A

APPENDIX A

Public Participation Materials

1

Presentation Outline

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

Onterra LLC Lake Management Planning

2

Onterra, LLC

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

Onterra LLC Lake Management Planning

3

Why create a lake management plan?

- Preserve/restore ecological function to ensure cultural services
- To create a better understanding of lake's positive and negative attributes.
- To discover ways to minimize the negative attributes and maximize the positive attributes.
- Snapshot of lake's current status or health.
- Foster realistic expectations and dispel any misconceptions.

A goal without a plan is just a wish!

Onterra LLC Lake Management Planning

4

Elements of an Effective Lake Management Planning Project

Data and Information Gathering

Environmental & Sociological

Planning Process

Brings it all together

Onterra LLC
Lake Management Planning

5

Data and information gathering

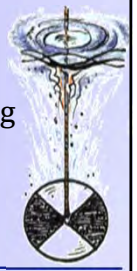
- Study Components
  - Water Quality Analysis
  - Watershed Assessment
  - Paleocore Collection & Analysis
  - Aquatic Plant Surveys
  - Fisheries Data Integration
  - Shoreland & CWH Assessment
  - Stakeholder Survey

Onterra LLC
Lake Management Planning

6

Water Quality Analysis

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



Onterra LLC
Lake Management Planning

7

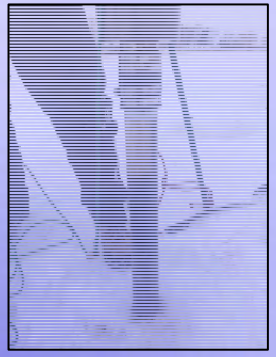
Watershed Assessment

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

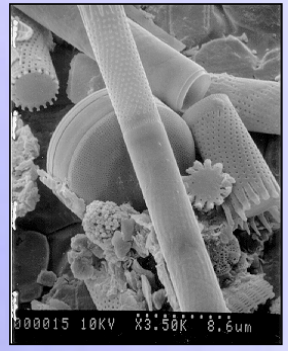
Onterra LLC
Lake Management Planning

8

Paleocore Collection & Analysis



Sediment core



Diatoms

Onterra LLC Lake Management Planning

9

Aquatic Plant Surveys

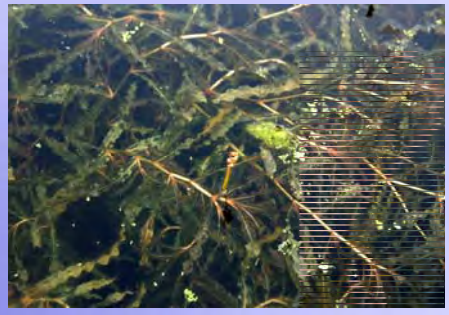
- Concerned with both native and non-native plants
- Multiple surveys used in assessment
  - Early-Season AIS Survey
  - Whole-lake point-intercept surveys
  - Emergent/Floating-leaf Mapping Survey

Onterra LLC Lake Management Planning

10

Non-native Aquatic Plants

Curly-leaf Pondweed



Onterra LLC Lake Management Planning

11

Non-native Aquatic Plants

Eurasian Water Milfoil

Onterra LLC Lake Management Planning

12

Non-native Aquatic Plants

Purple Loosestrife & Pale-yellow Iris

Onterra LLC
Lake Management Planning

13

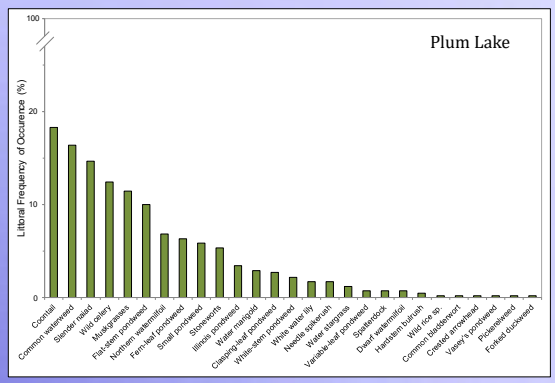
Aquatic Plant Point-Intercept Survey

Towanda Lake
39-meter Resolution
373 Total Points

Onterra LLC
Lake Management Planning

14

Littoral Frequency of Occurrence



Onterra LLC
Lake Management Planning

15

Emergent & Floating-leaf Aquatic Plants

16

Fisheries Data Integration

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

Onterra LLC Lake Management Planning

17

Shoreland Assessment

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

Urbanized **Natural**

Range

Onterra LLC Lake Management Planning

18

Stakeholder Survey

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

Onterra LLC Lake Management Planning

19

Planning Process

Planning Committee Meetings

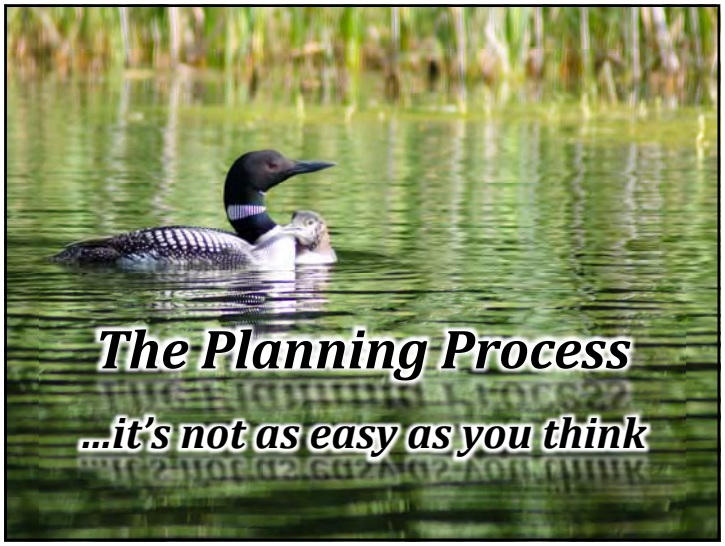
Study Results (including a stakeholder survey)
Conclusions & Initial Recommendations

Management Goals
Management Actions
  Timeframe
  Facilitator(s)

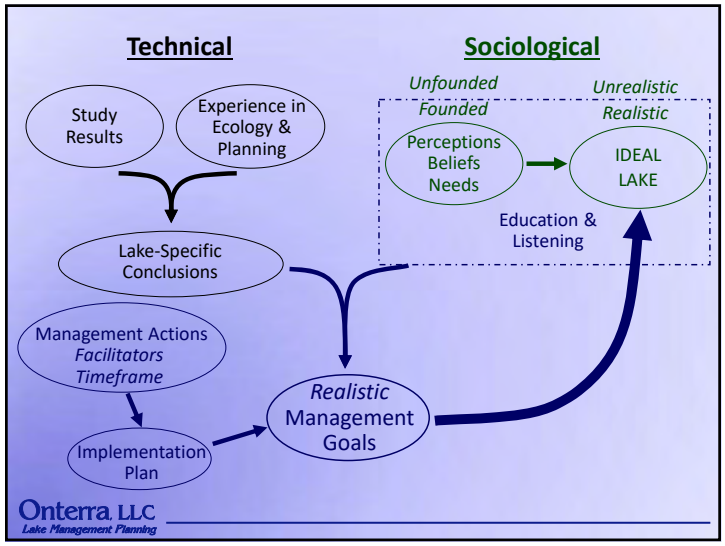
Implementation Plan

Onterra LLC Lake Management Planning

20


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

21


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

22

1

Presentation Outline

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

Onterra LLC Lake Management Planning

2

Management Planning Project Overview

Collect and compile information about Towanda Lake

Includes both environmental & sociological

Historical & current information

Past management actions

Planning Meeting I
Report Sections

Create a realistic and implementable management plan

Challenges facing lake and TLA

Create goals that will address challenges

Develop actions that will meet goals

Assign timeframes & facilitators

Planning Meeting II
Implementation Plan

Onterra LLC Lake Management Planning

3

Summary of Project Results

Water Quality

- Water quality is good and has been stable for the past 3 decades.
- Paleocore analysis may have picked up on some slight changes.

Watershed & Immediate Shoreline

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

Fisheries

- Not much data available, but WDNR is scheduled to complete fishery survey starting fall 2019.

Aquatic Plant Community

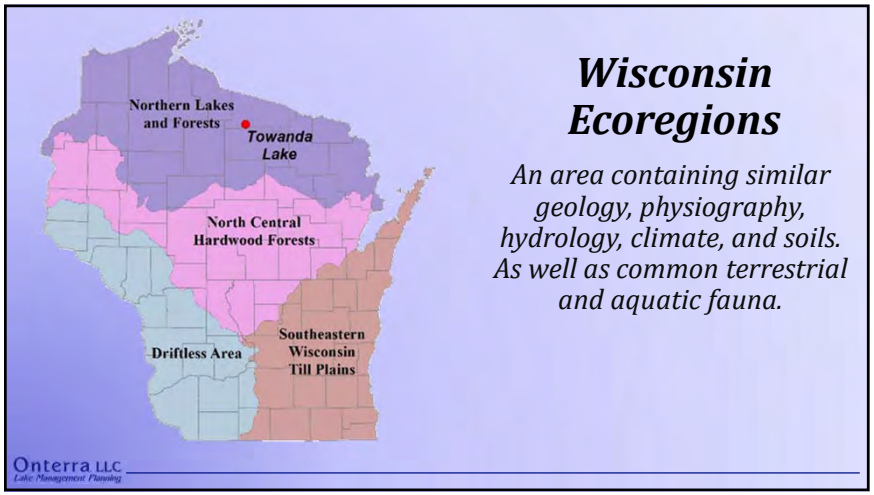
- Aquatic plant community is healthy and of better than average quality

Onterra LLC Lake Management Planning

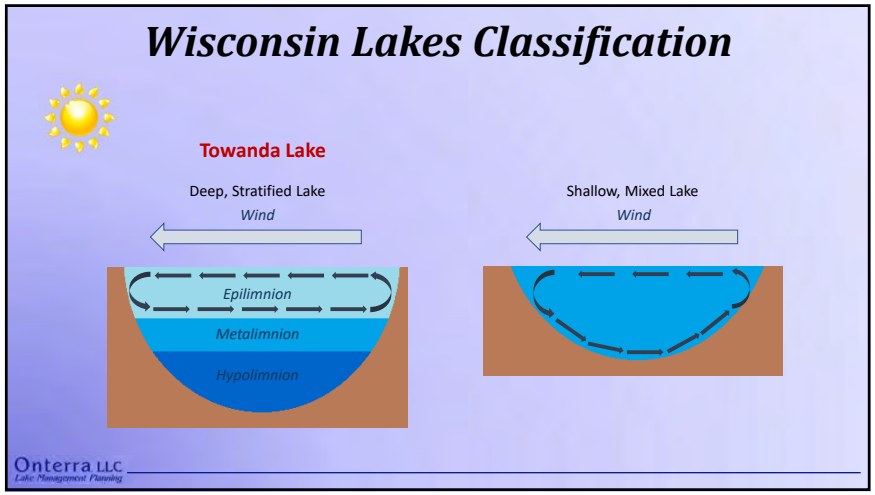
4


Water Quality

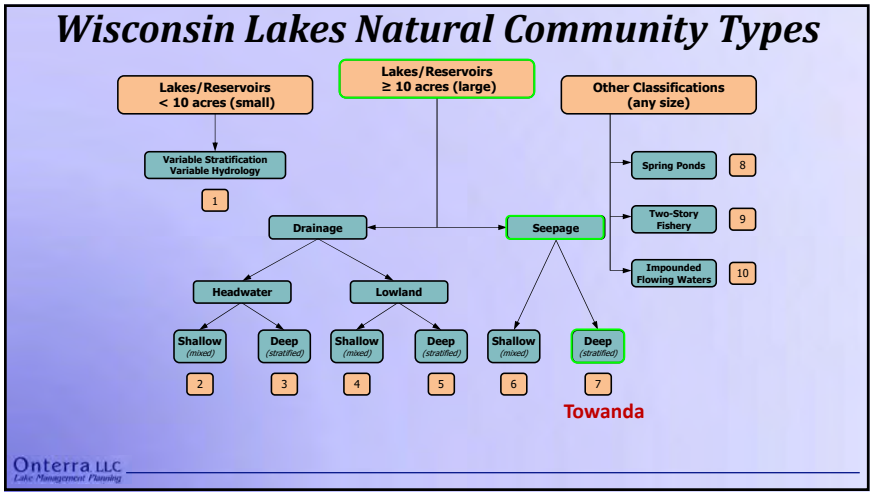
5


Northern Lakes and Forests
Towanda Lake
North Central Hardwood Forests
Driftless Area
Southeastern Wisconsin Till Plains
Wisconsin Ecoregions
An area containing similar geology, physiography, hydrology, climate, and soils. As well as common terrestrial and aquatic fauna.
Onterra LLC

6


Wisconsin Lakes Classification
Towanda Lake
Deep, Stratified Lake
Wind
Epilimnion
Metalimnion
Hypolimnion
Shallow, Mixed Lake
Wind
Onterra LLC

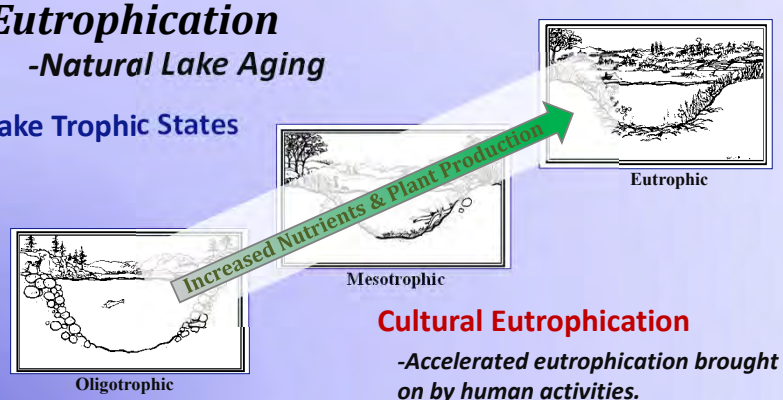
7


Wisconsin Lakes Natural Community Types
Lakes/Reservoirs < 10 acres (small)
Lakes/Reservoirs ≥ 10 acres (large)
Other Classifications (any size)
Variable Stratification Variable Hydrology
1
Drainage
Seepage
Spring Ponds
8
Two-Story Fishery
9
Impounded Flowing Waters
10
Headwater
Lowland
Shallow (mixed)
2
Deep (stratified)
3
Shallow (mixed)
4
Deep (stratified)
5
Shallow (mixed)
6
Deep (stratified)
7
Towanda
Onterra LLC

8

Eutrophication
-Natural Lake Aging

Lake Trophic States



Cultural Eutrophication

-Accelerated eutrophication brought on by human activities.

Onterra LLC

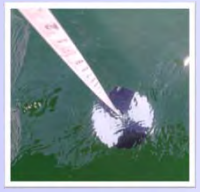
9

Lake Water Quality – Trophic Parameters

Phosphorus
Naturally occurring & essential for all life
Regulates phytoplankton biomass in **most** WI lakes
Most often 'limiting plant nutrient' (shortest supply) **N:P = 51:1**
Human activity often increases P delivery to lakes

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

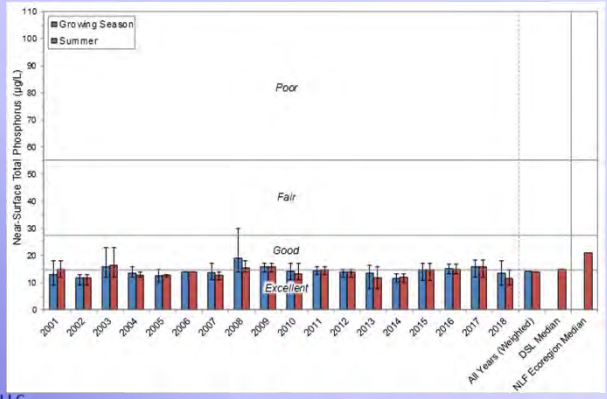
Secchi Disk Transparency
Measure of water clarity
Measured using a Secchi disk



Onterra LLC

10

Towanda Lake Water Quality - Phosphorus

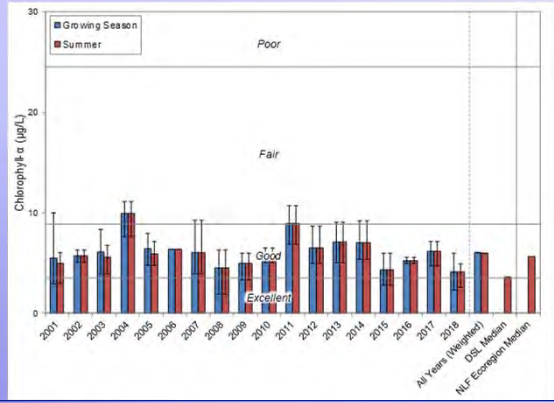


Overall, data indicate water quality is good and stable.

Onterra LLC

11

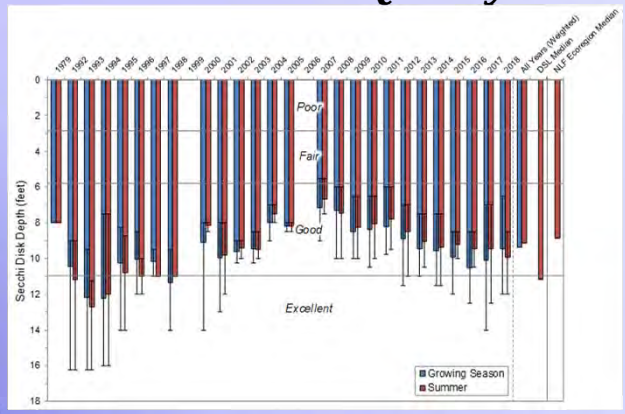
Towanda Lake Water Quality – Chlorophyll-a



Onterra LLC

12

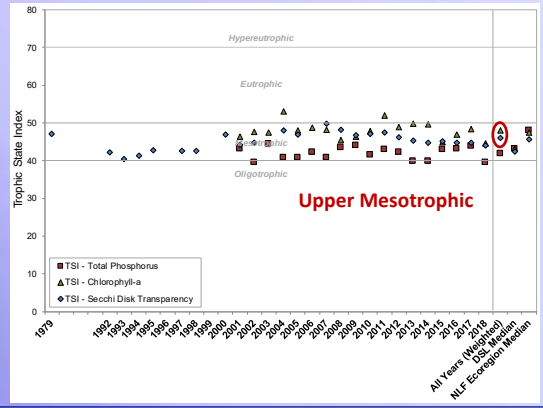
Towanda Lake Water Quality – Clarity



Onterra LLC
Lake Management Planning

13

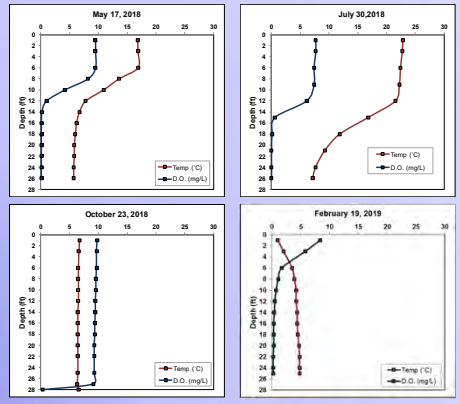
Towanda Lake Water Quality – Trophic State



Onterra LLC
Lake Management Planning

14

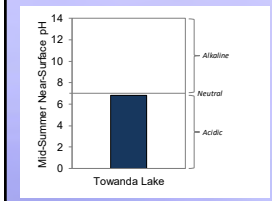
Dissolved Oxygen in Towanda Lake



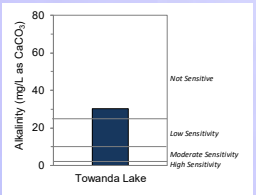
Onterra LLC
Lake Management Planning

15

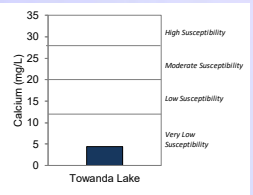
Additional Water Quality - Towanda Lake



Towanda has a near-neutral pH



Towanda's high calcium-carbonate concentrations means high buffering capacity against acid rain

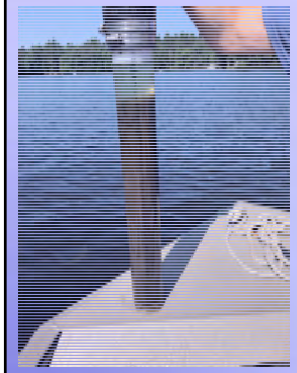


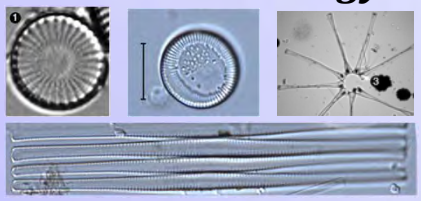
Low calcium levels mean very low susceptibility for zebra mussel infestation

Onterra LLC
Lake Management Planning

16

Towanda Lake - Paleoecology





Top-Bottom Sediment Core Results

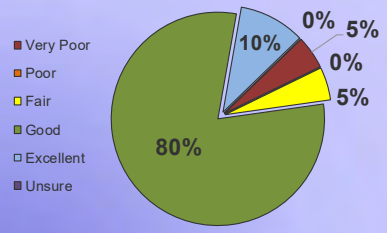
- Prior to European settlement, lake had slightly lower phosphorus and higher clarity.
- Phosphorus is still very low, but a bit higher.

Onterra LLC
Lake Management Planning

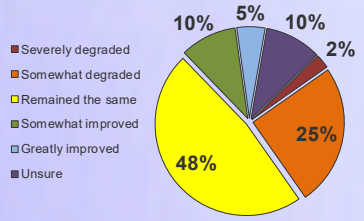
17

Water Quality – Stakeholder Survey Questions

Stakeholder survey response Question #16. How would you describe the overall current water quality of Towanda Lake?

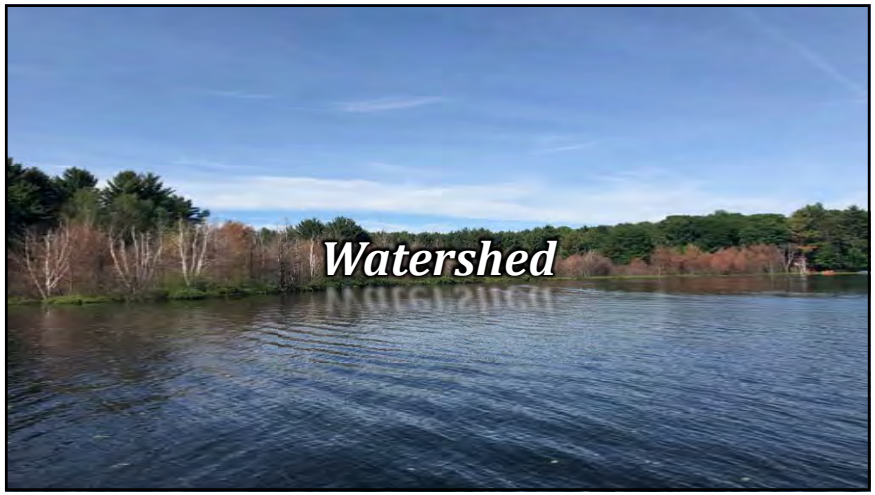


Stakeholder survey response Question #17. How has the overall water quality changed in Towanda Lake since you first visited the lake?

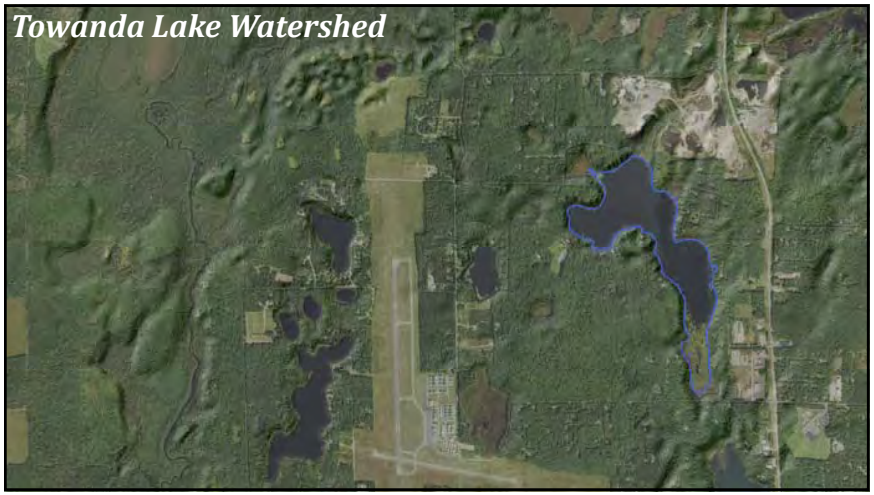


Onterra LLC
Lake Management Planning

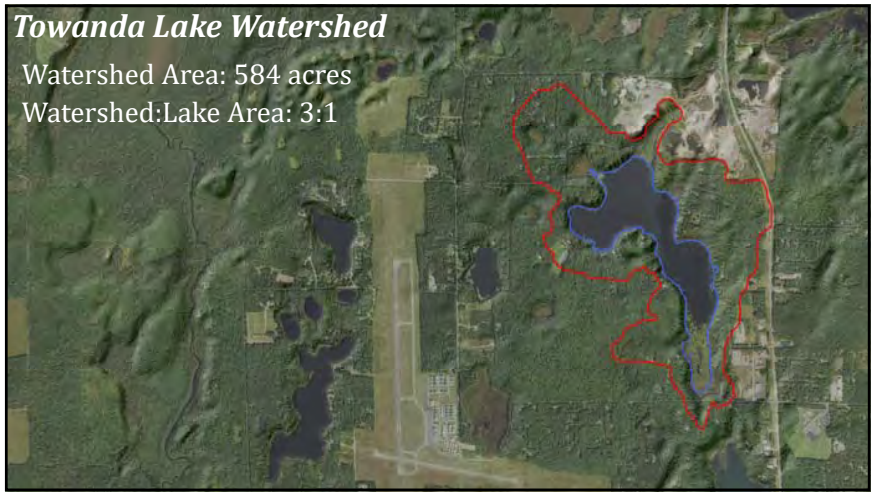
18



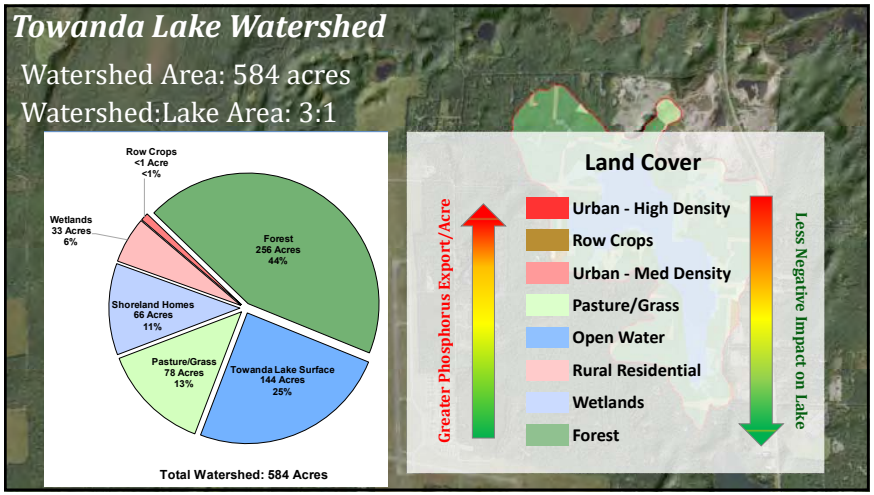
19



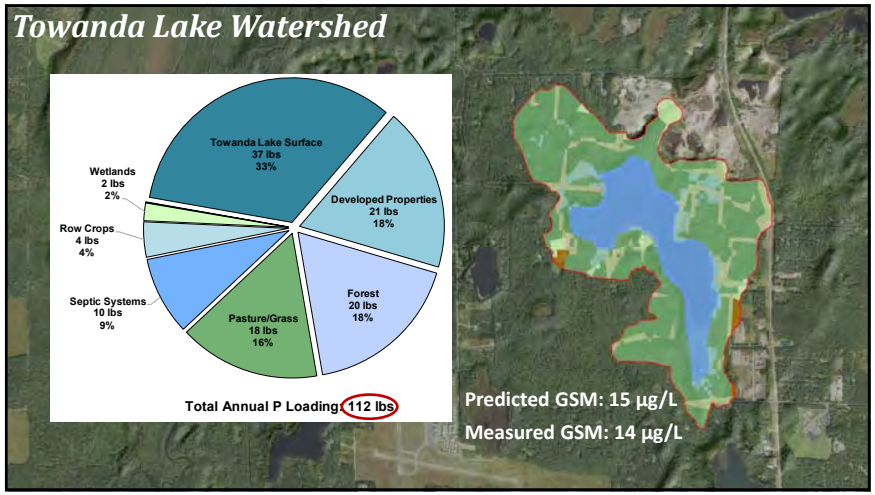
20


Towanda Lake Watershed
Watershed Area: 584 acres
Watershed:Lake Area: 3:1

21


Towanda Lake Watershed
Watershed Area: 584 acres
Watershed:Lake Area: 3:1
Row Crops
<1 Acre
<1%
Wetlands
33 Acres
6%
Forest
256 Acres
44%
Shoreland Homes
66 Acres
11%
Pasture/Grass
78 Acres
13%
Towanda Lake Surface
144 Acres
25%
Total Watershed: 584 Acres
Land Cover
Urban - High Density
Row Crops
Urban - Med Density
Pasture/Grass
Open Water
Rural Residential
Wetlands
Forest
Greater Phosphorus Export/Acre
Less Negative Impact on Lake

22


Towanda Lake Watershed
Towanda Lake Surface
37 lbs
33%
Developed Properties
21 lbs
18%
Wetlands
2 lbs
2%
Row Crops
4 lbs
4%
Septic Systems
10 lbs
9%
Pasture/Grass
18 lbs
16%
Forest
20 lbs
18%
Total Annual P Loading: 112 lbs
Predicted GSM: 15 µg/L
Measured GSM: 14 µg/L

23


Fisheries

24

Towanda Lake Fishery

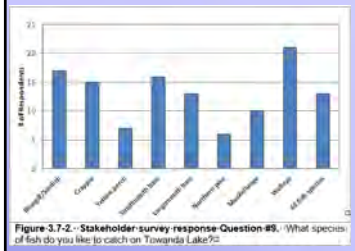


Figure 3.7-2. Stakeholder survey response Question #9. What species of fish do you like to catch on Towanda Lake?

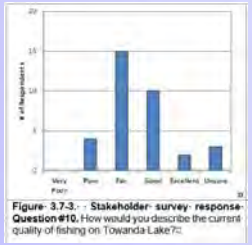


Figure 3.7-3. Stakeholder survey response Question #10. How would you describe the current quality of fishing on Towanda Lake?

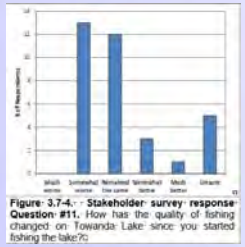


Figure 3.7-4. Stakeholder survey response Question #11. How has the quality of fishing changed on Towanda Lake since you started fishing the lake?

- No tribal spearing has occurred on Towanda.
- Towanda receives 10 extended growth walleyes per acre in each odd year.

Onterra LLC
Lake Management Planning

25

26

Aquatic Plant Surveys

- Assess both native and non-native populations
- Numerous surveys completed in 2018
  - Early-Season AIS Survey
  - Whole-Lake Point-Intercept Survey
  - Emergent/Floating-Leaf Community Mapping Survey

Onterra LLC
Lake Management Planning

27

Towanda Lake
39-meter Resolution
373 Total Points
Compare: No Earlier Data

Onterra LLC
Lake Management Planning

28

Aquatic Plant Species List

44 Native Species Total
28 Native Species on Rake
1 Non-Native Species
- Reed canary grass

2 Special Concern Species
- Northern Naiad
- Northeastern Bladderwort

Growth Form	Scientific Name	Common Name	Coefficient of Conservatism (C)	2018 (Onterra)
Emergent	*Carex comosa*	Bristly sedge	5	I
	Cladium mariscoides	Smooth sawgrass	10	I
	Dulichium arundinaceum	Three-way sedge	9	I
	Eleocharis palustris	Creeping spikerush	6	I
	Glyceria canadensis	Rattlesnake grass	7	I
	Juncus brachycephalus	Small-headed rush	10	I
	Juncus effusus	Soft rush	4	I
	Phalaris arundinacea	Reed canary grass	Exotic	I
	Sagittaria latifolia	Common arrowhead	3	I
	Schoenoplectus acutus	Hardstem bulrush	5	I
	Schoenoplectus tabernaemontani	Softstem bulrush	4	I
	Scirpus cyperinus	Wool grass	4	I
	Typha spp.	Cattail spp.	1	I
FL	*Brasenia schreberi*	Watershield	7	X
	Nuphar variegata	Spatterdock	6	X
	Nymphaea odorata	White water lily	6	X
	Persicaria amphibia	Water smartweed	5	I
	Sparganium angustifolium	Narrow-leaf bur-reed	9	I
	Sparganium fluctuans	Floating-leaf bur-reed	10	I
Submergent	*Chara* spp.	Muskgrasses	7	X
	Elodea canadensis	Common waterweed	3	X
	Eriocaulon aquaticum	Pipewort	9	X
	Myriophyllum tenellum	Dwarf watermilfoil	10	X
	Najas flexilis	Slender naiad	6	X
	Najas gracillima	Northern naiad	7 (Special Concern)	X
	Nitella spp.	Stoneworts	7	X
	Potamogeton amplifolius	Large-leaf pondweed	7	X
	Potamogeton berchtoldii	Slender pondweed	7	X
	Potamogeton epihydrus	Ribbon-leaf pondweed	8	X
	Potamogeton gramineus	Variable-leaf pondweed	7	X
	Potamogeton natans	Floating-leaf pondweed	5	X
	Potamogeton pusillus	Small pondweed	7	X
	Potamogeton robbinsii	Fern-leaf pondweed	8	X
	Potamogeton spirillus	Spiral-fruited pondweed	8	X
	Utricularia gibba	Creeping bladderwort	9	X
	Utricularia intermedia	Flat-leaf bladderwort	9	X
	Utricularia minor	Small bladderwort	10	X
	Utricularia resupinata	Northeastern bladderwort	9 (Special Concern)	X
	Utricularia vulgaris	Common bladderwort	7	X
	Vallisneria americana	Wild celery	6	X
S/E	*Eleocharis acicularis*	Needle spikerush	5	X
	Juncus pelocarpus	Brown-fruited rush	8	X
	Sagittaria graminea	Grass-leaved arrowhead	9	I
	Schoenoplectus subterminalis	Water bulrush	9	X
FF	*Lemna minor*	Lesser duckweed	5	X

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

Onterra LLC Lake Management Planning

29

Vegetation Analysis Matrices

Floristic Quality Analysis

Evaluates the closeness of an area's flora to undisturbed conditions.

$$I = \bar{C} \times \sqrt{N}$$

I Floristic Quality Index

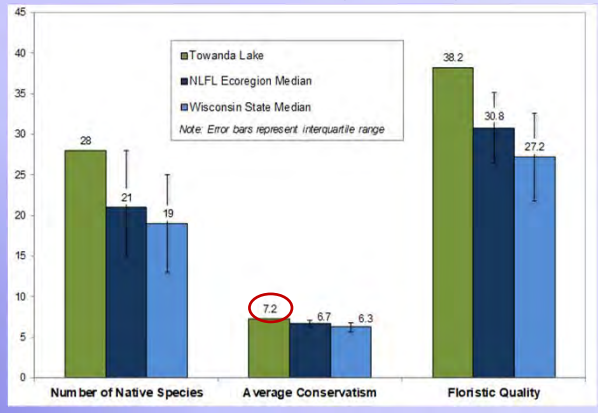
$\bar{C}$ Average Species Conservatism
1 – 10, higher number requires less disturbed condition

N Number of Native Species
Only species encountered on the rake are used (no incidentals)

Onterra LLC Lake Management Planning

30

Floristic Quality Analysis



Onterra LLC Lake Management Planning

31

Vegetation Analysis Matrices

Species Diversity

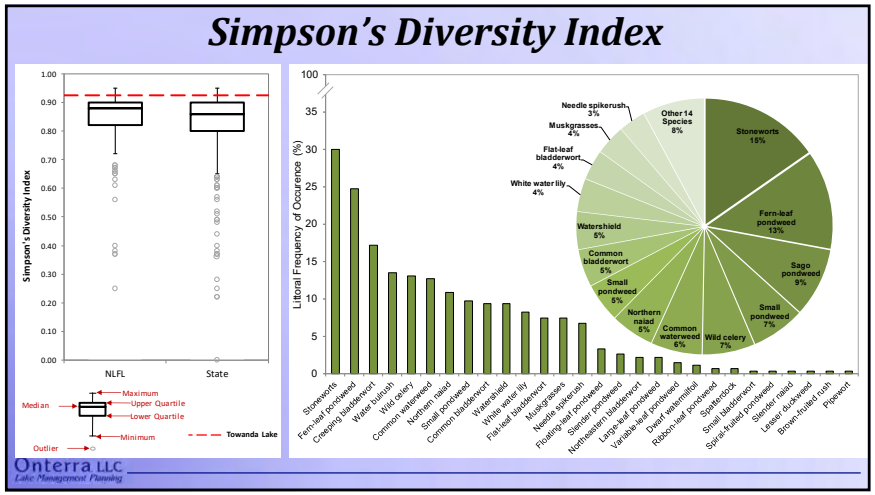
Species diversity utilizes species richness and also takes into account evenness or the variation in abundance of the individual species within the community.

A community of 10 species with the population evenly divided among those species is more diverse than a community of 10 species with 50% of the population in one or two species.

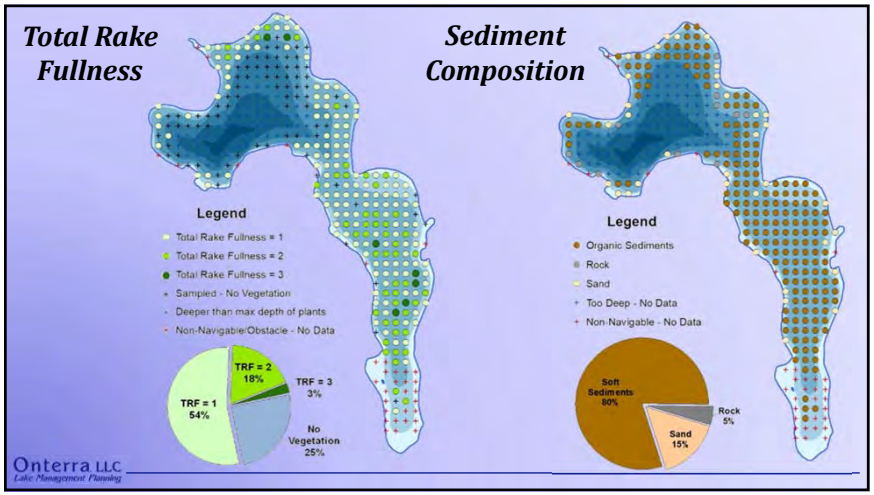
A more diverse community can withstand environmental fluctuations better than a less diversity community.

Onterra LLC Lake Management Planning

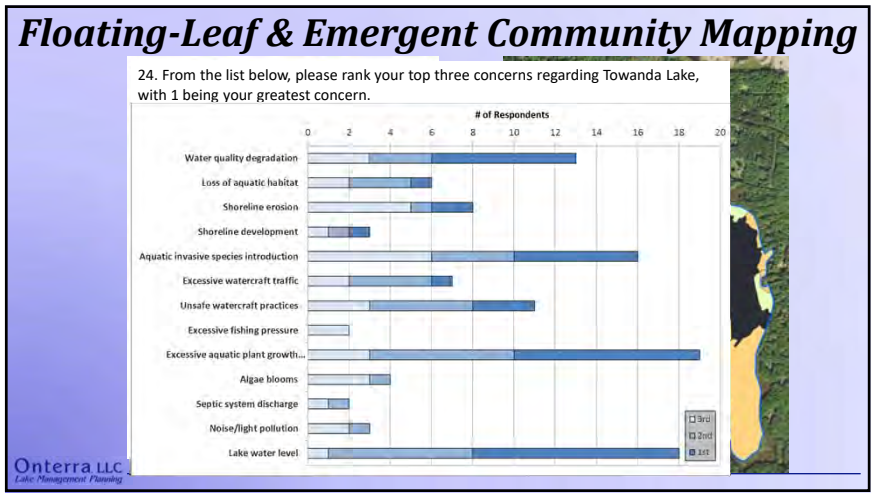
32


Simpson's Diversity Index
Simpson's Diversity Index
NLFL
State
Maximum
Upper Quartile
Median
Lower Quartile
Minimum
Outlier
Towanda Lake
Littoral Frequency of Occurence (%)
Stoneworts 15%
Fern-leaf pondweed 13%
Sago pondweed 9%
Small pondweed 7%
Wild celery 7%
Common waterweed 6%
Northern naiad 6%
Small pondweed 6%
Common bladderwort 6%
Watershield 6%
White water lily 4%
Flat-leaf bladderwort 4%
Muskgrasses 4%
Needle spikerush 3%
Other 14 Species 8%
Onterra LLC
Lake Management Planning

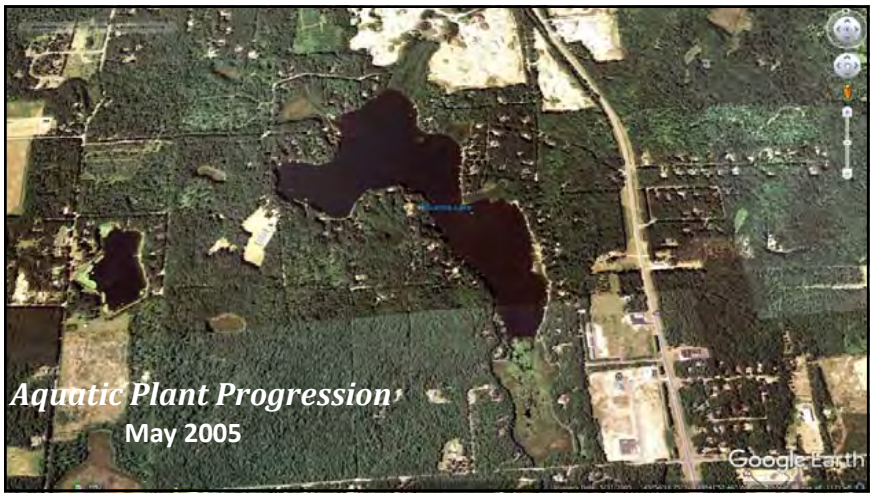
33


Total Rake Fullness
Legend
Total Rake Fullness = 1
Total Rake Fullness = 2
Total Rake Fullness = 3
Sampled - No Vegetation
Deeper than max depth of plants
Non-Navigable/Obstacle - No Data
TRF = 1 54%
TRF = 2 18%
TRF = 3 3%
No Vegetation 25%
Sediment Composition
Legend
Organic Sediments
Rock
Sand
Too Deep - No Data
Non-Navigable - No Data
Soft Sediments 80%
Rock 5%
Sand 15%
Onterra LLC
Lake Management Planning

34


Floating-Leaf & Emergent Community Mapping
24. From the list below, please rank your top three concerns regarding Towanda Lake, with 1 being your greatest concern.
# of Respondents
Water quality degradation
Loss of aquatic habitat
Shoreline erosion
Shoreline development
Aquatic invasive species introduction
Excessive watercraft traffic
Unsafe watercraft practices
Excessive fishing pressure
Excessive aquatic plant growth...
Algae blooms
Septic system discharge
Noise/light pollution
Lake water level
3rd
2nd
1st
Onterra LLC
Lake Management Planning

35


Aquatic Plant Progression
May 2005
Google Earth

36


Aquatic Plant Progression
June 2006
Google Earth

37


Aquatic Plant Progression
June 2008
Google Earth

38


Aquatic Plant Progression
June 2010
Google Earth

39

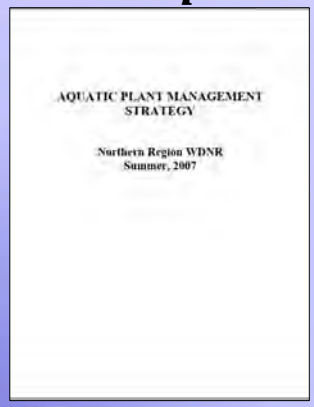

Aquatic Plant Progression
July 2015
Google Earth

40

41

42

Aquatic Plant Control


AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR
Summer, 2007

Onterra LLC
Lake Management Planning

43

Dredging

Three general categories of dredging

Manual Dredging – in many cases can remove up to 3 cu.yd./yr (roughly 100 sq. ft., 1 ft deep) by hand under an exemption.

Small-Scale Dredging – Less than 25 cu.yd. can be removed under general permit. Some companies offer this service, but permitting may be a serious issue in the Northwoods. May require sediment testing for contaminants.

Large-Scale Dredging – Completed with a hydraulic dredge unit at roughly $15/cu.yd. Dredging 1-acre of lake bottom 3-feet deeper (4,840 cu.yd.) costs about $72,600.

Onterra LLC
Lake Management Planning

44

Conclusions

Water Quality
- Water quality is good due to groundwater inputs and watershed condition.
- Paleoecological analysis detected a small increase in phosphorus and slightly worse water clarity since European settlement – this is not unexpected.
- Lake is currently moderately productive.

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

Aquatic Plant Community
- Plant community is of high quality and diversity.
- Potential increase in floating-leaf and emergent communities are natural and likely cyclic.
- Lake is essentially AIS plant free.

Aquatic Plant Management
- Mechanical harvesting is likely the only marginally realistic option for management.

Onterra LLC Lake Management Planning

45

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

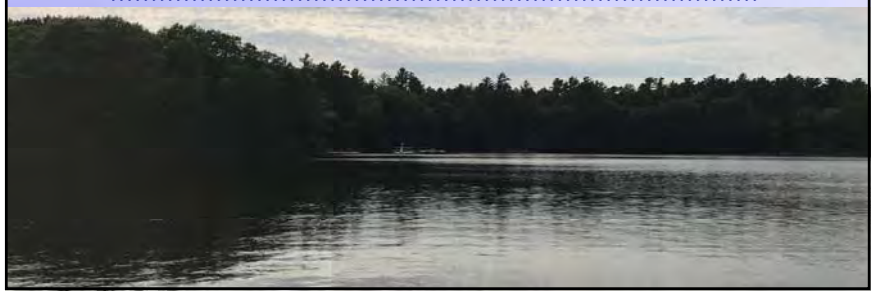
Assignment for Planning Meeting II
1. Create list of challenges facing lake and lake group
2. Review stakeholder survey results (Tim! - Handout)
3. Send potential report section edits and questions to Todd

Onterra LLC Lake Management Planning

46

Thank You

Onterra LLC
Lake Management Planning



47

1

Presentation Outline

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

Onterra LLC Lake Management Planning

2

Management Planning Project Overview

Collect and compile information about Towanda Lake

Includes both environmental & sociological

Historical & current information

Past management actions

Planning Meeting I
Report Sections

Create a realistic and implementable management plan

Challenges facing lake and TLA

Create goals that will address challenges

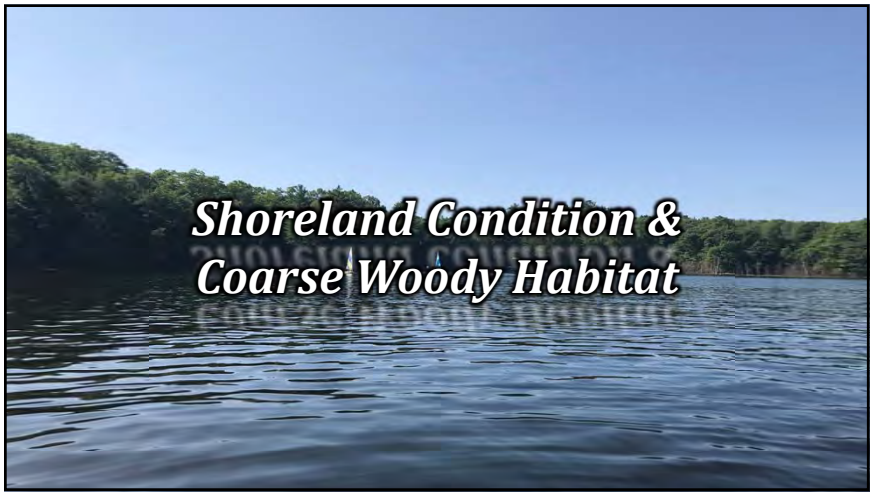
Develop actions that will meet goals

Assign timeframes & facilitators

Planning Meeting II
Implementation Plan

Onterra LLC Lake Management Planning

3



4

Shoreland Assessment

- Shoreland area is important for buffering runoff and provides valuable habitat for aquatic and terrestrial wildlife.
- EPA National Lakes Assessment results indicate shoreland development has greatest negative impact to health of our nation's lakes.

Onterra LLC Lake Management Planning

5

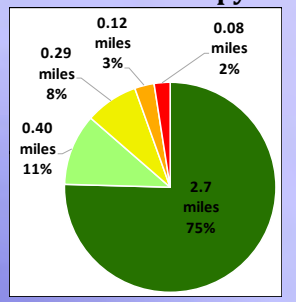
Shoreline Assessment Category Descriptions

Onterra LLC Lake Management Planning

6

Shoreland Condition

Percent Canopy

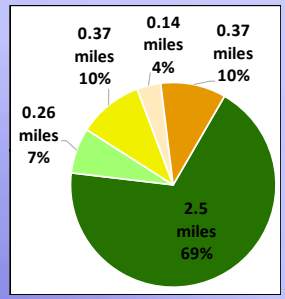


Onterra LLC Lake Management Planning

7

Shoreland Condition

Percent Shrub/Herbaceous

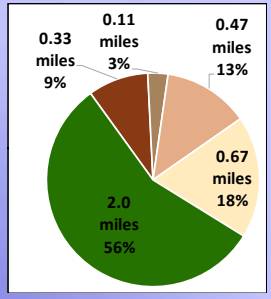


Onterra LLC Lake Management Planning

8

Shoreland Condition

Percent Manicured Lawn



Onterra LLC Lake Management Planning

9

Shoreland Condition

Documented Erosion

Onterra LLC Lake Management Planning

10

Conclusions

Water Quality

- Water quality is good due to groundwater inputs and watershed condition.
- Paleoecological analysis detected a small increase in phosphorus and slightly worse water clarity since European settlement – this is not unexpected.
- Lake is currently moderately productive.

Watershed

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

Aquatic Plant Community

- Plant community is of high quality and diversity.
- Potential increase in floating-leaf and emergent communities are natural and likely cyclic.
- Lake is essentially AIS plant free.

Aquatic Plant Management

- Mechanical harvesting is likely the only marginally realistic option for management.

Onterra LLC Lake Management Planning

11

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

Assignment for Planning Meeting II

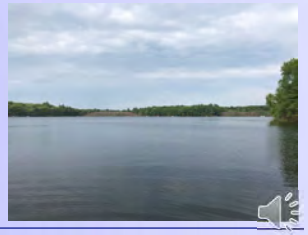
1. Create list of challenges facing lake and lake group
2. Review stakeholder survey results
3. Send potential report section edits and questions to Todd

Onterra LLC Lake Management Planning

12

Presentation Outline

- Lake Management Planning Project Overview
- Study Conclusions
- Study Results
  - Water Quality
  - Watershed
  - Aquatic Plants
- Implementation Plan



Onterra LLC Lake Management Planning

Management Planning Project Overview

Collect and compile information about lake

Includes both environmental & sociological data
Historical & current information
Past management actions

Create a realistic and implementable management plan

Challenges facing lake and lake group
Create goals that will address challenges
Develop actions that will meet goals
Assign timeframes & facilitators

Onterra LLC Lake Management Planning

Conclusions

Overarching Conclusion: Towanda Lake is ecologically healthy.

Water Quality

- Water quality is good due to groundwater inputs and watershed condition.
- Paleoecological analysis detected a small increase in phosphorus and slightly worse water clarity since European settlement – this is not unexpected.

Watershed

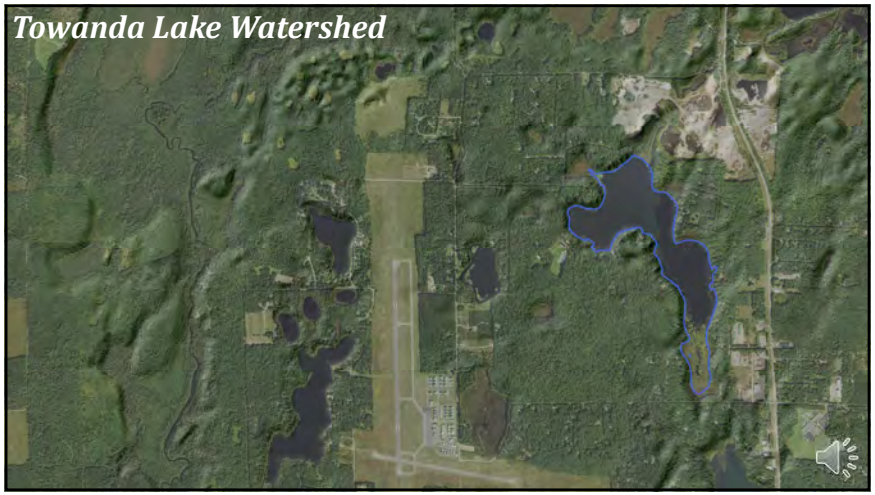
- Watershed is small and contains some of the best landcover types.
- Changes in nearshore areas will likely have the greatest impact on lake ecology.

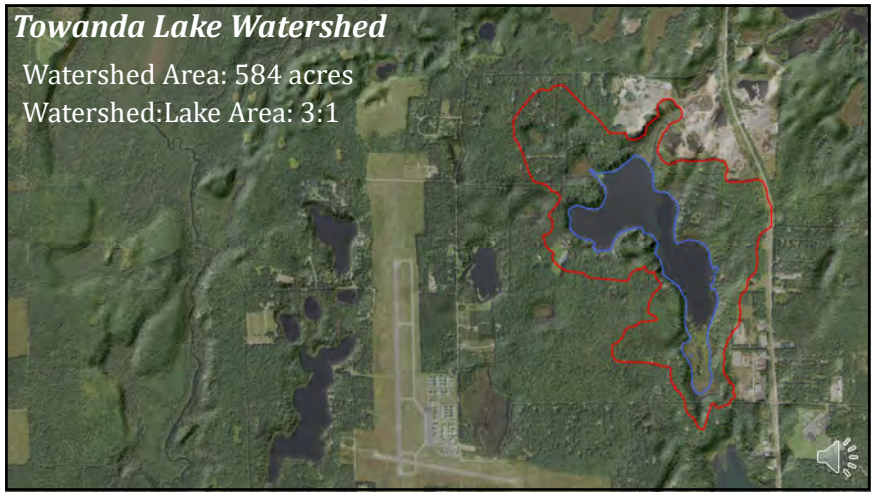
Aquatic Plant Community

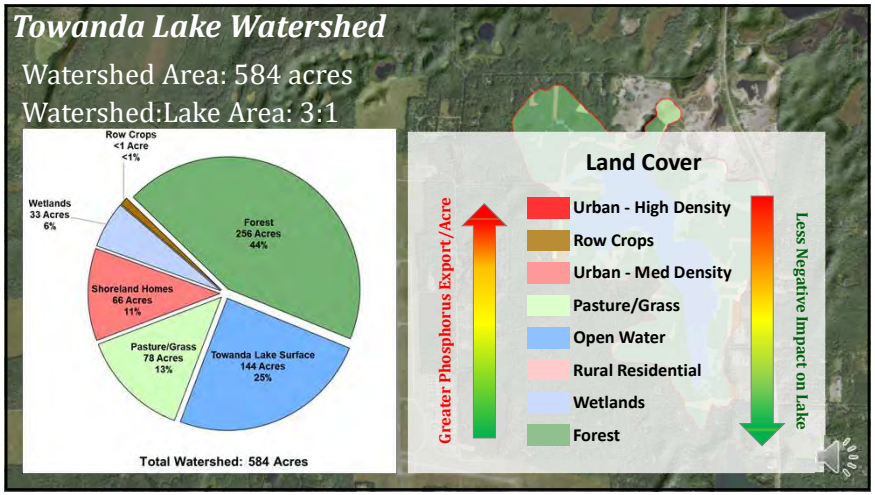
- Plant community is of high quality and diversity.
- Potential increase in floating-leaf and emergent communities are natural and likely cyclic.
- Lake is essentially AIS plant free, except reed canary grass, a common exotic.

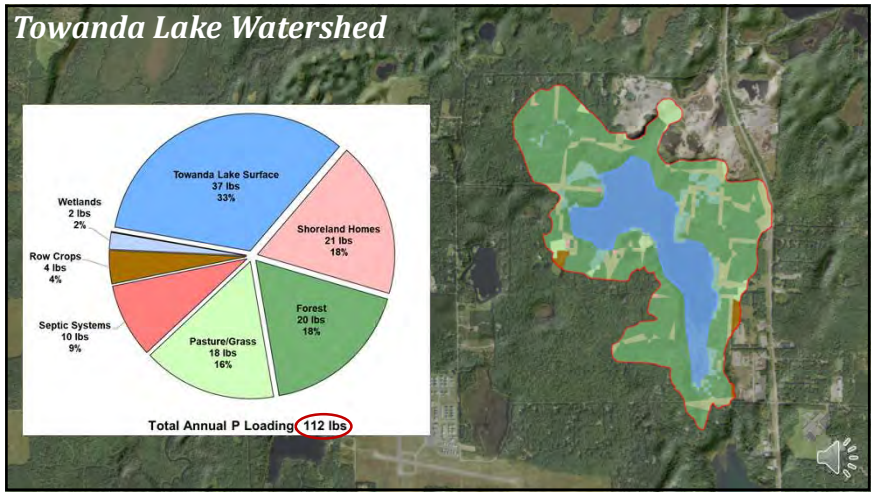
Onterra LLC Lake Management Planning


Watershed

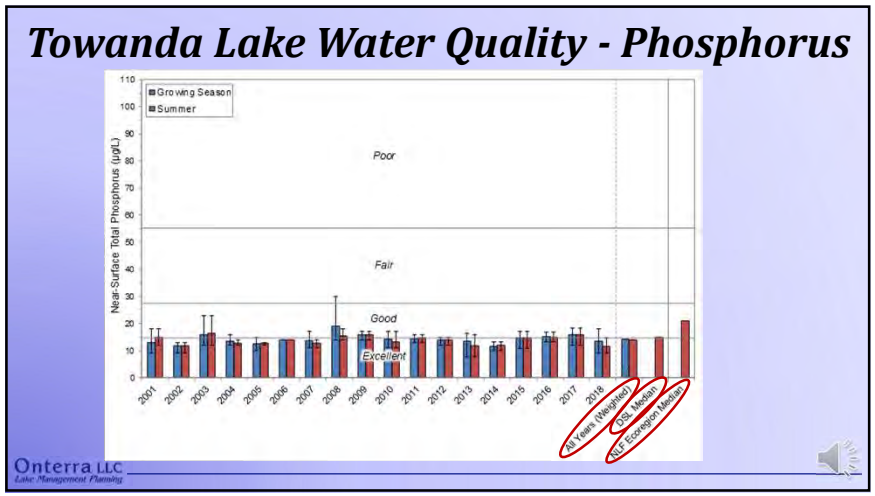

Towanda Lake Watershed

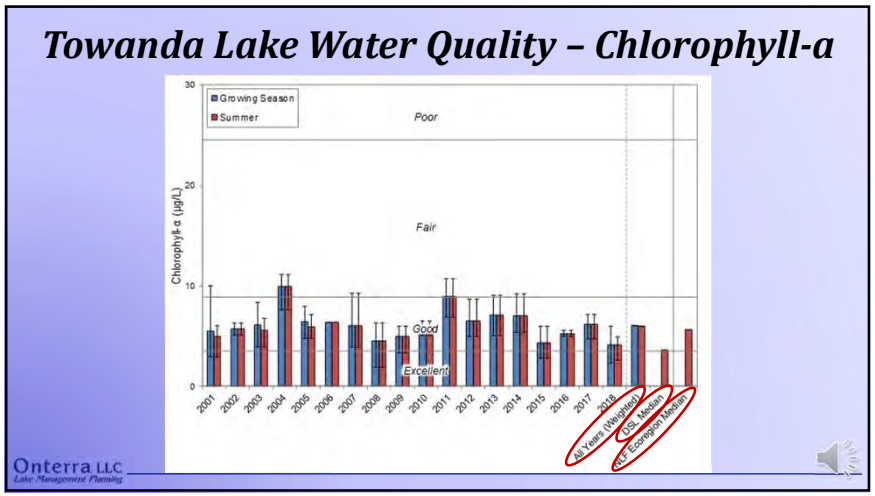

Towanda Lake Watershed
Watershed Area: 584 acres
Watershed:Lake Area: 3:1


Towanda Lake Watershed
Watershed Area: 584 acres
Watershed:Lake Area: 3:1
Row Crops
<1 Acre
<1%
Wetlands
33 Acres
6%
Forest
256 Acres
44%
Shoreland Homes
66 Acres
11%
Pasture/Grass
78 Acres
13%
Towanda Lake Surface
144 Acres
25%
Total Watershed: 584 Acres
Land Cover
Urban - High Density
Row Crops
Urban - Med Density
Pasture/Grass
Open Water
Rural Residential
Wetlands
Forest
Greater Phosphorus Export/Acre
Less Negative Impact on Lake

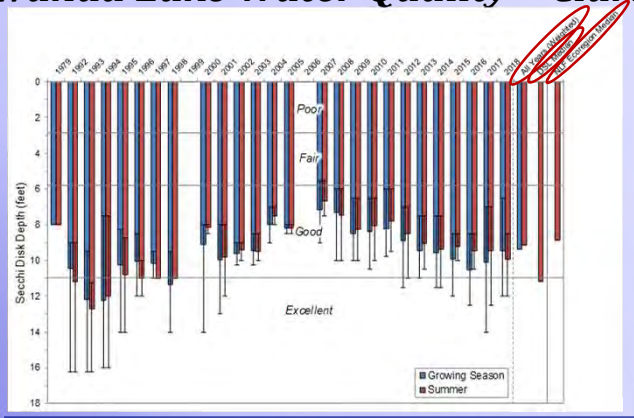

Towanda Lake Watershed
Towanda Lake Surface
37 lbs
33%
Shoreland Homes
21 lbs
18%
Forest
20 lbs
18%
Pasture/Grass
18 lbs
16%
Septic Systems
10 lbs
9%
Row Crops
4 lbs
4%
Wetlands
2 lbs
2%
Total Annual P Loading 112 lbs


Water Quality


Towanda Lake Water Quality - Phosphorus
Growing Season
Summer
Poor
Fair
Good
Excellent
Near-Surface Total Phosphorus (µg/L)
All Years (Weighted)
DSL Median
NLF Ecoregion Median
Onterra LLC
Lake Management Planning

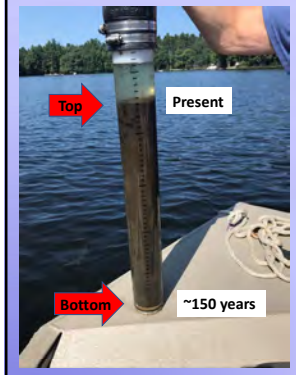

Towanda Lake Water Quality – Chlorophyll-a
Growing Season
Summer
Poor
Fair
Good
Excellent
Chlorophyll-a (µg/L)
All Years (Weighted)
DSL Median
NLF Ecoregion Median
Onterra LLC
Lake Management Planning

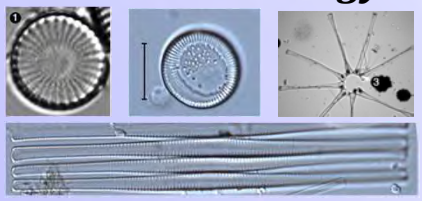
Towanda Lake Water Quality – Clarity



Onterra LLC Lake Management Planning

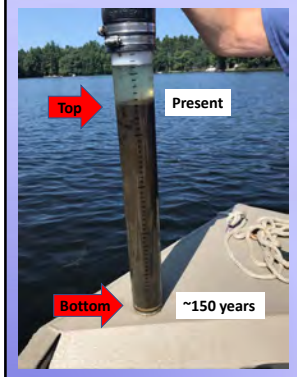
Towanda Lake - Paleoecology

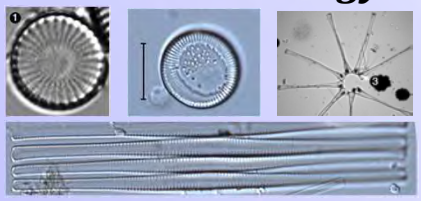




Onterra LLC Lake Management Planning

Towanda Lake - Paleoecology





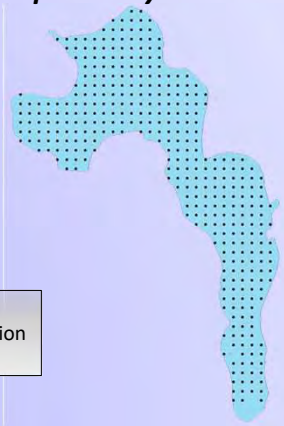
Top-Bottom Sediment Core Results

- Prior to European settlement, lake had slightly higher water clarity.
- Phosphorus is still very low, but a bit higher.

Onterra LLC Lake Management Planning

Aquatic Plants

Whole-Lake Point-Intercept Survey



Towanda Lake
39-meter resolution
373 total points

Onterra LLC Lake Management Planning

Vegetation Analysis Matrices

Floristic Quality Analysis

Evaluates the closeness of an area's flora to undisturbed conditions.

$$I = \bar{C} \times \sqrt{N}$$

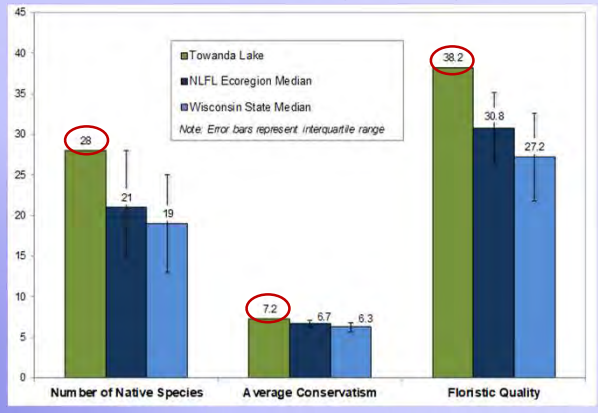
I Floristic Quality Index

$\bar{C}$ Average Species Conservatism
1 – 10, higher number requires less disturbed condition

N Number of Native Species
Only species encountered on the rake are used (no incidentals)

Onterra LLC Lake Management Planning

Floristic Quality Analysis



Onterra LLC Lake Management Planning

Vegetation Analysis Matrices

Species Diversity

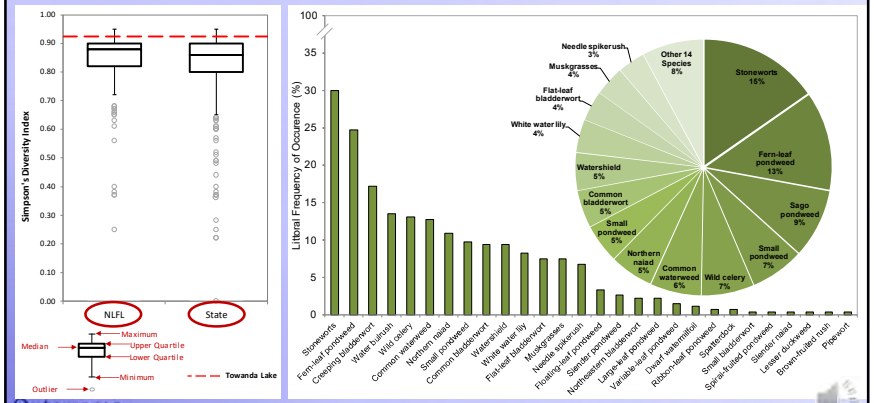
Species diversity utilizes species richness and also takes into account evenness or the variation in abundance of the individual species within the community.

A community of 10 species with the population evenly divided among those species is more diverse than a community of 10 species with 50% of the population in one or two species.

A more diverse community can withstand environmental fluctuations better than a less diversity community.

Onterra LLC Lake Management Planning

Simpson's Diversity Index



Towanda Lake Implementation Plan

Goal: Protect and Improve the Ecological Health of Towanda Lake

Action: Monitor water quality through WDNR CLMN Program.

Action: Continue to participate in the Loon Watch Program.

Action: Monitor Towanda Lake water levels.

Action: Educate stakeholders on the importance of shoreland condition, shoreland restoration, and proper shoreland stewardship on Towanda Lake.

Action: Increase understanding of Towanda Lake fisheries among riparians and increase important fish habitat within Towanda Lake.

Towanda Lake Implementation Plan

Goal: Increase the TLA's Capacity to Manage Towanda Lake, Communicate with Lake Stakeholders, and Facilitate Partnerships with Other Management Entities

Action: Promote lake protection and enjoyment through stakeholder education.

Action: Increase Towanda Lake Association membership.

Action: Continue TLA's involvement with other entities that have responsibilities in managing (management units) Towanda Lake.

Towanda Lake Implementation Plan

Goal: Prevent Aquatic Invasive Species Introductions to Towanda Lake

Action: Begin Clean Boats Clean Waters watercraft inspections at Towanda Lake public access location.

Action: Design and install customized AIS and lake information kiosk at Towanda public boat landing.

Action: Coordinate annual volunteer monitoring for Aquatic Invasive Species on Towanda Lake.

Action: Conduct periodic quantitative vegetation monitoring on Towanda Lake.

Action: Initiate rapid response plan following detection of AIS in Towanda Lake.

Onterra LLC Lake Management Planning

Towanda Lake Implementation Plan

Goal: Assure Safe and Pleasurable Recreational Opportunities on Towanda Lake for All Users

Action: Conduct a mechanical harvesting feasibility study.

Action: Update the Towanda Lake Association 'Gentlemen's Agreement'.

Onterra LLC Lake Management Planning

B

APPENDIX B

Stakeholder Survey Response Charts and Comments

Towanda Lake - Anonymous Stakeholder Survey

Surveys Distributed: 89
Surveys Returned: 41
Response Rate: 46%

Towanda Lake Property

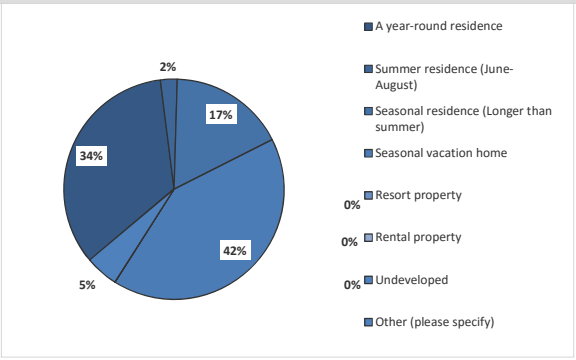
1. Is your property on the lake or off the lake?

Answer Options	Response Percent	Response Count
On the lake	97.6%	40
Off the lake	2.4%	1
answered question		41
skipped question		0

2. How is your property on Towanda Lake utilized?

Answer Options	Response Percent	Response Count
A year-round residence	34.1%	14
Summer residence (June-August)	2.4%	1
Seasonal residence (Longer than summer)	17.1%	7
Seasonal vacation home	41.5%	17
Resort property	0.0%	0
Rental property	0.0%	0
Undeveloped	0.0%	0
Other (please specify)	4.9%	2
answered question		41
skipped question		0

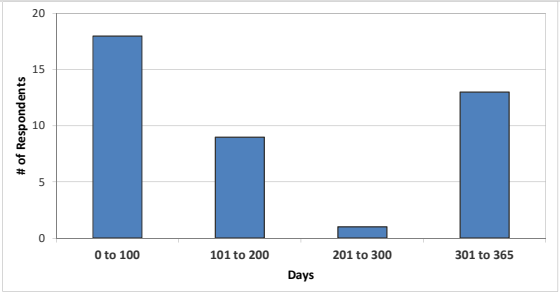
Number	Other (please specify)
1	year around vacation home
2	Summer Camp



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

Answer Options	Response Count
	41
answered question	41
skipped question	0

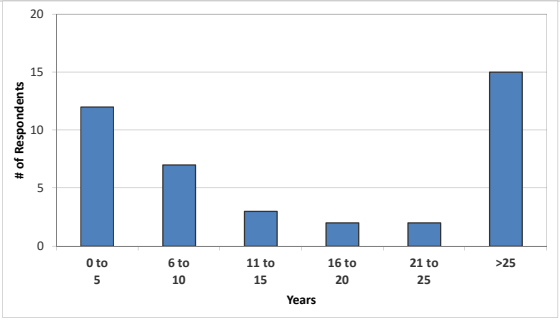
Category (# of days)	Responses	
0 to 100	18	44%
101 to 200	9	22%
201 to 300	1	2%
301 to 365	13	32%



4. How long have you owned your property on or near Towanda Lake?

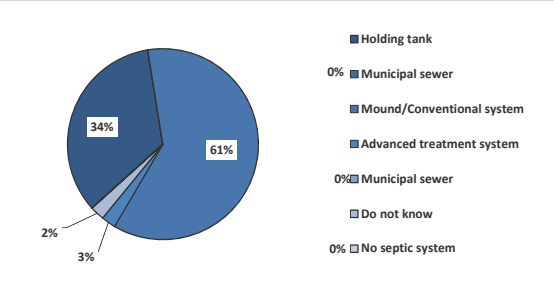
Answer Options	Response Count
	41
answered question	41
skipped question	0

Category (# of years)	Responses	% Response
0 to 5	12	29%
6 to 10	7	17%
11 to 15	3	7%
16 to 20	2	5%
21 to 25	2	5%
>25	15	37%



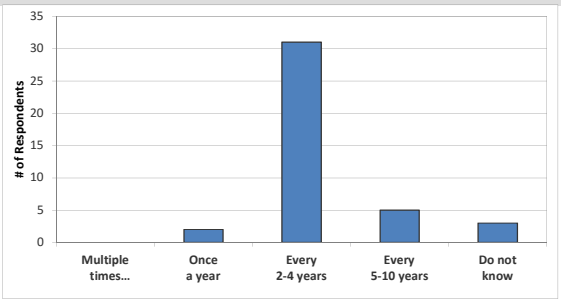
5. What type of septic system does your property utilize?

Answer Options	Response Percent	Response Count
Holding tank	34.1%	14
Municipal sewer	0.0%	0
Mound/Conventional system	61.0%	25
Advanced treatment system	2.4%	1
Municipal sewer	0.0%	0
Do not know	2.4%	1
No septic system	0.0%	0
answered question		41
skipped question		0



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

Answer Options	Response Percent	Response Count
Multiple times a year	0.0%	0
Once a year	4.9%	2
Every 2-4 years	75.6%	31
Every 5-10 years	12.2%	5
Do not know	7.3%	3
answered question		41
skipped question		0

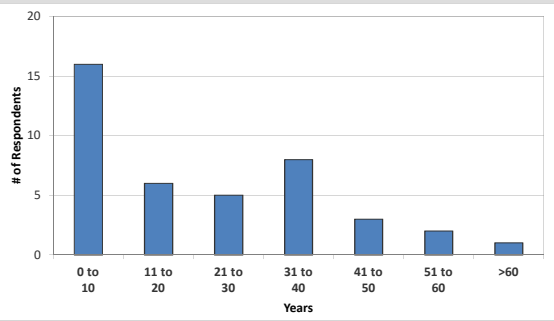


Recreational Activity on Towanda Lake

7. How many years ago did you first visit Towanda Lake?

Answer Options	Response Count
	41
answered question	41
skipped question	0

Category (# of days)	Responses	% Response
0 to 10	**16**	**39%**
11 to 20	**6**	**15%**
21 to 30	**5**	**12%**
31 to 40	**8**	**20%**
41 to 50	**3**	**7%**
51 to 60	**2**	**5%**
>60	**1**	**2%**

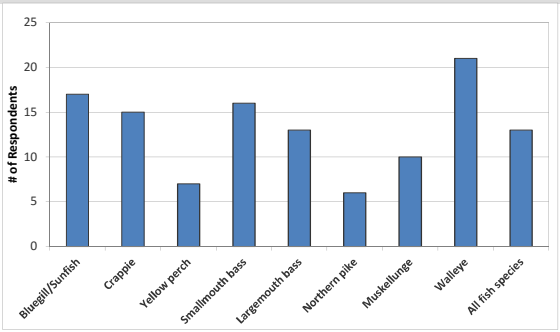


8. Have you personally fished on Towanda Lake in the past three years?

Answer Options	Response Percent	Response Count
Yes	82.9%	34
No	17.1%	7
answered question		41
skipped question		0

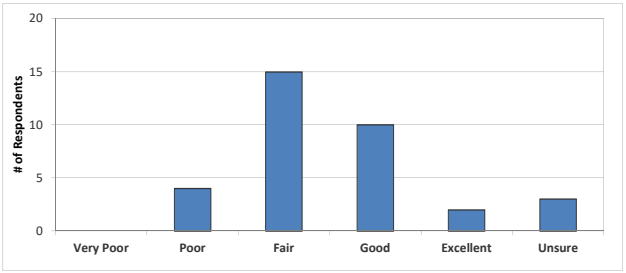
9. What species of fish do you like to catch on Towanda Lake?

Answer Options	Response Percent	Response Count
Bluegill/Sunfish	50.0%	17
Crappie	44.1%	15
Yellow perch	20.6%	7
Smallmouth bass	47.1%	16
Largemouth bass	38.2%	13
Northern pike	17.6%	6
Muskellunge	29.4%	10
Walleye	61.8%	21
All fish species	38.2%	13
Other (please specify)	0.0%	0
answered question		34
skipped question		7



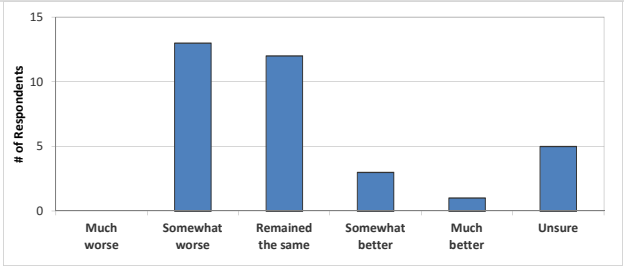
10. How would you describe the current quality of fishing on Towanda Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	0	4	15	10	2	3	34
answered question							34
skipped question							7



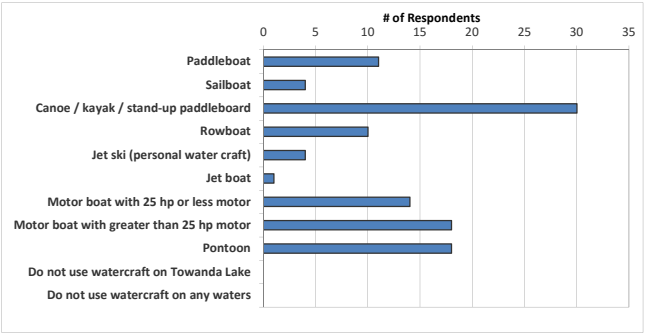
11. How has the quality of fishing changed on Towanda Lake since you have started fishing the lake?

Answer Options	Much worse	Somewhat worse	Remained the same	Somewhat better	Much better	Unsure	Response Count
	0	13	12	3	1	5	34
answered question							34
skipped question							7



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

Answer Options	Response Percent	Response Count
Paddleboat	26.8%	11
Sailboat	9.8%	4
Canoe / kayak / stand-up paddleboard	73.2%	30
Rowboat	24.4%	10
Jet ski (personal water craft)	9.8%	4
Jet boat	2.4%	1
Motor boat with 25 hp or less motor	34.1%	14
Motor boat with greater than 25 hp motor	43.9%	18
Pontoon	43.9%	18
Do not use watercraft on Towanda Lake	0.0%	0
Do not use watercraft on any waters	0.0%	0
answered question		41
skipped question		0



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

Answer Options	Response Percent	Response Count
Yes	50.0%	20
No	50.0%	20
answered question		40
skipped question		1

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

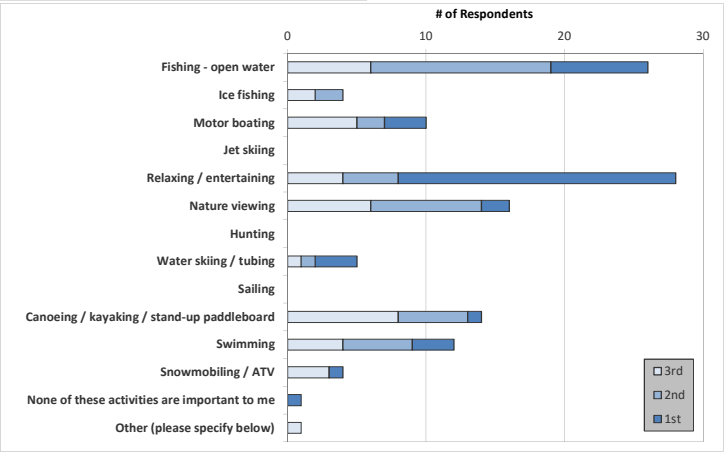
Answer Options	Response Percent	Response Count
Remove aquatic hitch-hikers (ex. - plant material, clams, mussels)	85.0%	17
Drain bilge	65.0%	13
Rinse boat	35.0%	7
Power wash boat	15.0%	3
Apply bleach	0.0%	0
Air dry boat for 5 or more days	40.0%	8
Do not clean boat	0.0%	0
Other (please specify)	10.0%	2
answered question		20
skipped question		21

Number	Other (please specify)
1	Drain Livewell
2	Not applicable

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

Answer Options	1st	2nd	3rd	Rating Average	Response Count
Fishing - open water	7	13	6	1.96	26
Ice fishing	0	2	2	2.5	4
Motor boating	3	2	5	2.2	10
Jet skiing	0	0	0	0	0
Relaxing / entertaining	20	4	4	1.43	28
Nature viewing	2	8	6	2.25	16
Hunting	0	0	0	0	0
Water skiing / tubing	3	1	1	1.6	5
Sailing	0	0	0	0	0
Canoeing / kayaking / stand-up paddleboard	1	5	8	2.5	14
Swimming	3	5	4	2.08	12
Snowmobiling / ATV	1	0	3	2.5	4
None of these activities are important to me	1	0	0	1	1
Other (please specify below)	0	0	1	3	1
answered question					41
skipped question					0

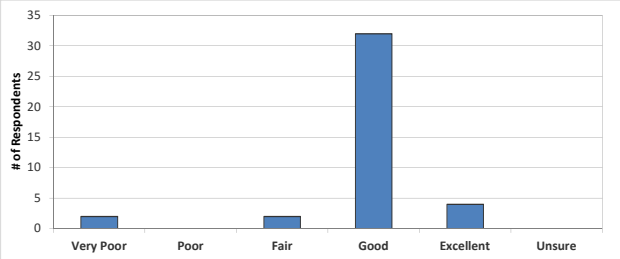
Number	"Other" responses
1	electric pontoon no wake



Towanda Lake Current and Historic Condition, Health and Management

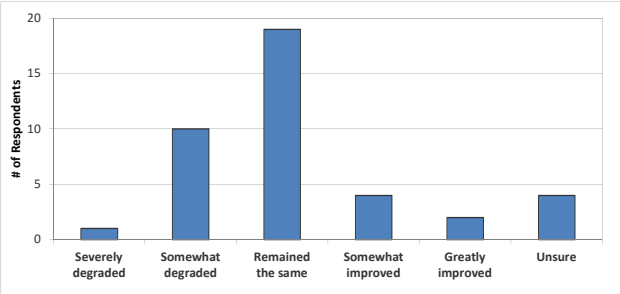
16. How would you describe the overall current water quality of Towanda Lake?

Answer Options	Very Poor	Poor	Fair	Good	Excellent	Unsure	Response Count
	2	0	2	32	4	0	40
						answered question	**40**
						skipped question	**1**



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

Answer Options	Severely degraded	Somewhat degraded	Remained the same	Somewhat improved	Greatly improved	Unsure	Response Count
	1	10	19	4	2	4	40
						answered question	**40**
						skipped question	**1**



18. Considering how you answered the questions above, what do you think of when describing water quality?

Answer Options	Response Percent	Response Count
Water clarity (clearness of water)	77.5%	31
Aquatic plant growth (not including algae blooms)	65.0%	26
Water color	17.5%	7
Algae blooms	37.5%	15
Smell	27.5%	11
Water level	65.0%	26
Fish kills	5.0%	2
Other (please specify)	0.0%	0
answered question		**40**
skipped question		**1**

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

Answer Options	Response Percent	Response Count
Water clarity (clearness of water)	42.5%	17
Aquatic plant growth (not including algae blooms)	30.0%	12
Water color	0.0%	0
Algae blooms	5.0%	2
Smell	2.5%	1
Water level	20.0%	8
Fish kills	0.0%	0
Other (please specify)	0.0%	0
answered question		40
skipped question		1

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

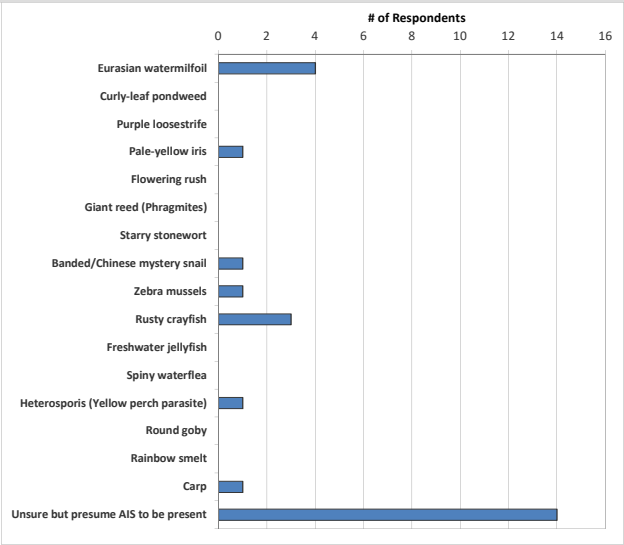
Answer Options	Response Percent	Response Count
Yes	100.0%	39
No	0.0%	0
answered question		39
skipped question		2

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

Answer Options	Response Percent	Response Count
Yes	12.5%	5
I think so but am not certain	40.0%	16
No	47.5%	19
answered question		40
skipped question		1

22. Which aquatic invasive species do you believe are in Towanda Lake?

Answer Options	Response Percent	Response Count
Eurasian watermilfoil	19.1%	4
Curly-leaf pondweed	0.0%	0
Purple loosestrife	0.0%	0
Pale-yellow iris	4.8%	1
Flowering rush	0.0%	0
Giant reed (Phragmites)	0.0%	0
Starry stonewort	0.0%	0
Banded/Chinese mystery snail	4.8%	1
Zebra mussels	4.8%	1
Rusty crayfish	14.3%	3
Freshwater jellyfish	0.0%	0
Spiny waterflea	0.0%	0
Heterosporis (Yellow perch parasite)	4.8%	1
Round goby	0.0%	0
Rainbow smelt	0.0%	0
Carp	4.8%	1
Unsure but presume AIS to be present	66.7%	14
Other (please specify)	4.8%	1
answered question		21
skipped question		20

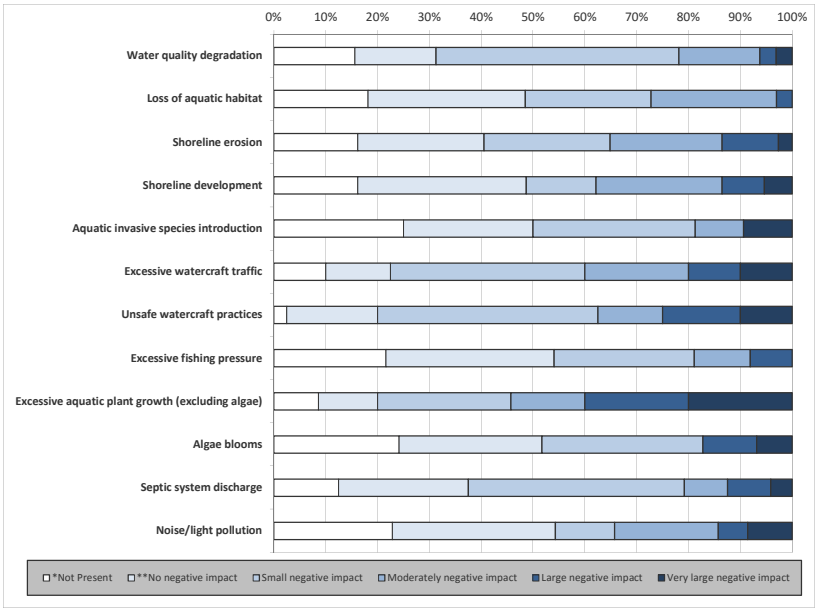


Number	"Other" responses
1	Lily pads

23. To what level do you believe each of the following factors may currently be negatively impacting Towanda Lake?
*** Not Present means that you believe the issue does not exist on Towanda Lake.**
**** No Impact means that the issue may exist on Towanda 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	5	5	15	5	1	1	6	0.84	38
Loss of aquatic habitat	6	10	8	8	1	0	6	0.69	39
Shoreline erosion	6	9	9	8	4	1	2	1.05	39
Shoreline development	6	12	5	9	3	2	3	1.00	40
Aquatic invasive species introduction	8	8	10	3	0	3	7	0.72	39
Excessive watercraft traffic	4	5	15	8	4	4	0	1.48	40
Unsafe watercraft practices	1	7	17	5	6	4	0	1.53	40
Excessive fishing pressure	8	12	10	4	3	0	2	0.69	39
Excessive aquatic plant growth (excluding algae)	3	4	9	5	7	7	4	1.74	39
Algae blooms	7	8	9	0	3	2	9	0.68	38
Septic system discharge	3	6	10	2	2	1	15	0.62	39
Noise/light pollution	8	11	4	7	2	3	2	0.97	37
Lake water level	6	10	7	3	8	5	1	1.43	40
								answered question	**40**
								skipped question	**1**

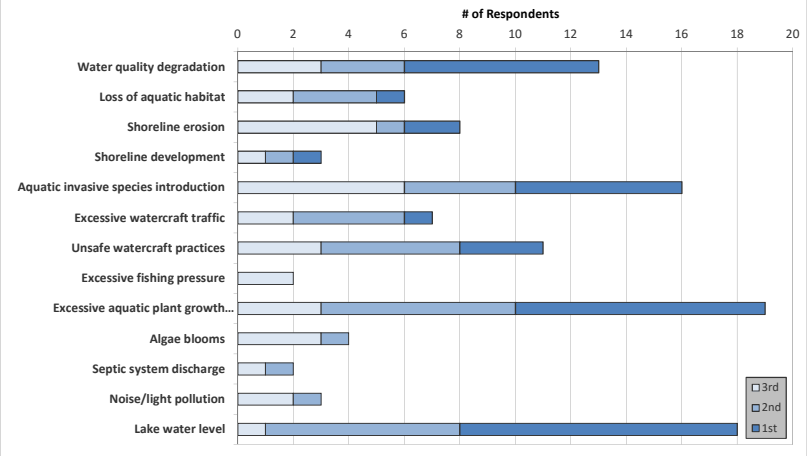
Number	Other (please specify)
1	SMELL FROM GRAVEL/BLACK TOP
2	CAMP CREATES ALOT OF NOISE AND BOAT TRAFFIC
3	Lake water level has negative impact
4	declining loon nesting areas



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

Answer Options	1st	2nd	3rd	Response Count
Water quality degradation	7	3	3	13
Loss of aquatic habitat	1	3	2	6
Shoreline erosion	2	1	5	8
Shoreline development	1	1	1	3
Aquatic invasive species introduction	6	4	6	16
Excessive watercraft traffic	1	4	2	7
Unsafe watercraft practices	3	5	3	11
Excessive fishing pressure	0	0	2	2
Excessive aquatic plant growth (excluding algae)	9	7	3	19
Algae blooms	0	1	3	4
Septic system discharge	0	1	1	2
Noise/light pollution	0	1	2	3
Lake water level	10	7	1	18
Other (please specify)	0	0	2	2
			answered question	40
			skipped question	1

Number	"Other" responses
1	GRAVEL PIT/BLACKTOP CO
2	running 3 camp boats does not allow much room for others.



Towanda Lake Association, Inc (TLA)

25. Before receiving this mailing, have you ever heard of the Towanda Lake Association, Inc (TLA)?

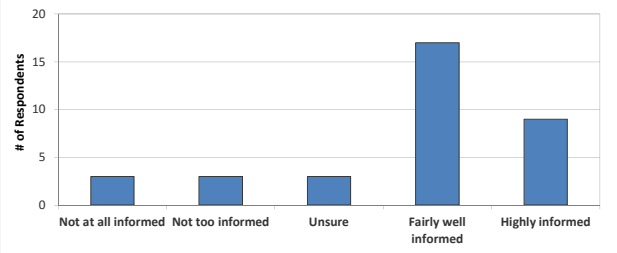
Answer Options	Response Percent	Response Count
Yes	100.0%	40
No	0.0%	0
answered question		40
skipped question		1

26. What is your membership status with the TLA?

Answer Options	Response Percent	Response Count
Current member	84.6%	33
Former member	2.6%	1
Never been a member	12.8%	5
answered question		39
skipped question		2

27. How informed has (or had) the TLA kept you regarding issues with Towanda Lake and its management?

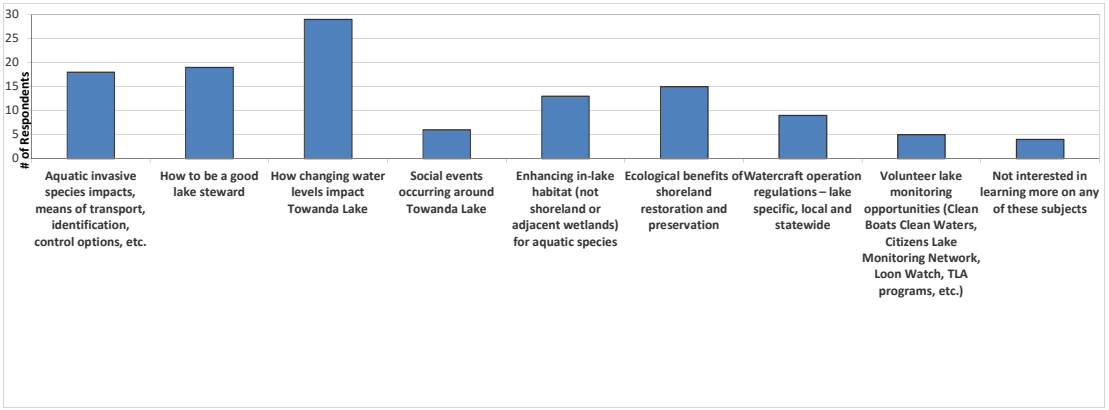
Answer Options	Not at all informed	Not too informed	Unsure	Fairly well informed	Highly informed	Response Count
	3	3	3	17	9	35
					answered question	**35**
					skipped question	**6**



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

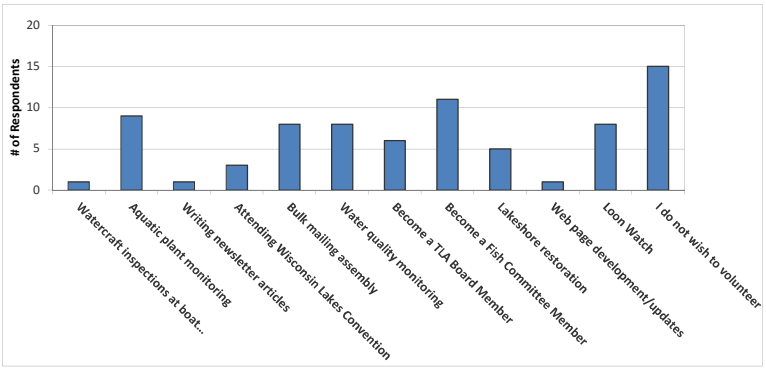
Answer Options	Response Percent	Response Count
Aquatic invasive species impacts, means of transport, identification, control options, etc.	46.2%	18
How to be a good lake steward	48.7%	19
How changing water levels impact Towanda Lake	74.4%	29
Social events occurring around Towanda Lake	15.4%	6
Enhancing in-lake habitat (not shoreland or adjacent wetlands) for aquatic species	33.3%	13
Ecological benefits of shoreland restoration and preservation	38.5%	15
Watercraft operation regulations – lake specific, local and statewide	23.1%	9
Volunteer lake monitoring opportunities (Clean Boats Clean Waters, Citizens Lake Monitoring Network, Loon Watch, TLA programs, etc.)	12.8%	5
Not interested in learning more on any of these subjects	10.3%	4
Some other topic (please specify)	2.6%	1
	answered question	**39**
	skipped question	**2**

Number	Other (please specify)
1	Plans to control Lily Pads



29. Please note that because this survey is anonymous, your answer to this question will not be regarded as a commitment to participate, but instead will be used to gauge potential participation of stakeholders in the TLA.The effective management of Towanda Lake will require the cooperative efforts of numerous volunteers. Please select the activities you would be willing to participate in if the TLA requires additional assistance.

Answer Options	Response Percent	Response Count
Watercraft inspections at boat landings	2.6%	1
Aquatic plant monitoring	23.1%	9
Writing newsletter articles	2.6%	1
Attending Wisconsin Lakes Convention	7.7%	3
Bulk mailing assembly	20.5%	8
Water quality monitoring	20.5%	8
Become a TLA Board Member	15.4%	6
Become a Fish Committee Member	28.2%	11
Lakeshore restoration	12.8%	5
Web page development/updates	2.6%	1
Loon Watch	20.5%	8
I do not wish to volunteer	38.5%	15
answered question		**39**
skipped question		**2**



30. What improvements to the Towanda Lake Area would you like to see in the next 10 years?

Answer Options	Response Count
	30
answered question	**30**
skipped question	**11**

Number	Response Text
1	NO SMELL OF ASPHALT
2	Banning jet ski use. Making sure that all home owners and guest are aware of the lakes gentleman agreement not just the ones in the lake assc. Discuss with camp owners to curve there
3	south end cleaned up floating bogs
4	LEAVE THE LAKE ALONE. IT IS FINE.
5	Without "over managing" the lake or lakeshore owners' individual activities, restore shoreline to a more natural state (where practical), improve fishing by improving habitat & establishing a regular fish stocking program, and protect Towanda Lake from the introduction of invasive aquatic species.
6	control of weed growthplant more fish
7	A culvert at South End of the lake at airport road to control the level of the lake. I was told that at one time a culvert was in place there. I'm not sure if the culvert is still there? Maybe it's just plugged? or maybe it has been removed? I would also like to see a portion of the muck removed from the bottom of the lake. At the present time there is approximately 9 inches of muck in the entire south end of the lake. Control use of power boats & jet skis. Set rules for no power boats & jet skis before 8am or after 6pm, that way the time is reserved to the fisherman. Placement of more fish cribs in the lake which would improve fishing conditions. Remove the vegetation on the south end of the lake that has migrated north over the last 15 years (150 yards) .I'd be happy to discuss any matters of the lake with anyone you can contact me at anytime: house 309-364-3049, cell 309-238-7777, lake house 715-356-2647. Thank you, Scott Wiedman
8	Walleye restockingLimiting noise from quarryPossible "No Wake" timesCheck into what causes strong fuel oil smell at times from quarry - improper fueling or spills??
9	restoration of lake
10	Reduction in weed growth. No Jet skis allowed on the Lake.
11	Leave as is.
12	Increased owner/resident in TLA, Bog growth curtailed, weed growth managed, fluctuating lake level managed.
13	Fish population increases, Improved boat landing, more fish habitat, reduction of bogs
14	Maintain the lake level. As of this writing, level is excessive and causing shoreline erosion. There is no known outlet or an old one has been abandon/removed. I would like to see the serenity of Lake Towanda to be preserved for our next generation.
15	Continue to monitor and support healthy fish and wildlife populations. Recommendations and resources for home owners to address shoreline erosion during periods of high water levels.
16	The south end of the lake weed issue addressed - muck removal.
17	Unsure what improvements we need or are a possibility - but always willing to learn
18	It would be great to swim in the lake again without all the sludge and visual microorganisms.
19	More crappie and walleye fishing improvements, less camp ski boat traffic on weekends when people are trying to use the lake
20	The southern half of the lake is becoming far too weed choked. It is becoming hard to boat & swim in it down that way. Also I feel like the ongoing summer water skiing activities of the Boys Camp utilize a far larger percentage of the lake during peak summer months then they have a right to use. (Especially the slalom ski course they temporarily put in through the narrow part & down into the South end of the lake.) Also, hopefully Towanda can become a better fishing lake in the future. Continually restocking the lake with small walleye might not be the way to go? We would actually like to see the lake be a great pan fish lake, and wonder why Muskies are even in a lake this small? They are probably eating up too many pan fish. We are also concerned about the growing light pollution we see on the lake. More people unfortunately installing very bright security lighting right down near the waterfront. Some of these lights go on automatically every evening year round. Not good! This is distracting & unnatural & greatly bothers some of us who live here year round.
21	Elimination of fireworks.
22	More fish Stocking
23	reduce the lily pad takeover
24	i would like to see the south end of the lake cleaned up and made more useable
25	Clear description of property rights re: lake shore use and development and enforcement -- the do's and don'ts that already exist
26	Adding fish sticks and fish cribs. Perhaps encouraging members to harvest the very abundant 14" bass and small pike Continued monitoring of shoreline habitat, water quality and fishing on the lake
27	Happy with current lake - Maybe a dock at the boat landing.
28	Fish habitat, cribs, etc.
29	Work with the Camp to request they not use ski boats on weekends, to reduce traffic.
30	Stock more walleye

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

Answer Options	Response Count
	15
answered question	15
skipped question	26

Number	Response Text
1	SMELL OF ASPHALT HAS BEEN A CONTINUING PROBLEM DURING OWNERSHIP OF THIS PROPERTY
2	Lines of communication need to
3	water level great now
4	MIS LEADING INFORMATION AND STUPID IDEAS TO DRILL FOR A SPRING TO FEED THE LAKE WHICH THE DNR KNOCKED DOWN. THE LAKE IS FINE. QUIT SPENDING MONEY ON CONSULTING. ITS NOT NEEDED
5	Avoid the temptation to over manage the lake. Just a few years ago we were concerned with record-low lake levels and excessive weed/plant growth in shallow areas. Today the lake is at relatively high levels and it appears that weed/plant growth has returned to a more normal state. Given the opportunity, nature will care for the lake and correct for most lake issues. We do, however, need to protect the lake from the introduction of invasive species, encourage lakeshore owners to maintain a more natural shoreline (where practical) and be aware of activities that adversely impact lake/ water quality.
6	It was hard to answer many of these questions without having access to data regarding the lakes current status relative to each area of concern.
7	See above.
8	Towanda Lake is a gem,which is why we own property here. Being a seepage lake, Towanda is susceptible to fluctuations in both weather trends and human activities. We all have a responsibility to minimize negative man made impacts and be conscientious custodians of our lake environment.
9	Seems like a lot of bog growth on the south end of the lake. Not sure if it can be stopped.
10	I think it's fantastic that the lake water levels are way up from the drought years of about a decade ago. Being primarily a "seepage" lake, Towanda now feels much more like a healthier lake concerning the higher water level, then when we bought our lake home here back in 2012. The primary thing I would like to see improved though is the growing number of weeds down in the southern half. It's getting harder to utilize the lake down there. Harder & harder to get motorized boats through in the southern part. People need to stop putting fertilizer on their lawns that slope down to the lake. We maintain a very natural lake front & wish everyone on Towanda would do so, and forget about maintaining grass lawns right up to the shoreline. Too much fertilizer is being used, with rain taking run off into the lake water & promoting weed growth.
11	Thank you to those of you who volunteer your time and expertises.
12	Love here, I have attended some meetings when had rented to see if we liked it here, was a little cold because we had not bought yet. Love here! Believe in and will join Lake Association this year!
13	TLA should regulate use of the lake; water ski hours, speed limits, no wake zones, etc.? No use of PWC's. Entry/exit from south bay should be a no wake zone. Buoys should be placed in the channel to the south bay and to mark the flat rock pile which is a problem when lake water level is lower.
14	N/A
15	There was less boat traffic on Towanda when we first bought our place.

C

APPENDIX C

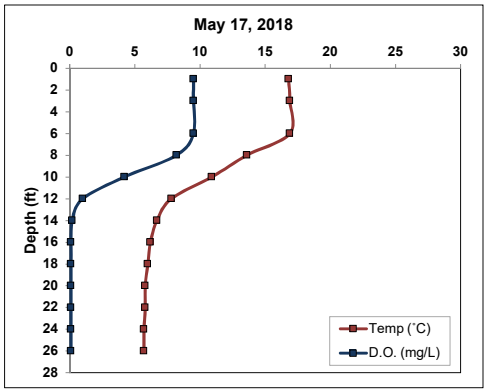
Water Quality Data

Towanda Lake

Date: 5/17/2018
Time: 8:00
Weather: 75% clouds, 55°F, 5mph wind
Entry: JLW

Max Depth: 27.4
LS Depth (ft): 3.0
LB Depth (ft): 24.0
Secchi Depth (ft): 7.6

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	16.8	9.5	98%		
3	16.9	9.5	98%	7.6	
6	16.9	9.5	98%		
8	13.6	8.2	79%		
10	10.9	4.2	38%		
12	7.8	1.0	8%	6.8	
14	6.7	0.2	2%		
16	6.2	0.1	1%		
18	6.0	0.1	1%		
20	5.8	0.1	1%		
22	5.8	0.1	1%		
24	5.7	0.1	1%	6.5	
26	5.7	0.1	1%		



Parameter	LS	LB
Total P (µg/L)	15.90	33.90
Dissolved P (µg/L)	ND	3.00
Chl-*a* (µg/L)	2.32	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	0.55	1.40
Lab Cond. (µS/cm)	50.50	80.60
Lab pH	7.13	6.50
Alkalinity (mg/L $CaCO_3$)	16.40	28.90
Total Susp. Solids (mg/L)	ND	ND
Calcium (mg/L)	4.49	NA
Magnesium (mg/L)	1.85	NA
Hardness (mg/L)	18.80	NA
Color (SU)	20.00	NA
Turbidity (NTU)	NA	NA

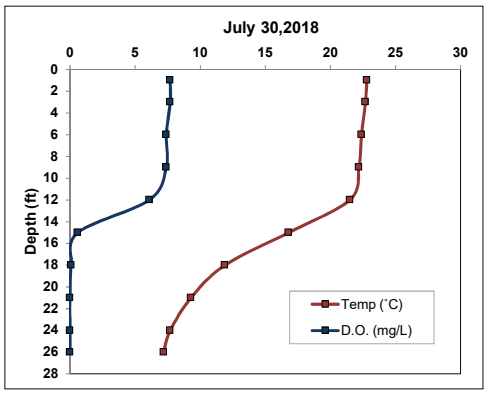
Data collected by JMB (Onterra). Moved water quality point west of existing point.

Towanda Lake

Date: 7/30/2018
Time: 10:15
Weather: sunny, 0% clouds, 72°F
Entry: HAL

Max Depth: 27.1
LS Depth (ft): 3.0
LB Depth (ft): 24.0
Secchi Depth (ft): 12.0

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	22.8	7.7	90%		
3	22.7	7.7	90%		
6	22.4	7.4	85%		
9	22.2	7.4	85%		
12	21.5	6.1	69%		
15	16.8	0.6	6%		
18	11.9	0.1	1%		
21	9.3	0.0	0%		
24	7.7	0.0	0%		
26	7.2	0.0	0%		



Parameter	LS	LB
Total P (µg/L)	11.30	63.50
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	2.60	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	572.00	NA
Lab Cond. (µS/cm)	106.00	93.40
Lab pH	6.80	6.35
Alkalinity (mg/L $CaCO_3$)	44.30	34.50
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	20.00	NA
Turbidity (NTU)	NA	NA

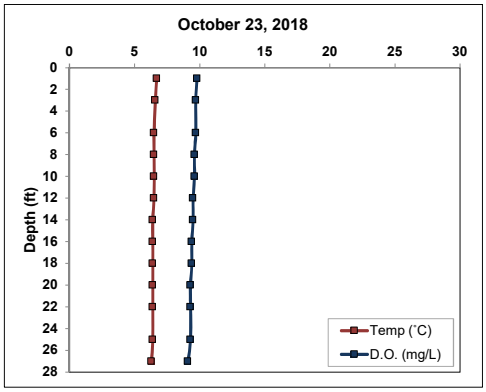
Data collected by Onterra (TAH & PJG). Core Coordinates: 542376.56, 607383.60. Cores @ 0-1 cm, 43-44cm, 45 cm long

Towanda Lake

Date: 10/23/2018
Time: 11:15
Weather: 5mph winds, 45°F, 100% clouds, snowing
Entry: HAL

Max Depth: 28.2
LS Depth (ft): 3.0
LB Depth (ft): 25.0
Secchi Depth (ft): 6.9

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	6.7	9.8	80%		
3	6.6	9.7	79%		
6	6.5	9.7	79%		
8	6.5	9.6	78%		
10	6.5	9.6	78%		
12	6.5	9.5	77%		
14	6.4	9.5	77%		
16	6.4	9.4	76%		
18	6.4	9.4	76%		
20	6.4	9.3	76%		
22	6.4	9.3	76%		
25	6.4	9.3	76%		
27	6.3	9.1	73%		



Parameter	LS	LB
Total P (µg/L)	18.10	12.10
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	5.98	NA
TKN (µg/L)	NA	NA
$NO_3 + NO_2$-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	ND	ND
Calcium (mg/L)	NA	NA
Magnesium (mg/L)	NA	NA
Hardness (mg/L)	NA	NA
Color (SU)	NA	NA
Turbidity (NTU)	NA	NA

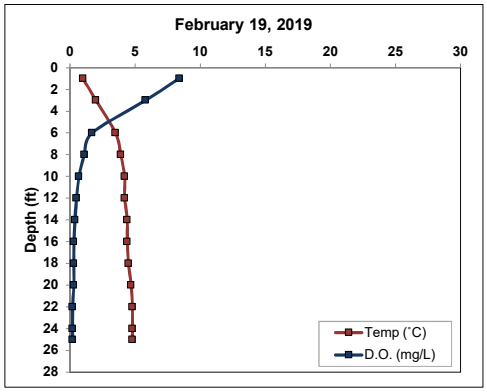
Data collected by Onterra (JMB, AMS).

Towanda Lake

Date: 2/19/2019
Time: 12:30
Weather: 0% clouds, 2 mph winds, 2deg F, 1.8' ice
Entry: HAL

Max Depth: 27.1
LS Depth (ft): 3.0
LB Depth (ft): 24.0
Secchi Depth (ft): 8.5

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)
1	1.0	8.4	59%		
3	2.0	5.8	42%		
6	3.5	1.7	13%		
8	3.9	1.1	8%		
10	4.2	0.7	5%		
12	4.2	0.5	4%		
14	4.4	0.4	3%		
16	4.4	0.3	2%		
18	4.5	0.3	2%		
20	4.7	0.3	2%		
22	4.8	0.2	2%		
24	4.8	0.2	2%		
25	4.8	0.2	2%		



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

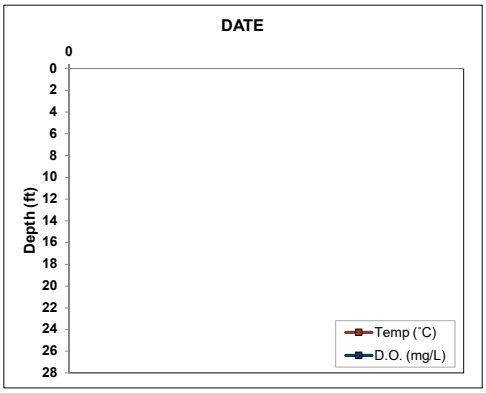
Data collected by Onterra (JMB, AMS) Noted in YB that the bottom sample smelled like sulfur "BAD"

Towanda Lake

Date:
Time:
Weather:
Entry:

Max Depth:
LS Depth (ft):
LB Depth (ft):
Secchi Depth (ft):

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)



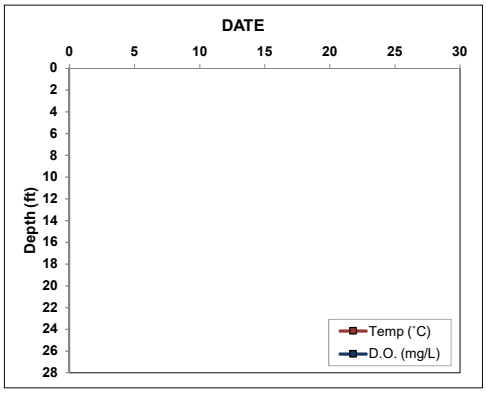
Parameter	LS	LB
Total P (µg/L)	NA	NA
Dissolved P (µg/L)	NA	NA
Chl-*a* (µg/L)	NA	NA
TKN (µg/L)	NA	NA
NO_3 + NO_2-N (µg/L)	NA	NA
NH_3-N (µg/L)	NA	NA
Total N (µg/L)	NA	NA
Lab Cond. (µS/cm)	NA	NA
Lab pH	NA	NA
Alkalinity (mg/L $CaCO_3$)	NA	NA
Total Susp. Solids (mg/L)	NA	NA
Calcium (mg/L)	NA	NA
Magnesium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

Towanda Lake

Date:
Time:
Weather:
Entry:

Max Depth:
LS Depth (ft):
LB Depth (ft):
Secchi Depth (ft):

Depth (ft)	Temp (˚C)	D.O. (mg/L)	% Saturation	pH	Sp. Cond. (µS/cm)



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

Water Quality Data

2018-2019	Surface		Bottom	
Parameter	Count	Mean	Count	Mean
Secchi Depth (feet)	4	8.8	NA	NA
Total P (µg/L)	3	15.1	3	36.5
Dissolved P (µg/L)	1	ND	1	3.0
Chl a (µg/L)	3	3.6	0	NA
TKN (µg/L	0	NA	0	NA
NO_3+NO_2-N (µg/L)	0	NA	0	NA
NH_3-N (µg/L)	0	NA	0	NA
Total N (µg/L)	2	286.3	1	1.4
Lab Cond. (µS/cm)	2	78.3	2	87.0
Alkal (mg/l $CaCO_3$)	2	30.4	2	31.7
Total Susp. Solids (mg/l)	2	ND	2	ND
Calcium (mg/L)	1	4.5	0	NA
Magnesium (mg/L)	1	1.9	0	NA
Hardness (mg/L)	1	18.8	0	NA
Color (SU)	2	20.0	0	NA
Turbidity (NTU)	0	NA	0	NA

Trophic State Index (TSI)

Year	TP	Chl-a	Secchi
1979			47.2
1992			42.3
1993			40.5
1994			41.3
1995			42.8
1996			42.6
1997			42.6
1998			42.6
1999			
2000			46.9
2001	43.2	46.3	44.2
2002	39.6	47.7	44.8
2003	44.4	47.4	44.7
2004	40.8	53.1	48.1
2005	40.8	48.0	46.9
2006	42.2	48.7	
2007	40.8	48.2	49.8
2008	43.5	45.4	48.2
2009	44.1	46.3	46.7
2010	41.5	47.9	47.0
2011	42.9	52.1	47.5
2012	42.2	48.9	46.3
2013	39.8	49.8	45.3
2014	39.9	49.7	44.9
2015	42.9	44.9	45.1
2016	43.2	46.9	44.8
2017	43.9	48.4	44.7
2018	39.5	44.5	44.1
All Years (Weighted)	41.9	48.0	46.1
DSL Median	43.2	43.2	42.4
NLF Ecoregion Median	48.1	47.5	45.7

	Secchi (feet)				Chlorophyll-*a* (µg/L)				Total Phosphorus (µg/L)			
	Growing Season		Summer		Growing Season		Summer		Growing Season		Summer	
Year	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean	Count	Mean
1979	1	8.0	1	8.0								
1992	6	10.5	4	11.2								
1993	6	12.2	4	12.7								
1994	7	12.2	6	12.0								
1995	8	10.3	5	10.8								
1996	5	10.1	3	11.0								
1997	3	10.2	1	11.0								
1998	4	11.4	2	11.0								
1999	0		0									
2000	6	9.1	4	8.1								
2001	14	10.0	10	9.8	6	5.5	4	5.0	7	12.9	4.0	15.0
2002	4	9.6	3	9.4	2	5.7	2	5.7	4	11.8	3.0	11.7
2003	5	9.5	3	9.5	5	6.1	4	5.6	6	15.8	4.0	16.3
2004	3	8.0	2	7.5	3	9.9	3	9.9	4	13.5	3.0	12.7
2005	4	8.2	3	8.2	4	6.4	3	5.9	5	12.6	3.0	12.7
2006	0		0		1	6.3	1	6.3	1	14.0	1.0	14.0
2007	6	7.2	3	6.7	3	6.0	3	6.0	4	13.8	3.0	12.7
2008	19	7.3	11	7.5	3	4.5	3	4.5	4	19.0	3.0	15.3
2009	23	8.5	15	8.3	3	5.0	3	5.0	4	16.0	3.0	16.0
2010	29	8.4	15	8.1	3	5.8	3	5.8	4	14.3	3.0	13.3
2011	15	8.2	10	7.8	3	8.9	3	8.9	4	14.5	3.0	14.7
2012	18	8.9	11	8.5	3	6.5	3	6.5	4	14.0	3.0	14.0
2013	14	9.5	7	9.1	2	7.1	2	7.1	3	13.4	2.0	11.9
2014	20	9.6	13	9.4	3	7.0	3	7.0	4	11.5	3.0	11.9
2015	22	9.9	11	9.2	3	4.3	3	4.3	4	14.8	3.0	14.7
2016	22	10.5	10	9.5	3	5.2	3	5.2	4	15.3	3.0	15.0
2017	22	10.1	12	9.5	3	6.2	3	6.2	3	15.8	3.0	15.8
2018	21	9.5	12	9.9	6	4.1	4	4.1	7	13.4	4.0	11.6
All Years (Weighted)		9.4		9.1		6.0		6.0		14.2		13.9
DSL Median				11.2				3.6				15.0
NLF Ecoregion Median				8.9				5.6				21.0
Mean 2009-18				8.9				5.9				13.9

D

APPENDIX D

Watershed Analysis WiLMS Results

Date: 6/24/2019 Scenario: Current w/ septic and developed props

Lake Id: Towanda Lake **Note: Changed 66 acres forest to developed properties.**

Watershed Id: 0

Hydrologic and Morphometric Data

Tributary Drainage Area: 444.0 acre
Total Unit Runoff: 14 in.
Annual Runoff Volume: 518.0 acre-ft
Lake Surface Area <As>: 144.0 acre
Lake Volume <V>: 1362.0 acre-ft
Lake Mean Depth <z>: 9.5 ft
Precipitation - Evaporation: 5.5 in.
Hydraulic Loading: 584.0 acre-ft/year
Areal Water Load <qs>: 4.1 ft/year
Lake Flushing Rate <p>: 0.43 1/year
Water Residence Time: 2.33 year
Observed spring overturn total phosphorus (SPO): 15.2 mg/m^3
Observed growing season mean phosphorus (GSM): 14.0 mg/m^3
% 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	6.0	0.50	1.00	3.00	4.2	1	2	7
Mixed AG	0.0	0.30	0.80	1.40	0.0	0	0	0
Pasture/Grass	78.0	0.10	0.30	0.50	16.3	3	9	16
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)	1.0	0.05	0.10	0.25	0.1	0	0	0
Wetlands	37.0	0.10	0.10	0.10	2.6	1	1	1
Forest	256	0.05	0.09	0.18	16.1	5	9	19
Developed Properties	66	0.3	0.5	0.8	23.0	8	13	21
Lake Surface	144.0	0.10	0.30	1.00	30.1	6	17	58

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	89				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		0.53	4.45	14.24	7.7

TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	56.1	128.0	302.5	100.0
Total Loading (kg)	25.4	58.0	137.2	100.0
Areal Loading (lb/ac-year)	0.39	0.89	2.10	
Areal Loading (mg/m^2-year)	43.66	99.61	235.44	
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)	42.1	79.6	142.6	92.3
Total NPS Loading (kg)	19.1	36.1	64.7	92.3

Water and Nutrient Outflow Module

Date: 6/24/2019 Scenario: 1
Average Annual Surface Total Phosphorus: 14.6mg/m^3
Annual Discharge: 5.84E+002 AF => 7.20E+005 m^3
Annual Outflow Loading: 22.0 LB => 10.0 kg

Phosphorus Prediction and Uncertainty Analysis Module

Date: 6/24/2019 Scenario: 3
Observed spring overturn total phosphorus (SPO): 15.2 mg/m^3
Observed growing season mean phosphorus (GSM): 14.0 mg/m^3
Back calculation for SPO total phosphorus: 0.0 mg/m^3
Back calculation GSM phosphorus: 0.0 mg/m^3
% Confidence Range: 70%
Nurenberg Model Input - Est. Gross Int. Loading: 0 kg

Lake Phosphorus Model	Low Total P (mg/m^3)	Most Likely Total P (mg/m^3)	High Total P (mg/m^3)	Predicted -Observed (mg/m^3)	% Dif.
Walker, 1987 Reservoir	16	36	86	22	157
Canfield-Bachmann, 1981 Natural Lake	15	28	50	14	100
Canfield-Bachmann, 1981 Artificial Lake	15	26	42	12	86
Rechow, 1979 General	3	8	18	-6	-43
Rechow, 1977 Anoxic	23	53	125	39	279
Rechow, 1977 water load<50m/year	8	19	44	5	36
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	16	36	86	21	138
Vollenweider, 1982 Combined OECD	13	27	54	12	82
Dillon-Rigler-Kirchner	9	19	46	4	26
Vollenweider, 1982 Shallow Lake/Res.	10	21	46	6	41
Larsen-Mercier, 1976	14	32	75	17	112
Nurnberg, 1984 Oxic	8	18	42	4	29

Lake Phosphorus Model	Confidence Lower Bound	Confidence Upper Bound	Parameter Fit?	Back Calculation (kg/year)	Model Type
Walker, 1987 Reservoir	20	69	Tw	0	GSM
Canfield-Bachmann, 1981 Natural Lake	9	81	FIT	1	GSM
Canfield-Bachmann, 1981 Artificial Lake	8	75	FIT	1	GSM
Rechow, 1979 General	4	15	FIT	0	GSM
Rechow, 1977 Anoxic	30	100	FIT	0	GSM
Rechow, 1977 water load<50m/year	10	36	FIT	0	GSM
Rechow, 1977 water load>50m/year	N/A	N/A	N/A	N/A	N/A
Walker, 1977 General	17	73	FIT	0	SPO
Vollenweider, 1982 Combined OECD	12	52	FIT	0	ANN
Dillon-Rigler-Kirchner	11	37	P L qs	0	SPO
Vollenweider, 1982 Shallow Lake/Res.	10	41	FIT	0	ANN
Larsen-Mercier, 1976	19	60	P Pin	0	SPO
Nurnberg, 1984 Oxic	9	35	FIT	0	ANN

E

APPENDIX E

Aquatic Plant Survey Data

Point Number	Latitude	Longitude	ID	Lake Name	County	Date	Field crew	Depth	Sediment	Pole; Rope	Comments	Total Rake Fullness	Brasenia schreberi	Chara spp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Eriocaulon aquaticum	Juncus pelocarpus	Lemna minor	Myriophyllum tenellum	Najas flexilis	Najas gracillima	Nitella spp.	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton berchtoldii	Potamogeton ephydrus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton spirillus	Schoenoplectus subterminalis	Spargenium fluctuans	Utricularia gibba	Utricularia intermedia	Utricularia minor	Utricularia resupinata	Utricularia vulgaris	Vallisneria americana	Freshwater sponge	Filamentous algae
1	45.941235	-89.715669	18	Towanda	Vilas	7/12/2018	EJH & HAL	4	Sand	Pole	SAMPLED	1	1																	1	1													
2	45.940884	-89.715671	17	Towanda	Vilas	7/12/2018	EJH & HAL	9	Muck	Pole	SAMPLED	1																				1												
3	45.940533	-89.715673	15	Towanda	Vilas	7/12/2018	EJH & HAL	11	Muck	Pole	SAMPLED	1																				1												
4	45.940182	-89.715675	10	Towanda	Vilas	7/12/2018	EJH & HAL	12	Muck	Pole	SAMPLED	0																																
5	45.939831	-89.715676	0	Towanda	Vilas	7/12/2018	EJH & HAL	5	Rock	Pole	SAMPLED	1	1																															
6	45.939480	-89.715678	9	Towanda	Vilas	7/12/2018	EJH & HAL	0			TERRESTRIAL																																	
7	45.940882	-89.715168	19	Towanda	Vilas	7/12/2018	EJH & HAL	13	Muck	Pole	SAMPLED	0																																
8	45.940531	-89.715170	14	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
9	45.940180	-89.715171	11	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	1																						1											
10	45.939829	-89.715173	7	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																																
11	45.939478	-89.715175	5	Towanda	Vilas	7/12/2018	EJH & HAL	14	Rock	Pole	SAMPLED	0																																
12	45.940881	-89.714665	20	Towanda	Vilas	7/12/2018	EJH & HAL	13	Muck	Pole	SAMPLED	0																																
13	45.940530	-89.714667	13	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																																
14	45.940179	-89.714668	12	Towanda	Vilas	7/12/2018	EJH & HAL	0			DEEP																																
15	45.939828	-89.714670	6	Towanda	Vilas	7/12/2018	EJH & HAL	0			DEEP																																
16	45.939477	-89.714672	4	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
17	45.939126	-89.714674	3	Towanda	Vilas	7/12/2018	EJH & HAL	0			SWIM AREA																																
18	45.940880	-89.714162	21	Towanda	Vilas	7/12/2018	EJH & HAL	12	Muck	Pole	SAMPLED	1																						1									1		
19	45.940529	-89.714163	22	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
20	45.940178	-89.714165	16	Towanda	Vilas	7/12/2018	EJH & HAL	0			DEEP																																
21	45.939827	-89.714167	141	Towanda	Vilas	7/12/2018	EJH & HAL	20			DEEP																																
22	45.939476	-89.714169	2	Towanda	Vilas	7/12/2018	EJH & HAL	19			DEEP																																
23	45.939125	-89.714171	1	Towanda	Vilas	7/12/2018	EJH & HAL	3	Rock	Pole	SAMPLED	0																																
24	45.943336	-89.713646	34	Towanda	Vilas	7/12/2018	EJH & HAL	0			TERRESTRIAL																																
25	45.940879	-89.713659	25	Towanda	Vilas	7/12/2018	EJH & HAL	9	Sand	Pole	SAMPLED	0																																
26	45.940528	-89.713660	23	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
27	45.940177	-89.713662	27	Towanda	Vilas	7/12/2018	EJH & HAL	20			DEEP																																
28	45.939826	-89.713664	0	Towanda	Vilas	7/12/2018		0			DEEP																																
29	45.939475	-89.713666	12	Towanda	Vilas	7/11/2018	JLW & NLS	23			DEEP																																
30	45.939124	-89.713668	11	Towanda	Vilas	7/11/2018	JLW & NLS	16		Rope	SAMPLED	0																																
31	45.938773	-89.713669	3	Towanda	Vilas	7/11/2018	JLW & NLS	4	Sand	Pole	SAMPLED	1	1																														
32	45.943335	-89.713143	35	Towanda	Vilas	7/12/2018	EJH & HAL	3	Muck	Pole	SAMPLED	1								1								1	1								1			1		
33	45.942984	-89.713145	36	Towanda	Vilas	7/12/2018	EJH & HAL	0			NONNAVIGABLE (PLANTS)																																
34	45.940877	-89.713155	26	Towanda	Vilas	7/12/2018	EJH & HAL	13	Rock	Pole	SAMPLED	0																																
35	45.940526	-89.713157	24	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																																
36	45.940175	-89.713159	28	Towanda	Vilas	7/12/2018	EJH & HAL	0			DEEP																																
37	45.939824	-89.713161	0	Towanda	Vilas	7/12/2018		0			DEEP																																
38	45.939473	-89.713163	13	Towanda	Vilas	7/11/2018	JLW & NLS	26			DEEP																																
39	45.939122	-89.713164	10	Towanda	Vilas	7/11/2018	JLW & NLS	19			DEEP																																
40	45.938771	-89.713166	4	Towanda	Vilas	7/11/2018	JLW & NLS	12	Muck	Pole	SAMPLED	1																1					1										
41	45.938420	-89.713168	2	Towanda	Vilas	7/11/2018	JLW & NLS	3	Sand	Pole	SAMPLED	1				1																1											
42	45.943333	-89.712640	37	Towanda	Vilas	7/12/2018	EJH & HAL	5	Sand	Pole	SAMPLED	1						1																						1	1			
43	45.942982	-89.712641	40	Towanda	Vilas	7/12/2018	EJH & HAL	6	Muck	Pole	SAMPLED	1																			1									1	1			
44	45.942631	-89.712643	33	Towanda	Vilas	7/12/2018	EJH & HAL	3	Sand	Pole	SAMPLED	1	1		V								1										1			1		1				
45	45.941578	-89.712649	32	Towanda	Vilas	7/12/2018	EJH & HAL	6	Sand	Pole	SAMPLED	1	1											1																		
46	45.941227	-89.712650	31	Towanda	Vilas	7/12/2018	EJH & HAL	12	Sand	Pole	SAMPLED	0																																
47	45.940876	-89.712652	30	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
48	45.940525	-89.712654	29	Towanda	Vilas	7/12/2018	EJH & HAL	20			DEEP																																
49	45.940174	-89.712656	0	Towanda	Vilas	7/12/2018		0			DEEP																																
50	45.939823	-89.712658	0	Towanda	Vilas	7/12/2018		0			DEEP																																
51	45.939472	-89.712660	14	Towanda	Vilas	7/11/2018	JLW & NLS	26			DEEP																																
52	45.939121	-89.712661	9	Towanda	Vilas	7/11/2018	JLW & NLS	20			DEEP																																
53	45.938770	-89.712663	5	Towanda	Vilas	7/11/2018	JLW & NLS	15	Muck	Pole	SAMPLED	0																																
54	45.938419	-89.712665	1	Towanda	Vilas	7/11/2018	JLW & NLS	5	Sand	Pole	SAMPLED	0																																
55	45.943332	-89.712136	38	Towanda	Vilas	7/12/2018	EJH & HAL	6	Muck	Pole	SAMPLED	2											2										1										
56	45.942981	-89.712138	39	Towanda	Vilas	7/12/2018	EJH & HAL	9	Muck	Pole	SAMPLED	2																					2										
57	45.942630	-89.712140	41	Towanda	Vilas	7/12/2018	EJH & HAL	10	Muck	Pole	SAMPLED	1		1																			1									1		
58	45.942279	-89.712142	42	Towanda	Vilas	7/12/2018	EJH & HAL	11	Muck	Pole	SAMPLED	1																					1										
59	45.941928	-89.712144	43	Towanda	Vilas	7/12/2018	EJH & HAL	12	Muck	Pole	SAMPLED	1																					1										

Point Number	Latitude	Longitude	ID	Lake Name	County	Date	Field crew	Depth	Sediment	Pole; Rope	Comments	Total Rake Fullness	Brasenia schreberi	Chara spp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Eriocaulon aquaticum	Juncus pelocarpus	Lemna minor	Myriophyllum tenellum	Najas flexilis	Najas gracillima	Nitella spp.	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton berchtoldii	Potamogeton epihydrus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton spirillus	Schoenoplectus subterminalis	Sparganium fluctuans	Utricularia gibba	Utricularia intermedia	Utricularia minor	Utricularia resupinata	Utricularia vulgaris	Vallisneria americana	Freshwater sponge	Filamentous algae
60	45.941577	-89.712146	44	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
61	45.941226	-89.712147	45	Towanda	Vilas	7/12/2018	EJH & HAL	15		Pole	SAMPLED	0																																
62	45.940875	-89.712149	46	Towanda	Vilas	7/12/2018	EJH & HAL	0			DEEP																															
63	45.940524	-89.712151	0	Towanda	Vilas	7/12/2018		0			DEEP																															
64	45.940173	-89.712153	0	Towanda	Vilas	7/12/2018		0			DEEP																															
65	45.939822	-89.712155	19	Towanda	Vilas	7/11/2018	JLW & NLS	0			DEEP																															
66	45.939471	-89.712156	15	Towanda	Vilas	7/11/2018	JLW & NLS	22			DEEP																															
67	45.939120	-89.712158	8	Towanda	Vilas	7/11/2018	JLW & NLS	16		Rope	SAMPLED	0																														
68	45.938769	-89.712160	6	Towanda	Vilas	7/11/2018	JLW & NLS	8	Sand	Pole	SAMPLED	1																						1								
69	45.943331	-89.711633	53	Towanda	Vilas	7/12/2018	EJH & HAL	9	Sand	Pole	SAMPLED	1																						1								
70	45.942980	-89.711635	52	Towanda	Vilas	7/12/2018	EJH & HAL	13	Muck	Pole	SAMPLED	1																						1								
71	45.942629	-89.711637	51	Towanda	Vilas	7/12/2018	EJH & HAL	14	Muck	Pole	SAMPLED	0																														
72	45.942278	-89.711639	50	Towanda	Vilas	7/12/2018	EJH & HAL	15	Muck	Pole	SAMPLED	0																														
73	45.941927	-89.711641	49	Towanda	Vilas	7/12/2018	EJH & HAL	15		Rope	SAMPLED	0																														
74	45.941576	-89.711642	48	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																														
75	45.941225	-89.711644	47	Towanda	Vilas	7/12/2018	EJH & HAL	0			DEEP																															
76	45.940874	-89.711646	139	Towanda	Vilas	7/12/2018	EJH & HAL	22			DEEP																															
77	45.940523	-89.711648	0	Towanda	Vilas	7/12/2018		0			DEEP																															
78	45.940172	-89.711650	0	Towanda	Vilas	7/12/2018		0			DEEP																															
79	45.939821	-89.711651	17	Towanda	Vilas	7/11/2018	JLW & NLS	24			DEEP																															
80	45.939470	-89.711653	16	Towanda	Vilas	7/11/2018	JLW & NLS	17		Rope	SAMPLED	0																														
81	45.939119	-89.711655	7	Towanda	Vilas	7/11/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																	
82	45.943680	-89.711128	54	Towanda	Vilas	7/12/2018	EJH & HAL	6	Sand	Pole	SAMPLED	1																						1								
83	45.943329	-89.711130	55	Towanda	Vilas	7/12/2018	EJH & HAL	14	Muck	Pole	SAMPLED	1																						1								
84	45.942978	-89.711132	56	Towanda	Vilas	7/12/2018	EJH & HAL	15		Rope	SAMPLED	0																														
85	45.942627	-89.711134	57	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																														
86	45.942276	-89.711136	58	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																														
87	45.941925	-89.711137	59	Towanda	Vilas	7/12/2018	EJH & HAL	0			DEEP																															
88	45.941574	-89.711139	137	Towanda	Vilas	7/12/2018	EJH & HAL	21			DEEP																															
89	45.941223	-89.711141	138	Towanda	Vilas	7/12/2018	EJH & HAL	22			DEEP																															
90	45.940872	-89.711143	140	Towanda	Vilas	7/12/2018	EJH & HAL	23			DEEP																															
91	45.940521	-89.711145	0	Towanda	Vilas	7/12/2018		0			DEEP																															
92	45.940170	-89.711147	22	Towanda	Vilas	7/11/2018	JLW & NLS	0			DEEP																															
93	45.939819	-89.711148	18	Towanda	Vilas	7/11/2018	JLW & NLS	19			DEEP																															
94	45.944030	-89.710623	66	Towanda	Vilas	7/12/2018	EJH & HAL	5	Sand	Pole	SAMPLED	1																						1			1			1		
95	45.943679	-89.710625	65	Towanda	Vilas	7/12/2018	EJH & HAL	11	Muck	Pole	SAMPLED	2																						2							1	
96	45.943328	-89.710627	64	Towanda	Vilas	7/12/2018	EJH & HAL	15	Muck	Pole	SAMPLED	1																						1								
97	45.942977	-89.710629	63	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																														
98	45.942626	-89.710631	62	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																														
99	45.942275	-89.710632	61	Towanda	Vilas	7/12/2018	EJH & HAL	19			DEEP																															
100	45.941924	-89.710634	60	Towanda	Vilas	7/12/2018	EJH & HAL	19			DEEP																															
101	45.941573	-89.710636	136	Towanda	Vilas	7/12/2018	EJH & HAL	21			DEEP																															
102	45.941222	-89.710638	135	Towanda	Vilas	7/12/2018	EJH & HAL	22			DEEP																															
103	45.940871	-89.710640	134	Towanda	Vilas	7/12/2018	EJH & HAL	23			DEEP																															
104	45.940520	-89.710642	0	Towanda	Vilas	7/12/2018		0			DEEP																															
105	45.940169	-89.710643	21	Towanda	Vilas	7/11/2018	JLW & NLS	23			DEEP																															
106	45.939818	-89.710645	20	Towanda	Vilas	7/11/2018	JLW & NLS	13	Sand	Pole	SAMPLED	0																														
107	45.944029	-89.710120	67	Towanda	Vilas	7/12/2018	EJH & HAL	8	Sand	Pole	SAMPLED	2		1									1										1	2							1	
108	45.943678	-89.710122	68	Towanda	Vilas	7/12/2018	EJH & HAL	12	Muck	Pole	SAMPLED	3																						3								
109	45.943327	-89.710124	69	Towanda	Vilas	7/12/2018	EJH & HAL	15	Muck	Pole	SAMPLED	0																														
110	45.942976	-89.710126	70	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																														
111	45.942625	-89.710128	71	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																														
112	45.942274	-89.710129	72	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																														
113	45.941923	-89.710131	73	Towanda	Vilas	7/12/2018	EJH & HAL	19			DEEP																															
114	45.941572	-89.710133	131	Towanda	Vilas	7/12/2018	EJH & HAL	20			DEEP																															
115	45.941221	-89.710135	132	Towanda	Vilas	7/12/2018	EJH & HAL	20			DEEP																															
116	45.940870	-89.710137	133	Towanda	Vilas	7/12/2018	EJH & HAL	22			DEEP																															
117	45.940519	-89.710138	0	Towanda	Vilas	7/12/2018		0			DEEP																															
118	45.940168	-89.710140	23	Towanda	Vilas	7/11/2018	JLW & NLS	20			DEEP																															

Point Number	Latitude	Longitude	ID	Lake Name	County	Date	Field crew	Depth	Sediment	Pole; Rope	Comments	Total Rake Fullness	Brasenia schreberi	Chara spp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Eriocaulon aquaticum	Juncus pelocarpus	Lemna minor	Myriophyllum tenellum	Najas flexilis	Najas gracillima	Nitella spp.	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton berchtoldii	Potamogeton epihydrus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton spirillus	Schoenoplectus subterminalis	Sparganium fluctuans	Utricularia gibba	Utricularia intermedia	Utricularia minor	Utricularia resupinata	Utricularia vulgaris	Vallisneria americana	Freshwater sponge	Filamentous algae
119	45.939817	-89.710142	24	Towanda	Vilas	7/11/2018	JLW & NLS	5	Rock	Pole	SAMPLED	0																																
120	45.944379	-89.709615	81	Towanda	Vilas	7/12/2018	EJH & HAL	6	Muck	Pole	SAMPLED	1																			1										1			
121	45.944028	-89.709617	80	Towanda	Vilas	7/12/2018	EJH & HAL	8	Muck	Pole	SAMPLED	1										1																		1			
122	45.943677	-89.709619	79	Towanda	Vilas	7/12/2018	EJH & HAL	11	Muck	Pole	SAMPLED	0																																
123	45.943326	-89.709621	78	Towanda	Vilas	7/12/2018	EJH & HAL	14	Muck	Pole	SAMPLED	0																																
124	45.942975	-89.709623	77	Towanda	Vilas	7/12/2018	EJH & HAL	15	Muck	Pole	SAMPLED	0																																
125	45.942624	-89.709624	76	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
126	45.942273	-89.709626	75	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																																
127	45.941922	-89.709628	74	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																																
128	45.941571	-89.709630	130	Towanda	Vilas	7/12/2018	EJH & HAL	18			DEEP																																
129	45.941220	-89.709632	129	Towanda	Vilas	7/12/2018	EJH & HAL	20			DEEP																																
130	45.940869	-89.709634	128	Towanda	Vilas	7/12/2018	EJH & HAL	20			DEEP																																
131	45.940518	-89.709635	30	Towanda	Vilas	7/11/2018	JLW & NLS	0			DEEP																																
132	45.940167	-89.709637	25	Towanda	Vilas	7/11/2018	JLW & NLS	18			DEEP																																
133	45.944377	-89.709112	82	Towanda	Vilas	7/12/2018	EJH & HAL	5	Muck	Pole	SAMPLED	1					1																							1			
134	45.944026	-89.709114	83	Towanda	Vilas	7/12/2018	EJH & HAL	8	Muck	Pole	SAMPLED	1	1																														
135	45.943675	-89.709116	84	Towanda	Vilas	7/12/2018	EJH & HAL	10	Muck	Pole	SAMPLED	3																					3									1		
136	45.943324	-89.709118	85	Towanda	Vilas	7/12/2018	EJH & HAL	12	Muck	Pole	SAMPLED	1																					1										
137	45.942973	-89.709119	86	Towanda	Vilas	7/12/2018	EJH & HAL	15	Muck	Pole	SAMPLED	0																																
138	45.942622	-89.709121	87	Towanda	Vilas	7/12/2018	EJH & HAL	15	Muck	Pole	SAMPLED	0																																
139	45.942271	-89.709123	88	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
140	45.941920	-89.709125	89	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
141	45.941569	-89.709127	90	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
142	45.941218	-89.709129	91	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																																
143	45.940867	-89.709130	127	Towanda	Vilas	7/12/2018	EJH & HAL	18			DEEP																																
144	45.940516	-89.709132	27	Towanda	Vilas	7/11/2018	JLW & NLS	0			DEEP																																
145	45.940165	-89.709134	26	Towanda	Vilas	7/11/2018	JLW & NLS	17		Rope	SAMPLED	0																																
146	45.939814	-89.709136	28	Towanda	Vilas	7/11/2018	JLW & NLS	0			TERRESTRIAL																																
147	45.944025	-89.708611	100	Towanda	Vilas	7/12/2018	EJH & HAL	5	Sand	Pole	SAMPLED	1																													1	1		
148	45.943674	-89.708613	99	Towanda	Vilas	7/12/2018	EJH & HAL	8	Muck	Pole	SAMPLED	2																			1									2			
149	45.943323	-89.708614	98	Towanda	Vilas	7/12/2018	EJH & HAL	9	Muck	Pole	SAMPLED	0																																
150	45.942972	-89.708616	97	Towanda	Vilas	7/12/2018	EJH & HAL	11	Muck	Pole	SAMPLED	0																																
151	45.942621	-89.708618	96	Towanda	Vilas	7/12/2018	EJH & HAL	13	Muck	Pole	SAMPLED	0																																
152	45.942270	-89.708620	95	Towanda	Vilas	7/12/2018	EJH & HAL	15	Muck	Pole	SAMPLED	0																																
153	45.941919	-89.708622	94	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
154	45.941568	-89.708624	93	Towanda	Vilas	7/12/2018	EJH & HAL	17		Rope	SAMPLED	0																																
155	45.941217	-89.708625	92	Towanda	Vilas	7/12/2018	EJH & HAL	20			DEEP																																
156	45.940866	-89.708627	126	Towanda	Vilas	7/12/2018	EJH & HAL	17			DEEP																																
157	45.940515	-89.708629	32	Towanda	Vilas	7/11/2018	JLW & NLS	19			DEEP																																
158	45.940164	-89.708631	31	Towanda	Vilas	7/11/2018	JLW & NLS	17		Rope	SAMPLED	0																																
159	45.939813	-89.708633	29	Towanda	Vilas	7/11/2018	JLW & NLS	12	Muck	Pole	SAMPLED	1																					1										
160	45.943322	-89.708111	101	Towanda	Vilas	7/12/2018	EJH & HAL	5	Rock	Pole	SAMPLED	0																																
161	45.942971	-89.708113	102	Towanda	Vilas	7/12/2018	EJH & HAL	6	Sand	Pole	SAMPLED	1									1										1												
162	45.942620	-89.708115	103	Towanda	Vilas	7/12/2018	EJH & HAL	7	Sand	Pole	SAMPLED	0																																
163	45.942269	-89.708117	104	Towanda	Vilas	7/12/2018	EJH & HAL	9	Sand	Pole	SAMPLED	0																																
164	45.941918	-89.708119	105	Towanda	Vilas	7/12/2018	EJH & HAL	6	Rock	Pole	SAMPLED	0																																
165	45.941567	-89.708120	106	Towanda	Vilas	7/12/2018	EJH & HAL	12	Rock	Pole	SAMPLED	0																																
166	45.941216	-89.708122	107	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	0																																
167	45.940865	-89.708124	108	Towanda	Vilas	7/12/2018	EJH & HAL	0			DEEP																																
168	45.940514	-89.708126	33	Towanda	Vilas	7/11/2018	JLW & NLS	19			DEEP																																
169	45.940163	-89.708128	34	Towanda	Vilas	7/11/2018	JLW & NLS	19			DEEP																																
170	45.939812	-89.708130	35	Towanda	Vilas	7/11/2018	JLW & NLS	14	Muck	Pole	SAMPLED	1					1																1										
171	45.939461	-89.708132	36	Towanda	Vilas	7/11/2018	JLW & NLS	5	Rock	Pole	SAMPLED	0																																
172	45.941916	-89.707616	112	Towanda	Vilas	7/12/2018	EJH & HAL	9	Sand	Pole	SAMPLED	1												1																			
173	45.941565	-89.707617	111	Towanda	Vilas	7/12/2018	EJH & HAL	11	Muck	Pole	SAMPLED	1					1						1									1									1		
174	45.941214	-89.707619	110	Towanda	Vilas	7/12/2018	EJH & HAL	16		Rope	SAMPLED	1																													1		
175	45.940863	-89.707621	109	Towanda	Vilas	7/12/2018	EJH & HAL	15	Muck	Pole	SAMPLED	1																					1					1					
176	45.940512	-89.707623	43	Towanda	Vilas	7/12/2018	JLW & NLS	16		Rope	SAMPLED	0																																
177	45.940161	-89.707625	50	Towanda	Vilas	7/12/2018	JLW & NLS	16		Rope	SAMPLED	0																																

Point Number	Latitude	Longitude	ID	Lake Name	County	Date	Field crew	Depth	Sediment	Pole; Rope	Comments	Total Rake Fullness	Brasenia schreberi	Chara spp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Eriocaulon aquaticum	Juncus pelocarpus	Lemna minor	Myriophyllum tenellum	Najas flexilis	Najas gracillima	Nitella spp.	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton berchtoldii	Potamogeton ephydrus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton spirillus	Schoenoplectus subterminalis	Sparganium fluctuans	Utricularia gibba	Utricularia intermedia	Utricularia minor	Utricularia resupinata	Utricularia vulgaris	Vallisneria americana	Freshwater sponge	Filamentous algae
178	45.939810	-89.707627	51	Towanda	Vilas	7/12/2018	JLW & NLS	15	Muck	Pole	SAMPLED	1																				1												
179	45.939459	-89.707628	37	Towanda	Vilas	7/11/2018	JLW & NLS	11	Muck	Pole	SAMPLED	1											1									1									1			
180	45.939108	-89.707630	53	Towanda	Vilas	7/12/2018	JLW & NLS	5	Sand	Pole	SAMPLED	1				1																1												
181	45.938757	-89.707632	54	Towanda	Vilas	7/12/2018	JLW & NLS	4	Sand	Pole	SAMPLED	0																										V						
182	45.938406	-89.707634	55	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	2				1									1						1									1			
183	45.938055	-89.707636	56	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	1	1			1										1											1						
184	45.941915	-89.707112	113	Towanda	Vilas	7/12/2018	EJH & HAL	9	Muck	Pole	SAMPLED	1												1																			
185	45.941564	-89.707114	114	Towanda	Vilas	7/12/2018	EJH & HAL	9	Muck	Pole	SAMPLED	1		1																											1			
186	45.941213	-89.707116	115	Towanda	Vilas	7/12/2018	EJH & HAL	11	Rock	Pole	SAMPLED	1		1																														
187	45.940862	-89.707118	116	Towanda	Vilas	7/12/2018	EJH & HAL	13	Muck	Pole	SAMPLED	1																				1												
188	45.940511	-89.707120	44	Towanda	Vilas	7/12/2018	JLW & NLS	14	Muck	Pole	SAMPLED	0																																
189	45.940160	-89.707122	49	Towanda	Vilas	7/12/2018	JLW & NLS	14	Muck	Pole	SAMPLED	1																				1												
190	45.939809	-89.707123	52	Towanda	Vilas	7/12/2018	JLW & NLS	14	Muck	Pole	SAMPLED	1																				1												
191	45.939458	-89.707125	38	Towanda	Vilas	7/11/2018	JLW & NLS	12	Muck	Pole	SAMPLED	1					1															1												
192	45.939107	-89.707127	57	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	1					1															1												
193	45.938756	-89.707129	58	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1					1							1																				
194	45.938405	-89.707131	59	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1	1				1							1							1	1					1						
195	45.938054	-89.707133	60	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1											1	1				1				1										
196	45.937703	-89.707135	61	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1		1																												
197	45.941914	-89.706609	120	Towanda	Vilas	7/12/2018	EJH & HAL	6	Muck	Pole	SAMPLED	1																													1		
198	45.941563	-89.706611	119	Towanda	Vilas	7/12/2018	EJH & HAL	9	Muck	Pole	SAMPLED	0																															
199	45.941212	-89.706613	118	Towanda	Vilas	7/12/2018	EJH & HAL	9	Rock	Pole	SAMPLED	2		1																											2		
200	45.940861	-89.706615	117	Towanda	Vilas	7/12/2018	EJH & HAL	10	Muck	Pole	SAMPLED	1		1																													
201	45.940510	-89.706617	45	Towanda	Vilas	7/12/2018	JLW & NLS	11	Muck	Pole	SAMPLED	1																			1	1											
202	45.940159	-89.706618	48	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	1												1							1	1									1		
203	45.939808	-89.706620	42	Towanda	Vilas	7/11/2018	JLW & NLS	10	Muck	Pole	SAMPLED	1											1	1								1								1		
204	45.939457	-89.706622	39	Towanda	Vilas	7/11/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1												1							1	1										
205	45.939106	-89.706624	69	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	1												1																			
206	45.938755	-89.706626	68	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2	1																			1		2								
207	45.938404	-89.706628	67	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	0																															
208	45.938053	-89.706630	66	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1					1						1	1							1											
209	45.937702	-89.706631	65	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1												1								1								1		
210	45.937351	-89.706633	64	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1											1	1																		
211	45.937000	-89.706635	63	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1	1										1	1								1						1				
212	45.936649	-89.706637	62	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	1	1			1																					1	1			1			
213	45.9415616	-89.706108	121	Towanda	Vilas	7/12/2018	EJH & HAL	7	Muck	Pole	SAMPLED	1																				1											
214	45.9412106	-89.7061098	122	Towanda	Vilas	7/12/2018	EJH & HAL	8	Sand	Pole	SAMPLED	0																															
215	45.9408596	-89.7061117	123	Towanda	Vilas	7/12/2018	EJH & HAL	9	Muck	Pole	SAMPLED	1												1			1															
216	45.9405086	-89.7061135	46	Towanda	Vilas	7/12/2018	JLW & NLS	9	Sand	Pole	SAMPLED	1					1							1							1												
217	45.9401575	-89.7061154	47	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1		1									1				1															
218	45.9398065	-89.7061172	41	Towanda	Vilas	7/11/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1		1		1														1												
219	45.9394555	-89.7061191	40	Towanda	Vilas	7/11/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1	1	1		1							1																			
220	45.9391045	-89.7061209	70	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	2	1			2							1														1					
221	45.9387535	-89.7061228	71	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	2		1							2																		1	1		
222	45.9384025	-89.7061247	72	Towanda	Vilas	7/12/2018	JLW & NLS	6	Sand	Pole	SAMPLED	1																		1							1					
223	45.9380515	-89.7061265	73	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1										1		1																		
224	45.9377005	-89.7061284	74	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1												1																		
225	45.9373494	-89.7061302	75	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1												1																		
226	45.9369984	-89.7061321	76	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2												1								2									1		
227	45.9366474	-89.7061339	77	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1	1																													
228	45.9362964	-89.7061358	78	Towanda	Vilas	7/12/2018	JLW & NLS	4	Sand	Pole	SAMPLED	0																															
229	45.9412093	-89.7056067	125	Towanda	Vilas	7/12/2018	EJH & HAL	3	Sand	Pole	SAMPLED	1		1																													
230	45.9408583	-89.7056085	124	Towanda	Vilas	7/12/2018	EJH & HAL	5	Sand	Pole	SAMPLED	1							1																					1			
231	45.9387522	-89.7056197	86	Towanda	Vilas	7/12/2018	JLW & NLS	4	Sand	Pole	SAMPLED	1														1				1						1	1					
232	45.9384012	-89.7056216	85	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1												1										1								
233	45.9380502	-89.7056234	84	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1		1																		1											
234	45.9376992	-89.7056253	83	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	0																															
235	45.9373481	-89.7056271	82	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1											1	1								1						1					
236	45.9369971	-89.705629	81	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	1												1								1								1		

Point Number	Latitude	Longitude	ID	Lake Name	County	Date	Field crew	Depth	Sediment	Pole; Rope	Comments	Total Rake Fullness	Brasenia schreberi	Chara spp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Eriocaulon aquaticum	Juncus pelocarpus	Lemna minor	Myriophyllum tenellum	Najas flexilis	Najas gracillima	Nitella spp.	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton berchtoldii	Potamogeton epihydrus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton spirillus	Schoenoplectus subterminalis	Sparganium fluctuans	Utricularia gibba	Utricularia intermedia	Utricularia minor	Utricularia resupinata	Utricularia vulgaris	Vallisneria americana	Freshwater sponge	Filamentous algae
237	45.9366461	-89.7056308	80	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2												1									2				1								
238	45.9362951	-89.7056327	79	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1	1										1	1								1	1											
239	45.9387509	-89.7051166	87	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	2				2														1											1			
240	45.9383999	-89.7051184	88	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	1	1											1																		1			
241	45.9380489	-89.7051203	89	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1												1																		1			
242	45.9376979	-89.7051222	90	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1					1							1													1					1			
243	45.9373468	-89.705124	91	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2					1							1				1					2								1			
244	45.9369958	-89.7051259	92	Towanda	Vilas	7/12/2018	JLW & NLS	11	Muck	Pole	SAMPLED	2																				2											
245	45.9366448	-89.7051278	93	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	2												1								2				1							
246	45.9362938	-89.7051296	94	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1											1	1							1										1			
247	45.9359428	-89.7051315	95	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1											1	1					1					1		1							
248	45.9355918	-89.7051333	96	Towanda	Vilas	7/12/2018	JLW & NLS	0			DOCK																																
249	45.9387496	-89.7046135	130	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	1		1		1																		1		1							
250	45.9383986	-89.7046153	129	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	2	2				1						1	1																		1	
251	45.9380476	-89.7046172	128	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1					1							1													1					1			
252	45.9376966	-89.7046191	127	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1					1							1																				
253	45.9373455	-89.7046209	126	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2												1								2											
254	45.9369945	-89.7046228	125	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	2												1								2											
255	45.9366435	-89.7046247	124	Towanda	Vilas	7/12/2018	JLW & NLS	11	Muck	Pole	SAMPLED	1												1								1											
256	45.9362925	-89.7046265	123	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	3					1							1								1											
257	45.9359415	-89.7046284	122	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2											1	1								2				1							
258	45.9355905	-89.7046303	121	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1											1	1							1										1			
259	45.9352395	-89.7046321	120	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1		1		1							1	1												1					1			
260	45.9348885	-89.704634	119	Towanda	Vilas	7/12/2018	JLW & NLS	4	Sand	Pole	SAMPLED	0																															
261	45.9345374	-89.7046358	118	Towanda	Vilas	7/12/2018	JLW & NLS	3	Sand	Pole	SAMPLED	1																														1			
262	45.9341864	-89.7046377	117	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	1											1								1				1	1	1						
263	45.9338354	-89.7046396	116	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	2														2										1	1			1			
264	45.9334844	-89.7046414	115	Towanda	Vilas	7/12/2018	JLW & NLS	4	Muck	Pole	SAMPLED	1														1										1							
265	45.9331334	-89.7046433	114	Towanda	Vilas	7/12/2018	JLW & NLS	4	Sand	Pole	SAMPLED	0																															
266	45.9320804	-89.7046489	199	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																			
267	45.9313783	-89.7046526	209	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																			
268	45.9387483	-89.7041104	131	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	2				1										2										1							
269	45.9383973	-89.7041122	132	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1					1							1								1											
270	45.9380463	-89.7041141	133	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1												1																		1			
271	45.9376953	-89.704116	134	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1												1																		1			
272	45.9373442	-89.7041178	135	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1											1	1																		1			
273	45.9369932	-89.7041197	136	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2												1									1											
274	45.9366422	-89.7041216	137	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	2												2																		1			
275	45.9362912	-89.7041234	138	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	1					1							2									1									1			
276	45.9359402	-89.7041253	139	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	2												2																		1			
277	45.9355892	-89.7041272	140	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	1												1														1				1			
278	45.9352382	-89.704129	141	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1												1														1				1			
279	45.9348872	-89.7041309	142	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1											1																					
280	45.9345361	-89.7041328	143	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	2												1								1	1		2		1							
281	45.9341851	-89.7041346	144	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1					1							1				1										1						
282	45.9338341	-89.7041365	145	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1	1																						1		1						
283	45.9334831	-89.7041384	146	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	2	1				1									1		1							1		1						
284	45.9331321	-89.7041402	113	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	1														1									1		1						1
285	45.9327811	-89.7041421	108	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	2														1									1		1			1			
286	45.9324301	-89.704144	107	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	2	1													1									1		1						
287	45.9320791	-89.7041458	200	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																	
288	45.931728	-89.7041477	201	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																	
289	45.931026	-89.7041514	210	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																	
290	45.930675	-89.7041533	221	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																	
291	45.930324	-89.7041552	220	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																	
292	45.929973	-89.704157	219	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																	
293	45.929622	-89.7041589	218	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																	
294	45.938747	-89.7036073	162	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	1				1										1														1			
295	45.938396	-89.7036091	161	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1												1																1			

Point Number	Latitude	Longitude	ID	Lake Name	County	Date	Field crew	Depth	Sediment	Pole; Rope	Comments	Total Rake Fullness	Brasenia schreberi	Chara spp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Eriocaulon aquaticum	Juncus pelocarpus	Lemna minor	Myriophyllum tenellum	Najas flexilis	Najas gracillima	Nitella spp.	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton berchtoldii	Potamogeton ephydrus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton spirillus	Schoenoplectus subterminalis	Sparganium fluctuans	Utricularia gibba	Utricularia intermedia	Utricularia minor	Utricularia resupinata	Utricularia vulgaris	Vallisneria americana	Freshwater sponge	Filamentous algae
296	45.938045	-89.703611	160	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1											1	1			1																	
297	45.937694	-89.7036129	159	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1											1																					
298	45.9373429	-89.7036148	158	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	2					1							1				1					2										
299	45.9369919	-89.7036166	157	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1												1																				
300	45.9366409	-89.7036185	156	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1												1									1										
301	45.9362899	-89.7036204	155	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2												1									1										
302	45.9359389	-89.7036222	154	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2												2									1				1						
303	45.9355879	-89.7036241	153	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	1												1									1				1			1			
304	45.9352369	-89.703626	152	Towanda	Vilas	7/12/2018	JLW & NLS	10	Muck	Pole	SAMPLED	1												1									1				1						
305	45.9348859	-89.7036278	151	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2					1							1			2															
306	45.9345348	-89.7036297	150	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2					1														1			2		1						
307	45.9341838	-89.7036316	149	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2					1														1			1							1		
308	45.9338328	-89.7036335	148	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	3					1															1		2							1		
309	45.9334818	-89.7036353	147	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	2																						2			1					
310	45.9331308	-89.7036372	112	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	2													1						1			1		1	1					
311	45.9327798	-89.7036391	109	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	1				1										1											1					
312	45.9324288	-89.7036409	106	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	2														1											1			1		
313	45.9320778	-89.7036428	103	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	2	1													2									1			1					
314	45.9317267	-89.7036447	202	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																		
315	45.9313757	-89.7036465	208	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																		
316	45.9310247	-89.7036484	102	Towanda	Vilas	7/12/2018	JLW & NLS	2	Muck	Pole	SAMPLED	2														2									1		1	1					
317	45.9306737	-89.7036503	100	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	0																															
318	45.9303227	-89.7036522	97	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1																			1						1						
319	45.9299717	-89.703654	98	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																		
320	45.9296207	-89.7036559	217	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																		
321	45.9383947	-89.703106	163	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	1			1																				V								
322	45.9380437	-89.7031079	164	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1			1																												
323	45.9376926	-89.7031098	165	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1											1	1																			
324	45.9373416	-89.7031117	166	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1					1							1								1								1		
325	45.9369906	-89.7031135	167	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1												1																		
326	45.9366396	-89.7031154	168	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	2					1							1			2														1		
327	45.9362886	-89.7031173	169	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1											1	1																1		
328	45.9359376	-89.7031192	170	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1					1							1									1									
329	45.9355866	-89.703121	171	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1				1																											
330	45.9352356	-89.7031229	172	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1					1							1								1				1						
331	45.9348845	-89.7031248	173	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	2												2								1										
332	45.9345335	-89.7031267	174	Towanda	Vilas	7/12/2018	JLW & NLS	9	Muck	Pole	SAMPLED	1					1							1																		
333	45.9341825	-89.7031285	175	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	3					1							1			2					1										
334	45.9338315	-89.7031304	176	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	2												1										2								
335	45.9334805	-89.7031323	177	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1														1								1			1					
336	45.9331295	-89.7031341	111	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	2				1										1								1		1	1					
337	45.9327785	-89.703136	110	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	1														1								1			1					
338	45.9324275	-89.7031379	105	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	2	1				1									2								1			1					
339	45.9320764	-89.7031398	104	Towanda	Vilas	7/12/2018	JLW & NLS	5	Muck	Pole	SAMPLED	1	1													1								1			1					
340	45.9317254	-89.7031416	203	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																		
341	45.9313744	-89.7031435	207	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																		
342	45.9310234	-89.7031454	211	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																		
343	45.9306724	-89.7031473	101	Towanda	Vilas	7/12/2018	JLW & NLS	2	Muck	Pole	SAMPLED	2														2									1						
344	45.9303214	-89.7031491	99	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																		
345	45.9299704	-89.703151	215	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																		
346	45.9380424	-89.7026048	191	Towanda	Vilas	7/12/2018	JLW & NLS	6	Sand	Pole	SAMPLED	0																														
347	45.9376913	-89.7026067	190	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	1				1																										
348	45.9373403	-89.7026086	189	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	0																														
349	45.9369893	-89.7026105	188	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1		1																												
350	45.9366383	-89.7026123	187	Towanda	Vilas	7/12/2018	JLW & NLS	8	Sand	Pole	SAMPLED	1												1																		
351	45.9362873	-89.7026142	186	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1												1										1								
352	45.9359363	-89.7026161	185	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	2	1				1														1					1						
353	45.9355853	-89.702618	184	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1	1				1																	1		1						
354	45.9352343	-89.7026198	183	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	3					1																	3								

Point Number	Latitude	Longitude	ID	Lake Name	County	Date	Field crew	Depth	Sediment	Pole; Rope	Comments	Total Rake Fullness	Brasenia schreberi	Chara spp.	Dulichium arundinaceum	Eleocharis acicularis	Elodea canadensis	Eriocaulon aquaticum	Juncus pelocarpus	Lemna minor	Myriophyllum tenellum	Najas flexilis	Najas gracillima	Nitella spp.	Nuphar variegata	Nymphaea odorata	Potamogeton amplifolius	Potamogeton berchtoldii	Potamogeton epihydrus	Potamogeton gramineus	Potamogeton natans	Potamogeton pusillus	Potamogeton robbinsii	Potamogeton spirillus	Schoenoplectus subterminalis	Sparganium fluctuans	Utricularia gibba	Utricularia intermedia	Utricularia minor	Utricularia resupinata	Utricularia vulgaris	Vallisneria americana	Freshwater sponge	Filamentous algae
355	45.9348832	-89.7026217	182	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	3												1								1			3										
356	45.9345322	-89.7026236	181	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	1												1									1												
357	45.9341812	-89.7026255	180	Towanda	Vilas	7/12/2018	JLW & NLS	8	Muck	Pole	SAMPLED	2																				1			2		1								
358	45.9338302	-89.7026273	179	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1												1		1									1		1								
359	45.9334792	-89.7026292	178	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1																							1		1								
360	45.9317241	-89.7026386	204	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																					
361	45.9313731	-89.7026405	205	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																					
362	45.9310221	-89.7026423	206	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																					
363	45.9306711	-89.7026442	212	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																					
364	45.9303201	-89.7026461	213	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																					
365	45.9299691	-89.702648	214	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																					
366	45.929618	-89.7026498	216	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																					
367	45.936988	-89.7021074	192	Towanda	Vilas	7/12/2018	JLW & NLS	3	Sand	Pole	SAMPLED	0																																	
368	45.936286	-89.7021111	193	Towanda	Vilas	7/12/2018	JLW & NLS	0	NONNAVIGABLE (PLANTS)																																					
369	45.935584	-89.7021149	194	Towanda	Vilas	7/12/2018	JLW & NLS	5	Sand	Pole	SAMPLED	1																				1			1		1								
370	45.9352329	-89.7021168	195	Towanda	Vilas	7/12/2018	JLW & NLS	6	Muck	Pole	SAMPLED	1				1										1									1		1								
371	45.9348819	-89.7021186	196	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	1		1																					1										
372	45.9345309	-89.7021205	197	Towanda	Vilas	7/12/2018	JLW & NLS	7	Muck	Pole	SAMPLED	2		1																					2										
373	45.9341799	-89.7021224	198	Towanda	Vilas	7/12/2018	JLW & NLS	5	Sand	Pole	SAMPLED	1									1															1		1								

F

APPENDIX F

Draft Implementation Plan Questionnaire for Committee Review

COMPILED by:
Phil Blazkowski,
President of TLA

Towanda Lake Management Plan Questionnaire for Planning Committee

RESULTS OF QUESTIONNAIRE

1. **South End Harvesting Plan - Onterra's Concept Map opening channels from the open water to piers sent out earlier to Committee.**

NOTE: TOTAL VOTES FOR ITEM 11 = (2) VOTES ON THE ISSUE

Do we want our Lake Management Plan include?

a. A navigable network in the south end of the lake consisting of a main artery (like a public road) to the open water and individual waterways (like driveways) to individual piers.

111111 Yes (6) 11 (2) No

The cost of establishing and maintaining the network be borne by: (check 1) **1 No Answer**

11_(2)_____ Those property owners that want the Navigable Network.

1_(1)_1/3_____ ½ by the Towanda Lake Association (TLA) & ½ by benefited property owners.

11 (2) 1/3 40% Towanda Lake Assocation and **60%** Primary Benefited Property Owners.

1_(1)_1/3_____ Fund raising effort by interested parties supported by TLA.

Comment: I don't think this will ever happen.

Comment: Depends on costs

b. Should Additional Weed Harvesting in other strategic areas around the lake.

11111_(5)_Yes 111_(3)_ No

c. Cost Estimates for the main artery, local waterways, and strategic areas?

11111111_(8)_ Yes _____ No

d. A flexible plan that can be altered as needed to provide new and existing piers that are not part of the original Plan.

11111 (5) Yes 11_(2)__ No 1 No answer

1. **Waterskiing, Boating, Fishing, and No Wake Issues**

a. Should the TLA request the Town Board of Arbor Vitae to establish by ordinance to regulate times for:

Water skiing **111 (3) YES 11111_(5)_** No

Water skiing location **11 (2) Yes** **111111 (6) No** **(1 Comment "Not in South Bay)**

Jet skiing **111 (3) Yes** **11111 (5) No**

Wake Boats **111 (3) Yes** **11111 (5) No** **(Comment: No Wake boats)**

Quite time/area for Fishing **11111 (5) Yes** **111 (3) No**

b. Or should these Issues be addressed by the TLA in an update of the Gentlemen's Agreement with enforcement on a case-by-case basis? **11111 (5) Yes 11 (2) No**

1 **- No Answer**

2. Lake Water Level

Towanda Lake is a Seepage Lake which means it does not have a surface water stream coming into the lake body or a water stream going out. The lake level varies from a low to a high of up to seven-feet. Some rejuvenation of lake water is from storm water runoff within the topographic area around the lake. Lake water is also recharged through the storm water soaking into the ground, mixing with the ground water table, and emerging as lake water. There are some water springs in Towanda Lake - we do not know where their water comes from. It is clear from the topographic maps and a meandering dry stream bed south of Towanda Lake and Airport Road that it is a part of a dendritic water system that feeds into Little Musky Lake, then into Brandy Lake, Lemma Creek, Johnson Lake, the Tomahawk River, Wisconsin River, Mississippi River, and Golf of Mexico.

During the late 1960's or early 70's the Town of Arbor Vitae re-built Airport Road, including fill in a major dip in the road south of Towanda Lake. There may or may not have been a culvert under the old Airport Road for water to flow from Towanda Lake to dendritic water system feeding into Little Musky Lake.

The United States Geological Survey has a lake level monitoring program available for people or organizations that would like to maintain lake elevation data.

The lake level questions are:

a. Should TLA pursue establishing a partnership with USGS to officially monitor and establish a data base to USGS standards to monitor ever changing water level?

111111 (6) Yes 1 No 1 Maybe

b. Should TLA pursue the placement of a culvert under Airport Road to bleed off extremely high lake water levels into the intermittent stream feeding storm water into Little Musky Lake with the Town of Arbor Vitae, WDNR, and USGS.

1111 (4) Yes 1111(4) No

3. **Does the Implementation Plan created by Onterra capture the thoughts of the Committee?11111111 (8) Yes _(-)_ No**

4. Should Onterra to include the **Committee Results** of this questionnaire in the Towanda Lake Management Plan.

1111111 (7)_ Yes 1(1)_ No

5. **Your Comments and Suggestions:**

1. **Good directions in these questions.**
2. **We would vehemently oppose restrictions on water skiing and other watercraft uses.**
3. **Couldn't answer some questions w/o more information**
4. **Good Survey. You did a good job of developing this survey. The reason I checked "No" on all the? about having the Town of Arbor Vitae set our rules is that I don't think we need to rule with a sludge hammer. I think most of these things are already well handled.**
5. **When is the Town going to fix the landing?**
6. **Share in Stakeholders survey to TLS members and post on website.**
7. **Share Implementation Plan to TLA members and post on website.**
8. **Work with WDNR to place buoys to identify where water skiing is OK, ie 100 feet from shore.**
9. **Sub-committee to work on how to educate and communicate about shoreland conditions and fisheries.**

CONCLUSIONS

C-1 The Towanda Lake Management Plan should contain a concept navigable network in the south end of the lake consisting of a main artery (like a public road) to the open water and individual waterways (like driveways) to individual piers.

C-2 Onterra is to provide estimated costs of establishing and maintaining a Navigable Network determined by Onterra as part of this planning process.

C-3 The estimated Weed Harvesting in other strategic areas around the lake should be considered as part of the Navigable Network Plan.

C-4 The Weed Harvesting Plan that can be altered as needed to provide new and existing piers that are not part of the original Plan as determined by the TLA Board.

C-5 Waterskiing, Boating, Fishing, and No Wake Issues should be addressed by the TLA Board in an update of the TLA Gentlemen's Agreement.

C-6 The TLA should pursue establishing a partnership with USGS to officially monitor and establish a data base to USGS standards to monitor ever changing water level.

C-7 Based on a tie vote, the TLA should not pursue the placement of a culvert under Airport Road to bleed off extremely high lake water levels into the intermittent stream feeding storm water into Little Musky Lake at this time.

C-8 The Committee concludes the Implementation Plan created by Onterra captures the thoughts of the Committee.

C-9 Onterra is herein directed to include the Results of this questionnaire in the Towanda Lake Management Plan.

Note: Copies of individual Committee members questionaries are available upon request from Phil Blazkowski.