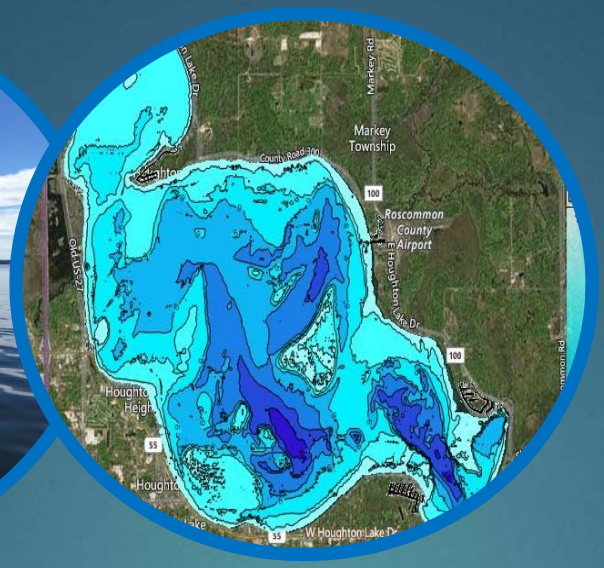


13 ANNUAL OTTAWA COUNTY WATER QUALITY FORUM

SUCCESSFUL CASE STUDIES ON LARGE LAKE MANAGEMENT: CONSIDERATIONS FOR SPRING LAKE AND LAKE MACATAWA

© BY: DR. JENNIFER L. JERMALOWICZ-JONES

RESTORATIVE LAKE SCIENCES

NOVEMBER 19, 2018

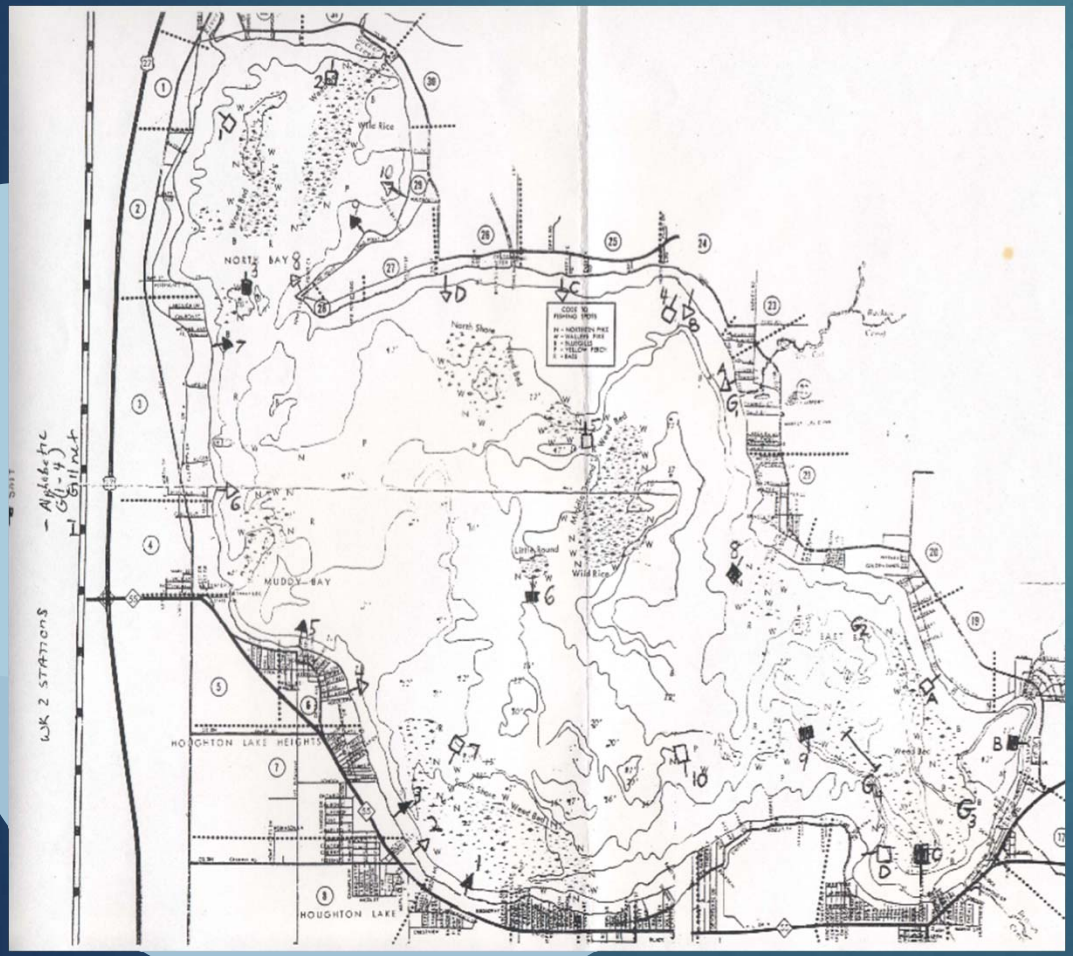
Restorative Lake Sciences™

CHALLENGES WITH MANAGING LARGE INLAND LAKES

Large-Lake Integrated Management Approach: Aquatic Vegetation

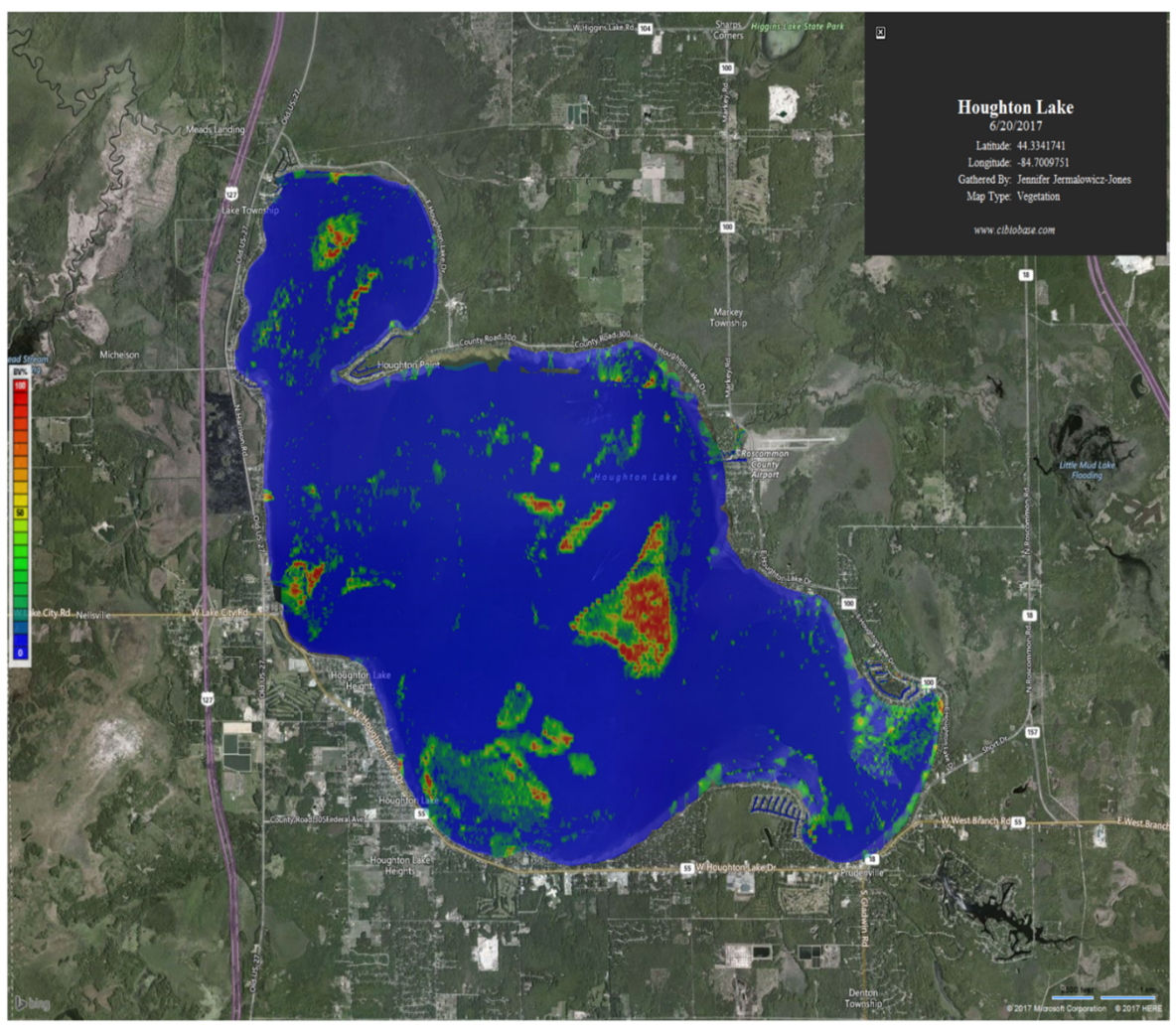
- Establishment of long-term goals
- Scale: time required for evaluation
- Detailed whole-lake GPS surveys
- QA/QC of GPS data
- Development of sensitive-species maps
- Development of relative abundance maps
- Development of polygon maps
- Scale-management method decision-making
- Site-selective management for unique/sensitive aquatic vegetation

#1a: Establishment of Long-term Management Goals



- Historical maps
- Original fishery habitats
- Restoration of emergent vegetation
- Pre-invasive species conditions
- Conditions to improve water quality and restore original lake conditions

#1b: Establishment of Long-term Management Goals



- Houghton Lake 2017: 66% of lake is unvegetated
- Must conserve as much native aquatic vegetation as possible for lake health and fishery
- Big challenge when the two groups co-exist!!

#2: Scale -Time for Evaluation

Example:

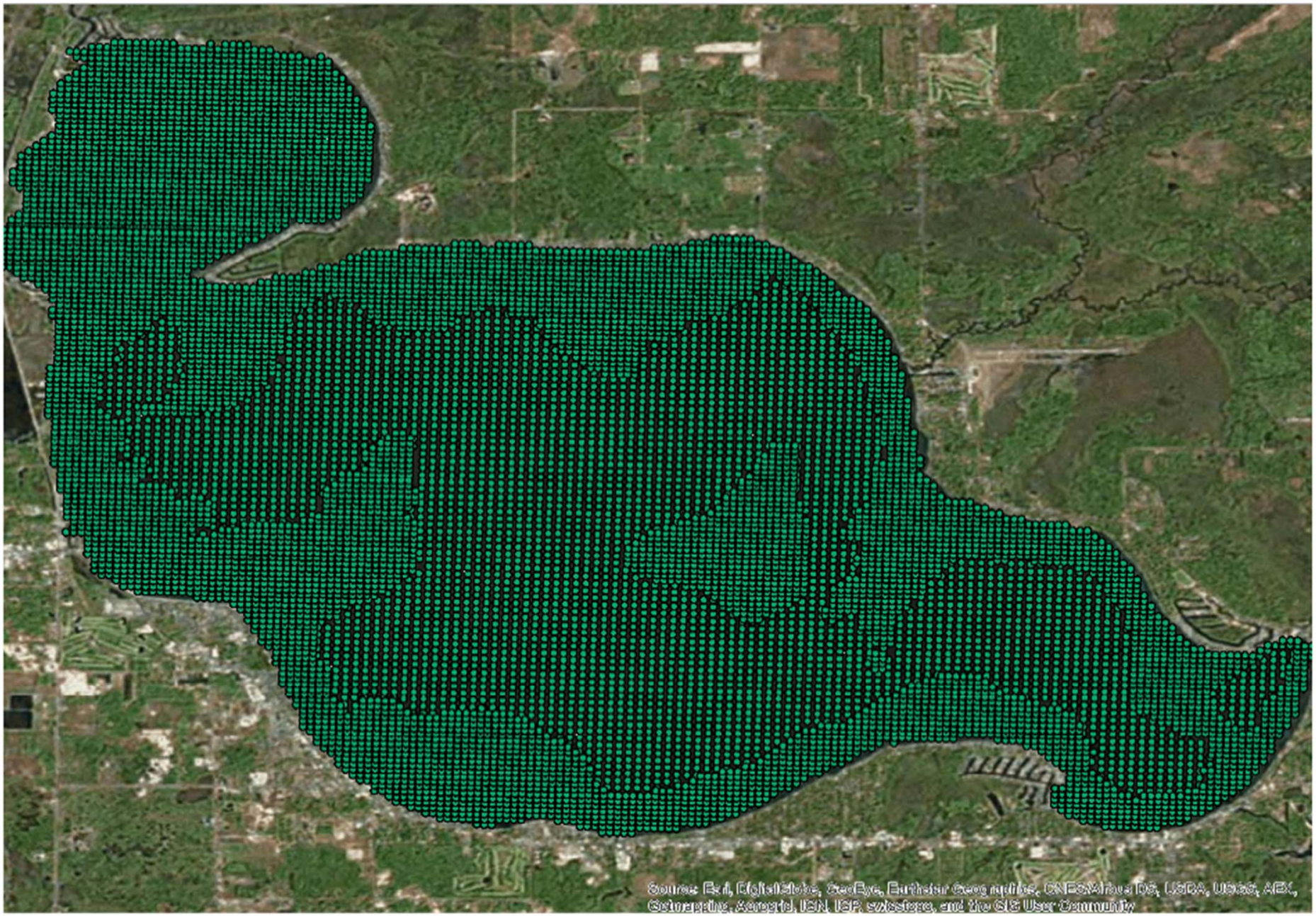
Houghton Lake

- 20,044 acres in area
- 30.5 miles of shoreline
- Mean depth of 8.5 ft.
- Maximum depth of 21 ft.
- Several tributaries
- Retention Time of 1.71 yrs.

Surveying a 20,044-acre Lake: Patience to Collect Good Data

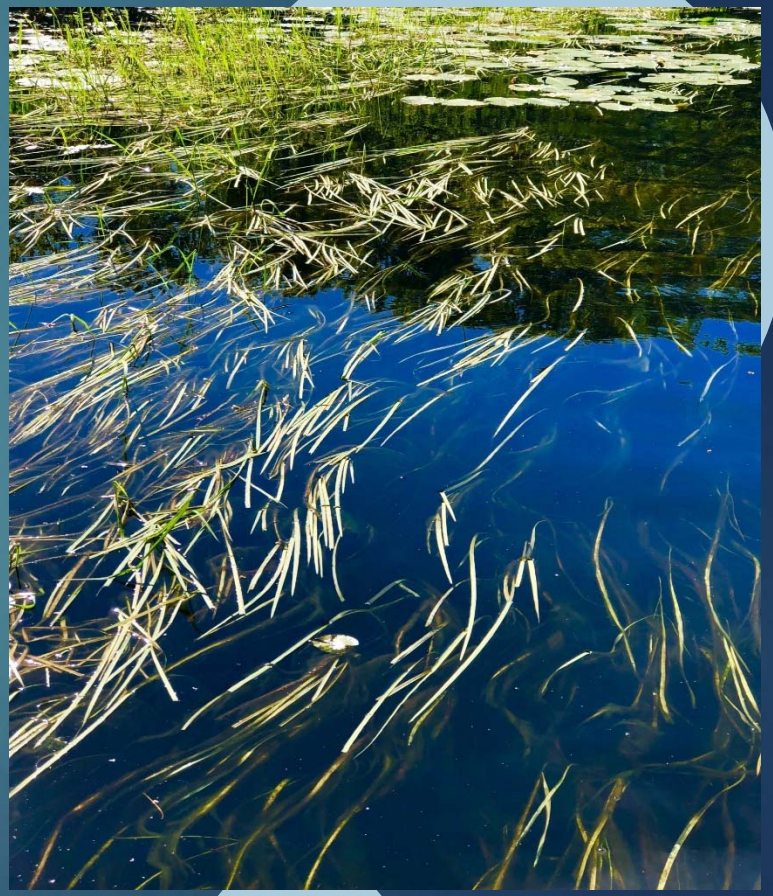
- Survey takes 2 weeks with three boats and a crew of six
- Boats have to move slowly to scan lake bottom and allow time for thorough data collection
- Over 15,000 sampling locations in main lake + many more in canals
- Data on invasives and native aquatic plant abundance

Houghton Lake Survey Grid Points

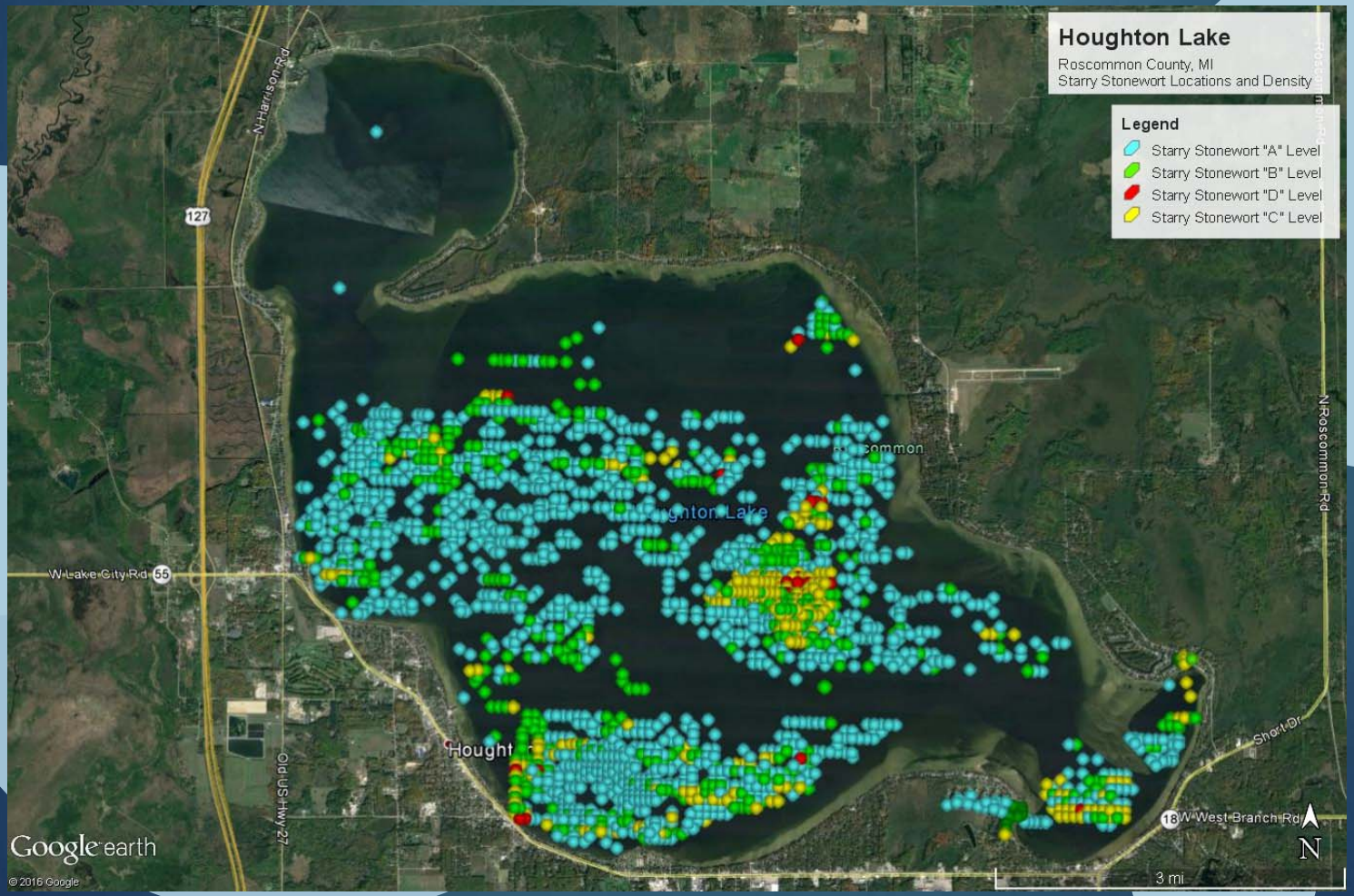


#3: QA/QC of GPS Data

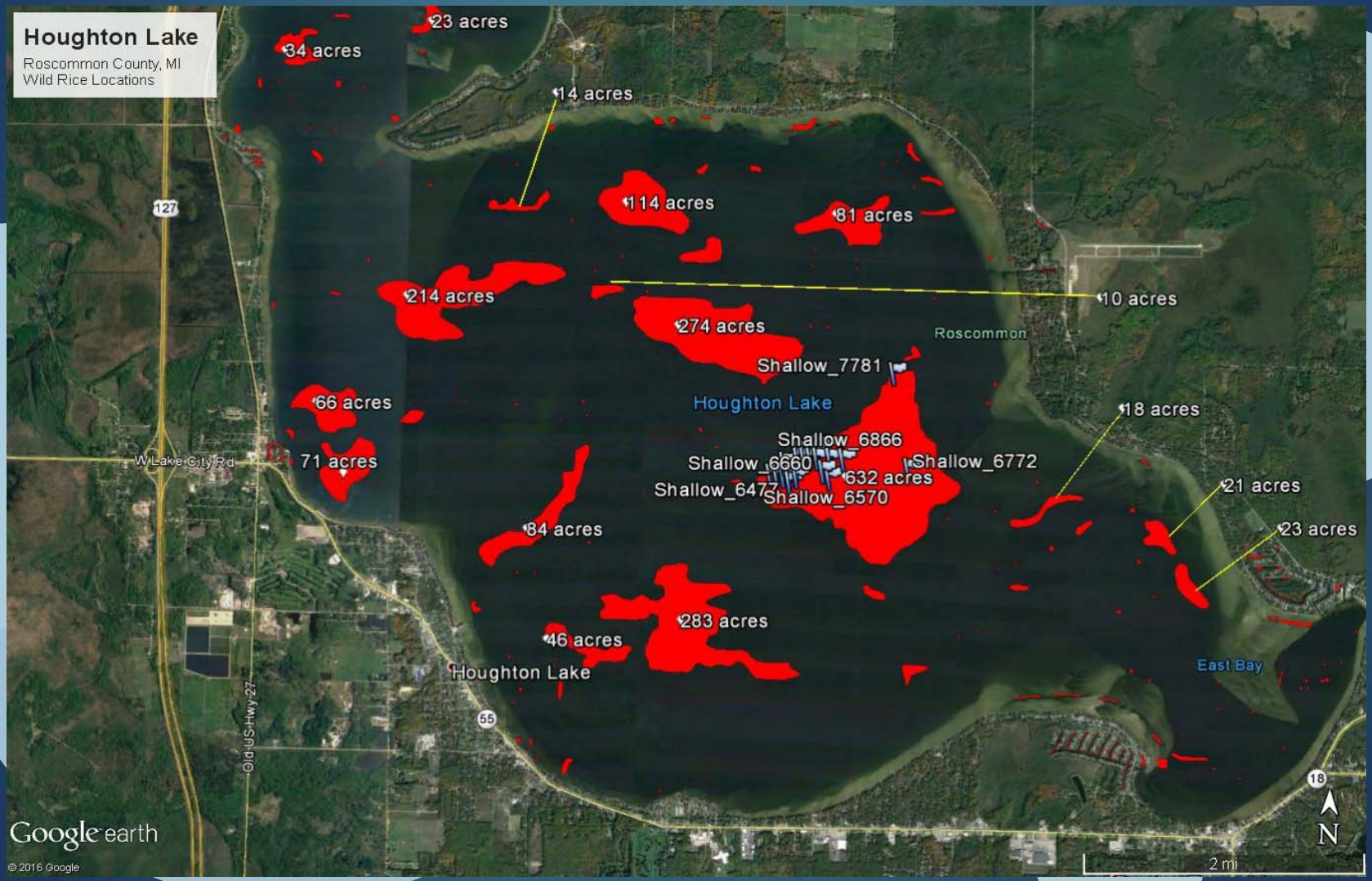
#4: Development of Management Maps- Sensitive Species



#5: Development of Management Maps- Relative Abundance



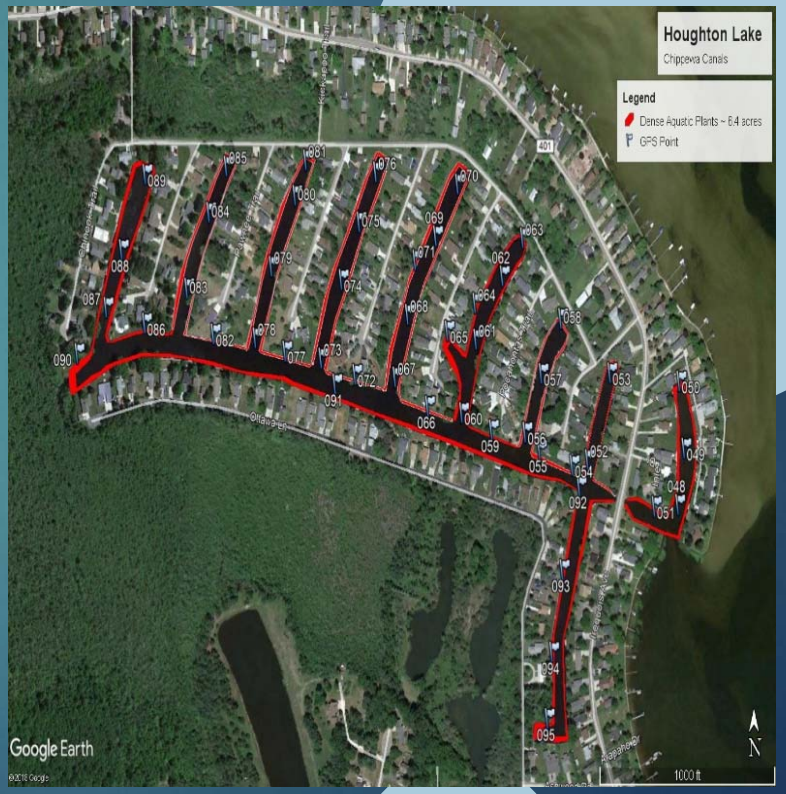
#6: Development of Management Maps-Polygons



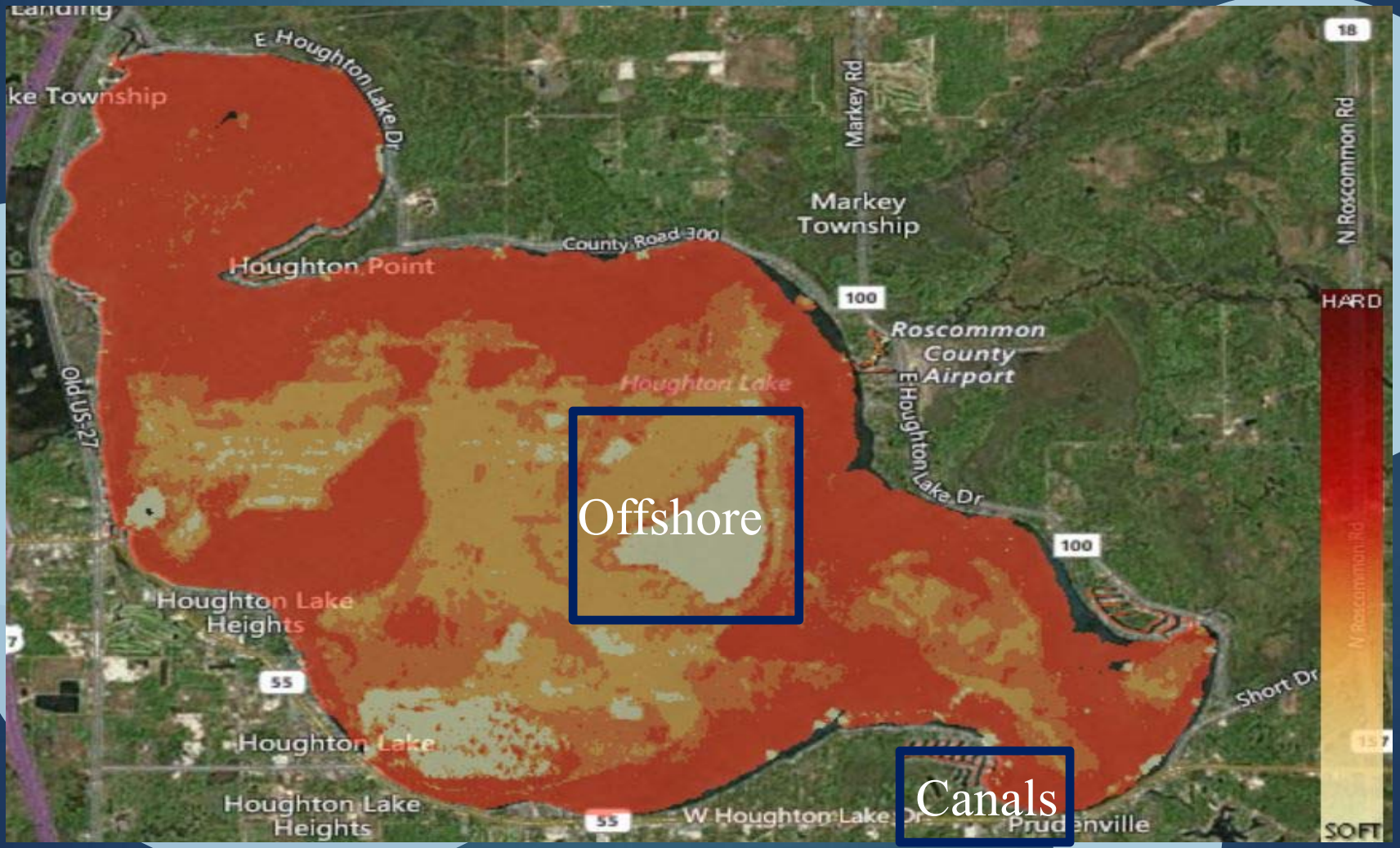
#7: Scale and Management Method Decision-Making

Harvest-Friendly

Not Harvest-Friendly

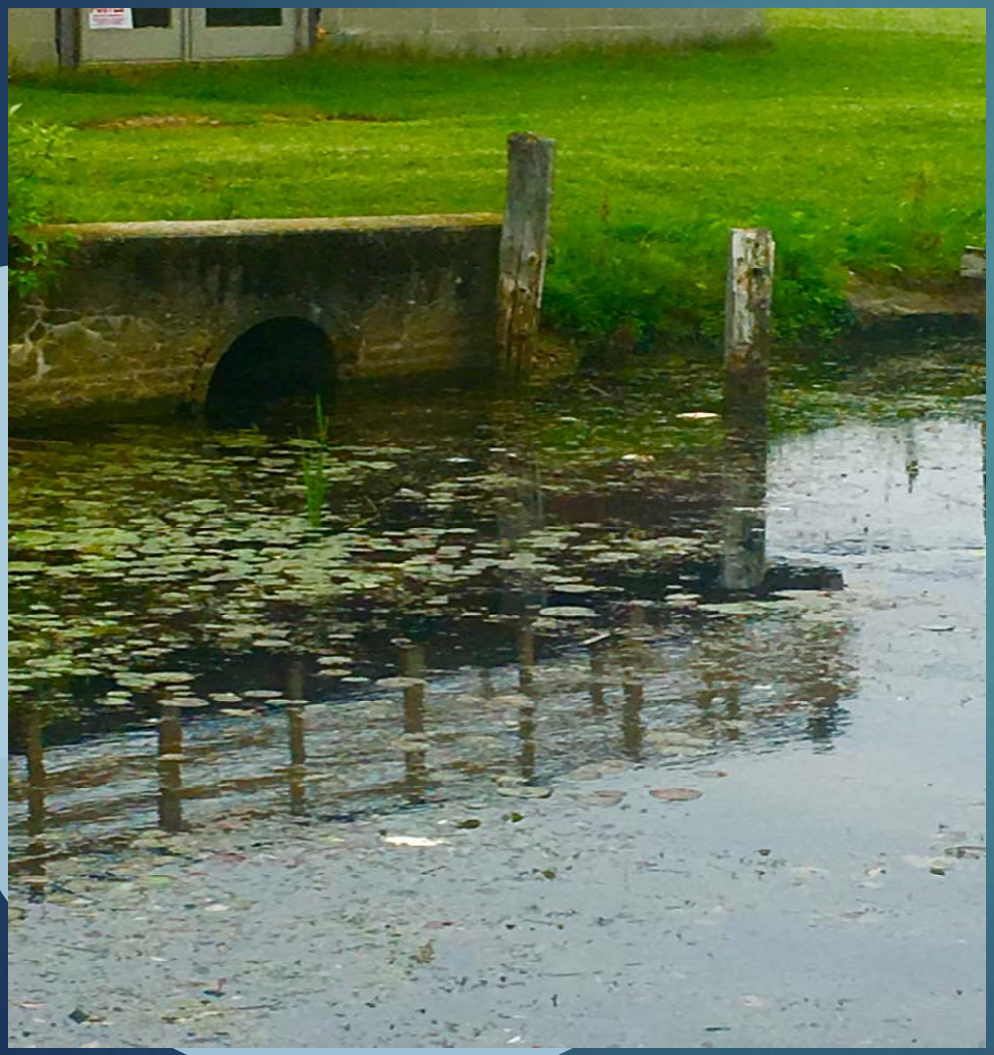


#8: Site-selective Management: Aquatic Vegetation in Unique Regions



INTEGRATED MANAGEMENT METHODS USED/RECOMMENDED:

Stormwater Management (canals)



- Best managed with drains, filters, BMPs
- Detection of CSA's and nutrient/sediment sources*
- Major parameters measured: TP, SRP, TKN, Cl-, TSS, TDS, Conductivity, DO

Chemical Herbicides (main lake)

Benefits

- Fast-acting
- Relatively low-cost
- Some are “broad-spectrum”
- Effective at right doses

Limitations

- Long-term impacts unknown to some biota
- Have to re-apply within and among seasons for sustained control
- Hybrid species now rapidly building resistance to many existing herbicides
- Some are costly

Mechanical Harvesting (small canals)

Benefits

- Removes some plant debris and associated organic nutrient
- Can reduce need for herbicides but is generalist
- Should not be used on species that fragment such as milfoil
- Immediate result

Limitations

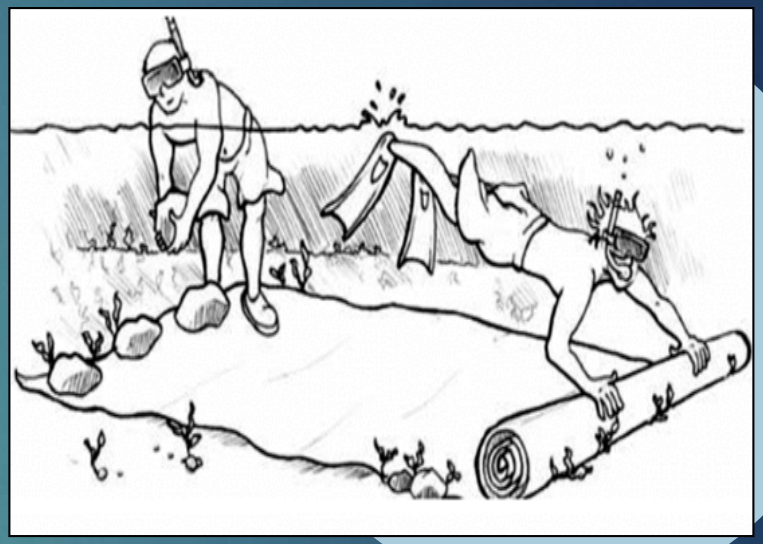
- Can increase biomass of fragment-producers
- Can create floating debris
- May need to be repeated in single season due to re-growth
- Practicality challenge in large offshore areas

DASH Boat Weed Removal (remote canals)

- Removes some plant debris and associated organic nutrient
- Can reduce need for herbicides
- Can be used on milfoil and species that fragment
- Requires MDEQ/USACE permit
- Cost ~$1K-$3k per acre
- Can be permanent

Benthic Barriers and Weed Rollers (nearshore)

- Prevents plants from germinating; non-chemical
- Localized control
- Great option for beach areas
- Benthic barriers low cost relative to Weed Rollers
- Easy installation
- Relatively low cost over time



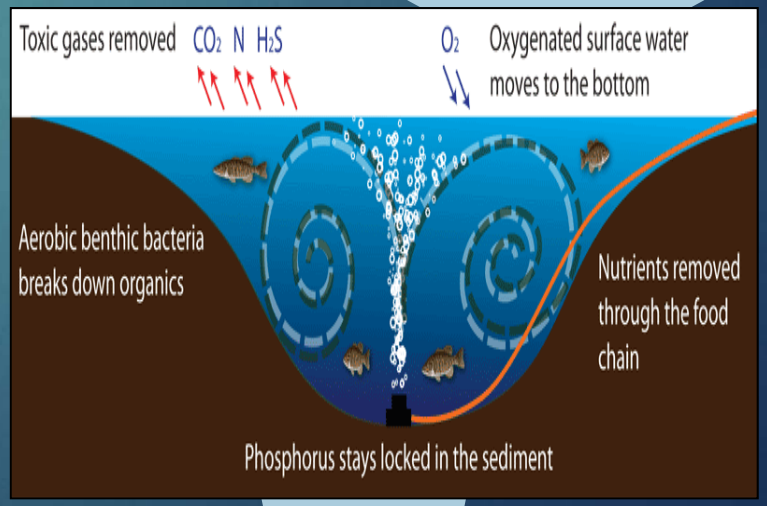
Laminar Flow Aeration (canals)

Benefits

- Non-chemical agent
- Sustainable
- Reduces algae/HAB's, organic muck, improves sediment, may reduce nutrients
- Addresses dissolved oxygen depletion issue in lakes
- Good for fishery/ecosystem health
- Supported by academic peer reviewed-research with many more on the way

Limitations

- Initially costly
- MDEQ testing requirements-costly
- Requires electrical supply for compressors/easement

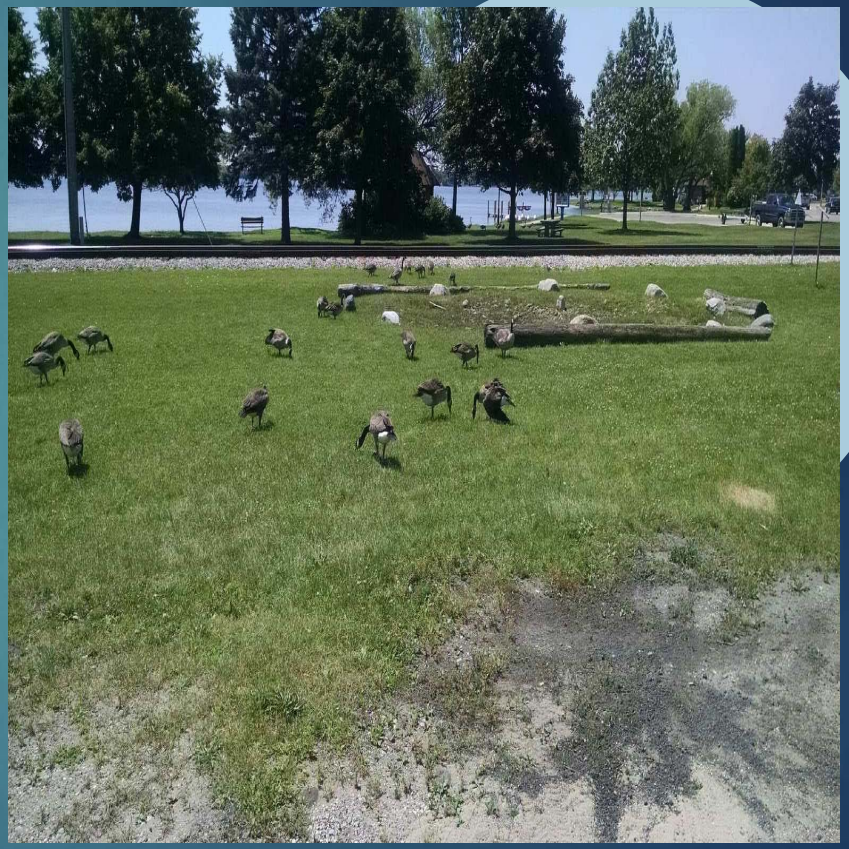


Erosion Control/Natural Shorelines (whole-lake, canals)

- Shoreline erosion surveys by a certified soil erosion professional can target critical areas of soil transfer (nutrient transfer)
- Soft or natural shorelines can stabilize erosion and also increase shoreline habitat biodiversity
- Erosion of soil can contribute to water quality degradation
- Can be effective for local goose control

Goose Control Methods lakefronts, parks)

- Droppings from geese can other waterfowl is high in N and bacteria
- Fecal matter can have a significant impact on water quality over time
- Tall grasses, special oils/solutions, lasers, goose nest destruction, egg replacement—effective reduction strategies



Boat Wash Stations (5 sites)

- Cooperative efforts between Association, HLIB, and community
- Reduces transfer of invasive species into lakes
- Will require education of locals and visitors
- Sets a good precedent for community involvement in lake management

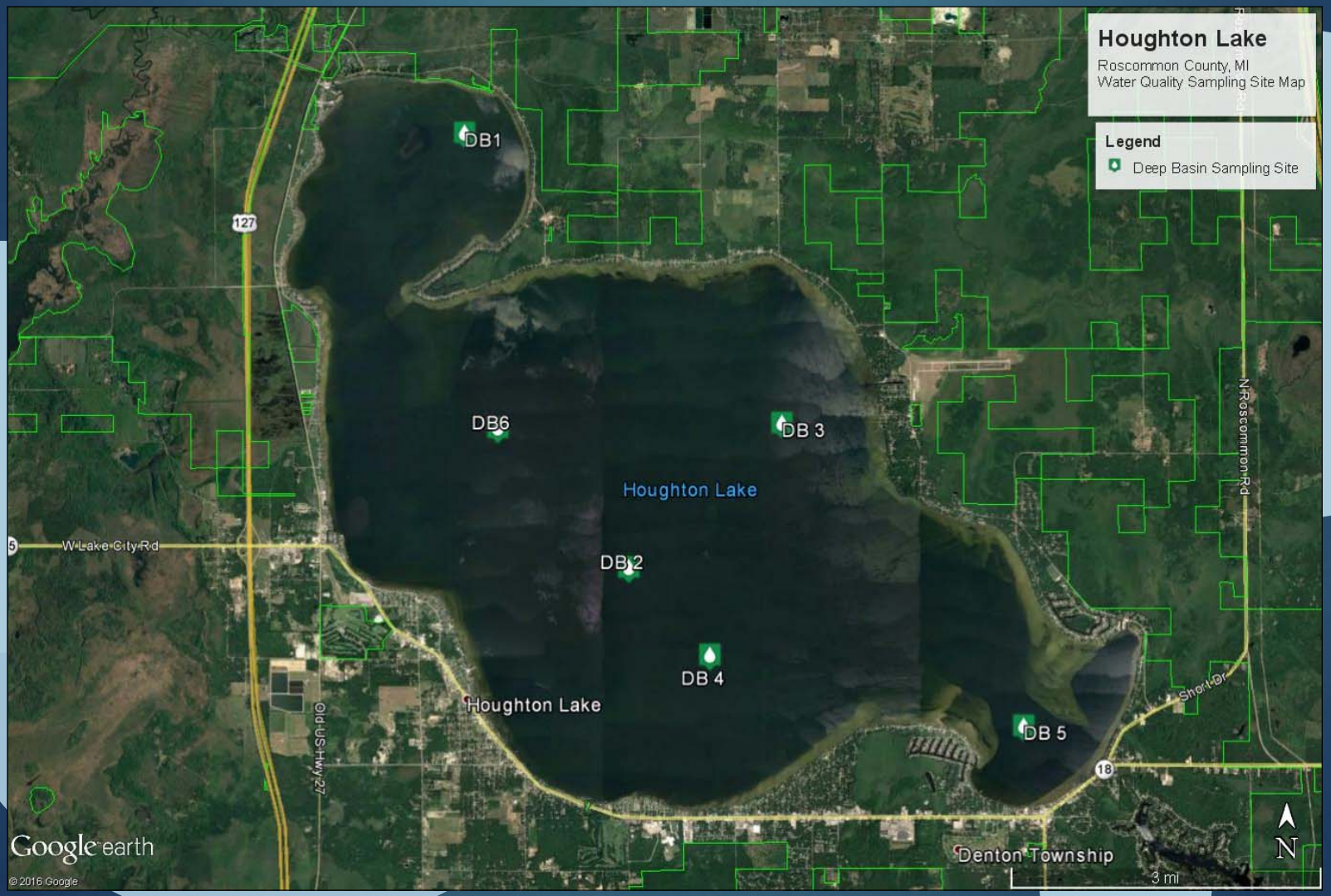
Large-Lake Integrated Management Approach: Water Quality/Sediments

- Establishment of long-term WQ goals
- Analysis of immediate watershed inputs
- Analysis of tributary inputs
- Development of consistent basin wq sampling sites
- Development of sensitive-species maps
- Development of relative abundance maps
- Development of polygon maps
- Scale-Management method decision-making
- Site-selective management for unique vegetation

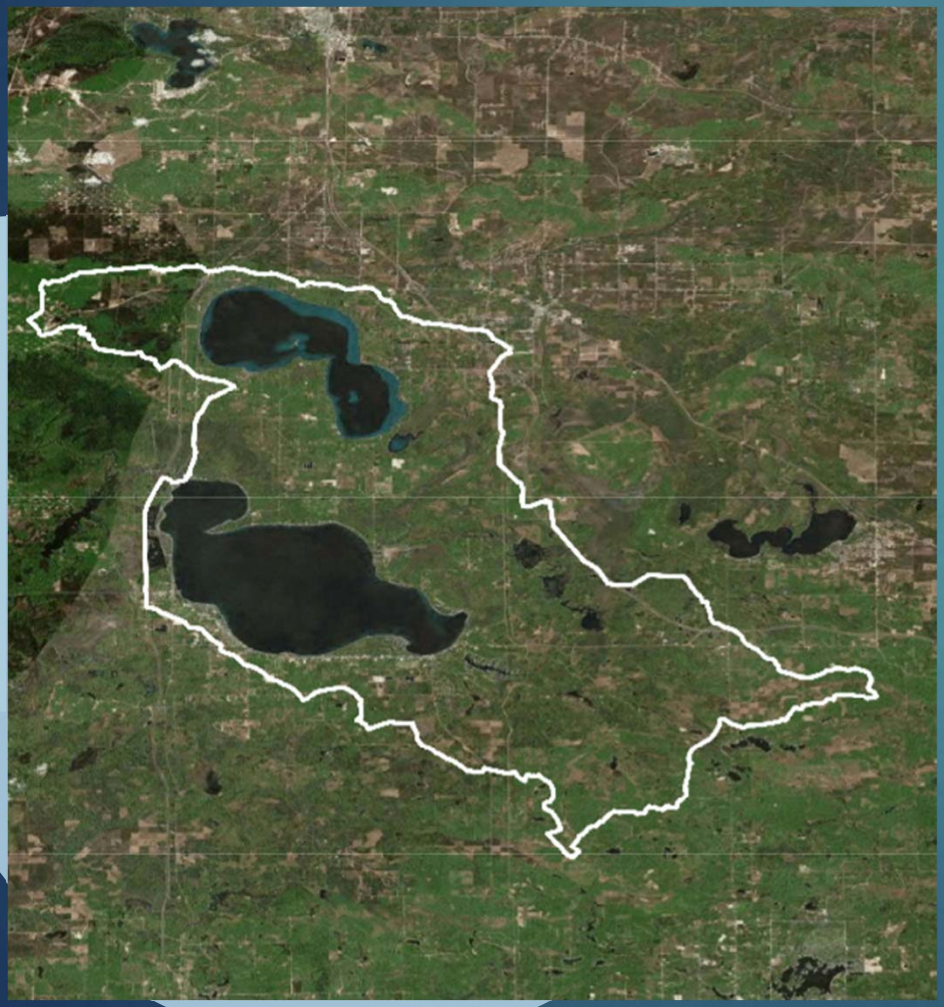
#1: Establishment of Long-term WQ goals:

- Prioritize goals
- Increase water clarity
- Reduce Chl-a
- Reduce TP, TKN, TN
- Increase zooplankton
- Increase favorable algae and decrease HAB's
- Reduce odorous (organic) muck

#4: Development of Consistent WQ Sampling Stations

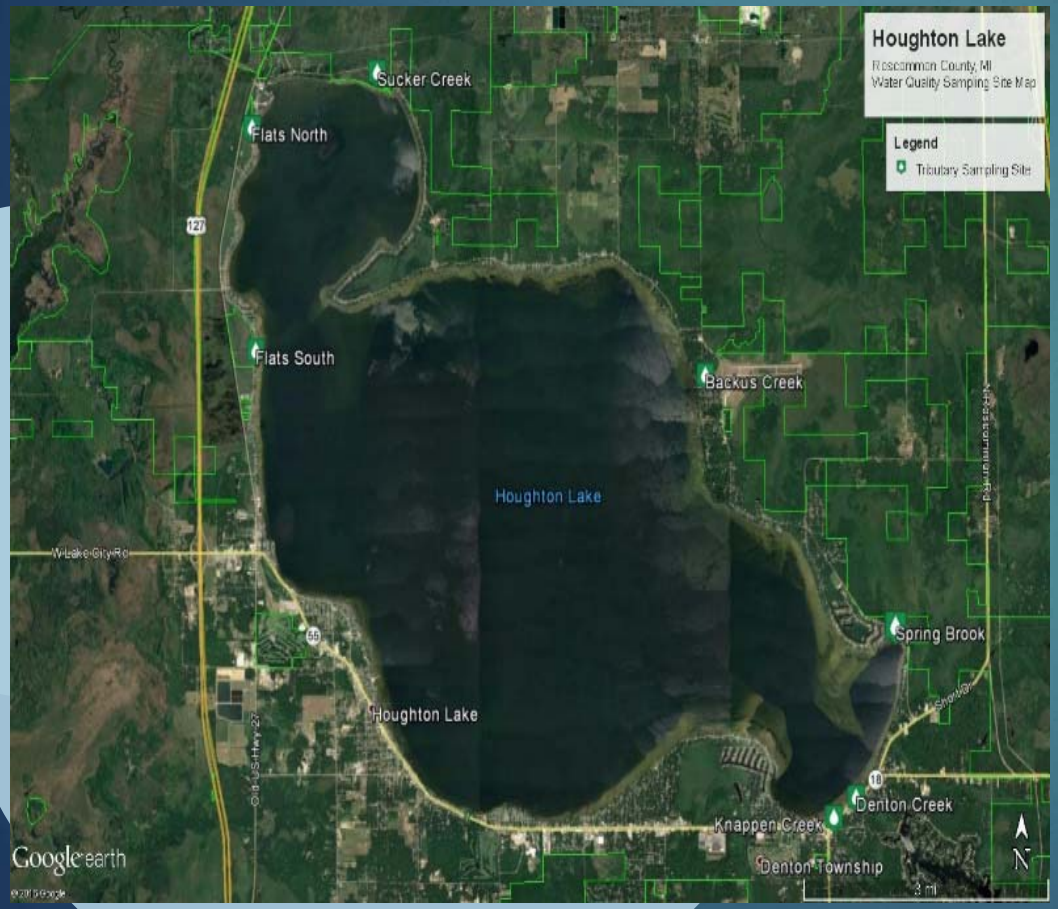


#2: Analysis of Immediate Watershed/Runoff Inputs



- Delineation of immediate watershed
- Characterization of areas of nutrient/solid inputs
- Characterization of physical water quality parameters
- CSA analysis
- Goals set to reduce inputs along with cost-efficient objectives/methods

#3: Analysis of Tributary Inputs



- Determination of nutrient/sediment loads from tribs
- Prioritization of trib restoration based on wq data/loads
- Trib restoration methods may be costly and require grants/special permits

Tributary Nutrient/Sediment Filters or Retention Ponds

- Sustainable
- Reduces nutrients and sediment loads to the lake
- Reasonable cost (ranged $3K-$10K per filter which lasts around 4-5 yrs. or longer for filters
- Retention ponds more costly but more easily permitted by MDEQ and will retain more solids with time

REAPING THE BENEFITS OF INTEGRATED LAKE MANAGEMENT:

Realized Benefits of Integrated Lake Management

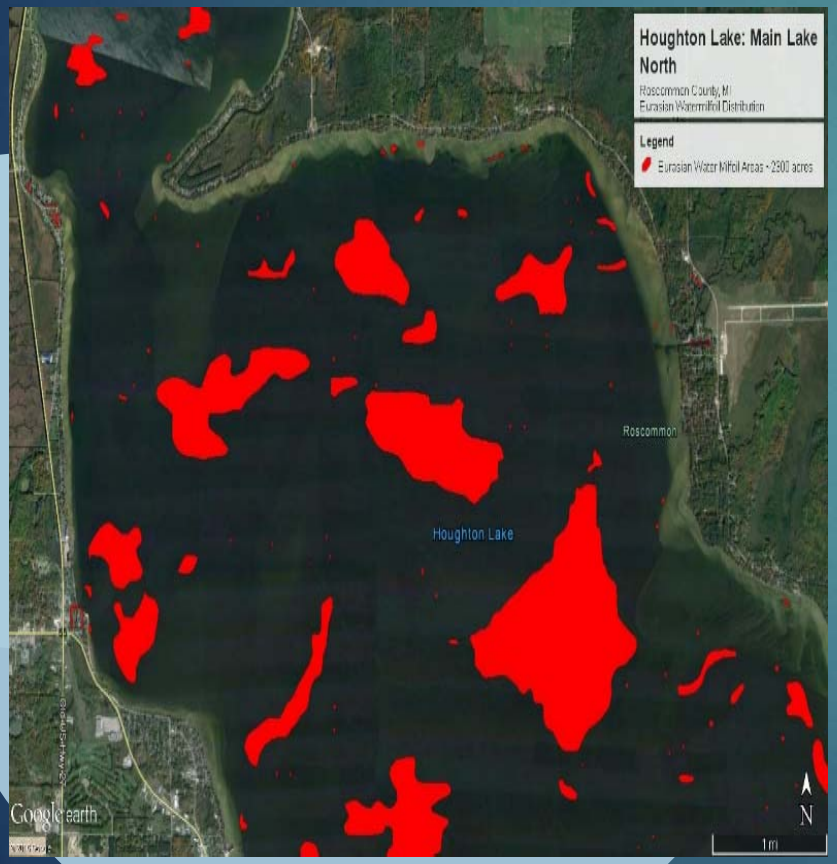
- Reduction in invasive species
- Protection and increases in native species
- Reduced nutrient loading to lake
- Increased support from community
- Reduced costs for continued management
- Sometimes—even improvement in lake trophic status!

Protection or Increase in Native Aquatic Plant Species

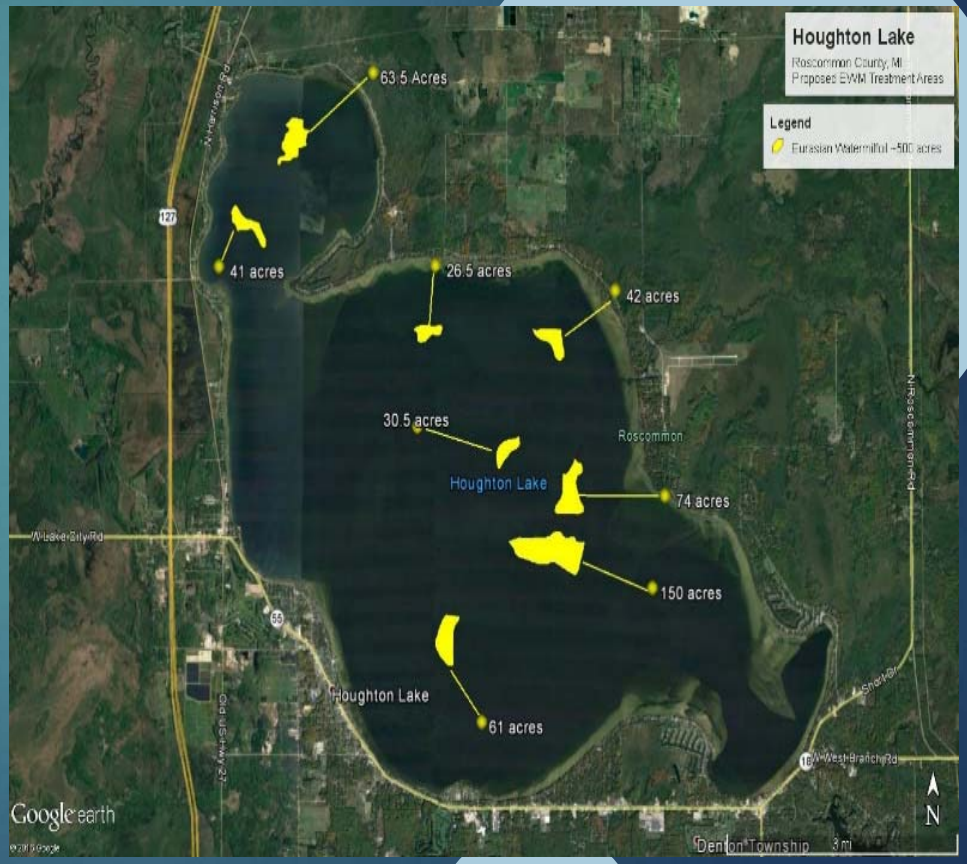
Lake Name	2008	2017-Present
Round Lake	6	12
Bear Lake Manistee	26	33
Long Lake	28	28

Reduction in Invasive Aquatic Plant Species

2016



2018



Reduced Nutrient Loading to Lake

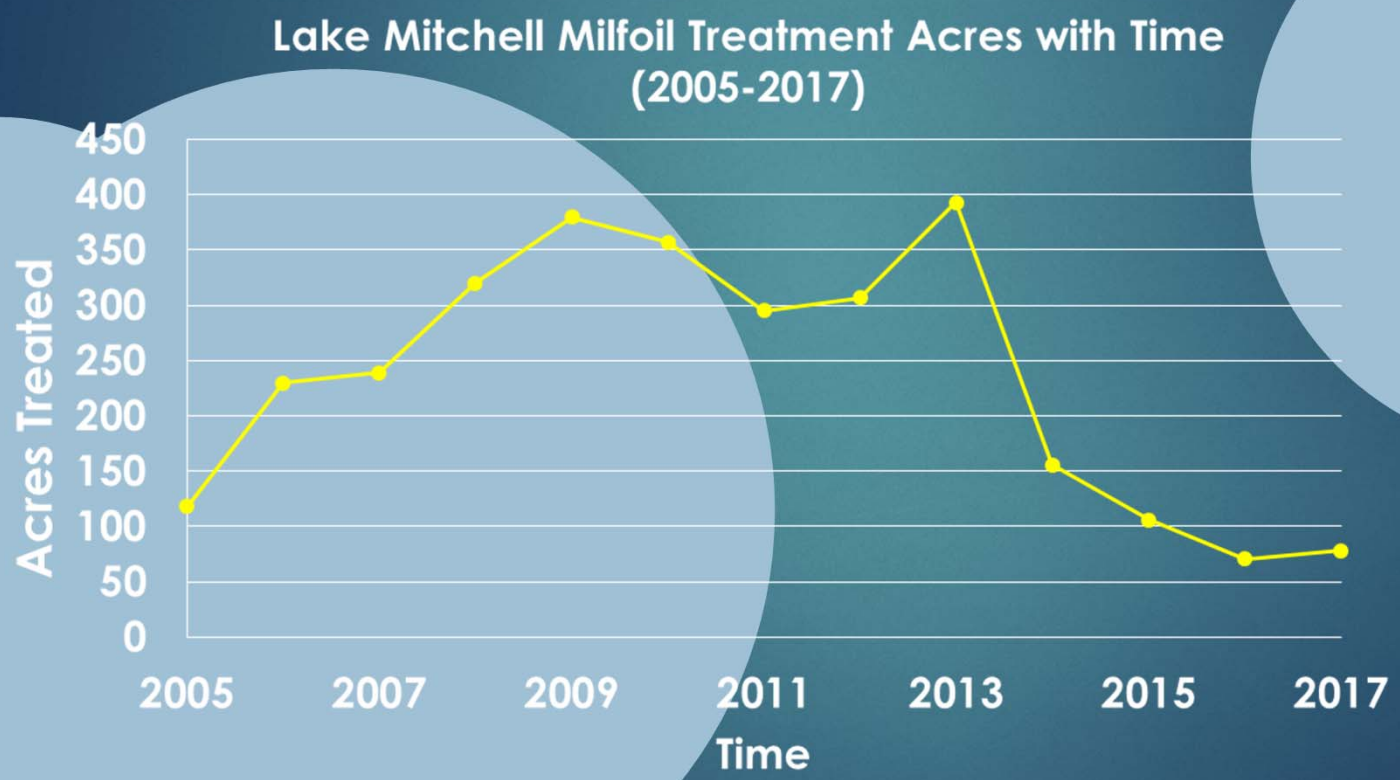
Year	Total Nitrogen (mg/l)	Total Phosphorus (mg/l)	Total Suspended Solids (mg/l)
2012	2.0	0.072	46.3
2013	1.3	0.061	28.7
2014	1.7	0.045	11.7
2015*	4.4	1.5	293
2016	0.8	0.046	26.5
2017	0.5	0.061	<10

*2015 was a year of record rainfall and the filters were challenged under these intense high-flow conditions which contributed record nutrient and solid loads to Indian Lake.

Increased Support from Lake Community

- When results are tangible and positive, community members support existing and future management
- Stakeholder awareness of lake issues is critical for securing local government (and even state) support
- Grant and local funding assistance opportunities increase with a successful program
- Seems to be contagious--Successful programs recruit other successful programs which is a win-win for our state inland lakes

Reduced Costs for Continued Management



Trophic Status Upgrade

- Indian Lake, Cass County, MI classified as eutrophic in 2009 and now as mesotrophic
- Removal of inlet nutrient removal barrier has caused rapid return of water resource issues

Conclusions

- Integrated lake management (ILM) is critical for the successful reduction of invasive species in large lakes & nearby lakes
- Large lakes have many different micro-ecosystems that require different management strategies
- Management of large lakes takes education, skill, tenacity, and precision
- ILM may be adaptive and subject to modifications based on environment, cultural requirements, climate, or budget, etc.

Questions?