

A


APPENDIX A

Public Participation Materials



Presentation Outline

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



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Lake Management Planning

Onterra, LLC

- Founded in 2005
- Staff
 - Four lead ecologists
 - Four 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?

A goal without a plan is just a wish!

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Why create a lake management plan?

- WDNR recommends lakes conducting active management update aspects of the plan every 5 years.
- Having a current and approved plan makes the sponsor eligible for WDNR grants that implement an action
- Conducting large-scale management requires a current and approved plan.

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Past Projects

1995 Stormwater Catch Basin Study



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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
 - Aquatic Plant Surveys
 - Fisheries Data Integration
 - Shoreline Assessment
 - Stakeholder Survey

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Water Quality Analysis

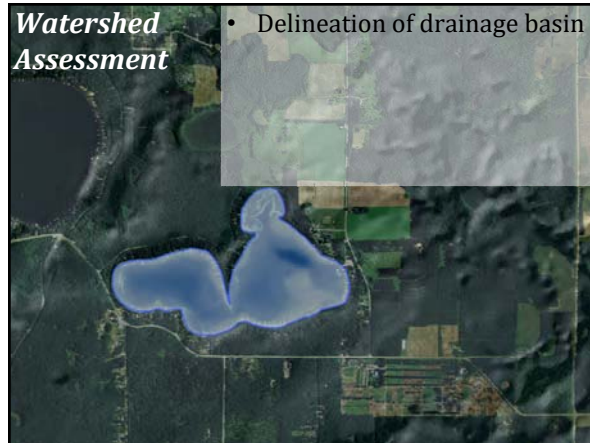
- General water chemistry (current & historic)
- Nutrient analysis
 - Lake trophic state (Eutrophication)
 - Limiting plant nutrient
- Supporting data for watershed modeling



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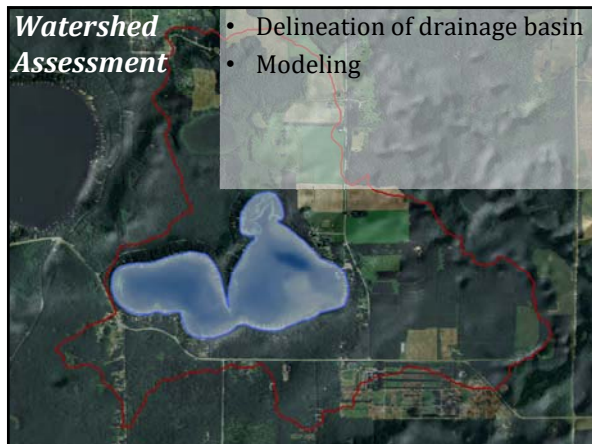
Watershed Assessment

- Delineation of drainage basin



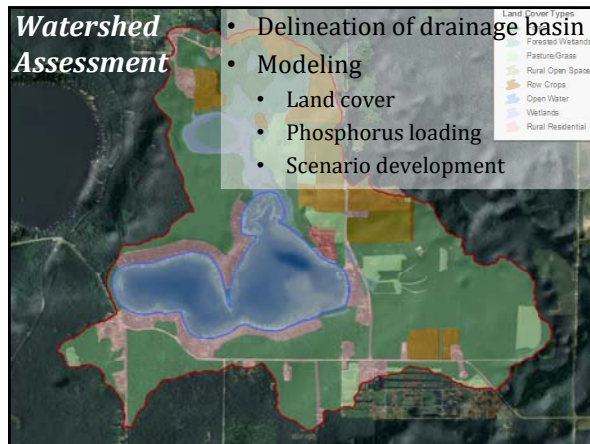
Watershed Assessment

- Delineation of drainage basin
- Modeling



Watershed Assessment

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



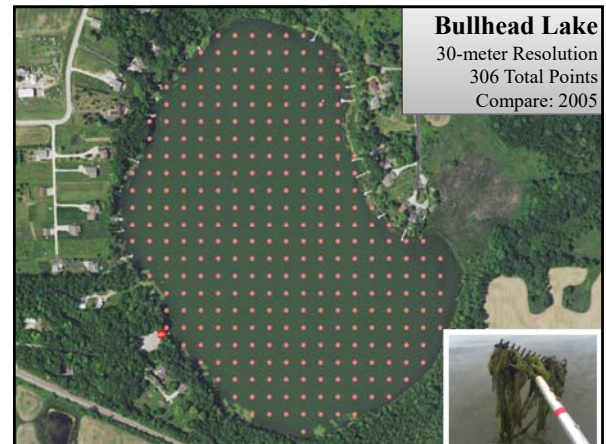
Aquatic Plant Surveys

- Concerned with both native and non-native plants
- Multiple surveys used in assessment
 - Early Season AIS Survey
 - Point-intercept Survey
 - Late-Summer EWM Survey
 - Floating-leaf and Emergent Community Mapping Survey

Historic Data Available {

Conducted In 2016 —

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Non-Native Aquatic Plants ***Curly-Leaf Pondweed***

- First documented in 2003
- Late-summer point-intercept surveys occur after senescence (die-off), so rely on mapping data

CLP Life-Cycle & Control Strategy Philosophy

Management

- CLP respond well to herbicides (*easy to kill*)
- Herbicide strategy requires repetition (*5-7+ years in a row*)
- Hand-harvesting is analogous to single treatment (*ineffective for established populations*)

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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More AIS than can be mapped using Point-based Methods

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Professional AIS Mapping

Polygon-Based Mapping

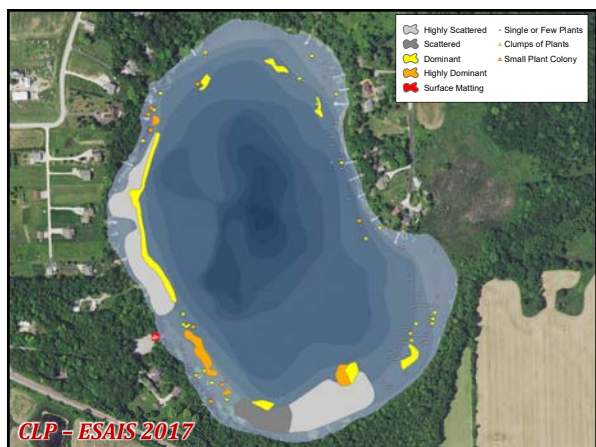
- Colonies or areas over 40-feet diameter
- Boundary at target plant extent or morphological feature (depth contour, shoreline)
- Density ratings:

May not represent true colonies or "beds"

Increase in Ecological Impact ↓

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

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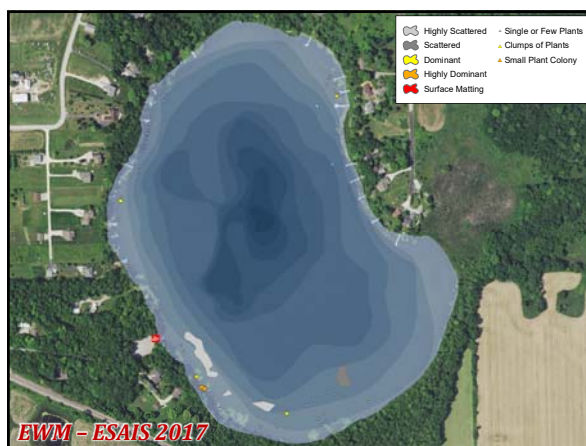
Non-Native Aquatic Plants

Eurasian Water Milfoil

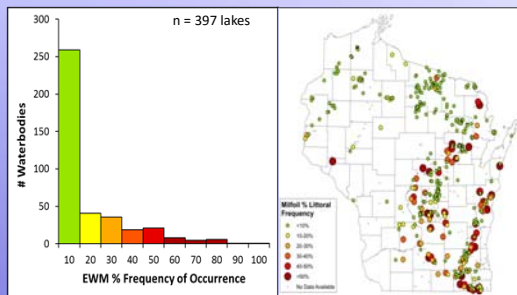
- First "officially" documented in 2005
- 1 sample confirmed by DNA as pure-strain EWM, 1 sample suspected to be EWM/HWM was native

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*)
- Winter drawdown is effective tool

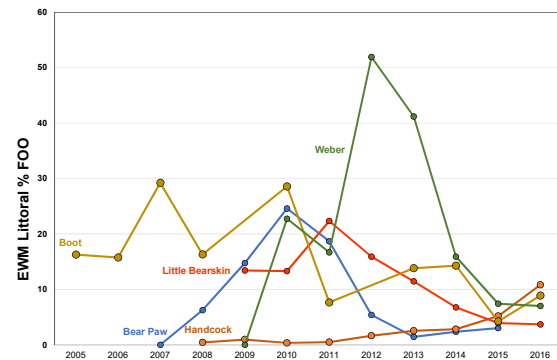


State-wide EWM Population Trends



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NLF Ecoregion – Unmanaged



AIS Active Management Discussion

Pros



Cons

- Keep AIS population low so native ecosystem can function as it did prior to AIS (**ecosystem restoration**)
- Keep AIS population low so it does not cause recreation, navigation, or aesthetic issues (**improve cultural ecosystem services**)
- Keep AIS population low so the lake is not a source population for other nearby lakes (**stewardship**)
- Management action itself may be damaging to the lake, so acknowledging potential known/unknown secondary impacts is important within the risk assessment.
- Management action may not be fully supported by public
- Unmanaged** AIS population may be low enough to not cause measurable ecosystem impacts or reduce cultural ecosystem services

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Fisheries Data Integration

- No fish sampling completed
- Assemble data from WDNR and other available sources
- Fish survey results summaries (if available)
- Use information in planning as applicable



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Stakeholder Survey

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



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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



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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

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WISCONSIN
DEPT. OF NATURAL RESOURCES


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Presentation Outline

- Meeting Objective
- Study Results
 - Aquatic Plants
 - Water Quality
 - Watershed
 - Shoreland Condition
 - Fishery (not much data)
- Conclusions
- Implementation Plan Development

Stakeholder Survey



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Meeting Objective

Planning Committee Meetings

Study Results
Conclusions & Initial Recommendations

Planning Meeting I

Management Goals
Management Actions
Timeframe
Facilitator(s)

Planning Meeting II

Implementation Plan



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Summary of Project Results

Aquatic Plants

- Comparisons with historical studies indicates that the Bullhead Lake aquatic plant community was vastly different in 2017 compared to earlier survey years
- This change was likely brought on by poor water quality conditions in 2017 and possibly earlier

Water Quality

- 2017 saw the worst water quality recorded on Bullhead Lake
- Worsening water quality since roughly 2008 is likely brought on partially by historical loadings

Watershed and Immediate Shorelands

- Watershed is dominated by agriculture
- Current watershed is not fully responsible for lake's water quality issues
- Shoreland condition and level of coarse woody habitat are pretty good

Fisheries

- Not much data available, but people like to fish the lake

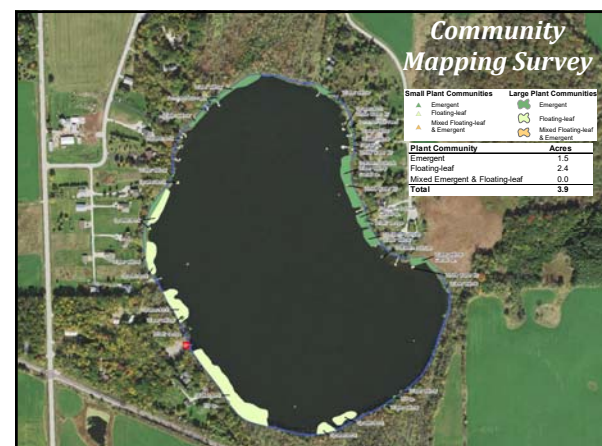
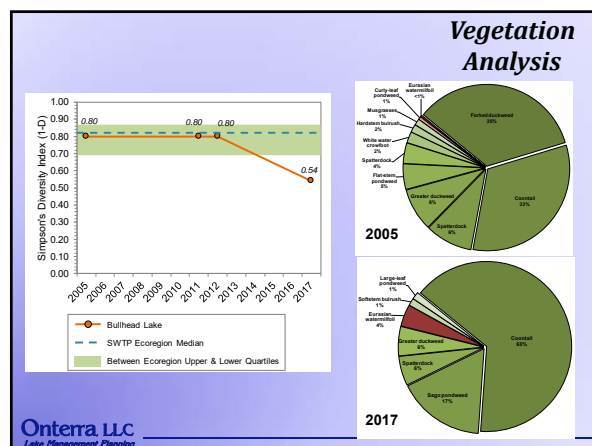
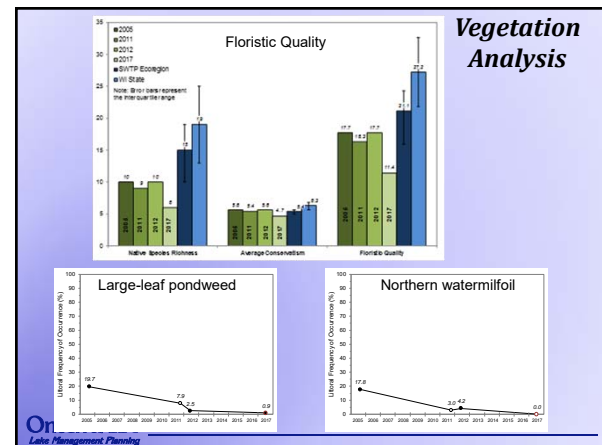
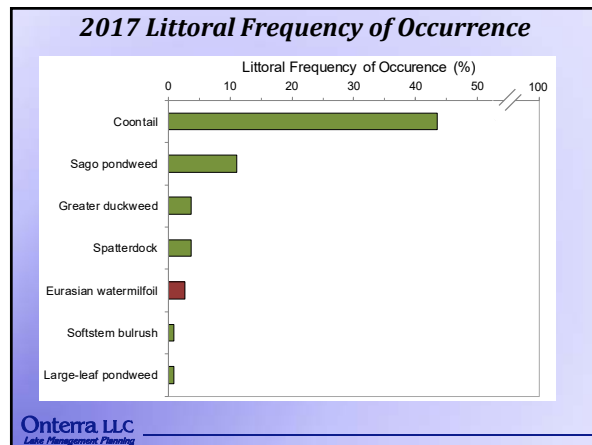
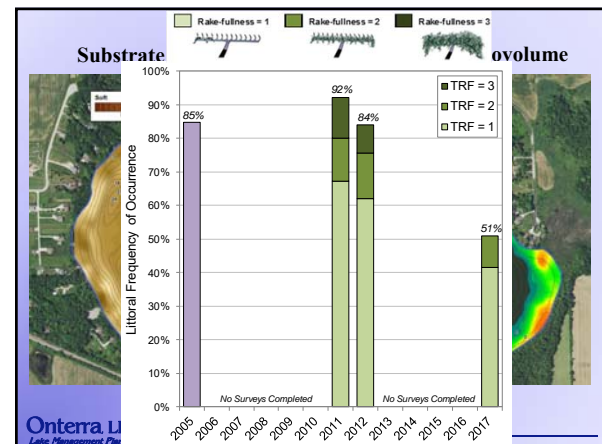
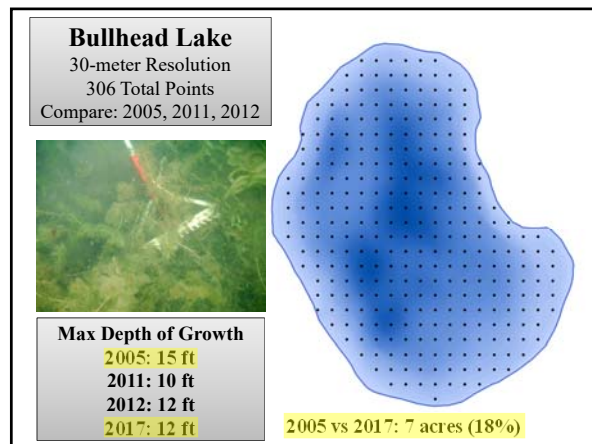
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Aquatic Plant Surveys

- Determine changes in plant community from past surveys
- Assess both native and non-native populations
- Numerous surveys completed in 2017
 - Early-Season AIS Survey
 - Whole-Lake Point-Intercept Survey
 - Emergent/Floating-Leaf Community Mapping Survey
 - EWM Peak-Biomass Survey


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Professional AIS Mapping

Point-Based Mapping


- Single plants to colonies or areas less than 40-feet in diameter
- Abundance descriptions:
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More AIS than can be mapped using Point-based Methods

Upper Kaubashine June 2015



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Professional AIS Mapping

Polygon-Based Mapping

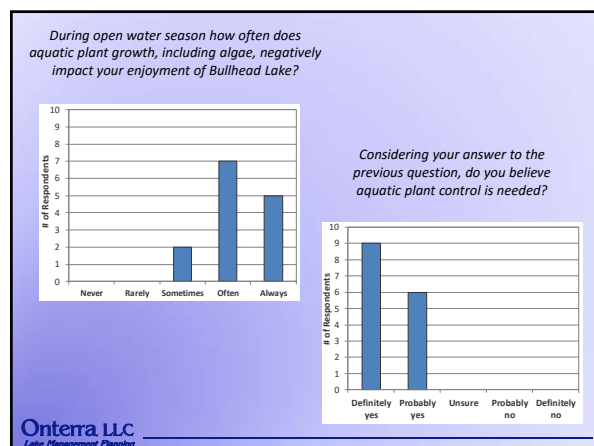
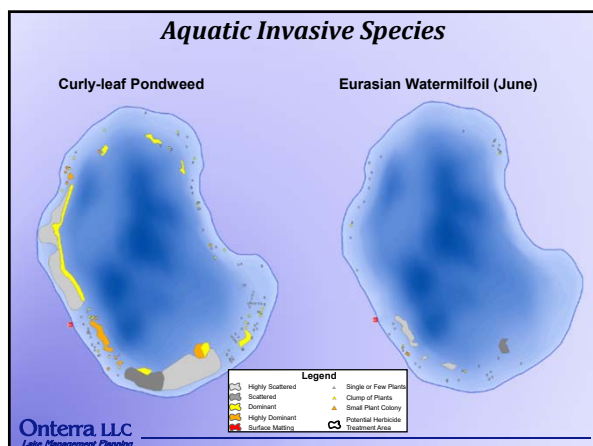
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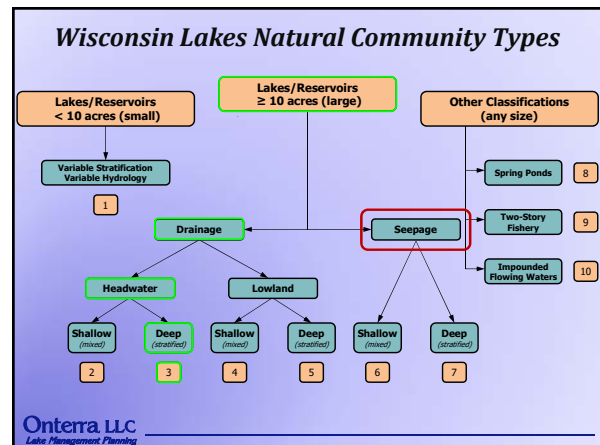
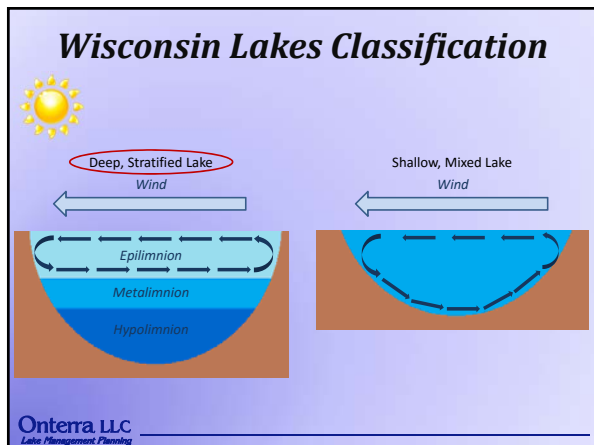
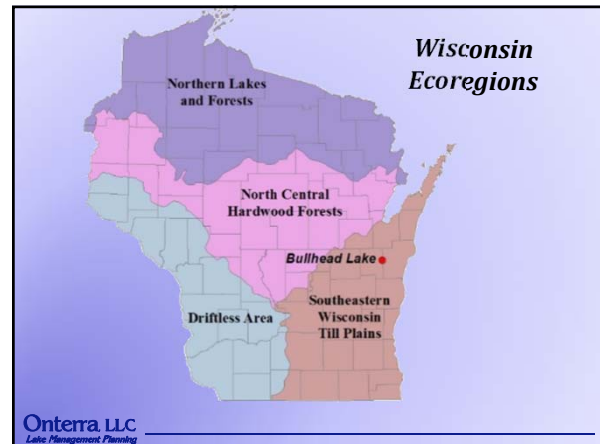
May not represent true colonies or "beds"

Increase in Ecological Impact



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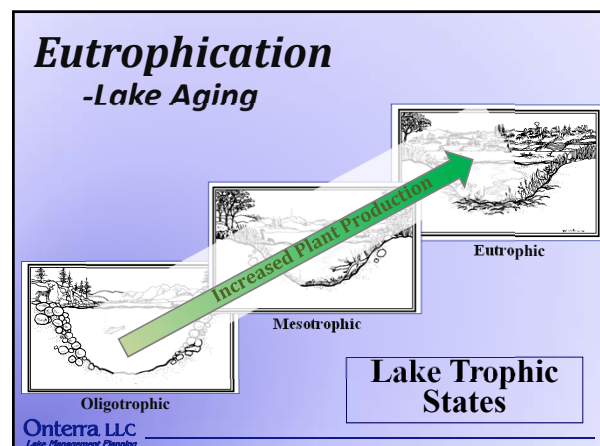


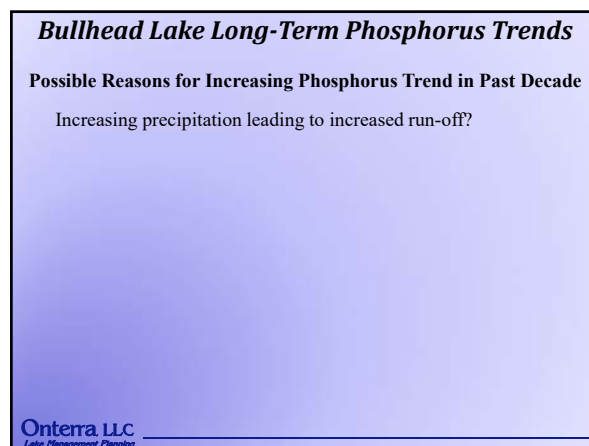
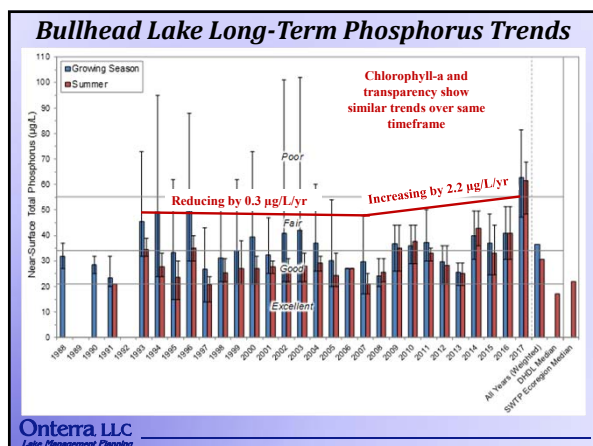
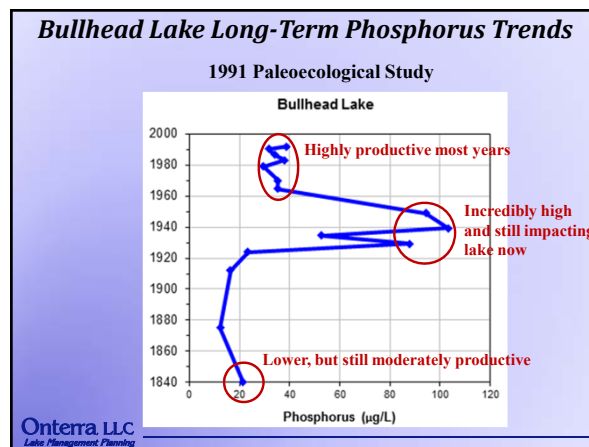
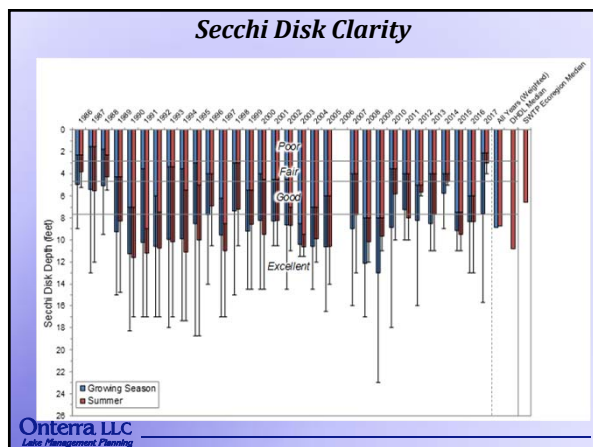
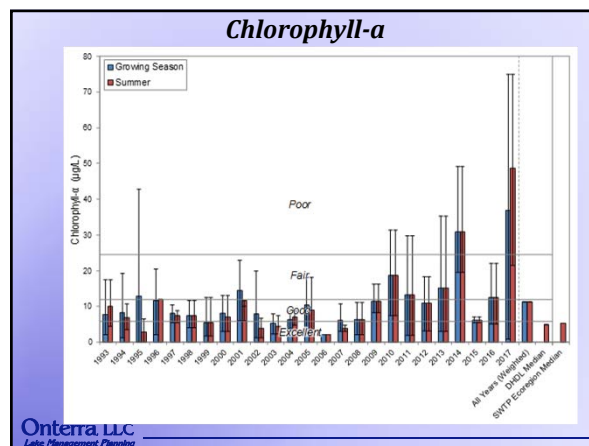
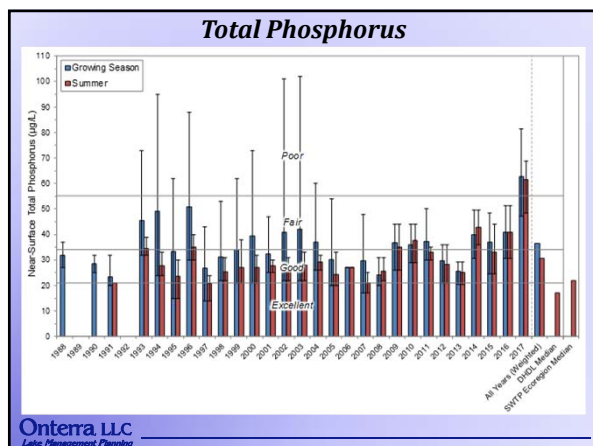


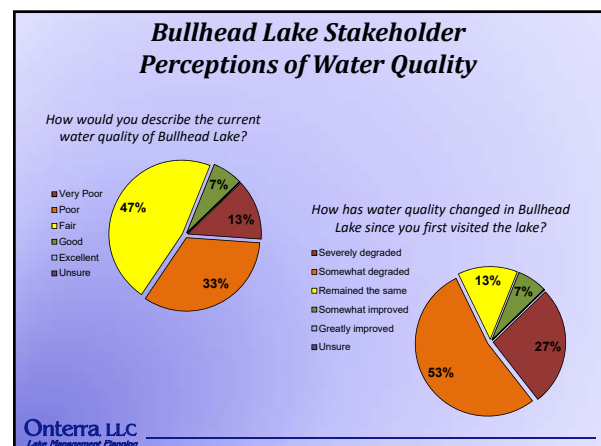
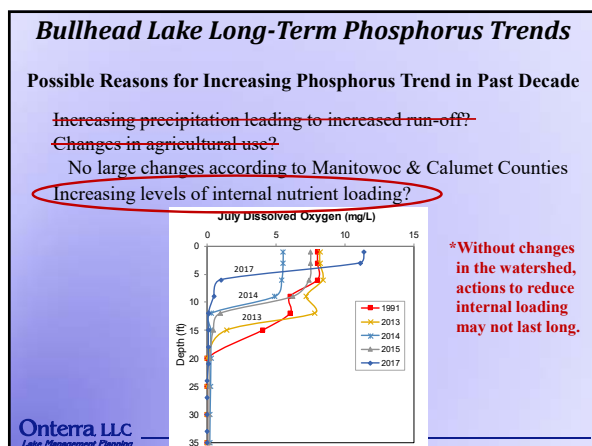
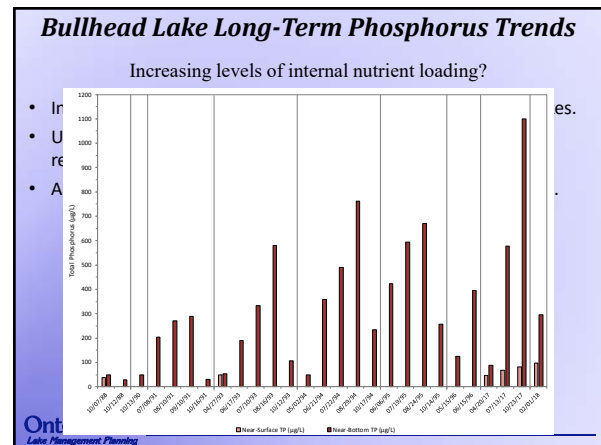
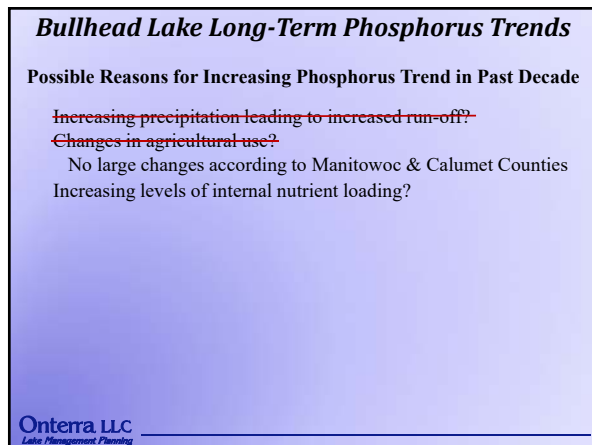
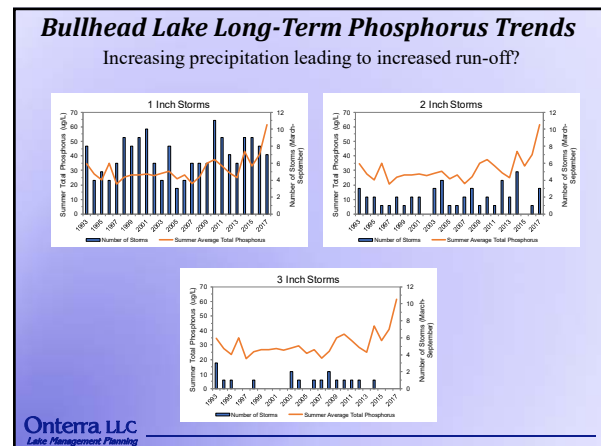
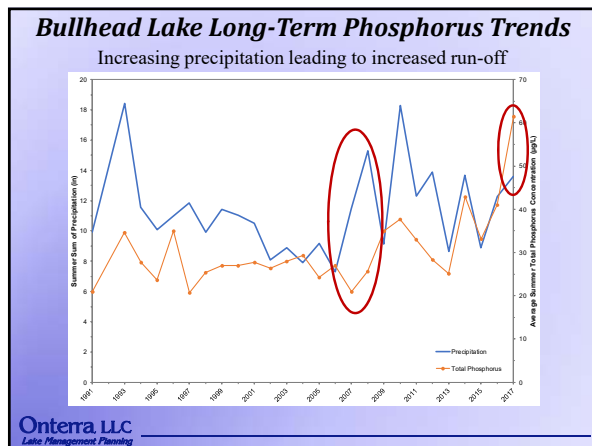
Introduction to Lake Water Quality

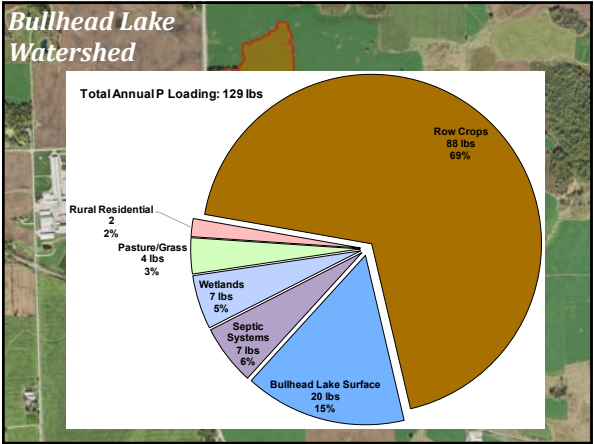
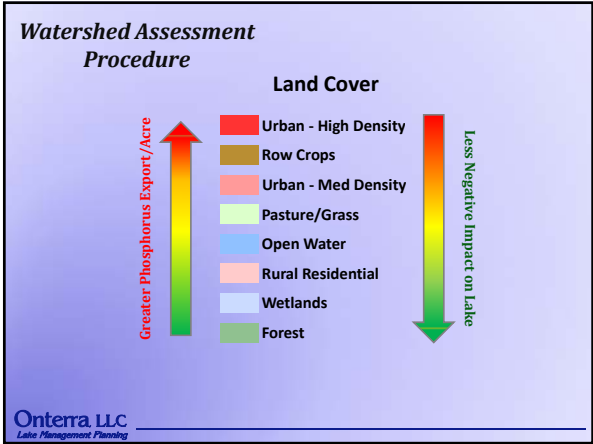
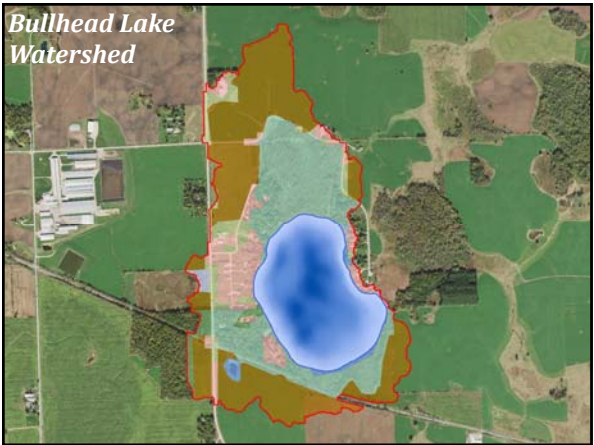
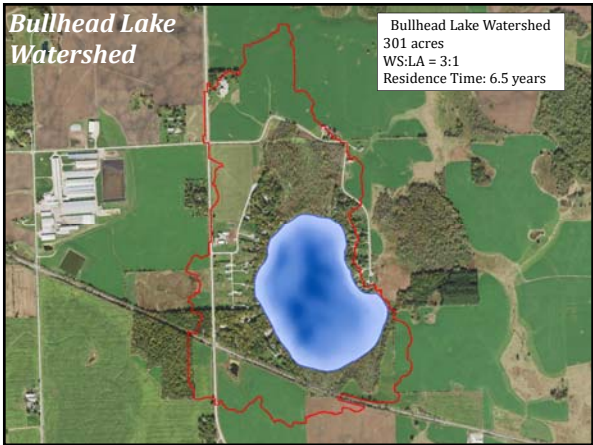
- ↑ Phosphorus**
 Naturally occurring & essential for all life
 Regulates phytoplankton biomass in **most** WI lakes
 Most often 'limiting plant nutrient' (shortest supply) **29:1**
 Human activity often increases P delivery to lakes
- ↑ Chlorophyll-a**
 Pigment used in photosynthesis
 Used as surrogate for phytoplankton biomass
- ↓ Secchi Disk Transparency**
 Measure of water clarity
 Measured using a Secchi disk

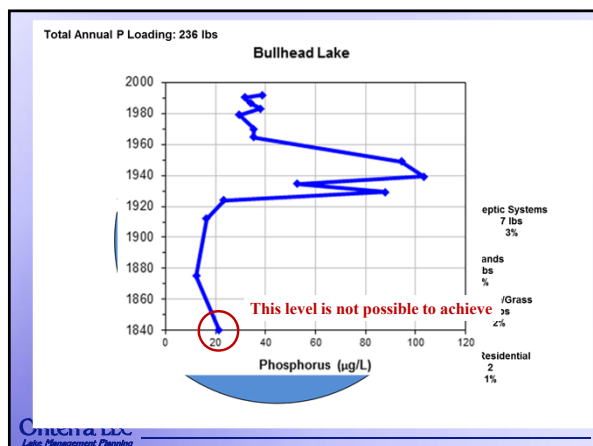
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Shoreland Assessment

- 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 nations lakes.
- Assessment considered shoreland area from shoreline back 35 feet

Urbanized

Natural

Range

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Shoreland Assessment

More Natural Habitat

Urbanized

Developed-Unnatural

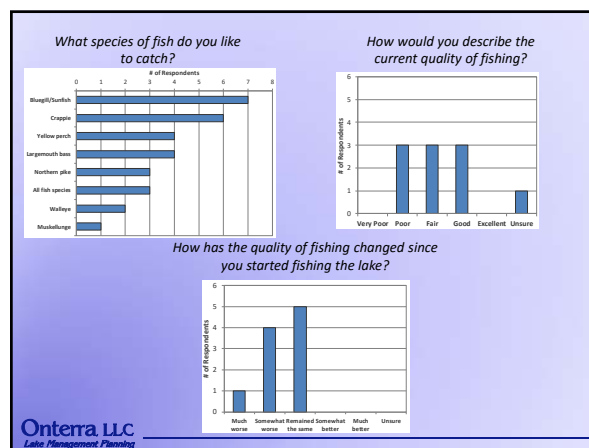
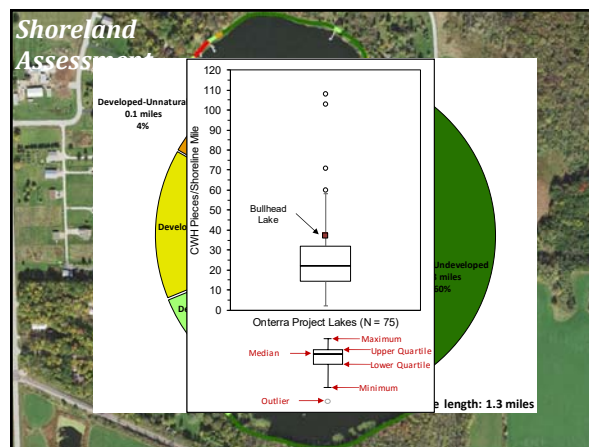
Developed-Semi-Natural

Developed-Natural

Natural/Undeveloped

Greater Need for Restoration

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Conclusions

Water Quality

- Water quality in Bullhead Lake has changed greatly in the past decade
- While 2017 produced the worse water quality on record, it is not known if the trend will continue at that level

Watershed & Immediate Shoreline

- Watershed contains much agriculture and while it impacts the lake, internal nutrient loading is responsible for much of phosphorus budget
- Changes to the shoreland properties would help increase habitat, but likely have little impact on phosphorus loading compared to other sources
- Advanced water quality studies will need to be completed to determine if a third alum treatment would be feasible to reduce internal loading

Aquatic Plant Community

- The 2017 surveys documented significant changes to the aquatic plant community – likely brought on by worsening water quality
- EWM and CLP are present now, but likely not causing issues – will need to reevaluate following any improvements to water quality

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Thank You

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Meeting Objective

Planning Committee Meetings

Study Results
 Conclusions & Initial Recommendations

Planning Meeting I

Management Goals
 Management Actions
 Timeframe
 Facilitator(s)

Planning Meeting II

Implementation Plan

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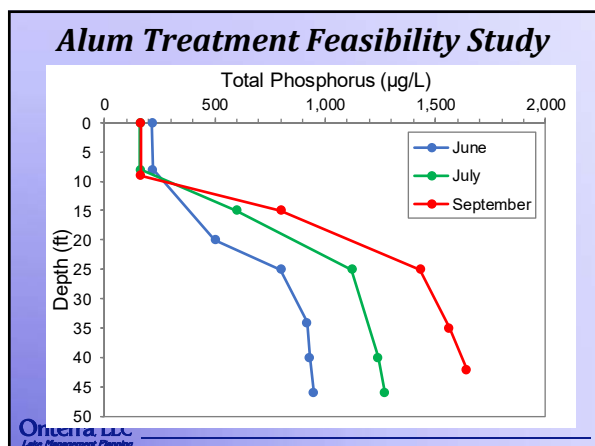
Planning Meeting II

Primary Objective: Create implementation plan framework

Steps to Achieve Objective:

1. Discuss challenges facing lake and lake group
2. Convert challenges to management goals
3. Create management actions to meet management goals
4. Determine timeframes and facilitators to carry out actions

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B

APPENDIX B

Stakeholder Survey Response Charts and Comments

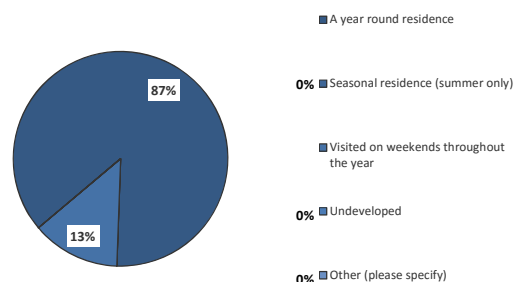
Bullhead Lake - Anonymous Stakeholder Survey

Surveys Distributed: 38
Surveys Returned: 15
Response Rate: 39%

Bullhead Lake Property

1. How is your property on Bullhead Lake utilized?

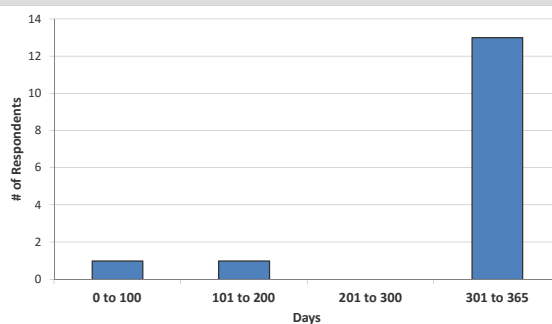
Answer Options	Response Percent	Response Count
A year round residence	86.7%	13
Seasonal residence (summer only)	0.0%	0
Visited on weekends throughout the year	13.3%	2
Undeveloped	0.0%	0
Other (please specify)	0.0%	0
answered question		15
skipped question		0



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

Answer Options	Response Count
	15
answered question	15
skipped question	0

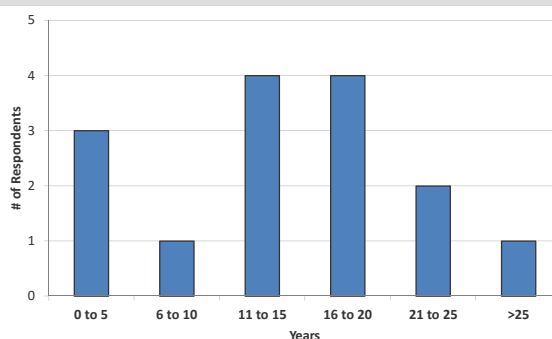
Category (# of days)	Responses		
0 to 100	1	6.7%	
101 to 200	1	6.7%	
201 to 300	0	0.0%	
301 to 365	13	86.7%	



3. How long have you owned your property on Bullhead Lake?

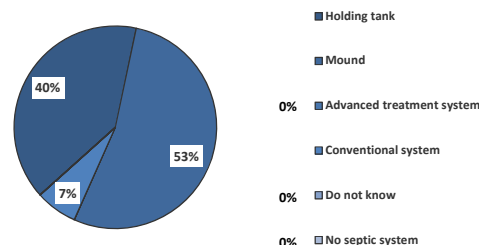
Answer Options	Response Count
	15
answered question	15
skipped question	0

Category (# of years)	Responses	% Response
0 to 5	3	20.0%
6 to 10	1	6.7%
11 to 15	4	26.7%
16 to 20	4	26.7%
21 to 25	2	13.3%
>25	1	6.7%



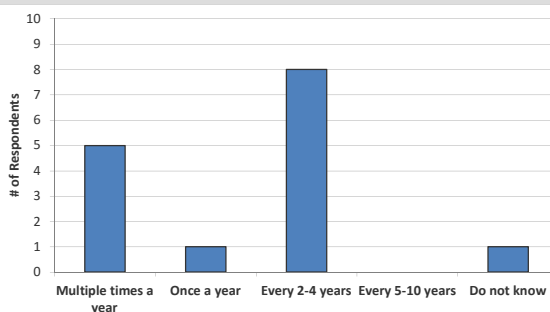
4. What type of septic system does your property utilize?

Answer Options	Response Percent	Response Count
Holding tank	40.0%	6
Mound	53.3%	8
Advanced treatment system	0.0%	0
Conventional system	6.7%	1
Do not know	0.0%	0
No septic system	0.0%	0
answered question		15
skipped question		0



5. How often is the septic system on your property pumped?

Answer Options	Response Percent	Response Count
Multiple times a year	33.3%	5
Once a year	6.7%	1
Every 2-4 years	53.3%	8
Every 5-10 years	0.0%	0
Do not know	6.7%	1
answered question		15
skipped question		0

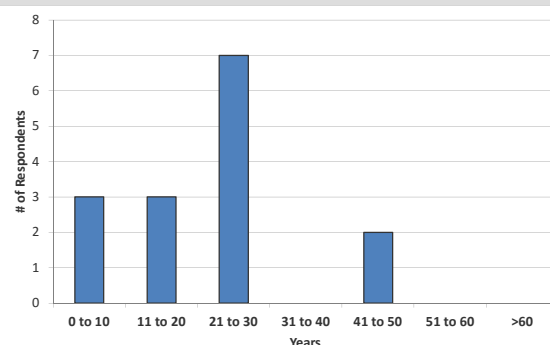


Recreational Activity on Bullhead Lake

6. How many years ago did you first visit Bullhead Lake?

Answer Options	Response Count
	15
answered question	15
skipped question	0

Category (# of days)	Responses	% Response
0 to 10	3	20%
11 to 20	3	20%
21 to 30	7	47%
31 to 40	0	0%
41 to 50	2	13%
51 to 60	0	0%
>60	0	0%



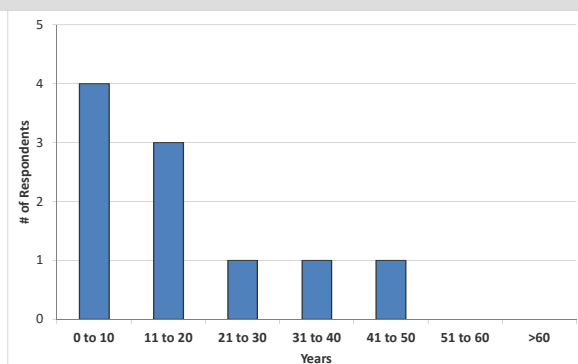
7. Have you personally fished on Bullhead Lake in the past three years?

Answer Options	Response Percent	Response Count
Yes	66.7%	10
No	33.3%	5
answered question		15
skipped question		0

8. For how many years have you fished Bullhead Lake?

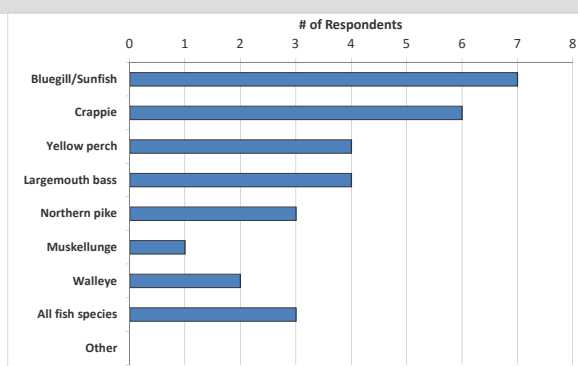
Answer Options	Response Count
	10
<i>answered question</i>	10
<i>skipped question</i>	5

Category (# of years)	Responses	% Response
0 to 10	4	40.0%
11 to 20	3	30.0%
21 to 30	1	10.0%
31 to 40	1	10.0%
41 to 50	1	10.0%
51 to 60	0	0.0%
>60	0	0.0%



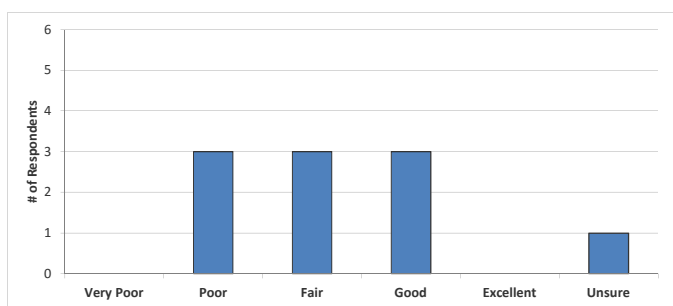
9. What species of fish do you like to catch on Bullhead Lake?

Answer Options	Response Percent	Response Count
Bluegill/Sunfish	70.0%	7
Crappie	60.0%	6
Yellow perch	40.0%	4
Largemouth bass	40.0%	4
Northern pike	30.0%	3
Muskellunge	10.0%	1
Walleye	20.0%	2
All fish species	30.0%	3
Other (please specify)	0.0%	0
<i>answered question</i>		10
<i>skipped question</i>		5



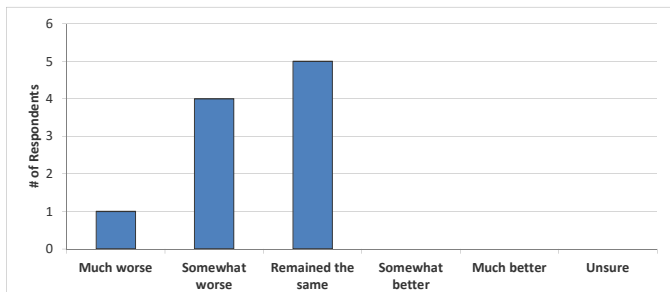
10. How would you describe the current quality of fishing on Bullhead Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	0	3	3	3	0	1	10
<i>answered question</i>							10
<i>skipped question</i>							5



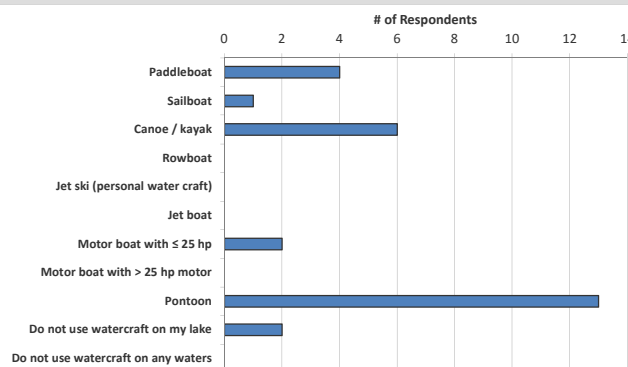
11. How has the quality of fishing changed on Bullhead Lake since you have started fishing the lake?

Answer Options	Much worse	Somewhat worse	Remained the same	Somewhat better	Much better	Unsure	Response Count
	1	4	5	0	0	0	10
<i>answered question</i>							10
<i>skipped question</i>							5



12. What types of watercraft do you currently use on Bullhead Lake?

Answer Options	Response Percent	Response Count
Paddleboat	26.7%	4
Sailboat	6.7%	1
Canoe / kayak	40.0%	6
Rowboat	0.0%	0
Jet ski (personal water craft)	0.0%	0
Jet boat	0.0%	0
Motor boat with 25 hp or less motor	13.3%	2
Motor boat with greater than 25 hp motor	0.0%	0
Pontoon	86.7%	13
Do not use watercraft on Bullhead Lake	13.3%	2
Do not use watercraft on any waters	0.0%	0
<i>answered question</i>		15
<i>skipped question</i>		0



13. Do you use your watercraft on waters other than Bullhead Lake?

Answer Options	Response Percent	Response Count
Yes	20.0%	3
No	80.0%	12
<i>answered question</i>		15
<i>skipped question</i>		0

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

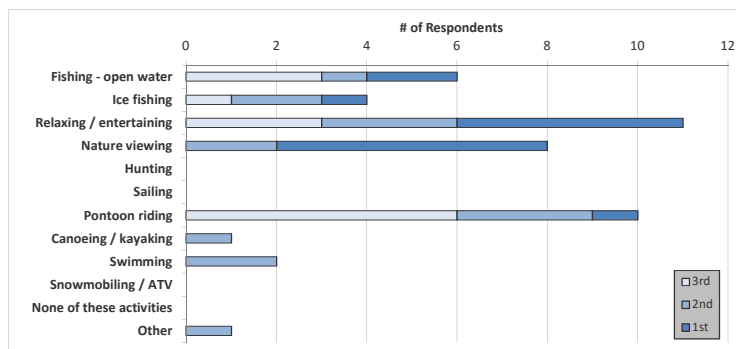
Answer Options	Response Percent	Response Count
Remove aquatic hitch-hikers (ex. - plant material, clams, mussels)	100.0%	3
Drain bilge	100.0%	3
Rinse boat	66.7%	2
Power wash boat	100.0%	3
Apply bleach	0.0%	0
Do not clean boat	0.0%	0
Other (please specify)		1
<i>answered question</i>		3
<i>skipped question</i>		12

Number	Other (please specify)
1	let it sit out of lake one week before putting back in.

15. For the list below, rank your top three activities that are important reasons for owning your property on Bullhead Lake, with 1 being the most important activity.

Answer Options	1st	2nd	3rd	Rating Average	Response Count
Fishing - open water	2	1	3	6.00	6
Ice fishing	1	2	1	4.00	4
Relaxing / entertaining	5	3	3	11.00	11
Nature viewing	6	2	0	8.00	8
Hunting	0	0	0	0.00	0
Sailing	0	0	0	0.00	0
Pontoon riding	1	3	6	10.00	10
Canoeing / kayaking	0	1	0	1.00	1
Swimming	0	2	0	2.00	2
Snowmobiling / ATV	0	0	0	0.00	0
None of these activities are important to me	0	0	0	0.00	0
Other (please specify below)	0	1	0	1.00	1
answered question					15
skipped question					0

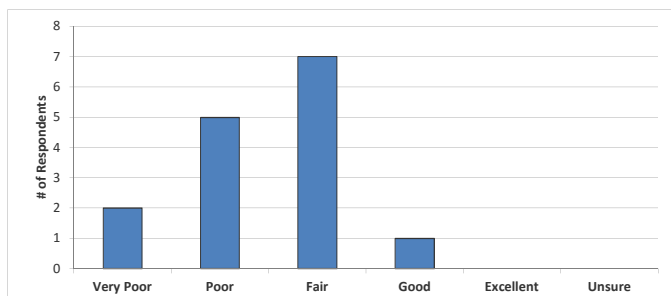
Number	"Other" responses
1	enjoying the view of the water



Bullhead Lake Current and Historic Condition, Health and Management

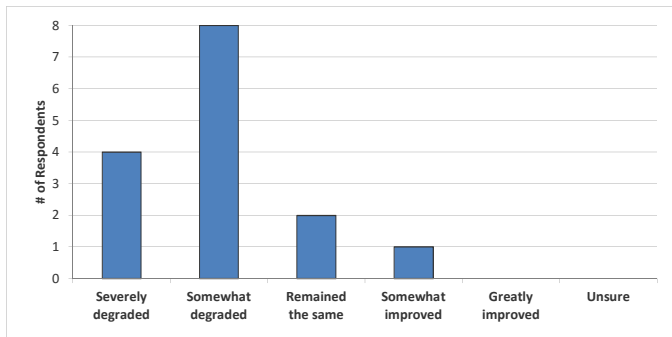
16. How would you describe the current water quality of Bullhead Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	2	5	7	1	0	0	15
answered question							15
skipped question							0



17. How has the water quality changed in Bullhead Lake since you first visited the lake?

Answer Options	Severely degraded	Somewhat degraded	Remained the same	Somewhat improved	Greatly improved	Unsure	Response Count
	4	8	2	1	0	0	15
<i>answered question</i>							15
<i>skipped question</i>							0



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

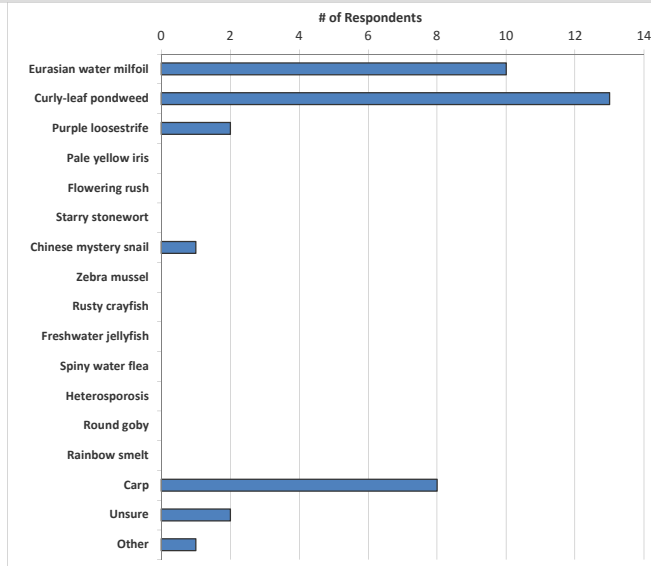
Answer Options	Response Percent	Response Count
Yes	93.3%	14
No	6.7%	1
<i>answered question</i>		15
<i>skipped question</i>		0

19. Do you believe aquatic invasive species are present within Bullhead Lake?

Answer Options	Response Percent	Response Count
Yes	85.7%	12
I think so but am not certain	14.3%	2
No	0.0%	0
<i>answered question</i>		14
<i>skipped question</i>		1

20. Which aquatic invasive species do you believe are in Bullhead Lake?

Answer Options	Response Percent	Response Count
Eurasian water milfoil	71.4%	10
Curly-leaf pondweed	92.9%	13
Purple loosestrife	14.3%	2
Pale yellow iris	0.0%	0
Flowering rush	0.0%	0
Starry stonewort	0.0%	0
Chinese mystery snail	7.1%	1
Zebra mussel	0.0%	0
Rusty crayfish	0.0%	0
Freshwater jellyfish	0.0%	0
Spiny water flea	0.0%	0
Heterosporosis (Yellow perch parasite)	0.0%	0
Round goby	0.0%	0
Rainbow smelt	0.0%	0
Carp	57.1%	8
Unsure but presume AIS to be present	14.3%	2
Other (please specify)	7.1%	1
<i>answered question</i>		14
<i>skipped question</i>		1



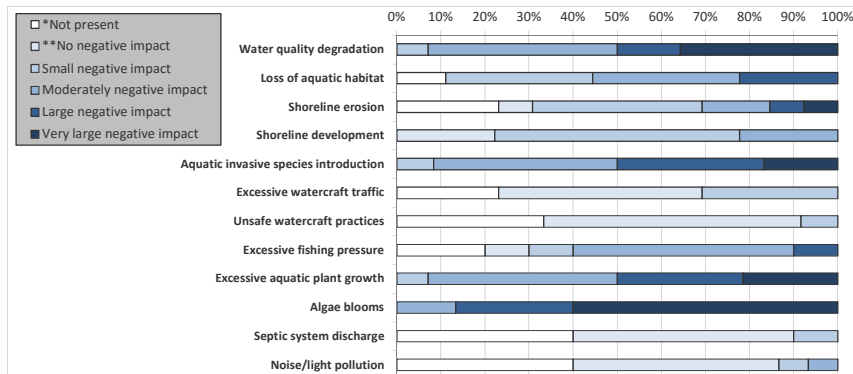
21. To what level do you believe each of the following factors may currently be negatively impacting Bullhead Lake?

*** Not present** means that you believe the issue does not exist on Bullhead Lake.

**** No impact** means that the issue may exist on Bullhead 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	0	0	1	6	2	5	0	2.79	14
Loss of aquatic habitat	1	0	3	3	2	0	4	1.15	13
Shoreline erosion	3	1	5	2	1	1	1	1.14	14
Shoreline development	0	2	5	2	0	0	4	0.69	13
Aquatic invasive species introduction	0	0	1	5	4	2	2	2.21	14
Excessive watercraft traffic	3	6	4	0	0	0	0	0.31	13
Unsafe watercraft practices	4	7	1	0	0	0	1	0.08	13
Excessive fishing pressure	2	1	1	5	1	0	2	1.17	12
Excessive aquatic plant growth	0	0	1	6	4	3	0	2.64	14
Algae blooms	0	0	0	2	4	9	0	3.47	15
Septic system discharge	4	5	1	0	0	0	4	0.07	14
Noise/light pollution	6	7	1	1	0	0	0	0.20	15
Other (please specify)									3
answered question									15
skipped question									0

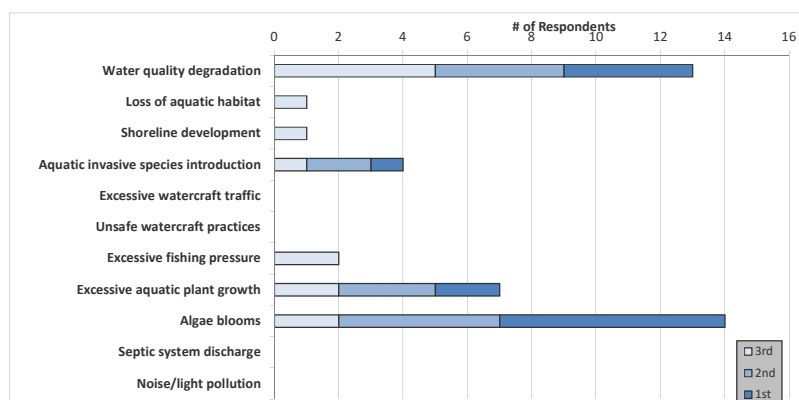
Number	Other (please specify)
1	Increased farm run off has had a major impact in water quality over the years.
2	Large Farm Manure Spreading on fields which drain into the lake
3	fertilizer/manure farm run-off negative impact



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

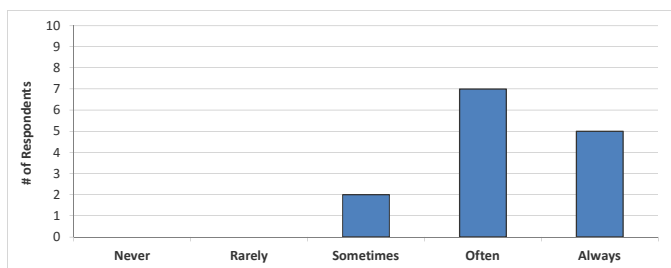
Answer Options	1st	2nd	3rd	Response Count
Water quality degradation	4	4	5	13
Loss of aquatic habitat	0	0	1	1
Shoreline development	0	0	1	1
Aquatic invasive species introduction	1	2	1	4
Excessive watercraft traffic	0	0	0	0
Unsafe watercraft practices	0	0	0	0
Excessive fishing pressure	0	0	2	2
Excessive aquatic plant growth	2	3	2	7
Algae blooms	7	5	2	14
Septic system discharge	0	0	0	0
Noise/light pollution	0	0	0	0
Other (please specify)	1	0	0	1
answered question				15
skipped question				0

Number "Other" responses
1 Farming as explained in Question 21.



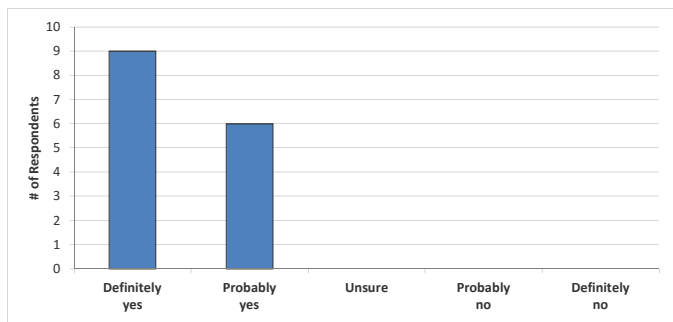
23. During open water season how often does aquatic plant growth, including algae, negatively impact your enjoyment of Bullhead Lake?

Answer Options	Never	Rarely	Sometimes	Often	Always	Response Count
	0	0	2	7	5	14
answered question						14
skipped question						1



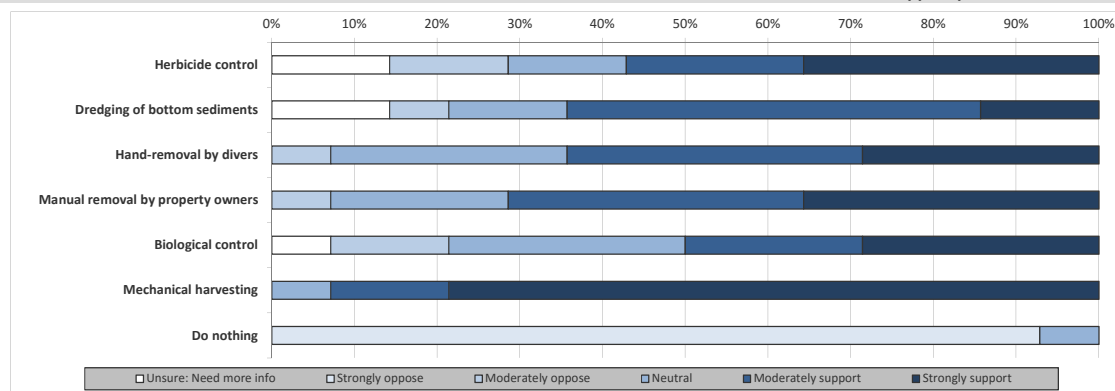
24. Considering your answer to the question above, do you believe aquatic plant control is needed on Bullhead Lake?

Answer Options	Definitely yes	Probably yes	Unsure	Probably no	Definitely no	Response Count
	9	6	0	0	0	15
<i>answered question</i>						15
<i>skipped question</i>						0



25. Aquatic plants can be managed using many techniques. Please tell us if you oppose or support the *responsible* use of the following techniques on Bullhead Lake.

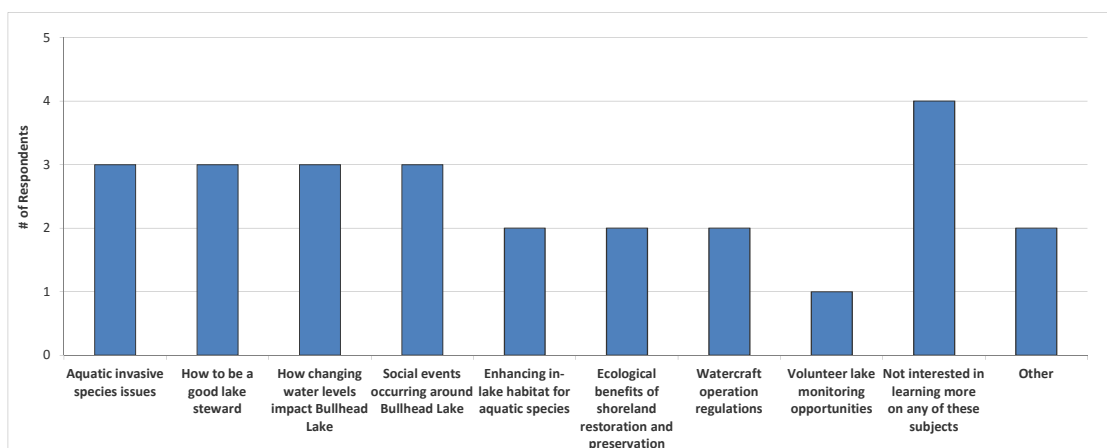
Answer Options	Strongly oppose	Moderately oppose	Neutral	Moderately support	Strongly support	Unsure: Need more info	Rating Average	Response Count
Herbicide (chemical) control	0	2	2	3	5	2	3.36	14
Dredging of bottom sediments	0	1	2	7	2	2	3.29	14
Hand-removal by divers	0	1	4	5	4	0	3.86	14
Manual removal by property owners	0	1	3	5	5	0	4.00	14
Biological control	0	2	4	3	4	1	3.43	14
Mechanical harvesting	0	0	1	2	11	0	4.71	14
Do nothing (do not manage plants)	13	0	1	0	0	0	1.14	14
<i>answered question</i>								14
<i>skipped question</i>								1



26. 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 issues	23.1%	3
How to be a good lake steward	23.1%	3
How changing water levels impact Bullhead Lake	23.1%	3
Social events occurring around Bullhead Lake	23.1%	3
Enhancing in-lake habitat for aquatic species	15.4%	2
Ecological benefits of shoreland restoration and preservation	15.4%	2
Watercraft operation regulations	15.4%	2
Volunteer lake monitoring opportunities	7.7%	1
Not interested in learning more on any of these subjects	30.8%	4
Other (please specify)	15.4%	2
answered question		13
skipped question		2

Number	Other (please specify)
1	It would be nice to see "all" lake property owners pay their Association dues especially those who use the lake. Perhaps consider having it placed on landowners property taxes. We would then have money in the Lake Association checkbook/savings to pay our fair share for these type of projects.
2	We are knowledgeable about the subjects



Bullhead Lake Advancement Association (BLAA)

27. Before receiving this mailing, had you ever heard of the BLAA?

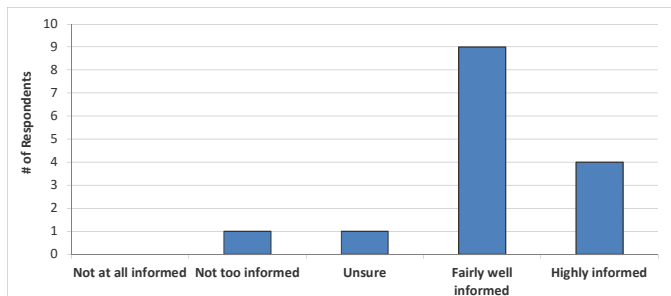
Answer Options	Response Percent	Response Count
Yes	100.0%	15
No	0.0%	0
answered question		15
skipped question		0

28. What is your membership status with the BLAA?

Answer Options	Response Percent	Response Count
Current member	93.3%	14
Former member	6.7%	1
Never been a member	0.0%	0
answered question		15
skipped question		0

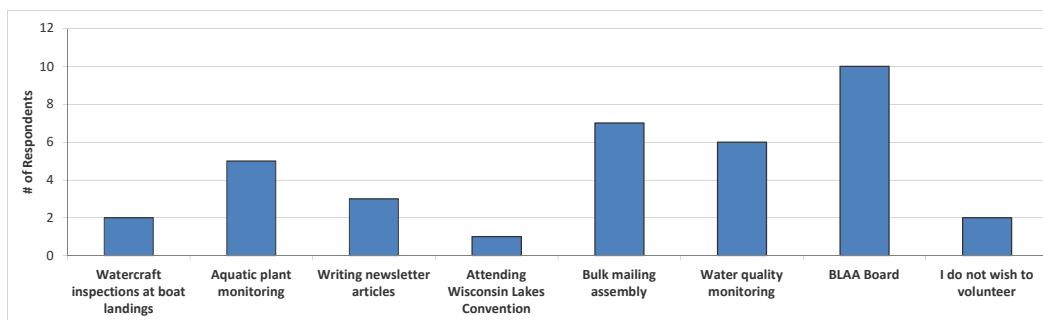
29. How informed has (or had) the BLAA kept you regarding issues with Bullhead Lake and its management?

Answer Options	Not at all informed	Not too informed	Unsure	Fairly well informed	Highly informed	Response Count
	0	1	1	9	4	15
<i>answered question</i>						15
<i>skipped question</i>						0



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

Answer Options	Response Percent	Response Count
Watercraft inspections at boat landings	13.3%	2
Aquatic plant monitoring	33.3%	5
Writing newsletter articles	20.0%	3
Attending Wisconsin Lakes Convention	6.7%	1
Bulk mailing assembly	46.7%	7
Water quality monitoring	40.0%	6
BLAA Board	66.7%	10
I do not wish to volunteer	13.3%	2
<i>answered question</i>		15
<i>skipped question</i>		0



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

Answer Options	Response Count
	7
<i>answered question</i>	7
<i>skipped question</i>	8

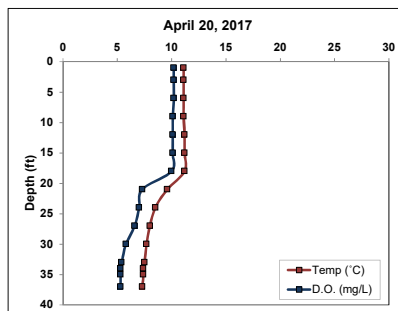
Number	Response Text
1	I think we should collect tax from landowners on the lake to better support the efforts to maintain the lake. It seems to fall on a small group at this time.
2	Thank you to all the volunteers on the committee!
3	Please check your records. The BLAA was formed prior to 1994. We have been very active in both the BLAA & the Manitowoc County Lakes Association and felt it time that some new blood become involved in the associations. It seems the history of the lake is getting lost in the process. The minutes of our association is a great resource & should be made available not only to all board members but should be available for lake property owners (both new and old) to serve as a refresher for current owners & educational for new owners so they have an understanding of the history of the lake over the years. Some things are cyclical and some things have evolved from introduction of new things occurring in our ecological system today. It's an on-going process. I also suggest board members return to providing newsletters each year (summer & winter) or quarterly, which has been done in the past, to BLAA property owners to keep everyone informed & up-to-date. Our former Presidents Don Glaeser, Gregg Peterson & Beth Kohlman produced quarterly or semi-annual newsletters, which were very informative and greatly appreciated. It kept everyone involved. I also appreciate Mrs. Peterson developing the Bullhead Lake Association "Email Listing" to help save on postage costs for the Association. She kept it current while her husband served as President of the Association and while they took care of the Annual BLAA Christmas Party invitations. They shared it with all BLAA members annually with updated emails. It would be appreciated if the current President or another board member of the Association resumed that responsibility by emailing to the BLAA members the updated email listing. It helps keep in touch quickly to get out a quick email to one another when former members pass away, wedding takes place or other events & a quick email can be sent to all BLAA to let them know and they can do what they want with the information. Thanks.
4	I feel continually harvesting the algae over time will reduce the algae growth into the future. I am a little concerned about using chemical options and the effects on good plants. At the same time I believe we need to control invasive plants because I think they are contributing to algae growth and will continue to do so if action is not taken
5	The weed collection boat would be more helpful if it were USED more often. LARGE amounts of algae collect on the north and south shore lines and early morning algae "floating islands" are present. Collecting the algae in these areas would certainly help a lot more especially in the calm of the morning hours. These areas seem to be ignored. Once the winds kick up the algae on the north and south shores go on the move to end up in front of property owner shore lines where it is harder to collect because of piers and etc.
6	I have been on the lake longer than most and have seen membership in the lake association rise and fall. The lake is clearly degrading and I think it would be a benefit for all to become engaged and support lake improvement efforts.
7	Algae growth/water quality is a huge negative. It would be helpful if more lake members would get involved in funding the removal efforts. Lake has been chemically treated before, which makes a huge difference. Would like to see that again.

C

APPENDIX C

Water Quality Data

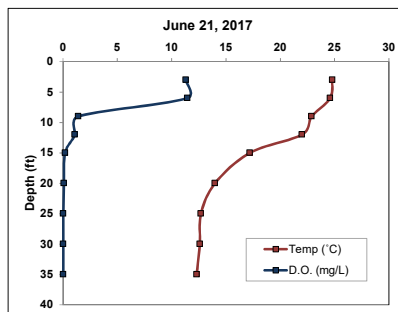
Max Depth: 38.5
BHDS Depth (ft): 3.0
BHDB Depth (ft): 34.0
Secchi Depth (ft): 12.6

[illegible]

Parameter	BHDS	BHDB
Total P (µg/L)	47.30	88.90
Dissolved P (µg/L)	9.90	59.20
Chl-a (µg/L)	ND	NA
TKN (µg/L)	NA	NA
NO ₃ -N (µg/L)	NA	NA
NH ₄ -N (µg/L)	NA	NA
Total N (µg/L)	1030.00	1230.00
Lab Cond. (µS/cm)	421.00	430.00
Lab pH	8.08	7.61
Alkalinity (mg/L CaCO ₃)	131.00	141.00
Total Susp. Solids (mg/L)	ND	ND
Calcium (mg/L)	31.50	NA
Magnesium (mg/L)	21.10	NA
Hardness (mg/L)	165.00	NA
Color (SU)	20.00	NA
Turbidity (NTU)	NA	NA

Data collected by JMB (Onterra).

Max Depth:
BHDS Depth (ft):
BHDB Depth (ft):
Secchi Depth (ft): 4.0

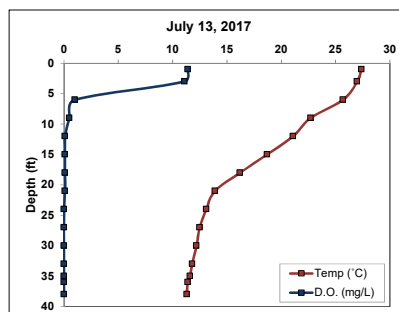
[illegible]

Parameter	BHDS	BHDB
Total P (µg/L)	68.90	NA
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L)	49.70	NA
TKN (µg/L)	NA	NA
NO ₃ + NO ₂ -N (µg/L)	NA	NA
NH ₄ -N (µg/L)	NA	NA
Total N (µg/L)	1390.00	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L calcO ₂)	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 Brian Kuckenbecker (CLMN volunteer).

Bullhead Lake

Max Depth: 38.1
BHDS Depth (ft): 3.0
BHDB Depth (ft): 35.0
Secchi Depth (ft): 2.1

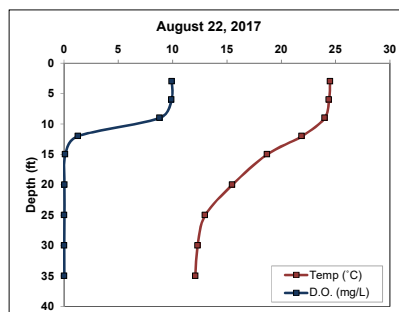
[illegible]

Parameter	BHDS	BHDB
Total P (µg/L)	67.20	577.00
Dissolved P (µg/L)	NA	NA
Chl-a (µg/L)	75.00	NA
TKN (µg/L)	NA	NA
NO ₃ + NO ₂ -N (µg/L)	NA	NA
NH ₄ -N (µg/L)	NA	NA
Total N (µg/L)	1950.00	NA
Lab Cond. (µS/cm)	392.00	475.00
Lab pH	9.10	7.20
Alkalinity (mg/L CaCO ₃)	150.00	150.00
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	30.00	NA
Turbidity (NTU)	NA	NA

Data collected by JLW and AMS (Onterra)

Bullhead Lake

Max Depth:
BHDS Depth (ft):
BHDB Depth (ft):
Secchi Depth (ft): 3.0

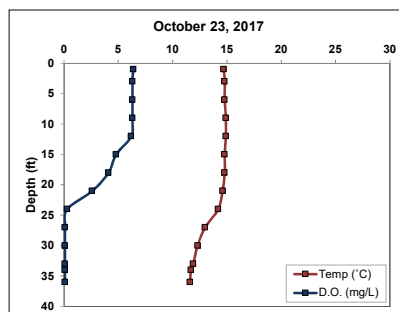
[illegible]

Parameter	BHDS	BHDB
Total P ($\mu\text{g/L}$)	48.40	NA
Dissolved P ($\mu\text{g/L}$)	NA	NA
Chl-a ($\mu\text{g/L}$)	21.50	NA
TKN ($\mu\text{g/L}$)	NA	NA
$\text{NO}_3^- + \text{NO}_2^-$ ($\mu\text{g/L}$)	NA	NA
$\text{NH}_4^+\text{-N}$ ($\mu\text{g/L}$)	NA	NA
Total N ($\mu\text{g/L}$)	1210.00	NA
Lab Cond. ($\mu\text{S/cm}$)	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 Brian Kuckenbecker (CLMN volunteer).

Bullhead Lake

Max Depth: 37.8
BHDS Depth (ft): 3.0
BHDB Depth (ft): 34.0
Secchi Depth (ft): 15.7

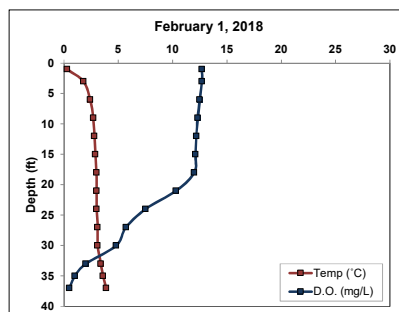
[illegible]

Parameter	BHDS	BHDB
Total P ($\mu\text{g/L}$)	81.40	1100.00
Dissolved P ($\mu\text{g/L}$)	NA	NA
Chl-a ($\mu\text{g/L}$)	0.91	NA
TKN ($\mu\text{g/L}$)	NA	NA
$\text{NO}_3^- + \text{NO}_2^- \text{N}$ ($\mu\text{g/L}$)	NA	NA
$\text{NH}_4^+ \text{N}$ ($\mu\text{g/L}$)	NA	NA
Total N ($\mu\text{g/L}$)	NA	NA
Lab Cond. ($\mu\text{S/cm}$)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L CaCO_3)	NA	NA
Total Susp. Solids (mg/L)	ND	3.25
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 CJF (Onterra).

Bullhead Lake

Max Depth: 38.0
BHDS Depth (ft): 3.0
BHDB Depth (ft): 35.0
Secchi Depth (ft): 12.8

[illegible]

Parameter	BHDS	BHDB
Total P ($\mu\text{g/L}$)	97.80	296.00
Dissolved P ($\mu\text{g/L}$)	75.20	238.00
Chl-a ($\mu\text{g/L}$)	NA	NA
TKN ($\mu\text{g/L}$)	NA	NA
$\text{NO}_3^- + \text{NO}_2^- \text{N}$ ($\mu\text{g/L}$)	NA	NA
$\text{NH}_4^+ \text{N}$ ($\mu\text{g/L}$)	NA	NA
Total N ($\mu\text{g/L}$)	1660.00	2460.00
Lab Cond. ($\mu\text{S/cm}$)	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 TWH and JMB (Onterra). Ice thickness = 1.2 feet

Water Quality Data

2017-2018 Parameter	Surface		Bottom	
	Count	Mean	Count	Mean
Secchi Depth (feet)	6	8.4	NA	NA
Total P (µg/L)	6	68.5	4	515.5
Dissolved P (µg/L)	2	42.6	2	148.6
Chl a (µg/L)	5	36.8	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)	5	1448.0	2	1845.0
Lab Cond. (µS/cm)	2	406.5	2	452.5
Alkal (mg/l CaCO ₃)	2	154.0	2	150.0
Total Susp. Solids (mg/l)	2	ND	2	3.3
Calcium (mg/L)	1	31.5	0	NA
Magnesium (mg/L)	1	21.1	0	NA
Hardness (mg/L)	1	165.0	0	NA
Color (SU)	2	25.0	0	NA
Turbidity (NTU)	0	NA	0	NA

Trophic State Index (TSI)

Year	TP	Chl-a	Secchi
1986			57.8
1987			52.5
1988			56.1
1989			46.6
1990			41.8
1991	48.1		42.3
1992			42.9
1993	55.3	53.3	43.7
1994	52.0	49.6	42.5
1995	49.8	40.8	43.9
1996	55.4	55.1	49.2
1997	47.8	50.3	42.6
1998	50.8	50.4	48.7
1999	51.7	47.2	46.1
2000	51.7	49.7	44.7
2001	52.0	54.7	46.7
2002	51.3	44.2	45.9
2003	52.2	45.0	43.1
2004	52.9	49.9	44.1
2005	50.2	52.2	43.1
2006	51.7	37.8	
2007	48.1	43.8	47.7
2008	50.9	48.9	43.7
2009	55.4	54.6	44.4
2010	56.5	59.3	51.7
2011	54.6	55.9	47.2
2012	52.4	54.1	52.1
2013	50.6	57.3	47.8
2014	58.3	64.3	54.9
2015	54.6	48.6	44.7
2016	57.7	55.4	46.6
2017	63.5	68.7	61.2
All Years (Weighted)	53.5	54.4	45.9
DHDL Median	45.0	46.4	42.8
SWTP Ecoregion Median	48.7	47.0	50.0

Year	Secchi (feet)				Chlorophyll-a (µg/L)						Total Phosphorus (µg/L)					
	Growing Season		Summer		Growing Season		Summer				Growing Season		Summer			
	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
1976			5	11.2												
1977			2	6.3												
1986	17	5.0	9	3.8												
1987	26	5.4	13	5.5												
1988	21	5.1	12	4.3							2	32.0		0.0		
1989	24	9.3	13	8.3							0			0.0		
1990	30	11.3	14	11.6							2	28.5		0.0		
1991	25	10.3	13	11.2							4	23.5		2.0	21.0	
1992	25	10.6	13	10.8							0			0.0		
1993	23	10.0	14	10.2	5	7.9	3	10.1			5	45.4		3.0	34.7	
1994	22	9.9	12	11.1	5	8.2	3	6.9			5	49.2		3.0	27.7	
1995	20	8.5	13	10.0	4	12.8	3	2.8			4	33.3		3.0	23.7	
1996	25	7.7	18	6.9	3	11.6	1	12.1			4	50.8		2.0	35.0	
1997	21	9.5	11	11.0	4	8.2	3	7.4			5	26.8		3.0	20.7	
1998	20	7.4	11	7.2	3	7.5	3	7.5			5	31.2		3.0	25.3	
1999	24	9.2	15	8.6	4	5.4	4	5.4			5	34.0		4.0	27.0	
2000	19	8.2	13	9.5	5	8.2	3	7.0			5	39.4		3.0	27.0	
2001	17	8.3	12	8.3	4	14.5	3	11.7			4	32.5		3.0	27.7	
2002	24	8.6	12	8.7	4	8.0	3	4.0			5	40.8		3.0	26.3	
2003	20	10.4	13	10.6	5	5.3	3	4.4			5	42.0		3.0	28.0	
2004	21	10.6	13	9.9	4	6.3	3	7.1			4	37.0		3.0	29.3	
2005	19	10.6	11	10.6	4	10.5	3	9.0			5	30.2		3.0	24.3	
2006	0		0		1	2.1	1	2.1			1	27.0		1.0	27.0	
2007	16	9.0	11	7.7	3	6.2	2	3.8			4	29.8		2.0	21.0	
2008	7	12.1	5	10.2	3	6.4	3	6.4			4	24.3		3.0	25.7	
2009	4	13.0	3	9.7	4	11.5	4	11.5			5	36.8		4.0	35.0	
2010	4	8.9	3	5.8	3	18.7	3	18.7			4	36.0		3.0	37.7	
2011	4	7.3	3	8.0	3	13.2	3	13.2			4	37.3		3.0	33.0	
2012	4	8.3	3	5.7	3	11.0	3	11.0			4	29.8		3.0	28.3	
2013	4	8.5	3	7.7	3	15.1	3	15.1			4	25.7		3.0	25.1	
2014	4	5.8	3	4.7	3	30.9	3	30.9			4	39.9		3.0	42.9	
2015	4	9.1	3	9.5	3	6.2	3	6.2			4	36.9		3.0	33.1	
2016	3	8.3	3	8.3	3	12.6	3	12.6			3	41.0		3.0	41.0	
2017	8	7.6	4	3.0	4	36.8	3	48.7			5	62.6		3.0	61.5	
All Years (Weighted)		8.9		8.7		11.4		11.3				36.6			30.6	
DHDL Median				10.8				5.0							17.0	
SWTP Ecoregion Median				6.6				5.3							22.0	

D

APPENDIX D

Watershed Analysis WiLMS Results

Date: 3/12/2018 Scenario: Bullhead Lake Watershed Current

Lake Id: Bullhead Lake

Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 226.0 acre

Total Unit Runoff: 7.60 in.

Annual Runoff Volume: 143.1 acre-ft

Lake Surface Area <As>: 73.0 acre

Lake Volume <V>: 1061.0 acre-ft

Lake Mean Depth <z>: 14.5 ft

Precipitation - Evaporation: 3.2 in.

Hydraulic Loading: 162.6 acre-ft/year

Areal Water Load <qs>: 2.2 ft/year

Lake Flushing Rate <p>: 0.15 1/year

Water Residence Time: 6.53 year

Observed spring overturn total phosphorus (SPO): 38.1 mg/m³

Observed growing season mean phosphorus (GSM): 36.6 mg/m³

% NPS Change: 0%

% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre	Low	Most Likely	High	Loading %	Low	Most Likely	High
	(ac)	Loading (kg/ha-year)				Loading (kg/year)		
Row Crop AG	99.0	0.50	1.00	3.00	68.5	20	40	120
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	14.0	0.10	0.30	0.50	2.9	1	2	3
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)	30.0	0.05	0.10	0.25	2.1	1	1	3
Wetlands	78.0	0.10	0.10	0.10	5.4	3	3	3
Forest	5.0	0.05	0.09	0.18	0.3	0	0	0
Lake Surface	73.0	0.10	0.30	1.00	15.1	3	9	30

POINT SOURCE DATA

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

SEPTIC TANK DATA

Description	Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)	0.30	0.50	0.80	
# capita-years		67.0		
% Phosphorus Retained by Soil	98.0	90.0	80.0	
Septic Tank Loading (kg/year)	0.40	3.35	10.72	5.7

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	61.3	129.0	374.4	100.0
Total Loading (kg)	27.8	58.5	169.8	100.0
Areal Loading (lb/ac-year)	0.84	1.77	5.13	
Areal Loading (mg/m ² -year)	94.17	198.13	574.94	
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)	53.9	102.1	285.7	94.3
Total NPS Loading (kg)	24.5	46.3	129.6	94.3

Phosphorus Prediction and Uncertainty Analysis Module

Date: 3/12/2018 Scenario: 297

Observed spring overturn total phosphorus (SPO): 38.1 mg/m³

Observed growing season mean phosphorus (GSM): 36.6 mg/m³

Back calculation for SPO total phosphorus: 0.0 mg/m³

Back calculation GSM phosphorus: 0.0 mg/m³

% Confidence Range: 70%

Nuremberg Model Input - Est. Gross Int. Loading: 0 kg

Lake Phosphorus Model	Low	Most Likely	High	Predicted	% Dif.
	Total P	Total P	Total P	-Observed	
	(mg/m ³)	(mg/m ³)	(mg/m ³)	(mg/m ³)	
Walker, 1987 Reservoir	31	65	188	28	77
Canfield-Bachmann, 1981 Natural Lake	26	42	78	5	14
Canfield-Bachmann, 1981 Artificial Lake	25	37	60	0	0
Rechow, 1979 General	8	16	46	-21	-57
Rechow, 1977 Anoxic	62	130	378	93	254
Rechow, 1977 water load<50m/year	15	32	92	-5	-14
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	47	100	289	62	163
Vollenweider, 1982 Combined OECD	31	58	138	21	56
Dillon-Rigler-Kirchner	33	68	199	30	79
Vollenweider, 1982 Shallow Lake/Res.	26	49	126	12	32
Larsen-Mercier, 1976	39	82	238	44	115
Nurnberg, 1984 Oxidic	27	57	167	20	55

Lake Phosphorus Model	Confidence	Confidence	Parameter	Back	Model
	Lower Bound	Upper Bound	Fit?	Calculation (kg/year)	Type
Walker, 1987 Reservoir	37	143	Tw	0	GSM
Canfield-Bachmann, 1981 Natural Lake	13	121	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	11	107	FIT	1	GSM
Rechow, 1979 General	9	35	qs	0	GSM
Rechow, 1977 Anoxic	76	287	FIT	0	GSM
Rechow, 1977 water load<50m/year	18	71	FIT	0	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	49	229	FIT	0	SPO
Vollenweider, 1982 Combined OECD	28	121	FIT	0	ANN
Dillon-Rigler-Kirchner	40	151	P qs p	0	SPO
Vollenweider, 1982 Shallow Lake/Res.	24	106	FIT	0	ANN
Larsen-Mercier, 1976	49	180	P Pin	0	SPO
Nurnberg, 1984 Oxid	29	130	FIT	0	ANN

Water and Nutrient Outflow Module

Date: 3/12/2018 Scenario: 256

Average Annual Surface Total Phosphorus: 36.6mg/m³

Annual Discharge: 1.63E+002 AF => 2.01E+005 m³

Annual Outflow Loading: 15.4 LB => 7.0 kg

E

APPENDIX E

Aquatic Plant Survey Data

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole, Rope	Comments	Notes	Nuisance	Total Lake Fullness	Myriophyllum spicatum	Ceratophyllum demersum	Nuphar variegata	Potamogeton amplifolius	Scheuchzeria palustris	Spirodela polyrrhiza	Stuckenia pectinata	Filamentous algae
1	44.104381	-88.040352	15	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	1	3	Sand	Pole	SAMPLED			1	1					1	1	
2	44.104111	-88.040361	14	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	2	5	Muck	Pole	SAMPLED			1	1							1
3	44.103841	-88.040370	13	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	3	5	Muck	Pole	SAMPLED			0			V			V		1
4	44.103571	-88.040379	12	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	4	6	Muck	Pole	SAMPLED			0								1
5	44.103301	-88.040388	11	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	5	4	Sand	Pole	SAMPLED			1	1						1	1
6	44.105185	-88.039951	1	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	6	2	Sand	Pole	SAMPLED			1	1							2
7	44.104915	-88.039960	2	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	7	3	Muck	Pole	SAMPLED			1	1	1						1
8	44.104645	-88.039968	3	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	8	6	Muck	Pole	SAMPLED			0								1
9	44.104375	-88.039977	4	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	9	12	Muck	Pole	SAMPLED			0								
10	44.104105	-88.039986	5	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	10	14	Muck	Pole	SAMPLED			0								
11	44.103835	-88.039995	6	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	11	14	Muck	Pole	SAMPLED			0								
12	44.103565	-88.040004	7	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	12	13	Muck	Pole	SAMPLED			0								
13	44.103295	-88.040013	8	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	13	12	Muck	Pole	SAMPLED			0								
14	44.103025	-88.040022	9	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	14	9	Muck	Pole	SAMPLED			0								1
15	44.102755	-88.040031	10	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	15	4	Muck	Pole	SAMPLED			1	1							1
16	44.105718	-88.039558	16	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	16	5	Muck	Pole	SAMPLED			1	1							
17	44.105448	-88.039567	17	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	17	8	Muck	Pole	SAMPLED			1	1							2
18	44.105178	-88.039576	18	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	18	12	Muck	Pole	SAMPLED			0								1
19	44.104908	-88.039585	19	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	19	15	Muck	Pole	SAMPLED			0								1
20	44.104638	-88.039594	20	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	20	17		Rope	SAMPLED			0								
21	44.104368	-88.039603	21	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	21	18		Rope	SAMPLED			0								1
22	44.104098	-88.039612	22	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	22	17		Rope	SAMPLED			1	1							1
23	44.103828	-88.039621	23	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	23	16		Rope	SAMPLED			0								
24	44.103559	-88.039630	24	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	24	16		Rope	SAMPLED			0								1
25	44.103289	-88.039638	25	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	25	16		Rope	SAMPLED			0								
26	44.103019	-88.039647	26	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	26	14	Muck	Rope	SAMPLED			0								1
27	44.102749	-88.039656	27	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	27	8	Muck	Pole	SAMPLED			0								1
28	44.102479	-88.039665	28	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	28	5	Muck	Pole	SAMPLED			0								1
29	44.102209	-88.039674	29	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	29	4	Sand	Pole	SAMPLED			0								1
30	44.101939	-88.039683	30	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	30	3	Muck	Pole	SAMPLED			1	1							1
31	44.105982	-88.039175	87	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	31	4	Sand	Pole	SAMPLED			0								1
32	44.105712	-88.039183	88	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	32	8	Muck	Pole	SAMPLED			2	2							1
33	44.105442	-88.039192	45	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	33	18		Rope	SAMPLED			0								
34	44.105172	-88.039201	44	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	34	19		Rope	SAMPLED			0								1
35	44.104902	-88.039210	43	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	35	24			DEEP											
36	44.104632	-88.039219	42	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	36	23			DEEP											
37	44.104362	-88.039228	41	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	37	17		Rope	SAMPLED			0								1
38	44.104092	-88.039237	40	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	38	18		Rope	SAMPLED			0								
39	44.103822	-88.039246	39	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	39	21			DEEP											
40	44.103552	-88.039255	38	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	40	19		Rope	SAMPLED			0								
41	44.103282	-88.039264	37	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	41	21		Rope	DEEP			0								
42	44.103012	-88.039273	36	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	42	20		Rope	SAMPLED			0								
43	44.102742	-88.039282	35	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	43	16		Rope	SAMPLED			0								
44	44.102472	-88.039291	34	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	44	13	Muck	Pole	SAMPLED			0								
45	44.102202	-88.039300	33	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	45	10	Muck	Pole	SAMPLED			0								

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole, Rope	Comments	Notes	Nuisance	Total Lake Fullness	Myriophyllum spicatum	Ceratophyllum demersum	Nuphar variegata	Potamogeton amplifolius	Scheuchzeria palustris	Spirodela polyrrhiza	Stuckenia pectinata	Filamentous algae
46	44.101932	-88.039308	32	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	46	6	Muck	Pole	SAMPLED			0								1
47	44.101663	-88.039317	31	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	47	4	Sand	Pole	SAMPLED			1	1						1	1
48	44.106245	-88.038791	48	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	48	2	Muck	Pole	SAMPLED			2	2							1
49	44.105975	-88.038800	49	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	49	9	Muck	Pole	SAMPLED			0								1
50	44.105705	-88.038809	50	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	50	13	Muck	Pole	SAMPLED			0								1
51	44.105435	-88.038818	51	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	51	17		Rope	SAMPLED			0								
52	44.105165	-88.038827	52	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	52	20		Rope	SAMPLED			0								
53	44.104895	-88.038836	53	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	53	22			DEEP											
54	44.104625	-88.038845	54	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	54	22			DEEP											
55	44.104356	-88.038854	55	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	55	18		Rope	SAMPLED			1	1							
56	44.104086	-88.038862	56	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	56	18		Rope	SAMPLED			0								
57	44.103816	-88.038871	57	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	57	20		Rope	SAMPLED			0								
58	44.103546	-88.038880	58	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	58	21		Rope	SAMPLED			0								
59	44.103276	-88.038889	59	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	59	24			DEEP											
60	44.103006	-88.038898	60	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	60	30			DEEP											
61	44.102736	-88.038907	61	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	61	29			DEEP											
62	44.102466	-88.038916	62	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	62	20		Rope	SAMPLED			0								
63	44.102196	-88.038925	63	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	63	16		Rope	SAMPLED			0								
64	44.101926	-88.038934	64	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	64	8	Muck	Pole	SAMPLED			1	1							1
65	44.101656	-88.038943	65	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	65	9	Muck	Pole	SAMPLED			1	1							1
66	44.101386	-88.038952	66	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	66	4	Sand	Pole	SAMPLED			1	1	1						1
67	44.106509	-88.038407	89	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	67	0			SHALLOW											
68	44.106239	-88.038416	86	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	68	6	Muck	Pole	SAMPLED			0								1
69	44.105969	-88.038425	85	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	69	12	Muck	Pole	SAMPLED			1								1
70	44.105699	-88.038434	84	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	70	16		Rope	SAMPLED			0								1
71	44.105429	-88.038443	83	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	71	16		Rope	SAMPLED			0								
72	44.105159	-88.038452	82	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	72	18		Rope	SAMPLED			0								
73	44.104889	-88.038461	81	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	73	19		Rope	SAMPLED			0								1
74	44.104619	-88.038470	80	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	74	18		Rope	SAMPLED			0								
75	44.104349	-88.038479	79	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	75	19		Rope	SAMPLED			0								
76	44.104079	-88.038488	78	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	76	20		Rope	SAMPLED			0								
77	44.103809	-88.038497	77	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	77	21		Rope	SAMPLED			0								
78	44.103539	-88.038506	76	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	78	23			DEEP											
79	44.103269	-88.038515	75	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	79	30			DEEP											
80	44.102999	-88.038524	74	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	80	36			DEEP											
81	44.102729	-88.038532	73	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	81	36			DEEP											
82	44.102459	-88.038541	72	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	82	33			DEEP											
83	44.102190	-88.038550	71	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	83	26			DEEP											
84	44.101920	-88.038559	70	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	84	21		Rope	SAMPLED			0								
85	44.101650	-88.038568	69	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	85	18		Rope	SAMPLED			0								1
86	44.101380	-88.038577	68	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	86	14	Muck	Pole	SAMPLED			0								
87	44.101110	-88.038586	67	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	87	8	Muck	Pole	SAMPLED			2	2							1
88	44.106502	-88.038033	90	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	88	7	Muck	Pole	SAMPLED			2	1							1
89	44.106232	-88.038042	91	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	89	12	Muck	Pole	SAMPLED			0								
90	44.105962	-88.038051	92	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	90	17		Rope	SAMPLED			0								

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole, Rope	Comments	Notes	Nuisance	Total Lake Fullness	Myriophyllum spicatum	Ceratophyllum demersum	Nuphar variegata	Potamogeton amplifolius	Scheuchzeria palustris	Spirodela polyrrhiza	Stuckenia pectinata	Filamentous algae
91	44.105692	-88.038060	93	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	91	19		Rope	SAMPLED			0								
92	44.105422	-88.038069	94	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	92	22		Rope	SAMPLED			0								
93	44.105152	-88.038077	95	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	93	24			DEEP											
94	44.104883	-88.038086	96	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	94	23			DEEP											
95	44.104613	-88.038095	97	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	95	23			DEEP											
96	44.104343	-88.038104	98	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	96	22			DEEP											
97	44.104073	-88.038113	99	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	97	26			DEEP											
98	44.103803	-88.038122	100	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	98	30			DEEP											
99	44.103533	-88.038131	101	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	99	30			DEEP											
100	44.103263	-88.038140	102	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	100	30			DEEP											
101	44.102993	-88.038149	103	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	101	33			DEEP											
102	44.102723	-88.038158	104	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	102	35			DEEP											
103	44.102453	-88.038167	105	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	103	30			DEEP											
104	44.102183	-88.038176	106	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	104	28			DEEP											
105	44.101913	-88.038185	107	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	105	32			DEEP											
106	44.101643	-88.038194	108	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	106	27			DEEP											
107	44.101373	-88.038202	109	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	107	24			DEEP											
108	44.101103	-88.038211	110	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	108	12	Muck	Pole	SAMPLED			0								
109	44.100833	-88.038220	111	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	109	6	Muck	Pole	SAMPLED			0								2
110	44.106496	-88.037658	134	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	110	6	Muck	Pole	SAMPLED			0								1
111	44.106226	-88.037667	133	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	111	10	Muck	Pole	SAMPLED			1	1							1
112	44.105956	-88.037676	132	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	112	17		Rope	SAMPLED			0								
113	44.105686	-88.037685	131	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	113	23			DEEP											
114	44.105416	-88.037694	130	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	114	28			DEEP											
115	44.105146	-88.037703	129	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	115	32			DEEP											
116	44.104876	-88.037712	128	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	116	32			DEEP											
117	44.104606	-88.037721	127	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	117	31			DEEP											
118	44.104336	-88.037730	126	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	118	30			DEEP											
119	44.104066	-88.037739	125	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	119	35			DEEP											
120	44.103796	-88.037747	124	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	120	37			DEEP											
121	44.103526	-88.037756	123	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	121	37			DEEP											
122	44.103256	-88.037765	122	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	122	35			DEEP											
123	44.102986	-88.037774	121	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	123	29			DEEP											
124	44.102717	-88.037783	120	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	124	28			DEEP											
125	44.102447	-88.037792	118	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	125	30			DEEP											
126	44.102177	-88.037801	119	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	126	29			DEEP											
127	44.101907	-88.037810	117	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	127	36			DEEP											
128	44.101637	-88.037819	116	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	128	29			DEEP											
129	44.101367	-88.037828	115	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	129	23		Rope	SAMPLED			0								
130	44.101097	-88.037837	114	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	130	17		Rope	SAMPLED			0								1
131	44.100827	-88.037846	113	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	131	10	Muck	Pole	SAMPLED			0								1
132	44.100557	-88.037855	112	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	132	4	Sand	Pole	SAMPLED			1	1						1	1
133	44.106489	-88.037284	135	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	133	5	Muck	Pole	SAMPLED			0								1
134	44.106219	-88.037292	136	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	134	11	Muck	Pole	SAMPLED			0								
135	44.105949	-88.037301	137	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	135	16		Rope	SAMPLED			0								

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole, Rope	Comments	Notes	Nuisance	Total Lake Fullness	Myriophyllum spicatum	Ceratophyllum demersum	Nuphar variegata	Potamogeton amplifolius	Scheuchzeria palustris	Spirodela polyrrhiza	Stuckenia pectinata	Filamentous algae
136	44.105679	-88.037310	138	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	136	21		Rope	SAMPLED			0								
137	44.105410	-88.037319	139	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	137	23		Rope	SAMPLED			0								
138	44.105140	-88.037328	140	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	138	32			DEEP											
139	44.104870	-88.037337	141	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	139	35			DEEP											
140	44.104600	-88.037346	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	140	0			DEEP											
141	44.104330	-88.037355	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	141	0			DEEP											
142	44.104060	-88.037364	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	142	0			DEEP											
143	44.103790	-88.037373	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	143	0			DEEP											
144	44.103520	-88.037382	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	144	0			DEEP											
145	44.103250	-88.037391	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	145	0			DEEP											
146	44.102980	-88.037400	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	146	0			DEEP											
147	44.102710	-88.037409	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	147	0			DEEP											
148	44.102440	-88.037418	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	148	0			DEEP											
149	44.102170	-88.037426	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	149	0			DEEP											
150	44.101900	-88.037435	146	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	150	25			DEEP											
151	44.101630	-88.037444	142	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	151	23		Rope	SAMPLED			0								
152	44.101360	-88.037453	143	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	152	21		Rope	SAMPLED			0								
153	44.101090	-88.037462	144	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	153	16		Rope	SAMPLED			0								
154	44.100821	-88.037471	145	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	154	11	Muck	Pole	SAMPLED			0								
155	44.100551	-88.037480	147	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	155	5	Muck	Pole	SAMPLED			2							2	1
156	44.106483	-88.036909	158	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	156	4	Muck	Pole	SAMPLED			2	2					1	2	1
157	44.106213	-88.036918	157	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	157	7	Muck	Pole	SAMPLED			0								1
158	44.105943	-88.036927	156	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	158	12	Muck	Pole	SAMPLED			1	1							
159	44.105673	-88.036936	155	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	159	20		Rope	SAMPLED			0								
160	44.105403	-88.036945	154	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	160	23			DEEP											
161	44.105133	-88.036954	284	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	161	0			DEEP											
162	44.104863	-88.036963	285	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	162	0			DEEP											
163	44.104593	-88.036971	283	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	163	0			DEEP											
164	44.104323	-88.036980	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	164	0			DEEP											
165	44.104053	-88.036989	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	165	0			DEEP											
166	44.103783	-88.036998	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	166	0			DEEP											
167	44.103513	-88.037007	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	167	0			DEEP											
168	44.103244	-88.037016	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	168	0			DEEP											
169	44.102974	-88.037025	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	169	0			DEEP											
170	44.102704	-88.037034	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	170	0			DEEP											
171	44.102434	-88.037043	276	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	171	0			DEEP											
172	44.102164	-88.037052	275	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	172	0			DEEP											
173	44.101894	-88.037061	153	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	173	23			DEEP											
174	44.101624	-88.037070	152	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	174	20		Rope	SAMPLED			0								
175	44.101354	-88.037079	151	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	175	19		Rope	SAMPLED			0								
176	44.101084	-88.037088	150	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	176	17		Rope	SAMPLED			0								1
177	44.100814	-88.037097	149	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	177	15	Muck	Pole	SAMPLED			0								
178	44.100544	-88.037105	148	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	178	7	Muck	Pole	SAMPLED			0								1
179	44.106476	-88.036534	159	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	179	3	Muck	Pole	SAMPLED			0								1
180	44.106206	-88.036543	160	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	180	6	Muck	Pole	SAMPLED			1				1				1

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole, Rope	Comments	Notes	Nuisance	Total Lake Fullness	Myriophyllum spicatum	Ceratophyllum demersum	Nuphar variegata	Potamogeton amplifolius	Scheuchzeria palustris	Spirodela polyrrhiza	Stuckenia pectinata	Filamentous algae
181	44.105937	-88.036552	161	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	181	12	Muck	Pole	SAMPLED			0								
182	44.105667	-88.036561	162	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	182	16		Rope	SAMPLED			0								
183	44.105397	-88.036570	163	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	183	18		Rope	SAMPLED			0								
184	44.105127	-88.036579	164	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	184	18		Rope	SAMPLED			0								1
185	44.104857	-88.036588	165	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	185	20		Rope	SAMPLED			0								
186	44.104587	-88.036597	166	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	186	22		Rope	SAMPLED			0								
187	44.104317	-88.036606	282	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	187	0			DEEP											
188	44.104047	-88.036615	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	188	0			DEEP											
189	44.103777	-88.036624	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	189	0			DEEP											
190	44.103507	-88.036633	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	190	0			DEEP											
191	44.103237	-88.036642	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	191	0			DEEP											
192	44.102967	-88.036650	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	192	0			DEEP											
193	44.102697	-88.036659	167	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	193	24			DEEP											
194	44.102427	-88.036668	168	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	194	22		Rope	SAMPLED			0								
195	44.102157	-88.036677	169	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	195	22		Rope	SAMPLED			0								
196	44.101887	-88.036686	170	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	196	18		Rope	SAMPLED			0								
197	44.101617	-88.036695	171	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	197	17		Rope	SAMPLED			0								
198	44.101348	-88.036704	172	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	198	16		Rope	SAMPLED			0								
199	44.101078	-88.036713	173	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	199	15	Muck	Rope	SAMPLED			0								
200	44.100808	-88.036722	174	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	200	12	Muck	Pole	SAMPLED			0								1
201	44.100538	-88.036731	175	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	201	8	Muck	Pole	SAMPLED			0								1
202	44.100268	-88.036740	176	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	202	5	Muck	Pole	SAMPLED			1	1							1
203	44.106200	-88.036169	192	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	203	4	Sand	Pole	SAMPLED			2	2						1	1
204	44.105930	-88.036178	191	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	204	6	Muck	Pole	SAMPLED			1	1							1
205	44.105660	-88.036186	190	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	205	9	Muck	Pole	SAMPLED			1	1							1
206	44.105390	-88.036195	189	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	206	12	Muck	Pole	SAMPLED			0								
207	44.105120	-88.036204	188	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	207	15	Muck	Pole	SAMPLED			0								1
208	44.104850	-88.036213	0	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	208	0			NO INFORMATION											
209	44.104580	-88.036222	187	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	209	23			DEEP											
210	44.104310	-88.036231	281	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	210	0			DEEP											
211	44.104041	-88.036240	280	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	211	0			DEEP											
212	44.103771	-88.036249	279	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	212	0			DEEP											
213	44.1035006	-88.036258	278	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	213	0			DEEP											
214	44.1032307	-88.0362669	277	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	214	0			DEEP											
215	44.1029607	-88.0362758	186	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	215	24			DEEP											
216	44.1026908	-88.0362848	185	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	216	22		Rope	SAMPLED			0								
217	44.1024209	-88.0362937	184	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	217	20		Rope	SAMPLED			0								1
218	44.1021509	-88.0363027	183	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	218	19		Rope	SAMPLED			0								
219	44.101881	-88.0363116	182	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	219	19		Rope	SAMPLED			0								1
220	44.101611	-88.0363205	181	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	220	17		Rope	SAMPLED			0								
221	44.1013411	-88.0363295	180	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	221	15	Muck	Pole	SAMPLED			0								
222	44.1010711	-88.0363384	179	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	222	15	Muck	Pole	SAMPLED			0								
223	44.1008012	-88.0363473	178	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	223	12	Muck	Pole	SAMPLED			0								
224	44.1005313	-88.0363563	177	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	224	7	Muck	Pole	SAMPLED			0								1
225	44.1059236	-88.0358029	193	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	225	4	Sand	Pole	SAMPLED			0								1

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole, Rope	Comments	Notes	Nuisance	Total Lake Fullness	Myriophyllum spicatum	Ceratophyllum demersum	Nuphar variegata	Potamogeton amplifolius	Scheuchzeria palustris	Spirodela polyrrhiza	Stuckenia pectinata	Filamentous algae
226	44.1056537	-88.0358118	194	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	226	5	Muck	Pole	SAMPLED			0								1
227	44.1053838	-88.0358208	195	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	227	6	Muck	Pole	SAMPLED			0								1
228	44.1051138	-88.0358297	196	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	228	4	Muck	Pole	SAMPLED			0								1
229	44.1048439	-88.0358386	197	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	229	7	Sand	Pole	SAMPLED			1	1							1
230	44.1045739	-88.0358476	198	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	230	9	Sand	Pole	SAMPLED			1	1							1
231	44.104304	-88.0358565	199	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	231	16		Rope	SAMPLED			0								
232	44.1040341	-88.0358655	200	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	232	16		Rope	SAMPLED			0								
233	44.1037641	-88.0358744	201	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	233	18		Rope	SAMPLED			0								0
234	44.1034942	-88.0358833	202	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	234	18		Rope	SAMPLED			0								
235	44.1032242	-88.0358923	203	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	235	22		Rope	SAMPLED			0								
236	44.1029543	-88.0359012	204	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	236	23		Rope	SAMPLED			0								
237	44.1026844	-88.0359102	205	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	237	21		Rope	SAMPLED			0								
238	44.1024144	-88.0359191	206	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	238	20		Rope	SAMPLED			0								
239	44.1021445	-88.035928	207	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	239	18		Rope	SAMPLED			0								
240	44.1018745	-88.035937	208	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	240	16		Rope	SAMPLED			0								
241	44.1016046	-88.0359459	209	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	241	15	Muck	Rope	SAMPLED			0								
242	44.1013346	-88.0359549	210	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	242	15	Muck	Rope	SAMPLED			0								
243	44.1010647	-88.0359638	211	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	243	11	Muck	Pole	SAMPLED			0								
244	44.1007948	-88.0359727	212	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	244	7	Muck	Rope	SAMPLED			0								1
245	44.1005248	-88.0359817	213	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	245	4	Sand	Pole	SAMPLED			1	1	1						1
246	44.1045675	-88.035473	229	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	246	0			SHALLOW											
247	44.1042976	-88.0354819	228	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	247	3	Rock	Pole	SAMPLED			0								
248	44.1040276	-88.0354908	227	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	248	7	Muck	Pole	SAMPLED			1	1						1	1
249	44.1037577	-88.0354998	226	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	249	15	Muck	Rope	SAMPLED			0								
250	44.1034877	-88.0355087	225	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	250	16		Rope	SAMPLED			0								
251	44.1032178	-88.0355177	224	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	251	17		Rope	SAMPLED			0								
252	44.1029479	-88.0355266	223	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	252	20		Rope	SAMPLED			0								
253	44.1026779	-88.0355356	222	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	253	20		Rope	SAMPLED			0								
254	44.102408	-88.0355445	221	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	254	20		Rope	SAMPLED			0								
255	44.102138	-88.0355534	220	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	255	18		Rope	SAMPLED			0								
256	44.1018681	-88.0355624	219	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	256	16		Rope	SAMPLED			0								
257	44.1015981	-88.0355713	218	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	257	14	Muck	Pole	SAMPLED			0								
258	44.1013282	-88.0355803	217	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	258	11	Muck	Pole	SAMPLED			0								
259	44.1010583	-88.0355892	216	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	259	11	Muck	Pole	SAMPLED			1	1	1						
260	44.1007883	-88.0355981	215	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	260	7	Muck	Pole	SAMPLED			1	1							1
261	44.1005184	-88.0356071	214	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	261	2	Muck	Pole	SAMPLED			1	1	1						1
262	44.1037512	-88.0351252	230	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	262	3	Muck	Pole	SAMPLED			1					1	1		3
263	44.1034813	-88.0351341	231	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	263	5	Sand	Pole	SAMPLED			0								1
264	44.1032113	-88.0351431	232	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	264	15	Muck	Pole	SAMPLED			0								
265	44.1029414	-88.035152	233	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	265	15	Muck	Pole	SAMPLED			0								
266	44.1026715	-88.0351609	234	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	266	16		Rope	SAMPLED			0								
267	44.1024015	-88.0351699	235	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	267	17		Rope	SAMPLED			0								
268	44.1021316	-88.0351788	236	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	268	16		Rope	SAMPLED			0								
269	44.1018616	-88.0351878	237	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	269	15	Muck	Rope	SAMPLED			0								
270	44.1015917	-88.0351967	238	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	270	13	Muck	Pole	SAMPLED			0								

Point Number	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	ID	Lake Name	County	Date	Field Crew	Point Number	Depth (ft)	Sediment	Pole, Rope	Comments	Notes	Nuisance	Total Lake Fullness	Myriophyllum spicatum	Ceratophyllum demersum	Nuphar variegata	Potamogeton amplifolius	Scheuchzeria palustris	Spirodela polyrrhiza	Stuckenia pectinata	Filamentous algae
271	44.1013218	-88.0352057	239	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	271	9	Muck	Pole	SAMPLED			0								1
272	44.1010518	-88.0352146	240	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	272	8	Muck	Pole	SAMPLED			1	1							1
273	44.1007819	-88.0352235	241	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	273	5	Muck	Pole	SAMPLED			1	1							1
274	44.1034748	-88.0347595	252	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	274	3	Muck	Pole	SAMPLED			2	1					1	2	1
275	44.1032049	-88.0347684	251	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	275	6	Sand	Pole	SAMPLED			0								
276	44.102935	-88.0347774	250	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	276	14	Muck	Pole	SAMPLED			0								
277	44.102665	-88.0347863	249	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	277	15	Muck	Rope	SAMPLED			0								
278	44.1023951	-88.0347953	248	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	278	16		Rope	SAMPLED			0								
279	44.1021251	-88.0348042	247	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	279	15	Muck	Pole	SAMPLED			0								
280	44.1018552	-88.0348132	246	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	280	14	Muck	Pole	SAMPLED			0								
281	44.1015853	-88.0348221	245	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	281	12	Muck	Pole	SAMPLED			0								1
282	44.1013153	-88.0348311	244	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	282	9	Muck	Pole	SAMPLED			0								1
283	44.1010454	-88.03484	243	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	283	8	Muck	Pole	SAMPLED			1	1							1
284	44.1007754	-88.0348489	242	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	284	4	Sand	Pole	SAMPLED			1	1							1
285	44.1031985	-88.0343938	253	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	285	3	Rock	Pole	SAMPLED			1								1
286	44.1029285	-88.0344028	254	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	286	7	Muck	Pole	SAMPLED			1	1							1
287	44.1026586	-88.0344117	255	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	287	11	Muck	Pole	SAMPLED			0								1
288	44.1023886	-88.0344207	256	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	288	9	Muck	Pole	SAMPLED			1	1							1
289	44.1021187	-88.0344296	257	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	289	9	Muck	Pole	SAMPLED			1	1							1
290	44.1018487	-88.0344386	258	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	290	7	Muck	Pole	SAMPLED			1	1							1
291	44.1015788	-88.0344475	259	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	291	9	Muck	Pole	SAMPLED			0								
292	44.1013089	-88.0344565	260	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	292	5	Muck	Pole	SAMPLED			1	1						1	1
293	44.1010389	-88.0344654	261	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	293	4	Muck	Pole	SAMPLED			0								
294	44.103192	-88.0340192	269	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	294	3	Muck	Pole	SAMPLED			1	1							1
295	44.1029221	-88.0340282	268	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	295	5	Muck	Pole	SAMPLED			1							1	1
296	44.1026521	-88.0340371	267	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	296	6	Muck	Pole	SAMPLED			2	2							1
297	44.1023822	-88.0340461	266	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	297	6	Muck	Pole	SAMPLED			0								1
298	44.1021122	-88.034055	265	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	298	6	Muck	Pole	SAMPLED			0								
299	44.1018423	-88.034064	264	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	299	6	Muck	Pole	SAMPLED			0								
300	44.1015724	-88.0340729	263	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	300	4	Muck	Pole	SAMPLED			2	2						2	1
301	44.1013024	-88.0340818	262	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	301	4	Muck	Pole	SAMPLED			0								1
302	44.1029156	-88.0336535	270	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	302	3	Muck	Pole	SAMPLED			1	1							1
303	44.1026457	-88.0336625	271	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	303	3	Muck	Pole	SAMPLED			1	1							1
304	44.1023757	-88.0336714	272	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	304	4	Muck	Pole	SAMPLED			0								1
305	44.1021058	-88.0336804	273	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	305	5	Muck	Pole	SAMPLED			0								1
306	44.1018359	-88.0336893	274	Bullhead Lake	Manitowoc	7/13/2017	JLW & AMS	306	4	Muck	Pole	SAMPLED			0								1

F

APPENDIX F

2017 WDNR Bullhead Lake Fisheries Report

2017 Bullhead Lake Report
Steve Hogler, Steve Surendonk and Derek Apps
WDNR Green Bay Fish Management

ABSTRACT

Bullhead Lake is a seepage lake located in western Manitowoc County. The lake has a surface area of 67 acres, a maximum depth of 40 feet and a shoreline development factor of 1.07.

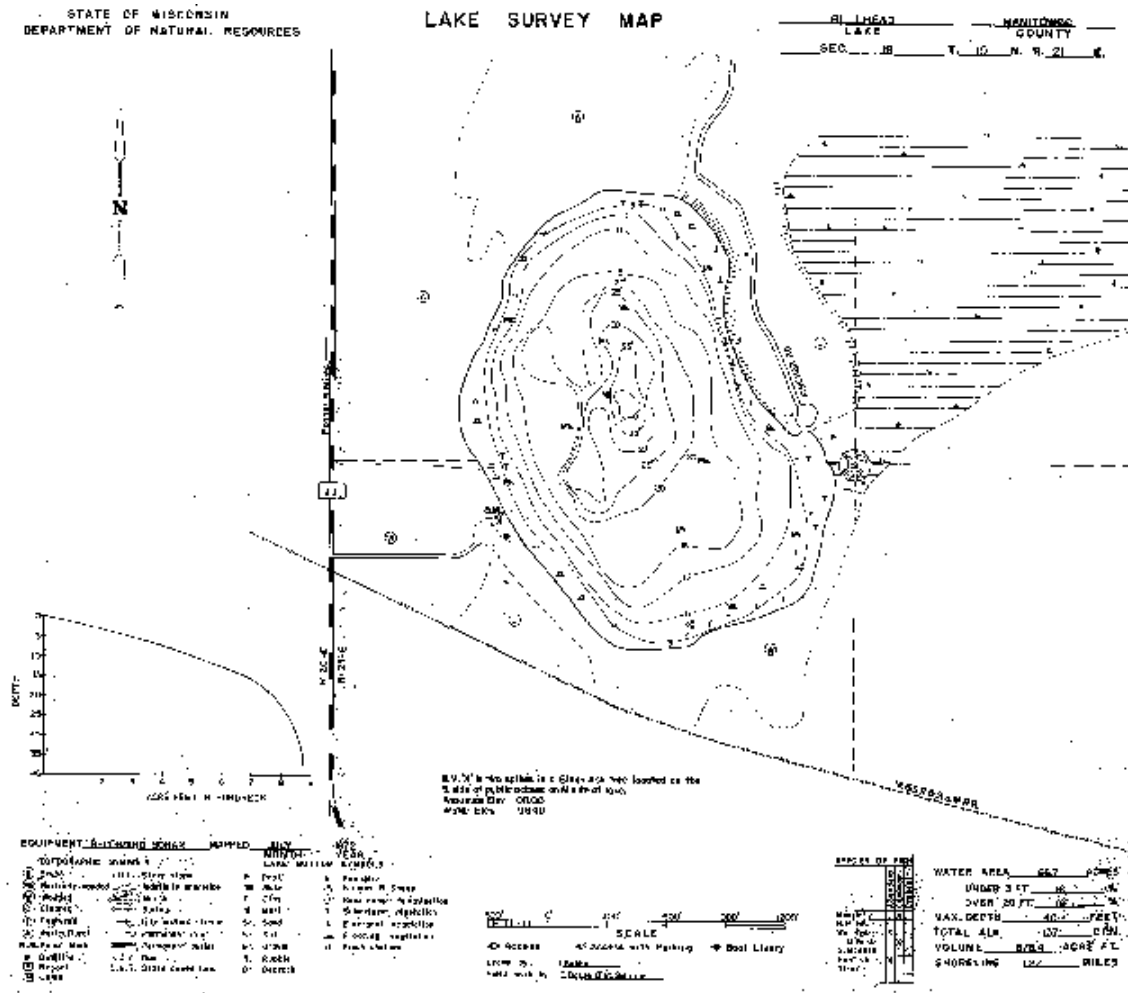
Traditionally, Bullhead Lake has been managed as a bass-panfish lake with the stocking of Muskellunge, Walleye and Yellow Perch to increase angling opportunities. Fish surveys from the 1950's found an unbalanced fish community with numerous large Carp and small panfish. In 1957, Fisheries Management chemically eradicated the fish population of Bullhead Lake with toxaphene to restore a balanced fish community. The restocking program included Largemouth Bass, Muskellunge, Bluegill and Yellow Perch. Surveys from the 1960's and 1970's found continuing issues with the fish community and poor water quality with fish kills and subsequent restocking noted. By the mid 1970's shocking surveys found good numbers of Walleye and Black Crappie along with lower numbers of Largemouth Bass and Yellow Perch. Muskellunge and Bluegill were present, but in low number. Shocking surveys conducted in the 1980's found improved fish populations with good numbers of Largemouth Bass, Black Crappie and Yellow Perch with lower numbers of Walleye and Bluegill. Results from the last three surveys in 1990's and 2000's indicated that Bullhead Lake was dominated by Largemouth Bass and Bluegill with a good mix of other species.

The Bullhead Lake Association has been an active partner with WDNR for many years. Among other activities, the Bullhead Lake Association has contributed to the management of the lake by collecting long-term water quality data, sponsoring alum treatments to control phosphorus and several Aquatic Plant Management (APM) studies.

A comprehensive fisheries was conducted on Bullhead Lake in April and May, 2017 to assess the fish populations of the lake. Two survey gears, fyke nets and a boomshocker was used to collect fish across the spring spawning period. In total, 1,721 fish representing eight species were captured. Overall, Bluegill dominated our catch chiefly because the large number of Bluegill captured in fyke nets. Largemouth Bass, Brown Bullhead and Northern Pike were the next most abundant species. Black Crappie, Yellow Perch, and Walleye were less common. In electroshocking surveys, Largemouth Bass and Bluegill dominated our catch. It is recommended to: regularly conduct fish surveys to assess population numbers, growth rates and the contribution of stocked fish to the fishery, to implement findings from the panfish project, to work with stakeholders to improve water quality in the lake, and to encourage shoreline owners to improve nearshore fish habitat.

INTRODUCTION

Bullhead Lake is a seepage lake located in western Manitowoc County. The lake has a surface area of 67 acres, a maximum depth of 40 feet and a shoreline development factor of 1.07 (Figure 1). The lake has one basin with an adjoining cattail wetland. The lake bottom consists of muck, sand and gravel and the water is considered hard. Bullhead Lake is surrounded by agricultural land with an increasing number of year-round residences being built along the shoreline and on adjacent lands. A public boat launch is present on the western side of the lake that has a single pier for boat launching and an additional pier for fishing.



angling opportunities (Table 1). The Bullhead Lake Association has stocked Yellow Perch and Fathead Minnow to augment their populations in the lake since 2002.

Table 1. The Bullhead Lake fish stocking record since 1973. Wisconsin DNR stocked the gamefish species, Walleye and Muskellunge and the Bullhead Lake Association stocked the Walleye in 2012 and the other species under a DNR stocking permit.

Year	Species	Age Class	Number Fish Stocked	Ave. Length (in)
1973	MUSKELLUNGE	FINGERLING	300	15
1974	Hybrid Muskellunge	FINGERLING	240	9
1976	Hybrid Muskellunge	FINGERLING	300	8
1977	Hybrid Muskellunge	FINGERLING	300	10
1978	Hybrid Muskellunge	FINGERLING	300	9
1979	Hybrid Muskellunge	FINGERLING	300	8.5
1980	Hybrid Muskellunge	FINGERLING	300	11
1983	WALLEYE	FINGERLING	3350	5
1985	WALLEYE	FINGERLING	3500	4
1989	WALLEYE	FRY	3094	3
1992	WALLEYE	FINGERLING	1774	2.5
1994	WALLEYE	FINGERLING	1776	2.5
1995	WALLEYE	FINGERLING	1677	2.8
1997	WALLEYE	LARGE FINGERLING	1675	2.7
1999	WALLEYE	SMALL FINGERLING	6700	1.5
2001	WALLEYE	SMALL FINGERLING	6700	1.6
2002	YELLOW PERCH	ADULT (BROODSTOCK)	600	6
2003	WALLEYE	SMALL FINGERLING	6695	1.5
2004	YELLOW PERCH	LARGE FINGERLING	500	5
2004	FATHEAD MINNOW	ADULT (BROODSTOCK)	200000	3
2005	YELLOW PERCH	LARGE FINGERLING	1000	5
2005	WALLEYE	SMALL FINGERLING	3335	1.4
2005	FATHEAD MINNOW	ADULT (BROODSTOCK)	40000	3
2006	YELLOW PERCH	LARGE FINGERLING	1000	5
2008	YELLOW PERCH	LARGE FINGERLING	541	6
2008	YELLOW PERCH	SMALL FINGERLING	500	3
2009	FATHEAD MINNOW	ADULT	0	2
2009	YELLOW PERCH	YEARLING	500	6
2009	WALLEYE	SMALL FINGERLING	2245	1.8
2010	YELLOW PERCH	YEARLING	850	6
2011	YELLOW PERCH	YEARLING	1100	6
2011	WALLEYE	SMALL FINGERLING	2570	1.9
2012	WALLEYE	YEARLING	397	6
2013	YELLOW PERCH	YEARLING	1200	5
2013	WALLEYE	SMALL FINGERLING	2340	2
2015	YELLOW PERCH	ADULT	500	8
2015	WALLEYE	SMALL FINGERLING	1504	1.7
2017	WALLEYE	SMALL FINGERLING	2432	1.7

Fishery surveys have been conducted on Bullhead Lake since the 1950's with variable fishery conditions described. Cline (1957) conducted a barge seine survey in 1955 on Bullhead Lake and captured nine fish species: Pumpkinseed Sunfish, Green Sunfish, Black Crappie, Yellow Perch, Carp, Bullhead, White Sucker, Golden Shiner and Northern Pike. Panfish were described as small and thin and Carp as extremely large. Since Largemouth Bass were absent from the catch, the lake was stocked with 3,191 fingerling Largemouth Bass in 1956. In 1957,

Fisheries Management chemically eradicated the fish population of Bullhead Lake with toxaphene to restore a balanced fish community. The restocking included Largemouth Bass, Muskellunge, Bluegill and Yellow Perch.

Schultz conducted a barge seine and shocking surveys in 1962 and 1964 (Schultz 1963 and 1965). These surveys found that the species stocked in 1957 were doing well and that all species were reproducing except for Muskellunge. However, following the winter of 1964-65, Schultz (1966) investigated a large winter-kill on Bullhead Lake. He reported finding dead Muskellunge, Largemouth Bass and Bluegill. Schultz restocked the lake with Muskellunge fry and fingerling, Largemouth Bass adult and fingerling and Walleye fry.

Belonger (1976) conducted a shocking survey in 1976 and found good numbers of Walleye and Black Crappie along with modest numbers of Largemouth Bass and Yellow Perch. Muskellunge and Bluegill were present in low numbers. Belonger noted poor over-winter survival of young Largemouth Bass.

Shocking surveys conducted by Peeters (1982, 1985 and 1988) found good numbers of Largemouth Bass, Black Crappie and Yellow Perch with lower numbers of Walleye, Bluegill and other species captured during each survey.

Results from the last three surveys conducted in 1999 (Surendonk and Hogler 2003), 2005 (Hogler and Surendonk 2005) and 2011 (Hogler and Surendonk 2012), indicated that Bullhead Lake was dominated by Largemouth Bass and Bluegill. These surveys found a good mix of gamefish and panfish in the lake with Largemouth Bass the dominant predator and Bluegill the most common panfish. Northern Pike and Walleye were captured during the surveys, but in low number and the other panfish species such as Black Crappie and Yellow Perch were also captured in low abundance. A creel survey that was conducted with the 1999 survey found that sport anglers were fishing the lake at a rate of 190 hours per acre with most anglers targeting Bluegill and Largemouth Bass with few individuals targeting the other species.

The Bullhead Lake Association has been an active partner with WDNR Fisheries and Water Resource staff for many years. Among other activities, the Bullhead Lake Association has contributed to the management of the lake by collecting long-term water quality data, sponsoring alum treatments to control phosphorus that occurred in 1978 and 1988 and several Aquatic Plant Management (APM) studies. Long-term monitoring data that the Association helped to collect indicates that since 2008 the trophic status of the lake has moved from mesotrophic to slightly eutrophic. APM studies have identified the presence of three invasive species: Banded Mystery Snail, Curly Leaf Pondweed and Eurasian Water Milfoil found in the lake since 2003. The APM surveys have also indicated increasing amounts of filamentous algae that can be found in large mats in the nearshore waters of the lake.

METHODS

Spring Fyke Netting

A standard comprehensive fisheries survey on Bullhead Lake began in April and continued through May 2017. Six fyke nets were set on April 5 and were lifted through April 14 (Figure 2). Fyke nets were set to capture and mark adult spring spawning Northern Pike, Walleye and Yellow Perch. Biological data was also collected from the other species that were captured in the nets. All fish were identified and measured, spines, rays or scales were removed from a sub-sample of all species for age determination and all gamefish were marked with a caudal fin clip for use in calculating a population estimate.



Figure 2. Spring 2017 fyke net locations on Bullhead Lake.

Spring Electrofishing

Recapture Run

Shortly after the completion of fyke netting, on the night of April 25, the entire shoreline of Bullhead Lake was electroshocked to look for marked fish. All fish were netted, identified, checked for marks and measured.

Centrarchid Electrofishing

On the night of May 24, the entire shoreline was electroshocked to estimate adult largemouth bass and panfish relative abundance. All fish were netted, identified, checked for marks and measured.

Statistical Analyses

Basic fisheries statistics, such as average length, length frequencies by survey type, age distributions, and population estimates were calculated when possible. Mean length at age was determined first by using an age length key to extrapolate length age distributions from the sub-sample of fish that were aged to the full sample length frequency, then second calculating the arithmetic mean of the length for a given age from the estimated full sample age distribution.

The Petersen population estimation method was used to estimate community population size when the recapture numbers were large enough to provide an unbiased estimate of population size. For the Petersen method, population size was estimated as the ratio between the number of fish initially marked and released during the marking period (M), times the number of fish captured and examined for marks (C) during the recapture period, divided by the number of fish that were found to have marks during the recapture period (R) using the Petersen estimator (Ricker 1975).

RESULTS

Spring Fyke Netting

During the fyke net portion of the survey, a total of 1422 fish were captured during the 54 net nights fished for a Catch per Effort (CPE) of 26.3 fish per net per night. Of the seven species captured, Bluegill, Brown Bullhead and Largemouth Bass dominated the catch, with fewer Northern Pike, Black Crappie, Yellow Perch and Walleye netted (Table 1).

Table 1. The number of each species that were captured with fyke nets fished from April 6 through April 14, 2017 in Bullhead Lake. Catch per unit effort, (CPE) is expressed as the number of fish per net per night. Lengths are reported in mm and in inches (") for each species.

Species	Number Caught	CPE	Length Range	Average Length
Walleye	2	0.0	525 mm- 596 mm (20.6"- 23.5")	561 mm (22.1")
Largemouth Bass	100	1.9	87 mm- 525 mm (3.3"- 20.7")	291 mm (11.5")
Northern Pike	94	1.6	410 mm- 791 mm (16.1"- 31.1")	565 mm (22.2")
Bluegill	888	16.4	87 mm- 244 mm (3.3"- 9.6")	163 mm (6.4")
Yellow Perch	58	1.1	120 mm- 268 mm (4.7"- 10.6")	167 mm (6.6")
Black Crappie	86	1.6	115 mm- 289 mm (4.5"- 11.4")	201 mm (7.9")
Brown Bullhead	194	3.6	194 mm- 374 mm (7.6"- 14.7")	295 mm (11.6")
Total	1422	26.3		

Gamefish

Largemouth Bass

Although not an early spring spawning fish, Largemouth Bass were the most abundant gamefish captured during fyke netting (Table 1). The 100 Largemouth Bass that were handled ranged in length from 87 mm to 525 mm (3.3"- 20.7") with an average length of 291 mm (11.5") (Table 2). Thirty-seven of the 100 Bass (37%) were longer than the 14" (356 mm) minimum size limit for harvest, but only one captured Bass was greater than 18" (457 mm) in length (Figure 3). Total CPE was 1.9 Bass per net per night (Table 1).

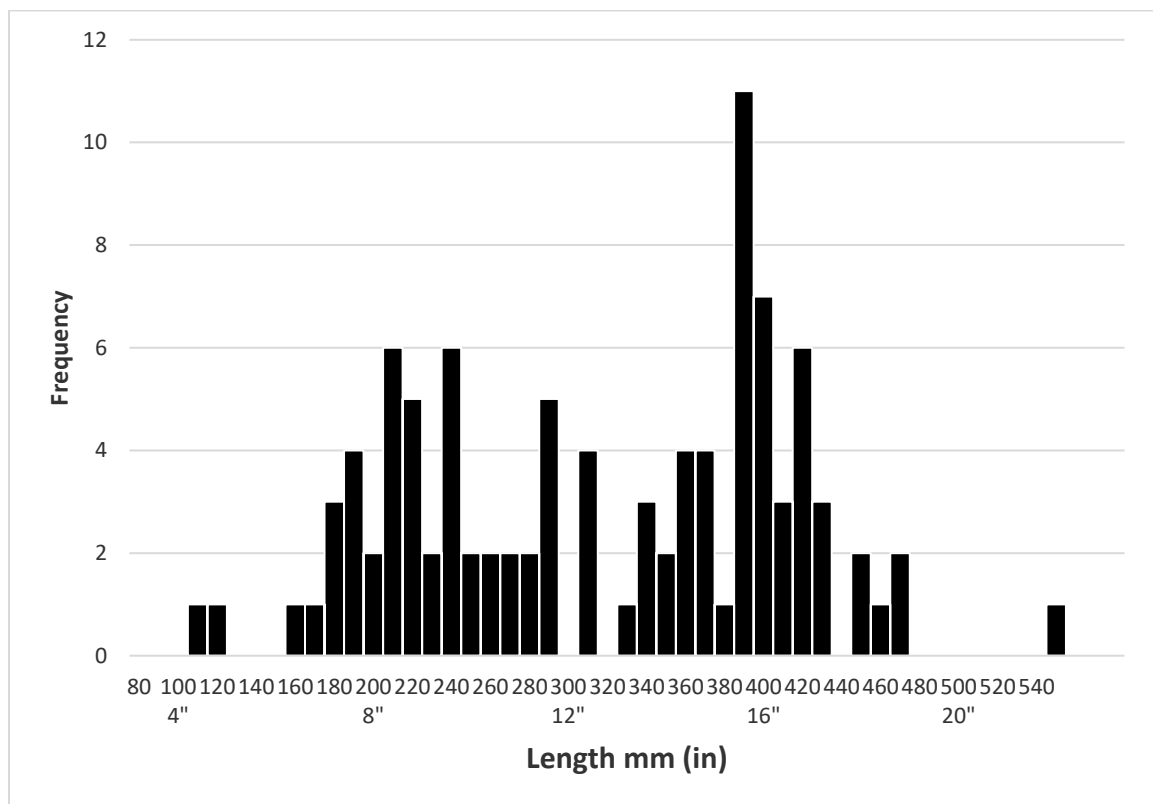


Figure 3. The length frequency distribution of Largemouth Bass captured during fyke netting on Bullhead Lake, April, 2017.

Age was determined from 96 of the captured Largemouth Bass using sectioned dorsal spines. Ages ranged from Age 2 through age 13, with age 2 the most common age followed by ages 3 and 8 (Table 3). Growth, as shown by average length at age is below State Averages, but is similar to values from the last full survey conducted in 1999 (Table 4).

Table 2. The length distribution of fish species caught on Bullhead Lake during the spring 2017 fyke net survey.

Length (in) mm	Largemouth Bass	Walleye	Bluegill	Yellow Perch	Black Crappie	Brown Bullhead
80	1		1			
90	1		2			
(4") 100			30			
110			76		1	
120			54	3	7	
130	1		46	10	4	
140	1		63	7	7	
(6") 150	3		93	3	3	
160	4		107	10	3	
170	2		104	6		
180	6		82	7		
190	5		41	5	6	1
(8") 200	2		42	1	19	1
210	6		34	4	12	4
220	2		27		2	8
230	2		15		1	5
240	2		2	1	1	8
(10") 250	2				7	8
260	5			1	7	11
270					3	10
280	4				2	14
290						12
(12") 300	1					17
310	3					17
320	2					9
330	4					9
340	4					22
(14") 350	1					7
360	11					2
370	7					1
380	3					
390	6					
(16") 400	3					
410						
420	2					
430	1					
440	2					
(18") 450						
460						
470						
480						
490						
(20") 500						
510						
520	1	1				
530						
540						
(22") 550						
560						
570						
580						
590		1				
(24") 600						
Total	100	2	819	58	85	166
Ave. Length	291 (11.5")	561 (22.1")	163 (6.4")	167 (6.6")	201 (7.9")	295 (11.6")
SD	94.7 (3.7")	50.2 (2.0")	32.9 (1.3")	30.9 (1.2")	47.3 (1.9")	40.7 (1.6")

Table 3. The length at age distribution of Largemouth Bass caught on Bullhead Lake during the spring 2017 fyke net survey.

Length (in) mm	AGE											
	2	3	4	5	6	7	8	9	10	11	12	13
130	1											
140	1											
(6") 150	3											
160	4											
170	2											
180	6											
190	5											
(8") 200	1	1										
210	1	5										
220		2										
230		2										
240		1										
(10") 250		1		1								
260		1	3	1								
270												
280				3	1							
290												
(12") 300				1								
310				2	1							
320				2								
330					3		1					
340					1	1		1				
(14") 350							1					
360					2	4	4		1			
370						3	1	1	2			
380							2	1				
390							3	2		1		
(16") 400						1		2				
410												
420									1			1
430											1	
440								1	1			
(18") 450												
460												
470												
480												
490												
(20") 500												
510												
520												1
Total	24	13	3	10	8	9	12	8	5	1	1	2
Ave. Length	177 (7")	224 (8.5")	265 (10.4")	295 (11.6")	341 (13.4")	368 (14.5")	372 (14.6")	393 (15.5")	399 (15.7")	391 (15.4")	430 (16.9")	475 (18.7")
S.D.	20 (0.8")	20 (0.8")	2.9 (0.1")	25.1 (1.0")	25.4 (1.0")	16.6 (0.7")	18.1 (0.7")	28 (1.1")	37.1 (1.5")	--	--	70.7 (2.8")

Table 4. Average length at age for fish collected during the 2017 Bullhead Lake Survey. Largemouth Bass were aged in 2017 using dorsal spines, Northern Pike were aged using anal rays and scales were used for all other species. Before the 2017 survey all fish were aged using scales. All lengths are in millimeters and inches (in).

Species	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8	AGE 9	AGE 10
Northern Pike										
2017		478 (18.8")	571 (22.5")	553 (21.8")	588 (23.1")	598 (23.5")	612 (24.1")	584 (23.0")	581 (22.9")	532 (22.9")
State Average	356 (14.0")	406 (16")	470 (18.5")	546 (21.5")	610 (24.0")	650 (25.6")	706 (27.8")	762 (30.0")	787 (30.9")	
Largemouth Bass										
2017		177 (7.0")	224 (8.5")	265 (10.4")	295 (11.6")	341 (13.4")	368 (14.5")	372 (14.6")	393 (15.5")	399 (15.7")
2011	121 (4.8")	177 (7.0")	260 (10.2")	313 (12.3")	337 (13.3")	338 (13.3")	--	--		
2005	94 (3.7")	155 (6.1")	228 (9.0")	288 (11.3")	329 (13.0")	380 (15.0")	--	--		
1999		154 (6.1")	217 (8.5")	279 (11.0")	307 (12.0")	376 (14.8")	406 (16.0")	463 (18.2")		
State Average	97 (3.8")	165 (6.5")	229 (9.0")	290 (11.4")	338 (13.3")	383 (15.1")	414 (16.3")	447 (17.6")	470 (18.5")	500 (19.2")
Bluegill										
2017		93 (3.7")	123 (4.8")	164 (6.5")	183 (7.2")	203 (8.0")	213 (8.4")	214 (8.4")	226 (8.9")	240 (9.4")
2011	65 (2.6")	105 (4.1")	141 (5.6")	211 (8.3")	--	--	--	--		
2005	50 (2.0")	110 (4.3")	139 (5.5")	158 (6.2")	193 (7.6")	205 (8.2")	--	--		
1999	43 (1.7")	74 (2.9")	100 (3.9")	129 (5.1")	155 (6.1")	168 (6.6")	182 (7.2")	192 (7.6")		
State Average	64 (2.6")	97 (3.8")	122 (4.8")	147 (5.9")	167 (6.6")	183 (7.2")	196 (7.8")	208 (8.2")		
Black Crappie										
2017		140 (5.5")	207 (8.1")	259 (10.2")	280 (11.0")					
State Average	79 (3.1")	137 (5.4")	183 (7.2")	218 (8.6")	241 (9.5")	267 (10.5")	274 (10.8")			
Yellow Perch										
2017		136 (5.4")	164 (6.5")	198 (7.8")	234 (9.2")		268 (10.6")			
State Average	74 (2.9")	119 (4.7")	152 (6.0")	180 (7.1")	208 (8.2")					

Northern Pike

The 94 northern Pike that were captured during netting ranged in length from 410 mm to 791 mm (16.1" to 31.1") and had an average length of 565 mm (22.2") (Table 1). Most captured pike were less than 600 mm (24") in length with only four (4.3%) greater than the 26" (660 mm) minimum harvest length and none were greater than 800 mm (32") in length (Table 5 and Figure 4). Of the 94 captured Pike, 24 (25.5%) were female, 69 (73.4%) were male and 1 (1.1%) was unknown sex. The average length for female and male Northern Pike was 587 mm (23.1") and 559 (22.0") respectively. Pike CPE was 1.6 fish per net each night (Table 1).

Anal rays from 92 Northern Pike were sectioned for aging with age 2 through age 10 and age 12 in the sample. To increase our sample size, all Pike regardless of sex were pooled for age analysis. Age 3 Pike were the most common followed by age 2 and age 4 Pike. Growth, as shown by the average length at age for Northern Pike from Bullhead Lake had mixed results. Through age 5 growth was at or above the Statewide value but from age 6 and older growth decreased to be below the State average (Table 4).

Table 5. The length frequency distribution of Northern Pike by sex for Pike captured by netting in Bullhead Lake during April 2017.

Length mm (in)	Total	Female	Male	Unknown
400 (16")				
410	1		1	
420				
430	1		1	
440				
450 (18")	2	1	1	
460	3	1	2	
470	2		1	1
480	6	1	5	
490	2	1	1	
500 (20")	1		1	
510	2		2	
520	6	2	4	
530	1		1	
540	5	2	3	
550 (22")	9	1	8	
560	6	1	5	
570	7		7	
580	12		12	
590	3	1	2	
600 (24")	4	3	1	
610	5	2	3	
620	6	5	1	
630	3		3	
640	2		2	
650 (26")	1		1	
660				
670	1	1		
680				
690	1	1		
700 (28")				
710	1		1	
720				
730				
740				
750 (30")				
760				
770				
780				
790	1	1		
800 (32")				
Total	94	24	69	1
Ave. Length	565 (22.2")	587 (23.1")	559 (22.0")	475 (18.7")
S.D.	63.2 (2.5")	79.0 (3.1")	55.4 (2.2")	--

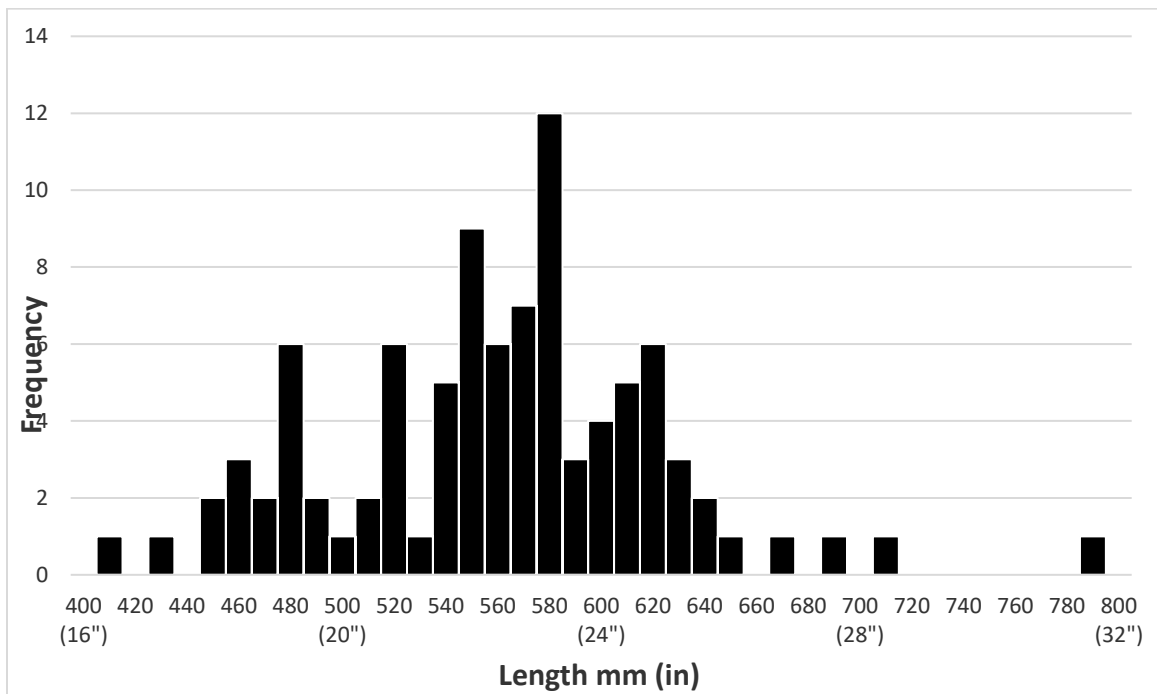


Figure 4. The length distribution of Northern Pike captured during spring netting on Bullhead Lake in April 2017. Length are in mm and inches.

Table 6. The length at age distribution of Northern Pike, sexes combined from spring netting in April 2017 on Bullhead Lake.

Length mm (in)	Age										
	2	3	4	5	6	7	8	9	10	11	12
410 (16")	1										
420											
430	1										
440											
450 (18")	2										
460	2	1									
470	1	1									
480	3	1	1						1		
490	2										
500 (20")			1								
510		2									
520	2	1	1				2				
530			1								
540	1	2	2								
550 (22")		1	1	2	1	1	2	1			
560		1	2		2	1					
570		1		2	1	1	1		1		
580		1	1	1	4	1	1	2			1
590		1				1		1			
600 (24")		1	1	1		1					
610		1				1	1				
620		3	1	1		1					
630				1			2				
640						1	1				
650 (26")						1					
660											
670		1									
680											
690		1									
700 (28")											
710						1					
720											
730											
740											
750 (30")											
760											
770											
780											
790 (31")					1						
Total	15	20	12	8	9	11	10	4	2	0	1
Ave. Length	478 (18.8")	571 (22.5")	553 (21.8")	588 (23.1")	598 (23.5")	612 (24.1")	584 (23.0")	581 (22.9")	532 (20.9")	--	582 (22.9")
S.D.	34 (1.4")	63.2 (2.5")	41.0 (1.6")	31.2 (1.2")	73.3 (2.9")	44.4 (1.7")	45.4 (1.8")	15.1 (0.6")	60.8 (2.4")	--	--

During the fyke net survey we captured two Walleye (Table 1). These Walleye ranged in length from 525 mm to 596 mm (20.6" to 23.5") and had an average length of 561 mm (22.1") (Table 2).

Panfish

Bluegill

Bluegill dominated our fyke net catch and accounted for more than 60% of the fish handled during netting (Table 1). The 819 measured Bluegill ranged in length from 87 mm to 244 mm (3.3" to 9.6") and had an average length of 163 mm (6.4") (Table 2). Of the measured Bluegill, 61.1% (500 of 819) were greater than 150 mm (6") in length and 14.7% were greater than 200 mm (8") in length (Figure 5). Most Bluegill were between 150 mm and 180 mm in length (6"-7"). Total Bluegill CPE was 16.4 Bluegill per net per night.

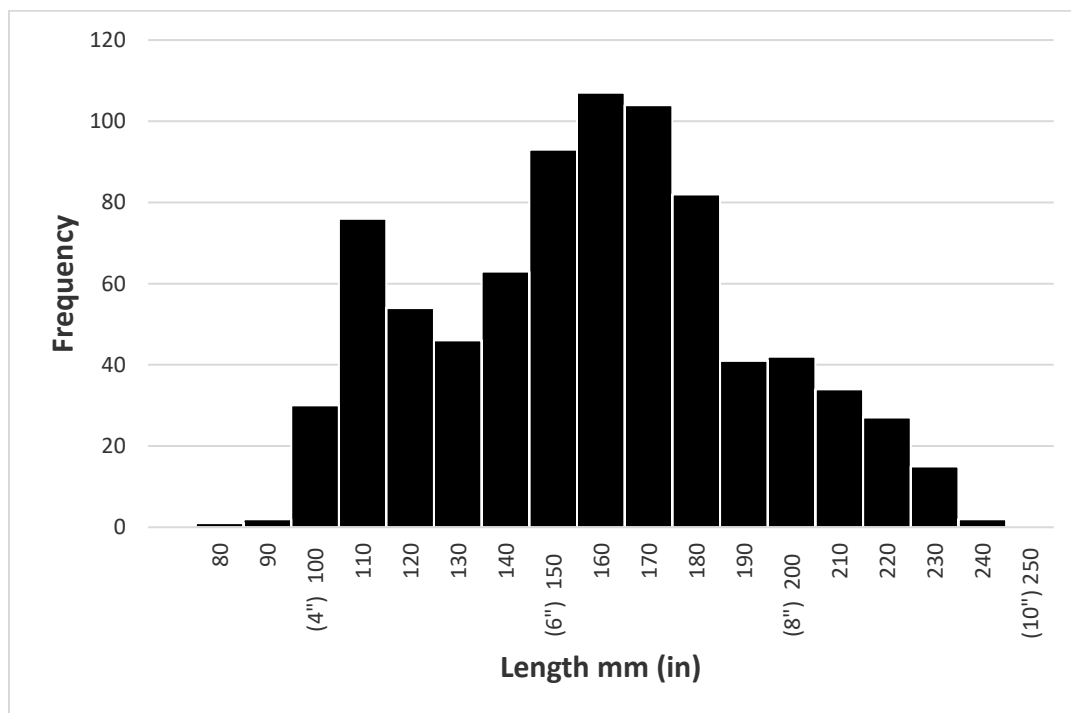


Figure 5. The Bluegill length frequency distribution for fish captured during April 2017 fyke netting on Bullhead Lake.

Scales were collected from a subsample of the captured Bluegill for analysis of age. 174 Bluegill were aged yielding an age distribution that ranged from age 2 through age 11. Age 4 and age 3 were the most common ages in our sample with other ages occurring at a lower frequency (Table 7). Growth as measured by the average length at age was above Statewide averages for all ages (Table 4). However, growth in 2017 was slightly less than measured during previous surveys.

Table 7. Bluegill length frequency and age distribution for fish that were captured with fyke nets during the 2017 survey. The age distribution of the entire measured catch was a projection based on the distribution of ages from scale samples. Lengths are reported in mm and in inches ().

Length (in) mm	Total Measured	Age									
		2	3	4	5	6	7	8	9	10	11
80	1	1									
90	2	2									
(4") 100	30		30								
110	76		76								
120	54		54								
130	46		28	18							
140	63		26	32	5						
(6") 150	93		9	84							
160	107		6	95	6						
170	104			83	21						
180	82			64	12	6					
190	41				15	11	11	4			
(8") 200	42				3	10	19	10			
210	34					6	10	14	4		
220	27					2	9	5	11		
230	15						5	1	3	1	5
240	2									1	1
Total	819	3	229	376	62	35	54	34	18	2	6
Ave. Length	163 (6.4")	93 (3.7")	123 (4.8")	164 (6.5")	183 (7.2")	203 (8.0")	213 (8.4")	214 (8.4")	226 (8.9")	240 (9.4")	238 (9.4")
S.D.	40 (1.6")	7.8 (0.3")	14.0 (0.6")	14.7 (0.6")	16.5 (0.6")	10.7 (0.4")	12.0 (0.5")	9.5 (0.3")	7.3 (0.3")	2.1 (0.1")	4.4 (0.2")

Black Crappie

Black Crappie were the second most common panfish that were captured during spring netting (Table 1). The 86 Crappie ranged in length from 115 mm to 289 mm (4.5" to 11.4") and had an average length of 201 mm (7.9") (Table 2). The distribution of Crappie was tri-modal with peaks around 130 mm (5.1"), 200 mm (8") and 255 mm (10") (Figure 6). CPE for Black Crappie was 1.6 fish per net per night (Table 1).

Scales were collected from 48 of the 86 measured Black Crappie. Ages ranged from age 2 through age 5, with ages 2, 3 and 4 occurring at similar frequency (Table 8). Age 5 Crappie were captured at a lower frequency. Growth, as

measured as average length at age, was at, or above Statewide averages at each age indicating good growth for Black Crappie in Bullhead Lake (Table 4).

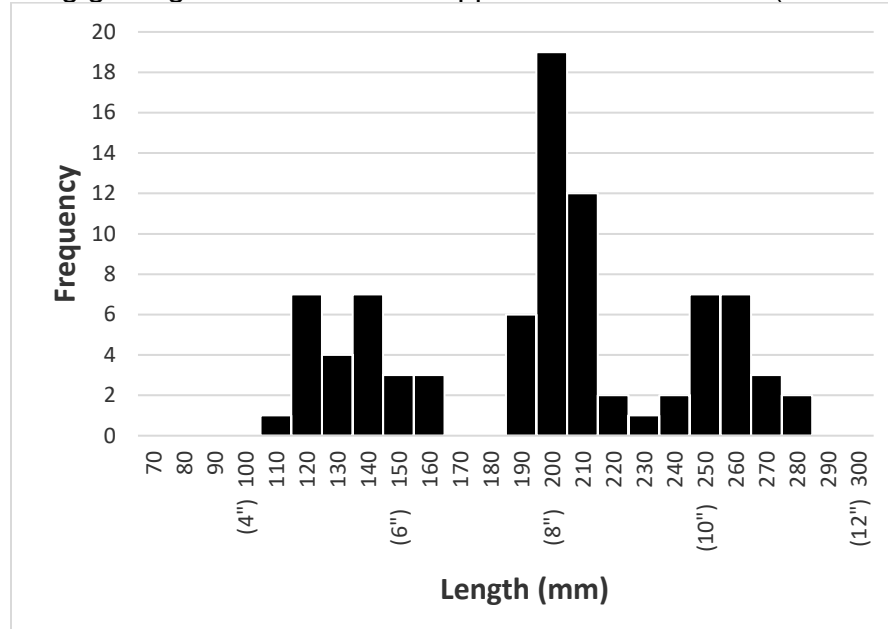


Figure 6. The Black Crappie length frequency distribution for fish captured during April 2017 fyke netting on Bullhead Lake.

Table 8. Black Crappie length frequency and age distribution for fish that were captured with fyke nets during the 2017 survey. The age distribution of the entire measured catch was a projection based on the distribution of ages from scale samples. Lengths are reported in mm and in inches ().

Length (in) mm	Total Measured	Age			
		2	3	4	5
(4") 100					
110	1	1			
120	7	7			
130	4	4			
140	7	7			
(6") 150	3	3			
160	3	3			
170					
180					
190	6		6		
(8") 200	19		19		
210	12		8	4	
220	2			2	
230	1			1	
240	2			2	
(10") 250	7			7	
260	7			6	1
270	3			3	
280	2				2
290					
(12") 300					
Total	86	25	33	25	3
Ave. Length	201 (7.9")	140 (5.5")	207 (8.1")	259 (10.2")	280 (11.0")
S.D.	54.3 (2.1")	15.2 (0.6")	7.4 (0.3")	16.5 (0.6")	10.6 (0.4")

Yellow Perch

A total of 58 Yellow Perch were captured by fyke net during this survey (Table 1). The Perch ranged in length from 120 mm to 268 mm (4.7" to 10.6") and had an average length of 167 mm (6.6") (Table 2). 50% of the captured Perch were greater than 150 mm (6") in length, but only 10.3% were greater than 200 mm (8") in length (Figure 7)

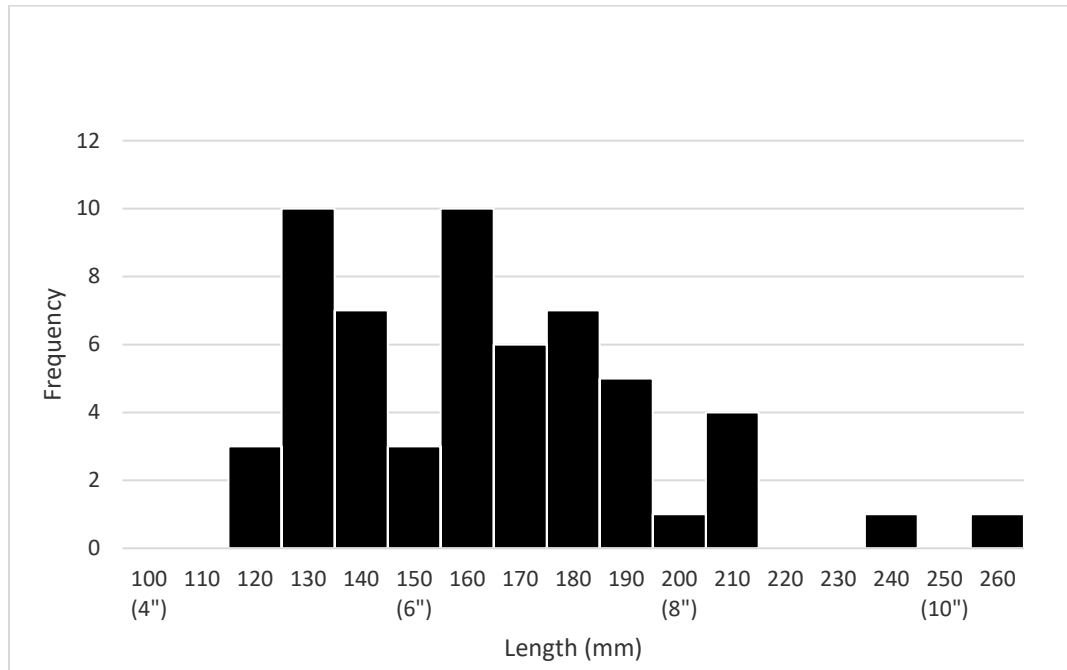


Figure 7. The length frequency distribution for Yellow Perch captured by fyke net from Bullhead Lake during April, 2017.

Spines were collected from captured Yellow Perch for age analysis. From the samples age 2 through age 5 and age 7 Perch were identified with age 3 Perch the most abundant (Table 9). Age 2 and age 4 were also present in good numbers. When average length at each age for Yellow Perch from Bullhead Lake is compared to Statewide values, Perch in Bullhead Lake are longer at each age (Table 4).

Table 9. Yellow Perch length frequency and age distribution for fish that were captured with fyke nets during the 2017 survey. Lengths are in mm and inches (in).

Length (in) mm	Age					
	2	3	4	5	6	7
120	3					
130	9	1				
140	3	4				
(6") 150	2	1				
160		10				
170		6				
180		4	3			
190			5			
(8") 200			1			
210			3	1		
220						
230						
240				1		
(10") 250						
260						1
Total	17	26	12	2	0	1
Ave. Length	136 (5.4")	164 (6.5")	198 (7.8")	234 (9.2")		268 (10.6")
S.D.	9.6 (0.4")	14.3 (0.6")	14.7 (0.6")	21.2 (0.8")		--

Other Species

Fyke nets also captured 194 Brown Bullhead (Table 1). These Bullhead ranged in length from 194 mm to 374 mm (7.6" to 14.7") and had an average length of 295 mm (11.6") (Table 2). Many of the captured Bullhead were greater than 280 mm (11") in length (Figure 8).

A small number of Bullhead had a pectoral spine removed for aging. The ages from this sample ranged from age 3 through age 13, with ages 7, 8 and 9 the most common.

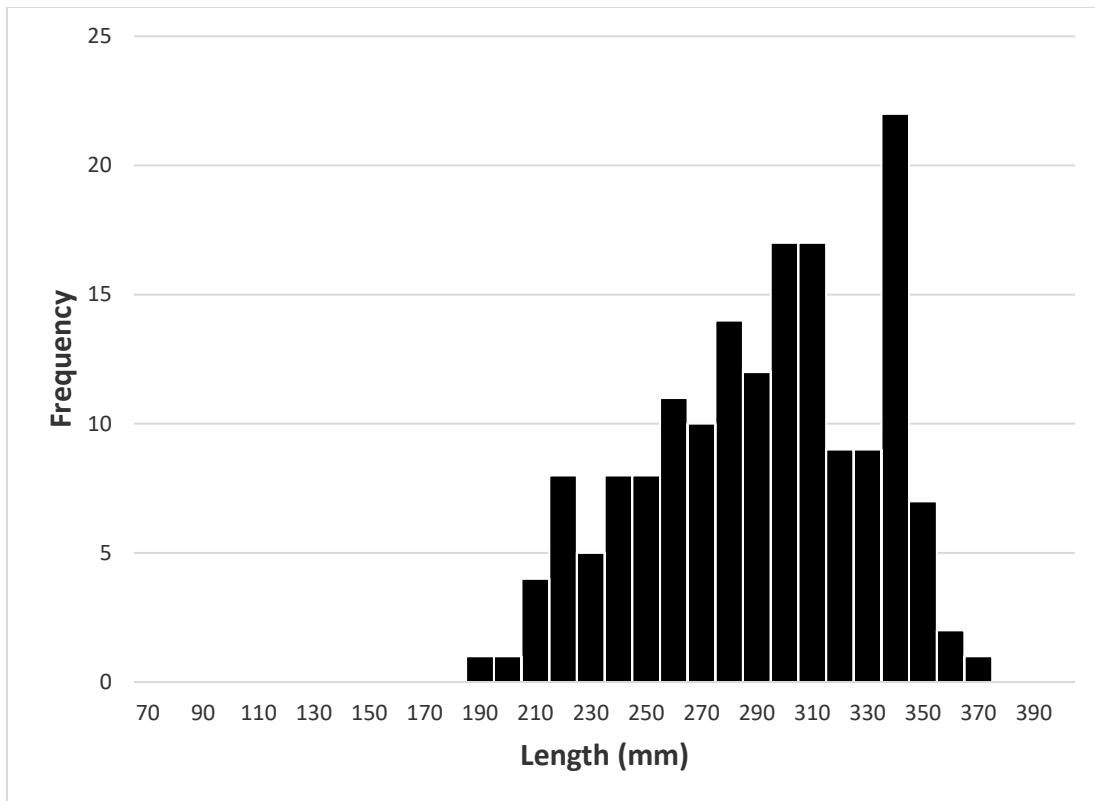


Figure 8. The length frequency distribution for Brown Bullhead captured by fyke net from Bullhead Lake during April, 2017.

Spring Electroshocking

Recapture Run

On the night of April 25, 2017, the entire 1.23 mile shoreline was electroshocked to look for fish marked during fyke netting to allow Peterson Population Estimates to be made. During the 48 minutes of electroshocking, 108 fish of four species were netted. Total CPE was 139 fish per hour shocked or 84 fish per mile shocked (Table 10). The most common fish netted were Largemouth Bass, with substantially fewer Northern Pike or Black Crappie netted. No Walleye were observed during shocking.

Table 10. The number of each species that were captured by electroshocking during the night of April 25, 2017 in Bullhead Lake. Catch per unit effort, (CPE) is expressed as the number of fish per hour shocked or mile shocked. Lengths are reported in mm and in inches () for each species.

Species	Number	CPE (Fish Per Hour)	CPE (Fish Per Mile)	Length Range	Average Length	Peterson P.E.	P.E Range
Walleye	0	--	--	--	--	--	--
Largemouth Bass	100	125	81.3	143 mm- 423 mm (5.6"- 16.7")	332 mm (13.0")	3333	1220-8333
Northern Pike	4	5	3.3	462 mm- 650 mm (18.2"- 25.6")	566 mm (22.3")	--	--
Black Crappie	4	5	3.3	197- 247 mm (7.8"-9.7")	214 mm (8.4")		
Total	108	139	84.6				

Largemouth Bass dominated our catch. The 100 captured Bass ranged in length from 143 mm to 423 mm (5.6" to 16.7") and had an average length of 332 mm (13") (Table 10). 38% of the captured Bass were greater in length than the 14" (356 mm) minimum size for harvest, but none were greater than 457 mm (18") in length (Table 11).

Of the 100 Bass that were captured, 97 were greater than 200 mm (8") in length and 2 were recaptures that were marked during fyke netting. This allowed a Peterson Population Estimate to be made. Using this method, it is estimated that 3,333 Largemouth Bass greater than 200 mm (8") with a range of 1,220 to 8,333 are in Bullhead Lake (Table 10). Since there was a low number of recaptures, estimates should be viewed with caution.

All unmarked Bass had a dorsal spine removed for aging. Age 2 through age 9, age 11 and age 13 were found in our sample. Age 5 was the most common aged Bass followed by age 7 and age 6 (Table 12). Other ages occurred less commonly. When the average length at age reported in Table 11 from electroshocking are compared to values in Table 4 for 2017 Largemouth Bass average length at age from the fyke net survey, they indicate nearly identical lengths at age. When compared to Statewide values, Bass in Bullhead Lake show good growth as young fish, but as they age, growth slows to below average.

The 4 captured Northern Pike ranged in length from 262 mm to 650 mm (18.2" to 25.6") and had an average length of 566 mm (22.3") (Tables 10 and 11).

The 4 Black Crappie ranged in length from 197 mm to 247 mm (7.8" to 9.7") and had an average length of 214 mm (8.4") (Tables 10 and 11).

Table 11. The length distribution of fish captured by electroshocking from Bullhead Lake on April 25, 2017.

Length (in) mm	Largemouth Bass	Northern Pike	Black Crappie
140	1		
(6") 150	1		
160	0		
170	1		
180	0		
190	0		1
(8") 200	1		1
210	0		1
220	1		
230	0		
240	1		1
(10") 250	1		
260	0		
270	1		
280	4		
290	14		
(12") 300	7		
310	6		
320	7		
330	4		
340	3		
(14") 350	9		
360	13		
370	11		
380	5		
390	6		
(16") 400	1		
410	1		
420	1		
430			
440			
(18") 450			
460		1	
470			
480			
490			
(20") 500			
510		1	
520			
530			
540			
(22") 550			
560			
570			
580			
590			
(24") 600			
610			
620			
630		1	
640			
(26") 650		1	
Total	100	4	4
Ave. Length	332 (13.0")	566 (22.3")	214 (8.4")
S.D.	52.2 (2.1")	93.1 (3.7")	22.9 (0.9")

Table 12. The age distribution by length for Largemouth Bass collected by electroshocking on April, 25, 2017 on Bullhead Lake.

Length (in) mm	Age											
	2	3	4	5	6	7	8	9	10	11	12	13
140	1											
(6") 150	1											
160												
170	1											
180												
190												
(8") 200	1											
210												
220			1									
230												
240			1									
(10") 250		1										
260												
270				1								
280			1	2	1							
290			1	13								
(12") 300				5	2							
310				4	1		1					
320				4	2	1						
330				1	2	1						
340					2		1					
(14") 350				1	5	3						
360						9	2	1		1		
370					3	2	2	2				
380						5						
390						3	2	1				
916") 400								1				
410										1		
420												1
Total	4	1	4	31	18	24	8	5	0	2	0	1
Ave. Length	169 (6.7")	254 (10.0")	260 (10.2")	305 (12.0")	340 (13.4")	370 (14.6")	364 (14.3")	382 (15.0")		389 (15.3")		423 (16.7")
S.D.	25 (1.0")	--	33.1 (1.3")	16.5 (0.6")	25.8 (1.0")	18.4 (0.7")	25.5 (1.0")	15.6 (0.6")		30.4 (1.2")		--

Centrarchid Electrofishing

On the night of May 24, 2017 the entire shoreline was electroshocked to assess bass and panfish populations. During the 57 minutes of shocking, 191 individual fish of seven species were captured (Table 13). Total CPE was 210.1 fish per hour shocked or 155.3 per mile shocked. Largemouth Bass and Bluegill dominated our catch with fewer fish of other species collected.

Table 13. The number of each species that were captured by electroshocking during the night of May 24, 2017 in Bullhead Lake. Catch per unit effort, (CPE) is expressed as the number of fish per hour shocked or mile shocked. Lengths are reported in mm and in inches (") for each species.

Species	Number	CPE (Fish Per Hour)	CPE (Fish Per Mile)	Length Range	Average Length	Peterson P.E.	P.E Range
Walleye	0	0	0	--	--		
Largemouth Bass	130	143.0	105.7	142 mm- 445 mm (5.6"- 17.5")	307 mm (12.1")	4333	1585- 10833
Northern Pike	4	4.4	3.3	549 mm- 678 mm (21.6"- 26.7")	595 mm (23.4")	125	46-313
Bluegill	47	51.7	38.2	67 mm- 220 mm (2.6"- 8.3")	153 mm (6.0")		
Yellow perch	2	2.2	1.6	112 mm- 119 mm (4.4"- 4.7")	116 mm (4.6")		
Black Crappie	5	5.5	4.1	75 mm- 228 mm (3"- 9")	155 mm (6.1")		
Brown Bullhead	2	2.2	1.6	280 mm- 338 mm (11"- 13.3")	309 mm (12.2")		
Common Carp	1	1.1	0.8	--	--		
Total	191	210.1	155.3				

Gamefish

Largemouth Bass dominated the catch, with the 130 captured Bass ranging in length from 142 mm to 445 mm (5.6" to 17.5") with an average length of 307 mm (12.1") (Tables 13 and 14). 27.7% of the Bass were greater than the 14" (356 mm) size limit with no fish greater than 457 mm (18") captured (Table 14). Two Bass were recaptured with marks from either fyke netting or the recapture electroshocking survey. Using the Peterson Population Estimate method, it was estimated that 4,333 Bass greater than 200 mm (8") (range 1,585 to 10,833) were in the lake. Since the estimate is based on only two recaptures this estimate should be view with caution.

Four Northern Pike were captured during this electroshocking run (Table 13). The Pike ranged in length from 549 mm to 678 mm (21.6" to 26.7") with an average length of 595 mm (23.4"). Two of the captured Pike were recaptures. The Peterson Population Estimate was 125 with a range of 46 to 313 (Table 13). Since the estimate is based on only two recaptures this estimate should be view with caution.

Panfish

Bluegill dominated the panfish catch. The 47 Bluegill ranged in length from 67 mm to 220 mm (2.6" to 8.3") with an average length of 153 mm (6") (Table 13 and 14). The average length for other panfish was 116 mm (4.6") for Yellow Perch and 155 mm (6.1") for Black Crappie (Tables 13 and 14).

Other species that were captured included Brown Bullhead and Common Carp. Both were captured in low number (Table 13).

Table 14. The length frequency distribution of captured fish from electroshocking on Bullhead Lake on May 24, 2017.

Length (in)	mm	Largemouth Bass	Bluegill	Black Crappie	Yellow Perch	Brown Bullhead
	60		1			
	70			1		
	80		2			
	90		1			
(4")	100		2			
	110		6		2	
	120		6			
	130		2	1		
	140	2		1		
(6")	150	5	5			
	160	1	2			
	170	3	4			
	180	4	8	1		
	190	3	3			
(8")	200		1			
	210	2	3			
	220	1	1	1		
	230	3				
	240	3				
(10")	250	3				
	260	3				
	270	3				
	280	5				1
	290	8				
(12")	300	9				
	310	8				
	320	5				
	330	7				1
	340	8				
(14")	350	10				
	360	9				
	370	6				
	380	8				
	390	5				
(16")	400	3				
	410					
	420					
	430	1				
	440	2				
(18")	450					
Total		130	47	5	2	2
Ave. Length		307 (12.1")	153 (6.0")	155 (6.1")	116 (4.6")	309 (12.2")
SD		72.3 (2.8")	39.5 (1.6")	57.6 (2.3")	4.9 (0.2")	41.0 (1.6")

During fyke netting and electroshocking surveys, fisheries staff noted abundant rooted vegetation and algae at several locations around Bullhead Lake and in addition, that water clarity on some survey dates appeared to be low. Before starting electroshocking on May 24, 2017 staff measured temperature, conductance and dissolved oxygen (DO) with an YSI Meter (Table 15).

Table 15. Temperature, conductance and dissolved oxygen values measured on May 24, 2017 on Bullhead Lake. Readings were taken starting at 8:10 pm.

Depth (m)	Temperature (C)	Dissolved Oxygen (mg/l)	Percent Oxygen Saturation	Conductance
Surface	15.4	9.2	96.0	0.3823
1	15.5	9.0	95.0	0.5833
2	15.5	9.0	94.0	
3	15.5	8.8	93.0	
4	15.5	8.8	93.0	
5	13.1	4.0	40.0	0.3900
6	11.0	3.0	29.0	0.3906
7	10.3	0.6	0.6	
8	9.8	0.2	0.2	0.3937
8.5	9.7	0.1	0.1	0.3949

The thermocline was found between 4 and 5 meters (12' to 16') of depth with DO and temperature dropped quickly below the thermocline (Table 15). Conductance was fairly uniform throughout the water column except at 1 meter (3") of depth where conductance was highest.

DISCUSSION

A comprehensive fisheries was conducted on Bullhead Lake in April and May, 2017 to assess the fish populations of the lake. Two survey gears, fyke nets and a boomshocker was used to collect fish across the spring spawning seasons. In total, 1,721 fish representing eight species were captured. Overall, Bluegill dominated our catch chiefly because the large number of Bluegill captured by fyke nets. Largemouth Bass, Brown Bullhead and Northern Pike were the next most abundant species with other species caught in lower number. In electroshocking surveys, Largemouth Bass and Bluegill dominated our catch.

Gamefish

Largemouth Bass were the most abundant gamefish captured during the overall survey and in each phase of the survey. Growth as measured by average length at each age was below Statewide averages indicating slow growth. This result is similar to past surveys where slow growth and the stacking of Bass just below the 14" (356 mm) minimum size limit for harvest was noted (Hogler and Surendonk 2012, Surendonk and Hogler 2003). However, in 2017 length frequencies indicate

that fewer fish were stacked just below the size limit as shown by an increase in the percentage of fish greater than 14" (356 mm) in that in 2017 that ranged from 27% to 37% compared to less than 20% in previous surveys. Recruitment of Bass appears to be consistent, with many year classes present in our age sample collected in 2017. Past surveys indicated poor survival past age 5 with few older fish. The increased number of year classes and the survival to older may be due to changing our aging structure from scales to dorsal spines.

Northern Pike were commonly captured during spring netting in 2017. Past surveys captured fewer Pike than did the 2017 survey (Hogler and Surendonk 2005, Surendonk and Hogler 2003). It is not clear why the Pike population appears to be increasing. Although there appears to be more Northern Pike in the lake, captured fish were generally small, with few fish greater than 660 mm (26") in length. Growth was at or above average through age 6 and decreased thereafter.

Walleye were infrequently captured during this survey despite ongoing stocking efforts. Survival of stocked Walleye appears to be low although anecdotal reports of sporadic angler catches are received each year.

Panfish

Bluegill were the most common fish and panfish that were captured during this survey. The large catch of Bluegill (888) during fyke netting was unexpected. Previous surveys caught modest numbers of Bluegill that were mostly small in size although a few very large Bluegill were captured in each survey (Hogler and Surendonk 2012, Surendonk and Hogler 2003). The 2017 survey caught greater numbers of Bluegill than did previous surveys although the average size was similar to past surveys. Fewer large, greater than 225 mm (9") Bluegill, were captured in 2017 compared to earlier surveys perhaps indicating angler harvest of these large Bluegill. Since the growth of Bluegill in Bullhead Lake is at or above Statewide averages, this could indicate that angler harvest may be cropping off large fish.

Black Crappie and Yellow Perch were also captured in 2017 surveys. Similar to past surveys, they are present but not in high abundances. Growth for each species was above Statewide averages.

Other Species

Brown Bullhead were commonly captured in fyke netting. Captured Bullhead were large in size with an average length of 295 mm (11.6"). It is likely that the current population of Bullhead in the lake is not causing negative impacts on other species.

A single Common Carp was captured in the May electroshocking survey. It is very unusual for Bullhead Lake to have carp in it. No Common Carp were captured during the past three surveys.

Very few forage fish were seen and none were netted during the 2017 survey. Past surveys captured small numbers of forage species and the lack of forage in 2017 is concerning and may account for the slow growth seen in some species.

Water Quality and Habitat

Possible declines in water quality since the last survey as indicated by increased algal growth and rooted plant growth is a fisheries concern. Thick mats of algae can cover spawning beds or recently deposited eggs reducing recruitment. Large diel swings in oxygen can also negatively impact fisheries as algae bloom and die. Improving water quality can improve the level and consistency of year classes that are produced improving gamefish, panfish and forage fish populations.

It was also noted during surveys that in water woody habitat was lacking in many areas of the lake. Studies have shown that with increasing amounts of wood in the lake, fish populations respond in a positive manner.

RECOMMENDATIONS

- Conduct a full comprehensive fish survey every ten years, with a Bass/Panfish survey between the comprehensive surveys to monitor the fish populations of the lake. Each survey should focus on:
 - The growth rates of Largemouth Bass, Northern Pike and Bluegill.
 - The contribution of stocked Walleye to the fishery.
 - The abundance of forage fish.
- Evaluate the results from the Panfish Study and make appropriate recommendations based on the findings of the study.
- Work with other DNR staff, the Manitowoc County Soil and Water Department, the Manitowoc Lakes Association, the Bullhead Lake Association and local residents to monitor water quality in the lake and to make changes in the watershed designed to improve water quality.
- Encourage the Bullhead Lake Association and shoreline owners to improve nearshore fish habitat by incorporating woody debris in their landscape.

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