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Hydrologic Controls on Nutrient Retention in a Restored Wetland

Presented by:
Emily Fox and
Dupe Oluwasesan

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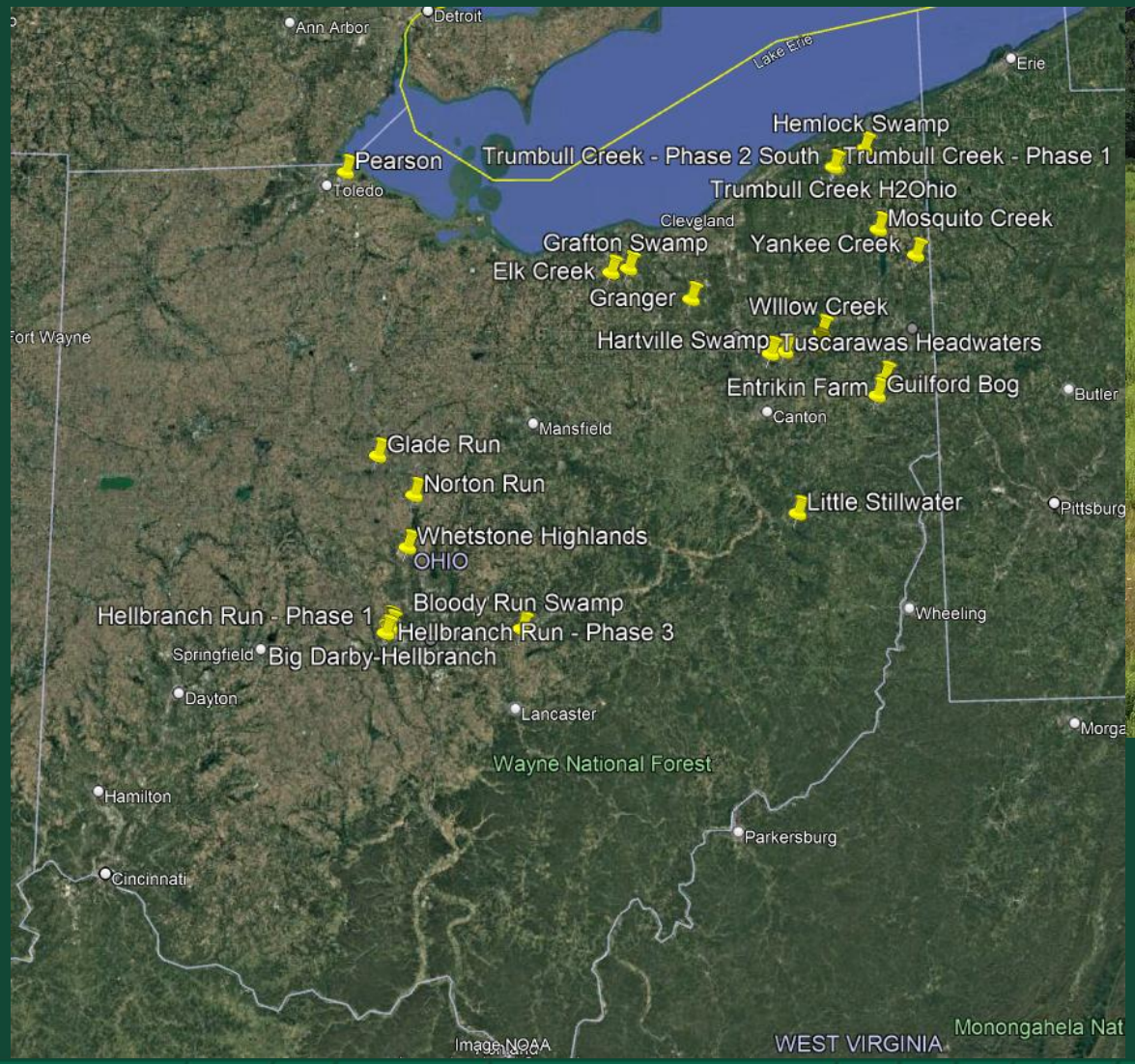
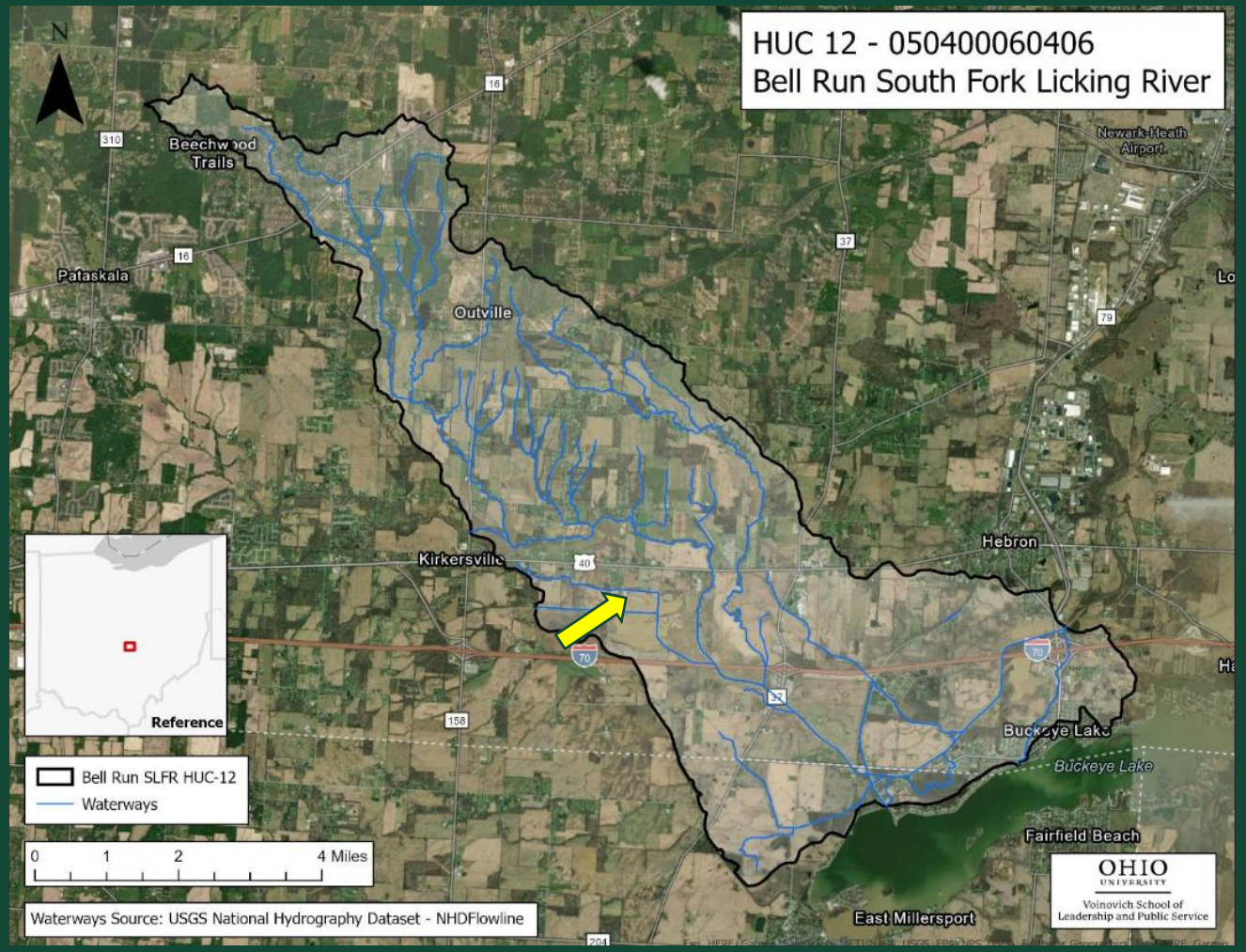
Stream + Wetlands Foundation



S+W Stream and Wetlands FOUNDATION

Bell-Run South Fork Licking River Watershed

- 25 miles east of Columbus
- Surface area = approx. 26 square miles



Ohio University (2021)

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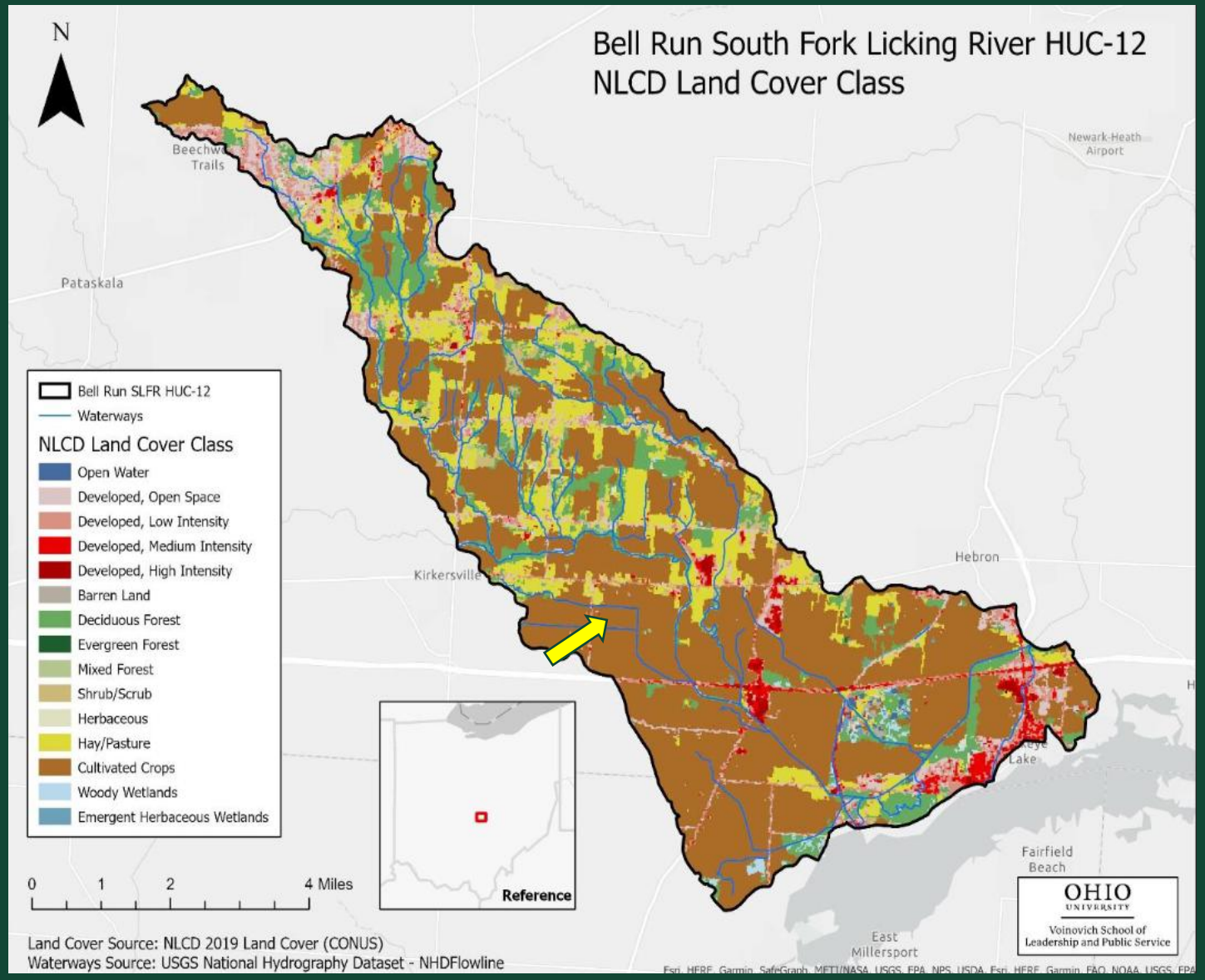
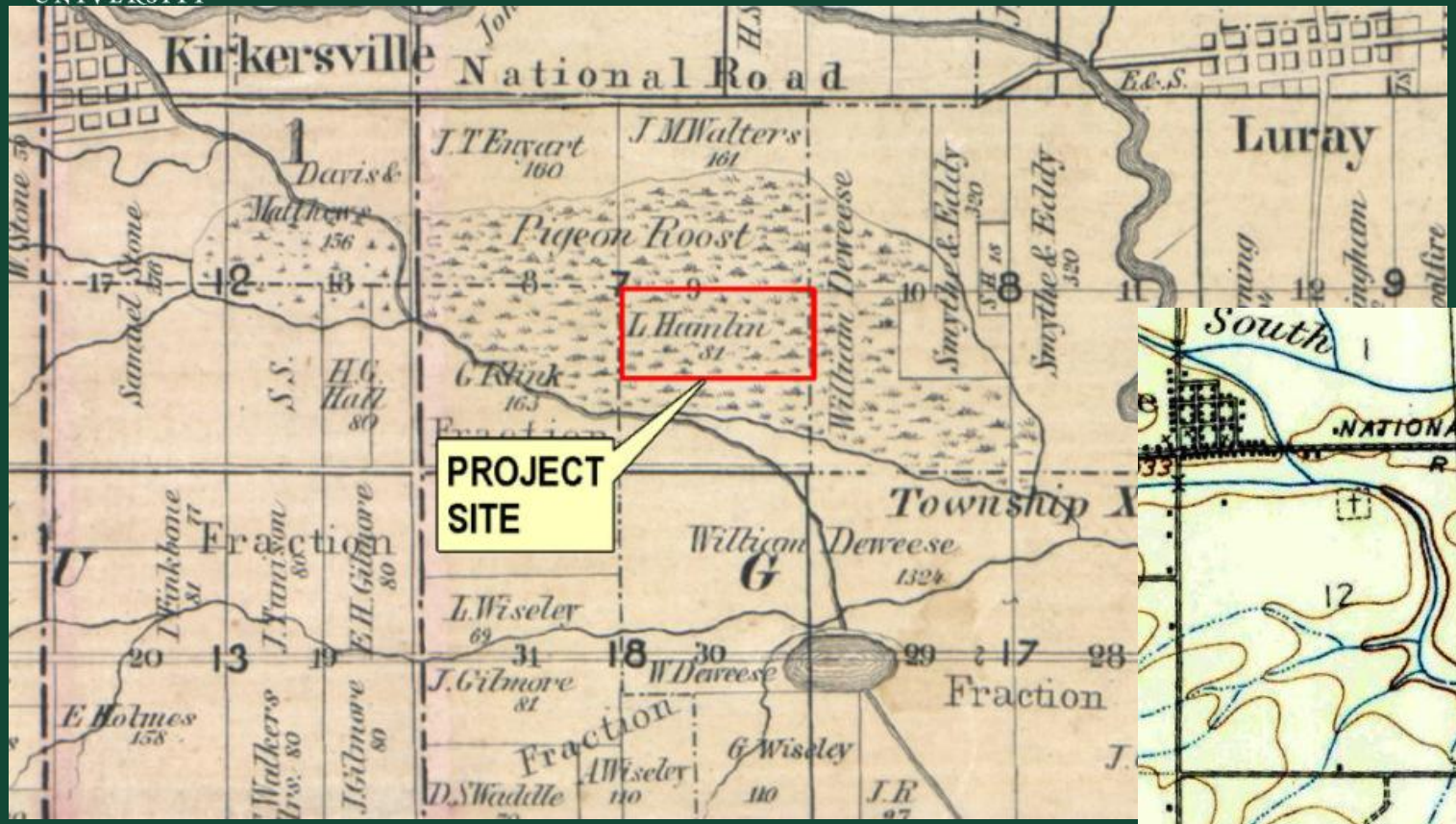
Land Cover Classes in the Watershed

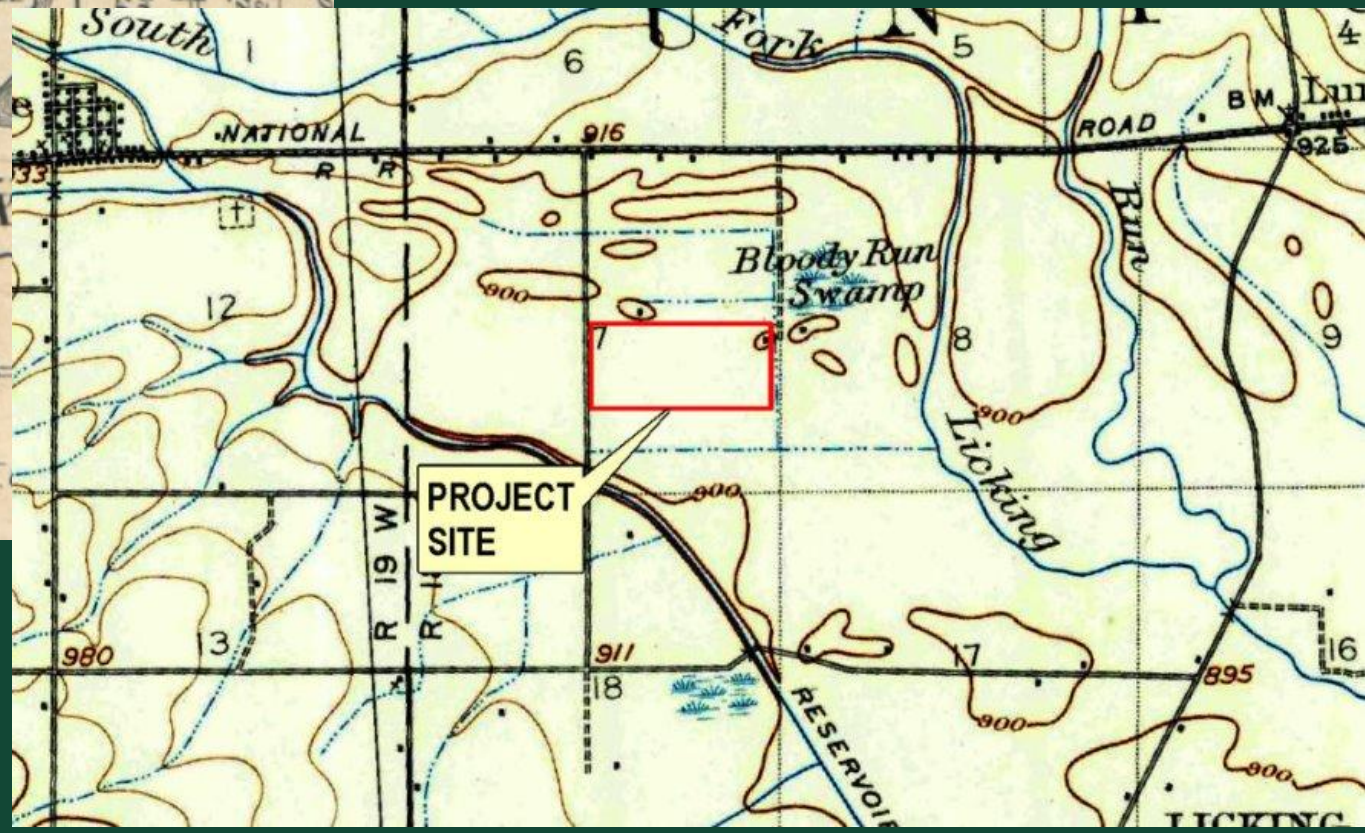
Primary Uses:

- 55% row crop
- 16% forest
- 15% pasture
- 14% residential areas



Ohio University (2021)





Maps courtesy of BLM General Land Office Records

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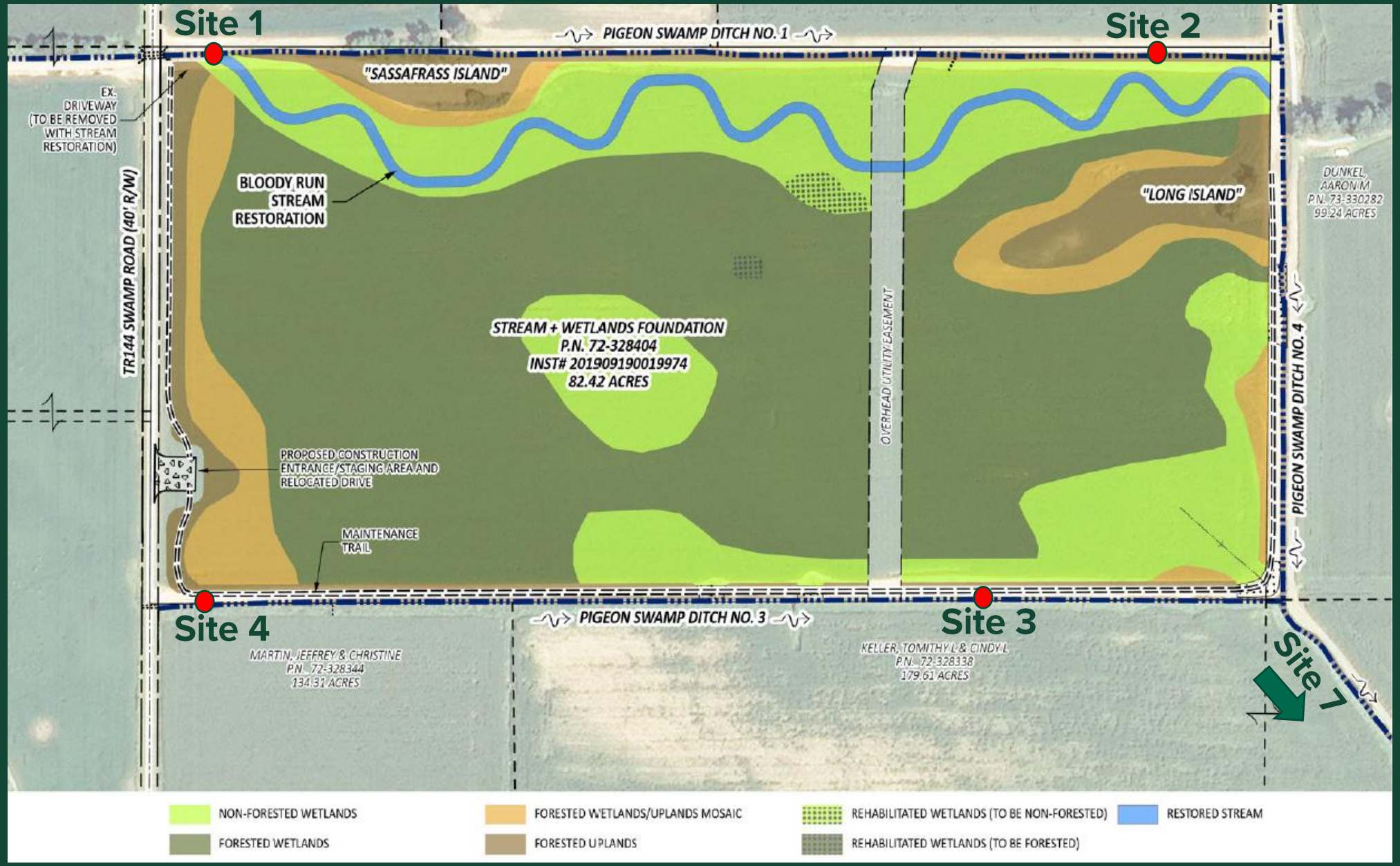
S+W Stream and Wetlands FOUNDATION


Site 1
Site 2
Swamp Rd SW
Bloody Run Swamp
Site 3
Bloody Run
Site 7
South Fork
Licking River
70
70
70
Palmer Rd SW
Lancaster Rd SW
0
0.25
0.5
1 Km


Site 1
PIGEON SWAMP DITCH NO. 1
Site 2
"SASSAFRASS ISLAND"
EX. DRIVEWAY (TO BE REMOVED WITH STREAM RESTORATION)
BLOODY RUN STREAM RESTORATION
"LONG ISLAND"
DUNKEL, AARON M
P.N. 73-330282
99.24 ACRES
TR144 SWAMP ROAD (40' R/W)
STREAM + WETLANDS FOUNDATION
P.N. 72-328404
INST# 201909190019974
82.42 ACRES
OVERHEAD UTILITY EASEMENT
PIGEON SWAMP DITCH NO. 4
PROPOSED CONSTRUCTION ENTRANCE/STAGING AREA AND RELOCATED DRIVE
MAINTENANCE TRAIL
Site 4
PIGEON SWAMP DITCH NO. 3
Site 3
Site 7
MARTIN, JEFFREY & CHRISTINE
P.N. 72-328344
134.31 ACRES
KELLER, TOMITHY L & CINDY L
P.N. 72-328338
179.61 ACRES
NON-FORESTED WETLANDS
FORESTED WETLANDS
FORESTED WETLANDS/UPLANDS MOSAIC
FORESTED UPLANDS
REHABILITATED WETLANDS (TO BE NON-FORESTED)
REHABILITATED WETLANDS (TO BE FORESTED)
RESTORED STREAM

Sampling Plan

- Pre-construction sampling: March – September 2022
- Construction Sampling: September 2022 – May 2023
- Post-construction: May 2023 – May 2025
- Bimonthly field measurements for student data
- Seasonal lab analysis for nutrient concentrations in water and sediment

Sampling Parameters

- Nitrogen (nitrates, nitrites, ammonia, total N)
- Phosphorus (orthophosphates, total P)
- Total suspended solids, total dissolved solids, total solids
- Total Carbon
- Metals

- Analysis:

Alloway Laboratory in Columbus, Ohio

Research Questions

- **How does nutrient loading to Bloody Run change after restoration?**
- How does water retention change?
- Did construction impact soil erosion rates?

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Pre-Construction Results

Zach Rundell MSES ‘24
Kehinde Ositimehin MSES ‘24

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Pre-Restoration Results - Nutrients

- Bloody Run was impaired by high concentrations of phosphorus and moderate concentrations of nitrogen
    - Water quality improved at Bloody Run during construction
    - Greater changes seen in nitrogen concentrations than phosphorus
    - Possible effects from the removal of tile drainage and lower precipitation.

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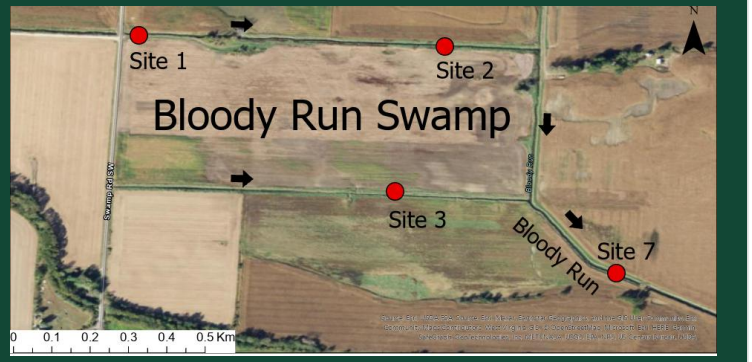
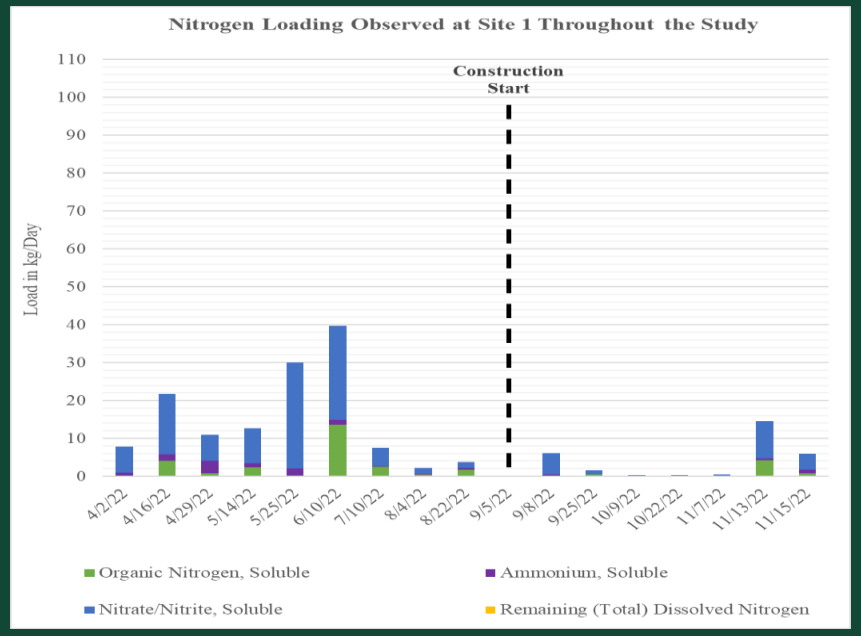
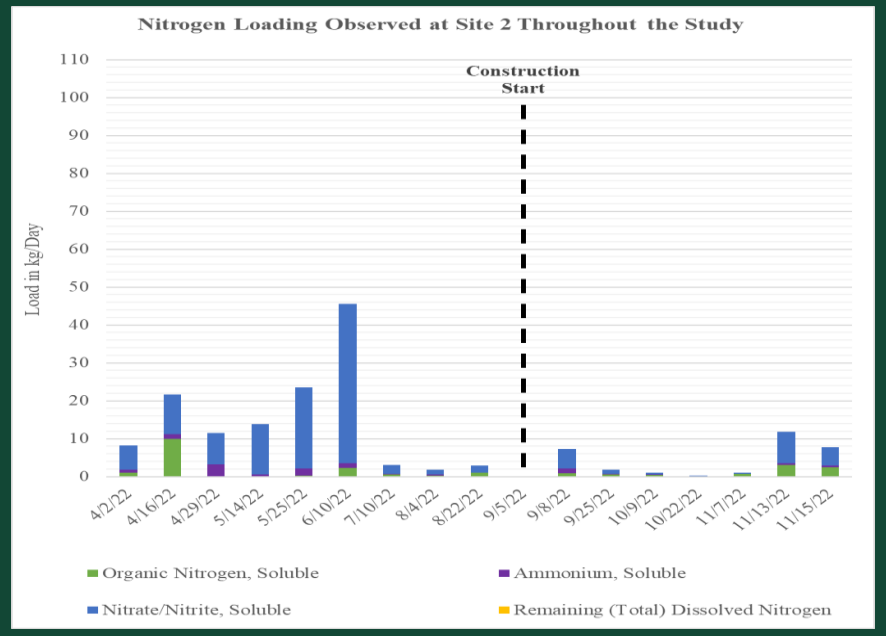
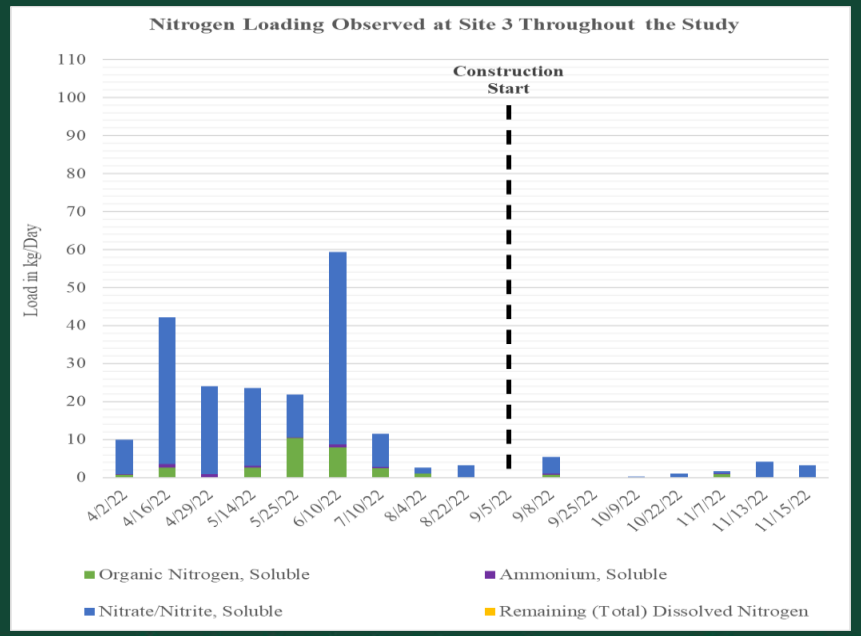
Pre-Restoration Nitrogen Loads

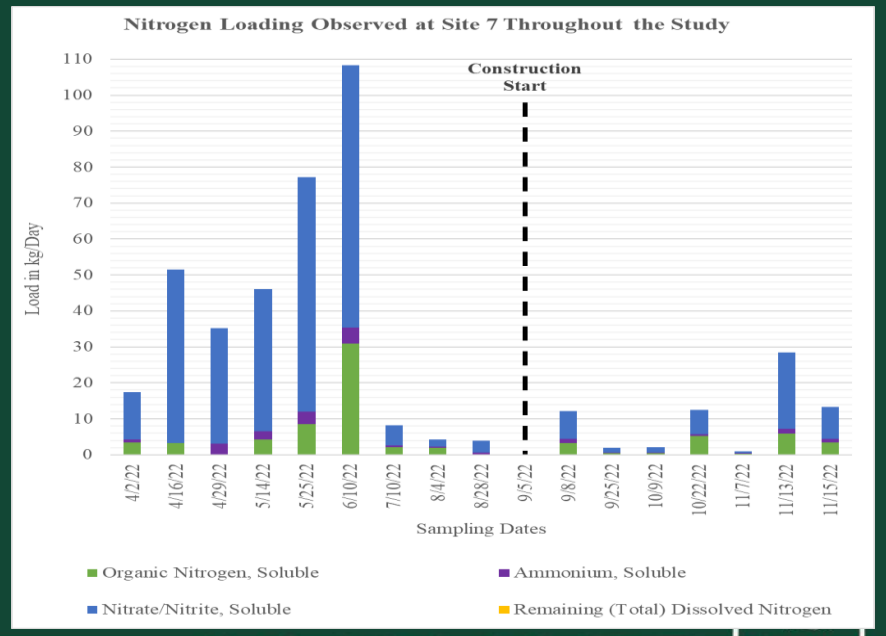


Credit @ Zachary Rundell (MSES '23)









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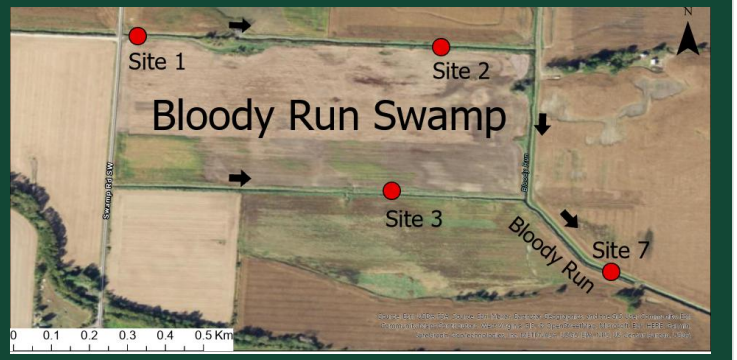
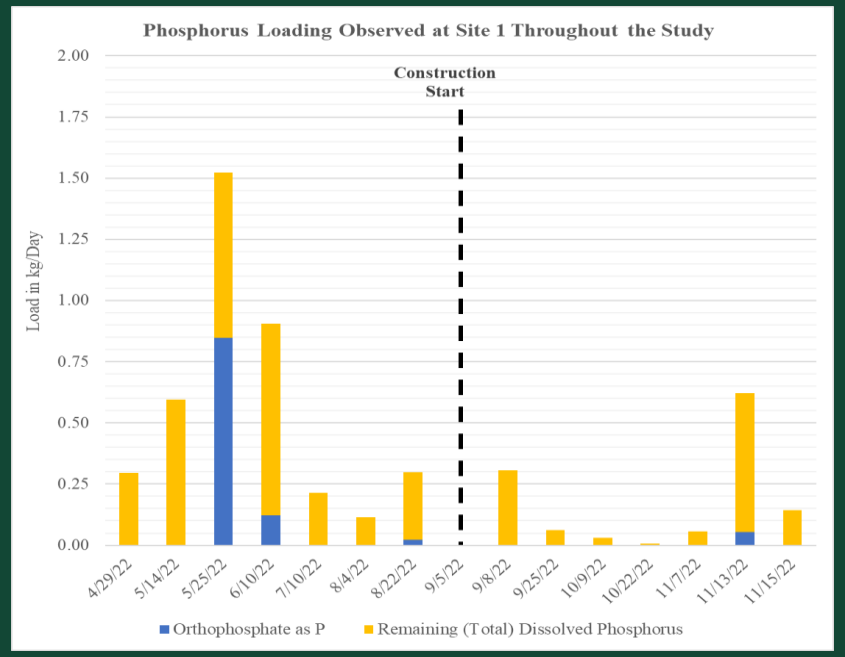
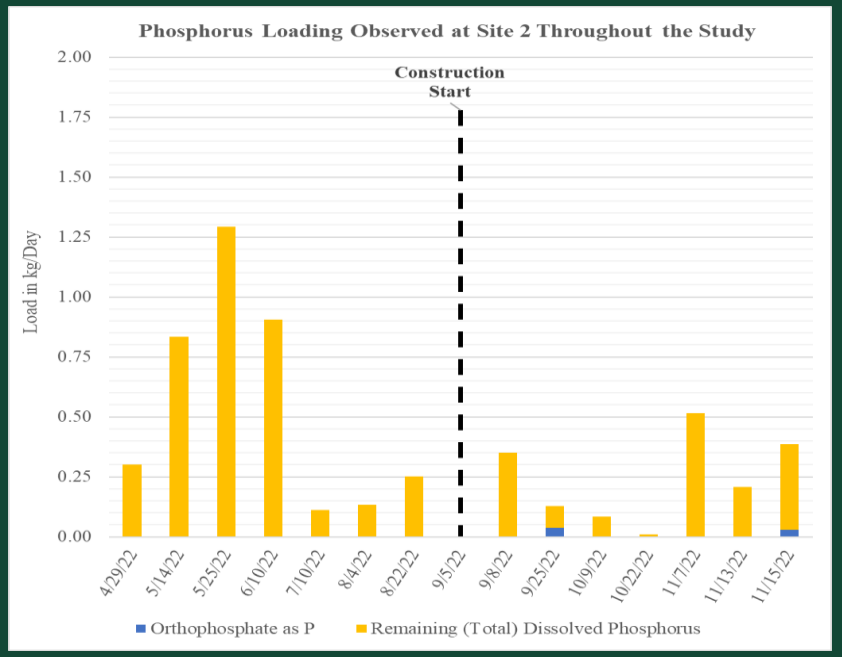
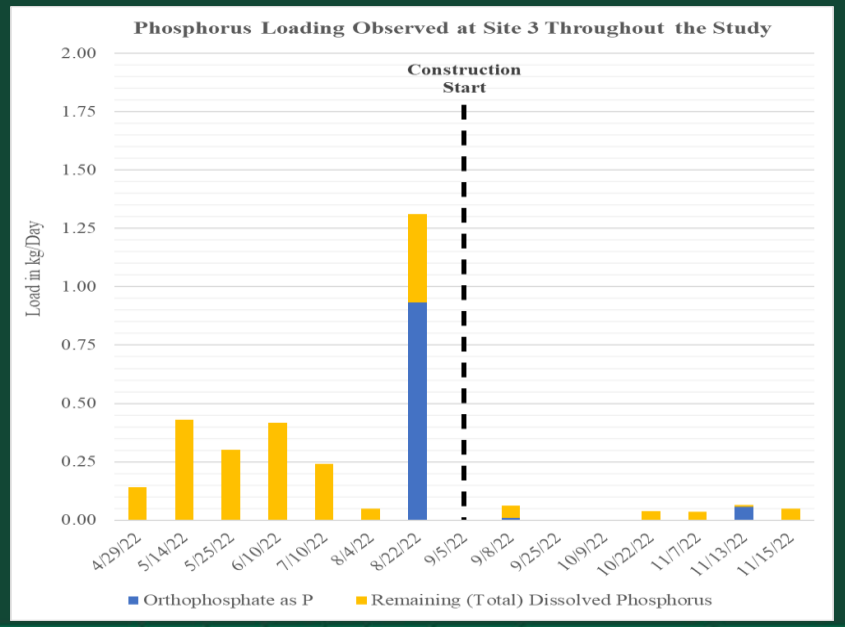
Pre-Restoration Phosphorus Loads

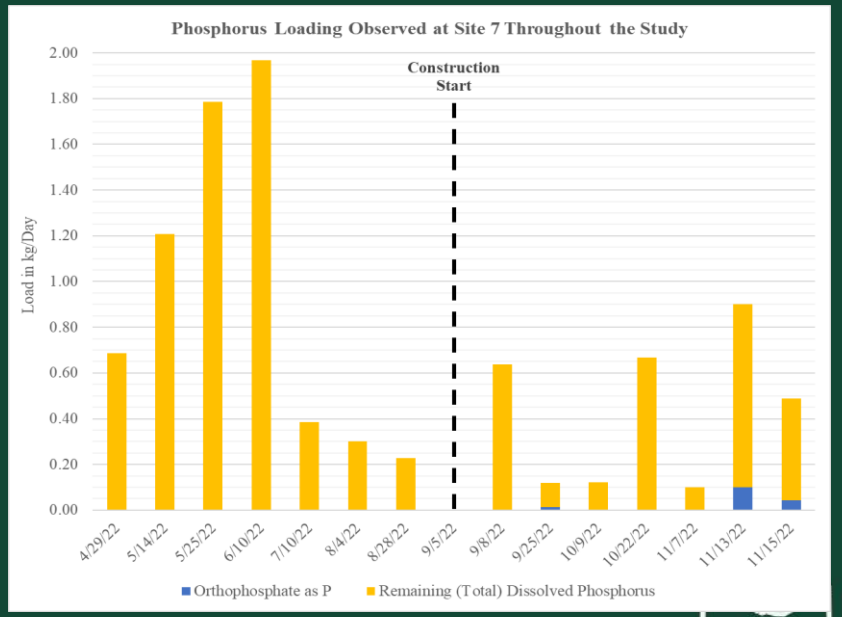


Credit @ Zachary Rundell (MSES '23)









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Post-Construction Results

Ellen Pokuah MSES ‘ 24

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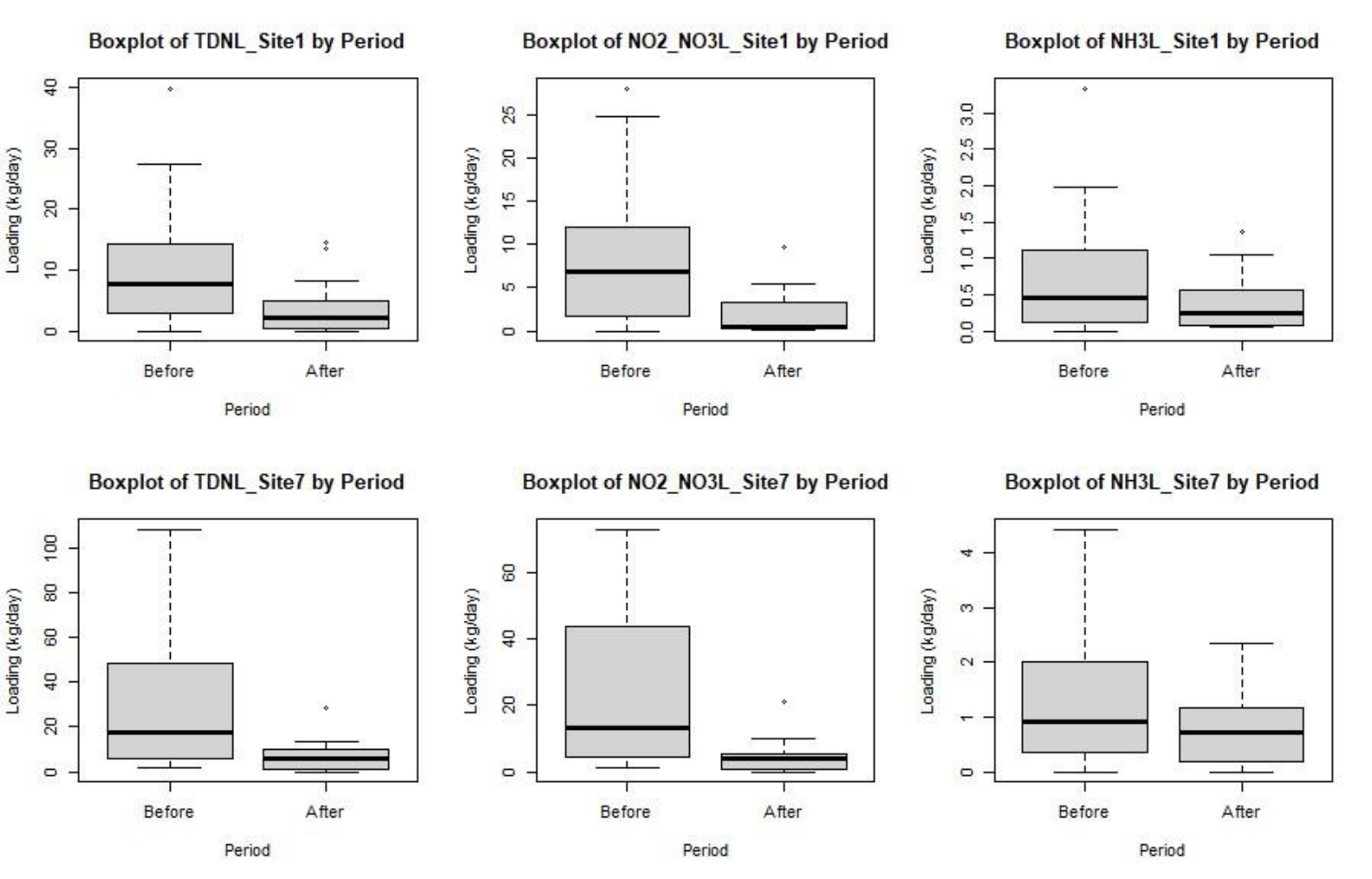
Nitrogen Species Loading- Relationship Between Pre and Post Construction Periods (Upstream and Downstream)



Credit @ Ellen Pokuah (MSES '24)

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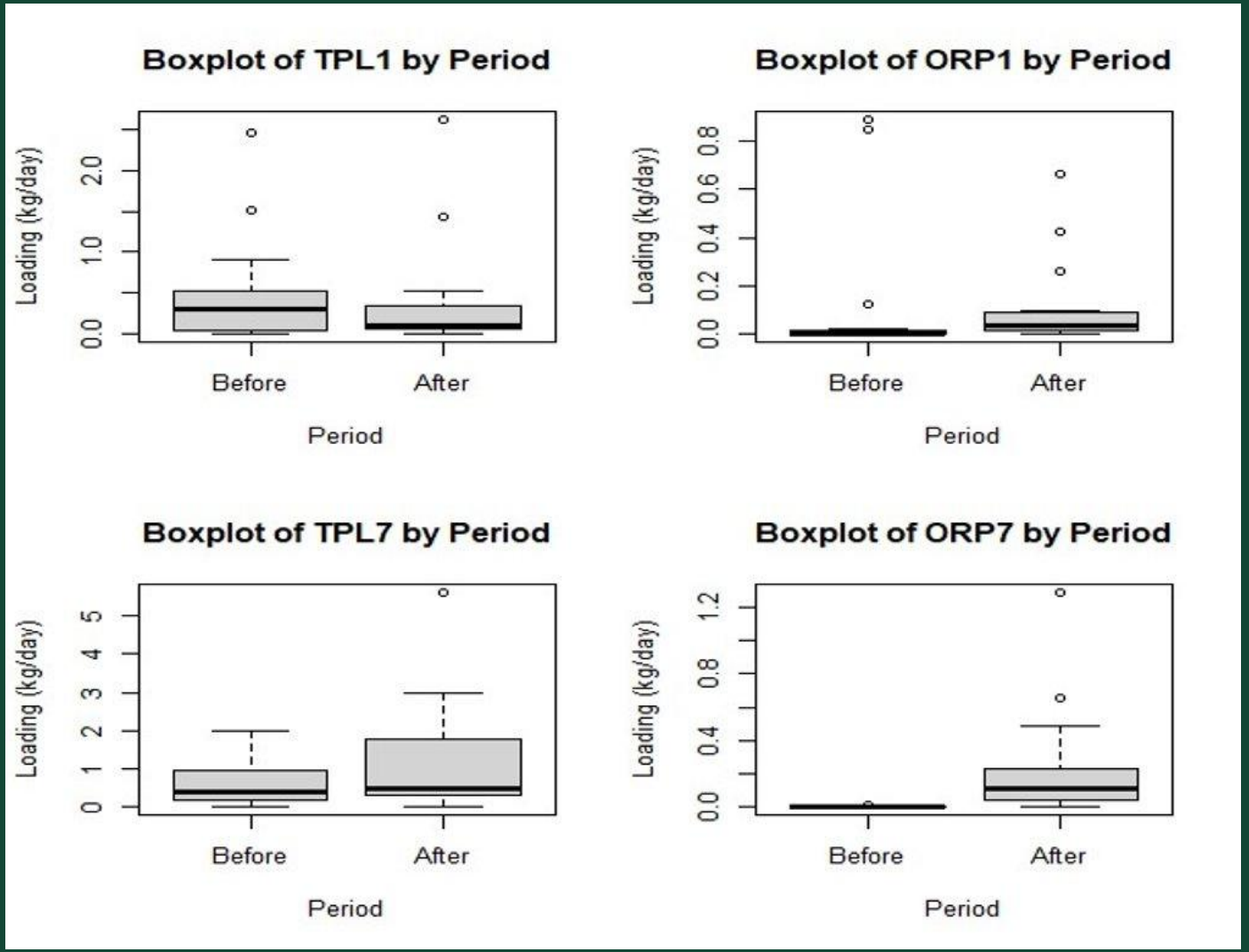
Phosphorus Loading- Relationship Between Pre and Post Construction Periods (Upstream and Downstream)



Credit @ Ellen Pokuah (MSES '24)

6-Month Post-Restoration Conclusions

Significant reductions in all nitrogen forms after construction. The highest reduction was achieved for NO_3/NO_2–N with lower reduction for NH_3-N.

Significant increases in all phosphorus forms after construction.

Overall, the wetland provided water quality benefits for nitrogen but contributed significant amount of phosphorus downstream.

Hydrology had a significant influence on nutrient loading and the nutrient retention ability of the site.

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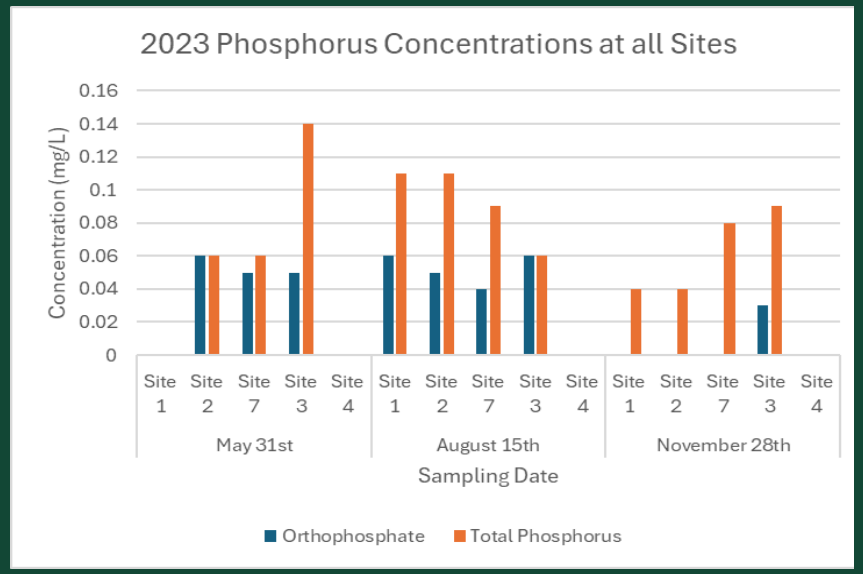
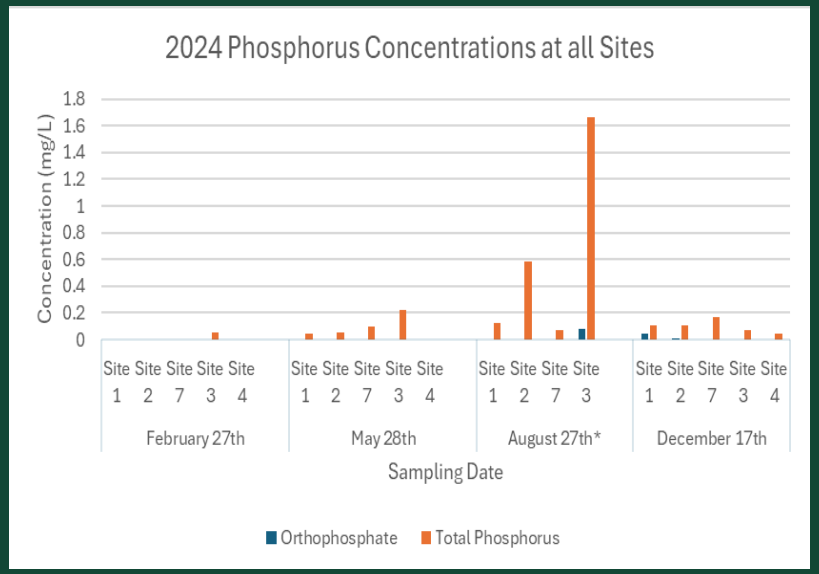
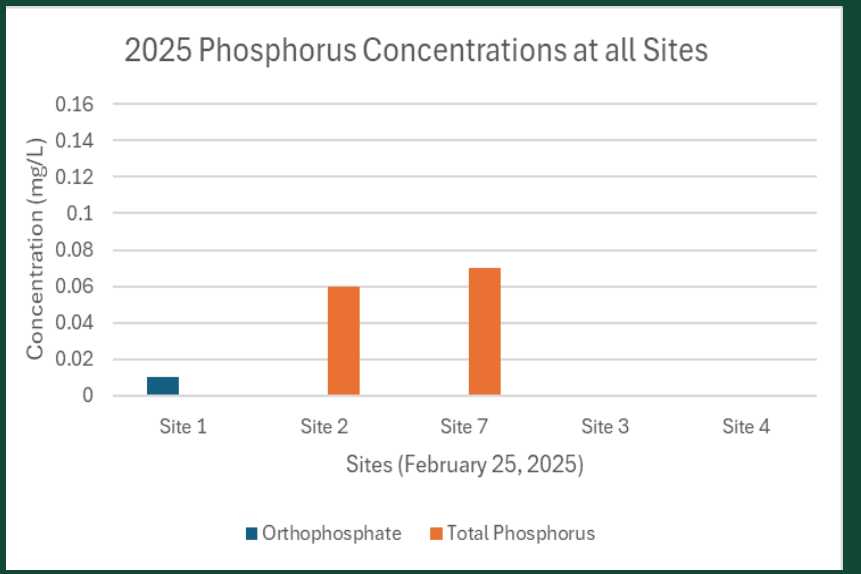
Post-Restoration Phosphorus Concentrations







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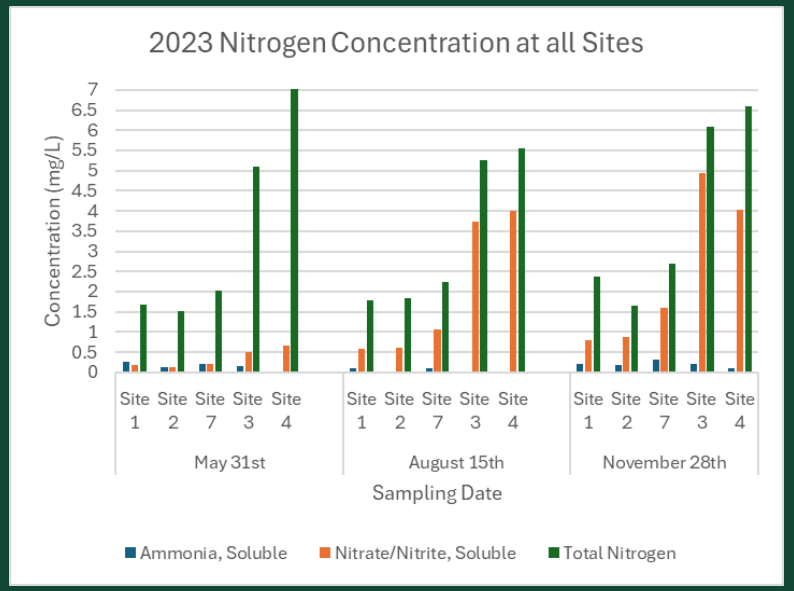
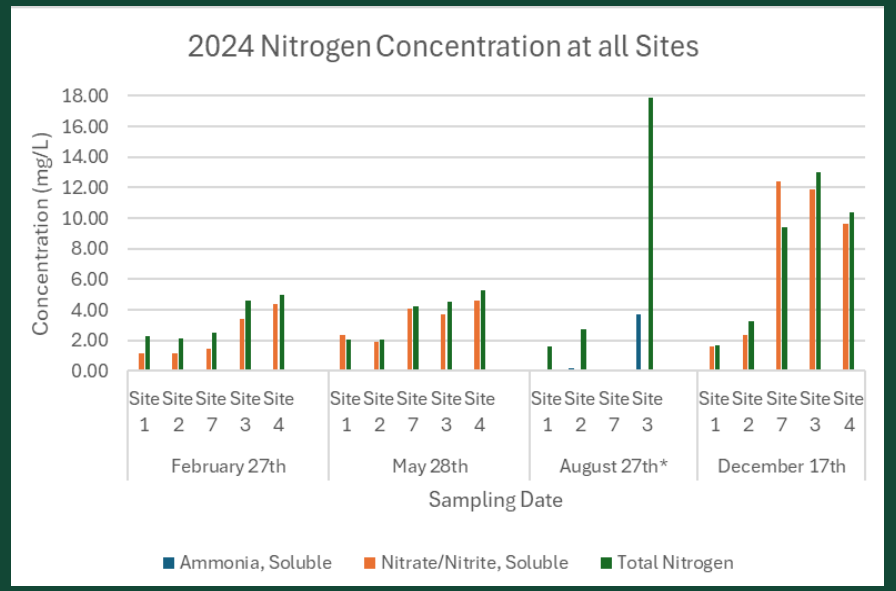
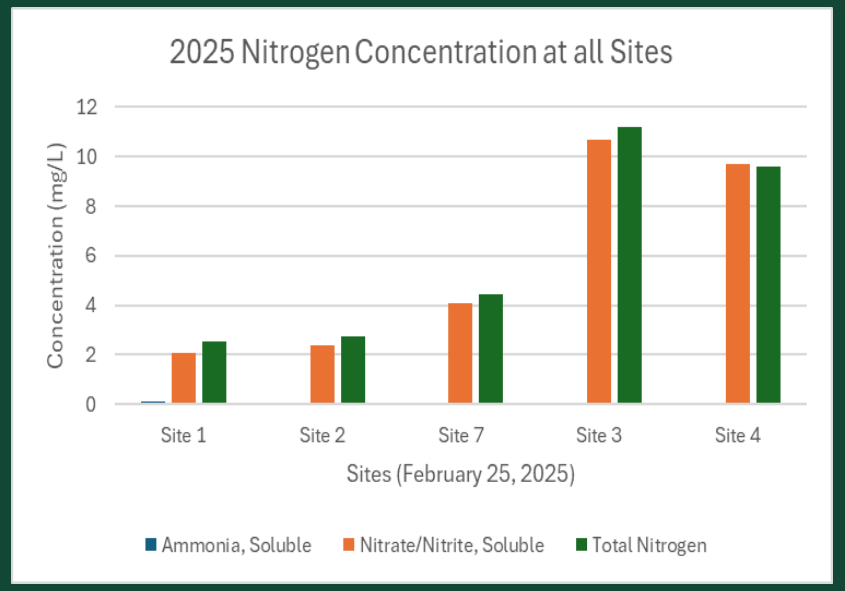
Post-Restoration Nitrogen Concentrations







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WHAT NEXT???

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Comparative Assessment of Ecosystem Service Components (SOM/SOC) Along Wet-to-Dry Transects in Preserved vs. Restored Wetlands in Ohio.

How does SOM/SOC content vary along a wet-to-dry transect between preserved and restored wetlands?

What is the relationship between soil moisture content and SOC storage in these wetlands?

Do restored wetlands achieve comparable SOC content as preserved wetlands?

Credit: Emily Fox

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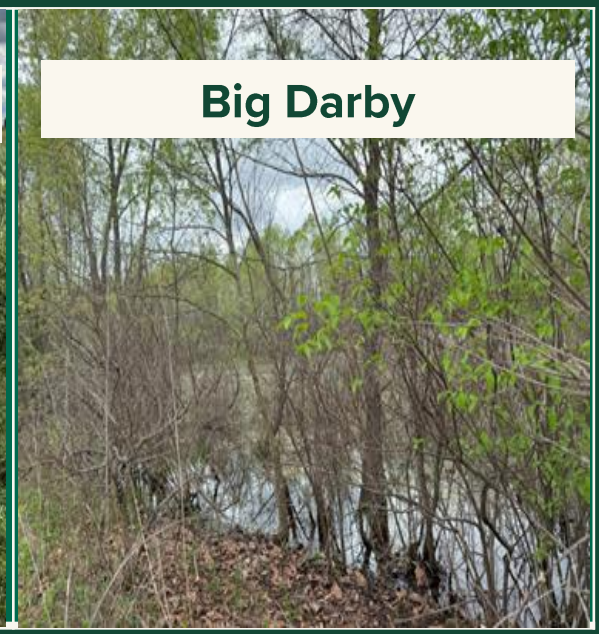
Preserved Vs. Restored Wetlands

Wetland	System Classification	Water Regime
Devil's Kettle	Palustrine Forested	Intermittently Flooded
Little Fish	Palustrine Emergent	Intermittently Flooded
Bloody Run	Palustrine Emergent	Intermittently Flooded
Big Darby	Palustrine Scrub-Shrub	Intermittently Flooded



Soil Sampling Methods/Analysis

Soil Corer
Soil Sampling

Oven
Soil Moisture Analysis

Muffle Furnace
SOM Analysis

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Restored and Preserved Wetlands as Habitat for Pollinating Insects Across Land Use Gradients in Central Ohio

(Emily Fox MSES '26)

Research Goals:

- Evaluate the ecological contributions of restored and preserved wetlands as pollinator habitats
- Quantify their role in supporting pollinating insect communities across adjacent land uses

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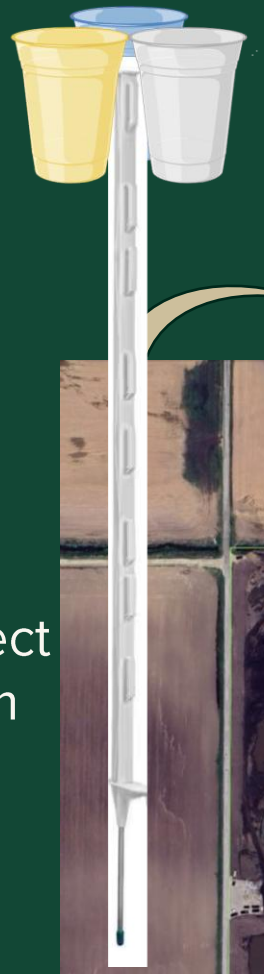
Field Sampling Methods and Analysis



6 Wetland plots
- 2 preserved sites
- 2 surrounding agricultural land use
- 2 mixed surrounding land use

Pan traps
- Set 150' transects with 5 traps/transect
- Sampling 1x/month, 24-48 hours from June - September

Sampling for:
- **Hymenoptera** (bees/wasps/ants)
- **Lepidoptera** (butterflies/moths)
- **Coleoptera** (beetles)

n = 15

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Restored and Preserved Wetlands as Habitat for Pollinating Insects Across Land Use Gradients in Central Ohio (Continued)

Goals and Objectives:

- Quantify the species richness and abundance of pollinating insects.
- Compare pollinator diversity and abundance across three categories of surrounding land use.
- Assess the spatial distribution of pollinators from wetlands to adjacent land plots to evaluate whether wetlands act as pollinator sources for surrounding landscapes.
- Examine the influence of site characteristics on pollinator presence and activity.
- Establish baseline data that may inform wetland restoration and land management practices aimed at enhancing pollinator habitat and ecosystem services.

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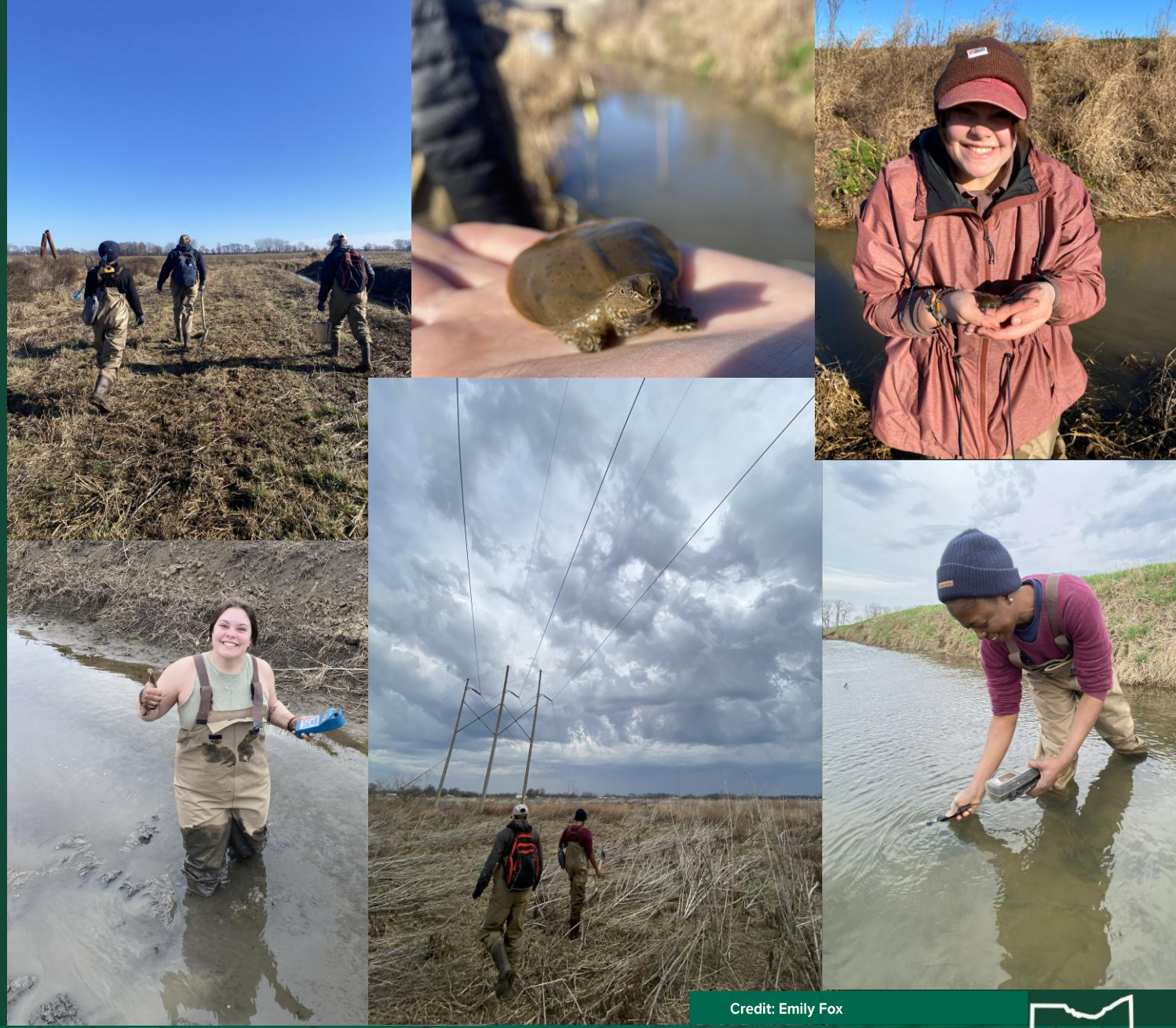
Acknowledgments:

The Stream + Wetlands Foundation
Dr. Natalie Kruse Daniels
Sebastian Teas
Jen Bowman
Kehinde M. Ositimehin, MSES ‘23
Zachary Rundell, MSES ‘23
Ellen Pokuah, MSES ‘24
The Faculty and Staff at the Voinovich School of Leadership & Public Service



Credit: Emily Fox

Thank you!

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Water Depth

- Changing the hydrology of the site affects water level in the ditches
- Water level was measured using Onset's HOBO Water Level loggers
- Pressure data was collected every ten minutes
- Data downloaded monthly and calibrated using barometric pressure

Photo courtesy of Onset

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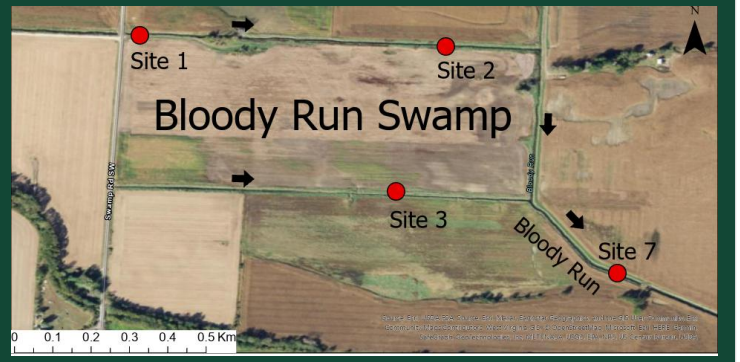
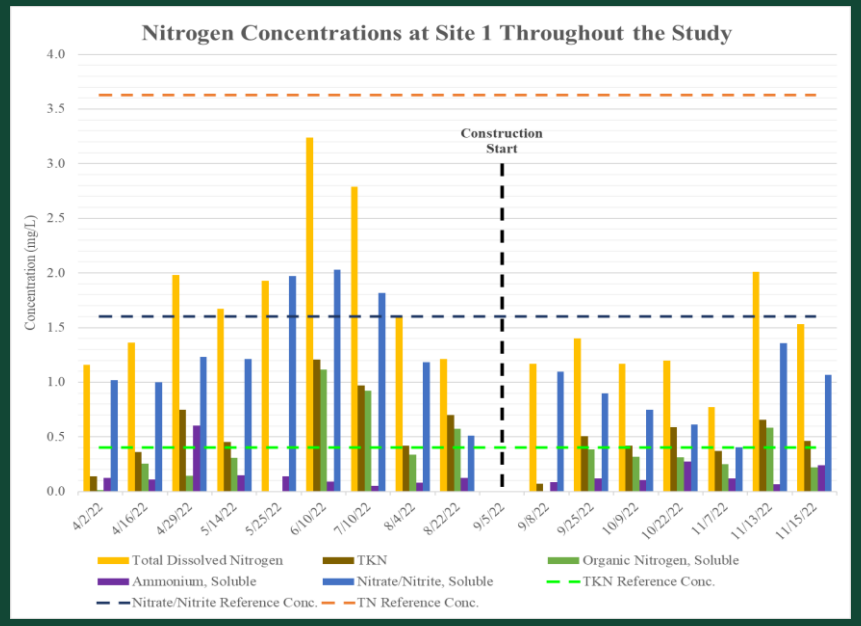
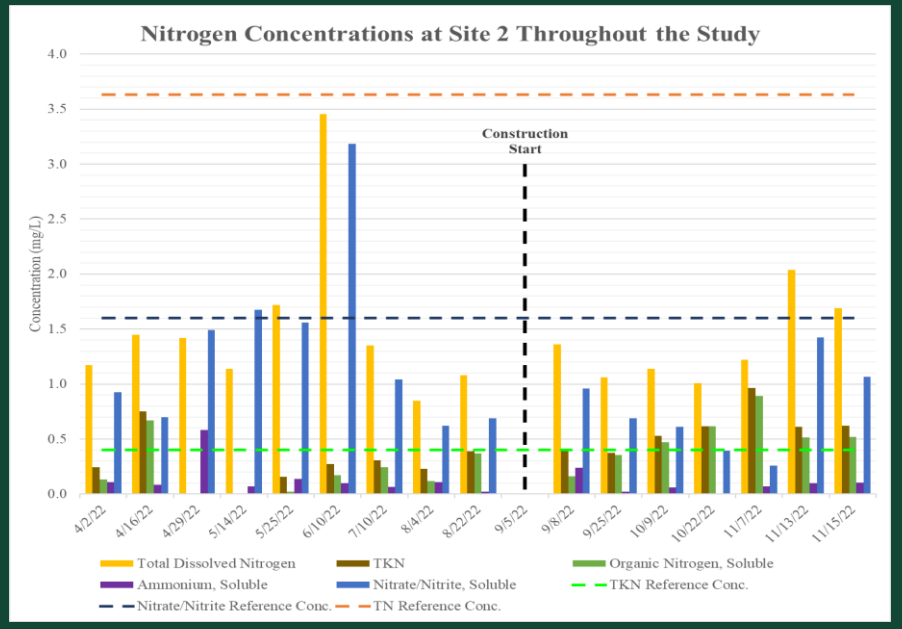
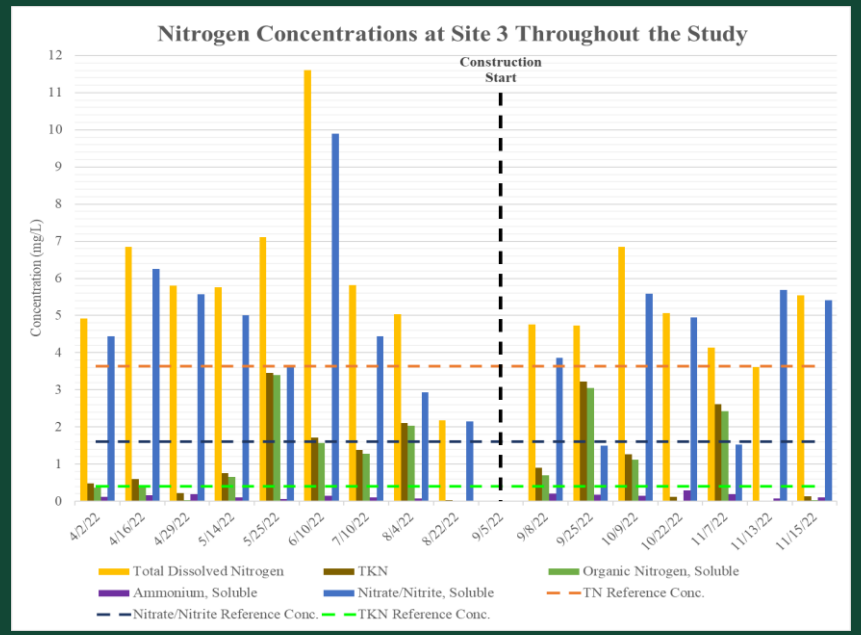
Pre-Restoration Nitrogen Concentrations

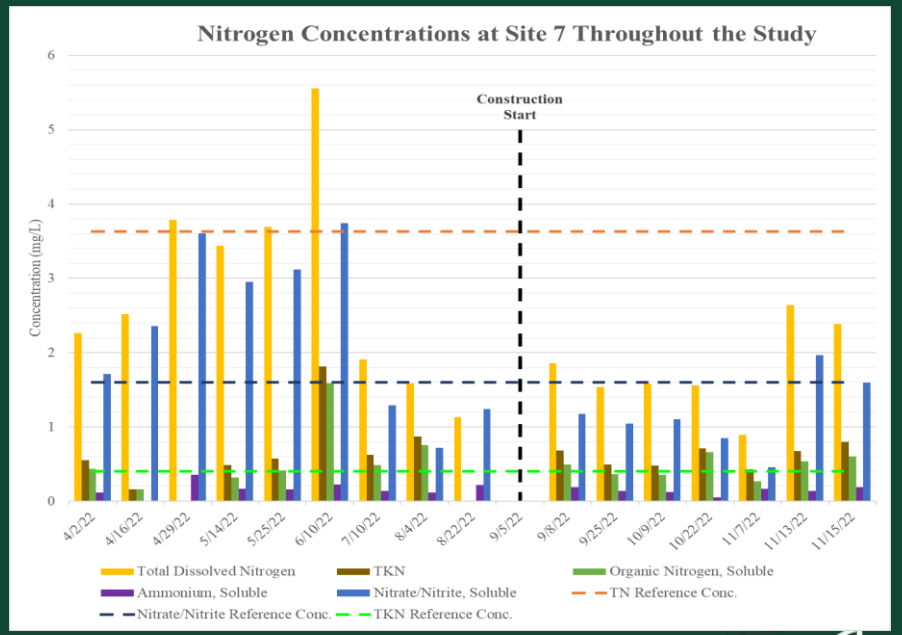


Credit @ Zachary Rundell (MSES '23)









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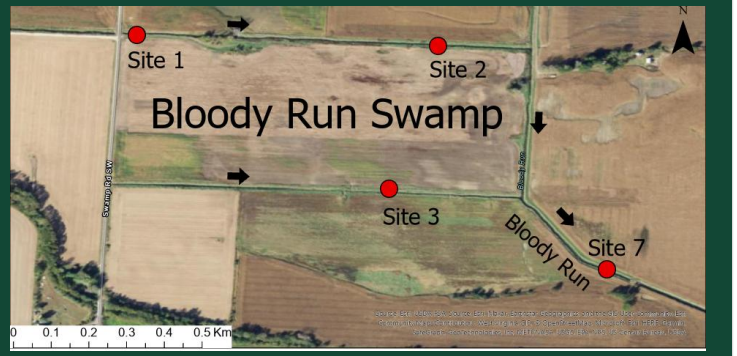
Pre-Restoration Phosphorus Concentrations



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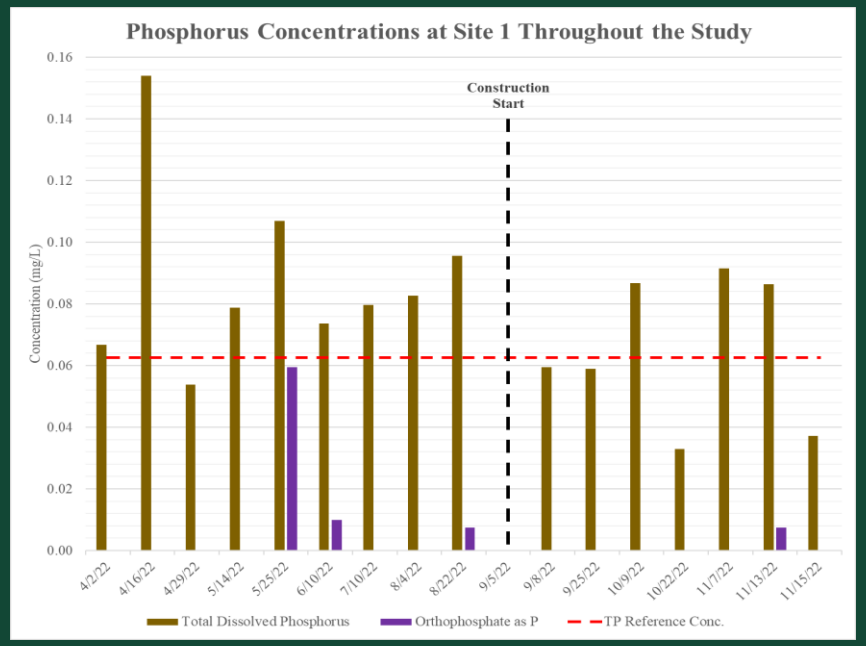

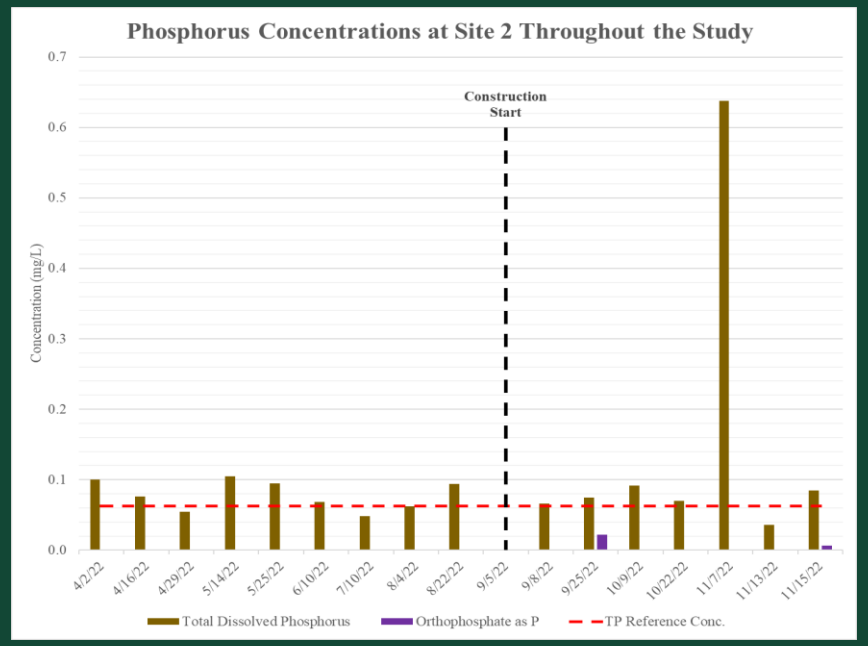

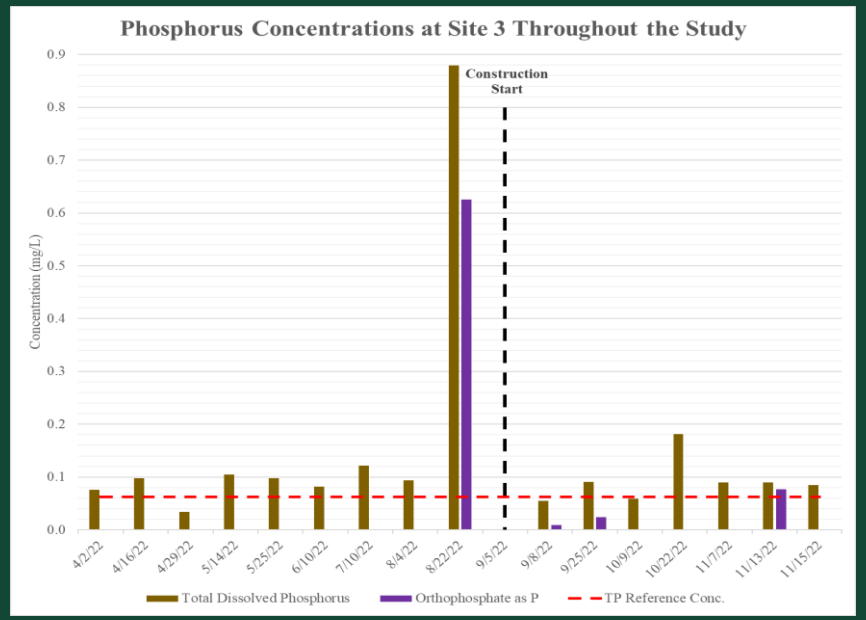

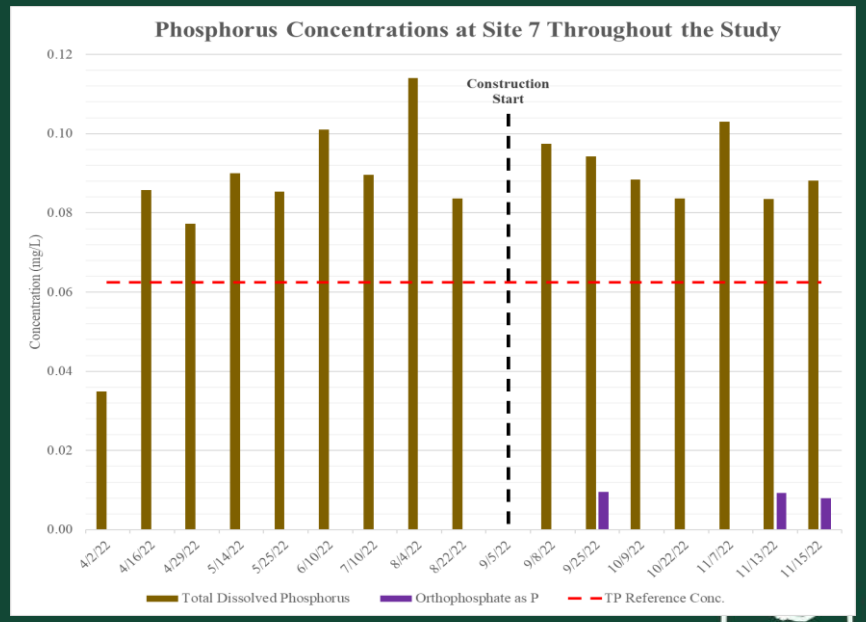

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