Kangaroo Lake Association
Kangaroo Lake
Management Planning Update Project
Wrap-Up Meeting
July 7, 2018
Tim Hoyman
Onterra LLC
Lake Management Planning

Presentation Outline

- Project Goals
- Overall Study Conclusions
- Key Study Results
- Management Goals and Actions
- Questions

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Study and Plan Goals

- Collect & Analyze Data
  - 2016/2017
- Construct Long-Term & Useable Plan
  - Planning Meetings 2017
  - Final Plan approved by WDNR in winter 2018

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Studies to also focus on north basin

- **Critical Habitat Area**
- **Shallow, marl lake with minimal development**
- **High-quality surrounding wetlands**

John Cabbott

Brenton Butterfield

Arthur Morris

Brian E. Small

Robert Kirchen

Laura Erickson

Janice Stiefel

Data and information gathering

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

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Summary of Project Conclusions

Water Quality

- Excellent for a shallow lowland drainage lake

Watershed & Immediate Shoreline

- Majority of watershed comprised of agriculture, but…
- Significantly less phosphorus than predicted – quick draining soils
- High degree of shoreland development in south basin; north basin largely undeveloped

Aquatic Plant Community

- High species richness for Southeast Wisconsin Till Plains Ecoregion
- Eurasian watermilfoil only non-native plant species located in 2016
- Hardstem bulrush community in south basin ~2.5 acres smaller than in 2003

Fisheries

- Some changes have occurred; lake shifting from walleye- to bass-dominated fishery

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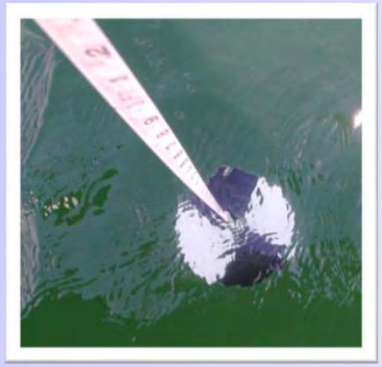
Water Quality

Introduction to Lake Water Quality

↑ **Phosphorus**
Naturally occurring & essential for all life
Regulates phytoplankton biomass in most WI lakes
Most often *limiting plant nutrient* (shortest supply) **TN:TP = 42:1**
Human development often increases P delivery to lakes

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

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



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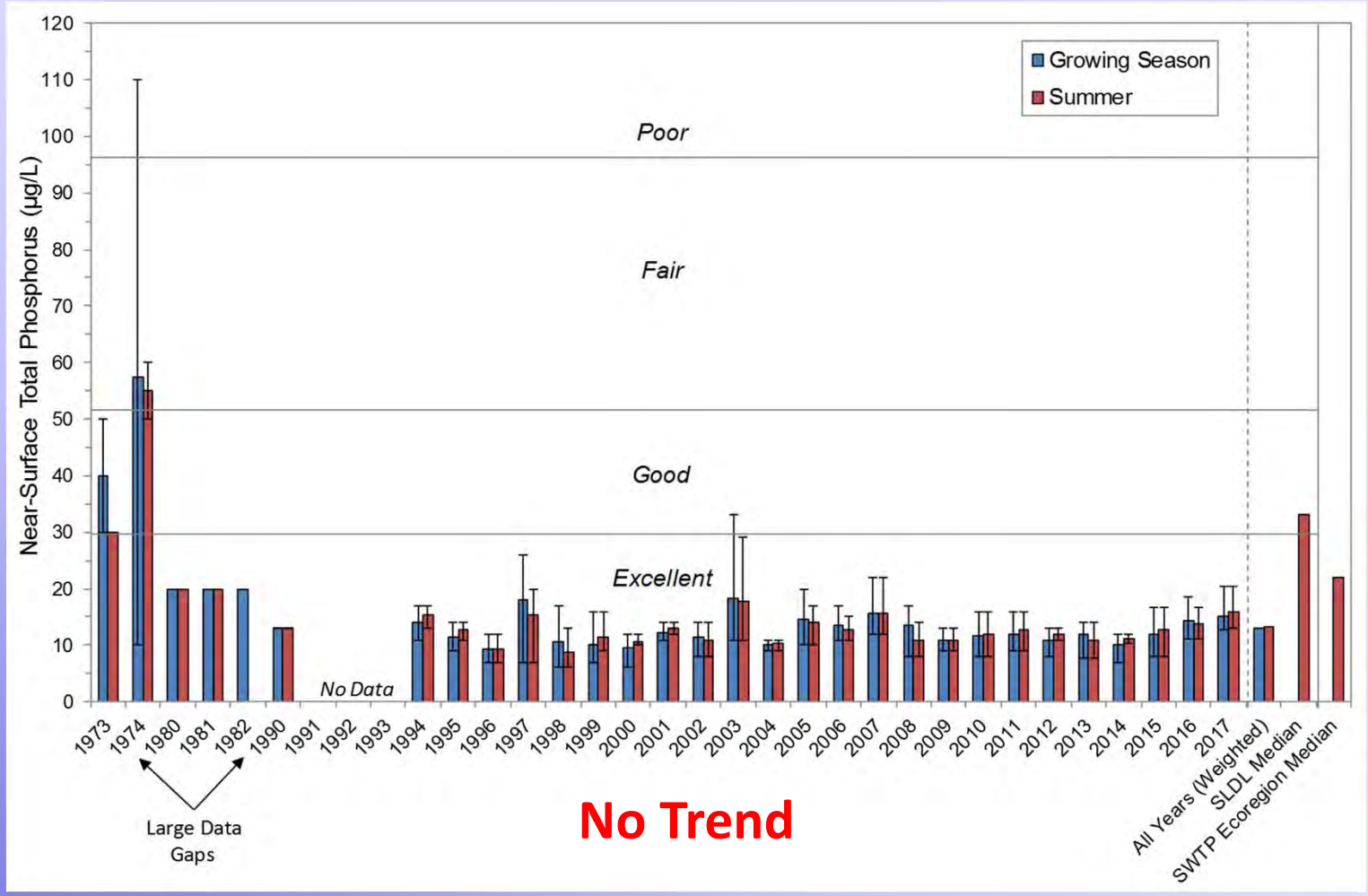
Near-Surface Total Phosphorus



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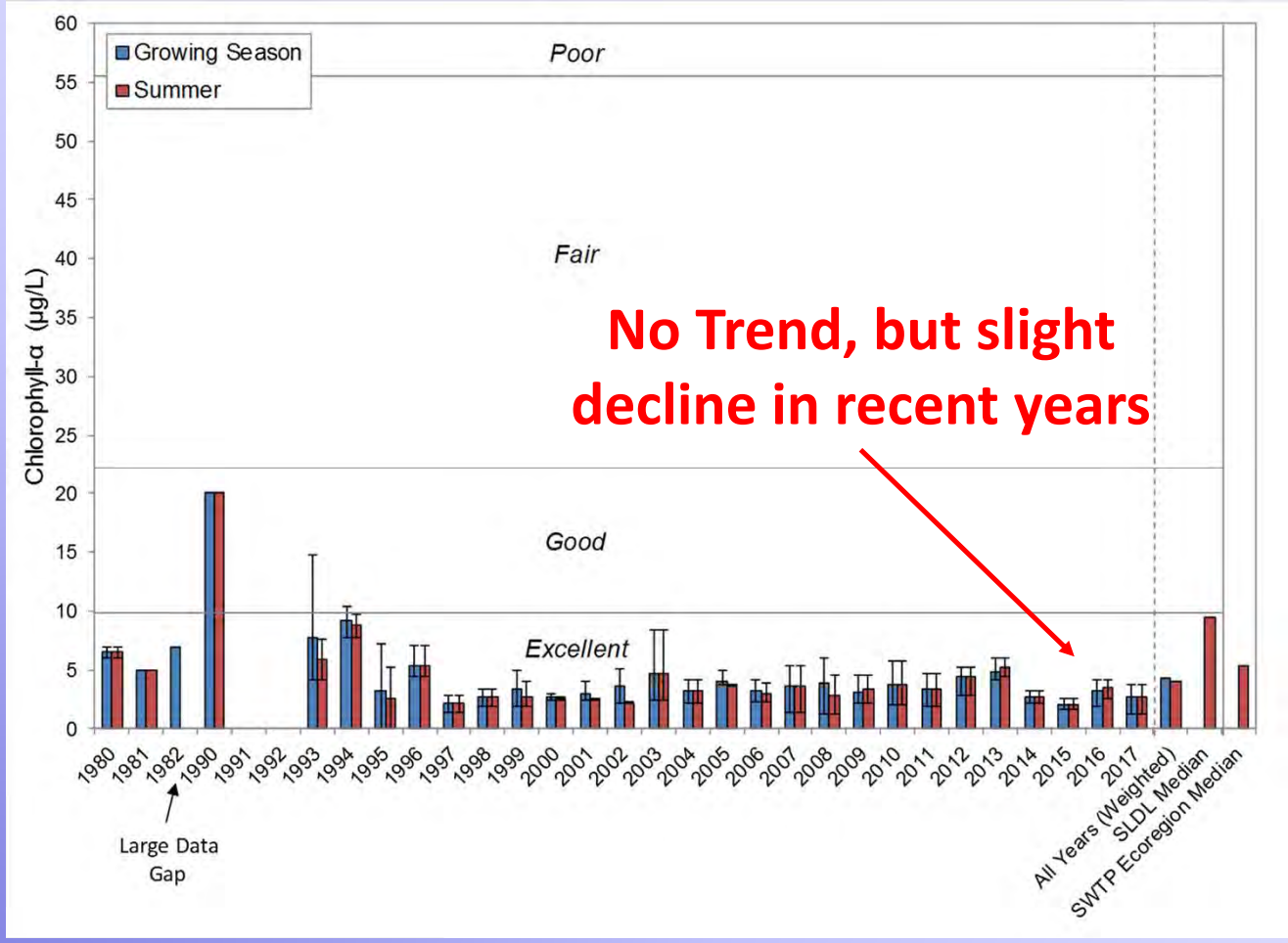
Chlorophyll-*a*



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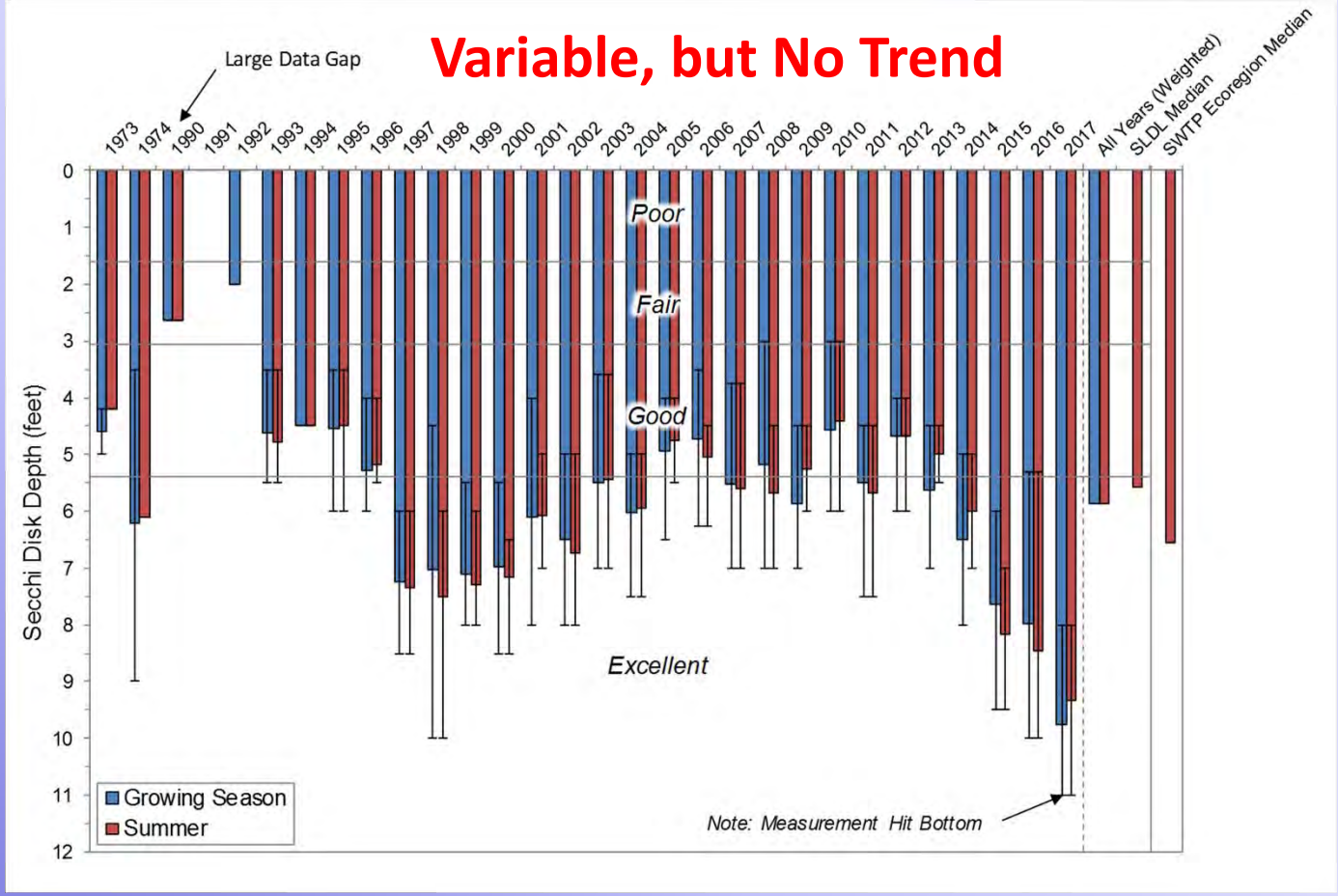
Secchi Disk Transparency (Water Clarity)



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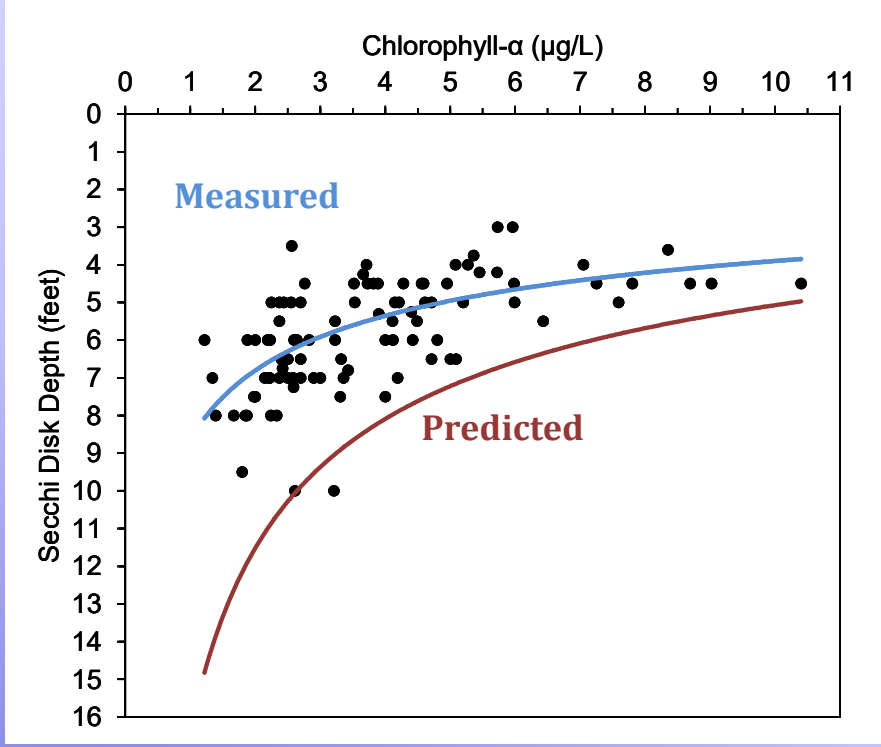
Chlorophyll – Secchi Relationship



- Lower water clarity due to sediment resuspension
- Shallow water in combination with large surface area

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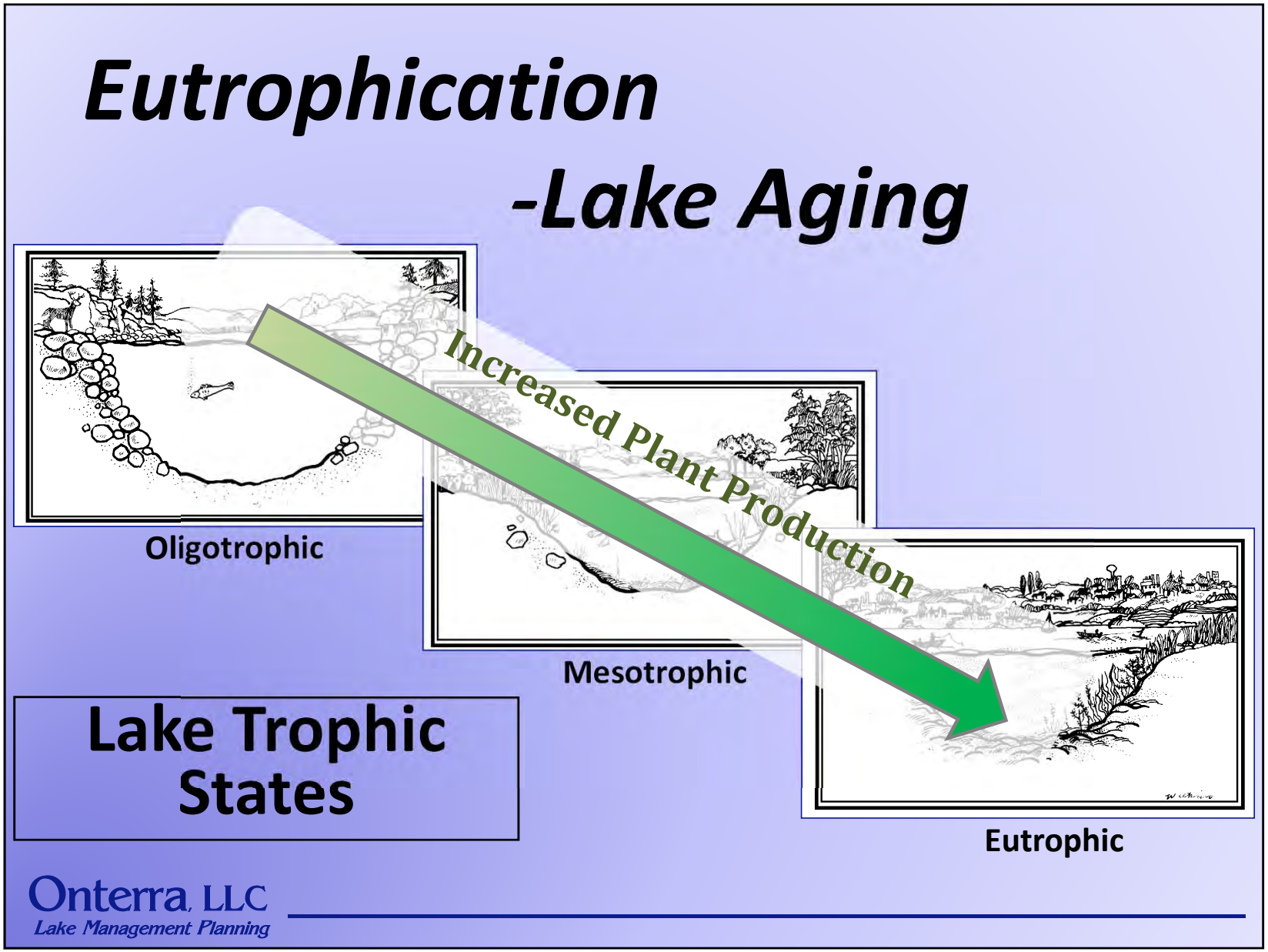
Eutrophication
-Lake Aging
Increased Plant Production
Oligotrophic
Mesotrophic
Eutrophic
Lake Trophic States
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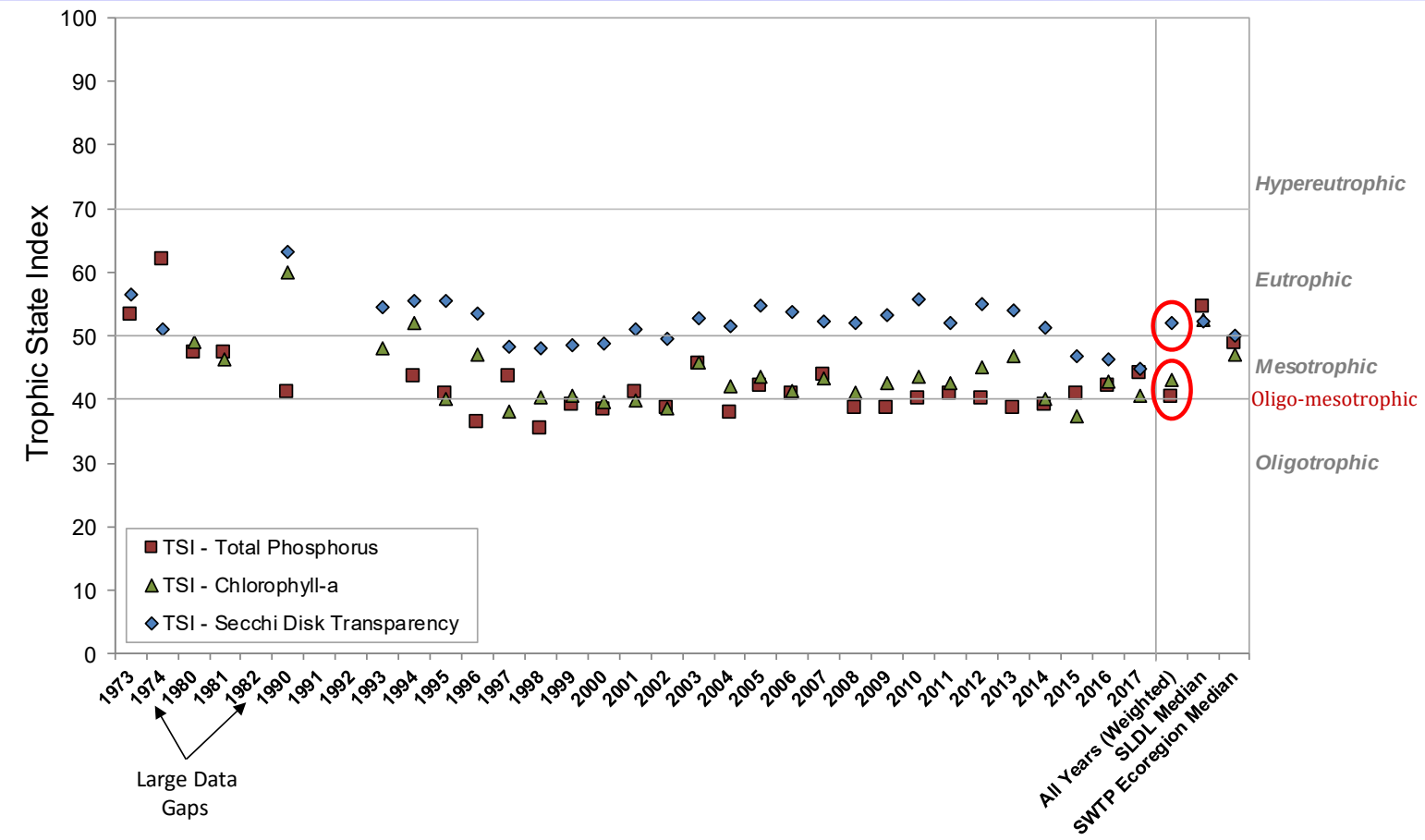
Trophic State Index



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Zebra Mussels (Dreissena polymorpha)

- **Discovered in Kangaroo Lake in 2008**
- **Create host of ecological & economic impacts**
  - **Alterations to food web**
  - **Changes in water quality**
  - **Displacement of native mussels**

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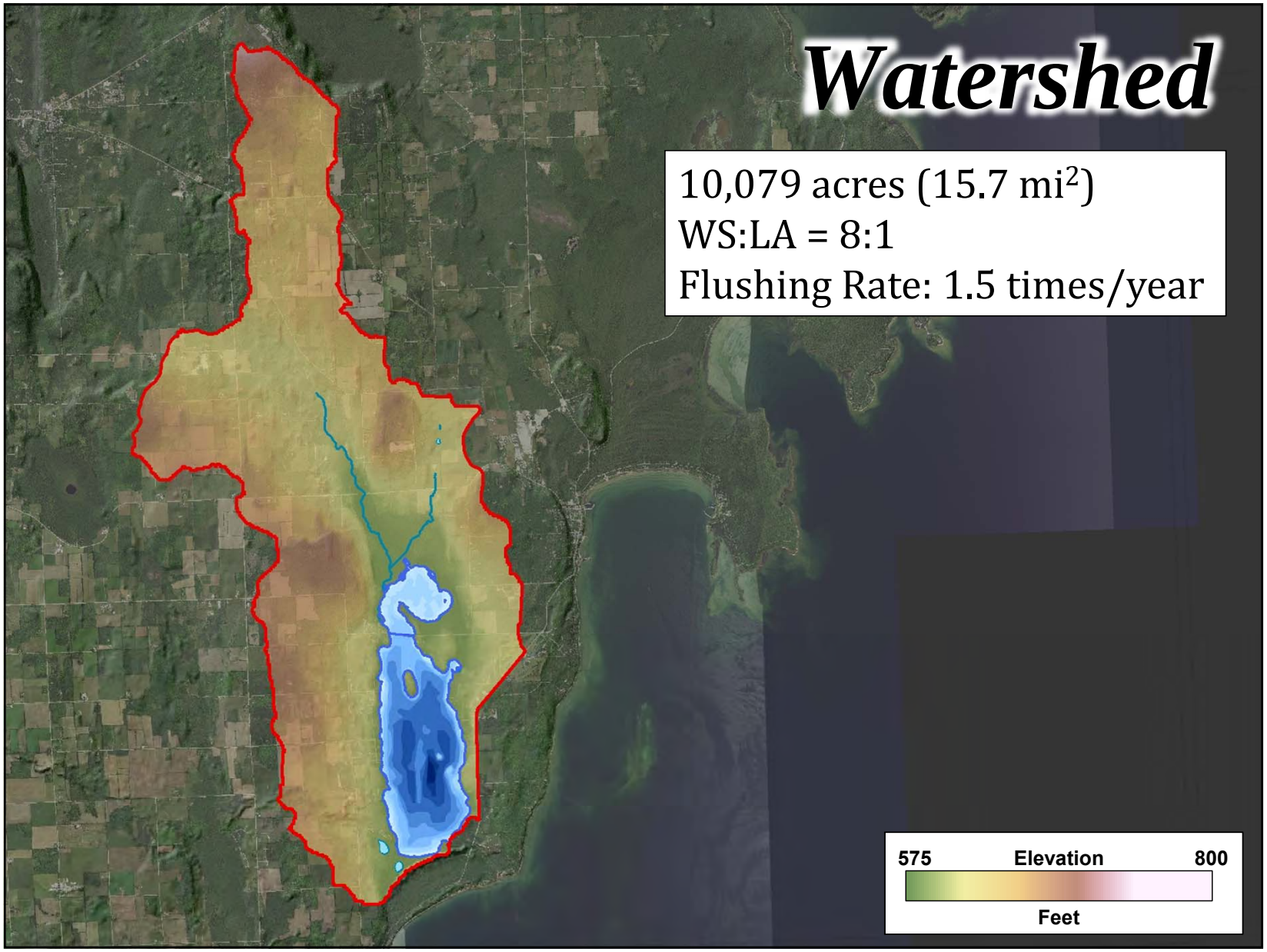
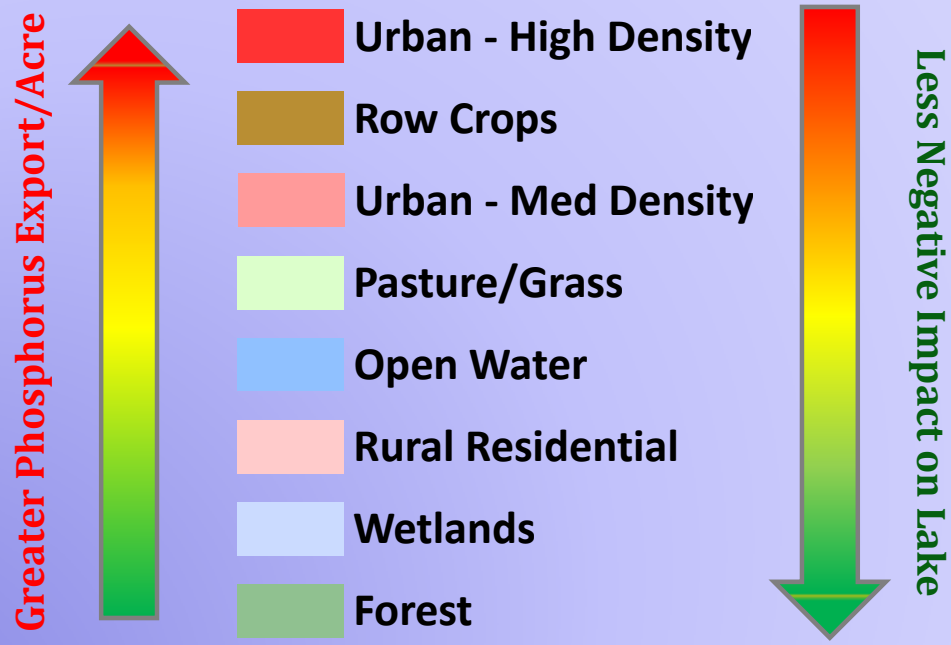

Watershed
10,079 acres (15.7 mi²)
WS:LA = 8:1
Flushing Rate: 1.5 times/year
575
Elevation
800
Feet

Watershed Assessment Procedure



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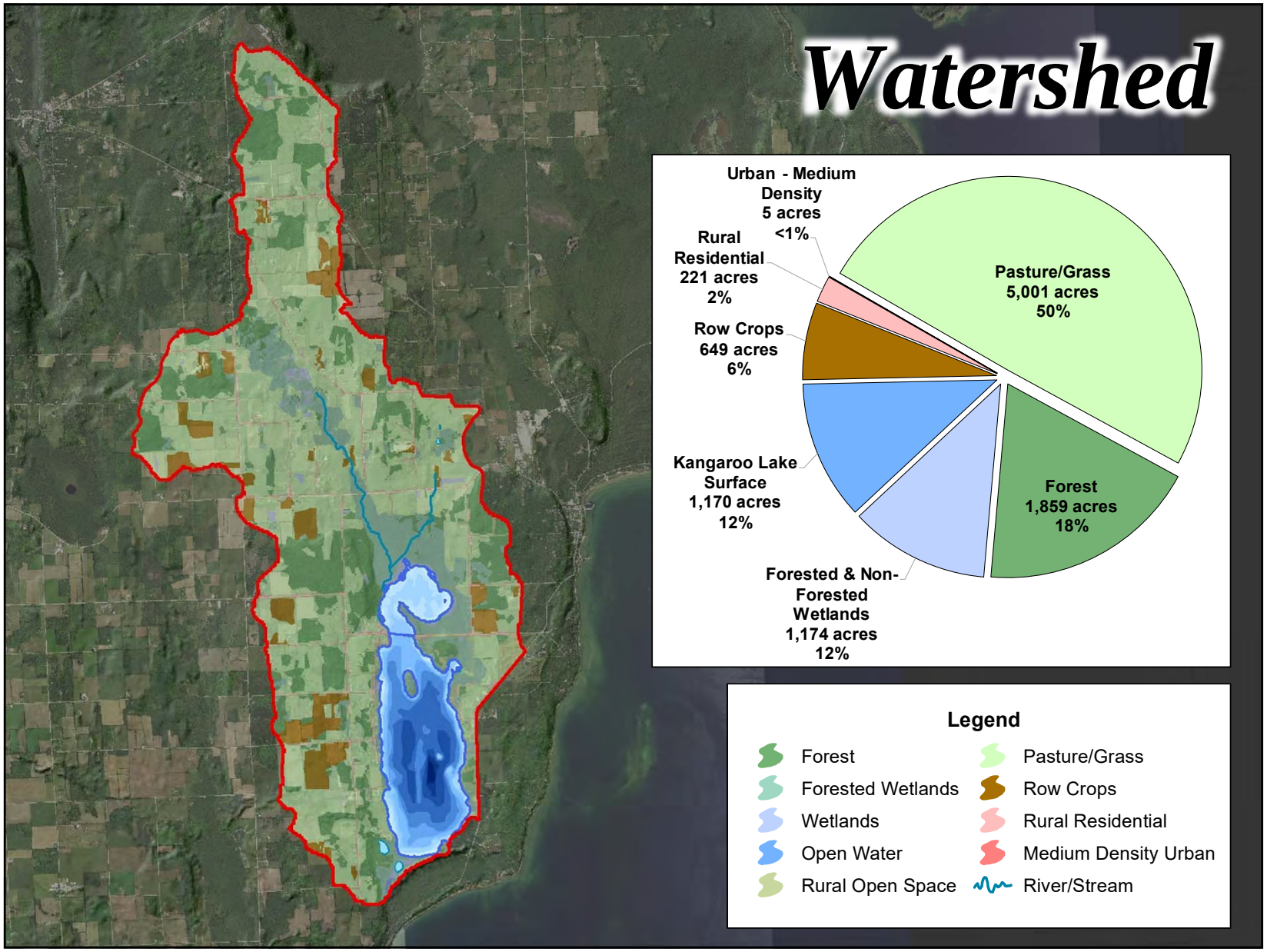
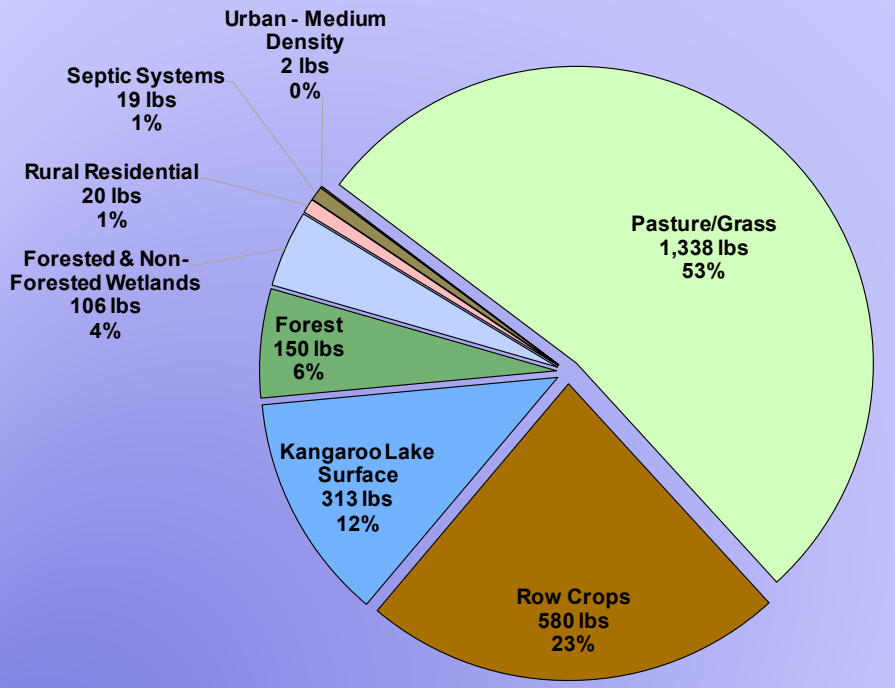
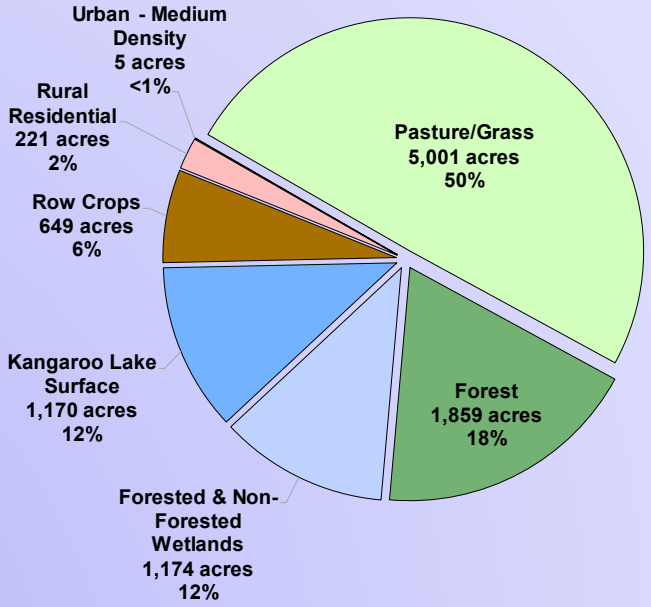

Watershed
Urban - Medium Density 5 acres <1%
Rural Residential 221 acres 2%
Row Crops 649 acres 6%
Kangaroo Lake Surface 1,170 acres 12%
Forested & Non-Forested Wetlands 1,174 acres 12%
Forest 1,859 acres 18%
Pasture/Grass 5,001 acres 50%
Legend
Forest
Forested Wetlands
Wetlands
Open Water
Rural Open Space
Pasture/Grass
Row Crops
Rural Residential
Medium Density Urban
River/Stream

Watershed Phosphorus Loading

Phosphorus Loading



Watershed Land Cover



Modeled Annual Potential Phosphorus Load From Watershed: **~2,500 lbs**

Predicted In-Lake Growing Season Mean Total Phosphorus Concentration:

52 µg/L

Actual In-Lake Growing Season Mean Total Phosphorus Concentration:

14.9 µg/L

248% Difference! Inaccurate Model!

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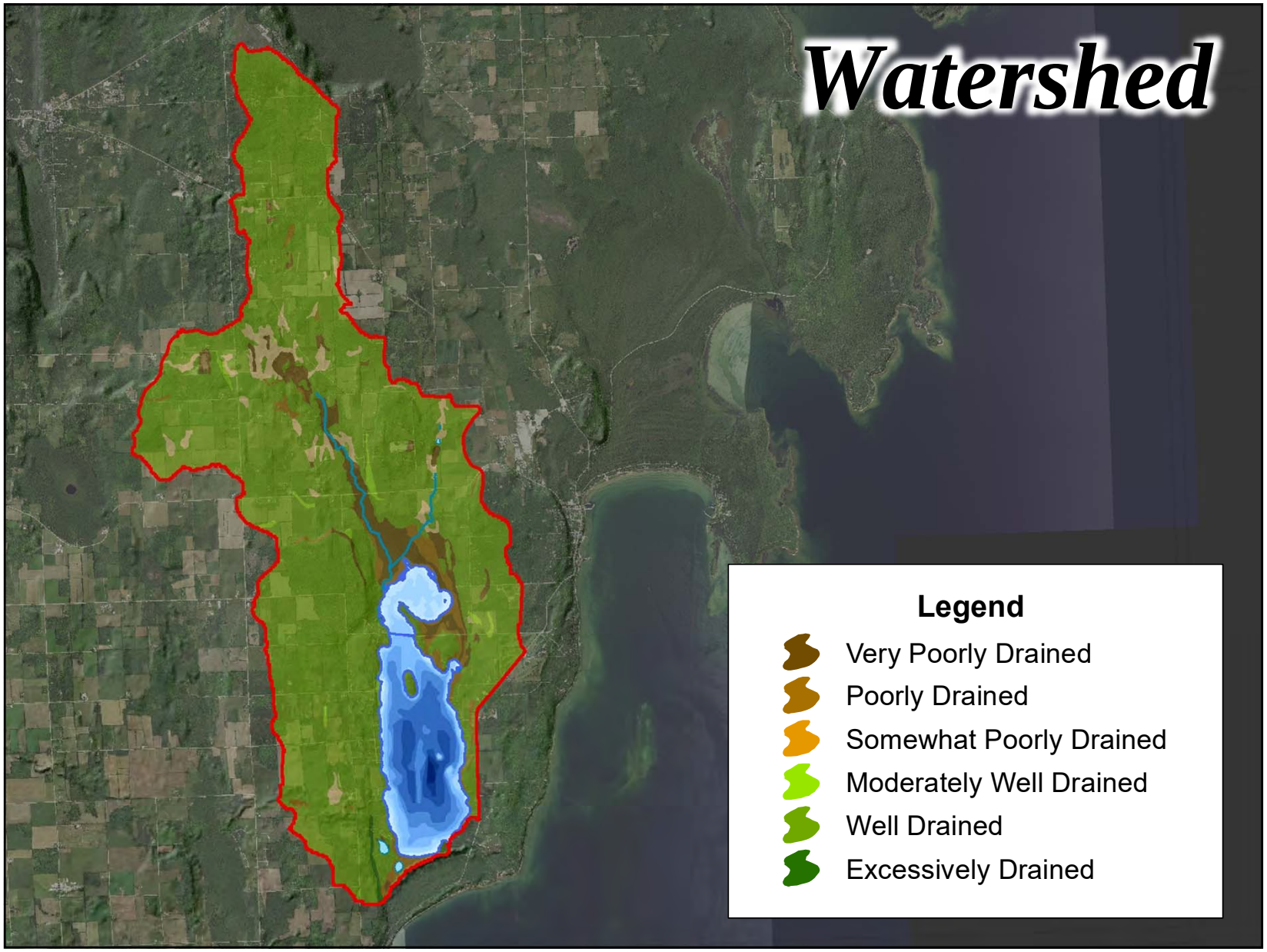
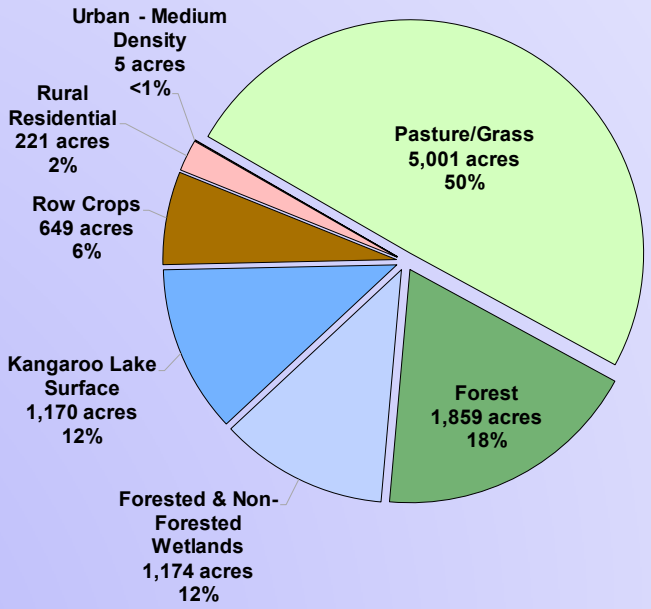
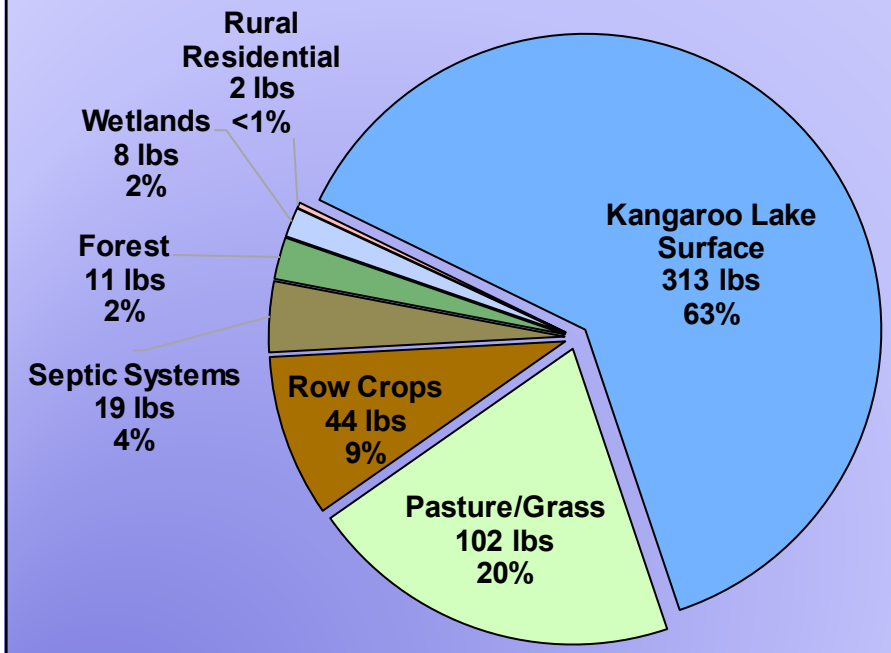

Watershed
Legend
Very Poorly Drained
Poorly Drained
Somewhat Poorly Drained
Moderately Well Drained
Well Drained
Excessively Drained

Watershed Phosphorus Loading

Watershed Land Cover



Phosphorus Loading



Total Loading: ~500 lbs/year

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Shoreland Condition

Shoreland Assessment

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

Urbanized **Natural**

Range

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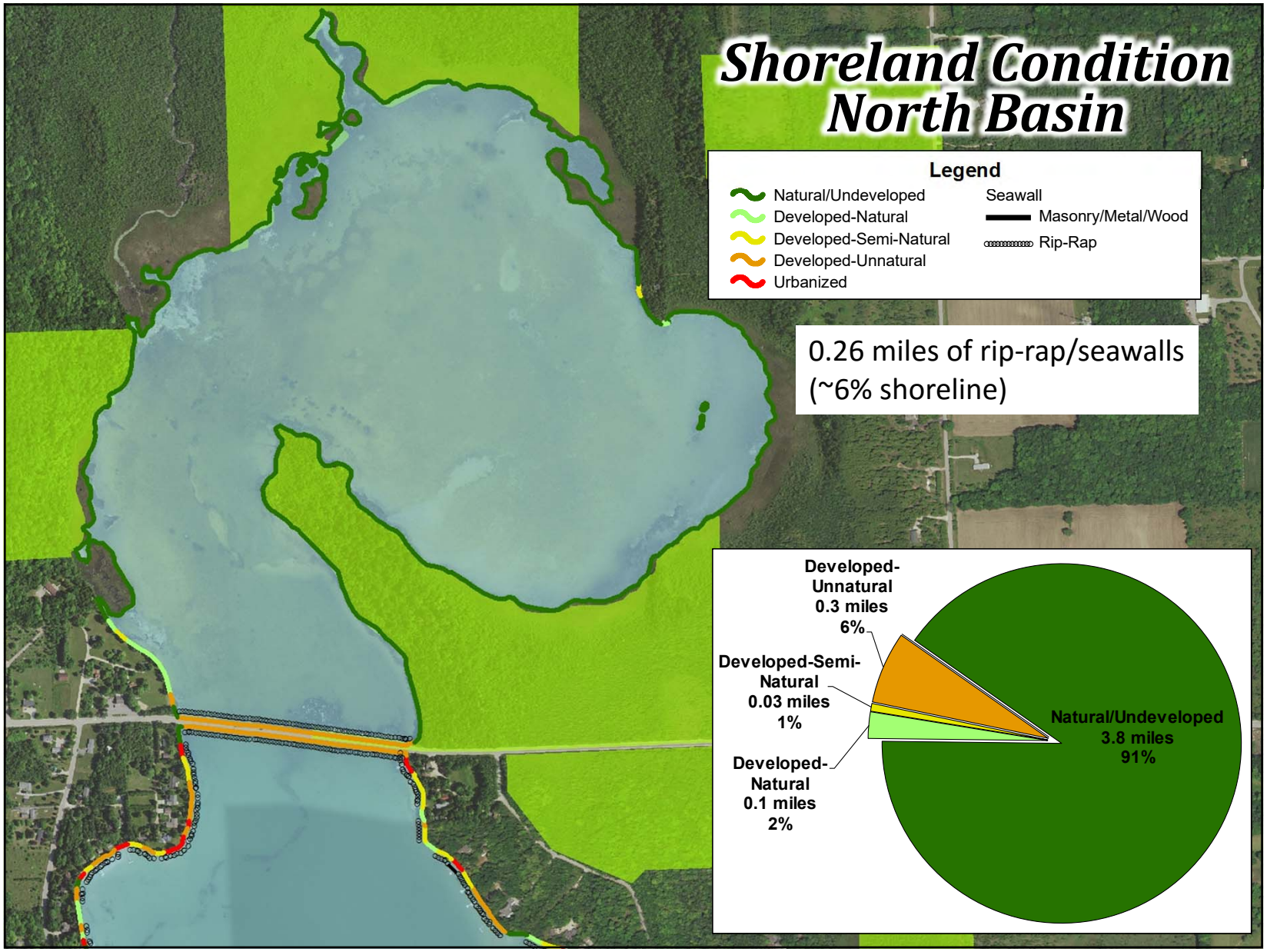
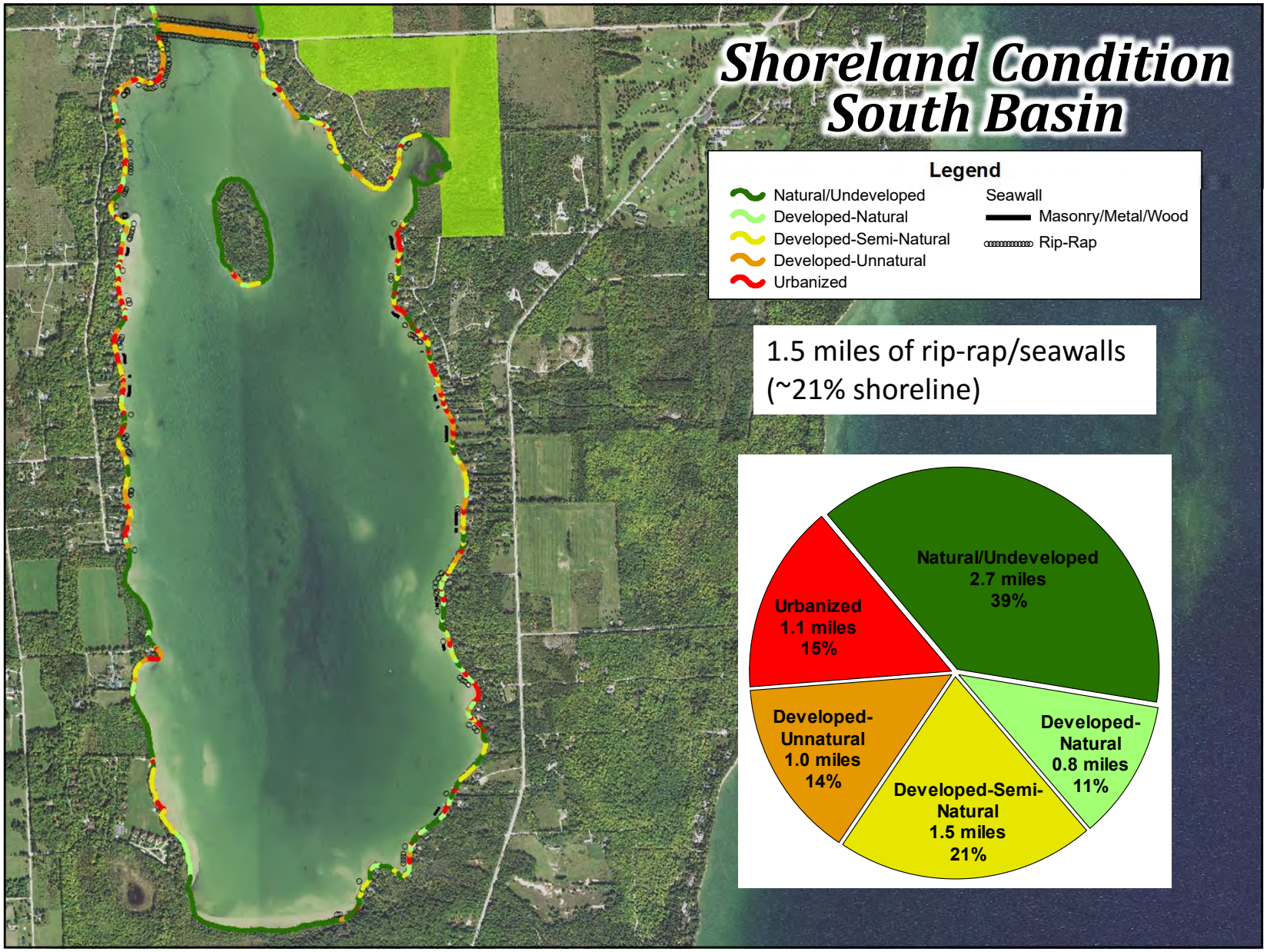
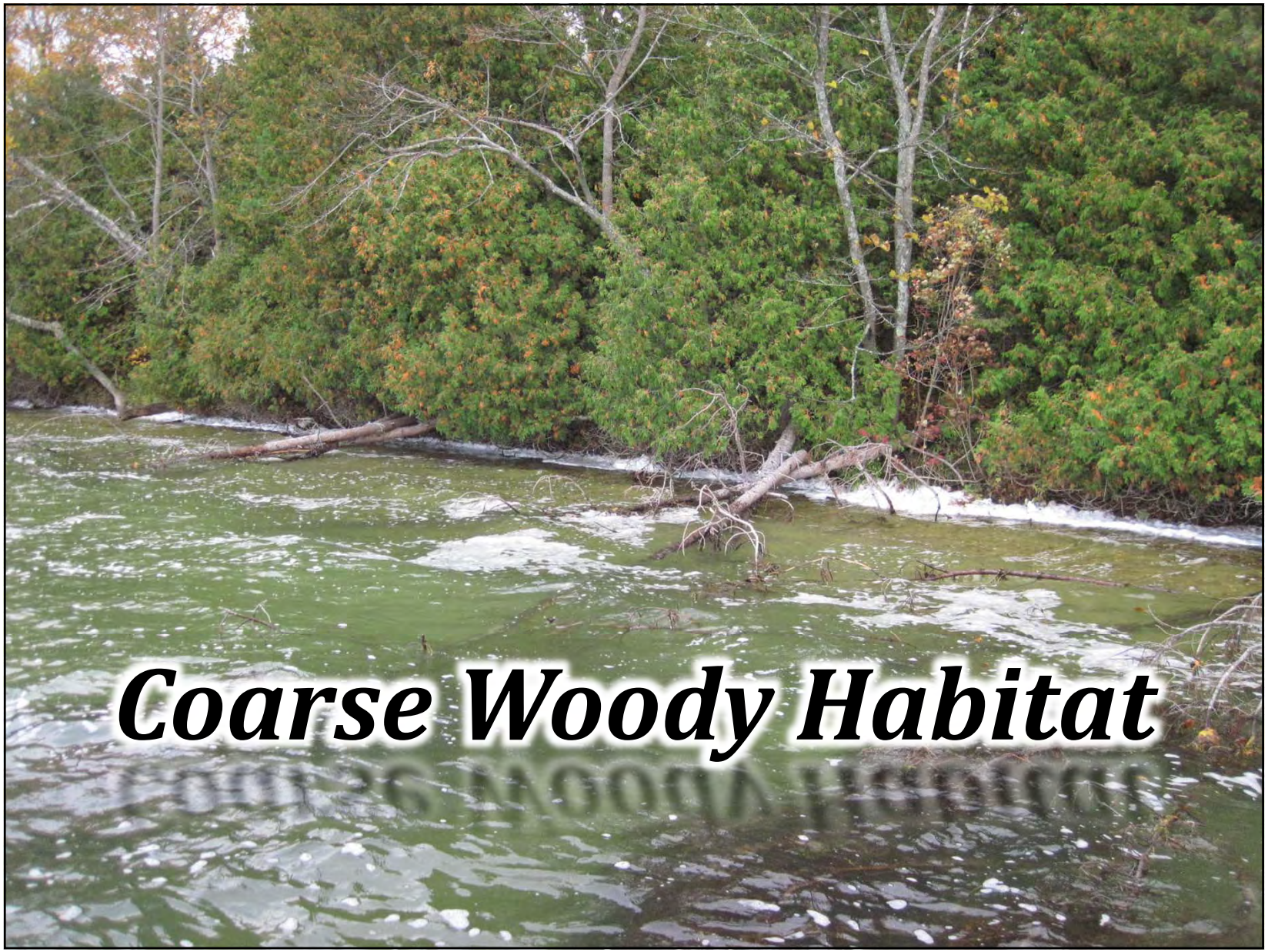
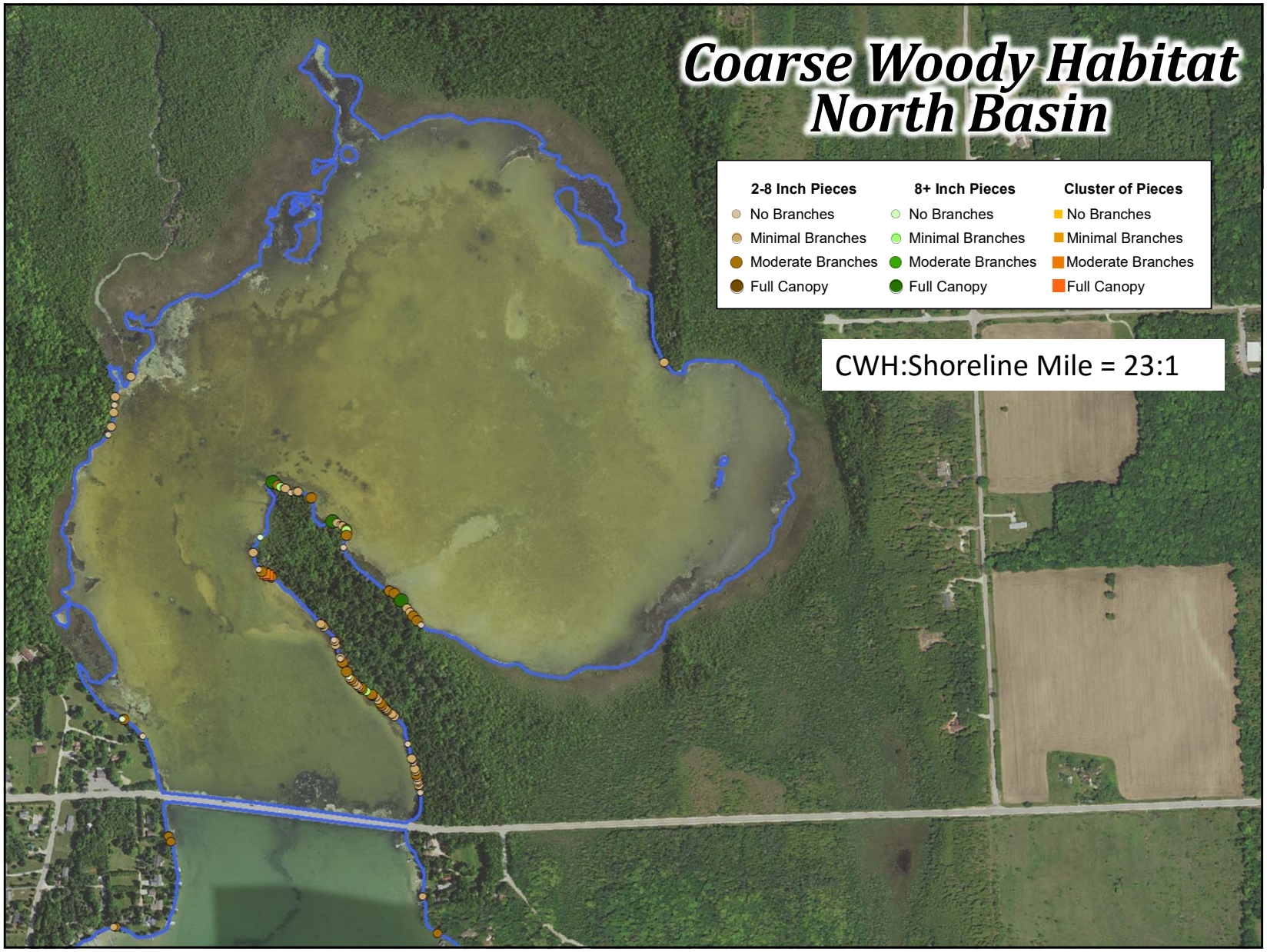
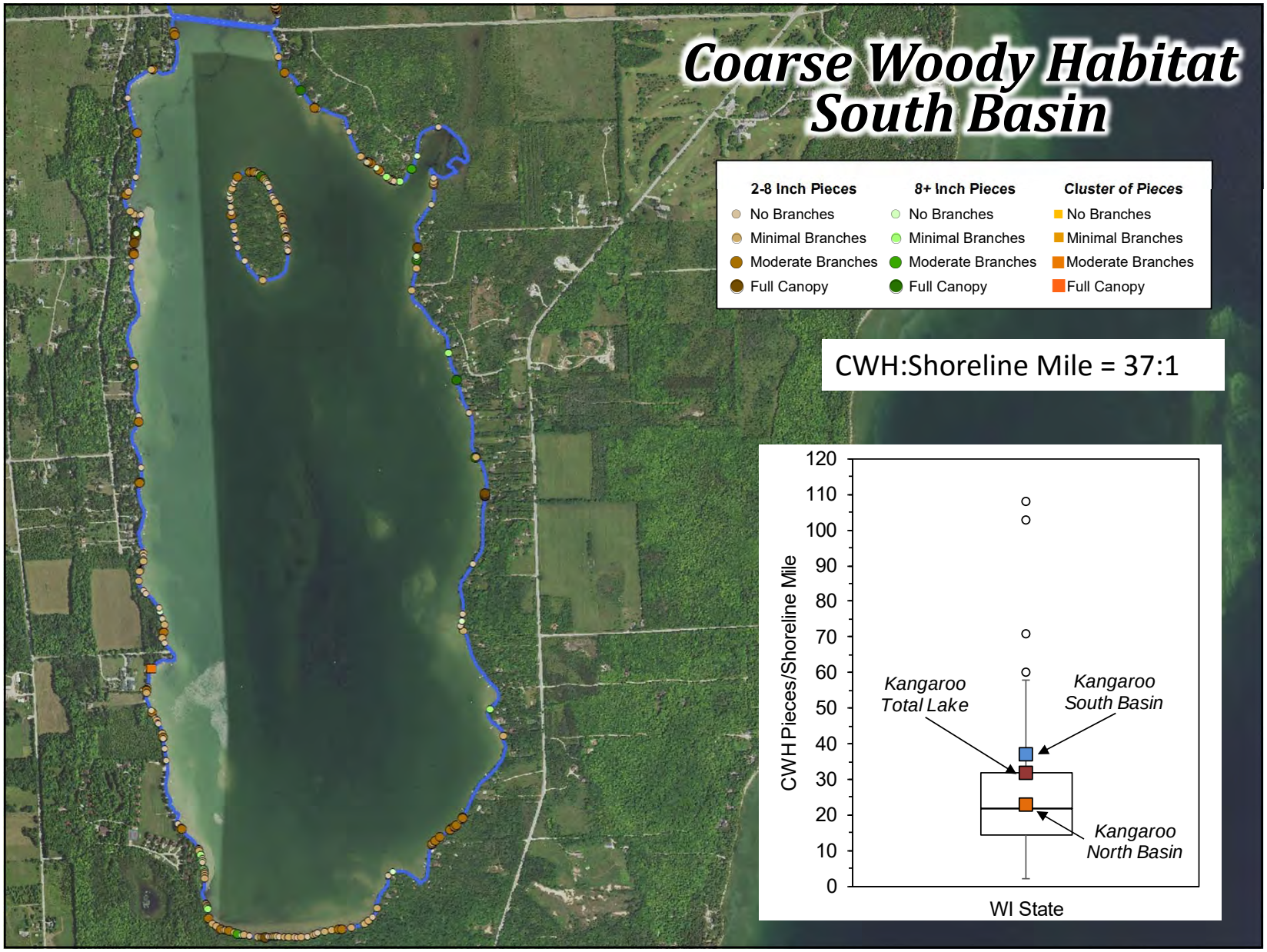

Shoreland Condition
North Basin
Legend
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
Seawall
Masonry/Metal/Wood
Rip-Rap
0.26 miles of rip-rap/seawalls
(~6% shoreline)
Developed-Unnatural 0.3 miles 6%
Developed-Semi-Natural 0.03 miles 1%
Developed-Natural 0.1 miles 2%
Natural/Undeveloped 3.8 miles 91%


Shoreland Condition
South Basin
Legend
Natural/Undeveloped
Developed-Natural
Developed-Semi-Natural
Developed-Unnatural
Urbanized
Seawall
Masonry/Metal/Wood
Rip-Rap
1.5 miles of rip-rap/seawalls
(~21% shoreline)
Natural/Undeveloped
2.7 miles
39%
Developed-
Natural
0.8 miles
11%
Developed-Semi-
Natural
1.5 miles
21%
Developed-
Unnatural
1.0 miles
14%
Urbanized
1.1 miles
15%


Coarse Woody Habitat


Coarse Woody Habitat
North Basin
2-8 Inch Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
8+ Inch Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
Cluster of Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
CWH:Shoreline Mile = 23:1


Coarse Woody Habitat
South Basin
2-8 Inch Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
8+ Inch Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
Cluster of Pieces
No Branches
Minimal Branches
Moderate Branches
Full Canopy
CWH:Shoreline Mile = 37:1
CWH Pieces/Shoreline Mile
120
110
100
90
80
70
60
50
40
30
20
10
0
Kangaroo Total Lake
Kangaroo South Basin
Kangaroo North Basin
WI State

Management Goal:
Maintain Current Water Quality Conditions

Management Actions

1. **Continue monitoring of lakes' water quality through WDNR Citizens Lake Monitoring Network (CLMN)**
2. **Continue monitoring of Piel Creek water quality through the WDNR Water Action Volunteers (WAV)**

   Important for tracking sudden & long-term changes.
3. **Preserve natural & restore highly developed shoreland areas on Kangaroo Lake to improve habitat, reduce erosion, & protect water quality.**
4. **Preserve natural land cover within the Kangaroo Lake watershed beyond the immediate shoreland zone.**

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Aquatic Plants

Aquatic Plant Species

- **28 species located**
  - 1 non-native: EWM
  - Native *Phragmites* subspecies located in north basin

Growth Form	Scientific Name	Common Name	Coeffecient of Conservatism (C)	South Basin (2003)	South Basin (2016)	North Basin (2016)
Emergent	*Eleocharis palustris*	Creeping spikerush	6	•	I	X
	Equisetum fluviatile	Water horsetail	7	•		
	Iris versicolor	Northern blue flag	5	•	I	I
	Juncus effusus	Soft rush	4		I	
	Phragmites australis subsp. *americanus*	Common reed	5			I
	Sagittaria latifolia	Common arrowhead	3	•	I	
	Sagittaria sp. (sterile)	Arrowhead sp. (sterile)	N/A		I	I
	Schoenoplectus acutus	Hardstem bulrush	5	•	X	X
	Schoenoplectus pungens	Three-square rush	5	•	X	I
	Schoenoplectus tabernaemontani	Softstem bulrush	4	•		
	Typha latifolia	Broad-leaved cattail	1	•	I	I
	Zizania palustris	Northern wild rice	8			X
FL	*Nuphar variegata*	Spatterdock	6	•	I	X
	Nymphaea odorata	White water lily	6	•		X
	Sparganium fluctuans	Floating-leaf bur-reed	10	•		
Submergent	*Chara* spp.	Muskgrasses	7	•	X	X
	Heteranthera dubia	Water stargrass	6		X	
	Myriophyllum heterophyllum	Various-leaved watermilfoil	7	•	X	X
	Myriophyllum spicatum	Eurasian watermilfoil	Exotic	•	X	X
	Najas flexilis	Slender naiad	6	•	X	X
	Potamogeton amplifolius	Large-leaf pondweed	7	•	X	
	Potamogeton friesii	Fries' pondweed	8			I
	Potamogeton gramineus	Variable-leaf pondweed	7	•	X	X
	Potamogeton illinoensis	Illinois pondweed	6	•	X	X
	Potamogeton illinoensis X *P. richardsonii*	Ilinois x clasping-leaf pondweed hybrid	N/A			I
	Potamogeton natans	Floating-leaf pondweed	5	•		X
	Potamogeton richardsonii	Clasping-leaf pondweed	5	•		
	Stuckenia pectinata	Sago pondweed	3	•	X	X
	Utricularia intermedia	Flat-leaf bladderwort	9			X
	Utricularia minor	Small bladderwort	10			X
	Utricularia vulgaris	Common bladderwort	7	•	X	X
	Vallisneria americana	Wild celery	6	•	X	X
S/E	*Eleocharis acicularis*	Needle spikerush	5	•		
FF	*Lemna minor*	Lesser duckweed	5	•		

• = Located during 2003 surveys; X = Located on rake during 2016 point-intercept survey; I = Incidentally located during 2016 surveys
FL = Floating-leaf; S/E = Submergent & Emergent; FF = Free-floating

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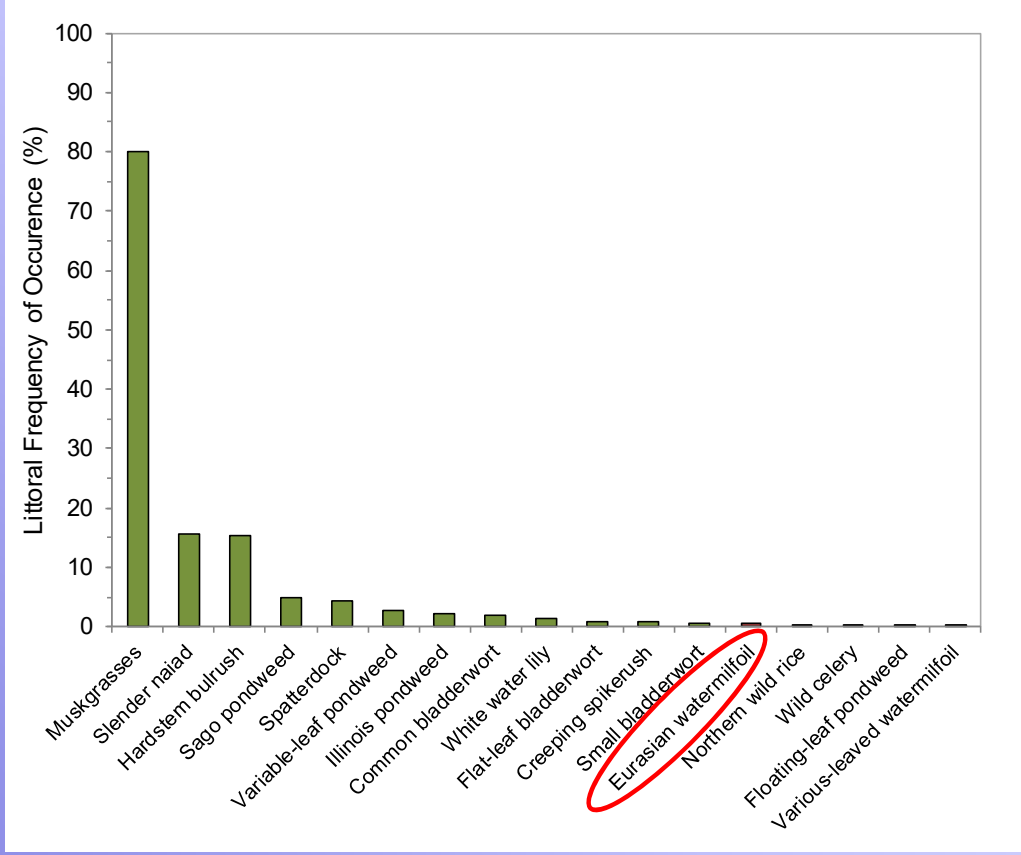
Littoral Frequency of Occurrence

North Basin



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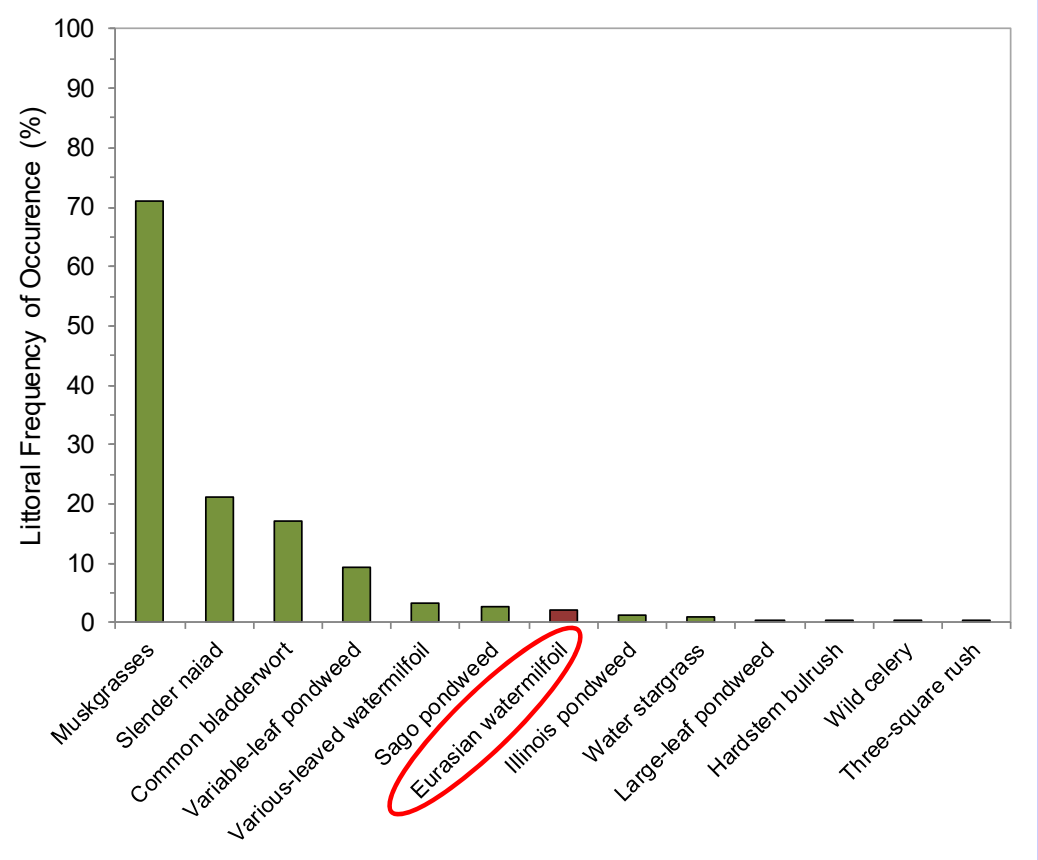
Littoral Frequency of Occurrence

South Basin



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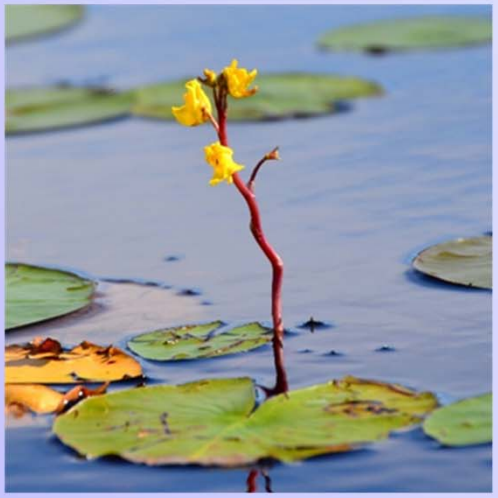
Kangaroo Lake Common Plants

Muskgrasses
(*Chara* spp.)

Slender Naiad
(*Najas flexilis*)

Common bladderwort
(*Utricularia vulgaris*)



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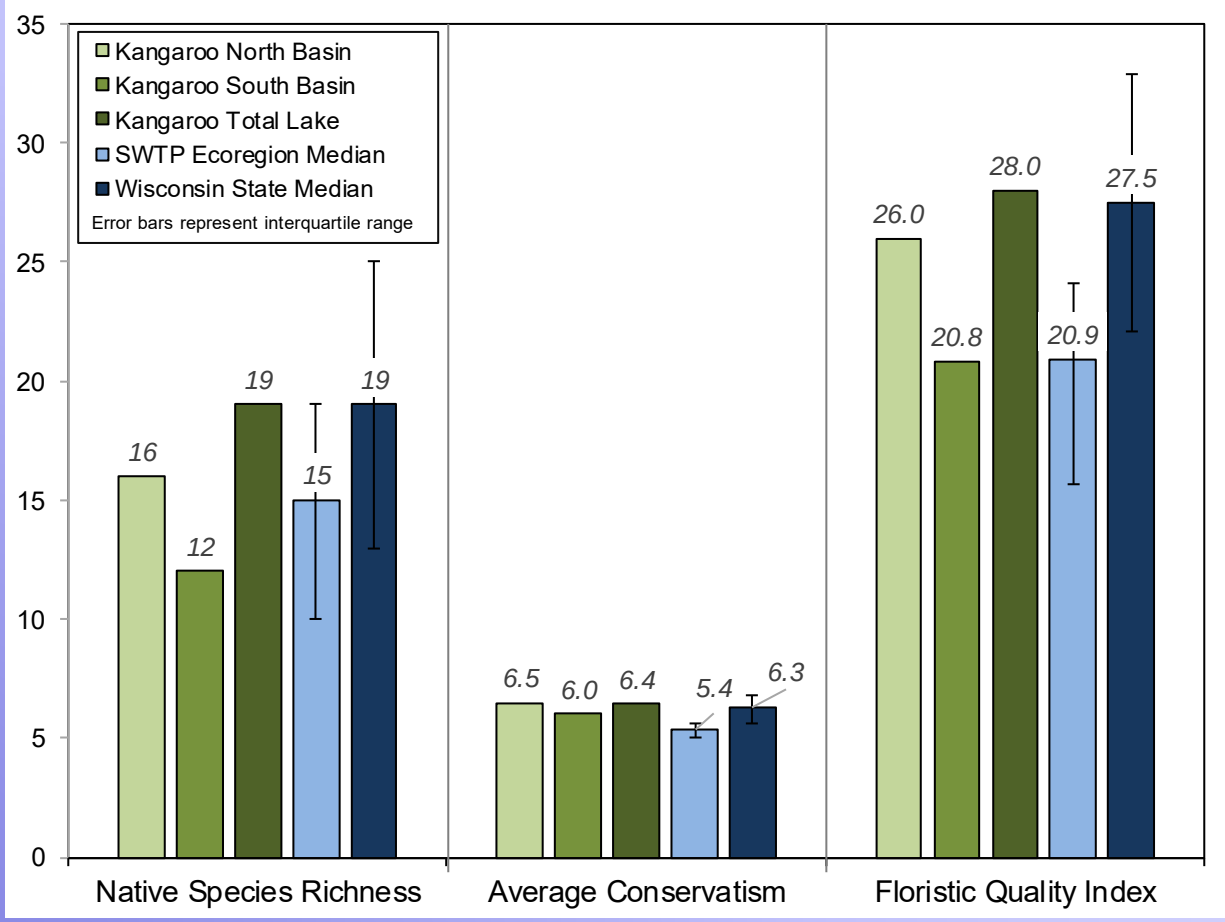
Floristic Quality Analysis



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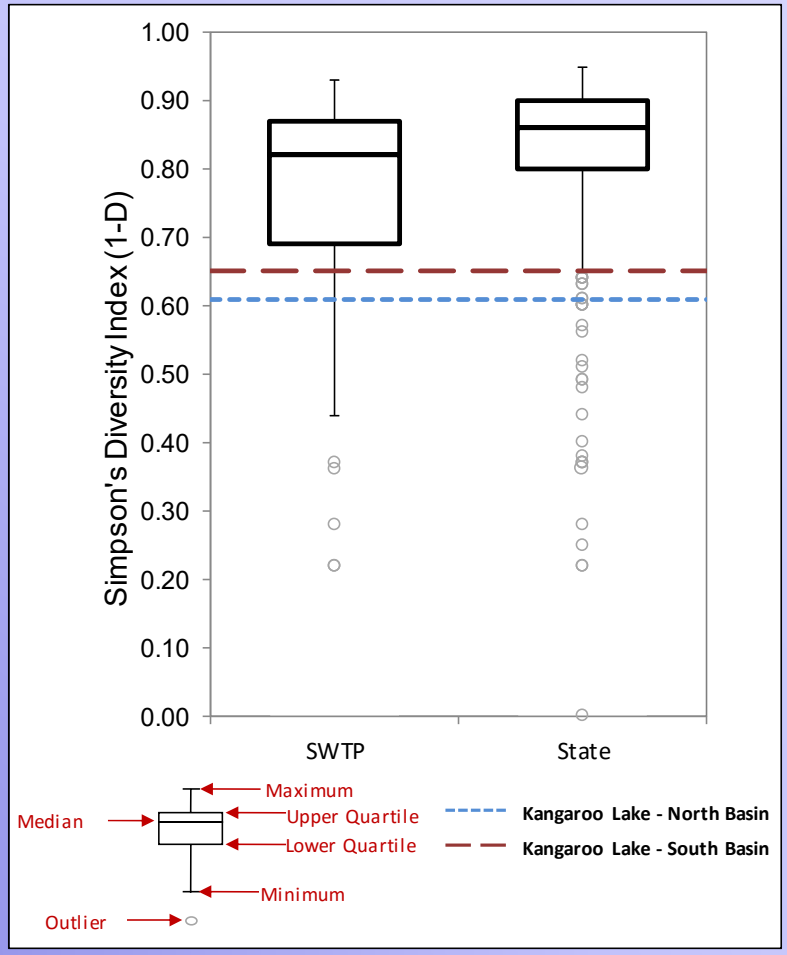
Simpson's Diversity Index



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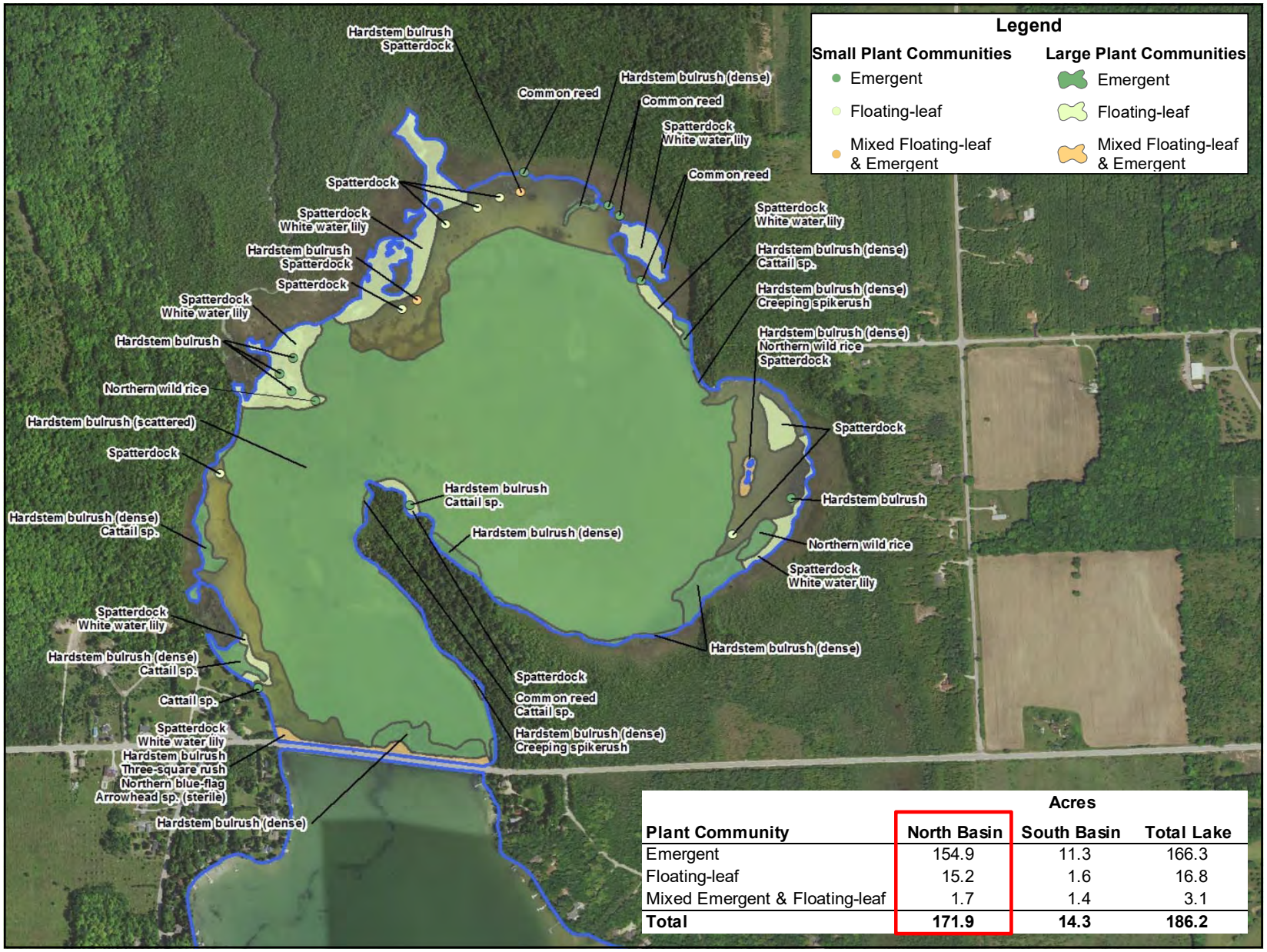
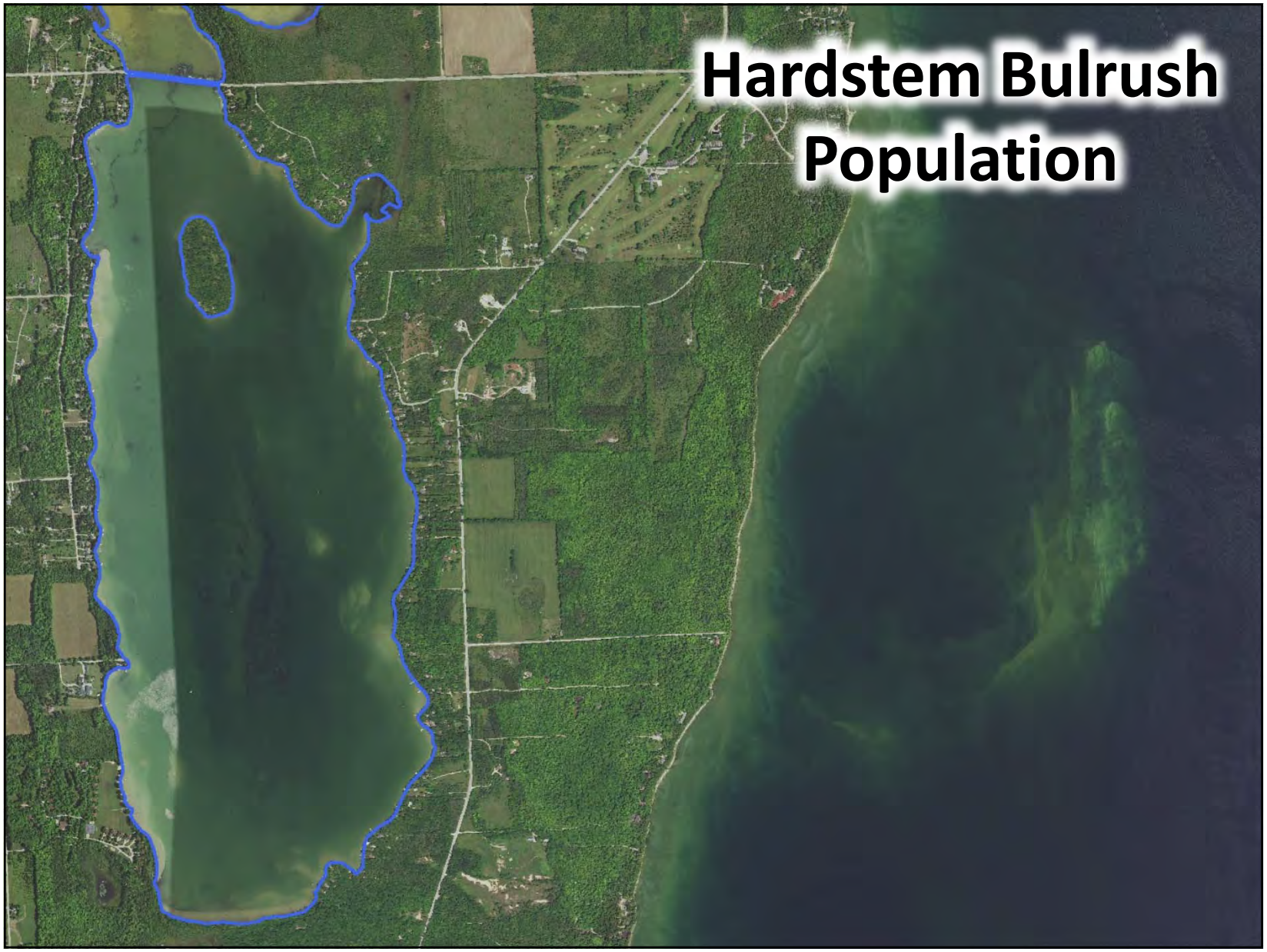
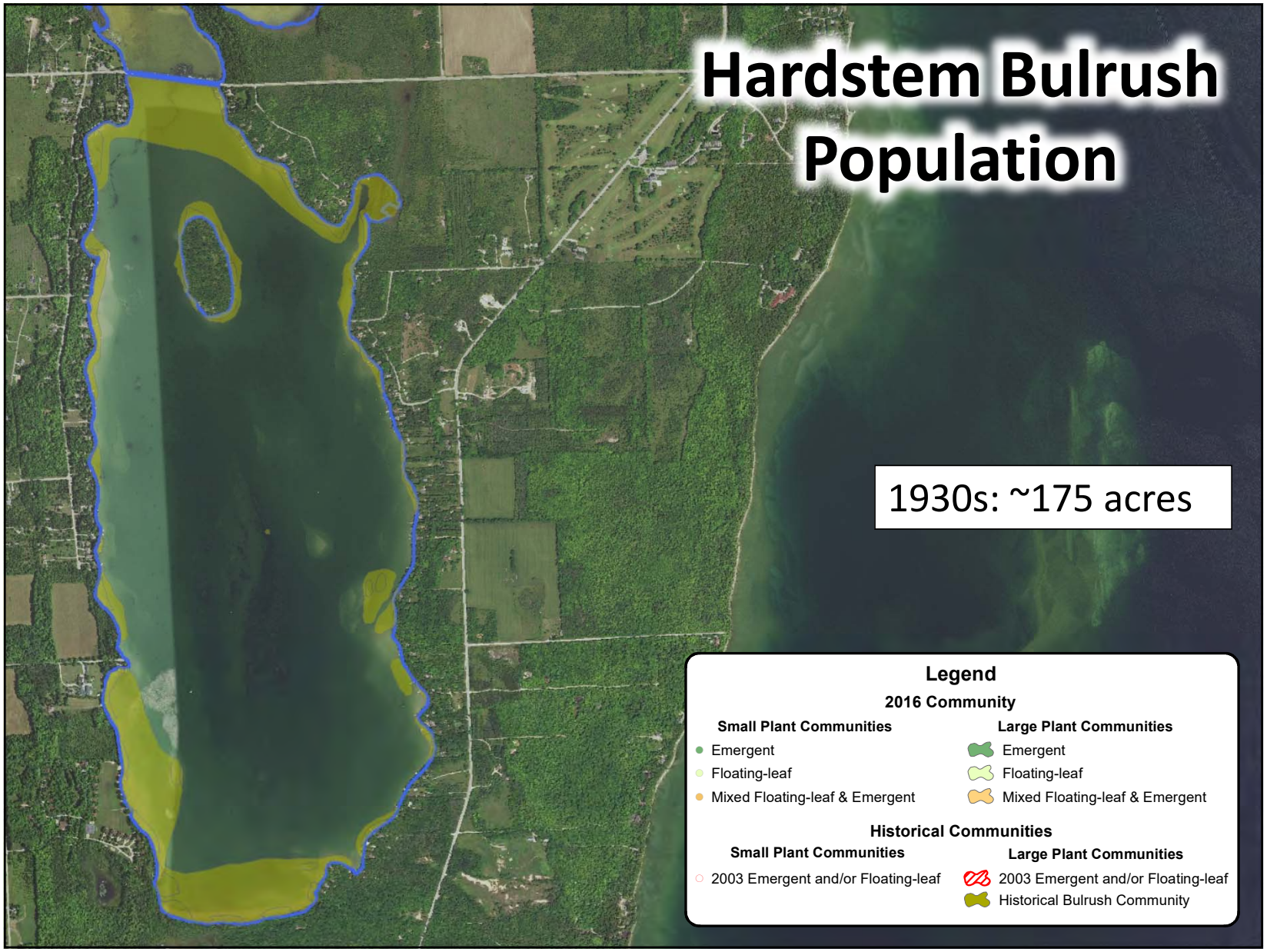
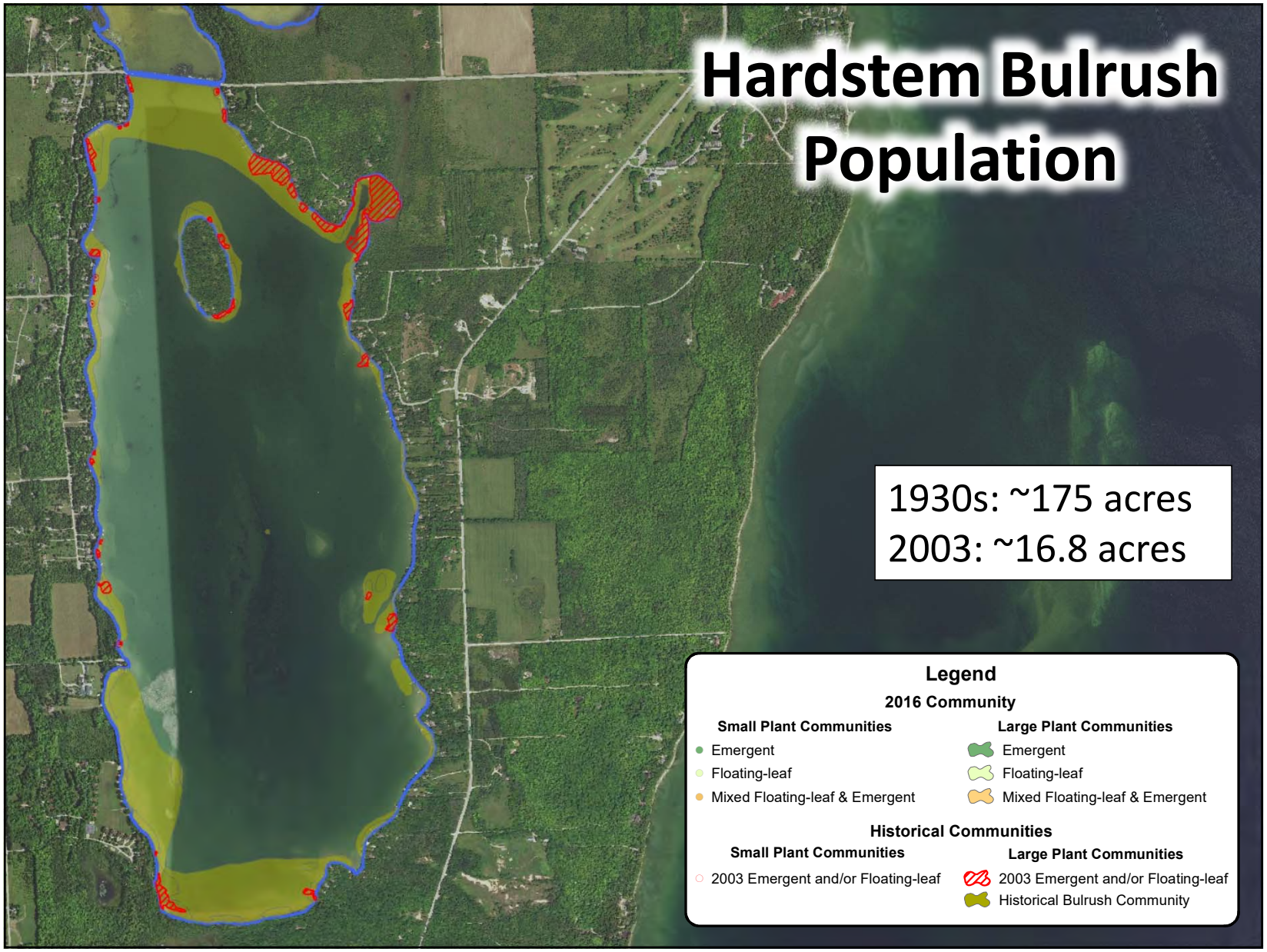
Emergent & Floating-leaf
Aquatic Plants



Plant Community	Acres North Basin	South Basin	Total Lake
Emergent	154.9	11.3	166.3
Floating-leaf	15.2	1.6	16.8
Mixed Emergent & Floating-leaf	1.7	1.4	3.1
Total	**171.9**	**14.3**	**186.2**


Hardstem Bulrush
Population


Hardstem Bulrush Population
1930s: ~175 acres
Legend
2016 Community
Small Plant Communities
Emergent
Floating-leaf
Mixed Floating-leaf & Emergent
Large Plant Communities
Emergent
Floating-leaf
Mixed Floating-leaf & Emergent
Historical Communities
Small Plant Communities
2003 Emergent and/or Floating-leaf
Large Plant Communities
2003 Emergent and/or Floating-leaf
Historical Bulrush Community


Hardstem Bulrush Population
1930s: ~175 acres
2003: ~16.8 acres
Legend
2016 Community
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Floating-leaf
Mixed Floating-leaf & Emergent
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Floating-leaf
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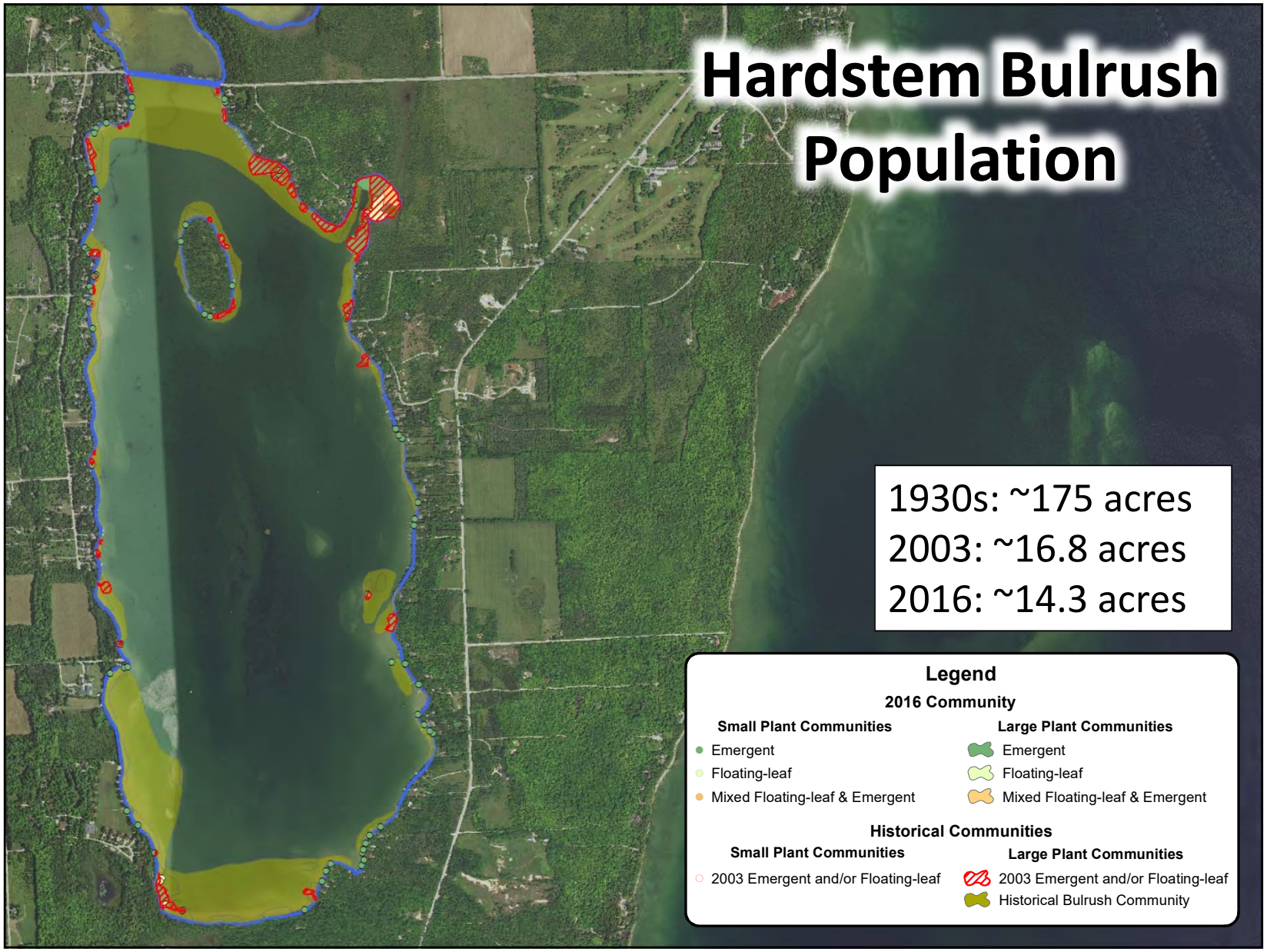
Large Plant Communities
2003 Emergent and/or Floating-leaf
Historical Bulrush Community


Hardstem Bulrush Population
1930s: ~175 acres
2003: ~16.8 acres
2016: ~14.3 acres
Legend
2016 Community
Small Plant Communities
Emergent
Floating-leaf
Mixed Floating-leaf & Emergent
Large Plant Communities
Emergent
Floating-leaf
Mixed Floating-leaf & Emergent
Historical Communities
Small Plant Communities
2003 Emergent and/or Floating-leaf
Large Plant Communities
2003 Emergent and/or Floating-leaf
Historical Bulrush Community

Reduction in Bulrushes

- Likely due to a combination of interacting factors
  - Changes in hydrology – dam installation in 1937
  - Increase in shoreland development
  - Increase in motorboat traffic
  - Increased herbivory? (Geese, muskrats)

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Management Goal:

Protect & Enhance Native Aquatic Plant Communities in Kangaroo Lake

Management Actions

1. **Protect & enhance the hardstem bulrush population in south basin of Kangaroo Lake**

   Continue monitoring of experimental plantings & education of lake users on importance of protection.

2. **Conduct periodic, professional monitoring of the emergent & floating-leaf aquatic plant communities within the south basin of Kangaroo Lake.**

   Conduct survey every 10 years to gain further insight into bulrush population dynamics. Next survey in 2025.

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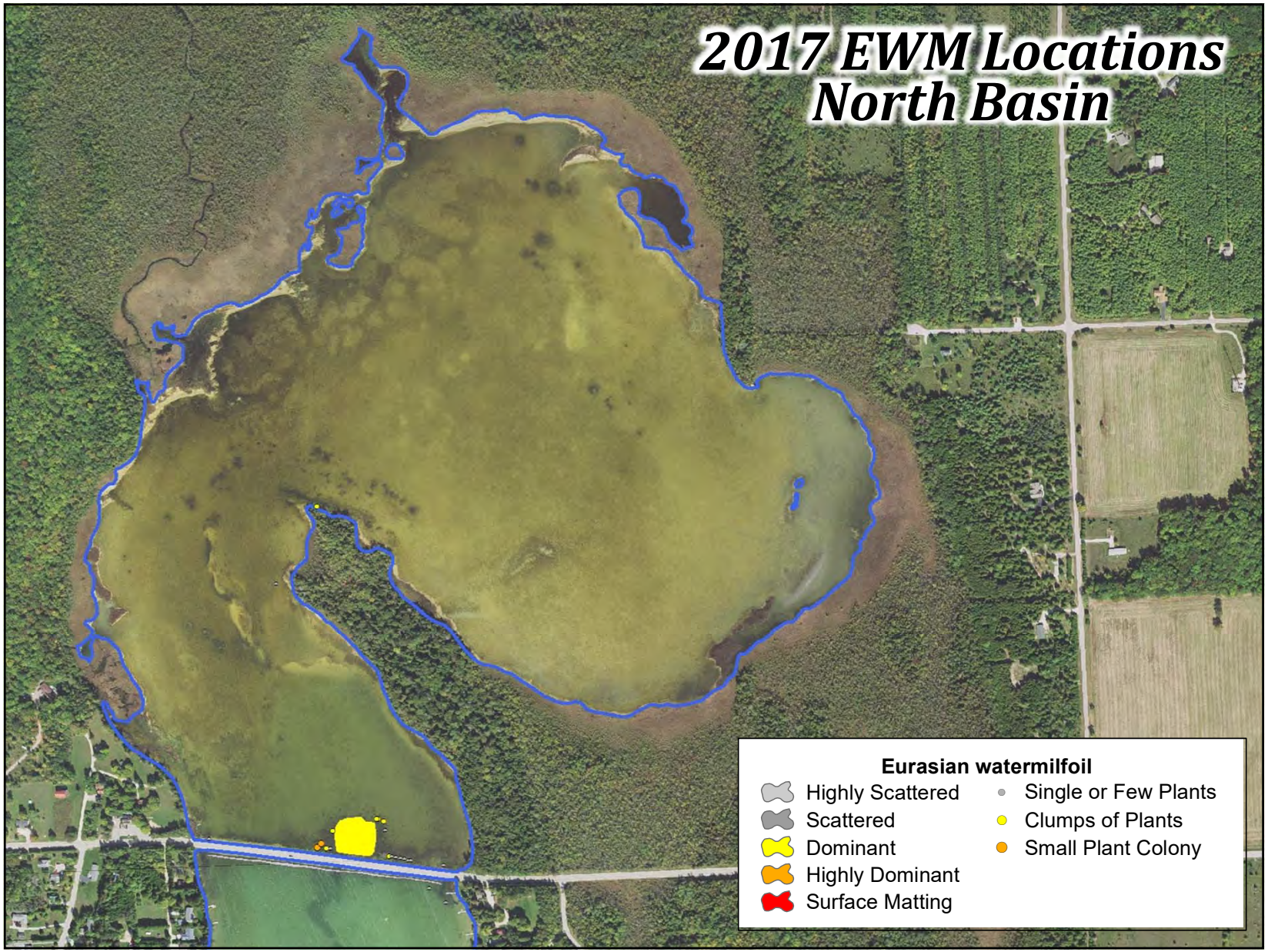
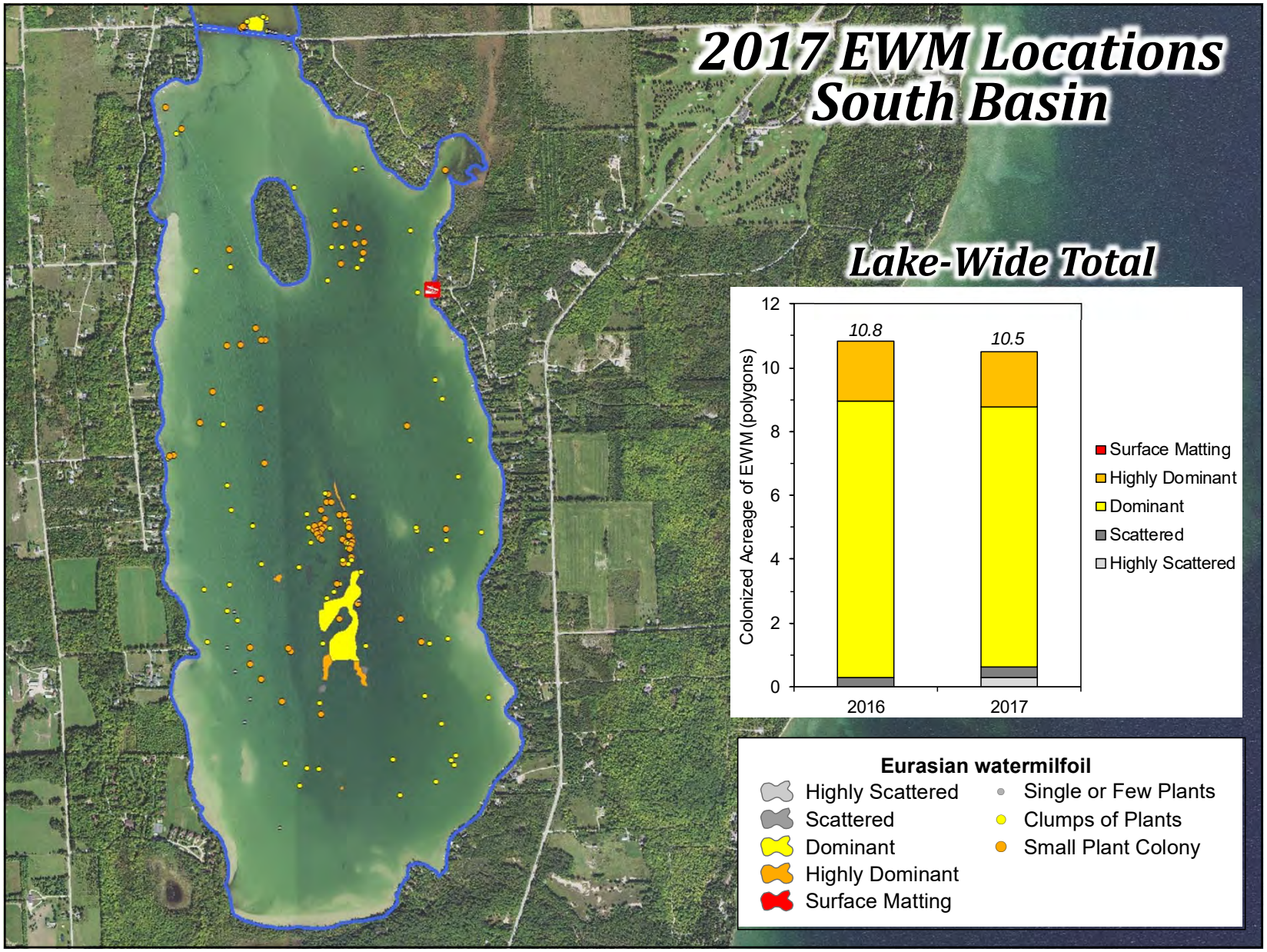
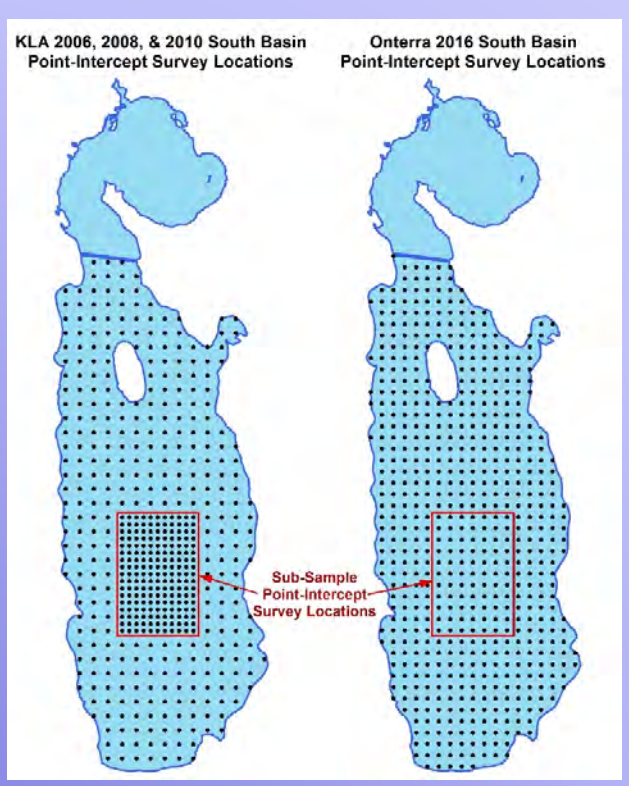
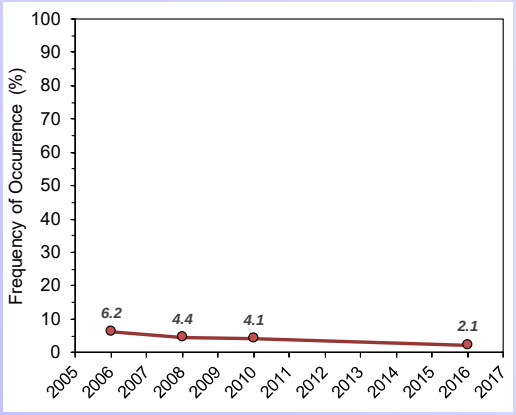

2017 EWM Locations
North Basin
Eurasian watermilfoil
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clumps of Plants
Small Plant Colony


2017 EWM Locations
South Basin
Lake-Wide Total
Colonized Acreage of EWM (polygons)
12
10
8
6
4
2
0
10.8
10.5
2016
2017
Surface Matting
Highly Dominant
Dominant
Scattered
Highly Scattered
Eurasian watermilfoil
Highly Scattered
Scattered
Dominant
Highly Dominant
Surface Matting
Single or Few Plants
Clumps of Plants
Small Plant Colony

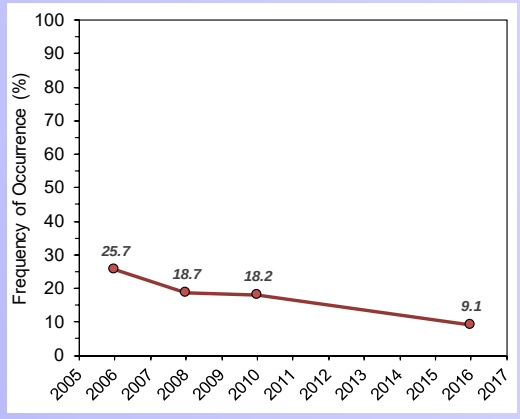
Eurasian watermilfoil



South Basin



Sub-Sample Locations



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Management Goal:

Control Existing Aquatic Invasive Species & Prevent New Introductions & Spread from Kangaroo Lake

Management Actions

1. **Conduct periodic, lake-wide professional vegetation monitoring in the south basin of Kangaroo Lake.**

   EWM population currently low. KLA would like to continue monitoring the population through PI survey every 5 years.

2. **Continue annual monitoring and hand-removal of EWM within the north basin of Kangaroo Lake.**

   Focused on smaller EWM occurrences. Led by Kari at the Nature Conservancy.

3. **Investigate feasibility of implementing DASH to control dominant colony of EWM in north basin of Kangaroo Lake.**

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Management Goal:

Control Existing Aquatic Invasive Species & Prevent New Introductions & Spread from Kangaroo Lake continued

Management Actions

4. **Investigate implementing annual, volunteer-based monitoring of Kangaroo Lake's zebra mussel population following established WDNR/UW-Extension protocols.**

   Deploy substrate samplers & count mussels to determine density.

5. **Initiate aquatic invasive species rapid response plan upon discovery of new infestation.**

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Management Goal:
Enhance the Fishery of Kangaroo Lake

Management Actions

1. **Develop a Kangaroo Lake Fisheries Committee to work with WDNR fisheries managers to enhance the fishery of Kangaroo Lake.**

   Lake may be shifting from walleye to bass/panfish fishery – cause is unknown.

   KLA is working with WDNR fisheries biologist to enhance coarse woody habitat.

   Fisheries committee will work with WDNR fisheries biologist to determine ways habitat can be enhanced further

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Management Goal:

Assure & Enhance the Communication & Outreach of the KLA with Lake Stakeholders

Management Actions

1. **Promote stakeholder involvement, inform stakeholders on various lake issues, as well as the quality of life on Kangaroo Lake**

   Continue newsletter publication & maintain website.

   Consider creation of Facebook page as additional avenue for distribution of information.

2. **Enhance the KLA's involvement with other entities that manage aspects of Kangaroo Lake.**

   KLA actively engages with all management entities (e.g. WDNR, Nature Conservancy, Bailey's Harbor, etc.)

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