Study of the Near-shore Environment on the south shore of Lake Erie

Kevin Czajkowski, Yitong Jiang, Kimberly Panozzo, Brinda Athreya, Patrick Lawrence – Geography and Planning, University of Toledo

April Ames – Public Health, University of Toledo

Johan Gottgens, Ricky Becker, Thomas Bridgeman, Carol Stepien, Ryan Jackwood, Daryl Dwyer – Environmental Sciences, University of Toledo

Housen Chu – Environmental Sciences, UC Berkeley

Jiquan Chen, Geography, Michigan State University

A.D. Svoboda - Ottawa County Health Department

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Near Shore Projects

- Development of wetlands to reduce *E coli* and P
- Rehabilitation of the Ottawa River
- Lake Erie Sensor Network – Carbon and Energy Fluxes
- Citizen Science aircraft to monitor Lake Erie.
- Agricultural BMP development from remote sensing

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Improving Water Quality with Ecosystem Restoration

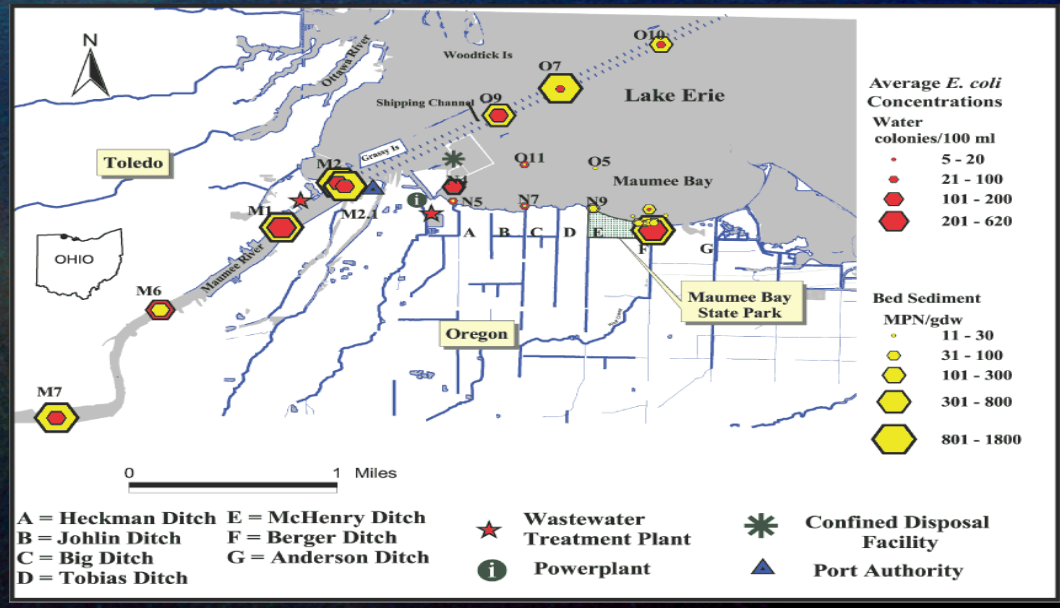
Ryan Jackwood, Daryl Dwyer

Department of Environmental Sciences

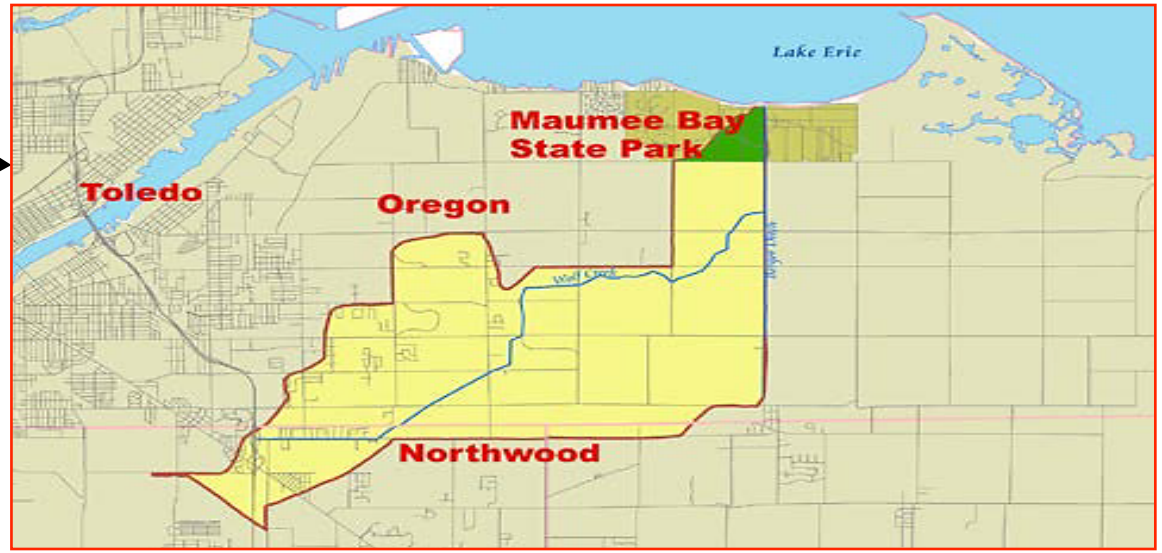
University of Toledo

Maumee Bay State Park – Oregon, OH

MBSP has posted an average of 25 swim advisories during each recreational season (late May to early September) since 2010 at its lakeside beach due to elevated algal and bacterial densities



Wolf Creek Watershed and Maumee Bay State Park



-Size: 16 mi^2
-Mostly Channelized Waterways
-Frequent Inputs from Agricultural Drain Tiles
-Mouth is Adjacent to Swimming Beaches at MBSP

Photo Courtesy: TMACOG

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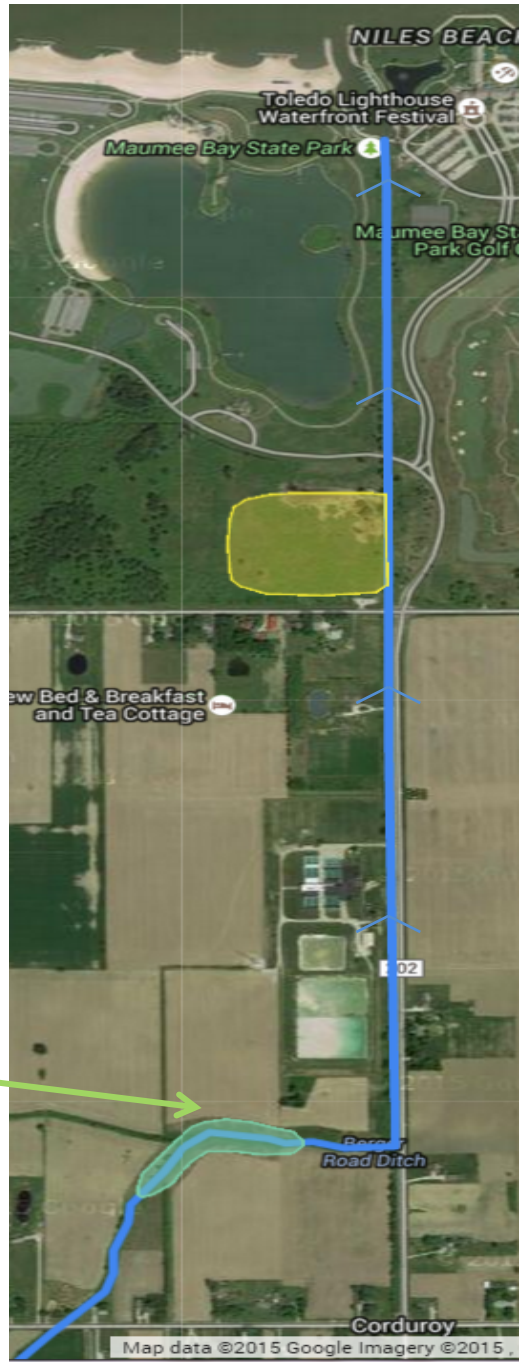
Demonstration Projects in the Wolf Creek Watershed

- **Goal:** Use Restored Riparian and Wetland Habitat engineered for concentrated removal of non-point source pollutants
- Strive to Delist BUIs:
  - Eutrophication
  - Beach Closings
  - Degradation of Aesthetics
  - Loss of Fish and Wildlife Habitat

- **First Project**: Sedimentation Pond
  - Accumulate Suspended and Bed Load Sediment
    - Approx. 40% of P and 70% of *E. coli* are attached to sediment
  - Restore Riparian Habitat
  - Increase Floodplain



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Upland Sedimentation Pond

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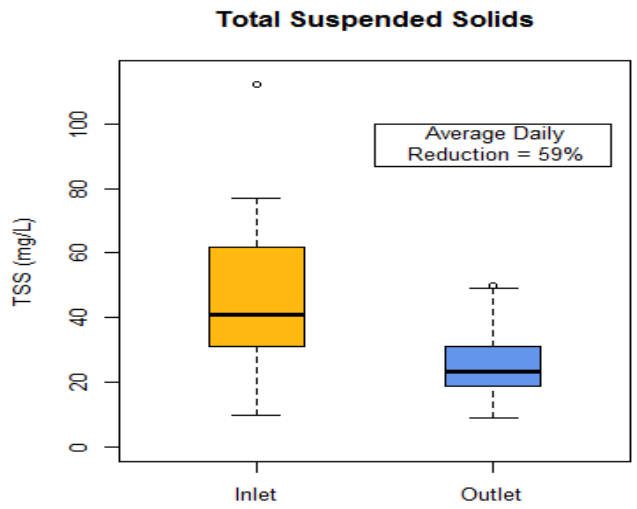
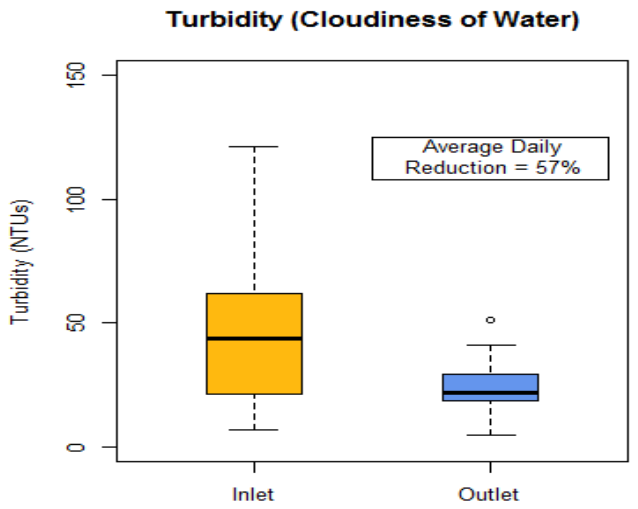
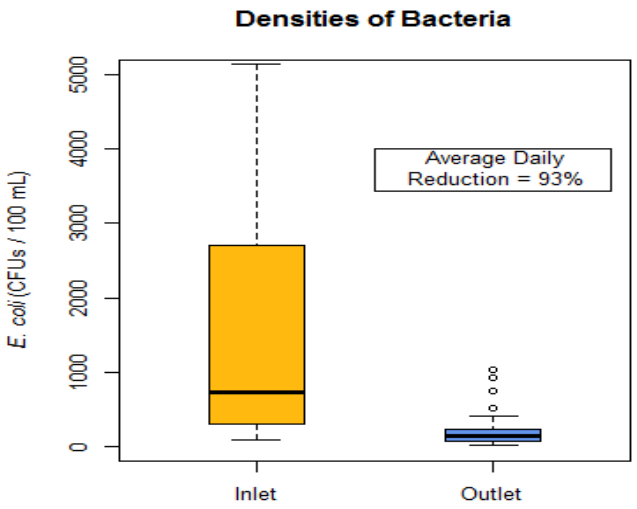
June 2013

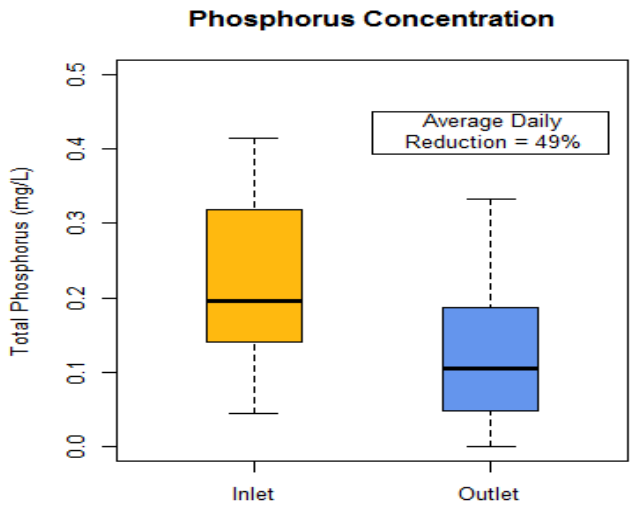
July 2015

Sedimentation Pond - Preliminary Data

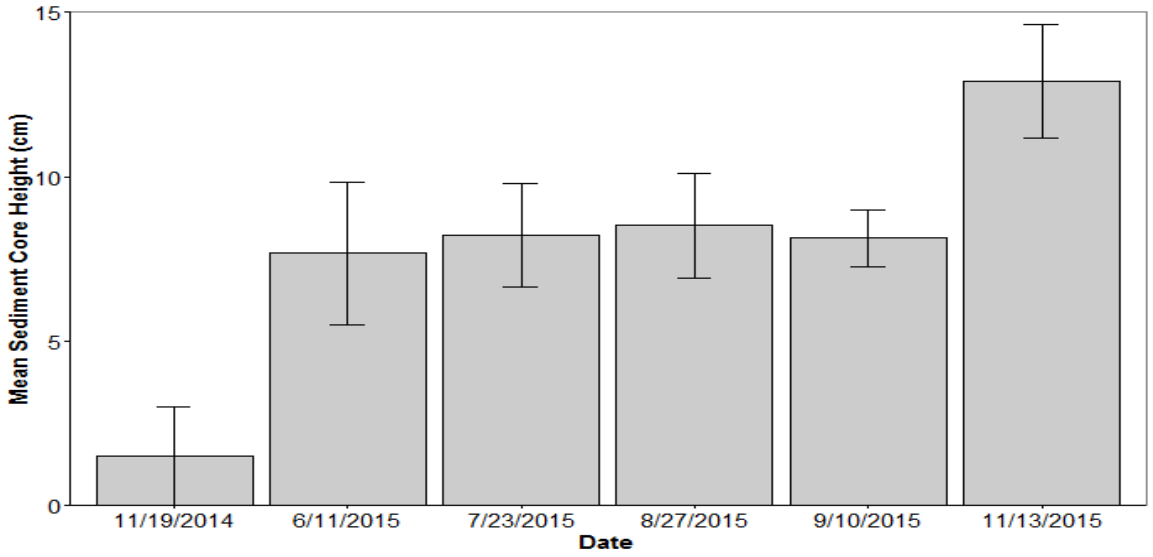






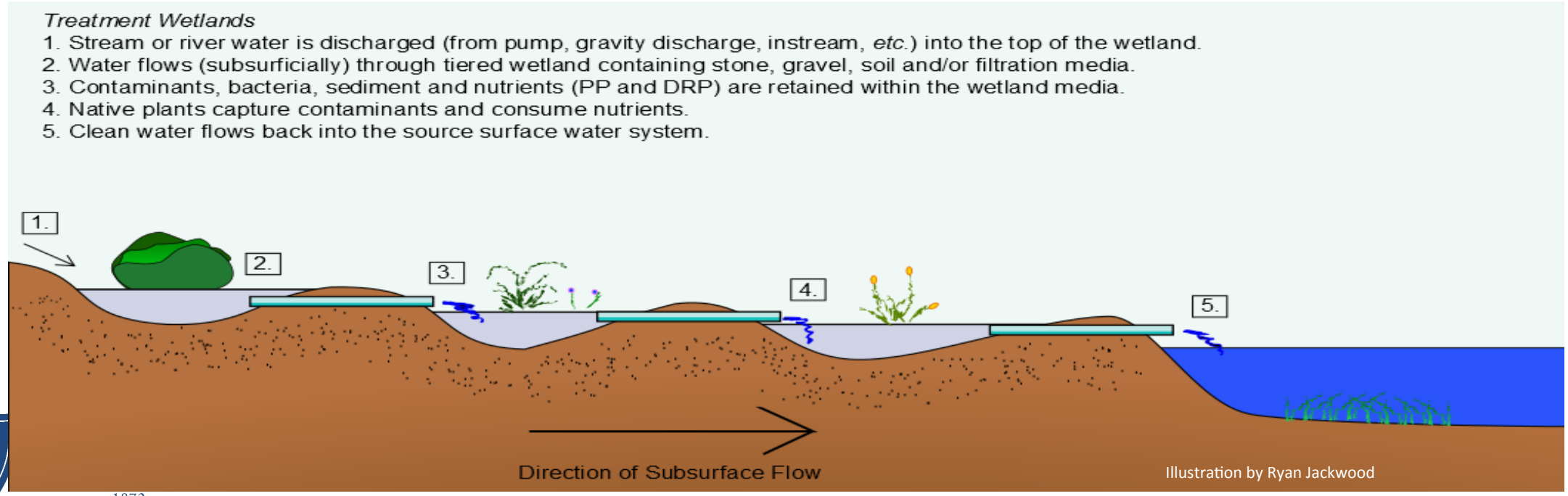


- Water Samples (Left): July 2014 – July 2015
- Sediment Accumulation (Bottom): Nov. 2014 – Nov. 2015
- Over 220 m^3 of Sediment has Accumulated Over the Past Year
- Or, 300 metric tons!!
- Approx. 0.5 tons of phosphorus is attached to this sediment

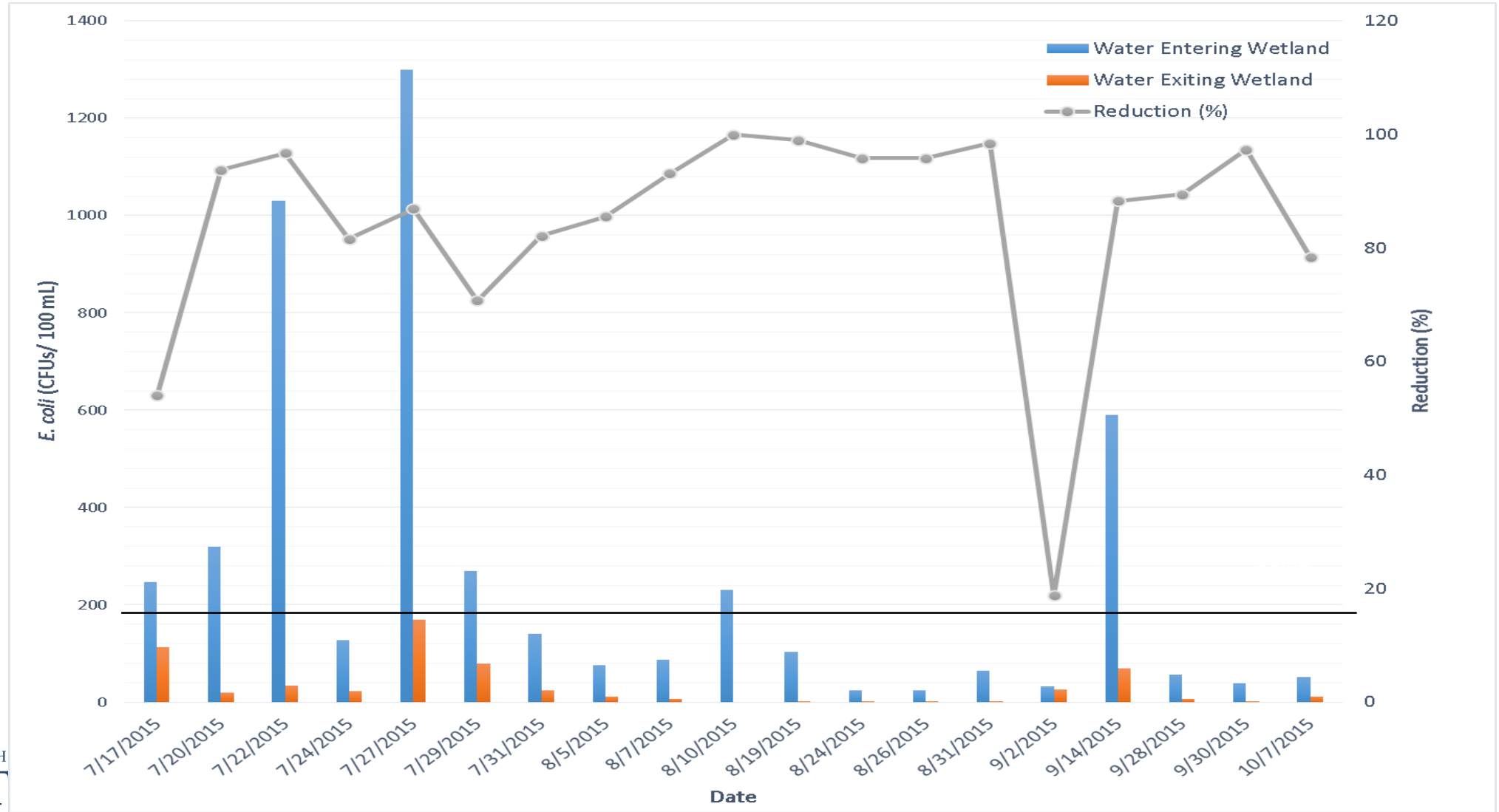


Constructed Wetland at Wolf Creek

- Three-tiered design
- Acts as a “polishing step” to remove nutrients, bacteria, and fine sediment
- Primarily subsurface flow
- Limestone fill to improve treatment efficiency
- Different elevations and frequency of flooding provide appropriate habitat for a variety of emergent, wetland, and prairie plants



E. Coli Removal in Wetland



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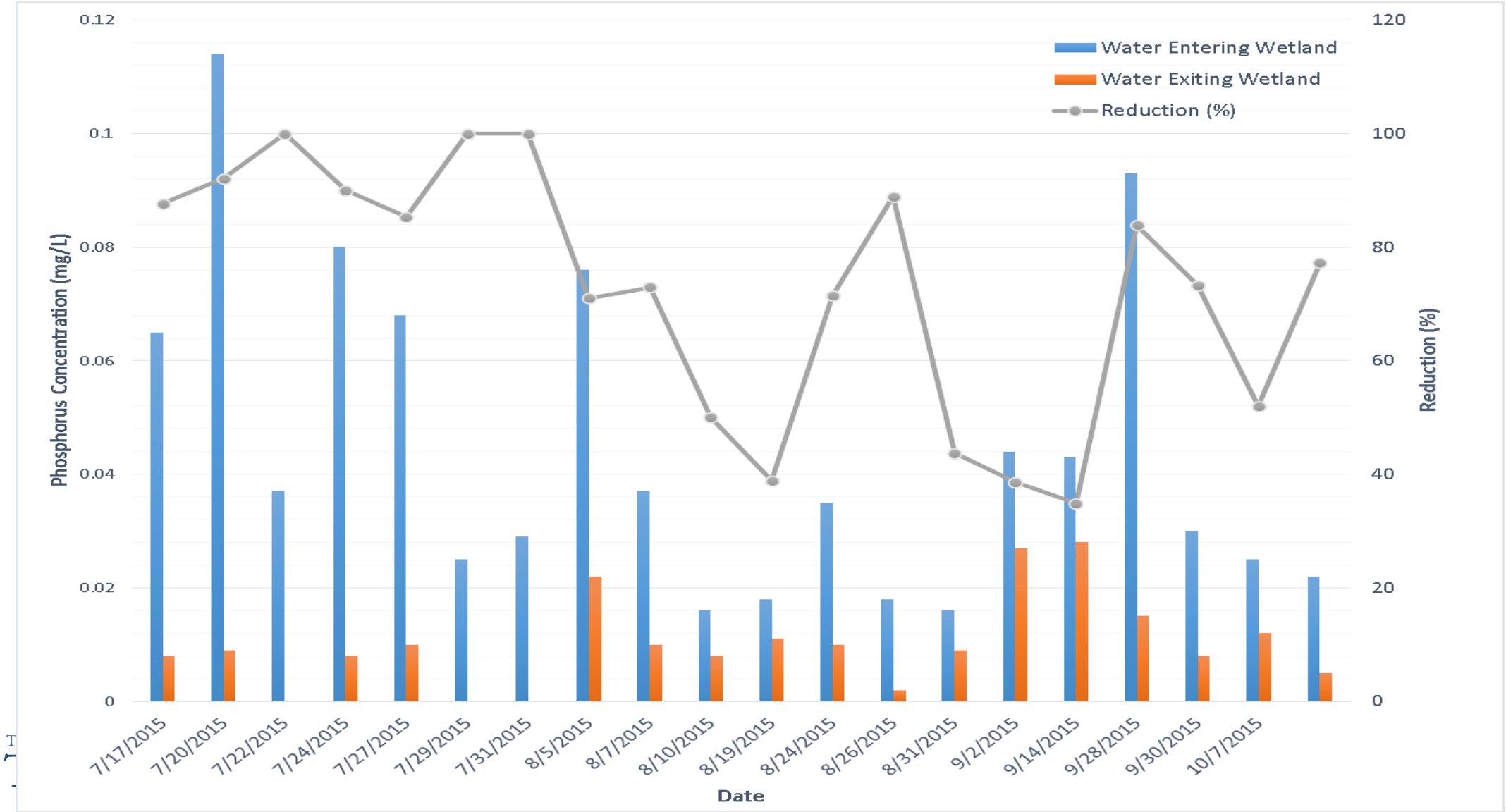
Total Dissolved Phosphorus Removal in Wetland



Funding for Daryl Dwyer's Groiup

Rehabilitation of the Ottawa River on the University of Toledo campus: Initial Habitat and Fish Community Responses

Gottgens, J.F.[1], Lawrence, P.L[2] and A.D. Svoboda[3]

[1] *Department of Environmental Sciences, The University of Toledo, Ohio 43606*

[2] *Department of Geography and Planning, The University of Toledo, Ohio 43606*

[3] *Ottawa County Health Department, Port Clinton, Ohio 43452*

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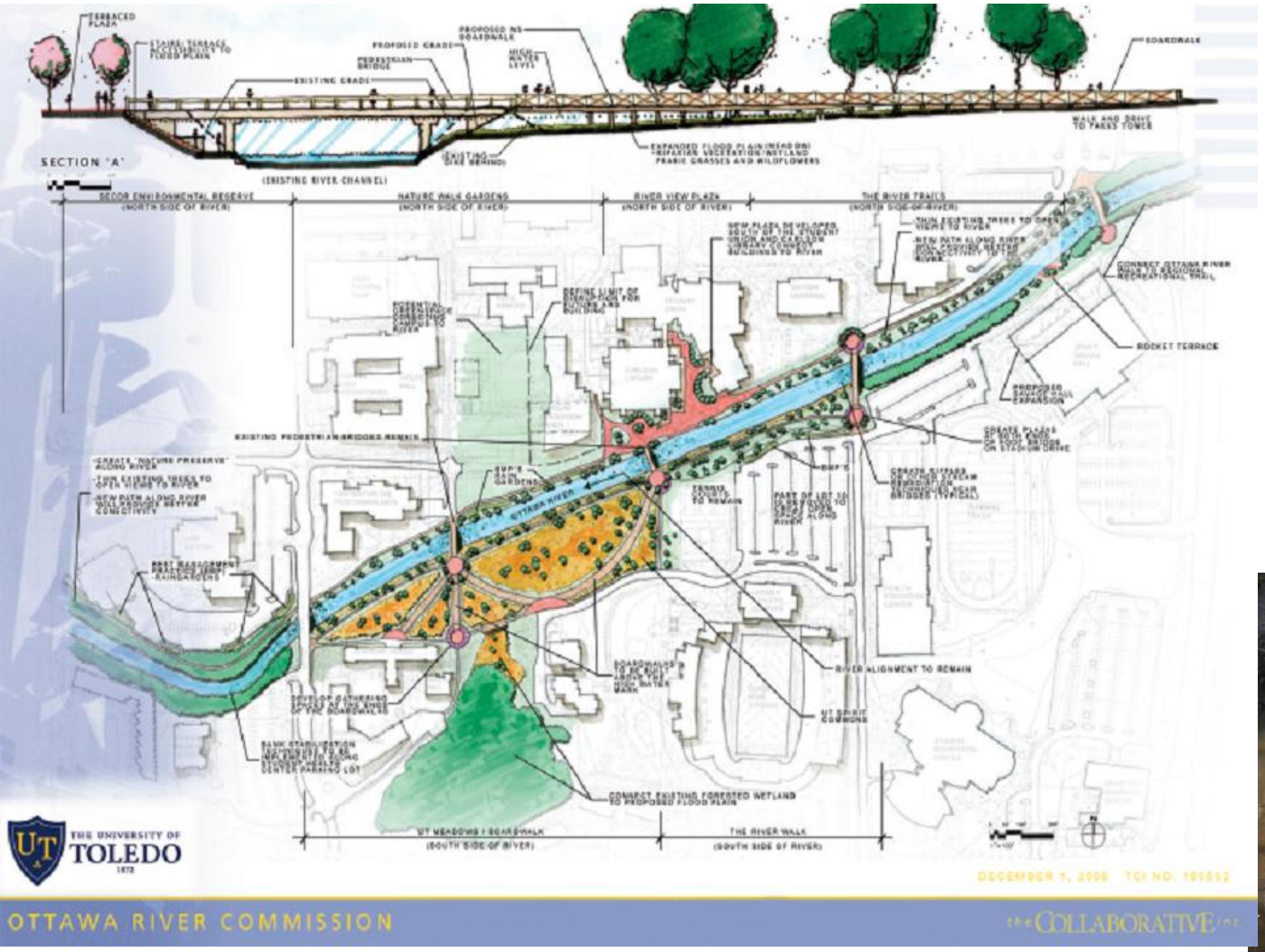

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Lake Erie Center Environmental Sensor Network

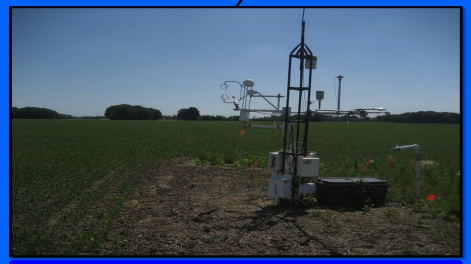
J. Chen, C. Stepien, R. Becker, J. Gottgens, K. Czajkowski, T. Bridgeman

Station Locations

Western basin, Lake Erie
CO_2, H_2O, and energy fluxes of a freshwater lake ecosystem on top of the city of Toledo water intake crib.

Western basin, Lake Erie
CO_2, H_2O, and energy fluxes of a freshwater lake ecosystem on top of the U.S. Coast Guard's Toledo Light #2 light beacon.

Swanton, Ohio
The Oak Openings MetroPark is the sole *Ameriflux* tower site in Ohio. Measureing the carbon sequestration capacity of managed forest ecosystems.



Curtice, Ohio
CO_2, CH_4, H_2O, N_2O, and energy fluxes in an agricultural field are measured using an open-path eddy covariance and static chamber.

Port Clinton, Ohio
CO_2, CH_4, H_2O, and energy fluxes in a marshland ecosystem of Lake Erie shoreline.

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Response and Biophysical regulation of Carbon Fluxes to Climate Variability and Anomaly in Contrasting Ecosystems



Housen Chu[1], J. Chen[2], J. Gottgens[1], R. Becker[1], K. Czajkowski[3]

[1]Department of Environmental Sciences, University of Toledo
[2]Department of Geography, Michigan State University
[3]Department of Geography and Planning, University of Toledo

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Site Information

Deciduous woodland

Red Oak (*Quercus rubra*) White Oak (*Q. alba*)
Black Oak (*Q. velutina*)
Red Maple (*Acer rubrum*)

Sandy mixed & Mesic
WT: -0.3 ~ -3.0 m
VWC: 17-25%

Conventional cropland

Soybean (*Glycine max*)
- *2011-2012/Sep*

Wheat (*Triticum spp.*)
- *2012/Sep-2013*

Silty Clay
WT: -0.3 ~ -3.0 m
VWC: 25-65%

Rain-fed, no irrigation

Freshwater marsh

Water Lily (*Nymphaea odorata*)
American Lotus (*Nelumbo lutea*)
Cattail (*Typha angustifolia*)
Rose Mallow (*Hibiscus moscheutos*)

Hydric (Permanent inundated)
WT: 0.2 ~ 1.0 m

Hydrologically connected to upstream croplands and downstream lake

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Hydrologic Carbon Flux

Inflow 3
⌀ 1.8 m

Inflow 2
⌀ 0.9 m

Inflow 1
⌀ 1.2 m

Outflow
1.6 × 1.6 m

Tower

250 m

Sandusky Bay

500 ft
200 m

Routine Sampling

Every 2-3 weeks, ice-free 2011 - 2013

POC / DOC: Weight Loss on Ignition
DIC: Alkalinity Titration
Discharge: Portable flow meter × Cross section

Instrumentation & Methodology

Met, Soil & Water variables

Soil temperature (Tg)
Friction velocity (u_*)
Ground water level (WT)
Air temperature (Ta)
Vapor pressure deficit (VPD)

Precipitation, Water temperature, Soil water content (VWC)
Photosynthetically Active Radiation (PAR)

Vegetation index

MODIS – NDVI

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Findings

- Freshwater marsh efficiently converted carbon to methane flux.
- Soil temperature influenced methane flux.
- Methane release from crops are much smaller than from the marsh.

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Citizen Science Aircraft to Monitor Lake Erie

Citizen Science Pilot Project to Help Tackle Remote Sensing of Harmful Algal Blooms

Rafat Ansari, PhD

NASA Glenn Research Center

APPROACH: Volunteer GA Pilots as Citizen Scientists

- 600,000 private pilots/200,000 GA aircrafts in the U.S.
- Use untapped resource to study land and aquatic systems.
- NASA did not pay for any pilot services, aircraft maintenance, hangar rent, fuel etc.

HAB Event (12mi east of Toledo)

Changes in Water Quality over Time –HAB Events

Photo credit: Marvin Smith, NASA

- HABs –Complex Phenomena
- Dynamic System –several orders of magnitude
- Timing is Everything

Conclusions

- GA pilot volunteers and citizen scientists can provide a vital data in efforts to monitor and maintain water quality standards

- We demonstrated an early warning system of an ensuing algal bloom is possible via a volunteer aerial network

- Near real-time data can be available for water quality science
  Valuable for:
  - Scientists to study the issues related to HABs
  - Water quality managers' to use in decision making
  - Students to use in advance learning and image processing via open-source free software

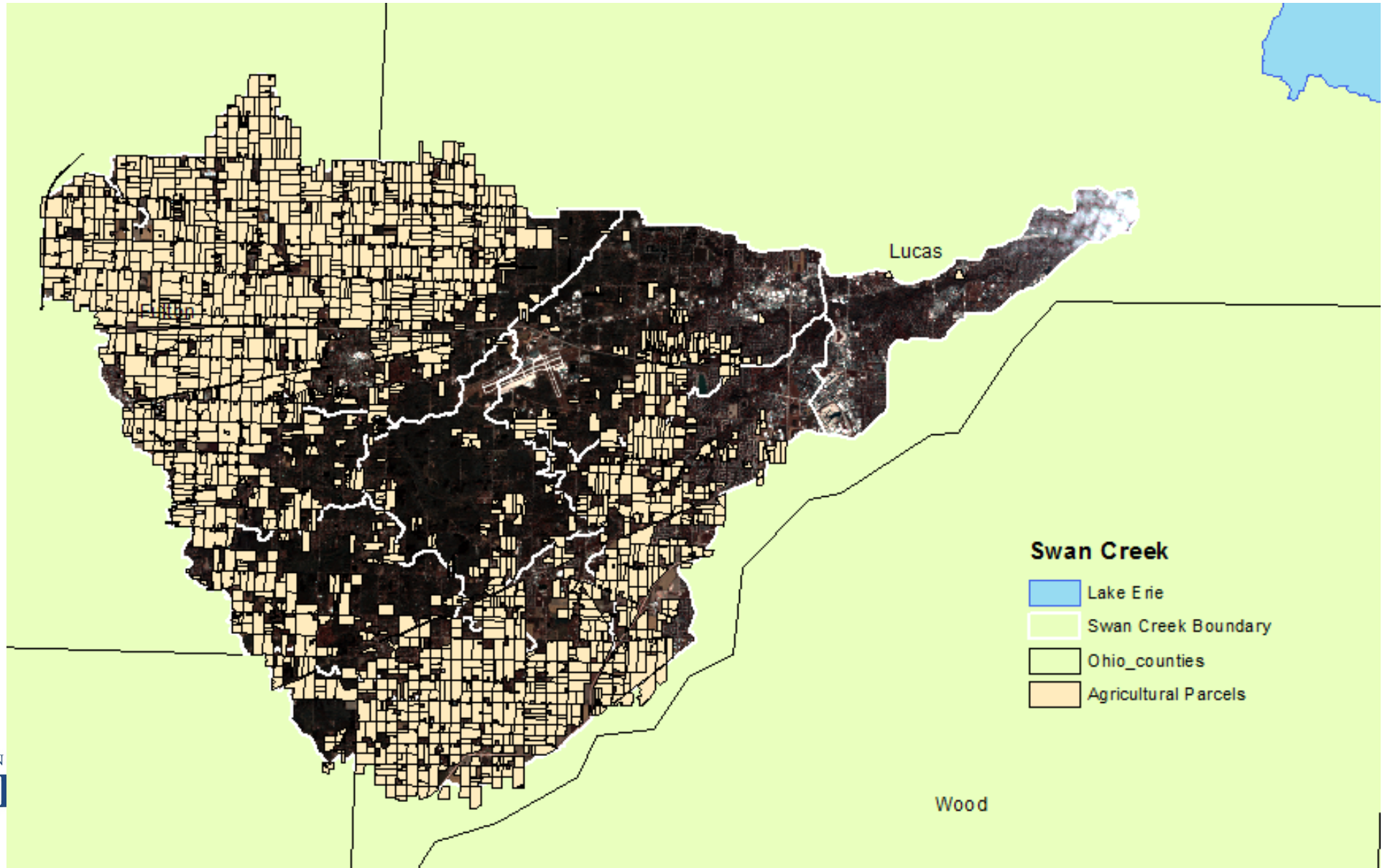
- Citizen science aerial data can be a "no to low"- cost tool to help assess water quality

BMP Development for Swan Creek Watershed: Pilot

Kevin Czajkowski, April Ames, Yitong Jiang, Kimberly Panozzo, Brinda Athreya

University of Toledo

BMP Mapping Pilot: Swan Creek Watershed



Agricultural practice (BMPs) identification

The following agriculture practices will be identified in this project:

- Cover Crops (types and periods)
- Tillage (no till, conservation tillage, traditional tillage)
- Buffer Strips (forest and grass)
- Wetlands (woody and herbaceous)
- Tile Drainage (location and density)

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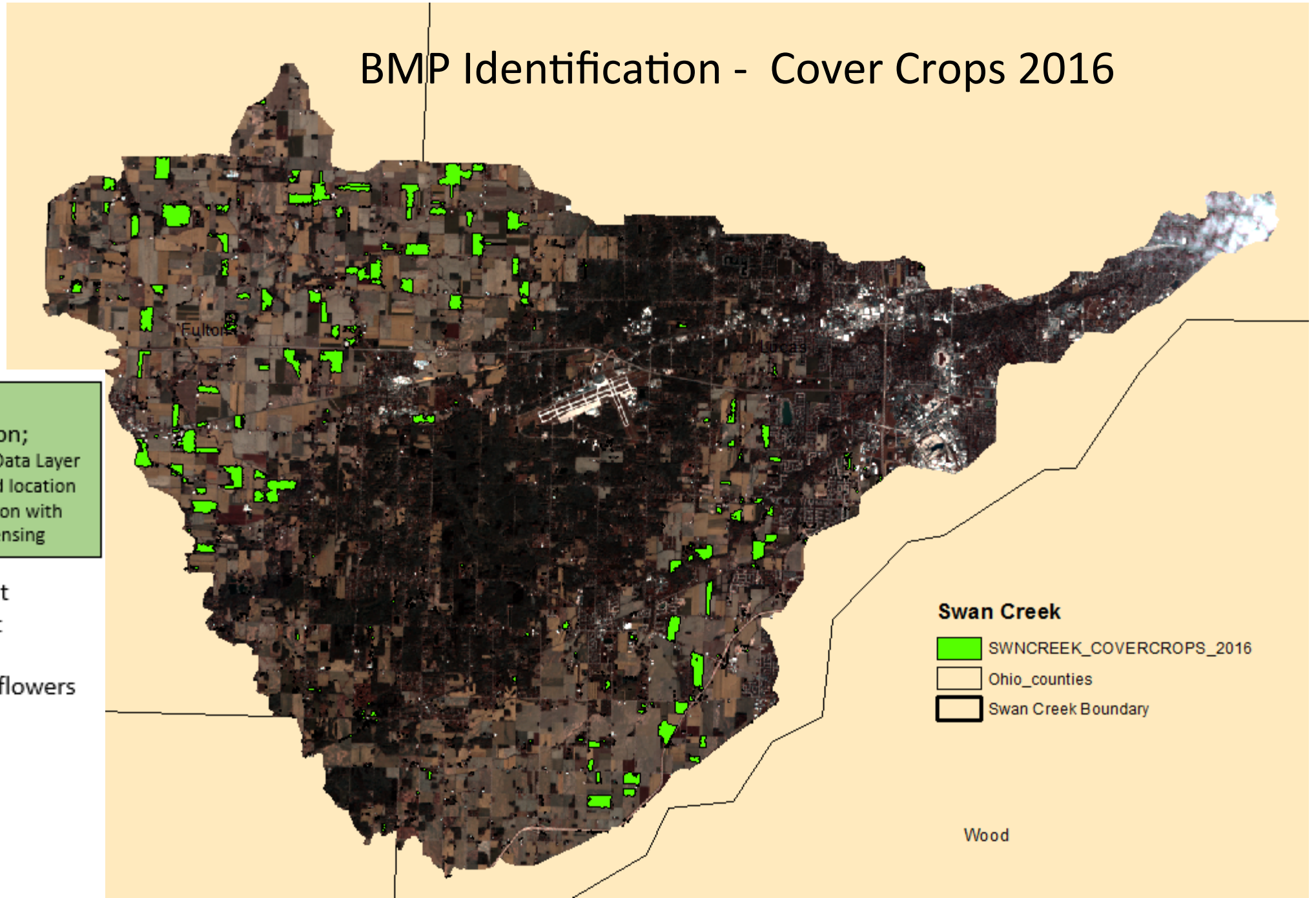
BMP Identification - Cover Crops 2016



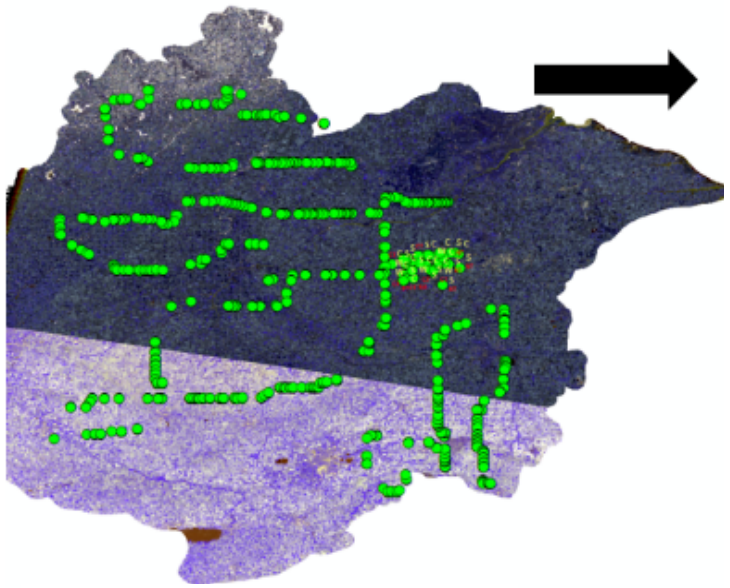
Cover Crop Identification;

- Cropland Data Layer
- In situ field location
- Classification with Remote Sensing

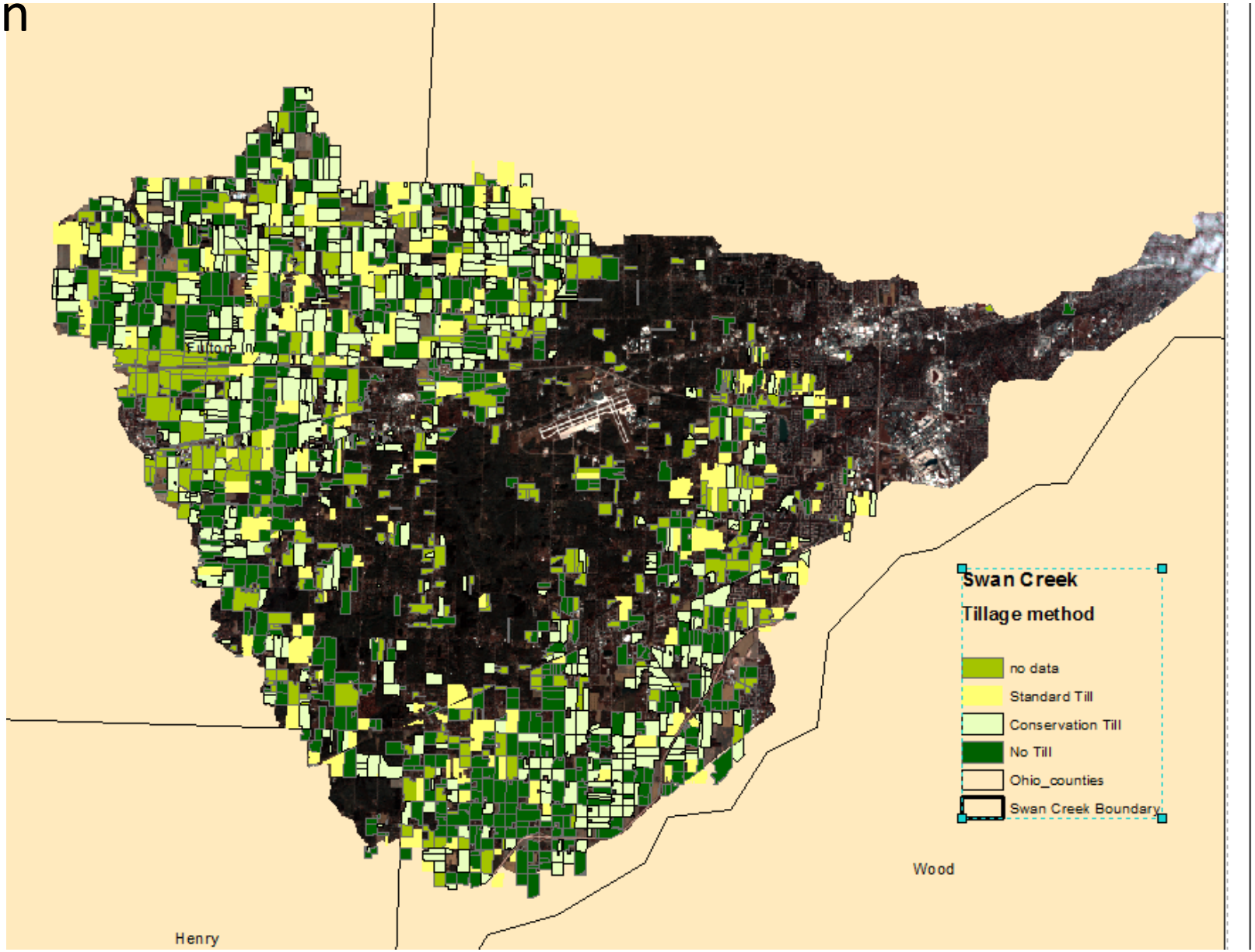
Winter wheat
Spring wheat
Alfalfa
Clover / wildflowers
Rye
Triticate
Speltz

Tillage Practice Identification

CONSERVATION TILL
NO TILL
STANDARD TILL



Field Observations



BMP Identification – Buffers (CDL)

Grass Buffers

Forested Buffer Strips

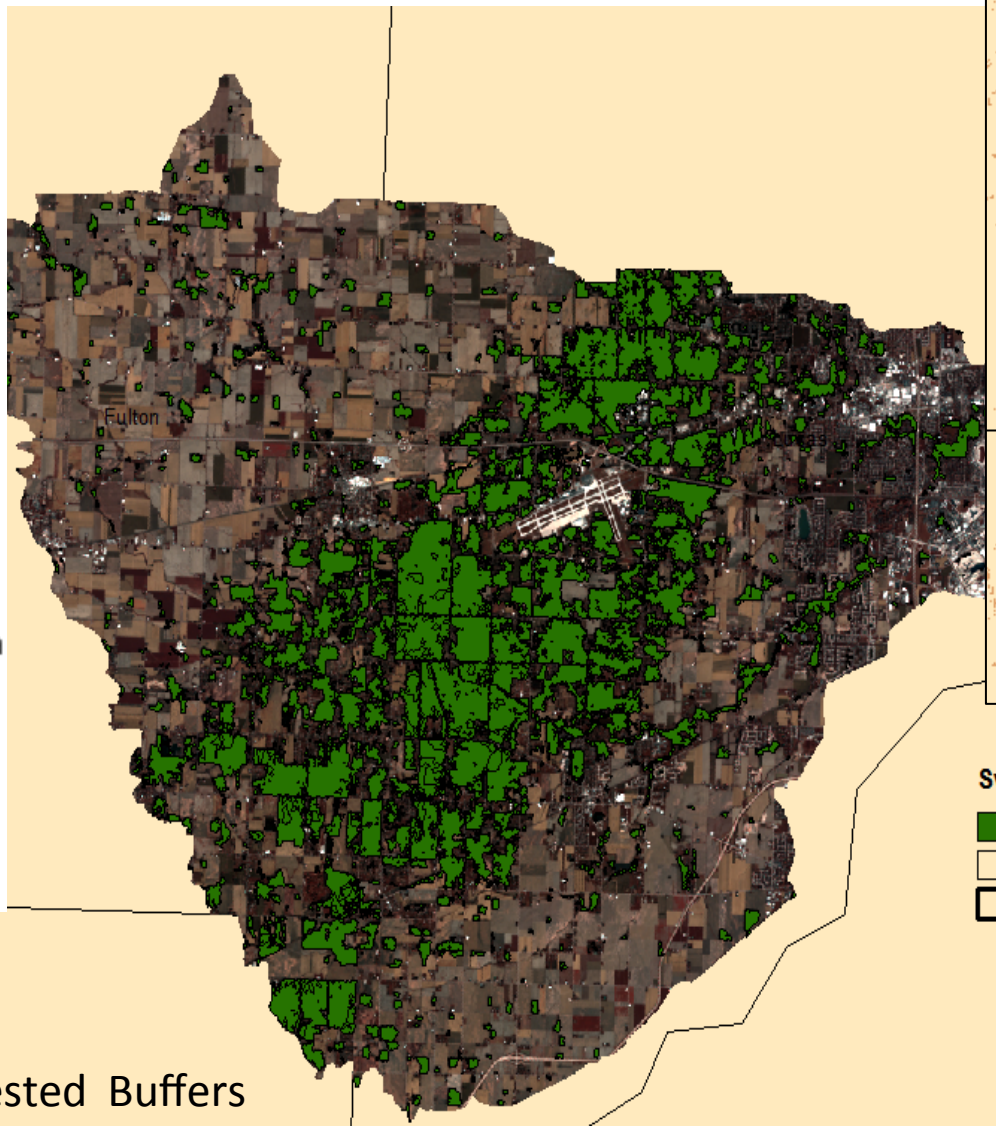
- Cropland Data Layer
- Areal image identification
- HWCD images

Forested buffers

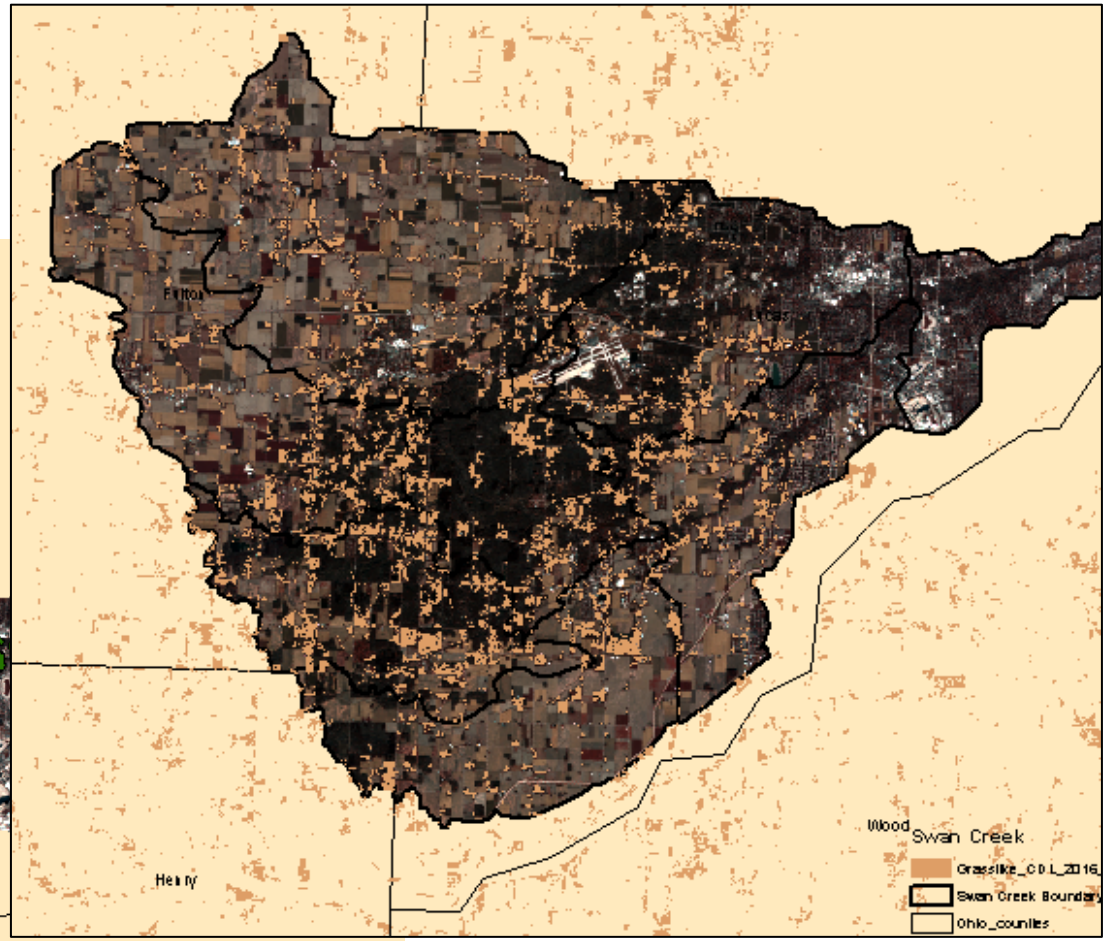
- Evergreen
- Deciduous

Grass buffers

- Fallow
- Grass/pasture
- Other hay/ non alfalfa
- Shrub land
- Sod/grass coverage

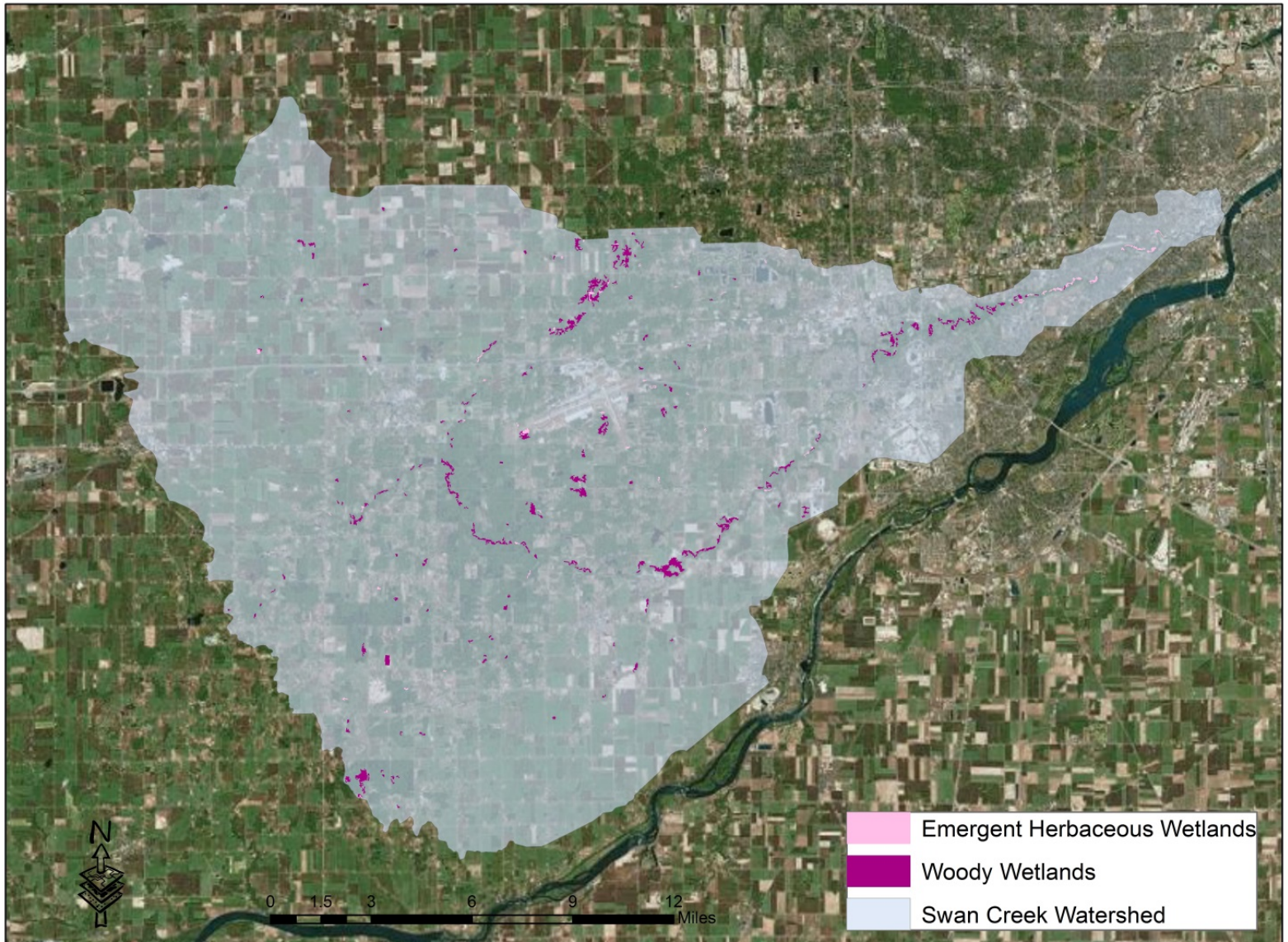


Forested Buffers



Grass Buffers

Wetlands Layer from National Land Cover Data Set (NLCD)



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Tile Drain Identification

Areal Images

Heads up Digitization

Automated Approach

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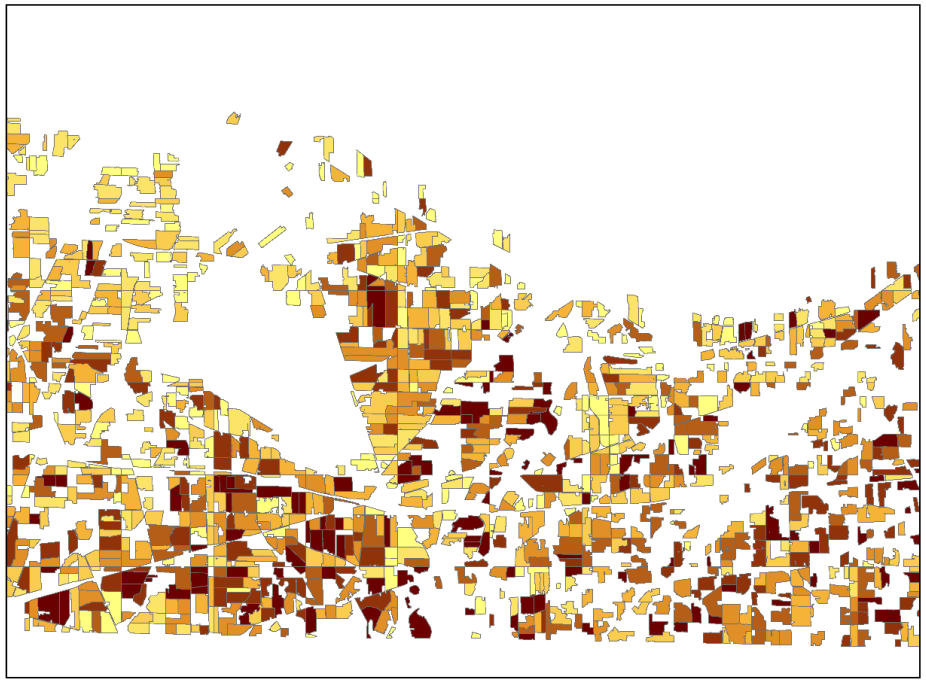
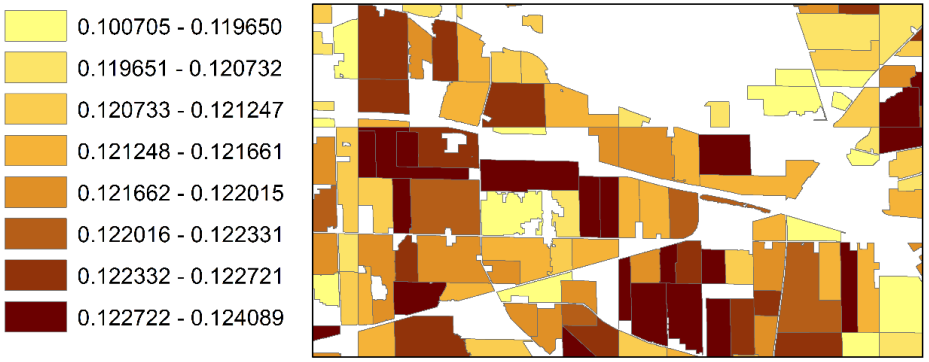
Tile outflow

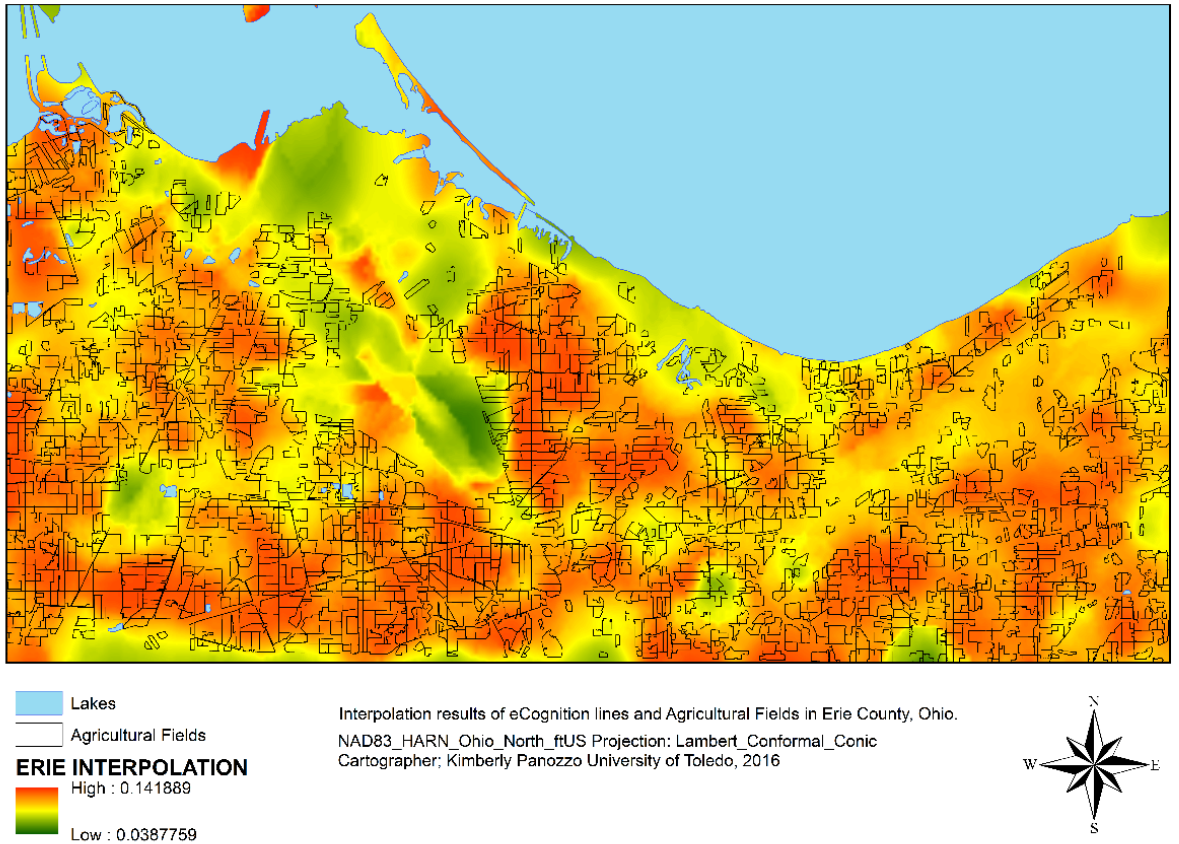
Erie County Tile Drain Output



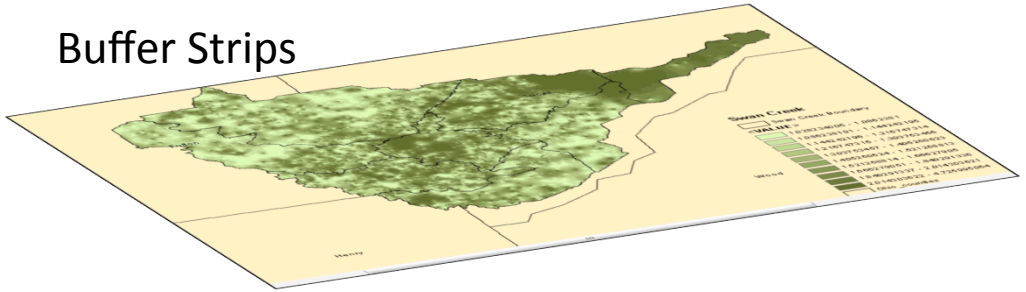
Erie County Tile Outflow Estimations



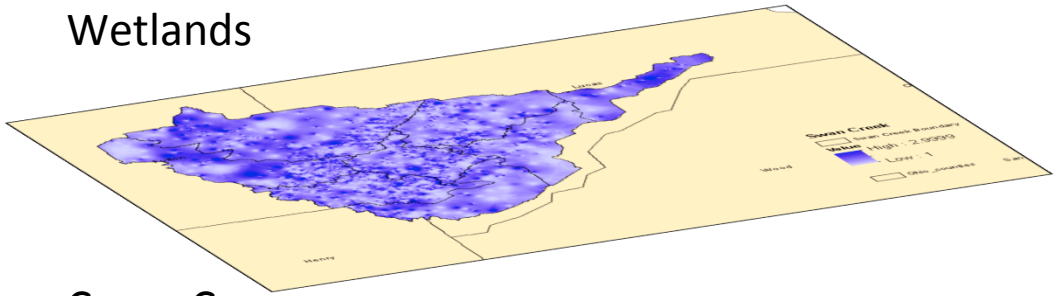
Tile Line Density



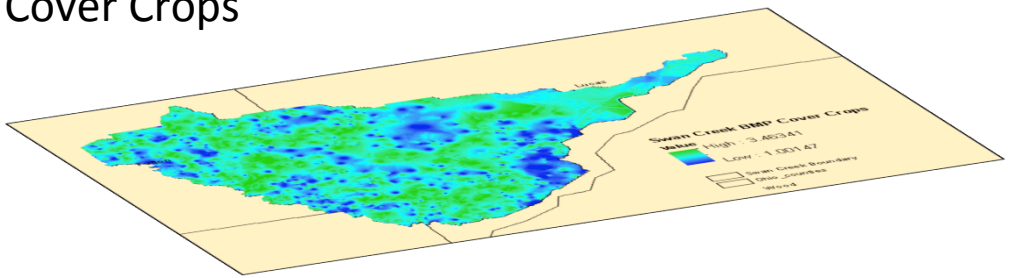
Buffer Strips



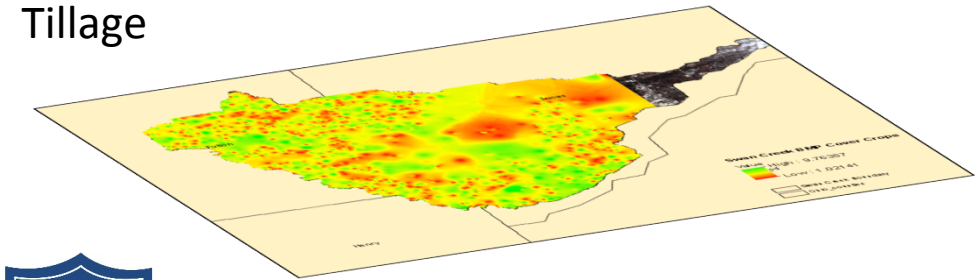
Wetlands



Cover Crops

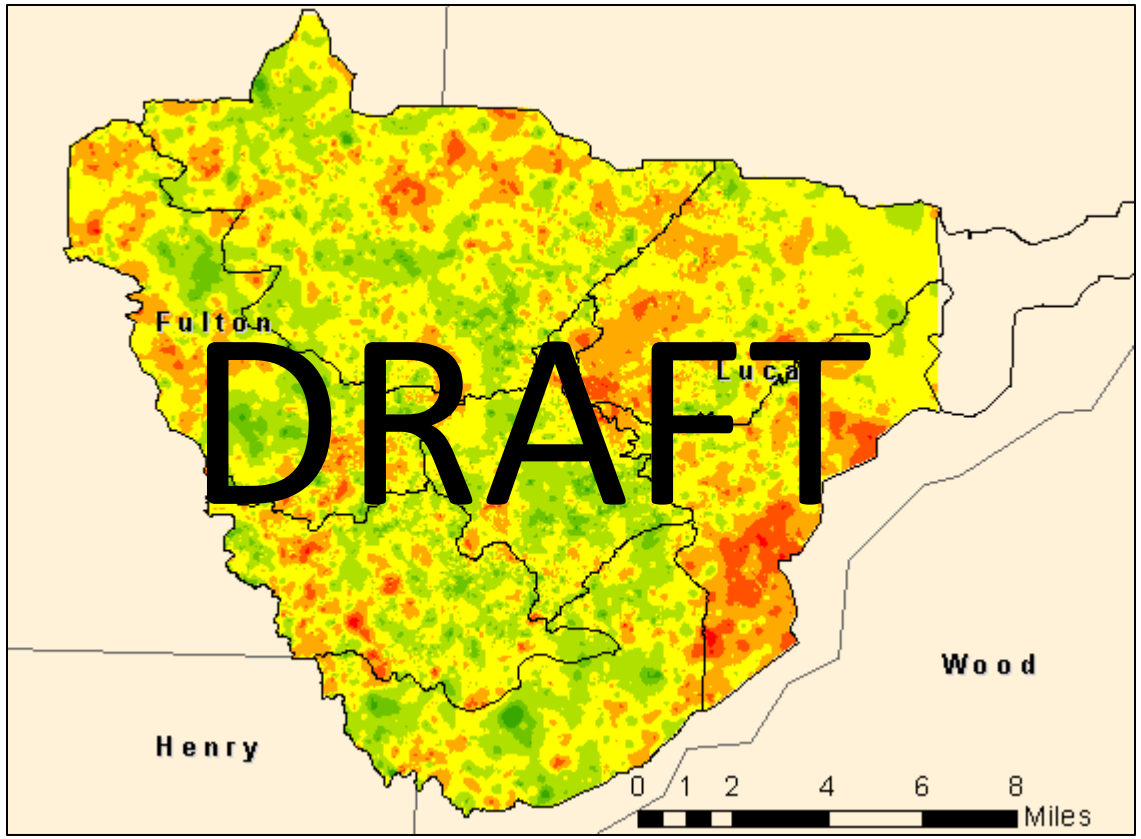


Tillage



Best Management Practices

(Buffer Strips, Wetlands, Tillage and Cover Crops)



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Thank You

Funding provided by