock-chute-style dam. The WDNR controls the water level in the lake when the new dam is complete. The WDNR and engineer recorded the "normal" water level prior to the dam failing and when the new dam is complete the water level will be returned to this standard.

Slow-no-wake Zone Update by Tom Borden/ Commissioner

Tom opened a discussion to get feedback from members about the 6 new buoys installed in late June. He reviewed that the purpose of the buoys is to protect the safety of people on the water and in the water, and to avoid shoreline erosion. The slow-no-wake zone follows state law and is 100 feet before buoys and 100 feet after buoys. Discussion ensued. The Board plans to take this under advisement and come up with solutions. They will look at buoy placement, quantity, education, enforceability and DNR support.

The Board plans to take slow-no-wake zone feedback under advisement and come up with solutions. They will look at buoy placement, quantity, education, enforceability and DNR support.

A motion was made as follows by Anne Yourchuck, second by Vince Teuber: The motion was to wait until next season to vote in a special session if necessary (immediately following the Spring Meeting) to make changes regarding the buoys. Unanimous. Motion carries.

Comment by Ken Sample/Polk County Board

Ken encouraged our district to work in unison with other districts and organizations in the county to have the most impact. He offered assistance to help "carry our message" wherever needed to achieve our lake management plan.

STANDING COMMITTEE REPORTS

Clean Boats, Clean Waters (CBCW) by Peggy Lauritsen/AIS Coordinator

There are three seasonal goals:

1. Volunteers perform 400 hours of CBCW monitoring (200 hours per each of two landings);
2. Educate boaters and the public to avoid the accidental spreading of invasives; and
3. Increase awareness with district members that our grant requires volunteer hours. Peggy thanked all past CBCW volunteers who have helped to meet our goals year after year.

From the 2014 Member Survey we learned that:

- 89% of us/members believe AIS (invasives) are a top priority
- 89% want monitoring of new AIS (invasives)
- 86% want to keep our CBCW program
- 50% believe we can identify curly leaf pondweed, the invasive weed we have now

CBCW Results – YTD: Education & boat inspections: goal is 400 hours per season.

Completed hours YTD: 295 hours, 73% complete. We are right on target.

In the 45 days until September 30 we have 105 hours remaining to finish our goal. We will meet our goal same as last year. Most of our boat inspection data is entered online and is up-to-date.

AIS Training done this year:
Seventeen volunteers attended two trainings June 6 and 13 as part of the DNR "Drain Campaign" a statewide initiative started last year to make sure anglers know about Wisconsin's invasive species laws, and the Annual 4th of July DNR 7th annual statewide Landing Blitz, focused on boaters with heightened awareness about invasives. We were one of 290 lakes in 53 counties in WI participating again this year.

Pontoon Classroom – 8 people attended on July 2, rescheduled due to rain from June 13. Instructors were Katelin and Jeremy, Polk County Land and Water Resources Department. We learned about how to extract water samples, algae samples, sediment and identification of invasives.

Public Awareness Efforts to achieve our CBCW goals:

- CBCW information published in BL Bugle sent 2-3x per year to district members.
- Literature and displays at May and August member meetings: includes the latest AIS information from state and county sources.
- Email communications to 40 volunteers 2x month, June to October.
- Distribute brochures and posters to local bait shops throughout the Summer.
- Placed 1 newspaper article in Inter-County Leader, published 2nd week of July about the Landing Blitz and featured pictures of our volunteers. We received excellent Outdoor Section page placement. This newspaper has a circulation of 13,000 readers.

Peggy is completing her fourth year as CBCW Coordinator. She asked for a new CBCW coordinator. No volunteer came forward. She suggested that a committee approach of several volunteers could be considered instead of having just one person coordinate all efforts.

APM Harvey Report by Jim Maxwell/ APM Coordinator

The first weed cutting this year started May 1. By May 31 we cut 131 loads of curly leaf pondweed. Since then we cut 32 more loads for a total of 163 loads YTD. In all of 2014 we cut 28 total loads. There have been a few minor repairs to the Harvester. Max Bay has been helping to drive the Harvester. We have cut 30 loads of coontail YTD. We need more places to dump weeds on the east side of the lake.

EPP Grant Update by Sam Rivers Weber

See guest presentation for reference to new lake management committee forming and potential for new grant too.

NEW BUSINESS

July 4th Boat Parade

A motion was made by Ford Elliott, second by Steve Wistrcill to move the July 4 Boat Parade to Sunday, July 3, at 4:00 pm. Unanimous. Motion carries.

It was also suggested that boaters in the parade leave their own dock at 4pm and start the parade from their dock and not meet at the north end. This will allow more people at the south end and east side to see the parade. Ford Elliott volunteers to fire up his shot gun at 4pm to officially start the parade.

There was discussion about the water balloon fights between parade boaters. People reported having to clean up after the parade and are picking balloons out of the water, consider them pollution and a hazard to wildlife. Water guns, on the other hand are fine in the parade. A motion was made by Sue Ogren for no water balloons in the July 4th parade, second by Vince Teuber. Unanimous. Motion carries.

ANNUAL BUSINESS

Annual Budget

A motion was made to approve the budget by Ken Knutson, second by Roxanne Smith. Unanimous. Motion carries.

Election of 2 New Commissioners: Vote

Two candidates were on the ballot. Peggy Lauritsen nominated Shelley Rodriguez and Ford Elliott nominated Jen Wistrcill. Roxanne Smith was nominated by Francis O'Connor. A motion was made to approve the nominees by Allen Moe, second by Vince Teuber. Unanimous. Motion carries. The voting resulted in the election of Shelley Rodriguez and Jen Wistrcill.

ANNOUNCEMENTS

2016 Spring Meeting will be May 21, 9am to noon (3rd Saturday in May)

2016 Annual Meeting will be August 20, 9am to noon (3rd Saturday in August)

2016 Boat Parade July 3 at 4pm. (July 4th falls on a Monday)

Meeting adjourned at 11:15am. A total of 83 district members attended the Annual Meeting.

Minutes respectfully submitted by Peggy Lauritsen, Communications Commissioner/Secretary, plauritsen@pldg.com

The Blake Lake Bugle is a publication of the Big Blake Lake Protection and Rehabilitation District. The Bugle is published seasonally for friends and members of the district. To receive lake news, send your email address to Peggy at plauritsen@pldg.com or mail to the address below.

CONGRATS TO CLEAN BOATS, CLEAN WATERS VOLUNTEERS

Annual Goal Completed – 400 hours!

Thanks to the volunteers on our lake who contribute 400 hours each season to check boats at the landings and educate boaters about invasive species.

Pictured L to R: Peggy Lauritsen, Vicky Dorner, Gabe Benjamin, Adriel Benjamin, Ford Elliott, Vince Teuber and Mike Rogge.
Seated in front: Joanne Elliott, Diane Borden, Marge Filkins, Jim Filkins, Jim Maxwell, Joan Maxwell, and Naomi Anderson.
Back row: Mary Teuber, Sue Ogren and Sam Rivers Weber. 2015 volunteers not pictured: Joyce Booth, Gail Rustad, Max and Loretta Bay, Tom Borden, Dale Butler, Larry Knutson, Shelley Rodriguez, Ann Foley, and Kathy Maradon.

Save the Dates!

2016 Spring Meeting, May 21, 9am to noon. (3rd Saturday in May)

2016 Annual Meeting, August 20, 9am to noon. (3rd Saturday in August)

2016 Boat Parade, July 3 at 4pm. (July 4th falls on a Monday)

BLAKE LAKE BUGLE

1988 S. Baker Road
Balsam Lake, WI 54810

Big Blake Lake Protection and Rehabilitation District

CLIP AND SAVE — SHARE WITH VISITORS, GUESTS AND RENTERS

KNOW SAFETY TIPS BEFORE FUN ON THE LAKE

Slow-no-wake zone: Is defined as the minimum speed required to maintain steerage. Includes all boaters and jet skis. Boaters watch your distance, 100 FEET: WI law prohibits boaters within 100 feet of shoreline, docks, rafts, piers, swimmers and buoyed restricted areas. Jet skis watch your distance, 200 FEET: Cannot operate at a speed greater than slow-no-wake within 200 feet of the shoreline of any lake. They also are required to cut back to slow-no-wake speed when passing within 100 feet of other boats, including other jet skis.

Life jackets: required for kids under 13. A life jacket is required for every person on your boat.

Jet ski safety: A USCG approved life jacket is required. Do not operate between sunset and sunrise. Be mindful of wildlife (geese and loons). Must be at least 12 years old to operate, see below.

Paddle boards: Life jacket is recommended. Fastest growing water sport in the world!

Age to operate? Anyone born on or after January 1, 1989 is required to complete a boating safety course to legally operate a motorized boat or jet ski. Must be at least 10 years old to operate a motorboat; 10 to 11-year-olds must be accompanied by parent or someone at least 18 years old. Must be at least 12 years old to operate a jet ski. Persons at least 12 but less than 16 years of age may operate a personal watercraft if they have successfully completed a DNR prescribed Boating Safety Course and possess a safety certificate issued by the Department or state of their residency. Parental accompaniment may not be substituted for possession of a valid DNR safety certificate.

Sunset to sunrise: WI law… no skiing, no towing, no jet skis

Other checklist items: Is there a fire extinguisher on the boat? Is there a throwable floatation device on the boat? Test all of the lights work for sunset cruising? Is there a lifejacket on board for everyone? Leave alcohol on shore and never use alcohol before or during operating a craft on the water.

Wildlife caution: Watch out for loons! They are hard to see and cherished on our lake. Stay clear of geese families by 100 feet.

Emergency Contacts: DNR Warden: 715-822-8107
Polk County Sheriff: 715-485-8300

More than 90% of boat fatalities related to drowning involve victims not wearing life jackets, you need one for your safety.

Intoxicants are related to 50% of all boating accidents.

More boating safety tips:
http://dnr.wi.gov/topic/boat/boatSafetyTips.html

WI fishing license: http://dnr.wi.gov/topic/Fishing

Wisconsin Laws:
http://dnr.wi.gov/files/PDF/pubs/LE/LE0301.pdf

Polk County Laws:
http://www.obnet.com/polkcounty/tourism/boat.html

10 MOST COMMON BOATING VIOLATIONS

1. Failure to provide life jackets for all on board.
2. Operating boat without valid certificate of number.
3. Operating boat in prohibited area, in excess of speed limit on lakes 50 acres or less, or in excess of fixed limits.
4. Personal Watercraft (jet ski) violations.
5. Operating motorboat while under the influence of an intoxicant, or operating motorboat with BAC of 0.1% or greater.
6. Operating within 100 feet of dock, raft, swimmer, pier, etc.
7. Operating boat at night without required lights.
8. Failure to display registration number or decal on boat.
9. Failure to secure or cover storage battery.
10. Failure to have certificate of number on board.

BOAT PARADE — SUNDAY, JULY 3
4:00PM START AT YOUR DOCK

The Independence Day holiday is almost here! We are expecting a lot of enthusiasm for the Blake Lake Boat Parade. Last year, over 30 boats participated! Everyone is welcome to join in the parade, decorated or undecorated boats. We are trying something new this year. Boats will wait at their dock until a 4pm "shotgun start" and travel counter clockwise around the lake. Ford Elliott has offered to perform the shotgun task from their property on the northeast side of the lake.

Please note that water balloons are discouraged during the parade. Water guns, on the other hand are fine. Please be mindful of all boaters, those who do not want to get wet or who have small children.

WEED CUTTING — RECORD YEAR

ANOTHER BUMPER CROP OF CURLY-LEAF IN POLK COUNTY LAKES

Just like 2015, we have a "bumper crop" of curly leaf pondweed in the lake again this year. So far this year we have harvested a record 159 loads of weeds compared to 171 loads in all of 2015 and only 30 loads in 2014! Weather permitting (wind or rain), weed cutting continues at a heavy pace until mid July. Max Bay and Bruce Peterson operate the harvester. Weeds are not cut on the weekend. "We expect to cut weeds at this pace until the weeds drop or die down starting now in late June. After mid-July we will cut as needed until August 30", says BLPRD Aquatic Plant Manager Jim Maxwell. He can be reached at 715-857-5316 if you have questions.

The majority of weeds you are seeing on the lake are curly-leaf pondweed, an invasive species, unfortunately, common to 542 lakes in Wisconsin. According to Jeremy Williamson, Water Quality Specialist, Polk County Land and Water Resources Department, "weed growth in lakes varies year to year. Light snow cover over the ice allowed more light to penetrate. More than any other factor, this is likely the reason we are seeing more weed growth in lakes across Polk County". Another factor that added to the bumper crop of curly-leaf is the lower water level of the lake at the start of Spring.

WHY IS THE LAKE WATER SO CLEAR? IT'S THE WEEDS

With a bumper crop of curly-leaf pondweed growing this year, more weeds means more clarity. Up until now that is. Once the curly-leaf dies back in July, nutrients will be available to other plant forms, and by August, you will see the change. Water clarity, or seechi depth, changes over the Summer. Seechi depth is a measure of the cloudiness or turbidity of surface water. In May, seechi depth can be 11 feet, in June it can be 8.5 feet and August, 4 feet.

SLOW-NO-WAKE ZONE — BUOYS MARK THE ZONE

BLPRD established, and is enforcing, a slow-no-wake zone in the narrows, marked by 6 buoys. Slow-no-wake is defined as the minimum speed required to maintain steerage and the law applies to all boaters, pontoons, jet skis, fishing boats, speed boats, etc. Wisconsin law prohibits boaters within 100 feet of shoreline, docks, rafts, piers, swimmers and buoyed restricted areas.

Jet skis cannot operate at a speed greater than slow-no-wake within 200 feet of the shoreline. They also are required to cut back to slow-no-wake speed when passing within 100 feet of other boats, including other jet skis.

BLAKE LAKE BUGLE
1988 S. Baker Road
Balsam Lake, WI 54810

BLAKE LAKE BUGLE

BLAKELAKE.ORG

AUGUST 2016

Annual Meeting

Saturday, August 20, 2016
New location! Georgetown Lutheran Church,
877 190th Ave./County Road G, Balsam Lake, WI 54810
(.8 mile west of Baker Road)

8:00 - 9:00am	Breakfast* / Door Prizes / Mini Lake Fair
9:00 - 11:00am	Annual Meeting

*a $5 donation is kindly requested for the meal. All proceeds will go to the Georgetown Lutheran Church".

Board Members:
Sam Rivers Weber: Co-Chair, Adam Elliott: Co-Chair, Shelley Rodriguez: Commissioner, Jen Wistrcill: Treasurer, Peggy Lauritsen: Secretary, Representative, Polk County Board, and Ron Ogren: Georgetown Chair.

AGENDA (with flexibility)

Welcome and introductions, approval of minutes

Treasurer's Report

Presentation: New Lake Management Plan
(Commissioner Rodriguez) with Q&A by a representative from Polk County Land & Water Resources Dept. 20 min

Old Business

1. Dam Update: (Co-Chair Elliott and Larry Gotham, P.E.) 20 min.
2. Buoy placements, slow-no-wake zone: (Co-Chairs Weber and Elliott). Vote: on options for buoys placement. 10 min

Committee Reports

1. AIS / Clean Boats Clean Waters: (Commissioner Lauritsen). 5 min
2. APM Harvey Report: (APM Coordinator Jim Maxwell). 5 min
3. EPP/AIS/HL Grants Update: (Co-Chair Weber). 10 min

New Business

1. Healthy Lakes Program/managing runoff & phosphorus: (Commissioner Lauritsen). 5 min
2. WI Lakes Partnership Convention delegates for April 5-7, 2017. 2 min
3. Polk County Updates. 5 min
4. Georgetown Updates. 5 min

Annual Business

1. Approval of 2017 Annual Budget and review of audit results: (Treasurer Wistrcill). 5 min
2. Vote: Election of 1 new commissioner — 3-year term currently held by Adam Elliott. 15 min
3. Communications: (Commissioner Lauritsen). 5 min
4. Recognition of volunteers. 10 min

Announcements

August 20, 2016 — BLPRD Board Meeting to follow Annual Meeting at Georgetown Lutheran Church.

May 20, 2017 — Spring Meeting,
8:30 am-11:00 am (3rd Saturday in May)

August 19, 2017 — Annual Meeting,
8:00am to 11:00 am (3rd Saturday in August)

July 4, 2017 — Boat Parade
(July 4th is on Tuesday), 4pm

BLPRD 2017 Annual Budget: Vote to approve

Category	Budget
EPP	$0
APM	$2,500
WLP	$1,500
Dues	$475
Harvey	$8,500
Ins.	$4,500
Admin	$4,525
TOTAL	$22,000

Spring Meeting Minutes

Meeting Date: May 21, 2016

The Spring Meeting at Georgetown Lutheran Church was called to order by Co-Chair Sam Rivers Weber at 9:07am.

Board Members present: Sam Rivers Weber/Co-Chair, Adam Elliott/ Co-Chair, Shelley Rodriguez/ Commissioner, Jen Wistrcill/Treasurer, and Peggy Lauritsen/ Secretary, Communications. Also present Sedric Solland/Polk County Board.

AGENDA

Welcome and Introductions

Co-Chair Elliott expressed thanks to the Georgetown Lutheran Church for offering the use of the site at no charge. We are confirmed for our annual meeting on August 20 at this site. Donations to the church welcomed. Members were encouraged to fill out feedback comment cards on the tables and sign up for committees at the volunteer table in the back.

After board introductions, Co-Chair Elliott proposed to approve agenda with flexibility. Motion was made to approve agenda with flexibility by Marge Kabis, second by Gerry Smith. Unanimous motion carries.

Approval of Minutes

Minutes of the Annual Meeting were printed in the Fall Bugle newsletter, mailed to members and are also located on our new website. Copies of the minutes were also available for view at the meeting. A motion was made to approve minutes by Gail Rustad second by Ford Elliott. Unanimous. Motion carries.

TREASURER'S REPORT

Jen Wistrcill reported account balances as of 30-APR-2016 as follows: Big Blake Lake (BBL) checking $15,216.67, Dam checking $106,958.41, BBL Money Market $52,474.84, Savings $5.00. Brief discussion on loan granted for dam and that first payment was made in March 2016.

GUEST PRESENTATION

Laws and Enforcement for Slow-No-Wake Zones (WDNR Conservation Warden Jesse Ashton)
Introduction. What is enforceable by DNR? Operating at greater than a no wake speed, DNR citation around $200 if someone were to go too fast through the zone. DNR Warden and local sheriff can issue citations. DNR is probably on our lake 5-7 times over the summer.

Reviewed slow-no-wake zone, which is "The lowest possible speed that you can keep maintaining steering control". If you are on a PWC you have to be 200 feet away from shore or dock. For boats it is 100 feet. Jumping wakes or spraying each other on PWC with wake are common citations. Question from member: "What would we do if someone issued a complaint?" "Depends how bad it was, is there video? " DNR can issue citations. DNR does not do written warnings only verbal, however Sheriff can give written warnings. The most common problem is visitors of property owners who do not know the laws or the rules. Suggestion to the board of putting the basic laws up on the website to inform. One member reported problems taking off full tilt within the buoys. Seeing people skiing through the center. If the buoys are not installed, then the zone is not enforceable. Once buoys are placed, it is considered posted and enforceable. No one has been fined on BBL since the buoys have been placed according to Warden Ashton.

Has the decision been made to put the buoys out? Yes, until we revise ordinances we have to. Can you ski through the no wake zone? No, identified by the buoys, this is a restricted zone. Jesse reinforced that we, the district, decide on the buoys. Is there a restriction on where you stop before the buoys? No, it is like a speed zone. In order to change the buoys placement we have to resubmit to Spooner. The 100ft and 200ft from shoreline distance also applies to docks. Mentioned that with the docks extend the limit of 100 and 200 ft. Buoys do not need a light on them. Ordinances around the buoys are determined by the district.

What are the restrictions for floating devices? Beyond 200 feet of shore it has to have a light on it. There is a size restriction? Must be 144 sq. ft. or less, and larger requires a permit.

OLD BUSINESS:

Buoy placements, slow-no-wake zone (Co-Chairs Sam Weber and Adam Elliott)

Reviewed what was discussed last year. Reviewed why we brought Warden Ashton in to discuss rules and laws. Reviewed slides of what was approved several years ago by the district. Option presented: buoys will go in and we can vote to remove buoys, change buoys or leave as is at the August 20 Annual Meeting. Motion made by Trent Walden for the following options for vote at August annual meeting:

1. Remove
2. Keep six buoys but compress area and revise plan
3. Leave buoys as-is

Second by Sheila Munson. With discussion. Amendment to the motion purposed by Jack Belisle to add three options of placement if a revise option 2 is picked. Amendment accepted by Trent Walden. Second the amendment to the motion Sheila Munson.

Dam Update (Co-Chair Elliott)

Going as planned. Our engineer, Larry, for the last two months has been getting project/engineering plan to the DNR for approval. Larry believes the plan will be approved by June/July timeframe. One minor complication was that Round Lake has to have a hydrology study which also would apply to our lake. We hope to have approval by end of July from WDNR. Late summer or early fall the construction can take place. The WDNR/Larry don't anticipate any issues. Once the plan is approved it has to go for bid for at least three sources. Estimate for the dam project is $100,000.00 - $150,000.00.

COMMITTEE REPORTS

Lake Plan Update (Commissioner Rodriguez)

A committee of 8-12 people was formed and will meet 5 times to establish a new lake plan prior to the Annual Meeting. Slides noted committee members. Slide covered survey results and goals. As of 2016, BBL is on the impaired waters list, due to high levels of phosphorus – with goal to get us off the list. There is more to come at the August meeting as the plan is finalized. There will be many opportunities to volunteer to be part of our new lake plan.

WI Lakes Partnership Convention (Commissioner Lauritsen)

Peggy attended the 3-day lakes convention. As a district we benefit by attending: Networking with leaders in our county and state; Get the latest info and best practices; and at our Spring and Annual Meetings we share free literature and resources. Four key takaways from the convention: 1) Updates on legislation/ shoreland zoning and more (handout to all); 2) Deer Lake Conservancy wins national recognition for successful watershed efforts – literature in packets given to all ("Lake Tides" cover story); 3) AIS and CBCW – latest information in displays (Wisconsin know as "best in nation" addressing AIS, last 14 yrs); and 4) Improving water quality – Healthy Lakes Program supports our emerging new lake plan. She reviewed the Healthy Lakes 3-year program started last year by WDNR and WI Lakes Partnership which includes simple and inexpensive projects – up to $1000 per project, 75% covered by grants typically.

Healthy Lakes Program goals:

- Filter runoff water, through buffers, plants, shrubs
- Stop phosphorus and other nutrients from entering the lake
- Slow down and divert runoff – hard surfaces, roofs, driveways, slopes; help water soak into ground
- Improve shoreline wildlife habitat - frogs, birds, turtles, fish
- Cleaner swimming, reduce algae, beautify view, keep geese out
- Preserving water quality for generations to come

Peggy will be organizing with the lake plan committee to get more training and to apply for the grants involved.

AIS/Clean Boats Clean Waters (AIS Coordinator Lauritsen)

We are looking for more volunteers and a team approach. Help is needed. Thank you to the people who have volunteered. Our district goals are to 1) perform free boat checks; 2) talk to boaters at landings; 3) prevent the spread of invasives entering or exiting our lake and 4) inform and educate. We are participating in the WDNR "Drain Campaign" on June 10-12, a statewide initiative to make sure anglers know about Wisconsin's invasive species laws. We are also participating in the WDNR 8th annual statewide Landing Blitz, July 1-4, with heightened awareness and inspections at both landings. This is our 5th year participating. We are one of 90 lakes in Wisconsin participating again this year. Peggy reviewed current top threats such as Eurasian milfoil and zebra mussels and the nearby lakes that have these invasives. There was a special thank you from board members for Peggy's current role with AIS.

APM Harvesting (APM Coordinator Maxwell)

Repairs were made to the harvestor such as changing the oil (it's been five years) and replacing a chain. Weeds are bad again this year, and we started havesting last week and took 33 loads out. Max Bay is driving the harvestor. Question on how close to shorelines we can harvest… 100 feet from shore, stay out of 3 feet water, 10 feet away from the dock. We were able to cut paths on south and west ends. Comment from member goal of the harvestor was to hopefully eliminate weeds from the lake, last few years have been higher. Possibly due to the lower lake levels, and less snow cover in last two winters.

Jeremy Williamson, Water Quality Specialist and Aquatic Invasive Species Biologist, Polk County Land & Water Resources Department, reviewed BBL nutrient budget and internal loading (handouts supplied). Since we have harvesting since 2006 we have reduced the phosphorus 158.7 pounds to 98.5 pounds. We have reduced the amount of phosphorus by 38% by removing the curly leaf from the lake. This is a significant success, and proof that our harvesting strategy is working.

EPP Grant (Co-Chair Weber)

Sam reviewed the status of the grant (slides presented). We will have a report at the annual meeting.

NEW BUSINESS

Communications, new website reveal (Commissioner Lauritsen)

Our new website is blakelake.org. It launched in March at the WLP convention. We were offered a special opportunity in December to be part of a pilot program that allowed us to create a website in 60 days with 150 volunteer hours, at a cost of $450, saving the district $9500. We had 374 visitors to the site in the first week. Peggy reviewed the content strategy, features and functions of the site and how it will meet the needs of our members. Peggy also recruited a new volunteer, Dave Rogge, to help us maintain fresh content on the site. He has volunteered to donate $4800 of his time over the next year. Peggy also recommended that we consider increasing the annual budget to meet the demands of members who want multi-channel communications about district news.

ANNOUNCEMENTS

20-August-2016 Annual Meeting (3rd Sat. in August)
03-July-2016 Boat Parade 4PM

Motion to adjourn the meeting by Vince Teuber, 2nd by Marge Kabis.

Meeting adjourned at 11:29pm. A total of 75 district members attended the Annual Meeting.

Meeting minutes respectfully submitted by Jen Westrcill, Treasurer and Peggy Lauritsen, Secretary.

BOARD ELECTIONS: LAKE DISTRICT BOARD COMMITMENT

- The Board shall nominate one or more members for any vacant positions. Additional nominations present at the annual meeting and willing to serve may be taken from the floor.
- The Board consists of a Chairman, a Treasurer, a Secretary and commissioners.
- Beyond the Spring meeting and the Annual meeting, the Board is also required to meet within 60 days of the Annual meeting. Other meetings are held as lake district business demands. Over the past couple of years, the board has gotten together 3-5 times each year to follow up on business related to the dam, the new lake management plan and new channels of communication.
- Board meetings are held in person if possible or via teleconference.
- Board members are asked to serve three year terms.
- Board members are not compensated for their board service.

Healthy Lakes Workshop

Stop phosphorous from entering the lake — manage runoff on your property

Sponsored by Polk County Association of Lakes and Rivers (PCALR)

Date: Wednesday, August 17
Time: 6-9:00 pm
Place: Justice Center in Balsam Lake, WI
Cost: FREE*
RSVP: **president@pcalr.org or call 651-395-0969**
*A $10 membership to PCALR is encouraged. Apply online at pcalr.org.

One District Board Position Open Fall 2016

One current board member will be completing their term of office this year, Adam Elliot. He may run again, be re-elected, or, we will elect a new member at our Annual Meeting on Saturday, August 20. Now is the time to think about serving on the board. For more information contact Sam Rivers Weber at 2cherokeerivers@gmail.com or (715) 554-1054, or see page 3 for a description.

Workshop presenters: Pamela Toshner and Alex Smith, Water Resources Management Specialists, Wisconsin DNR. Many Polk County lake districts have expressed interest in the Healthy Lakes Initiative grants so Pamela and Alex are bringing the workshop to us! This is your chance to learn how to reduce runoff on your property, with plenty of time to submit our grant application (in February 2017) for funding. The lake district submits a collective grant application for all members. This learning opportunity with state experts doesn't come any closer!!

What you will learn: The 5 Healthy Lakes practices, the grants process, and tools for designing and constructing the practices at your property. The Healthy Lakes practices are: 10'x35' native plantings (shoreline buffers), rain gardens, fish sticks, diversion (driveway, slopes), rock infiltration (trenches, boxes).

Healthy Lakes goals:

- **Filter** runoff water, through buffers, plants, shrubs
- **Stop** phosphorus and other nutrients from entering the lake
- **Slow** down and divert runoff — hard surfaces, roofs, driveways, slopes; help water soak into ground
- **Improve** shoreline wildlife habitat — frogs, birds, turtles, fish
- **Cleaner swimming**, reduce algae, beautify view, keep geese out
- **Preserve water quality** for generations to come

Need more details? Visit healthylakeswi.com where practices are explained and downloads are available.

If you are unable to attend this workshop, but want your property involved in the Healthy Lakes Program on Blake Lake, more information will be available at the Annual Meeting on August 20. You can also contact Peggy Lauritsen at plauritsen@pldg.com.

BLAKE LAKE BUGLE

1988 S. Baker Road
Balsam Lake, WI 54810

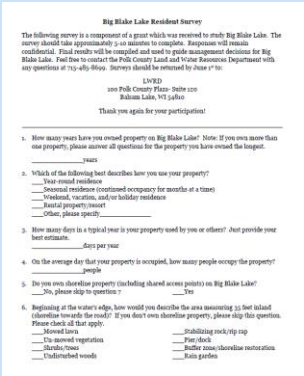
SAVE THE DATE

Annual Meeting: Saturday, August 20, 8am – 11:00am

District Members: This newsletter has the annual meeting agenda on the cover. You will not be receiving a POST CARD announcing the annual meeting.

Big Blake Lake Resident Survey Spring 2015

Katelin Holm
Polk County Land and Water Resources Department



Big Blake Lake Resident Survey

The following survey is a component of a grant which was received to study Big Blake Lake. The survey should take approximately 5-10 minutes to complete. Responses will remain confidential. Final results will be compiled and used to guide management decisions for Big Blake Lake. Feel free to contact the Polk County Land and Water Resources Department with any questions at 715-485-8669. Surveys should be returned by June 1st to:

LWRD
100 Polk County Plaza- Suite 170
Balsam Lake, WI 54810

Thank you again for your participation!

1. How many years have you owned property on Big Blake Lake? Note: If you own more than one property, please answer all questions for the property you have owned the longest.
   _____years
2. Which of the following best describes how you use your property?
   ___Year-round residence
   ___Seasonal residence (continued occupancy for months at a time)
   ___Weekend, vacation, and/or holiday residence
   ___Rental property; insert
   ___Other, please specify_____
3. How many days in a typical year is your property used by you or others? Just provide your best estimate.
   _____days per year
4. On the average day that your property is occupied, how many people occupy the property?
   _____people
5. Do you own shoreline property (including shared access points) on Big Blake Lake?
   ___No, please skip to question 7 ___Yes
6. Beginning at the water's edge, how would you describe the area measuring 35 feet inland (shoreline towards the road)? If you don't own shoreline property, please skip this question. Please check all that apply.
   ___Mowed lawn ___Stabilizing rock/rip rap
   ___Un-mowed vegetation ___Pier/dock
   ___Shrubs/trees ___Buffer zone/shoreline restoration
   ___Undisturbed woods ___Rain garden

Mailed 217 surveys in May 2014

126 respondents, 58%

Thank you!

Big Blake Lake Property Owners

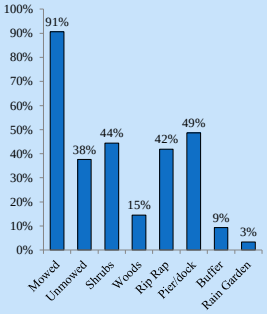
Property ownership: 21 years

People occupying property: 3.6

Half of property owners are weekend, vacation, or holiday residents (56%) and one third are full time residents (33%)

Number of days property used: 148 days

Characterizing the Shoreline



Half of property owners think the amount of lawn on Big Blake Lake is just right,

one quarter think there is too much lawn,

and **one quarter** are unsure.

Nearly **three quarters** believe that buffers, rain gardens, and natives plants are somewhat or very important to the water quality of Big Blake Lake.

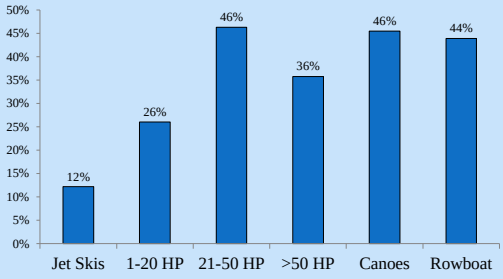
A Very Positive Side Note

98% of survey respondents either don't use fertilizer or use phosphorus free fertilizers

Activities Enjoyed on Big Blake Lake

Peace and tranquility (93%)
Scenic view (89%)
Open water fishing (83%)
Motorized boating (80%)
Observing birds/wildlife (79%)
Swimming (70%)
Non-motorized boating (47%)
Ice fishing (45%)

Watercraft and Use

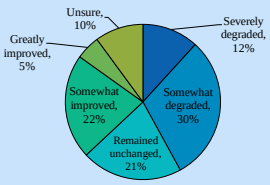


A quarter of respondents use their watercraft on other waterbodies

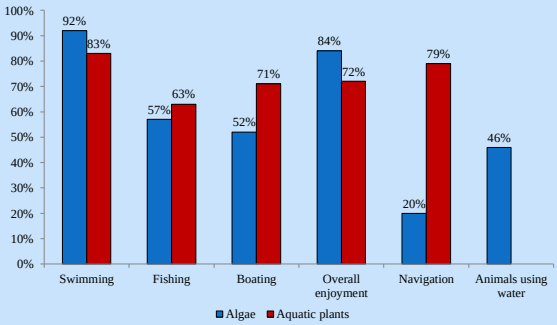
Concern	Total Points
Expansion of current invasive species (curly leaf pondweed)	411
Excessive algae blooms	406
Excessive aquatic plant growth	401
Lack of water clarity or quality	394
Decrease in overall lake health	388
New invasive species entering the lake	373
Increased nutrient pollution	350
Decreased property values	336
Decreased fisheries	304
Unsafe use of motorized water craft	303
Disregard for slow-no-wake zones	288
Loss of natural scenery/beauty	275
Increased development	259
Excessive noise level on the lake	249
Decreased wildlife populations	248

Current Conditions on Big Blake Lake

Water level:
too low (81%)
Water quality:
fair (54%) or good (26%)
Change in water quality:
graph
Months algae is a problem:
July (66%) and August (88%)
Aquatic plants:
too many (69%) and healthy amount (29%)
Months aquatic plants are a problem:
June (46%), July (74%), and August (67%)



Uses Impaired by Algae and Aquatic Plants



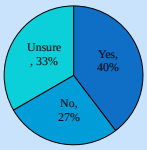
Curly Leaf Pondweed (CLP)

Half of respondents can definitely recognize curly leaf pondweed and another 20% probably can

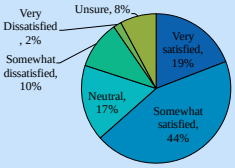
Paul Skawinski, UW-Extension Lakes

Aquatic Plant Management Program

Is the current program effectively controlling nuisance aquatic plant growth?



How satisfied are property owners with the aquatic plant harvesting program?



Actions to Manage Big Blake Lake

Ranked by priority

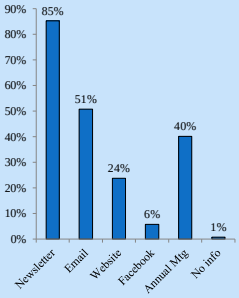
Bring the dam up to code: 91%
Programs to prevent and monitor AIS: 89%
Enhance fisheries: 78%
Upgrade non-conforming septic systems: 71%
Install shoreline buffers/rain gardens: 61%
Install farmland conservation practices: 54%
Lake fairs and workshops: 44%
Enforce slow no wake zones: 44%

Actions to Manage Aquatic Invasive Species (AIS)

Ranked by priority

Harvesting CLP: 90%
Monitoring to detect new AIS: 89%
Clean Boats, Clean Waters: 86%
Educational programs: 72%
Trainings to identify and manage AIS: 69%
Herbicide control of CLP: 54%
Boat landing cameras: 37%
Boat wash stations: 35%

Communication



Half of property owners were unaware of the Facebook page and another third have never visited the page.

Grant Update

2015 is the last year of a three year grant!

Projects completed include:

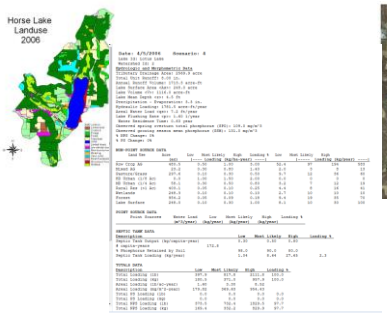
- In-lake monitoring for chemistry, algae, zooplankton, plants, and CLP turions
- Tributary monitoring
- Lake resident survey
- Education efforts: The Landing Blitz, Citizen Lake Monitoring Network, Drain Campaign, and Clean Boats, Clean Waters

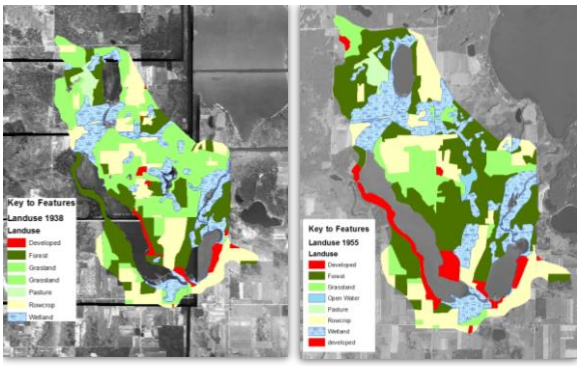
Projects yet to be completed include:

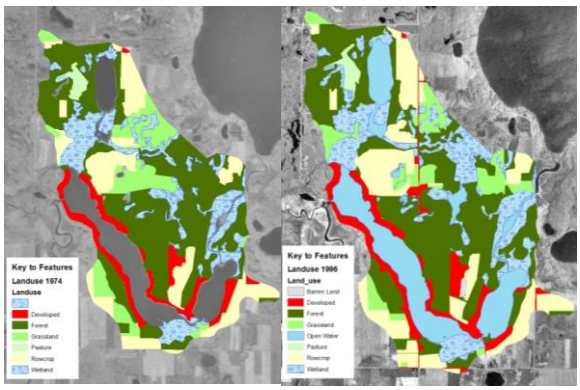
- Pontoon Classroom: **Saturday, June 13th from 12-2 pm at the North Boat Landing**
- Development of a Lake Management Plan

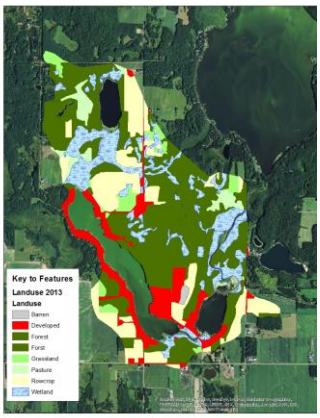
Historical Land Use

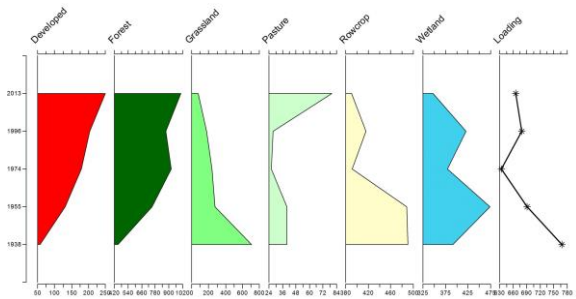
Watershed Modeling

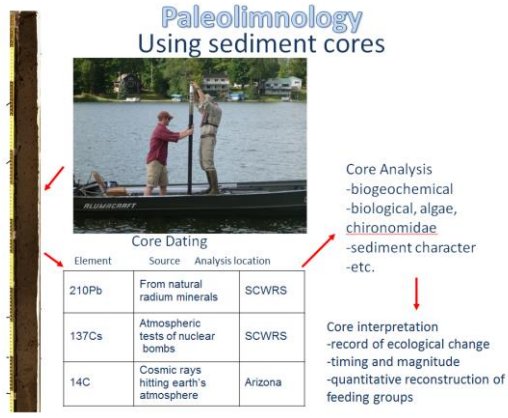


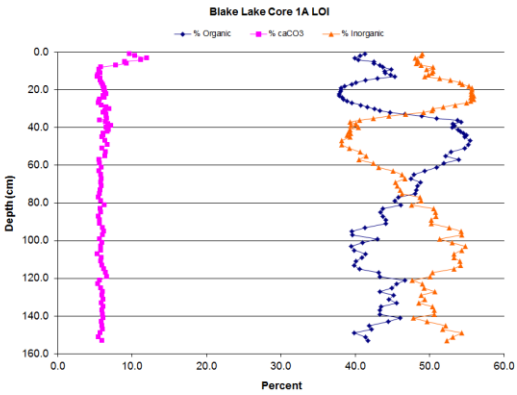


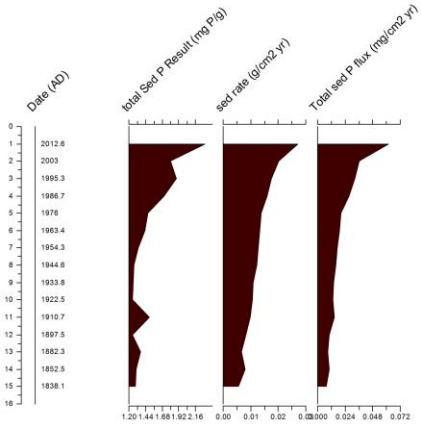





Developed
Forest
Grassland
Pasture
Rowcrop
Wetland
Loading
2013
1996
1974
1955
1938

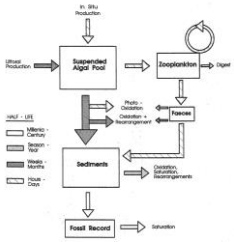

Paleolimnology
Using sediment cores
Core Dating
Element
Source
Analysis location
210Pb
From natural radium minerals
SCWRS
137Cs
Atmospheric tests of nuclear bombs
SCWRS
14C
Cosmic rays hitting earth's atmosphere
Arizona
Core Analysis
-biogeochemical
-biological, algae, chironomidae
-sediment character
-etc.
Core interpretation
-record of ecological change
-timing and magnitude
-quantitative reconstruction of feeding groups


Blake Lake Core 1A LOI
% Organic
% caCO3
% Inorganic
Depth (cm)
Percent

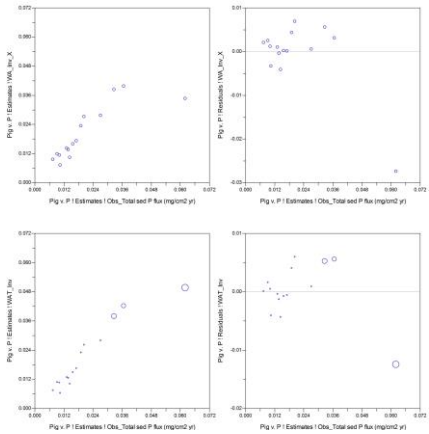

Date (AD)
total Sed P Result (mg P/g)
sed rate (g/cm2 yr)
Total sed P flux (mg/cm2 yr)

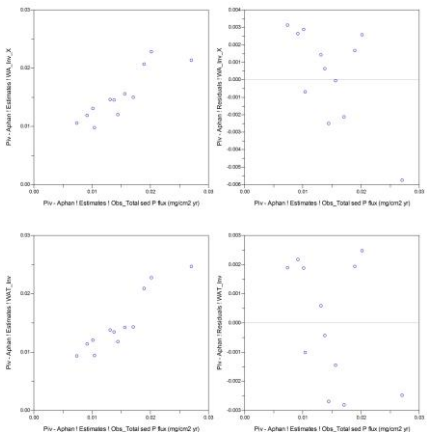
Pigment sedimentation

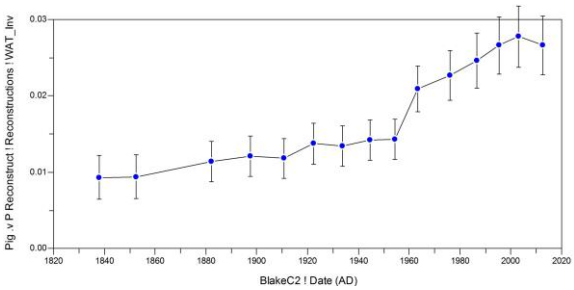
- Pigments are an important record of non-siliceous algae
- Pigment losses are well studied
- Zooplankton can increase transfer rate

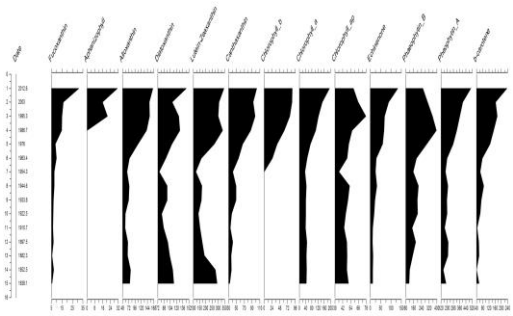


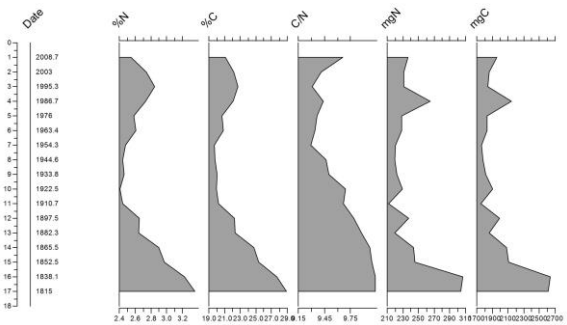
Slide courtesy of N. John Anderson











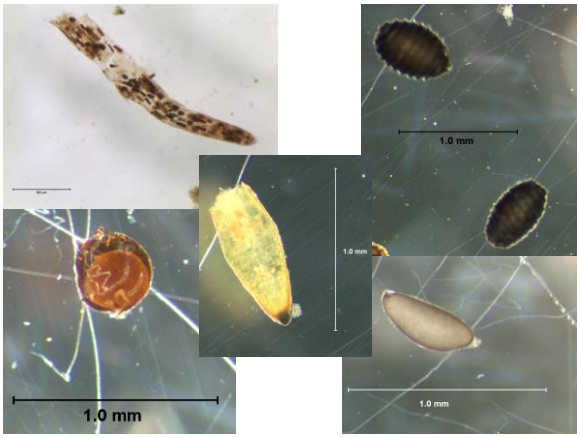
Blake Lake 1852

Blake Lake 2012

Altered biological structure and the reconstruction of fish

- How do we get to fish from the sediment record?
  - **directly: fish scales**
  - **indirectly - through zooplankton assemblage structure**
  - **Pigments – grazing indicators**

Slide courtesy of N. John Anderson



Questions?

Jeremy A. Williamson
Water Quality Specialist
Aquatic Invasive Species Biologist
Polk County Land & Water Resources Department
100 Polk County Plaza, Suite 120
Balsam Lake, WI 54810
jeremyw@co.polk.wi.us
http://www.co.polk.wi.us/index/landwater
715-485-8639

Big Blake Lake: 2016 Lake Management Plan Overview

Prepared and presented by:

Shelley Rodriguez, Commissioner

Big Blake Lake Protection and Rehabilitation District

August 20, 2016

Lake Management Plan Committee

A special thank you to the following Blake Lake Management Committee volunteers for their contributions to this project.

Big Blake Lake - Lake Management Plan Committee	
John Belisle	Sue Budd
Don Craft	Peggy Lauritsen
Jim Maxwell	Jim Mitchell
Sam Rivers	Mike Rogge
Gerry Smith	Roxanne Smith

Big Blake Lake at at Glance

- Big Blake Lake is a 208 acre lake located in the Town of Georgetown in Polk County, Wisconsin, approximately 80 miles northeast of the Twin Cities metropolitan area.
- The main inlet for Big Blake Lake is a channel flowing directly from Little Blake Lake. Big Blake Lake also receives water from an inlet located on the north side of the lake. This tributary flows from Lost Lake and is called Lost Creek. The lake's outlet is located on the northwest side of Big Blake Lake and flows to the Apple River via Fox Creek.
- Big Blake Lake is defined as a **drainage lake**, or a lake with an inlet and an outlet.
- The **residence time** for Big Blake Lake is 0.10 year, meaning that water is replaced approximately every 36 days.
- The Big Blake Lake Protection and Rehabilitation District was formed in 1976 in response to concerns about algae blooms and aquatic plant problems.
- The District includes two hundred twenty-two residences.

Big Blake Lake Characteristics

Area: 208 Acres

Maximum depth: 14 feet

Mean depth: 9 feet

Bottom: 55% sand, 0% gravel, 0% rock, and 45% muck

Total shoreline: 6.65 miles

Invasive species: Curly-leaf pondweed, Chinese mystery snail, and banded mystery snail

Fish: Musky, panfish, largemouth bass, northern pike, and walleye

Boat landings: 2

Impaired Waters

Big Blake Lake was assessed during the 2016 listing cycle and proposed for listing for the pollutant total phosphorus and the impairment of excess algal growth. The general condition is suspected poor.

- **Total phosphorus** sample data exceeded the 2016 Wisconsin's Consolidated Assessment and Listing Methodology (WisCALM) listing thresholds for recreational use (40 µg/L) <u>but not</u> for fish and aquatic life use (100 µg/L).
- **Chlorophyll** sample data exceeded the 2016 WisCALM listing thresholds for recreational use (30% of days in the sampling season have nuisance algal blooms with chlorophyll values greater than 20 µg/L) <u>and</u> fish and aquatic life use (60 µg/L).

Listing thresholds can be found in: Wisconsin 2014 Consolidated Assessment and Listing Methodology (WisCALM) Clean Water Act Section 305(b), 314, and 303(d) Integrated Reporting, Wisconsin Department of Natural Resources, September 2013

- http://dnr.wi.gov/water/waterDetail.aspx?key=16558

What is Phosphorus? Where does it come from?

- Phosphorus is **necessary for plant and algae growth.**
- **Excessive amounts** can lead to an overabundance of growth which can **decrease water clarity** and lead to **nutrient pollution** in lakes.
- When lakes lose oxygen in the winter or when the hypolimnion becomes anoxic in the summer, these particles dissolve and phosphorus is redistributed throughout the water column with **strong wind action or turnover events**.

How does Phosphorus get into the lake?	
• Naturally in soil and rocks	• Release from lake bottom sediments
• Atmosphere in form of dust	• Fertilizer runoff both urban and agricultural
• Groundwater	• **Watershed drainage**
• Soil erosion	

Big Blake Lake Management Plan:

Vision

- *Big Blake Lake is a sustainable, healthy environment for people, recreation, wildlife, and native plants. Engaged and informed stakeholders protect the lake and its watershed.*

Big Blake Lake Management Plan

Guiding Principles

- *Lake management decisions are data driven and evidence-based to incorporate analysis of past, present, and future data and are implemented in a manner that will limit unintended negative environmental impacts.*
- *Member education, engagement, and neighbor-to-neighbor communications for all generations are important to meet the vision of and manage the future of Big Blake Lake.*
- *Clear and concise multi-channel communications to members express the ever evolving nature of lake management and the complexity of issues.*

7 Plan Goals

Goal 1: Reduce nuisance algae and plant growth by reducing watershed and internal sources of phosphorus

Goal 2: Reduce curly-leaf pondweed coverage and density to restore reasonable uses of the lake while promoting the recovery of the beneficial native plant community and protecting sensitive areas from disturbances

Goal 3: Provide information and education with the intent of changing stakeholder behaviors to protect Big Blake Lake

Goal 4: Prevent the introduction of new invasive species and eradicate newly introduced invasive species

Goal 5: Evaluate the progress of lake management efforts and needs through monitoring

Goal 6: Protect, maintain, and enhance fish and wildlife habitat

Goal 7: Sustain the implementation of the plan

Goal 1: Reduce nuisance algae and plant growth by reducing watershed and internal sources of phosphorus

- **Objective 1.** Support harvesting of curly leaf pondweed to remove nutrients from Big Blake Lake
- **Objective 2.** Install at least 10 shoreline native plantings/restorations, diversion practices, rock infiltration practices or rain gardens per year
- **Objective 3.** Evaluate the purchase of highly erodible/ecologically sensitive land if option arises
- **Objective 4.** Engage the agricultural community as a partner in reducing watershed runoff
- **Objective 5.** Ensure that stakeholders understand the relationship between boat traffic and phosphorus release from the sediment
- **Objective 6.** Upgrade non-compliant septic systems by engaging and educating 100% of shoreline property owners

Goal 2: Reduce curly-leaf pondweed coverage and density to restore reasonable uses of the lake while promoting the recovery of the beneficial native plant community and protecting sensitive areas from disturbances

- **Objective 1.** Ensure that the timing and location of harvesting is appropriate
- **Objective 2.** Allow individual riparian owners to manually remove vegetation if adequate navigational opportunities are not provided with the harvester
- **Objective 3.** Monitor the success of the harvesting program
- **Objective 4.** Plant control will prevent harm to important fish spawning and nursery habitat and prevent direct removal or indirect harm to wild rice

Goal 3: Provide information and education with the intent of changing stakeholder behaviors to protect Big Blake Lake

- **Objective 1.** Use existing channels to deliver at least one focused educational message per year to meet the goals of this plan
- **Objective 2.** Explore new and innovative methods to provide information and education

Goal 4: Prevent the introduction of new invasive species and eradicate newly introduced invasive species

- **Objective 1.** Ensure that lake residents and users understand the steps necessary to prevent invasive species
- **Objective 2.** Implement an annual monitoring program to quickly identify the introduction of new invasive species

Goal 5: Evaluate the progress of lake management efforts and needs through monitoring

- **Objective 1.** Continue current data collection efforts to evaluate progress
- **Objective 2.** Expand data collection efforts depending on needs

Goal 6: Protect, maintain, and enhance fish and wildlife habitat

- **Objective 1.** Maintain and enhance desirable populations of game fish in Big Blake Lake by installing 5 habitat improvements such as fish sticks
- **Objective 2.** Restore 10 developed shorelines to more native habitats per year

Goal 7: Sustain the implementation of the plan

Objective 1. Form teams to ensure that the goals of the plan are met

- *Water quality (land acquisition and healthy lakes sub teams), fish and wildlife, information and education, aquatic invasive species and aquatic plans teams*

Objective 2. Continue to seek funding to implement the Big Blake Lake Management Plan

- *Apply for WDNR Lake Planning, Lake Protection, and Aquatic Invasive Species Grants*
- *Leverage current partner efforts to strengthen grant applications*
- *Identify additional funding sources and partners to expand opportunities for action*

Team and sub-team volunteers

Our Plan cannot become a reality without **YOU!**
Volunteers for the following teams/committees are needed!

- **Water quality team**
  - Land acquisition sub team
  - Healthy Lakes sub team
- **Fish and wildlife team**
- **Information and education team**
- **Aquatic invasive species team**
- **Aquatic plans team**

? Questions ?

Big Blake Lake Protection and Rehabilitation District

Annual Meeting, August 16, 2014

Agenda

Board Members: Tom Borden, Co-Chair Sam Weber, Co-Chair;
Jim Filkins, Treasurer; Joan Maxwell, Secretary; Adam Elliott Commissioner
Ken Sample, Polk County Board; Ron Ogren, Georgetown Chair

Call to Order at 9:05 by Sam Weber.

Welcome and Introductions

Board Members Present: Sam Weber, Tom Borden, Jim Filkins, Joan Maxwell, Polk Co Designee Cedric Solland.

Board Members Absent: Adam Elliott, Ron Ogren

Approval of meeting minutes (handout) Motion to accept/approve minutes from 2013 Annual meeting by Stephanie Hinrichs; Second by Sue Ogren. Motion carries.

Approval of Treasurer's report (handout) Motion to approve Treasurer's report by Char Dunst; Second by Stephanie Hinrichs. Motion carries

Introduction of Guests and Presentations:

Jeremy Williamson, Polk Co LWRD - re: Core Sediment Sampling

Jeremy Williamson presented an update on the findings for the core sampling collected in September 2013. Jeremy has been doing studies on our lake since 2006. He is currently doing top and bottom water chemistry, algae and zooplankton sampling and reconstructing the history of Blake Lake through the core sampling.

They took two core samples and have 195cm of mud, essentially. From this core, they are extracting a lot of geo-chemical data looking at what phosphorus is bound to, finding out how much erosion has occurred in the entire watershed, etc. They date the core, calibrate it, then pull out the diatoms, zooplankton fossils, fish flies, pigments, and all sorts of things to measure and observe.

Blake Lake is really interesting because it has changed significantly over time. We have a low sedimentation rate. They took 2 meters of "mud" and they were able to go back to pre-settlement within 40cm... back to around the 1300s. Our geo-chemical analysis so far seems to indicate that our lake really began changing in the 1970s. In looking back to where we've been, to where our lake has been historically, we will be able to more accurately develop an aquatic plant management plan that is realistic and is based on evidence from where our lake has been in the past.

At the end of this core sampling data analysis, Blake Lake will develop a plan that will outline where we are going with respect to aquatic plant management. This will involve forming a committee to look at the data and present a plan to the District. This will also involve continued citizen lake monitoring participants. Clean Boats Clean Waters will also play a huge role in preventing the spread of aquatic invasive species and protecting our lake water and ecosystem.

Old Business

Slow-no-wake Zone (Tom Borden) Commissioner Tom Borden updated the District that most of the paperwork has been approved by WDNR and we are making progress toward gaining final approval for buoys to mark the slow-no-wake zone through the Narrows on Big Blake Lake. We expect to have full approval by next Spring for the 2015 boating season.

Email list The District would like to have an email address for every District member in order to communicate in a timely fashion. An email list sign-up sheet was circulated during this meeting; anyone who wishes to add their email address to our District list-serve for District info, CBCW info, and dam updates please give your email address to Peggy Lauritsen: plauritsen@pldg.com

Standing Committee/Report

Clean Boats Clean Waters (Peggy Lauritsen) 52 Volunteers have already completed 76 percent of our seasonal goal of 400 hours of CBCW monitoring per landing. We still have 45 days left to complete our goal.

Through the Drain Campaign, the Landing Blitz, and AIS flyers and brochures, our CBCW team is increasing awareness among our Lake District members and visiting boaters that AIS is a serious issue on area lakes. This year we handed out free AIS towels and ice packs to educate boaters on WDNR's statewide initiative to teach anglers to "Drain and Ice" - drain all lake water from your boat, your live-well, your bait buckets; ice your catch - this will help stop the spread of aquatic invasive species.

Three CBCW vounteers attended a 9-hour training through PCALR for Citizen Lake Monitoring Network; thank you Gail Rustad, Marge Filkins, and Vicky Dorner for attending this training.

Polk Co LWRD expert Katelin Holm/ Water Quality Specialist held a training here at Big Blake Lake to help us identify invasive species and go over the new inspection forms for CBCW. Big thanks to attendees for this training session: Judy Hall, Mike Rogge, Naomi Anderson, Tom Borden, Diane Borden, Sue Ogren, Marge Filkins, Jim Filkins, Peggy Lauritsen, and Kathy Maraden.

APM Harvey Report (Jim Maxwell) Our APM Coordinator Jim Maxwell informed us that 30 loads of CLP and 1 load of Coontail have been harvested this season (so far). Due to the decreasing density of CLP, it takes more hours of active harvesting to get an entire load of weeds. This is great news for our harvesting efforts as it is active proof that we are making a difference in our invasive weed population. Jim explained that as we continue to harvest CLP before it drops its seeds (turions), we have better odds of long-term reduction because new seeds are harvested while they are still attached to the CLP plant, then loaded onto a trailer and tilled into someone's farmland or garden thereby ending their cycle of growth in our lakebed.

EPP Grant Update (Sam Weber) The EPP Grant (Education, Prevention, and Planning) is a 3 yr, $49k grant designed to educate District members about the lake and about aquatic invasive species (AIS), to prevent the spread of AIS through programs like

CBCW and CLMN along with Bait Dealer Initiatives and the distribution of flyers at the boat landings, and to plan for the future of our lake by developing a comprehensive Aquatic Plant Management (APM) Plan.

Each Spring and Fall Polk Co LWRD conducts a full point intercept survey at 276 gps coordinates on our lake plus every-other week they collect water samples, plant samples, and related water quality data such as water temperature, etc. at those same sites. Samples are sent to the State Lab of Hygiene (SLOH) where further analysis is conducted and transmitted back to Polk Co LWRD.

An executive summary will be available to all District members at the end of this grant cycle in 2016. Please consider becoming part of the APM Committee to help develop our comprehensive APM Plan beginning next year.

New Business

Polk County updates - Ken Sample or designee C.Solland

No Polk Co updates other than our opportunity to greet Cedric Solland as our Big Blake Lake designee. Cedric will serve as a liaison between our lake district and the county. Welcome Cedric.

Georgetown updates - Ron Ogren There were no Georgetown updates.

WAL Convention Delegates (April 23-25, 2015; Stevens Point)

Annual Business

VOTE: Annual Budget (Treasurer: Jim Filkins) Jim Maxwell/Vince Teuber motion to approve the annual budget of $20,000. Motion carries unanimously.

VOTE: Commissioner Election: 3-year terms currently held by Sam Rivers Weber and Joan Maxwell.

Voting held by private ballot with Joan Maxwell, Sam Weber, and Peggy Lauritsen as nominees. Sam Weber and Peggy Lauritsen were elected to these positions for the next 3 yrs.

DAM Discussion The BBL P&R District Board presented a powerpoint explaining the procedures for reconstruction of the Dam. Through a series of meetings with the Sherrard family, the BBL P&R District, WDNR, and our Engineer, we've developed a scope and sequence of events; a timeline, as it were, to reconstruct the Dam that went out on or around April 28th, 2014.

A Rip-Rap Rock Chute Dam is our best choice because it is economical, simple, and virtually maintenance free. The Board also looked at Concrete Dams, and Concrete Drop Box Dams, both of which require de-watering prior to construction, which would cost at least $100,000 more than a Rip-Rap Rock Chute Dam.

The "red tape" will take about 10-12 months to complete with property surveys, transferring deeds, approval of project, drafts, and final approval by the DNR then bidding from Dam builders. Once construction starts, it'll take about 30 days to complete the Dam. We are hoping to have this fully completed by next summer.

The preliminary figure we've been given by the engineer is between $100k-150k.

Therefore, the board is seeking approval from the District to reconstruct the Dam, to assess the District for the costs of this project, and to borrow funds to get things rolling on this with a cap of $175k. If Dam costs go above $175k, the District will hold a special meeting to discuss the project costs and seek approval for additional funding. We do not anticipate this happening, and feel comfortable with the $175k borrowing approval at this time.

VOTE: Funding for Dam Reconstruction: Approved

Motion approving the Dam Reconstruction project by Sue Ogren/Ford Elliott. Motion carried unanimously.

VOTE: Consideration of Borrowing Funds for Dam Reconstruction: Approved unanimously.

Three methods of assessment were presented to the District:

1) Riparian v Non-Riparian

2) Unique Flat Fee v non-Unique Flat Fee

3) Flat Fee for All plus Riparian cost per foot of shoreline

*Riparian means you have deeded access to the lake or you own lakeshore property.

The Board will determine the method of assessment; thank you for your input.

Announcements

Spring Meeting will be held May 16, 2015 (3rd Saturday in May)

2015 Annual Meeting will be held August 15th (3rd Saturday in August)

2015 Parade Date (July 4th falls on a Saturday) PARADE HELD ON THE 4th at 4pm.

Sue Ogren/Gail Rustad motion to adjourn at 11:10 carries unanimously.

78 District Members attended the annual meeting; 6 non-District attendees.

Common Acronyms you may hear or read today:

APM:	Aquatic Plant Management
AIS:	Aquatic Invasive Species
BBLP&RD:	Big Blake Lake Protection & Rehabilitation District
CBCW:	Clean Boats Clean Waters
CLMN:	Citizen's Lake Monitoring Network
EPP:	Education, Prevention, & Planning
LWRD:	Polk Co. Land & Water Resources Department
PCALR:	Polk Co Association of Lakes and Rivers
SWIMS:	Surface Water Integrated Monitoring System [Database]
WAL:	Wisconsin Area Lakes [now: WI Lakes Partnership]
WDNR:	Wisconsin Department of Natural Resources

Minutes: BIG BLAKE LAKE P&R DISTRICT ANNUAL MEETING
AUG. 17 2013

Tom Borden called the meeting to order at 9:00 AM

Jim Thorn/Sue Ogren motion to approve minutes as printed in June Bugle, unanimous.

Jim Filkins presented the Treasurer's report and spoke about the need to approve a 50K Reserve account for Harvey as a Capital Expense Acct. Something that never was officially approved in the past. Sue Ogren motioned to approve capital exp acct and Peggy Lauritsen seconded, motion carried. Ogren/Lauritsen motion to approve Treasurer's report carries.

Jeremy Williamson - Core Sediment Sampling: Jeremy and Katelin from Polk Co LWRD did point intercept surveys on the lake this summer and spoke about gathering extensive data and entering into the mapping program. Curly leaf way behind this year. Native plants are growing where curly leaf used to be abundant, and that's a good thing. Taking chemistry samples at inlet and outlet and using a flow meter to gain critical information. Also is interested in doing sediment core samples – working with science museum – doing Geo chemical analysis also and looking at historical land use, going back 150 years or so.
Lessening curly leaf makes us eligible for more grants.

Old Business:
Slow – No-wake. DNR needed comments and feedback from residents on the lake who have been impacted by the land erosion and lack of a slow wake zone.
* Jack Belisle who doesn't live in the narrows commented on the boaters
* Gerry Smith remarked about possibly having an on-line survey for our residents to give feedback regarding the need for a slow-no-wake zone. He thought it might be a danger to boaters to hit the buoy with their boat. He was told that it is the boaters responsibility if he does. This was a quote from Mark Little @ DNR.
* Gale Rustad lives in the narrows and has seen rip-rap totally washed away and seen people spin their watercraft in narrows.
* Peggy Lauritsen has seen a lot of traffic right by their dock. She commented that in her line of work they do surveys on-line often and if you get a 30% response on the survey is good.
* Ford Elliott says that 200 feet North of narrows gets hammered with wake. Says buoys are in the water at Balsam. On our lake we would be placing two buoys at each end. They are made of covered foam.
* Adam Elliott had a question regarding clarity on what kind of buoy.
* Sue Ogren says boaters are still coming too close to property. Suggested reminding boaters.
* Jerry Belisle has seen boaters going between his float and his shoreline.
* Vincent Tueber asked about the number of feet from shore and other boaters.
* Gail Rustad says people are asking "Where does the no wake zone start and end?" Says they need to see the signs.

Trash can vs. Signage at landings: Tom Borden reported that trash cans rent for $55 a month and two would be required if we go that route. It was decided – no trash barrels. Signage is better to encourage people to take home their trash and dispose of it properly.

Vicky Dorner - is continuing to work on the email spreadsheet for District contacts.

Standing Committee report:
CBCW: Peggy Lauritsen – 42 people signed up this year. Some volunteers put literature at Bait Shops. We should be at landings 400 hours a season. We are not hiring kids to do 'voluntary' hours but we might have to. Our Landing Blitz was mentioned in the Amery Free Press which has a 5000 circulation.

APM: Jim Maxwell says Harvey is running good this year. Took out 6 loads of coontail compared to 85 last year.
On 6/30/2013 Jim Maxwell and Jim Filkins met with two fellows from the DNR and GLIFWC and received permission to expand cutting at the Belisle and Foley properties and near Lyle Sunde's property. Areas that were not permitted in the past.
Large mouth bass limits were discussed and DNR Fisheries agent Aaron Cole encouraged us to keep everything the same. Vicky Dorner would like Aaron as a guest at a future meeting.
The $3010 GPS system that was purchased last fall allows the Harvey driver to punch in the coordinates and not cover the same ground he just went over. Fixed head on Harvey by rearranging small motors; runs quieter now.

EPP Grant (AIS) Sam Weber reports that as we go to the next level of study we may qualify for a new grant. The Education, Prevention, and Planning Grant will involve more lake citizens for monitoring and CBCW activities and next summer there will be a Pontoon Classroom.

Core Sampling Grant Approval: The total for District's commitment to the core grant is $8,000 over two years. Motioned to approve made by Jim Thorn, Ford Elliott seconded. Motion carried.

New Business:
No update from Polk Cty or from Georgetown.

Annual budget - Jim Filkins reports that insurance has gone up significantly. The board is actively looking for alternatives. Budget remains at $20,000 per year. Vince Tueber/Ford Elliott motion to approve carries unanimously.

Wal Convention: Stevens Point hosts it this year. Ford Elliott strongly recommended that a board member attend. Tom Borden and Peggy Lauritsen volunteered to go this Spring (2014).

The 4th of July falls on a Friday in 2014 – the boat parade will be on that Friday at 4pm.

It was announced that the spring meeting in 2014 will be on May 17th (third Sat in May) and the Annual meeting will be on August 16, 2014 (third Sat in August).

Adam Elliott volunteered to be a commissioner; Elliott/Filkins motion carried.

Motion to adjourn made by Ford Elliott / Seconded by Vicky Dorner. Adjourned 10:15 a.m.

G BLAKE LAKE
ROTECTION AND
REHABILITATION
STRICT

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Communications Commissioner/ Secretary
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SPRING MEETING MINUTES

Meeting Date: 5-16-15 FINAL

Meeting at Georgetown Town Hall called to order by Co-Chair Sam Rivers Weber at 9:01 am.
Board Members present: Sam Rivers Weber/Co-Chair, Adam Elliott/ Co-Chair, Tom Borden/ Commissioner, Jim Filkins/Treasurer, and Peggy Lauritsen/Secretary.

Agenda

Welcome and Introductions

Co-Chair Rivers Weber proposed to approve the agenda with flexibility. Motion was made to approve agenda with flexibility by Jack Belisle, second by Mike Rogge. Unanimous. Motion carries.

Approval of Minutes

Co-Chair Rivers Weber explained the amended minutes from the 2014 Annual Meeting, published on page 6 in the Spring 2015 newsletter. Motion to approve minutes by Jim Seifert, second by Sheila Monson. Unanimous. Motion carries.

Treasurer's Report

Jim Filkins reported account balances as of 4-30-15 as follows: Checking $6363.99; Savings $5.00; and Money market $65,704.88. Anticipated taxes are $8000-$9000.

Introduction of Guest Presentation

Presenter: Katelin Holm, Information and Education Coordinator/Water Quality Specialist, Polk County Land & Water Resources Dept.
Grants ending: We have 2 grants that are ending in 2015, EPP Grant (Education/prevention/planning) and the Sediment Core Grant. Blake Lake is the only lake in Wisconsin that has a state harvesting grant to control invasive weeds, and not use a chemical treatment. Because of this we have a flagship program in the state.

2014 District Member Survey Results. The survey was mailed to 217 district members in May, 2014. There were 126 responses, or 58% response, which is excellent given that a 30% response is considered good or acceptable. The survey results will inform our lake management plan going forward.

Top concerns by 75% of members: new invasives, more curly leaf, excessive plant growth, excess algae, water clarity, increased nutrient pollution and decrease on overall lake health.
Low or no concern: 60% believe there is no concern about excessive noise or decreased wildlife.

The average number of years owned property on the lake: 21 years. 50% living on the lake seasonally, which is common in Polk County; 56% are weekend residents and 33% are full-time residents. 148 days per year property is used. This data can helps with modeling and septic systems.
Shoreline buffer zone of 35 feet is ideal that includes plants, shrubs and trees. 91% of properties have mowed lawns; 38% unmowed section, 50% have shrubs in this area; and 15% have woods on shoreline.
49% of properties have piers/docks
Amount of lawns: 50% of members said its just right; 25% said too much; and 25% were not sure.
Interest in shoreline improvement: 75% interested
Use phosphorous on property: 98% don't use or use phosphorous-free fertilizer.

What activities members enjoy most: 93% value views and peaceful enjoyment.
Watercraft used: 46% use canoes, kayaks and other non-motorized; 46% use watercraft with 21-50HP; 25% use boats on other lakes.
Water Quality: 54% rated it fair; 26% rated it good. More people thought water quality had degraded rather than improved. What month algae a problem: 66% said July and 88% August.
Plants: 2/3 thought there were too many plants; 1/3 thought there is a healthy amount of plants. Members thought plants are a problem 46% in June, 74% in July and 67% in August.
Impairments: 92% algae impairs swimming; 57% fishing; 52% boating/pets & animals. Boating not impaired by algae.
Impairments by plants /Curly leaf identification: 50% could recognize it.
Plant Harvesting/ how satisfied?: 44% somewhat; 19% very satisfied
Key Actions and Priorities to Manage Big Blake Lake: 91% of members want the dam up to code; 89% believe AIS (invasives) is a top priority; 78% enhance fisheries, 71% upgrade non-conforming septic systems; 61% install shoreline buffers and rain gardens; 54% install farmland conservation practices; 44% want lake fairs and workshops and 44% want enforcement in slow-no-wake-zones; 90% want harvesting of lake weeds; 89% want monitoring of new AIS; 86% want Clean Boats, Clean Waters; 72% want educational programs; 54% want to use herbicides to control curly leaf; 37% want landing cameras; and 35% want washing stations at landings (not in Polk Co. now).
Communications members want: 85% want the newsletter; 51% email; 24% website; 6% Facebook; and 40% annual meeting.

Katelin will email the full 10-page report summary to anyone who wants it. Contact her at katelin.holm@co.polk.wi.us.

Katelin reported on the APP Grant expiration in 2015: Blake Lake has a 3-year AIS (aquatic invasive species) grant that ends in 2015. Every other week samples are collected from the lake including pH, temperature. Once a month nutrient samples are sent to the lab. Algae and zooplankton are measured once a year. The Spring and Fall plant survey is measured at 276 GPS points on the lake and three people rake samples of plants. Once-a-year dredge samples taken. In the Spring, curly leaf pondweed turions are sampled. Nutrient levels are sampled at inlets and outlets.

Katelin reported there is a county and state emphasis on AIS prevention via the June Drain Campaign (focused on anglers) and the July Landing Blitz (focused on all boaters). A key component of prevention is educating members, and all boaters. She handed out a list of AIS training and classes in June. Again this year she will be leading several of the trainings at the east landing including a new class "Pontoon Classroom" on June 13 from noon to 2pm. Details were published in the Spring newsletter.

Katelin advised us to think about the development of a lake management plan with a sightline of the next 20 years. How do we want the lake to be in the future? Everyone is invited to contribute to this coming effort.

Katelin reported on the Sediment Core Grant. Samples are taken from the deepest part of the lake to see how the lake is changing and has changed over the past 150-200 years. Samples identify what the state of the original lake was. Jeremy Williamson will be reporting updates at the Annual Meeting in August.

Old Business

Dam update by Adam Elliott/Co-chair. We hired a good engineer Larry Gotham, early in the process to manage the project and keep things moving. The DNR advised that we had good timing for fast-tracking the project. We are approved for the loan of $150,000 as of May 5. We have 4 months, until September 5, to draw down the funds. We are expecting a 3% interest rate upon drawn down with a 5-year term. The funding

source, BCPL (Board of Commissioners of Public Lands), funds schools and libraries in the state. We are in the process of getting the outlot transferred from the property owners/Sherrards. Once we get the ownership of the outlot the district takes over to start the reconstruction. There will be a permanent easement for maintenance and temporary easements for construction. Legal agreements are being processed, and with that we can get approval from the DNR. In all, the process is going well and going down the right path. Once all agreements are in place to the DNR, the reconstruction can start. Regarding the timeline, we do not know at this date if the project will be done in 2015. We are moving forward as much as we can and with respect to the Sherrard family dealing with estate issues. The new dam will be a rip-rap-rock-chute dam style. When the new construction goes in the old dam comes out. Members were encouraged to contact any district board member with questions. Board member contacts are listed on page 2 of the newsletter. A question and answer period followed the presentation.

Slow-no-wake zone update by Tom Borden/Commissioner. The 6 buoys are arriving within a week and will be installed by June. Signs will be posted at the landings. The buoys will identify the slow-no-wake zone through the narrows on Big Blake Lake.

Standing Committee Reports

Clean Boats, Clean Waters (CBCW) by Peggy Lauritsen/AIS Coordinator.
There are three seasonal goals: 1) volunteers perform 400 hours of CBCW monitoring (200 hours per each of two landings); 2) educate boaters and the public to avoid the accidental spreading of invasives; and 3) increase awareness with district members that our grant requires volunteer hours.

Peggy thanked all past CBCW volunteers who have helped to meet our goals year after year. Thanks to Vicky Dorner for representing our lake, attending the Annual CBCW training April 29 presented by Katelin Holm, Polk Co. Land and Water Resources Dept. Highlights are included in our display at the meeting.

CBCW training dates and activities: There will be training on two June Saturday mornings to refresh CBCW volunteers in June as part of the WDNR "Drain Campaign" June 12-14, a statewide initiative to make sure anglers know about Wisconsin's invasive species laws. Dates are June 6 and 13. Posters, ice packs and flyers will be available for volunteers to give anglers at the landings again this year. Training on June 13 will be lead by Katelin Holmes, Water Quality Specialist, Polk County Land and Water Resources Department. She and Jeremy Williamson will lead the new Pontoon Classroom on June 13 from noon to 2pm, an on the water experience to learn how water samples, algae samples, and sediment samples are collected and analyzed on Big Blake Lake. This is your opportunity to learn how to find wild rice, how water samples work, learn more about Big Blake Lake and ask any questions you have regarding the lake. There is no cost to attend. Blake Lake will also participate in the WDNR 7th annual statewide Landing Blitz, July 3 -6. We are one of 90 lakes in Wisconsin participating again this year.

Peggy described the goals for the CBCW public relations efforts and named 4 ways for volunteers to get involved.

New CBCW coordinator wanted. Peggy announced that she will complete her fourth year and retire as CBCW Coordinator. We are looking for a new coordinator for 2016. She suggested that a committee approach of several volunteers could be considered instead of having just one person coordinate all efforts.

APM Harvey Report by Jim Maxwell, APM Coordinator. There are lots of weeds already this year. This is the ninth year of studies done on our lake by the research team. This team needs to complete samples of the weed population before cutting can start. As soon as that happens cutting will be aggressive.

EPP Grant Update by Sam Rivers Weber. The EPP Grant (Education, Prevention, and Planning) is a 3 year grant that is ending in 2015. It is a $66,000 project designed to educate District members about the lake and about aquatic invasive species (AIS). Katelin Holm's report today is the detailed update on where we are at currently with the grant. District members are forming a committee to study the results of all the studies and surveys to inform our APM committee at the annual meeting in August.

WLP Convention by Peggy Lauritsen. The Wisconsin Lakes Partnership Convention (WLP) is an annual, statewide convention that she attended on April 23-25 in Stevens Point. Wisconsin Lakes Partnership consists of 3 core groups: 1) Wisconsin DNR (technical, financial, regulatory); 2) University of WI extension Lakes (educational materials) and 3) Wisconsin Lakes (advocates statewide for local lake people and lakes). The Wisconsin Lakes Partnership brings science, education, and citizens together to empower people to work together to care for our lakes. Six educational tracks included "Watersheds, Groundwater and Water Levels", AIS, Ecology, "People Policy and Politics", "Nutrients in our Lakes" and Public Health.

Approximately 600 people attend from all over the state. Sessions and workshops were excellent. Speakers were very knowledgeable and attendees very willing to share best practices, resources and advice.

Conference highlights and value we can bring to our district include:
Networking with attendees: AIS leaders in our area attending from Balsam Lake, Deer Lake, Bone Lake, Amery Lakes, Round Lake and White Ash Lake.
Takeaways: literature in the display today is the latest and some "just published", many statewide contacts to experts in many areas.
Leadership training: all day workshop for "Beginner and Advanced Lake District Commissioner Training**".**

The latest information on key topics:
a) "Long term EW Milfoil research and long term effects of herbicide on native plants". Learnings: there are 100 plant species in Wisconsin lakes. After herbicide treatment some plant species NEVER COME BACK after treat. As was the case in Sandbar Lake and Tomahawk Lake.

b) "Learning from our Neighbors: What's new in Minnesota AIS prevention and management". Tina Wolbers-AIS (Aquatic Invasive Species) Prevention Planner, Minnesota DNR. Learnings: AIS laws
• MN has a 21- day dry time for docks/lifts
• Citation: transport or possess prohibited species; and launch into non-infested waters with AIS attached MN=$500; WI=$295
• Since 2013 MN using dogs to detect zebra mussels
• MN increased the use of roadway checkpoints by 300% in last 3 years. Violation rate is 17%, down from 31% three years ago.
• Top invasives include curly-leaf pondweed, Eurasian milfoil and flowering rush.
• New rules for Lake Service Providers (marina, boat club, yacht club; rent o leases water related equipment that will be placed into or removed from waters) owners or managers must:
- register online for a service provider training
- pay $50 application and testing fee
- attend AIS training, pass AIS 20 minute online test and recertify every 3 years
- the business owner must have all staff trained and certified

c) Greater awareness of impacts to the watershed that effects our district and lake.

d) Fighting invasive species is a very big threat: Increased education and strategies to fight Eurasian milfoil, zebra mussels, and purple loosestrife are top priorities.

e) County alliances forming for lakes and rivers: Eau Claire area watershed creating a coalition to qualify for federal grants. Polk County has 14 lake districts, with increased talk about collaborations to improve shorelines and buffer zones. Special sessions at the conference in 2016 to support new alliances.

f) 50% of Polk County revenue comes from waterfront property taxes. Important economically to protect our lakes and rivers.

Recommendations: Attending future WLP annual convention is highly recommended. It serves to make us stronger as a district. Attendance will engage and inspire members with the latest information to be able to protect the lake we all value.
• representation at the state convention annually (2-4 people) so we can better cover more educational tracks related to our top priorities
•Regular participation at county level such as PCALR

Communications

Peggy Lauritsen reported that the results of the 2014 Member Survey will help to shape communications to members going forward. We are currently sending the newsletter to 226 members 2x per year; our email list is sent almost monthly to 92 members with an open rate of 65-70%; social media using Facebook has grown from 10 fans in 2013 to 77 fans in 2014 to 165 fans as of May 2015.

Announcements

2015 Annual Meeting will be held August 15th (3rd Saturday in August)
2015 Boat Parade July 4 at 4pm. (July 4th falls on a Saturday)

A motion was made by Jim Sieffert to adjourn the meeting and second by Marge Kabis. Meeting adjourned 12:01 pm. A total of 68 district members attended the Spring Meeting.

Minutes respectfully submitted by Peggy Lauritsen, Communications Commissioner/Secretary, plauritsen@pldg.com

Big Blake Lake Protection and Rehabilitation District

District Leadership

Sam Weber *Co-Chair*
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ANNUAL MEETING MINUTES

Meeting Date: 8-15-15 FINAL

Annual meeting at Georgetown Town Hall called to order by Co-Chair Adam Elliott at 9:00 am.
Board Members present: Sam Rivers Weber/Co-Chair, Adam Elliott/ Co-Chair, Tom Borden/ Commissioner, Jim Filkins/Treasurer, and Peggy Lauritsen/Secretary, Communications. Also present Ken Sample/Polk County Board.

Agenda

Welcome and Introductions

After Board introductions, Co-Chair Elliott proposed to approve the agenda with flexibility. Motion was made to approve agenda with flexibility by Allen Moe, second by Jerry Smith. Unanimous. Motion carries.

Approval of Minutes

Minutes of the Spring Meeting were printed in the Bugle newsletter and mailed to members, received on August 10. An email with the Spring Meeting minutes was sent on August 13. Copies of the minutes were also handed out at the meeting. A motion was made to approve the minutes by Steve Paul, second by Sue Ogren. Unanimous. Motion carries.

Treasurer's Report

Jim Filkins reported account balances as of 7-31-15 as follows: Checking $633.25, Dam Project checking $1034.50; Savings $5.00; and Money Market $45,276.97.

Guest Presentation

Presenter: Jeremy Williamson, Water Quality Specialist and Aquatic Invasive Species Biologist, Polk County Land & Water Resources Department, presented "A History of Blake Lake – Results of Core Sediment Sampling". Since 2006 plant studies have been done on Blake Lake. Over the last 3 years a comprehensive water quality study has been done. A sediment core sampling was done to reconstruction the ecological history of the lake. Water quality has changed substantially over the past 50 years, and not in a healthy direction. Now with the data collected, a comprehensive lake management plan can be created. What do members want the lake water quality, plant life and fishing to be over the next 20 years? A Lake Management Committee (LMC) will be formed of 5-10 people/members. A sign-up sheet was passed around and approximately 15 people signed up to be a part of this committee. There will be 3-5 meetings over the Winter at a Balsam Lake location in the evening. At the 2016 Annual Meeting, the LMC committee will present the new lake management plan for approval to district members. If members want to sign up who were not at the meeting contact Sam Rivers Weber at 715-554-1054 or 2cherokeerivers@gmail.com.

Jeremy went on to explain the findings from the sediment core samples collected. Sediment reveals atmospheric nuclear testing done in the 50s. He used historic photos of Blake Lake for a geographic reference and overlaid the watershed area. From that he is able to see a timeline of historic loading, the amount of phosphorus in water. Jeremy talked about changes in property and housing development over time. From 1938 to 1974 there was very little buildings around the lake. Since 1974 there has been dramatically more development. Originally, the lake land around the lake was logged off, it reforested and row crop (sp) dramatically reduced loading. "The good news is…we can get our house in order with very little effort".

Jeremy has analyzed loading rates for phosphorus in the mud of other Polk County lakes near the size of Blake Lake at 250 acres. Mud can have a lot of nutrients collect and it's an easy fix to get phosphorus to move. This corrolates with when curly leaf pondweed rally took off. Since the 60s and 70s pigments increases and drastically changed. Much greener due to algae. Blue-green algae pigment increased possibly due to internal load or curly leaf.

Jeremy went on to say that he is reconstructing the fish history from the 1800s. The lake was 10 feet deeper at one time before logging and the dam. Jeremy is one of four in North America working on plant microphossils. Part of his mission is to find ways to restore good native plants. From 1800s to 1990s the lake plant community completely changed, sediment and water quality also changed. Changes in sediment changes the plants.

In Blake Lake the curly leaf has been reduced, but the challenge is to get back to native plants that provide clear water quality and good fish habitat. He sited Deer Lake has done many best practices to achieve significantly clearer water. Deer Lake and Bone Lake used grants to help pay for 75% of the costs.

A question and answer period followed the presentation.

Old Business

Dam update by Adam Elliott/Co-chair. We have spent $15,000 to date on the Dam Project. While there are still aspects of the project still out of our control, here are the latest projections after conferring with our Engineer.

1. **Land Transfer**: DNR approval of Transfer is expected to occur in early September. Upon DNR approval, the Deed can be signed and recorded. The property will then be transferred to the District at that point in time.
2. **Planning**: Our engineers will be working on the overall dam design this Fall and early Winter.
3. **DNR Approval**: We are expecting approval of dam plans in the Spring of 2016.
4. **Contractor**: Upon DNR approval, our engineer will help us select a contractor as soon as possible — expected in early Summer of 2016.
5. **Construction**: Our engineering team is expecting to commence work in late Summer or early Fall of 2016. Late Summer or early Fall is generally a time of lower stream flows.
6. **Completion**: Project completion and certification to the DNR is expected in the Fall of 2016.

The BLPRD Board applied for and was granted a $150,000 loan. Here is a summary of the financing terms:

- On August 26th, 2015 a check for the entire loan amount ($150,000) will be sent to BLPRD.
- The term of the loan is 5 years.
- The interest rate on the loan is 3%.
- The total finance charge is approximately $12,000.
- We have the ability to pay the loan off early.

Jim Filkins, Treasurer, confirmed we are receiving the loan on 8-26-15 and reminded members that we have locked in an interest rate of 3% for a 5-year term. The style of the dam will be a rip-rap-rock-chute-style dam. The WDNR controls the water level in the lake when the new dam is complete. The WDNR and engineer

recorded the "normal" water level prior to the dam failing and when the new dam is complete the water level will be returned to this standard.

Slow-no-wake zone update by Tom Borden/Commissioner. Tom opened a discussion to get feedback from members about the 6 new buoys installed in late June. He reviewed that the purpose of the buoys is to protect the safety of people on the water and in the water, and to avoid shoreline erosion. The slow-no-wake zone follows state law and is 100 feet before buoys and 100 feet after buoys. Discussion ensued. The Board plans to take this under advisement and come up with solutions. They will look at buoy placement, quantity, education, enforceability and DNR support.

A motion was made as follows by Anne Yourchuck, second by Vince Teuber: The motion was to wait until next season to vote in a special session if necessary (immediately following the Spring Meeting) to make changes regarding the buoys. Unanimous. Motion carries.

Comment by Ken Sample/Polk County Board. Ken encouraged our district to work in unison with other districts and organizations in the county to have the most impact. He offered assistance to help "carry our message" wherever needed to achieve our lake management plan.

Standing Committee Reports

Clean Boats, Clean Waters (CBCW) by Peggy Lauritsen/AIS Coordinator.
There are three seasonal goals: 1) volunteers perform 400 hours of CBCW monitoring (200 hours per each of two landings); 2) educate boaters and the public to avoid the accidental spreading of invasives; and 3) increase awareness with district members that our grant requires volunteer hours. Peggy thanked all past CBCW volunteers who have helped to meet our goals year after year.

<u>From the 2014 Member Survey we learned that:</u>
89% of us/members believe AIS (invasives) are a top priority
89% want monitoring of new AIS (invasives)
86% want to keep our CBCW program
50% believe we can identify curly leaf pondweed, the invasive weed we have now

CBCW Results – YTD: Education & boat inspections: goal is 400 hours per season.
Completed hours YTD: 295 hours, 73% complete. *We are right on target.*

In the 45 days until September 30 we have 105 hours remaining to finish our goal. We will meet our goal same as last year. Most of our boat inspection data is entered online and is up-to-date.

<u>AIS Training done this year</u>
Seventeen volunteers attended two trainings June 6 and 13 as part of the **DNR "Drain Campaign"** a statewide initiative started last year to make sure anglers know about Wisconsin's invasive species laws, and the Annual **4th of July DNR 7th annual statewide Landing Blitz**, focused on boaters with heightened awareness about invasives. We were one of 290 lakes in 53 counties in WI participating again this year.

Pontoon Classroom – 8 people attended on July 2, rescheduled due to rain from June 13.
Instructors were Katelin and Jeremy, Polk County Land and Water Resources Department. We learned about how to extract water samples, algae samples, sediment and identification of invasives.

Public Awareness Efforts to achieve our CBCW goals:

- CBCW information published in BL Bugle sent 2-3x per year to district members.
- Literature and displays at May and August member meetings: includes the latest AIS information from state and county sources.
- Email communications to 40 volunteers 2x month, June to October.
- Distribute brochures and posters to local bait shops throughout the Summer.
- Placed 1 newspaper article in Inter-County Leader, published 2nd week of July about the Landing Blitz and featured pictures of our volunteers. We received excellent Outdoor Section page placement. This newspaper has a circulation of 13,000 readers.

Peggy is completing her fourth year as CBCW Coordinator. She asked for a new CBCW coordinator. No volunteer came forward. She suggested that a committee approach of several volunteers could be considered instead of having just one person coordinate all efforts.

APM Harvey Report by Jim Maxwell/APM Coordinator.
The first weed cutting this year started May 1. By May 31 we cut 131 loads of curly leaf pondweed. Since then we cut 32 more loads for a total of 163 loads YTD. In all of 2014 we cut 28 total loads. There have been a few minor repairs to the Harvester. Max Bay has been helping to drive the Harvester. We have cut 30 loads of coontail YTD. We need more places to dump weeds on the east side of the lake.

EPP Grant Update by Sam Rivers Weber. See guest presentation for reference to new lake management committee forming and potential for new grant too.

New Business

July 4th boat parade: A motion was made by Ford Elliott, second by Steve Wistrcill to move the July 4 Boat Parade to Sunday, July 3, at 4:00 pm. Unanimous. Motion carries.

It was also suggested that boaters in the parade leave their own dock at 4pm and start the parade from their dock and not meet at the north end. This will allow more people at the south end and east side to see the parade. Ford Elliott volunteers to fire up his shot gun at 4pm to officially start the parade.

There was discussion about the water balloon fights between parade boaters. People reported having to clean up after the parade and are picking balloons out of the water, consider them pollution and a hazard to wildlife. Water guns, on the other hand are fine in the parade. A motion was made by Sue Ogren for no water balloons in the July 4th parade, second by Vince Teuber. Unanimous. Motion carries.

Annual Business

Annual Budget
A motion was made to approve the budget by Ken Knutson, second by Roxanne Smith. Unanimous. Motion carries.
Election of 2 New Commissioners: Vote
Two candidates were on the ballot. Peggy Lauritsen nominated Shelley Rodriguez and Ford Elliott nominated Jen Wistrcill. Roxanne Smith was nominated by Francis_____. A motion was made to approve the nominees by Allen Moe, second by Vince Teuber. Unanimous. Motion carries. The voting resulted in the election of Shelley Rodriguez and Jen Wistrcill.

Announcements

2016 Spring Meeting will be May 21, 9am to noon (3rd Saturday in May)
2016 Annual Meeting will be August 20, 9am to noon (3rd Saturday in August)
2016 Boat Parade July 3 at 4pm. (July 4th falls on a Monday)

Meeting adjourned at 11:15am. A total of 83 district members attended the Annual Meeting.

Minutes respectfully submitted by Peggy Lauritsen, Communications Commissioner/Secretary, plauritsen@pldg.com

BIG BLAKE LAKE PROTECTION AND REHABILITATION DISTRICT

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SPRING MEETING MINUTES

Meeting Date: May 21, 2016 FINAL: July 15, 2016

The Spring Meeting at Georgetown Lutheran Church was called to order by Co-Chair Sam Rivers Weber at 9:07am.
Board Members present: Sam Rivers Weber/Co-Chair, Adam Elliott/ Co-Chair, Shelley Rodriguez/ Commissioner, Jen Wistrcill/Treasurer, and Peggy Lauritsen/Secretary, Communications. Also present Sedric Solland/Polk County Board.

Agenda

Welcome and Introductions
Co-Chair Elliott expressed thanks to the Georgetown Lutheran Church for offering the use of the site at no charge. We are confirmed for our annual meeting on August 20 at this site. Donations to the church welcomed. Members were encouraged to fill out feedback comment cards on the tables and sign up for committees at the volunteer table in the back.

After board introductions, Co-Chair Elliott proposed to approve agenda with flexibility. Motion was made to approve agenda with flexibility by Marge Kabis, second by Gerry Smith. Unanimous motion carries.

Approval of Minutes
Minutes of the Annual Meeting were printed in the Fall Bugle newsletter, mailed to members and are also located on our new website. Copies of the minutes were also available for view at the meeting. A motion was made to approve minutes by Gail Rustad second by Ford Elliott. Unanimous. Motion carries.

Treasurer's Report
Jen Wistrcill reported account balances as of 30-APR-2016 as follows: Big Blake Lake (BBL) checking $15,216.67, Dam checking $106,958.41, BBL Money Market $52,474.84, Savings $5.00. Brief discussion on loan granted for dam and that first payment was made in March 2016.

Guest Presentation: Laws and Enforcement for Slow-No-Wake Zones (WDNR Conservation Warden Jesse Ashton)
Introduction. What is enforceable by DNR? Operating at greater than a no wake speed, DNR citation around $200 if someone were to go too fast through the zone. DNR Warden and local sheriff can issue citations. DNR is probably on our lake 5-7 times over the summer.

Reviewed slow-no-wake zone, which is "The lowest possible speed that you can keep maintaining steering control". If you are on a PWC you have to be 200 feet away from shore or dock. For boats it is 100 feet. Jumping wakes or spraying each other on PWC with wake are common citations. Question from member: "What would we do if someone issued a complaint?" "Depends how bad it was, is there video? " DNR can issue citations. DNR does not do written warnings only verbal,

however Sheriff can give written warnings. The most common problem is visitors of property owners who do not know the laws or the rules. Suggestion to the board of putting the basic laws up on the website to inform. One member reported problems taking off full tilt within the buoys. Seeing people skiing through the center. If the buoys are not installed, then the zone is not enforceable. Once buoys are placed, it is considered posted and enforceable. No one has been fined on BBL since the buoys have been placed according to Warden Ashton.

Has the decision been made to put the buoys out? Yes, until we revise ordinances we have to. Can you ski through the no wake zone? No, identified by the buoys, this is a restricted zone. Jesse reinforced that we, the district, decide on the buoys. Is there a restriction on where you stop before the buoys? No, it is like a speed zone. In order to change the buoys placement we have to resubmit to Spooner. The 100ft and 200ft from shoreline distance also applies to docks. Mentioned that with the docks extend the limit of 100 and 200 ft. Buoys do not need a light on them. Ordinances around the buoys are determined by the district.

What are the restrictions for floating devices? Beyond 200 feet of shore it has to have a light on it. There is a size restriction? Must be 144 sq. ft. or less, and larger requires a permit.

Old Business:

1. Buoy placements, slow-no-wake zone (Co-Chairs Sam Weber and Adam Elliott)

Reviewed what was discussed last year. Reviewed why we brought Warden Ashton in to discuss rules and laws. Reviewed slides of what was approved several years ago by the district. Option presented: buoys will go in and we can vote to remove buoys, change buoys or leave as is at the August 20 Annual Meeting. Motion made by Trent Walden for the following options for vote at August annual meeting:

1. Remove
2. Keep six buoys but compress area and revise plan
3. Leave buoys as-is

Second by Sheila Munson. With discussion. Amendment to the motion purposed by Jack Belisle to add three options of placement if a revise option 2 is picked. Amendment accepted by Trent Walden. Second the amendment to the motion Sheila Munson.

4. Dam Update (Co-Chair Elliott)

Going as planned. Our engineer, Larry, for the last two months has been getting project/engineering plan to the DNR for approval. Larry believes the plan will be approved by June/July timeframe. One minor complication was that Round Lake has to have a hydrology study which also would apply to our lake. We hope to have approval by end of July from WDNR. Late summer or early fall the construction can take place. The WDNR/Larry don't anticipate any issues. Once the plan is approved it has to go for bid for at least three sources. Estimate for the dam project is $100,000.00 - $150,000.00.

Committee Reports

1. Lake Plan Update (Commissioner Rodriguez)

A committee of 8-12 people was formed and will meet 5 times to establish a new lake plan prior to the Annual Meeting. Slides noted committee members. Slide covered survey results and goals. As of 2016, BBL is on the impaired waters list, due to high levels of phosphorus – with goal to get us off the list. There is more to come at the August meeting as the plan is finalized. There will be many opportunities to volunteer to be part of our new lake plan.

2. WI Lakes Partnership Convention (Commissioner Lauritsen)

Peggy attended the 3-day lakes convention. As a district we benefit by attending: Networking with leaders in our county and state; Get the latest info and best practices; and at our Spring and Annual Meetings we share free literature and resources. Four key takaways from the convention: 1) Updates on legislation/ shoreland zoning and more (handout to all); 2) Deer Lake Conservancy wins national recognition for successful watershed efforts – literature in packets given to all ("Lake Tides" cover story); 3) AIS and CBCW – latest information in displays (Wisconsin know as "best in nation" addressing AIS, last 14 yrs); and 4) Improving water quality – Healthy Lakes program supports our emerging new lake plan. She reviewed the Healthy Lakes 3-year program started last year by WDNR and WI Lakes Partnership which includes simple and inexpensive projects – up to $1000 per project, 75% covered by grants typically.

Healthy Lakes Program goals:

- **Filter** runoff water, through buffers, plants, shrubs
- **Stop** phosphorus and other nutrients from entering the lake
- **Slow** down and divert runoff – hard surfaces, roofs, driveways, slopes; help water soak into ground
- **Improve** shoreline wildlife habitat - frogs, birds, turtles, fish
- **Cleaner swimming**, reduce algae, beautify view, keep geese out
- **Preserving water quality** for generations to come

Peggy will be organizing with the lake plan committee to get more training and to apply for the grants involved.

3. AIS/Clean Boats Clean Waters (AIS Coordinator Lauritsen)

We are looking for more volunteers and a team approach. Help is needed. Thank you to the people who have volunteered. Our district goals are to 1) perform free boat checks; 2) talk to boaters at landings; 3) prevent the spread of invasives entering or exiting our lake and 4) inform and educate. We are participating in the WDNR "Drain Campaign" on June 10-12, a statewide initiative to make sure anglers know about Wisconsin's invasive species laws. We are also participating in the WDNR 8th annual statewide Landing Blitz, July 1-4, with heightened awareness and inspections at both landings. This is our 5th year participating. We are one of 90 lakes in Wisconsin participating again this year. Peggy reviewed current top threats such as Eurasian milfoil and zebra mussels and the nearby lakes that have these invasives. There was a special thank you from board members for Peggy's current role with AIS.

4. APM Harvesting (APM Coordinator Maxwell)

Repairs were made to the harvestor such as changing the oil (it's been five years) and replacing a chain. Weeds are bad again this year, and we started havesting last week and took 33 loads out. Max Bay is driving the harvestor. Question on how close to shorelines we can harvest… 100 feet from shore, stay out of 3 feet water, 10 feet away from the dock. We were able to cut paths on south and west ends. Comment from member goal of the harvestor was to hopefully eliminate weeds from the lake, last few years have been higher. Possibly due to the lower lake levels, and less snow cover in last two winters.

Jeremy Williamson, Water Quality Specialist and Aquatic Invasive Species Biologist, Polk County Land & Water Resources Department, reviewed BBL nutrient budget and internal loading (handouts supplied). Since we have harvesting since 2006 we have reduced the phosphorus 158.7 pounds to 98.5 pounds. We have reduced the amount of phosphorus by 38% by removing the curly leaf from the lake. This is a significant success, and proof that our harvesting strategy is working.

5. EPP Grant (Co-Chair Weber)

Sam reviewed the status of the grant (slides presented). We will have a report at the annual meeting.

New Business

Communications, new website reveal (Commissioner Lauritsen)

Our new website is blakelake.org. It launched in March at the WLP convention. We were offered a special opportunity in December to be part of a pilot program that allowed us to create a website in 60 days with 150 volunteer hours, at a cost of $450, saving the district $9500. We had 374 visitors to the site in the first week. Peggy reviewed the content strategy, features and functions of the site and how it will meet the needs of our members. Peggy also recruited a new volunteer, Dave Rogge, to help us maintain fresh content on the site. He has volunteered to donate $4800 of his time over the next year. Peggy also recommended that we consider increasing the annual budget to meet the demands of members who want multi-channel communications about district news.

Announcements

20-August-2016 Annual Meeting (3rd Sat. in August)
03-July-2016 Boat Parade 4PM

Motion to adjourn the meeting by Vince Teuber, 2nd by Marge Kabis.

Meeting adjourned at 11:29pm. A total of 75 district members attended the Annual Meeting.

Meeting minutes respectfully submitted by Jen Westrcill, Treasurer and Peggy Lauritsen, Secretary.

2015 Upcoming Events

Polk County Aquatic Invasive Species Strategic Plan

Wednesday, May 20th, 7-9 pm, Polk County Justice Center, Balsam Lake
Wednesday, June 17th, 7-9 pm, Polk County Justice Center, Balsam Lake

Everyone with a stake in the prevention of aquatic invasive species is encouraged to attend this strategic planning session to help prioritize which actions should take place in Polk County in response to aquatic invasive species.

Big Blake Lake Clean Boats, Clean Waters Refresher Basics and Training

Saturday, June 6th, 10am-noon, East Landing/North End of the Lake/Bystrom Lane
Saturday, June 13th, 10am-noon, East Landing/North End of the Lake/Bystrom Lane

Learn the basics of boat inspections and what is needed to educate the public about invasives! These trainings are part of the WDNR Drain Campaign, a statewide initiative to increase awareness of Wisconsin's invasive species laws.

Big Blake Lake Pontoon Classroom

Saturday, June 13th, noon-2 pm, East Landing/North End of the Lake/Bystrom Lane

Join the Polk County Land and Water Resources Department for an on-the-water experience to learn how water samples, algae samples, and sediment samples are collected and analyzed on Big Blake Lake. This is your opportunity to learn how to find wild rice, how water samples work, learn more about Big Blake Lake and ask any questions you have regarding the lake.

Project RED Training

Classroom Training: Thursday, June 11th, 6-8pm OR Tuesday, June 16th, 6-8 pm, St. Croix River Association, St. Croix Falls
River Detection Field Day: Tuesday, June 23rd , time to be determined, St. Croix River

Become a Riverine Early Detector and monitor rivers and streams for 16 invasive species.

Aquatic Invasive Species Citizen Lake Monitoring Network

Wednesday, July 15th, 1-4pm , Polk County Government Center , Balsam Lake

Join a network of volunteers to monitor Big Blake Lake for aquatic invasive species.

Aquatic Invasive Species Bridge Snapshot Day

Saturday, August 29th, 9am-1pm , St. Croix River Association, St. Croix Falls

Join 200 other volunteers at one of more than 20 rendezvous sites statewide to help search for invasive species on rivers.

All events are free. Please RSVP to Katelin Holm, katelin.holm@co.polk.wi.us , 715-485-8637.

Big Blake Lake Protection & Rehabilitation District

VOLUNTEERS NEEDED

Protect our lake, prevent invasives

Join us. We have great volunteers, but always need more. Let's talk. It's easy and fun.

Clean Boats, Clean Waters Program

WHEN: **June through September**
TIME: 4 hours per month
Best times: Fridays: 3-9pm; Saturdays, Sundays, holidays, fishing tournaments
WHO: You and a buddy, friend or spouse (homeowners on the lake, or in area)
Veteran volunteers will assist and train new volunteers.

WHAT: **you can volunteer to help in many ways, such as:**

a) inspect boats at the landings, hand out literature to visitors and neighbors launching a watercraft;
b) put brochures at bait shops in the area; help with displays at the annual meeting
c) enter data online into SWIMS database as other volunteers complete inspection forms;
d) write copy for the newsletter, social media or for mailings.

TRAINING: Watch one of several 7-minute videos, read a few pages of orientation and do your first inspection with an experienced volunteeer. That's it ….easy and fun.

DNR grant to district requires 400 hours

The Big Blake Lake P& R District receives a grant to remove coontail weeds and control the spread of AIS. Currently, curly-leaf pondweed is an invasive weed in Big Blake Lake. The DNR requires a contribution of 400 hours per season inspecting boats at 2 landings, 200 hours per landing. Without this grant, homeowners would have to pay these costs. Volunteers are critical to keep costs down.

About Clean Boats, Clean Waters Program

With the growing concern over the spread of aquatic invasive species to Wisconsin's inland lakes, many lake district members and other concerned citizens are looking for ways to get involved. The *Clean Boats, Clean Waters* volunteer watercraft inspection program is an opportunity to take a front line defense against the spread of aquatic invasive species.

Contact:
Peggy Lauritsen / Clean Boats, Clean Waters – AIS *Volunteer Coordinator*
Big Blake Lake Protection & Rehabilitation District plauritsen@pldg.com 612-940-2006

Resources for CBCW Volunteers

1) Learn more about Clean Boats, Clean Waters?
Learn about aquatic invasive species laws?
Learn about data entry?
Instructions or tips for completing inspection forms?
Get more inspection forms forms?
Find more training?

This site has it all for you:
http://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/programs/cbcw/default.aspx

2) Enter data from completed inspection forms? *(if you don't want to enter data online, submit forms to Peggy L. and she will handle data entry for you).*
http://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/programs/cbcw/data.aspx

Enter data here: Wisconsin DNR: Surface Water Integrated Monitoring System (SWIMS)
https://dnrx.wisconsin.gov/swims/login.jsp?site=ais

3) CBCW Inspection Video Scenarios, June 4, 2015
New Clean Boats, Clean Waters Watercraft Inspection Video Scenarios are now available to view on the CBCW website! Seven scenarios were created to help volunteer inspectors learn how to have a conversation with boaters and anglers at the boat landing while conducting an inspection. An introductory video explains the purposes of the scenarios, and the first scenario provides an example of a complete watercraft inspection from start to finish. The following six videos focus on specific scenarios, such as how to talk to an angler leaving the landing with live bait, and begin after the inspector has introduced themselves to the boater and asked some of the initial questions from the inspection report form. The last video discusses how to thoroughly take the prevention steps and walks through the process of cleaning off a boat. These videos are meant to enhance the CBCW trainings, not replace them, and serve as a post-training resource for our inspectors.
CBCW Inspection Video Scenarios: http://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/programs/cbcw/resources.aspx

This older video is a good one for new volunteers: Watch this7-minute video about boat and trailer inspections: http://www.youtube.com/watch?v=OdFmFaC7ldE&noredirect=1

Big Blake Lake Protection & Rehabilitation District

CBCW VOLUNTEERS

AIS - Facts to use at the landing

Invasives Blake Lake has now: Curly-leaf pondweed, banded mystery snail, Chinese mystery snail. 38 Polk County lakes have curly-leaf pondweed.

TOP THREATS: Eurasian milfoil and zebra mussels

Why? Because these invasives are very difficult and expensive to get rid of

Eurasian Milfoil

Quick to spread: It only takes ¼ inch of the plant to start a new population.
Small fragments can blow from one side of the lake to the other.

Costly: In another lake district in the area, members pay $600+ per year to treat milfoil with herbicide.

Extra caution: 4 nearby waters have milfoil; Horseshoe, Pike, Long Trade (and St. Croix River).

Nearby in Twin Cities lakes: 150 TC lakes have milfoil. 275 lakes in Minnesota have milfoil.
Many visitors to Blake Lake are from the TC metro, only 77 miles away.

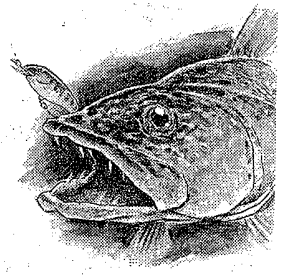
Zebra Mussels

Nearby in St. Croix County: Bass Lake and Lake St. Croix.

Nearby in Minnesota: 141 waterbodies in MN have zebra mussels!

INTER-COUNTY LEADER

OUTDOORS



ATVS · BIRDING · BOATING · CAMPING · FISHING · HIKING · HUNTING · RECREATIONAL VEHICLES

Clean boats, clean waters on Blake Lake

Boat checks part of DNR Landing Blitz over holiday weekend

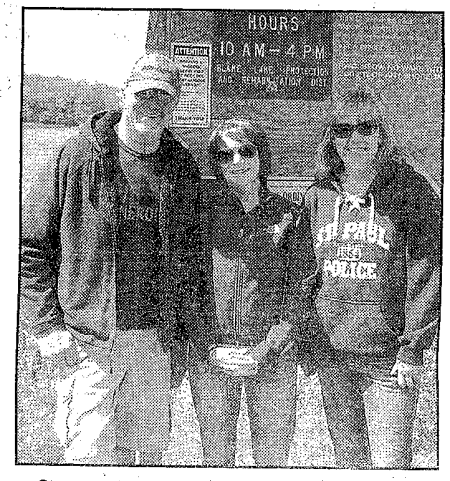
BALSAM LAKE – Volunteers from the Big Blake Lake Protection and Rehabilitation District educated boaters and conducted free boat checks over the Fourth of July weekend as part of the seventh-annual statewide DNR Landing Blitz. Over 200 lakes were part of the blitz this year. Statewide last year, over 12,000 boats were inspected and 28,573 people were contacted during the holiday. Inspectors work to assure that boaters do not accidentally spread Eurasian water milfoil, zebra mussels and other aquatic invasive species.

The volunteer inspectors help boaters understand Wisconsin's invasive species laws and what they must do to clean equipment entering or exiting the water.

"Invasives are a serious threat to water quality and property value. By following simple steps, boaters can preserve the quality of our lakes for our grandkids to enjoy," says Peggy Lauritsen, Clean Boats, Clean Waters, AIS coordinator. "We have 40 dedicated volunteers who give 400 hours per season to help protect water quality on Blake Lake."

Invasive species crowd out native species, disrupt lake ecosystems and interfere with boating, fishing and other recreation.

Clean Boats, Clean Waters training and volunteers on Blake Lake over the Fourth of July weekend shown (L to R) are: Aquatic invasive species experts Jeremy Williamson and Katelin Holm, water quality specialists of Polk County Land and Water Resources; volunteer boat inspectors Mike Rogge, Judy Hall, Vince and Mary Teuber, Vicky Dorner, Sue Ogren and Diane Borden. Not pictured: Peggy Lauritsen, Tom Borden, Jim and Marge Filkins and Joyce Booth.



Some of the Clean Boats, Clean Waters volunteers on Blake Lake over the Fourth of July weekend shown (L to R) are: Mike Foley, Ann Foley and Shelley Rodriguez.

The main ways invasive species and fish diseases spread to new waters is aboard boating and fishing equipment, live fish or water moved from one water body to another.

The volunteers, who have been trained through Wisconsin's Clean Boats, Clean Waters program, demonstrated the required prevention steps boaters must take, provided stickers for boaters to place on their trailer posts to remind them of these steps and talked about Wisconsin invasive species and VHS laws.

Boaters, anglers and others enjoying Wisconsin waters are required to inspect boats, trailers and equipment; remove all attached aquatic plants and animals; drain all water from boats, vehicles and equipment; and never move plants or live fish away from a water body. Limited exceptions apply. Visit dnr.wi.gov and search for bait laws. – *from CBCW*

Appendix L

Management Options for Aquatic Plants

Management Options for Aquatic Plants

Updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
No management	N	Do not actively manage plants	Minimizing disturbance can protect native species that provide habitat for aquatic fauna, reduce shoreline erosion, may improve water clarity, and may limit spread of invasive species	May allow small population of invasive plants to become larger, more difficult to control later
			No financial cost	Excessive plant growth can hamper navigation and recreational lake use
			No system disturbance	May require modification of lake users' behavior and perception
			No unintended effects of chemicals	
			Permit not required	
Mechanical Control	May be required under NR 109	Plants reduced by mechanical means	Flexible control	Must be repeated, often more than once per season
		Wide range of techniques, from manual to highly mechanized	Can balance habitat and recreational needs	Can suspend sediments and increase turbidity and nutrient release
a. Handpulling/Manual raking	Y/N	SCUBA divers or snorkelers remove plants by hand or plants are removed with a rake	Little to no damage done to lake or to native plant species	Very labor intensive
		Works best in soft sediments	Can be highly selective	Needs to be carefully monitored
			Can be done by shoreline property owners without permits within an area <30 ft wide OR where selectively removing exotics	Roots, runners, and even fragments of some species, particularly Eurasian watermilfoil (EWM) will start new plants, so all of plant must be removed
			Can be very effective at removing problem plants, particularly following early detection of an invasive exotic species	Small-scale control only

Management Options for Aquatic Plants

Updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
b. Harvesting	Y	Plants are "mowed" at depths of 2-5 ft, collected with a conveyor and off-loaded onto shore	Immediate results	Not selective in species removed
		Harvest invasives only if invasive is already present throughout the lake	EWM removed before it has the opportunity to autofragment, which may create more fragments than created by harvesting	Fragments of vegetation can re-root
			Usually minimal impact to lake ecology	Can remove some small fish and reptiles from lake
			Harvested lanes through dense weed beds can increase growth and survival of some fish	Initial cost of harvester expensive
			Can remove some nutrients from lake	
Biological Control	Y	Living organisms (e.g. insects or fungi) eat or infect plants	Self-sustaining; organism will over-winter, resume eating its host the next year	Effectiveness will vary as control agent's population fluctates
			Lowers density of problem plant to allow growth of natives	Provides moderate control - complete control unlikely
				Control response may be slow
				Must have enough control agent to be effective
a. Weevils on EWM	Y	Native weevil prefers EWM to other native water-milfoil	Native to Wisconsin: weevil cannot "escape" and become a problem	Need to stock large numbers, even if some already present
			Selective control of target species	Need good habitat for overwintering on shore (leaf litter) associated with undeveloped shorelines
			Longer-term control with limited management	Bluegill populations decrease densities through predation

Management Options for Aquatic Plants

Updated Oct 2006

	Option	Permit Needed?	How it Works	PROS	CONS
b.	Pathogens	Y	Fungal, bacterial, or viral pathogen introduced to target species to induce mortalitiy	May be species specific May provide long-term control Few dangers to humans or animals	Largely experimental; effectiveness and longevity unknown Possible side effects not understood
c.	Allelopathy	Y	Aquatic plants release chemical compounds that inhibit other plants from growing	May provide long-term, maintenance-free control Spikerushes (*Eleocharis* spp.) appear to inhibit Eurasian watermilfoil growth	Initial transplanting slow and labor-intensive Spikerushes native to WI, and have not effectively limited EWM growth Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water
d.	Native plantings	Y	Diverse native plant community established to compete with invasive species	Native plants provide food and habitat for aquatic fauna Diverse native community more repellant to invasive species	Initial transplanting slow and labor-intensive Nuisance invasive plants may outcompete plantings Transplants from another lake or nursery may unintentionally introduce invasive species Largely experimental; few well-documented cases

Management Options for Aquatic Plants

Updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
Physical Control	Required under Ch. 30 / NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a. Fabrics/ Bottom Barriers	Y	Prevents light from getting to lake bottom	Reduces turbidity in soft-substrate areas Useful for small areas	Eliminates all plants, including native plants important for a healthy lake ecosystem May inhibit spawning by some fish Need maintenance or will become covered in sediment and ineffective Gas accumulation under blankets can cause them to dislodge from the bottom Affects benthic invertebrates Anaerobic environment forms that can release excessive nutrients from sediment
b. Drawdown	Y, May require Environmental Assessment	Lake water lowered with siphon or water level control device; plants killed when sediment dries, compacts or freezes Season or duration of drawdown can change effects	Winter drawdown can be effective at restoration, provided drying and freezing occur. Sediment compaction is possible over winter Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization, and increased water quality Success demonstrated for reducing EWM, variable success for curly-leaf pondweed (CLP) Restores natural water fluctuation important for all aquatic ecosystems	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling May impact attached wetlands and shallow wells near shore Species growing in deep water (e.g. EWM) that survive may increase, particularly if desirable native species are reduced Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning Winter drawdawn must start in early fall or will kill hibernating reptiles and amphibians Navigation and use of lake is limited during drawdown

Management Options for Aquatic Plants

Updated Oct 2006

	Option	Permit Needed?	How it Works	PROS	CONS
c.	Dredging	Y	Plants are removed along with sediment Most effective when soft sediments overlay harder substrate For extremely impacted systems Extensive planning required	Increases water depth Removes nutrient rich sediments Removes soft bottom sediments that may have high oxygen demand	Severe impact on lake ecosystem Increases turbidity and releases nutrients Exposed sediments may be recolonized by invasive species Sediment testing may be necessary Removes benthic organisms Dredged materials must be disposed of
d.	Dyes	Y	Colors water, reducing light and reducing plant and algal growth	Impairs plant growth without increasing turbidity Usually non-toxic, degrades naturally over a few weeks.	Appropriate for very small water bodies Should not be used in pond or lake with outflow Impairs aesthetics Effects to microscopic organisms unknown
e.	Non-point source nutrient control	N	Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use) thereby providing fewer nutrients available for plant growth	Attempts to correct source of problem, not treat symptoms Could improve water clarity and reduce occurrences of algal blooms Native plants may be able to better compete with invasive species in low-nutrient conditions	Results can take years to be evident due to internal recycling of already-present lake nutrients Requires landowner cooperation and regulation Improved water clarity may increase plant growth

Management Options for Aquatic Plants

Updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
Chemical Control	Required under NR 107	Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae	Some flexibility for different situations	Possible toxicity to aquatic animals or humans, especially applicators
		Results usually within 10 days of treatment, but repeat treatments usually needed	Some can be selective if applied correctly	Often affect desirable plant species that are important to lake ecology and compete with invasive species
		Chemicals must be used in accordance with label guidelines and restrictions	Can be used for restoration activities	Treatment set-back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration
				May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape
				Often controversial
a. 2,4-D (e.g. Weedar, Navigate)	Y	Systemic[1] herbicide selective to broadleaf[2] plants that inhibits cell division in new tissue	Moderately to highly effective, especially on EWM	May cause oxygen depletion after plants die and decompose
		Applied as liquid or granules during early growth phase	Monocots, such as pondweeds (e.g. CLP) and many other native species not affected.	May affect native dicots such as water lilies and coontail
			Can be used in synergy with endotholl for early season CLP and EWM treatments	Cannot be used in combination with copper herbicides (used for algae)
			Can be selective depending on concentration and seasonal timing	Toxic to fish
			Widely used aquatic herbicide	

Management Options for Aquatic Plants

Updated Oct 2006

	Option	Permit Needed?	How it Works	PROS	CONS
b.	Endothall (e.g. Aquathol)	Y	Broad-spectrum[3], contact[4] herbicide that inhibits protein synthesis Applied as liquid or granules	Especially effective on CLP and also effective on EWM May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring Can be selective depending on concentration and seasonal timing Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds Limited off-site drift	Affects many native pondweeds Not as effective in dense plant beds; heavy vegetation requires multiple treatments Not to be used in water supplies; post-treatment restriction on irrigation Toxic to aquatic fauna (to varying degrees)
c.	Diquat (e.g. Reward)	Y	Broad-spectrum, contact herbicide that disrupts cellular functioning Applied as liquid, can be combined with copper treatment	Mostly used for water-milfoil and duckweed Rapid action Limited direct toxicity on fish and other animals	May affect non-target plants, especially native pondweeds, coontail, elodea, naiads Toxic to aquatic invertebrates Must be reapplied several years in a row Ineffective in muddy or cold water (<50°F)

Management Options for Aquatic Plants

Updated Oct 2006

	Option	Permit Needed?	How it Works	PROS	CONS
d.	Fluridone (e.g. Sonar or Avast)	Y; special permit and Environmental Assessment may be required	Broad-spectrum, systemic herbicide that inhibits photosynthesis	Effective on EWM for 1 to 4 years with aggressive follow-up treatments	Affects native milfoils, coontails, elodea, and naiads, even at low concentrations
			Must be applied during early growth stage	Some reduction in non-target effects can be achieved by lowering dosage	Requires long contact time: 60-90 days
			Available with a special permit only; chemical applications beyond 150 ft from shore not allowed under NR 107	Slow decomposition of plants may limit decreases in dissolved oxygen	Often decreases water clarity, particularly in shallow eutrophic systems
			Applied at very low concentration at whole lake scale	Low toxicity to aquatic animals	Demonstrated herbicide resistance in hydrilla subjected to repeat treatments
					Unknown effect of repeat whole-lake treatments on lake ecology
e.	Glyphosate (e.g. Rodeo)	Y	Broad-spectrum, systemic herbicide that disrupts enzyme formation and function	Effective on floating and emergent plants	RoundUp is often illegally substituted for Rodeo; surfactants in RoundUp believed to be toxic to reptiles and amphibians
			Usually used for purple loosestrife stems or cattails	Selective if carefully applied to individual plants	Cannot be used near potable water intakes
			Applied as liquid spray or painted on loosestrife stems	Non-toxic to most aquatic animals at recommended dosages	Ineffective in muddy water
				Effective control for 1-5 years	No control of submerged plants

Management Options for Aquatic Plants

Updated Oct 2006

	Option	Permit Needed?	How it Works	PROS	CONS
f.	Triclopyr (e.g. Renovate)	Y	Systemic herbicide selective to broadleaf plants that disrupts enzyme function	Effective on many emergent and floating plants	Impacts may occur to some native plants at higher doses (e.g. coontail)
			Applied as liquid spray or liquid	Most effective on dicots, such as purple loosestrife; may be more effective than glyphosate	May be toxic to sensitive invertebrates at higher concentrations
				Control of target plants occurs in 3-5 weeks	Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm)
				Low toxicity to aquatic animals	Sensitive to UV light; sunlight can break herbicide down prematurely
				No recreational use restrictions following treatment	Relatively new management option for aquatic plants (since 2003)
g.	Copper compounds (e.g. Cutrine Plus)	Y	Broad-spectrum, systemic herbicide that prevents photosynthesis	Reduces algal growth and increases water clarity	Elemental copper accumulates and persists in sediments
			Used to control planktonic and filamentous algae	No recreational or agricultural restrictions on water use following treatment	Short-term results
			Wisconsin allows small-scale control only	Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin	Long-term effects of repeat treatments to benthic organisms unknown
					Toxic to invertebrates, trout and other fish, depending on the hardness of the water
					Clear water may increase plant growth

[1]Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.
[2]Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.
[3]Broad-spectrum herbicide - Affects both monocots and dicots.
[4]Contact herbicide - Unable to move within the plant; kills only plant tissue it contacts directly.

This document is intended to be a guide to available aquatic plant control techniques, and is not necessarily an exhaustive list.
References to registered products are for your convenience and not intended as an endorsement or criticism of that product versus other similar products.
Specific effects of herbicide treatment contingent on usage within label guidelines and in accordance with all applicable laws.
Please contact your local Aquatic Plant Management Specialist when considering a permit.

Aquatic Plant Control Techniques Not Allowed in Wisconsin

Updated Oct 2006

Option	How it Works	PROS	CONS
Biological Control			
a. Carp	Plants eaten by stocked carp	Effective at removing aquatic plants	Illegal to transport or stock carp in Wisconsin
		Involves species already present in Madison lakes	Carp cause resuspension of sediments, increased water temperature, lower dissolved oxygen levels, and reduction of light penetration
			Widespread plant removal deteriorates habitat for other fish and aquatic organisms
			Complete alteration of fish assemblage possible
			Dislodging of plants such as EWM or CLP turions can lead to accelerated spreading of plants
b. Crayfish	Plants eaten by stocked crayfish	Reduces macrophyte biomass	Illegal to transport or stock crayfish in Wisconsin
			Control not selective and may decimate plant community
			Not successful in productive, soft-bottom lakes with many fish predators
			Complete alteration of fish assemblage possible
Mechanical Control			
a. Cutting (no removal)	Plants are "mowed" with underwater cutter	Creates open water areas rapidly	Root system remains for regrowth
		Works in water up to 25 ft	Fragments of vegetation can re-root and spread infestation throughout the lake
			Nutrient release can cause increased algae and bacteria and be a nuisance to riparian property owners
			Not selective in species removed
			Small-scale control only
b. Rototilling	Sediment is tilled to uproot plant roots and stems	Decreases stem density, can affect entire plant	Creates turbidity
	Works in deep water (17 ft)	Small-scale control	Not selective in species removed
		May provide long-term control	Fragments of vegetation can re-root
			Complete elimination of fish habitat
			Releases nutrients
			Increased likelihood of invasive species recolonization
c. Hydroraking	Mechanical rake removes plants from lake	Creates open water areas rapidly	Fragments of vegetation can re-root
	Works in deep water (14 ft)		May impact lake fauna
			Creates turbidity
			Plants regrow quickly
			Requires plant disposal

Appendix M

Meeting Agendas and Materials

Big Blake Lake Management Plan Development
Committee Meeting 1

Saturday, February 20th
9-11 am
Polk County Justice Center

9:00 Introductions, roles, and responsibilities (all)

9:15 Schedule future meetings—bring your calendar (all)
- March
- April
- May

9:20 Presentation (Polk County Land and Water Resources Department)
- Purpose of the meeting
- Big Blake Lake chemistry results
- Big Blake Lake resident survey results
- Time for questions

10:00 Brainstorming session (Management Plan Committee)
- What do you value about Big Blake Lake?
- What concerns/issues do you have for Big Blake Lake?

11:00 Adjourn

Katelin Holm
(715) 485-8637
katelin.holm@co.polk.wi.us

Jeremy Williamson
(715) 485-8639
jeremyw@co.polk.wi.us

Big Blake Lake Management Plan Development Rules and Responsibilities

Overall Objective

Develop a Lake and Aquatic Plant Management Plan for Big Blake Lake

A management plan outlines goals and actions that everyone can live with

Ground Rules

Listen to what others are saying
Don't interrupt when others are speaking
Input is heard from everyone
Stay on topic and stick to the agenda

Management Plan Committee Responsibilities

Attend all meetings
Share your knowledge and concerns about Big Blake Lake
Review background information and draft documents
Develop lake and aquatic plant management strategies
Decide when draft document is ready to forward to board for approval

Land and Water Resources Department Responsibilities

Send out agendas and materials prior to meetings
Keep discussion on track, may need to interrupt to keep discussion focused
Summarize key study findings
Write goals, objectives, and action items for the plan using committee input
Write draft and final plan documents
Submit plan for public comment and WDNR review

District Responsibilities

Participate as part of the committee
Review draft Management Plan
Approve draft Management Plan to forward to the WI DNR <u>or</u> disapprove draft Management Plan and return to committee

Big Blake Lake Management Plan Development Committee Meeting 1 Notes
Saturday, February 20th
9:00-11:15 am
Polk County Justice Center

Introductions, roles, and responsibilities
Mike Rogge, Peggy Lauritsen, Jim Mitchell, Don Craft, Shelley Rodriguez, Sam Rivers, Sue Budd, John Belisle, Roxanne Smith, Gerry Smith, Katelin Holm, and Jeremy Williamson

Schedule March meeting—Saturday, March 12th 9-11am

Discussed the purpose of the meetings and the activities covered under both grants
Reviewed Big Blake Lake chemistry results from 2013-2015
Reviewed Big Blake Lake resident survey results

Discussion points resulting from presentation
Discussed the use of buffers and rain gardens as a strategy for lake improvement and how native plants provide benefits to water quality
Discussed aquatic plant management techniques
- Allow individual permits for herbicide
- Allow for harvesting of individual navigation channels for access
- Mechanical harvesting (with a rake) does not require a permit

Discussed the impact of raising and lowering the dam on water quality
Discussed offering individual property owner consultations for making improvements
Discussed sources of phosphorus (watershed, internal loading)
Discussed the relationship between curly-leaf pondweed and internal loading
Discussed the life cycle of curly leaf pondweed
Discussed the impacts that harvesting has had on curly-leaf pondweed

Brainstormed concerns for Big Blake Lake
- ✓ Algae
- ✓ Curly-leaf pondweed
- ✓ New AIS, such as Eurasian water milfoil
- ✓ Dangerous jet skis, specifically in regards to loons
- ✓ Phosphorus
- ✓ Failing/outdated septic systems
- ✓ Septic waste being spread on neighboring fields
- ✓ Farm field runoff
- ✓ Loss of wildlife

- ✓ Lake gets stirred up during the weekend
    - Can we limit speeds by enforcing slow no wake? Would we want to?
    - Can we limit tournaments?
    - Can we limit power-loading or the speed when boats take off?
- ✓ Enforcement
    - Septic, boating, etc
- ✓ Aging population
    - How can we engage the younger generation?

Education needs and messaging

- ✓ Shoreline restoration/buffers
- ✓ The impact of boating speed and size of motor on phosphorus loading from the sediments
    - There are reports on this topic which could be posted on the website
- ✓ Everyone has an impact
- ✓ Provide Clean Boats, Clean Waters education (clean when leave and launch) for people who don't live on the lake

Over-riding factors to consider

- ✓ Communication
    - One-on-one conversations
    - Stress the important issues
    - Repeat the same message
    - Highlight a simple take away message
- ✓ Member engagement (being neighborly)
    - Connect with people, know the person
    - How can we let everyone know who we are?

Adjourn

Purpose of the Meeting

Review the data collected

Develop Aquatic Plant Management Plan

Develop Lake Management Plan

Grant Deliverables-Data Collected

- Lake resident survey
- In-lake physical and chemical monitoring
- Tributary monitoring
- Phytoplankton
- Zooplankton
- Aquatic plant point intercept surveys
- Curly leaf pondweed biomass and turion monitoring
- Watershed delineation, land use determination, and modeling
- Participation in AIS statewide programs: Citizen Lake Monitoring Network for AIS and Water Quality, Bait Dealer Initiative, and Clean Boats, Clean Waters
- Communication of information: the Blake Lake Bugle Newsletter, pontoon classrooms, and distribution of AIS flyers
- Sediment core collection and analysis
- Historical land use and conditions
- Development of an Aquatic Plant and Lake Management Plan

2004 Goals

- Public education and shoreline restoration
- Create a committee to improve the Straight River Watershed
- Work with County and Towns as they create land use and zoning regulations
- Collect in-lake data
- Reduce CLP
- Harvest CLP and native plants in navigation channels
- Implement watershed best management practices
- Promote the growth of native plants in sensitive areas

2016 Goals Format

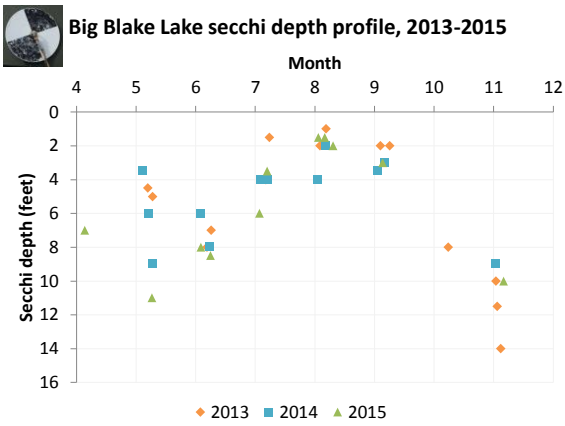
Goal 1: Reduce algae and phosphorus in the three lake system by reducing watershed runoff

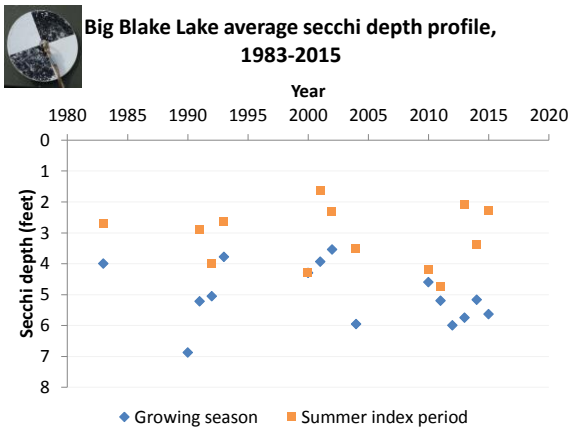
Action	Timeline	Cost Estimate	Volunteer Hours	Responsible Parties	Funding Sources
Identify shoreline landowners willing to install shoreline buffers, rain gardens, and water diversions on their property	2013, ongoing	$1,000	80	Board Water quality committee	District
Provide technical assistance and cost sharing for implementation of projects	2014, ongoing	$250,000		Board Consultant	District WDNR Lake Protection Grant*
Recognize landowners that have taken steps to reduce watershed runoff	Ongoing	$50 annual		Board	District
Partner with landowners to install rain gardens, water diversions, and erosion control practices at or near the Church Pine Lake boat landing	2014, ongoing	TBD		Board Consultant	District WDNR Lake Protection Grant*
Support the work of the Horse Creek Watershed Farmer Led Council	2015, ongoing	TBD		Board LWRD	District
Work with Polk County LWRD/consultant to identify agricultural best management practices to reduce the phosphorus load from North Creek	2014, ongoing	TBD		Board LWRD Consultant	District WDNR Lake Planning Grant
Examine the economic feasibility and effectiveness of a sediment pond on North Creek	2015	$2,500		Board Consultant	District WDNR Lake Planning Grant
Partner with landowners to install rain gardens, water diversions, and erosion control practices at or near the Big Lake boat landing	2014, ongoing	TBD		Board Consultant	District WDNR Lake Protection Grant*

Secchi Depth

Measure of water clarity

Bigger numbers = greater clarity





Phosphorus (P)

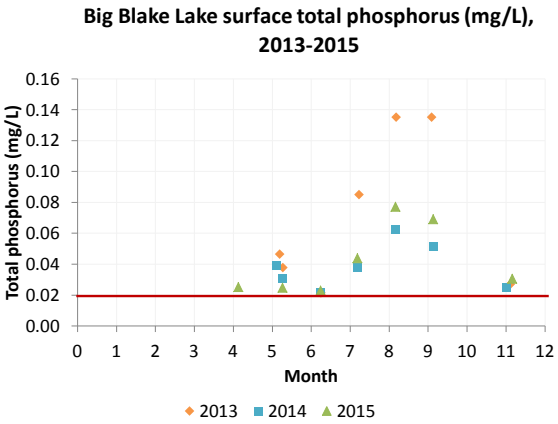
Excess amounts can cause excessive plant and algae growth

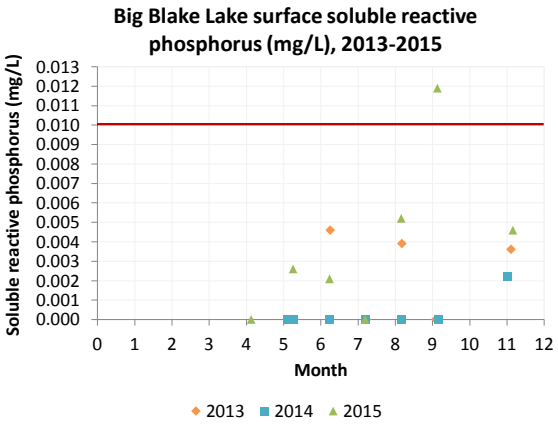
Occurs naturally in soil

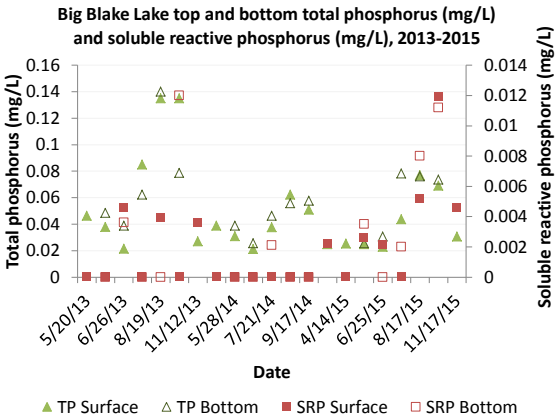
Component of fertilizer

Total P= all P in a water sample

Soluble reactive P = P dissolved in water, ready for uptake by plants and algae





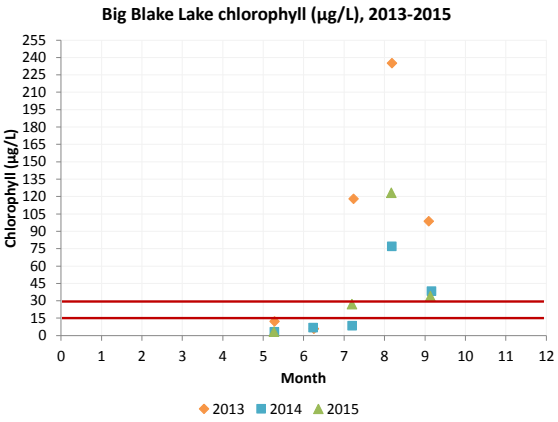


Chlorophyll

Pigment in plants and algae

Provides a general indication of the amount of algae in a lake

Higher values = more algae



Trophic State Index

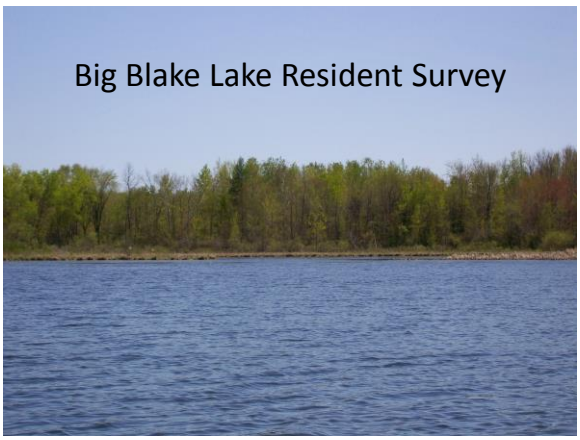
Serves as an indicator of water quality

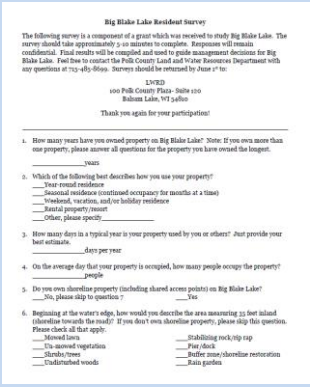
– Reflects nutrient and clarity levels

Trophic State Index

2013 = 73 2014 = 62 2015 = 67

TSI	General Description
<30	Oligotrophic; clear water, high dissolved oxygen throughout the year/lake
30-40	Oligotrophic; clear water, possible periods of oxygen depletion in the lower depths of the lake
40-50	Mesotrophic; moderately clear water, increasing chance of anoxia near the bottom of the lake in summer, fully acceptable for all recreation/aesthetic uses
50-60	Mildly eutrophic; decreased water clarity, anoxic near the bottom, may have macrophyte problem; warm-water fisheries only
60-70	Eutrophic; blue-green algae dominance, scums possible, prolific aquatic plant growth. Full body recreation may be decreased
70-80	Hypereutrophic; heavy algal blooms possible throughout the summer, dense algae and macrophytes
>80	Algal scums, summer fish kills, few aquatic plants due to algal shading, rough fish dominate





Big Blake Lake Resident Survey

The following survey is a component of a grant which was received to study Big Blake Lake. The survey should take approximately 5-10 minutes to complete. Responses will remain confidential. Final results will be compiled and used to guide management decisions for Big Blake Lake. Feel free to contact the Polk County Land and Water Resources Department with any questions at 715-485-8669. Surveys should be returned by June 1st to:

LWRD
100 Polk County Plaza- Suite 120
Balsam Lake, WI 54810

Thank you again for your participation!

1. How many years have you owned property on Big Blake Lake? Note: If you own more than one property, please answer all questions for the property you have owned the longest.
   _____years
2. Which of the following best describes how you use your property?
   ___Year-round residence
   ___Seasonal residence (continued occupancy for months at a time)
   ___Weekend, vacation, and/or holiday residence
   ___Rental property/resort
   ___Other, please specify_____
3. How many days in a typical year is your property used by you or others? Just provide your best estimate.
   _____days per year
4. On the average day that your property is occupied, how many people occupy the property?
   _____people
5. Do you own shoreline property (including shared access points) on Big Blake Lake?
   ___No, please skip to question 7 ___Yes
6. Beginning at the water's edge, how would you describe the area measuring 35 feet inland (shoreline towards the road)? If you don't own shoreline property, please skip this question. Please check all that apply.
   ___Mowed lawn ___Stabilizing rock/rip rap
   ___Un-mowed vegetation ___Pier/dock
   ___Shrubs/trees ___Buffer zone/shoreline restoration
   ___Undisturbed woods ___Rain garden

Mailed 217 surveys in May 2014

126 respondents, 58%

Thank you!

Big Blake Lake Owners

Property ownership: 21 years

People occupying property: 3.6

Number of days property used: 148 days

Most people are weekend residents (56%)
One third are full time residents (33%)

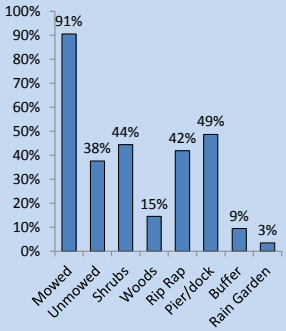
Characterizing the Shoreline

Half of property owners think the amount of lawn on Big Blake Lake is just right,

one quarter think there is too much lawn,

and one quarter are unsure.

Most believe that buffers, rain gardens, and natives plants are somewhat (34%) or very important (37%) to the water quality of Big Blake Lake.



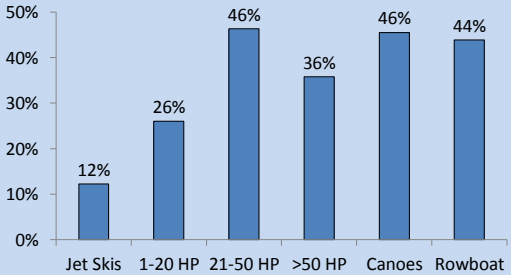
A Very Positive Note

98% of survey respondents either don't use fertilizer or use phosphorus free fertilizers

Activities Enjoyed on Big Blake Lake?

Peace and tranquility (93%)
Scenic view (89%)
Fishing (83%)
Motorized boating (80%)
Observing birds/wildlife (79%)
Swimming (70%)
Non-motorized boating (47%)
Ice fishing (45%)

Watercraft and Use



A quarter of respondents use their watercraft on other waterbodies

Concerns for Big Blake Lake

High or Medium Concern
By 75% of respondents

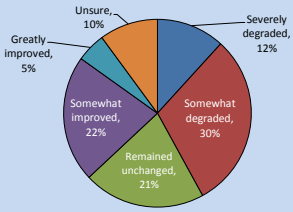
- Excessive aquatic plant growth
- Expansion of curly leaf pondweed
- Excessive algae blooms
- Decrease in overall lake health
- Lack of water clarity or quality
- New invasive species entering the lake
- Increased nutrient pollution

Low or No Concern
By 60% of respondents

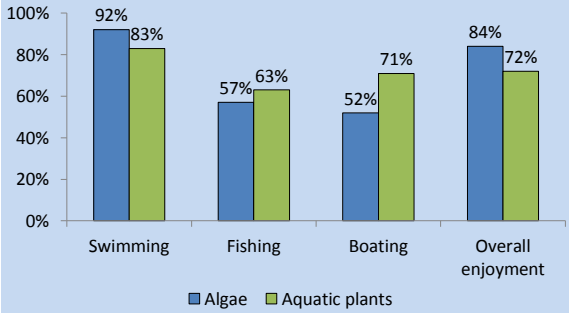
- Excessive noise level on the lake
- Decreased wildlife populations

Current Conditions on Big Blake Lake

Water level:
too low (81%)
Water quality:
fair (54%) or good (26%)
Change in water quality:
graph
Months algae is a problem:
July (66%) and August (88%)
Aquatic plants:
too many (69%) and healthy amount (29%)
Months aquatic plants are a problem:
June (46%), July (74%), and August (67%)



Uses Impaired by Algae and Aquatic Plants



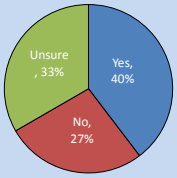
Curly Leaf Pondweed (CLP)

50% of respondents can definitely recognize curly leaf pondweed and another 20% probably can

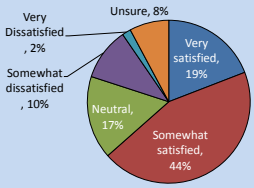
Paul Skawinski, UW-Extension Lakes

Aquatic Plant Management Program

Is the current program effectively controlling nuisance aquatic plant growth?



How satisfied are property owners with the aquatic plant harvesting program?



Actions to Manage Big Blake Lake

Ranked by priority

- Bring the dam up to code: 91%
- Programs to prevent and monitor AIS: 89%
- Enhance fisheries: 78%
- Upgrade non-conforming septic systems: 71%
- Install shoreline buffers/rain gardens: 61%
- Install farmland conservation practices: 54%
- Lake fairs and workshops: 44%
- Enforce slow no wake zones: 44%

Actions to Manage Aquatic Invasive Species (AIS)

Ranked by priority

Harvesting CLP: 90%

Monitoring to detect new AIS: 89%

Clean Boats, Clean Waters: 86%

Educational programs: 72%

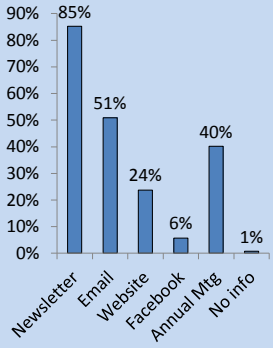
Trainings to identify and manage AIS: 69%

Herbicide control of CLP: 54%

Boat landing cameras: 37%

Boat wash stations: 35%

Communication



Half of property owners were unaware of the Facebook page and another third have never visited the page.

Questions?

Thank you!

Big Blake Lake Management Plan Development
Committee Meeting 2

Saturday, March 12th, 2016
9-11 am
Polk County Government Center, County Board Room (note location change)
100 Polk County Plaza, Balsam Lake (kiddie corner across street from Justice Center)

9:00 Introductions

9:05 Consider possible vision statements and guiding principles

A vision statement is an overall statement for what you want the waterbody to look like
Guiding principles provide guidance on how the lake management plan will be implemented

9:30 Review and make changes to draft goals
Begin to brainstorm objectives and actions (as time allows)

10:15 Presentation (Polk County Land and Water Resources Department)

Harvesting background information (page 62 in management plan)
CLP biomass and turion sampling (pages 63-65 in management plan)
Point intercept aquatic macrophyte surveys (pages 66-79 in management plan)

11:00 Adjourn

Next meeting will be scheduled through a doodle poll

Katelin Holm
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Jeremy Williamson
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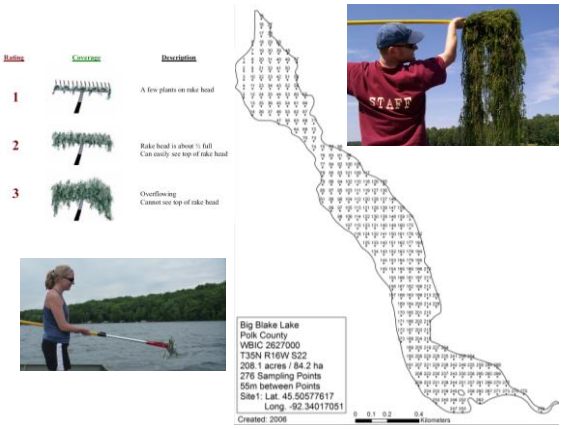
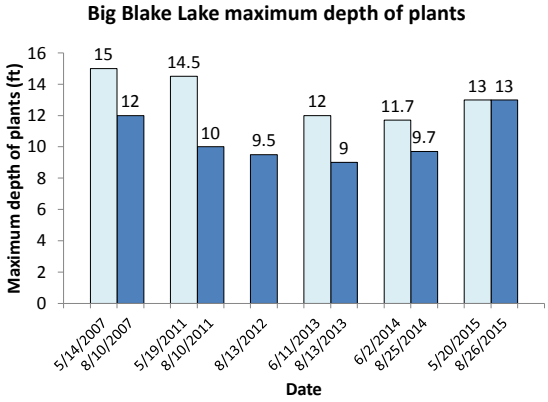
History of Harvesting

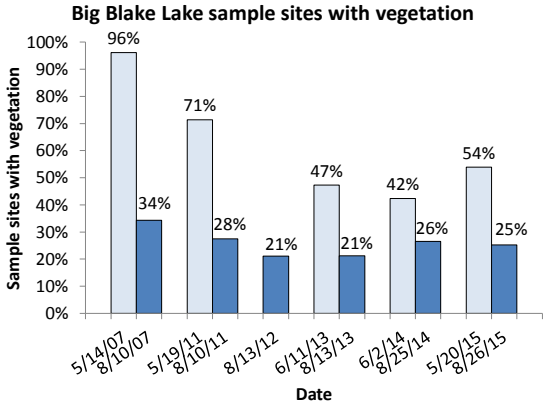
1976	District formed
1980/1990	Contracted harvesting, herbicide
1998	First plant survey
1999	Plant management plan
2004	Plant survey and plan
2007	District begins harvesting

Curly-leaf pondweed harvesting information			
	Harvesting start date	Harvesting end date	Loads of curly-leaf pondweed removed
2013	June 16	July 3	8
2014	June 8	July 14	30
2015	May 19	July 1	143

Coontail harvesting information			
	Harvesting start date	Harvesting end date	Loads of coontail removed
2013	July 18	Sept 17	14
2014	Aug 14	Sept 18	6
2015	July 22	Sept 3	28







What are the dominant species?

??

Relative frequency

?

Frequency of occurrence at sites shallower than maximum depth of plants

??

FREQUENCY OF OCCURRENCE IN VEGETATED AREAS

??

??

CLP Frequency of Occurrence

SPRING	5/14/07	5/19/11	6/11/13	6/2/14	5/20/15
Vegetated areas	100%	93%	73%	59%	93%
Maximum depth of plants	97%	67%	53%	32%	51%

FALL	8/10/07	8/10/11	8/13/12	8/13/13	8/25/14	8/26/15
Vegetated areas	1.1%	1.4%	1.8%	1.8%	1.4%	1.5%
Maximum depth of plants	0.4%	0.8%	0.9%	1.1%	0.8%	0.4%

Coontail Frequency of Occurrence

SPRING	5/14/07	5/19/11	6/11/13	6/2/14	5/20/15
Vegetated areas	20%	26%	34%	32%	19%
Maximum depth of plants	19%	18%	25%	17%	11%

FALL	8/10/07	8/10/11	8/13/12	8/13/13	8/25/14	8/26/15
Vegetated areas	86%	92%	86%	82%	73%	85%
Maximum depth of plants	31%	52%	44%	51%	42%	22%

Relative Frequency

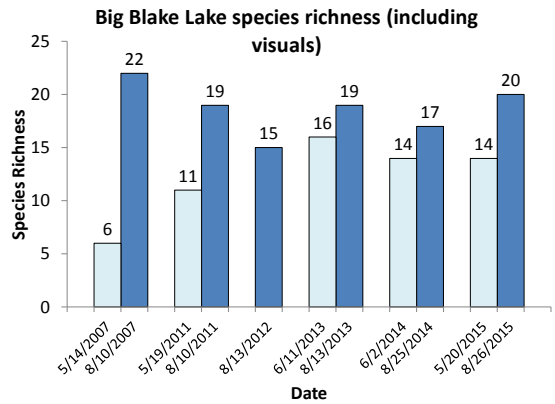
- How common a species is compared to all the species found
- Adds up to 100%

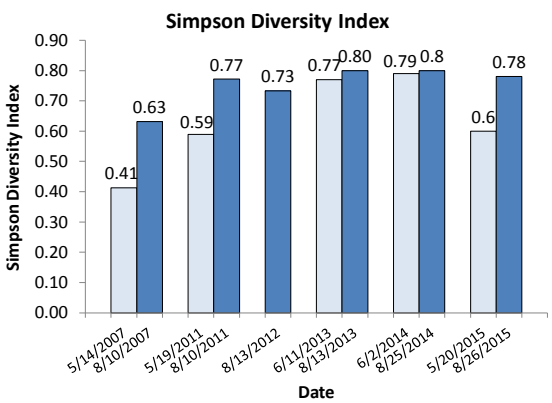
	5/14/07	5/19/11	6/11/13	6/2/14	5/20/15
CLP	75%	61%	38%	32%	60%
Coontail	15%	17%	18%	17%	13%

	8/10/07	8/10/11	8/13/12	8/13/13	8/25/14	8/26/15
CLP	0.7%	0.6%	1%	0.8%	0.7%	0.7%
Coontail	59%	41%	46%	36%	36%	38%

Spring relative frequency, 2007, 2011, and 2013-2015					
	5/14/07	5/19/11	6/11/13	6/2/14	5/20/15
Ceratophyllum demersum, coontail	14.6	16.7	17.8	17.1	12.6
Filamentous algae	6.3				
Heteranthera dubia, water star-grass			0.8		0.5
Lemna minor, small duckweed			1.2		
Lemna trisulca, forked duckweed	1.5	8.0	8.1	16.1	3.6
Myriophyllum sibiricum, northern water milfoil		1.3	0.4	1.4	2.7
Nitella sp., nitella					0.5
Nuphar variegata, spatterdock		0.7	0.4	1.9	0.9
Nymphaea odorata, white water lily		0.3	1.2	0.9	0.5
Potamogeton crispus, curly-leaf pondweed	74.9	60.7	38.1	32.2	60.4
Potamogeton praelongis, white-stem pondweed		0.3	1.6	0.9	0.9
Potamogeton pulcher, spotted pondweed		0.3			
Potamogeton pusillus, small pondweed	0.9	9.0	18.6	21.3	12.2
Potamogeton zosteriformis, flat-stem pondweed	1.8	2.7	8.5	7.1	3.6
Ranunculus aquatilis, white water crowfoot			1.6		0.9
Vallisneria americana, wild celery			0.4		
Wolffia columbiana, common watermeal			0.8		
Zizania palustris, northern wild rice			0.4	0.9	0.9

Fall relative frequency, 2007, 2011, and 2013-2015						
	8/10/07	8/10/11	8/13/12	8/13/13	8/25/14	8/26/15
Ceratophyllum demersum, coontail	58.5	40.7	45.7	36.2	36.4	38.4
Chara sp., Muskgrasses						0.7
Elodea canadensis, common waterweed	0.7					2.0
Filamentous algae	5.9		2.9			
Heteranthera dubia, water star-grass	0.7	1.2		1.6	3.5	1.3
Lemna minor, small duckweed	2.2	3.0		0.8	2.8	2.0
Lemna trisulca, forked duckweed	9.6	19.2	16.2	12.6	18.9	19.9
Myriophyllum sibiricum, northern water milfoil	2.2	3.6	7.6	3.9	6.3	5.3
Najas flexilis, bushy pondweed	0.7	1.8		0.8	4.2	
Nitella sp., nitella	0.7					
Nuphar variegata, spatterdock		3.0	1.0		2.1	0.7
Nymphaea odorata, white water lily	1.5	1.8	3.8	3.9	2.8	3.3
Potamogeton amplifolius, large-leaf pondweed					0.7	
Potamogeton crispus, curly-leaf pondweed	0.7	0.6	1.0	0.8	0.7	0.7
Potamogeton illinoensis, Illinois pondweed	2.2					
Potamogeton praelongis, white-stem pondweed		1.2		1.6		2.0
Potamogeton pusillus, small pondweed	0.7	3.6		7.9	5.6	1.3
Potamogeton richardsonii, clasping-leaf pondweed	1.5	1.2	1.0	3.9	0.7	2.0
Potamogeton zosteriformis, flat-stem pondweed	10.4	13.8	14.3	21.3	14.0	15.9
Ranunculus aquatilis, white water crowfoot		0.6		0.8	0.7	1.3
Sparganium angustifolium, narrow-leaved burreed			4.8			
Spirodela polyrhiza, large duckweed	0.7	3.0		0.8		
Stuckenia pectinata, sago pondweed	0.7					
Vallisneria americana, wild celery		0.6	1.9	2.4		1.3
Wolffia columbiana, common watermeal		0.6		0.8	0.7	2.0
Zizania palustris, northern wild rice		0.6				

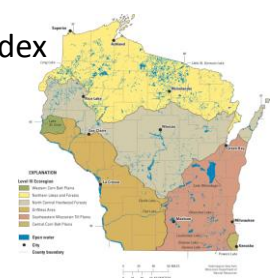




Floristic Quality Index

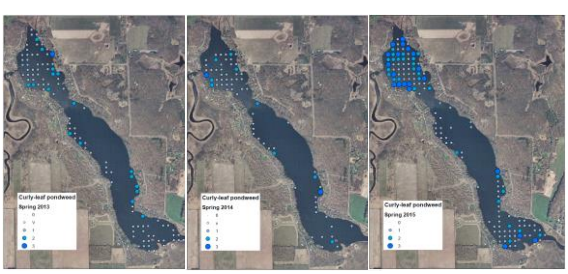
Closeness of flora to an undisturbed condition

Mean species richness = 14
Mean average conservatism = 5.6
Mean Floristic Quality = 20.9



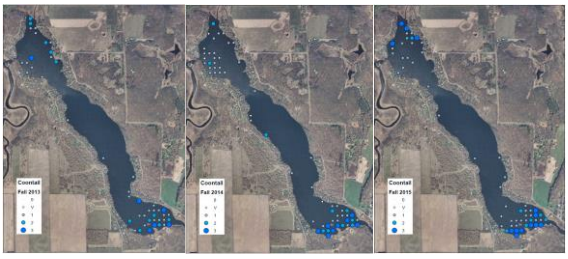
	5/14/07	8/9/07	5/19/11	8/10/11	8/13/12	6/11/13	8/13/13	6/2/14	8/25/14	5/20/15	8/26/15
Species Richness	4	15	9	17	9	14	15	9	14	12	16
Conservatism	5.5	5.3	6.4	5.9	6.0	6.1	5.9	6.2	5.8	6.4	5.8
FQI	11.0	20.4	19.3	24.5	18.0	22.7	22.7	18.7	21.6	22.2	23.0

Spring Curly-leaf Pondweed

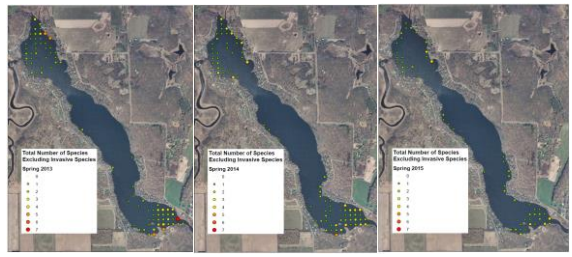


Spring Coontail

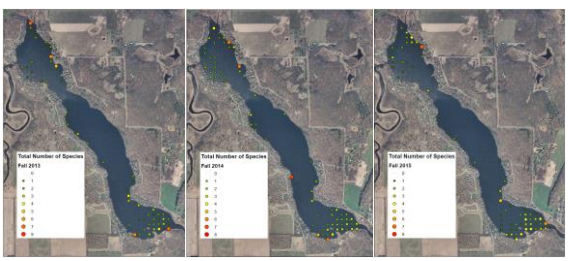
Fall Coontail



Spring All Species (Excluding AIS)



Fall All Species

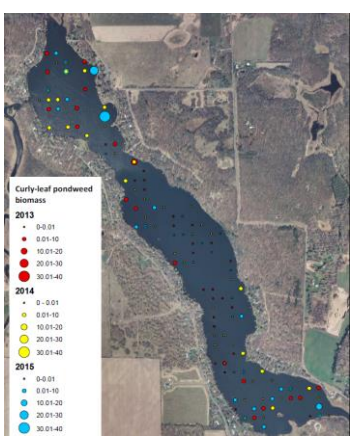


CLP Biomass and Turion Sampling

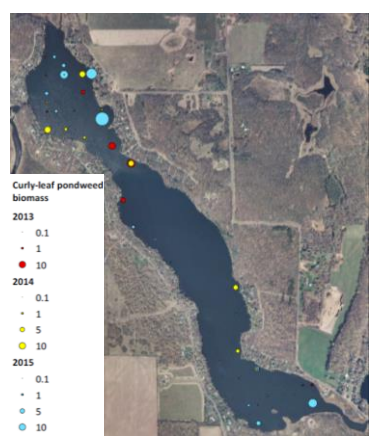
Year	Turions per dredge sample	Turions per square meter	Curly-leaf pondweed biomass (grams)
2013	2.7	117	0.656
2014	1.9	83	0.768
2015	1.3	56	2.272

Big Blake Lake dry weight curly-leaf pondweed biomass (grams), 2013-2015

Shows a biomass of zero

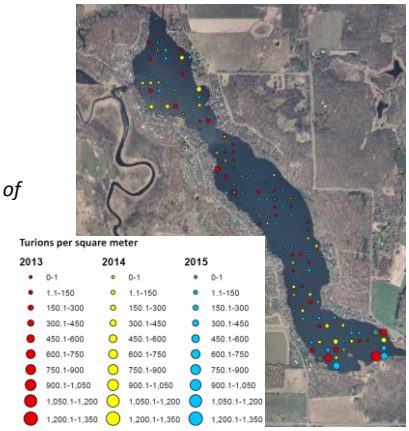


Big Blake Lake dry weight curly-leaf pondweed biomass (grams), 2013-2015

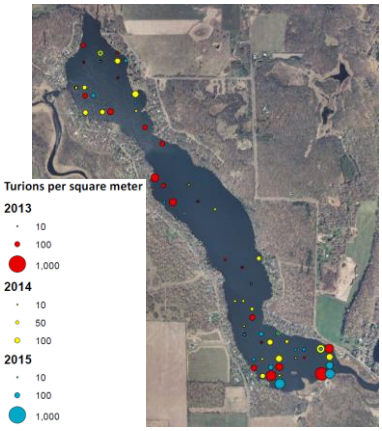


Big Blake Lake turions per square meter, 2013-2015

Shows a turion of zero



Big Blake Lake turions per square meter, 2013-2015



Big Blake Lake Management Plan Development
Committee Meeting 3

Tuesday, April 5, 2016
6-8 PM
Polk County Government Center, County Board Room
100 Polk County Plaza, Balsam Lake

6:00 Introductions

6:05 Review vision statement, guiding principles, and goals
Brainstorm and review objectives and actions

7:15 Presentation (Polk County Land and Water Resources Department)
- Tributary and Outlet Chemistry (pages 41-43, 46-47, and 50 in management plan)
- Land Use (pages 82-87 in management plan)
- Modeling

8:00 Adjourn

Next meeting will be scheduled through a doodle poll

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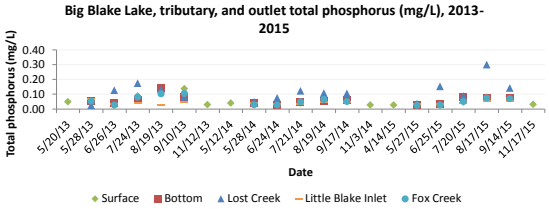
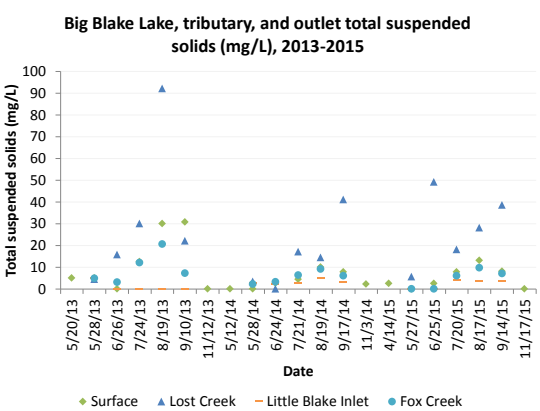
katelin.holm@co.polk.wi.us

Jeremy Williamson
(715) 485-8639
jeremyw@co.polk.wi.us

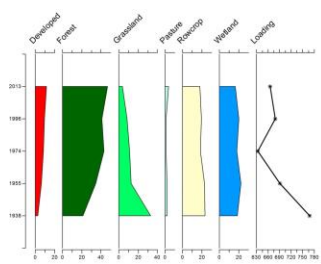
Average total phosphorus (mg/L)			
	2013	2014	2015
Surface of Big Blake Lake	0.08	0.04	0.05
Bottom of Big Blake Lake	0.07	0.04	0.06
Lost Creek	0.11	0.09	0.14
Little Blake Lake Inlet	0.04	0.04	0.04
Fox Creek	0.07	0.04	0.05

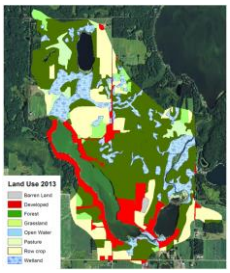


Site	TP (mg/L)	Area (m^2)	Discharge (l/s)	Phosphorus (lb/yr)
2013 Fox Creek	0.0720	4.11	4,942	24,755
2014 Fox Creek	0.0422	5.72	10,696	31,402
2015 Fox Creek	0.0477	4.08	7,075	23,479
2013 Lost Creek	0.1065	5.90	360	2,667
2014 Lost Creek	0.0899	7.22	1,227	7,674
2015 Lost Creek	0.1423	8.26	760	7,524
2013 Little Blake Inlet	0.0424	10.37	4,571	13,484
2014 Little Blake Inlet	0.0415	8.17	7,487	21,616
2015 Little Blake Inlet	0.0445	8.21	5,460	16,904

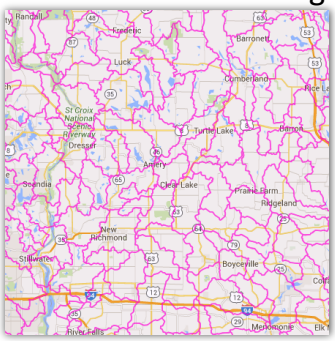


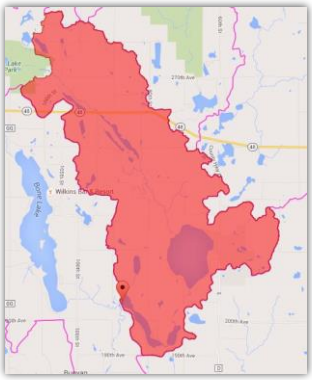
Date	Developed (acres)	Forest (acres)	Grassland (acres)	Pasture (acres)	Row crop (acres)	Wetland (acres)	Phosphorus loading (lbs/yr)
1938	57, (3%)	451, (21%)	705, (33%)	40, (2%)	490, (23%)	391, (18%)	769
1955	132, (6%)	753, (35%)	279, (13%)	40, (2%)	489, (23%)	474, (22%)	691
1974	179, (8%)	922, (43%)	244, (11%)	26, (1%)	392, (18%)	379, (18%)	634
1996	204, (10%)	873, (41%)	177, (8%)	28, (1%)	417, (20%)	421, (20%)	679
2013	250, (12%)	1004, (47%)	80, (4%)	80, (4%)	390, (18%)	348, (16%)	666

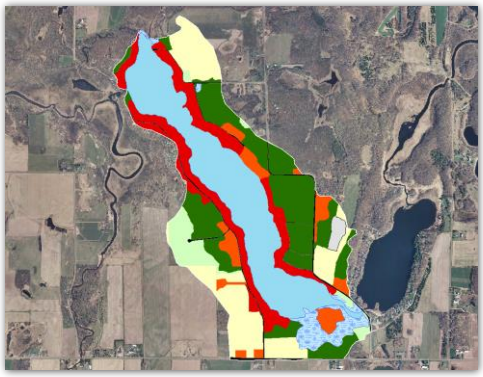


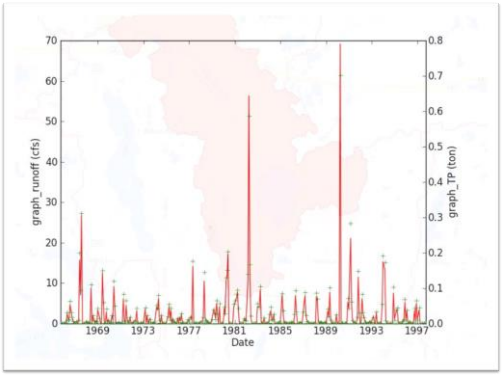


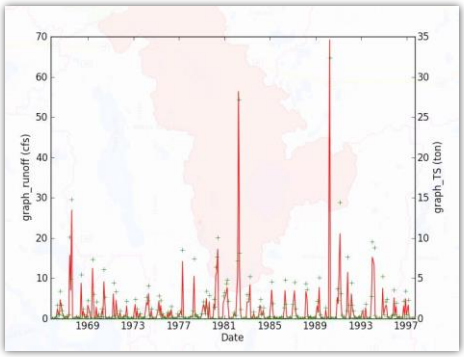
Watershed Modeling



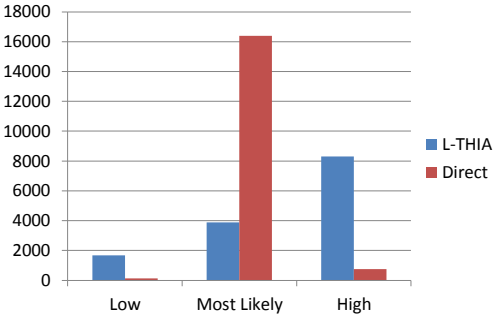




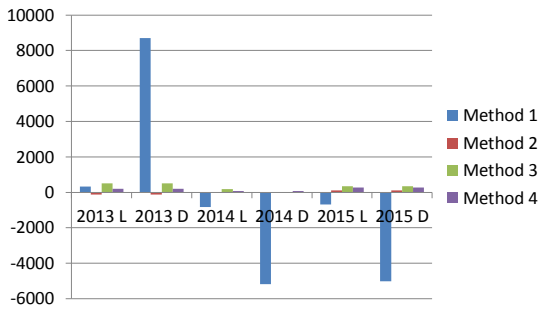




External Loading



Internal Loading

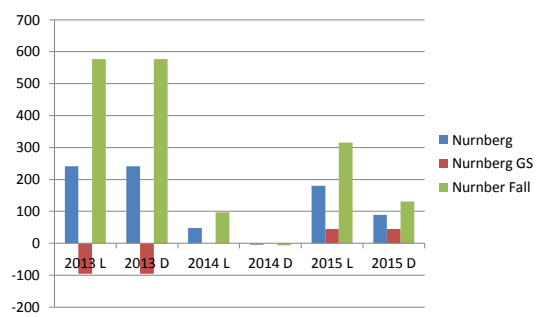


Nurnberg Model

$$P = \frac{L_{Ext}}{q_s}(1 - R) + \frac{L_{int}}{q_s}$$

Where $R = \frac{15}{18 + q_s}$

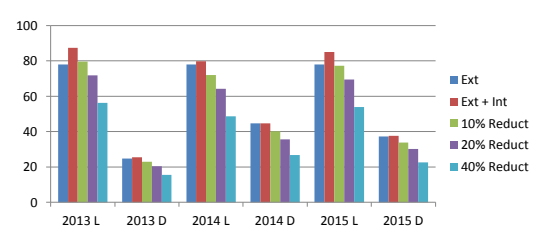
Nurnberg Model



Reckhow Model

$$P = \frac{L}{0.17z + 1.13\,{}^{z}/_{T_w}}$$

Reckhow Model



	2013 L	2013 D	2014 L	2014 D	2015 L	2015 D
Ext	77.91	24.76	77.91	44.57	77.91	37.3
Ext + Int	87.37	25.43	79.78	44.57	84.98	37.55
10% Reduct	79.58	22.96	71.98	40.12	77.19	33.82
20% Reduct	71.79	20.48	64.19	35.66	69.4	30.09
40% Reduct	56.21	15.53	48.61	26.74	53.81	22.63

Big Blake Lake Management Plan Development
Committee Meeting 4

Thursday, June 30, 2016
6-8 PM
Polk County Government Center, County Board Room
100 Polk County Plaza, Balsam Lake

6:00 Introductions

6:05 Nutrient Budget and Sediment Core Presentation (Jeremy Williamson)

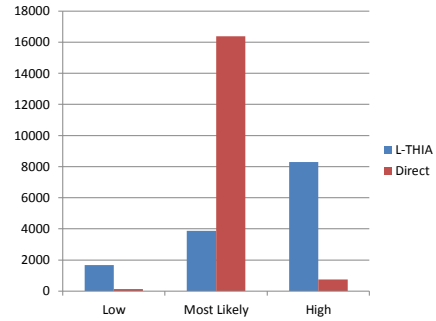
6:30 Complete goals spreadsheet (all)

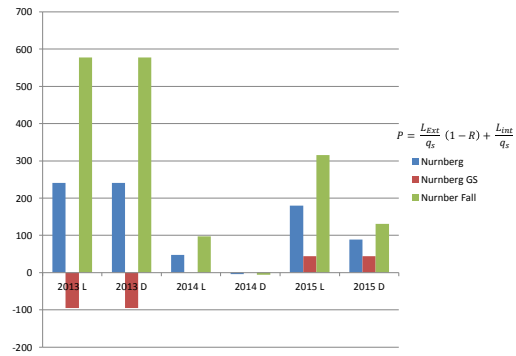
8:00 Adjourn

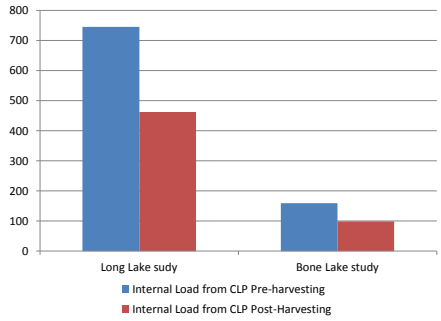
Katelin Anderson
(715) 485-8637
katelin.anderson@co.polk.wi.us

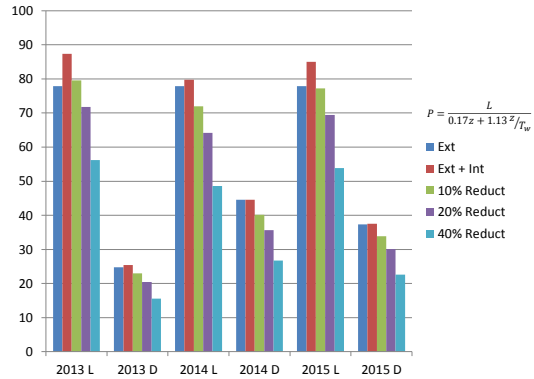
Jeremy Williamson
(715) 485-8639
jeremyw@co.polk.wi.us

Blake Lake Nutrient Budget and Reconstruction
Jeremy Williamson
Water Quality Specialist
Polk County Land & Water Resources Dept.

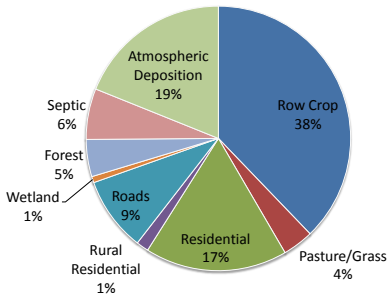

18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Low
Most Likely
High
L-THIA
Direct


700
600
500
400
300
200
100
0
-100
-200
2013 L
2013 D
2014 L
2014 D
2015 L
2015 D
$P = \frac{L_{Ext}}{q_s}(1-R) + \frac{L_{int}}{q_s}$
Nurnberg
Nurnberg GS
Nurnber Fall

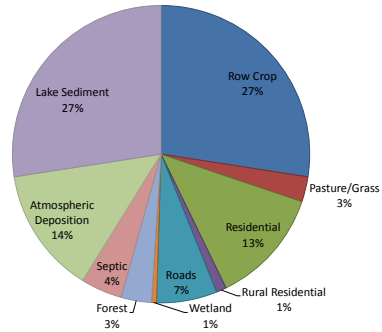

800
700
600
500
400
300
200
100
0
Long Lake sudy
Bone Lake study
Internal Load from CLP Pre-harvesting
Internal Load from CLP Post-Harvesting


100
90
80
70
60
50
40
30
20
10
0
2013 L
2013 D
2014 L
2014 D
2015 L
2015 D
$P = \frac{L}{0.17z + 1.13\,{}^{Z}/_{T_w}}$
Ext
Ext + Int
10% Reduct
20% Reduct
40% Reduct

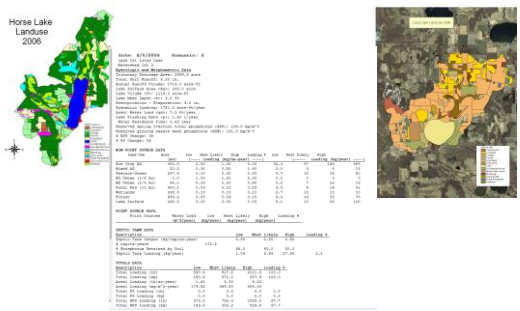
Big Blake Lake Nutrient Budget P Load kg/yr

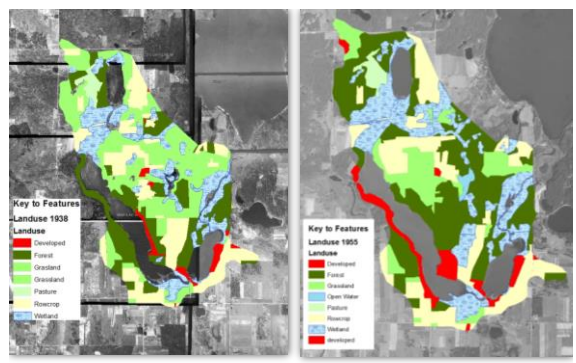


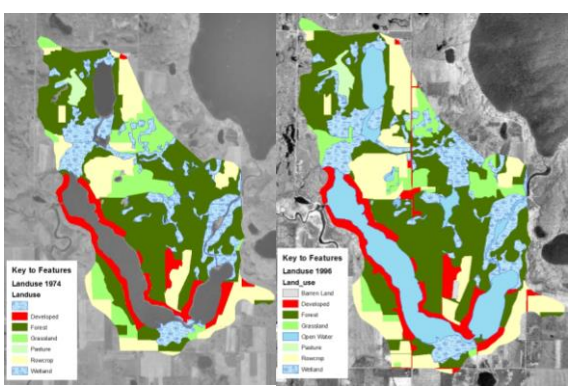
Big Blake Lake Nutrient Budget P Load kg/yr

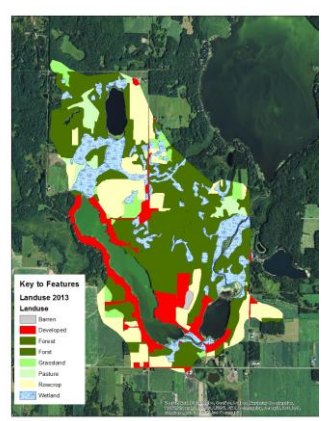


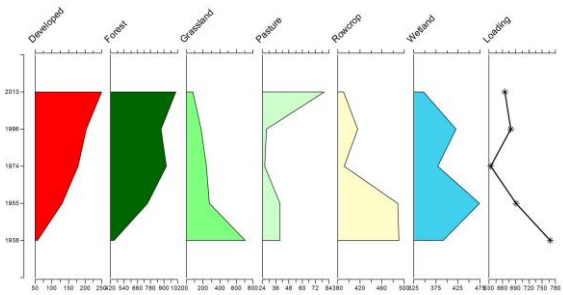
Watershed Modeling

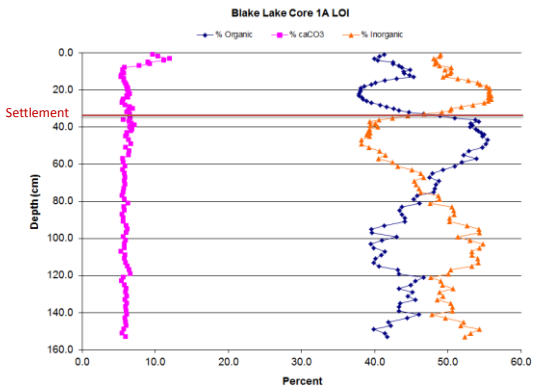


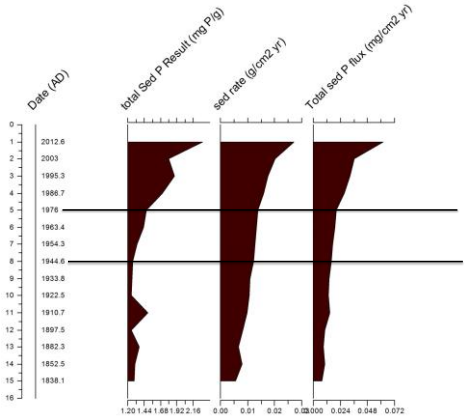


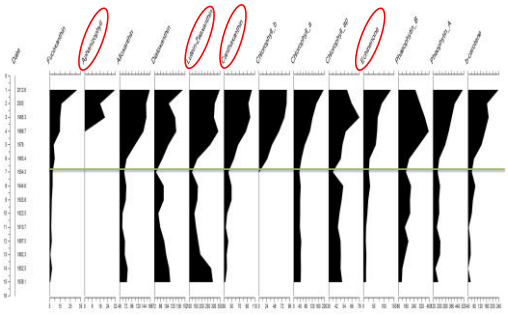


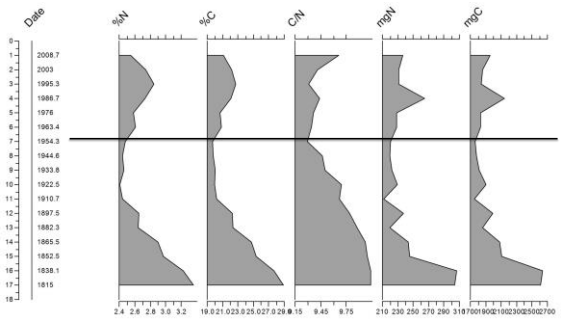


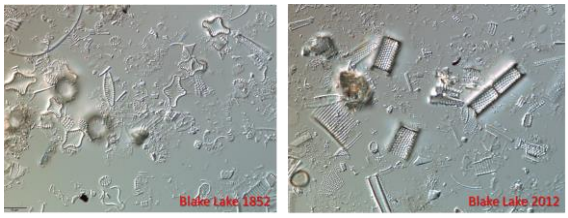

Developed
Forest
Grassland
Pasture
Rowcrop
Wetland
Loading
2013
1996
1974
1955
1938

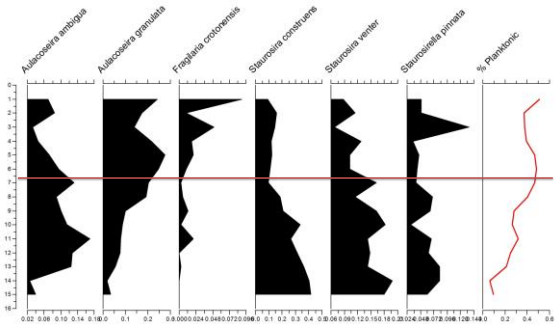

Blake Lake Core 1A LOI
% Organic
% caCO3
% Inorganic
Settlement
Depth (cm)
Percent

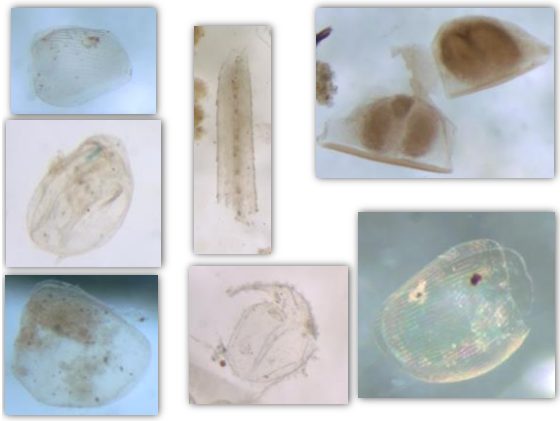

Date (AD)
total Sed P Result (mg P/g)
sed rate (g/cm2 yr)
Total sed P flux (mg/cm2 yr)
2012.6
2003
1995.3
1986.7
1976
1963.4
1954.3
1944.6
1933.8
1922.5
1910.7
1897.5
1882.3
1852.5
1838.1

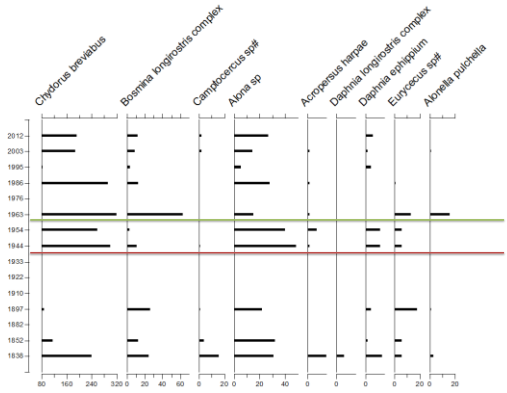


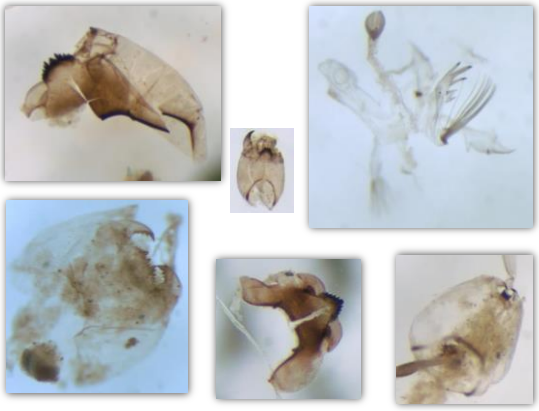

Date
%N
%C
C/N
mgN
mgC

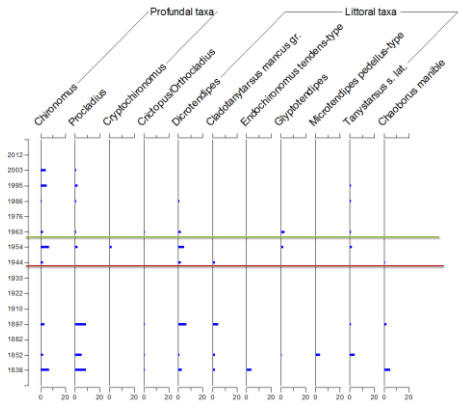

Blake Lake 1852
Blake Lake 2012

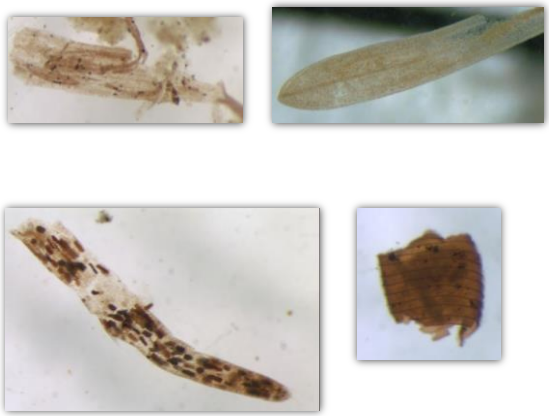

Aulacoseira ambigua
Aulacoseira granulata
Fragilaria crotonensis
Staurosira construens
Staurosira venter
Staurosirella pinnata
% Planktonic

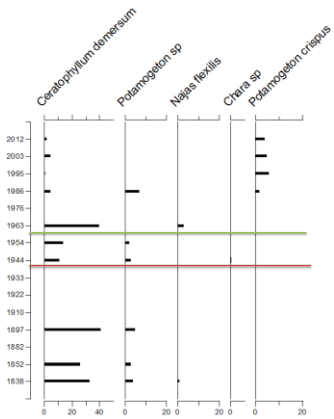


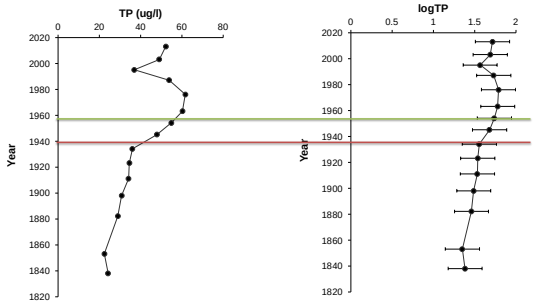

Chydorus brevilabis
Bosmina longirostris complex
Camptocercus spp
Alona sp
Acroperus harpae
Daphnia longirostris complex
Daphnia ephippium
Eurycercus spp
Alonella pulchella




Profundal taxa
Littoral taxa
Chironomus
Procladius
Cryptochironomus
CricotopusOrthocladius
Dicrotendipes
Cladotanytarsus mancus gr.
Endochironomus tendens-type
Glyptotendipes
Microtendipes pedellus-type
Tanytarsus s. lat.
Chaoborus mandible
2012
2003
1995
1986
1976
1963
1954
1944
1933
1922
1910
1897
1882
1852
1838




Ceratophyllum demersum
Potamogeton sp
Najas flexilis
Chara sp
Potamogeton crispus
2012
2003
1995
1986
1976
1963
1954
1944
1933
1922
1910
1897
1882
1852
1838


TP (ug/l)
logTP
Year
Year

Questions?