

SEPTEMBER 21<sup>ST</sup>, 2022

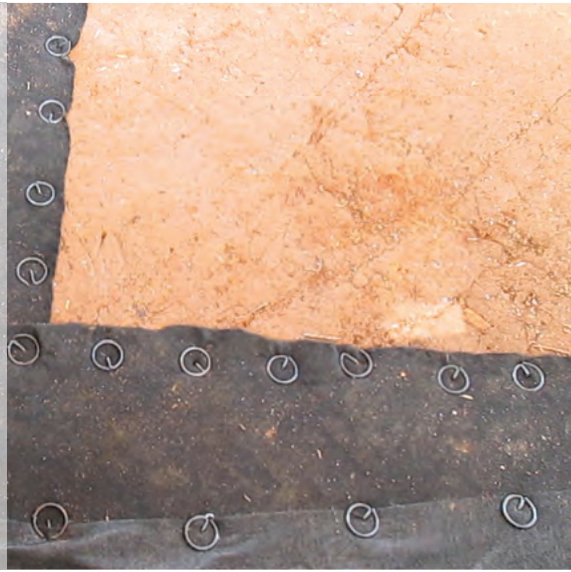

# STORMWATER RESEARCH UPDATES

MICHAEL A. PEREZ, PH.D., P.E., CPESC  
 CIVIL & ENVIRONMENTAL ENGINEERING  
 AUBURN UNIVERSITY

AU STORMWATER RESEARCH FACILITY

STORMWATER.AUBURN.EDU

CLEAR WATER ALABAMA  
 2022 SEMINAR & FIELD DAY  
 DAPHNE, AL





2021 REPORT CARD FOR AMERICA'S INFRASTRUCTURE  
 ASCE




STORMWATER

2022 REPORT CARD FOR ALABAMA'S INFRASTRUCTURE

ALABAMA SECTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Stormwater





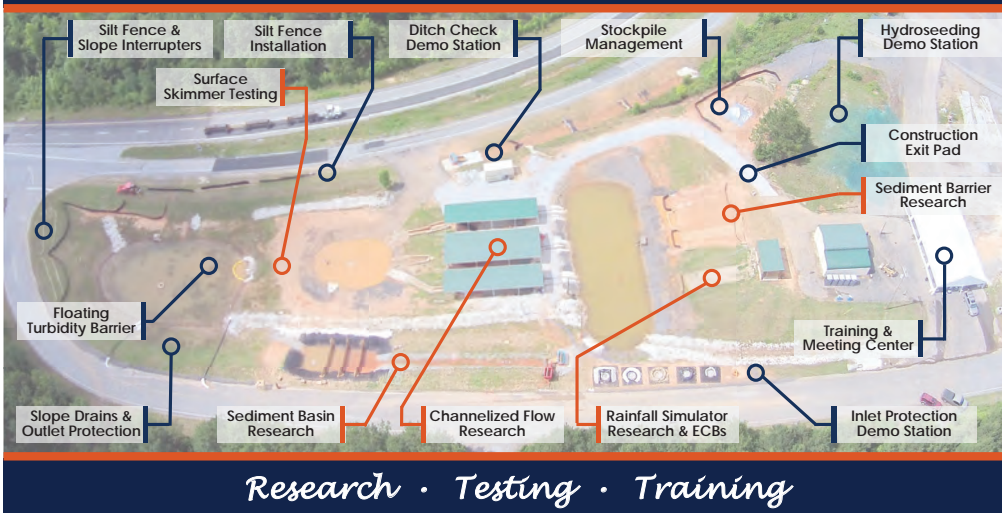
# CONSTRUCTION STORMWATER NEEDS



# STORMWATER RESEARCH FACILITY



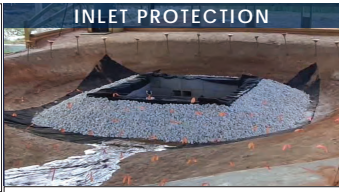
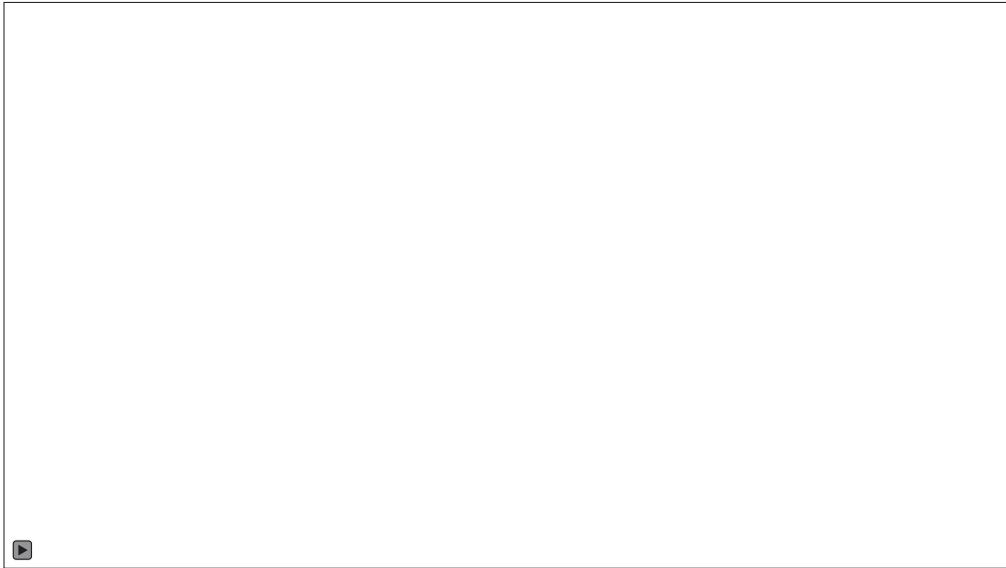
# STORMWATER RESEARCH FACILITY



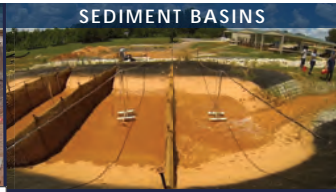
# STORMWATER RESEARCH FACILITY





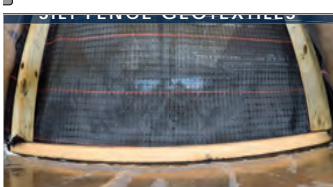
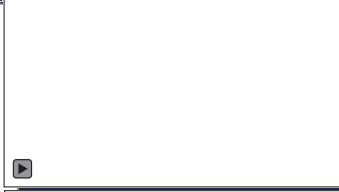
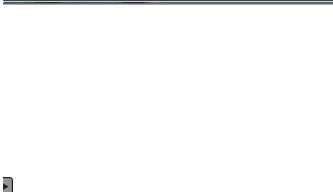
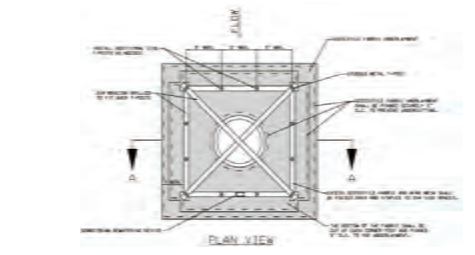


INLET PROTECTION

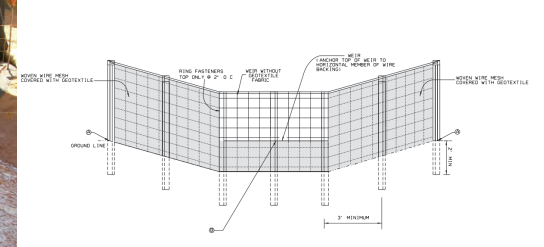


SEDIMENT BASINS

ALDOT STANDARD DRAWINGS



RAINFALL SIMULATORS

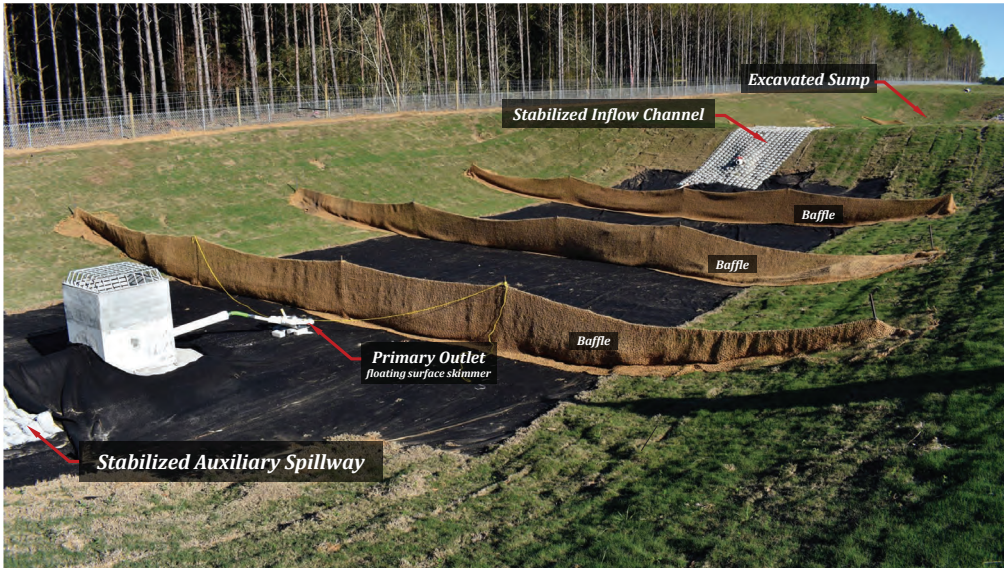
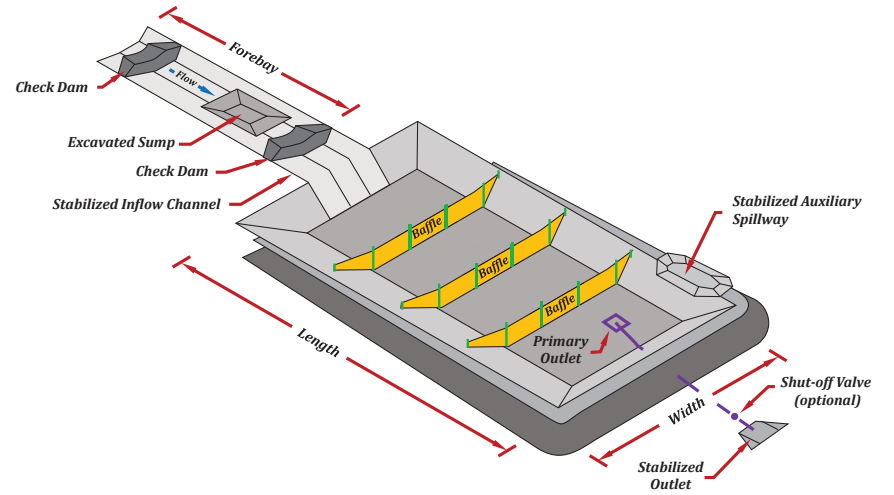




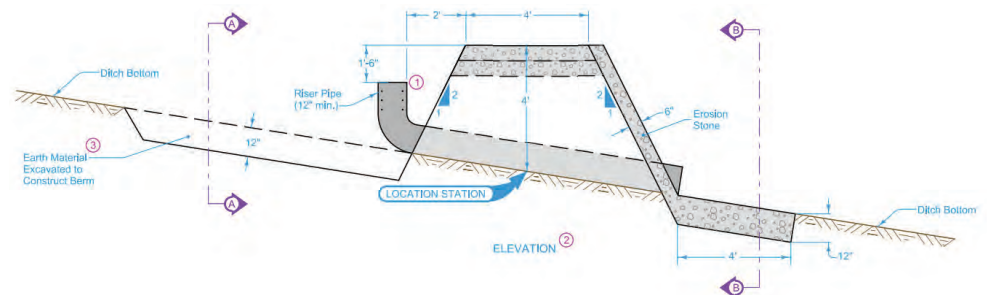
# SEDIMENT BASIN PERFORMANCE RESEARCH



## TYPICAL SEDIMENT BASIN DESIGN



## IOWA DOT SEDIMENT CONTROL BASIN (EC-601)



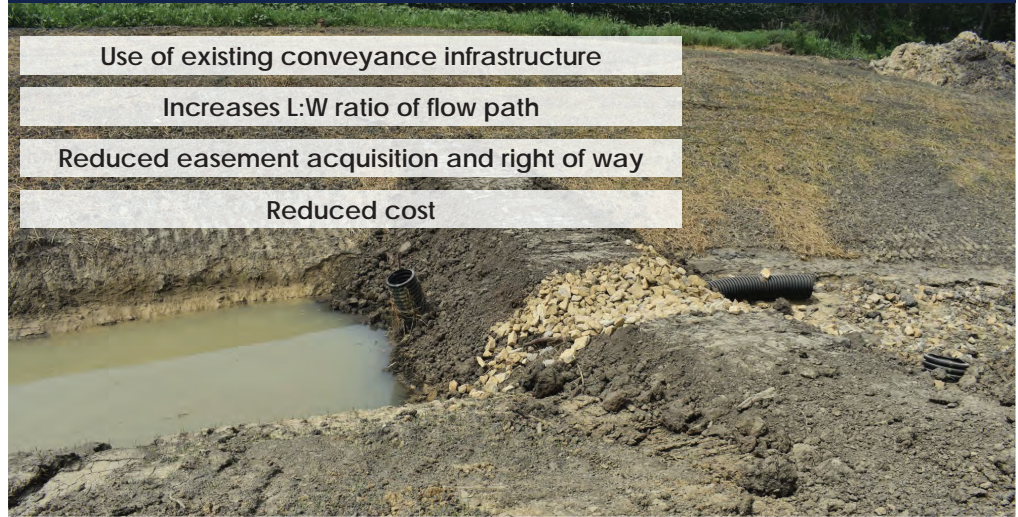


## IOWA DOT SEDIMENT CONTROL BASIN (EC-601)



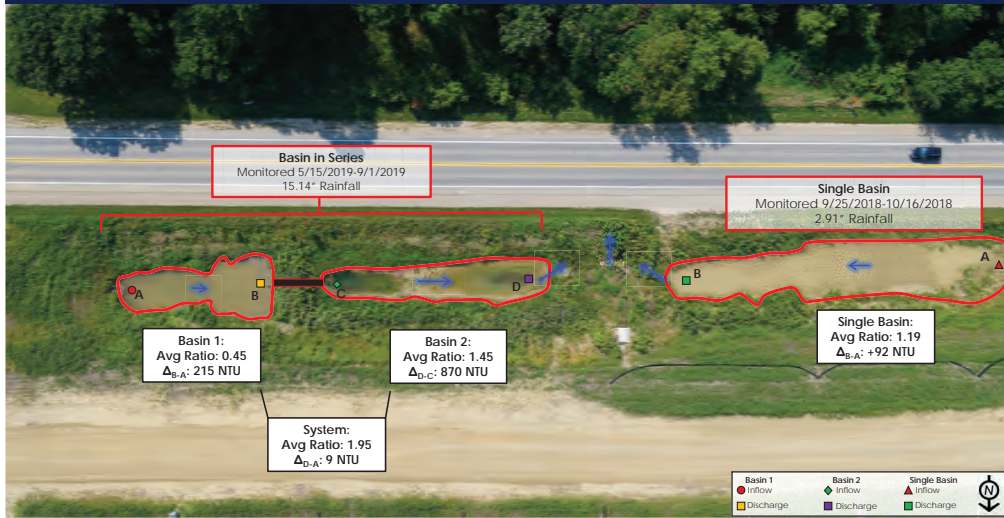
## IOWA DOT SEDIMENT CONTROL BASIN (EC-601)

- Use of existing conveyance infrastructure
- Increases L:W ratio of flow path
- Reduced easement acquisition and right of way
- Reduced cost





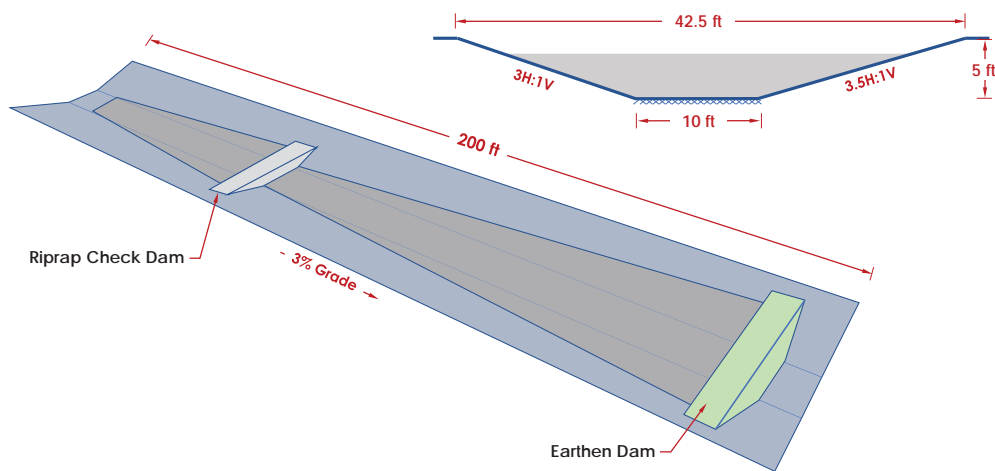
## BASIN MONITORING - U.S. 30



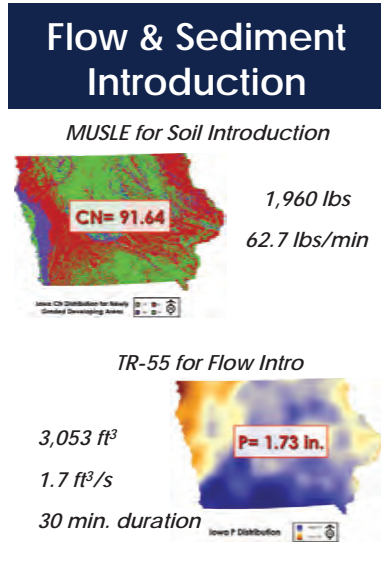
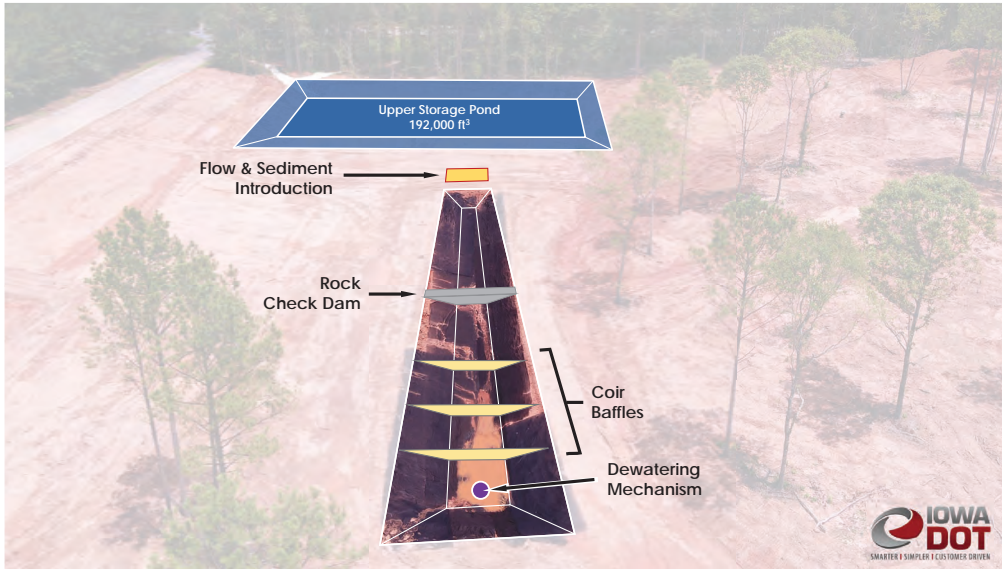
## RESEARCH OBJECTIVE: DEVELOP PRACTICAL & COST-EFFECTIVE DESIGN AND CONSTRUCTION IMPROVEMENTS



## BASIN DESIGN

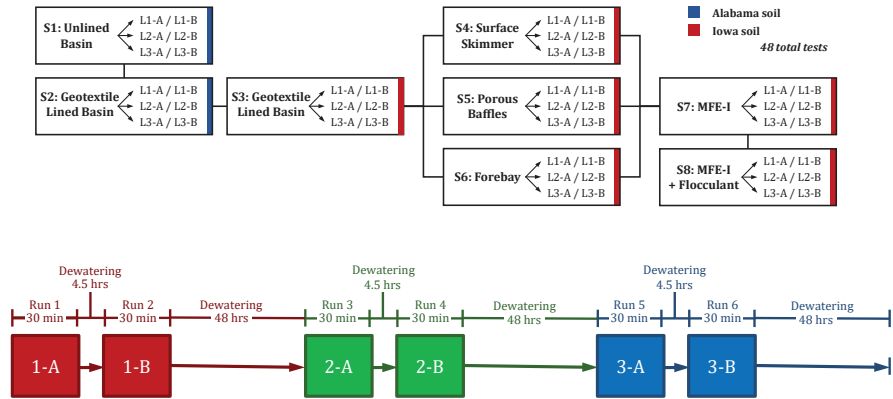




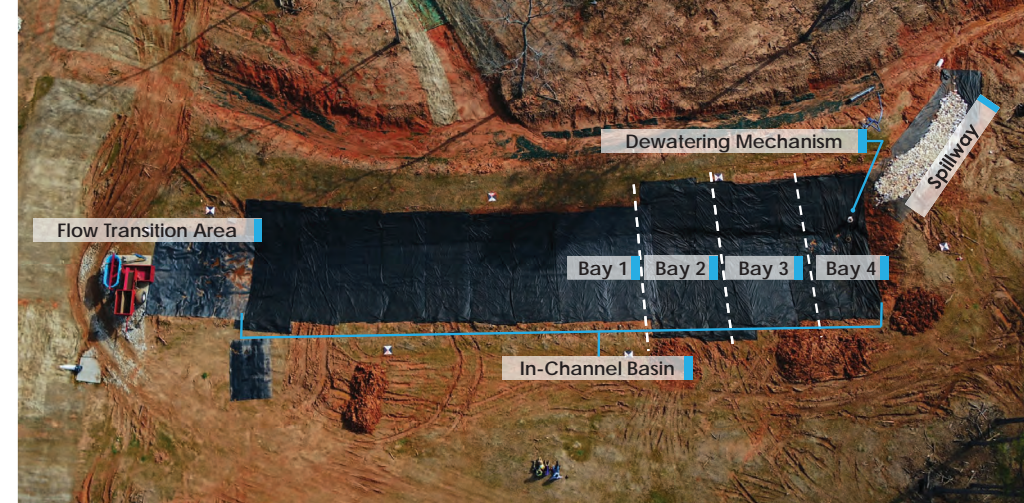




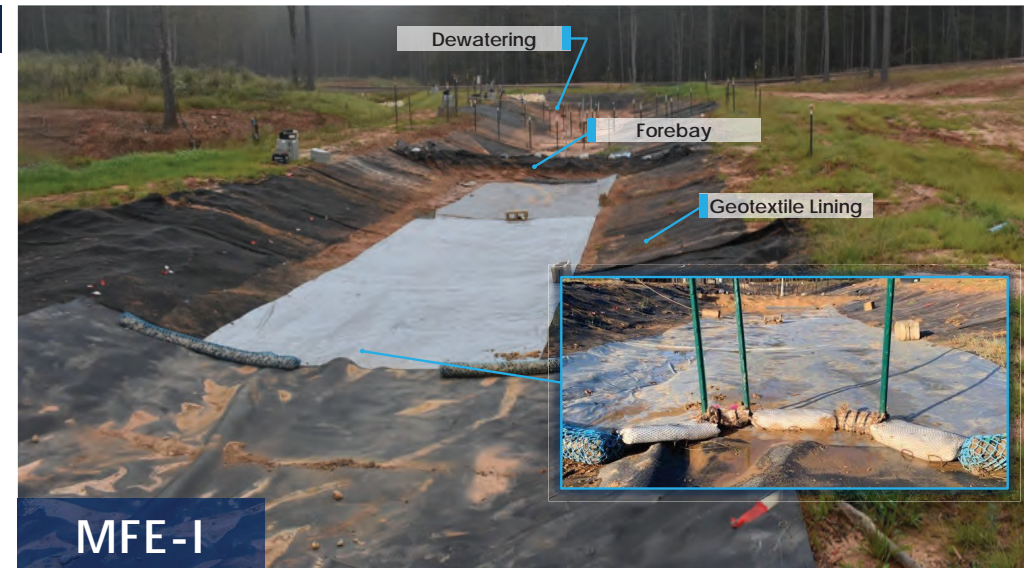
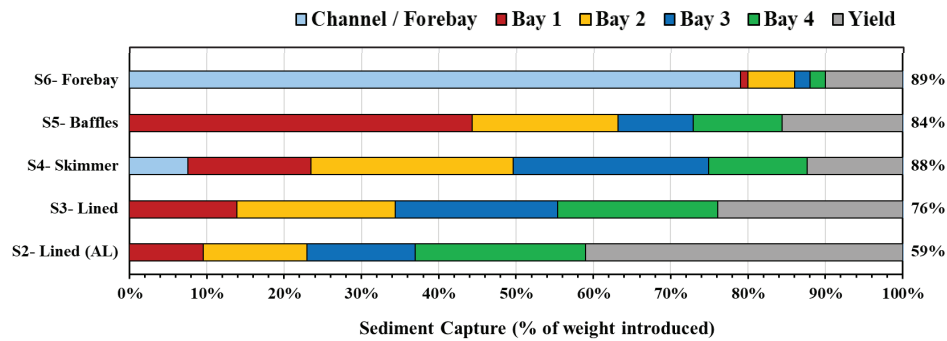
# EXPERIMENTAL TESTING REGIMEN



# SEDIMENT BASIN SETUP

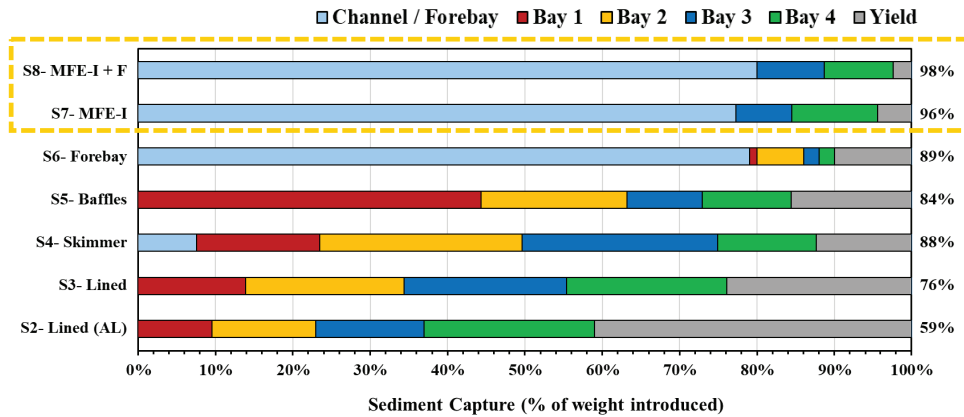


# COMBINED COMPARISON - SEDIMENTATION

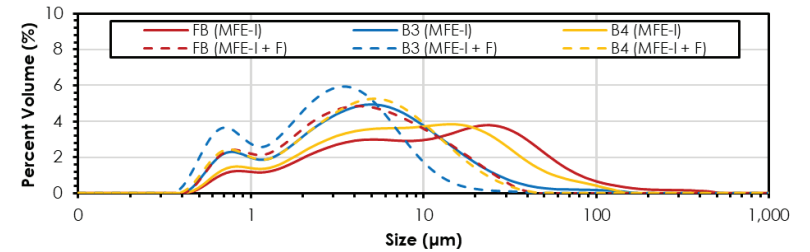




# COMBINED COMPARISON - SEDIMENTATION

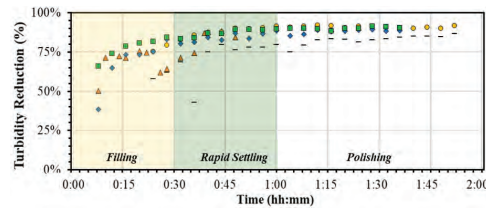
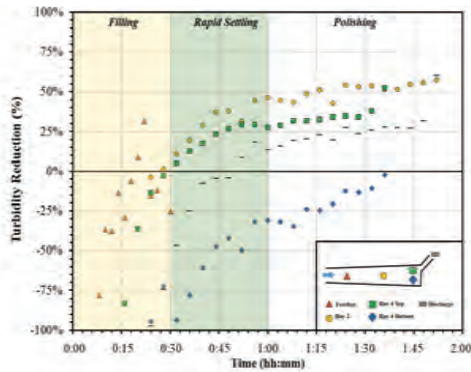


# GRAIN SIZE CAPTURE W/ DISPERSANT



Decreased  $D_{50}$  by 51% when flocculant was applied

# TURBIDITY REDUCTION

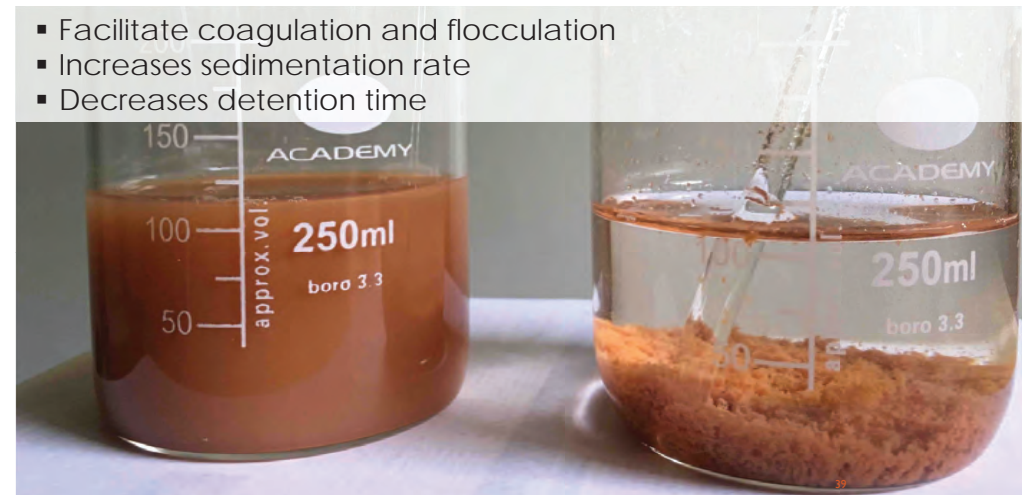


MFE-I

MFE-I + FLOCCULANT

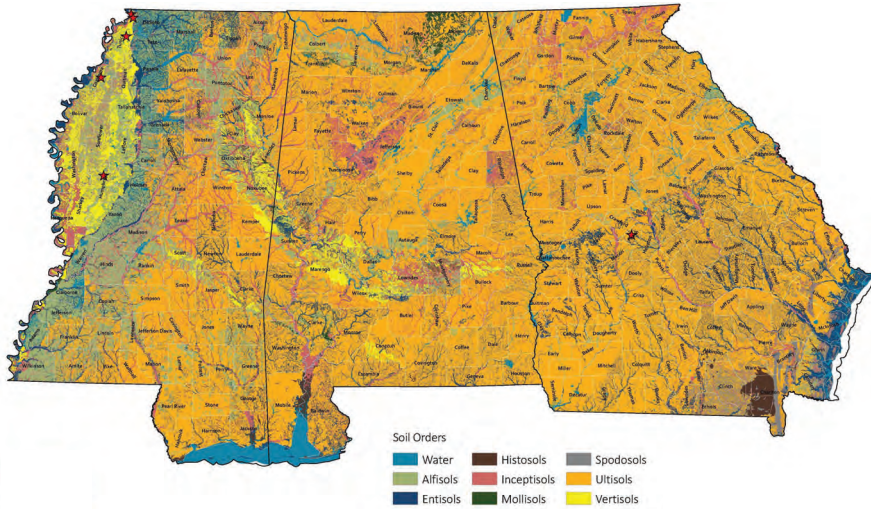
# Flocculants

- Facilitate coagulation and flocculation
- Increases sedimentation rate
- Decreases detention time





## FLOCCULANTS ARE SOIL SPECIFIC



## SOILS VARY ACROSS A SINGLE PROJECT



## CURRENT RESEARCH: FLOCCULANT GUIDANCE

- Develop best practices for use
  - design-based guidance
  - provide more effective and responsible use on job sites
- Performance of market-available products and practices
- Determine optimum dosage requirements and delivery mechanisms

**ALDOT**  
Alabama Department of Transportation

## RESEARCH GOAL: DEVELOP GUIDANCE

Longevity?	Application Intervals?	Flocculant Type?
Maintenance Frequency?	Soil Analysis?	Product Selection?
Optimum Dosage?	Residuals?	Application Technique?







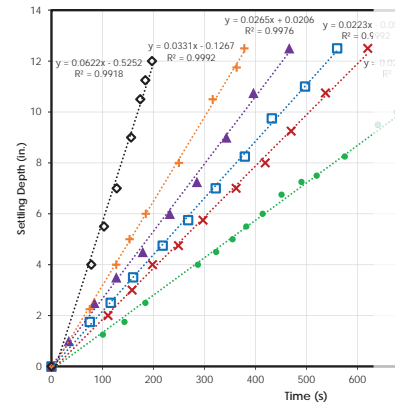
## DOSAGE TEST – SUPERNATANT



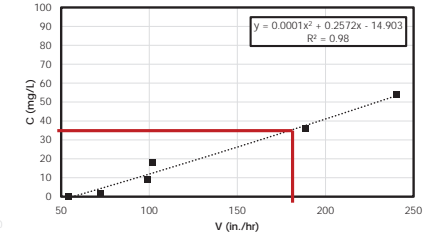
Dosage	0 mg/L	10 mg/L	20 mg/L	40 mg/L	50 mg/L	100 mg/L
ΔNTU (%)	72.6	98.8	97.6	97.3	97.0	96.4
ΔpH	0.05	0.04	0.10	0.10	0.07	0.09
Color	Light yellow	Clear	Clear	Clear	Clear	Clear
Size Floc	N/A	0.75-1.0	0.75-1.0	1.0-1.5	1.0-1.5	1.0-1.5

## 3 - RESIDUAL TESTING METHOD – SETTLING VELOCITY

Product: B1



- Dosage target: 50 mg/L
- Residual: 35 mg/L
- Residual of application dosage: 70%



## LARGE SCALE DOSAGE TESTING



## FLOCCULANT INJECTION SYSTEM





# EVALUATION OF EROSION CONTROL PRODUCTS USING RAINFALL SIMULATION

**ALDOT**  
Alabama Department of Transportation



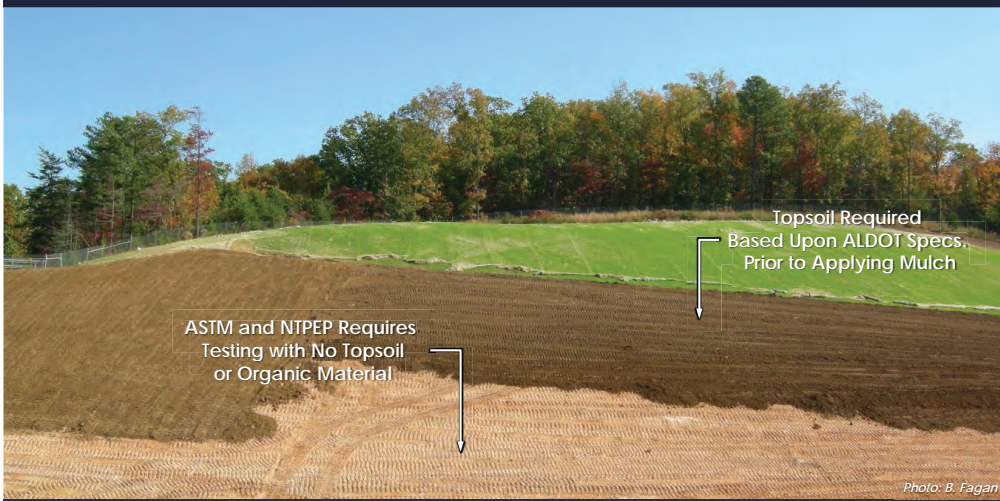
## Objectives

- Design and construct 12 simulators
- Observe various rainfall distributions and erosion patterns
- Develop erosion control techniques

## Features

- 4:1 and 3:1 Slopes
- Benchmark soils for ALDOT sites
- Two sets of portable sprinklers

## TOPSOIL PLACED & TRACKED PRIOR TO EROSION CONTROL



Topsoil Required  
Based Upon ALDOT Specs,  
Prior to Applying Mulch

ASTM and NTEP Requires  
Testing with No Topsoil  
or Organic Material

Photo: B. Fagan

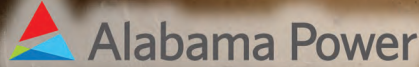
## CURRENT RESEARCH: RAINFALL SIMULATION

- Varying configurations: slope, soil type, topsoil
- Develop design-based guidance on practice selection





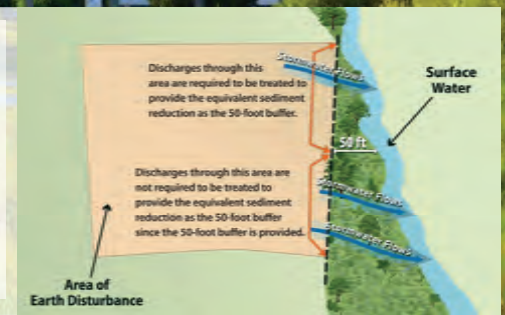
# SEDIMENT BARRIER TESTING



## 50 FT BUFFER REQUIREMENT – NDEE & U.S. EPA

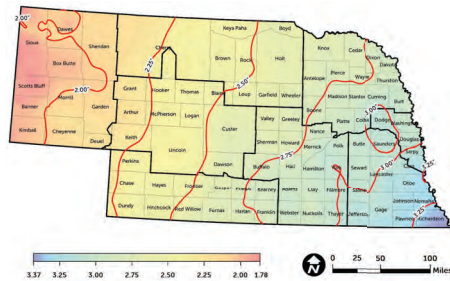
A 50 ft buffer is required between construction activity and WOTUS. If infeasible, then BMPs must achieve equivalent stormwater treatment to a 50 ft buffer.

- **Option 1:** 50 ft buffer
- **Option 2:** >50 ft buffer + additional E&SCs
  - Together achieves sediment load reduction of a 50 ft buffer
- **Option 3:** E&SCs that achieve sediment load reduction equivalent of a 50 ft buffer



## LARGE-SCALE TESTING METHODOLOGY

- Flow and sediment introduction rate calculated based on common conditions observed on NDOT construction sites
- Modified ASTM D7351-13 Testing Apparatus



## IMPOUNDMENT VS. FILTRATION





Construction General Permit Requires Regular Inspection and Maintenance of E&SC Practices



Notice of Termination relieves ALDOT of I&M Obligations

## FINAL STABILIZATION

100% of soil surface uniformly covered in permanent vegetation with density of 85% or greater



## KEY CHALLENGES

Vegetative establishment currently determined using visual assessments



There is a need to better document vegetative establishment, species coverage and density

## ALDOT UAS FLIGHTS

- Pre-construction flight
- 6 week intervals during construction
- Post-construction flight

- 3D model captured at 1,000 ft intervals throughout corridor
- Drone deploy software





## RESEARCH OBJECTIVE

- Develop methodology using UASs that ALDOT inspectors can use to determine and document vegetative establishment on construction sites
- Verify stabilization and vegetation requirements have been met prior to suspension of permit coverage



## VEGETATION COVER



**Basal Cover**  
Portion of plant that grows into soil surface.

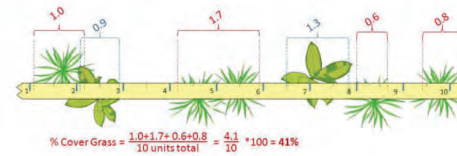


**Canopy Cover**  
Area below plant that covers soil surface.

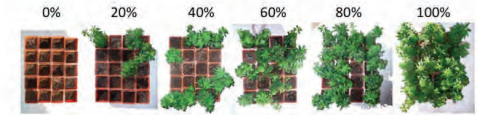


**Foliar Cover**  
Soil surface with leaves direction above, not including space between leaves.

## LINE TRANSECT METHOD



## QUADRAT METHOD



## SPECIES SELECTION



## SPECIES SELECTION





## TEST PLOT CONSTRUCTION



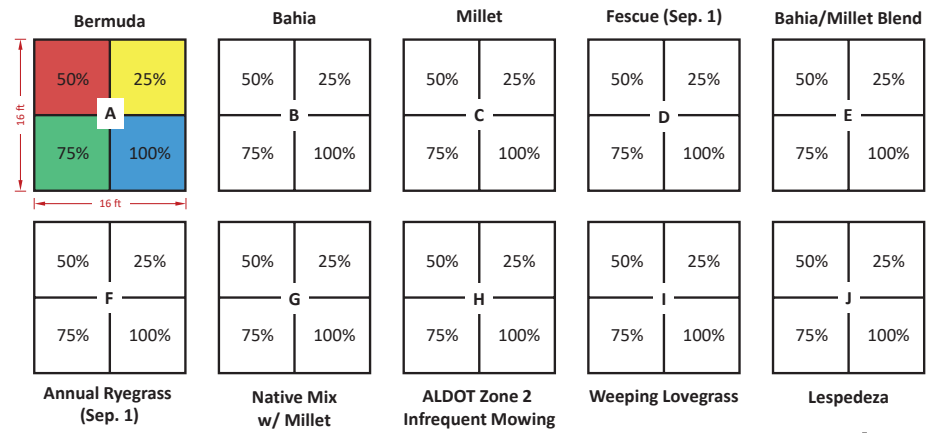
## TEST PLOT CONSTRUCTION



## TEST PLOT CONSTRUCTION



## TEST PLOT CONSTRUCTION





## ALDOT ROADSIDE MIX

ZONE 2 - AREAS NOT SUBJECT TO FREQUENT MOWING REQUIRED POUNDS PER ACRE {KILOGRAMS PER HECTARE} OF PURE LIVE SEED				
Date of Planting	Jan. 1 to Feb. 15	Feb. 16 to Aug. 31	Sept. 1 to Nov. 15	Nov. 16 to Dec. 31
Annual Ryegrass	10 {11}	5 {6}	10 {11}	10 {11}
Hulled Bermudagrass		18 {20}	12 {13}	
Unhulled Bermudagrass	24 {27}	12 {13}	12 {13}	24 {27}
Tall Fescue	29 {33}		35 {39}	29 {33}
Weeping Lovegrass		2 {2}	2 {2}	
Annual Lespedeza (Kobe)		50 {56}		
Reseeding Crimson Clover	29 {33}		29 {33}	29 {33}
Pensacola Bahia Grass	29 {33}	29 {33}	29 {33}	29 {33}
Required Permanent Plant	Mixed			



## TASK 3: DEVELOP UAS INSPECTION METHODS

Flights at 60 ft AGL



**Headwall Nano Hyperspec**  
400-1000 nm Spectral range  
272 spectral bands  
640 spatial bands

**Sentera 6X Multispectral Sensor**  
5X 3.2MP Monochrome Global Shutter  
1X 20MP RGB Electronic Rolling Shutter

DJI Matrice 600 Pro



## TASK 3: DEVELOP UAS INSPECTION METHODS

### Skydio2 Autonomous Drone

- Flights at 10 ft AGL
- 12.3 MP CMOS sensor
- Used for close-up imaging



## VEGETATIVE ESTABLISHMENT INSPECTIONS



## AERIAL RGB IMAGES TAKEN BY 6X MULTISPECTRAL



RED

GREEN

BLUE

NIR

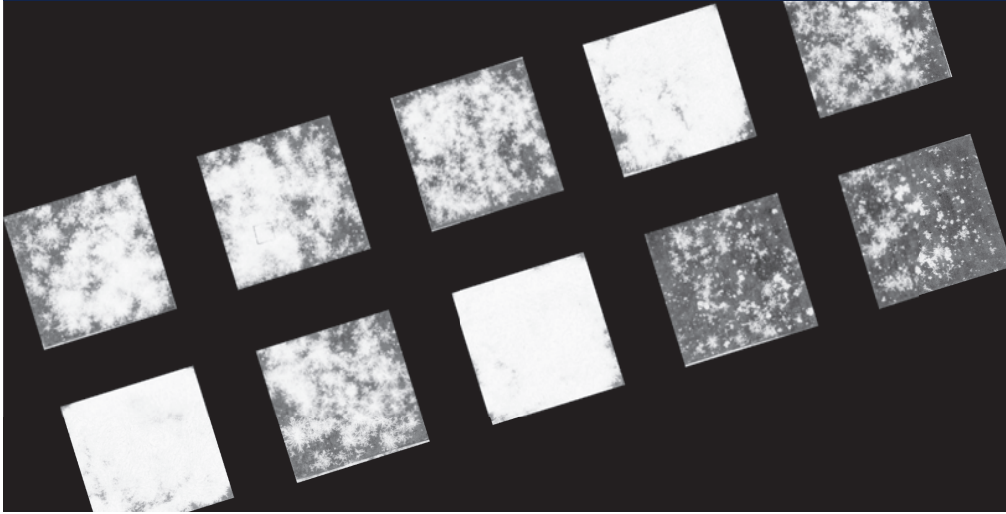
RED EDGE

## GRID LAYOUT FOR MULTISPECTRAL SENSOR

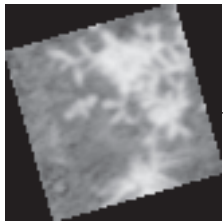




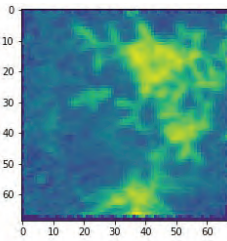
# NDVI MAPPING



# TILE EXTRACTION



Automated correction of orientation for all images



Density calculation based on NDVI values

Density from ground images

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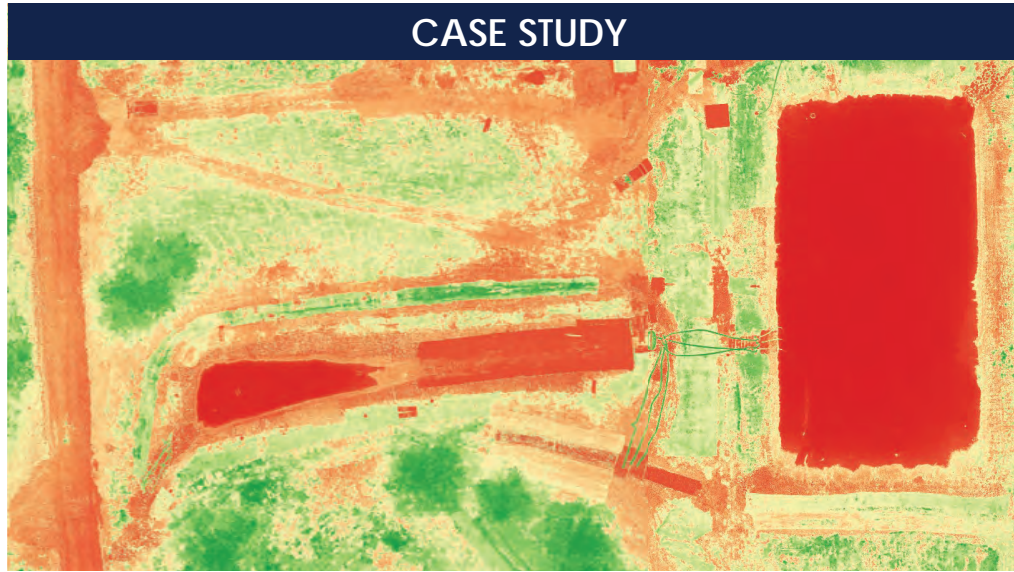
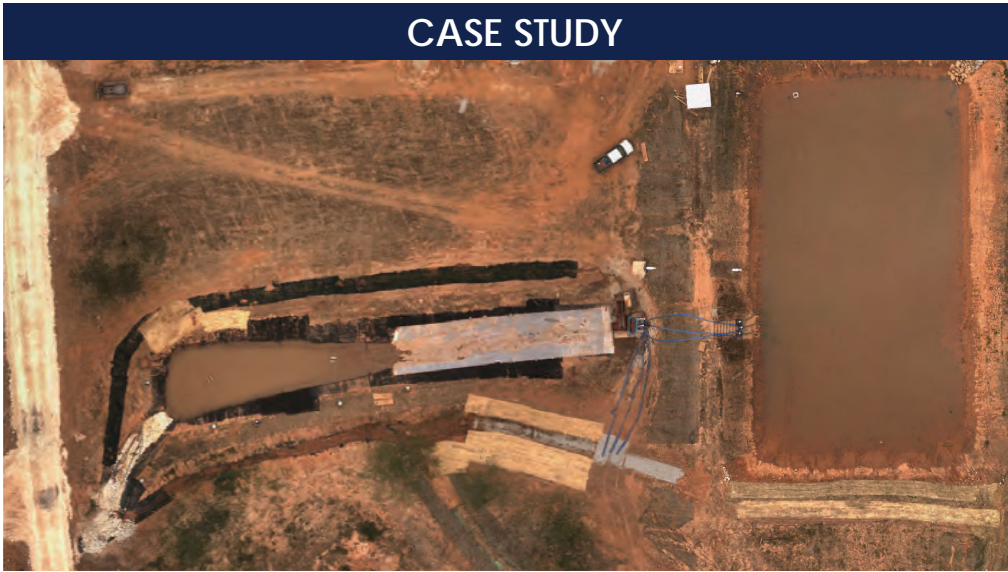
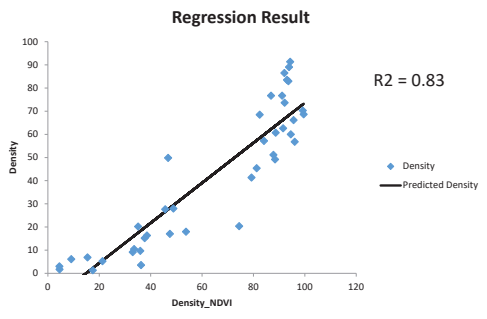
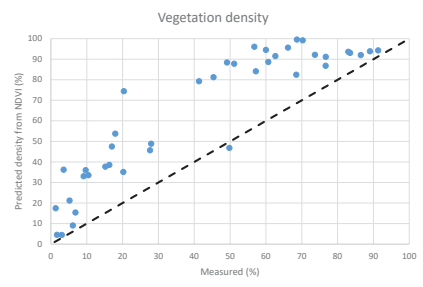
Density from aerial images (NDVI)

Merged data

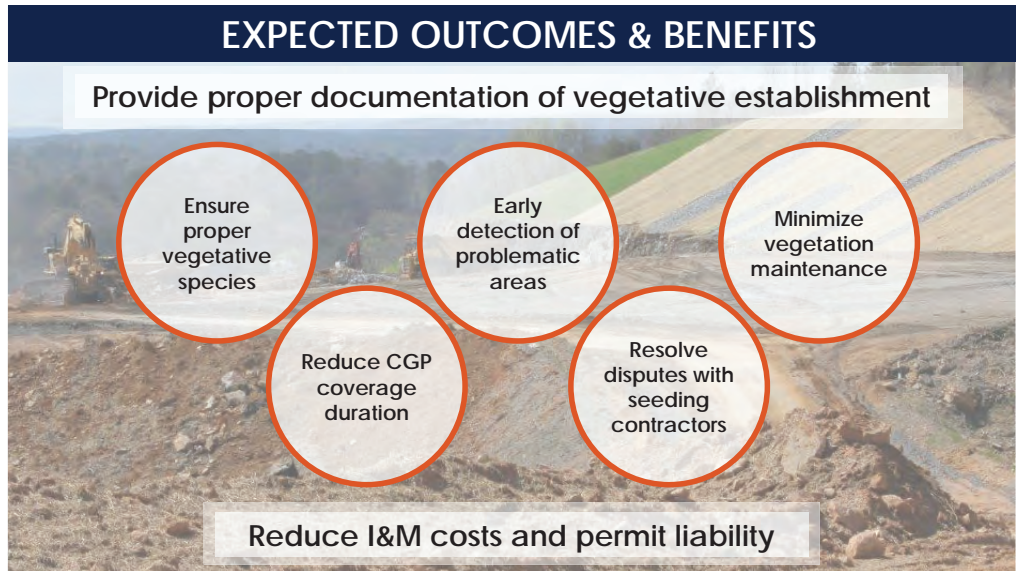
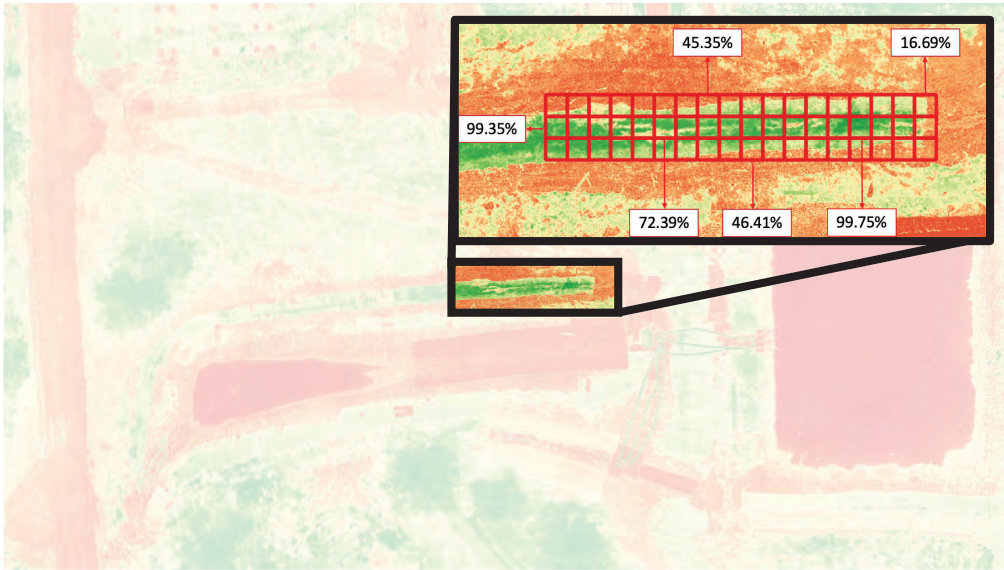
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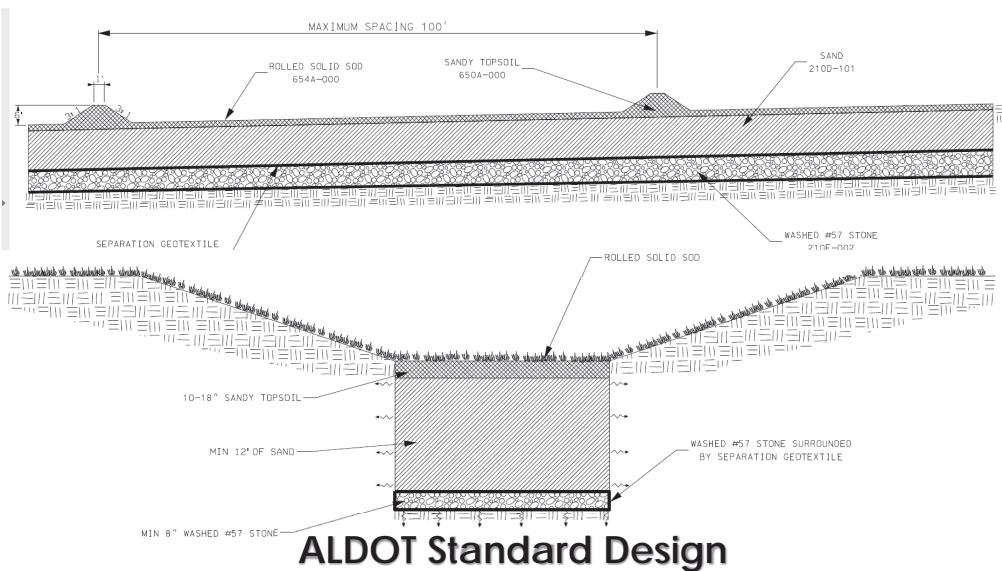
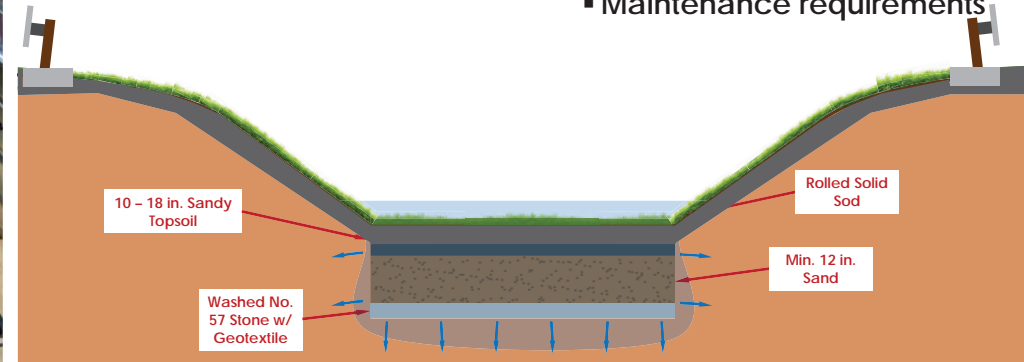
## EVALUATE SMALL-SCALE SEDIMENT BASIN CONFIGURATIONS



## INFILTRATION SWALES

Engineered system that promotes groundwater infiltration and reduces surface runoff

- Material limitations
- Infiltration rates
- Flow rates
- Degradation
- Maintenance requirements



## PRODUCT EVALUATION



Conduct third-party, independent, performance-based testing to evaluate manufactured devices/practices



## TRAINING & OUTREACH



## SAVE THE DATE!



**Hands-on Installer Training: May 16-17, 2022**  
**Field Day: May 18, 2022**

## BRANDING & MARKETING

**Stormwater Testing Facility**

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STORMWATER RESEARCH FACILITY

**Upcoming Events**

- Date: Event name
- Date: Event name
- Date: Event name

No upcoming events.

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**TESTING**

**TRAINING**

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New Publication Alert: Hydraulic Performance Evaluation of

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The AU-ESCTF is an Auburn University research center focused on providing research, testing, and training for the erosion and sediment control industry.

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- Let's make it to the top of the day!

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MICHAEL A. PEREZ, Ph.D., P.E., CPESC

(334) 844-6267 | [MIKE.PEREZ@AUBURN.EDU](mailto:MIKE.PEREZ@AUBURN.EDU)



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