A

APPENDIX A

Public Participation Materials

1

Presentation Outline

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

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Onterra, LLC

- Founded in 2005
- Staff
  - Two full-time ecologists
  - One part-time paleoecologist
  - Three full-time field technicians
  - Four summer interns
- Services
  - Science and planning
- Philosophy
  - Promote realistic planning
  - Assist, not direct

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Why create a lake management plan?

- Preserve/restore ecological function to ensure cultural services

A goal without a plan is just a wish!

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Elements of an Effective Lake Management Planning Project

Data and Information Gathering

Environmental & Sociological

Planning Process

Brings it all together

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Data and information gathering

- Study Components
  - Water Quality Analysis
  - Watershed Assessment
  - Paleocore Collection & Analysis
  - Aquatic Plant Surveys
  - Fisheries Data Integration
  - Shoreland & CWH Assessment
  - Stakeholder Survey

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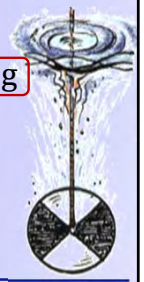
Water Quality Analysis

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



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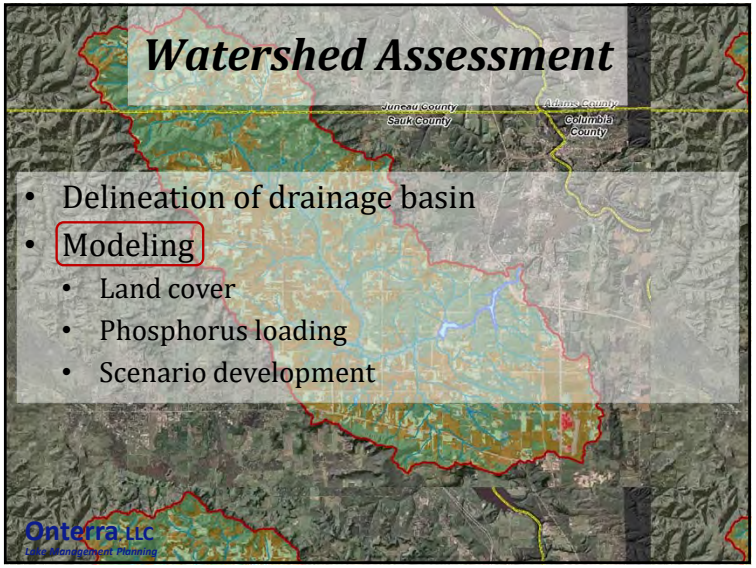
Watershed Assessment



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

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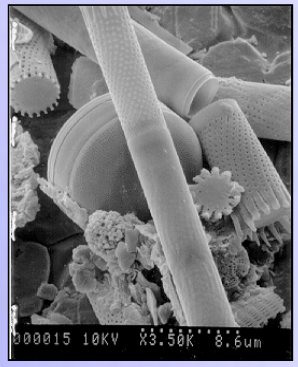
Paleocore Collection & Analysis

Sediment core



Diatoms

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Aquatic Plant Surveys

- Concerned with both native and non-native plants

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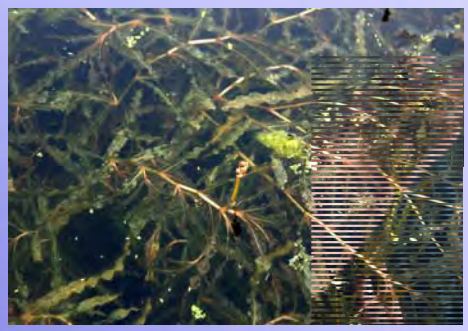
Non-native Aquatic Plants

Curly-leaf Pondweed



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Non-native Aquatic Plants

Eurasian Water Milfoil

First Found 2004

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Non-native Aquatic Plants

Pale Yellow Iris

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Non-native Aquatic Plants

Purple Loosestrife

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Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Point-Intercept Survey

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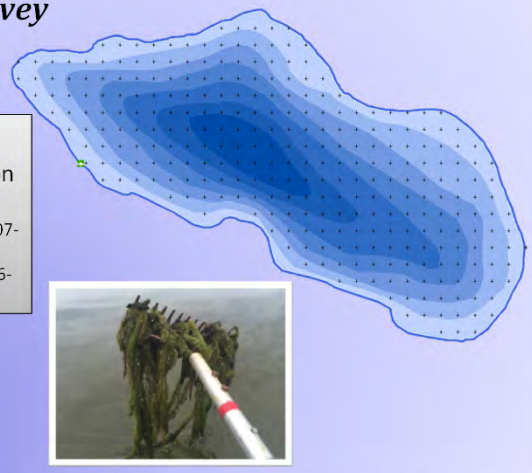
Aquatic Plant Point-Intercept Survey



Crystal Lake
40-meter Resolution
302 Total Points
WDNR Surveys: 2005, 2007-2015
Golden Sands RC&D: 2016-2017

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Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Point-intercept survey
  - Aquatic plant community mapping

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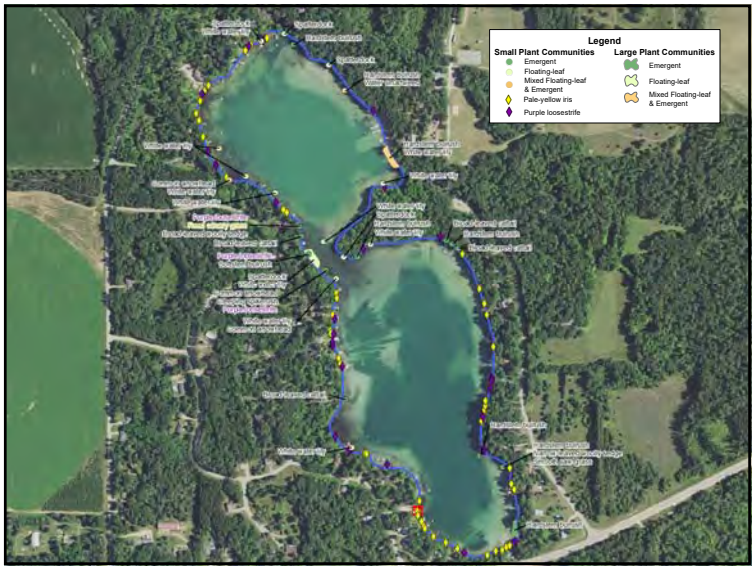

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Fisheries Data Integration

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

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Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- Assessment ranks shoreland area from shoreline back 35 feet
- Assess shoreland development and habitat
  - Coarse woody habitat

Urbanized **Natural**

Range

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Planning Process

Planning Committee Meetings

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

Implementation Plan

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Thank You

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

Wisconsin Lakes Partnership
UW Extension
Wisconsin Dept. of Natural Resources

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The Planning Process

…it's not as easy as you may think.

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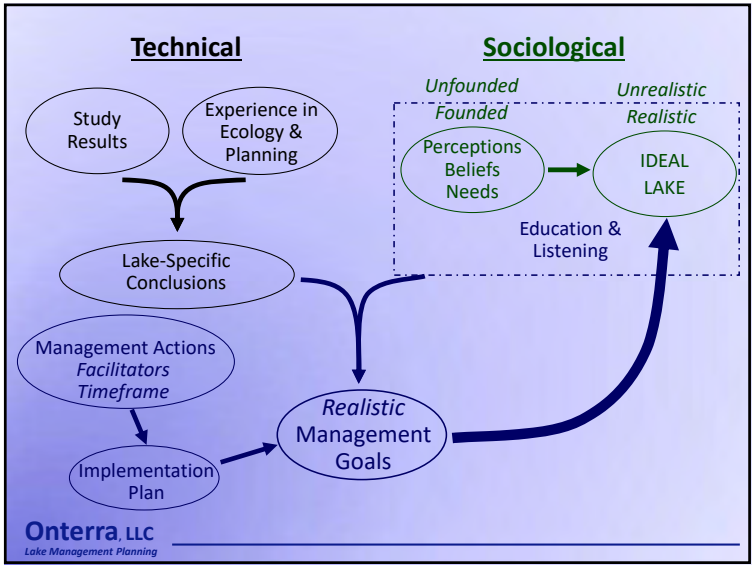

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Presentation Outline

- Lake Management Planning Project Overview
- Meeting Objective
- Study Results
  - Water Quality
  - Watershed
  - Shoreland Condition/Coarse Woody Habitat
  - Fishery
  - Aquatic Plants
- "Big Picture"
- Planning Meeting II

Onterra LLC Lake Management Planning

Management Planning Project Overview

Collect and compile information about Crystal Lake
- *Includes both environmental & sociological*
- *Historical & current information*
- *Past management actions*

Planning Meeting I
Report Sections

Create a realistic and implementable management plan
- *Challenges facing lake and CLC*
- *Create goals that will address challenges*
- *Develop actions that will meet goals*
- *Assign timeframes & facilitators*

Planning Meeting II
Implementation Plan

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Summary of Project Results

Water Quality
- Water quality is excellent.
- Paleocore analysis may have picked up on some slight changes.

Watershed & Immediate Shoreline
- Watershed is small and in pretty good condition.
- Changes in watershed and near shore zone would impact lake.

Fisheries
- WNDR Surveys in 2004-2005, 2013. Managed for bluegill & largemouth bas

Aquatic Plant Community
- Community is as expected for deep, low productivity, marl lake.
- Large historical dataset suggests most of community is in a stable state.
- Hybrid watermilfoil is prevalent, but relatively stable.
- Aquatic plant control options are limited and unclear.
- Need for HWM control is unclear as well.

Specifics in Planning Meeting II

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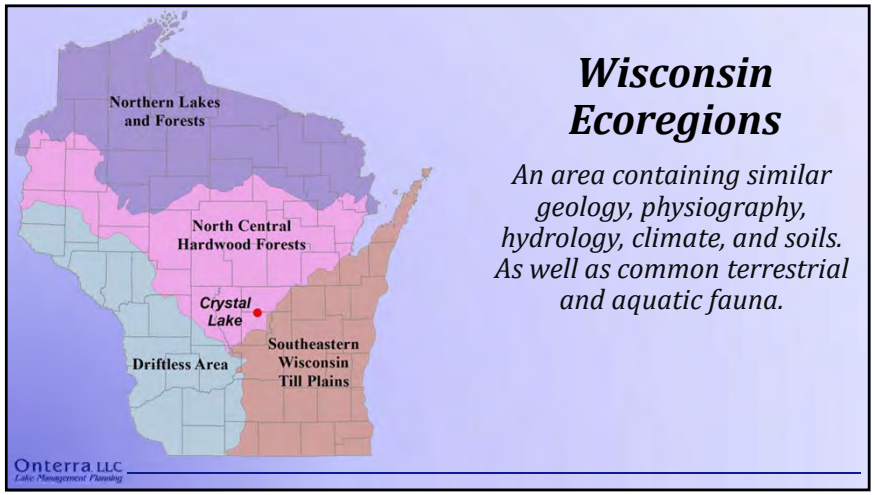
Wisconsin Ecoregions
An area containing similar geology, physiography, hydrology, climate, and soils. As well as common terrestrial and aquatic fauna.
Northern Lakes and Forests
North Central Hardwood Forests
Crystal Lake
Driftless Area
Southeastern Wisconsin Till Plains
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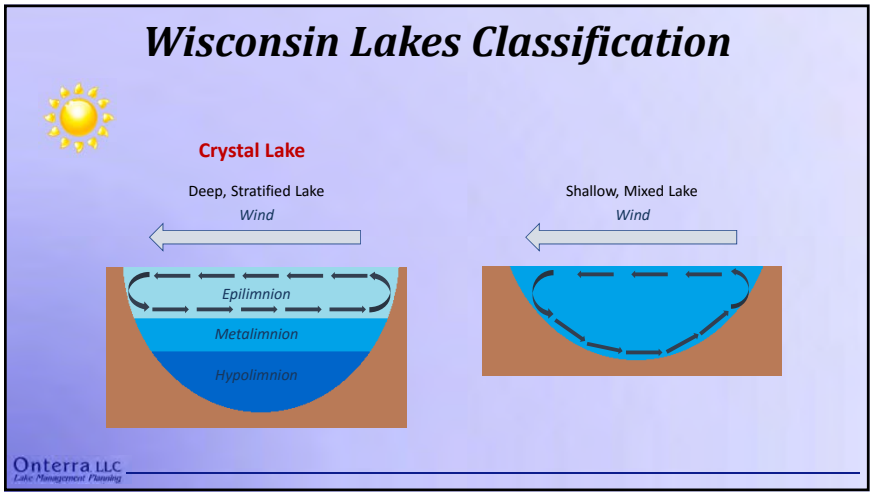
Wisconsin Lakes Classification
Crystal Lake
Deep, Stratified Lake
Wind
Epilimnion
Metalimnion
Hypolimnion
Shallow, Mixed Lake
Wind
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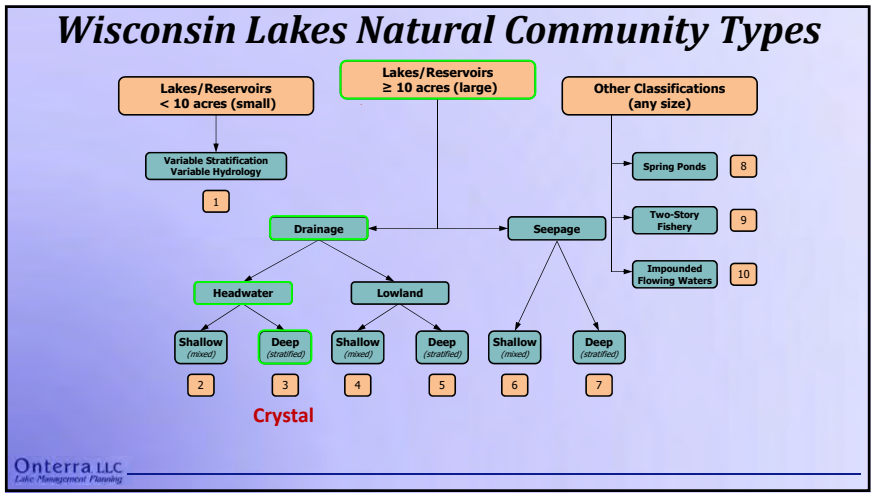
Wisconsin Lakes Natural Community Types
Lakes/Reservoirs < 10 acres (small)
Lakes/Reservoirs ≥ 10 acres (large)
Other Classifications (any size)
Variable Stratification Variable Hydrology
1
Drainage
Seepage
Spring Ponds
8
Two-Story Fishery
9
Impounded Flowing Waters
10
Headwater
Lowland
Shallow (mixed)
Deep (stratified)
2
3
4
5
6
7
Crystal
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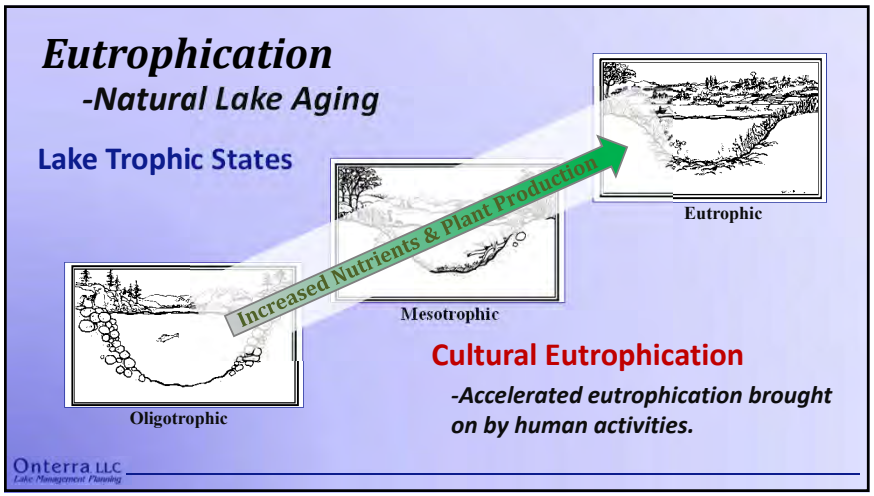
Eutrophication
-Natural Lake Aging
Lake Trophic States
Eutrophic
Increased Nutrients & Plant Production
Mesotrophic
Oligotrophic
Cultural Eutrophication
-Accelerated eutrophication brought on by human activities.
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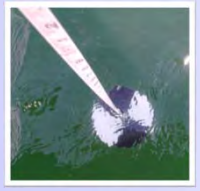
Lake Water Quality – Trophic Parameters

Phosphorus
Naturally occurring & essential for all life
Regulates phytoplankton biomass in **most** WI lakes
Most often 'limiting plant nutrient' (shortest supply)
Human activity often increases P delivery to lakes

Chlorophyll-*a*
Pigment used in photosynthesis
Used as surrogate for phytoplankton biomass

Secchi Disk Transparency
Measure of water clarity
Measured using a Secchi disk



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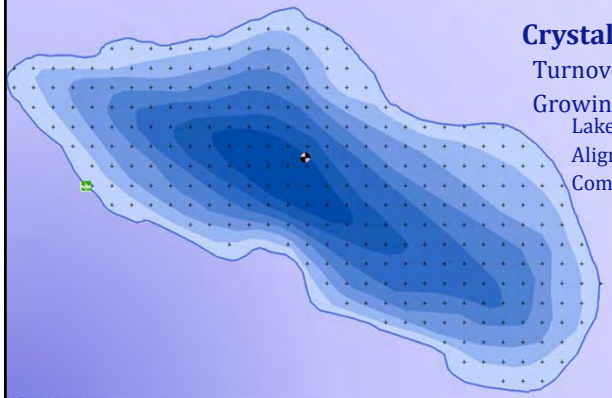
Crystal Lake Water Quality Sample Site & Data



Crystal Lake Deep Hole
Turnover data – 1987-2017
Growing season data - 2018
Lake modeling data
Aligns with biological processes
Comparable datasets

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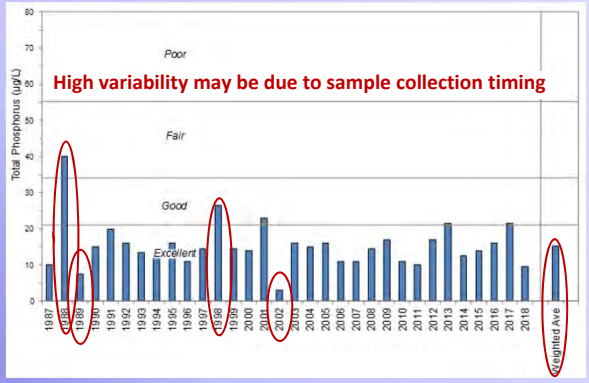
Crystal Lake Water Quality - Phosphorus



Overall, data indicate water quality is excellent

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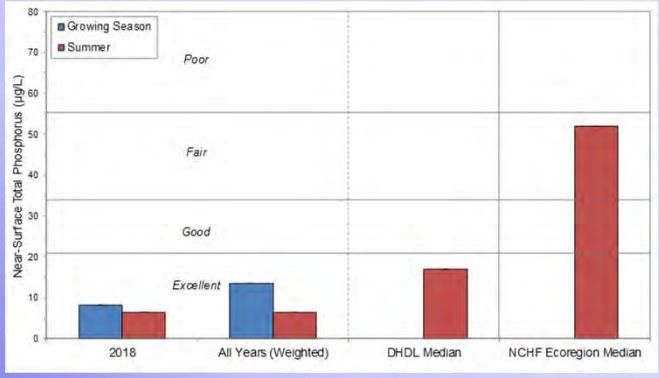
Crystal Lake Water Quality - Phosphorus



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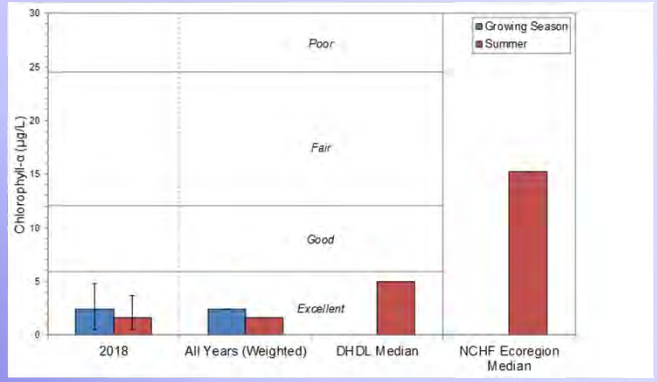
Crystal Lake Water Quality – Chlorophyll-a



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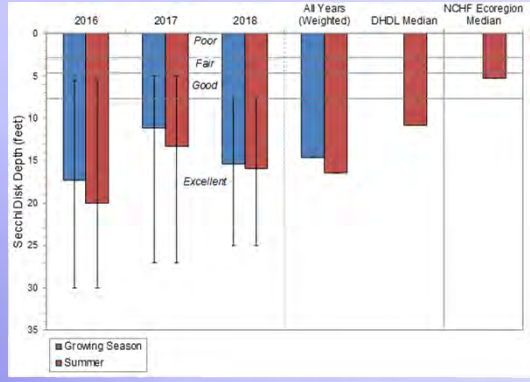
Crystal Lake Water Quality – Clarity



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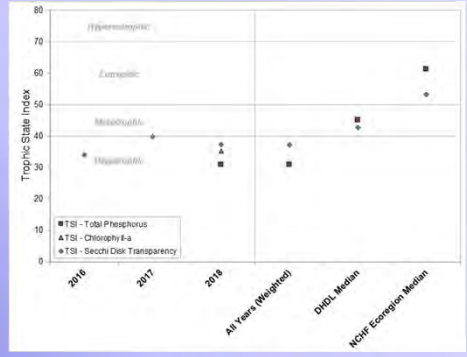
Crystal Lake Water Quality – Trophic State



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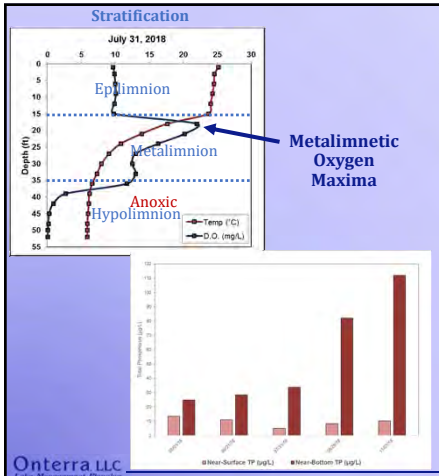
Crystal Lake Water Quality
Internal Phosphorus Loading?



What is internal loading?

- Release of P from anoxic sediments
- Iron binds P with oxygen and releases it (dissolves) when no oxygen is present (anoxic).
- P is then made available to algae following turnover event.

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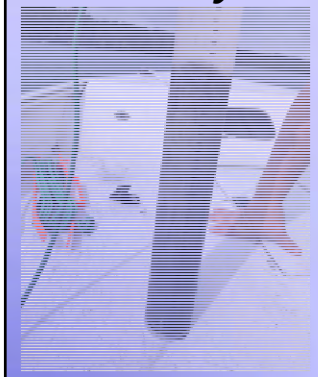
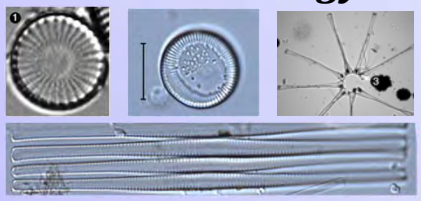
Crystal Lake - Paleoecology





Top-Bottom Sediment Core Results

- Prior to European settlement, lake had low phosphorus and silica concentrations and high clarity.
- Phosphorus is still very low, but up a bit higher.
- Silica concentration is also higher and clarity is a little less.

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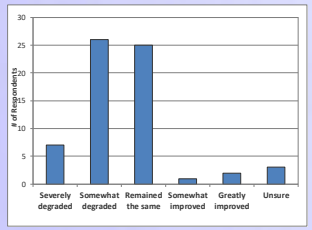
Water Quality – Stakeholder Survey Questions

Stakeholder survey response Question #13. How would you describe the overall current water quality of Crystal Lake?

Stakeholder survey response Question #14. How has the overall water quality changed in Crystal Lake since you first visited the lake?



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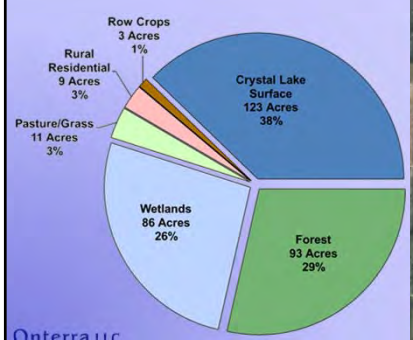
Crystal Lake Watershed

Watershed Area: 326 acres
Watershed:Lake Area: 2:1



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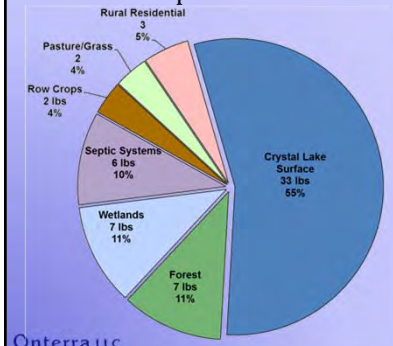
Crystal Lake Watershed

Watershed Area: 326 acres
Annual Phosphorus Load: 60lbs



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Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- EPA National Lakes Assessment results indicate shoreland development has greatest negative impact to health of our nation's lakes.
- It does not look at lake shoreline on a property-by-property basis.
- Assessment ranks shoreland area from shoreline back 35 feet

Urbanized → Range → **Natural**

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Shoreline Assessment Category Descriptions

More Natural Habitat

Greater Need for Restoration

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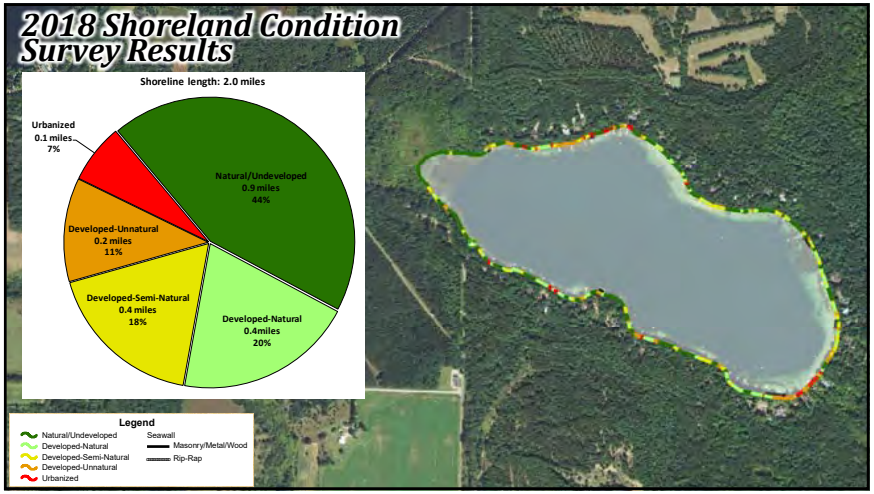
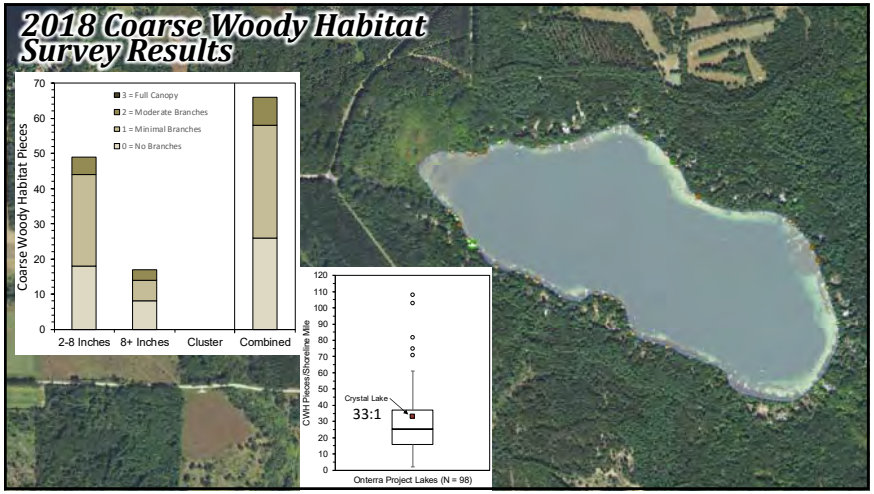
2018 Shoreland Condition Survey Results



2018 Coarse Woody Habitat Survey Results



Fisheries – Stakeholder Survey Questions

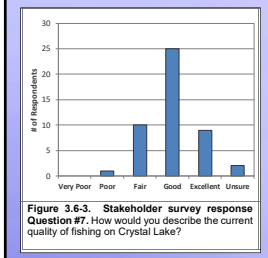


Figure 3.6-3. Stakeholder survey response Question #7. How would you describe the current quality of fishing on Crystal Lake?

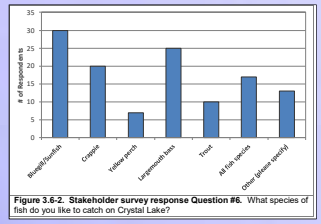


Figure 3.6-2. Stakeholder survey response Question #6. What species of fish do you like to catch on Crystal Lake?

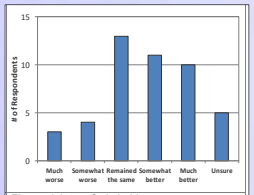


Figure 3.6-4. Stakeholder survey response Question #8. How has the quality of fishing changed on Crystal Lake since you started fishing the lake?

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Fisheries Data Integration

Species List
Stocking Records
Habitat (CWH, substrate, etc.)
Regulations
<u>WDNR Surveys</u>

- 8-Year sampling rotation, last in 2013
- Managed for bluegill and largemouth bass

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Aquatic Plant Surveys

- Determine changes in plant community from past surveys
- Assess both native and non-native populations
- Numerous surveys completed in 2018
  - Early-Season AIS Survey
  - Whole-Lake Point-Intercept Survey
  - Emergent/Floating-Leaf Community Mapping Survey
  - EWM Peak-Biomass Survey

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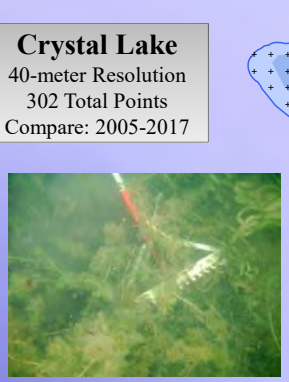
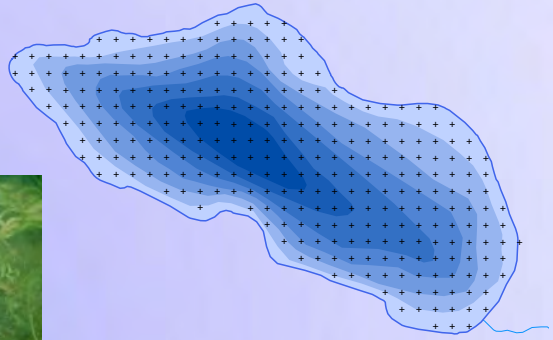
Crystal Lake
40-meter Resolution
302 Total Points
Compare: 2005-2017





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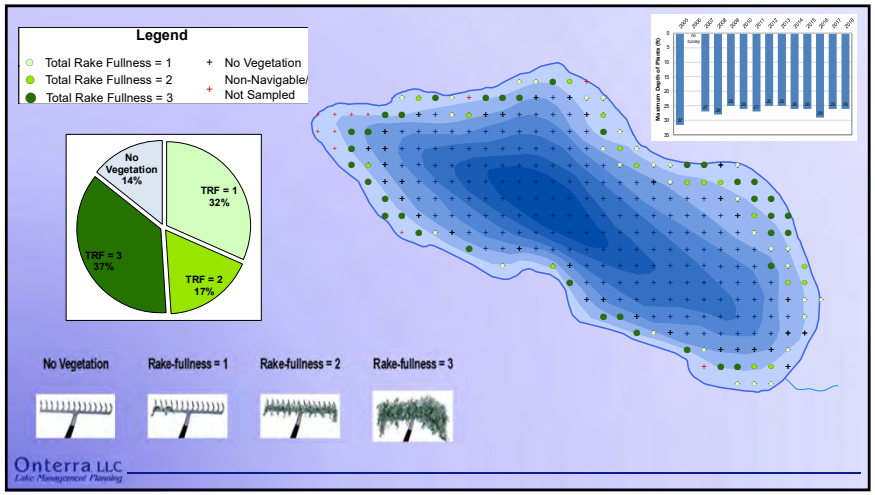

Aquatic Plant Species List

26 Native Species
2 Non-Native Species
Reed canary grass
Hybrid Eurasian watermilfoil
Incidental species
High average C-value

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Emergent	*Carex* sp.	Sedge sp.	N/A					I								
	Carex histericina	Porcupine sedge	N/A													I
	Decodon verticillatus	Water-willow	7	I	I		I	I	I	I	I			X		I
	Eleocharis palustris	Creeping spikerush	6					I								
	Equisetum fluviatile	Water horsetail	7					I		I						
	Phalaris arundinaceae	Reed canary grass	Exotic					I								I
	Sagittaria latifolia	Common arrowhead	3					I								I
	Sagittaria sp.	Arrowhead sp.	N/A						I	I	I			I		
	Schoenoplectus tabernaemontani	Softstem bulrush	4													I
	Typha latifolia	Broad-leaf cattail	1	I												
	Typha sp.	Cattail sp.	1		I			I	I	I	I					I
FL	*Nuphar variegata*	Spatterdock	6											I	I	I
	Nymphaea odorata	White water lily	6	X	X	X	X	X	X	X	X			I	I	I
Submergent	*Ceratophyllum demersum*	Coontail	3	X	X	X	X	X	X	X		X	X	X	X	
	Chara spp.	Muskgrasses	7	X	X	X	X	X	X	X	X	X	X	X	X	X
	Myriophyllum sibiricum	Northern watermilfoil	7	X										I	I	
	Myriophyllum spicatum x sibiricum	Hybrid watermilfoil	Exotic	X	X	X	X	X	X	X	X	X	X	X	X	X
	Najas flexilis	Slender naiad	6	X	X	X	X	X	X	X	X	X	I	X	X	X
	Najas guadalupensis	Southern naiad	7												I	
	Potamogeton amplifolius	Large-leaf pondweed	7	X												
	Potamogeton friesii	Fries's pondweed	8	X			X		X			X	X		X	X
	Potamogeton gramineus	Variable-leaf pondweed	7	X	X	X	X	X	X	X	X	X	X	X	X	X
	Potamogeton illinoensis	Illinois pondweed	6	X	X	X	X	X	X	X	X	X	X	X	X	X
	Potamogeton natans	Floating-leaf pondweed	5	I	X	I	X	X	X	I	I	I	X	X	X	I
	Potamogeton X scoliophyllus	Large-leaf X Illinois pondweed	N/A		X											
	Potamogeton zosteriformis	Flat-stem pondweed	6			X								X	X	X
	Stuckenia pectinata	Sago pondweed	3	X	X	X	X	X	X	X	X	X	X	I	X	X
	Utricularia vulgaris	Common bladderwort	7	I										I	I	
	Vallisneria americana	Wild celery	6	X	X	X	X	X	X	X	X	X	X	X	X	X
S/E	*Eleocharis acicularis*	Needle spikerush	5							I				X		X
FF	*Lemna minor*	Lesser duckweed	5	X	X			I	I	I		X		X	I	
	Spirodela polyrhiza	Greater duckweed	5						I						I	

FL = Floating Leaf; S/E = Submergent and Emergent; FF = Free Floating
X = Located on rake during point-intercept survey; I = Incidental Species

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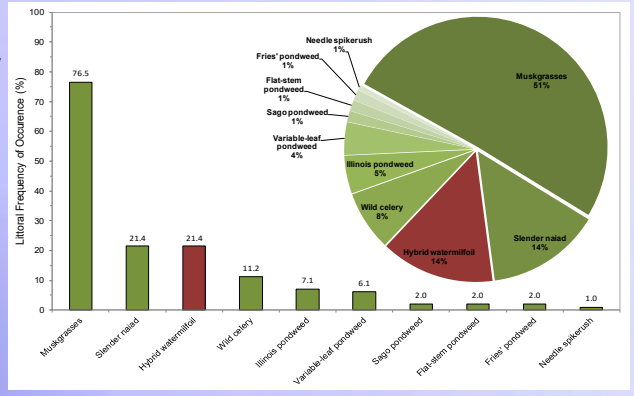
2018 Frequency of Occurrence

Littoral Frequency of Occurrence (LFOO)

Relative Frequency of Occurrence



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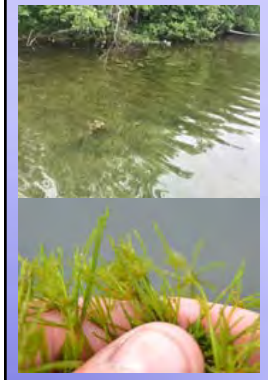
Chara spp. (muskgrasses)



- Macroalgae – not vascular plant
- Common in hardwater marl lakes
- Native, valuable food source for waterfowl
- Sequesters phosphorus (Coops 2002)

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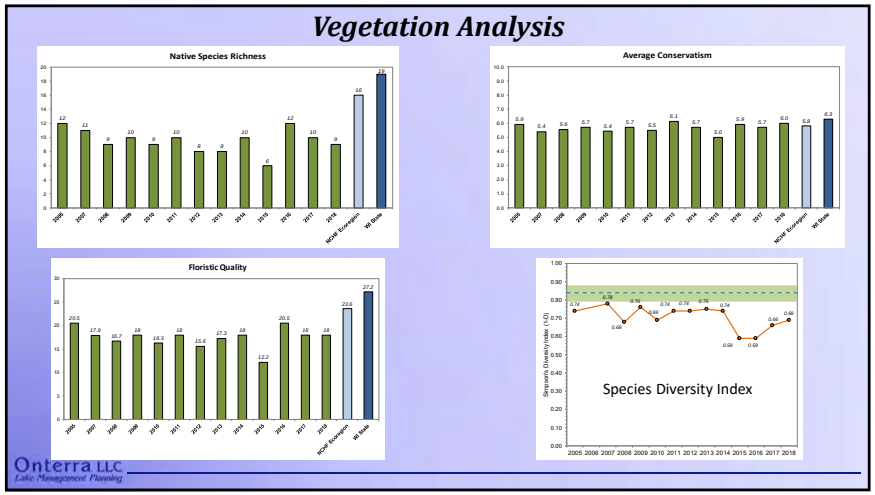
Vegetation Analysis
Native Species Richness
Average Conservatism
Floristic Quality
Species Diversity Index
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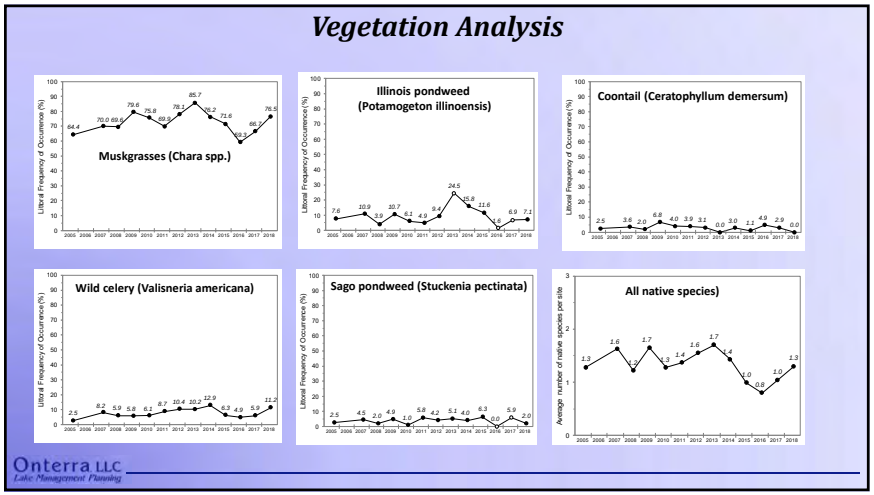
Vegetation Analysis
Muskgrasses (Chara spp.)
Illinois pondweed (Potamogeton illinoensis)
Coontail (Ceratophyllum demersum)
Wild celery (Valisneria americana)
Sago pondweed (Stuckenia pectinata)
All native species)
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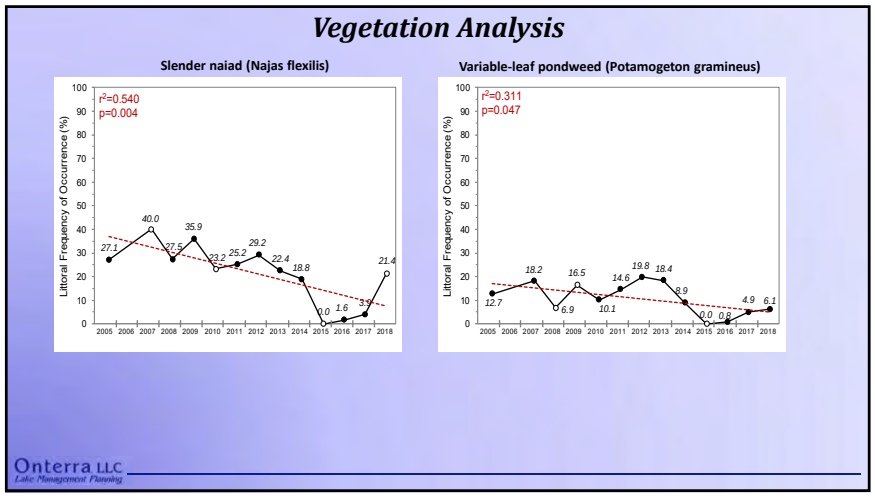
Vegetation Analysis
Slender naiad (Najas flexilis)
r²=0.540
p=0.004
Variable-leaf pondweed (Potamogeton gramineus)
r²=0.311
p=0.047
Littoral Frequency of Occurrence (%)
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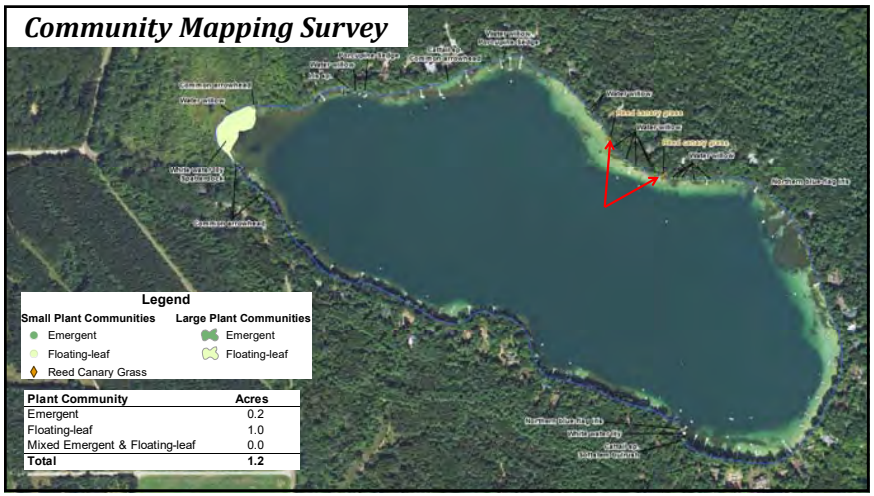
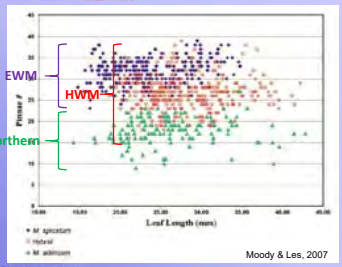

Community Mapping Survey
Legend
Small Plant Communities
Emergent
Floating-leaf
Reed Canary Grass
Large Plant Communities
Emergent
Floating-leaf
Plant Community | Acres
Emergent | 0.2
Floating-leaf | 1.0
Mixed Emergent & Floating-leaf | 0.0
Total | 1.2

Eurasian Watermilfoil vs Hybrid Watermilfoil



Hybrid Watermilfoil

- Hybrid vigor
  - Overlapping leaflet count
  - Thicker stems
  - Prolific flowerer
  - Rapid growth
- Less susceptible to control
  - Biological
  - Herbicides

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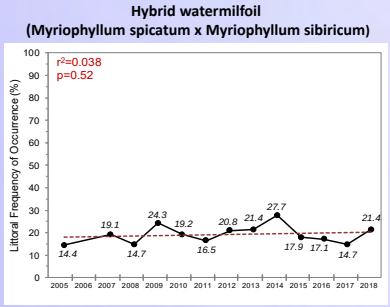
Hybrid Watermilfoil Analysis

- 2018 LFOO (21.4%) near mean (19.2%)
- No statistical trend in population
- Unmanaged population shows natural variation
- Dynamic equilibrium



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Professional AIS Mapping

Point-Based Mapping

- Single plants to colonies or areas less than 40-feet in diameter
- Abundance descriptions:
  - Single or Few Plants
  - Clumps of Plants
  - Small Plant Colony

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Professional AIS Mapping

Polygon-Based Mapping

- Colonies or areas over 40-feet diameter
- Boundary at target plant extent or morphological feature (depth contour, shoreline)
- Density ratings:

May not represent true colonies or "beds"

Increase in Ecological Impact

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting

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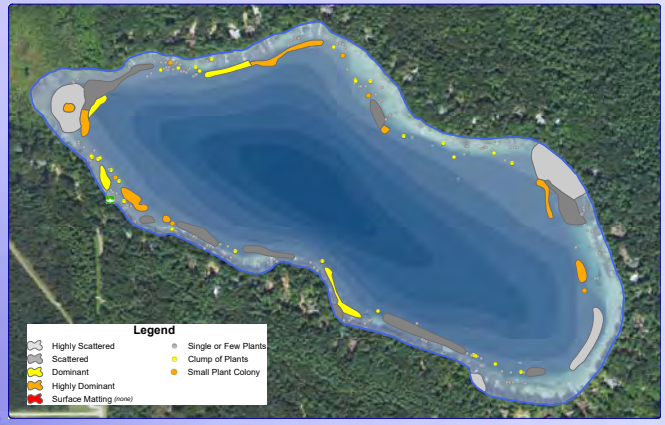
HWM Mapping Survey (Late-Summer 2018)



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HWM Monitoring & Management Strategy Development

Potential HWM Management Goals

Not making any decisions today!

1. **No Coordinated Active Management**
   (Let Nature Take its Course)
   - Focus on education of manual removal by property owners
   - Consistent monitoring is important
2. **Minimize navigation and recreation impediment**
   (Nuisance Control)
   - Accomplished through professional hand-harvesting of areas or lanes
   - Hand-harvesting may not be able to accomplish this goal and herbicides or a mechanical harvester may be required
3. **Reduce HWM Population on a lake-wide level**
   (Lake-Wide Population Management)
   - Would likely rely on herbicide treatment strategies (risk assessment)
   - Will not "eradicate" HWM
   - Set triggers (thresholds) of implementation and tolerance

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Conclusions

Water Quality
- Water quality is excellent due to groundwater inputs, watershed, and marl precip.
- Paleoecological analysis detected a small change since settlement.
- Group should be moving towards Citizens Lake Monitoring Network sampling.

Watershed
- Watershed is small and contains some of the best landcover types.
- Changes in nearshore areas will likely have the greatest impact on lake ecology.

Aquatic Plant Community
- Plant community characteristics are as expected for a marl lake
- Long-Term dataset shows most species relatively stable, two native species trending lower
- HWM population moderate and relatively stable

Aquatic Plant Management
- Alternatives will be discussed and weighed at Planning Meeting II

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Presentation Outline

- Lake Management Planning Project Overview
- Review of study conclusions
- Potential "localized phosphorus source" study
- EWM Life-Cycle and Control Strategy Discussion
- Challenges discussion
- Goals and actions development

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Localized Phosphorus Source Study

Objective: Determine sources of nutrients fueling filamentous algae growth in localized areas of Crystal Lake

Methods:

- Determine areas were filamentous algae grow consisting
  - Roughly map these areas
- Determine if areas of growth are up-welling, down-welling, or neutral areas
  - Mini-piezometer testing
- Groundwater upwelling areas
  - Areas with FA and without FA sampled for nutrient analysis
  - Compare these results to determine differences
- Determine possible sources of nutrients if differences are found

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Management Planning Project Overview

Collect and compile information about Crystal Lake

Includes both environmental & sociological

Historical & current information

Past management actions

Planning Meeting I
Report Sections

Create a realistic and implementable management plan

Challenges facing lake and CLC

Create goals that will address challenges

Develop actions that will meet goals

Assign timeframes & facilitators

Planning Meeting II
Implementation Plan

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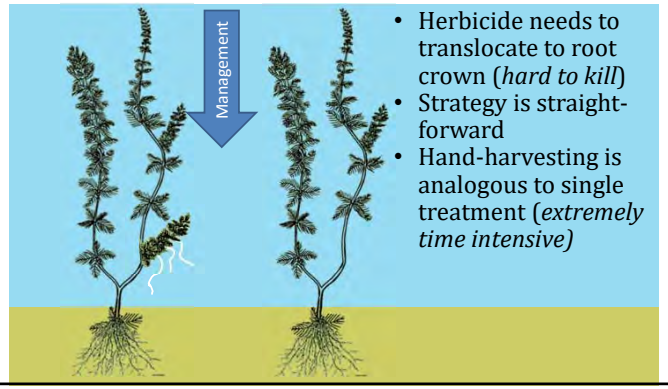
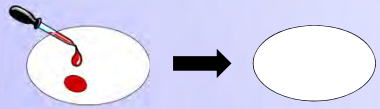
EWM Life-Cycle & Control Strategy Philosophy



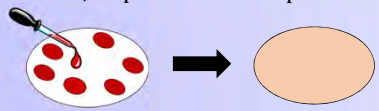
- Herbicide needs to translocate to root crown (*hard to kill*)
- Strategy is straight-forward
- Hand-harvesting is analogous to single treatment (*extremely time intensive)*

Ecological Definitions

Spot Treatment: Herbicide applied at a scale where dissipation will not result in significant lake wide concentrations; impacts are anticipated to be localized to in/around application area.



Whole-Lake Treatment: Herbicide applied at a scale where dissipation will result in significant lake wide concentrations; impacts are anticipated to be on a lake wide scale.



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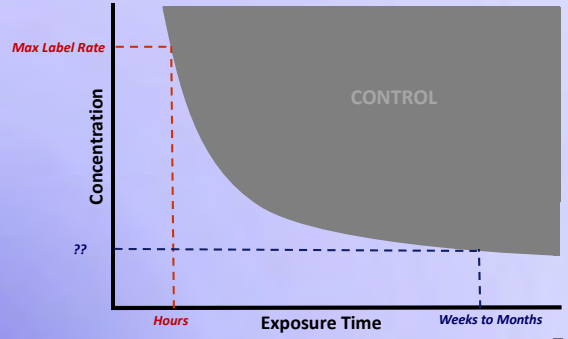
Herbicide Use Patterns



Treatment Type

High Concentration ► Short Exposure Time — ***Spot***

Low Concentration ► Long Exposure Time — ***Whole-lake***

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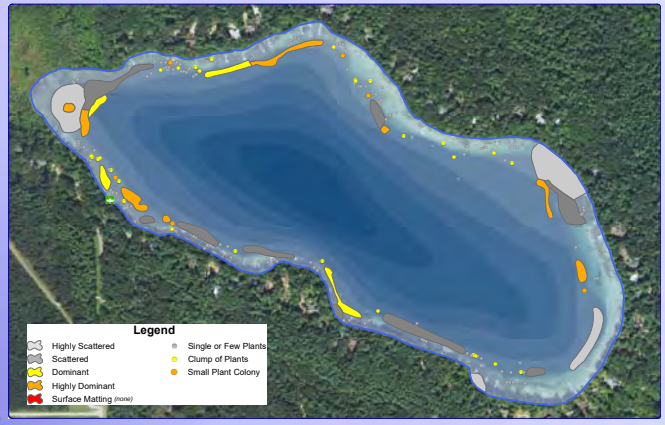
HWM Mapping Survey (Late-Summer 2018)



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HWM Monitoring & Management Strategy Development

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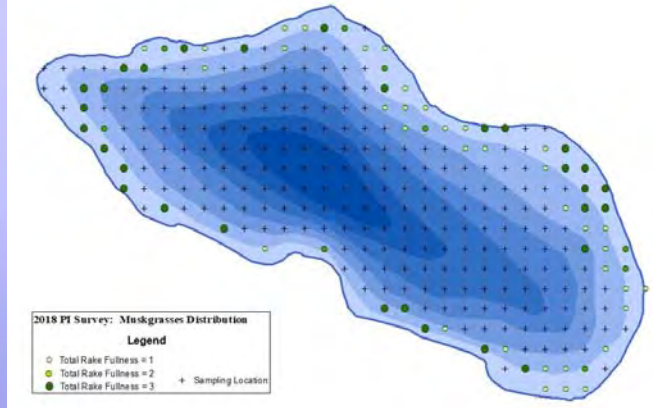

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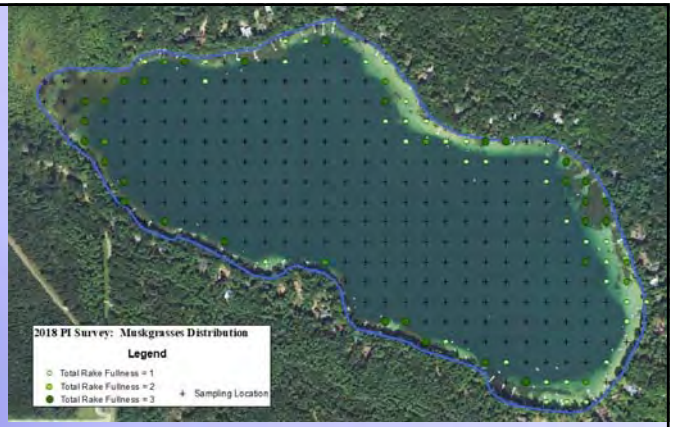

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B

APPENDIX B

Stakeholder Survey Response Charts and Comments

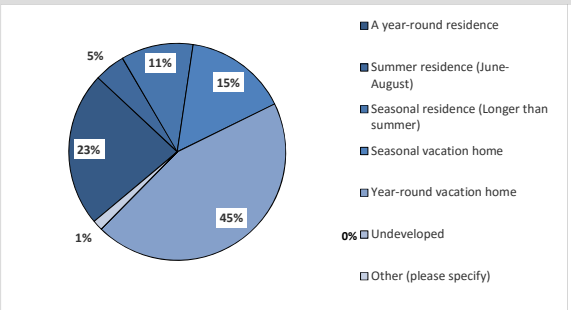
Crystal Lake - Anonymous Stakeholder Survey

Surveys Distributed: 76
Surveys Returned: 65
Response Rate: 86%

Crystal Lake Property

1. How is your property on Crystal Lake utilized?

Answer Options	Response Percent	Response Count
A year-round residence	23.1%	15
Summer residence (June-August)	4.6%	3
Seasonal residence (Longer than summer)	10.8%	7
Seasonal vacation home	15.4%	10
Year-round vacation home	44.6%	29
Undeveloped	0.0%	0
Other (please specify)	1.5%	1
answered question		65
skipped question		0

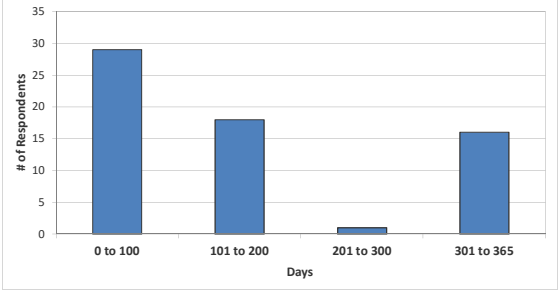


Number	Other (please specify)
1	year-round resident

2. How many days each year is your property used by you or others?

Answer Options	Response Count
	64
answered question	64
skipped question	1

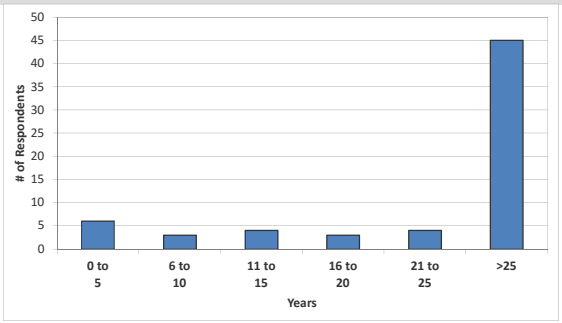
Category (# of days)	Responses	
0 to 100	29	45%
101 to 200	18	28%
201 to 300	1	2%
301 to 365	16	25%



3. How long have you or has your family owned your property on Crystal Lake?

Answer Options	Response Count
	65
answered question	65
skipped question	0

Category (# of years)	Responses	% Response
0 to 5	6	9%
6 to 10	3	5%
11 to 15	4	6%
16 to 20	3	5%
21 to 25	4	6%
>25	45	69%

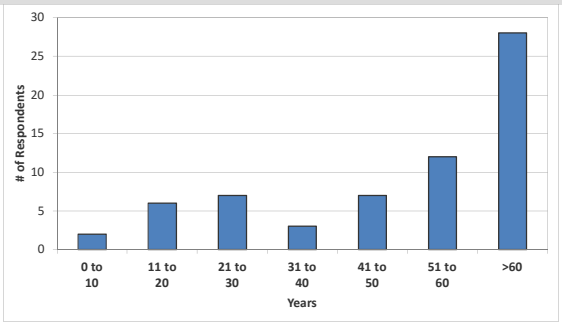


Recreational Activity on Crystal Lake

4. How many years ago did you first visit Crystal Lake?

Answer Options	Response Count
	65
answered question	65
skipped question	0

Category (# of days)	Responses	% Response
0 to 10	2	3%
11 to 20	6	9%
21 to 30	7	11%
31 to 40	3	5%
41 to 50	7	11%
51 to 60	12	18%
>60	28	43%

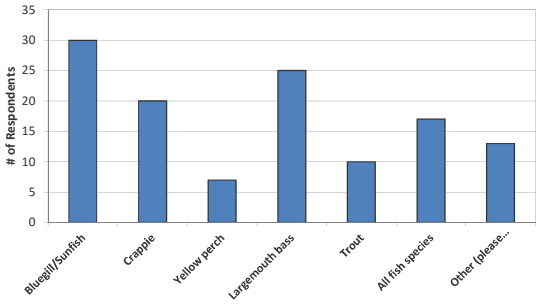


5. Have you personally fished on Crystal Lake in the past three years?

Answer Options	Response Percent	Response Count
Yes	71.4%	45
No	28.6%	18
answered question		63
skipped question		2

6. What species of fish do you like to catch on Crystal Lake?

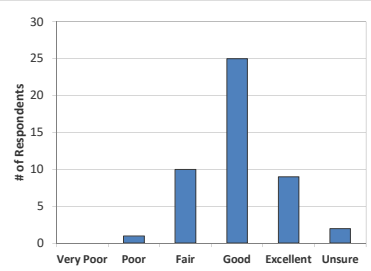
Answer Options	Response Percent	Response Count
Bluegill/Sunfish	63.8%	30
Crappie	42.6%	20
Yellow perch	14.9%	7
Largemouth bass	53.2%	25
Trout	21.3%	10
All fish species	36.2%	17
Other (please specify)	27.7%	13
answered question		47
skipped question		18



Number	Other (please specify)
1	Northern,
2	Northern Pike
3	Northern Pike
4	walleyes
5	pickeral, gar
6	Northern Pike
7	Northern Pike
8	none
9	Northern Pike
10	northern pike
11	don't care too much
12	northern
13	Small mouth bass

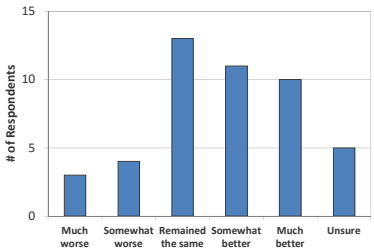
7. How would you describe the current quality of fishing on Crystal Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	0	1	10	25	9	2	47
						answered question	47
						skipped question	18



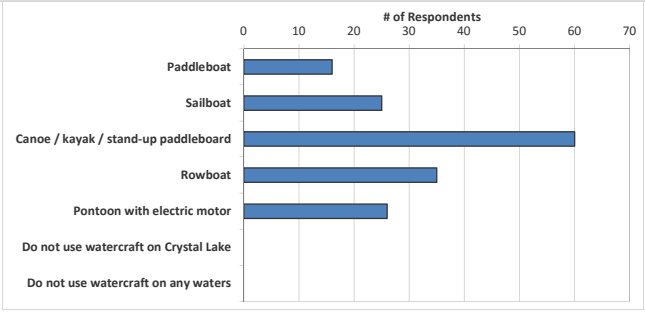
8. How has the quality of fishing changed on Crystal Lake since you have started fishing the lake?

Answer Options	Much worse	Somewhat worse	Remained the same	Somewhat better	Much better	Unsure	Response Count
	3	4	13	11	10	5	46
						answered question	46
						skipped question	19



9. What types of watercraft do you currently use on Crystal Lake?

Answer Options	Response Percent	Response Count
Paddleboat	25.4%	16
Sailboat	39.7%	25
Canoe / kayak / stand-up paddleboard	95.2%	60
Rowboat	55.6%	35
Pontoon with electric motor	41.3%	26
Do not use watercraft on Crystal Lake	0.0%	0
Do not use watercraft on any waters	0.0%	0
answered question		63
skipped question		2



10. Do you use your watercraft on waters other than Crystal Lake?

Answer Options	Response Percent	Response Count
Yes	15.0%	9
No	85.0%	51
answered question		60
skipped question		5

11. What is your typical cleaning routine after using your watercraft on waters other than Crystal Lake?

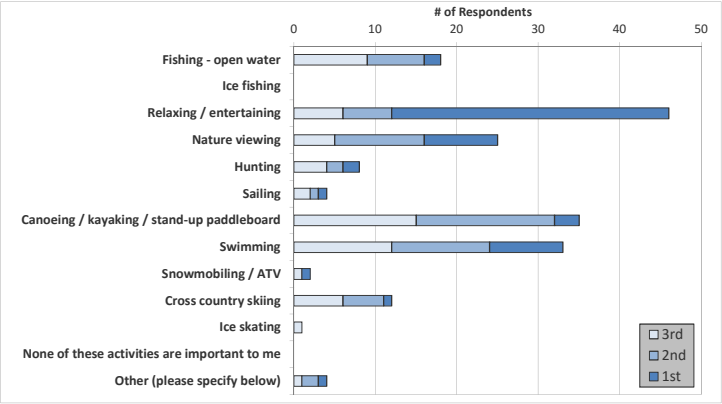
Answer Options	Response Percent	Response Count
Remove aquatic hitch-hikers (ex. - plant material, clams, mussels)	10.0%	1
Drain bilge	10.0%	1
Rinse boat	40.0%	4
Power wash boat	0.0%	0
Apply bleach	0.0%	0
Air dry boat for 5 or more days	40.0%	4
Do not clean boat	40.0%	4
Other (please specify)		3
answered question		**10**
skipped question		**55**

Number	Other (please specify)
1	NA
2	kayak on the mecan only
3	I have canoes that I use in other waters. They are clean when I use them in Crystal lake, but not sanitized or pressue washed

12. Please rank up to three activities that are important reasons for owning your property on Crystal Lake, with 1 being the most important activity.

Answer Options	1st	2nd	3rd	Rating Average	Response Count
Fishing - open water	2	7	9	2.39	18
Ice fishing	0	0	0	0	0
Relaxing / entertaining	34	6	6	1.39	46
Nature viewing	9	11	5	1.84	25
Hunting	2	2	4	2.25	8
Sailing	1	1	2	2.25	4
Canoeing / kayaking / stand-up paddleboard	3	17	15	2.34	35
Swimming	9	12	12	2.09	33
Snowmobiling / ATV	1	0	1	2	2
Cross country skiing	1	5	6	2.42	12
Ice skating	0	0	1	3	1
None of these activities are important to me	0	0	0	0	0
Other (please specify below)	1	2	1	2	4
			answered question		**63**
			skipped question		**2**

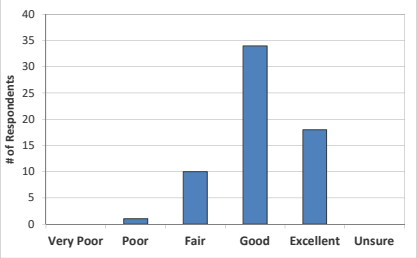
Number	"Other" responses
1	also enjoy forest beauty, boating, icefishing, ATVing,
2	pontoon boat
3	One of the very best things about Crystal Lake is my neighbors
4	disc golf
5	running trails, golf course, and roads



Crystal Lake Current and Historic Condition, Health and Management

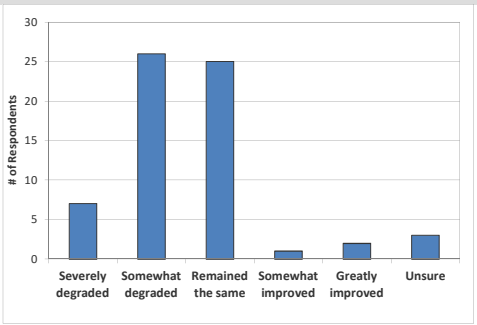
13. How would you describe the overall current water quality of Crystal Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	0	1	10	34	18	0	63
						answered question	**63**
						skipped question	**2**



14. How has the overall water quality changed in Crystal Lake since you first visited the lake?

Answer Options	Severely degraded	Somewhat degraded	Remained the same	Somewhat improved	Greatly improved	Unsure	Response Count
	7	26	25	1	2	3	64
						answered question	**64**
						skipped question	**1**



15. Considering how you answered the questions above, how do you describe water quality?

Answer Options	Response Percent	Response Count
Water clarity (clearness of water)	78.1%	50
Aquatic plant growth (not including algae blooms)	68.8%	44
Chara (macro algae) growth	31.3%	20
Water color	40.6%	26
Algae blooms	40.6%	26
Smell	18.8%	12
Water level	17.2%	11
Fish kills	6.3%	4
Other (please specify)	9.4%	6
	answered question	**64**
	skipped question	**1**

Number	Other (please specify)
1	Very concerned about dense weed growth - even "good" weeds
2	amount of foam at shore (do not know if b,c or e are relavent.
3	no odors, no form or suds
4	When I was very young there were carp in the lake that decimated the habitat for other fish. The water was clear, but not healthy. Now we have a better fish habitat, but excessive weed growth due to run off and electric propeller boat motors that chop up the weeds, enabling them to grow.
5	murkiness--30 years ago clearer at depth
6	Spreading EWM

16. Based on your answer above, which of the following answers is the single most important aspect when considering water quality?

Answer Options	Response Percent	Response Count
Water clarity (clearness of water)	59.4%	38
Aquatic plant growth (not including algae blooms)	18.8%	12
Chara (macro algae) growth	9.4%	6
Water color	1.6%	1
Algae blooms	6.3%	4
Smell	1.6%	1
Water level	0.0%	0
Fish kills	0.0%	0
Other (please specify)	3.1%	2
answered question		64
skipped question		1

Number	Other (please specify)
1	We are very concerned about dense weed growth - even "good" weeds
2	There is too much nitrogen and plant pieces that cause excessive vegetative and occasional algae growth.

17. Is fertilizer applied anywhere on your property?

Answer Options	Response Percent	Response Count
No	87.5%	56
Yes, I apply all of it	10.9%	7
Yes, a lawn service applies it	1.6%	1
Yes, I apply some and a lawn service applies some	0.0%	0
I don't know	0.0%	0
answered question		64
skipped question		1

18. Does the fertilizer used on your property contain phosphorus?

Answer Options	Response Percent	Response Count
Yes	25.0%	2
I don't know	25.0%	2
No	50.0%	4
answered question		8
skipped question		57

19. Before reading the statement above, had you ever heard of aquatic invasive species?

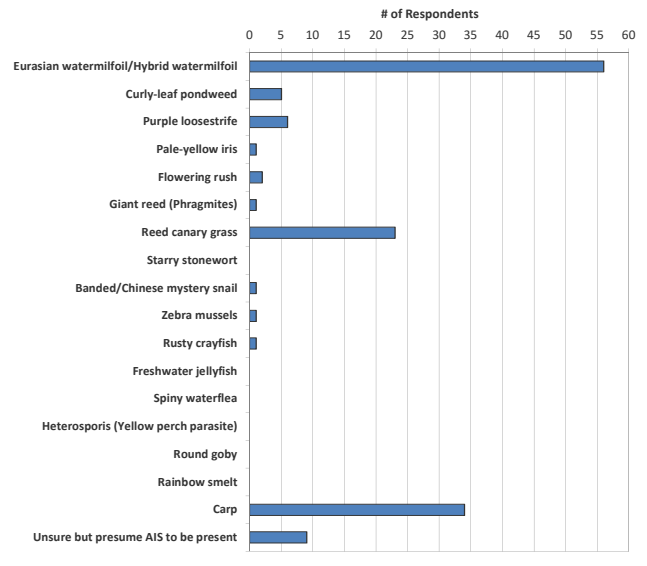
Answer Options	Response Percent	Response Count
Yes	98.4%	62
No	1.6%	1
answered question		63
skipped question		2

20. Do you believe aquatic invasive species are present within LakeName?

Answer Options	Response Percent	Response Count
Yes	85.5%	53
I think so but am not certain	9.7%	6
No	4.8%	3
answered question		62
skipped question		3

21. Do you believe aquatic invasive species are present within Crystal Lake?

Answer Options	Response Percent	Response Count
Eurasian watermilfoil/Hybrid watermilfoil	94.9%	56
Curly-leaf pondweed	8.5%	5
Purple loosestrife	10.2%	6
Pale-yellow iris	1.7%	1
Flowering rush	3.4%	2
Giant reed (Phragmites)	1.7%	1
Reed canary grass	39.0%	23
Starry stonewort	0.0%	0
Banded/Chinese mystery snail	1.7%	1
Zebra mussels	1.7%	1
Rusty crayfish	1.7%	1
Freshwater jellyfish	0.0%	0
Spiny waterflea	0.0%	0
Heterosporis (Yellow perch parasite)	0.0%	0
Round goby	0.0%	0
Rainbow smelt	0.0%	0
Carp	57.6%	34
Unsure but presume AIS to be present	15.3%	9
Other (please specify)	6.8%	4
answered question		**59**
skipped question		**6**

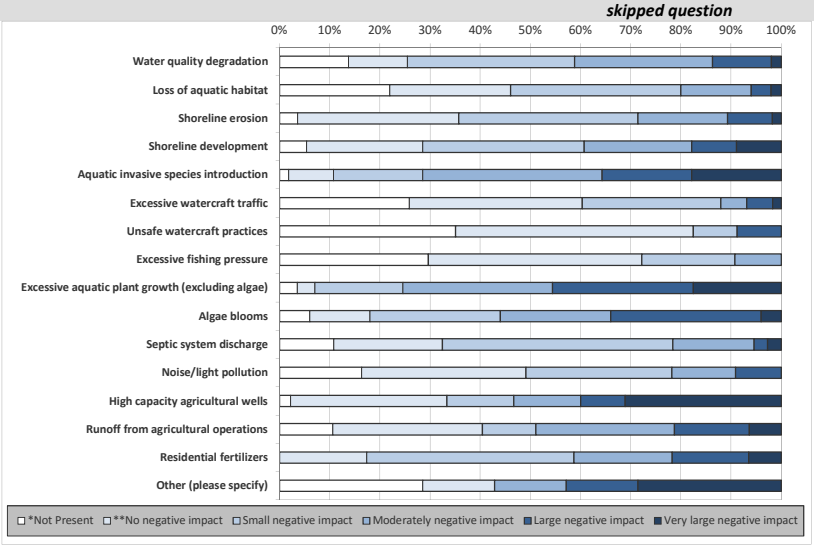


Number	"Other" responses
1	Not very aware of other AIS
2	Carp and gar are temporary visitors; don't know names of all invasive plants
3	note familar enough to identify
4	You list many land plants that are present on Crystal Lake property, but not in Crystal Lake

22. To what level do you believe each of the following factors may currently be negatively impacting Crystal Lake?
*** Not Present means that you believe the issue does not exist on Crystal Lake.**
**** No Impact means that the issue may exist on Crystal Lake but it is not negatively impacting the lake.**

Answer Options	*Not Present	**No negative impact	Small negative impact	Moderately negative impact	Large negative impact	Very large negative impact	Unsure: Need more information	Rating Average	Response Count
Water quality degradation	7	6	17	14	6	1	10	1.10	61
Loss of aquatic habitat	11	12	17	7	2	1	9	0.69	59
Shoreline erosion	2	18	20	10	5	1	4	0.98	60
Shoreline development	3	13	18	12	5	5	5	1.26	61
Aquatic invasive species introduction	1	5	10	20	10	10	6	1.94	62
Excessive watercraft traffic	15	20	16	3	3	1	0	0.60	58
Unsafe watercraft practices	20	27	5	0	5	0	1	0.34	58
Excessive fishing pressure	16	23	10	5	0	0	6	0.33	60
Excessive aquatic plant growth (excluding alg	2	2	10	17	16	10	6	2.10	63
Algae blooms	3	6	13	11	15	2	9	1.49	59
Septic system discharge	4	8	17	6	1	1	24	0.59	61
Noise/light pollution	9	18	16	7	5	0	3	0.78	58
High capacity agricultural wells	1	14	6	6	4	14	15	1.43	60
Runoff from agricultural operations	5	14	5	13	7	3	14	1.05	61
Residential fertilizers	0	8	19	9	7	3	14	1.17	60
Other (please specify)	2	1	0	1	1	2	1	1.63	8
								answered question	**64**
								skipped question	**1**

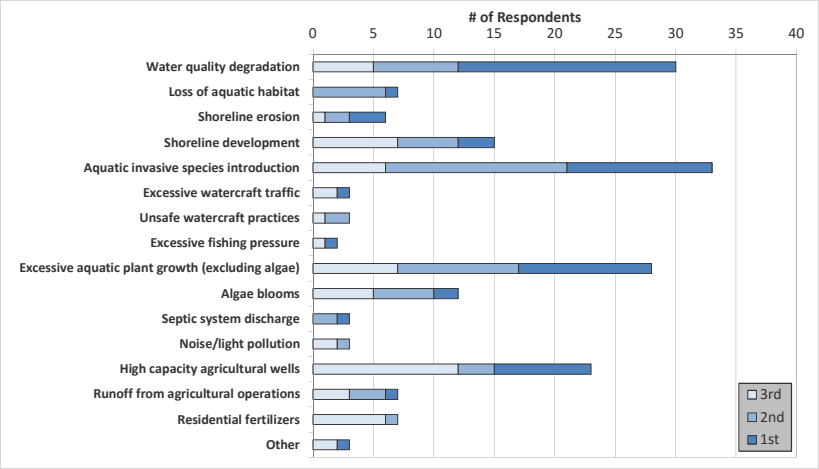
Number	Other (please specify)
1	the runoff is concerning
2	leaking, aging septic tanks, homeowners pumping water from lake to water lawns, etc.
3	I want people to stop cutting down trees between their houses and the lake. I don't want to see their houses. I want people to stop cutting down trees to improve their view with the result being that they ruin my view.
4	larger electric motor
5	development/wake and erosion filling in with marl, decomposing weeds, encroachment of weeds by tamarack end of lake
6	There are more boats with propellers since the introduction of electric motors, leading to more human impact on the aquatic environment.
7	high speed electric motors, fireworks
8	CLC unwillingness to address excessive Chara and spreading EWM



23. From the list below, please rank your top three concerns regarding Crystal Lake, with 1 being your greatest concern.

Answer Options	1st	2nd	3rd	Response Count
Water quality degradation	18	7	5	30
Loss of aquatic habitat	1	6	0	7
Shoreline erosion	3	2	1	6
Shoreline development	3	5	7	15
Aquatic invasive species introduction	12	15	6	33
Excessive watercraft traffic	1	0	2	3
Unsafe watercraft practices	0	2	1	3
Excessive fishing pressure	1	0	1	2
Excessive aquatic plant growth (excluding algae)	11	10	7	28
Algae blooms	2	5	5	12
Septic system discharge	1	2	0	3
Noise/light pollution	0	1	2	3
High capacity agricultural wells	8	3	12	23
Runoff from agricultural operations	1	3	3	7
Residential fertilizers	0	1	6	7
Other (please specify)	1	0	2	3
		answered question		**63**
		skipped question		**2**

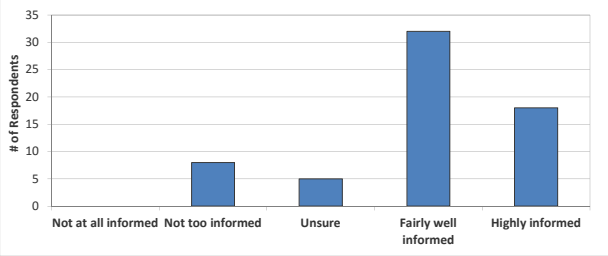
Number	"Other" responses
1	Concerned about new large pontoon boat with larger electric motors also noisy remote control water "toys". Not happy with excessive size of new home development.
2	With more electric motors, traveling close to shore I'm concerned that they cut up aquatic plants and may cause spreading of these plants, but don't know.
3	there are still many in the area that who do not know that Crystal Lake exists. This is a private corporation and the CLC land is private. CLC members are dutyn bound to preserve. Thus not involving themselves wilth government agencies except when absolutely necessary in order to follow county, state/federal laws. Good job and thank yiou to whomever told people they cannot put tarps in the lake, cause they did not want weeds by their dock. Hope it was CLC Board. It is my observation that some CLC members and CLC Board members enjoy committees and involving themseleves with social issues. I would prefer that the CLC involve itself outside agencies, citizen groups, conventions, etc. I personally would prefer that this remain a privatly held corporation, and that the Board of Directors lead the shareholders best interest, including personally communicating with share holders.
4	1. concern that ATV trails will encroach upon cross country/walking trails 2. concern that others may want to make Crystal Lake a no-wake lake for electric motors
5	Fear Driven regulations being imposed without substantial scientific backing



Crystal Lake Club (CLC)

24. How informed has (or had) the CLC kept you regarding issues with Crystal Lake and its management?

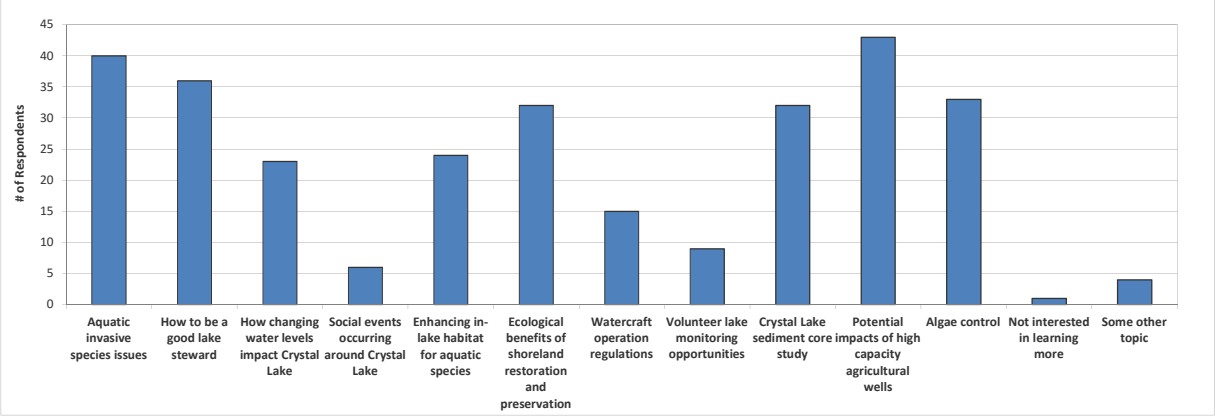
Answer Options	Not at all informed	Not too informed	Unsure	Fairly well informed	Highly informed	Response Count
	0	8	5	32	18	63
					answered question	**63**
					skipped question	**2**



25. Stakeholder education is an important component of every lake management planning effort. Which of these subjects would you like to learn more about?

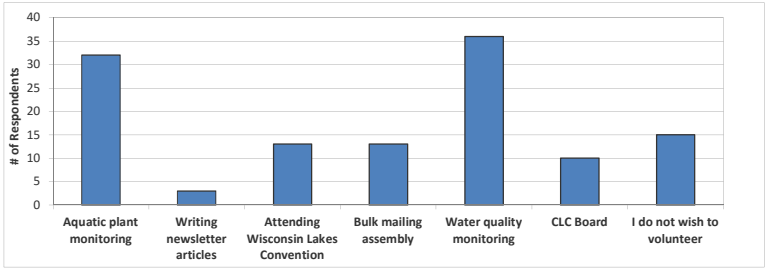
Answer Options	Response Percent	Response Count
Aquatic invasive species impacts, means of transport, identification, control options, etc.	64.5%	40
How to be a good lake steward	58.1%	36
How changing water levels impact Crystal LAke	37.1%	23
Social events occurring around Crystal Lake	9.7%	6
Enhancing in-lake habitat (not shoreland or adjacent wetlands) for aquatic species	38.7%	24
Ecological benefits of shoreland restoration and preservation	51.6%	32
Watercraft operation regulations – lake specific, local and statewide	24.2%	15
Volunteer lake monitoring opportunities (Clean Boats Clean Waters, Citizens Lake Monitoring Network, Loon Watch, CLC programs, etc.)	14.5%	9
Past and present water quality conditions of Crystal Lake from sediment core study	51.6%	32
Potential impacts of high capacity agricultural wells	69.4%	43
Algae control	53.2%	33
Not interested in learning more on any of these subjects	1.6%	1
Some other topic (please specify)	6.5%	4
	answered question	**62**
	skipped question	**3**

Number	Other (please specify)
1	Now that I know there are battery operated jet skis, I want to know more about them and their potential impact on the lake.
2	possible impact agricultural waste
3	negative impacts of increased wake size/power on shoreline and animal habitats
4	maintenance/restoration options



26. The effective management of your lake will require the cooperative efforts of numerous volunteers. Please select the activities you would be willing to participate in if the CLC requires additional assistance.

Answer Options	Response Percent	Response Count
Aquatic plant monitoring	52.5%	32
Writing newsletter articles	4.9%	3
Attending Wisconsin Lakes Convention	21.3%	13
Bulk mailing assembly	21.3%	13
Water quality monitoring	59.0%	36
CLC Board	16.4%	10
I do not wish to volunteer	24.6%	15
answered question		61
skipped question		4



27. Please feel free to provide written comments concerning Crystal Lake, its current and/or historic condition and its management.

Answer Options	Response Count
	33
answered question	33
skipped question	32

Number	Response Text
1	We love the lake and want to help keep it's pristine nature!
2	The lake quality and water clarity was better back in the70s when gas powered motors were allowed. That is just a statement of factUal observation. The weed growth was minimal back then. Invasive species presence was nonexistent. Shoreline he Ros invasive species presence was nonexistent. Shoreline erosion was not what it is today even though gas motors existed on the lake. I am not saying I want gas powered motors again I just wonder why this is ☺
3	concerned with water quality for recreational water usage and high capacity well effect in the future
4	Please help manage the lake quality! Just read The Death and Life of the Great Lakes. We need to do a better job of protecting our fresh water lakes. even a small one like Crystal Lake. If Zebra mussels and other invasives are found in Crystal Lake that will be very sad, especially since there is such limited boat launching.
5	Love the lake , desire we keep it as pristine as possible, I have noticed the types of weeds in lake have seemed to change over the years. My area of lake is quite good not as sure as other with significant Charra growth.
6	Don't forget that drinking water quality has degraded during these same recent years with lake water quality
7	I know that a complete report of Crystal Lake water quality as published a few years ago before anyone spent for partial funding of this survey. I read that documents but cannot find it right now. The correct answers as to questions 14 - 16 could be gleaned from that documents, I assume. There are still many in the area who do not know that Crystal Lake exists. This is a private corporation and the CLC land is private. CLC members are duty bound to preserve. Thus perhaps NOT involving with government agencies, except when absolutely necessary in order to follow county/state/federal laws. Good job and thank you to whomever told people they cannot put tarps in the lake, cause they did not want weeds near their dock. Hope it was the CLC board! It is my observation that some CLC members enjoy committees and involving themselves with social issues. In would prefer that the CLC involve itself with outside agencies, citizens groups, conventions, etc. I personally would prefer that this remain a privately held corporation and that the Board of Directors lead in the shareholders best interests. Including personally communicating with shareholders and title holders of plotted lands on the shoreline of Crystal Lake, if said shareholders engage in conduct which would tend to injure the corporation/Club. Some Club members may need management and yes, we humans need to corporate and do the right thing for this place.
8	I've been a permanent resident of this beautiful place for 44 years. Life is good.
9	I have been coming to Crystal Lake since the mid 1930s. We first came as campers on what I believe was the Eichstadt farm and later in the cottages, owned by the Meckleberg family.
10	I would like to see trout planted in the lake and would contribute to the cost
11	Was this a survey regarding Lake Management or Club management. Seems Blended! Next year (USGS) comes out with laser maps. I suggest you start with contours maps so you know what Crystal Lake watershed really is.
12	My main concern is people cutting down trees between their houses and the shoreline.
13	Monitoring local impact of deep water wells, agricultural runoff and invasives and partnering with experts to maintain a healthy body of wate
14	USGS has a new watershed map coming out in 2019. I believe that should be utilized when looking at things like farm field runoff etc. Looking at the current USGS watershed map it would appear that Crystal Lake is protected from the runoff concerns many other lakes face. Our time/money should be focused on protecting our fishery from the increased fishing pressure from our public access as well as proper control of Millfoil and Chara.
15	The lake association has been a good steward of property for over 90 years, hope we can continue it. Very special place
16	It is so peaceful here. Like it this way.
17	We are relatively new to the lake and have much to learn. Many of these areas of focus are of interest to us
18	CLC has many standing committees but many are not active, never meet, do not periodically assess whether there is a need. This is a mistake
19	We believe we should stick to the ideal outlined in Article 1 unless a 2/3's majority of property owners want to change it. When we bought we looked at the articles of incorporation and what was expressed in them was part of our attraction to the lake.
20	At one time the marl was mined for farm use. Can something like that be done again? The increase in weeds has significantly increased in the last 20 years. Has the removal of gas engines contributed to weed growth as there is now no disruption of bottom? The muck has significantly increased on the west end of the lake and the increase in weeds is filling in that end.
21	Thanks Mr. Church for all that you do for our lake.
22	It certainly isn't the place that I was blessed to grow up in...those were the days
23	Nothing was done to combat Reed Canary Grass when it showed up 10 years ago. The milfoil growth is low some years and high others, and I think they get a little too overconcerned about this versus some of the other problems. I just had curly dock growing from my shoreline for the first time. The water quality has declined in that I have more algae growth than I have ever had each of the last 5 years and it seems to be getting worse. My lakeshore was clean and now is choked with Chara grass and another plant I am not sure of. I know that chara grass is good and native but I wonder whey it has become so prolific in the last 10 years. This may be based on fertilizers or some chemical that is causing growth.
24	We have a beautiful and varied environment here and we need to preserve it
25	The lake needs to do a better job of welcoming new owners on the lake and provide history of the lake. For instance, the reasoning for banning gas engines and the impact that has had on the lake would be good for all to know.
26	It's good to see that we are finally taking lake management seriously
27	I feel it is well managed, but unfortunately just like everywhere, we have a few that cause problems

Number	Response Text
28	Good survey. I would volunteer for more but ill and without enough contact there
29	We have only been on the lake for a short time.
30	keep development to a minimum. maximum size restrictions enforced. no high speed electric motors.no ATV's on the trails
31	We have numerous committees for our lands and two committees for the lake. Those two committees are known as committees that always say "no" and nothing moves forward to address over growth of chara and spreading EWM.
32	By and large CLC has done a pretty good job being a good steward of the lake and land.
33	A very pristine lake that needs to be kept that way for the future

C

APPENDIX C

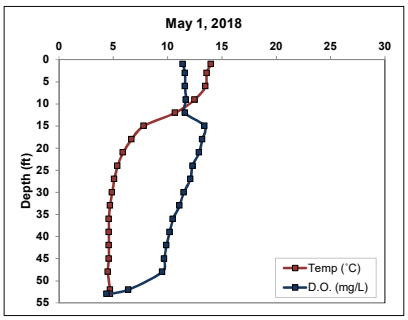
Water Quality Data

Crystal Lake

Date: 5/1/2018
Time: 10:30
Weather: 100% clouds, 18mph wind, 70°F
Entry: JLW

Max Depth: 54.8
CLS Depth (ft): 3.0
CLB Depth (ft): 52.0
Secchi Depth (ft): 12.4

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	14.0	11.4	111%		
3	13.6	11.6	112%	8.4	
6	13.5	11.6	112%		
9	12.5	11.7	109%		
12	10.7	11.6	105%		
15	7.8	13.4	113%	8.5	
18	6.7	13.2	108%		
21	5.9	12.9	103%		
24	5.4	12.3	98%		
27	5.1	12.1	95%		
30	4.9	11.5	90%	8.4	
33	4.7	11.1	86%		
36	4.6	10.5	81%		
39	4.6	10.2	79%		
42	4.6	9.9	77%		
45	4.6	9.7	75%	8.2	
48	4.5	9.5	74%		
52	4.7	6.4	50%	7.9	
53	4.7	4.4	34%		



Parameter	CLS	CLB
Total P (µg/L)	13.40	24.90
Dissolved P (µg/L)	ND	2.20
Chl-a (µg/L	4.79	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	1070.00	1240.00
Lab Cond. (µS/cm)	317.00	309.00
Lab pH	8.03	8.37
Alkalinity (mg/L $CaCO_3$)	150.00	144.00
Total Susp. Solids (mg/L)	ND	ND
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	19.50	NA
Hardness (mg/L)	169.00	NA
Color (SU)	10.00	NA
Turbidity (NTU)	NA	NA

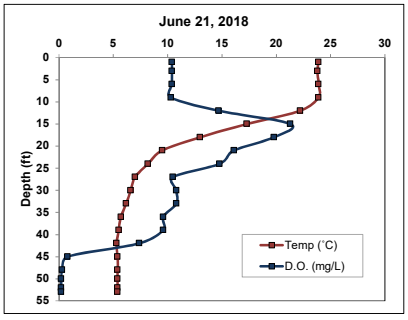
Data collected by JMB & TWH (Onterra).

Crystal Lake

Date: 6/21/2018
Time: 2:15
Weather: 100% clouds, 75°F, 4mph NNW wind
Entry: JLW

Max Depth: 53.8
CLS Depth (ft): 3.0
CLB Depth (ft): 50.0
Secchi Depth (ft): 7.6

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	23.9	10.4	124%		
3	23.8	10.4	122%		
6	23.9	10.4	124%		
9	23.9	10.3	123%		
12	22.2	14.7	169%		
15	17.3	21.3	222%		
18	13.0	19.8	189%		
21	9.5	16.1	141%		
24	8.2	14.8	125%		
27	7.0	10.5	87%		
30	6.6	10.8	88%		
33	6.2	10.8	87%		
36	5.7	9.6	77%		
39	5.5	9.6	76%		
42	5.3	7.4	58%		
45	5.4	0.8	6%		
48	5.4	0.3	2%		
50	5.4	0.2	2%		
52	5.4	0.2	2%		
53	5.4	0.2	2%		



Parameter	CLS	CLB
Total P (µg/L)	11.00	28.40
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L	3.62	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

Data collected by Onterra (JLW & NLS).

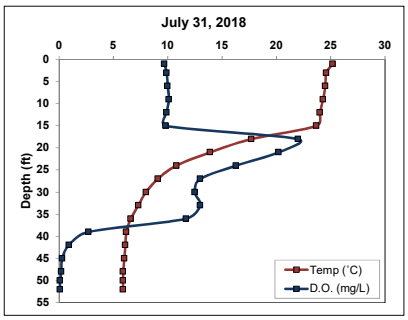
Crystal Lake

Date: 7/31/2018
Time: 10:00
Weather: 0% clouds, 74°F
Entry: HAL

Max Depth: 52.7
CLS Depth (ft): 3.0
CLB Depth (ft): 50.0
Secchi Depth (ft): 22.7

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	25.2	9.7	118%		
3	24.6	9.9	119%		
6	24.5	10.0	120%		
9	24.3	10.1	120%		
12	24.0	9.9	118%		
15	23.7	9.8	115%		
18	17.7	22.0	232%		
21	13.9	20.2	196%		
24	10.8	16.3	147%		
27	9.1	13.0	113%		
30	8.0	12.5	106%		
33	7.3	13.0	107%		
36	6.6	11.7	95%		
39	6.2	2.7	22%		
42	6.1	0.9	7%		
45	6.0	0.3	2%		
48	5.9	0.2	2%		
50	5.9	0.1	1%		
52	5.9	0.1	1%		

*DO out of range



Parameter	CLS	CLB
Total P (µg/L)	ND	33.70
Dissolved P (µg/L)	ND	ND
Chl-a (µg/L	0.50	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	624.00	2250.00
Lab Cond. (µS/cm)	245.00	369.00
Lab pH	8.72	7.56
Alkalinity (mg/L $CaCO_3$)	110.00	177.00
Total Susp. Solids (mg/L)	ND	3.60
Calcium (mg/L)	20.90	NA
Magnesium (mg/L)	18.00	NA
Hardness (mg/L)	126.00	NA
Color (SU)	ND	NA
Turbidity (NTU)	NA	NA

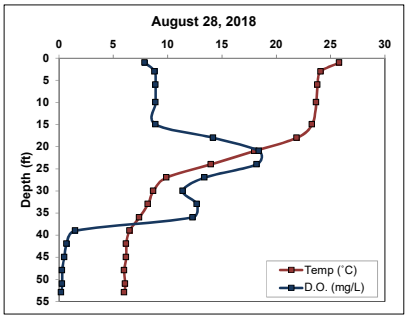
Data collected by Onterra (TWH & NLS). At 18' DO was out of range - high.

Crystal Lake

Date: 8/28/2018
Time: 10:45
Weather: (not entered)
Entry: HAL

Max Depth: 54.7
CLS Depth (ft): 3.0
CLB Depth (ft): 52.0
Secchi Depth (ft): 19.1

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	25.8	7.9	98%		
3	24.1	8.8	105%		
6	23.8	8.9	105%		
10	23.7	8.9	105%		
15	23.3	8.9	105%		
18	21.9	14.2	161%		
21	18.0	18.4	194%		
24	14.0	18.2	177%		
27	9.9	13.4	119%		
30	8.7	11.4	98%		
33	8.2	12.7	108%		
36	7.4	12.3	103%		
39	6.5	1.5	12%		
42	6.2	0.7	6%		
45	6.2	0.5	4%		
48	6.0	0.3	2%		
51	6.1	0.3	2%		
53	6.0	0.2	2%		



Parameter	CLS	CLB
Total P (µg/L)	8.22	82.10
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L	0.73	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

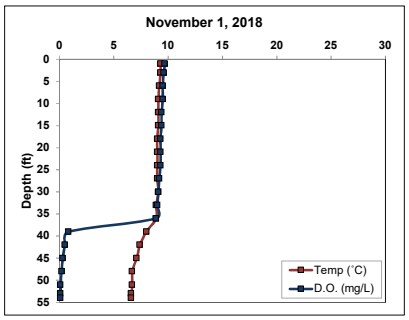
Data collected by Onterra (EJH & TAH) w/ YSI.

Crystal Lake

Date: 11/1/2018
Time: 12:00
Weather: 50% clouds, 5mph winds, 45ºF
Entry: HAL

Max Depth: 55.2
CLS Depth (ft): 3.0
CLB Depth (ft): 51.0
Secchi Depth (ft): 16.6

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	9.3	9.7	84%		
3	9.3	9.6	83%		
6	9.2	9.5	83%		
9	9.1	9.5	83%		
12	9.1	9.4	82%		
15	9.1	9.4	82%		
18	9.0	9.3	80%		
21	9.0	9.3	80%		
24	9.0	9.3	80%		
27	9.0	9.2	79%		
30	9.1	9.1	79%		
33	8.9	9.0	78%		
36	8.9	8.9	77%		
39	8.0	0.8	7%		
42	7.4	0.5	4%		
45	7.1	0.3	2%		
48	6.7	0.2	2%		
51	6.7	0.1	1%		
53	6.6	0.1	1%		
54	6.6	0.1	1%		



Parameter	CLS	CLB
Total P (µg/L)	10.20	112.00
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L	2.90	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	ND	2.40
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

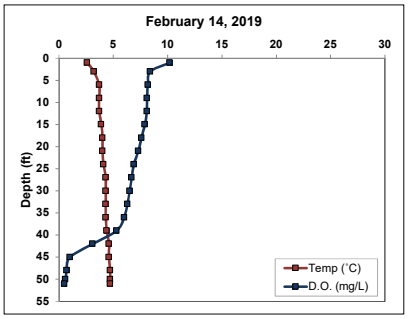
Data collected by Onterra

Crystal Lake

Date: 2/14/2019
Time: 12:15
Weather: 100% clouds, 29F, 1.3' ice
Entry: HAL

Max Depth: 53.5
CLS Depth (ft): 3.0
CLB Depth (ft): 50.0
Secchi Depth (ft): 19.0

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	2.6	10.2	75%		
3	3.2	8.4	63%		
6	3.7	8.2	62%		
9	3.7	8.1	61%		
12	3.7	8.1	61%		
15	3.9	7.9	60%		
18	4.0	7.6	58%		
21	4.0	7.3	56%		
24	4.1	6.9	53%		
27	4.3	6.7	52%		
30	4.3	6.5	50%		
33	4.3	6.3	48%		
36	4.3	6.0	46%		
39	4.4	5.3	41%		
42	4.6	3.1	24%		
45	4.6	1.0	8%		
48	4.7	0.7	5%		
50	4.7	0.6	5%		
51	4.7	0.5	4%		



Parameter	CLS	CLB
Total P (µg/L)	NA	NA
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L	NA	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

Data collected by Onterra (TWH, AMS, JMB)

Water Quality Data

2018-2019	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	6	16.2	NA	NA
Total P (µg/L)	5	10.7	5	56.2
Dissolved P (µg/L)	2	ND	2	2.2
Chl a (µg/L)	5	2.5	0	NA
TKN (µg/L	0	NA	0	NA
NO_3+NO_2-N (µg/L)	0	NA	0	NA
NH_3-N (µg/L)	0	NA	0	NA
Total N (µg/L)	2	847.0	2	1745.0
Lab Cond. (µS/cm)	2	281.0	2	339.0
Alkal (mg/l $CaCO_3$)	2	130.0	2	160.5
Total Susp. Solids (mg/l)	3	ND	3	3.0
Calcium (mg/L)	1	20.9	0	NA
Magnesium (mg/L)	2	18.8	0	NA
Hardness (mg/L)	2	147.5	0	NA
Color (SU)	2	10.0	0	NA
Turbidity (NTU)	0	NA	0	NA

Trophic State Index (TSI)

Year	TP	Chl-a	Secchi
1987			
1988			
1989			
1990			
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002			
2003			
2004			
2005			
2006			
2007			
2008			
2009			
2010			
2011			
2012			
2013			
2014			
2015			
2016			34.0
2017			39.8
2018	34.3	35.3	37.2
2019			
All Years (Weighted)	34.3	35.3	37.2
DHDL Median	45.0	46.4	42.8
NCHF Ecoregion Median	61.1	57.3	53.2

Turnover

	Secchi (feet)				Chlorophyll-*a* (µg/L)				Total Phosphorus (µg/L)			
	Growing Season		Summer		Growing Season		Summer		Growing Season		Summer	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
1987									2	10.0	0.0	
1988									2	40.0	0.0	
1989									2	7.5	0.0	
1990									2	15.0	0.0	
1991									1	20.0	0.0	
1992									2	16.0	0.0	
1993									2	13.5	0.0	
1994									2	12.0	0.0	
1995									2	16.0	0.0	
1996									1	11.0	0.0	
1997									2	14.5	0.0	
1998									2	26.5	0.0	
1999									2	14.5	0.0	
2000									2	14.0	0.0	
2001									1	23.0	0.0	
2002									1	3.0	0.0	
2003									1	16.0	0.0	
2004									1	15.0	0.0	
2005									2	16.0	0.0	
2006									1	11.0	0.0	
2007									2	11.0	0.0	
2008									2	14.5	0.0	
2009									2	17.0	0.0	
2010									2	11.0	0.0	
2011									1	10.0	0.0	
2012									1	17.0	0.0	
2013									2	21.5	0.0	
2014									2	12.5	0.0	
2015									2	14.0	0.0	
2016	5	17.3	4	20.0					2	16.0	0.0	
2017	6	11.2	3	13.3					2	21.5	0.0	
2018	10	15.4	8	15.9	4	2.4	3	1.6	5	9.6	3.0	8.1
2019												
Weighted Ave		14.6		16.5		2.4		1.6		15.2		8.1
DHDL Median				10.8				5.0				17.0
NCHF Ecoregion Median				5.3				15.2				52.0

D

APPENDIX D

Watershed Analysis WiLMS Results

Date: 2/26/2019 Scenario: 4

Lake Id: Crystal, Marquette

Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 202.0 acre
Total Unit Runoff: 9.7 in.
Annual Runoff Volume: 163.3 acre-ft
Lake Surface Area <As>: 123 acre
Lake Volume <V>: 3307 acre-ft
Lake Mean Depth <z>: 26.9 ft
Precipitation - Evaporation: 3 in.
Hydraulic Loading: 194.0 acre-ft/year
Areal Water Load <qs>: 1.6 ft/year
Lake Flushing Rate <p>: 0.06 1/year
Water Residence Time: 17.04 year
Observed spring overturn total phosphorus (SPO): 7 mg/m^3
Observed growing season mean phosphorus (GSM): 13 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	3	0.50	1.00	3.00	4.4	1	1	4
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	11	0.10	0.30	0.50	4.9	0	1	2
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)	9	0.05	0.10	0.25	1.3	0	0	1
Wetlands	86	0.10	0.10	0.10	12.7	3	3	3
Forest	93	0.05	0.09	0.18	12.3	2	3	7
Lake Surface	123.0	0.10	0.30	1.00	54.4	5	15	50

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	55				
% Phosphorus Retained by Soil		98	90	80	
Septic Tank Loading (kg/year)		0.33	2.75	8.80	10.0

TOTALS DATA

Description	Low	Most Likely	High	Loading %

Total Loading (lb)	26.2	60.5	166.7	100.0
Total Loading (kg)	11.9	27.5	75.6	100.0
Areal Loading (lb/ac-year)	0.21	0.49	1.36	0.0
Areal Loading (mg/m^2-year)	23.92	55.18	151.90	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)	14.5	21.6	37.6	90.0
Total NPS Loading (kg)	6.6	9.8	17.0	90.0

Phosphorus Prediction and Uncertainty Analysis Module

Date: 2/26/2019 Scenario: 4
Observed spring overturn total phosphorus (SPO): 7.0 mg/m^3
Observed growing season mean phosphorus (GSM): 13.0 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	13	29	80	16	123
Canfield-Bachmann, 1981 Natural Lake	9	15	27	2	15
Canfield-Bachmann, 1981 Artificial Lake	11	16	27	3	23
Rechow, 1979 General	2	5	12	-8	-62
Rechow, 1977 Anoxic	12	28	78	15	115
Rechow, 1977 water load<50m/year	3	6	18	-7	-54
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	12	29	79	22	314
Vollenweider, 1982 Combined OECD	10	20	45	10	100
Dillon-Rigler-Kirchner	12	27	73	20	286
Vollenweider, 1982 Shallow Lake/Res.	8	16	38	6	60
Larsen-Mercier, 1976	10	22	62	15	214
Nurnberg, 1984 Oxic	9	22	60	9	69

Lake Phosphorus Model	Confidence Lower Bound	Confidence Upper Bound	Parameter Fit?	Back Calculation (kg/year)	Model Type
Walker, 1987 Reservoir	16	62	Tw	0	GSM
Canfield-Bachmann, 1981 Natural Lake	5	43	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	5	46	FIT	1	GSM
Rechow, 1979 General	3	10	L qs	0	GSM
Rechow, 1977 Anoxic	16	60	FIT	0	GSM
Rechow, 1977 water load<50m/year	3	14	FIT	0	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	14	64	FIT	0	SPO
Vollenweider, 1982 Combined OECD	9	40	FIT	0	ANN

Dillon-Rigler-Kirchner	15	56	P L qs p	0	SPO
Vollenweider, 1982 Shallow Lake/Res.	8	33	FIT	0	ANN
Larsen-Mercier, 1976	13	47	P Pin	0	SPO
Nurnberg, 1984 Oxic	11	48	FIT	0	ANN

E

APPENDIX E

Aquatic Plant Survey Data

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE_	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	TRF	Hybrid watermilfoil	Chara spp.	Eleocharis acicularis	Najas flexilis	Potamogeton friesii	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton zosteriformis	Stuckenia pectinata	Vallisneria americana
1	43.972756	-89.366888	192	Crystal	Marquette	7/31/2018	TWH & NLS	1	0		NONNAVIGABLE (PLANTS)												
2	43.972395	-89.366892	116	Crystal	Marquette	7/31/2018	TWH & NLS	2	0		NONNAVIGABLE (PLANTS)												
3	43.972753	-89.366389	118	Crystal	Marquette	7/31/2018	TWH & NLS	3	0		NONNAVIGABLE (PLANTS)												
4	43.972393	-89.366393	117	Crystal	Marquette	7/31/2018	TWH & NLS	4	0		NONNAVIGABLE (PLANTS)												
5	43.972033	-89.366397	119	Crystal	Marquette	7/31/2018	TWH & NLS	5	0		NONNAVIGABLE (PLANTS)												
6	43.972750	-89.365891	191	Crystal	Marquette	7/31/2018	TWH & NLS	6	0		NONNAVIGABLE (PLANTS)												
7	43.972390	-89.365894	115	Crystal	Marquette	7/31/2018	TWH & NLS	7	4	Sand	Pole	SAMPLED	3		3				1	1			
8	43.972030	-89.365898	120	Crystal	Marquette	7/31/2018	TWH & NLS	8	5	Sand	Pole	SAMPLED	3		3								1
9	43.971670	-89.365902	121	Crystal	Marquette	7/31/2018	TWH & NLS	9	5	Sand	Pole	SAMPLED	3		3								
10	43.972747	-89.365392	190	Crystal	Marquette	7/31/2018	TWH & NLS	10	0		NONNAVIGABLE (PLANTS)												
11	43.972387	-89.365396	114	Crystal	Marquette	7/31/2018	TWH & NLS	11	7	Sand	Pole	SAMPLED	3	1	3								
12	43.972027	-89.365400	124	Crystal	Marquette	7/31/2018	TWH & NLS	12	18		Rope	SAMPLED	0										
13	43.971667	-89.365403	123	Crystal	Marquette	7/31/2018	TWH & NLS	13	17		Rope	SAMPLED	2		2								
14	43.971307	-89.365407	122	Crystal	Marquette	7/31/2018	TWH & NLS	14	3	Sand	Pole	SAMPLED	3		3				1				
15	43.972744	-89.364893	112	Crystal	Marquette	7/31/2018	TWH & NLS	15	7	Sand	Pole	SAMPLED	3	2	3								
16	43.972384	-89.364897	113	Crystal	Marquette	7/31/2018	TWH & NLS	16	17		Rope	SAMPLED	0										
17	43.972024	-89.364901	125	Crystal	Marquette	7/31/2018	TWH & NLS	17	30		Rope	SAMPLED	0										
18	43.971664	-89.364905	128	Crystal	Marquette	7/31/2018	TWH & NLS	18	32		Rope	SAMPLED	0										
19	43.971304	-89.364909	129	Crystal	Marquette	7/31/2018	TWH & NLS	19	25		Rope	SAMPLED	0										
20	43.970944	-89.364912	130	Crystal	Marquette	7/31/2018	TWH & NLS	20	13	Sand	Pole	SAMPLED	3		3								
21	43.970584	-89.364916	131	Crystal	Marquette	7/31/2018	TWH & NLS	21	2	Sand	Pole	SAMPLED	3		3								
22	43.973102	-89.364391	111	Crystal	Marquette	7/31/2018	TWH & NLS	22	5	Sand	Pole	SAMPLED	1		1		1						
23	43.972742	-89.364395	110	Crystal	Marquette	7/31/2018	TWH & NLS	23	18		Rope	SAMPLED	3		3								
24	43.972382	-89.364398	109	Crystal	Marquette	7/31/2018	TWH & NLS	24	36			DEEP											
25	43.972021	-89.364402	126	Crystal	Marquette	7/31/2018	TWH & NLS	25	40			DEEP											
26	43.971661	-89.364406	127	Crystal	Marquette	7/31/2018	TWH & NLS	26	40			DEEP											
27	43.971301	-89.364410	135	Crystal	Marquette	7/31/2018	TWH & NLS	27	33		Rope	SAMPLED	0										
28	43.970941	-89.364414	134	Crystal	Marquette	7/31/2018	TWH & NLS	28	23		Rope	SAMPLED	0										
29	43.970581	-89.364418	133	Crystal	Marquette	7/31/2018	TWH & NLS	29	12	Sand	Pole	SAMPLED	3	3									
30	43.970221	-89.364421	132	Crystal	Marquette	7/31/2018	TWH & NLS	30	0		NONNAVIGABLE (PLANTS)												
31	43.973099	-89.363892	106	Crystal	Marquette	7/31/2018	TWH & NLS	31	10	Sand	Pole	SAMPLED	2	1	2		1						
32	43.972739	-89.363896	107	Crystal	Marquette	7/31/2018	TWH & NLS	32	28		Rope	SAMPLED	0										
33	43.972379	-89.363900	108	Crystal	Marquette	7/31/2018	TWH & NLS	33	39			DEEP											
34	43.972019	-89.363904	0	Crystal	Marquette	7/31/2018	TWH & NLS	34	0			DEEP											
35	43.971659	-89.363907	0	Crystal	Marquette	7/31/2018	TWH & NLS	35	0			DEEP											
36	43.971298	-89.363911	136	Crystal	Marquette	7/31/2018	TWH & NLS	36	40			DEEP											
37	43.970938	-89.363915	137	Crystal	Marquette	7/31/2018	TWH & NLS	37	37			DEEP											
38	43.970578	-89.363919	138	Crystal	Marquette	7/31/2018	TWH & NLS	38	26		Rope	SAMPLED	0										
39	43.970218	-89.363923	139	Crystal	Marquette	7/31/2018	TWH & NLS	39	11	Sand	Pole	SAMPLED	3		3		1						
40	43.973096	-89.363393	105	Crystal	Marquette	7/31/2018	TWH & NLS	40	7	Sand	Pole	SAMPLED	3	1	3					1			

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE_	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	TRF	Hybrid watermilfoil	Chara spp.	Eleocharis acicularis	Najas flexilis	Potamogeton friesii	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton zosteriformis	Stuckenia pectinata	Vallisneria americana
41	43.972736	-89.363397	104	Crystal	Marquette	7/31/2018	TWH & NLS	41	33			DEEP											
42	43.972376	-89.363401	103	Crystal	Marquette	7/31/2018	TWH & NLS	42	42			DEEP											
43	43.972016	-89.363405	0	Crystal	Marquette	7/31/2018	TWH & NLS	43	0			DEEP											
44	43.971656	-89.363409	0	Crystal	Marquette	7/31/2018	TWH & NLS	44	0			DEEP											
45	43.971296	-89.363413	0	Crystal	Marquette	7/31/2018	TWH & NLS	45	0			DEEP											
46	43.970936	-89.363416	0	Crystal	Marquette	7/31/2018	TWH & NLS	46	0			DEEP											
47	43.970575	-89.363420	141	Crystal	Marquette	7/31/2018	TWH & NLS	47	33			DEEP											
48	43.970215	-89.363424	140	Crystal	Marquette	7/31/2018	TWH & NLS	48	16	Sand	Pole	SAMPLED	1	1									
49	43.973093	-89.362895	100	Crystal	Marquette	7/31/2018	TWH & NLS	49	1	Sand	Pole	SAMPLED	1		1								
50	43.972733	-89.362899	101	Crystal	Marquette	7/31/2018	TWH & NLS	50	21		Rope	SAMPLED	1		1								
51	43.972373	-89.362902	102	Crystal	Marquette	7/31/2018	TWH & NLS	51	37			DEEP											
52	43.972013	-89.362906	0	Crystal	Marquette	7/31/2018	TWH & NLS	52	0			DEEP											
53	43.971653	-89.362910	0	Crystal	Marquette	7/31/2018	TWH & NLS	53	0			DEEP											
54	43.971293	-89.362914	0	Crystal	Marquette	7/31/2018	TWH & NLS	54	0			DEEP											
55	43.970933	-89.362918	0	Crystal	Marquette	7/31/2018	TWH & NLS	55	0			DEEP											
56	43.970573	-89.362922	142	Crystal	Marquette	7/31/2018	TWH & NLS	56	41			DEEP											
57	43.970213	-89.362926	143	Crystal	Marquette	7/31/2018	TWH & NLS	57	29		Rope	SAMPLED	0										
58	43.973091	-89.362396	99	Crystal	Marquette	7/31/2018	TWH & NLS	58	0			DOCK											
59	43.972731	-89.362400	98	Crystal	Marquette	7/31/2018	TWH & NLS	59	16	Sand	Pole	SAMPLED	2	2									
60	43.972370	-89.362404	97	Crystal	Marquette	7/31/2018	TWH & NLS	60	36			DEEP											
61	43.972010	-89.362408	0	Crystal	Marquette	7/31/2018	TWH & NLS	61	0			DEEP											
62	43.971650	-89.362412	0	Crystal	Marquette	7/31/2018	TWH & NLS	62	0			DEEP											
63	43.971290	-89.362415	0	Crystal	Marquette	7/31/2018	TWH & NLS	63	0			DEEP											
64	43.970930	-89.362419	0	Crystal	Marquette	7/31/2018	TWH & NLS	64	0			DEEP											
65	43.970570	-89.362423	0	Crystal	Marquette	7/31/2018	TWH & NLS	65	0			DEEP											
66	43.970210	-89.362427	145	Crystal	Marquette	7/31/2018	TWH & NLS	66	35			DEEP											
67	43.969850	-89.362431	144	Crystal	Marquette	7/31/2018	TWH & NLS	67	17		Rope	SAMPLED	3		3								
68	43.973088	-89.361897	94	Crystal	Marquette	7/31/2018	TWH & NLS	68	7	Sand	Pole	SAMPLED	3	1	3		1						
69	43.972728	-89.361901	95	Crystal	Marquette	7/31/2018	TWH & NLS	69	26		Rope	SAMPLED	0										
70	43.972368	-89.361905	96	Crystal	Marquette	7/31/2018	TWH & NLS	70	40			DEEP											
71	43.972008	-89.361909	0	Crystal	Marquette	7/31/2018	TWH & NLS	71	0			DEEP											
72	43.971647	-89.361913	0	Crystal	Marquette	7/31/2018	TWH & NLS	72	0			DEEP											
73	43.971287	-89.361917	0	Crystal	Marquette	7/31/2018	TWH & NLS	73	0			DEEP											
74	43.970927	-89.361921	0	Crystal	Marquette	7/31/2018	TWH & NLS	74	0			DEEP											
75	43.970567	-89.361924	0	Crystal	Marquette	7/31/2018	TWH & NLS	75	0			DEEP											
76	43.970207	-89.361928	146	Crystal	Marquette	7/31/2018	TWH & NLS	76	45			DEEP											
77	43.969847	-89.361932	147	Crystal	Marquette	7/31/2018	TWH & NLS	77	34			DEEP											
78	43.973085	-89.361399	93	Crystal	Marquette	7/31/2018	TWH & NLS	78	7	Sand	Pole	SAMPLED	3	3									
79	43.972725	-89.361403	91	Crystal	Marquette	7/31/2018	TWH & NLS	79	31		Rope	SAMPLED	0										
80	43.972365	-89.361407	92	Crystal	Marquette	7/31/2018	TWH & NLS	80	0			DEEP											

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE_	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	TRF	Hybrid watermilfoil	Chara spp.	Eleocharis acicularis	Najas flexilis	Potamogeton friesii	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton zosteriformis	Stuckenia pectinata	Vallisneria americana
81	43.972005	-89.361410	0	Crystal	Marquette	7/31/2018	TWH & NLS	81	0			DEEP											
82	43.971645	-89.361414	0	Crystal	Marquette	7/31/2018	TWH & NLS	82	0			DEEP											
83	43.971285	-89.361418	0	Crystal	Marquette	7/31/2018	TWH & NLS	83	0			DEEP											
84	43.970924	-89.361422	0	Crystal	Marquette	7/31/2018	TWH & NLS	84	0			DEEP											
85	43.970564	-89.361426	0	Crystal	Marquette	7/31/2018	TWH & NLS	85	0			DEEP											
86	43.970204	-89.361430	0	Crystal	Marquette	7/31/2018	TWH & NLS	86	0			DEEP											
87	43.969844	-89.361434	149	Crystal	Marquette	7/31/2018	TWH & NLS	87	33			DEEP											
88	43.969484	-89.361437	148	Crystal	Marquette	7/31/2018	TWH & NLS	88	4	Sand	Pole	SAMPLED	1		1								1
89	43.973442	-89.360896	87	Crystal	Marquette	7/31/2018	TWH & NLS	89	2	Sand	Pole	SAMPLED	1		1								
90	43.973082	-89.360900	88	Crystal	Marquette	7/31/2018	TWH & NLS	90	11	Sand	Pole	SAMPLED	3	3	1								1
91	43.972722	-89.360904	89	Crystal	Marquette	7/31/2018	TWH & NLS	91	33			DEEP											
92	43.972362	-89.360908	0	Crystal	Marquette	7/31/2018	TWH & NLS	92	0			DEEP											
93	43.972002	-89.360912	0	Crystal	Marquette	7/31/2018	TWH & NLS	93	0			DEEP											
94	43.971642	-89.360916	0	Crystal	Marquette	7/31/2018	TWH & NLS	94	0			DEEP											
95	43.971282	-89.360919	0	Crystal	Marquette	7/31/2018	TWH & NLS	95	0			DEEP											
96	43.970922	-89.360923	0	Crystal	Marquette	7/31/2018	TWH & NLS	96	0			DEEP											
97	43.970561	-89.360927	0	Crystal	Marquette	7/31/2018	TWH & NLS	97	0			DEEP											
98	43.970201	-89.360931	151	Crystal	Marquette	7/31/2018	TWH & NLS	98	0			DEEP											
99	43.969841	-89.360935	150	Crystal	Marquette	7/31/2018	TWH & NLS	99	32		Rope	SAMPLED	0										
100	43.973440	-89.360398	86	Crystal	Marquette	7/31/2018	TWH & NLS	100	7	Sand	Pole	SAMPLED	1		1		1						
101	43.973080	-89.360401	85	Crystal	Marquette	7/31/2018	TWH & NLS	101	28		Rope	SAMPLED	0										
102	43.972719	-89.360405	90	Crystal	Marquette	7/31/2018	TWH & NLS	102	40			DEEP											
103	43.972359	-89.360409	0	Crystal	Marquette	7/31/2018	TWH & NLS	103	0			DEEP											
104	43.971999	-89.360413	0	Crystal	Marquette	7/31/2018	TWH & NLS	104	0			DEEP											
105	43.971639	-89.360417	0	Crystal	Marquette	7/31/2018	TWH & NLS	105	0			DEEP											
106	43.971279	-89.360421	0	Crystal	Marquette	7/31/2018	TWH & NLS	106	0			DEEP											
107	43.970919	-89.360425	0	Crystal	Marquette	7/31/2018	TWH & NLS	107	0			DEEP											
108	43.970559	-89.360429	0	Crystal	Marquette	7/31/2018	TWH & NLS	108	0			DEEP											
109	43.970199	-89.360432	0	Crystal	Marquette	7/31/2018	TWH & NLS	109	0			DEEP											
110	43.969838	-89.360436	152	Crystal	Marquette	7/31/2018	TWH & NLS	110	37			DEEP											
111	43.973437	-89.359899	83	Crystal	Marquette	7/31/2018	TWH & NLS	111	11	Sand	Pole	SAMPLED	3	1	3		2						1
112	43.973077	-89.359903	84	Crystal	Marquette	7/31/2018	TWH & NLS	112	35			DEEP											
113	43.972717	-89.359907	0	Crystal	Marquette	7/31/2018	TWH & NLS	113	0			DEEP											
114	43.972357	-89.359911	0	Crystal	Marquette	7/31/2018	TWH & NLS	114	0			DEEP											
115	43.971996	-89.359914	0	Crystal	Marquette	7/31/2018	TWH & NLS	115	0			DEEP											
116	43.971636	-89.359918	0	Crystal	Marquette	7/31/2018	TWH & NLS	116	0			DEEP											
117	43.971276	-89.359922	0	Crystal	Marquette	7/31/2018	TWH & NLS	117	0			DEEP											
118	43.970916	-89.359926	0	Crystal	Marquette	7/31/2018	TWH & NLS	118	0			DEEP											
119	43.970556	-89.359930	0	Crystal	Marquette	7/31/2018	TWH & NLS	119	0			DEEP											
120	43.970196	-89.359934	0	Crystal	Marquette	7/31/2018	TWH & NLS	120	0			DEEP											

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121	43.969836	-89.359938	153	Crystal	Marquette	7/31/2018	TWH & NLS	121	0			DEEP											
122	43.969476	-89.359941	154	Crystal	Marquette	7/31/2018	TWH & NLS	122	17		Rope	SAMPLED	2		2								
123	43.973434	-89.359400	82	Crystal	Marquette	7/31/2018	TWH & NLS	123	7	Sand	Pole	SAMPLED	2		2							1	
124	43.973074	-89.359404	81	Crystal	Marquette	7/31/2018	TWH & NLS	124	28		Rope	SAMPLED	0										
125	43.972714	-89.359408	80	Crystal	Marquette	7/31/2018	TWH & NLS	125	39			DEEP											
126	43.972354	-89.359412	79	Crystal	Marquette	7/31/2018	TWH & NLS	126	51			DEEP											
127	43.971994	-89.359416	78	Crystal	Marquette	7/31/2018	TWH & NLS	127	52			DEEP											
128	43.971633	-89.359420	0	Crystal	Marquette	7/31/2018	TWH & NLS	128	0			DEEP											
129	43.971273	-89.359424	0	Crystal	Marquette	7/31/2018	TWH & NLS	129	0			DEEP											
130	43.970913	-89.359427	0	Crystal	Marquette	7/31/2018	TWH & NLS	130	0			DEEP											
131	43.970553	-89.359431	0	Crystal	Marquette	7/31/2018	TWH & NLS	131	0			DEEP											
132	43.970193	-89.359435	0	Crystal	Marquette	7/31/2018	TWH & NLS	132	0			DEEP											
133	43.969833	-89.359439	156	Crystal	Marquette	7/31/2018	TWH & NLS	133	0			DEEP											
134	43.969473	-89.359443	155	Crystal	Marquette	7/31/2018	TWH & NLS	134	27		Rope	SAMPLED	0										
135	43.969113	-89.359447	157	Crystal	Marquette	7/31/2018	TWH & NLS	135	10	Sand	Pole	SAMPLED	3	2					1				
136	43.973431	-89.358902	74	Crystal	Marquette	7/31/2018	TWH & NLS	136	0			TERRESTRIAL											
137	43.973071	-89.358905	73	Crystal	Marquette	7/31/2018	TWH & NLS	137	4	Sand	Pole	SAMPLED	1		1		1						
138	43.972711	-89.358909	75	Crystal	Marquette	7/31/2018	TWH & NLS	138	19		Rope	SAMPLED	0										
139	43.972351	-89.358913	76	Crystal	Marquette	7/31/2018	TWH & NLS	139	36			DEEP											
140	43.971991	-89.358917	77	Crystal	Marquette	7/31/2018	TWH & NLS	140	47			DEEP											
141	43.971631	-89.358921	0	Crystal	Marquette	7/31/2018	TWH & NLS	141	0			DEEP											
142	43.971271	-89.358925	0	Crystal	Marquette	7/31/2018	TWH & NLS	142	0			DEEP											
143	43.970910	-89.358929	0	Crystal	Marquette	7/31/2018	TWH & NLS	143	0			DEEP											
144	43.970550	-89.358933	0	Crystal	Marquette	7/31/2018	TWH & NLS	144	0			DEEP											
145	43.970190	-89.358936	0	Crystal	Marquette	7/31/2018	TWH & NLS	145	0			DEEP											
146	43.969830	-89.358940	0	Crystal	Marquette	7/31/2018	TWH & NLS	146	0			DEEP											
147	43.969470	-89.358944	159	Crystal	Marquette	7/31/2018	TWH & NLS	147	41			DEEP											
148	43.969110	-89.358948	158	Crystal	Marquette	7/31/2018	TWH & NLS	148	37			DEEP											
149	43.968750	-89.358952	160	Crystal	Marquette	7/31/2018	TWH & NLS	149	28		Rope	SAMPLED	0										
150	43.973068	-89.358407	72	Crystal	Marquette	7/31/2018	TWH & NLS	150	2	Sand	Pole	SAMPLED	1		1								
151	43.972708	-89.358411	71	Crystal	Marquette	7/31/2018	TWH & NLS	151	4	Sand	Pole	SAMPLED	2		2		1		1				
152	43.972348	-89.358415	70	Crystal	Marquette	7/31/2018	TWH & NLS	152	10	Sand	Pole	SAMPLED	3		3		1						2
153	43.971988	-89.358418	69	Crystal	Marquette	7/31/2018	TWH & NLS	153	20		Rope	SAMPLED	1		1								
154	43.971628	-89.358422	68	Crystal	Marquette	7/31/2018	TWH & NLS	154	36			DEEP											
155	43.971268	-89.358426	67	Crystal	Marquette	7/31/2018	TWH & NLS	155	49			DEEP											
156	43.970908	-89.358430	0	Crystal	Marquette	7/31/2018	TWH & NLS	156	0			DEEP											
157	43.970548	-89.358434	0	Crystal	Marquette	7/31/2018	TWH & NLS	157	0			DEEP											
158	43.970187	-89.358438	0	Crystal	Marquette	7/31/2018	TWH & NLS	158	0			DEEP											
159	43.969827	-89.358442	0	Crystal	Marquette	7/31/2018	TWH & NLS	159	0			DEEP											
160	43.969467	-89.358446	0	Crystal	Marquette	7/31/2018	TWH & NLS	160	0			DEEP											

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161	43.969107	-89.358449	163	Crystal	Marquette	7/31/2018	TWH & NLS	161	0			DEEP											
162	43.968747	-89.358453	162	Crystal	Marquette	7/31/2018	TWH & NLS	162	29		Rope	SAMPLED	0										
163	43.968387	-89.358457	161	Crystal	Marquette	7/31/2018	TWH & NLS	163	7	Sand	Pole	SAMPLED	3		3		1			1			
164	43.972345	-89.357916	63	Crystal	Marquette	7/31/2018	TWH & NLS	164	3	Sand	Pole	SAMPLED	1		1		1						
165	43.971985	-89.357920	64	Crystal	Marquette	7/31/2018	TWH & NLS	165	5	Sand	Pole	SAMPLED	2		1		2		1				
166	43.971625	-89.357924	65	Crystal	Marquette	7/31/2018	TWH & NLS	166	20		Rope	SAMPLED	1		1								
167	43.971265	-89.357928	66	Crystal	Marquette	7/31/2018	TWH & NLS	167	40			DEEP											
168	43.970905	-89.357931	0	Crystal	Marquette	7/31/2018	TWH & NLS	168	0			DEEP											
169	43.970545	-89.357935	0	Crystal	Marquette	7/31/2018	TWH & NLS	169	0			DEEP											
170	43.970185	-89.357939	0	Crystal	Marquette	7/31/2018	TWH & NLS	170	0			DEEP											
171	43.969824	-89.357943	0	Crystal	Marquette	7/31/2018	TWH & NLS	171	0			DEEP											
172	43.969464	-89.357947	0	Crystal	Marquette	7/31/2018	TWH & NLS	172	0			DEEP											
173	43.969104	-89.357951	0	Crystal	Marquette	7/31/2018	TWH & NLS	173	0			DEEP											
174	43.968744	-89.357955	164	Crystal	Marquette	7/31/2018	TWH & NLS	174	35			DEEP											
175	43.968384	-89.357959	165	Crystal	Marquette	7/31/2018	TWH & NLS	175	11	Sand	Pole	SAMPLED	3	2	3								
176	43.971982	-89.357421	62	Crystal	Marquette	7/31/2018	TWH & NLS	176	2	Sand	Pole	SAMPLED	1		1	1							
177	43.971622	-89.357425	61	Crystal	Marquette	7/31/2018	TWH & NLS	177	21		Rope	SAMPLED	2		2								
178	43.971262	-89.357429	60	Crystal	Marquette	7/31/2018	TWH & NLS	178	40			DEEP											
179	43.970902	-89.357433	59	Crystal	Marquette	7/31/2018	TWH & NLS	179	45			DEEP											
180	43.970542	-89.357437	0	Crystal	Marquette	7/31/2018	TWH & NLS	180	0			DEEP											
181	43.970182	-89.357441	0	Crystal	Marquette	7/31/2018	TWH & NLS	181	0			DEEP											
182	43.969822	-89.357444	0	Crystal	Marquette	7/31/2018	TWH & NLS	182	0			DEEP											
183	43.969462	-89.357448	0	Crystal	Marquette	7/31/2018	TWH & NLS	183	0			DEEP											
184	43.969101	-89.357452	0	Crystal	Marquette	7/31/2018	TWH & NLS	184	0			DEEP											
185	43.968741	-89.357456	168	Crystal	Marquette	7/31/2018	TWH & NLS	185	0			DEEP											
186	43.968381	-89.357460	167	Crystal	Marquette	7/31/2018	TWH & NLS	186	27		Rope	SAMPLED	0										
187	43.968021	-89.357464	166	Crystal	Marquette	7/31/2018	TWH & NLS	187	3	Sand	Pole	SAMPLED	3		3								
188	43.971619	-89.356926	56	Crystal	Marquette	7/31/2018	TWH & NLS	188	10	Sand	Pole	SAMPLED	1		1								
189	43.971259	-89.356930	57	Crystal	Marquette	7/31/2018	TWH & NLS	189	33		Rope	SAMPLED	0										
190	43.970899	-89.356934	58	Crystal	Marquette	7/31/2018	TWH & NLS	190	44			DEEP											
191	43.970539	-89.356938	0	Crystal	Marquette	7/31/2018	TWH & NLS	191	0			DEEP											
192	43.970179	-89.356942	0	Crystal	Marquette	7/31/2018	TWH & NLS	192	0			DEEP											
193	43.969819	-89.356946	0	Crystal	Marquette	7/31/2018	TWH & NLS	193	0			DEEP											
194	43.969459	-89.356950	0	Crystal	Marquette	7/31/2018	TWH & NLS	194	0			DEEP											
195	43.969099	-89.356954	0	Crystal	Marquette	7/31/2018	TWH & NLS	195	0			DEEP											
196	43.968739	-89.356957	0	Crystal	Marquette	7/31/2018	TWH & NLS	196	0			DEEP											
197	43.968378	-89.356961	169	Crystal	Marquette	7/31/2018	TWH & NLS	197	34			DEEP											
198	43.968018	-89.356965	170	Crystal	Marquette	7/31/2018	TWH & NLS	198	9	Sand	Pole	SAMPLED	1		1		1						1
199	43.971617	-89.356428	55	Crystal	Marquette	7/31/2018	TWH & NLS	199	2	Sand	Pole	SAMPLED	1		1								
200	43.971257	-89.356432	54	Crystal	Marquette	7/31/2018	TWH & NLS	200	24		Rope	SAMPLED	1		1								

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE_	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	TRF	Hybrid watermilfoil	Chara spp.	Eleocharis acicularis	Najas flexilis	Potamogeton friesii	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton zosteriformis	Stuckenia pectinata	Vallisneria americana
201	43.970896	-89.356436	53	Crystal	Marquette	7/31/2018	TWH & NLS	201	40			DEEP											
202	43.970536	-89.356439	0	Crystal	Marquette	7/31/2018	TWH & NLS	202	0			DEEP											
203	43.970176	-89.356443	0	Crystal	Marquette	7/31/2018	TWH & NLS	203	0			DEEP											
204	43.969816	-89.356447	0	Crystal	Marquette	7/31/2018	TWH & NLS	204	0			DEEP											
205	43.969456	-89.356451	0	Crystal	Marquette	7/31/2018	TWH & NLS	205	0			DEEP											
206	43.969096	-89.356455	0	Crystal	Marquette	7/31/2018	TWH & NLS	206	0			DEEP											
207	43.968736	-89.356459	0	Crystal	Marquette	7/31/2018	TWH & NLS	207	0			DEEP											
208	43.968376	-89.356463	172	Crystal	Marquette	7/31/2018	TWH & NLS	208	42			DEEP											
209	43.968015	-89.356467	171	Crystal	Marquette	7/31/2018	TWH & NLS	209	26		Rope	SAMPLED	0										
210	43.971614	-89.355929	50	Crystal	Marquette	7/31/2018	TWH & NLS	210	2	Sand	Pole	SAMPLED	3		3				1				
211	43.971254	-89.355933	51	Crystal	Marquette	7/31/2018	TWH & NLS	211	16	Sand	Pole	SAMPLED	2	2	1						1		
212	43.970894	-89.355937	52	Crystal	Marquette	7/31/2018	TWH & NLS	212	35			DEEP											
213	43.9705335	-89.35594079	0	Crystal	Marquette	7/31/2018	TWH & NLS	213	0			DEEP											
214	43.9701734	-89.35594468	0	Crystal	Marquette	7/31/2018	TWH & NLS	214	0			DEEP											
215	43.9698133	-89.35594857	0	Crystal	Marquette	7/31/2018	TWH & NLS	215	0			DEEP											
216	43.9694531	-89.35595247	0	Crystal	Marquette	7/31/2018	TWH & NLS	216	0			DEEP											
217	43.969093	-89.35595636	0	Crystal	Marquette	7/31/2018	TWH & NLS	217	0			DEEP											
218	43.9687329	-89.35596025	0	Crystal	Marquette	7/31/2018	TWH & NLS	218	0			DEEP											
219	43.9683728	-89.35596414	173	Crystal	Marquette	7/31/2018	TWH & NLS	219	47			DEEP											
220	43.9680127	-89.35596803	174	Crystal	Marquette	7/31/2018	TWH & NLS	220	36			DEEP											
221	43.9676525	-89.35597192	175	Crystal	Marquette	7/31/2018	TWH & NLS	221	14	Sand	Pole	SAMPLED	3		3								
222	43.971611	-89.35543047	49	Crystal	Marquette	7/31/2018	TWH & NLS	222	1	Sand	Pole	SAMPLED	3		3								
223	43.9712509	-89.35543437	48	Crystal	Marquette	7/31/2018	TWH & NLS	223	19		Rope	SAMPLED	2	2									
224	43.9708908	-89.35543826	47	Crystal	Marquette	7/31/2018	TWH & NLS	224	38			DEEP											
225	43.9705307	-89.35544215	46	Crystal	Marquette	7/31/2018	TWH & NLS	225	48			DEEP											
226	43.9701706	-89.35544605	0	Crystal	Marquette	7/31/2018	TWH & NLS	226	0			DEEP											
227	43.9698104	-89.35544994	0	Crystal	Marquette	7/31/2018	TWH & NLS	227	0			DEEP											
228	43.9694503	-89.35545384	0	Crystal	Marquette	7/31/2018	TWH & NLS	228	0			DEEP											
229	43.9690902	-89.35545773	0	Crystal	Marquette	7/31/2018	TWH & NLS	229	0			DEEP											
230	43.9687301	-89.35546163	0	Crystal	Marquette	7/31/2018	TWH & NLS	230	0			DEEP											
231	43.96837	-89.35546552	0	Crystal	Marquette	7/31/2018	TWH & NLS	231	0			DEEP											
232	43.9680098	-89.35546942	178	Crystal	Marquette	7/31/2018	TWH & NLS	232	38			DEEP											
233	43.9676497	-89.35547331	177	Crystal	Marquette	7/31/2018	TWH & NLS	233	20		Rope	SAMPLED	1		1								
234	43.9672896	-89.3554772	176	Crystal	Marquette	7/31/2018	TWH & NLS	234	0		TEMPORARY OBSTACLE												
235	43.9716082	-89.35493183	42	Crystal	Marquette	7/31/2018	TWH & NLS	235	2	Sand	Pole	SAMPLED	0										
236	43.9712481	-89.35493572	43	Crystal	Marquette	7/31/2018	TWH & NLS	236	15	Sand	Pole	SAMPLED	2	2				1					
237	43.970888	-89.35493962	44	Crystal	Marquette	7/31/2018	TWH & NLS	237	30		Rope	SAMPLED	0										
238	43.9705279	-89.35494352	45	Crystal	Marquette	7/31/2018	TWH & NLS	238	39			DEEP											
239	43.9701678	-89.35494742	0	Crystal	Marquette	7/31/2018	TWH & NLS	239	0			DEEP											
240	43.9698076	-89.35495131	0	Crystal	Marquette	7/31/2018	TWH & NLS	240	0			DEEP											

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE_	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	TRF	Hybrid watermilfoil	Chara spp.	Eleocharis acicularis	Najas flexilis	Potamogeton friesii	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton zosteriformis	Stuckenia pectinata	Vallisneria americana
241	43.9694475	-89.35495521	0	Crystal	Marquette	7/31/2018	TWH & NLS	241	0			DEEP											
242	43.9690874	-89.35495911	0	Crystal	Marquette	7/31/2018	TWH & NLS	242	0			DEEP											
243	43.9687273	-89.35496301	0	Crystal	Marquette	7/31/2018	TWH & NLS	243	0			DEEP											
244	43.9683672	-89.3549669	0	Crystal	Marquette	7/31/2018	TWH & NLS	244	0			DEEP											
245	43.968007	-89.3549708	179	Crystal	Marquette	7/31/2018	TWH & NLS	245	40			DEEP											
246	43.9676469	-89.3549747	180	Crystal	Marquette	7/31/2018	TWH & NLS	246	28		Rope	SAMPLED	0										
247	43.9672868	-89.3549786	181	Crystal	Marquette	7/31/2018	TWH & NLS	247	8	Sand	Pole	SAMPLED	3	1	3								
248	43.9716054	-89.35443318	41	Crystal	Marquette	7/31/2018	TWH & NLS	248	2	Sand	Pole	SAMPLED	1				1						
249	43.9712453	-89.35443708	40	Crystal	Marquette	7/31/2018	TWH & NLS	249	14	Sand	Pole	SAMPLED	3	2	1			1			1		3
250	43.9708852	-89.35444098	39	Crystal	Marquette	7/31/2018	TWH & NLS	250	22		Rope	SAMPLED	1		1								
251	43.9705251	-89.35444488	38	Crystal	Marquette	7/31/2018	TWH & NLS	251	29		Rope	SAMPLED	0										
252	43.9701649	-89.35444878	37	Crystal	Marquette	7/31/2018	TWH & NLS	252	39			DEEP											
253	43.9698048	-89.35445268	36	Crystal	Marquette	7/31/2018	TWH & NLS	253	49			DEEP											
254	43.9694447	-89.35445659	35	Crystal	Marquette	7/31/2018	TWH & NLS	254	50			DEEP											
255	43.9690846	-89.35446049	0	Crystal	Marquette	7/31/2018	TWH & NLS	255	0			DEEP											
256	43.9687245	-89.35446439	0	Crystal	Marquette	7/31/2018	TWH & NLS	256	0			DEEP											
257	43.9683643	-89.35446829	0	Crystal	Marquette	7/31/2018	TWH & NLS	257	0			DEEP											
258	43.9680042	-89.35447219	185	Crystal	Marquette	7/31/2018	TWH & NLS	258	43			DEEP											
259	43.9676441	-89.35447609	184	Crystal	Marquette	7/31/2018	TWH & NLS	259	29		Rope		0										
260	43.967284	-89.35447999	183	Crystal	Marquette	7/31/2018	TWH & NLS	260	11	Sand	Pole	SAMPLED	3		1		2						1
261	43.9669239	-89.35448389	182	Crystal	Marquette	7/31/2018	TWH & NLS	261	2	Sand	Pole	SAMPLED	1		1		1					1	
262	43.9712425	-89.35393844	29	Crystal	Marquette	7/31/2018	TWH & NLS	262	3	Sand	Pole	SAMPLED	3		3								
263	43.9708824	-89.35394234	30	Crystal	Marquette	7/31/2018	TWH & NLS	263	7	Sand	Pole	SAMPLED	3	1	3								
264	43.9705222	-89.35394625	31	Crystal	Marquette	7/31/2018	TWH & NLS	264	10	Sand	Pole	SAMPLED	2	1						1			
265	43.9701621	-89.35395015	32	Crystal	Marquette	7/31/2018	TWH & NLS	265	19		Rope	SAMPLED	1		1								
266	43.969802	-89.35395406	33	Crystal	Marquette	7/31/2018	TWH & NLS	266	35			DEEP											
267	43.9694419	-89.35395796	34	Crystal	Marquette	7/31/2018	TWH & NLS	267	42			DEEP											
268	43.9690818	-89.35396186	0	Crystal	Marquette	7/31/2018	TWH & NLS	268	0			DEEP											
269	43.9687216	-89.35396577	0	Crystal	Marquette	7/31/2018	TWH & NLS	269	0			DEEP											
270	43.9683615	-89.35396967	0	Crystal	Marquette	7/31/2018	TWH & NLS	270	0			DEEP											
271	43.9680014	-89.35397357	186	Crystal	Marquette	7/31/2018	TWH & NLS	271	44			DEEP											
272	43.9676413	-89.35397748	187	Crystal	Marquette	7/31/2018	TWH & NLS	272	29		Rope	SAMPLED	0										
273	43.9672812	-89.35398138	188	Crystal	Marquette	7/31/2018	TWH & NLS	273	7	Sand	Pole	SAMPLED	2		1		1						
274	43.966921	-89.35398528	189	Crystal	Marquette	7/31/2018	TWH & NLS	274	2	Sand	Pole	SAMPLED	1		1								
275	43.9708795	-89.35344371	28	Crystal	Marquette	7/31/2018	TWH & NLS	275	3	Sand	Pole	SAMPLED	3		3					1			
276	43.9705194	-89.35344761	27	Crystal	Marquette	7/31/2018	TWH & NLS	276	4	Sand	Pole	SAMPLED	3	1	3					1			
277	43.9701593	-89.35345152	26	Crystal	Marquette	7/31/2018	TWH & NLS	277	5	Sand	Pole	SAMPLED	3		3								1
278	43.9697992	-89.35345543	25	Crystal	Marquette	7/31/2018	TWH & NLS	278	13	Sand	Pole	SAMPLED	1		1		1						
279	43.9694391	-89.35345933	24	Crystal	Marquette	7/31/2018	TWH & NLS	279	26		Rope	SAMPLED	3		3								
280	43.9690789	-89.35346324	23	Crystal	Marquette	7/31/2018	TWH & NLS	280	31			DEEP											

Point Number	Latitude	Longitude	ID	LAKE_NAME	COUNTY	DATE_	FIELD_CREW	PNT_NUM	DEPTH	SEDIMENT	POLE_ROPE	COMMENTS	TRF	Hybrid watermilfoil	Chara spp.	Eleocharis acicularis	Najas flexilis	Potamogeton friesii	Potamogeton gramineus	Potamogeton illinoensis	Potamogeton zosteriformis	Stuckenia pectinata	Vallisneria americana
281	43.9687188	-89.35346715	22	Crystal	Marquette	7/31/2018	TWH & NLS	281	39			DEEP											
282	43.9683587	-89.35347105	21	Crystal	Marquette	7/31/2018	TWH & NLS	282	44			DEEP											
283	43.9679986	-89.35347496	20	Crystal	Marquette	7/31/2018	TWH & NLS	283	37			DEEP											
284	43.9676385	-89.35347886	19	Crystal	Marquette	7/31/2018	TWH & NLS	284	22		Rope	SAMPLED	0										
285	43.9672783	-89.35348277	18	Crystal	Marquette	7/31/2018	TWH & NLS	285	6	Sand	Pole	SAMPLED	2		2		1						
286	43.9669182	-89.35348668	17	Crystal	Marquette	7/31/2018	TWH & NLS	286	2	Sand	Pole	SAMPLED	1		1								
287	43.9705166	-89.35294898	11	Crystal	Marquette	7/31/2018	TWH & NLS	287	2	Sand	Pole	SAMPLED	3		3								
288	43.9701565	-89.35295289	10	Crystal	Marquette	7/31/2018	TWH & NLS	288	2	Sand	Pole	SAMPLED	3		3								
289	43.9697964	-89.3529568	12	Crystal	Marquette	7/31/2018	TWH & NLS	289	4	Sand	Pole	SAMPLED	1		1								
290	43.9694362	-89.35296071	13	Crystal	Marquette	7/31/2018	TWH & NLS	290	6	Sand	Pole	SAMPLED	1		1		1						
291	43.9690761	-89.35296462	14	Crystal	Marquette	7/31/2018	TWH & NLS	291	8	Sand	Pole	SAMPLED	2		1								2
292	43.968716	-89.35296852	15	Crystal	Marquette	7/31/2018	TWH & NLS	292	22		Rope	SAMPLED	0										
293	43.9683559	-89.35297243	16	Crystal	Marquette	7/31/2018	TWH & NLS	293	32														
294	43.9679958	-89.35297634	3	Crystal	Marquette	7/31/2018	TWH & NLS	294	24		Rope	SAMPLED	0										
295	43.9676356	-89.35298025	2	Crystal	Marquette	7/31/2018	TWH & NLS	295	7	Sand	Pole	SAMPLED	1		1								1
296	43.9672755	-89.35298416	1	Crystal	Marquette	7/31/2018	TWH & NLS	296	1	Sand	Pole	SAMPLED	0										
297	43.9694334	-89.35246208	9	Crystal	Marquette	7/31/2018	TWH & NLS	297	2	Sand	Pole	SAMPLED	2		2					1			
298	43.9690733	-89.35246599	8	Crystal	Marquette	7/31/2018	TWH & NLS	298	2	Sand	Pole	SAMPLED	2		2								
299	43.9687132	-89.3524699	6	Crystal	Marquette	7/31/2018	TWH & NLS	299	4	Sand	Pole	SAMPLED	1		1		1						
300	43.9683531	-89.35247382	5	Crystal	Marquette	7/31/2018	TWH & NLS	300	5	Sand	Pole	SAMPLED	1		1								
301	43.9679929	-89.35247773	4	Crystal	Marquette	7/31/2018	TWH & NLS	301	2	Sand	Pole	SAMPLED	0										
302	43.9687103	-89.35197128	7	Crystal	Marquette	7/31/2018	TWH & NLS	302	1	Sand	Pole	SAMPLED	1		1								

F

APPENDIX F

WDNR Fisheries Studies

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2004

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: Sep 29, 2004 to Sep 29, 2004

WDNR Survey ID: 80180

Gear Types: MINI BOOM SHOCKER Survey Type: BASELINE MONITORING

BLACK CRAPPIE

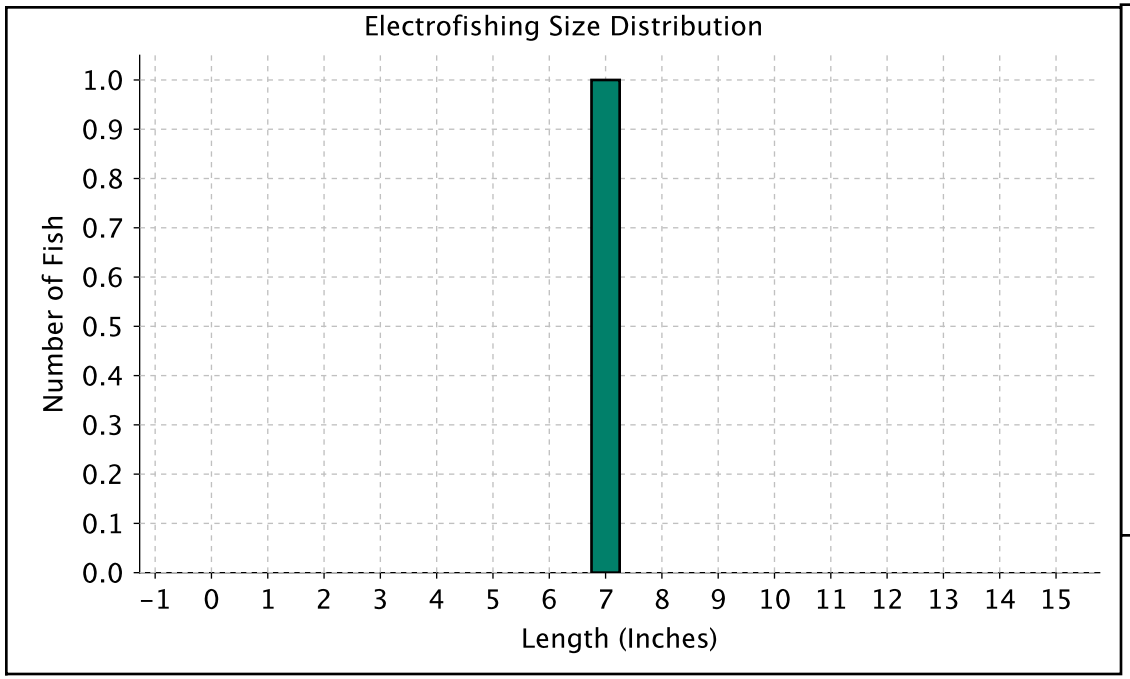
Electrofishing Relative Abundance

Total Catch:	1
Miles of Electrofishing:	1
Catch per mile:	1.00

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	5	Quality Size (in):	8
Measured Fish Count:			1
Count of Fish >= Stock Size:			1
Count of Fish >= Quality Size:			0
PSD_8 :			Too few fish



Minimum Length: 7

Maximum Length: 7

Average Length: 7.25

Number Measured: 1

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2004

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: Sep 29, 2004 to Sep 29, 2004

WDNR Survey ID: 80180

Gear Types: MINI BOOM SHOCKER Survey Type: BASELINE MONITORING

BLUEGILL

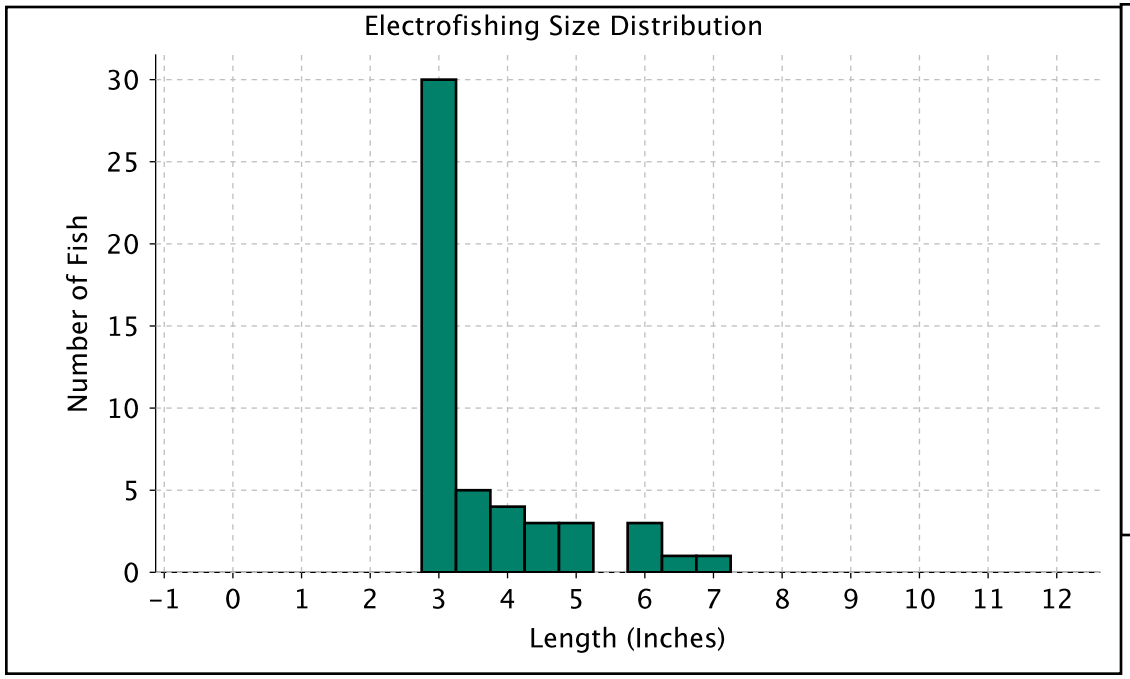
Electrofishing Relative Abundance

Total Catch:	50
Miles of Electrofishing:	1
Catch per mile:	50.00

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	3	Quality Size (in):	6
Measured Fish Count:			50
Count of Fish >= Stock Size:			50
Count of Fish >= Quality Size:			5
PSD_6 :			Too few fish



Minimum Length: 3

Maximum Length: 7

Average Length: 3.92

Number Measured: 50

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2004

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: Sep 29, 2004 to Sep 29, 2004

WDNR Survey ID: 80180

Gear Types: MINI BOOM SHOCKER Survey Type: BASELINE MONITORING

GREEN SUNFISH

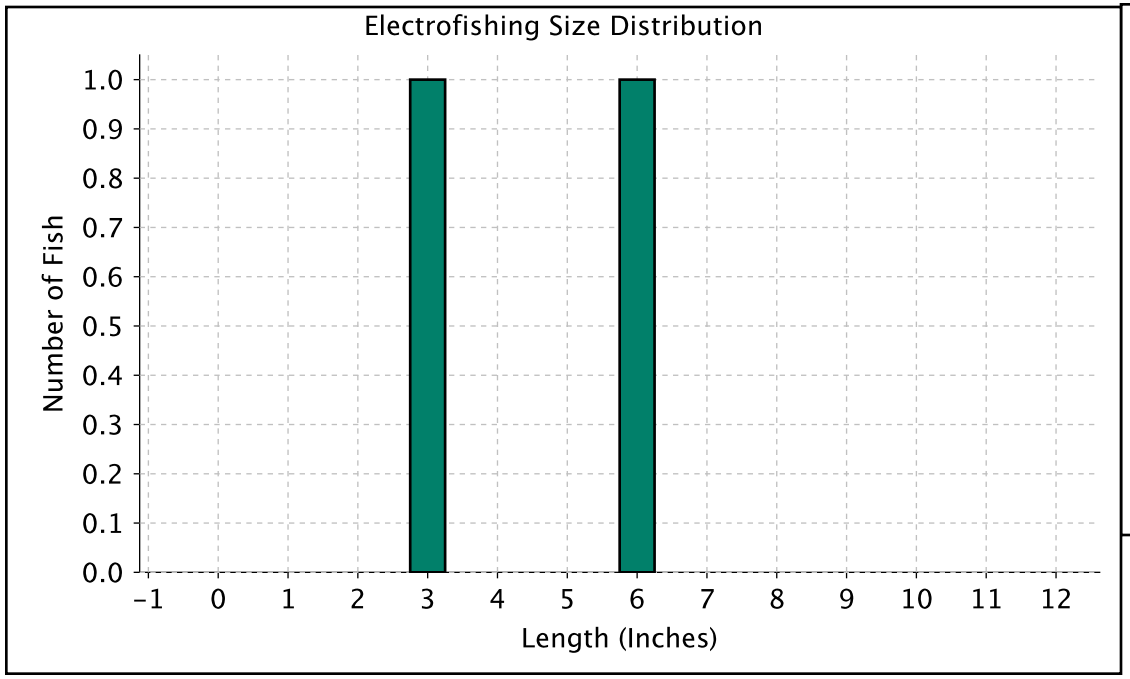
Electrofishing Relative Abundance

Total Catch:	2
Miles of Electrofishing:	1
Catch per mile:	2.00

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	3	Quality Size (in):	6
Measured Fish Count:			2
Count of Fish >= Stock Size:			2
Count of Fish >= Quality Size:			1
PSD_6 :			Too few fish



Minimum Length: 3

Maximum Length: 6

Average Length: 4.75

Number Measured: 2

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2004

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: Sep 29, 2004 to Sep 29, 2004

WDNR Survey ID: 80180

Gear Types: MINI BOOM SHOCKER Survey Type: BASELINE MONITORING

LARGEMOUTH BASS

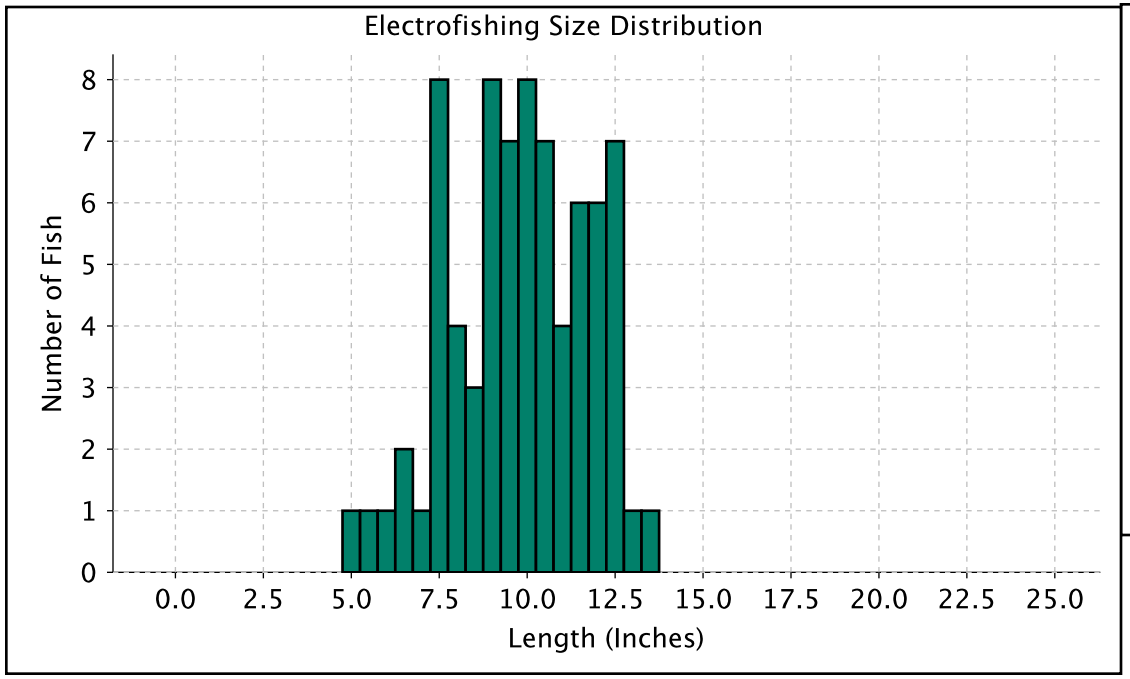
Electrofishing Relative Abundance

Total Catch:	76
Miles of Electrofishing:	2.1
Catch per mile:	36.19

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	8	Quality Size (in):	12
Measured Fish Count:			76
Count of Fish >= Stock Size:			62
Count of Fish >= Quality Size:			15
PSD 12 :			Too few fish



Minimum Length: 5

Maximum Length: 13.5

Average Length: 10.05

Number Measured: 76

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2004

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: Sep 29, 2004 to Sep 29, 2004

WDNR Survey ID: 80180

Gear Types: MINI BOOM SHOCKER Survey Type: BASELINE MONITORING

NORTHERN PIKE

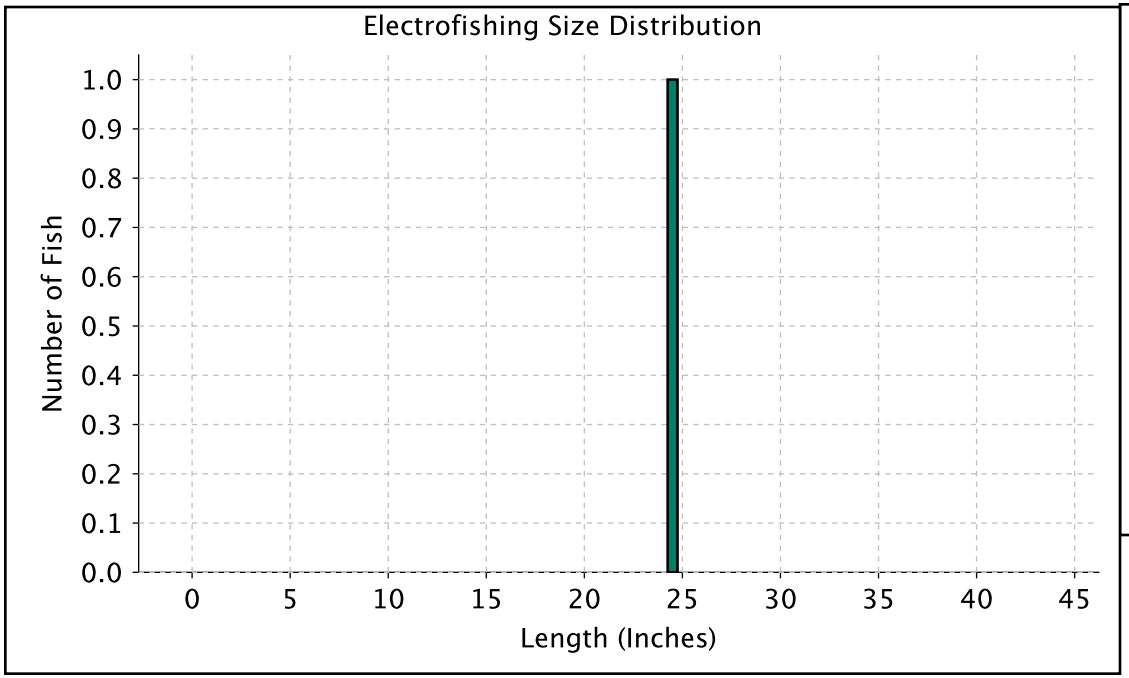
Electrofishing Relative Abundance

Total Catch:	1
Miles of Electrofishing:	2.1
Catch per mile:	0.48

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	14	Quality Size (in):	21
Measured Fish Count:			1
Count of Fish >= Stock Size:			1
Count of Fish >= Quality Size:			1
PSD 21 :			Too few fish



Minimum Length: 24.5

Maximum Length: 24.5

Average Length: 24.75

Number Measured: 1

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2004

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: Sep 29, 2004 to Sep 29, 2004

WDNR Survey ID: 80180

Gear Types: MINI BOOM SHOCKER Survey Type: BASELINE MONITORING

ROCK BASS

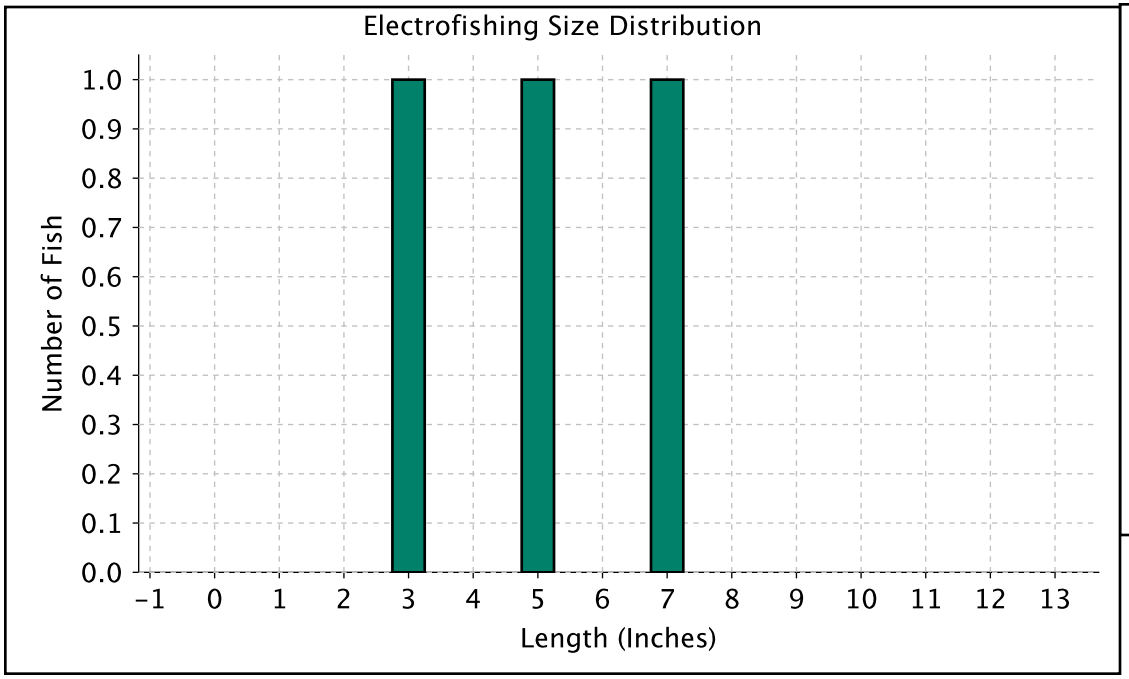
Electrofishing Relative Abundance

Total Catch:	3
Miles of Electrofishing:	1
Catch per mile:	3.00

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	4	Quality Size (in):	7
Measured Fish Count:			3
Count of Fish >= Stock Size:			2
Count of Fish >= Quality Size:			1
PSD_7 :			Too few fish



Minimum Length: 3

Maximum Length: 7

Average Length: 5.25

Number Measured: 3

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2004

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: Sep 29, 2004 to Sep 29, 2004

WDNR Survey ID: 80180

Gear Types: MINI BOOM SHOCKER Survey Type: BASELINE MONITORING

YELLOW PERCH

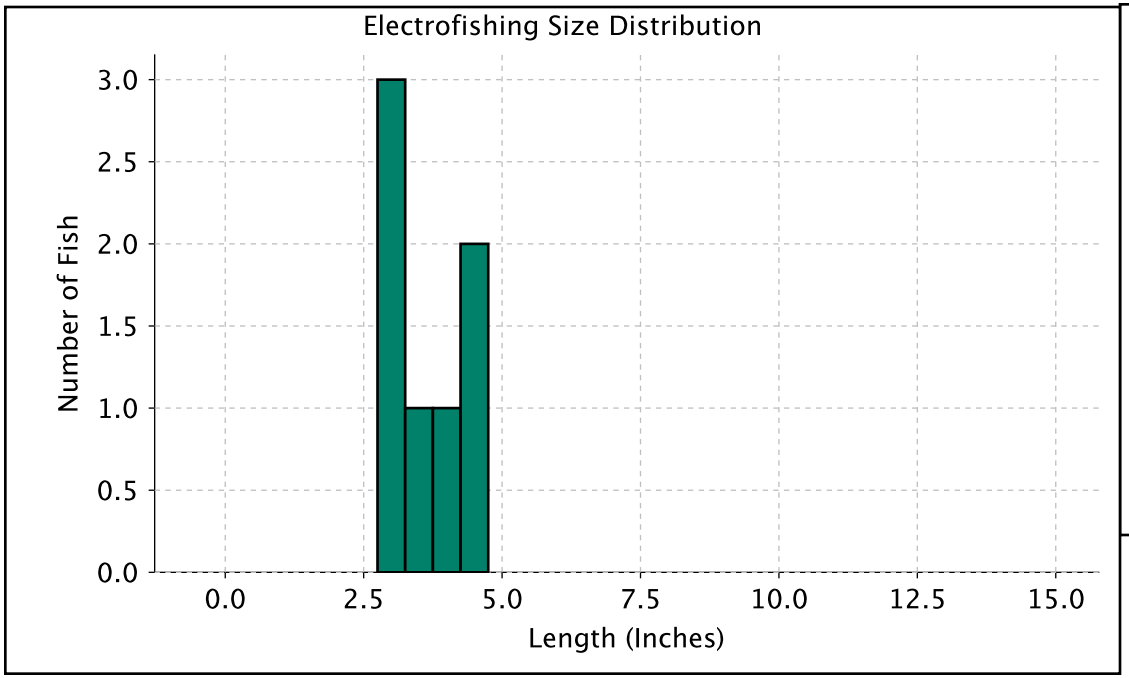
Electrofishing Relative Abundance

Total Catch:	7
Miles of Electrofishing:	1
Catch per mile:	7.00

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	5	Quality Size (in):	8
Measured Fish Count:			7
Count of Fish >= Stock Size:			0
Count of Fish >= Quality Size:			0
PSD_8 :			Too few fish



Minimum Length:	3
Maximum Length:	4.5
Average Length:	3.89
Number Measured:	7

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2013

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: May 23, 2013 to May 23, 2013

WDNR Survey ID: 515088511

Gear Types: MINI BOOM SHOCKER

Survey Type: FISHERIES ASSESSMENTS LAKES
LATE SPRING BASS PAN

BLACK CRAPPIE

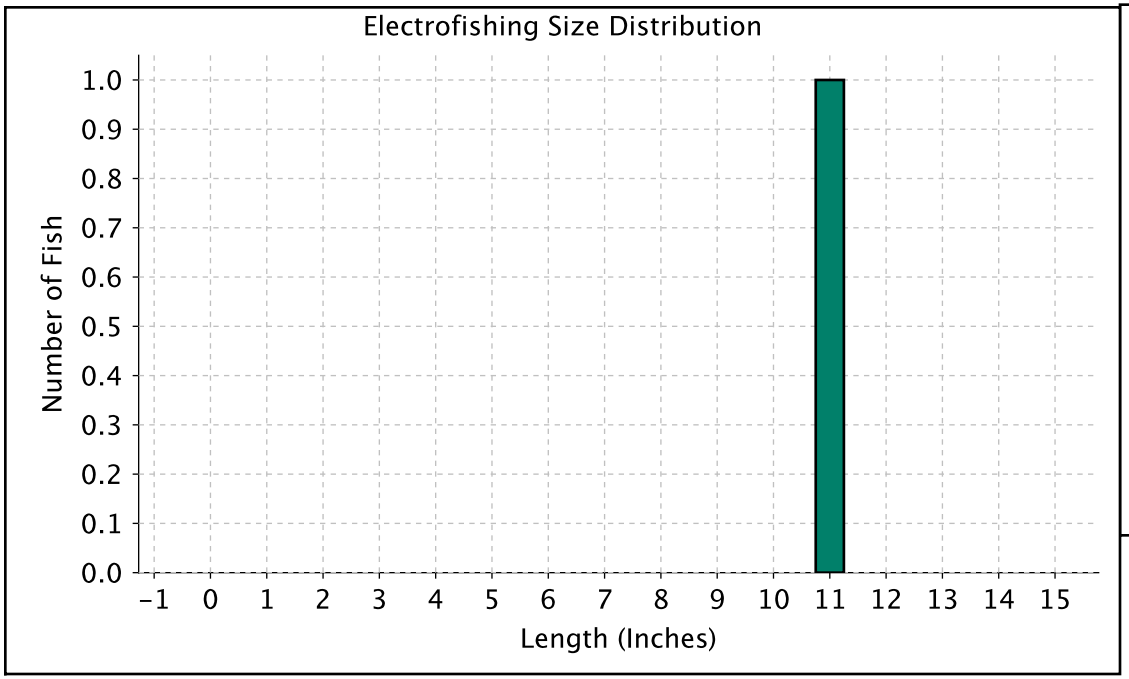
Electrofishing Relative Abundance

Total Catch:	1
Miles of Electrofishing:	1
Catch per mile:	1.00

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	5	Quality Size (in):	8
Measured Fish Count:			1
Count of Fish >= Stock Size:			1
Count of Fish >= Quality Size:			1
PSD_8 :			Too few fish



Minimum Length: 11

Maximum Length: 11

Average Length: 11.25

Number Measured: 1

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2013

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: May 23, 2013 to May 23, 2013

WDNR Survey ID: 515088511

Gear Types: MINI BOOM SHOCKER

Survey Type: FISHERIES ASSESSMENTS LAKES LATE SPRING BASS PAN

BLUEGILL

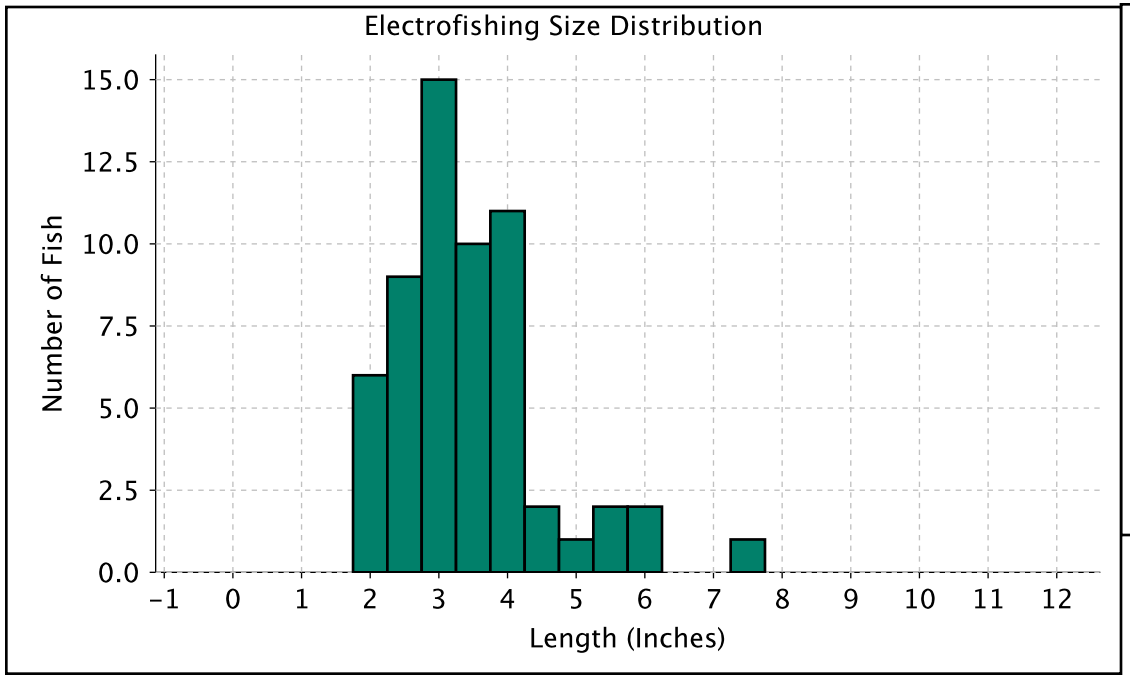
Electrofishing Relative Abundance

Total Catch:	345
Miles of Electrofishing:	1
Catch per mile:	345.00

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	3	Quality Size (in):	6
Measured Fish Count:			59
Count of Fish >= Stock Size:			44
Count of Fish >= Quality Size:			3
PSD_6 :			Too few fish



Minimum Length: 2

Maximum Length: 7.5

Average Length: 3.69

Number Measured: 59

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2013

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: May 23, 2013 to May 23, 2013

WDNR Survey ID: 515088511

Gear Types: MINI BOOM SHOCKER

Survey Type: FISHERIES ASSESSMENTS LAKES LATE SPRING BASS PAN

LARGEMOUTH BASS

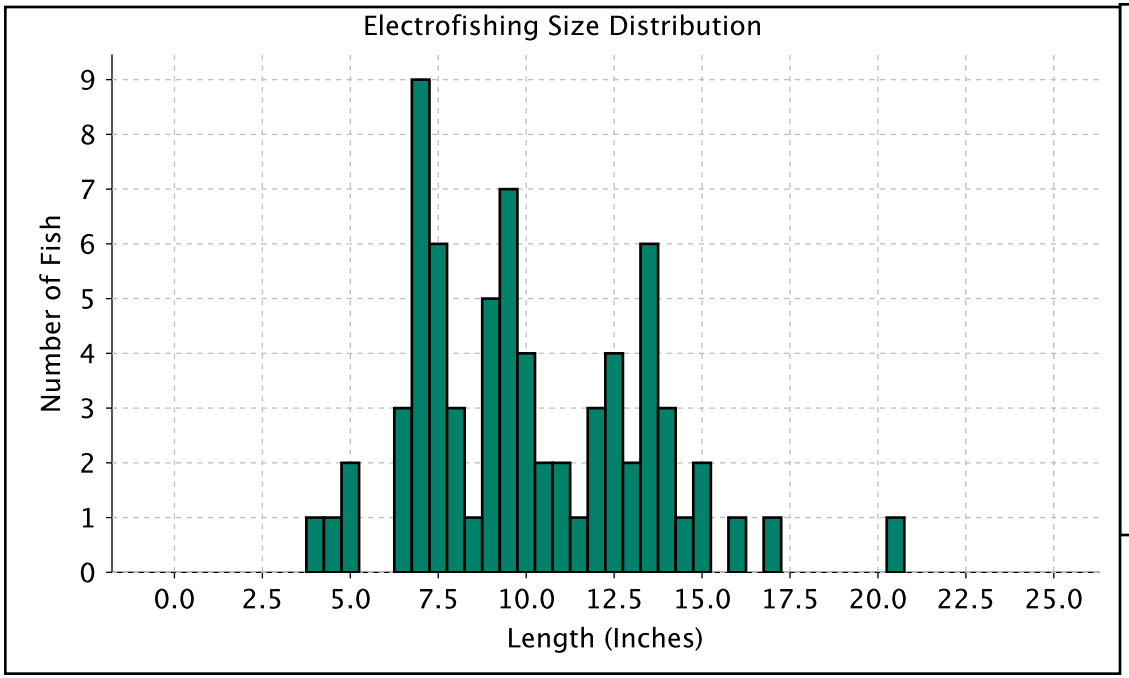
Electrofishing Relative Abundance

Total Catch:	71
Miles of Electrofishing:	1.94
Catch per mile:	36.60

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	8	Quality Size (in):	12
Measured Fish Count:			71
Count of Fish >= Stock Size:			49
Count of Fish >= Quality Size:			24
PSD 12 :			49



Minimum Length: 4

Maximum Length: 20.5

Average Length: 10.36

Number Measured: 71

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2013

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: May 23, 2013 to May 23, 2013

WDNR Survey ID: 515088511

Gear Types: MINI BOOM SHOCKER

Survey Type: FISHERIES ASSESSMENTS LAKES LATE SPRING BASS PAN

NORTHERN PIKE

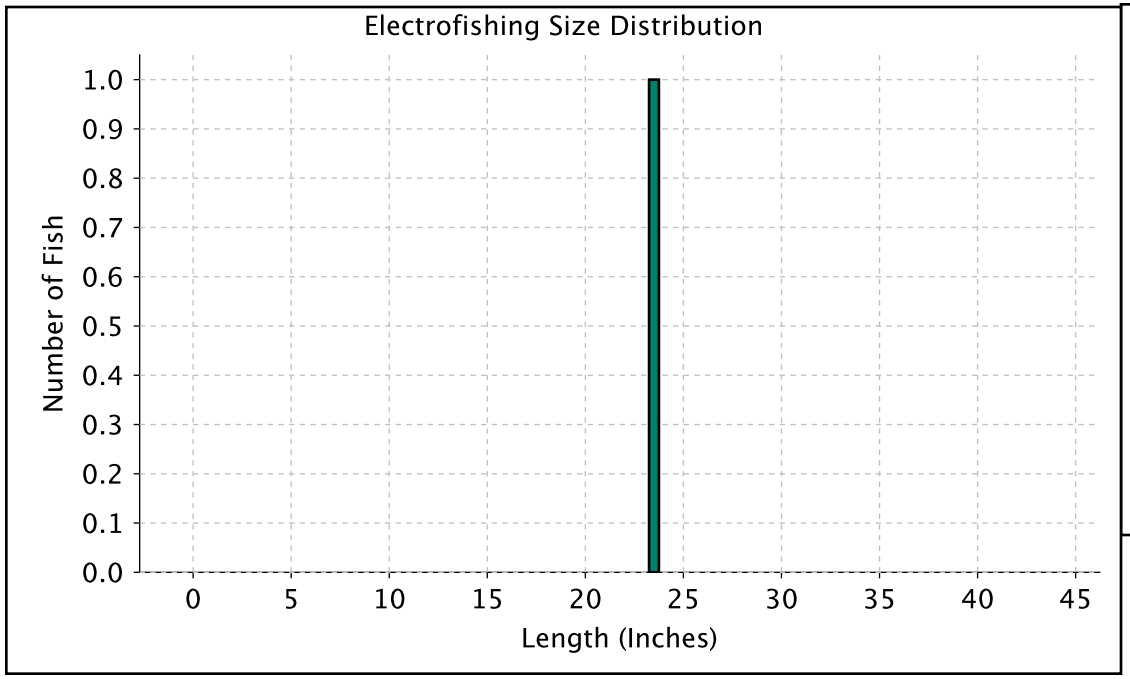
Electrofishing Relative Abundance

Total Catch:	1
Miles of Electrofishing:	1.94
Catch per mile:	0.52

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	14	Quality Size (in):	21
Measured Fish Count:			1
Count of Fish >= Stock Size:			1
Count of Fish >= Quality Size:			1
PSD 21 :			Too few fish



Minimum Length: 23.5

Maximum Length: 23.5

Average Length: 23.75

Number Measured: 1

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2013

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: May 23, 2013 to May 23, 2013

WDNR Survey ID: 515088511

Gear Types: MINI BOOM SHOCKER

Survey Type: FISHERIES ASSESSMENTS LAKES LATE SPRING BASS PAN

PUMPKINSEED

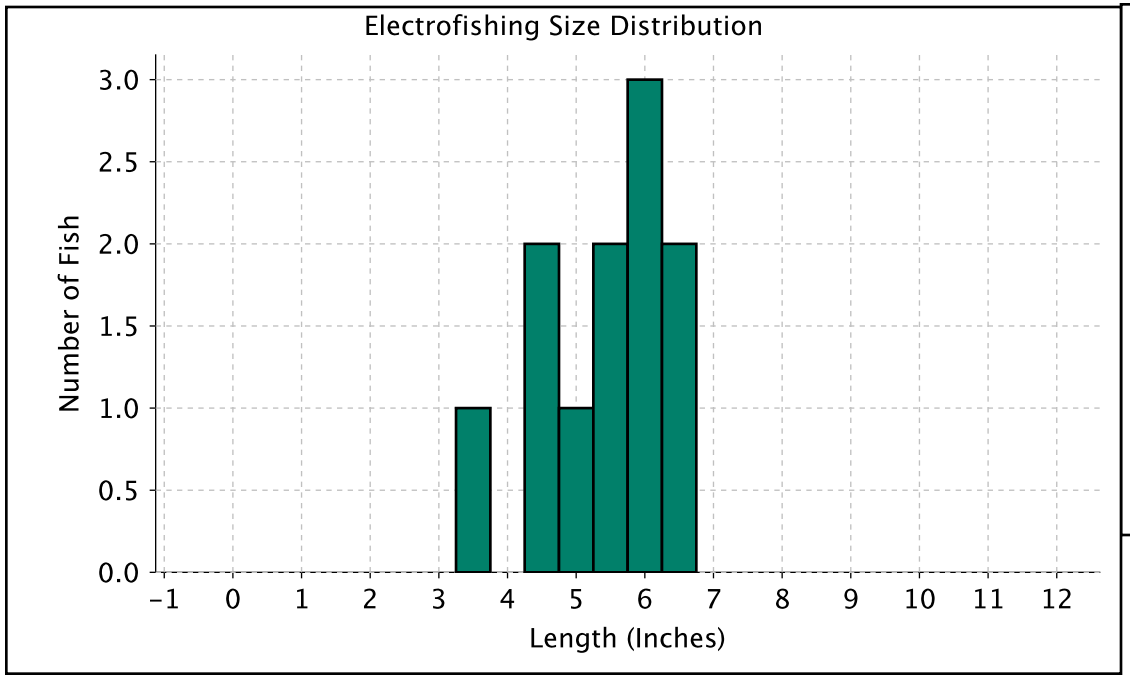
Electrofishing Relative Abundance

Total Catch:	11
Miles of Electrofishing:	1
Catch per mile:	11.00

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	3	Quality Size (in):	6
Measured Fish Count:			11
Count of Fish >= Stock Size:			11
Count of Fish >= Quality Size:			5
PSD_6 :			Too few fish



Minimum Length: 3.5

Maximum Length: 6.5

Average Length: 5.66

Number Measured: 11

WISCONSIN DNR FISHERIES INFORMATION SHEET

County: MARQUETTE
Lake Name: CRYSTAL LAKE
WBIC: 157300
Survey Year: 2013

WDNR Fish Biologist Contact Information
Dave Bartz - Wautoma - 920-787-3016

Lake Characteristics

Lake Type: DEEP HEADWATER DRAINAGE

Acres: 124 **Shoreline miles:** 2.2 **Maximum Depth (feet):** 60

Survey Information

Survey Dates: May 23, 2013 to May 23, 2013

WDNR Survey ID: 515088511

Gear Types: MINI BOOM SHOCKER

Survey Type: FISHERIES ASSESSMENTS LAKES LATE SPRING BASS PAN

ROCK BASS

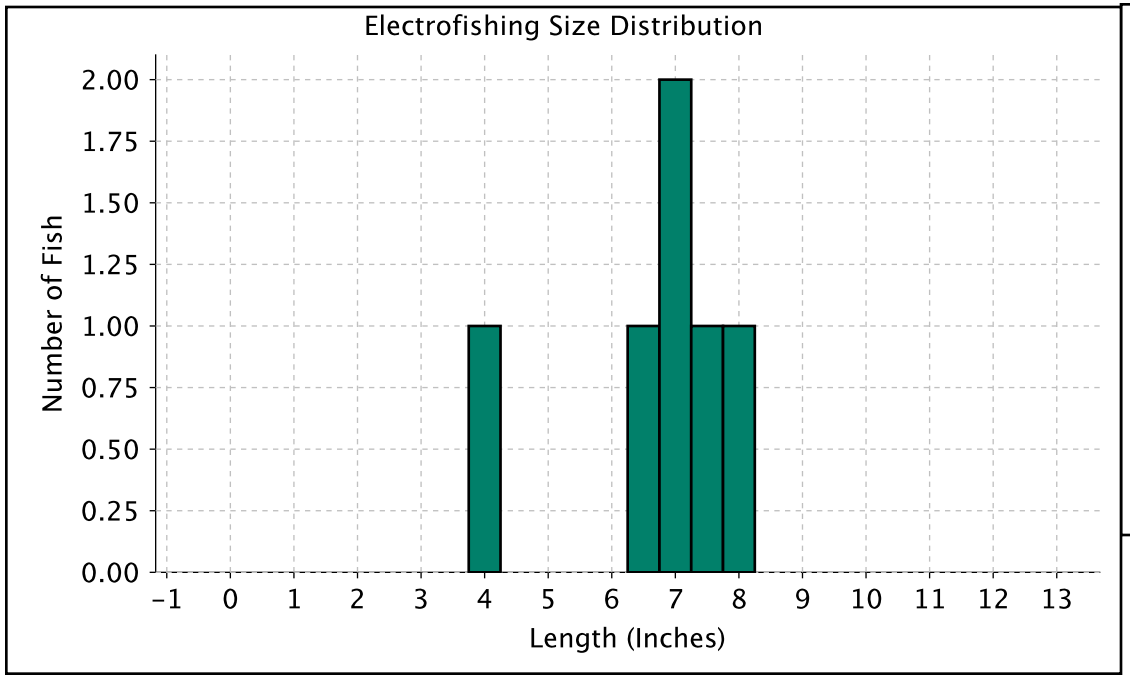
Electrofishing Relative Abundance

Total Catch:	6
Miles of Electrofishing:	1
Catch per mile:	6.00

Proportional Size Distribution (PSD)

(For All Days of Electrofishing)

Stock Size (in):	4	Quality Size (in):	7
Measured Fish Count:			6
Count of Fish >= Stock Size:			6
Count of Fish >= Quality Size:			4
PSD_7 :			Too few fish



Minimum Length: 4

Maximum Length: 8

Average Length: 6.92

Number Measured: 6