A

APPENDIX A

Public Participation Materials

Presentation Outline

- Onterra, LLC
- Why Create a Management Plan?
- Elements of a Lake Management Planning Project
  - Data & Information
  - Planning Process

Onterra, LLC

- Founded in 2005
- Staff
  - Five full-time ecologists
  - One part-time ecologist
  - One intern
- Services
  - Science and planning
- Philosophy
  - Promote realistic planning
  - Assist, not direct

Why create a lake management plan?

- To create a better understanding of lake's positive and negative attributes.
- To discover ways to minimize the negative attributes and maximize the positive attributes.
- To foster realistic expectations and dispel myths.
- To create a snapshot of the lake for future reference and planning.

Elements of an Effective Lake Management Planning Project

Data and Information Gathering

Environmental & Sociological

Planning Process

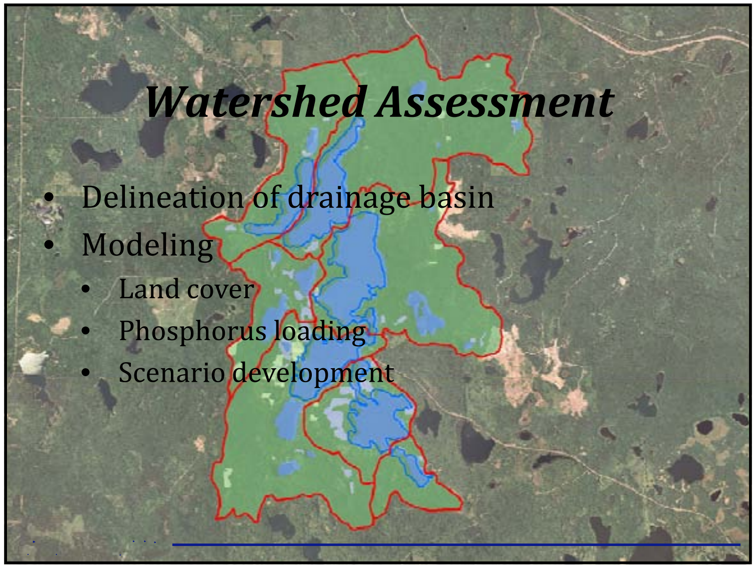
Brings it all together

Data and information gathering

- Study Components
  - Water Quality Analysis
  - Watershed Assessment
  - Aquatic Plant Surveys
  - Fisheries Data Integration
  - Stakeholder Survey
  - Shoreline Assessment

Water Quality Analysis

- General water chemistry (current & historic)
  - Citizens Lake Monitoring Network
- Nutrient analysis
  - Lake trophic state (Eutrophication)
  - Limiting plant nutrient
- Supporting data for watershed modeling



Watershed Assessment

- Delineation of drainage basin
- Modeling
  - Land cover
  - Phosphorus loading
  - Scenario development

Aquatic Plant Surveys

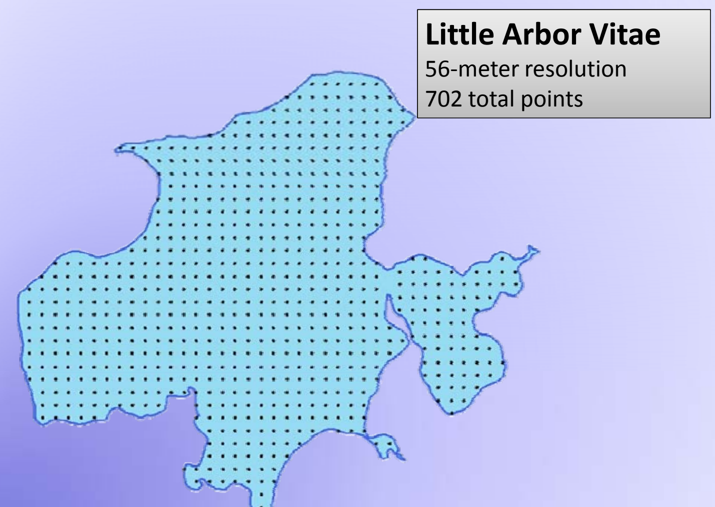
- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Curly-leaf pondweed survey
  - Point-intercept survey
  - Plant community mapping
  - Volunteer survey findings

Non-native Aquatic Plants

Curly-leaf Pondweed

Non-native Aquatic Plants

Eurasian Water Milfoil

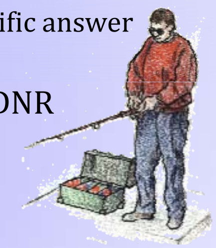


Fisheries Data Integration

- No fish sampling completed
- Assemble data from WDNR, USGS, USFWS, & GLIFWC
- Fish survey results summaries (if available)
- Use information in planning as applicable

Stakeholder Survey

- Standard survey used as base
  - Planning committee potentially develops additional questions and options
  - Must not lead respondent to specific answer through a “loaded” question
- Survey must be approved by WDNR



Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- It does not look at lake shoreline on a property-by-property basis.
- Assessment ranks shoreland area from shoreline back 35 feet

Planning Process

Planning Committee Meetings

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

Implementation Plan

Little Arbor Vitae Lake
Management Planning Project

Update: June 2011

Submitted by: Brenton Butterfield, Onterra, LLC

All field studies relating to the Little Arbor Vitae Lake Management Planning Project have been completed and we greatly enjoyed out time spent on Little Arbor Vitae Lake. Field studies on the lake began with the spring water quality sampling in April 2010. Samples were also collected during each summer month, October, and through the ice in February. Additional water clarity data was also collected by Little Arbor Vitae Lake volunteers as part of the Citizen Lake Monitoring Program.

The data show that Little Arbor Vitae Lake has sufficient nutrient content to be a very productive, eutrophic system with high algal abundance. This is typical for systems like Little Arbor Vitae Lake that have relatively large watersheds. Little Arbor Vitae Lake is classified as a deep, lowland drainage lake, meaning that the water stratifies during the summer, the lake possess an inlet and/or outlet, and has a watershed of greater than 2,560 acres. In fact, the watershed of Little Arbor Vitae Lake was calculated to be approximately 13,960 acres. This means that any precipitation falling within this 13,960-acre area has the potential to eventually flow into Little Arbor Vitae Lake and although the majority of the lake's watershed is forested, the sheer size of the watershed cumulatively delivers a large amount of nutrients into the lake. The high nutrient levels, particularly phosphorus, fuel free-floating algae and generate large algae blooms in the summer, in turn, reducing water clarity.

A Wisconsin Department of Natural Resources-approved stakeholder survey was sent to all district members. The return rate was around 56%, above the desired 50% and is believed to be an adequate representation of Little Arbor Vitae Lake stakeholders. The majority of respondents, approximately 34%, describe the current water quality on Little Arbor Vitae Lake as "Fair" and 48% believe it has remained the same since they have obtained their property. Respondents also indicated that they believe algae blooms are having the greatest negative impact to Little Arbor Vitae Lake and that they would like to learn more about water quality monitoring methods.

Total phosphorus and chlorophyll-*a* (algae) levels averaged from all years were found to be higher than the median values for other deep, lowland drainage lakes in the state as well as lakes within the Northern Lakes Ecoregion and fall within the "Fair" and "Poor" categories respectively. Secchi disk transparency, a measure of water clarity, averaged from all years fell below both median values and overall was found to be in the "Fair" category (Figure 1). While these values fall into the "Fair" and "Poor" thresholds,

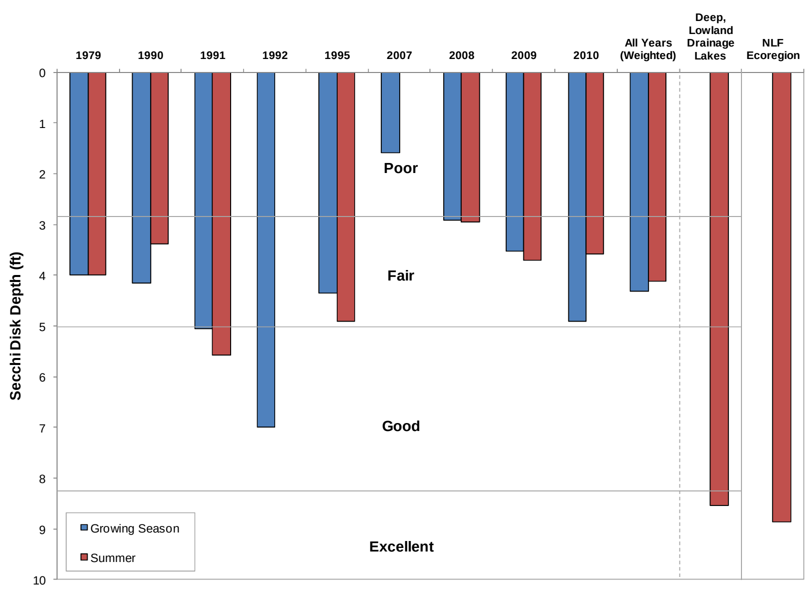


Figure 1. Secchi disk transparency on Little Arbor Vitae Lake.

the high nutrient levels in Little Arbor Vitae Lake are not believed to be anthropogenic in nature, but a result of the size of the lake's watershed.

Numerous aquatic plant surveys were completed on the lake throughout the summer of 2010. A total of 34 native aquatic plant species were located during the surveys, and neither of the non-native, invasive species Eurasian water milfoil nor curly-leaf pondweed were located. It is likely these species do not exist in Little Arbor Vitae Lake or exist at an undetectable level. One incidence of the exotic purple loosestrife was recorded growing on the lakeshore.

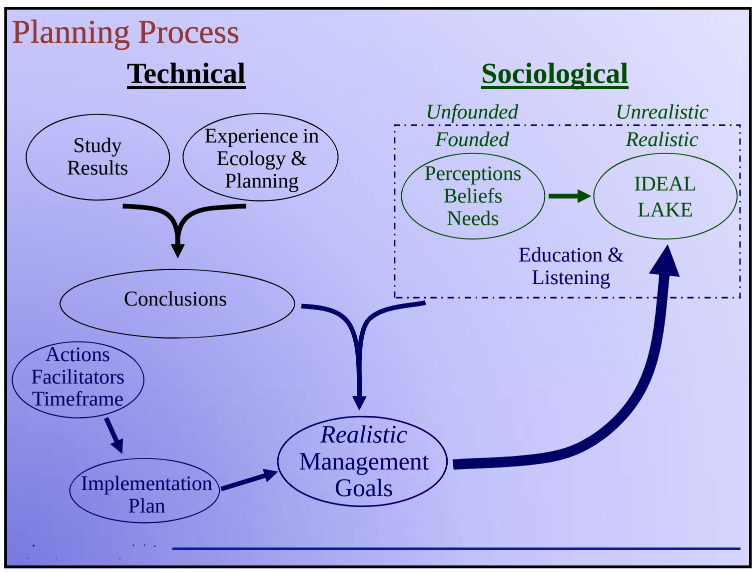
The floating-leaf and emergent plant communities within Little Arbor Vitae Lake were also accurately mapped, creating a snap-shot in which future data can compare and determine whether these communities are expanding or receding; which is often the case with fluctuating water levels or other environmental changes. A survey assessing the quality of shoreline habitat was also completed.

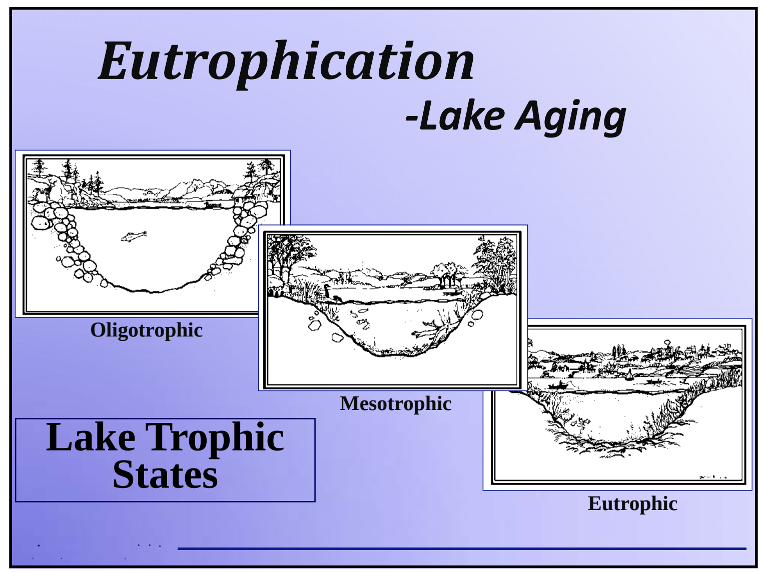
Our next steps over these coming months will be to finish analyzing the data collected during the field surveys and to begin drawing more detailed conclusions on the current status of the lake's water quality, its plant community, and the shoreline areas of Little Arbor Vitae Lake. Because aquatic plants are the foundation of all ecosystems, we will use specific analysis methods such as the Floristic Quality Index to assess the current condition of Little Arbor Vitae Lake's plant community, as well as compare it to those of other lakes within the Northern Lakes Ecoregion and Wisconsin. The data collected from the shoreline assessment survey will allow us to delineate and prioritize areas that may be possible candidates for shoreline protection or restoration.

Once the data analyses and studies report are complete, the Planning Committee members will meet with Onterra ecologists to develop realistic and implementable management actions. The management actions will be a collaborative effort to help stakeholders meet their realistic management goals while doing what is best ecologically for the lake. The timing of this meeting will depend upon the availability of the committee members. Once the management plan is developed, a public meeting called a "Project Wrap-up Meeting" will be held to present the study results and the management plan to all those who are interested.


Little Arbor Vitae Lake
Protection & Rehabilitation District
Little Arbor Vitae Lake
Management Planning Project
Planning Meeting I
October 25, 2011
Tim Hoyman &
Brenton Butterfield
Onterra LLC
Lake Management Planning


Study and Plan Goals
•Collect & Analyze Data
•Construct Long-Term & Useable Plan

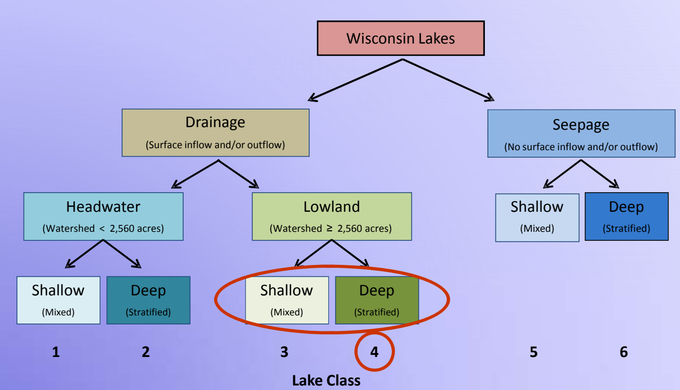

Planning Process
Technical
Sociological
Study Results
Experience in Ecology & Planning
Conclusions
Unfounded
Unrealistic
Founded
Realistic
Perceptions Beliefs Needs
IDEAL LAKE
Education & Listening
Actions Facilitators Timeframe
Implementation Plan
Realistic Management Goals


Eutrophication
-Lake Aging
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic States

Water Quality

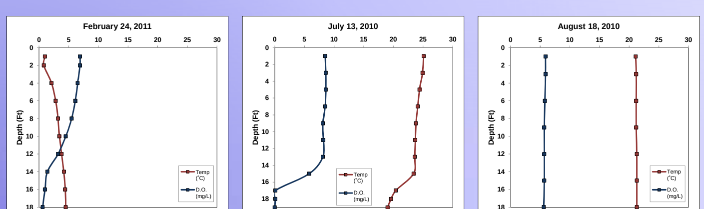
- ↑ **Phosphorus (Limiting Plant Nutrient)**
- ↑ **Chlorophyll-*a* (Algal Abundance)**
- ↓ **Water Clarity (Secchi Disk)**

Wisconsin Lakes Classification

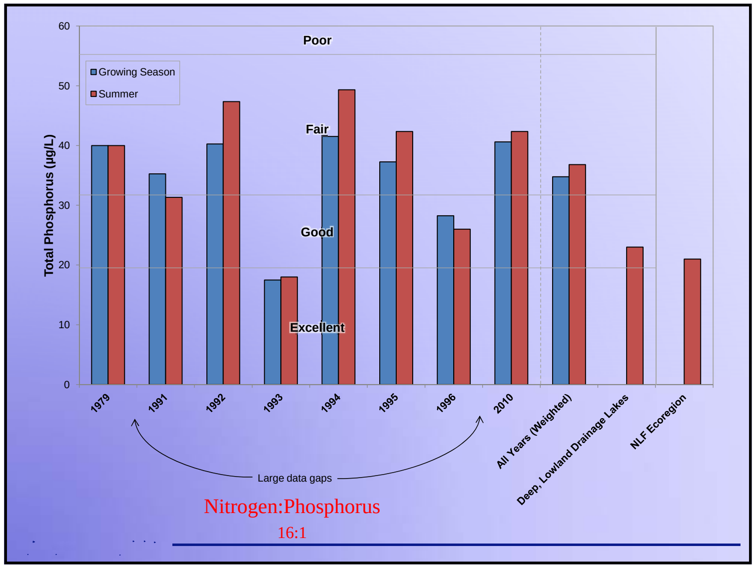


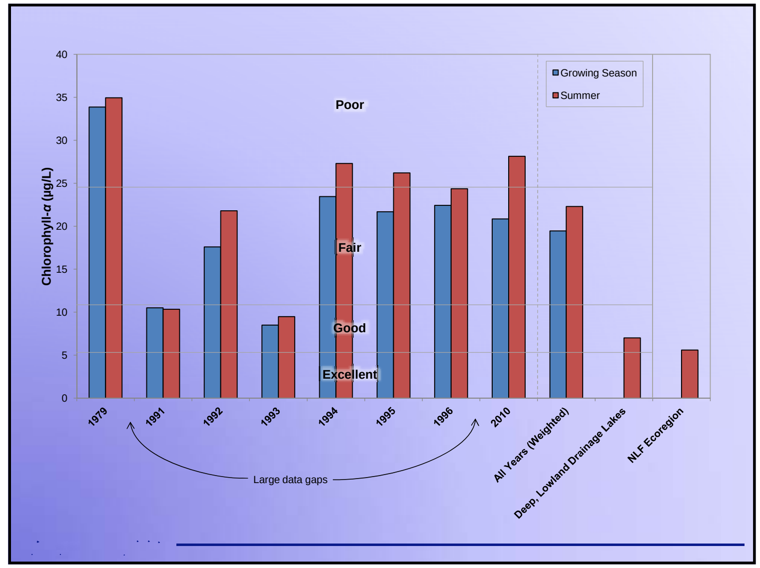
Dissolved Oxygen and Temperature Profiles

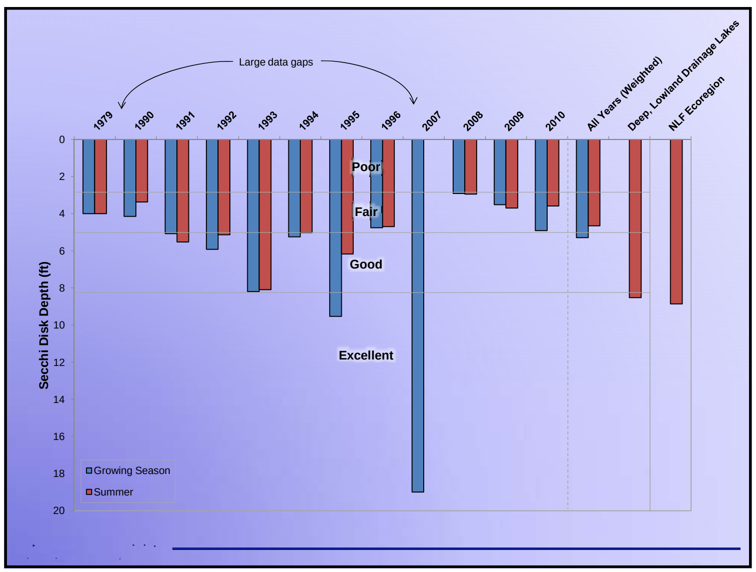
- **Dissolved Oxygen and Temperature Profiles**
  - Lake is stratified during winter
  - Mixing may occur multiple times during summer: polymicitc
    - In the end, there is little concern for winter or summer fishkill

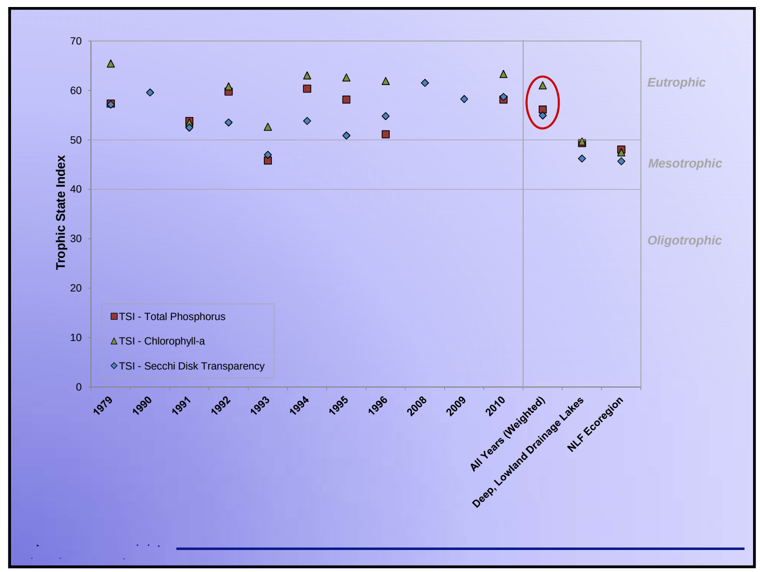


Wisconsin Ecoregions


Poor
Fair
Good
Excellent
Growing Season
Summer
Total Phosphorus (µg/L)
Large data gaps
All Years (Weighted)
Deep, Lowland Drainage Lakes
NLF Ecoregion
Nitrogen:Phosphorus
16:1

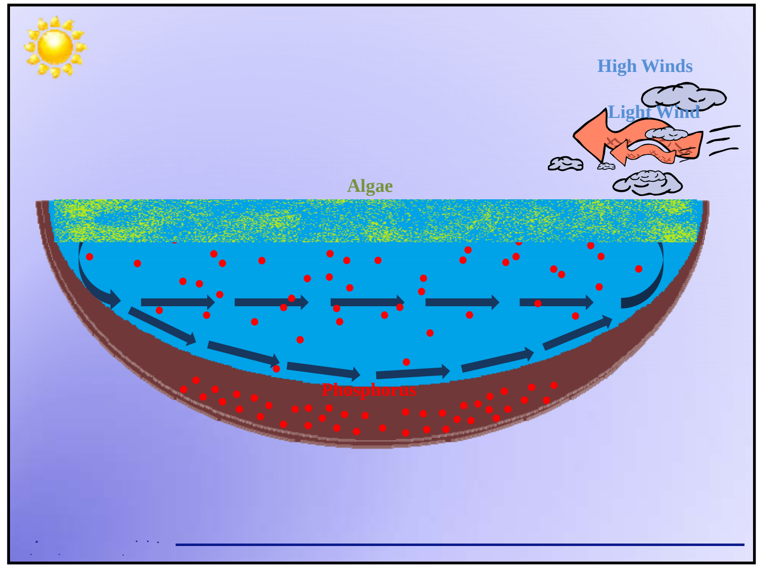

Poor
Fair
Good
Excellent
Growing Season
Summer
Chlorophyll-α (µg/L)
Large data gaps
All Years (Weighted)
Deep, Lowland Drainage Lakes
NLF Ecoregion

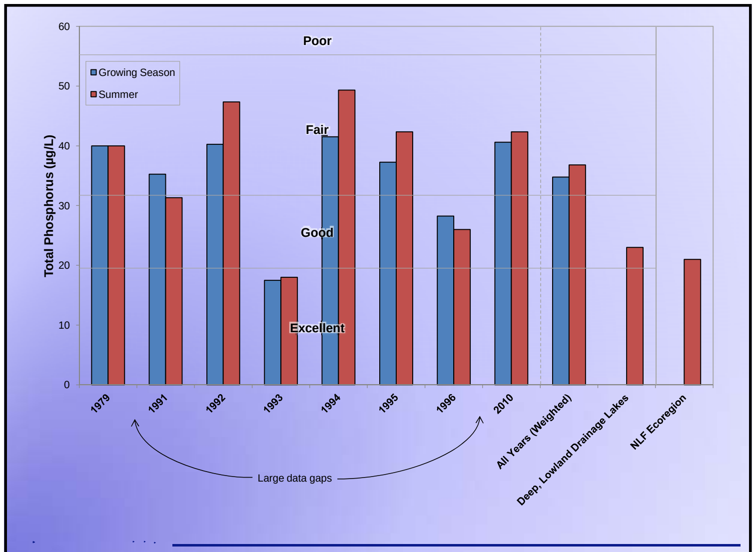

Large data gaps
Poor
Fair
Good
Excellent
Secchi Disk Depth (ft)
Growing Season
Summer
All Years (Weighted)
Deep, Lowland Drainage Lakes
NLF Ecoregion

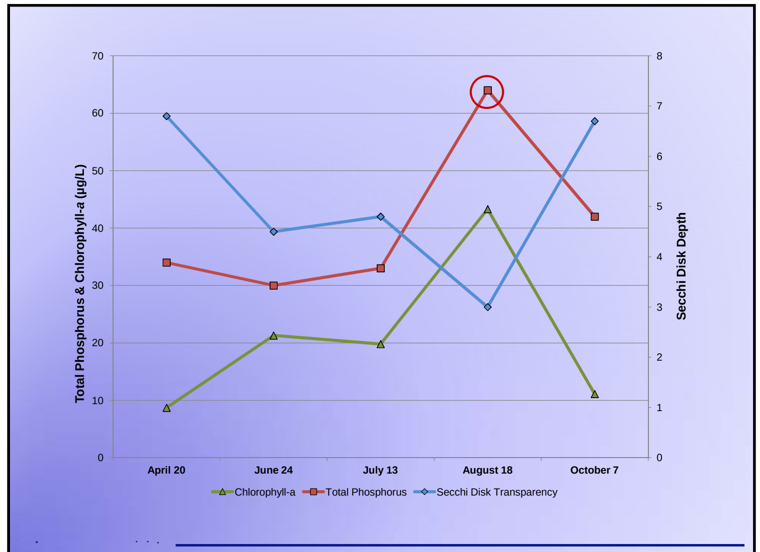

Eutrophic
Mesotrophic
Oligotrophic
Trophic State Index
TSI - Total Phosphorus
TSI - Chlorophyll-a
TSI - Secchi Disk Transparency
All Years (Weighted)
Deep, Lowland Drainage Lakes
NLF Ecoregion

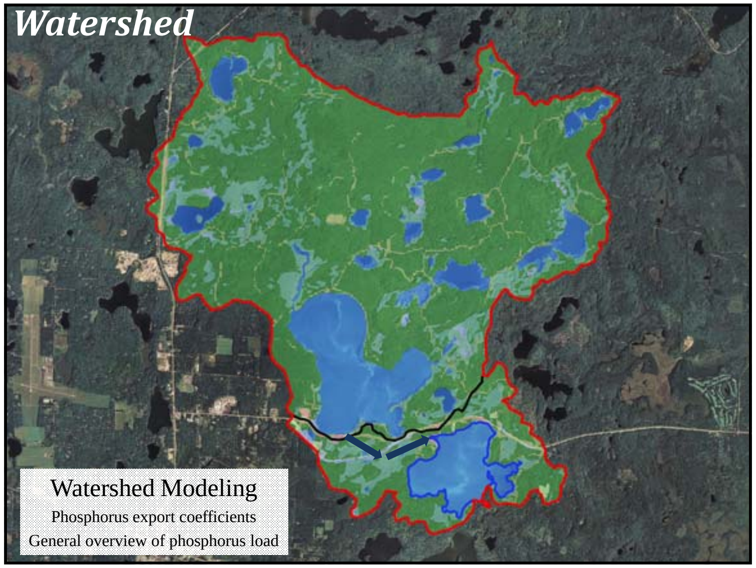
Discrepancy between WiLMS watershed modeling predicted phosphorus and 2010 field measurements

- **Unaccounted source(s) of phosphorus**
  - ~~Ground water inputs?~~
  - ~~Septic system inputs?~~
  - ~~Big Arbor Vitae Lake curly-leaf pondweed die-off?~~
  - Internal loading from bottom sediments? ✔
    - Development of anoxic hypolimnion in June and July
    - Historic hypolimnetic phosphorus ranged from 100 – 500 µg/L
    - Osgood Index value of 2.3; polymictic lake



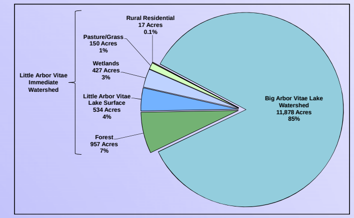




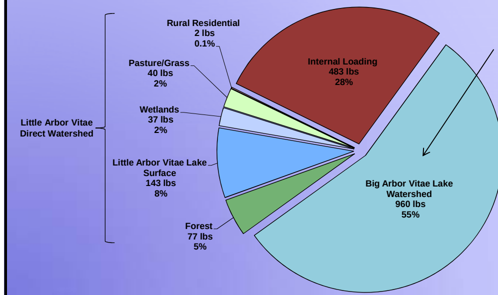


Watershed

Land Cover



Phosphorus Loading



Big Arbor Vitae receives 1,265 lbs of phosphorus, retains 305 lbs

Annual Load: 1,743 lbs

Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- It does not look at lake shoreline on a property-by-property basis.
- Assessment ranks shoreland area from shoreline back 35 feet

Urbanized

Range

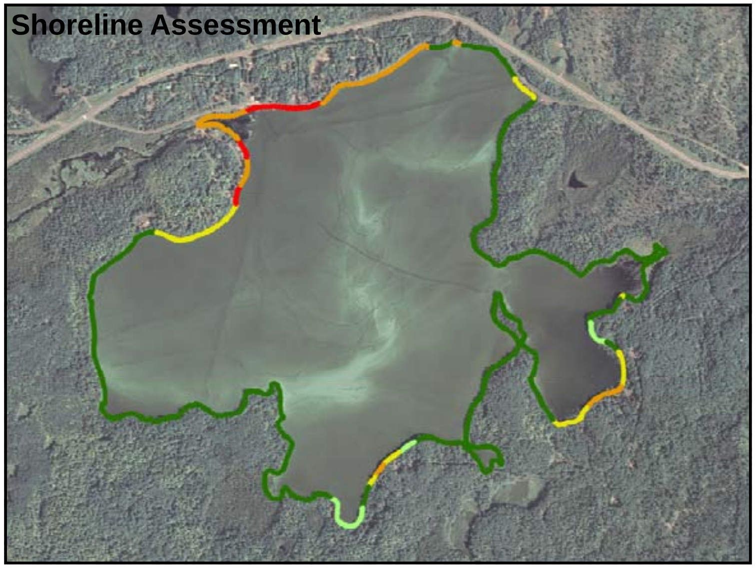
Natural

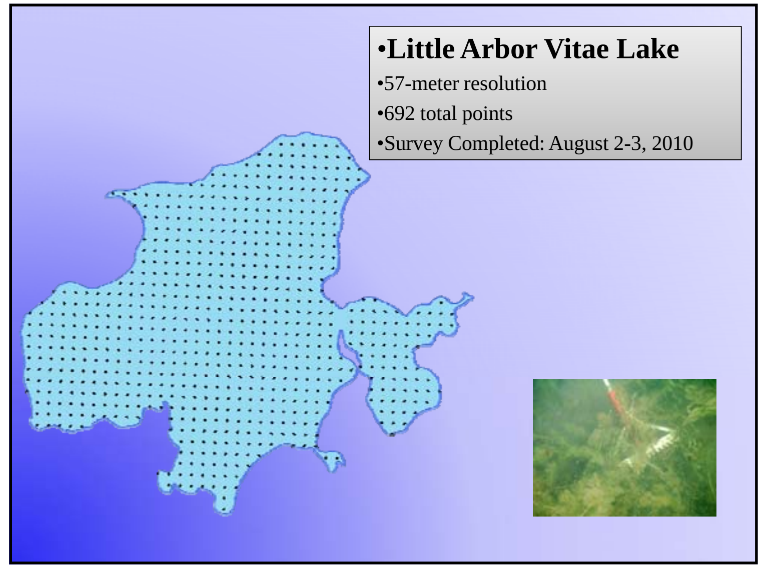
Shoreline Assessment Category Descriptions

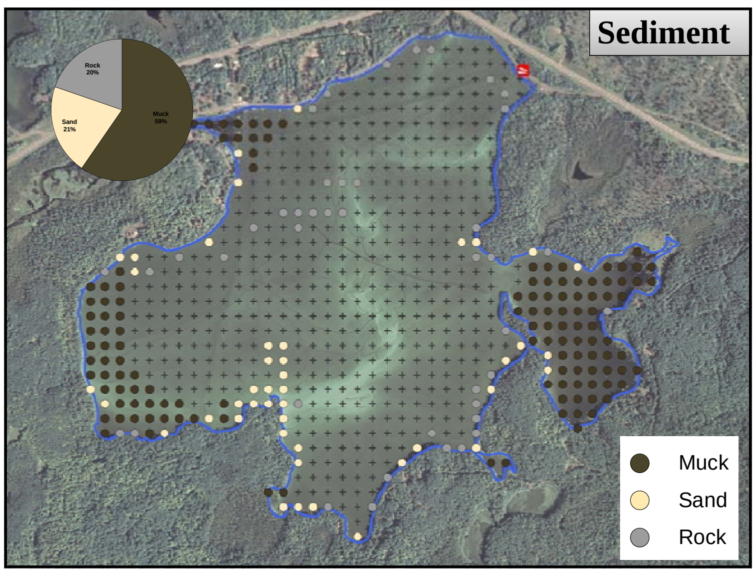
More Natural Habitat

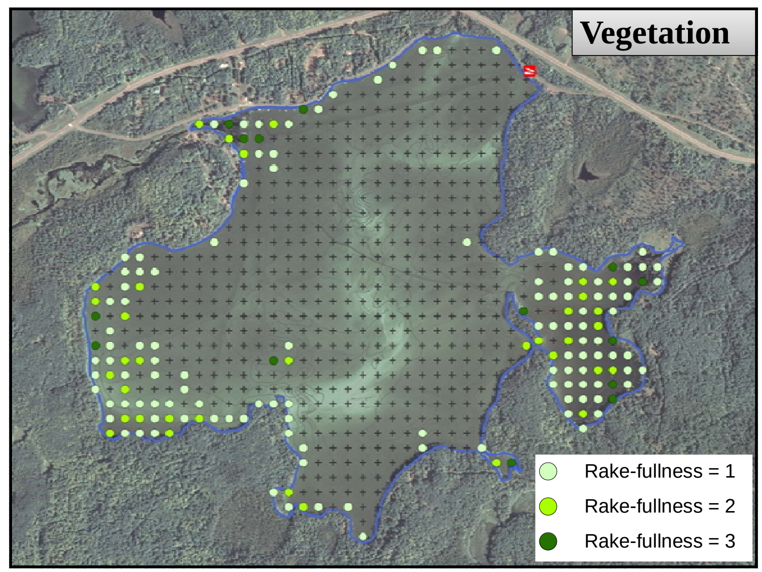
Urbanized | Developed-Unnatural | Developed-Semi-Natural | Developed-Natural | Natural/Undeveloped

Greater Need for Restoration


Shoreline Assessment


•Little Arbor Vitae Lake
•57-meter resolution
•692 total points
•Survey Completed: August 2-3, 2010


Sediment
Rock 20%
Sand 21%
Muck 59%
Muck
Sand
Rock


Vegetation
Rake-fullness = 1
Rake-fullness = 2
Rake-fullness = 3

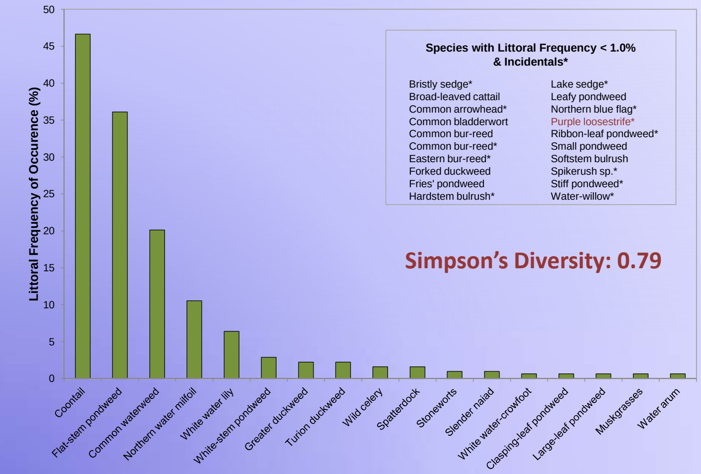
Species List

- **34 Native Species**
- **1 Non-native Species**
  - Purple loosestrife
- **Avg. Conservatism: 5.8**

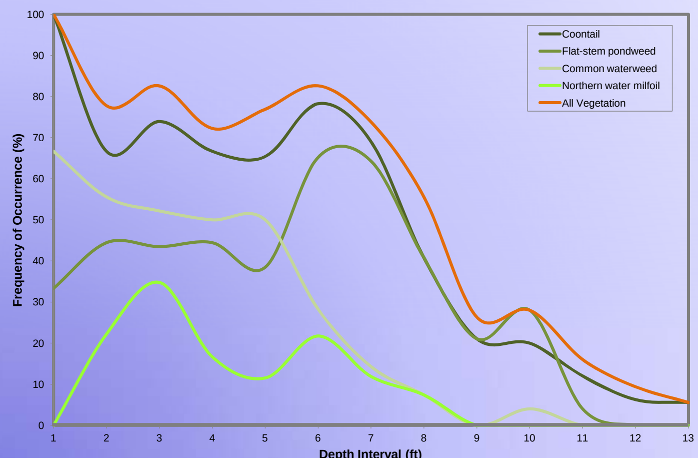
Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)
Emergent	*Carex comosa*	Bristly sedge	5
	Carex lacustris	Lake sedge	6
	Calla palustris	Water arum	9
	Decodon verticillatus	Water-willow	7
	Iris versicolor	Northern blue flag	5
	Lythrum salicaria	Purple loosestrife	Exotic
	Sagittaria latifolia	Common arrowhead	3
	Schoenoplectus acutus	Hardstem bulrush	5
	Schoenoplectus tabernaemontani	Softstem bulrush	4
	Typha latifolia	Broad-leaved cattail	1
FL	*Nuphar variegata*	Spatterdock	6
	Nymphaea odorata	White water lily	6
FL/E	*Sparganium americanum*	Eastern bur-reed	8
	Sparganium eurycarpum	Common bur-reed	5
Submergent	*Chara sp.*	Muskgrasses	7
	Ceratophyllum demersum	Coontail	3
	Elodea canadensis	Common waterweed	3
	Myriophyllum sibiricum	Northern water milfoil	7
	Najas flexilis	Slender naiad	6
	Nitella sp.	Stoneworts	7
	Potamogeton epihydrus	Ribbon-leaf pondweed	8
	Potamogeton strictifolius	Stiff pondweed	8
	Potamogeton foliosus	Leafy pondweed	6
	Potamogeton friesii	Fries' pondweed	8
	Potamogeton pusillus	Small pondweed	7
	Potamogeton amplifolius	Large-leaf pondweed	7
	Potamogeton richardsonii	Clasping-leaf pondweed	5
	Potamogeton praelongus	White-stem pondweed	8
	Potamogeton zosteriformis	Flat-stem pondweed	6
	Ranunculus aquatilis	White water-crowfoot	8
	Utricularia vulgaris	Common bladderwort	7
	Vallisneria americana	Wild celery	6
FF	*Lemna trisulca*	Forked duckweed	6
	Lemna turionifera	Turion duckweed	2
	Spirodela polyrhiza	Greater duckweed	5

FL = Floating Leaf
FL/E = Floating Leaf and Emergent
FF = Free Floating

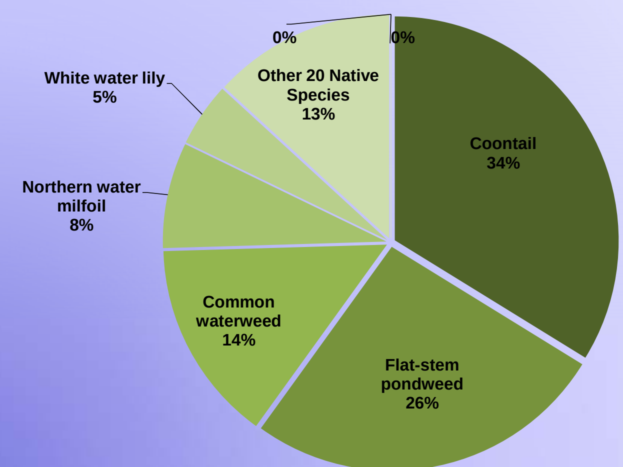
Littoral Frequency of Occurrence

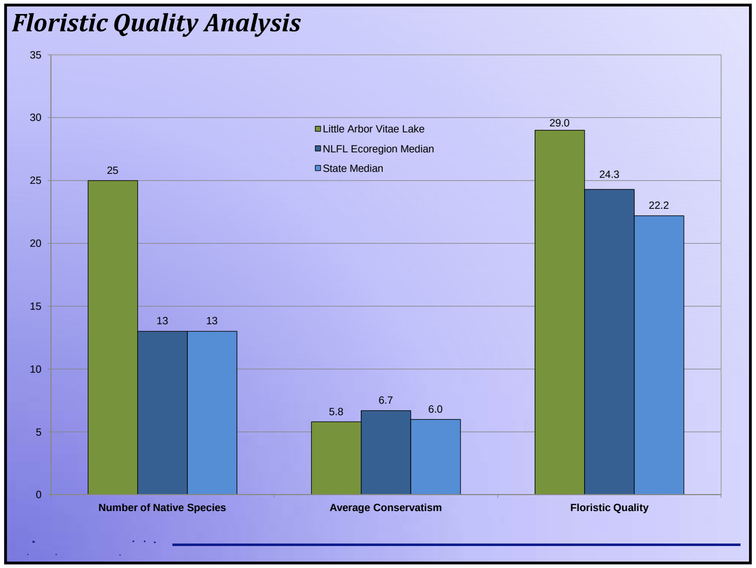


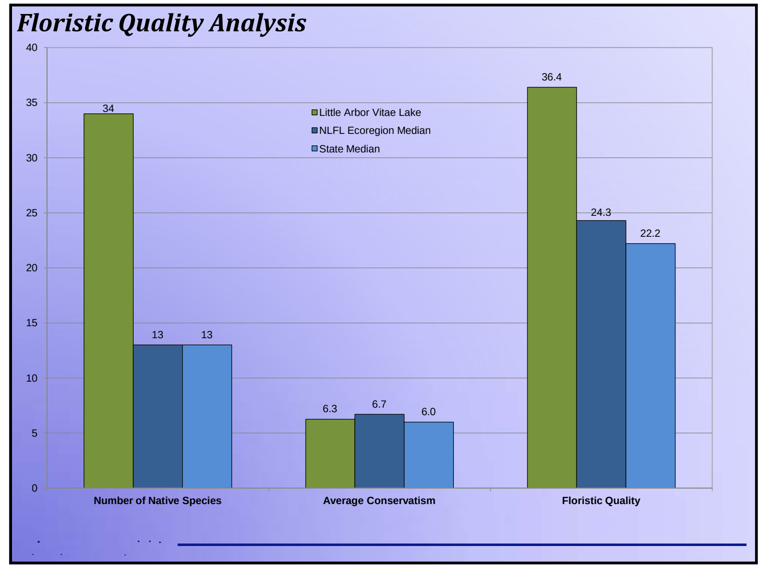
Maximum Depth of Plant Colonization

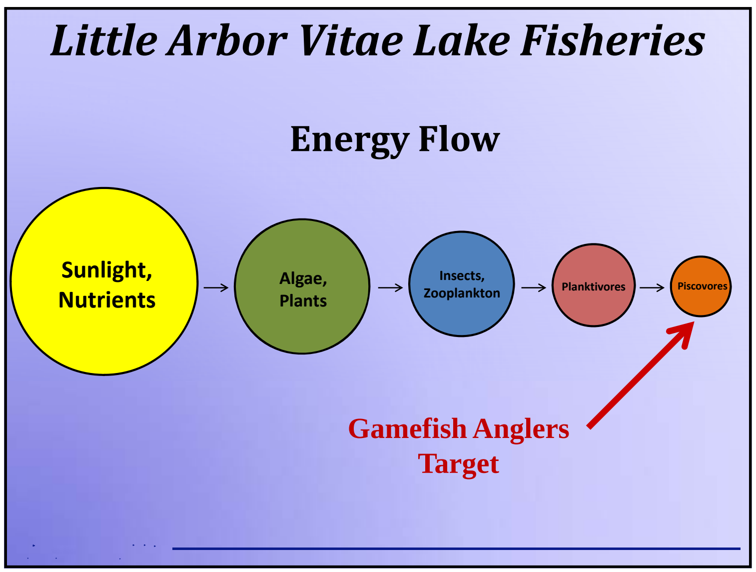


Relative Frequency



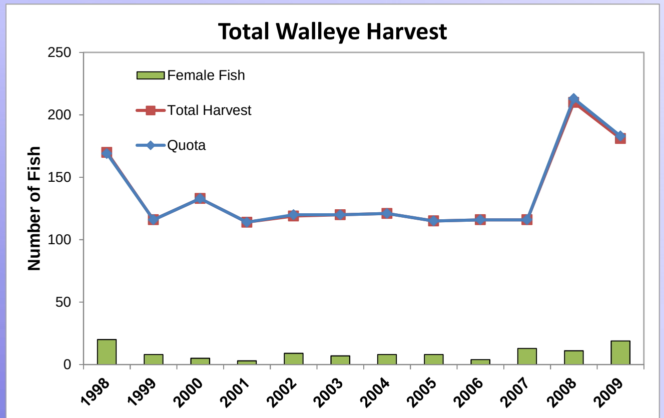

Floristic Quality Analysis
35
30
25
20
15
10
5
0
Little Arbor Vitae Lake
NLFL Ecoregion Median
State Median
25
13
13
5.8
6.7
6.0
29.0
24.3
22.2
Number of Native Species
Average Conservatism
Floristic Quality


Floristic Quality Analysis
40
35
30
25
20
15
10
5
0
Little Arbor Vitae Lake
NLFL Ecoregion Median
State Median
34
13
13
6.3
6.7
6.0
36.4
24.3
22.2
Number of Native Species
Average Conservatism
Floristic Quality

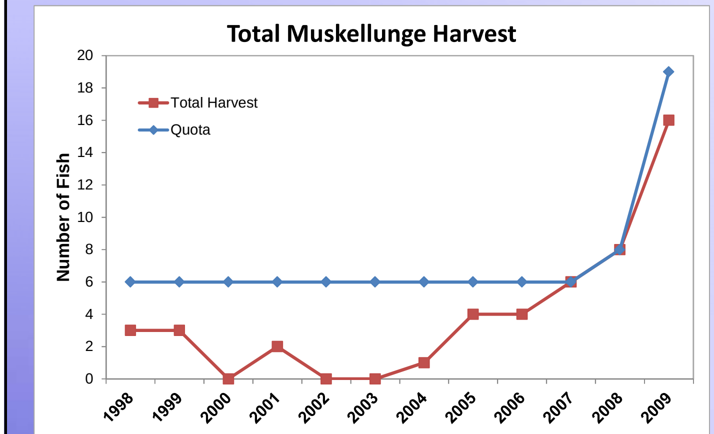

Little Arbor Vitae Lake Fisheries
Energy Flow
Sunlight, Nutrients
Algae, Plants
Insects, Zooplankton
Planktivores
Piscovores
Gamefish Anglers Target


Little Arbor Vitae Fisheries
Treaty of 1842
Treaty of 1837
Little Arbor Vitae Lake

Little Arbor Vitae Lake Fisheries



Little Arbor Vitae Lake Fisheries



Conclusions

- Water quality is fair.
  - Lake is naturally productive, but internal loading likely a significant source of phosphorus leading to algae blooms
- Overall watershed is in great condition.
  - Land cover exports minimal phosphorus but…
  - Sheer size of watershed relative to lake area means higher amounts of phosphorus entering the lake.
- Aquatic plant community
  - Based upon standard analysis, native community is of high quality
  - Lake has relatively low diverse plant community, but is expected in this type of system

Conclusions Continued

- Fisheries
- Lake's high productivity likely translates to high fish biomass
- High plant abundance within bays is beneficial to fishery as they provide valuable structural habitat

Little Arbor Vitae Lake
Management Planning Project

June 2012 Update

Submitted by: Brenton Butterfield, Onterra, LLC

With the help of large-scale Lake Management Planning Grants totaling over $25,000 through the Wisconsin Department of Natural Resources (WDNR), a project is underway to create a lake management plan for Little Arbor Vitae Lake. The lake management plan will contain historic and current data from the lake as well as provide guidance for its management by integrating stakeholder needs and goals with what is ecologically beneficial for the system.

As described further below, numerous field studies were conducted on Little Arbor Vitae Lake during 2010-2011. To gain knowledge as to what concerns Little Arbor Vitae Lake stakeholders have regarding their lake, a planning committee comprised of Little Arbor Vitae Lake Protection & Rehabilitation District (LAVPRD) members created a stakeholder survey, which was distributed in September of 2010. Much was learned about the people who use and care for Little Arbor Vitae Lake. Many stakeholders expressed concerns over algae blooms, excessive aquatic plant growth, and water quality degradation.

One of the major components of this study focused on assessing the aquatic plant community of Little Arbor Vitae Lake. These surveys were aimed at both native and non-native species. In June 2010, a meander-based survey was conducted that focused upon locating any potential occurrences of the non-native, invasive species curly-leaf pondweed. This non-native plant has a unique lifecycle when compared to our native aquatic plants in that it reaches its peak growth in June and begins t senesce, or die back, in early July. Fortunately, no occurrences of curly-leaf pondweed were located during the 2010 survey, and it is believed that this plant does not currently exist within Little Arbor Vitae Lake or it exists at an undetectable level.

In early August 2010, a whole-lake point-intercept survey was conducted on Little Arbor Vitae Lake to characterize and analyze the lake's entire aquatic plant community. This survey includes the navigation to numerous grid-based points and sampling the aquatic vegetation with a large double-headed rake. On Little Arbor Vitae Lake, these points were 56 meters apart yielding a total of 692 points. Of these points, 313 were located within the maximum depth of plant growth (13 feet), and 165 (53%) contained aquatic vegetation.

Overall, 34 native aquatic plant species were located during the survey. Figure 1 shows the relative frequency of occurrence of the species located in Little Arbor Vitae Lake. The relative frequency of occurrence is a metric which describes the frequency of a species within the littoral (near shore) zone of a lake compared to the sum of the littoral occurrence for all species. Essentially, the percentage expressed for a given species in Figure 1 describes what percentage of the entire aquatic plant population that species comprises. Coontail, was the most frequently encountered plant during this survey, with a relative frequency of 34%. Flat-stem pondweed and common waterweed were common as well with frequencies of 26% and 14%, respectively. What Figure 1 illustrates is that the aquatic plant community of Little Arbor Vitae Lake is dominated by only a few species, and the remaining species that were encountered are relatively infrequent.

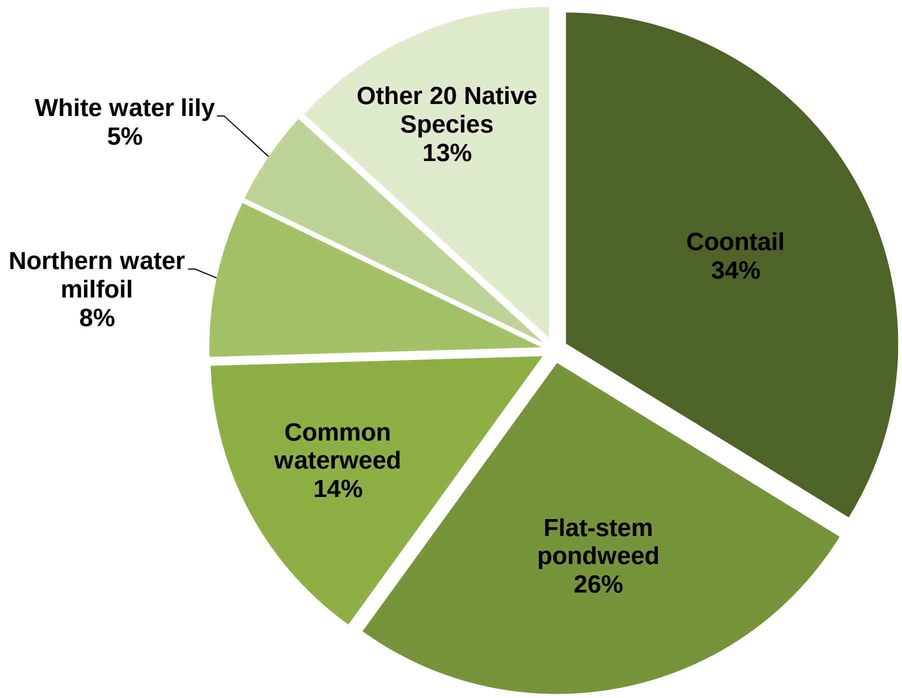


Figure 1. Little Arbor Vitae Lake aquatic plant relative occurrence analysis. Created using data from 2010 aquatic plant point-intercept survey.

The water quality and watershed of Little Arbor Vitae Lake were also studied in 2010. Additionally, available historic water quality data from the lake was obtained in an effort to examine potential trends in this aspect of the ecosystem. Overall, the water quality of Little Arbor Vitae Lake in 2010 straddled the *Good*/*Fair* threshold for shallow, lowland drainage lakes. While there were no apparent trends in water quality over time within the historic data that are available, the watershed modeling assessment revealed that the amount of total phosphorus measured within the lake in 2010 was significantly higher than what the model predicted. Looking into the water quality data collected in 2010 and historic data collected in the mid-1990s by the USGS, it is believed that Little Arbor Vitae Lake is currently experiencing internal phosphorus loading from bottom sediments. This internal loading maybe a significant source of phosphorus that is fueling the nuisance algae blooms during the summer.

In lakes that stratify in the summer and develop a hypolimnion (cold bottom layer of water) devoid of oxygen (anoxic), accumulated sediment phosphorus can be released into this layer and become mixed throughout the entire water column during turnover events, which in turn fuel algae blooms. Dissolved oxygen/temperature profiles taken on Little Arbor Vitae Lake during the growing season indicate that in June and July the lake was stratified with a developed anoxic hypolimnion at around 15 feet. The average total phosphorus concentration within the hypolimnion in 2010 was 47.6 µg/L, well below the 200 µg/L internal nutrient loading threshold for candidate lakes. However, looking at historic hypolimnetic phosphorus data from 1991 to 1996 shows that in some of the July and August sampling periods, total phosphorus values ranged from 100 µg/L to 486 µg/L indicating potential for internal nutrient loading.

The buildup of sediment phosphorus in Little Arbor Vitae Lake is likely due to both natural and anthropogenic factors. Though the runoff from Little Arbor Vitae Lake's watershed carries relatively little phosphorus because of all the forest and wetland land cover, the cumulative amounts from natural delivery from a large watershed over the 10,000-year period of the lake's existence have built up a significant sediment layer. Lakes with large watersheds fill in, or age more rapidly than lakes with smaller watersheds. On top of this, human settlement within Little Arbor Vitae Lake's watershed likely hastened this process with the advent of historic clear-cutting logging practices and damming of both Little and Big Arbor Vitae Lakes. Removal of forests and construction of impervious surfaces increases the amount and velocity of runoff entering the lake. While damming lakes increases their volume, it reduces their flow and flushing rate which increases the rate of sediment accumulation.

The Osgood Index is a measure relating a lake's volume to its surface area and is used to determine whether a lake is dimictic or polymictic. Dimictic lakes completely mix or turnover two times per year, once in spring and again in fall, while polymictic lakes have the potential to turn over multiple times per year depending upon wind events. Little Arbor Vitae Lake has a calculated Osgood Index value of 2.3, indicating that it is polymictic. Its large surface area and relatively shallow depth make it susceptible to mixing during periods of high winds. From the dissolved oxygen/temperature profiles, it is known that during calmer weather periods Little Arbor Vitae Lake stratifies and forms an anoxic hypolimnion to which phosphorus is released from the bottom sediments. During high wind events stratification is broken and the phosphorus from the hypolimnion is mixed throughout the entire water column, making the phosphorus available to algae growing near the surface and fueling undesired algae blooms.

Observed hypolimnetic phosphorus concentrations do not always exceed 200 μg/L because Little Arbor Vitae Lake is likely mixing multiple times throughout the summer, preventing stratification for a long enough period to accumulate higher phosphorus concentrations. However, the years 1993 and 1996 have the lowest summer surface phosphorus values recorded from Little Arbor Vitae Lake and some of the highest recorded hypolimnetic values. This indicates the lake may have remained stratified for a longer period of time allowing hypolimnetic phosphorus to reach higher levels. The polymictic nature of the lake makes surface phosphorus concentrations highly variable and dependent on meteorological events.

Internal nutrient loading in polymictic lakes such as Little Arbor Vitae can be more problematic than internal nutrient loading in dimictic lakes. Although phosphorus concentrations within the hypolimnion reach higher levels in dimictic lakes because they remain stratified during the summer, these lakes turn over at times of the year (spring and fall) when water temperatures are cooler and algae growth is reduced. Though the amount of phosphorus delivered from the hypolimnion to the rest of the water column may be lower in polymicitc lakes, the periodic loading of phosphorus during the summer when algae is actively growing can cause unwanted blooms.

While the data collected in 2010 provides evidence that internal nutrient loading is a significant source of phosphorus for Little Arbor Vitae Lake, we cannot with the data available at this time, accurately estimate the amount of internal loading. Onterra will be working with the Wisconsin Department of Natural Resources and United States Geological Survey to develop a more in-depth study to take a detailed look at the full extent of the internal loading and determine potential remedies.

In summary, the Little Arbor Vitae Lake Planning Project is coming along well. The field studies have been completed, and data completely analyzed. Onterra ecologists Tim Hoyman and Brenton Butterfield met with the LAVPRD Planning Committee on two occasions this past fall to discuss the results of the study and form realistic management goals. The goals developed include: 1) Increase Little Arbor Vitae Lake Protection & Rehabilitation District's Capacity to Communicate with Lake Stakeholders, 2) Maintain/Enhance Current Water Quality Conditions, and 3) Prevent Aquatic Invasive Species Introductions to Little Arbor Vitae Lake. A completed first draft of the management plan will be completed by the end of the summer.

B

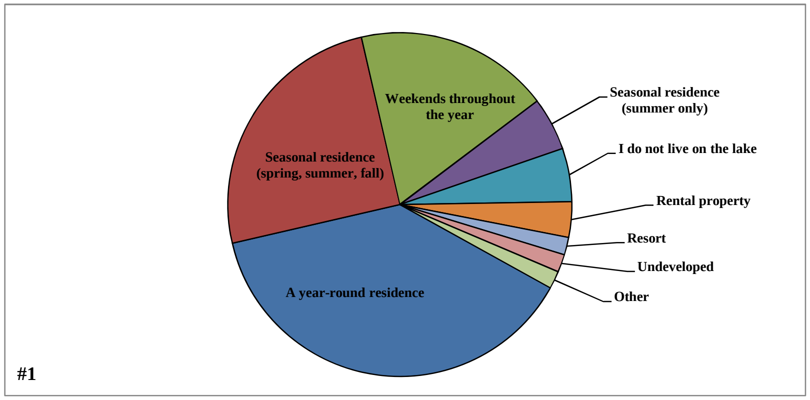
APPENDIX B

Stakeholder Survey Response Charts and Comments

Returned Surveys	59
Sent Surveys	106
Response Rate (%)	55.7

#1 What type of property do you own on Little Arbor Vitae Lake?

	Total	%
A year-round residence	23	*39.7*
Seasonal residence (spring, summer, fall)	15	*25.9*
Weekends throughout the year	11	*19.0*
Seasonal residence (summer only)	3	*5.2*
I do not live on the lake	3	*5.2*
Rental property	2	*3.4*
Resort	1	*1.7*
Undeveloped	1	*1.7*
Other	1	*1.7*
	58	*100.0*

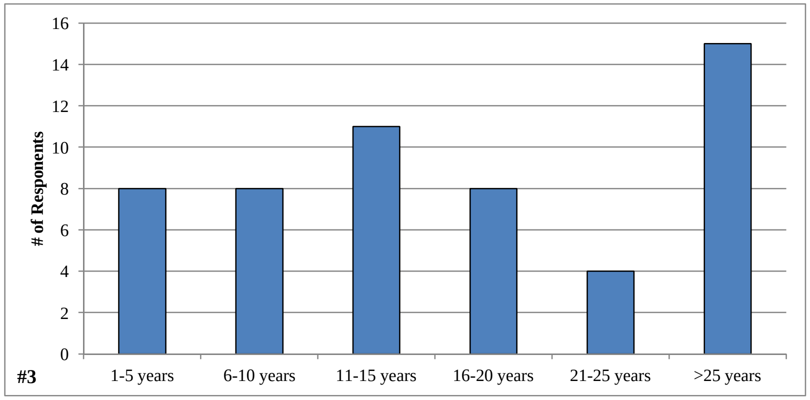


#2 If you are not a year-round resident, how many days each year is your property used by you or others?

Answered Question	28
Average	81.6
Standard deviation	69.9

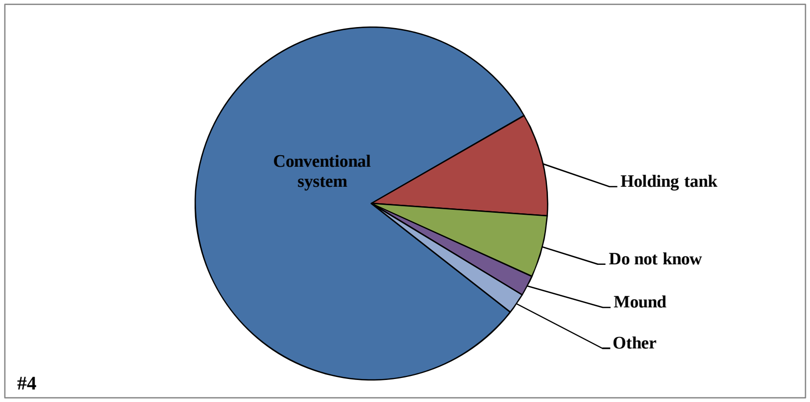
#3 How long have you owned your property on Little Arbor Vitae Lake?

	Total	%
1-5 years	8	*14.8*
6-10 years	8	*14.8*
11-15 years	11	*20.4*
16-20 years	8	*14.8*
21-25 years	4	*7.4*
>25 years	15	*27.8*
	54	*100.0*



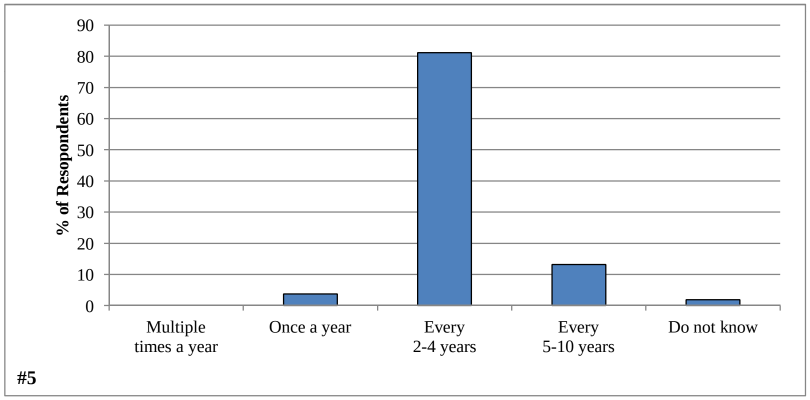
#4 What type of septic system does your property utilize?

	Total	%
Conventional system	43	*82.7*
Holding tank	5	*9.6*
Do not know	3	*5.8*
Mound	1	*1.9*
Advanced treatment system	0	*0.0*
Municipal sewer	0	*0.0*
Other	1	*1.9*
	52	*100.0*



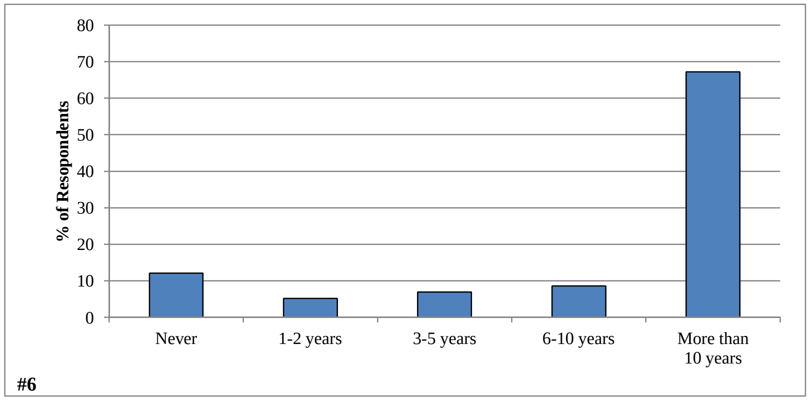
#5 How often is the septic tank on your property pumped?

	Total	%
Multiple times a year	0	*0.0*
Once a year	2	*3.8*
Every 2-4 years	43	*81.1*
Every 5-10 years	7	*13.2*
Do not know	1	*1.9*
	53	*100.0*



#6 For how many years have you fished Little Arbor Vitae Lake?

	Total	%
Never	7	*12.1*
1-2 years	3	*5.2*
3-5 years	4	*6.9*
6-10 years	5	*8.6*
More than 10 years	39	*67.2*
	58	*100.0*

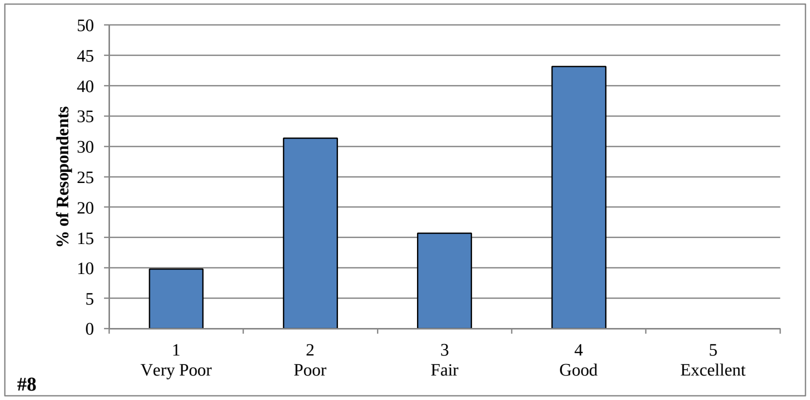


#7 Have you personally fished on Little Arbor Vitae Lake in the past 3 years?

	Total	%
Yes	48	*92.3*
No	4	*7.7*
	52	*100.0*

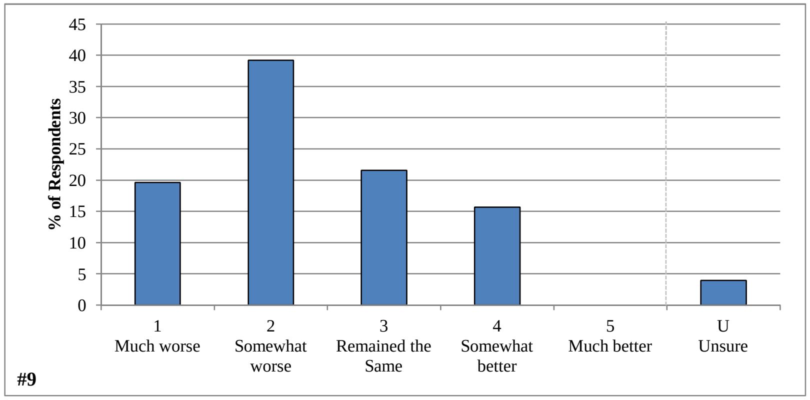
#8 How would you describe the current quality of fishing on Little Arbor Vitae Lake?

	Total	%
1 - Very Poor	5	*9.8*
2 - Poor	16	*31.4*
3 - Fair	8	*15.7*
4 - Good	22	*43.1*
5 - Excellent	0	*0.0*
	51	*100.0*



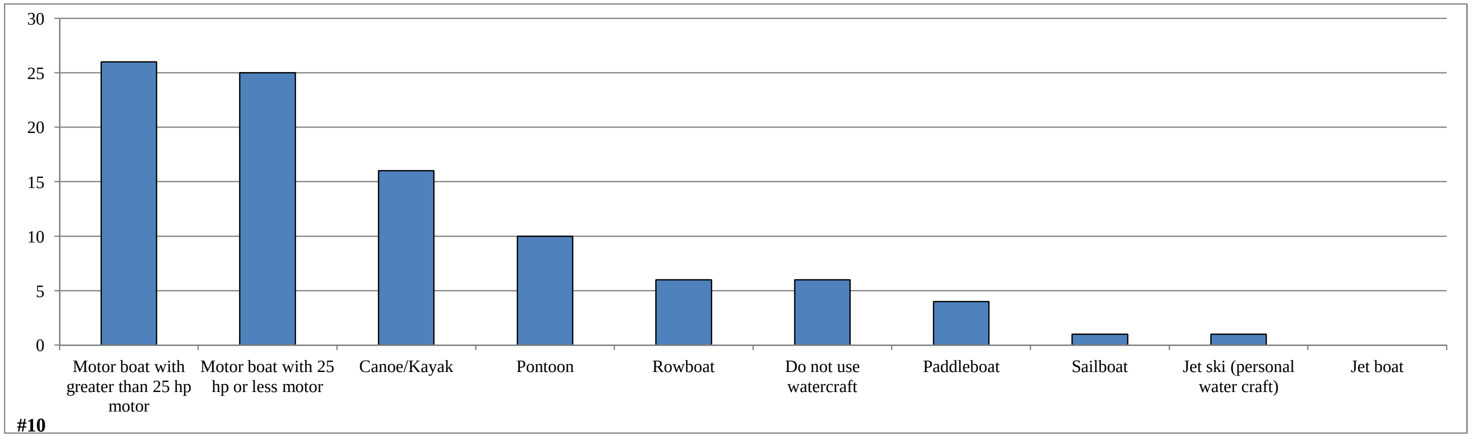
#9 How has the quality of fishing changed on Little Arbor Vitae Lake since you started fishing the lake?

	Total	%
1 - Much worse	10	*19.6*
2 - Somewhat worse	20	*39.2*
3 - Remained the Same	11	*21.6*
4 - Somewhat better	8	*15.7*
5 - Much better	0	*0.0*
U - Unsure	2	*3.9*
	51	*100.0*



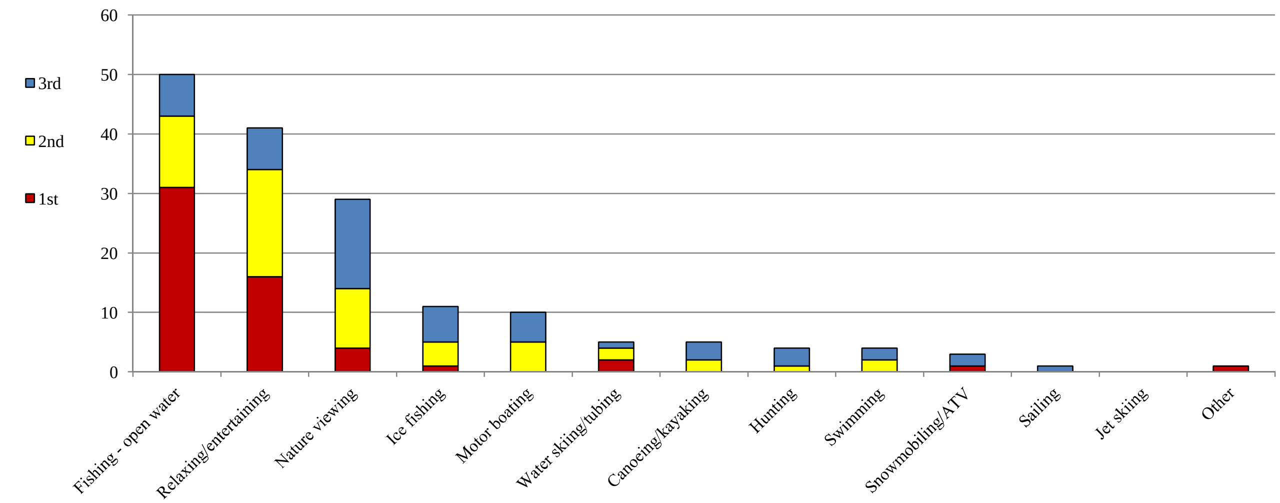
#10 What types of watercraft do you currently use on the lake?

	Total
Motor boat with greater than 25 hp motor	26
Motor boat with 25 hp or less motor	25
Canoe/Kayak	16
Pontoon	10
Rowboat	6
Do not use watercraft	6
Paddleboat	4
Sailboat	1
Jet ski (personal water craft)	1
Jet boat	0
	94



#11 Please rank up to three activities that are important reasons for owning your property on or near the lake.

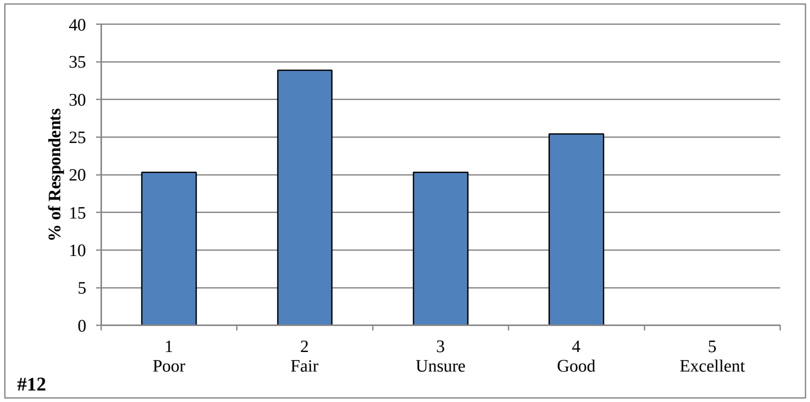
	1st	2nd	3rd	*% ranked*
Fishing - open water	31	12	7	*30.5*
Relaxing/entertaining	16	18	7	*25.0*
Nature viewing	4	10	15	*17.7*
Ice fishing	1	4	6	*6.7*
Motor boating	0	5	5	*6.1*
Water skiing/tubing	2	2	1	*3.0*
Canoeing/kayaking	0	2	3	*3.0*
Hunting	0	1	3	*2.4*
Swimming	0	2	2	*2.4*
Snowmobiling/ATV	1	0	2	*1.8*
Sailing	0	0	1	*0.6*
Jet skiing	0	0	0	*0.0*
Other	1	0	0	*0.6*
	56	56	52	*100.0*



#11

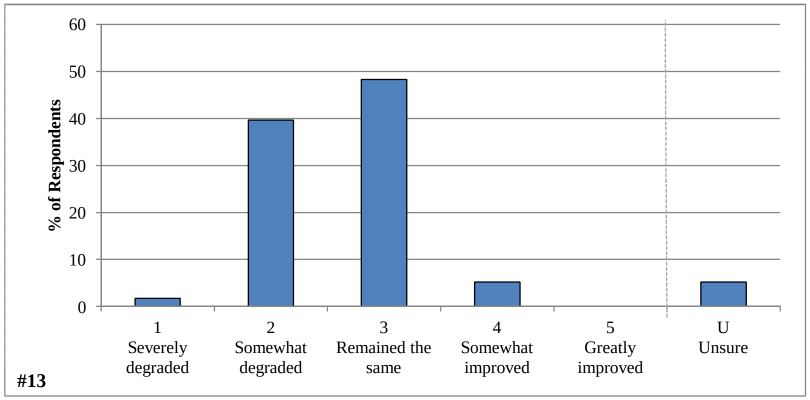
#12 How would you describe the current water quality of Little Arbor Vitae Lake?

	Total	%
1 - Poor	12	*20.3*
2 - Fair	20	*33.9*
3 - Unsure	12	*20.3*
4 - Good	15	*25.4*
5 - Excellent	0	*0.0*
	59	*100.0*



#13 How has the water quality changed in Little Arbor Vitae Lake since you obtained your property?

	Total	%
1 - Severely degraded	1	*1.7*
2 - Somewhat degraded	23	*39.7*
3 - Remained the same	28	*48.3*
4 - Somewhat improved	3	*5.2*
5 - Greatly improved	0	*0.0*
U - Unsure	3	*5.2*
	58	*100.0*



#14 Have you ever heard of aquatic invasive species?

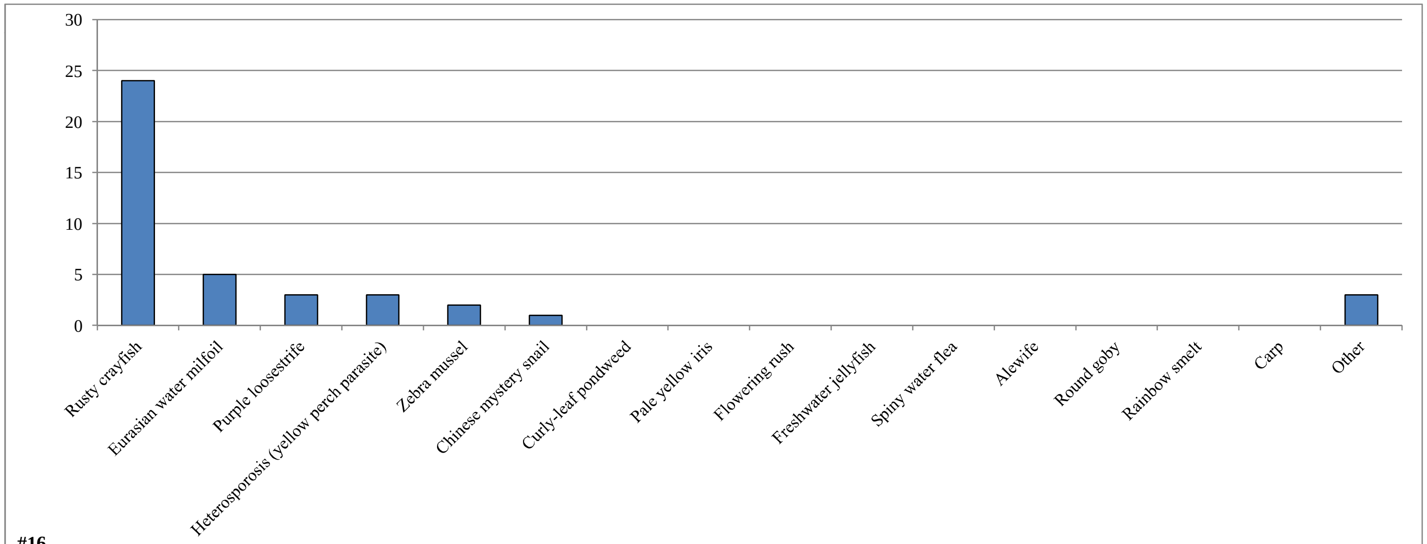
	Total	%
Yes	57	*96.6*
No	2	*3.4*
	59	*100.0*

#15 Are you aware of aquatic invasive species in Little Arbor Vitae Lake?

	Total	%
Yes	27	*49.1*
No	28	*50.9*
	55	*100.0*

#16 Which aquatic invasive species are you aware of in the lake or channel?

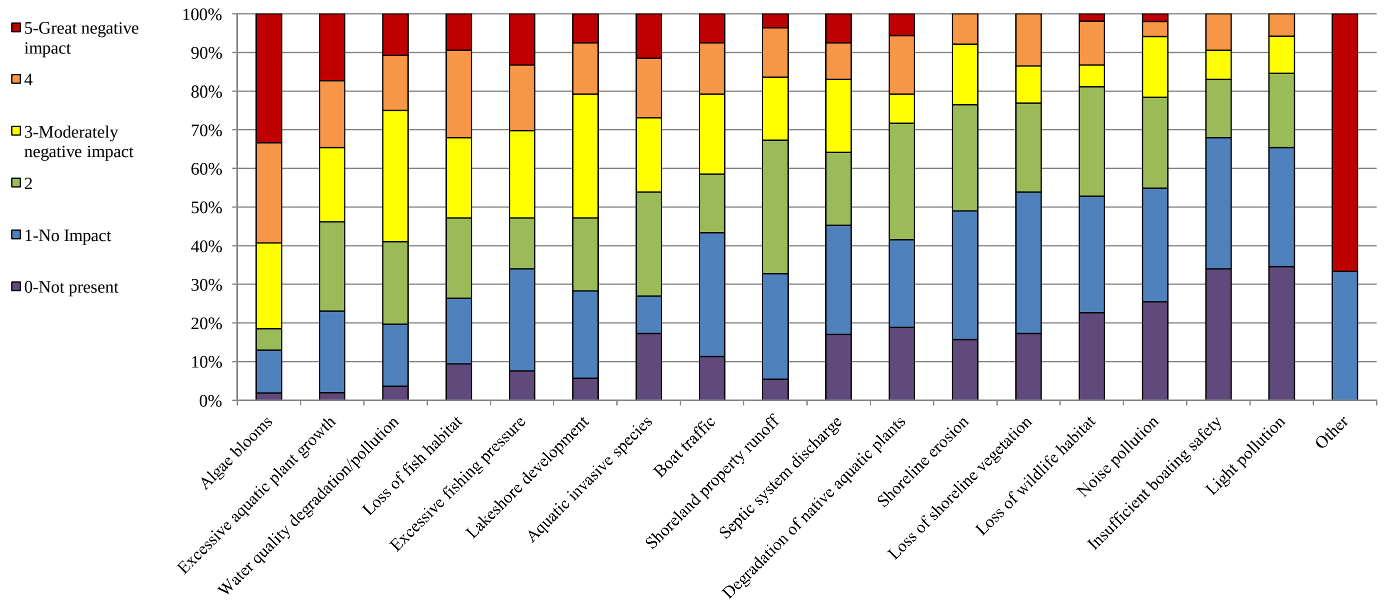
	Total
Rusty crayfish	24
Eurasian water milfoil	5
Purple loosestrife	3
Heterosporosis (yellow perch parasite)	3
Zebra mussel	2
Chinese mystery snail	1
Curly-leaf pondweed	0
Pale yellow iris	0
Flowering rush	0
Freshwater jellyfish	0
Spiny water flea	0
Alewife	0
Round goby	0
Rainbow smelt	0
Carp	0
Other	3



#16

#17 To what level do you believe each of the following factors may be negatively impacting Little Arbor Vitae Lake?

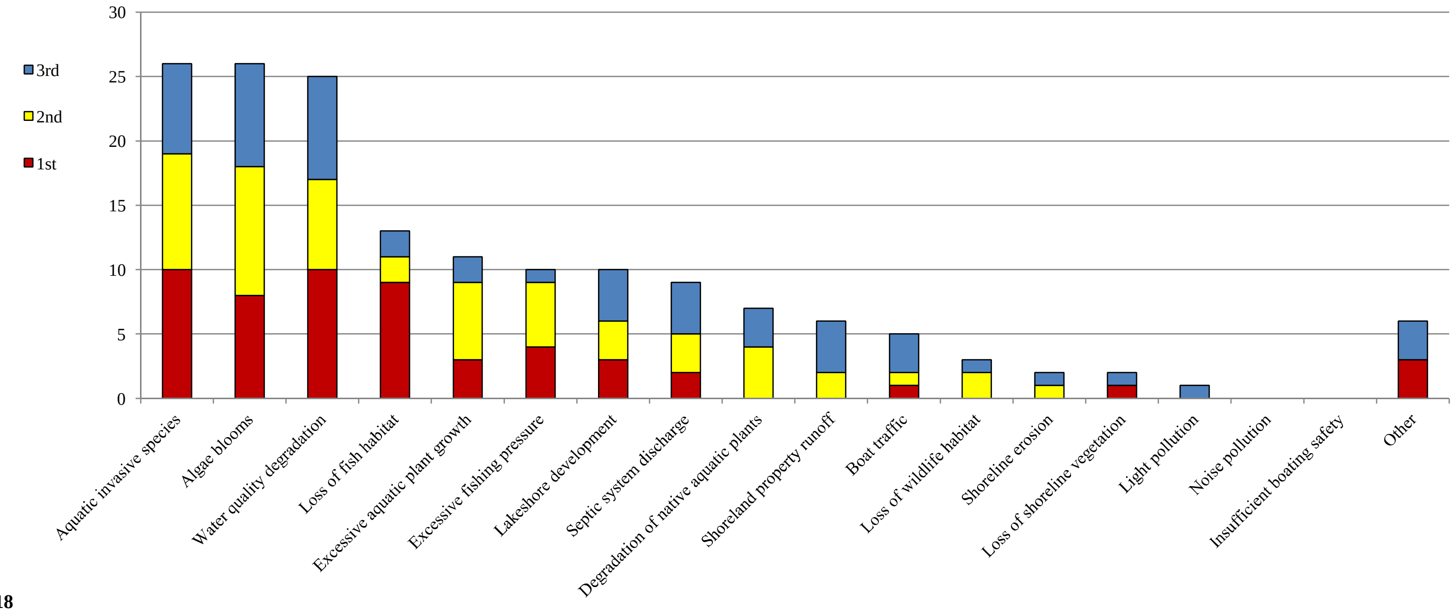
	0-Not present	1-No Impact	2	3-Moderately negative impact	4	5-Great negative impact	*Total*	*Average*
Algae blooms	1	6	3	12	14	18	*53*	*3.6*
Excessive aquatic plant growth	1	11	12	10	9	9	*51*	*2.8*
Water quality degradation/pollution	2	9	12	19	8	6	*54*	*2.7*
Loss of fish habitat	5	9	11	11	12	5	*48*	*2.6*
Excessive fishing pressure	4	14	7	12	9	7	*49*	*2.5*
Lakeshore development	3	12	10	17	7	4	*50*	*2.5*
Aquatic invasive species	9	5	14	10	8	6	*43*	*2.4*
Boat traffic	6	17	8	11	7	4	*47*	*2.2*
Shoreland property runoff	3	15	19	9	7	2	*52*	*2.1*
Septic system discharge	9	15	10	10	5	4	*44*	*2.0*
Degradation of native aquatic plants	10	12	16	4	8	3	*43*	*1.9*
Shoreline erosion	8	17	14	8	4	0	*43*	*1.7*
Loss of shoreline vegetation	9	19	12	5	7	0	*43*	*1.7*
Loss of wildlife habitat	12	16	15	3	6	1	*41*	*1.6*
Noise pollution	13	15	12	8	2	1	*38*	*1.5*
Insufficient boating safety	18	18	8	4	5	0	*35*	*1.2*
Light pollution	18	16	10	5	3	0	*34*	*1.2*
Other	0	1	0	0	0	2	*3*	*3.7*



#17

#18 From the list below, please rank your top three concerns regarding Little Arbor Vitae Lake.

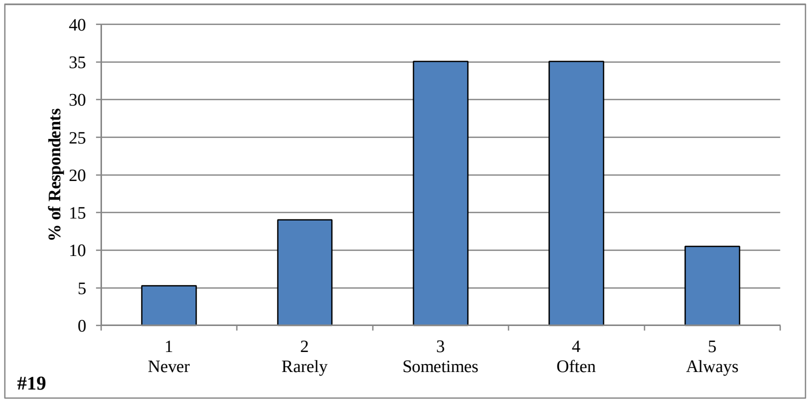
	1st	2nd	3rd	*% Ranked*
Aquatic invasive species	10	9	7	*16.0*
Algae blooms	8	10	8	*16.0*
Water quality degradation	10	7	8	*15.4*
Loss of fish habitat	9	2	2	*8.0*
Excessive aquatic plant growth	3	6	2	*6.8*
Excessive fishing pressure	4	5	1	*6.2*
Lakeshore development	3	3	4	*6.2*
Septic system discharge	2	3	4	*5.6*
Degradation of native aquatic plants	0	4	3	*4.3*
Shoreland property runoff	0	2	4	*3.7*
Boat traffic	1	1	3	*3.1*
Loss of wildlife habitat	0	2	1	*1.9*
Shoreline erosion	0	1	1	*1.2*
Loss of shoreline vegetation	1	0	1	*1.2*
Light pollution	0	0	1	*0.6*
Noise pollution	0	0	0	*0.0*
Insufficient boating safety	0	0	0	*0.0*
Other	3	0	3	*3.7*
	54	55	53	*100.0*



#18

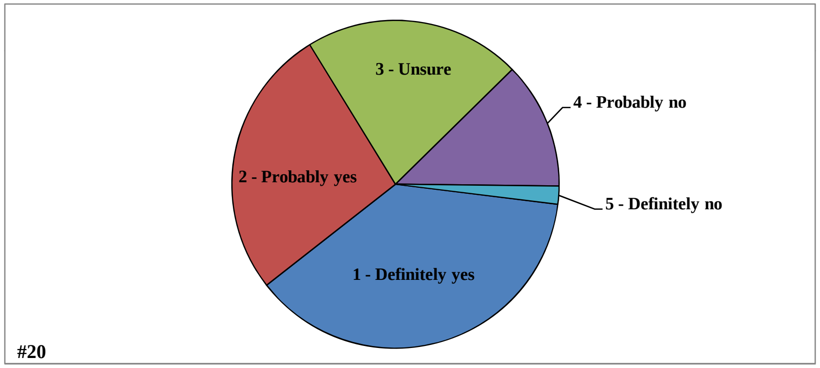
#19 During open water season how often does aquatic plant growth, including algae, negatively impact your enjoyment of Little Arbor Vitae Lake?

	Total	%
1 - Never	3	*5.3*
2 - Rarely	8	*14.0*
3 - Sometimes	20	*35.1*
4 - Often	20	*35.1*
5 - Always	6	*10.5*
	57	*100.0*



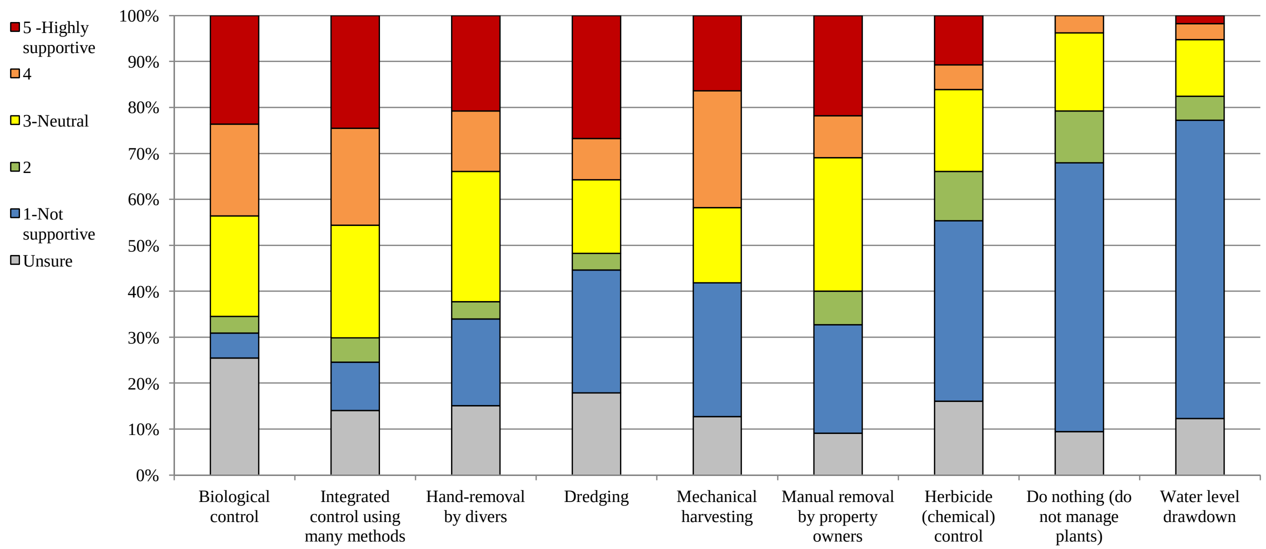
#20 Considering your answer to the question above, do you believe aquatic plant control is needed on Little Arbor Vitae Lake?

	Total	%
1 - Definitely yes	21	*37.5*
2 - Probably yes	15	*26.8*
3 - Unsure	12	*21.4*
4 - Probably no	7	*12.5*
5 - Definitely no	1	*1.8*
	56	*100.0*



#21 What is your level of support for the responsible use of the following techniques on Little Arbor Vitae Lake?

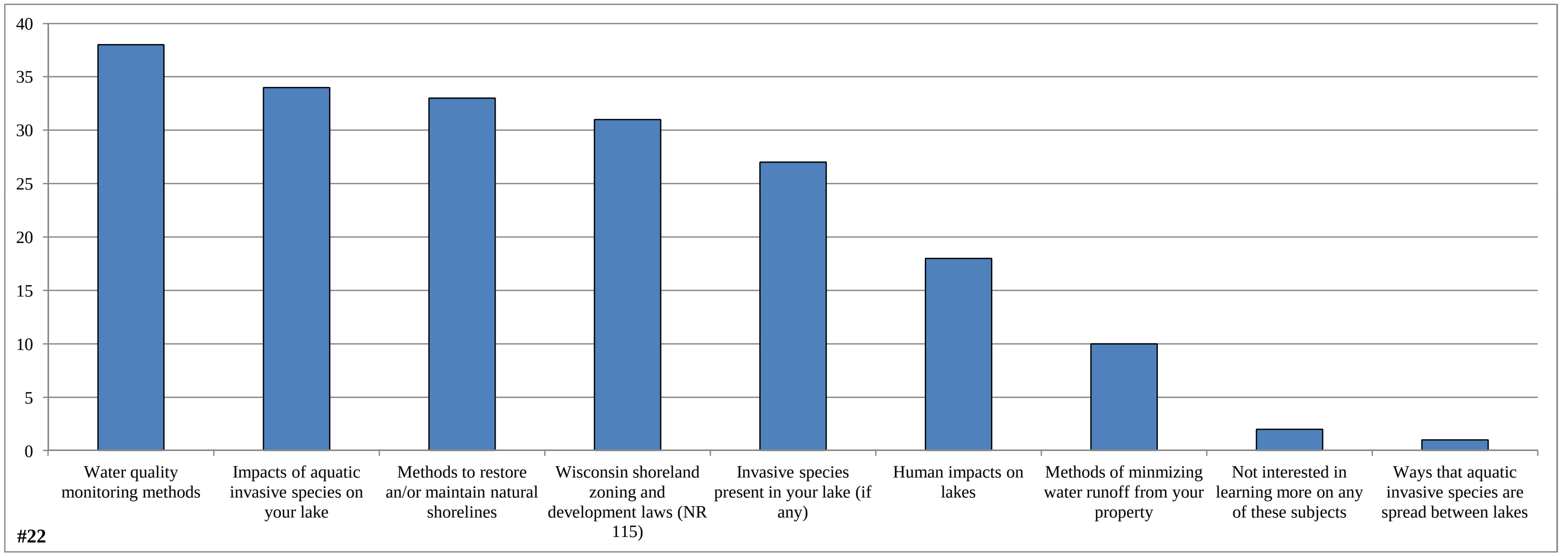
	1-Not supportive	2	3-Neutral	4	5 -Highly supportive	Unsure	*Total*	*Average*
Biological control	3	2	12	11	13	14	*41*	*3.7*
Integrated control using many methods	6	3	14	12	14	8	*49*	*3.5*
Hand-removal by divers	10	2	15	7	11	8	*45*	*3.1*
Dredging	15	2	9	5	15	10	*46*	*3.1*
Mechanical harvesting	16	0	9	14	9	7	*48*	*3.0*
Manual removal by property owners	13	4	16	5	12	5	*50*	*3.0*
Herbicide (chemical) control	22	6	10	3	6	9	*47*	*2.3*
Do nothing (do not manage plants)	31	6	9	2	0	5	*48*	*1.6*
Water level drawdown	37	3	7	2	1	7	*50*	*1.5*



#21

#22 Which of these subjects would you like to learn more about?

	Total
Water quality monitoring methods	38
Impacts of aquatic invasive species on your lake	34
Methods to restore an/or maintain natural shorelines	33
Wisconsin shoreland zoning and development laws (NR 115)	31
Invasive species present in your lake (if any)	27
Human impacts on lakes	18
Methods of minmizing water runoff from your property	10
Not interested in learning more on any of these subjects	2
Ways that aquatic invasive species are spread between lakes	1

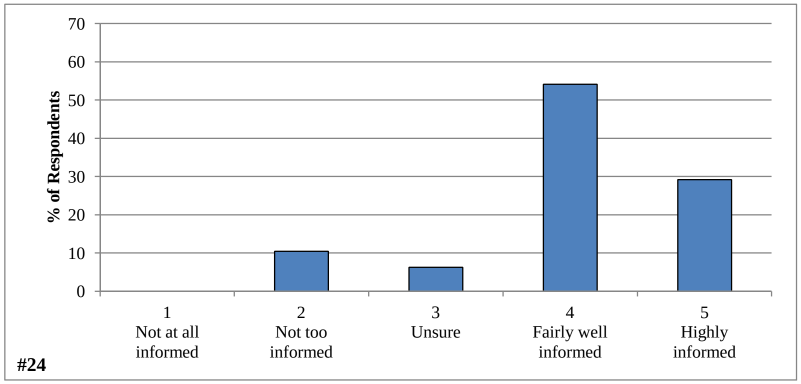


#23 Before receiving this mailing, have you ever heard of the Little Arbor Vitae Lake P & R District?

	Total	%
Yes	47	*85.5*
No	8	*14.5*
	55	*100.0*

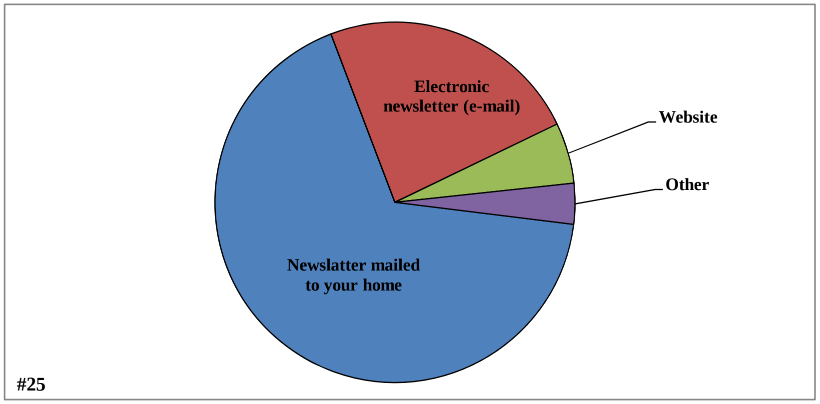
#24 How informed has the Little Arbor Vitae Lake P & R District kept you regarding issues with Little Arbor Vitae Lake and its management?

	Total	%
1 - Not at all informed	0	*0.0*
2 - Not too informed	5	*10.4*
3 - Unsure	3	*6.3*
4 - Fairly well informed	26	*54.2*
5 - Highly informed	14	*29.2*
	48	*100.0*



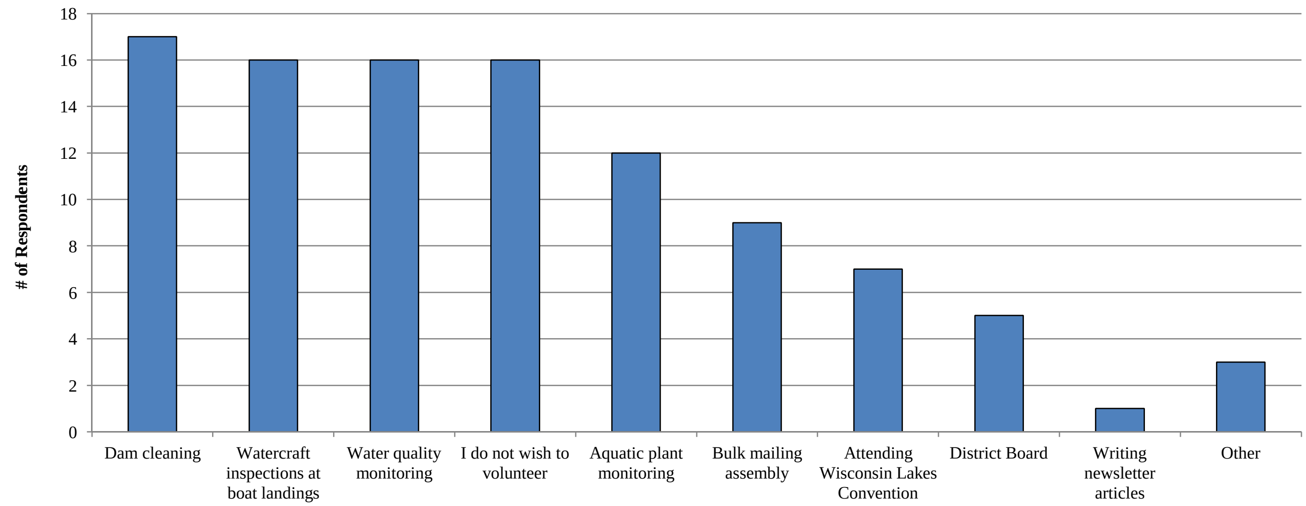
#25 Through what source would you most like to receive communication about Little Arbor Vitae Lake?

	Total
Newslatter mailed to your home	37
Electronic newsletter (e-mail)	13
Website	3
Other	2



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

	Total
Dam cleaning	17
Watercraft inspections at boat landings	16
Water quality monitoring	16
I do not wish to volunteer	16
Aquatic plant monitoring	12
Bulk mailing assembly	9
Attending Wisconsin Lakes Convention	7
District Board	5
Writing newsletter articles	1
Other	3



#26

Survey Number	1h Comment	4g Comment	11m Comment	16p Comment	17r Comments	18r Comment	22i Comment	25d Comment	26j Comment	Other Comments (and Question 27)
1										
2										
3										
4										I feel more informational meetings should be held - perhaps quarterly. Seems some of the problems on Little Arb may be flowing down stream to Little Arb and Carrol Lake from Big Arb. Perhaps more fish cribs should be constructed. Consider an outside professional (Not DNR) to look at the lake and outline a long range plan for the lake as well as short term plans
6										The District Board and its leadership have done a very good job over the years. However, unless we are able to control development at the lakeshore and its resulting problems our beautiful lake will go the way of so many other lakes in the North. Question 17 badly worded
7									Live out of state	
8										
9								Everyone should go to the meetings we have		
11										We now have numerous uncontrolled amounts of not bad weeds in our lake since the crayfish are gone and they are a pain for boat motors, trailors, shore stations. Thank goodness though they are the good weeds, but there are way too many of them. Its also a shame that we can't swim or even want to paddle boat or kayak from middle of July to October. The turn over in the water is awful. Not only is it gross there is a smell. Not very appealing and not great to look at green water.
12					Loss of walleye					Ever since the walleye size limit was changed from 15" min to present size limit, walleye have been depleted!
13										
14										
15										
16										At the present time our walleye population is the lowest I have seen it. We should find out why and try to correct this.
17										We are not up north as residents. We have much work to do on our unfinished house and also maintenance each weekend we come. I say this because any spare time we have when we come up is rare. The algae blooms on Little Arb may be coming from the septic at the campgrounds on Big Arb. Big Arb did not get much algae bloom this year. That why I think it is coming downstream or from the campgrounds into link creek then into Little Arb from the creet inlet. Lets not mention any drawdowns of lake levels again, especially on these drought years. At the last meeting this spring at the LAVL P & Rehabilitation meeting it was brought up several times about a lake draw down. Each time we were assured quote "There would be no draw downs allowed"
18										Coult you send info copies of Lake District info to: (*name removed*). He and his family use the property more than I do now - I'm almost 87 years old

19										
20										
21			Privacy	Northern Pike Prior to 1962 I had fished open water and ice fished for 18 years. During that period I had netted for musky spawn (DNR) 13 years (1949-1962) To my knowledge there have been no Northerns caught in Little AV Lake until recent years. As we know, Northern pike are the first fish to spawn		spring spear fishing	Impacts of ATV's traversing stream eand lake beds in adjacent counties. For Human impact "c" include DNR (not tribal) creel census during ice seasons			Since its inception the Little AV Lake District has benefitted the lake and surrounding property owners greatly. Through the years various impacts have continued to challenge its leadership but members have chosen wisely. The dam has proven to maintain uniform lake levels regardless of rain or drought. With the visible increase in aquatic growth choking Link Creek, it would seem advisable to regularly monitor the water chemistry of that which flow from the outlet of Big Arbor Vitae Lake
22						spearing				I feel fishing and water quality has gone down hill in the last 5 years. Water quality is a big one. Invasive species and people taking water to water their grass. Something should be done by the frontage road to protect the water better. Runoff and buffer strip between water and land. A wash station at the boat launch would be a great idea. I use the crick for duck hunting and the beavers are a big problem and might have some impact on water quality. Blocking water flow they need to be taken care of. The DNR or someone with knowledge should look at the stream between Big and Little Arb. There is a spot where water comes down to nothing. You can't even get a canoe through because land is taking over. Other than those issues and spearing the lake is decent. Feel it was hit hard the last two years.
23										
24										
25										The walleye fishery has deteriorated greatly. Would like to see an effort made to restore the walleye fishery.
26					spearing	spearing				
27										The apparent drop in walleye numbers is a concern. (Havenn't caught a walleye in two years and neighbors say the same thing. The apparent theory is that the crappie population is high and they eat the walleye frye. Supposedly with enough fishing pressure on the crappie it will correct isself in 5 years. My question is why can't we put some pressure on DNR to stock walleye fingerlings to help speed the process of walleye recovery? My # 1 issue is the lack of walleye.
28										
29									Will volunteer when we move to area	

30										I have fished LAV for 50 years as has my family. I am not well versed on some of the conditions affecting our lake. But my historic information from the time my husband's family began fishing here is that there is an over-abundance of vegetation now and far fewer fish. LAV is very important to our family.
31										
32										
33										
34										Lake has changed a lot in the 7 years I owned my place. Back then it was loaded with walleye. Today walleye numbers are way down but bass, northern and crappies are up. I don't know if that's a bad thing. I just like catching fish. Weeds in Butler Bay can be a problem most years but I can live with that. Maybe we should ask the DNR to stock walleye to make up for our naturally produced fry that are being eaten up by our numerous bass population.
35										
36										
37										Improve public boat ramp, is not wide enough. Dredge south end of Blue Island Bay. Water is becoming too shallow. Increase Muskie length to 40"
38										
39										
40										
41										Current quality of fishing is good except for walleye due to spearing
42										
43										
44										
45										
46										
47										Would like to receive communication about Little Arbor Vitae Lake from Glenn Speich
48									If I lived there any of the above. Now my time does not allow it.	Fishing was much better 40 years ago. Water was a lot cleaner. Years ago the channel going to Big Arbor Vitae was a lot deeper and cleaner. I personally think that's 90% of the problem. Dredge that clean and make pockets for sediment before it gets to Little Arbor Lake.
49					Northern pike invasion	Northern invasion	How to control Northern population			I grew up on the lake from the age of 17 (1945), left in 1960, and have returned as often as I could. There is no doubt the invasion of the rusty crayfish changed its character and primarily with the virtual elimination of the muskiie weed (some call it cabbage). Just this summer I see a minor attempt for the weed to recover. Also, since that invasion came the introduction (How?) of Northern Pike and small mouth bass (How?). I'm not aware of a negative impact off the small mouth, but it is generally accepted (I believe) that Northerns tend to severely degrade muskie reproduction and growth
50										Quality of fishing has improved this summer
51										
52										
53										
54										
55										
56				Northern pike		Loss of walleye. More pike and small mouth bass				2010 was a bad year for weeds. I am not able to volunteer. My famly cleans their boats when they come in from fishing. We are good stewards of the water.
57										
58										
59										
60								Lake Association Meetings		

C

APPENDIX C

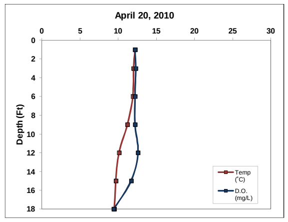
Water Quality Data

Little Arbor Vitae Lake

Date: 4/20/2010
Time: 13:20
Weather: sunny, 68°F
Entry: TWH

Max Depth: 20.0
LAVLS Depth (ft): 3.0
LAVLB Depth (ft): 18.0
Secchi Depth (ft): 6.8

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	12.2	12.2	8.8	
3	12.0	12.3	8.8	
6	11.9	12.2	8.8	
9	11.2	12.2	8.9	
12	10.1	12.6	9.0	
15	9.7	11.7	8.8	
18	9.5	9.4	8.2	



Parameter	LAVLS	LAVLB
Total P (µg/L)	34.00	49.00
Dissolved P (µg/L)	2.00	ND
Chl-*a* (µg/L)	8.71	NA
TKN (µg/L)	530.00	730.00
NO_3 + NO_2-N (µg/L)	ND	ND
NH_3-N (µg/L)	ND	ND
Total N (µg/L)	530.00	730.00
Lab Cond. (µS/cm)	138.00	141.00
Lab pH	8.86	8.16
Alkalinity (mg/L $CaCO_3$)	60.00	60.00
Total Susp. Solids (mg/L)	5.00	10.00
Calcium (mg/L)	16.40	NA

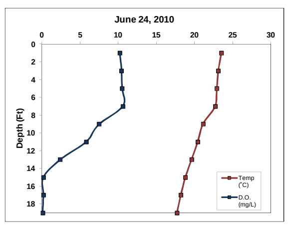
Data collected by SNR and TWH (Onterra)

Little Arbor Vitae Lake

Date: 6/24/2010
Time: 8:20
Weather: sunny, 67°F haze, slight breeze
Entry: TWH **Verf:**

Max Depth: 20.9
LAVLS Depth (ft): 3.0
LAVLB Depth (ft): 17.0
Secchi Depth (ft): 4.5

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	23.5	10.2		
3	23.1	10.4		
5	22.9	10.5		
7	22.7	10.6		
9	21.1	7.5		
11	20.4	5.8		
13	19.6	2.4		
15	18.8	0.2		
17	18.2	0.2		
19	17.7	0.1		



Parameter	LAVLS	LAVLB
Total P (µg/L)	30.00	30.00
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	21.30	NA
TKN (µg/L)	NA	NA
NO_3 + NO_2-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	6.00	4.00
Calcium (mg/L)	NA	NA

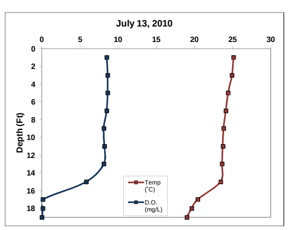
Data collected by SNR, BTB and TWH (Onterra)

Little Arbor Vitae Lake

Date: 7/13/2010
Time: 11:36
Weather: sunny, 34°F 60% clouds
Entry: TWH **Verf:**

Max Depth: 19.2
LAVLS Depth (ft): 3.0
LAVLB Depth (ft): 16.0
Secchi Depth (ft): 4.8

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	25.1	8.5		
3	24.9	8.6		
5	24.4	8.6		
7	24.1	8.5		
9	23.8	8.1		
11	23.7	8.2		
13	23.6	8.1		
15	23.4	5.8		
17	20.4	0.1		
18	19.6	0.1		
19	19.0	0.0		



Parameter	LAVLS	LAVLB
Total P (µg/L)	33.00	60.00
Dissolved P (µg/L)	3.00	14.00
Chl-*a* (µg/L)	19.80	NA
TKN (µg/L)	650.00	960.00
NO_3 + NO_2-N (µg/L)	32.00	ND
NH_3-N (µg/L)	ND	521.00
Total N (µg/L)	682.00	960.00
Lab Cond. (µS/cm)	135.00	157.00
Lab pH	8.88	7.34
Alkalinity (mg/L $CaCO_3$)	58.00	68.00
Total Susp. Solids (mg/L)	4.00	4.00
Calcium (mg/L)	NA	NA

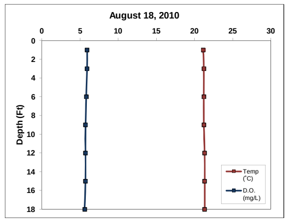
Data collected by DAC and EJH (Onterra)

Little Arbor Vitae Lake

Date: 8/18/2010
Time: 9:30
Weather: windy, 65°F 100% clouds
Entry: TWH **Verf:**

Max Depth: 19.0
LAVLS Depth (ft): 3.0
LAVLB Depth (ft): 17.0
Secchi Depth (ft): 3.0

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	21.1	5.9		
3	21.2	5.9		
6	21.2	5.8		
9	21.2	5.7		
12	21.3	5.7		
15	21.3	5.7		
18	21.3	5.6		



Parameter	LAVLS	LAVLB
Total P (µg/L)	64	57
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	43.3	NA
TKN (µg/L)	NA	1330
NO_3 + NO_2-N (µg/L)	NA	ND
NH_3-N (µg/L)	NA	300
Total N (µg/L)	NA	1330
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	8	8
Calcium (mg/L)	NA	NA

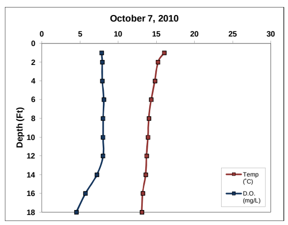
Data collected by TAH (Onterra)
Note: The water was observed to be very green or gray/green.

Little Arbor Vitae Lake

Date: 10/7/2010
Time: 13:30
Weather: clear, light breeze 68°F
Entry: TWH **Verf:**

Max Depth: 18.7
LAVLS Depth (ft): 3
LAVLB Depth (ft): 16
Secchi Depth (ft): 6.7

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	16	7.8		
2	15.2	7.9		
4	14.8	7.9		
6	14.3	8.1		
8	14	8		
10	13.9	8		
12	13.7	8		
14	13.6	7.2		
16	13.2	5.7		
18	13.1	4.5		



Parameter	LAVLS	LAVLB
Total P (µg/L)	42	42
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	11.1	NA
TKN (µg/L)	NA	610
NO_3 + NO_2-N (µg/L)	NA	ND
NH_3-N (µg/L)	NA	ND
Total N (µg/L)	NA	610
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	4	3
Calcium (mg/L)	NA	NA

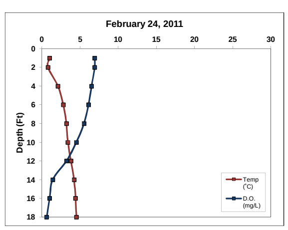
Data collected by TAH and TWH (Onterra)

Little Arbor Vitae Lake

Date: 2/24/2011
Time: 8:48
Weather: overcast, light breeze, 26°F
Entry: TWH

Max Depth: 18.8
LAVLS Depth (ft): 3
LAVLB Depth (ft): 16
Secchi Depth (ft): 11.5

Depth (ft)	Temp (˚C)	D.O. (mg/L)	pH	Sp. Cond. (µS/cm)
1	1	6.9		
2	0.8	6.9		
4	2.1	6.5		
6	2.8	6.1		
8	3.2	5.5		
10	3.4	4.5		
12	3.8	3.2		
14	4.2	1.4		
16	4.4	1		
18	4.5	0.6		



Parameter	LAVLS	LAVLB
Total P (µg/L)	22	25
Dissolved P (µg/L)	ND	5
Chl-*a* (µg/L)	NA	NA
TKN (µg/L)	360	350
NO_3 + NO_2-N (µg/L)	144	414
NH_3-N (µg/L)	64	ND
Total N (µg/L)	360	350
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	ND	ND
Calcium (mg/L)	NA	NA

Data collected by TAH and DAC (Onterra) Note: Ice depth 1.3'

Water Quality Data

2010	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	6	6.2	NA	NA
Total P (µg/L)	6	37.5	6	43.8
Dissolved P (µg/L)	3	2.5	3	9.5
Chl a (µg/L)	5	20.8	0	NA
TKN (µg/L	3	513.3	5	796.0
NO3+NO2-N (µg/L)	3	88.0	5	414.0
NH3-N (µg/L)	3	64.0	5	410.5
Total N (µg/L)	3	524.0	5	796.0
Lab Cond. (µS/cm)	2	136.5	2	149.0
Lab pH	2	8.9	2	7.8
Alkal (mg/l CaCO3)	2	59.0	2	64.0
Total Susp Sol (mg/l)	6	5.4	6	5.8
Calcium (µg/L)	1	16.4	0	NA

Morphological / Geographical Data

Parameter	Value
Acreage	
Volume (acre-feet)	
Perimeter (miles)	
Shoreland Developmetnt Factor	
Maximum Depth (feet)	
County	
WBIC	
Lillie Mason Region (1983)	NLF Ecoregion
Nichols Ecoregion (1999)	NLFL

Watershed Data

WiLMS Class	Acreage	kg/yr	lbs/yr
Forest			0.0
Open Water			0.0
Pasture/Grass			0.0
Row Crops			0.0
Urban - Rural Residential			0.0
Wetland			0.0
Watershed to Lake Area			

Wisconsin Trophic State Index (WTSI)

Year	TP	Chl-a	Secchi
1979	57.3	65.5	57.1
1990			59.6
1991	53.8	53.5	52.5
1992	59.8	60.8	53.5
1993	45.8	52.7	47.0
1994	60.4	63.0	53.8
1995	58.2	62.6	50.9
1996	51.1	61.9	54.8
2007			
2008			61.5
2009			58.3
2010	58.2	63.3	58.7
All Years (Weighted)	56.1	61.1	54.9
ep, Lowland Drainage Lak	49.4	49.7	46.2
NLF Ecoregion	48.1	47.5	45.7

	Secchi (feet)				Chlorophyll-*a* (µg/L)				Total Phosphorus (µg/L)			
	Growing Season		Summer		Growing Season		Summer		Growing Season		Summer	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
1979	2	4.0	1	4.0	3	33.9	2	34.9	1	40.0	1.0	40.0
1990	5	4.2	2	3.4								
1991	22	5.1	14	5.5	4	10.5	3	10.3	4	35.3	3.0	31.3
1992	5	5.9	3	5.1	4	17.6	3	21.8	4	40.3	3.0	47.3
1993	4	8.2	3	8.1	4	8.5	3	9.5	4	17.5	3.0	18.0
1994	4	5.2	3	5.0	4	23.5	3	27.3	4	41.5	3.0	49.3
1995	8	9.5	6	6.2	4	21.7	3	26.2	4	37.3	3.0	42.3
1996	4	4.8	3	4.7	4	22.4	3	24.4	4	28.3	3.0	26.0
2007	1	19.0	0									
2008	9	2.9	5	3.0								
2009	11	3.5	10	3.7								
2010	17	4.9	12	3.6	5	20.8	3	28.1	5	40.6	3.0	42.3
All Years (Weighted)		5.3		4.7		19.5		22.3		34.8		36.8
Deep, Lowland Drainage Lakes				8.5				7.0				23.0
NLF Ecoregion				8.9				5.6				21.0

Summer 2010 N: 682.0
Summer 2010 P: 42.3

Summer 2011 N:P 16 :1

D

APPENDIX D

Watershed Analysis WiLMS Results

Date: 10/11/2012 Scenario: LAV Immediate WS & PS

Lake Id: Little Arbor Vitae
Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 3298.0 acre
Total Unit Runoff: 14.00 in.
Annual Runoff Volume: 3847.7 acre-ft
Lake Surface Area <As>: 534.0 acre
Lake Volume <V>: 6052.0 acre-ft
Lake Mean Depth <z>: 11.3 ft
Precipitation - Evaporation: 5.5 in.
Hydraulic Loading: 12252.5 acre-ft/year
Areal Water Load <qs>: 22.9 ft/year
Lake Flushing Rate <p>: 2.02 1/year
Water Residence Time: 0.49 year
Observed spring overturn total phosphorus (SPO): 30.0 mg/m^3
Observed growing season mean phosphorus (GSM): 34.8 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	26	0.50	1.00	3.00	2.0	5	11	32
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	156	0.10	0.30	0.50	3.5	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)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	24	0.05	0.10	0.25	0.2	0	1	2
Wetlands	586	0.10	0.10	0.10	4.4	24	24	24
Forest	2506	0.05	0.09	0.18	17.0	51	91	183
Lake Surface	534.0	0.10	0.30	1.00	12.1	22	65	216

POINT SOURCE DATA

Point Sources	Water Load (m^3/year)	Low (kg/year)	Most Likely (kg/year)	High (kg/year)	Loading %
BAV Outlet	10065360.0	0.0	326.4	0.0	60.8

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)	238.3	1183.1	1075.7	100.0
Total Loading (kg)	108.1	536.7	487.9	100.0
Areal Loading (lb/ac-year)	0.45	2.22	2.01	
Areal Loading (mg/m^2-year)	50.02	248.34	225.79	
Total PS Loading (lb)	0.0	719.6	0.0	60.8
Total PS Loading (kg)	0.0	326.4	0.0	60.8
Total NPS Loading (lb)	190.7	320.6	599.3	39.2
Total NPS Loading (kg)	86.5	145.4	271.8	39.2

Phosphorus Prediction and Uncertainty Analysis Module

Date: 10/11/2012   Scenario: 60
Observed spring overturn total phosphorus (SPO): 30.0 mg/m^3
Observed growing season mean phosphorus (GSM): 34.8 mg/m^3
Back calculation for SPO total phosphorus: 0.0 mg/m^3
Back calculation GSM phosphorus: 0.0 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 0 kg

Lake Phosphorus Model	Low Total P (mg/m^3)	Most Likely Total P (mg/m^3)	High Total P (mg/m^3)	Predicted -Observed (mg/m^3)	% Dif.
Walker, 1987 Reservoir	4	22	20	-13	-37
Canfield-Bachmann, 1981 Natural Lake	6	23	21	-12	-34
Canfield-Bachmann, 1981 Artificial Lake	6	21	19	-14	-40
Rechow, 1979 General	3	12	11	-23	-66
Rechow, 1977 Anoxic	6	29	27	-6	-17
Rechow, 1977 water load<50m/year	4	20	18	-15	-43
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	4	22	20	-8	-27
Vollenweider, 1982 Combined OECD	5	19	17	-13	-40
Dillon-Rigler-Kirchner	2	11	10	-19	-63
Vollenweider, 1982 Shallow Lake/Res.	4	15	14	-17	-52

Larsen-Mercier, 1976	4	21	19	-9	-30
Nurnberg, 1984 Oxic	3	14	13	-21	-60

Lake Phosphorus Model	**Confidence** Lower Bound	**Confidence** Upper Bound	**Parameter** Fit?	**Back** Calculation (kg/year)	**Model** Type
Walker, 1987 Reservoir	9	30	FIT	0	GSM
Canfield-Bachmann, 1981 Natural Lake	7	66	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	7	60	FIT	1	GSM
Rechow, 1979 General	5	17	FIT	0	GSM
Rechow, 1977 Anoxic	13	39	FIT	0	GSM
Rechow, 1977 water load<50m/year	9	28	FIT	0	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	8	35	FIT	0	SPO
Vollenweider, 1982 Combined OECD	7	32	FIT	0	ANN
Dillon-Rigler-Kirchner	5	15	FIT	0	SPO
Vollenweider, 1982 Shallow Lake/Res.	6	25	FIT	0	ANN
Larsen-Mercier, 1976	10	27	P Pin	0	SPO
Nurnberg, 1984 Oxic	6	21	FIT	0	ANN

Water and Nutrient Outflow Module

Date: 10/11/2012   Scenario: 45
Average Annual Surface Total Phosphorus: 32.4mg/m^3
Annual Discharge: 1.23E+004 AF => 1.51E+007 m^3
Annual Outflow Loading: 1031.1 LB =>   467.7 kg

E

APPENDIX E

Aquatic Plant Survey Data

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
1	45.9122634	-89.63419715	6	M	P		2	2	1																							
2	45.9117594	-89.63420047	5	M	P		2	2	1		1																					
3	45.9112554	-89.63420378	6	M	P		3	3	1		1																					
4	45.9107514	-89.63420709	7	M	P	No Vegetation																										
5	45.9102474	-89.6342104	6	M	P		3			1											2			1								
6	45.9097433	-89.63421371	6	M	P		1	1	1																							
7	45.9092393	-89.63421702	6	M	P		1	1			1																					
8	45.9087353	-89.63422033	5	S	P		1	1																								
9	45.9127651	-89.63347178	2	R	P	No Vegetation																										
10	45.9122611	-89.6334751	8	M	P	No Vegetation																										
11	45.9117571	-89.63347841	8	M	P		1	1	1																							
12	45.9112531	-89.63348173	8	M	P	No Vegetation																										
13	45.9107491	-89.63348505	8	M	P		1		1																							
14	45.9102451	-89.63348837	8	M	P		1	1	1	1	1																					
15	45.909741	-89.63349168	7	M	P		1		1																							
16	45.909237	-89.633495	7	M	P		2	1	2																							
17	45.908733	-89.63349832	7	M	P	No Vegetation																										
18	45.908229	-89.63350164	6	S	P		1	1	1	1																						
19	45.907725	-89.63350495	7	M	P		1	1																								
20	45.9072209	-89.63350827	5	M	P		2	2	1	1																						
21	45.9132668	-89.63274639	2	S	P		1	1	1	1																						
22	45.9127628	-89.63274972	7	M	P		1	1	1																							
23	45.9122588	-89.63275304	9	M	P		1	1	1																							
24	45.9117548	-89.63275636	9	M	P		1	1	1																							
25	45.9112508	-89.63275969	9	M	P		2	1	2																							
26	45.9107467	-89.63276301	9	M	P	No Vegetation																										
27	45.9102427	-89.63276634	9	M	P	No Vegetation																										
28	45.9097387	-89.63276966	8	M	P		2	1	2																							
29	45.9092347	-89.63277298	8	M	P		1	1	1																							
30	45.9087307	-89.63277631	8	M	P		2	2	1																							
31	45.9082267	-89.63277963	7	M	P		1	1	1																							
32	45.9077226	-89.63278296	6	M	P		2	1	2																							
33	45.9072186	-89.63278628	3	R	P		1	1	1																							
34	45.9132645	-89.63202432	6	S	P		1	1	1																							
35	45.9127605	-89.63202765	7	S	P		1	1	1	1																						
36	45.9122565	-89.63203098	10		R		2	1	2																							
37	45.9117525	-89.63203431	10		R	No Vegetation																										
38	45.9112484	-89.63203764	10		R	No Vegetation																										
39	45.9107444	-89.63204098	10		R	No Vegetation																										
40	45.9102404	-89.63204431	10		R		1		1																							
41	45.9097364	-89.63204764	10		R		2	1	2																							

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
42	45.9092324	-89.63205097	9	M	P	No Vegetation																										
43	45.9087284	-89.6320543	8	M	P	No Vegetation																										
44	45.9082243	-89.63205763	8	M	P		1	1	1																							
45	45.9077203	-89.63206096	7	M	P		2	2	1																							
46	45.9072163	-89.63206429	4	R	P		1	1																								
47	45.9132622	-89.63130225	10		R	No Vegetation																										
48	45.9127582	-89.63130559	7	R	P		1	1	1	1																						
49	45.9122541	-89.63130893	11		R	No Vegetation																										
50	45.9117501	-89.63131226	11		R	No Vegetation																										
51	45.9112461	-89.6313156	11		R	No Vegetation																										
52	45.9107421	-89.63131894	11		R	No Vegetation																										
53	45.9102381	-89.63132228	11		R		1	1																								
54	45.9097341	-89.63132561	10		R		1	1	1																							
55	45.90923	-89.63132895	10		R		1		1																							
56	45.908726	-89.63133229	9	M	P	No Vegetation																										
57	45.908222	-89.63133562	8	M	P		1	1	1																							
58	45.907718	-89.63133896	7	M	P		1	1	1																							
59	45.907214	-89.6313423	8	M	P		1		1																							
60	45.9132599	-89.63058018	10		R	No Vegetation																										
61	45.9127558	-89.63058353				Too Deep																										
62	45.9122518	-89.63058687				Too Deep																										
63	45.9117478	-89.63059021	13		R	No Vegetation																										
64	45.9112438	-89.63059356	12		R	No Vegetation																										
65	45.9107398	-89.6305969	12		R	No Vegetation																										
66	45.9102358	-89.63060024	12		R	No Vegetation																										
67	45.9097317	-89.63060359	11		R	No Vegetation																										
68	45.9092277	-89.63060693	10		R	No Vegetation																										
69	45.9087237	-89.63061027	10		R	No Vegetation																										
70	45.9082197	-89.63061362	9	M	P		1		1																							
71	45.9077157	-89.63061696	8	M	P		2	1	2																							
72	45.9072116	-89.6306203	6	S	P		2	2	1																							
73	45.9132575	-89.62985811	5	R	P	No Vegetation																										
74	45.9127535	-89.62986146	13		R	No Vegetation																										
75	45.9122495	-89.62986481				Too Deep																										
76	45.9117455	-89.62986816				Too Deep																										
77	45.9112414	-89.62987151				Too Deep																										
78	45.9107374	-89.62987486	12		R	No Vegetation																										
79	45.9102334	-89.62987821	12		R	No Vegetation																										
80	45.9097294	-89.62988156	12		R	No Vegetation																										
81	45.9092254	-89.62988491	11		R		1		1																							
82	45.9087214	-89.62988826	10		R		1	1	1	1																						

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
83	45.9082173	-89.62989161	8	M	P	No Vegetation																										
84	45.9077133	-89.62989496	7	M	P		1	1	1										1													
85	45.9177913	-89.62910582	3	M	P		2	2		1		1		1	1	1																
86	45.9132552	-89.62913604	10		R	No Vegetation																										
87	45.9127512	-89.6291394	13		R	No Vegetation																										
88	45.9122471	-89.62914276				Too Deep																										
89	45.9117431	-89.62914611				Too Deep																										
90	45.9112391	-89.62914947				Too Deep																										
91	45.9107351	-89.62915283	13		R	No Vegetation																										
92	45.9102311	-89.62915618	12		R	No Vegetation																										
93	45.9097271	-89.62915954	12		R	No Vegetation																										
94	45.909223	-89.6291629	11		R	No Vegetation																										
95	45.908719	-89.62916625	10		R	No Vegetation																										
96	45.908215	-89.62916961	10		R		1	1	1																							
97	45.907711	-89.62917297	6	M	P		2	2		1	1																					
98	45.917789	-89.6283837	3	M	P		1	1		1		1										1										
99	45.9137568	-89.62841061	6	S	P		1		1	1																						
100	45.9132528	-89.62841397	12		R	No Vegetation																										
101	45.9127488	-89.62841734				Too Deep																										
102	45.9122448	-89.6284207				Too Deep																										
103	45.9117408	-89.62842406				Too Deep																										
104	45.9112368	-89.62842743				Too Deep																										
105	45.9107327	-89.62843079				Too Deep																										
106	45.9102287	-89.62843415				Too Deep																										
107	45.9097247	-89.62843752	12		R	No Vegetation																										
108	45.9092207	-89.62844088	11		R	No Vegetation																										
109	45.9087167	-89.62844424	10		R	No Vegetation																										
110	45.9082127	-89.62844761	10		R	No Vegetation																										
111	45.9077086	-89.62845097	5	S	P		1		1																							
112	45.9177866	-89.62766157	3	M	P		3	3							1																	
113	45.9172826	-89.62766494	3	M	P		2	2	1	1	1	V				1						1		1	1							1
114	45.9142585	-89.62768516	12		R	No Vegetation																										
115	45.9137545	-89.62768853	12		R	No Vegetation																										
116	45.9132505	-89.6276919	6	R	P	No Vegetation																										
117	45.9127465	-89.62769527				Too Deep																										
118	45.9122424	-89.62769864				Too Deep																										
119	45.9117384	-89.62770201				Too Deep																										
120	45.9112344	-89.62770538				Too Deep																										
121	45.9107304	-89.62770875				Too Deep																										
122	45.9102264	-89.62771212				Too Deep																										
123	45.9097224	-89.62771549				Too Deep																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
124	45.9092183	-89.62771886	11		R	No Vegetation																										
125	45.9087143	-89.62772223	11		R	No Vegetation																										
126	45.9082103	-89.6277256	9	M	P	No Vegetation																										
127	45.9077063	-89.62772897	6	M	P		1	1	1																							
128	45.9177843	-89.62693944	5	M	P		1	1																								
129	45.9172803	-89.62694282	4	M	P		3	2	2	1	1																					
130	45.9167762	-89.62694619	4	S	P		2	2	1																							
131	45.9157682	-89.62695295	4	S	P		1	1	1	1																						
132	45.9152642	-89.62695633	12		R	No Vegetation																										
133	45.9147602	-89.6269597	13		R	No Vegetation																										
134	45.9142562	-89.62696308				Too Deep																										
135	45.9137521	-89.62696646				Too Deep																										
136	45.9132481	-89.62696983	12		R	No Vegetation																										
137	45.9127441	-89.62697321				Too Deep																										
138	45.9122401	-89.62697659				Too Deep																										
139	45.9117361	-89.62697996				Too Deep																										
140	45.9112321	-89.62698334				Too Deep																										
141	45.910728	-89.62698672				Too Deep																										
142	45.910224	-89.62699009				Too Deep																										
143	45.90972	-89.62699347				Too Deep																										
144	45.909216	-89.62699685	12		R	No Vegetation																										
145	45.908712	-89.62700022	11		R	No Vegetation																										
146	45.908208	-89.6270036	9	S	P	No Vegetation																										
147	45.9077039	-89.62700697	3	S	P		1	1	1		1						1		1													
148	45.9177819	-89.62621731	6	M	P		1	1	1	1																						
149	45.9172779	-89.6262207	7	M	P		3	1	1																							
150	45.9167739	-89.62622408	7	M	P		1	1	1																							
151	45.9162699	-89.62622746	9	M	P	No Vegetation																										
152	45.9157658	-89.62623085	11		R	No Vegetation																										
153	45.9152618	-89.62623423	12		R	No Vegetation																										
154	45.9147578	-89.62623761	12		R	No Vegetation																										
155	45.9142538	-89.626241	7	R	P	No Vegetation																										
156	45.9137498	-89.62624438				Too Deep																										
157	45.9132458	-89.62624776				Too Deep																										
158	45.9127417	-89.62625115				Too Deep																										
159	45.9122377	-89.62625453				Too Deep																										
160	45.9117337	-89.62625791				Too Deep																										
161	45.9112297	-89.6262613				Too Deep																										
162	45.9107257	-89.62626468				Too Deep																										
163	45.9102217	-89.62626806				Too Deep																										
164	45.9097176	-89.62627145	10		R	No Vegetation																										

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165	45.9092136	-89.62627483	11		R	No Vegetation																										
166	45.9087096	-89.62627821	8	S	P	No Vegetation																										
167	45.9082056	-89.62628159	4	S	P		1	1	1	1																						
168	45.9177795	-89.62549518	7	M	P		2	1	2																							
169	45.9172755	-89.62549857	9	M	P	No Vegetation																										
170	45.9167715	-89.62550196	11		R		1	1																								
171	45.9162675	-89.62550535	11		R		1	1																								
172	45.9157635	-89.62550874	13		R	No Vegetation																										
173	45.9152595	-89.62551214	12		R	No Vegetation																										
174	45.9147554	-89.62551553				Too Deep																										
175	45.9142514	-89.62551892				Too Deep																										
176	45.9137474	-89.62552231				Too Deep																										
177	45.9132434	-89.6255257				Too Deep																										
178	45.9127394	-89.62552909				Too Deep																										
179	45.9122354	-89.62553247				Too Deep																										
180	45.9117314	-89.62553586				Too Deep																										
181	45.9112273	-89.62553925				Too Deep																										
182	45.9107233	-89.62554264				Too Deep																										
183	45.9102193	-89.62554603	6	S	P				1																							
184	45.9097153	-89.62554942	6	S	P		3	3		1																						
185	45.9092113	-89.62555281	10		R	No Vegetation																										
186	45.9087073	-89.6255562	8	S	P	No Vegetation																										
187	45.9082032	-89.62555959	2	S	P		1	1	1	1							1				1											
188	45.9051791	-89.62557992	2	M	P		1					1		1	1																	
189	45.9177772	-89.62477306	8	M	P		1																									
190	45.9172732	-89.62477645	11		R	No Vegetation																										
191	45.9167691	-89.62477985	12		R	No Vegetation																										
192	45.9162651	-89.62478325	13		R	No Vegetation																										
193	45.9157611	-89.62478664	12		R	No Vegetation																										
194	45.9152571	-89.62479004				Too Deep																										
195	45.9147531	-89.62479344	7	R	P	No Vegetation																										
196	45.9142491	-89.62479683	12		R	No Vegetation																										
197	45.913745	-89.62480023				Too Deep																										
198	45.913241	-89.62480363				Too Deep																										
199	45.912737	-89.62480702				Too Deep																										
200	45.912233	-89.62481042				Too Deep																										
201	45.911729	-89.62481382				Too Deep																										
202	45.911225	-89.62481721				Too Deep																										
203	45.9107209	-89.62482061				Too Deep																										
204	45.9102169	-89.624824	5	S	P		1	1										1	1													
205	45.9097129	-89.6248274	5	S	P		2	1	1	2																		1				

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206	45.9092089	-89.62483079	8	S	P	No Vegetation																										
207	45.9087049	-89.62483419	7	S	P	No Vegetation																										
208	45.9082009	-89.62483759	3	S	P		1			1																						
209	45.9076968	-89.62484098	3	S	P		1	1																								
210	45.9071928	-89.62484438	1	S	P		1	1		1						1																
211	45.9051768	-89.62485796	2	M	P		2	1			1	1				1		2								1						
212	45.9046727	-89.62486135	3	S	P		1	1	1	1	1	1																				
213	45.9182788	-89.62404752	3	S	P		3	1										3														
214	45.9177748	-89.62405093	10		R	No Vegetation																										
215	45.9172708	-89.62405433	12		R	No Vegetation																										
216	45.9167668	-89.62405773	13		R	No Vegetation																										
217	45.9162628	-89.62406114	13		R	No Vegetation																										
218	45.9157587	-89.62406454	12		R	No Vegetation																										
219	45.9152547	-89.62406794				Too Deep																										
220	45.9147507	-89.62407135	4	R	P	No Vegetation																										
221	45.9142467	-89.62407475	8	R	P	No Vegetation																										
222	45.9137427	-89.62407815				Too Deep																										
223	45.9132387	-89.62408156				Too Deep																										
224	45.9127346	-89.62408496				Too Deep																										
225	45.9122306	-89.62408836				Too Deep																										
226	45.9117266	-89.62409177				Too Deep																										
227	45.9112226	-89.62409517				Too Deep																										
228	45.9107186	-89.62409857				Too Deep																										
229	45.9102146	-89.62410197				Too Deep																										
230	45.9097105	-89.62410538				Too Deep																										
231	45.9092065	-89.62410878				Too Deep																										
232	45.9087025	-89.62411218				Too Deep																										
233	45.9081985	-89.62411558	7	R	P	No Vegetation																										
234	45.9076945	-89.62411898	11		R	No Vegetation																										
235	45.9071905	-89.62412239				Fisherman																										
236	45.9066864	-89.62412579	4	S	P		1			1																						
237	45.9061824	-89.62412919	6	S	P		1	1	1	1																						
238	45.9056784	-89.62413259				Too Deep																										
239	45.9051744	-89.62413599	12		R	No Vegetation																										
240	45.9046704	-89.62413939	6	S	P		2	2	1		1																					
241	45.9182764	-89.62332539	7	R	P		1	1	1	1																						
242	45.9177724	-89.6233288	13		R	No Vegetation																										
243	45.9172684	-89.62333221	13		R	No Vegetation																										
244	45.9167644	-89.62333562				Too Deep																										
245	45.9162604	-89.62333903				Too Deep																										
246	45.9157564	-89.62334244	13		R	No Vegetation																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
247	45.9152523	-89.62334585				Too Deep																										
248	45.9147483	-89.62334926	4	R	P	No Vegetation																										
249	45.9142443	-89.62335267				Too Deep																										
250	45.9137403	-89.62335608				Too Deep																										
251	45.9132363	-89.62335949				Too Deep																										
252	45.9127323	-89.6233629				Too Deep																										
253	45.9122282	-89.62336631				Too Deep																										
254	45.9117242	-89.62336972				Too Deep																										
255	45.9112202	-89.62337313				Too Deep																										
256	45.9107162	-89.62337653				Too Deep																										
257	45.9102122	-89.62337994				Too Deep																										
258	45.9097082	-89.62338335				Too Deep																										
259	45.9092041	-89.62338676				Too Deep																										
260	45.9087001	-89.62339017				Too Deep																										
261	45.9081961	-89.62339358				Too Deep																										
262	45.9076921	-89.62339699				Too Deep																										
263	45.9071881	-89.6234004				Too Deep																										
264	45.9066841	-89.6234038				Too Deep																										
265	45.9061801	-89.62340721				Too Deep																										
266	45.905676	-89.62341062				Too Deep																										
267	45.905172	-89.62341403				Too Deep																										
268	45.904668	-89.62341744	9	S	P		1	1																								
269	45.9187781	-89.62259984	7	R	P		1	1	1	1																						
270	45.9182741	-89.62260325	12		R	No Vegetation																										
271	45.91777	-89.62260667	14		R	No Vegetation																										
272	45.917266	-89.62261009	14		R	No Vegetation																										
273	45.916762	-89.62261351				Too Deep																										
274	45.916258	-89.62261692				Too Deep																										
275	45.915754	-89.62262034	6	R	P	No Vegetation																										
276	45.91525	-89.62262375	12		R	No Vegetation																										
277	45.9147459	-89.62262717	8	R	P	No Vegetation																										
278	45.9142419	-89.62263059				Too Deep																										
279	45.9137379	-89.622634				Too Deep																										
280	45.9132339	-89.62263742				Too Deep																										
281	45.9127299	-89.62264084				Too Deep																										
282	45.9122259	-89.62264425				Too Deep																										
283	45.9117218	-89.62264767				Too Deep																										
284	45.9112178	-89.62265108				Too Deep																										
285	45.9107138	-89.6226545				Too Deep																										
286	45.9102098	-89.62265791				Too Deep																										
287	45.9097058	-89.62266133				Too Deep																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
288	45.9092018	-89.62266474				Too Deep																										
289	45.9086978	-89.62266816				Too Deep																										
290	45.9081937	-89.62267158				Too Deep																										
291	45.9076897	-89.62267499				Too Deep																										
292	45.9071857	-89.62267841				Too Deep																										
293	45.9066817	-89.62268182				Too Deep																										
294	45.9061777	-89.62268523				Too Deep																										
295	45.9056737	-89.62268865				Too Deep																										
296	45.9051696	-89.62269206				Too Deep																										
297	45.9046656	-89.62269548	4	R	P	No Vegetation																										
298	45.9187757	-89.6218777	10		R	No Vegetation																										
299	45.9182717	-89.62188112	13		R	No Vegetation																										
300	45.9177677	-89.62188454				Too Deep																										
301	45.9172636	-89.62188797				Too Deep																										
302	45.9167596	-89.62189139				Too Deep																										
303	45.9162556	-89.62189481				Too Deep																										
304	45.9157516	-89.62189824	5	R	P	No Vegetation																										
305	45.9152476	-89.62190166	11		R	No Vegetation																										
306	45.9147436	-89.62190508	7	R	P	No Vegetation																										
307	45.9142395	-89.62190851				Too Deep																										
308	45.9137355	-89.62191193				Too Deep																										
309	45.9132315	-89.62191535				Too Deep																										
310	45.9127275	-89.62191877				Too Deep																										
311	45.9122235	-89.6219222				Too Deep																										
312	45.9117195	-89.62192562				Too Deep																										
313	45.9112154	-89.62192904				Too Deep																										
314	45.9107114	-89.62193246				Too Deep																										
315	45.9102074	-89.62193588				Too Deep																										
316	45.9097034	-89.62193931				Too Deep																										
317	45.9091994	-89.62194273				Too Deep																										
318	45.9086954	-89.62194615				Too Deep																										
319	45.9081913	-89.62194957				Too Deep																										
320	45.9076873	-89.62195299				Too Deep																										
321	45.9071833	-89.62195641				Too Deep																										
322	45.9066793	-89.62195984				Too Deep																										
323	45.9061753	-89.62196326				Too Deep																										
324	45.9056713	-89.62196668				Too Deep																										
325	45.9051672	-89.6219701				Too Deep																										
326	45.9046632	-89.62197352	12		R		1																									
327	45.9187733	-89.62115556	13		R	No Vegetation																										
328	45.9182693	-89.62115899				Too Deep																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
329	45.9177653	-89.62116242				Too Deep																										
330	45.9172612	-89.62116585				Too Deep																										
331	45.9167572	-89.62116928				Too Deep																										
332	45.9162532	-89.62117271				Too Deep																										
333	45.9157492	-89.62117614	7	R	P	No Vegetation																										
334	45.9152452	-89.62117957				Too Deep																										
335	45.9147412	-89.62118299				Too Deep																										
336	45.9142372	-89.62118642				Too Deep																										
337	45.9137331	-89.62118985				Too Deep																										
338	45.9132291	-89.62119328				Too Deep																										
339	45.9127251	-89.62119671				Too Deep																										
340	45.9122211	-89.62120014				Too Deep																										
341	45.9117171	-89.62120357				Too Deep																										
342	45.9112131	-89.621207				Too Deep																										
343	45.910709	-89.62121043				Too Deep																										
344	45.910205	-89.62121386				Too Deep																										
345	45.909701	-89.62121728				Too Deep																										
346	45.909197	-89.62122071				Too Deep																										
347	45.908693	-89.62122414				Too Deep																										
348	45.908189	-89.62122757				Too Deep																										
349	45.9076849	-89.621231				Too Deep																										
350	45.9071809	-89.62123442				Too Deep																										
351	45.9066769	-89.62123785				Too Deep																										
352	45.9061729	-89.62124128				Too Deep																										
353	45.9056689	-89.62124471				Too Deep																										
354	45.9051649	-89.62124814				Too Deep																										
355	45.9046608	-89.62125156				Too Deep																										
356	45.9041568	-89.62125499				Too Deep																										
357	45.9036528	-89.62125842	8	S	P		1	1	1	1																						
358	45.9192749	-89.62042998	13		R		1	1																								
359	45.9187709	-89.62043342				Too Deep																										
360	45.9182669	-89.62043685				Too Deep																										
361	45.9177629	-89.62044029				Too Deep																										
362	45.9172588	-89.62044373				Too Deep																										
363	45.9167548	-89.62044716				Too Deep																										
364	45.9162508	-89.6204506				Too Deep																										
365	45.9157468	-89.62045403				Too Deep																										
366	45.9152428	-89.62045747				Too Deep																										
367	45.9147388	-89.62046091				Too Deep																										
368	45.9142348	-89.62046434				Too Deep																										
369	45.9137307	-89.62046778				Too Deep																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
370	45.9132267	-89.62047121				Too Deep																										
371	45.9127227	-89.62047465				Too Deep																										
372	45.9122187	-89.62047808				Too Deep																										
373	45.9117147	-89.62048152				Too Deep																										
374	45.9112107	-89.62048496				Too Deep																										
375	45.9107066	-89.62048839				Too Deep																										
376	45.9102026	-89.62049183				Too Deep																										
377	45.9096986	-89.62049526				Too Deep																										
378	45.9091946	-89.6204987				Too Deep																										
379	45.9086906	-89.62050213				Too Deep																										
380	45.9081866	-89.62050557				Too Deep																										
381	45.9076825	-89.620509				Too Deep																										
382	45.9071785	-89.62051243				Too Deep																										
383	45.9066745	-89.62051587				Too Deep																										
384	45.9061705	-89.6205193				Too Deep																										
385	45.9056665	-89.62052274				Too Deep																										
386	45.9051625	-89.62052617				Too Deep																										
387	45.9046584	-89.62052961	6	R	P	No Vegetation																										
388	45.9197765	-89.61970439	6	R	P		1	1	1																							
389	45.9192725	-89.61970783				Too Deep																										
390	45.9187685	-89.61971128				Too Deep																										
391	45.9182645	-89.61971472				Too Deep																										
392	45.9177605	-89.61971816				Too Deep																										
393	45.9172564	-89.61972161				Too Deep																										
394	45.9167524	-89.61972505				Too Deep																										
395	45.9162484	-89.61972849				Too Deep																										
396	45.9157444	-89.61973193				Too Deep																										
397	45.9152404	-89.61973538				Too Deep																										
398	45.9147364	-89.61973882				Too Deep																										
399	45.9142324	-89.61974226				Too Deep																										
400	45.9137283	-89.6197457				Too Deep																										
401	45.9132243	-89.61974915				Too Deep																										
402	45.9127203	-89.61975259				Too Deep																										
403	45.9122163	-89.61975603				Too Deep																										
404	45.9117123	-89.61975947				Too Deep																										
405	45.9112083	-89.61976291				Too Deep																										
406	45.9107042	-89.61976635				Too Deep																										
407	45.9102002	-89.6197698				Too Deep																										
408	45.9096962	-89.61977324				Too Deep																										
409	45.9091922	-89.61977668				Too Deep																										
410	45.9086882	-89.61978012				Too Deep																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
411	45.9081842	-89.61978356				Too Deep																										
412	45.9076801	-89.619787				Too Deep																										
413	45.9071761	-89.61979044				Too Deep																										
414	45.9066721	-89.61979389				Too Deep																										
415	45.9061681	-89.61979733	11		R	No Vegetation																										
416	45.9056641	-89.61980077	5	R	P	No Vegetation																										
417	45.9197741	-89.61898224	10		R	No Vegetation																										
418	45.9192701	-89.61898569				Too Deep																										
419	45.9187661	-89.61898914				Too Deep																										
420	45.9182621	-89.61899259				Too Deep																										
421	45.9177581	-89.61899604				Too Deep																										
422	45.917254	-89.61899948				Too Deep																										
423	45.91675	-89.61900293				Too Deep																										
424	45.916246	-89.61900638				Too Deep																										
425	45.915742	-89.61900983				Too Deep																										
426	45.915238	-89.61901328				Too Deep																										
427	45.914734	-89.61901673				Too Deep																										
428	45.9142299	-89.61902018				Too Deep																										
429	45.9137259	-89.61902363				Too Deep																										
430	45.9132219	-89.61902708				Too Deep																										
431	45.9127179	-89.61903053				Too Deep																										
432	45.9122139	-89.61903397				Too Deep																										
433	45.9117099	-89.61903742				Too Deep																										
434	45.9112059	-89.61904087				Too Deep																										
435	45.9107018	-89.61904432				Too Deep																										
436	45.9101978	-89.61904777				Too Deep																										
437	45.9096938	-89.61905122				Too Deep																										
438	45.9091898	-89.61905466				Too Deep																										
439	45.9086858	-89.61905811				Too Deep																										
440	45.9081818	-89.61906156				Too Deep																										
441	45.9076777	-89.61906501				Too Deep																										
442	45.9071737	-89.61906845				Too Deep																										
443	45.9066697	-89.6190719				Too Deep																										
444	45.9061657	-89.61907535	4	S	P	No Vegetation																										
445	45.9202757	-89.61825663	8	R	P		1				1																					
446	45.9197717	-89.61826008				Too Deep																										
447	45.9192677	-89.61826354				Too Deep																										
448	45.9187637	-89.618267				Too Deep																										
449	45.9182597	-89.61827045				Too Deep																										
450	45.9177556	-89.61827391				Too Deep																										
451	45.9172516	-89.61827736				Too Deep																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
452	45.9167476	-89.61828082				Too Deep																										
453	45.9162436	-89.61828428				Too Deep																										
454	45.9157396	-89.61828773				Too Deep																										
455	45.9152356	-89.61829119				Too Deep																										
456	45.9147316	-89.61829464				Too Deep																										
457	45.9142275	-89.6182981				Too Deep																										
458	45.9137235	-89.61830155				Too Deep																										
459	45.9132195	-89.61830501				Too Deep																										
460	45.9127155	-89.61830846				Too Deep																										
461	45.9122115	-89.61831192				Too Deep																										
462	45.9117075	-89.61831537				Too Deep																										
463	45.9112034	-89.61831883				Too Deep																										
464	45.9106994	-89.61832228				Too Deep																										
465	45.9101954	-89.61832574				Too Deep																										
466	45.9096914	-89.61832919				Too Deep																										
467	45.9091874	-89.61833265				Too Deep																										
468	45.9086834	-89.6183361				Too Deep																										
469	45.9081793	-89.61833956				Too Deep																										
470	45.9076753	-89.61834301				Too Deep																										
471	45.9071713	-89.61834646	12		R		1	1																								
472	45.9066673	-89.61834992	5	S	P		1			1																						
473	45.9202733	-89.61753447	7	R	P		1			1																						
474	45.9197693	-89.61753793				Too Deep																										
475	45.9192653	-89.61754139				Too Deep																										
476	45.9187613	-89.61754486				Too Deep																										
477	45.9182572	-89.61754832				Too Deep																										
478	45.9177532	-89.61755178				Too Deep																										
479	45.9172492	-89.61755524				Too Deep																										
480	45.9167452	-89.61755871				Too Deep																										
481	45.9162412	-89.61756217				Too Deep																										
482	45.9157372	-89.61756563				Too Deep																										
483	45.9152332	-89.61756909				Too Deep																										
484	45.9147291	-89.61757255				Too Deep																										
485	45.9142251	-89.61757602				Too Deep																										
486	45.9137211	-89.61757948				Too Deep																										
487	45.9132171	-89.61758294				Too Deep																										
488	45.9127131	-89.6175864				Too Deep																										
489	45.9122091	-89.61758986				Too Deep																										
490	45.911705	-89.61759333				Too Deep																										
491	45.911201	-89.61759679				Too Deep																										
492	45.910697	-89.61760025				Too Deep																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
493	45.910193	-89.61760371				Too Deep																										
494	45.909689	-89.61760717				Too Deep																										
495	45.909185	-89.61761063				Too Deep																										
496	45.908681	-89.61761409				Too Deep																										
497	45.9081769	-89.61761755				Too Deep																										
498	45.9076729	-89.61762101				Too Deep																										
499	45.9071689	-89.61762448	6	R	P	No Vegetation																										
500	45.9202709	-89.61681231				Too Deep																										
501	45.9197669	-89.61681578				Too Deep																										
502	45.9192629	-89.61681925				Too Deep																										
503	45.9187588	-89.61682272				Too Deep																										
504	45.9182548	-89.61682618				Too Deep																										
505	45.9177508	-89.61682965				Too Deep																										
506	45.9172468	-89.61683312				Too Deep																										
507	45.9167428	-89.61683659				Too Deep																										
508	45.9162388	-89.61684006				Too Deep																										
509	45.9157348	-89.61684353				Too Deep																										
510	45.9152307	-89.616847				Too Deep																										
511	45.9147267	-89.61685047				Too Deep																										
512	45.9142227	-89.61685394				Too Deep																										
513	45.9137187	-89.6168574				Too Deep																										
514	45.9132147	-89.61686087				Too Deep																										
515	45.9127107	-89.61686434				Too Deep																										
516	45.9122066	-89.61686781				Too Deep																										
517	45.9117026	-89.61687128				Too Deep																										
518	45.9111986	-89.61687474				Too Deep																										
519	45.9106946	-89.61687821				Too Deep																										
520	45.9101906	-89.61688168				Too Deep																										
521	45.9096866	-89.61688515				Too Deep																										
522	45.9091825	-89.61688862				Too Deep																										
523	45.9086785	-89.61689208				Too Deep																										
524	45.9081745	-89.61689555				Too Deep																										
525	45.9076705	-89.61689902				Too Deep																										
526	45.9071665	-89.61690249				Too Deep																										
527	45.9066625	-89.61690595	2	R	P	No Vegetation																										
528	45.9202685	-89.61609015	14		R	No Vegetation																										
529	45.9197645	-89.61609362				Too Deep																										
530	45.9192604	-89.6160971				Too Deep																										
531	45.9187564	-89.61610058				Too Deep																										
532	45.9182524	-89.61610405				Too Deep																										
533	45.9177484	-89.61610753				Too Deep																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
534	45.9172444	-89.616111				Too Deep																										
535	45.9167404	-89.61611448				Too Deep																										
536	45.9162363	-89.61611795				Too Deep																										
537	45.9157323	-89.61612143				Too Deep																										
538	45.9152283	-89.6161249				Too Deep																										
539	45.9147243	-89.61612838				Too Deep																										
540	45.9142203	-89.61613185				Too Deep																										
541	45.9137163	-89.61613533	5	S	P		1			1																	1					
542	45.9132123	-89.6161388				Too Deep																										
543	45.9127082	-89.61614228				Too Deep																										
544	45.9122042	-89.61614575				Too Deep																										
545	45.9117002	-89.61614923				Too Deep																										
546	45.9111962	-89.6161527				Too Deep																										
547	45.9106922	-89.61615618				Too Deep																										
548	45.9101882	-89.61615965				Too Deep																										
549	45.9096841	-89.61616313				Too Deep																										
550	45.9091801	-89.6161666				Too Deep																										
551	45.9086761	-89.61617007				Too Deep																										
552	45.9081721	-89.61617355				Too Deep																										
553	45.9076681	-89.61617702				Too Deep																										
554	45.9071641	-89.6161805				Too Deep																										
555	45.90666	-89.61618397	6	R	P	No Vegetation																										
556	45.920266	-89.61536799	13		R	No Vegetation																										
557	45.919762	-89.61537147				Too Deep																										
558	45.919258	-89.61537495				Too Deep																										
559	45.918754	-89.61537844				Too Deep																										
560	45.91825	-89.61538192				Too Deep																										
561	45.917746	-89.6153854				Too Deep																										
562	45.9172419	-89.61538888				Too Deep																										
563	45.9167379	-89.61539236				Too Deep																										
564	45.9162339	-89.61539585				Too Deep																										
565	45.9157299	-89.61539933				Too Deep																										
566	45.9152259	-89.61540281				Too Deep																										
567	45.9147219	-89.61540629				Too Deep																										
568	45.9142179	-89.61540977	3	R	P	No Vegetation																										
569	45.9137138	-89.61541326	3	S	P	No Vegetation																										
570	45.9132098	-89.61541674	9	R	P	No Vegetation																										
571	45.9127058	-89.61542022				Too Deep																										
572	45.9122018	-89.6154237				Too Deep																										
573	45.9116978	-89.61542718				Too Deep																										
574	45.9111938	-89.61543066				Too Deep																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
575	45.9106897	-89.61543414				Too Deep																										
576	45.9101857	-89.61543762				Too Deep																										
577	45.9096817	-89.6154411				Too Deep																										
578	45.9091777	-89.61544458				Too Deep																										
579	45.9086737	-89.61544807	7	R	P	No Vegetation																										
580	45.9081697	-89.61545155	5	R	P	No Vegetation																										
581	45.9076657	-89.61545503	5	R	P	No Vegetation																										
582	45.9071616	-89.61545851	3	R	P	No Vegetation																										
583	45.9066576	-89.61546199	3	S	P		1													1										1	1	
584	45.9202636	-89.61464583	12		R		1	1																								
585	45.9197596	-89.61464932				Too Deep																										
586	45.9192556	-89.61465281	6	R	P	No Vegetation																										
587	45.9187516	-89.6146563	10		R	No Vegetation																										
588	45.9182475	-89.61465979				Too Deep																										
589	45.9177435	-89.61466327				Too Deep																										
590	45.9172395	-89.61466676				Fisherman																										
591	45.9167355	-89.61467025				Too Deep																										
592	45.9162315	-89.61467374	10		R	No Vegetation																										
593	45.9157275	-89.61467723	11		R	No Vegetation																										
594	45.9152235	-89.61468072				Too Deep																										
595	45.9147194	-89.6146842	11		R	No Vegetation																										
596	45.9132074	-89.61469467	4	R	P	No Vegetation																										
597	45.9127034	-89.61469816				Too Deep																										
598	45.9121994	-89.61470164				Too Deep																										
599	45.9116953	-89.61470513	12		R	No Vegetation																										
600	45.9111913	-89.61470862				Too Deep																										
601	45.9106873	-89.61471211				Too Deep																										
602	45.9101833	-89.61471559	11		R	No Vegetation																										
603	45.9096793	-89.61471908				Too Deep																										
604	45.9091753	-89.61472257	9	R	P	No Vegetation																										
605	45.9086713	-89.61472606	5	S	P	No Vegetation																										
606	45.9061512	-89.61474349	3	M	P		2	2		1		1											1									
607	45.9197572	-89.61392717	13		R	No Vegetation																										
608	45.9192531	-89.61393066	13		R	No Vegetation																										
609	45.9187491	-89.61393416	9	R	P	No Vegetation																										
610	45.9182451	-89.61393765	3	R	P	No Vegetation																										
611	45.9106849	-89.61399007	7	R	P	No Vegetation																										
612	45.9101809	-89.61399357	12		R	No Vegetation																										
613	45.9096768	-89.61399706	9	S	P	No Vegetation																										
614	45.9061487	-89.61402151	4	M	P		3	2	1								1												1			
615	45.9192507	-89.61320852	11		R	No Vegetation																										

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
616	45.9187467	-89.61321202	11		R	No Vegetation																										
617	45.9101784	-89.61327154	6	S	P		2	1	1		1																					
618	45.9128693	-89.61338162	12		R	No Vegetation																										
619	45.9123653	-89.61338512				Too Deep																										
620	45.9118613	-89.61338862	9	M	P	No Vegetation																										
621	45.9113573	-89.61339211	6	M	P		3	2		1																						
622	45.9133709	-89.61265605	5	S	P		1	1		1	1																					
623	45.9128669	-89.61265955	9	M	P	No Vegetation																										
624	45.9123629	-89.61266306	8	M	P		1	1																								
625	45.9118589	-89.61266657	7	M	P		1	1	1																							
626	45.9113548	-89.61267007	8	M	P	No Vegetation																										
627	45.9108508	-89.61267358	6	M	P		1	1			1																					
628	45.9103468	-89.61267708	3	M	P		2	1		1	1	1					1															
629	45.9133684	-89.61193398	6	R	P		1	1	1																							
630	45.9128644	-89.61193749	8	M	P	No Vegetation																										
631	45.9123604	-89.611941	8	M	P	No Vegetation																										
632	45.9118564	-89.61194452	7	M	P		1	1																								
633	45.9113524	-89.61194803	6	M	P	No Vegetation																										
634	45.9108484	-89.61195154	6	M	P		1	1	1																							
635	45.9103444	-89.61195505	7	M	P	No Vegetation																										
636	45.9098403	-89.61195857	6	S	P		2	2	1		1	1																				
637	45.9093363	-89.61196208	4	S	P		1	1		1																						
638	45.9088323	-89.61196559	4	M	P		1	1	1	1																						
639	45.912862	-89.61121543	7	M	P		1	1	1																							
640	45.912358	-89.61121895	8	M	P		1	1																								
641	45.9118539	-89.61122247	7	M	P		1	1	1		1																					
642	45.9113499	-89.61122598	6	M	P		2	2	1																							
643	45.9108459	-89.6112295	7	M	P		1	1	1																							
644	45.9103419	-89.61123302	7	M	P		2	1	1		1																					
645	45.9098379	-89.61123654	7	M	P		1	1	1																							
646	45.9093339	-89.61124006	6	M	P		1	1	1																							
647	45.9088299	-89.61124358	6	M	P		1	1	1																							
648	45.9083258	-89.6112471	5	M	P		1	1	1																							
649	45.9078218	-89.61125062	4	M	P		1	1	1	1	1	1		1		1																
650	45.9128595	-89.61049336	4	S	P		1	1	1		1						1															
651	45.9123555	-89.61049689	7	M	P		2	2	1																							
652	45.9118515	-89.61050042	7	M	P		2	1	1		1																					
653	45.9113475	-89.61050394	7	M	P		1	1	1		1																					
654	45.9108435	-89.61050747	7	M	P		1	1			1																					
655	45.9103394	-89.61051099	7	M	P		1	1	1	1																						
656	45.9098354	-89.61051452	7	M	P		1	1	1																							

sampling point	Latitude (need electronic copy of site locations)	Longitude (need electronic copy of site locations)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)?	comments	Total Rake Fullness	Ceratophyllum demersum	Potamogeton zosteriformis	Elodea canadensis	Myriophyllum sibiricum	Nymphaea odorata	Potamogeton praelongus	Lemna turionifera	Spirodela polyrhiza	Nuphar variegata	Vallisneria americana	Najas flexilis	Nitella sp.	Calla palustris	Chara sp.	Potamogeton amplifolius	Potamogeton richardsonii	Ranunculus aquatilis	Lemna trisulca	Potamogeton foliosus	Potamogeton friesii	Potamogeton pusillus	Schoenoplectus tabernaemontani	Sparganium eurycarpum	Typha latifolia	Utricularia vulgaris
657	45.9093314	-89.61051804	7	M	P		1	1	1																							
658	45.9088274	-89.61052157	6	M	P		1	1																								
659	45.9083234	-89.61052509	6	M	P		1	1	1	1																						
660	45.9078194	-89.61052862	4	M	P		2	1		1													1									
661	45.9073153	-89.61053214	1	M	P		1	1	1	1		1		1	1					1												
662	45.912353	-89.60977483	5	M	P		1	1	1																							
663	45.911849	-89.60977837	6	M	P		1	1	1																							
664	45.911345	-89.6097819	6	M	P		2	1	1				1																			
665	45.910841	-89.60978543	6	M	P		2	2	1	1																						
666	45.910337	-89.60978896	6	M	P		1	1	1				1																			
667	45.909833	-89.60979249	6	M	P		1	1		1			1																			
668	45.9093289	-89.60979603	6	M	P		2	1	1	1			1																			
669	45.9088249	-89.60979956	6	M	P		1	1																								
670	45.9083209	-89.60980309	5	M	P		1	1		1																						
671	45.9078169	-89.60980662	3	M	P		1	1	1	1	1	1																				
672	45.9128546	-89.60904924	5	M	P		3	2	1	1	1	1	1																			
673	45.9123506	-89.60905278	7	M	P		2	1	1				1																			
674	45.9118466	-89.60905632	6	M	P		1	1	1		1																					
675	45.9113425	-89.60905985	1	R	P		1	1																								
676	45.9103345	-89.60906693	3	M	P		3	3	1	1	1	1																				
677	45.9098305	-89.60907047	5	M	P		1	1	1	1																						
678	45.9093265	-89.60907401	5	M	P		2	1		1																						
679	45.9088225	-89.60907755	5	M	P		3	2		1																						
680	45.9083184	-89.60908109	3	M	P		3	1	2	1	1																					
681	45.9128521	-89.60832718	5	M	P		1	1	1	1																						
682	45.9123481	-89.60833072	6	M	P		1	1	1		1		1																			
683	45.9118441	-89.60833427	6	M	P		1	1	1	1	1																					
684	45.909828	-89.60834845	4	M	P		1	1		1		1	1																			
685	45.909324	-89.60835199	5	M	P		1	1		1																						
686	45.90882	-89.60835554	5	M	P		1	1	1	1																						
687	45.9133537	-89.60760156	2	M	P		1	1	1	1	1	1		1	1																	
688	45.9128496	-89.60760511	3	M	P		1	1	1	1		1																				
689	45.9123456	-89.60760867	3	M	P		3	2	1	1		1	1																			
690	45.9093215	-89.60762998	2	M	P		1	1		1		1		1	1																	
691	45.9128472	-89.60688305	2	M	P		1	1	1	1		1		1	1																	
692	45.9123431	-89.60688661	3	M	P		1	1	1		1	1																				

F

APPENDIX F

Arbor Vitae Lakes Sediment Core Report, WDNR 2012.

RESULTS OF SEDIMENT CORES TAKEN FROM BIG AND LITTLE ARBOR VITAE LAKES, VILAS COUNTY, WISCONSIN

Paul Garrison Wisconsin Department of Natural Resources
October 2012

Aquatic organisms are good indicators of a lake's water quality because they are in direct contact with the water and are strongly affected by the chemical composition of their surroundings. Most indicator groups grow rapidly and are short lived so the community composition responds rapidly to changing environmental conditions. One of the most useful organisms for paleolimnological analysis are diatoms. These are a type of algae which possess siliceous cell walls, which enables them to be highly resistant to degradation and are usually abundant, diverse, and well-preserved in sediments. They are especially useful, as they are ecologically diverse. Diatom species have unique features as shown in Figure 1, which enable

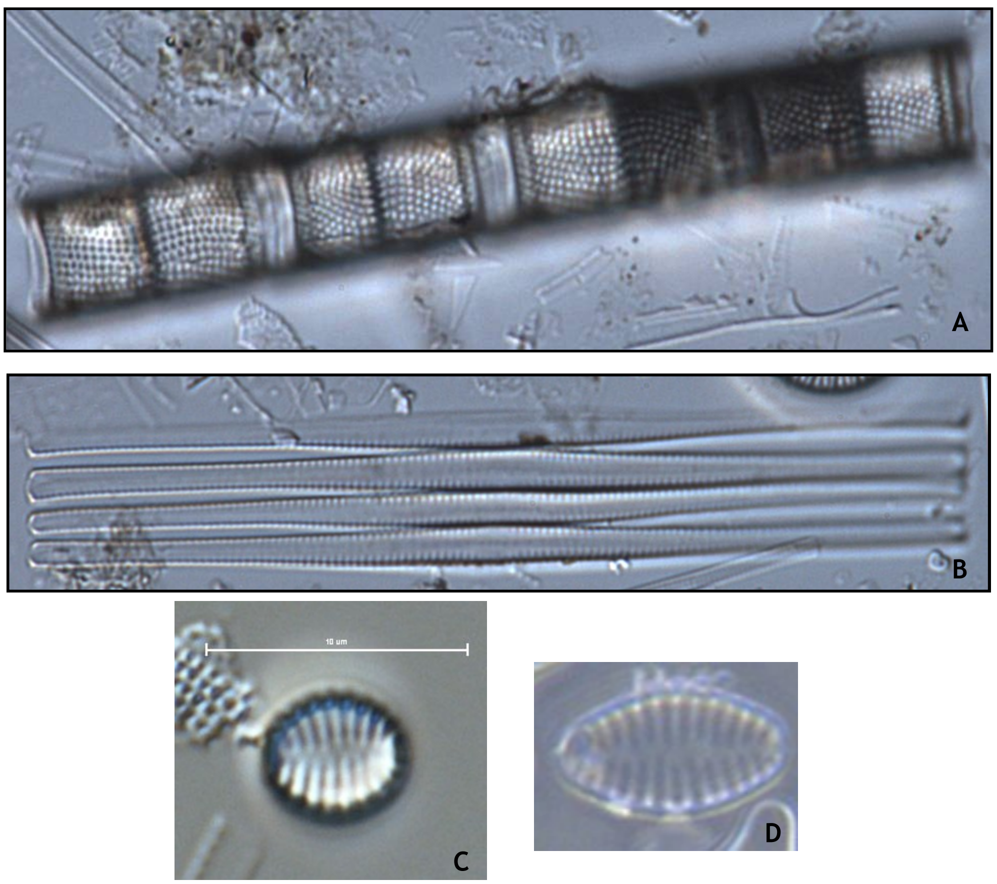

Figure 1. Photomicrographs of the diatoms commonly found in the study lakes. The top two diatoms, *Aulacoseira am*bigua (A), and *Fragilaria crotonensis* (B) are found in the open water environments while the bottom two diatoms are part of the benthic *Fragilaria* (C and D). The latter two diatoms are commonly found attached to substrates such as macrophytes. The top diatom, *A. ambigua*, was a common part of the diatom community in top sample of the lakes while the benthic *Fragilaria* were more common in the bottom core samples.

them to be readily identified. Certain taxa are usually found under nutrient poor conditions while others are more common under elevated nutrient levels. Some species float in the open water areas while others grow attached to objects such as aquatic plants or the lake bottom.

By determining changes in the diatom community it is possible to determine water quality changes that have occurred in the lake. The diatom community provides information about changes in nutrient concentrations, water clarity, and pH conditions as well as alterations in the aquatic plant (macrophyte) community.

On 19 September 2012 sediment cores were collected near the deep areas of Big Arbor Vitae (N45.93201° W89.65263°) and Little Arbor Vitae (N45.91312° W89.61984°) lakes using a gravity corer. The water depth in Big Arbor Vitae was 28 feet and 21 feet in Little Arbor Vitae. The length of the Big Arbor Vitae core was 46.5 cm and the length of the Little Arbor Vitae core was 45 cm. It is assumed that the upper sample represents present conditions while the deeper sample is indicative of water quality conditions at least 100 years ago. In the Big Arbor Vitae core the upper 20 cm was brown in color with scattered black particles while the bottom half of the core was a uniform brown color. In the Little Arbor Vitae core, the upper 19 cm was dark brown in color while the bottom portion of the core was medium brown in color.

Results

In both Big and Little Arbor Vitae lakes the diatom community in the bottom samples (bottom portion of the sediment cores) was dominated by benthic diatoms (Figures 2 and 3). The dominant taxa were of the genus *Fragilaria*, which have recently been split into various other genera. The dominant species were *Staurosira construens* and *Staurosirella pinnata*. Both of these taxa are common in many lakes. These are diatoms which grow either on substrates such as macrophytes or on the sediment.

The diatom communities were much different in the top samples. The community was dominated by planktonic diatoms (Figures 2 and 3) which are taxa that float in the open water. The most common species were *Aulacoseira granulata* and *Fragilaria crotonensis*. The latter species is common in lakes with moderate phosphorus levels while A. granulata is common in wind swept lakes with elevated phosphorus levels. The shift from benthic to planktonic species is also an indication of increased phosphorus levels. With higher phosphorus concentrations the decreasing water clarity reduces the light available for diatoms that grow on substrates and favors those diatoms that float near the surface.

In many lakes in northern and north central WI there has been an increase in submerged aquatic vegetation (SAV) and only a small increase in phosphorus in recent years. This does not appear to be the case in the Arbor Vitae lakes. The diatom community indicates that in both of these lakes the current phosphorus levels are higher than they were historically.

Diatom assemblages historically have been used as indicators of nutrient changes in a qualitative way. In recent years, ecologically relevant statistical methods have been developed to infer environmental conditions from diatom assemblages. These methods are based on multivariate ordination and weighted averaging regression and calibration. Ecological preferences of diatom species are determined by relating modern limnological variables to sur-

BIG ARBOR VITAE LAKE

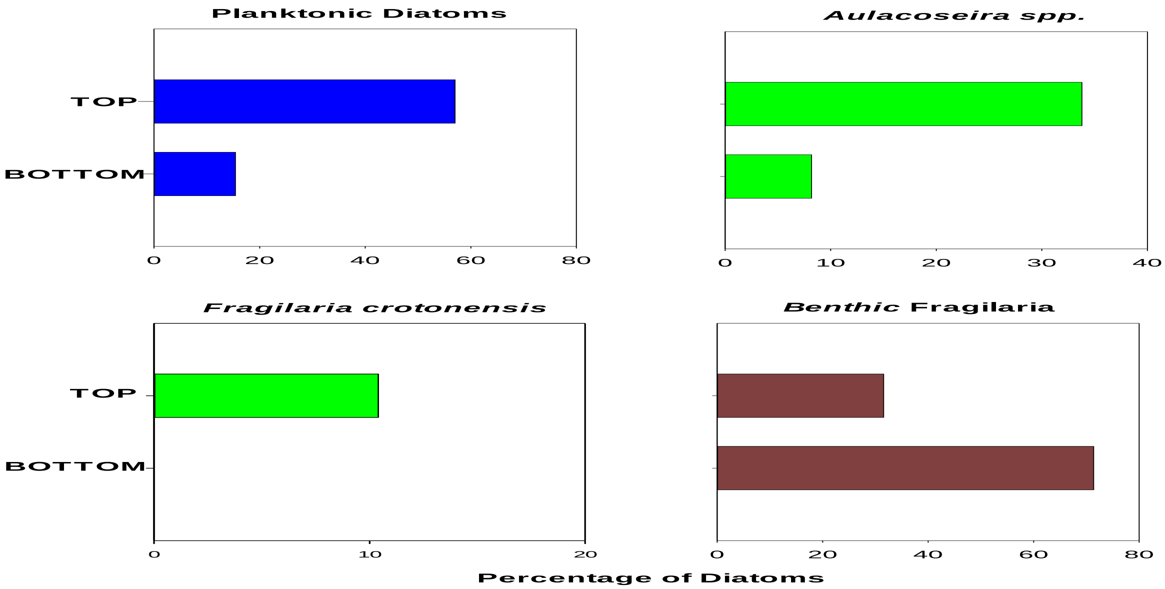

Figure 2. Changes in the abundance of some important diatoms found in the Big Arbor Vitae Lake sediment core. The dominant diatoms at the present time are those that float in the open water. The increase in planktonic diatoms in the top sample compared with the bottom sample, indicates higher phosphorus levels in the top sample.

LITTLE ARBOR VITAE LAKE

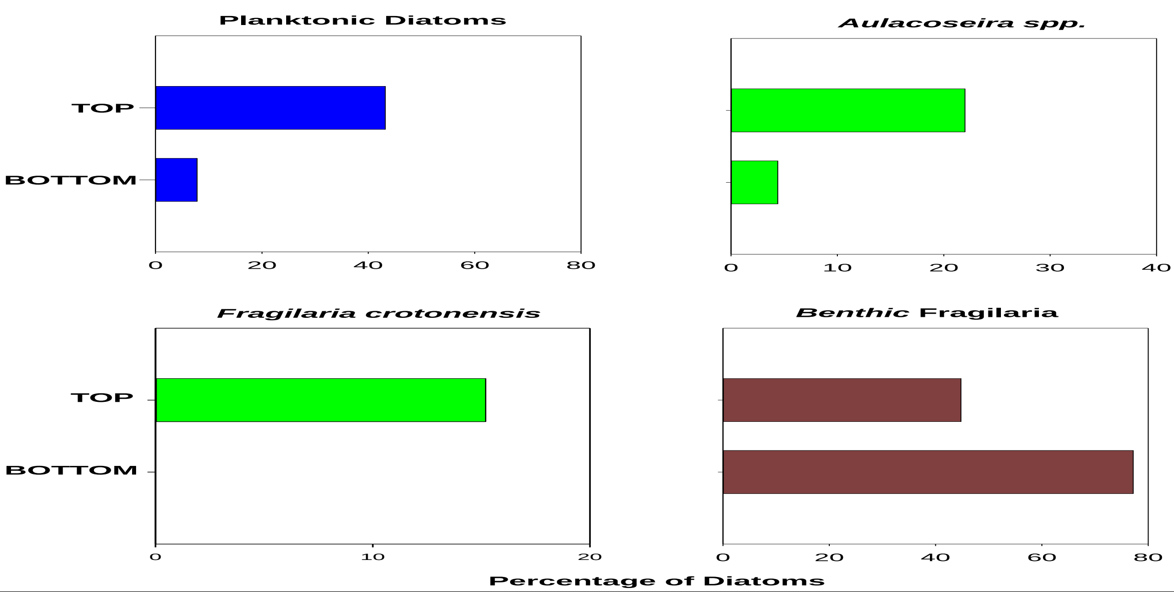

Figure 3. Changes in the abundance of some important diatoms found in the Little Arbor Vitae Lake sediment core. The dominant diatoms at the present time are those that float in the open water. The increase in planktonic diatoms in the top sample compared with the bottom sample, indicates higher phosphorus levels in the top sample.

face sediment diatom assemblages. The species-environment relationships are then used to infer environmental conditions from fossil diatom assemblages found in the sediment core.

Such a model was applied to the diatom communities in the Arbor Vitae lakes. In both lakes the present day phosphorus concentration is significantly higher than it was historically (Table 1). The predicted value for Little Arbor Vitae is similar to the mean summer phosphorus level measured in 2010. Phosphorus concentrations was 30 μg L^{-1} until mid-summer and then increased to 50-60 μg L^{-1} later in the summer. The model may be slightly over estimating the historical phosphorus concentration, especially in Little Arbor Vitae Lake because the dominate taxa were benthic *Fragilaria*. These diatoms have a wide tolerance of phosphorus concentrations. Since the model was developed using recently deposited diatom communities there were few lakes that likely had the lower phosphorus concentrations that were more common prior to European settlement.

Table. 1. Mean summer phosphorus concentrations in the Arbor Vitae lakes (μg L^{-1}). The observed value represents the last 5 years in White Ash Lake and 2010 in North White Ash Lake. The concentration for the top and bottom samples were estimated from the diatom community.

	Top	Bottom
Big Arbor Vitae	57	29
Little Arbor Vitae	44	34

In summary, the diatom community indicates that the present day phosphorus concentrations experienced in the Arbor Vitae lakes is significantly higher than it was prior to the arrival of European settlers. Historically the phosphorus concentration was around 30 μg L^{-1} in both lakes. Most lakes in this region where the diatom community has been examined in sediment cores do not show this amount of phosphorus increase. This amount of phosphorus increase is more common in southern and central Wisconsin lakes with highly altered landuse in the watershed.

BIG ARBOR VITAE LAKE					
Vilas County				Aulacoseira spp.	0.338
				Small Fragilaria	0.200
Top (0-2 cm)				Benthic Fragilaria	0.316
				Cyclotella spp.	0.010
	COUNT TOTAL			Stephanodiscus spp.	0.066
	Number	Prop.			
TAXA					
Achnanthes oblongella Østrup	5	0.010		Species Richness	46
Achnanthidium exiguum (Grunow) Czarnecki	1	0.002		Diversity	2.72
Amphora copulata (kützing) Schoeman et Archibald	2	0.004			
Amphora pediculus (Kützing) Grunow	1	0.002			
Asterionella formosa Hassal	15	0.030			
Aulacoseira ambigua (Grunow) Simonsen	74	0.148			
Aulacoseira granulata (Ehrenberg) Simonsen	88	0.176			
Aulacoseira italica (Ehrenberg) Simonsen	3	0.006			
Aulacoseira sp. 1?	4	0.008			
Caloneis silicula (Ehrenberg) Cleve	4	0.008			
Cocconeis placentula var. lineata (Ehrenberg) Van Heurck	2	0.004			
Cocconeis placentula var. placentula Ehrenberg	3	0.006			
Cocconeis pseudothumensis Reichardt	1	0.002			
Discotella stelligera (Hustedt) Houk et Klee	5	0.010			
Encyonema spp.	1	0.002			
Fragilaria capucina var. mesolepta Rabenhorst	1	0.002			
Fragilaria crotonensis Kitton	22	0.044			
Fragilaria crotonensis var. oregona Sovereign	30	0.060			
Fragilaria vaucheriae (Kützing) Petersen	3	0.006			
Geissleria paludosa (Hustedt) Lange-Bertalot et Metzeltin	1	0.002			
Gomphonema insigne Gregory	1	0.002			
Gomphonema spp.	2	0.004			
Navicula cincta (Ehrenberg) Ralfs	2	0.004			
Navicula harderii Hustedt	2	0.004			
Navicula obdurata Hohn et Hellermann	2	0.004			
Navicula pseudoventralis Hustedt	4	0.008			
Nitzschia amphibia Grunow	1	0.002			
Nitzschia dissipata var. media (Hantzsch) Grunow	1	0.002			
Nitzschia spp.	2	0.004			
Pinnularia subgibba Krammer	1	0.002			
Planothidium frequentissimum (Lange-Bertalot) Lange-Bertalot	3	0.006			
Planothidium joursacense (Héribaud) Lange-Bertalot	1	0.002			
Pseudostaurosira brevistriata (Grunow) Williams et Round	20	0.040			
Sellaphora laevissima (Kützing) Mann	2	0.004			
Sellaphora pupula (Kützing) Meresckowsky	2	0.004			
Staurosira construens Ehrenberg	32	0.064			
Staurosira construens var. venter (Ehrenberg) Hamilton	7	0.014			
Staurosirella leptostauron var. dubia (Grunow) Edlund	3	0.006			
Staurosirella martyi (Héribaud) Morales et Manoylov	2	0.004			
Staurosirella pinnata (Ehrenberg) Williams et Round	93	0.186			
Staurosirella pinnata var. lancettula (Schumann) Siver et Hamilton	1	0.002			
Stephanodiscus minutulus (Kützing) Cleve et Möller	3	0.006			
Stephanodiscus niagarae Ehrenberg	30	0.060			
Synedra acus Kützing	1	0.002			
Synedra acus var. angustissima (Grunow) Van Heurck	6	0.012			
Tabellaria flocculosa (strain IIIp) sensu Koppen	5	0.010			
unknown pennate	5	0.010			
TOTAL	500	1.000			
Planktonic diatoms		0.570			
Nonplanktonic diatoms		0.430			

BIG ARBOR VITAE LAKE					
Vilas County				Aulacoseira spp.	0.082
				Small Fragilaria	0.428
Bottom (42-44 cm)				Benthic Fragilaria	0.714
				Cyclotella spp.	0.000
	COUNT TOTAL			Stephanodiscus spp.	0.072
	Number	Prop.			
TAXA					
Achnanthes curtissima Carter	2	0.004		Species Richness	30
Achnanthes oblongella Østrup	1	0.002		Diversity	1.94
Achnanthidium spp	1	0.002			
Amphora copulata (kützing) Schoeman et Archibald	3	0.006			
Aulacoseira ambigua (Grunow) Simonsen	1	0.002			
Aulacoseira granulata (Ehrenberg) Simonsen	38	0.076			
Aulacoseira sp. 1?	2	0.004			
Cavinula scutelloides (Smith) Lange-Bertalot et Metzeltin	3	0.006			
Cocconeis placentula var. placentula Ehrenberg	1	0.002			
Encyonema spp.	3	0.006			
Fragilaria vaucheriae (Kützing) Petersen	3	0.006			
Gomphonema spp.	4	0.008			
Karayevia clevei (Grunow) Bukhtiyarova	2	0.004			
Navicula pseudoventralis Hustedt	6	0.012			
Navicula spp.	1	0.002			
Navicula vulpina Kützing	3	0.006			
Opephora olsenii Möller	12	0.024			
Planothidium frequentissimum (Lange-Bertalot) Lange-Bertalot	1	0.002			
Planothidium joursacense (Héribaud) Lange-Bertalot	10	0.020			
Pseudostaurosira brevistriata (Grunow) Williams et Round	7	0.014			
Reimeria sinuata (Gregory) Kociolek et Stoermer	1	0.002			
Sellaphora sp. 1?	1	0.002			
Staurosira construens Ehrenberg	114	0.228			
Staurosira construens var. venter (Ehrenberg) Hamilton	2	0.004			
Staurosirella leptostauron var. dubia (Grunow) Edlund	11	0.022			
Staurosirella martyi (Héribaud) Morales et Manoylov	1	0.002			
Staurosirella pinnata (Ehrenberg) Williams et Round	212	0.424			
Staurosirella pinnata var. lancettula (Schumann) Siver et Hamilton	10	0.020			
Stephanodiscus minutulus (Kützing) Cleve et Möller	3	0.006			
Stephanodiscus niagarae Ehrenberg	33	0.066			
unknown pennate	8	0.016			
TOTAL	500	1.000			
Planktonic diatoms		0.154			
Nonplanktonic diatoms		0.846			

LITTLE ARBOR VITAE LAKE					
Vilas County				Aulacoseira spp.	0.220
				Small Fragilaria	0.114
Top (0-2 cm)				Benthic Fragilaria	0.448
				Cyclotella spp.	0.000
	COUNT TOTAL			Stephanodiscus spp.	0.058
	Number	Prop.			
TAXA					
Achnanthidium jackii Rabhenhorst	2	0.004		Species Richness	36
Amphora pediculus (Kützing) Grunow	2	0.004		Diversity	2.60
Asterionella formosa Hassal	1	0.002			
Aulacoseira granulata (Ehrenberg) Simonsen	64	0.128			
Aulacoseira italica (Ehrenberg) Simonsen	46	0.092			
Cavinula scutelloides (Smith) Lange-Bertalot et Metzeltin	1	0.002			
Cocconeis placentula var. lineata (Ehrenberg) Van Heurck	1	0.002			
Cymbella cymbiformis Agardh	2	0.004			
Encyonema minutum (Hilse) Mann	3	0.006			
Encyonema spp.	1	0.002			
Epithemia turgida (Ehrenberg) Kützing	1	0.002			
Fragilaria capucina var. mesolepta Rabenhorst	19	0.038			
Fragilaria crotonensis Kitton	33	0.066			
Fragilaria crotonensis var. oregona Sovereign	43	0.086			
Fragilaria tenera (Smith) Lange-Bertalot	1	0.002			
Gomphonema acuminatum Ehrenberg	1	0.002			
Gomphonema minutum (Agardh) Agardh	1	0.002			
Navicula spp.	1	0.002			
Neidium spp.	1	0.002			
Nitzschia inconspicua Grunow	1	0.002			
Nitzschia spp.	3	0.006			
Opephora olsenii Möller	1	0.002			
Pinnularia spp.	1	0.002			
Placoneis gastrum (Ehrenberg) Mereschkowsky	1	0.002			
Planothidium haynaldii (Schaarschmidt) Lange-Bertalot	2	0.004			
Planothidium joursacense (Héribaud) Lange-Bertalot	2	0.004			
Planothidium lanceolatum (Brébisson ex Kützing) Lange-I	4	0.008			
Pseudostaurosira brevistriata (Grunow) Williams et Round	31	0.062			
Pseudostaurosira parasitica (Smith) Morales	2	0.004			
Sellaphora pupula (Kützing) Meresckowsky	1	0.002			
Staurosira construens Ehrenberg	51	0.102			
Staurosira construens var. binodis (Ehrenberg) Hamilton	77	0.154			
Staurosirella leptostauron var. dubia (Grunow) Edlund	2	0.004			
Staurosirella pinnata (Ehrenberg) Williams et Round	57	0.114			
Staurosirella pinnata var. lancettula (Schumann) Siver et	6	0.012			
Stephanodiscus niagarae Ehrenberg	29	0.058			
unknown pennate	5	0.010			
TOTAL	500	1.000			
Planktonic diatoms		0.432			
Nonplanktonic diatoms		0.568			

LITTLE ARBOR VITAE LAKE				
Vilas County			Aulacoseira spp.	0.044
			Small Fragilaria	0.368
Bottom (42-44 cm)			Benthic Fragilaria	0.772
			Cyclotella spp.	0.000
	COUNT TOTAL		Stephanodiscus spp.	0.024
	Number	Prop.		
TAXA				
Achnanthidium exiguum (Grunow) Czarnecki	1	0.002	Species Richness	38
Amphora copulata (kützing) Schoeman et Archibald	1	0.002	Diversity	2.06
Amphora pediculus (Kützing) Grunow	2	0.004		
Asterionella formosa Hassal	4	0.008		
Aulacoseira ambigua (Grunow) Simonsen	11	0.022		
Aulacoseira granulata (Ehrenberg) Simonsen	5	0.010		
Aulacoseira italica (Ehrenberg) Simonsen	4	0.008		
Aulacoseira sp. 1?	2	0.004		
Encyonema mesianum (Cholnoky) Mann in Round, Crawford and Man	2	0.004		
Encyonema spp.	7	0.014		
Fragilaria crotonensis Kitton	1	0.002		
Fragilaria sp. 1	4	0.008		
Gomphonema minutum (Agardh) Agardh	1	0.002		
Karayevia clevei (Grunow) Bukhtiyarova	1	0.002		
Navicula cryptotenella Lange-Bertalot ex Krammer et Lange-Bertalot	1	0.002		
Navicula minima Grunow in Van Heurck	2	0.004		
Navicula modica Hustedt	2	0.004		
Navicula peregrina (Ehrenberg) Kützing	1	0.002		
Navicula pseudoanglica Lange-Bertalot	2	0.004		
Navicula pseudoventralis Hustedt	18	0.036		
Navicula spp.	2	0.004		
Neidium spp.	1	0.002		
Nitzschia amphibia fo. frauenfeldii (Grunow) Lange-Bertalot	1	0.002		
Nitzschia amphibia Grunow	1	0.002		
Nitzschia spp.	1	0.002		
Placoneis clementis (Grunow) Cox	1	0.002		
Planothidium joursacense (Héribaud) Lange-Bertalot	3	0.006		
Platessa conspicua (Mayer) Lange-Bertalot	2	0.004		
Pseudostaurosira brevistriata (Grunow) Williams et Round	25	0.050		
Punctastriata mimetica Morales	9	0.018		
Sellaphora laevissima (Kützing) Mann	2	0.004		
Sellaphora sp. 1?	1	0.002		
Staurosira construens Ehrenberg	141	0.282		
Staurosira construens var. binodis (Ehrenberg) Hamilton	6	0.012		
Staurosirella leptostauron var. dubia (Grunow) Edlund	3	0.006		
Staurosirella pinnata (Ehrenberg) Williams et Round	184	0.368		
Staurosirella pinnata var. lancettula (Schumann) Siver et Hamilton	18	0.036		
Stephanodiscus niagarae Ehrenberg	12	0.024		
unknown pennate	15	0.030		
TOTAL	500	1.000		
Planktonic diatoms		0.078		
Nonplanktonic diatoms		0.922		

G

APPENDIX G

WDNR Fish Stocking Records.

Little Arbor Vitae WDNR Muskellunge Stocking

Year	Species	Strain (Stock)	Age Class	# Fish Stocked	Avg Fish Length (in)
1972	Muskellunge	Unspecified	Fingerling	1,200	11
1973	Muskellunge	Unspecified	Fingerling	1,100	9
1974	Muskellunge	Unspecified	Fingerling	1,100	11
1975	Muskellunge	Unspecified	Fingerling	1,100	9
1976	Muskellunge	Unspecified	Fingerling	1,100	11
1977	Muskellunge	Unspecified	Fingerling	1,100	9
1979	Muskellunge	Unspecified	Fingerling	500	11
1980	Muskellunge	Unspecified	Fingerling	1,179	9.67
1981	Muskellunge	Unspecified	Fingerling	400	11
1982	Muskellunge	Unspecified	Fingerling	1,100	11
1983	Muskellunge	Unspecified	Fingerling	1,100	12
1984	Muskellunge	Unspecified	Fingerling	1,100	11
1985	Muskellunge	Unspecified	Fingerling	1,100	10
1986	Muskellunge	Unspecified	Fingerling	1,100	10.5
1986	Muskellunge	Unspecified	Fry	67,500	1
1987	Muskellunge	Unspecified	Fingerling	3,327	12
1987	Muskellunge	Unspecified	Fry	33,000	2
1988	Muskellunge	Unspecified	Fingerling	1,091	10.5
1988	Muskellunge	Unspecified	Fry	40,500	1
1989	Muskellunge	Unspecified	Fingerling	3,050	7.33
1990	Muskellunge	Unspecified	Fry	32,400	1
1991	Muskellunge	Unspecified	Fingerling	500	11
1992	Muskellunge	Unspecified	Fingerling	500	10
1993	Muskellunge	Unspecified	Fingerling	500	10
1993	Muskellunge	Unspecified	Fry	67,300	0.4
1996	Muskellunge	Unspecified	Fry	27,000	0.5
1997	Muskellunge	Unspecified	Fry	225,000	0.5
1998	Muskellunge	Unspecified	Fry	115,000	0.5
1998	Muskellunge	Unspecified	Large Fingerling	500	12
1999	Muskellunge	Unspecified	Fry	379,150	0.5
2000	Muskellunge	Unspecified	Fry	161,050	0.5
2000	Muskellunge	Unspecified	Large Fingerling	500	10.9
2000	Muskellunge	Unspecified	Small Fingerling	12,927	1.1
2001	Muskellunge	Unspecified	Fry	342,850	0.5
2001	Muskellunge	Unspecified	Large Fingerling	267	10.2
2003	Muskellunge	Unspecified	Large Fingerling	266	10.3
2005	Muskellunge	Unspecified	Large Fingerling	267	10.6
2007	Muskellunge	Upper Wisconsin River	Large Fingerling	178	12.1
2009	Muskellunge	Upper Wisconsin River	Large Fingerling	266	9.9
2011	Muskellunge	Upper Wisconsin River	Large Fingerling	265	9.3

Little Arbor Vitae WDNR Walleye Stocking

Year	Species	Strain (Stock)	Age Class	# Fish Stocked	Avg Fish Length (in)
1972	Walleye	Unspecified	Fingerling	88,000	3
1973	Walleye	Unspecified	Fingerling	25,180	3
1974	Walleye	Unspecified	Fingerling	23,070	3
1975	Walleye	Unspecified	Fingerling	15,000	3
1976	Walleye	Unspecified	Fingerling	27,000	3
1988	Walleye	Unspecified	Fry	2,020,000	1
1990	Walleye	Unspecified	Fry	284,000	1
1997	Walleye	Unspecified	Fry	1,000,000	0.3
2012	Walleye	Mississippi Headwaters	Small Fingerling	9,344	1.6