19th Annual Regional Stormwater Conference

October 2024

Chattanooga, TN

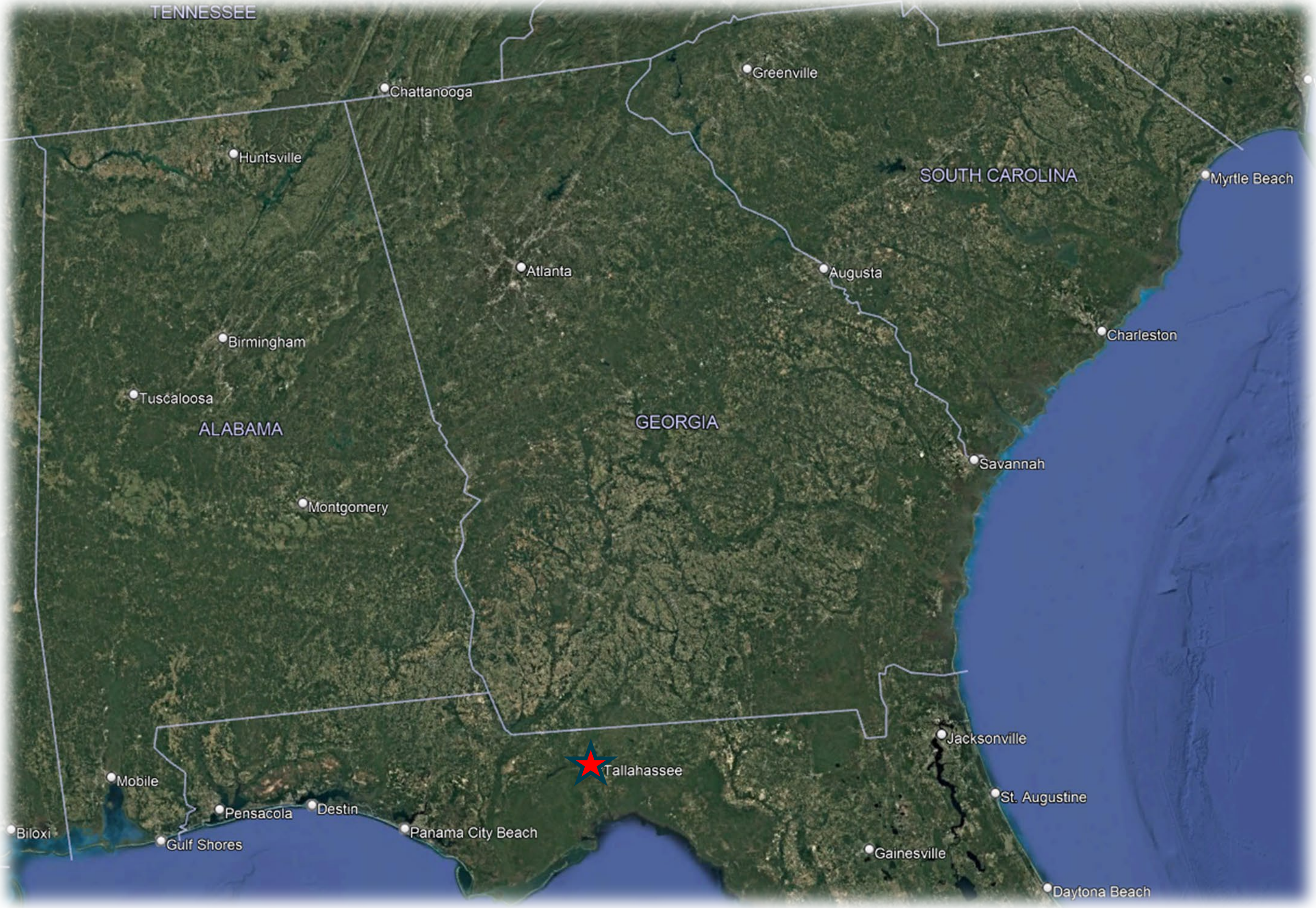
"Shakey"-ing Things Up in Tallahassee: A Study in Water Quality Restoration

Nico Pisarello, GISP
Water Resources Scientist
Geosyntec Consultants

Mark Heidecker, CPM
Program Manager
City of Tallahassee

Background

- Tallahassee, FL
- Population 200,000
- 8^{th} most populous FL city
- Home to several large colleges & universities
  - Florida State
  - Florida A&M
  - Tallahassee State College
- Subtropical climate – hot/humid summers with average annual rainfall near 60”



Background

- Shallow 14-acre pond
- Surrounded by single family homes and a public park
- Originally a marsh-stream which was altered in the early 1990s to provide lake frontage and flood control
- Poor water quality
  - Impaired for TP and Chl-a
- Private control structure failure 2018
  - Current water level approximately 5-feet below the normal water level

Background

Background

Gardenview Way
Giverny Cir
Hyde Park
Colonnade Dr
Shakey Pond
A J Henry Park Dr
Charleston Rd
2012
Stowe Trce
Leighton
Whitney Dr E
2024

Background

Background

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Objective

Identify management strategies to

- Improve overall water quality
- Address TP and chl-a impairments

Project Components

- Hydrologic Budget
- Water Quality Assessment
- Sediment Assessment
- Nutrient Budget

Hydrologic Budget

Data Compilation

- Drainage Infrastructure
- Topography
- Soils
- Land Cover / Land Use

Needed to support the development of a hydrologic and hydraulic (H&H) model

Hydrologic Budget

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Field Reconnaissance

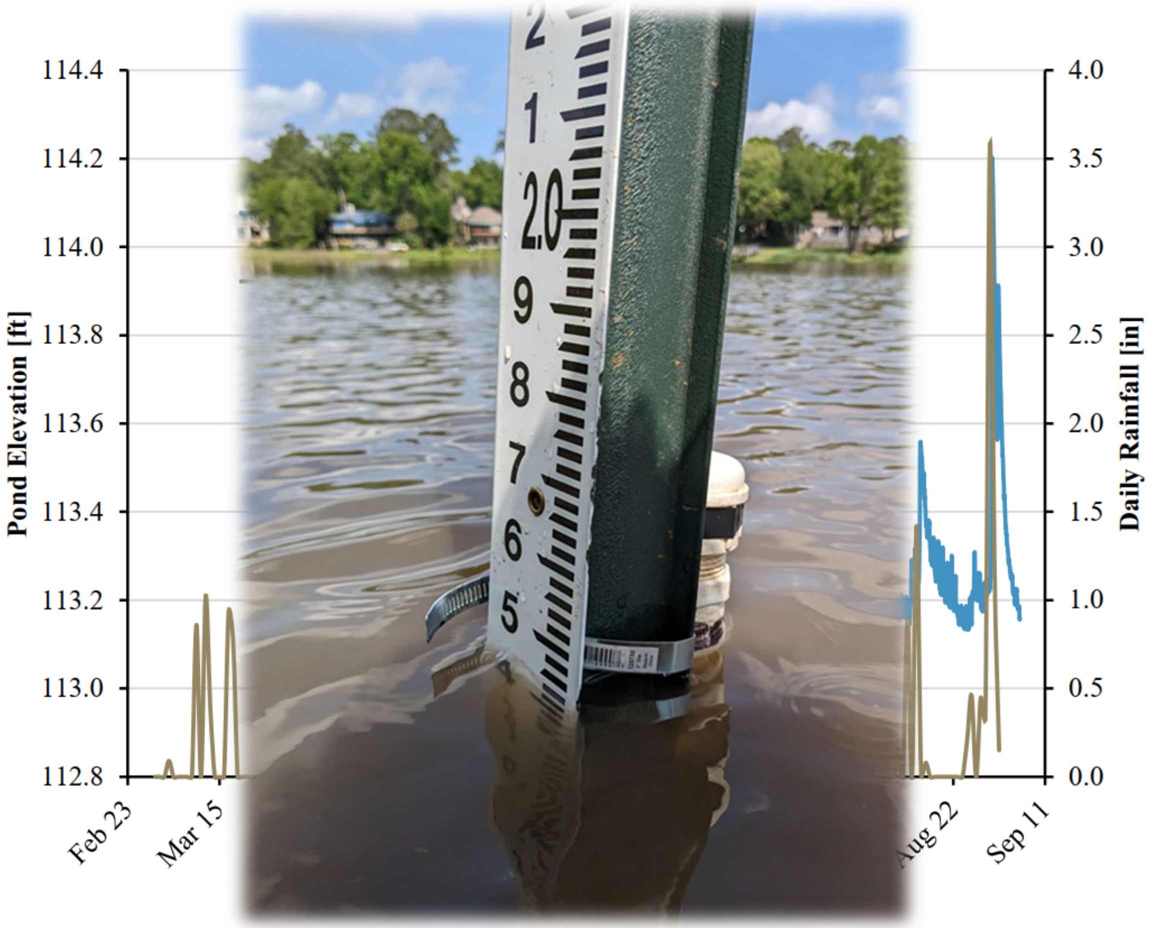
- Watershed boundaries
- Drainage infrastructure
- Pipe invert elevations

- Meet the neighbors!

Hydrologic Budget

Rainfall and Pond Level Monitoring

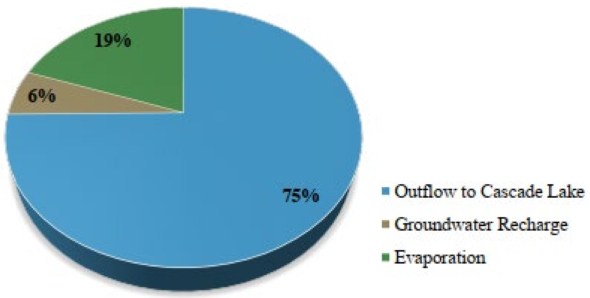
- Install Field Equipment
  - Water Level
  - Rain Gauge
  - Barometric Pressure
- Pond Stage Survey
- Monitoring
  - 4 months

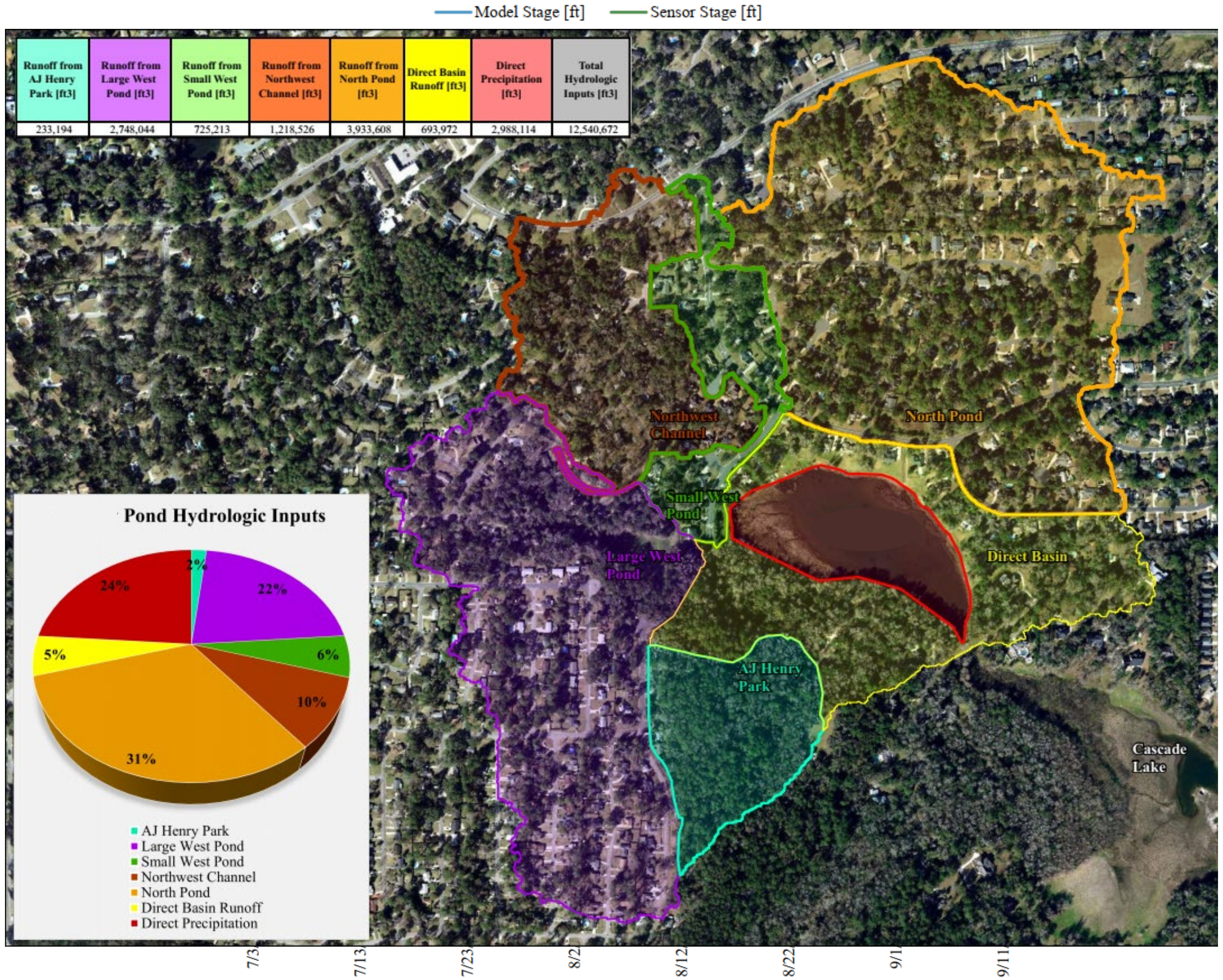


Hydrologic Budget

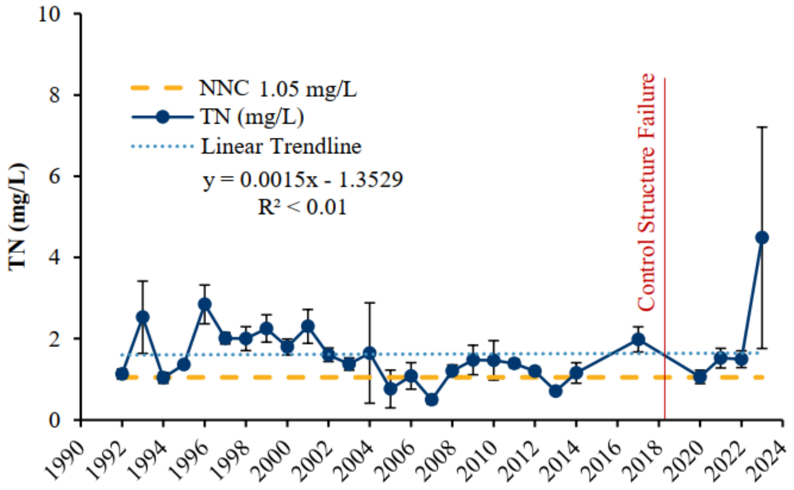
Hydrologic and Hydraulic Model

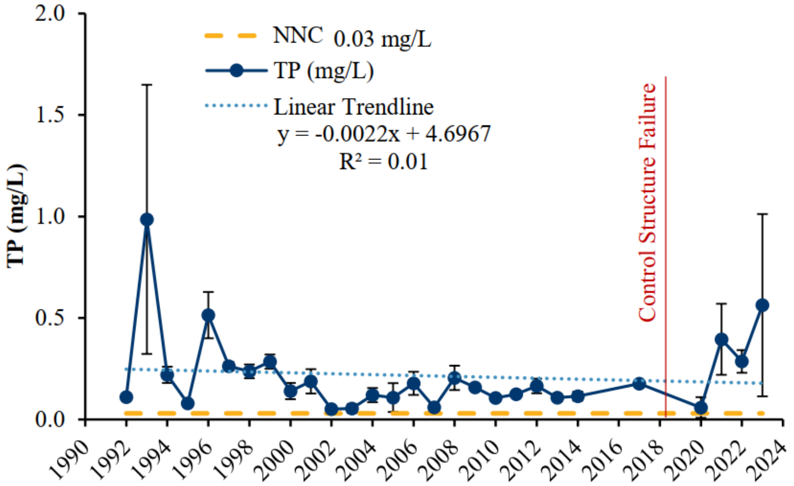
- Model Development
- Model Validation
- 10-year simulation





Water Quality Assessment





- Alkalinity
- Color
- Chlorophyll-a
- Nitrogen
- Phosphorus
- Dissolved Oxygen
- pH

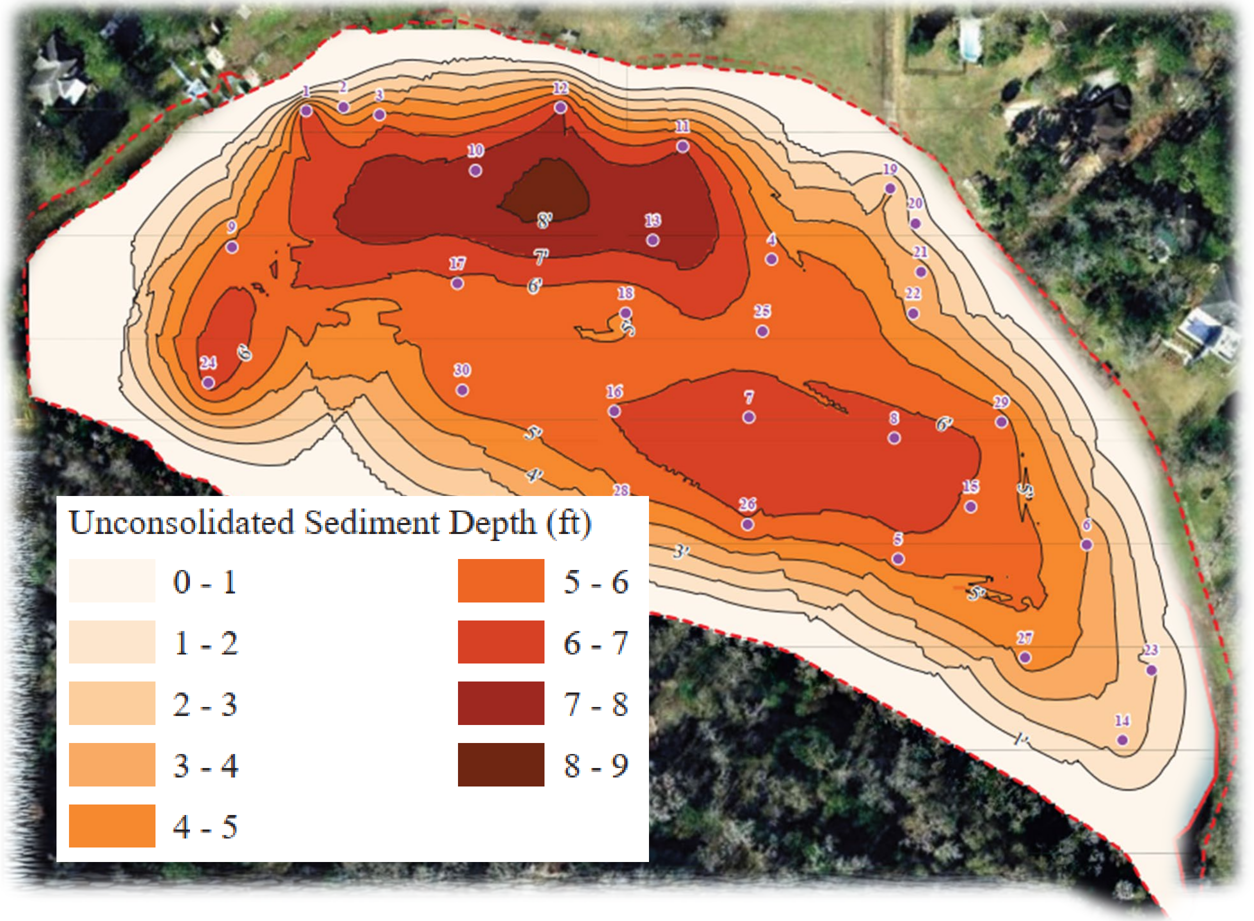
After Control Structure Failure

- *Higher Ammonium*
- *Higher Nitrate*
- *Lower pH*

Sediment Assessment

Bathymetric Evaluation

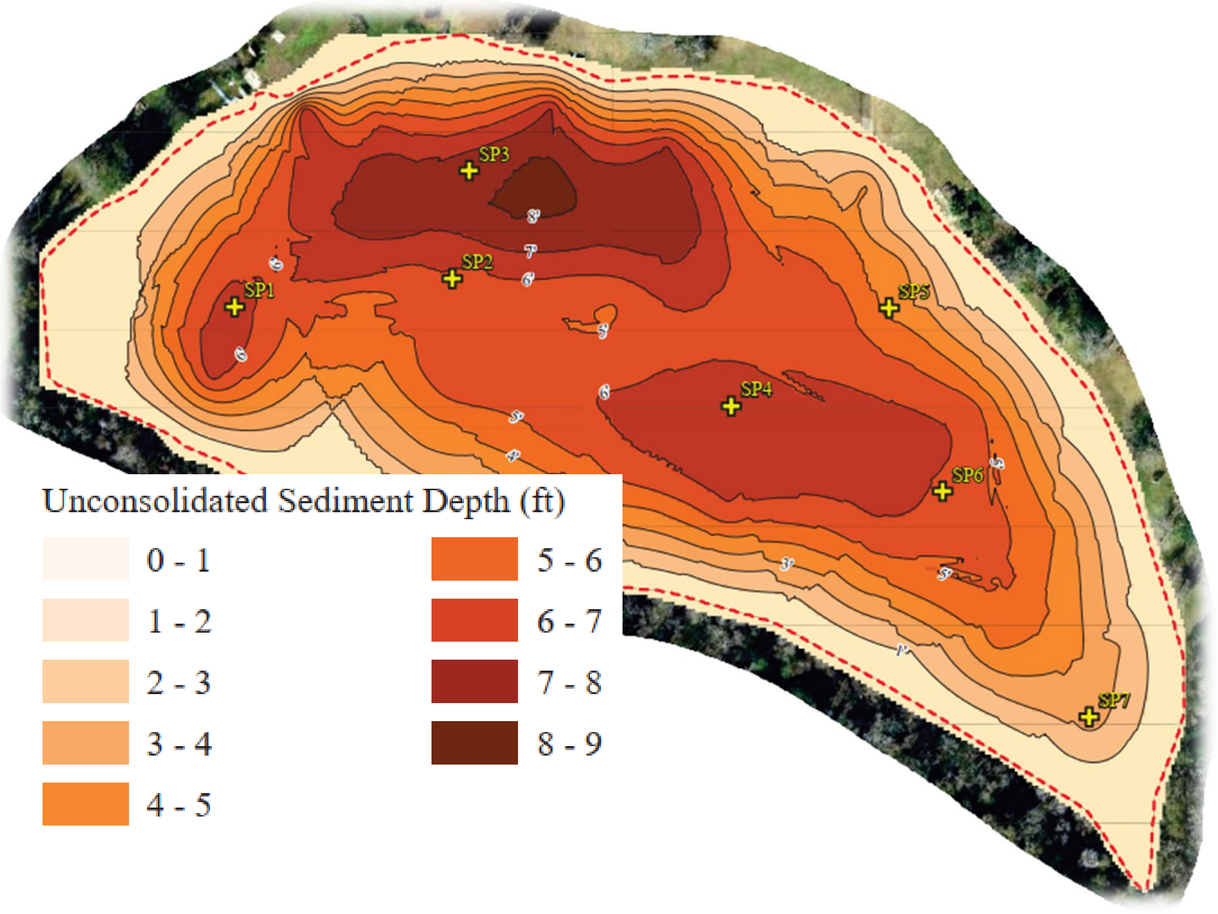
- Water Depth
- Muck Thickness



Sediment Assessment

Sample Collection

- Sediment Cores
  - Lithology
  - Organic Muck
  - Parent Soil
- Porewater
  - Collected from within the muck layer (mid-depth)



Sediment Assessment

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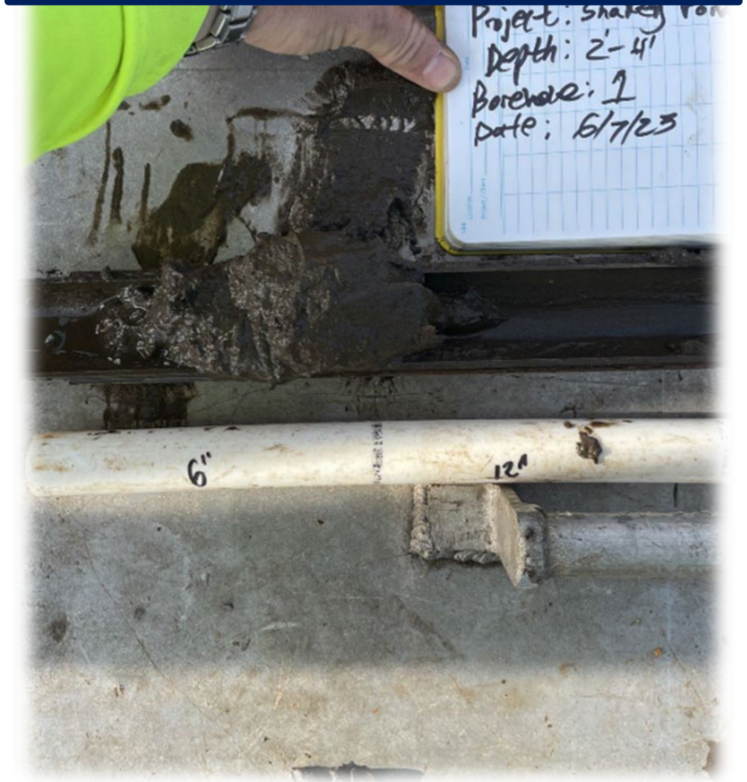
Organic Muck

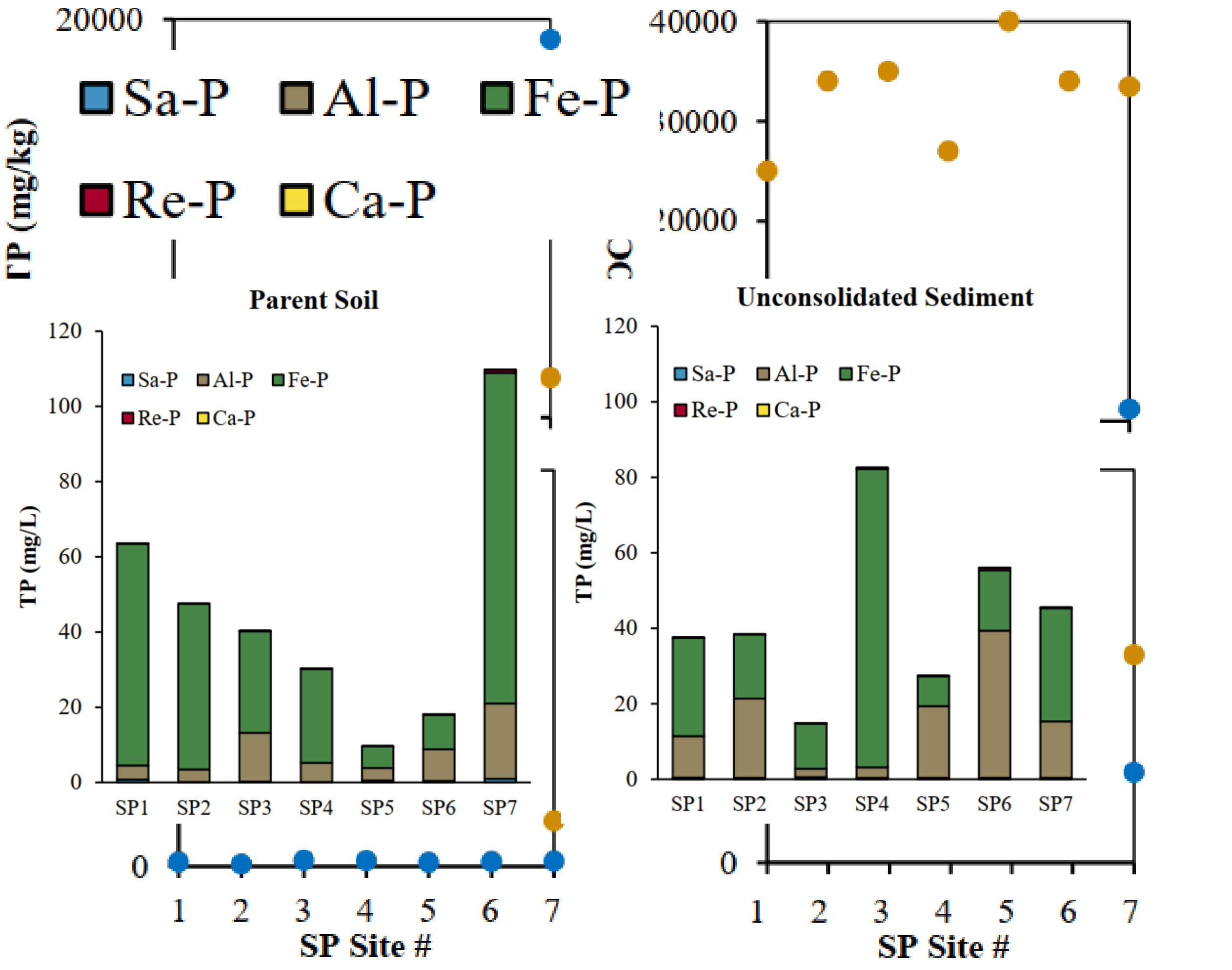


Parent Soil

Sediment Assessment

Sediment Core Sample Results

- ***Muck*** had high organic carbon, nitrogen, and moisture content
- Both ***muck*** and ***parent soils*** had similar phosphorus content
- Iron-bound P was abundant



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Porewater Sample Results

Site	Sample ID	Depth[a] (ft)	Alkalinity (mg/L)	NH_4^+ (mg/L)	NO_x (mg/L)	OP (mg/L)	TKN (mg/L)	TN (mg/L)	TP (mg/L)
SP1	SPPW1	4.83	23	0.2	0.26	0.47	0.13[b]	0.3	0.47[c]
SP2	SPPW2	4.50	26	2.2	0.085	0.70	2.4	2.5	0.70
SP3	SPPW3	3.50	32	8.6	0.079	0.86	10.0	10.0	0.97
SP4	SPPW4	3.83	180	44.0	0.038	0.09	38.0	38.0	3.50
SP5	SPPW5	1.83	84	15.0	0.027	0.62	20.0	20.0	1.10
SP6	SPPW6	3.00	100	13.0	0.009[b]	1.87	15.0	15.0	1.87[c]
SSP7	SPPW7	1.00	150	15.0	0.036	0.25	17.0	17.0	2.80

Plants

Nutrient Budget

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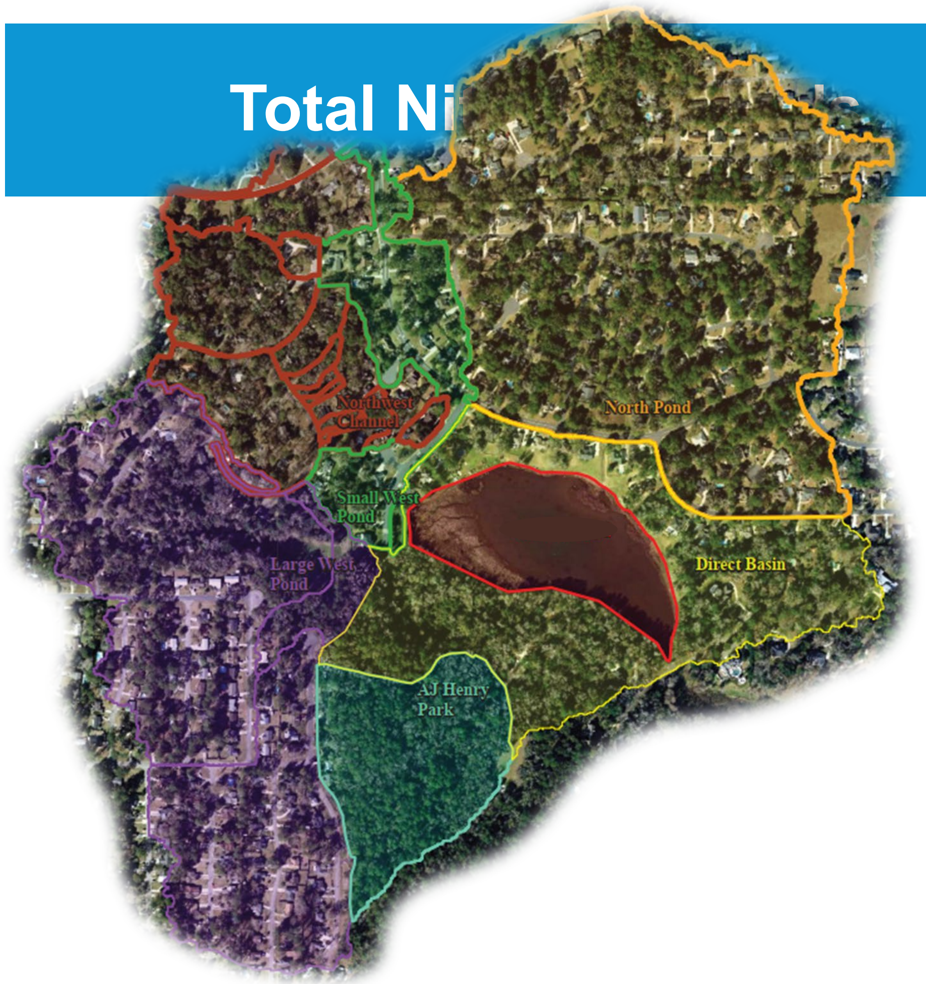
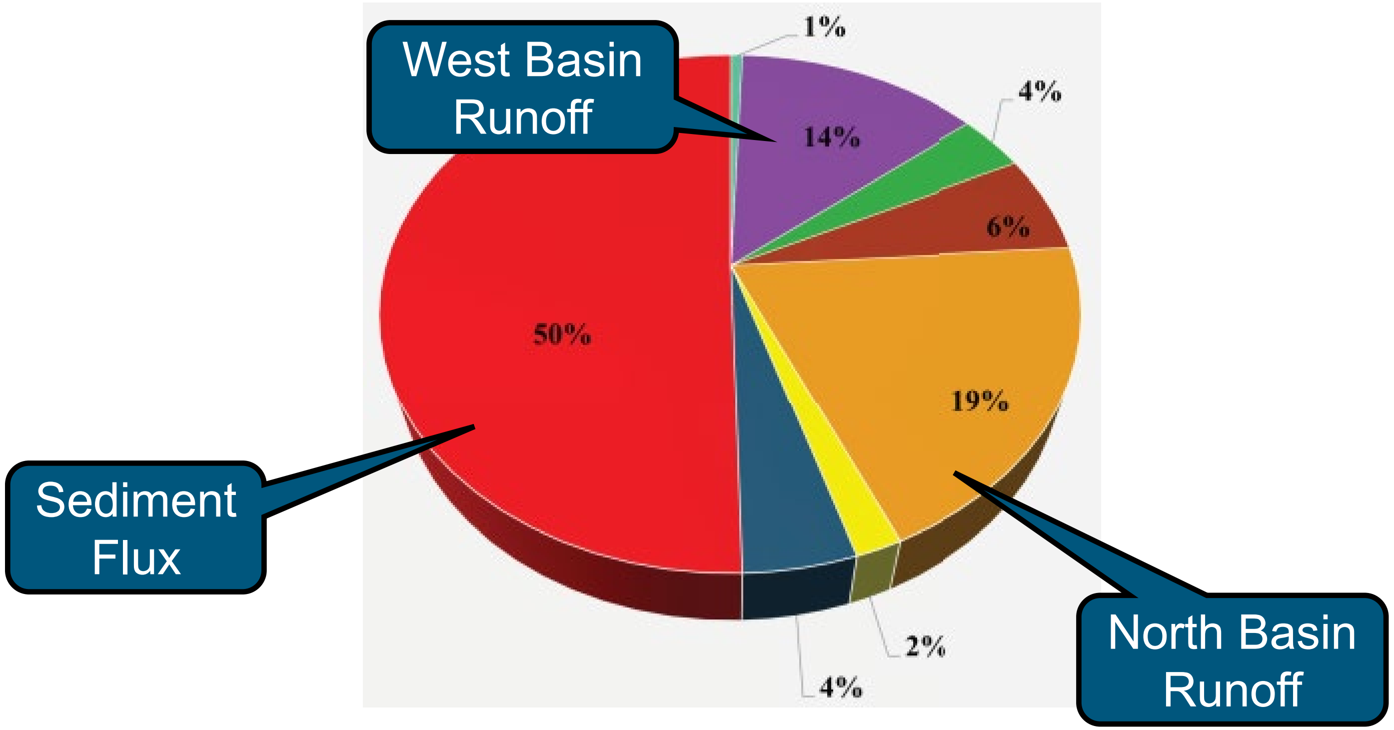
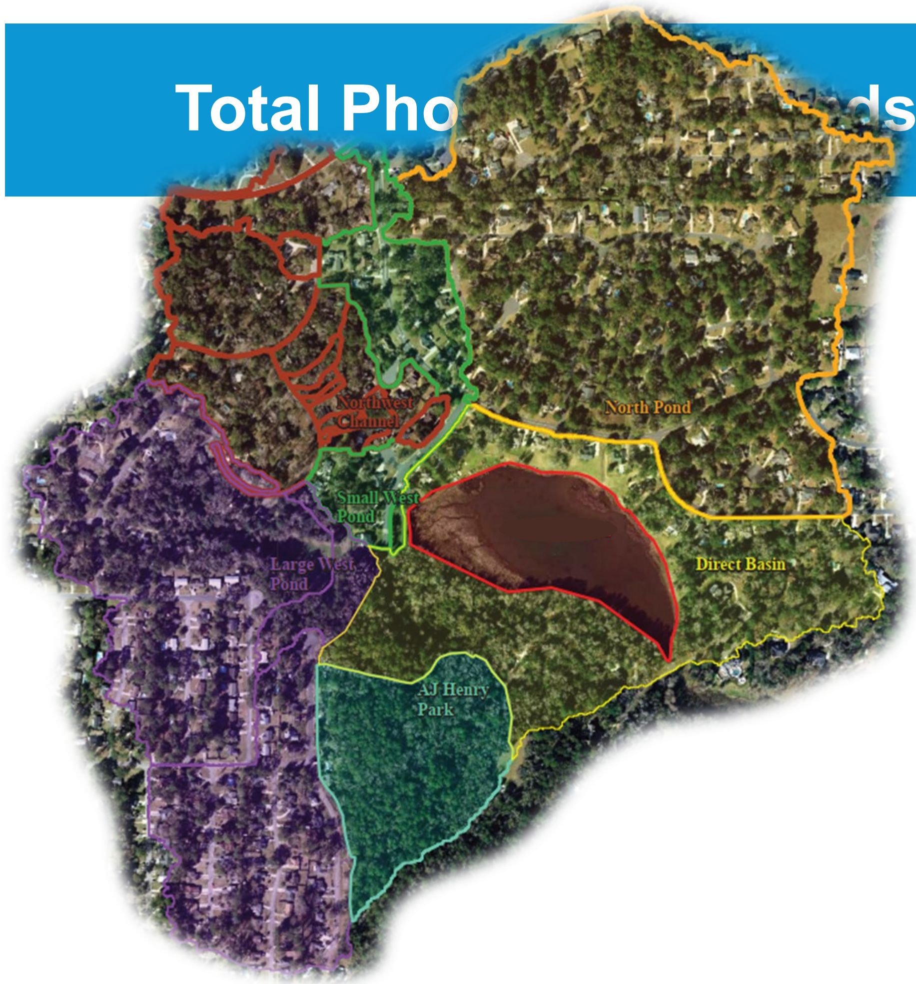
Total Ni

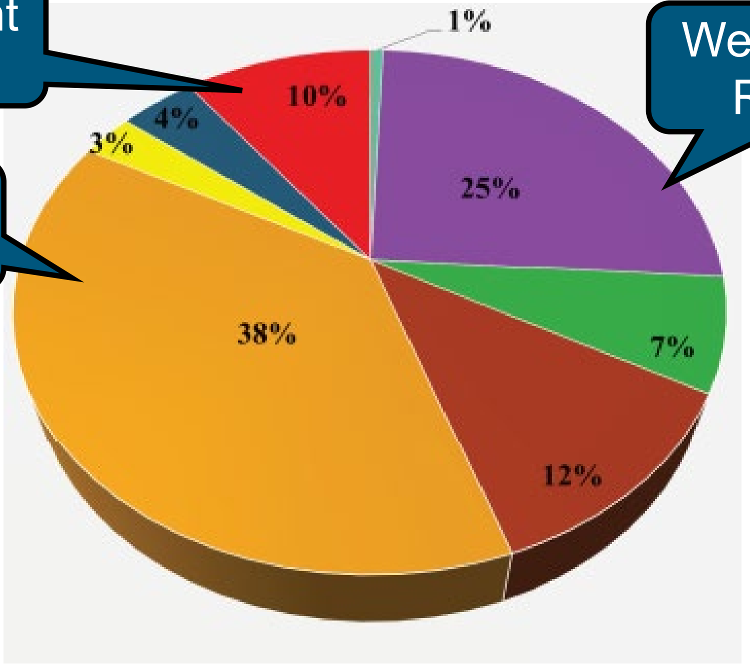




Nutrient Budget

Total Pho … ds





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Water Quality Improvement Strategies

- Chemical Treatment
- Sediment Dredging
- Wetland Reversion

Water Quality Improvement Strategies

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Chemical Treatment

- Aluminum Sulfate
- Lanthanum Modified Bentonite
- Removes P in the water column through adsorption and settling
- Reduces P diffusive flux from the sediments
  - Only 10% of P loads are from sediment
- No direct removal or reduction of N flux
  - 50% of N loads are from sediment
- Consumes alkalinity, reducing pH
  - Alkalinity is already low
- Not suitable for shallow lakes
  - Water depth < 3 feet
- Not suitable for lakes with large external nutrient loads
  - 90% of P loads and 50% of N loads are external

Estimated Project Cost $410,000

- $920 per lb N removed
- $850 per lb P removed

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Sediment Dredging

- Mechanical removal of accumulated muck
  - Parent Soil N content is much lower
  - Parent Soil P content is similar
- Increases pond depth and storage capacity
  - Likely to result in anoxic conditions and release Iron-bound P
- Does not address external nutrient loads
  - 90% of P loads and 50% of N loads are external
- Expensive!

Estimated Project Cost $8.3 Million

- $484 per lb N removed
- $29,021 per lb P removed

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Wetland Reversion

- Plant native vegetation
- Requires a shallow lake
  - Water depth < 3 feet
- Treats internal nutrient loads
  - Oxygenates sediments to reduce Fe-P release and convert pollutants into less harmful forms (NH_4 to NO_3)
  - Nutrient uptake and assimilation by plants
- Treats external nutrient loads
  - Natural filter, slows stormwater flow, allows settling
  - Increased residence time
- Promotes biodiversity

Estimated Project Cost $460,000

- $20 per lb N removed
- $173 per lb P removed

Water Quality Improvement Strategies

Chemical Treatment

Project Cost $410,000

$920 per lb N removed

$850 per lb P removed

Sediment Dredging

Project Cost $8.3 Million

$480 per lb N removed

$29,000 per lb P removed

Wetland Reversion

Project Cost $460,000

$20 per lb N removed

$170 per lb P removed

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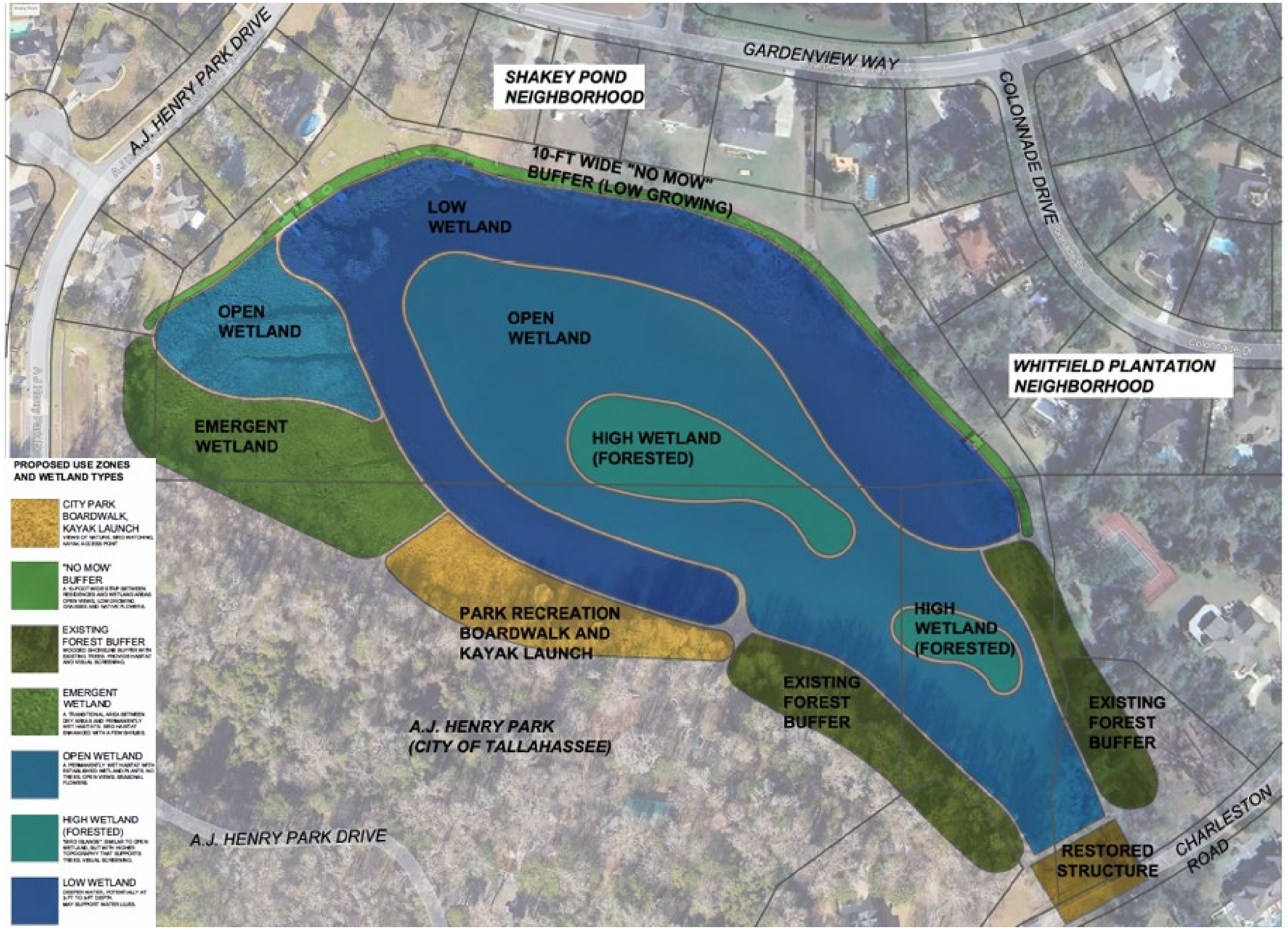
Next Steps

- Bathymetric Survey (Complete)
- Preliminary Engineering (Underway)
- Continued Neighborhood Dialogue
- Continued Dialogue w/ DEP
- Final Design & Permitting
- Construction

Water Quality Improvement Strategies



With Gratitude…

Geosyntec Consultants

- Kevin Tyre
- Brady Schwabach
- Alexandria Foos
- Mike Hardin
- Mark Ellard

SiREM Lab

- Jacques Smith

Advanced Environmental Lab

- Todd Romero

Amdrill

Questions?

Nico Pisarello

Water Resources Scientist

Geosyntec Consultants

(407) 321-7030

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