A

APPENDIX A

Public Participation Materials

Mid Lake
Comprehensive Management Plan
Project Kick-Off Meeting
July 26th, 2008 9:00 AM
Woodruff Town Hall – 418 1st Avenue, Woodruff

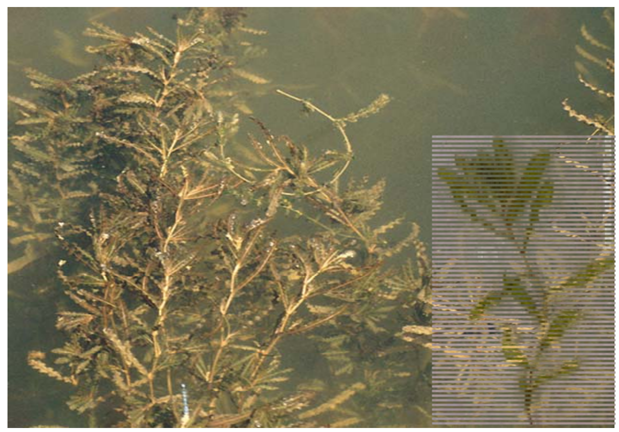

Aquatic ecologist, Eddie Heath, speaks to a lake group in Lincoln County about their lake management plan. Public participation will be integral part of the Mid Lake project.

The Mid Lake Protection & Rehabilitation District has received two grants totaling over $16,000 from the Wisconsin Department of Natural Resources to partially fund the completion of a comprehensive management plan for Mid Lake. The design for the management plan has been finalized and approved by the WDNR and includes two primary objectives: 1)the completion of an in-depth study including multiple plant surveys, water quality sampling, and watershed investigations; 2) the completion of a realistic management plan for the lake and its watershed. Most of the studies will be completed during this spring, summer and fall. The tasks associated with the analysis of the data will be completed during the fall and winter. The project will also incorporate opportunities for stakeholder education and input, which are both very important components of all lake management planning efforts. The first opportunity for your participation in the process will be at the Project Kick-off Meeting to be held on Saturday, July 26th at 9:00 am at the Woodruff Town Hall.

Onterra, LLC, a lake management planning firm out of De Pere, has been hired to lead the project. During the meeting Eddie Heath, an Aquatic Ecologist with Onterra, will describe the project and its importance. His presentation will include a description of the project's components, a quick course on general lake ecology, and a breakdown of how the District's Planning Committee will be involved in the plan's completion. So, please plan on attending the meeting and do not hesitate to ask questions or make comments.

Mid Lake Curly-leaf Pondweed Survey Results

On June 19, 2008 Eddie Heath and Sonya Krogh, of Onterra, LLC visited Mid Lake to locate and map curly-leaf pondweed (CLP). CLP is a European exotic first discovered in Wisconsin in the early 1900's that has an unconventional lifecycle giving it a competitive advantage over our native plants. CLP begins growing almost immediately after ice-out and by mid-June is at peak biomass. While it is growing, each plant produces many turions (asexual reproductive shoots) along its stem. By mid-July most of the plants have senesced, or died-back, leaving the turions in the sediment. The turions lie dormant until fall when they germinate to produce winter foliage, which thrives under the winter snow and ice. It remains in this state until spring foliage is produced almost immediately following ice-out, giving the plant a significant jump on native vegetation. CLP can become so abundant that it hampers recreational activities within the lake. Furthermore, its mid-summer die back can cause algal blooms spurred from the nutrients released during the plant's decomposition.



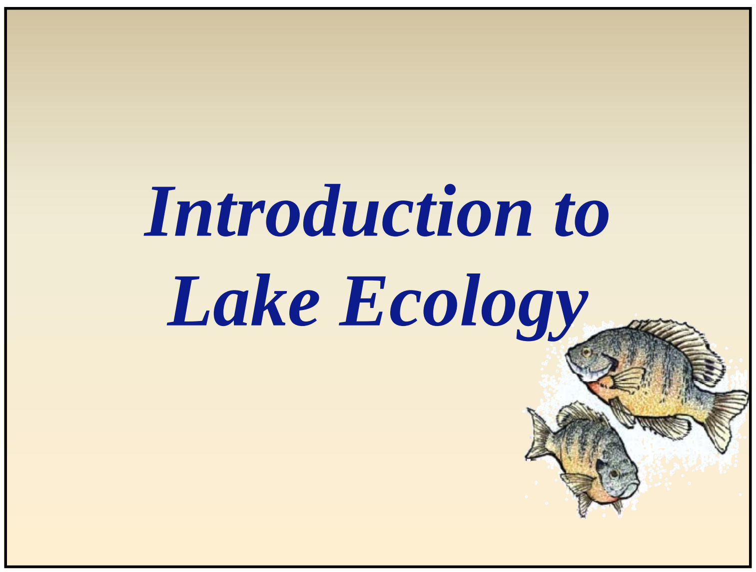
As mentioned above, the primary mode of spread used by CLP is through the production and dispersal of turions. The turions are naturally dislodged from the plant as it dies back during early July. The majority will likely settle very close to the plant from which they it originated. The mature turions can also be dislodged through disruption by boats, animals, or wind-driven currents. Mechanical harvesting not only dislodges the turions, but also spreads them along its path. On many lakes, this is evidenced by the harvester off-loading site often being infested with CLP even though the colonization originated elsewhere in the lake. Mid Lake is no exception to this phenomenon. Maps used to complete the CLP herbicide treatment in 2005 indicated the densest colonies were located northeast of the island (map on back). The most recent surveys indicate that the infestation has spread greatly to the southwest where the harvester off-load site is located. If harvesting of turion-laden CLP continues, we can expect the plant to continue its spread to encompass much of the lake. It is true that if no harvesting occurred within Mid Lake, that the CLP would spread, but the spread is greatly accelerated via the harvesting.

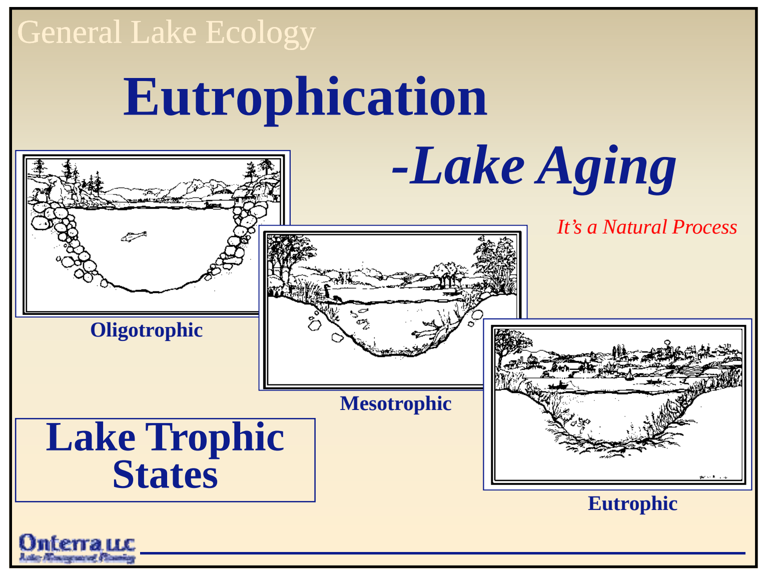
We have advised the Mid Lake P & R District to hold off on harvesting the densest areas to minimize the accelerated spread of CLP to new areas. The harvesting of CLP is also prohibited in the district's current 3-year harvesting permit, which expires at the end of 2008. A component of the planning process will include the creation of the district's harvesting plan as well as management actions to control CLP.

Once the CLP dies back, likely by mid July, the harvesting activities could resume in those areas if needed. This topic will be discussed as much as possible during the Management Planning Project Kick-off Meeting to be held on July 26th at the Woodruff Town Hall beginning at 9:00 am.


Mid Lake Protection
& Rehabilitation District
Mid Lake
Management Planning Project
Kick-off Meeting
July 26, 2008
Eddie Heath
Aquatic Ecologist
Onterra LLC


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


Introduction to
Lake Ecology


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

General Lake Ecology

Cultural Eutrophication

Accelerated eutrophication caused by human activity.

General Lake Ecology

Limiting Nutrient

2 Cups Water
2 Cups Flour
2 Cups Sugar
2 Eggs

2 Cups Water
2 Cups Flour
2 Cups Sugar
2 Eggs

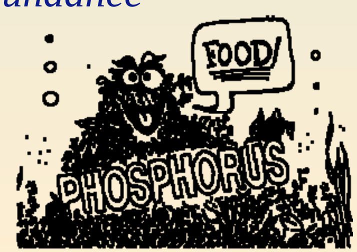
2 Cups Water
2 Cups Flour
2 Cups Sugar
2 Eggs

2 Cups Water
2 Cups Flour
2 Cups Sugar
2 Eggs

General Lake Ecology

Phosphorus

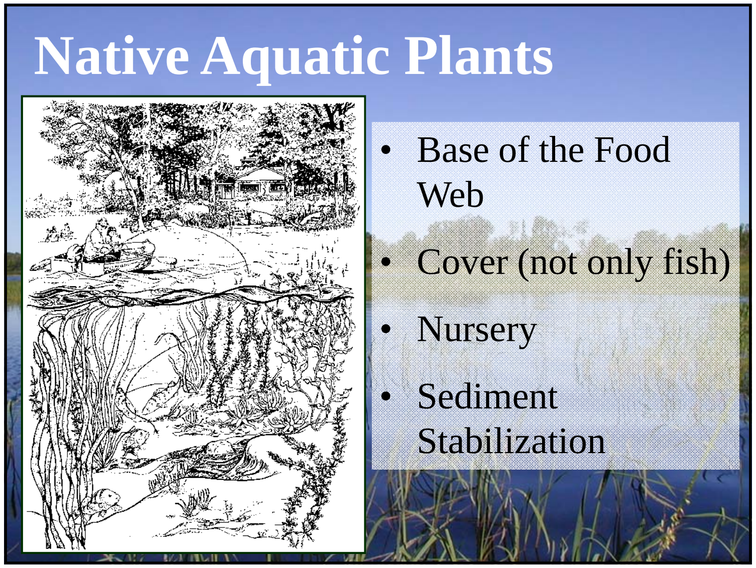
- *Limiting Nutrient*
- *Controls Plant Abundance (Productivity)*
  - *Algae*
  - *Macrophytes*



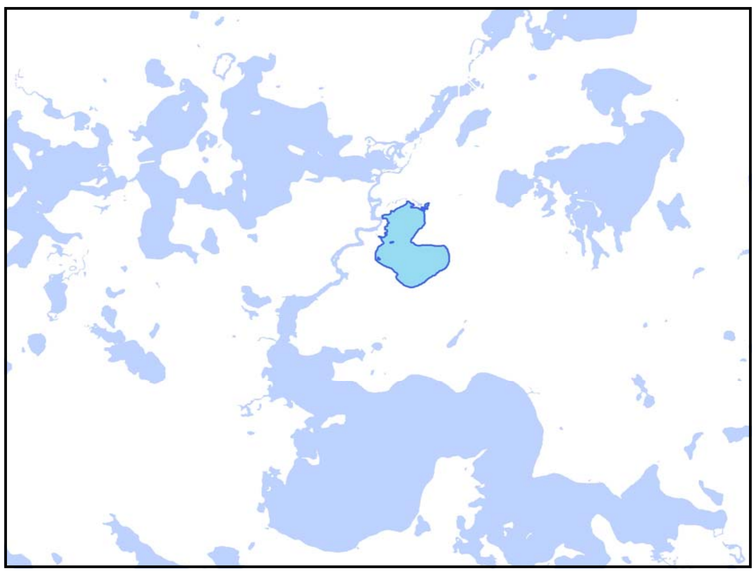
General Lake Ecology

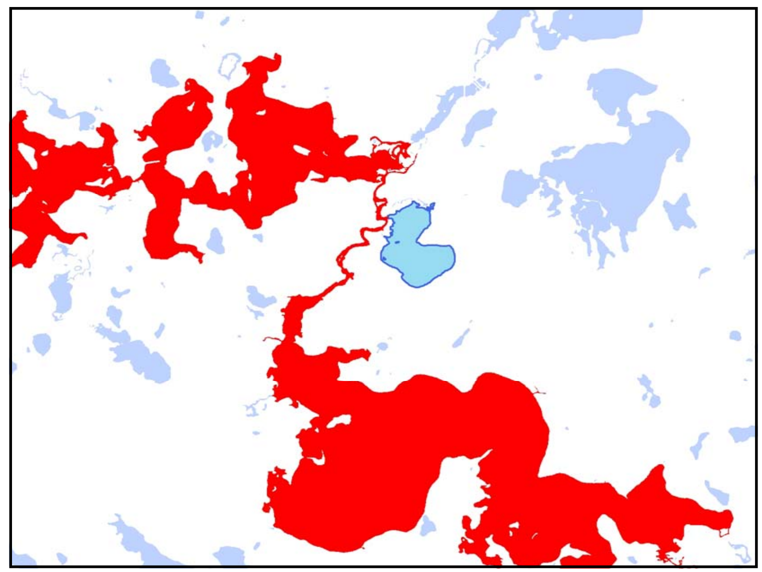
Aquatic Plants (macrophytes)

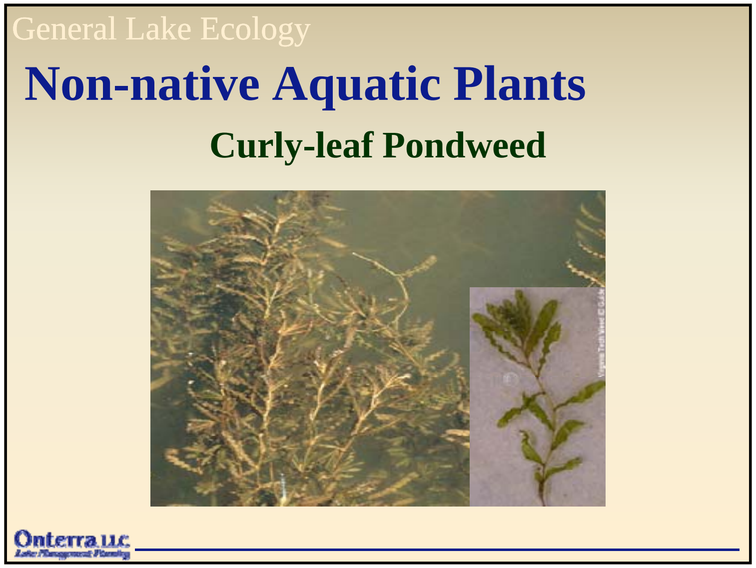
- *Native Plants*
- *Exotic Plants (non-native)*

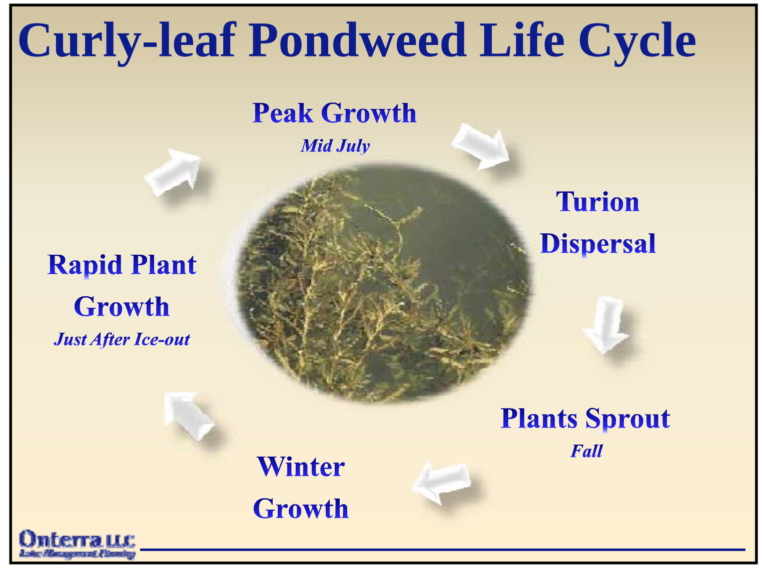

Native Aquatic Plants
• Base of the Food Web
• Cover (not only fish)
• Nursery
• Sediment Stabilization

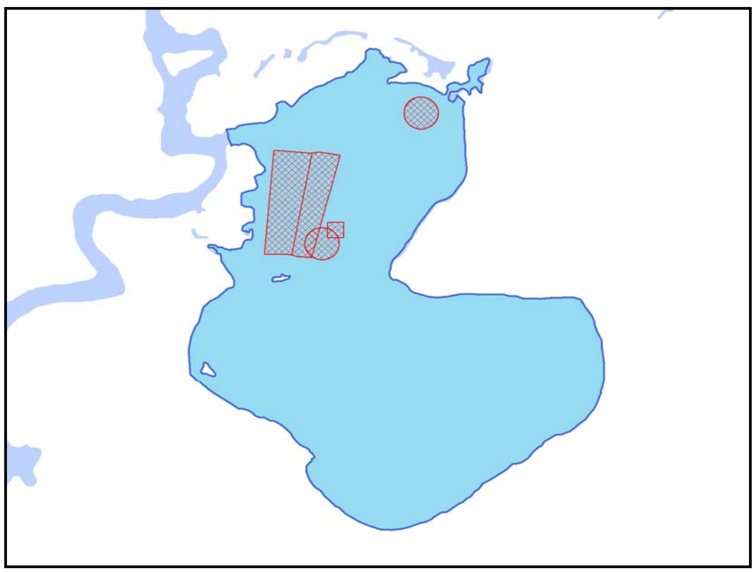

General Lake Ecology
Non-native Aquatic Plants
Eurasian Water Milfoil
Onterra LLC

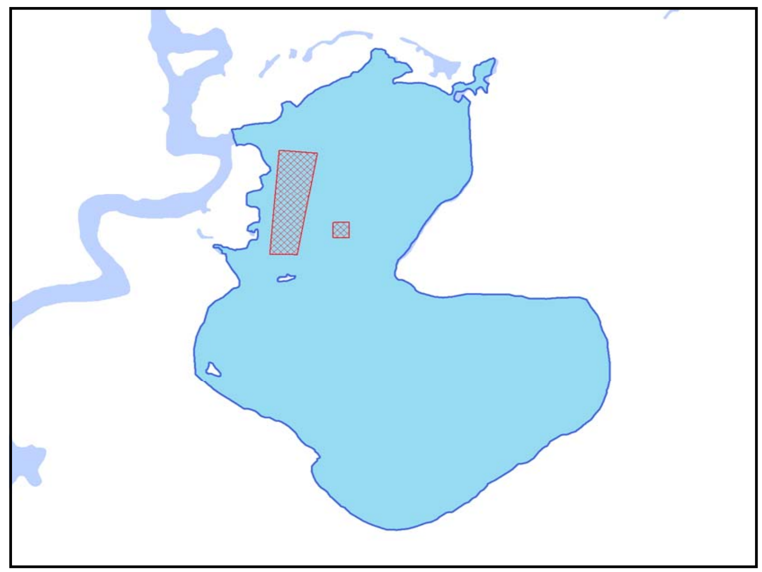


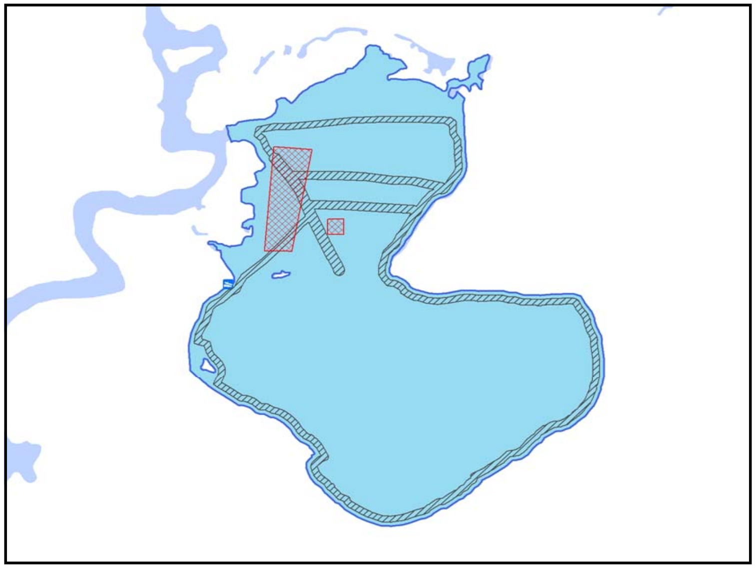


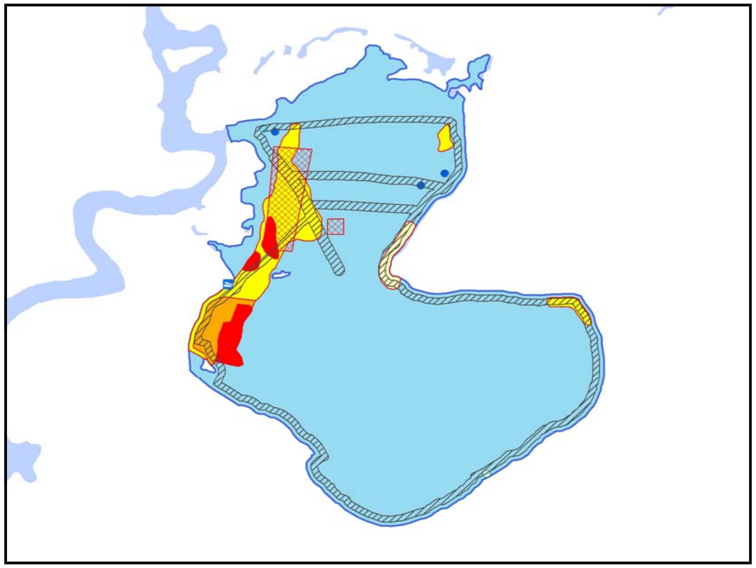

General Lake Ecology
Non-native Aquatic Plants
Curly-leaf Pondweed
Onterra LLC

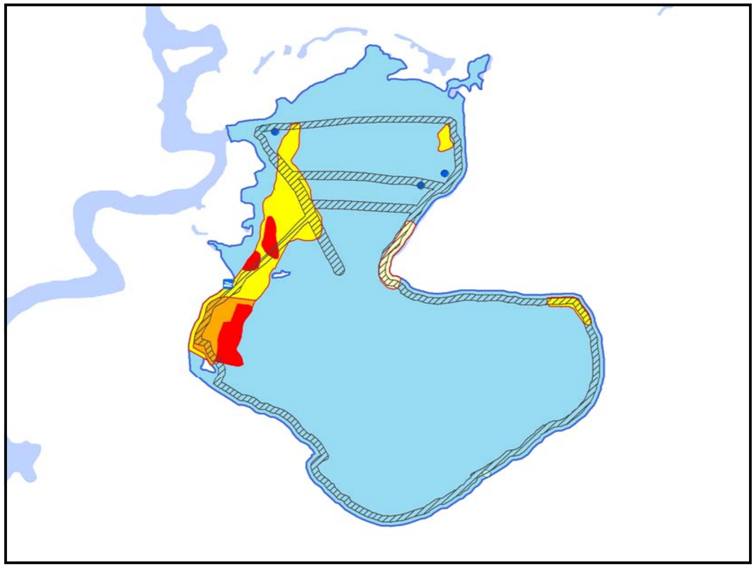

Curly-leaf Pondweed Life Cycle
Peak Growth
Mid July
Turion
Dispersal
Plants Sprout
Fall
Winter
Growth
Rapid Plant
Growth
Just After Ice-out
Onterra LLC

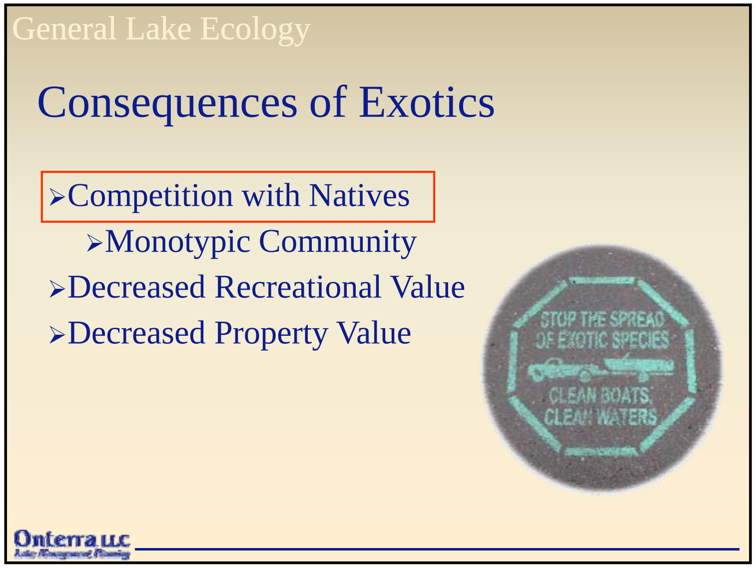











General Lake Ecology
Consequences of Exotics
➢Competition with Natives
➢Monotypic Community
➢Decreased Recreational Value
➢Decreased Property Value
STOP THE SPREAD OF EXOTIC SPECIES
CLEAN BOATS, CLEAN WATERS
Onterra LLC

Current Project

Study and Plan Goals

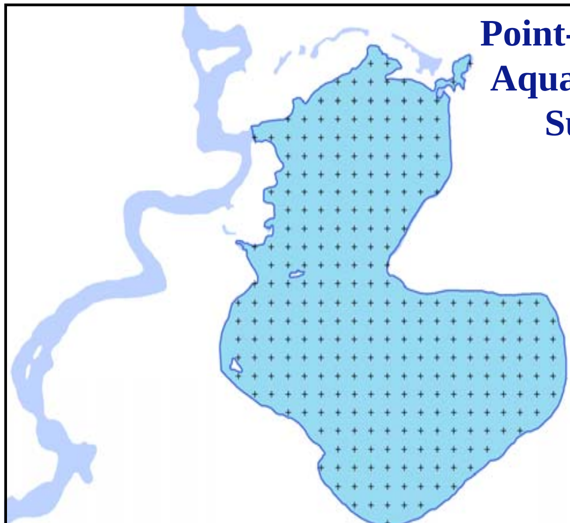
- Collect & Analyze Data
- Construct Long-Term & Useable Plan

A goal without a plan is just a wish.

Project Components

- Public Participation
- Watershed Modeling
- Water Quality
- Aquatic Vegetation
  - Curly-leaf Survey
  - Comprehensive Survey
- Zebra Mussel Veliger Survey
- Ecologically Valuable Habitat Delineation
- Fisheries Data Integration
- Plan Development

Point-intercept Aquatic Plant Survey

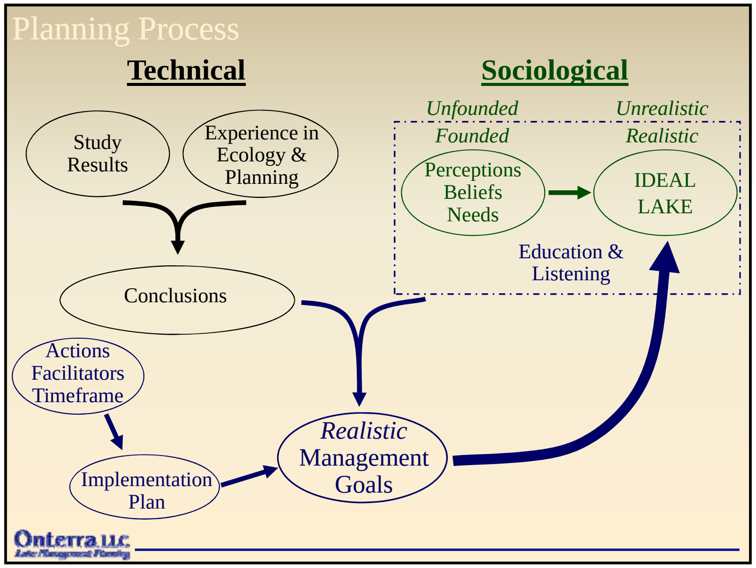



Current Project
Your Participation is Important to the Success of this Project
Onterra LLC


Current Project
Planning Process
Planning Committee Meetings
•Study Results (including a stakeholder survey)
•Conclusions & Initial Recommendations
•Management Goals
•Management Actions
•Timeframe
•Facilitator(s)
Implementation Plan
Onterra LLC


Thank You
Eddie Heath eheath@onterra-eco.com
Many of the graphics used in this presentation were supplied by:
Wisconsin Lakes Partnership
Extension
WISCONSIN DEPT. OF NATURAL RESOURCES
Onterra LLC


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


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

Mid Lake Management Planning Project & Curly-leaf Pondweed Control Strategy Update – July 2009

Submitted by:
Eddie Heath
Aquatic Ecologist
Onterra, LLC

The Mid Lake Management Planning Project is moving along well. All field studies associated with the project have been completed and analysis of that data is nearly finished. We have also assisted the Planning Committee with the development and disbursal of the stakeholder survey. The committee has tallied the information in a spreadsheet we supplied and Sonya from our staff will soon be analyzing that data so it can be utilized within the development of the management plan.

A great deal of focus has been placed upon the non-native species, curly-leaf pondweed that was located in Mid Lake. Surveys competed last year in June showed that curly-leaf pondweed has spread to many areas of the lake, especially just south of Grundy Point, where the harvester off-loading site is located. Last year, we advised the Mid Lake P & R District to hold off on harvesting the densest areas to minimize the accelerated spread of CLP to new areas. The harvesting of CLP is also prohibited in the district's current 3-year harvesting permit, which expired at the end of 2008.

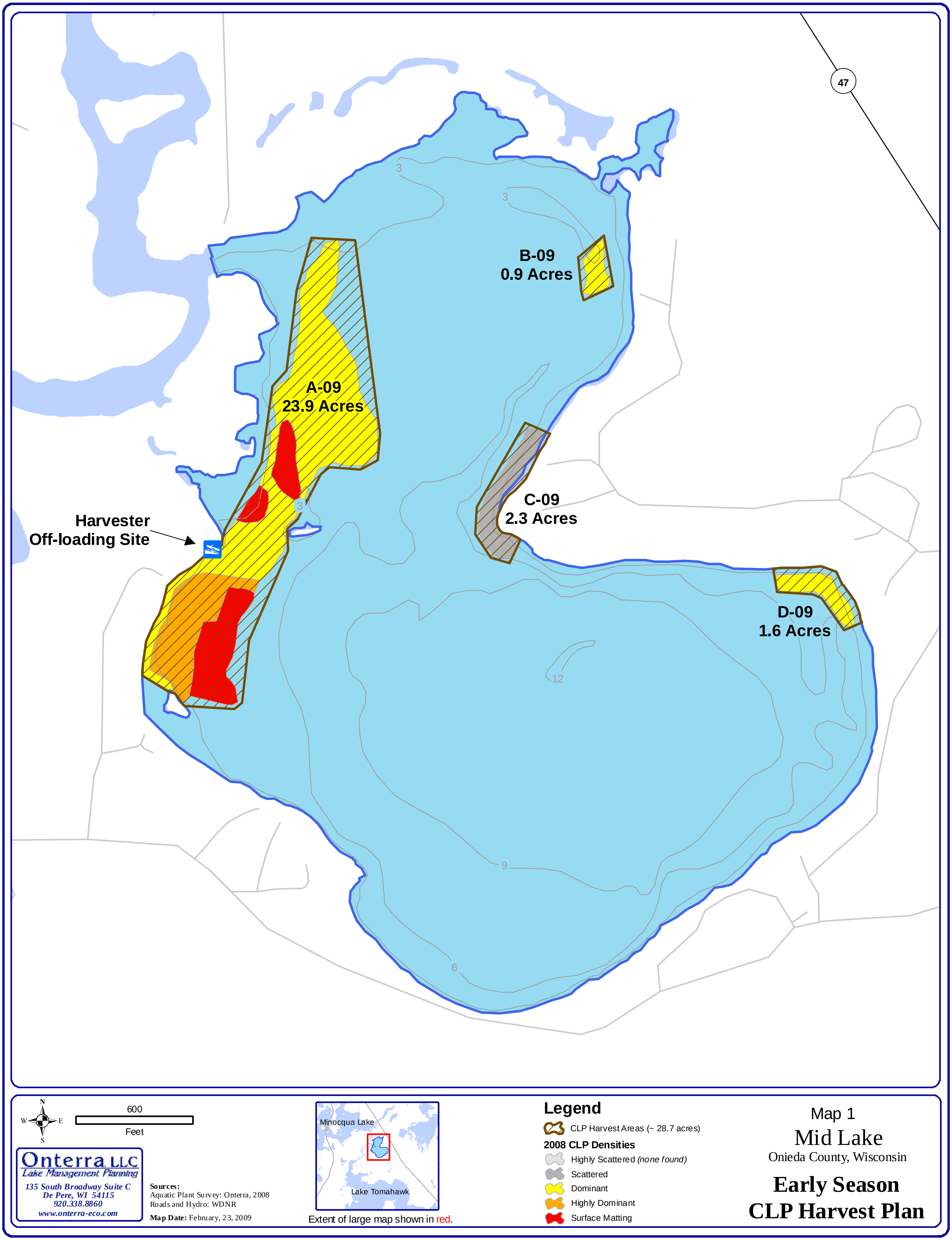
Traditionally, curly-leaf pondweed control consists of herbicide treatments conducted in May of each year. This will kill each year's plants before they are able to produce reproductive turions (asexual seed-like structures). After multiple years of treatment, the turion base becomes exhausted and the curly-leaf pondweed infestation becomes significantly lessened.

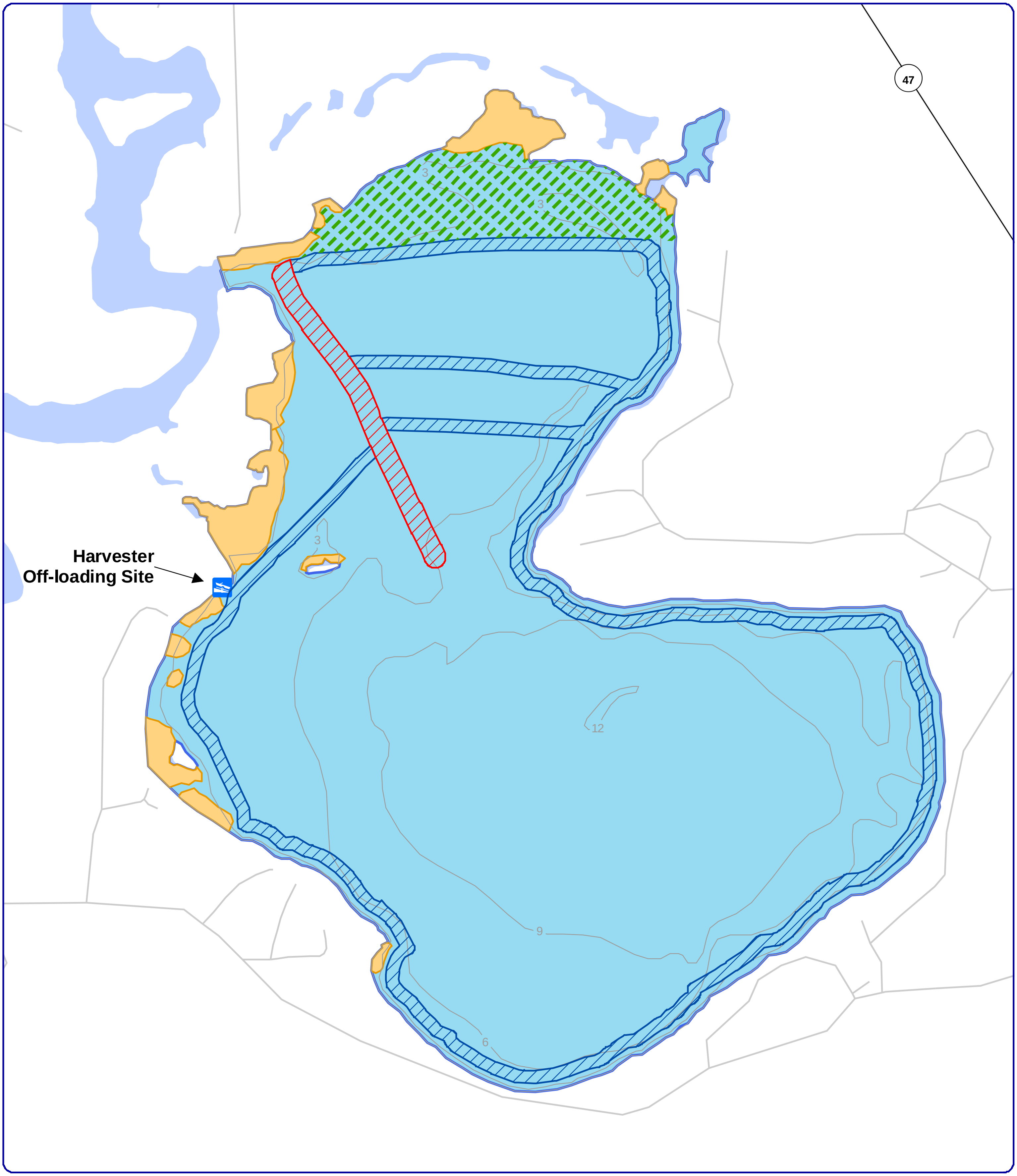
Over the winter months, with cooperation from the Wisconsin Department of Natural Resources (WDNR), a control strategy was developed to reduce curly-leaf pondweed occurrences within the lake. Utilizing the district's mechanical harvester, early-season harvesting activities will be aimed at cutting curly-leaf pondweed before turion production occurs and continuing until the middle of July, when this plant begins to die back (Map 1). The WDNR has extended additional grant funds to the district to help cover the costs of monitoring this experimental approach to curly-leaf pondweed management. Harvesting of curly-leaf pondweed started in early June and was completed on June 16th.

The district will continue its regular harvest program during the latter part of the summer, operating under a 1-year harvesting permit. Once the management plan for Mid Lake is completed, the WDNR will likely allow the group to obtain a multi-year harvesting permit. Later in the summer, Onterra ecologists will meet with members of the Mid Lake Planning Committee to develop management goals for the lake including the associated management actions that will be needed to help reach these goals. The original project schedule called for the lake management plan to be completed at the end of December. The progression of the management plan has been delayed slightly in order to learn more about the results of the experimental early-season curly-leaf pondweed harvesting program. If the program proves to be successful, this management action will be included within the management plan.

During our plant surveys, we located 40 native plant species and 3 non-native species (curly-leaf pondweed, purple loosestrife, and pale-yellow iris). The establishment of a large and diverse population of native plant species likely has made it difficult for Eurasian water milfoil to take residence in Mid Lake. Large established populations of this species are present in the other lakes of the Minocqua Chain and have ongoing large-scale (and costly) management actions occurring on them to reduce their populations. As we know, Mid Lake has the ability to support a large amount of aquatic plants. If Eurasian water milfoil becomes established in Mid Lake, the nuisance plant problems that the district currently deals with will seem quite small in comparison.

Because the lake contains a large biomass of aquatic plants, very low oxygen levels have been documented during the winter. The decomposition of plant material over the winter depletes the oxygen within the lake. These anoxic conditions have the ability to cause ‘minor’ fish kills, as observed this year when dead fish washed up on the shores after ice-out. WDNR fisheries biologist, John Kubisiak, noted that partial fish kills have been documented on Mid Lake since the 1960’s. He is not concerned about this phenomenon, as many large game fish likely detect the low oxygen levels and migrate to other parts of the system. Aeration systems can be a technique to alleviate this problem, but the costs of these systems and the dangers associated with open water on the lake during the winter may outweigh the benefits. This will need to be addressed as a part of the planning process when the planning committee develops its management goals.


47
B-09
0.9 Acres
A-09
23.9 Acres
C-09
2.3 Acres
D-09
1.6 Acres
Harvester
Off-loading Site
3
3
3
12
9
6
N
W
E
S
600
Feet
Onterra LLC
Lake Management Planning
135 South Broadway Suite C
De Pere, WI 54115
920.338.8860
www.onterra-eco.com
Sources:
Aquatic Plant Survey: Onterra, 2008
Roads and Hydro: WDNR
Map Date: February, 23, 2009
Minocqua Lake
Lake Tomahawk
Extent of large map shown in red.
Legend
CLP Harvest Areas (~ 28.7 acres)
2008 CLP Densities
Highly Scattered (none found)
Scattered
Dominant
Highly Dominant
Surface Matting
Map 1
Mid Lake
Oneida County, Wisconsin
Early Season
CLP Harvest Plan



N
W E
S
600
Feet

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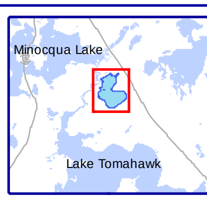


Extent of large map shown in red.

Legend

Mechanical Harvest Areas

- 100-ft lane (~ 3.5 acres)
- 60-ft lane (~ 20.7 acres)
- Open Water Conservation Area (~ 13 acres)
- Native Plant Community (no harvest area, ~ 9.4 acres)

Map 2

Mid Lake
Onieda County, Wisconsin

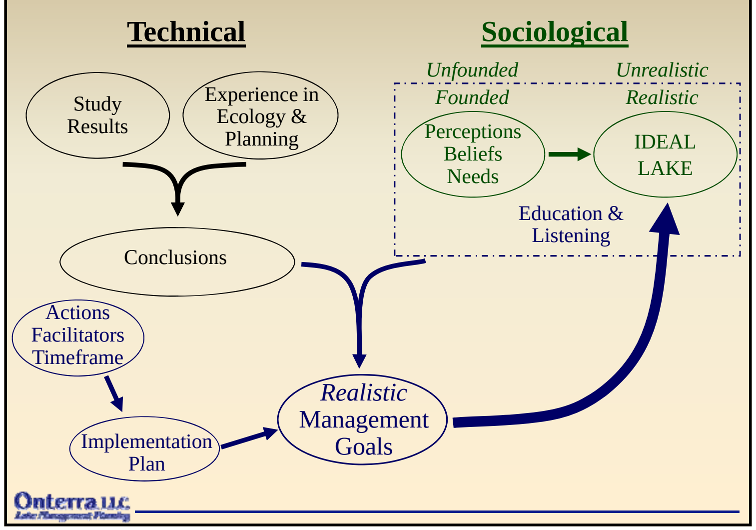
Mechanical Harvesting Plan

Presentation Outline

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

Study and Plan Goals

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

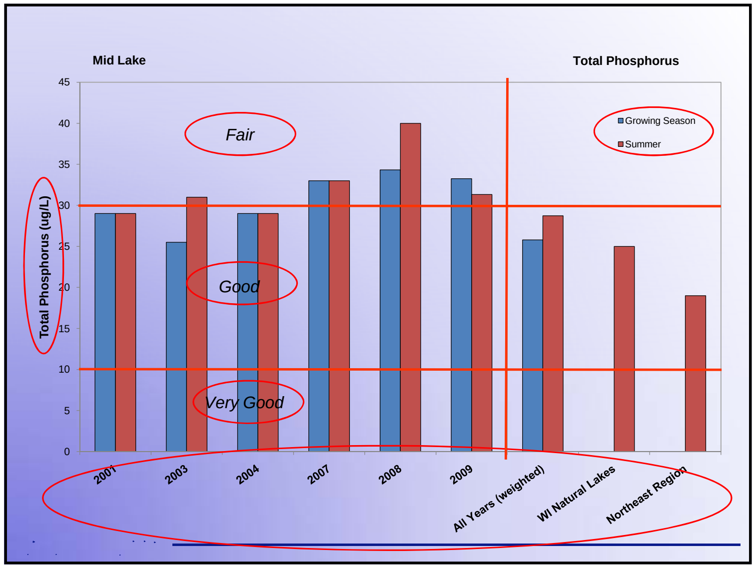


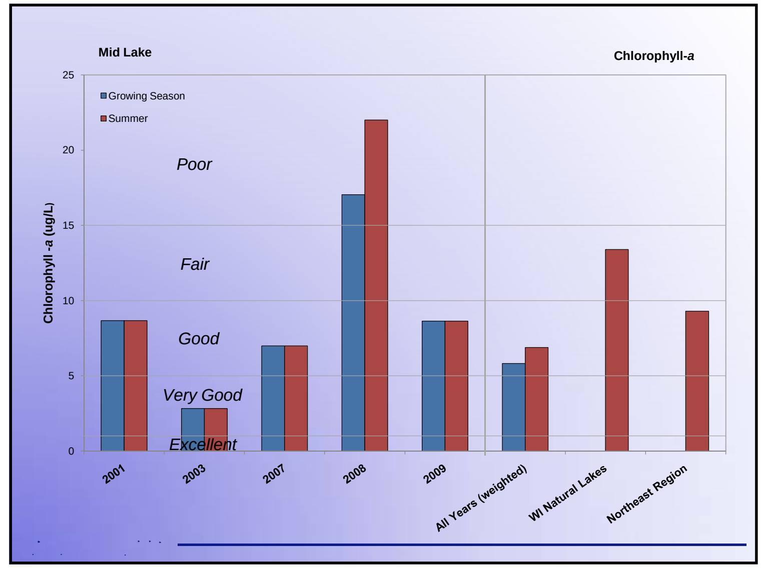
Water Quality

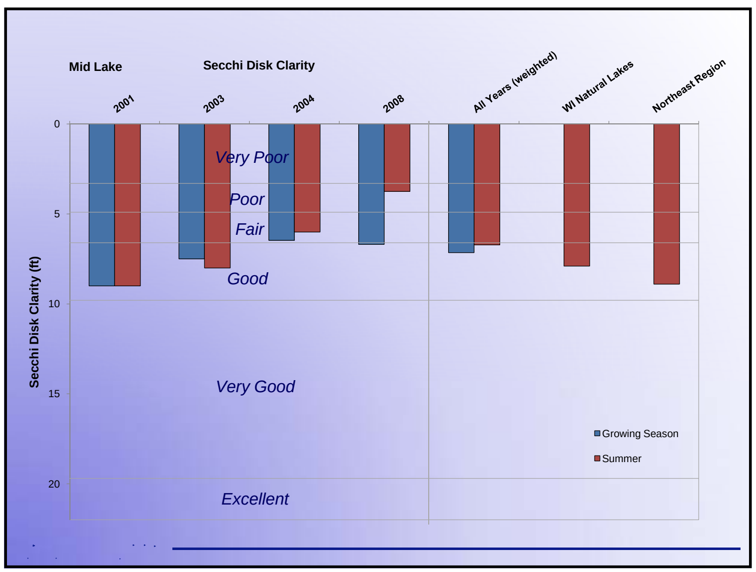
Lillie Mason Regions

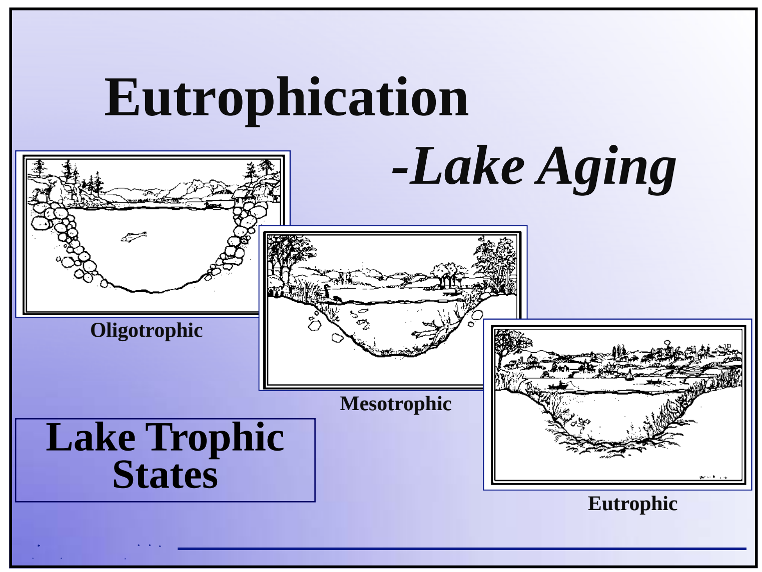
Water Quality

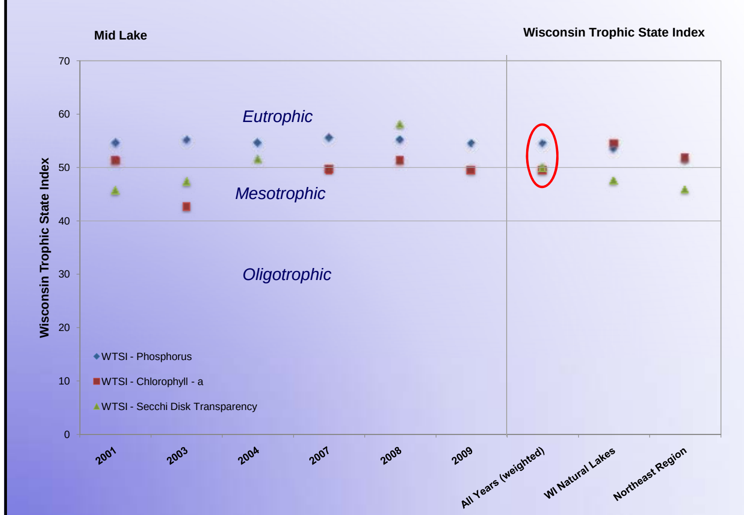
- ↑ Phosphorus (Limiting Plant Nutrient)
- ↑ Chlorophyll-*a* (Algal Abundance)
- ↓ Water Clarity (Secchi Disk)


Mid Lake
Total Phosphorus
Total Phosphorus (ug/L)
Fair
Good
Very Good
Growing Season
Summer
45
40
35
30
25
20
15
10
5
0
2001
2003
2004
2007
2008
2009
All Years (weighted)
WI Natural Lakes
Northeast Region


Mid Lake
Chlorophyll-a
Chlorophyll -a (ug/L)
Growing Season
Summer
Poor
Fair
Good
Very Good
Excellent
25
20
15
10
5
0
2001
2003
2007
2008
2009
All Years (weighted)
WI Natural Lakes
Northeast Region

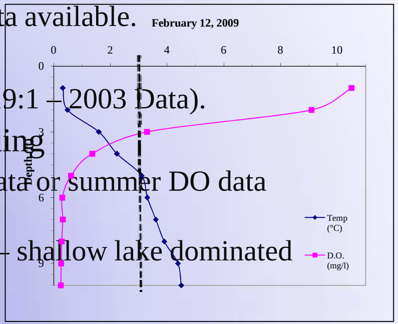

Mid Lake
Secchi Disk Clarity
Secchi Disk Clarity (ft)
2001
2003
2004
2008
All Years (weighted)
WI Natural Lakes
Northeast Region
0
5
10
15
20
Very Poor
Poor
Fair
Good
Very Good
Excellent
Growing Season
Summer


Eutrophication
-Lake Aging
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic States



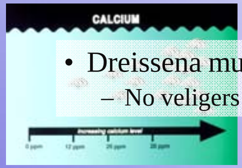
Additional Water Quality Results

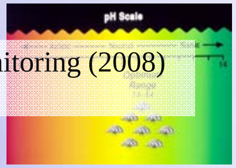
- Dissolved Oxygen and Temperature Profiles
  - Stratification occurs, hypolimnion reaches anoxia during winter.
  - No current summer data available.
- Limiting Nutrient
  - Phosphorus Limited (19:1 – 2003 Data).
- Internal Nutrient Loading
  - No hypolimnetic TP data or summer DO data available.
  - Not overly concerned – shallow lake dominated by aquatic plants



Additional Water Quality Results

- Alkalinity (buffer capacity)
  - 38 ppm $CaCO_3$ – August 2003
  - Non-sensitive to acid rain
- Calcium
  - 10 ppm – August 2003
  - Low susceptibility to zebra mussels
- Acidity (pH)
  - 5.1 to 6.0 – February 2009
  - 8.9 – August 2003
  - Susceptible to zebra mussels

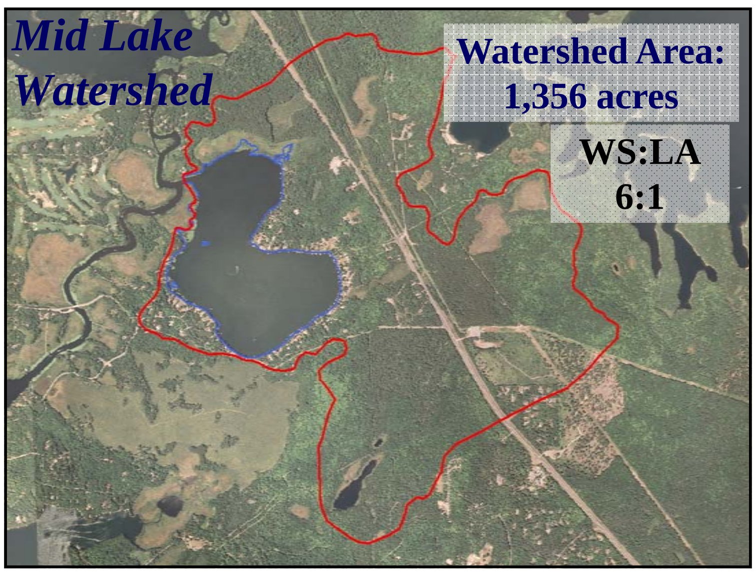


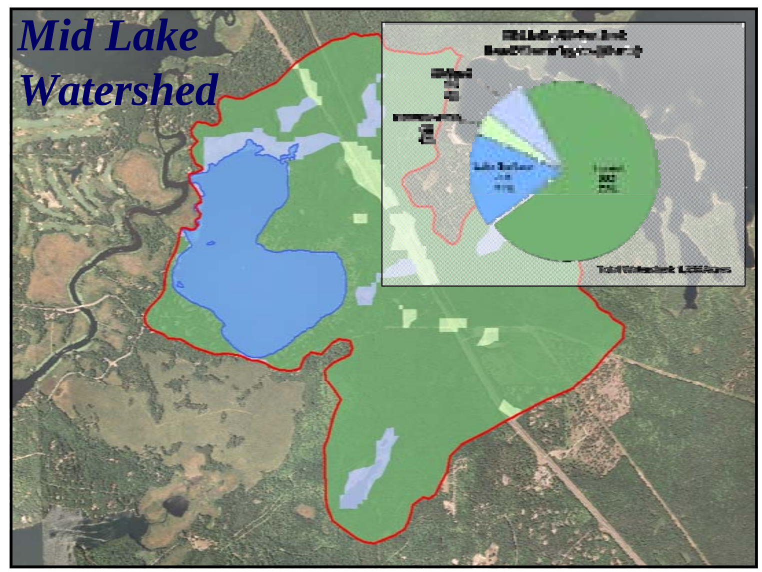


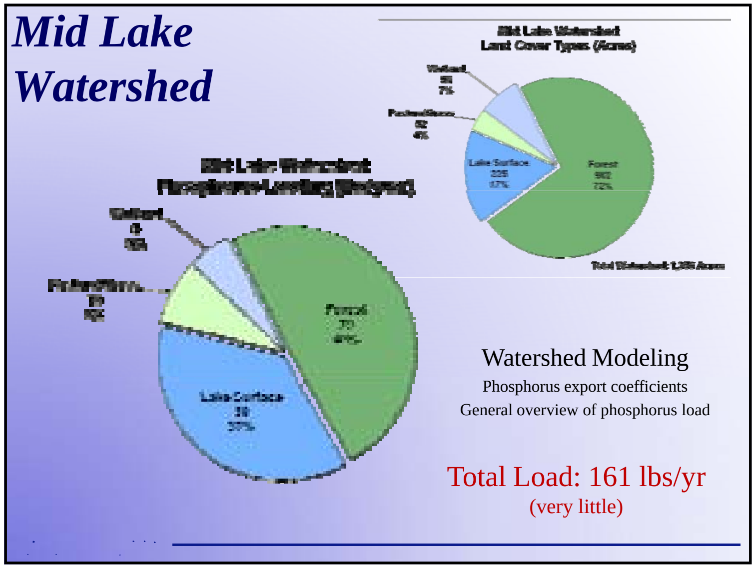
- Dreissena mussel monitoring (2008)
  - No veligers found

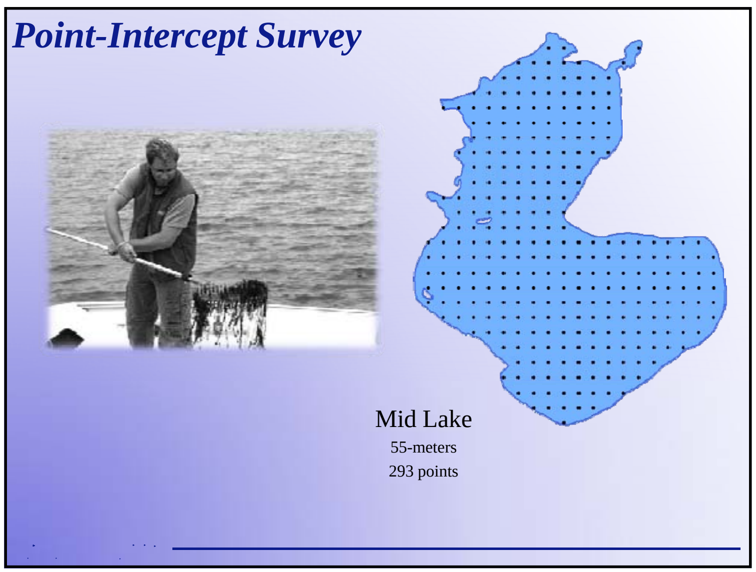

Mid Lake
Watershed

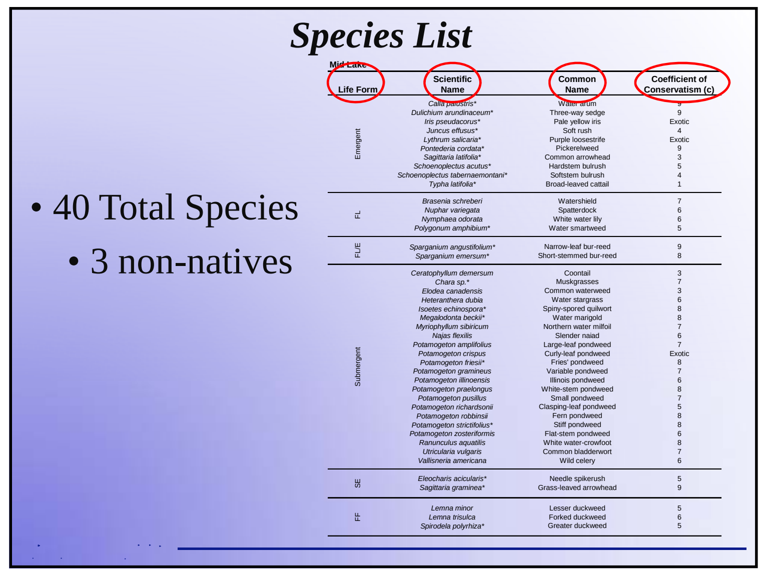

Mid Lake
Watershed


Mid Lake
Watershed
Watershed Area:
1,356 acres
WS:LA
6:1

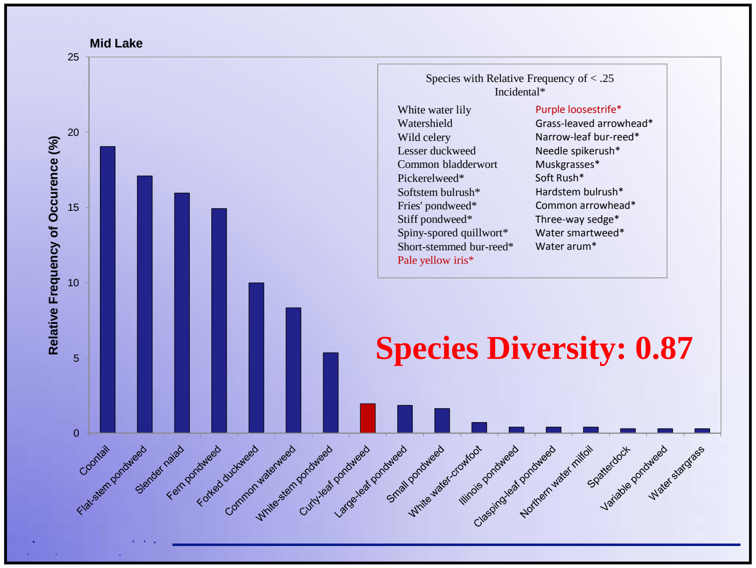

Mid Lake
Watershed

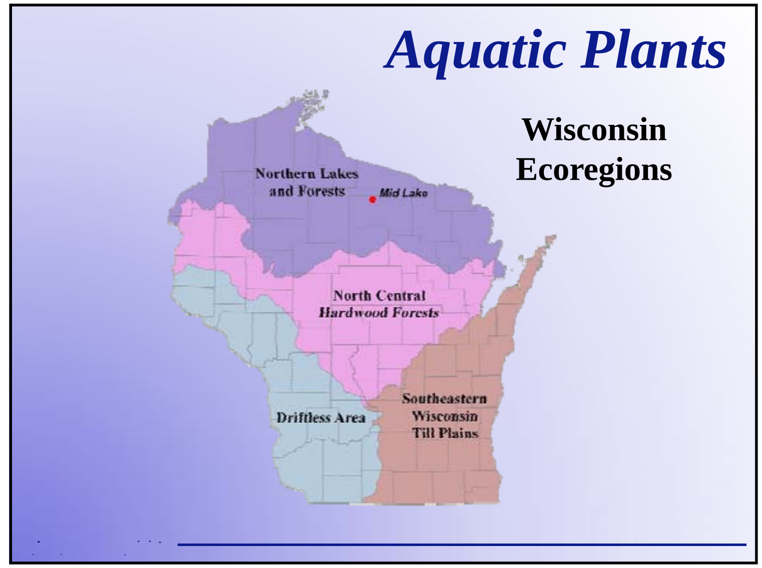


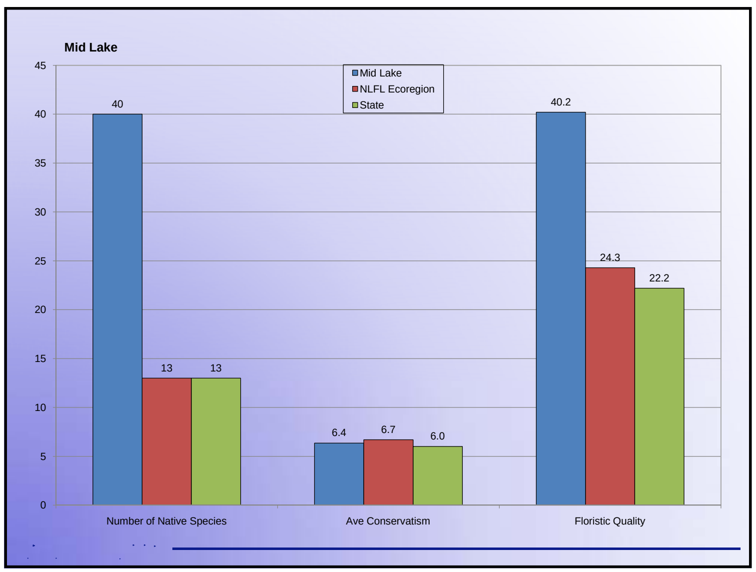


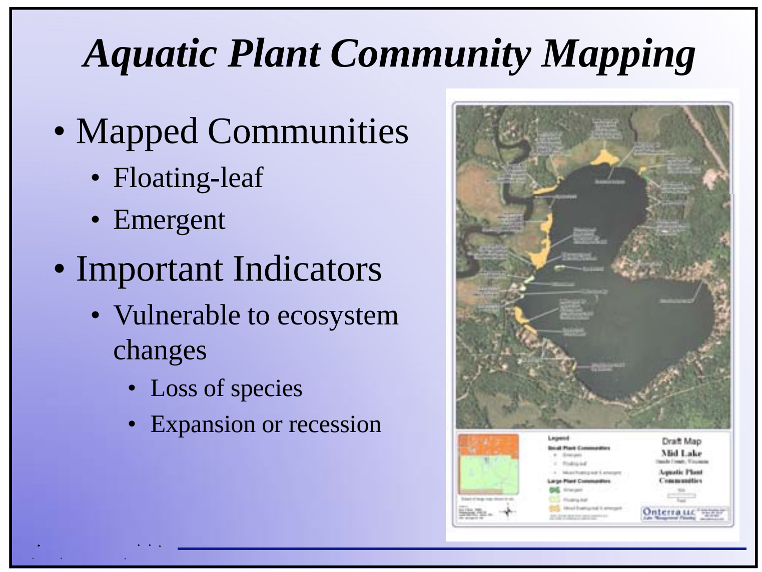


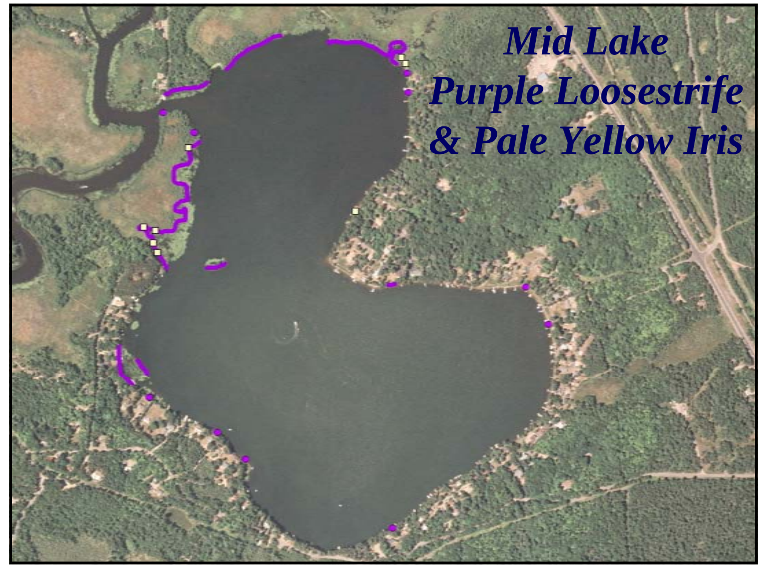
Life Form	Scientific Name	Common Name	Coefficient of Conservatism (c)
Emergent	*Calla palustris**	Water arum	9
	*Dulichium arundinaceum**	Three-way sedge	9
	*Iris pseudacorus**	Pale yellow iris	Exotic
	*Juncus effusus**	Soft rush	4
	*Lythrum salicaria**	Purple loosestrife	Exotic
	*Pontederia cordata**	Pickerelweed	9
	*Sagittaria latifolia**	Common arrowhead	3
	*Schoenoplectus acutus**	Hardstem bulrush	5
	*Schoenoplectus tabernaemontani**	Softstem bulrush	4
	*Typha latifolia**	Broad-leaved cattail	1
FL	*Brasenia schreberi*	Watershield	7
	Nuphar variegata	Spatterdock	6
	Nymphaea odorata	White water lily	6
	*Polygonum amphibium**	Water smartweed	5
FL/E	*Sparganium angustifolium**	Narrow-leaf bur-reed	9
	*Sparganium emersum**	Short-stemmed bur-reed	8
Submergent	*Ceratophyllum demersum*	Coontail	3
	*Chara sp.**	Muskgrasses	7
	Elodea canadensis	Common waterweed	3
	Heteranthera dubia	Water stargrass	6
	*Isoetes echinospora**	Spiny-spored quilwort	8
	*Megalodonta beckii**	Water marigold	8
	Myriophyllum sibiricum	Northern water milfoil	7
	Najas flexilis	Slender naiad	6
	Potamogeton amplifolius	Large-leaf pondweed	7
	Potamogeton crispus	Curly-leaf pondweed	Exotic
	*Potamogeton friesii**	Fries' pondweed	8
	Potamogeton gramineus	Variable pondweed	7
	Potamogeton illinoensis	Illinois pondweed	6
	Potamogeton praelongus	White-stem pondweed	8
	Potamogeton pusillus	Small pondweed	7
	Potamogeton richardsonii	Clasping-leaf pondweed	5
	Potamogeton robbinsii	Fern pondweed	8
	*Potamogeton strictifolius**	Stiff pondweed	8
	Potamogeton zosteriformis	Flat-stem pondweed	6
	Ranunculus aquatilis	White water-crowfoot	8
	Utricularia vulgaris	Common bladderwort	7
	Vallisneria americana	Wild celery	6
SE	*Eleocharis acicularis**	Needle spikerush	5
	*Sagittaria graminea**	Grass-leaved arrowhead	9
FF	*Lemna minor*	Lesser duckweed	5
	Lemna trisulca	Forked duckweed	6
	*Spirodela polyrhiza**	Greater duckweed	5


Mid Lake
Relative Frequency of Occurence (%)
25
20
15
10
5
0
Species with Relative Frequency of < .25
Incidental*
White water lily
Watershield
Wild celery
Lesser duckweed
Common bladderwort
Pickerelweed*
Softstem bulrush*
Fries' pondweed*
Stiff pondweed*
Spiny-spored quillwort*
Short-stemmed bur-reed*
Pale yellow iris*
Purple loosestrife*
Grass-leaved arrowhead*
Narrow-leaf bur-reed*
Needle spikerush*
Muskgrasses*
Soft Rush*
Hardstem bulrush*
Common arrowhead*
Three-way sedge*
Water smartweed*
Water arum*
Species Diversity: 0.87
Coontail
Flat-stem pondweed
Slender naiad
Fern pondweed
Forked duckweed
Common waterweed
White-stem pondweed
Curly-leaf pondweed
Large-leaf pondweed
Small pondweed
White water-crowfoot
Illinois pondweed
Clasping-leaf pondweed
Northern water milfoil
Spatterdock
Variable pondweed
Water stargrass


Aquatic Plants
Wisconsin
Ecoregions
Northern Lakes
and Forests
Mid Lake
North Central
Hardwood Forests
Southeastern
Wisconsin
Till Plains
Driftless Area


Mid Lake
Mid Lake
NLFL Ecoregion
State
45
40
35
30
25
20
15
10
5
0
40
13
13
6.4
6.7
6.0
40.2
24.3
22.2
Number of Native Species
Ave Conservatism
Floristic Quality


Aquatic Plant Community Mapping
• Mapped Communities
• Floating-leaf
• Emergent
• Important Indicators
• Vulnerable to ecosystem changes
• Loss of species
• Expansion or recession



Additional Results

- *Dreissena* mussel monitoring
  - No veligers found
- Fisheries Data Summary
  - Compilation nearly complete
  - Analysis will be completed for report
- Stakeholder Survey
  - Tabulation completed (Thanks Karen!)
  - Charts and comments compiled

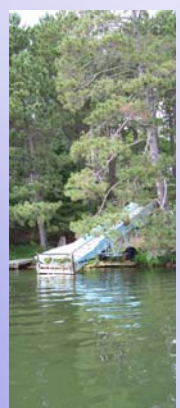
Conclusions

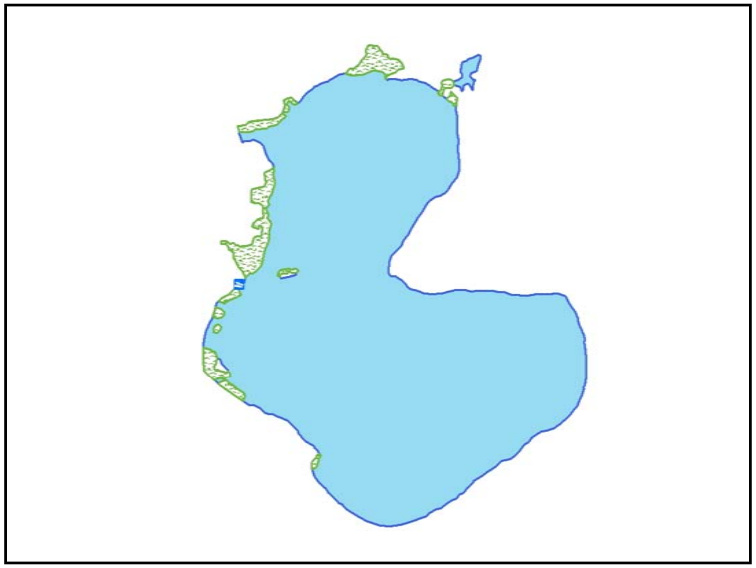
- Water quality is *good*
  - Considering size, depth, & development of shoreline
  - At times, has high TP & Chl-*a*, but aligned with similar lakes (shallow, productive).
  - Limited historic data made trend analysis impossible.
- Overall watershed is in great condition.
  - Land cover exports minimal phosphorus.
  - Moderately long residence time (1.14 year or lake flushes 0.9 times/year).
  - Largest, *controllable* contributor is likely shoreland properties.
    - – Run-off or septic inputs

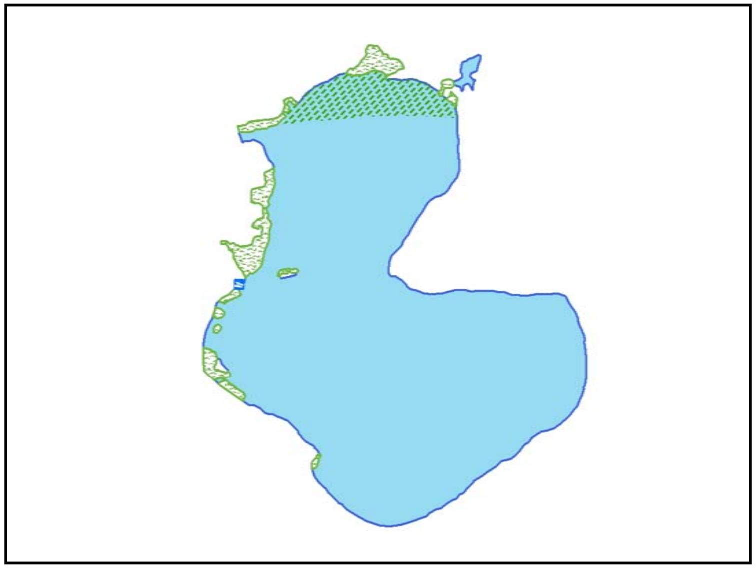
Conclusions

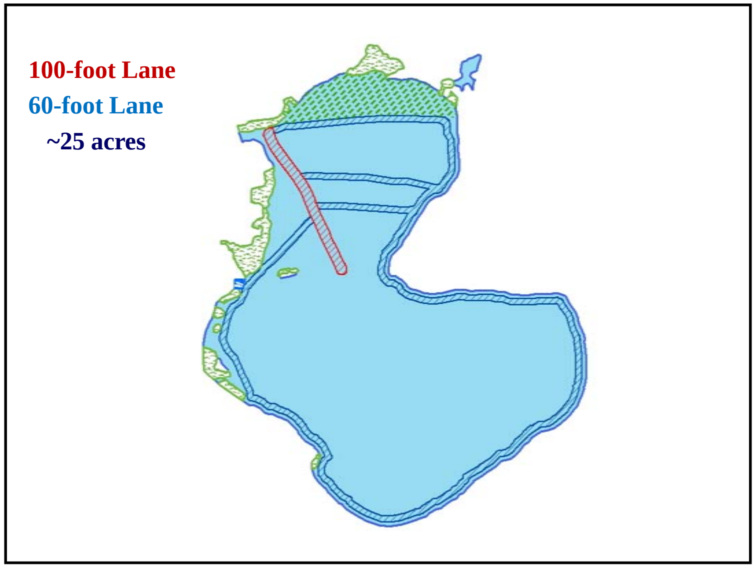
- Aquatic plant community is healthy
  - Native community is of moderate high quality
    - High number of species
    - Good conservatism values
    - Moderately low diversity
  - Presence of exotic species
    - Pale-yellow iris (garden escape)
    - Curly-leaf pondweed and purple Loosestrife
    - No EWM found during surveys

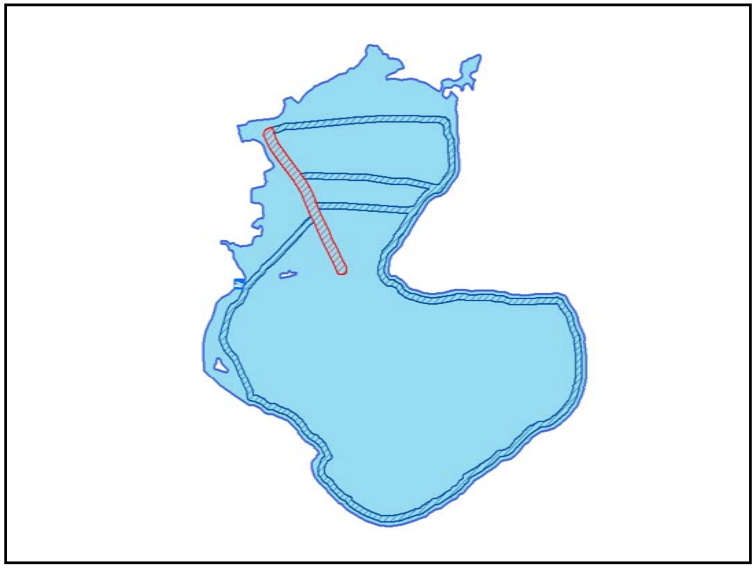
Mechanical Harvesting Plan

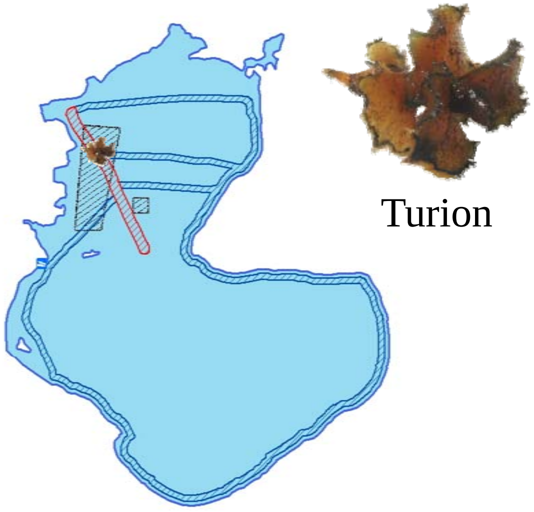


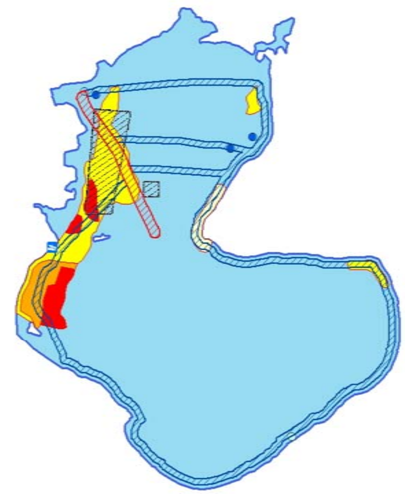


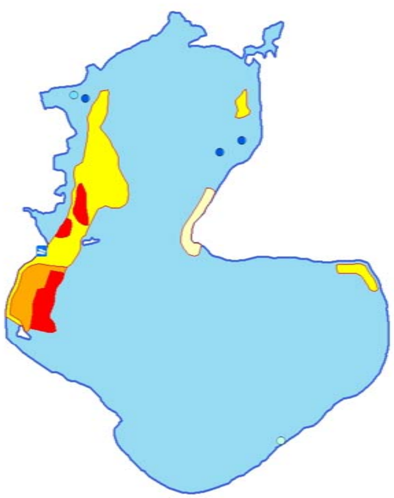



100-foot Lane
60-foot Lane
~25 acres





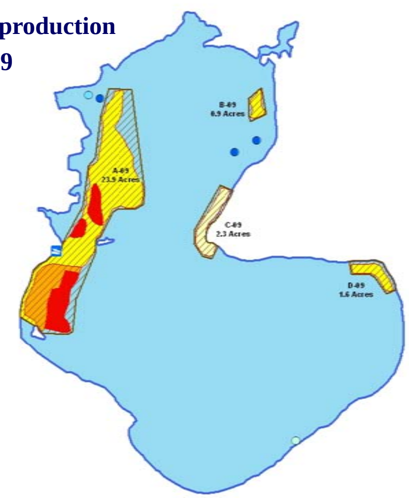


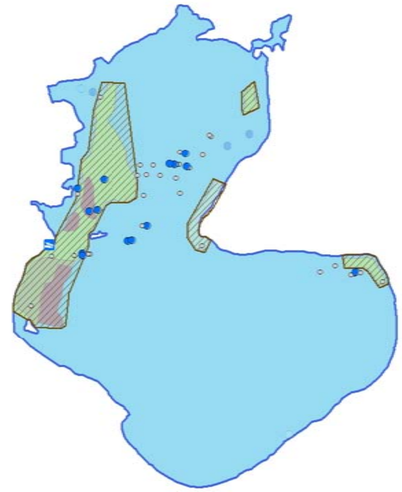


Early Season Aimed at CLP

-Before turion production

~29 acres in ‘09





Mechanical Harvest Plan

- Nuisance-native plant harvesting program
  - Relatively unchanged from past
  - Only harvest as needed
  - Pick up *floaters*, but not within conservation area
- Early-season CLP harvesting program
  - Repeat of 2009 areas & expand to include 2009 findings
  - Continue monitoring
    - Peak-biomass surveys & quantitative PI

Thank You

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

Wisconsin Lakes Partnership

UW Extension

Wisconsin Dept. of Natural Resources

B

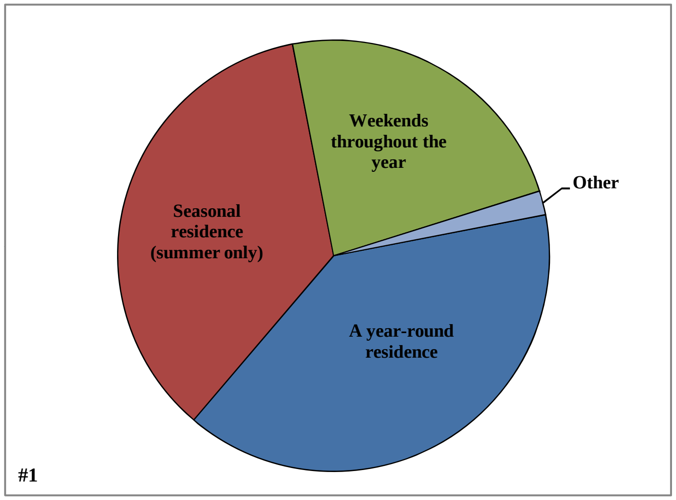
APPENDIX B

Stakeholder Survey Response Charts and Comments

Returned Surveys	55
Sent Surveys	
Response Rate (%)	#DIV/0!

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

	Total	*%*
A year-round residence	22	*39.3*
Seasonal residence (summer only)	20	*35.7*
Weekends throughout the year	13	*23.2*
Resort	0	*0.0*
Rental Property	0	*0.0*
Undeveloped	0	*0.0*
Other	1	*1.8*
	56	*100.0*

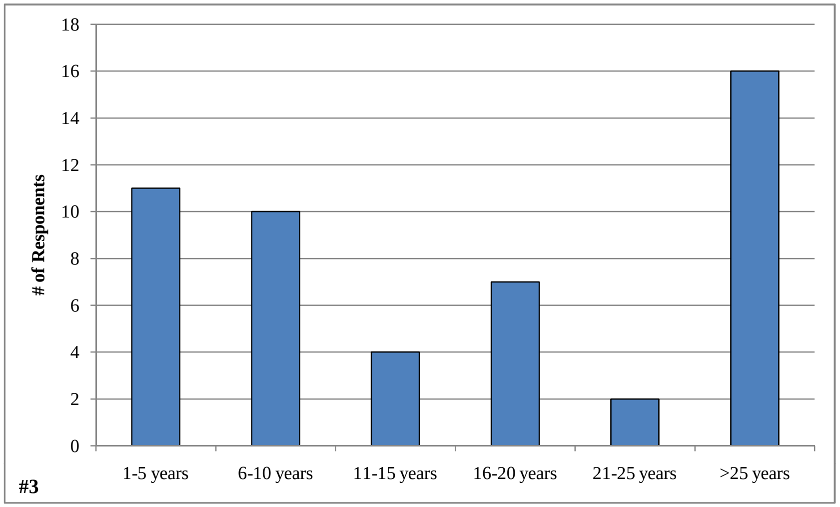


#2 If you are not a year-round resident, how many days each year is your property used by you or others?

Answered Question	30
Average	95.0
Standard deviation	56.4

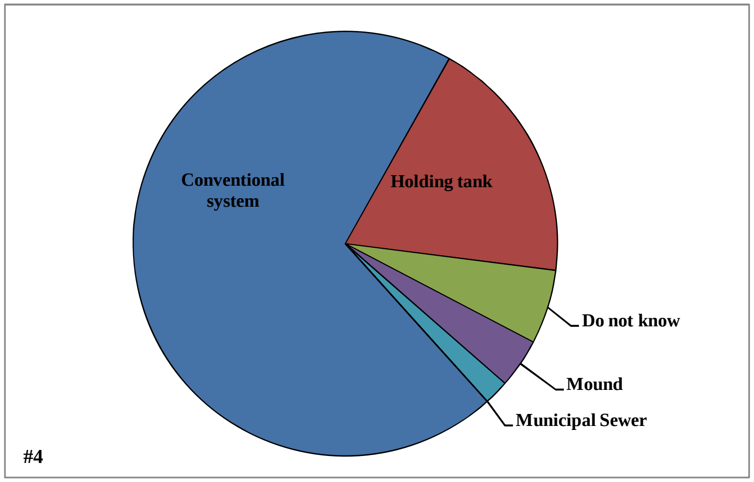
#3 How many years have you owned property on Mid Lake?

	Total	%
1-5 years	11	*22.0*
6-10 years	10	*20.0*
11-15 years	4	*8.0*
16-20 years	7	*14.0*
21-25 years	2	*4.0*
>25 years	16	*32.0*
	50	*100.0*



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

	Total	%
Conventional system	37	*69.8*
Holding tank	10	*18.9*
Do not know	3	*5.7*
Mound	2	*3.8*
Advanced treatment system	1	*1.9*
Municipal Sewer	0	*0.0*
	53	*100.0*

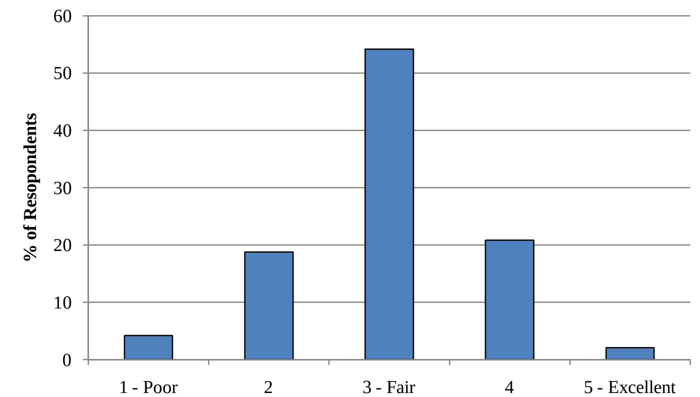


#5 Have you fished on Mid Lake in the past 3 years?

	Total	%
Yes	46	*88.5*
No	6	*11.5*
	52	*100.0*

#6 How would you describe the current quality of fishing on Mid Lake?

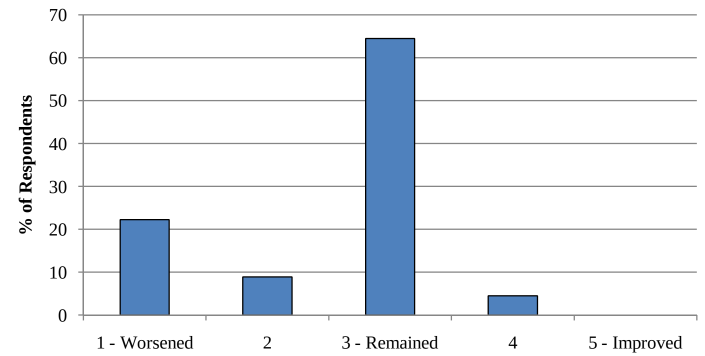
	Total	%
1 - Poor	2	*4.2*
2	9	*18.8*
3 - Fair	26	*54.2*
4	10	*20.8*
5 - Excellent	1	*2.1*
	48	*100.0*



#6

#7 How has the quality of fishing changed on Mid Lake since you obtained your property?

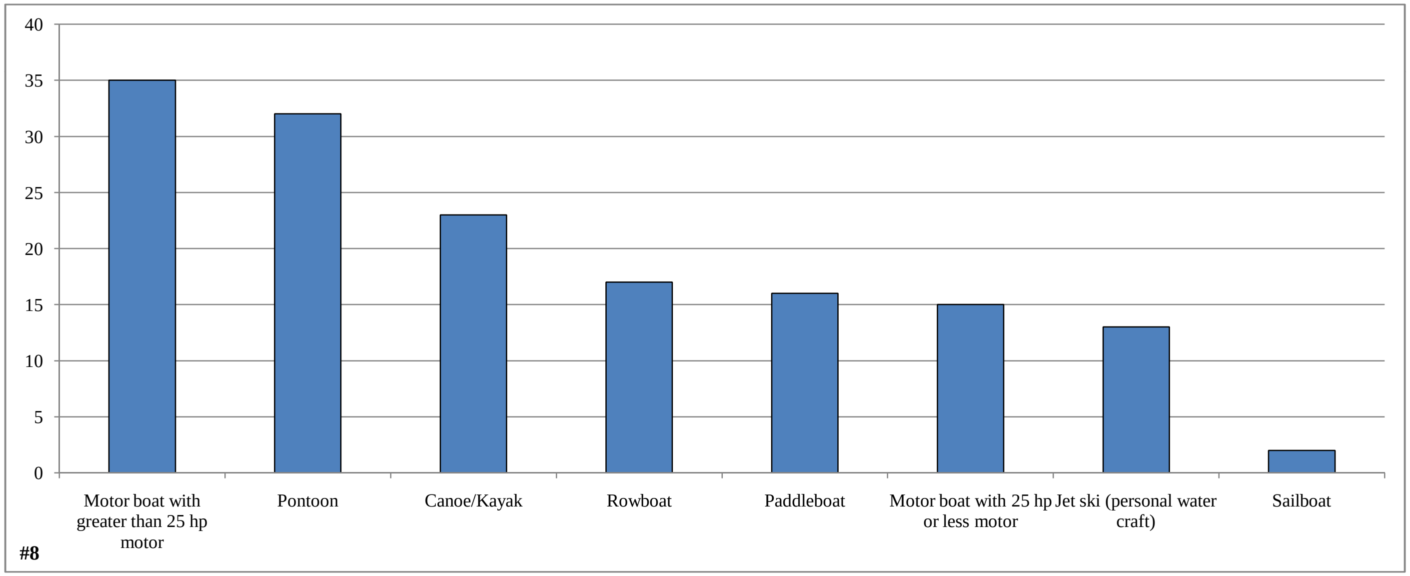
	Total	%
1 - Worsened	10	*22.2*
2	4	*8.9*
3 - Remained the Same	29	*64.4*
4	2	*4.4*
5 - Improved	0	*0.0*
	45	*100.0*



#7

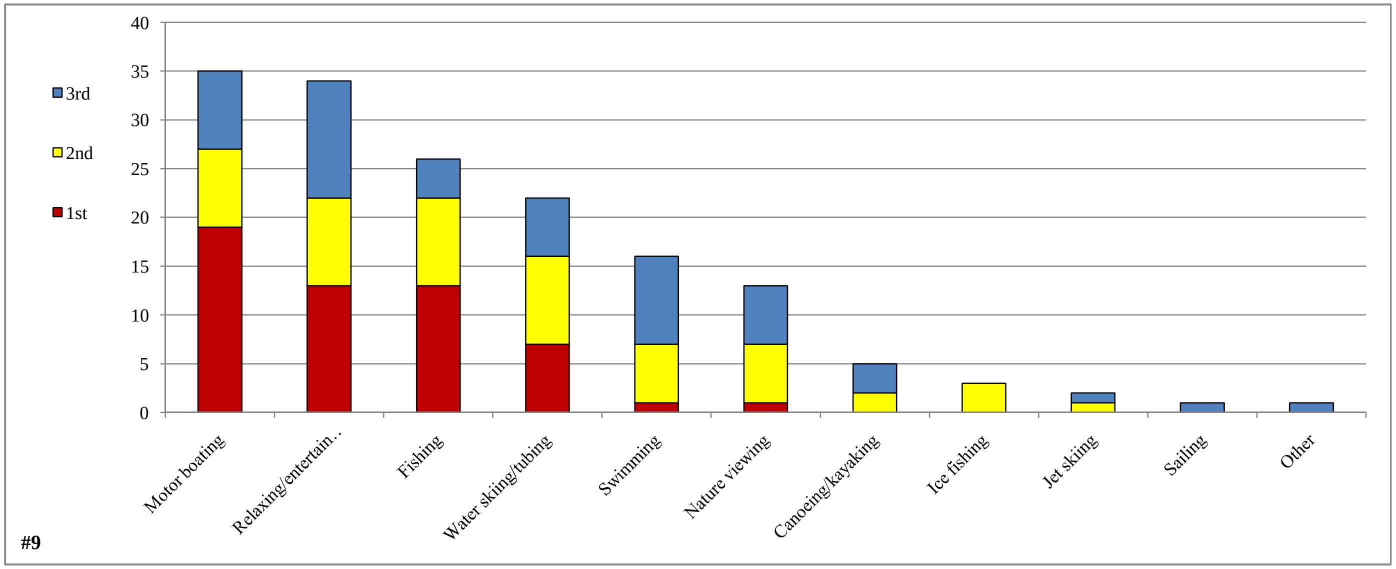
#8 What types of watercraft do you or others that use your property, currently use on the lake?

	Total
Motor boat with greater than 25 hp motor	35
Pontoon	32
Canoe/Kayak	23
Rowboat	17
Paddleboat	16
Motor boat with 25 hp or less motor	15
Jet ski (personal water craft)	13
Sailboat	2
	153



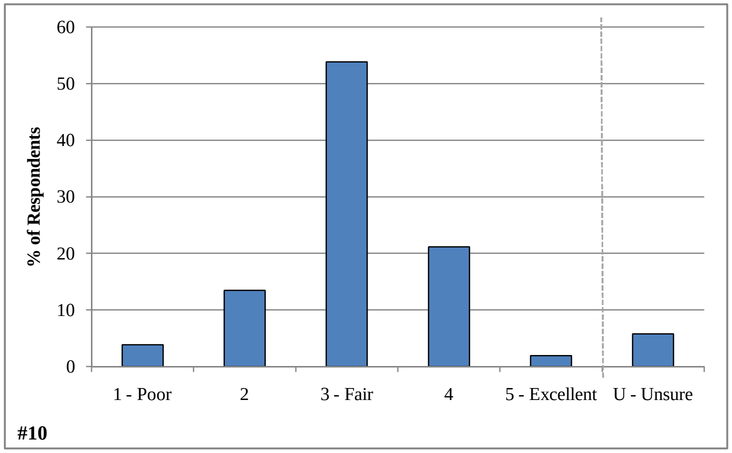
#9 Please rank the activities below that are the most important or enjoyable to you on Mid Lake?

	1st	2nd	3rd	*% ranked*
Motor boating	19	8	8	*22.2*
Relaxing/entertaining	13	9	12	*21.5*
Fishing	13	9	4	*16.5*
Water skiing/tubing	7	9	6	*13.9*
Swimming	1	6	9	*10.1*
Nature viewing	1	6	6	*8.2*
Canoeing/kayaking	0	2	3	*3.2*
Ice fishing	0	3	0	*1.9*
Jet skiing	0	1	1	*1.3*
Sailing	0	0	1	*0.6*
Other	0	0	1	*0.6*
Hunting	0	0	0	*0.0*
Snowmobiling/ATV	0	0	0	*0.0*
	54	53	51	*100.0*



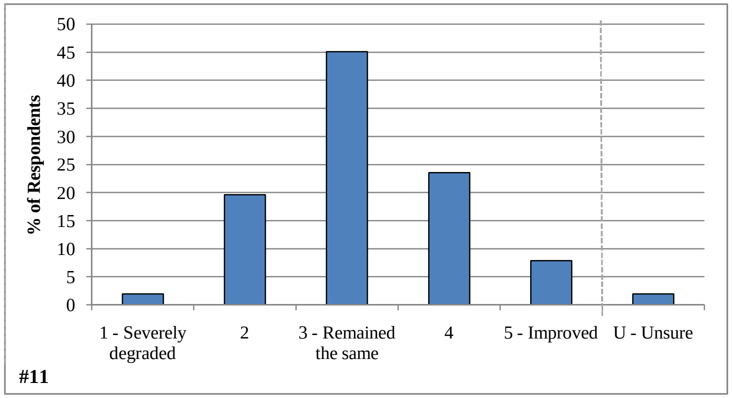
#10 How would you describe the current water quality of Mid Lake?

	Total	%
1 - Poor	2	*3.8*
2	7	*13.5*
3 - Fair	28	*53.8*
4	11	*21.2*
5 - Excellent	1	*1.9*
U - Unsure	3	*5.8*
	52	*100.0*



#11 How has the water quality changed in Mid Lake since you obtained your property?

	Total	%
1 - Severely degraded	1	*2.0*
2	10	*19.6*
3 - Remained the same	23	*45.1*
4	12	*23.5*
5 - Improved	4	*7.8*
U - Unsure	1	*2.0*
	51	*100.0*



#12 Have you ever heard of aquatic invasive species?

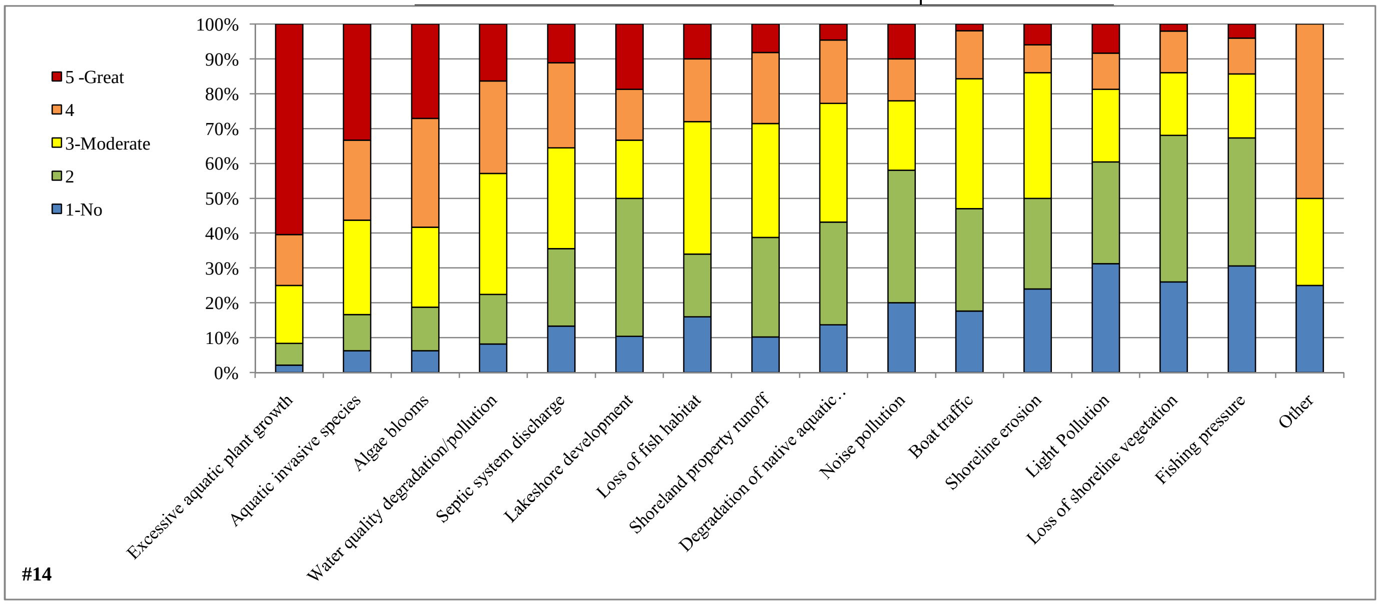
	Total	%
Yes	52	*98.1*
No	1	*1.9*
	53	*100.0*

#13 Are you aware of aquatic invasive species in Mid Lake?

	Total	%
Yes	39	*75.0*
No	13	*25.0*
	52	*100.0*

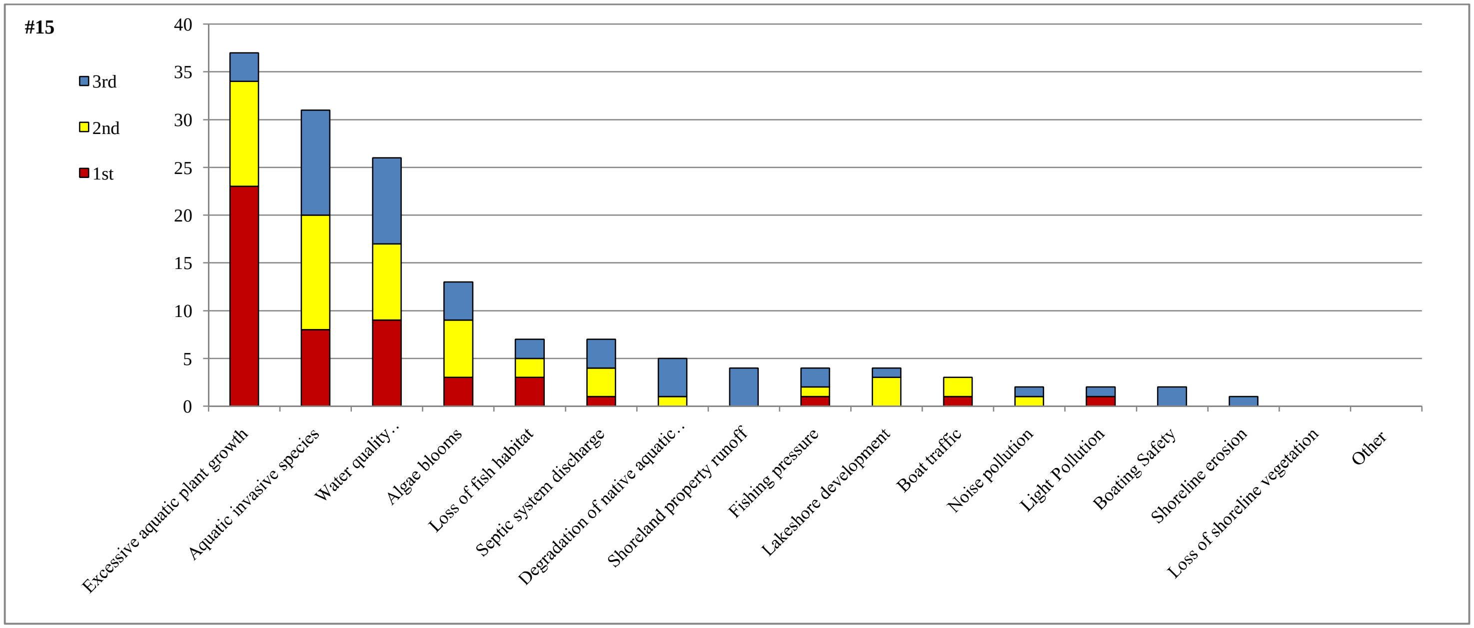
#14 To what level do you believe each the following factors are negatively impacting Mid Lake?

	1-No	2	3-Moderate	4	5 -Great	*Total*	*Average*
Excessive aquatic plant growth	1	3	8	7	29	*48*	*4.3*
Aquatic invasive species	3	5	13	11	16	*48*	*3.7*
Algae blooms	3	6	11	15	13	*48*	*3.6*
Water quality degradation/pollution	4	7	17	13	8	*49*	*3.3*
Septic system discharge	6	10	13	11	5	*45*	*3.0*
Lakeshore development	5	19	8	7	9	*48*	*2.9*
Loss of fish habitat	8	9	19	9	5	*50*	*2.9*
Shoreland property runoff	5	14	16	10	4	*49*	*2.9*
Degradation of native aquatic plants	6	13	15	8	2	*44*	*2.7*
Noise pollution	10	19	10	6	5	*50*	*2.5*
Boat traffic	9	15	19	7	1	*51*	*2.5*
Shoreline erosion	12	13	18	4	3	*50*	*2.5*
Light Pollution	15	14	10	5	4	*48*	*2.4*
Loss of shoreline vegetation	13	21	9	6	1	*50*	*2.2*
Fishing pressure	15	18	9	5	2	*49*	*2.2*
Other	1	0	1	2	0	*4*	*3.0*



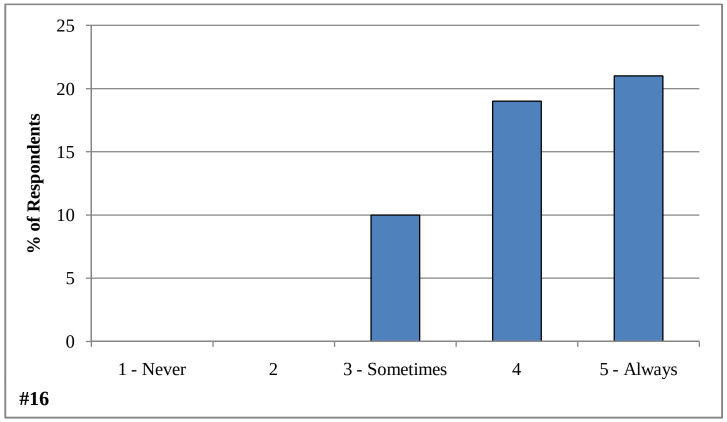
#15 From the list below, please rank your top three concerns regarding Mid Lake?

	1st	2nd	3rd	*% Ranked*
Excessive aquatic plant growth	23	11	3	*25.0*
Aquatic invasive species	8	12	11	*20.9*
Water quality degradation/pollution	9	8	9	*17.6*
Algae blooms	3	6	4	*8.8*
Loss of fish habitat	3	2	2	*4.7*
Septic system discharge	1	3	3	*4.7*
Degradation of native aquatic plants	0	1	4	*3.4*
Shoreland property runoff	0	0	4	*2.7*
Fishing pressure	1	1	2	*2.7*
Lakeshore development	0	3	1	*2.7*
Boat traffic	1	2	0	*2.0*
Noise pollution	0	1	1	*1.4*
Light Pollution	1	0	1	*1.4*
Boating Safety	0	0	2	*1.4*
Shoreline erosion	0	0	1	*0.7*
Loss of shoreline vegetation	0	0	0	*0.0*
Other	0	0	0	*0.0*
	50	50	48	*100.0*



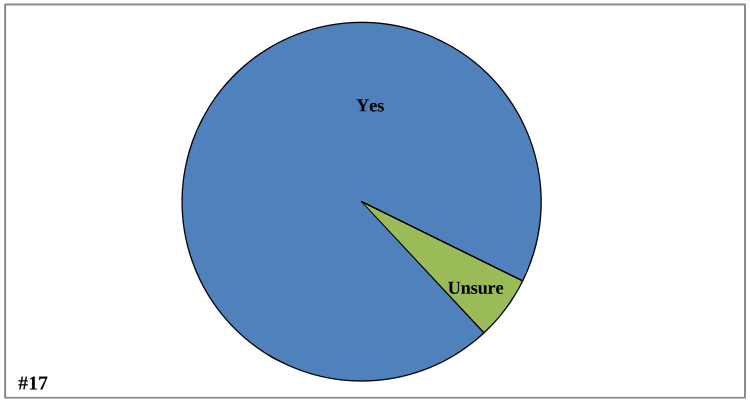
#16 How often does aquatic plant growth impact your enjoyment of Mid Lake?

	Total	%
1 - Never	0	*0.0*
2	0	*0.0*
3 - Sometimes	10	*20.0*
4	19	*38.0*
5 - Always	21	*42.0*
	50	*100.0*



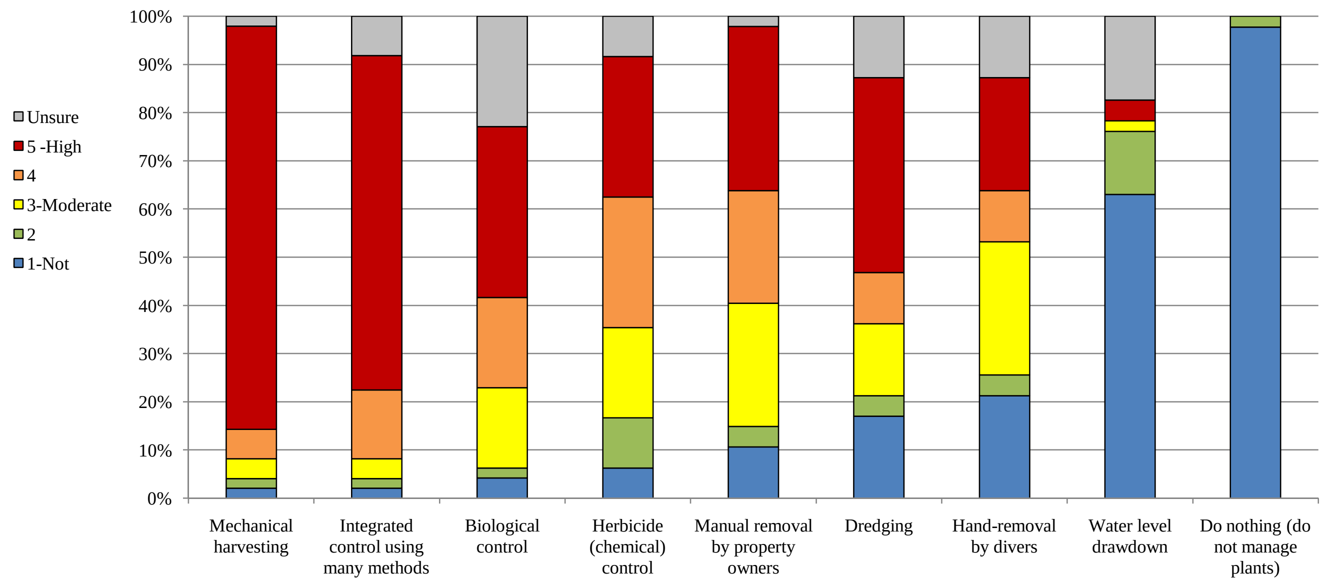
#17 Considering your answer to the question above, do you believe aquatic plant control is needed on Mid Lake?

	Total	%
Yes	49	*94.2*
No	0	*0.0*
Unsure	3	*5.8*
	52	*100.0*



#18 What is your level of support for the responsible use of the following techniques on Mid Lake?

	1-Not	2	3-Moderate	4	5 -High	Unsure	*Total*	*Average*
Mechanical harvesting	1	1	2	3	41	1	*48*	*4.7*
Integrated control using many methods	1	1	2	7	34	4	*45*	*4.6*
Biological control	2	1	8	9	17	11	*37*	*4.0*
Herbicide (chemical) control	3	5	9	13	14	4	*44*	*3.7*
Manual removal by property owners	5	2	12	11	16	1	*46*	*3.7*
Dredging	8	2	7	5	19	6	*41*	*3.6*
Hand-removal by divers	10	2	13	5	11	6	*41*	*3.1*
Water level drawdown	29	6	1	0	2	8	*38*	*1.4*
Do nothing (do not manage plants)	43	1	0	0	0	0	*44*	*1.0*



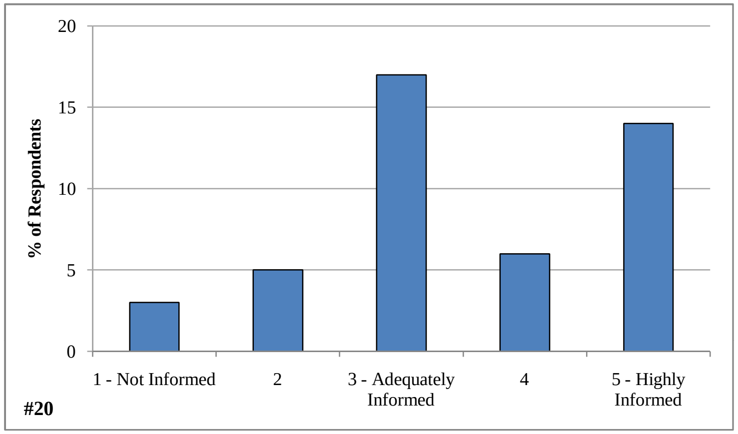
#18

#19 Before receiving this mailing, have you ever heard of the Mid Lake Protection & Rehabilitation District?

	Total	%
Yes	44	*86.3*
No	7	*13.7*
	51	*100.0*

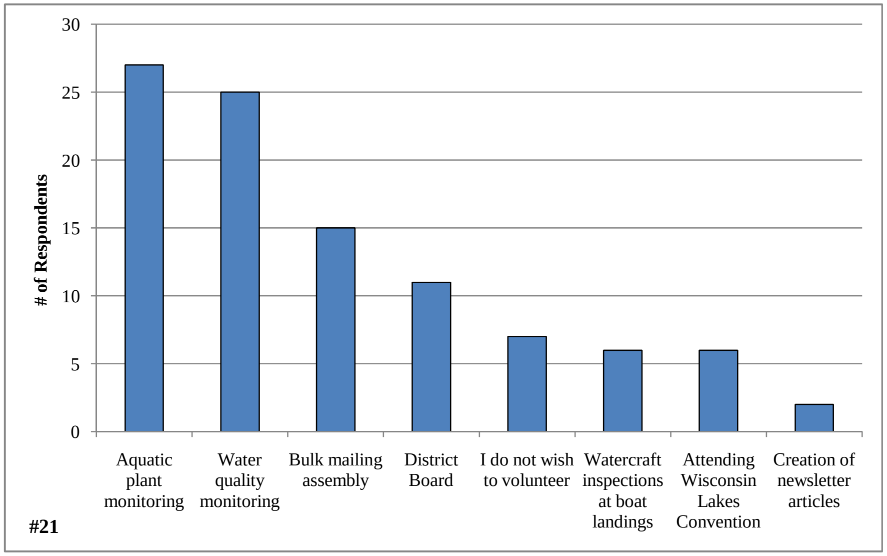
#20 Do you believe the Mid Lake Protection & Rehabilitation District has kept you adequately informed regarding issues with Mid Lake and its management?

	Total	%
1 - Not Informed	3	*6.7*
2	5	*11.1*
3 - Adequately Informed	17	*37.8*
4	6	*13.3*
5 - Highly Informed	14	*31.1*
	45	*100.0*



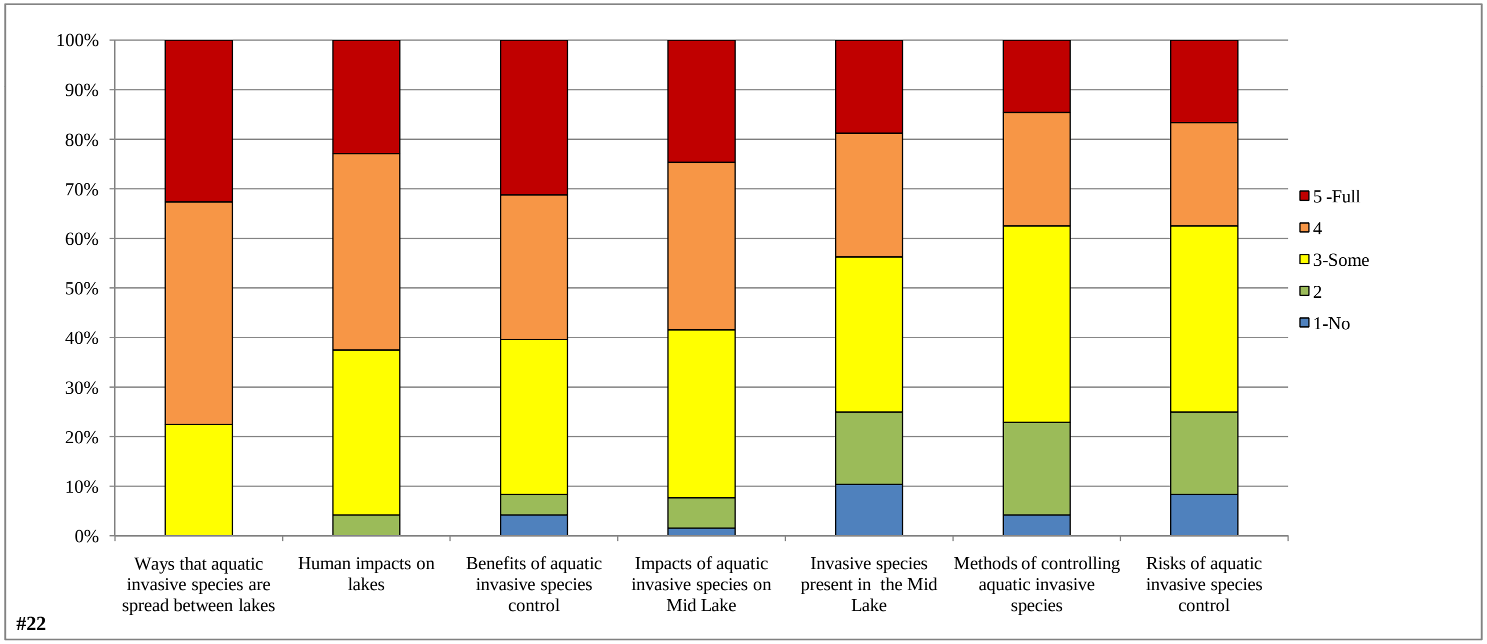
#21 Please circle the activities you would be willing to participate in if called upon.

	Total
Aquatic plant monitoring	27
Water quality monitoring	25
Bulk mailing assembly	15
District Board	11
I do not wish to volunteer	7
Watercraft inspections at boat landings	6
Attending Wisconsin Lakes Convention	6
Creation of newsletter articles	2
	99



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

	1-No	2	3-Some	4	5 -Full	*Total*	*Average*
Ways that aquatic invasive species are spread between lakes	0	0	11	22	16	*49*	*4.1*
Human impacts on lakes	0	2	16	19	11	*48*	*3.8*
Benefits of aquatic invasive species control	2	2	15	14	15	*48*	*3.8*
Impacts of aquatic invasive species on Mid Lake	1	4	22	22	16	*65*	*3.4*
Invasive species present in the Mid Lake	5	7	15	12	9	*48*	*3.3*
Methods of controlling aquatic invasive	2	9	19	11	7	*48*	*3.3*
Risks of aquatic invasive species control	4	8	18	10	8	*48*	*3.2*



Survey Number	Comments
1	Thanks a lot for taking the time to prepare this survey and for checking input form our lake community. Appreciate your efforts in attempting to keep our lake healthy and happy.
2	Dredging silt from parts of the lake to increase depth and fish habitat would be nice. Move aggressive weed control- weeds are cutting off parts of the lake and fish habitat. Light pollution - whats with the 3000 watt light bulbs - turn off the lights - the stars are spectacular. This lake should be a catch and release lake for Bass - we need bigger bass to cut down on the over-population of small bluegills and in turn their size should increase. Also (How about barbless hooks for bass fishing)
3	
4	My wife and I have only owned on Mid Lake for less than one year. But we have been regular visitors for decades. In that I feel the fishing has gone down, and the weeds have definitely gone up. I enjoy fishing, and I very much want to be able to motor across the lake without needing to clear the prop 3 times. I can go faster and not catch as many weeds, but the slow cruises are very enjoyable. Lastely, thank you for your continued efforts.
5	
6	
7	
8	I'm concerned that if a greater percentage of the lake is not subject to aquatic vegetation control of some sort then the quality of the lake for recreational boating and fishing will continue to deteriate and property values will decline. The current management a the lake in regards to aquatic vegetation control by the district is commendable given that they are restricted to harvestting only 20% of the lake. This limitation must be lifted by the DNR ASAP. We are very pleased with the Districts efforts.
9	Could some of the silt be pumped out?
10	
11	
12	
13	
14	I stongly believe we should be able to cut more weeds in our lake than 10%, which is all the DNR allows. Cutting more in the north bay would greatly help in controlling the weeds.
15	
16	
17	
18	Our weed cutters do an excellent job. The DNR rescriction this year are holding them back from doing their job as they have done in the past.
19	
20	
21	
22	
23	
24	
25	I have lived on or used Mid Lake for almost 60 years. The lake historically was an excellent fishing lake with good species of aquatic life. Then in the late 1950's or early 1960's poisons were used to control weed growth, I think with a negative impact. Fishing pressure also increased. Many people need to be educated on the proper fishing methods. If you are bobber fishing near someones dock and are catching one after another of small blue gills, that are all that are doing to be there. They don't realize that 2/3rds of the throw backs will die, killing tomorrows fishery. I think one way to improve fishing would be to enact a lake ordinance, that prohibits fishing within 150 feet of a shoreline dock, exempting the property owner. Secondly, attack the bad aquatic plants with chemicals or exessive weed harvesting when certain plants start growing to minimize their returning. Then re-evaluate after 2-years and adjust methods.
26	Mid Lake is a great lake - it's quiet and off the beaten path - it has ample wildlife and fishery - It's great for recreation and relaxation land and it's on the Chain! I applaud and appreciate the management team and its efforts!! I attend the yearly meetings and will help in any way I can to maintain the quality of Mid Lake!

Survey Number	Comments
27	Once heard that Mid Lake was choked with weeds making boating nearly impossible, esp. in the north end of the lake. That area of the lake needs to be harvested aggressively, expanding the current areas. The more weed matter removed from the lake, the healthier the lake will become. Dredging certain areas would also be a huge benefit. Limit chemical control to areas of invasives and only after full impact of chemicals is known. Also need to somehow convince DNR that we are not he enemy of our lake, that all of us have a great investment in our property. More cooperation from the DNR would be greatly appreciated.
28	
29	
30	Weed mowing is somewhat effective. I would like to see the use of chemicals to control the weeds where the mower can't or won't reach namely the west shore and around the islands.
31	Too much sea weed floating when cut, they need to be picked up more often than once a week.
32	
33	
34	
35	
36	Mid Lake property owners need more information on what each of us can do to improve water quality of the lake. I feel if we were more informed, property owners would be more likely to do their part. Newsletters or e-mails would be very beneficial.
37	
38	
39	
40	
41	I would like to see the weed cutter out more frequently for longer periods of time. I would like to see the use of herbicide to control exessive plant growth. I would like to understand the costs and possibility of dredging to remove the highly nutrient sediments in the lake.
42	Just wanted to say thank you to the men who man the weed cutter. Loads of weeds taken out require a lot of work hours. Thanks for doing such a great job! We appreciate it!
43	When boats were unable to cross the north bay our Mid Lake organization was formed to deal with it. First cutting only, then years of chemical treatments and later cutting and weed pick up. While swimming is less than enjoyable due to weeks, water skiing and other water sports are enjoyable and boats get around reasonably well. More of the lake's surface should be harvested so fewer weeds would be cut by boat propellers and float in to our swimming beaches.
44	
45	
46	
47	Cutting weeds and vegetation helps, but killing some of it might be another solution.
48	I think we shoud continue t work with DNR. Though, they can be difficult we need them on our side. I think the Board has done an excellent job of building the Association.
49	
50	
51	
52	

Survey Number	Comments
53	In the past weed harvesting was done by an outside contractor who only was on the lake about ten days each summer. Since we have had our own machine , we have greatly intensified the harvesting effort. I don't see only real difference on the results, and in addition, we now are troubled by curly-leaf pondweed and purple loosestrife that we didn't have before. There are a few ancient septic systems left on the lake, I think, but many have been replaced by new owners, etc. I believe there should be door to door inspections and find out if there are any remaining polluters. For the past ten years or so I believe we have been attempting to clear cut the weeds (for cosmetic reasons) and it has had zero impact on the density of the growth, and in addition, we are seeing growth close to shore that we never saw before, including curly-leaf pondweed and purple loosestrife (on shore). I believe we should concentrate on keeping a few lanes open to cross the lake, keep it cleaned out close to shore, and poison areas that have been hit by the new invasive species. We should not be clear cutting! The weekend pickup service is invaluable and should be continued!
54	
55	
56	

C

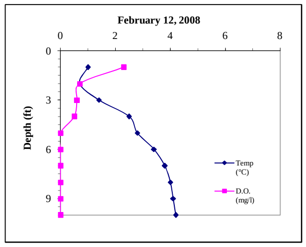
APPENDIX C

Water Quality Data

Mid

Date:	**02-13-08**	**Max Depth (ft):**	11.8
Time:	1:00	**MLS Depth (ft):**	3.0
Weather:	-10 degf	**MLB Depth (ft):**	10.0
Ent:	BTB **Verf:**	**Secchi Depth (ft):**	4.8

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	1.0	2.3	7.8	176
2.0	0.7	0.7	7.3	178
3.0	1.4	0.6	7.1	177
4.0	2.5	0.5	6.9	174
5.0	2.8	0.0	6.7	176
6.0	3.4	0.0	6.6	184
7.0	3.8	0.0	6.6	184
8.0	4.0	0.0	6.6	189
9.0	4.1	0.0	6.6	191
10.0	4.2	0.0	6.6	201



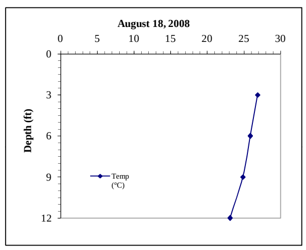
Parameter	MLS	MLB
Total P (µg/L)	23.000	NA
Dissolved P (µg/L)	3.000	NA
Chl a (µg/L)	NA	NA
TKN (µg/L	340.00	NA
NO3+NO2-N (µg/L)	ND	NA
NH3-N (µg/L)	100.000	NA
Total N (µg/L)	340.00	NA
Lab Cond. (µS/cm)	177	NA
Lab pH	7.10	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	2	NA
Calcium (mg/l)	NA	NA

Data Collected by TAH and EJH. Ice = 1.5 ft
Hydrolab malfunctioning - DO is suspect

Mid

Date:	**08-18-08**	**Max Depth (ft):**	NA
Time:	NA	**MLS Depth (ft):**	6.0
Weather:	NA	**MLB Depth (ft):**	NA
Ent:	BTB **Verf:**	**Secchi Depth (ft):**	3.8

Depth (ft)	Temp (°F)	Temp (°C)	pH	Sp. Cond (µS/cm)
3.0	75.0	26.9	NA	NA
6.0	73.4	25.9	NA	NA
9.0	71.8	24.9	NA	NA
12.0	69.0	23.1	NA	NA



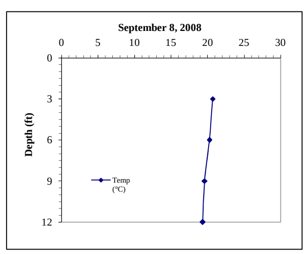
Parameter	MLS	MLB
Total P (µg/L)	40.000	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	22.00	NA
TKN (µg/L	NA	NA
NO3+NO2-N (µg/L)	NA	NA
NH3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	NA	NA
Calcium (mg/l)	NA	NA

Data collected by Roger Smith (Mid Lake CLMN)

Mid

Date:	**09-08-08**	**Max Depth (ft):**	NA
Time:	NA	**MLS Depth (ft):**	6.0
Weather:	NA	**MLB Depth (ft):**	NA
Ent:	BTB **Verf:**	**Secchi Depth (ft):**	5.0

Depth (ft)	Temp (°F)	Temp (°C)	pH	Sp. Cond (µS/cm)
3.0	65.1	20.7	NA	NA
6.0	64.4	20.3	NA	NA
9.0	63.3	19.6	NA	NA
12.0	62.9	19.3	NA	NA



Parameter	MLS	MLB
Total P (µg/L)	36.000	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	21.90	NA
TKN (µg/L	NA	NA
NO3+NO2-N (µg/L)	NA	NA
NH3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	NA	NA
Calcium (mg/l)	NA	NA

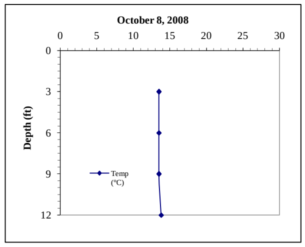
Data collected by Roger Smith (Mid Lake CLMN)

Mid

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

Max Depth (ft): NA
MLS Depth (ft): 6.0
MLB Depth (ft): NA
Secchi Depth (ft): 11.3

Depth (ft)	Temp (°F)	Temp (°C)	pH	Sp. Cond (µS/cm)
3.0	53.6	13.5	NA	NA
6.0	53.6	13.5	NA	NA
9.0	53.6	13.5	NA	NA
12.0	54.1	13.8	NA	NA



Parameter	MLS	MLB
Total P (µg/L)	27.00	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	7.21	NA
TKN (µg/L	NA	NA
NO3+NO2-N (µg/L)	NA	NA
NH3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	NA	NA
Calcium (mg/l)	NA	NA

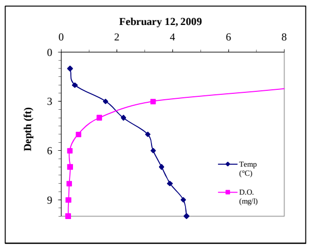
Data collected by Mid Lake CLMN

Mid

Date: 02-13-09
Time: 9:00
Weather: 26°F
Ent: EJH **Verf:**

Max Depth (ft): 10.6
MLS Depth (ft): 3.0
MLB Depth (ft): 9.0
Secchi Depth (ft): 5.1

Depth (ft)	Temp (°C)	D.O. (mg/l)	pH	Sp. Cond (µS/cm)
1.0	0.3	10.5	5.1	54
2.0	0.5	9.1	5.2	100
3.0	1.6	3.3	5.2	163
4.0	2.2	1.4	5.5	175
5.0	3.1	0.6	5.8	179
6.0	3.3	0.3	6.0	184
7.0	3.6	0.3	6.2	189
8.0	3.9	0.3	6.3	191
9.0	4.4	0.3	6.4	200
10.0	4.5	0.3	6.6	199



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

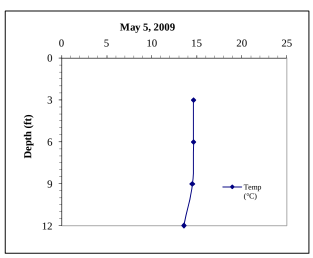
Data Collected by SNK and EJH. Ice = 2.0 ft

Mid

Date: 05-05-09
Time: 10:00
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): 12.0
MLS Depth (ft): 3.0
MLB Depth (ft): 12.0
Secchi Depth (ft): 7.0

Depth (ft)	Temp (°F)	Temp (°C)
3.0	55.4	14.6
6.0	55.4	14.6
9.0	55.2	14.5
12.0	53.7	13.6



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

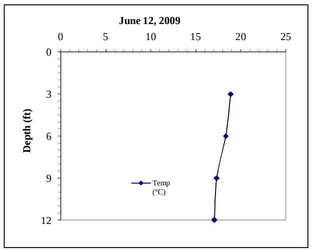
Data Collected by Roger Smith CLMN
Data were not available on SWIMS

Mid

Date: 06-12-09
Time: 1:00
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): 12.0
MLS Depth (ft): 3.0
MLB Depth (ft): 12.0
Secchi Depth (ft): 10.0

Depth (ft)	Temp (°F)	Temp (°C)
3.0	62.2	18.9
6.0	61.3	18.3
9.0	59.7	17.3
12.0	59.3	17.1



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

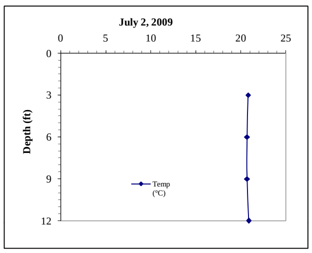
Data Collected by Roger Smith CLMN
Data were not available on SWIMS

Mid

Date: 07-02-09
Time: 10:50
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): 12.0
MLS Depth (ft): 3.0
MLB Depth (ft): 12.0
Secchi Depth (ft): 10.0

Depth (ft)	Temp (°F)	Temp (°C)
3.0	65.3	20.8
6.0	65.1	20.7
9.0	65.1	20.7
12.0	65.4	20.9



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

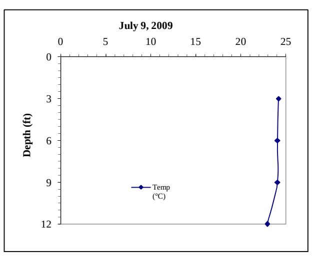
Data Collected by Roger Smith CLMN
Data were not available on SWIMS

Mid

Date: 07-09-09
Time: 11:00
Weather: NA
Ent: BTB **Verf:**

Max Depth (ft): 12.0
MLS Depth (ft): 3.0
MLB Depth (ft): 12.0
Secchi Depth (ft): 6.0

Depth (ft)	Temp (°F)	Temp (°C)
3.0	70.7	24.2
6.0	70.5	24.1
9.0	70.5	24.1
12.0	68.7	22.9



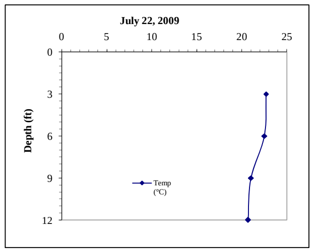
Parameter	MLS	MLB
Total P (µg/L)	NA	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	NA	NA
TKN (µg/L	NA	NA
NO3+NO2-N (µg/L)	NA	NA
NH3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	NA	NA
Calcium (mg/l)	NA	NA

Data Collected by Roger Smith CLMN
Data were not available on SWIMS

Mid

Date:	07-22-09		**Max Depth (ft):**	12.0
Time:	11:00		**MLS Depth (ft):**	3.0
Weather:	NA		**MLB Depth (ft):**	12.0
Ent:	BTB	**Verf:**	**Secchi Depth (ft):**	5.5

Depth (ft)	Temp (°F)	Temp (°C)
3.0	68.3	22.7
6.0	68.0	22.5
9.0	65.6	21.0
12.0	65.1	20.7



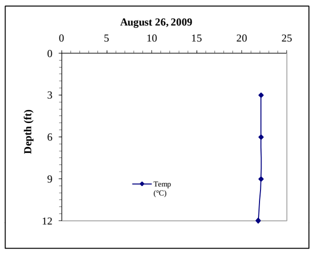
Parameter	MLS	MLB
Total P (µg/L)	NA	NA
Dissolved P (µg/L)	NA	NA
Chl a (µg/L)	NA	NA
TKN (µg/L	NA	NA
NO3+NO2-N (µg/L)	NA	NA
NH3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkal (mg/l CaCO3)	NA	NA
Total Susp Sol (mg/l)	NA	NA
Calcium (mg/l)	NA	NA

Data Collected by Roger Smith CLMN
Data were not available on SWIMS

Mid

Date:	08-26-09		**Max Depth (ft):**	12.0
Time:	NA		**MLS Depth (ft):**	3.0
Weather:	NA		**MLB Depth (ft):**	12.0
Ent:	BTB	**Verf:**	**Secchi Depth (ft):**	NA

Depth (ft)	Temp (°F)	Temp (°C)
3.0	67.4	22.1
6.0	67.4	22.1
9.0	67.4	22.1
12.0	66.9	21.8



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

Data Collected by Roger Smith CLMN
Data were not available on SWIMS

Water Quality Data

2008/2009	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	10	6.8	NA	NA
Total P (µg/L)	4	31.500	NA	NA
Dissolved P (µg/L)	1	3.000	NA	NA
Chl a (µg/L)	3	17.037	NA	NA
TKN (µg/L	1	340.000	NA	NA
NO3+NO2-N (µg/L)	1	ND	ND	ND
NH3-N (µg/L)	1	100.000	NA	NA
Total N (µg/L)	1	340.000	NA	NA
Lab Cond. (µS/cm)	1	177.000	NA	NA
Lab pH	1	7.100	NA	NA
Alkal (mg/l CaCO3)	NA	NA	NA	NA
Total Susp Sol (mg/l)	1	2.000	NA	NA
Calcium (µg/L)	NA	NA	NA	NA

Morphological / Geographical Data

Parameter	Value
Acreage	215
Volume (acre-feet)	1290
Perimeter (miles)	3.09
Shoreland Development	1.5
Maximum Depth (feet)	12
County	Oneida County
WBIC	1542600
Lillie Mason Region(1983)	Northeast Region
Nichols Ecoregion(1999)	NLFF

Watershed Data

WiLMS Class	Acreage	kg/yr	lbs/yr
Forest	981.7	36	79
Open Water	224.9	27	59
Pasture/Grass	51.6	6	13
Row Crops	0.0	0	0
Urban - Rural Residential	0.0	0	0
Wetland	97.7	4	9

Watershed to Lake Area 6 :1

Wisconsin Trophic State Index (WTSI)			
Year	TP	Chla	SD
1979		53.01	51.93
1992	56.35	49.54	49.39
2001	54.35	50.96	45.45
2003	54.87	42.57	47.15
2004	54.35		51.30
2007	55.35	49.35	
2008	56.85	57.94	58.07
2009	54.95	50.94	48.08
All Years (weighted)	54.55	51.75	49.53
WI Natural Lakes	53.19	54.23	47.33
Northeast Region	51.05	51.49	45.61

	Secchi (feet)				Chlorophyll a (µg/L)				Phosphorus (µg/L)				Phosphorus (µg/L)				Nitrogen (µg/L)			
	Growing Season		Summer		Growing Season		Summer		Growing Season				Spring Turnover		Fall Turnover		Spring Turnover		Fall Turnover	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
1979	10	6.2	6	5.74	5	11.14	3	11.39												
1992	2	6.85	2	6.85	3	8.94	2	7.17	3	38.67	2	37.5								
2001	3	9.00	3	9	3	8.67	3	8.67	3	29	3	29								
2003	2	7.50	1	8	1	2.83	1	2.83	2	25.5	1	31								
2004	7	6.46	2	6					3	29	3	29								
2007					3	6.99	3	6.99	4	33	4	33								
2008	3	6.69	1	3.75	3	17.04	1	22.00	3	34.33	1	40								
2009	5	7.40	4	7.50	3	8.64	3	8.64	4	33.25	3	31.33								
All Years (weighted)		6.9		6.8		10.5		9.6		27.5		29.8								
WI Natural Lakes				7.9				13.4				25								
Northeast Region				8.9				9.3				19								

D

APPENDIX D

Watershed Analysis WiLMS Results

Date: 10/5/2009 Scenario: Mid Oneida Current

Lake Id: Mid_Oneida

Watershed Id: Mid

Hydrologic and Morphometric Data

Tributary Drainage Area: 1131.0 acre
Total Unit Runoff: 12.2 in.
Annual Runoff Volume: 1149.8 acre-ft
Lake Surface Area <As>: 224.9 acre
Lake Volume <V>: 1430.5 acre-ft
Lake Mean Depth <z>: 6.4 ft
Precipitation - Evaporation: 5.8 in.
Hydraulic Loading: 1258.6 acre-ft/year
Areal Water Load <qs>: 5.6 ft/year
Lake Flushing Rate <p>: 0.88 1/year
Water Residence Time: 1.14 year
Observed spring overturn total phosphorus (SPO): 39 mg/m^3
Observed growing season mean phosphorus (GSM): 25.8 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	0.0	0.50	1.00	3.00	0.0	0	0	0
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	51.6	0.10	0.30	0.50	8.5	2	6	10
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	0.0	0.30	0.50	0.80	0.0	0	0	0
Rural Res (>1 Ac)	0.0	0.05	0.10	0.25	0.0	0	0	0
Wetlands	97.7	0.10	0.10	0.10	5.4	4	4	4
Forest	981.7	0.05	0.09	0.18	48.8	20	36	72
Lake Surface	224.9	0.10	0.30	1.00	37.3	9	27	91

POINT SOURCE DATA

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

SEPTIC TANK DATA

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

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	77.2	161.6	390.0	100.0
Total Loading (kg)	35.0	73.3	176.9	100.0
Areal Loading (lb/ac-year)	0.34	0.72	1.73	0.0
Areal Loading (mg/m^2-year)	38.47	80.52	194.39	0.0
Total PS Loading (lb)	0.0	0.0	0.0	0.0
Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	57.1	101.4	189.4	100.0
Total NPS Loading (kg)	25.9	46.0	85.9	100.0

Phosphorus Prediction and Uncertainty Analysis Module

Date: 10/5/2009 Scenario: **Mid Oneida Current**
Observed spring overturn total phosphorus (SPO): 39.0 mg/m^3
Observed growing season mean phosphorus (GSM): 25.8 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	14	29	70	3	12
Canfield-Bachmann, 1981 Natural Lake	13	23	45	-3	-12
Canfield-Bachmann, 1981 Artificial Lake	13	22	39	-4	-16
Rechow, 1979 General	3	6	14	-20	-78
Rechow, 1977 Anoxic	17	36	86	10	39
Rechow, 1977 water load<50m/year	8	17	41	-9	-35
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	12	25	61	-14	-36
Vollenweider, 1982 Combined OECD	11	20	42	-12	-37
Dillon-Rigler-Kirchner	6	12	28	-27	-69
Vollenweider, 1982 Shallow Lake/Res.	8	16	35	-16	-49
Larsen-Mercier, 1976	11	23	55	-16	-41
Nurnberg, 1984 Oxic	5	11	27	-15	-58

Lake Phosphorus Model	**Confidence** Lower Bound	**Confidence** Upper Bound	**Parameter** Fit?	**Back** Calculation (kg/year)	**Model** Type
Walker, 1987 Reservoir	17	56	FIT	0	GSM
Canfield-Bachmann, 1981 Natural Lake	7	66	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	7	63	FIT	1	GSM
Rechow, 1979 General	3	11	FIT	0	GSM
Rechow, 1977 Anoxic	21	69	FIT	0	GSM
Rechow, 1977 water load<50m/year	10	33	FIT	0	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	12	51	FIT	0	SPO
Vollenweider, 1982 Combined OECD	10	39	FIT	0	ANN
Dillon-Rigler-Kirchner	7	23	L	0	SPO
Vollenweider, 1982 Shallow Lake/Res.	8	32	FIT	0	ANN
Larsen-Mercier, 1976	14	44	P Pin	0	SPO
Nurnberg, 1984 Oxic	6	22	FIT	0	ANN

E

APPENDIX E

2008 Aquatic Plant Survey Data

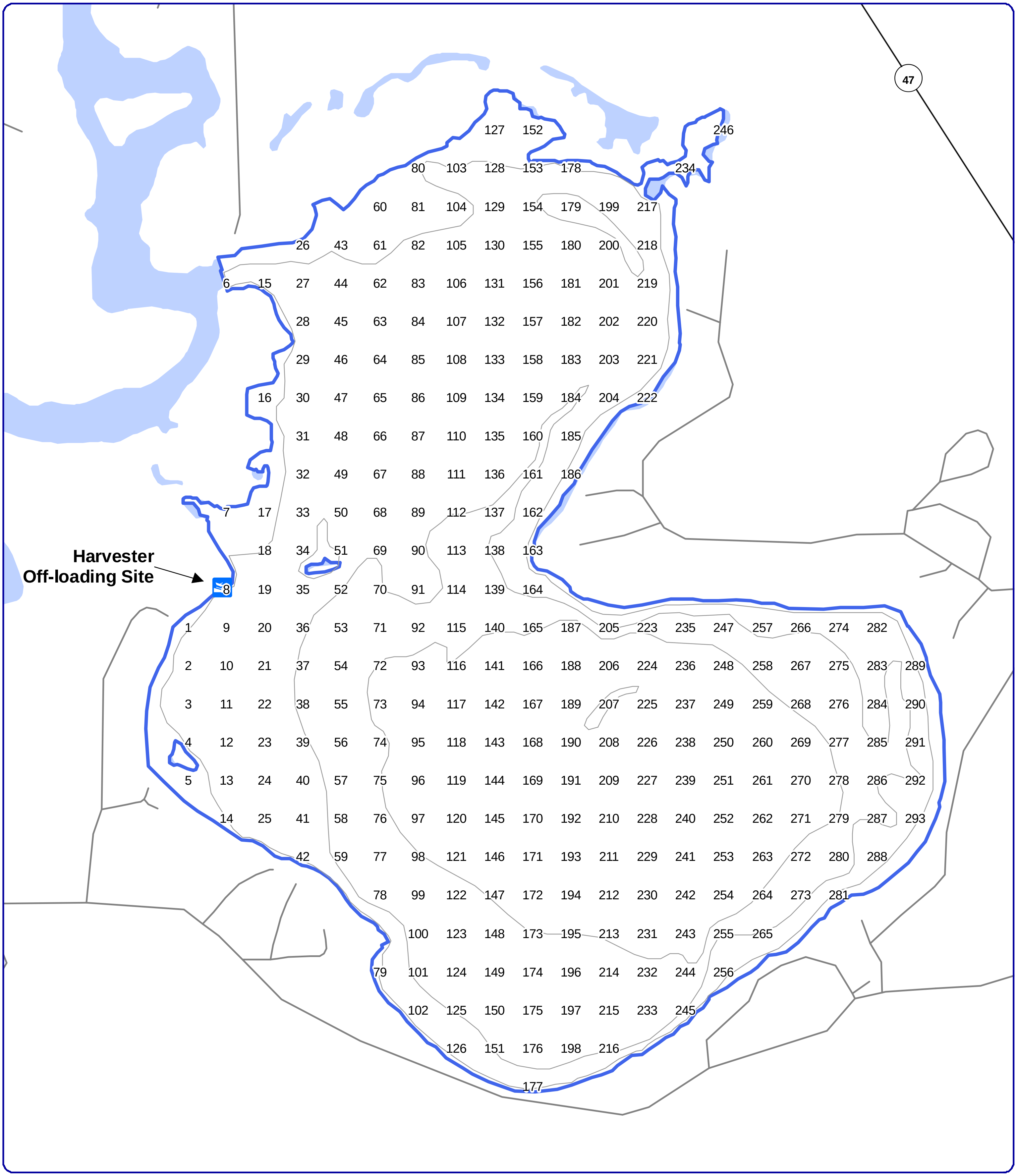
Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Comment	Potamogeton crispus	Brasenia schreberi	Ceratophyllum demersum	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Myriophyllum sibiricum	Najas flexilis	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton zosteriformis	Ranunculus aquatilis	Utricularia vulgaris	Vallisneria americana
1	45.8580257	-89.6698506	3	M	P					1		1		2									1				
2	45.8575306	-89.6698536	3	M	P		2		1	1				3											1		
3	45.8570356	-89.6698565	5	M	P					1				3			1						1	1			
4	45.8565406	-89.6698594	5	M	P		1			2				1										1			
5	45.8560456	-89.6698623	3	M	P				1			2		3					1				1				1
6	45.8624788	-89.6691157	5	M	P				3	1		2		1													
7	45.8595087	-89.6691333	3	M	P				1	1		1		1		1					1		1	1			
8	45.8585186	-89.6691392	4	M	P				1	1		1		1									1				
9	45.8580236	-89.6691422	5	M	P		2			2													1				
10	45.8575286	-89.6691451	4	M	P		1		1	2		2															
11	45.8570336	-89.669148	5	M	P							3											1	1			
12	45.8565385	-89.669151	5	M	P				1	2		1		1									1				
13	45.8560435	-89.6691539	5	M	P				1	1		2		1									1	1			
14	45.8555485	-89.6691568	3	M	P							1							2				2				
15	45.8624768	-89.6684072	5	M	P					1		1		2							1						
16	45.8609917	-89.668416	4	M	P				1	1		2			1								1	1	1		
17	45.8595066	-89.6684249	4	M	P				1	1		2			1						1		1		1		
18	45.8590116	-89.6684278	4	M	P				1	2		1	1	1							1		1	1			
19	45.8585166	-89.6684307	5	M	P							1		1													
20	45.8580216	-89.6684337	7	M	P		1			2														1			
21	45.8575265	-89.6684366	6	M	P							1		3						1							
22	45.8570315	-89.6684396	5	M	P				1	1				1						1			2				
23	45.8565365	-89.6684425	5	M	P					1		1								2			2				
24	45.8560415	-89.6684454	6	M	P					2		1											1	1			
25	45.8555464	-89.6684484	5	M	P				1	1		1		1									1	1			
26	45.8629697	-89.6676957	4	M	P				1	1		3												1			
27	45.8624747	-89.6676987	5	M	P		1					2		1													
28	45.8619797	-89.6677016	5	M	P					1	1	1									3						
28	45.8614847	-89.6677046	4	M	P			1	1	1		2		1				1	1								
29	45.8609896	-89.6677075	6	M	P					2		1		2									1				
30	45.8604946	-89.6677105	5	M	P							1		3													
31	45.8599996	-89.6677134	6	M	P		2		1	1		2		1										1			
32	45.8595046	-89.6677164	4	M	P		1		1	2	1			1									1				
33	45.8590096	-89.6677193	4	M	P		2		1	1		1											1				
34	45.8585145	-89.6677223	4	M	P					1		1											2				
35	45.8580195	-89.6677252	4	M	P				1			1		1									1				
36	45.8575245	-89.6677282	6	M	P				1	1				3						1			1				
37	45.8570295	-89.6677311	4	M	P				1								2						1	1			
38	45.8565344	-89.667734	6	M	P				1					1			1			1			1	1			
39	45.8560394	-89.667737	4	M	P				1					1						1			1	1			
40	45.8555444	-89.6677399	5	M	P				1			1											2				
41	45.8550494	-89.6677429	5	M	P				1	1		1											1	1			
43	45.8629677	-89.6669872	5	M	P							1		1							1			2			
44	45.8624726	-89.6669901	5	M	P		1		1			1		2										1			
45	45.8619776	-89.6669931	5	M	P		1					1		1													
46	45.8614826	-89.666996	5	M	P		1		1	1		1		1							1			1			
47	45.8609876	-89.666999	5	M	P		2		1			1												1			
48	45.8604926	-89.667002	4	M	P		1			2				2									1	1			
49	45.8599975	-89.6670049	5	M	P				1	1		1		1										3			
50	45.8595025	-89.6670079	5	M	P					1				2										1			
51	45.8590075	-89.6670108	4	M	P							2															
52	45.8585125	-89.6670138	6	M	P				1	1		1		1									2	1			
53	45.8580174	-89.6670167	6	M	P				1					1			1						1				
54	45.8575224	-89.6670197	5	M	P															1			3	1			
55	45.8570274	-89.6670226	10	M	P				2					1						1							
56	45.8565324	-89.6670256	4	M	P				1								1						1				
57	45.8560374	-89.6670285	5	M	P				1					3													
58	45.8555423	-89.6670315	4	M	P				1														3				
59	45.8550473	-89.6670345				Unreachable																					
60	45.8634606	-89.6662757	5	M	P									3							1			1			
61	45.8629656	-89.6662786	5	M	P				1					3													
62	45.8624706	-89.6662816	4	M	P				1					3													
63	45.8619756	-89.6662846	4	M	P				1	1				3										1			
64	45.8614805	-89.6662875	6	M	P							1		1										2			
65	45.8609855	-89.6662905	4	M	P		1		1	2		1		1									1	1			

Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Comment	Potamogeton crispus	Brasenia schreberi	Ceratophyllum demersum	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Myriophyllum sibiricum	Najas flexilis	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton zosteriformis	Ranunculus aquatilis	Utricularia vulgaris	Vallisneria americana
66	45.8604905	-89.6662934	5	M	P					2		1		1			2							1			
67	45.8599955	-89.6662964	6	M	P					3		1		1													
68	45.8595004	-89.6662994	5	M	P					2		1									1						
69	45.8590054	-89.6663023	5	M	P				1	1				3									1				
70	45.8585104	-89.6663053	7	M	P				2			1		1										1			
71	45.8580154	-89.6663083	7	M	P					1				2									1				
72	45.8575204	-89.6663112	8	M	P							1		2			1							1			
73	45.8570253	-89.6663142	9	M	P				1											3							
74	45.8565303	-89.6663171	6	M	P				1					1						1							
75	45.8560353	-89.6663201	8	M	P				1											1			2	1			
76	45.8555403	-89.6663231	6	M	P		1		2											1		1		1			
77	45.8550452	-89.666326	6	M	P				2	1													2	1			
78	45.8545502	-89.666329	4	M	P				2	1		1		3									1				
79	45.8535602	-89.6663349	4	M	P				1			1						1					1				
80	45.8639536	-89.6655642	5	M	P				1	1				1										2			
81	45.8634586	-89.6655671	5	M	P							1		3									1	1			
82	45.8629635	-89.6655701	5	M	P							1		3													
83	45.8624685	-89.6655731	6	M	P									3										1			
84	45.8619735	-89.665576	4	M	P									2						1				2			
85	45.8614785	-89.665579	5	M	P									1													
86	45.8609834	-89.665582	7	M	P				1					1									1				
87	45.8604884	-89.6655849	5	M	P							1		1										1			
88	45.8599934	-89.6655879	5	M	P				1	2		1					1							1			
89	45.8594984	-89.6655909	5	M	P					1		2					1							1			
90	45.8590034	-89.6655938	6	M	P				1			3					1										
91	45.8585083	-89.6655968	4	M	P				1			2		1			1										1
92	45.8580133	-89.6655998	5	M	P				1					3						1				1			
93	45.8575183	-89.6656027	8	M	P				2															1			
94	45.8570233	-89.6656057	9	M	P				1											1			2	1			
95	45.8565282	-89.6656087	7	M	P				2														1				
96	45.8560332	-89.6656116	8	M	P				1	1										1			3	1			
97	45.8555382	-89.6656146	6	M	P				1					1						2			1				
98	45.8550432	-89.6656176	6	M	P				1														3				
99	45.8545481	-89.6656205	5	M	P				2					1									1				
100	45.8540531	-89.6656235	8	M	P				2			1											1	1	2		
101	45.8535581	-89.6656265	4	M	P							1					2						2				
102	45.8530631	-89.6656294	6	M	P							1					1						2	1			
103	45.8639515	-89.6648556	4	M	P				1			2		1				1									
104	45.8634565	-89.6648586	4	M	P									3													
105	45.8629615	-89.6648616	5	M	P									3									1				
106	45.8624664	-89.6648645	5	M	P									3						1				1			
107	45.8619714	-89.6648675	5	M	P									2						2							
108	45.8614764	-89.6648705	5	M	P				1					2						1							
109	45.8609814	-89.6648735	4	M	P				1					1													
110	45.8604863	-89.6648764	4	M	P							1															
111	45.8599913	-89.6648794	5	M	P				1	1		1		3										1			
112	45.8594963	-89.6648824	7	M	P				1			1		1										1			
113	45.8590013	-89.6648854	7	M	P				2	1		3		1									1				
114	45.8585063	-89.6648883	6	M	P				1	1				3						1							
115	45.8580112	-89.6648913	6	M	P				1					3													
116	45.8575162	-89.6648943	8	M	P				1					1									2	1			
117	45.8570212	-89.6648972	9	M	P				2											1							
118	45.8565262	-89.6649002	7	M	P	No Vegetation			1															1			
119	45.8560311	-89.6649032	12	M	P				3					1										1			
120	45.8555361	-89.6649062	5	M	P					1				1						1			2	1			
121	45.8550411	-89.6649091	8	M	P																		3	1			
122	45.8545461	-89.6649121	5	M	P				1											1			1	1			
123	45.854051	-89.6649151	7	M	P				2											1			1	1			
124	45.853556	-89.6649181	6	M	P				1											1			1	3			
125	45.853061	-89.664921	6	M	P				1					1			1						3				
126	45.852566	-89.664924	6	M	P							1											2	1			
127	45.8644444	-89.6641441				Unreachable																					
128	45.8639494	-89.6641471				Unreachable																					
129	45.8634544	-89.66415	3	M	P									1										2			
130	45.8629594	-89.664153	5	M	P									3													

Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Comment	Potamogeton crispus	Brasenia schreberi	Ceratophyllum demersum	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Myriophyllum sibiricum	Najas flexilis	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton zosteriformis	Ranunculus aquatilis	Utricularia vulgaris	Vallisneria americana
131	45.8624644	-89.664156	5	M	P				1					3													
132	45.8619693	-89.664159	5	M	P				1					3										1			
133	45.8614743	-89.664162	6	M	P									3													
134	45.8609793	-89.6641649	4	M	P					1				3										1			
135	45.8604843	-89.6641679	6	M	P									3													
136	45.8599892	-89.6641709	5	M	P									1													
137	45.8594942	-89.6641739	4	M	P				1	1		1		3									1	1			
138	45.8589992	-89.6641769	5	M	P							1		3													
139	45.8585042	-89.6641798	8	M	P				1	1				1						1							
140	45.8580092	-89.6641828	6	M	P				1					3													
141	45.8575141	-89.6641858	7	M	P				2					1										1			
142	45.8570191	-89.6641888	6	M	P															1				2			
143	45.8565241	-89.6641918				No Data																					
144	45.8560291	-89.6641947	7	M	P				1					3						1				1			
145	45.855534	-89.6641977	10	M	P				1											1				2			
146	45.855039	-89.6642007	7	M	P				1	1													2	1			
147	45.854544	-89.6642037	8	M	P				1															3			
148	45.854049	-89.6642067	10	M	P				1														2				
149	45.8535539	-89.6642096	5	M	P															1			2				
150	45.8530589	-89.6642126	6	M	P				1					1			1			1				2			
151	45.8525639	-89.6642156	4	M	P							2											1				
152	45.8644424	-89.6634355	3	M	P			1				1			1	1										1	
153	45.8639473	-89.6634385	3	M	P					1				1													
154	45.8634523	-89.6634415	4	M	P				1			1		3										2			
155	45.8629573	-89.6634445	5	M	P									3						1				1			
156	45.8624623	-89.6634475	6	M	P									2													
157	45.8619672	-89.6634505	5	M	P				1					1										1			
158	45.8614722	-89.6634534	6	M	P									3								1		1			
159	45.8609772	-89.6634564	6	M	P									2										1			
160	45.8604822	-89.6634594	5	M	P									1						2							
161	45.8599872	-89.6634624	5	M	P							1		3													
162	45.8594921	-89.6634654	4	M	P				2	1		1		2									1	1			
163	45.8589971	-89.6634684	2	S	P							1		1					1					1			
164	45.8585021	-89.6634714	5	M	P							1					1						2	1	1		
165	45.8580071	-89.6634743	10	M	P				1	1				2													
166	45.857512	-89.6634773	6	M	P				1														1	1			
167	45.857017	-89.6634803	6	M	P				1					1										1			
168	45.856522	-89.6634833	8	M	P				1					1										2			
169	45.856027	-89.6634863	7	M	P				1					1										1			
170	45.855532	-89.6634893	5	M	P				1															2			
171	45.8550369	-89.6634923	9	M	P				1															2			
172	45.8545419	-89.6634952	8	M	P				3					1									1	1			
173	45.8540469	-89.6634982	9	M	P				1											1			1				
174	45.8535519	-89.6635012	5	M	P				1					2						1			1	1			
175	45.8530568	-89.6635042	6	M	P				2														1	1			
176	45.8525618	-89.6635072	6	M	P				1														3	1			
177	45.8520668	-89.6635102	5	M	P																		3	1			
178	45.8639452	-89.66273	3	M	P						1			1										1			
179	45.8634502	-89.662733	4	M	P									2									1	1			
180	45.8629552	-89.6627359	5	M	P									3													
181	45.8624602	-89.6627389	5	M	P									2										1			
182	45.8619652	-89.6627419	4	M	P				1	1				3						1							
183	45.8614701	-89.6627449	5	M	P									2						1	1						
184	45.8609751	-89.6627479	6	M	P									1													
185	45.8604801	-89.6627509	5	M	P		1		1			1		1							1			2			
186	45.8599851	-89.6627539	4	M	P				1			1	1	2										1			
187	45.858005	-89.6627659	8	M	P				1	1				1										2			
188	45.85751	-89.6627689	14	M	P				1														1	1			
189	45.8570149	-89.6627719	13	M	P				1															2			
190	45.8565199	-89.6627748	9	M	P									1									1				
191	45.8560249	-89.6627778	14	M	P				1															2			
192	45.8555299	-89.6627808	6	M	P				1															2			
193	45.8550348	-89.6627838	8	M	P				1															2			
194	45.8545398	-89.6627868	8	M	P																		1	2			
195	45.8540448	-89.6627898	7	M	P				1														1	2			

Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Comment	Potamogeton crispus	Brasenia schreberi	Ceratophyllum demersum	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Myriophyllum sibiricum	Najas flexilis	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton zosteriformis	Ranunculus aquatilis	Utricularia vulgaris	Vallisneria americana
196	45.8535498	-89.6627928	9	M	P				1											1			3				
197	45.8530547	-89.6627958	5	M	P					1													3				
198	45.8525597	-89.6627988	5	M	P				1														3	1			
199	45.8634481	-89.6620244	5	M	P				1	1		1		3										1			
200	45.8629531	-89.6620274	4	M	P	No Vegetation																					
201	45.8624581	-89.6620304	4	M	P				1					1						2				1			
202	45.8619631	-89.6620334	6	M	P									3									1	1			
203	45.861468	-89.6620364	6	M	P									2							1		1				
204	45.860973	-89.6620394	5	M	P				1	1		1		3										1			
205	45.8580029	-89.6620574	5	M	P							1										1	2				
206	45.8575079	-89.6620604	8	M	P				1					2									1	1			
207	45.8570128	-89.6620634	10	M	P				1					2										1			
208	45.8565178	-89.6620664	11	M	P				1					2										1			
209	45.8560228	-89.6620694	11	M	P				1					1										1			
210	45.8555278	-89.6620724	10	M	P				1															2			
211	45.8550327	-89.6620754	8	M	P				1											1			2				
212	45.8545377	-89.6620784	10	M	P				1														1	3			
213	45.8540427	-89.6620814	7	M	P				1											1			2				
214	45.8535477	-89.6620844	5	M	P				1	1				1									3	1			
215	45.8530527	-89.6620874	6	M	P																		3				
216	45.8525576	-89.6620904	5	M	P				2	1		1											2	1			
217	45.863446	-89.6613159	4	M	P									2													
218	45.862951	-89.6613189	4	M	P	No Vegetation																					
219	45.862456	-89.6613219	5	M	P		2			1				2													
220	45.861961	-89.6613249	6	M	P					1				1										2			
221	45.8614659	-89.6613279	5	M	P							1		1							1			1			
222	45.8609709	-89.6613309	3	M	P							1		3										1			
223	45.8580008	-89.6613489	7	M	P				1			1											2	1			
224	45.8575058	-89.6613519	6	M	P				1														1	2			
225	45.8570107	-89.6613549	6	M	P				1					1										2			
226	45.8565157	-89.6613579	10	M	P				1					1										2			
227	45.8560207	-89.6613609	11	M	P				1					1									1				
228	45.8555257	-89.6613639	10	M	P				1														1	3			
229	45.8550307	-89.661367	10	M	P																		2				
230	45.8545356	-89.66137	10	M	P									2									2	1			
231	45.8540406	-89.661373	9	M	P				1	1														3			
232	45.8535456	-89.661376	8	M	P				1															2			
233	45.8530506	-89.661379	6	M	P				1			1		1									1	1			
234	45.863939	-89.6606043				Unreachable																					
235	45.8579987	-89.6606404	6	M	P				1			1											1	2			
236	45.8575037	-89.6606435	9	M	P				1														2	1			
237	45.8570086	-89.6606465	13	M	P				1					1										1			
238	45.8565136	-89.6606495	9	M	P				1															2			
239	45.8560186	-89.6606525	11	M	P				2											1			1	1			
240	45.8555236	-89.6606555	9	M	P																		3				
241	45.8550285	-89.6606585	10	M	P				1	1										1			1	1			
242	45.8545335	-89.6606615	8	M	P				1														3				
243	45.8540385	-89.6606645	10	M	P				1															3			
244	45.8535435	-89.6606675	5	M	P				1														1	1			
245	45.8530485	-89.6606706	5	M	P				3	1		1	1										1				
246	45.8644319	-89.6598927				Unreachable																					
247	45.8579966	-89.659932	7	M	P				1	1		1		1								1	1	1			
248	45.8575016	-89.659935	6	M	P																			2			
249	45.8570065	-89.659938	7	M	P				1														1	1			
250	45.8565115	-89.659941	10	M	P				1											1			1	1			
251	45.8560165	-89.659944	9	M	P				1														2				
252	45.8555215	-89.6599471	9	M	P				1					1						1			1	1			
253	45.8550264	-89.6599501	10	M	P															1			2	1			
254	45.8545314	-89.6599531	9	M	P				1			1												1			
255	45.8540364	-89.6599561	10	M	P				2					2										2			
256	45.8535414	-89.6599591	4	M	P				1	1		3	1											1			
257	45.8579945	-89.6592235	5	M	P				1			1		1									1				
258	45.8574994	-89.6592265	8	M	P		1										1						1	2			
259	45.8570044	-89.6592295	7	M	P																		2				
260	45.8565094	-89.6592326	8	M	P				1											1				2			

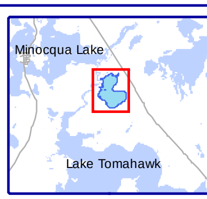
Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Depth (ft)	Sediment type (M=muck, S=Sand, R=Rock)	Rope (R); Pole (P); Visual (V)	Comment	Potamogeton crispus	Brasenia schreberi	Ceratophyllum demersum	Elodea canadensis	Heteranthera dubia	Lemna trisulca	Myriophyllum sibiricum	Najas flexilis	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton praelongus	Potamogeton pusillus	Potamogeton richardsonii	Potamogeton robbinsii	Potamogeton zosteriformis	Ranunculus aquatilis	Utricularia vulgaris	Vallisneria americana
261	45.8560144	-89.6592356	9	M	P				1					1									1	2			
262	45.8555194	-89.6592386	11	M	P				1															3			
263	45.8550243	-89.6592416	7	M	P				1															2			
264	45.8545293	-89.6592447	5	M	P				1														2				
265	45.8540343	-89.6592477	5	M	P				2														1				
266	45.8579924	-89.658515	5	M	P				1			3											1	1	1		
267	45.8574973	-89.6585181	4	M	P				1	1													1	2			
268	45.8570023	-89.6585211	5	M	P									1						1			2				
269	45.8565073	-89.6585241	6	M	P																		2				
270	45.8560123	-89.6585271	7	M	P				1											1			2	1			
271	45.8555172	-89.6585302	10	M	P				1														2	1			
272	45.8550222	-89.6585332	8	M	P				1					1										2			
273	45.8545272	-89.6585362	6	M	P				1														3				
274	45.8579902	-89.6578065	4	M	P				1			1		1							1		2				
275	45.8574952	-89.6578096	5	M	P				1	1				3													
276	45.8570002	-89.6578126	7	M	P				1	1							1						3	1			
277	45.8565052	-89.6578157	6	M	P															1			2				
278	45.8560101	-89.6578187	7	M	P				2											1			1				
279	45.8555151	-89.6578217	7	M	P				1	1													3				
280	45.8550201	-89.6578248	5	M	P				1					2									3	1			
281	45.8545251	-89.6578278	4	M	P				1			1									1		2	1			
282	45.8579881	-89.6570981	4	M	P				1	2		1											1	1			
283	45.8574931	-89.6571011	4	M	P				1			1											3	1			
284	45.8569981	-89.6571042	6	M	P				1														2				
285	45.856503	-89.6571072	6	M	P				1					1										1			
286	45.856008	-89.6571102	7	M	P																		2				
287	45.855513	-89.6571133	4	M	P				1														3	1			
288	45.855018	-89.6571163	5	M	P					1		1											3				
289	45.857491	-89.6563926	3	M	P				1	1		1									1		1	1	1		
290	45.8569959	-89.6563957	5	M	P							1		1										1			
291	45.8565009	-89.6563987	5	M	P				2														2				
292	45.8560059	-89.6564018	5	M	P				2														1	1			
293	45.8555109	-89.6564048	6	M	P					1													2	1			



600
Feet

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

Sources:
Aquatic Plant Survey: Onterra, 2008
Roads and Hydro: WDNR
Map Date: May 25, 2010



Extent of large map shown in red.

Legend

Point-intercept Sample Location

Appendix E

Mid Lake

Onieda County, Wisconsin

Point-intercept Sample Locations

F

APPENDIX F

WDNR Fish Stocking Data for the Minocqua Chain

Kawaguesaga Lake WDNR Fish Stocking

Year	Stocked Waterbody	Species	Age Class	# Fish Stocked	Avg Fish Length (in)
1973	Kawaguesaga Lake	Muskellunge	Fingerling	1,600	9
1974	Kawaguesaga Lake	Muskellunge	Fingerling	300	11
1976	Kawaguesaga Lake	Muskellunge	Fingerling	600	7
1979	Kawaguesaga Lake	Muskellunge	Fingerling	1,919	9
1981	Kawaguesaga Lake	Muskellunge	Fingerling	200	12
1983	Kawaguesaga Lake	Muskellunge	Fingerling	1,538	10.33
1984	Kawaguesaga Lake	Muskellunge	Fingerling	1,290	9
1985	Kawaguesaga Lake	Muskellunge	Fingerling	1,000	13
1987	Kawaguesaga Lake	Muskellunge	Fingerling	1,245	12
1987	Kawaguesaga Lake	Muskellunge	Fry	36,000	3
1989	Kawaguesaga Lake	Muskellunge	Fingerling	3,300	7
1991	Kawaguesaga Lake	Muskellunge	Fingerling	420	11
1992	Kawaguesaga Lake	Muskellunge	Fingerling	600	11
1993	Kawaguesaga Lake	Muskellunge	Fingerling	600	12.4
1996	Kawaguesaga Lake	Muskellunge	Fingerling	670	10
1997	Kawaguesaga Lake	Muskellunge	Fry	100,000	0.5
1998	Kawaguesaga Lake	Muskellunge	Large Fingerling	670	12.35
2000	Kawaguesaga Lake	Muskellunge	Large Fingerling	670	10.9
1974	Kawaguesaga Lake	Walleye	Fingerling	10,270	3
1976	Kawaguesaga Lake	Walleye	Fingerling	20,000	3
1987	Kawaguesaga Lake	Walleye	Fry	1,352,000	2
1987	Kawaguesaga Lake	Walleye		676,000	
1988	Kawaguesaga Lake	Walleye	Fry	2,296,000	3
1992	Kawaguesaga Lake	Walleye	Fry	283,000	0

Minocqua Lake WDNR Fish Stocking

Year	Stocked Waterbody	Species	Age Class	# Fish Stocked	Avg Fish Length (in)
1972	Minocqua Lake	Muskellunge	Fry	156,700	1
1973	Minocqua Lake	Muskellunge	Fingerling	2,742	9
1973	Minocqua Lake	Muskellunge	Fry	62,000	
1974	Minocqua Lake	Muskellunge	Fingerling	1,705	8
1974	Minocqua Lake	Muskellunge	Fry	222,750	1
1975	Minocqua Lake	Muskellunge	Fry	117,571	
1976	Minocqua Lake	Muskellunge	Fingerling	865	12
1976	Minocqua Lake	Muskellunge	Fry	125,000	
1977	Minocqua Lake	Muskellunge	Fingerling	500	11
1977	Minocqua Lake	Muskellunge	Fry	254,700	
1978	Minocqua Lake	Muskellunge	Fingerling	1,519	12
1979	Minocqua Lake	Muskellunge	Fingerling	2,436	11.33
1979	Minocqua Lake	Muskellunge	Fry	131,250	
1980	Minocqua Lake	Muskellunge	Fingerling	1,266	3
1980	Minocqua Lake	Muskellunge	Fry	67,553	
1981	Minocqua Lake	Muskellunge	Fingerling	645	12
1981	Minocqua Lake	Muskellunge	Fry	271,750	
1982	Minocqua Lake	Muskellunge	Fingerling	2,209	11.6
1982	Minocqua Lake	Muskellunge	Fry	291,600	
1984	Minocqua Lake	Muskellunge	Fingerling	2,408	10
1985	Minocqua Lake	Muskellunge	EGG	50,000	1
1985	Minocqua Lake	Muskellunge	Fingerling	2,500	12.75
1987	Minocqua Lake	Muskellunge	Fingerling	8,058	11
1987	Minocqua Lake	Muskellunge	Fry	138,900	3
1989	Minocqua Lake	Muskellunge	Fingerling	4,194	9.75
1990	Minocqua Lake	Muskellunge	Fry	35,100	1
1991	Minocqua Lake	Muskellunge	Fingerling	1,410	11.67
1992	Minocqua Lake	Muskellunge	Fingerling	1,547	11
1993	Minocqua Lake	Muskellunge	Fingerling	3,099	9.5
1995	Minocqua Lake	Muskellunge	Fingerling	1,800	10.3
1997	Minocqua Lake	Muskellunge	Fry	131,000	0.5
1997	Minocqua Lake	Muskellunge	Large Fingerling	900	10.7
1972	Minocqua Lake	Walleye	Fingerling	20,000	3
1975	Minocqua Lake	Walleye	Fingerling	20,000	3
1987	Minocqua Lake	Walleye	Fry	960,000	2
1987	Minocqua Lake	Walleye		480,000	
1988	Minocqua Lake	Walleye	Fry	1,180,000	3
1989	Minocqua Lake	Walleye	Fry	300,000	3
1990	Minocqua Lake	Walleye	Fry	612,000	1
1991	Minocqua Lake	Walleye	Fry	4,000,000	0
1996	Minocqua Lake	Walleye	Fry	500,000	0.3
1997	Minocqua Lake	Walleye	Fry	2,000,000	0.3
1997	Minocqua Lake	Walleye	Large Fingerling	27,625	2.1
2000	Minocqua Lake	Walleye	Fry	3,000,000	0.3

Tomahawk Lake WDNR Fish Stocking

Year	Stocked Waterbody	Species	Age Class	# Fish Stocked	Avg Fish Length (in)
1974	Tomahawk Lake	Lake Whitefish	Egg	124,917	
1973	Tomahawk Lake	Muskellunge	Fingerling	575	13
1973	Tomahawk Lake	Muskellunge	Fry	94,250	
1974	Tomahawk Lake	Muskellunge	Fingerling	2,317	10.2
1976	Tomahawk Lake	Muskellunge	Fingerling	686	11
1977	Tomahawk Lake	Muskellunge	Fingerling	7,757	7
1978	Tomahawk Lake	Muskellunge	Fingerling	722	12
1979	Tomahawk Lake	Muskellunge	Fingerling	2,500	9
1980	Tomahawk Lake	Muskellunge	Fingerling	3,493	7.83
1980	Tomahawk Lake	Muskellunge	Fry	32,400	
1983	Tomahawk Lake	Muskellunge	Fingerling	3,000	10
1985	Tomahawk Lake	Muskellunge	Fingerling	4,420	11.33
1987	Tomahawk Lake	Muskellunge	Fingerling	5,817	11.67
1988	Tomahawk Lake	Muskellunge	Fingerling	86	10
1989	Tomahawk Lake	Muskellunge	Fingerling	7,377	7.67
1990	Tomahawk Lake	Muskellunge	Fry	101,250	1
1991	Tomahawk Lake	Muskellunge	Fingerling	2,355	11.5
1992	Tomahawk Lake	Muskellunge	Fingerling	4,055	10.83
1992	Tomahawk Lake	Muskellunge	Fry	82,750	1
1993	Tomahawk Lake	Muskellunge	Fingerling	1,385	10.5
1995	Tomahawk Lake	Muskellunge	Fry	200,000	0.4
1996	Tomahawk Lake	Muskellunge	Fry	82,400	0.5
1997	Tomahawk Lake	Muskellunge	Fry	334,000	0.5
1997	Tomahawk Lake	Muskellunge	Large Fingerling	1,500	10.9
1998	Tomahawk Lake	Muskellunge	Fry	56,750	0.5
1999	Tomahawk Lake	Muskellunge	Large Fingerling	1,000	12.1
2000	Tomahawk Lake	Muskellunge	Fry	42,100	0.5
1972	Tomahawk Lake	Walleye	Fry	8,408,834	1
1973	Tomahawk Lake	Walleye	Fry	5,400,000	
1974	Tomahawk Lake	Walleye	Fingerling	21,186	5
1974	Tomahawk Lake	Walleye	Fry	4,200,000	
1975	Tomahawk Lake	Walleye	Fry	3,500,000	
1976	Tomahawk Lake	Walleye	Fingerling	40,000	3
1976	Tomahawk Lake	Walleye	Fry	2,820,000	
1977	Tomahawk Lake	Walleye	Fry	1,500,000	
1978	Tomahawk Lake	Walleye	Fry	2,344,000	
1979	Tomahawk Lake	Walleye	Fingerling	102,545	3.4
1979	Tomahawk Lake	Walleye	Fry	1,480,000	
1980	Tomahawk Lake	Walleye	Fingerling	38,350	4
1980	Tomahawk Lake	Walleye	Fry	1,500,000	
1981	Tomahawk Lake	Walleye	Fingerling	92,575	2.6
1981	Tomahawk Lake	Walleye	Fry	540,000	
1982	Tomahawk Lake	Walleye	Fingerling	132,540	3
1982	Tomahawk Lake	Walleye	Fry	1,020,000	
1983	Tomahawk Lake	Walleye	Fry	4,960,000	1

Tomahawk Lake WDNR Fish Stocking ***(continued)***

Year	Stocked Waterbody	Species	Age Class	# Fish Stocked	Avg Fish Length (in)
1984	Tomahawk Lake	Walleye	Fingerling	69,991	3.4
1984	Tomahawk Lake	Walleye	Fry	5,660,000	1
1985	Tomahawk Lake	Walleye	Fingerling	134,220	3
1985	Tomahawk Lake	Walleye	Fry	3,968,000	1
1986	Tomahawk Lake	Walleye	Fingerling	100,000	2.67
1986	Tomahawk Lake	Walleye	Fry	3,456,000	1
1987	Tomahawk Lake	Walleye	Fingerling	116,100	2
1988	Tomahawk Lake	Walleye	Fingerling	100,460	3.86
1988	Tomahawk Lake	Walleye	Fry	835,000	3
1989	Tomahawk Lake	Walleye	Fingerling	116,373	2.2
1989	Tomahawk Lake	Walleye	Fry	1,442,540	2.33
1990	Tomahawk Lake	Walleye	Fingerling	95,418	2
1990	Tomahawk Lake	Walleye	Fry	800,000	1
1991	Tomahawk Lake	Walleye	Fingerling	94,448	3
1991	Tomahawk Lake	Walleye	Fry	7,220,104	0
1992	Tomahawk Lake	Walleye	Fingerling	92,965	3.4
1992	Tomahawk Lake	Walleye	Fry	3,588,000	0
1993	Tomahawk Lake	Walleye	Fry	1,786,000	0.2
1994	Tomahawk Lake	Walleye	Fingerling	99,990	2
1994	Tomahawk Lake	Walleye	Fry	2,500,000	0.2
1995	Tomahawk Lake	Walleye	Fingerling	85,902	3.53
1995	Tomahawk Lake	Walleye	Fry	2,500,000	0.2
1996	Tomahawk Lake	Walleye	Fingerling	100,000	1.5
1996	Tomahawk Lake	Walleye	Fry	1,000,000	0.3
1997	Tomahawk Lake	Walleye	Fry	3,000,000	0.3
1998	Tomahawk Lake	Walleye	Fry	5,300,000	0.3
1998	Tomahawk Lake	Walleye	Small Fingerling	339,200	1.63
1999	Tomahawk Lake	Walleye	Fry	4,700,000	0.3
2000	Tomahawk Lake	Walleye	Fry	6,500,000	0.3
2000	Tomahawk Lake	Walleye	Small Fingerling	311,889	1.9
2001	Tomahawk Lake	Walleye	Small Fingerling	330,000	1.27
2004	Tomahawk Lake	Walleye	Small Fingerling	169,676	1.25
2006	Tomahawk Lake	Walleye	Small Fingerling	118,700	1.7
2007	Tomahawk Lake	Walleye	Fry	1,660,000	0.3
2008	Tomahawk Lake	Walleye	Small Fingerling	118,854	1.6

G

APPENDIX A

Mid Lake WDNR 2003 Fisheries Information Sheet

WISCONSIN DNR
FISHERIES INFORMATION SHEET

LAKE: Mid **COUNTY:** ONEIDA **YEAR:** 2003

The Department of Natural Resources surveyed Mid Lake, Oneida County with six mini-fyke nets on August 21-22, 2003 as part of a baseline survey. The baseline surveys are designed to inventory fish populations across a variety of lakes. Mid Lake is a soft-water spring lake with sand and muck substrate and abundant aquatic vegetation. It has a surface area of 215 acres, 3.1 miles of shoreline and a maximum depth of 13 feet.

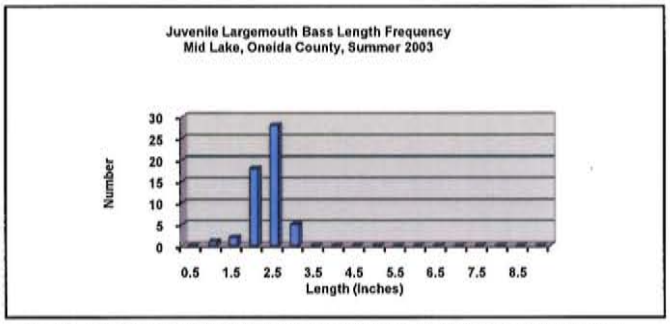


Figure 1. Length frequency distribution of 54 juvenile largemouth bass captured during a fisheries survey of Mid Lake, Oneida County, in summer 2003.

Largemouth Bass

Young-of-year largemouth bass were relatively abundant in Mid Lake. The vegetated habitat is well-suited to largemouth. We captured 54 largemouth bass and four smallmouth bass in the mini-fyke nets.

Bluegill

Bluegill were the most abundant species in the mini-fyke nets. Two cohorts are apparent from the netting data, most likely young-of-year up to 2 inches in length and age-1 fish 2 to 4 inches in length.

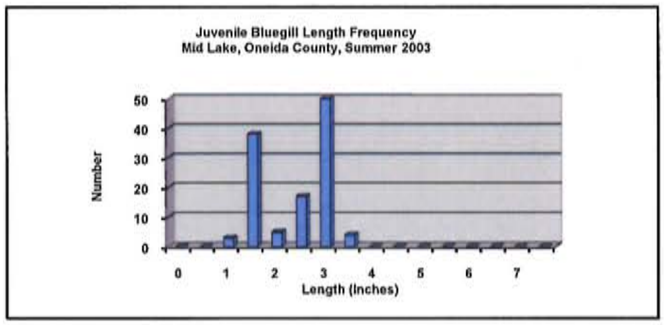


Figure 2. Length frequency distribution of 117 bluegill captured during a fisheries survey of Mid Lake, Oneida County, in summer 2003.

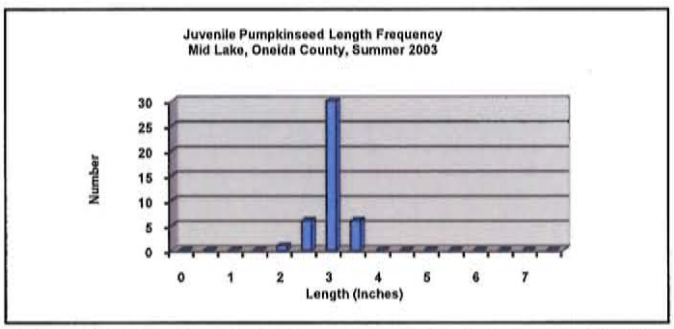


Figure 3. Length frequency distribution of 43 pumpkinseed captured during a fisheries survey of Mid Lake, Oneida County, in summer 2003.

Pumpkinseed

We captured 43 pumpkinseed during our mini-fyke netting survey of Mid Lake. These were primarily age-1 and 2 fish. Smaller pumpkinseed are poorly marked and were not separated from the bluegill.

Other Species

We captured nine species of fish in our mini-fyke netting sample of Mid Lake. In addition to the species listed above, we caught moderate numbers of smallmouth bass, muskellunge, northern pike, black crappie, yellow bullhead and black bullhead. Five additional species were collected during a September 23 2003 electroshocking sample: walleye, rock bass, white sucker, bowfin and grass pickerel.

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H

APPENDIX H

Minocqua Chain 2009 WDNR fisheries report

Comprehensive Fisheries Survey of Minocqua Chain, Oneida County Wisconsin during 2009.

Waterbody Identification Codes: Little Tomahawk 1543900, Mud 1544000, Tomahawk 1542700, Mid 1542600, Minocqua 1542400, Kawaguesaga 1542300.

John Kubisiak
Senior Fisheries Biologist
Rhinelander
March, 2010

WISCONSIN
DEPT. OF NATURAL RESOURCES

SPORT FISH RESTORATION

Your purchase of fishing equipment and motor boat fuel supports boating access and Sport Fish Restoration.

Comprehensive Fisheries Survey of Minocqua Chain, Oneida County Wisconsin during 2009.

John Kubisiak
Senior Fisheries Biologist
March, 2010

EXECUTIVE SUMMARY

A comprehensive fisheries survey was conducted the Minocqua Chain during spring and fall, 2009. Largemouth bass (Tomahawk population estimate, PE = 3.5 adults per acre) and smallmouth bass (Tomahawk PE = 3.9 adults per acre), were the dominant gamefish, along with moderate numbers of walleye (combined PE = 1.7 adults per acre), muskellunge and northern pike. All game species showed good size and appeared to be in excellent condition. Panfish species were also abundant, with good size. We found moderate catches of black crappie, bluegill, pumpkinseed, rock bass and yellow perch, along with low numbers of black bullhead, bluegill x pumpkinseed hybrids and yellow bullhead. Non-game species in the catch include bowfin, cisco, golden shiner, grass pickerel and white sucker. I recommend managing Minocqua Chain for walleye, muskellunge, bass and panfish. Walleye are at moderate abundance except in Tomahawk, where walleye recruitment is suppressed by cisco and the fishery is supplemented by stocking. All three lakes have very good numbers of quality- and trophy-size walleye. A low-density muskellunge population with trophy size potential is also present. Bass are abundant with moderate size structure.

<u>Lakes and location</u>:
Minocqua Chain includes Little Tomahawk, Mud, Tomahawk, Mid, Minocqua and Kawaguesaga lakes. Four additional lakes are connected by navigable channels but are not generally named with the Minocqua Chain: A non-flowing constructed channel connects Tomahawk to Katherine Lake; a wetland channel in Kemps Bay connects Tomahawk and unnamed Lake 30-6; a constructed channel connects Minocqua to Jerome Lake; and a wetland channel connects Kawaguesaga with Baker Lake. Minocqua Chain is located in north-central Oneida County, with the village of Lake Tomahawk and City of Minocqua on its shores. The Chain is part of the Upper Wisconsin River watershed, and forms the headwaters of the Tomahawk River. Mud, Little Tomahawk and Mid are considered spring lakes (no inlets and flowing outlets), and the Chain is also fed by the Minocqua Thoroughfare. A dam on Kawaguesaga with 5 feet of head is owned and operated by Wisconsin Valley Improvement Company (WVIC) to help regulate flow in the Tomahawk River. The Minocqua Chain reservoir maximum elevation is 1585.05 ft MSL with a summer minimum of 1584.05 ft (June 1 – September 30) and a winter minimum elevation of 1582.72 ft (October 1 – May 31). The summer target elevation is 1584.55 ft MSL. (Dave Coon, WVIC, personal communication).

<u>Physical/Chemical attributes</u> (Andrews and Threinen 1966 except as noted):
Morphometry: area 5841 acres with maximum depth of 84 feet in Tomahawk (from lake maps; excluding the Tomahawk Thoroughfare).
Watershed: 89 square miles, including 602 acres of adjoining wetlands.
Lake type: drainage (except Little Tomahawk, Mud and Mid are spring lakes).
Basic water chemistry: Soft – weighted average alkalinity 43 mg/l, conductance 100 μmhos.
Water clarity: Clear water of moderate transparency.
Littoral substrate: weighted average of 57% sand, 19%, gravel, 13% rubble, 10% muck with some boulders present.
Aquatic vegetation: moderate to abundant. Eurasian water milfoil is present.
Winterkill: Mid Lake experiences periodic winterkill.

Boat landings: Little Tomahawk has a roadside carry-in along Bird Lake Road. Tomahawk has paved ramps in Town of Lake Tomahawk on Coffen Lane (fee, parking lot has 21 trailer stalls and 28 additional vehicles) and at Indian Mounds State Forest Campground (State Park fee, 15 trailer stalls and 15 additional vehicles; launch may be shallow due to sand). There is a paved ramp on Tomahawk Thoroughfare at Thoroughfare Road (fee, 6 trailer stalls). Mid Lake has a gravel ramp at the end of Grundy Point Road (room for 2-3 trailers). Minocqua has a paved ramp at Brunswick Road on Stacks Bay (11 trailer stalls and 8 additional vehicles); gravel ramp at Cedar Street (fee, roadside parking); paved ramp at Chicago Street (fee, about 8 trailer stalls at the Minocqua city lot); paved ramp at Park Street (fee, 4 trailer stalls). Kawaguesaga has a paved ramp at Dam Road (5 trailer stalls).

Purpose of Survey: Assess status of game species and develop management recommendations.
Dates of fieldwork: Walleye netting, April 21 to May 1 2009. Muskellunge netting, April 27 to May 15. Electroshocking (entire shoreline): April 27 (Kawaguesaga walleye); April 28 (Minocqua walleye); May 3 (Tomahawk walleye); June 4 and 8 (Tomahawk bass). Cisco gillnetting in Tomahawk, September 10-11.

BACKGROUND

Half-page spring netting records from Tomahawk during April and May of 1948, 53, 54, 56 and 57 appear to be from northern pike removals and spawning operations. A large number of similar records are from the Minocqua Thoroughfare or Tomahawk Thoroughfare during 1947-54 and 56. The records list species, size range and number of fish by date. A spawning record sheet for Minocqua Thoroughfare in 1952 contains a sketch of 2 net locations west of the Hwy 47 bridge, 2 locations around the railroad bridge and 2 locations on islands just east of the bridges. Northern pike were apparently being removed during these operations. The 1947 sheets (one from each thoroughfare) both have headings of “Northern Pike”. A single-page memorandum dated April 18, 1956 in the Minocqua file deals with northern pike removal from the Minocqua Thoroughfare. It indicates that “various people in Minocqua” were concerned about northern pike removal, but agreed to allow it for a period of three years as long as pike growth rates were tracked for any changes. Presumably the removal of northern pike was intended to improve growth rates on the remaining fish, but no results are contained in the file.

Mid-June netting on Mid Lake during 1955, 56 and 59 found an average catch rate per net night (average respective length from 1955 and 56 in parentheses) of 1.1 walleye (20.0 and 18.9 inches), 1.3 largemouth bass (9.9 and 7.6 inches), 0.06 smallmouth bass (N/A and 11.8 inches), 1.9 northern pike (15.7 and 17.4 inches), 0.03 muskellunge (one fish, 28.5 inches), 7.5 crappies, 107 bluegill, 31 “sunfish” (likely pumpkinseed), 13 yellow perch, 1.4 rock bass, 5.1 bullheads and 0.53 suckers.

Seining with a 2000 foot shoreline seine was conducted in Minocqua and Tomahawk during 1959. The July 20 Minocqua catch included a 23.1-inch muskellunge and four 3.3-6.2 inch walleye, along with (in decreasing abundance) perch, rock bass, bluegill, “sunfish”, and crappie. Electroshocking 1 mile for 6 hours (compared to a current target of 2 miles per hour) on July 27 resulted in observations of 2,800 walleye, 250 largemouth bass, 60 smallmouth bass, 23 northern pike and 6 muskellunge. Also listed were 3,500 yellow perch, 2,100 bluegill, 1,500 rock bass, 1,200 crappies, and abundant suckers and minnows. Tomahawk was seined on July 21, and estimated numbers of fish include 91 walleye, 154 smallmouth, 7 “sunfish”, 1,012 bluegill and 1,138 yellow perch.

Tomahawk was stocked with yearling lake trout in 1962 (10,000), 1963 (10,000, 6-9 inches) and 1964 (8,000). Two nights of gill netting during July 14-15, 1964 did not find any lake trout, but yielded 255 cisco (5.5 to 11.5 inches), 3 perch (3-4 inches) and 2 “muddlers” (likely mottled sculpin, 2.5 inches) (Radonski 1964). Electroshocking for lake trout in May 1965 only resulted in observations of walleye and suckers (Radonski 1965). Two lake trout were captured in a 1967-68 survey (McKnight and Theis 1968, below)

A survey using fyke nets, gill nets, seining and electrofishing was conducted on Tomahawk during May and September of 1967 and April of 1968 (McKnight and Theis 1968). A primary focus of the survey was a walleye assessment and mark-recapture population estimate (although not enough recaptures were obtained to complete the walleye population estimate). The spring walleye catch of 31.2 per net night was a little lower than the walleye catch during four years of spawning operations during mid-1950s of 33.4 to 46.5 per net night. Walleye reproduction was considered adequate and stocking was recommended only during years of spawn taking. “Plant-back” stocking into broodstock lakes was a standard practice at that time. Two lake trout (25 and 27 inches) were captured, but midsummer temperature and oxygen were judged to be marginal for trout. Experimental stocking of splake was recommended and 15,300 yearling splake were subsequently stocked in 1968. Their catch of 237 cisco had modes at 6.75 and 11 inches (2,250 feet of bottom-set gillnet had bar-measure mesh sizes of 0.75 and 1.25 inches).

Although spawning habitat in Tomahawk for muskellunge and northern pike is described as “good,” McKnight and Theis (1968) also suggest that “Periodic support stocking of muskellunge is recommended.” The report indicates that muskellunge and northern pike were spawned during most recent years in the Tomahawk Thoroughfare, and northern pike were removed at the same time, with removal numbers given for 1964-68. The report seems to question the usefulness of removing northern pike, but recommends continuing the program:

> “III. <u>Fish Removal</u>
> As part of the muskellunge management program, northern pike are being removed from the chain. This is to decrease competition between the species. Whether this program is as effective as intended is difficult to assess. Catch records (see V, “Past Management”) do not reveal the answer. There are considerable amounts of northern pike spawning areas where removal is not carried on. The result, therefore, may merely be the removal of a “harvestable surplus”. Since this removal program coincides with spawn-taking operations, however, continuation is recommended. Intensification of this effort might be <u>considered</u>.” (McKnight and Theis 1968)

A netting and shocking survey of Minocqua in 1973 to assess the walleye population found 24 walleye per net night with a good size distribution. The report indicates that little effort was spent on other species, but mentions large numbers of bluegill and small yellow perch and a good number of muskellunge measuring 18.0 to 47.5 inches (Wendt 1974).

A netting and shocking survey of Tomahawk was conducted in 1978 “with the main purpose of evaluating the present state of the walleye population and determining whether several years of walleye spawn-taking … had an adverse impact on the walleye population.” (Serns 1979). The May fyke net catch was moderate, with 10.5 walleye, 0.02 largemouth bass, 1.2 northern pike and 0.3 muskellunge per net-night. Walleye fry had been stocked annually since 1971, along with fingerling stockings of 595 in 1973, 21,186 in 1974 and 40,000 in 1976. The report recommends continued fry stocking, along with 10 to 25 fingerlings per acre for a period of 9 years. Muskellunge stocking was also recommended. Serns (1979) commented “Based on the 1967-68 survey, splake were introduced, but they contributed little to the sport-fishery in subsequent years and no additional stocking of this species was done.”

A page of data and map from a May 18, 1983 electroshocking survey of 4.4 shoreline miles on Minocqua found 33.6 walleye, 3.6 largemouth, 1.1 muskellunge, 0.23 northern pike and 0.45 grass pickerel per mile. Notes in the margin indicate "Windy & light rain – poor night for shocking. Looks like a good bunch of black crappie 7-9 inches coming up."

Several surveys were conducted to assess the walleye population in Tomahawk with the onset of spearing by Chippewa tribal members. A 1986 survey estimated 3.7 adult walleyes per acre, while a survey the following year estimated 1.9 per acre. Walleye net catch was 13.2 in 1986 and 10.0 in 1987. A catch of 97 muskellunge ranging 11.5 to 44.0 inches was reported in 120 fyke net lifts (0.73 per net night) during April 16-23 1986 (Newman 1987). Muskellunge were marked with the same clip as walleye in the 1987 survey (Newman 1988), with a catch of 184 muskellunge ranging from 15.5 to 46.5 inches in 224 fyke net lifts (0.8 per net night); 7 were recaptures of previously-marked fish.

A spring, 1992 survey estimated the adult walleye populations (per acre) of Tomahawk = 2.5, Mid = 0.86, Minocqua = 5.6 and Kawaguesaga = 4.4. The area-weighted average across the four lakes = 3.4 per acre (or 3.5 if Mid Lake is excluded). A walleye survey in 1998 (excluding Mid Lake) found similar populations of Tomahawk = 2.5, Minocqua = 4.6 and Kawaguesaga = 5.2 per acre. The area-weighted average was again 3.4 per acre.

Great Lakes Indian Fish & Wildlife Commission (GLIFWC) estimated the combined Tomahawk and Little Tomahawk walleye populations in 2000, 2002 and 2004 at 1.4, 2.4 and 2.2 per acre, respectively.

A muskellunge survey on Tomahawk during 2005 and 2006 estimated a population of 339 fish 30 inches and larger, or 0.10 per acre (Kubisiak 2007).

Nine-month angler creel surveys were conducted during the open gamefish season, May through early March (excluding the low-effort month of November) of 1987-88, 1992-93, 1998-99 and 2009-10 (reported separately)

Most fall electroshocking surveys target juvenile walleyes, and in some cases other species are not handled. Fall surveys are also used as an index of muskellunge recruitment, but muskellunge catch rates are higher at colder water temperatures and faster boat speed than typical for walleye surveys. Current DNR standards during fall young-of-year (YOY) surveys are to collect juvenile gamefish, including walleye under 15 inches, bass under 14 inches and northern pike and muskellunge under 20 inches. Recent GLIFWC surveys recorded only walleyes. Fall YOY electroshocking surveys were conducted on Little Tomahawk (1991-96 and 2008), Tomahawk (1965, 78, 83, 85 and 86), Mid (1962, 92 and 2003) and Minocqua (1973 and 86). In 1987 and annually from 1990 to present, fall surveys were conducted by either DNR or GLIFWC on Tomahawk, Minocqua (except missed in 1992) and Kawaguesaga. Fall survey trends are discussed further in the walleye and muskellunge results, below.

A baseline survey was conducted on Tomahawk, Mid, Minocqua and Kawaguesaga in 2003, consisting of 35 mini-fyke net-nights targeting small and young-of-year fishes in August and electroshocking in September. All sizes of gamefish were targeted during electroshocking, and all species were picked up on 11, 0.5-mile stations. The catch included 25 species, dominated by young-of-year bluegill and bluntnose minnow, along with good numbers of young largemouth and smallmouth bass.

METHODS

Eight standard fyke nets (¾-inch mesh, bar measure) were set on Kawaguesaga and ten nets on Minocqua on April 21, 2009. Tomahawk was set with 8 nets on April 25 and another 18 nets on April 26 (daily walleye net numbers on Tomahawk then fluctuated from 25 to 27). These nets targeted walleye. Net numbers were reduced by 2 on Kawaguesaga on April 25 and by two on Minocqua on April 28 and the remaining nets moved to muskellunge locations on April 27 (Kawaguesaga) and April 28 (Minocqua). The Tomahawk nets were reduced to 18 and moved to muskellunge locations on May 1. Two muskellunge nets set in Little Tomahawk for 9 nights are included with the Tomahawk results; two muskellunge nets were set in Mid on May 1. Nets were pulled on May 3 (Kawaguesaga and Mid), May 5 (Minocqua) and May 13-15 (Tomahawk, 6 pulled each day). Effort totaled 249 net nights targeting walleye and 350 net nights targeting muskellunge.

WDNR-standard alternating current electrofishing boats were used to collect gamefish, targeting walleye on April 27 (Kawaguesaga, 2 boats), April 28 (Minocqua, 3 boats) and May 3 (Tomahawk, 5 boats). Tomahawk received additional nights of electrofishing targeting bass on June 4 (2 boats) and June 8 (4 boats). One boat also targeted bass with hook-and-line on June 2 and June 5.

A seven-panel gillnet was set in 78 feet of water on Tomahawk during September 10-11 (about 24 hours), targeting cisco. Each panel was 10 feet wide and reached from surface to bottom. Mesh sizes were 19, 25, 32, 38, 51, 64 and 89 mm, bar measure.

Length or length category (nearest half-inch) was recorded for all gamefish. Adult gamefish were given a half-fin clip (half-clips provide an adequate mark and regenerate better than fully-removed fins) and juveniles were given a top-tail clip for use in mark-recapture population estimates. The clips were right ventral (Kawaguesaga), right pectoral (Minocqua), bottom caudal (Mid), left ventral (Tomahawk) and left pectoral (Little Tomahawk). Age structures (scales or spines) were removed from ten gamefish per species, per half-inch group for the three largest lakes.

RESULTS AND DISCUSSION

Walleye

During walleye netting, 938 walleye were captured on Kawaguesaga, 805 on Minocqua and 1,384 on Tomahawk for a total of 3,127 in 249 net-nights. This includes 487 recaptures and 5 juvenile fish (walleye of unknown sex shorter than 15 inches), at a rate of 13.9 walleye per net night (Table 1). The electrofishing recapture sample yielded 800 walleye (13.2 fish per mile), including 15 juveniles. An additional 307 walleye were handled during muskellunge netting.

The mark-recapture population estimates are 2,274 adult walleye ($\pm$ 184 SD), or 3.4 per acre on Kawaguesaga; 2,764 ($\pm$ 463) or 2.0 per acre on Minocqua and 4,321 ($\pm$ 523) or 1.3 per acre on Tomahawk. For Kawaguesaga and Minocqua, this compares to predicted values of 3.4 and 3.3 per acre for 670 and 1,360-acre lakes supported by natural reproduction. The walleye population in Tomahawk is supported by stocking, and in past surveys the walleye fishery averaged 2.4 per acre, mid-way between the predicted populations in similar-sized stocked lakes (1.2 per acre) and naturally reproducing lakes (3.2 per acre). Taken together, the three lakes averaged 1.7 walleye per acre in 2009. I consider around one walleye per acre a minimum value for a “fishable” population, where an angler has a reasonable chance of catching a walleye.

Walleye showed excellent size structure, with a 19.7-inch average adult length. Forty percent of adult walleye were 20 inches or larger, while 17% were at least 25 inches (Figure 1). Walleye growth rates were good, with male length-at-age ahead of the regional average through age 8, and about average at older ages. Female length-at age was average or a little behind. Both sexes showed incredible longevity. We captured good numbers of males out to age 15 and females to age 20 (Appendix A).

Despite the presence of good spawning gravel, natural recruitment by walleye in Tomahawk is low due to competition and predation on walleye fry by cisco. This results in low catch of YOY walleye in fall surveys (Figure 2). Hatchery walleye were marked with Oxytetracycline (OTC, an antibiotic that leaves a stain on bones) in 2001, 04, 06 and 08. The OTC-marked fish respectively contributed 80, 100, 93.5 and 67% of the fall YOY catch. However, after a high catch of 70.1 YOY per mile in 2000, fall catch averaged only 2.0 during subsequent stocked years and 0.6 during non-stocked years. Walleye stocking quotas were changed to large fingerlings beginning in 2010, due to the poor recent performance of small fingerlings.

In northern Wisconsin, fall catch of YOY walleye in lakes supported by natural reproduction averages 34 per mile of shoreline. Over the 20 years of fall surveys from 1990 through 2009, Minocqua and Kawaguesaga have not shown the high numbers of YOY walleye typical of many other naturally reproducing lakes (Figure 2). Nevertheless, recruitment produced above-average adult walleye densities on the two lakes with estimates that ranged from 4.4 to 5.6 per acre in 1992 and 1998. Seven consecutive years of low recruitment has had an impact. The current walleye populations in Tomahawk, Minocqua and Kawaguesaga are about half of historic values, although still within the range of normal fluctuation. Tomahawk requires supplemental stocking, but enough recruitment is trickling in to Minocqua and Kawaguesaga to maintain the populations until strong yearclasses return.

Figure 1. Length-frequency of adult walleye during 2009 in Minocqua Chain, Oneida County WI.

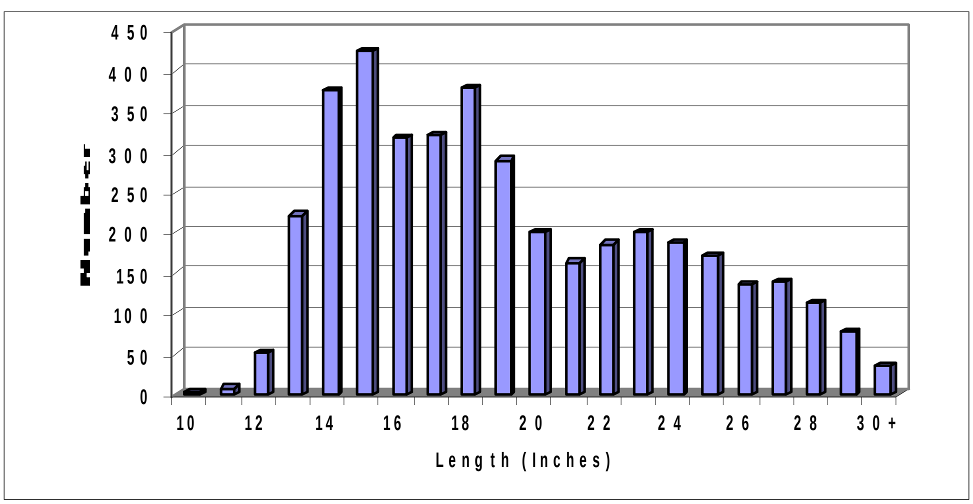
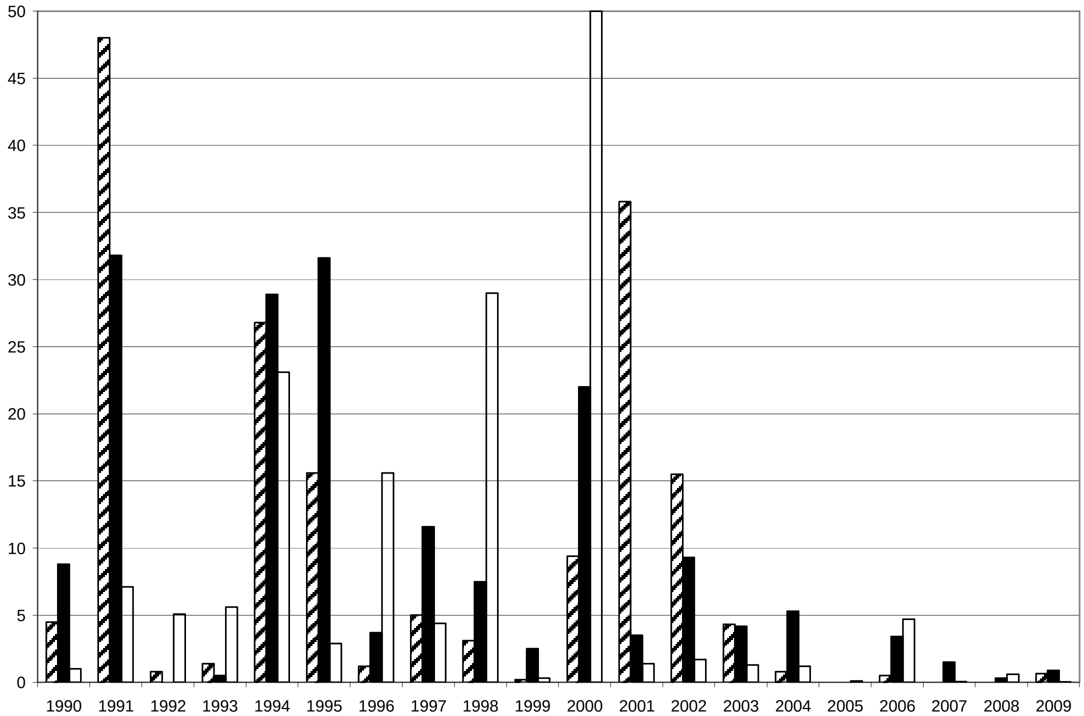


Table 1. Fish catch per unit effort during a 2009 survey of Minocqua Chain, Oneida County WI. Netting catch rates are reported as number of fish per net night, while electrofishing catch rates are number of fish per mile of shoreline. Only gamefish were collected during shocking runs and the bass marking run only covered about half the shoreline.

species	walleye netting	muskellunge netting	walleye recapture shocking	bass marking shocking (Tomahawk)	bass recapture shocking (Tomahawk)
walleye	13.9	0.85	13.2		
largemouth bass	0.39	2.4	4.8	26.5	14.3
muskellunge	0.21	0.15	0.12		
northern pike	0.48	0.22	0.43		
smallmouth bass	0.40	0.91	1.7	31.0	10.8
black bullhead	0	0.0086			
black crappie	4.9	3.4			
bluegill	2.3	32.6			
hybrid bluegill x pumpkinseed	0.0040	0.47			
bowfin	0.22	0.66			
cisco	0.016	0.0057			
golden shiner	0	0.0086			
grass pickerel	0.040	0.21			
pumpkinseed	0.73	6.4			
rock bass	2.7	8.9			
white sucker	0.44	0.28			
yellow bullhead	0.50	2.0			
yellow perch	45.5	10.8			

Figure 2. Young-of-year walleye catch in Kawaguesaga (striped), Minocqua (solid) and Tomahawk (clear bars) during 1990 through 2009. Minocqua was not surveyed in 1992; the Tomahawk catch of 70.1 per mile in 2000 was truncated for scale.



Largemouth and Smallmouth Bass

The bass catch included 2,058 largemouth and 1,360 smallmouth bass during spring sampling, including recaptures of 112 largemouth and 40 smallmouth that were previously-marked, and 70 juvenile largemouth and 191 juvenile smallmouth smaller than 8 inches in length. Bass were not marked for a population estimate during shocking runs on Minocqua and Kawaguesaga. Mark-recapture population estimates were calculated for Tomahawk at 11,891 adult largemouth bass (± 1,849 SD), or 3.5 per acre and 13,082 adult smallmouth (± 3,281 SD) or 3.9 per acre.

Both species of bass had good numbers of fish up to 16 or 17 inches, with low numbers of larger fish (Figures 3 and 4). The longest largemouth bass were 19.9 inches from Mid and 19.8 inches from Kawaguesaga. Twenty-one percent of largemouth were 14 inches and larger. The longest smallmouth was 19.7 inches from Tomahawk and 12% were 14 inches or larger. Length-at-age of largemouth was at or slightly above the regional average, while smallmouth length-at-age was slightly below average (Appendix A).

Northern Pike

We captured 211 northern pike (including 11 recaptures of previously-marked fish and 1 immature fish less than 12 inches in length). Average size of northern pike was 23.5 inches and 30% of adult pike were 26 inches or larger while 9.9% were at least 30 inches (Figure 4). The largest northern pike was a 37.7-inch female from Kawaguesaga. Abundant northern pike have been shown to inhibit muskellunge recruitment, but the netting catch rates below 0.5 per net-night suggest a low-density population.

Figure 3. Length-frequency of largemouth bass during 2009 in Minocqua Chain, Oneida County WI.

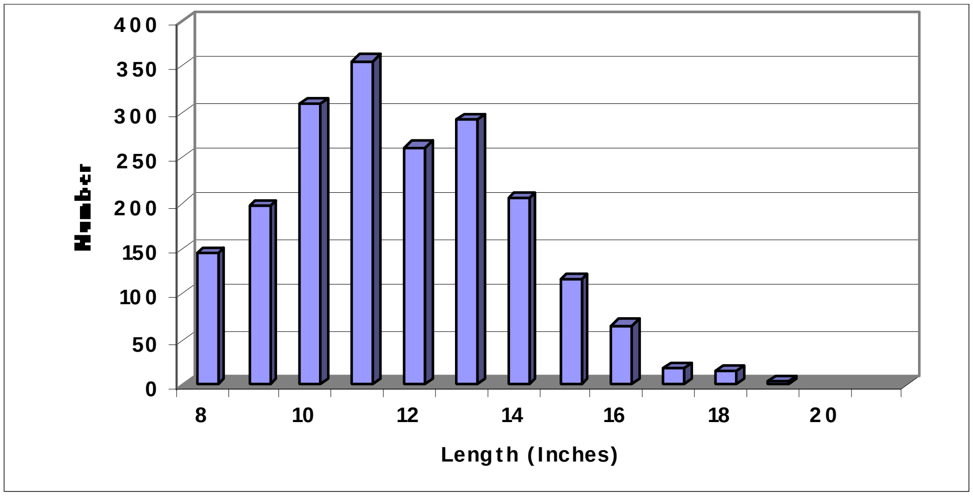


Figure 4. Length-frequency of smallmouth bass during 2009 in Minocqua Chain, Oneida County WI.

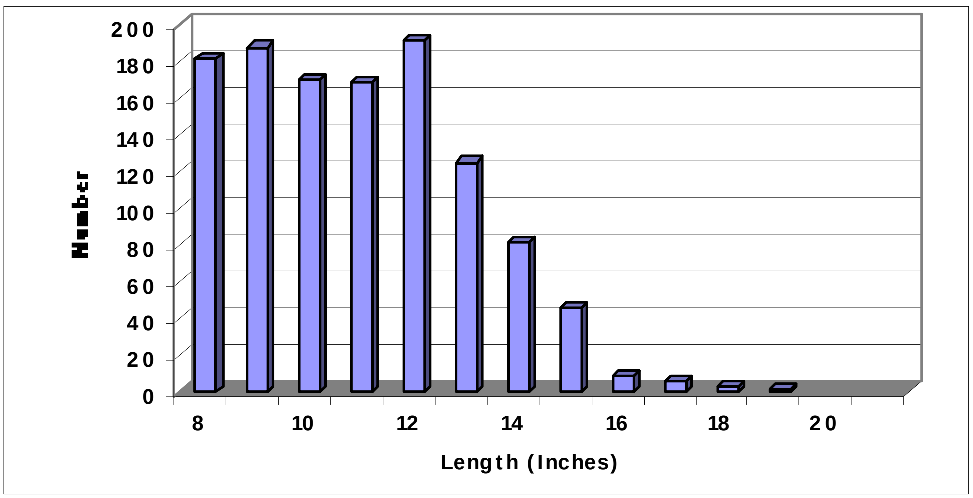
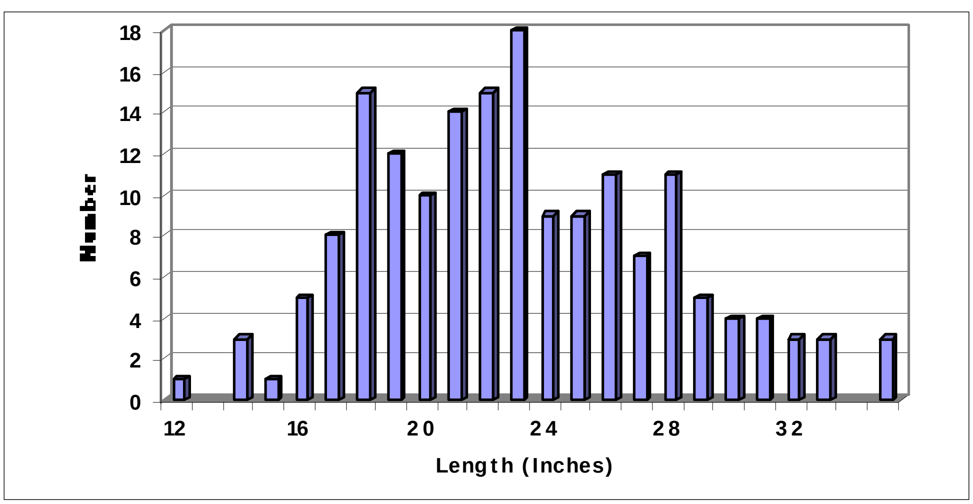


Figure 5. Length-frequency of adult northern pike during 2009 in Minocqua Chain, Oneida County WI.



Muskellunge

One hundred and six muskellunge were captured during the survey, including three recaptures of previously-marked fish and one juvenile smaller than 30 inches in length. Muskellunge ranged from 23.0 to 50.5 inches in length, with 57% at least 40 inches in length and 15% at least 45 inches (Figure 5). The largest fish was a 50.5 inch, 35.1 pound female from Tomahawk, aged at 18 from a scale. Scale ages tend to underestimate the age of older muskellunge, but accurate age structures like otoliths and cleithral bones require the fish to be sacrificed (Crossman and Casselman 2000). One 40.5-inch male muskellunge that died in the net was aged at 19 from a cleithrum.

Large fingerling muskellunge were stocked in Minocqua Chain as recently as 2001 (Table 2). The contribution of natural reproduction is difficult to assign prior to 2001 because of consecutive years of muskellunge stocking. Thus, the contribution of stocked fish to relatively strong yearclasses (based on catch in fall surveys) in 1989, 90 and 91 is unknown. No muskellunge were stocked during another strong yearclass in 1993. In 2009, any fish less than age 8 can be assumed to have recruited from natural reproduction. However, only 9 of 30 male, 4 of 62 female and 2 of 3 unknown-gender muskellunge were assigned age 8 or younger (Appendix A), suggesting low recruitment from natural reproduction. In addition, length-frequency modes at 38 and 41 inches (Figure 6) correspond to modes at 33 and 35 inches in 2005-06 (Kubisiak 2007), suggesting that the existing fish are growing longer over time but few young fish are coming in. The recapture portion of the muskellunge population estimate scheduled for spring, 2010 will give one more opportunity to look at muskellunge size structure and recruitment dynamics. If the 2010 results confirm that recruitment is lagging, then muskellunge stocking should be resumed.

Trophy muskellunge potential is discussed by Kubisiak (2007). Some additional large fish were documented during 2009. On July 1, 2009 I received a photograph of a large muskellunge reported to be 51-52 inches in length, recently caught and kept from Minocqua Chain; LAX Taxidermy plans to save a cleithrum. The Tomahawk creel clerk saw photographs of a 50+ inch muskellunge caught and released on August 14, and he measured a 49.1-inch muskellunge with 21.5-inch girth, caught and released on August 25. On September 8, the same clerk helped an angler release a 44-inch fish, he found a dead 43-inch muskellunge that appeared to have been badly hooked on Tomahawk and a partly decomposed mid-30's fish on Little Tomahawk.

Figure 6. Length-frequency of adult muskellunge during 2009 in Minocqua Chain, Oneida County WI.

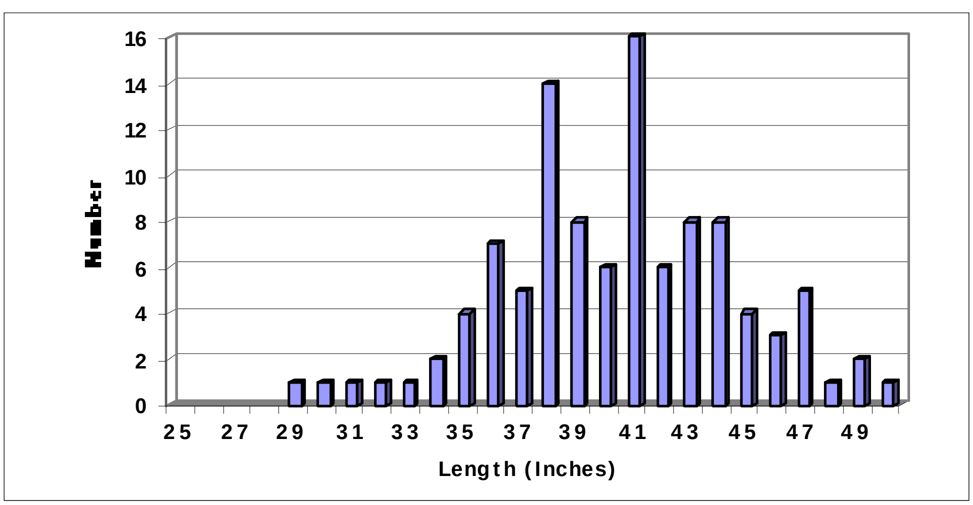


Table 2. Fish stocking record during 1995 through 2009 in Minocqua Chain, Oneida County WI.

Year	Lake	Species	Size	Number	Comments
1995	Tomahawk	walleye	fry	2,500,000	
1995	Tomahawk	muskellunge	fry	225,000	
1995	Tomahawk	walleye	small fingerling	85,902	
1996	Tomahawk	walleye	fry	1,000,000	
1996	Tomahawk	muskellunge	fry	82,400	
1996	Tomahawk	walleye	small fingerling (1.5 inch)	100,000	
1996	Minocqua	walleye	fry (0.3 inch)	500,000	
1996	Kawaguesaga	muskellunge	large fingerling (10 inch)	670	
1997	Tomahawk	walleye	fry	3,000,000	
1997	Tomahawk	muskellunge	fry	334,000	
1997	Tomahawk	muskellunge	large fingerling	1,500	
1997	Mid	muskellunge	fry	25,000	
1997	Minocqua	walleye	fry	2,000,000	
1997	Minocqua	muskellunge	large fingerling	680	
1997	Kawaguesaga	muskellunge	fry	100,000	
1998	Tomahawk	walleye	fry	5,300,000	
1998	Tomahawk	muskellunge	fry	56,750	
1998	Tomahawk	walleye	small fingerling (1.3 inch)	339,206	
1998	Minocqua	muskellunge	fry	79,900	Thoroughfare
1998	Kawaguesaga	muskellunge	large fingerling (12 inch)	670	
1999	Tomahawk	walleye	fry	4,700,000	
1999	Tomahawk	muskellunge	large fingerling (12.1 inch)	1,000	
1999	Minocqua	muskellunge	fry	121,500	Thoroughfare
1999	Minocqua	muskellunge	large fingerling	680	
2000	Tomahawk	walleye	fry (0.3 inch)	6,500,000	
2000	Tomahawk	muskellunge	fry (0.5 inch)	42,100	
2000	Tomahawk	walleye	small fgl. (1.7 & 2.3 inch)	311,889	
2000	Tomahawk	walleye	fingerling (4-6 inch)	1,500	private funds
2000	Minocqua	walleye	fry (0.5 inch)	3,000,000	
2000	Minocqua	muskellunge	fry (0.3 inch)	85,050	
2000	Kawaguesaga	muskellunge	large fingerling (10.9 inch)	670	
2001	Tomahawk	walleye	small fingerling (1.3 inch)	330,000	marked with Oxytetracycline
2001	Tomahawk	walleye	large fingerling (8 inch)	800	private funds
2001	Tomahawk	muskellunge	large fingerling (12.0 inch)	850	
2001	Minocqua	muskellunge	large fingerling (12 inch)	700	private funds
2004	Tomahawk	walleye	small fingerling (1.3 inch)	169,676	marked with Oxytetracycline
2006	Tomahawk	walleye	small fingerling (1.7 inch)	118,700	marked with Oxytetracycline
2007	Tomahawk	walleye	fry (0.3 inch)	1,660,000	
2008	Tomahawk	walleye	small fingerling (1.6 inch)	118,404	marked with Oxytetracycline

Cisco

The gillnet captured 370 cisco, 1 smallmouth bass, 1 black crappie and 1 bluegill. Forty-four percent of the cisco were 3.3 to 4.0 inches in length and were captured in the 19 mm mesh. Modes in length that likely correspond to yearclasses were also present at 6.75 and 9.75 inches (Figure 7). The largest cisco was 13.8 inches. Cisco inhibit walleye recruitment by preying on or competing with the fry, but they are also an important forage fish for large walleye and muskellunge. The heaviest catch of cisco was 30 to 40 feet below the surface, near the thermocline. However, some cisco were scattered through the upper water column and a few cisco that may have been chasing minnows were captured within a foot of the surface. We noted schools of small minnows holding near the net at the surface, and minnows were regurgitated by several cisco.

Figure 7. Length-frequency of cisco during September 10-11, 2009 gillnetting in Tomahawk Lake, Oneida County WI.

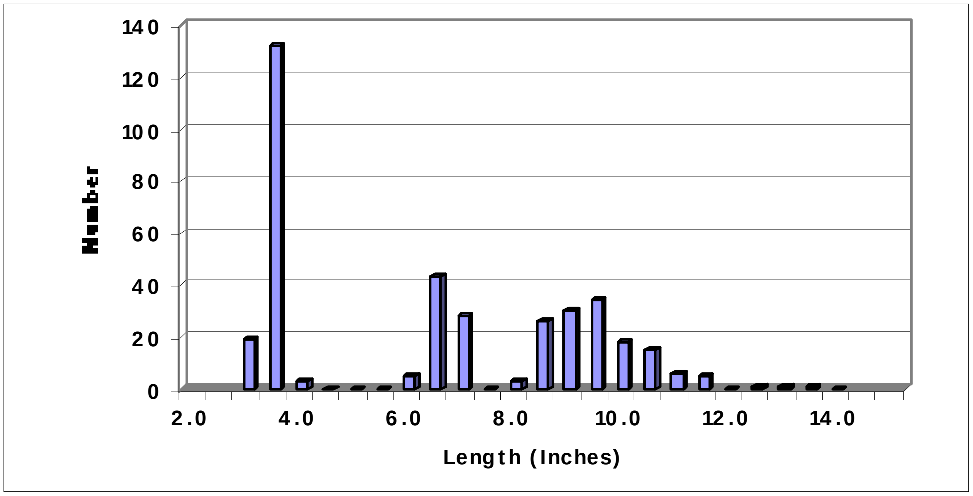


Table 3. Temperature and dissolved oxygen profile of Tomahawk Lake, Oneida County WI on September 10, 2009.

Depth below surface (feet)	Dissolved Oxygen (mg/l)	Temperture (˚C)	Temperture (˚F)
0 (Surface)	8.2	22.2	72.0
5	8.3	21.8	71.2
10	8.3	21.5	70.7
15	8.7	20.3	68.5
20	8.5	19.5	67.1
25	8.0	19.1	66.4
30	7.3	18.7	65.7
35	5.9	18.0	64.4
40	1.6	13.9	57.0
45	1.3	12.3	54.1
50	1.1	11.3	52.3
55	1.0	10.9	51.6
60	0.8	10.6	51.1
65	0.8	10.3	50.5
70	0.7	10.0	50.0
75	0.5	9.7	49.5
78 (bottom)			

Panfish

Minocqua Chain has many well-vegetated bays and shorelines and supports good populations of panfish. This survey did not target panfish, but we found a high catch of yellow perch during walleye netting, good bluegill numbers during muskellunge netting and moderate numbers of rock bass and black crappie (Table 1).

MANAGEMENT RECOMMENDATIONS

Minocqua Chain supports a diverse fishery. Smallmouth and largemouth bass were the dominant gamefish. Abundance of walleye was moderate and muskellunge was low, but both species showed excellent numbers of quality- and trophy-size fish. Northern pike were also low density. Yellow perch and bluegill dominated the panfish catch, while rock bass and black crappie were moderate in abundance. Low numbers of black bullhead, bluegill x pumpkinseed hybrids, pumpkinseed and yellow bullhead were also present. Forage and non-game species include bowfin, cisco, golden shiner, grass pickerel and white sucker. Minocqua Chain is best managed for walleye, muskellunge, bass and panfish. Supplemental stocking of walleye is recommended on Tomahawk, where cisco inhibit natural reproduction. Muskellunge stocking may also be necessary, pending results of the recapture portion of a muskellunge population estimate in spring, 2010.

ACKNOWLEDGEMENTS

Mike Coshun and Dennis Scholl supervised the field work for this survey with field assistance from Jeff Blonski, Steve Gilbert, Fred Hagstrom, Rick Halder, Jason Halverson, Wes Jahns, Marty Kiepke, Steve Kramer, Tracy Kusek, Aaron Nelson, Jeff Reissmann, Ben Rolling, Steve Timler, Tim Tobias, Joelle Underwood, Mike Vogelsang, Keith Worrall, Scott Yonker and me. Steve Kramer assigned fish ages from spines and scales and Mike Coshun calculated the walleye and bass population estimates.

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APPENDIX A
FISH AGE RESULTS

The aged subsamples were applied against the full length-frequency to eliminate bias from a non-random subsample of age structures.

Table A.1. Male walleye length at age in Minocqua Chain, Oneida County Wisconsin during 2009.

Age	Number of fish	avg. length	Northern WI avg.
2	6	12.4	11.3
3	40	13.7	11.9
4	17	14.6	13.3
5	32	15.1	14.2
6	23	16.0	15.6
7	31	17.0	16.6
8	21	18.3	17.6
9	14	18.3	18.7
10	12	19.2	19.2
11	11	19.6	19.4
12	9	19.7	20.0
13	5	20.1	
14	9	21.2	
15	2	21.3	

Table A.2. Female walleye length at age in Minocqua Chain, Oneida County Wisconsin during 2009.

Age	Number of fish	avg. length	Northern WI avg.
3	1	12.8	13.3
4	9	15.4	15.0
5	26	16.4	16.2
6	24	17.7	17.8
7	30	18.9	19.6
8	36	19.8	21.0
9	21	20.8	22.5
10	27	22.1	23.5
11	37	23.3	24.7
12	25	23.6	25.4
13	24	24.5	26.5
14	37	25.4	27.4
15	30	27.3	27.7
16	20	27.8	
17	11	28.0	
18	12	28.6	
19	7	29.1	
20	5	29.6	

Table A.3. Largemouth bass length at age in Minocqua Chain, Oneida County Wisconsin during 2009.

Age	Number of fish	avg. length	Northern WI avg.
2	11	6.1	6.6
3	40	9.3	8.9
4	57	11.2	10.5
5	40	12.7	12.1
6	48	13.7	13.6
7	51	15.0	14.9
8	21	15.7	15.8
9	8	17.0	16.2
10	11	17.6	17.1
11	6	18.7	17.8
13	1	19.8	18.3

Table A.4. Smallmouth bass length at age in Minocqua Chain, Oneida County Wisconsin during 2009.

Age	Number of fish	avg. length	Northern WI avg.
2	4	7.4	6.9
3	25	9.1	9.3
4	32	11.1	11.8
5	39	13.0	13.5
6	14	14.2	15.2
7	11	15.4	16.1
8	4	15.5	17.1
9	1	18.3	17.7
10	1	18.7	18.3

Table A.5. Male muskellunge length at age in Minocqua Chain, Oneida County Wisconsin during 2009.

Age	Number of fish	avg. length	Northern WI avg.
4	2	30.3	27.3
5	1	30.2	29.2
6			31.5
7	3	34.7	33.3
8	3	35.5	34.4
9	2	36.1	35.8
10	5	37.0	37.3
11	7	38.4	37.9
12	4	38.3	39.0
13			38.9
14	1	37.2	43.5
15	1	41.0	39.0
19	1	40.5	

Table A.6. Female muskellunge length at age in Minocqua Chain, Oneida County Wisconsin during 2009.

Age	Number of fish	avg. length	Northern WI avg.
5	1	32.6	31.9
6			33.7
7	1	36.5	35.8
8	2	38.3	38.1
9	8	40.5	39.5
10	14	41.0	41.0
11	11	42.5	43.2
12	6	42.2	43.7
13	7	44.0	44.3
14	6	46.7	
15	1	47.0	
16	2	47.4	
17	1	47.4	
18	1	50.5	
19			
20	1	49.3	