River Raisin Watershed Council - 2018 Spring Semi-Annual Delegate Meeting

OHIO SEA GRANT AND STONE LABORATORY

Lake Erie Algae, Nutrient Loading and Current Research Efforts

Dr. Christopher J. Winslow, Director

Ohio Sea Grant and Ohio State University's Stone Lab

April 26th, 2018

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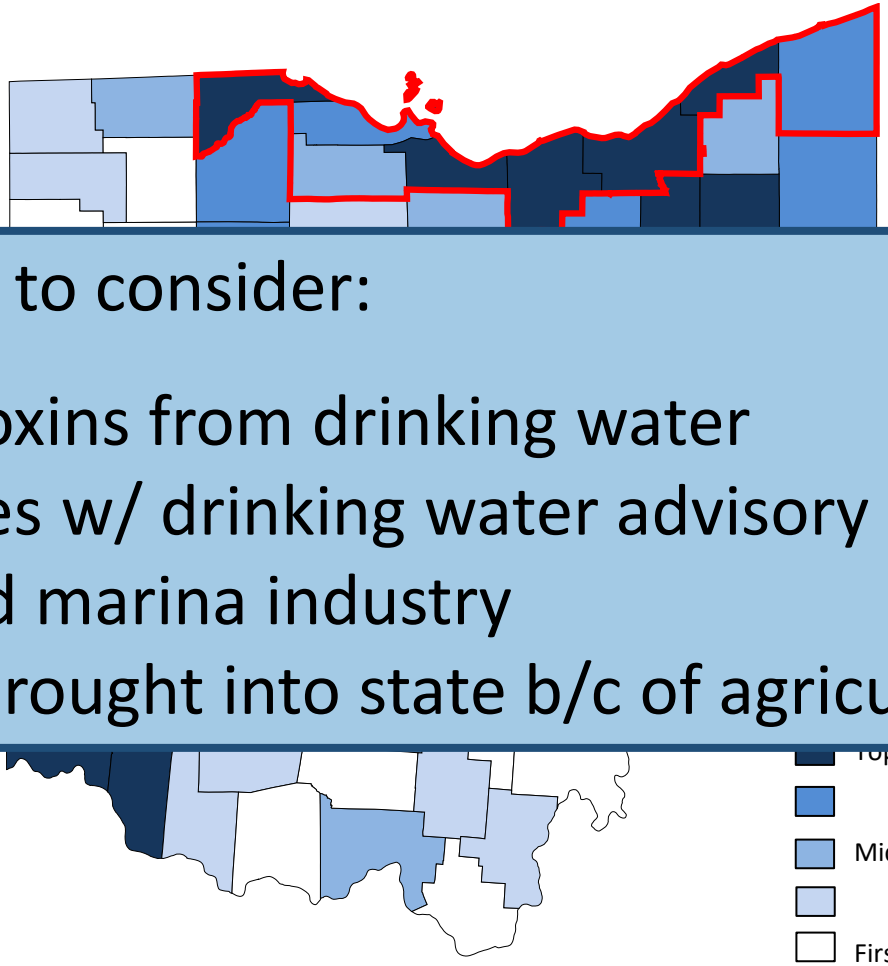
NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

The Economic Impact of Tourism in the Lake Erie Region of Ohio

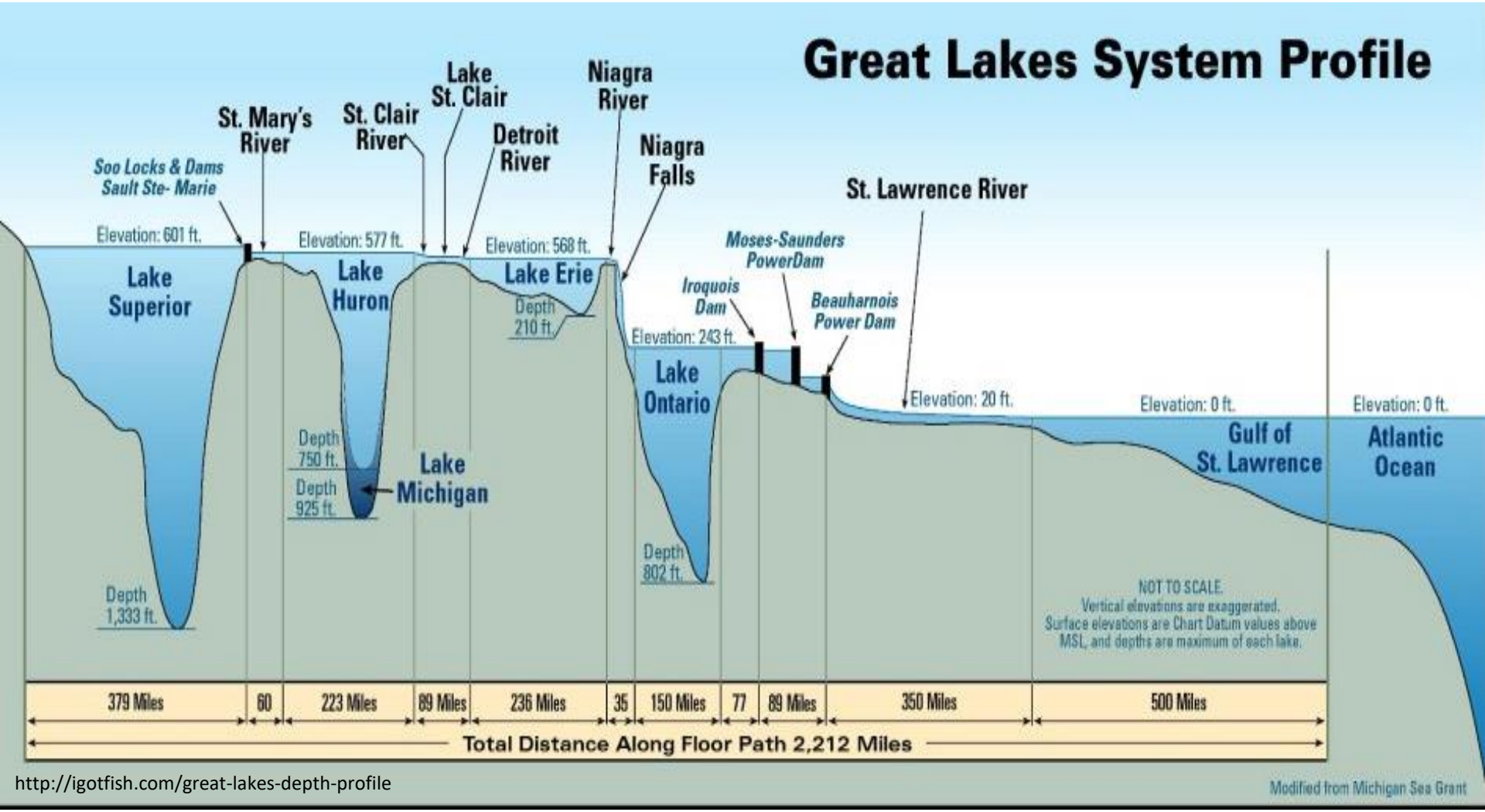
Total Tourism Impact Lake Region	
Sales	$14.1 billion



Oher economic factors to consider:

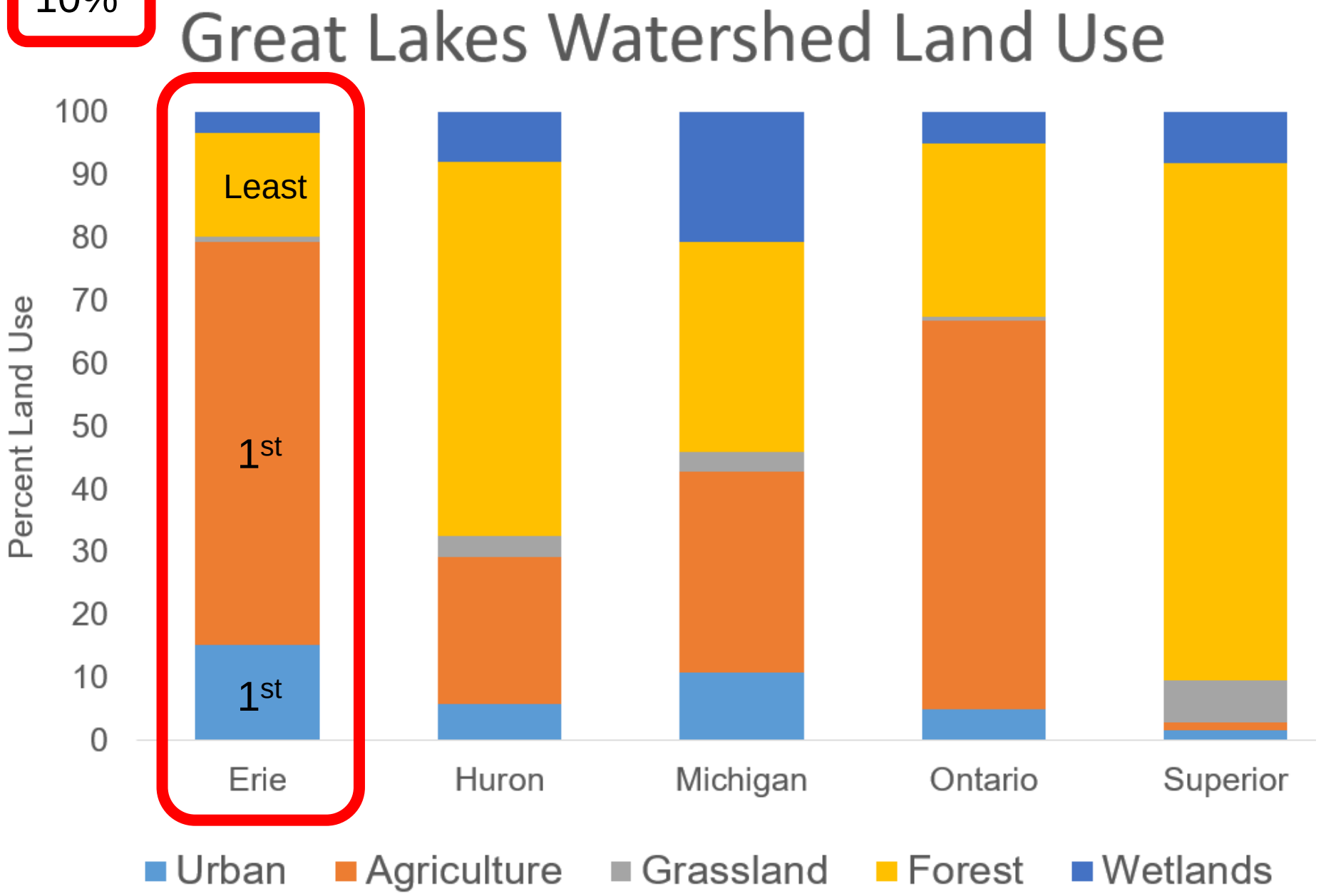
- Cost of removing toxins from drinking water
- Cost to communities w/ drinking water advisory
- Charter captain and marina industry
- Jobs and revenue brought into state b/c of agriculture

Setting the Stage for Lake Erie HABs



http://igotfish.com/great-lakes-depth-profile

10%


Great Lakes Watershed Land Use
Percent Land Use
100
90
80
70
60
50
40
30
20
10
0
Least
1st
1st
Erie
Huron
Michigan
Ontario
Superior
Urban
Agriculture
Grassland
Forest
Wetlands

Microcystis at Stone Lab (8/10/10)


September 11th, 2011

Microcystis near Marblehead

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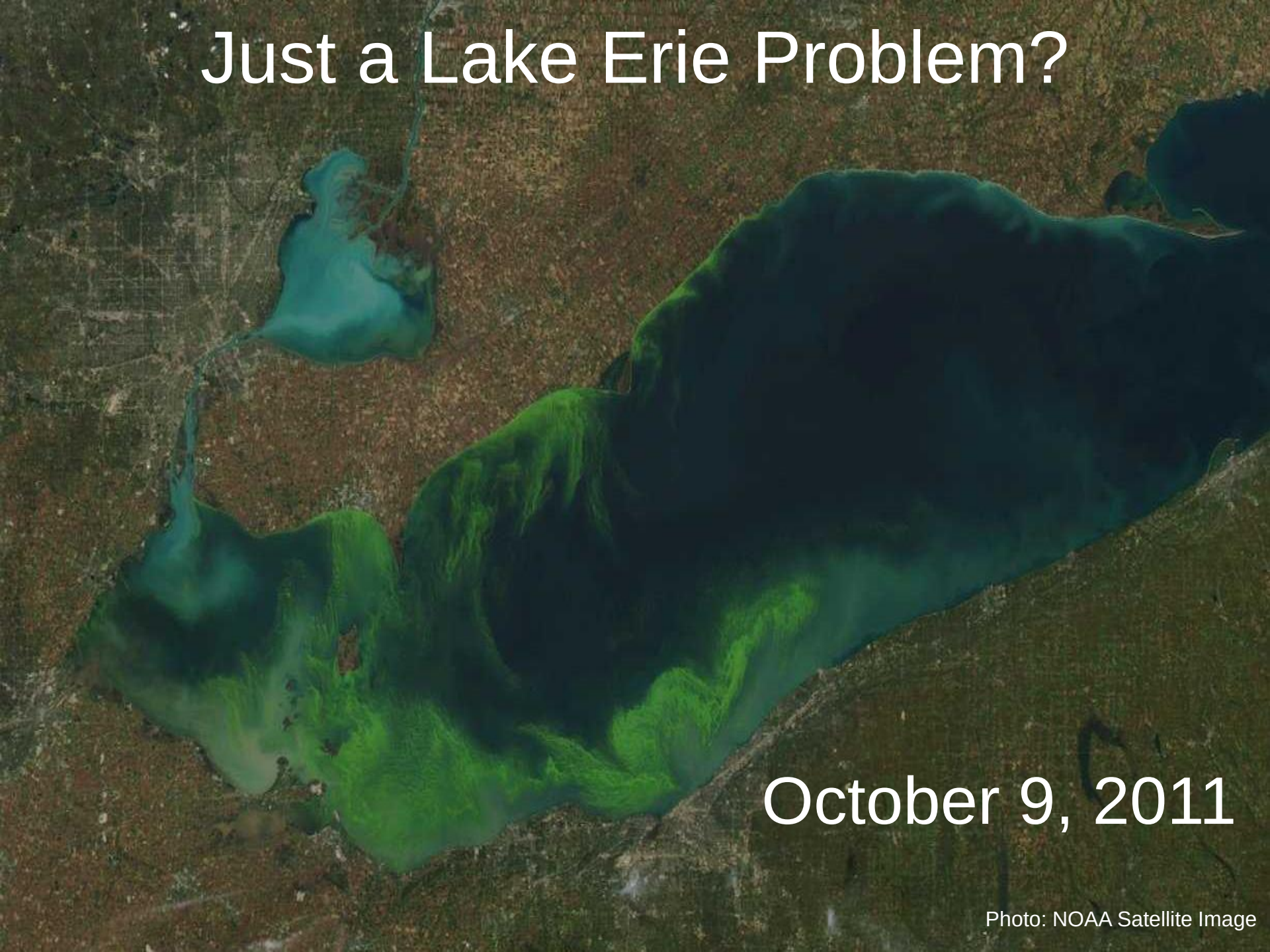
Just Western Basin Problem?

September 24th, 2013

http://coastwatch.glerl.noaa.gov/gallery/jpg/a1.13267.1852.LakeErie.143.250m.jpg

Just a Lake Erie Problem?



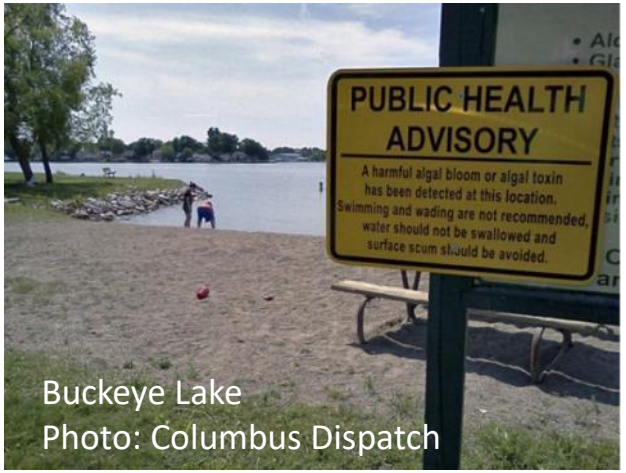
October 9, 2011

Photo: NOAA Satellite Image

State, Country, and Global Problem


Muddy Creek
Photo: Ohio EPA


Lake Hope
Photo: Ohio EPA



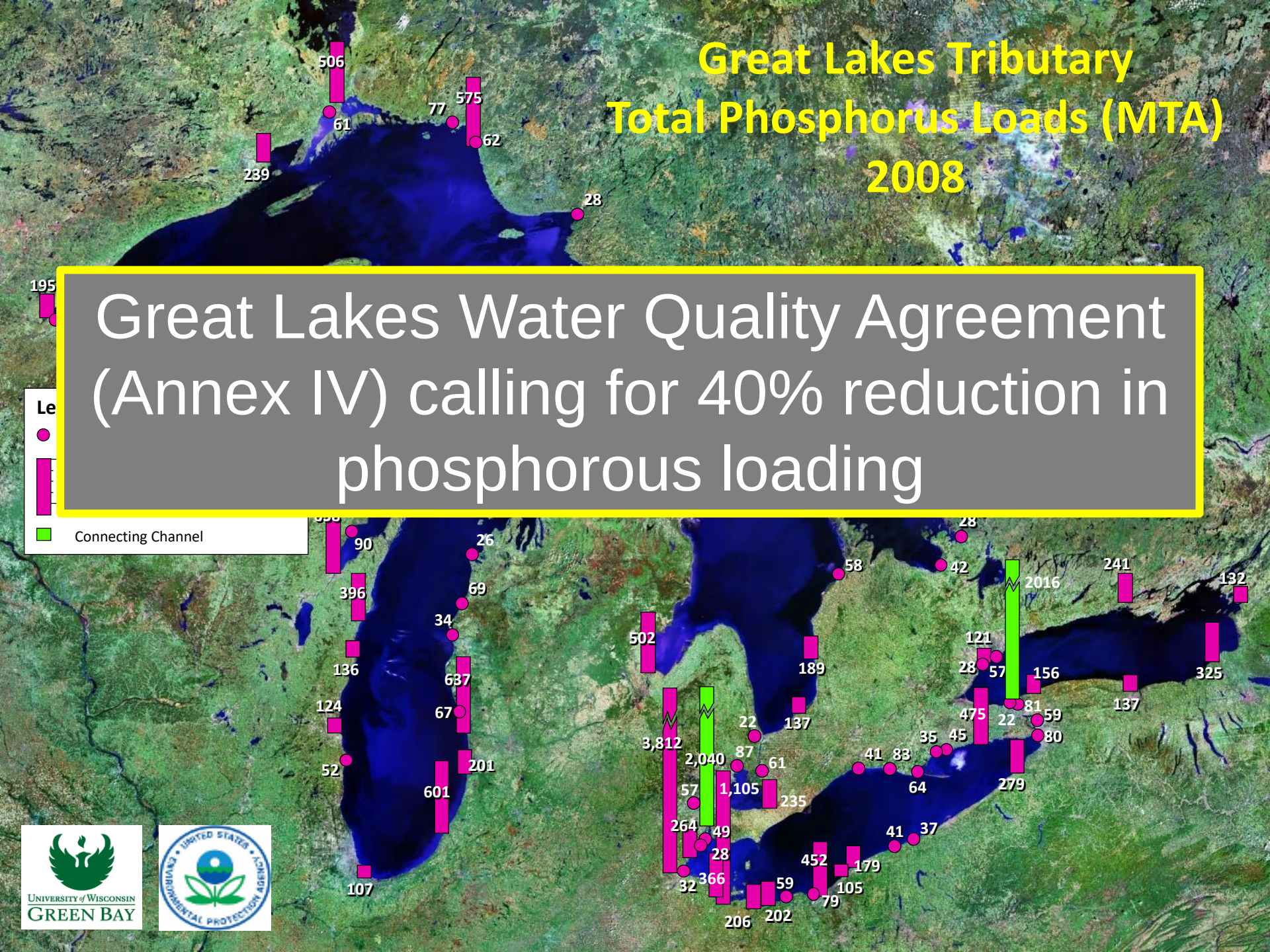
Buckeye Lake
Photo: Columbus Dispatch


Burr Oak
Photo: Ohio EPA

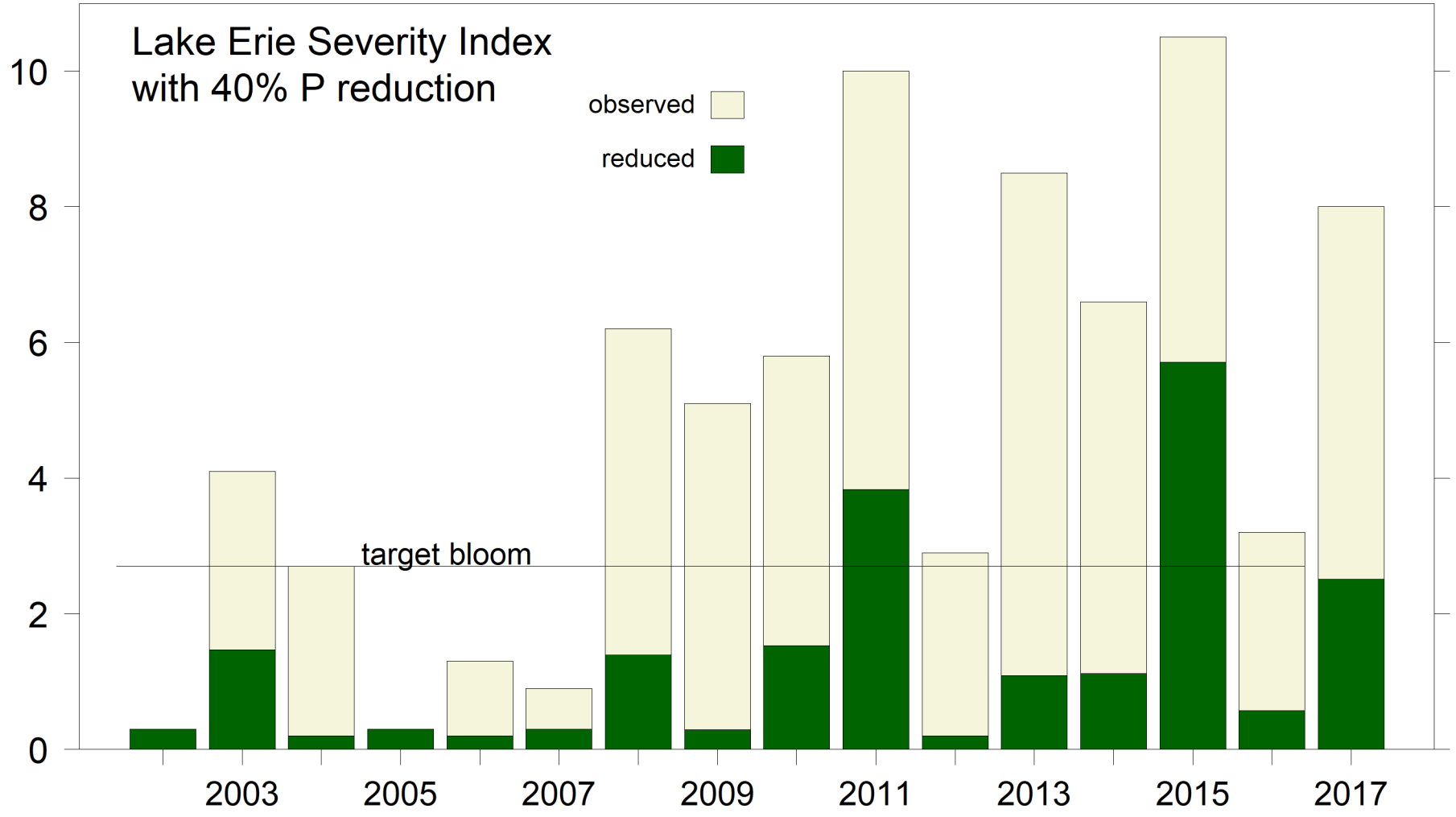

Caesar Creek Lake
Photo: Ohio EPA


Ohio River
Photo: Ohio EPA


Grand Lake St. Marys
Photo: Ohio EPA


Great Lakes Tributary
Total Phosphorus Loads (MTA)
2008
Great Lakes Water Quality Agreement (Annex IV) calling for 40% reduction in phosphorous loading
Connecting Channel
506
61
77
575
62
239
28
195
90
26
396
69
34
136
637
124
67
52
201
601
107
58
42
28
2016
241
132
502
189
121
28
57
156
325
137
475
22
81
59
80
3,812
2,040
87
61
22
137
35
45
41
83
64
279
57
1,105
235
264
49
28
32
366
59
206
202
452
179
105
79
41
37
University of Wisconsin Green Bay

What Might Phosphorus Reduction Do?



Dr. Rick Stumpf --- NOAA National Centers for Coastal Ocean Science

HAB Research Initiative has …….

- Provided new answers and practical guidance about **producing safe drinking**
- Started to fill critical knowledge gaps about the risks that algal toxins present for **human health**
- Identified **how blooms behave** and how to address **nutrient runoff** into aquatic ecosystems
- Driven **information sharing and priority setting** between universities and agencies, positioning Ohio to better prevent and manage future crises

>$3mil spent, ~$3mil ongoing, and more to come….

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2016 report on 2015 efforts

2017 report on 2015 & 16 efforts

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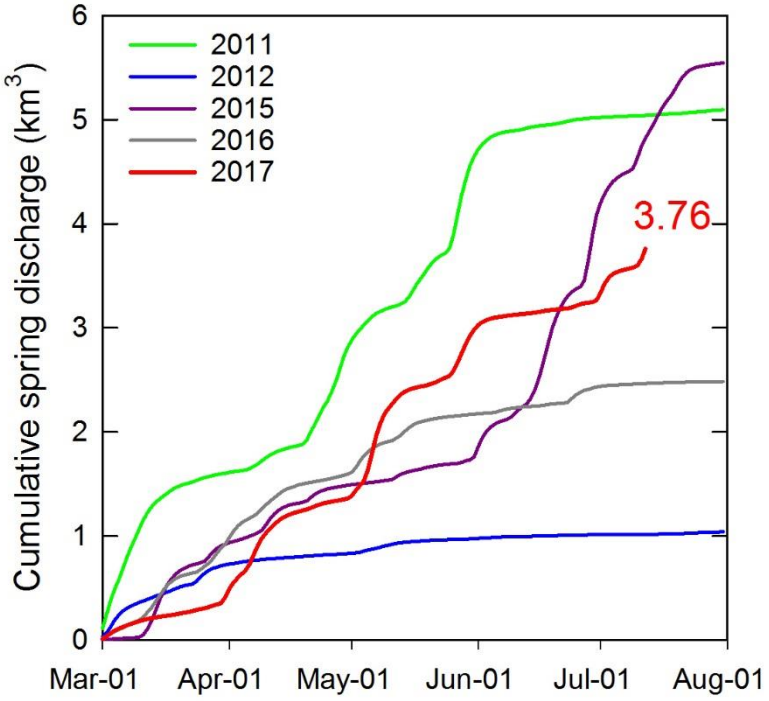
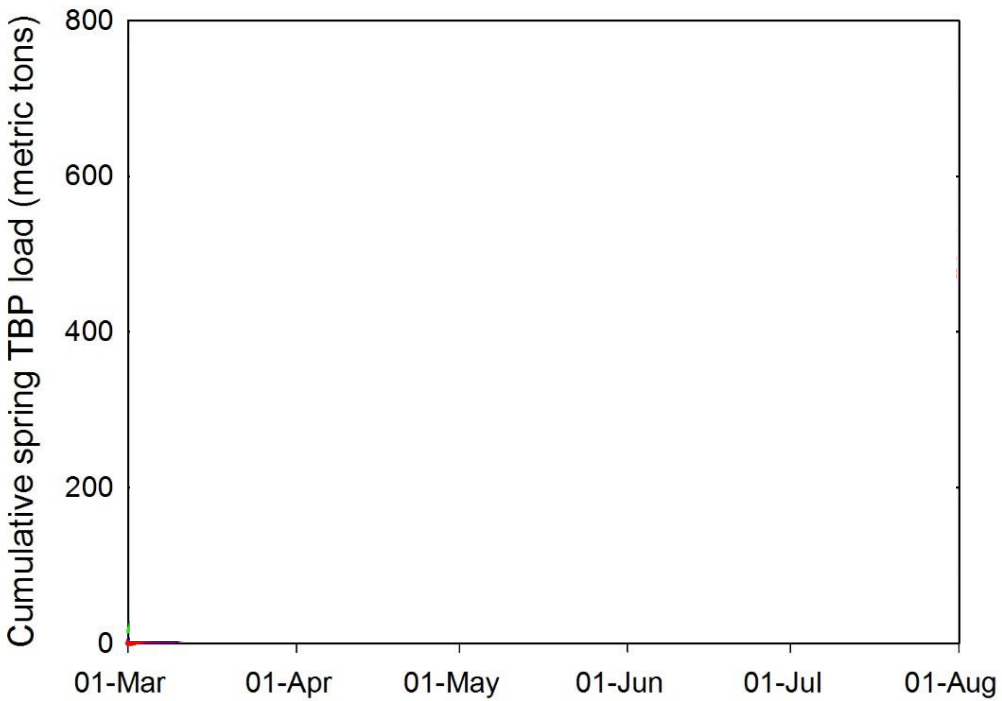
Nutrient Sources Today

- Maumee and Sandusky Rivers largest Phosphorous loaders
  - 87% of Phosphorous from nonpoint sources
  - Agri. is dominant land use in these watersheds (>70%)

- Between 2002 and 2013, 70-90% of Phosphorous loads occurred during highest 20% of flows
  - i.e., most loading occurred during ~10 storm events/year (Baker et al., 2014)

70-90% of Loading 20% of Time





Source: Drs. Laura Johnson, Heidelberg University

Nutrient Sources Today

- >75% reduction in Phosphorous from WWTPs; contribute <9% of Phosphorous today
- CSOs: Long Term Control Plans in place (i.e., by 2020, 40 of 62 communities will have addressed)
  - 2013, CSOs in Maumee contributed <1% of Phosphorous
- In Maumee, septic systems contribute ~4% Phosphorous
  - Recent state regulations will continue to reduce
- Scott's Miracle-Gro removed Phosphorous from lawn care products
  - 95% market followed Scott's lead
- Internal loading of Phosphorous ~3-7% of total load

Understanding Agricultural Nutrient Loss

- 70s to mid-1990s, Phosphoous applied at 10-40 lbs. P_2O_5 above crop removal rates, resulting in accumulation
- Since the mid-1990s, ***Phosphorous being applied***:
  - at ~5 lbs P_2O_5 below crop removal rates (Mullen 2013)
  - on average, 5.5 lbs P_2O_5 above removal rates while 58% of fields have Phosphorous applied at or below crop removal rates (NRCS 2016)
- NRCS (2016) found that 42% of acres accounted for 78% of Phosphorous runoff and 80% of sediment loss

We are Directionally Correct

- Avoiding frozen (fall/winter) **application** of fertilizer and manure (SB1)
- No fertilizer when rain is in **forecast** and **saturated** soils (SB1)
- 4R Nutrient Program (SB 150):
  - Right fertilizer source (i.e., manure)
  - Right rate (i.e., amount)
  - Right time (i.e., rain/frozen ground)
  - Right place (i.e., needed)
- Eliminate **broadcast application** and **incorporate** fertilizer (i.e., subsurface placement; band/inject)
- **Soil testing** of all fields to prevent application of too much Phosphorous
  - Do not apply Phosphorous above agronomic need (Tri-state Reco.)
- **Drainage water management:**
  - Disconnect hydrologic pathways; drain tiles vs. wetlands & blind inlets
  - Good portion of Phosphorous leaving fields is going through tiles

What Other Levers Can We Turn?

- **Lawn Care** Recommendations:
  - Follow Scott's lead…..all lawn care fertilizer sellers and lawn care applicators meet the zero P goal
- Reduce **property runoff** (e.g., rain barrels, terraces, porous surfaces, etc.)
- Sewage Treatment Plant Recommendations:

Immediate Needs:

- Arm water treatment plants with tools, technology, and training to remove toxins
- Reduce load of P into Lake Erie by 40%
  - Water management
  - Soil testing (<30ppm)

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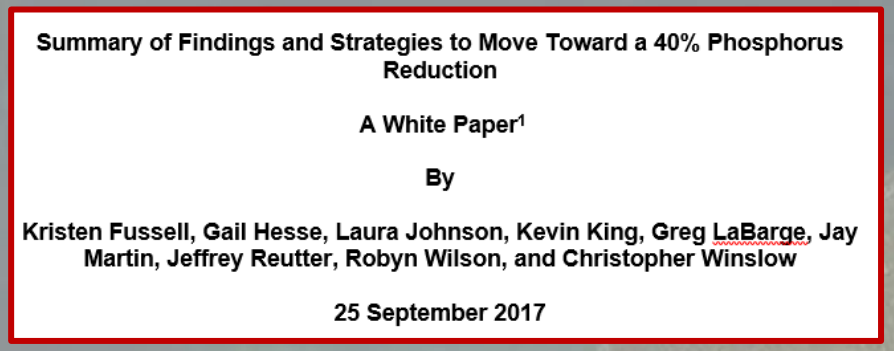
"New" White Paper

- "Summary of Findings and Strategies to Move Toward a 40% Phosphorus Reduction"
- Numerous relevant sections:
  - "Introduction and Goal"
  - "Background and History "
  - "Nutrient Sources Today"
  - "Understanding Agricultural Nutrient Loss"
  - "Identifying Effective BMPs"
  - "Understanding Farmer Decisions"
  - "Information Gaps and Research Needs "


Summary of Findings and Strategies to Move Toward a 40% Phosphorus Reduction

A White Paper[1]

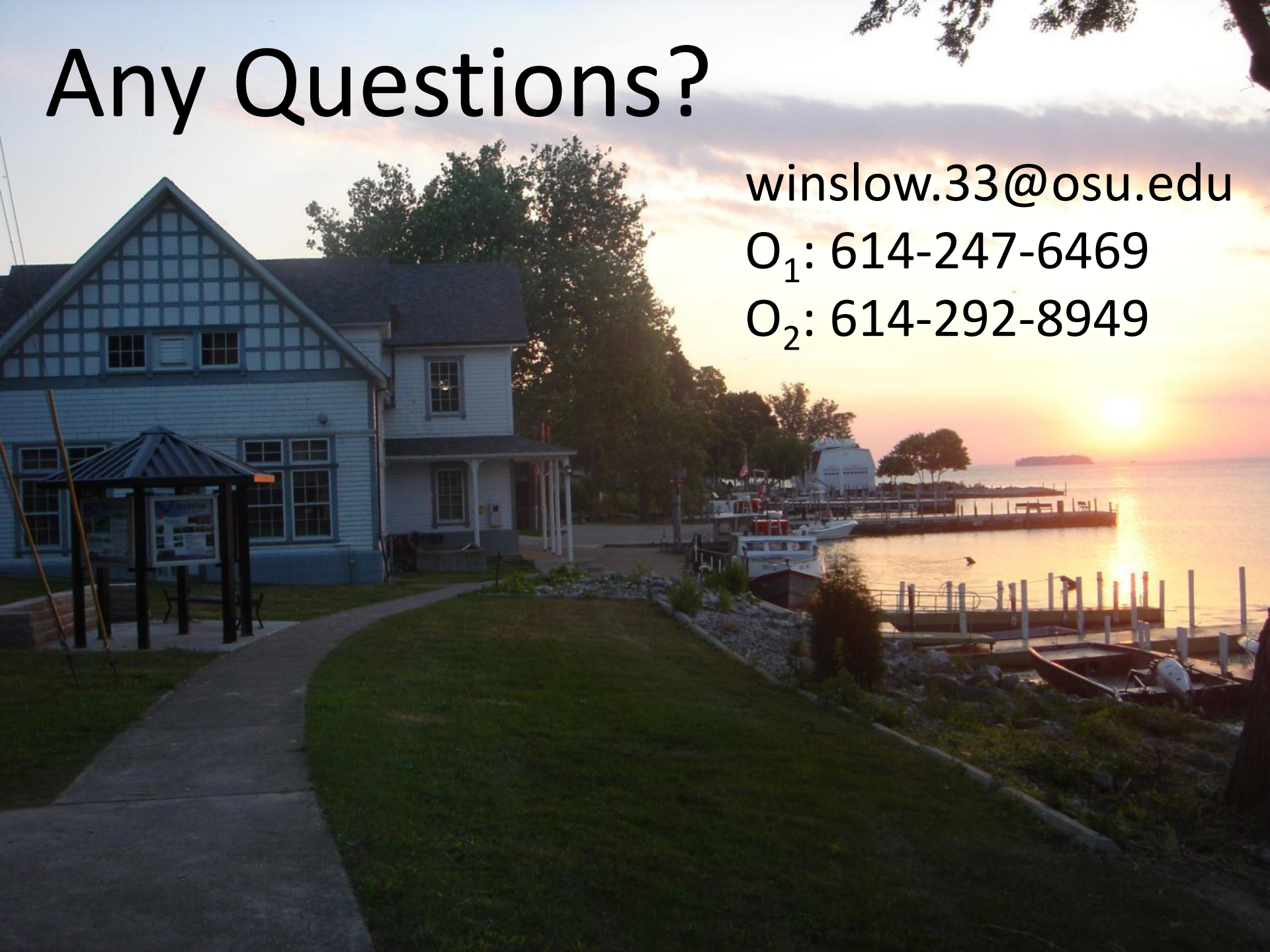
By

Kristen Fussell, Gail Hesse, Laura Johnson, Kevin King, Greg LaBarge, Jay Martin, Jeffrey Reutter, Robyn Wilson, and Christopher Winslow

25 September 2017

http://go.osu.edu/habswhitepaper

Any Questions?



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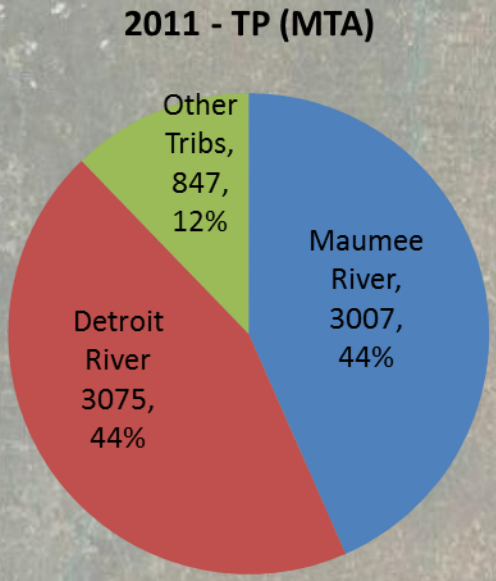
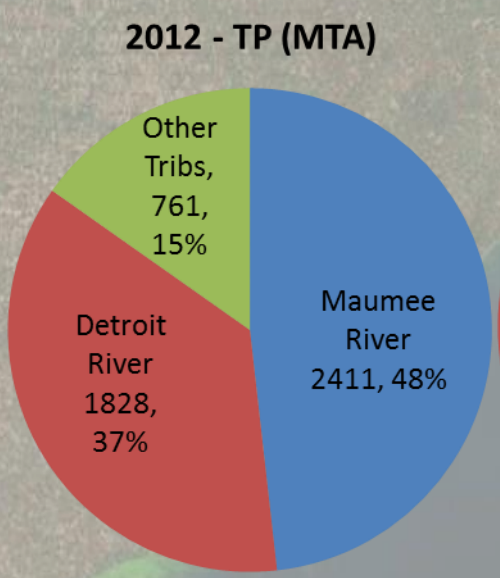
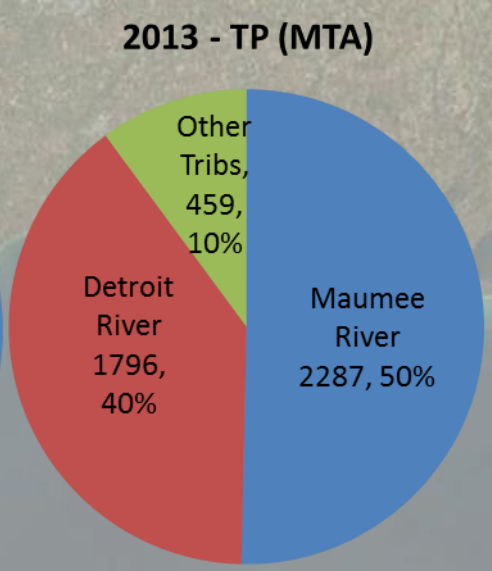
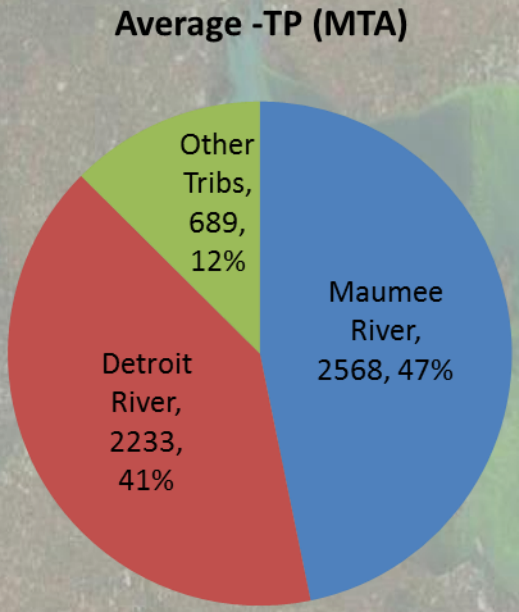
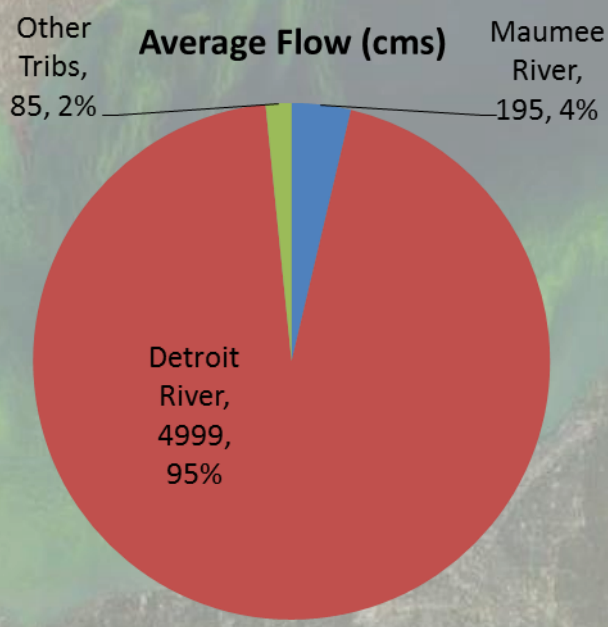
O_2: 614-292-8949

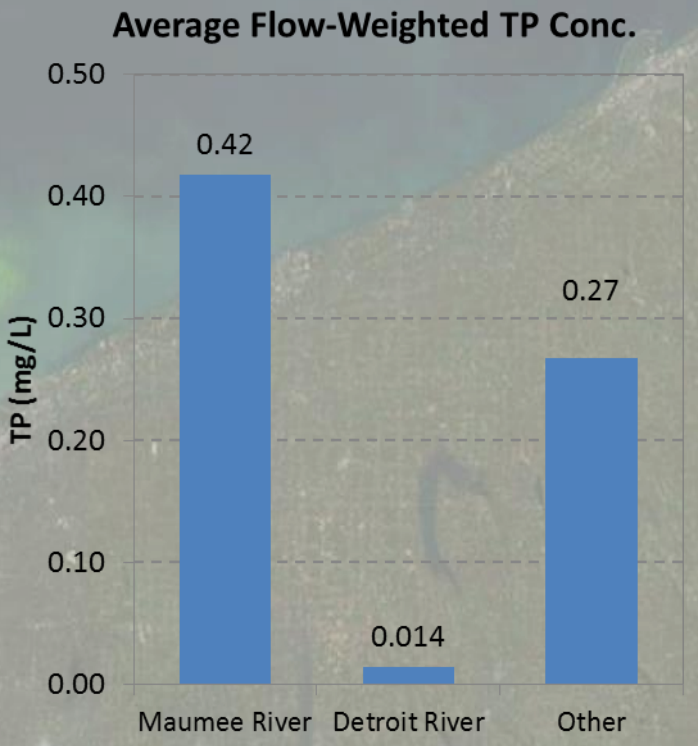






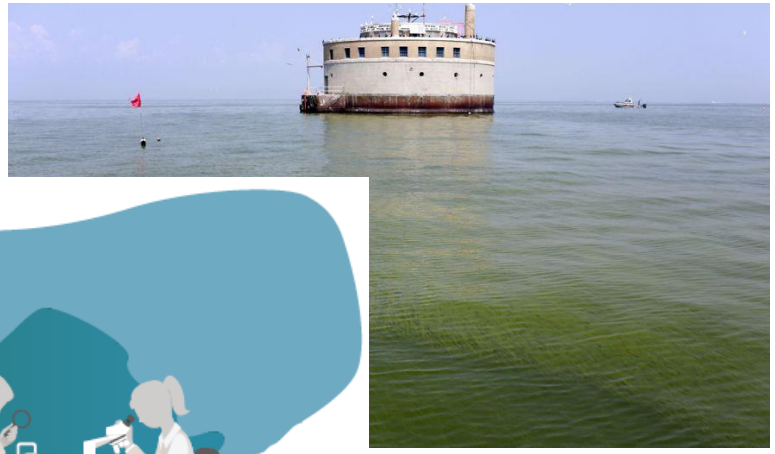


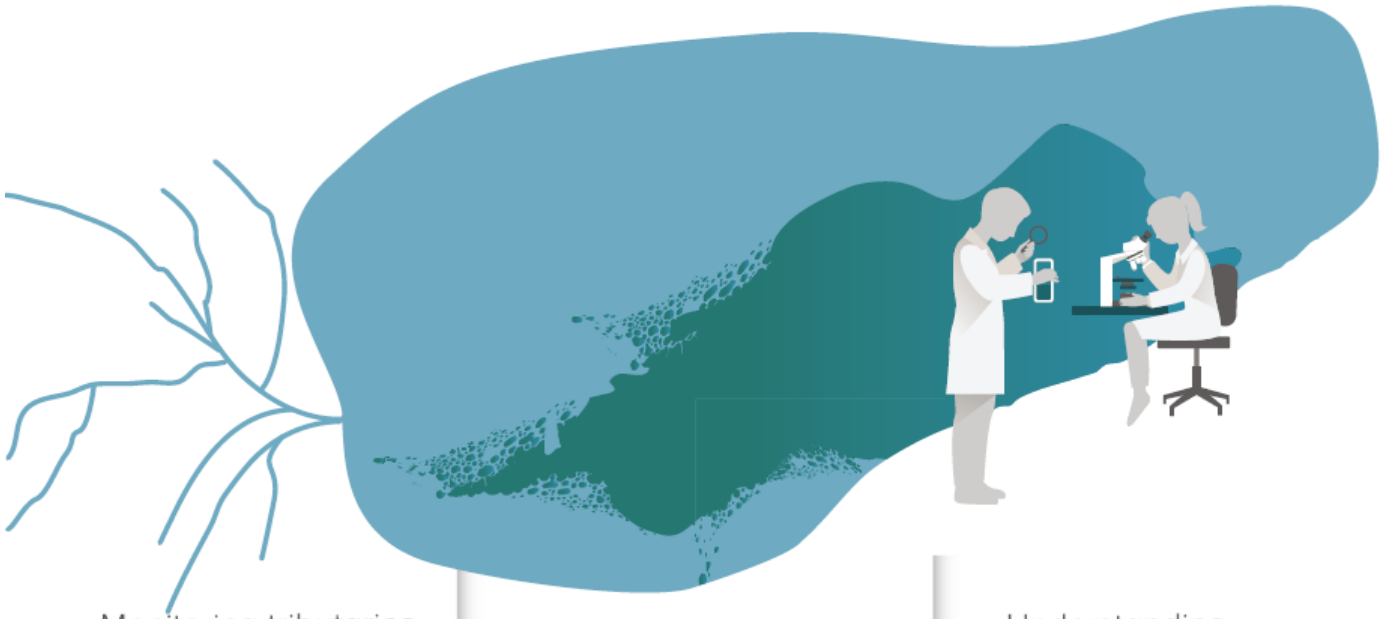




FWMC of 0.23 mg/L TP

Track Blooms From the Source





Monitoring tributaries for nutrients that cause algal blooms

Early warning systems for bloom activity

Understanding blooms better for smarter management

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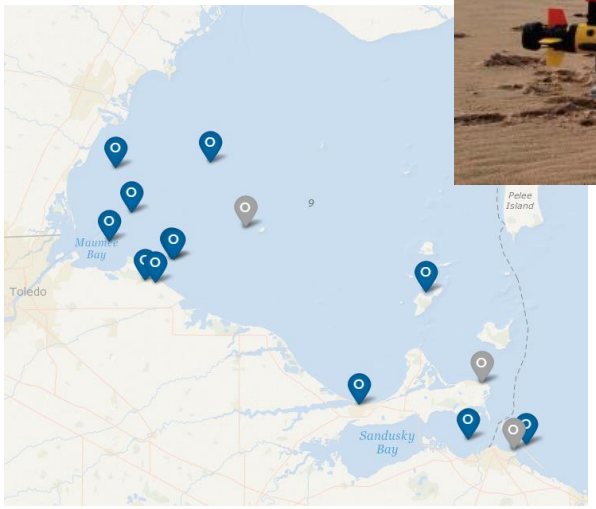
The Bottom Line:



- Event warnings (x2)
  - GLOS
- Rock and Honey Creeks
- Fingerprinting
- Vertical movement
- Shifts between toxic and non-toxic blooms
- Central Basin blooms
- Multi-Model collaboration
- The winter piece

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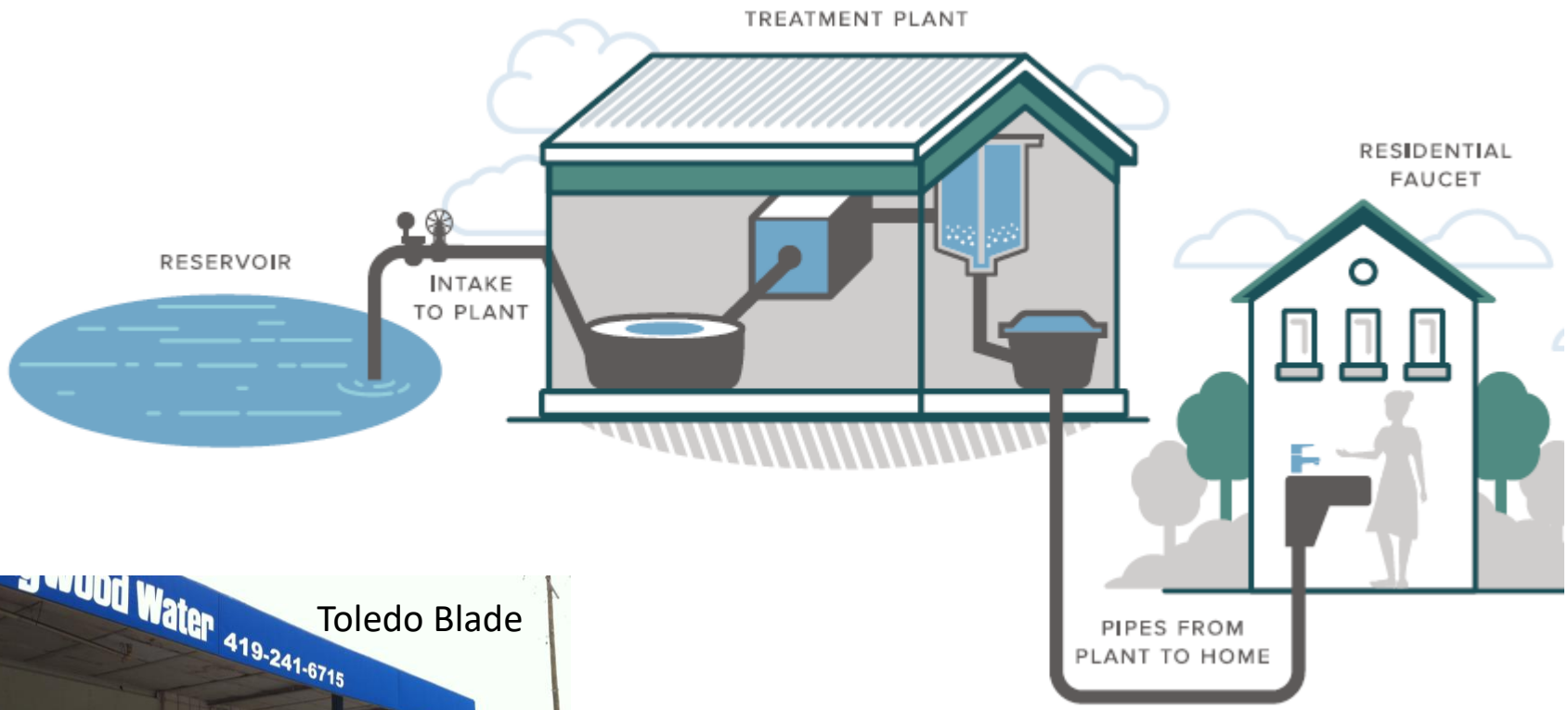
Produce Safe Drinking Water



Toledo Blade

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The Bottom Line:

- Distribution system (fate of toxins)
- Biofilters and potassium permanganate
- Bioremediation (toxin eating and phages)
- PAC ***and*** algaecide; type and dose
- ELISA vs. LC-MS
- Ozone vs. UV
- Enzyme pathway for treatment
- Point-of-use reverse osmosis

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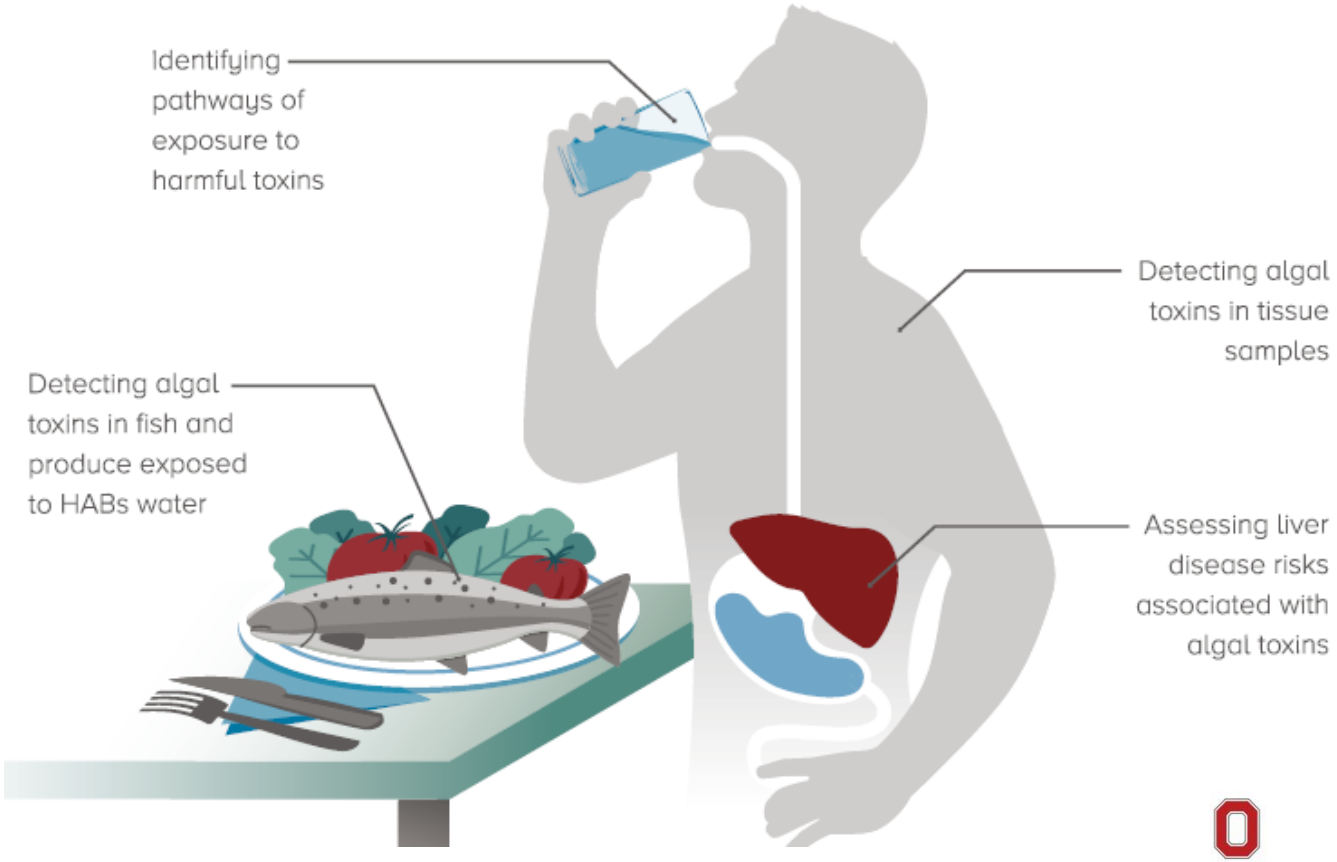
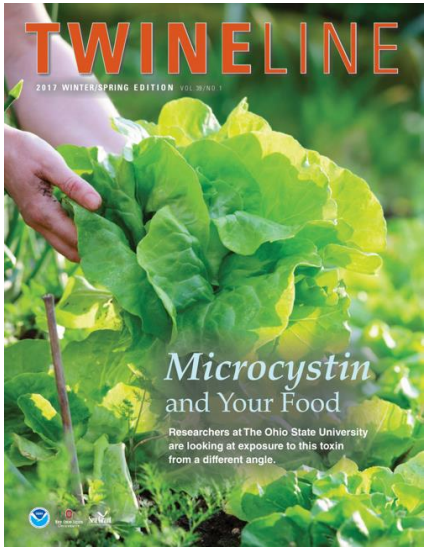
Protect Public Health





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The Bottom Line:

- Fish flesh and fresh produce
- People who are predisposed to or already have liver damage may be more susceptible
- Detecting toxins in biological samples

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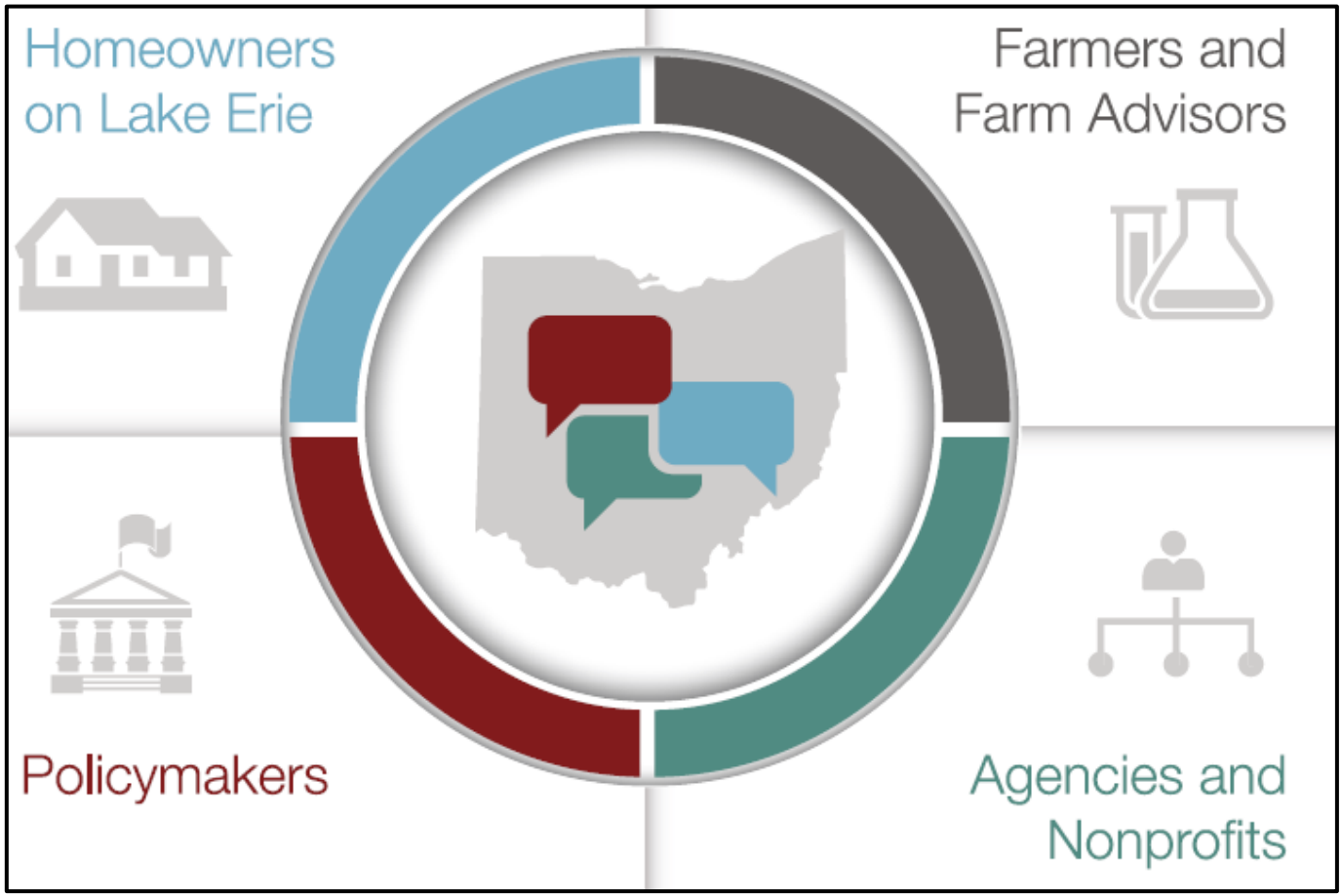
Engage Stakeholders



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The Bottom Line:

- Social network analysis
- Stakeholder-Informed decision-making support system
- 56 on 80; BMPs to optimize agriculture outputs and water quality

The Nature Conservancy
Protecting nature. Preserving life.

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Kent State University

UT

Identify Effective BMPs

- Soil-test-informed application rates (??%, 60%, then 30%)
- Adopt subsurface placement (25%, 36%, then 29%)
- Cover crops (27%, 20%, then 38%)
- Other BMPs:
  - Blind inlets (Phosphorous reduction by 60%)
  - Water management (1% increase = .75” rain)
  - Majority of farmers are concerned and know issue…but are not convinced that proposed BMPs are effective (either feasible or ability to reduce P loss)

What is Causing the Harmful Algal Blooms in Lake Erie?

Clean Air Act
Climate change
Commodity prices
Cropping systems
Crop uptake
Equipment size
Ethanol
Fertilizer placement
Fertilizer rates
Fertilizer source
Fertilizer timing
Glyphosate
GMOs
Increased soil pH
Ignoring amounts of P loss
Larger farm size
Lower levels of sediment in the water
Manure
Misconceptions about P by researchers
Conservation Tillage (No-till & reduced till)
Nitrogen
Rental agreements
Products sold to increase P solubility in soil
Soil biology alterations
Soil testing and analysis
Stratification of P
Tile drainage
Zebra mussels, "near-shore shunt"

Smith et al., 2014