NC STATE UNIVERSITY

Field Assessments of Bioretention:

Are In-Practice Facilities Satisfying Design Standards?

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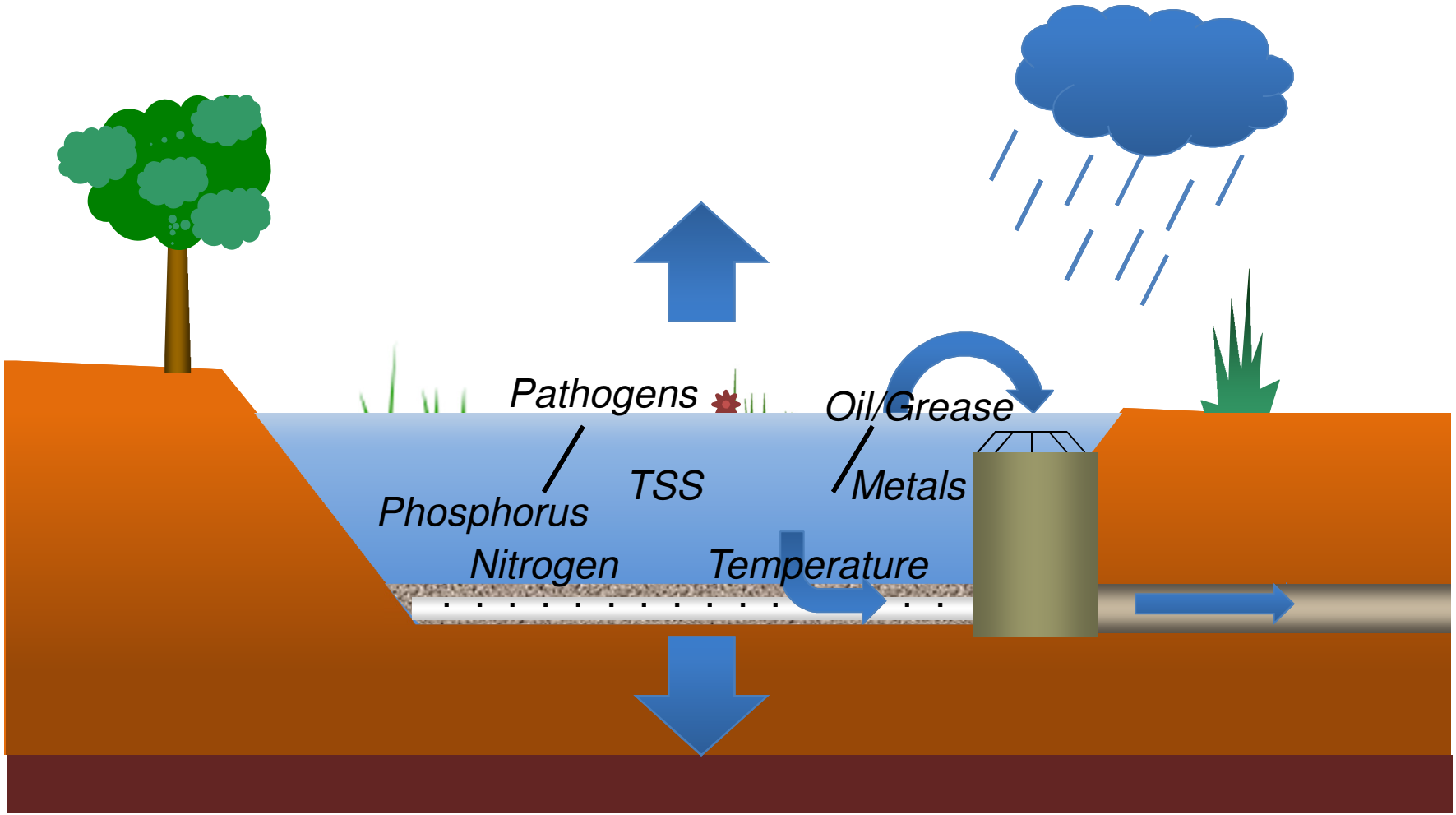
NC STATE UNIVERSITY Bio&Ag ENGINEERING

Presentation Goals

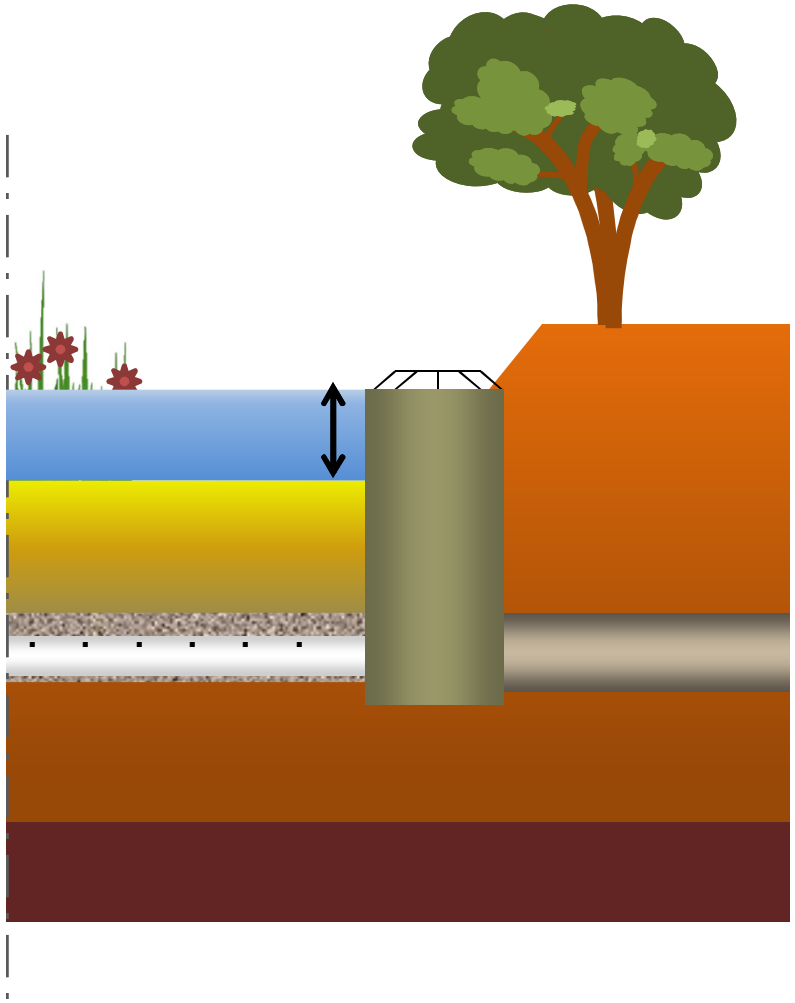
- Are bioretention cells in NC meeting design standards?
- Are the current design standards adequate?

Overview of Bioretention



NC Bioretention Design Standard

- Water Quality Volume = First 2.5 cm (1 in) Runoff
  - Storage provided in bowl above mulch surface
  - Assumes no intra-event infiltration
- 30 cm (1 ft) Max. Ponding



NC Bioretention Design Standard

Media Component	Standard Specification
Sand	85 - 88%
Fines	8 - 12%
Organic Matter	3 - 5%
Permeability	2.5 – 15 cm/hr (1-6 in/hr)

Project Need: Why Assess Installation?

- Limited As-Built Data
- Visual Accounts of Poor Construction
- Studies of Poor/Undersized BRCs
  - Asleson et al., 2009
  - Brown & Hunt, 2011
  - Luell et al., 2011

Why do We Care?

- **Flooding**: threatens human life & property
- **Increased stormwater volume**: accelerates stream erosion
- **Increased pollutant load**: impairs water quality for humans & other organisms

Matt Hood 2008, with permission

US EPA, 2011

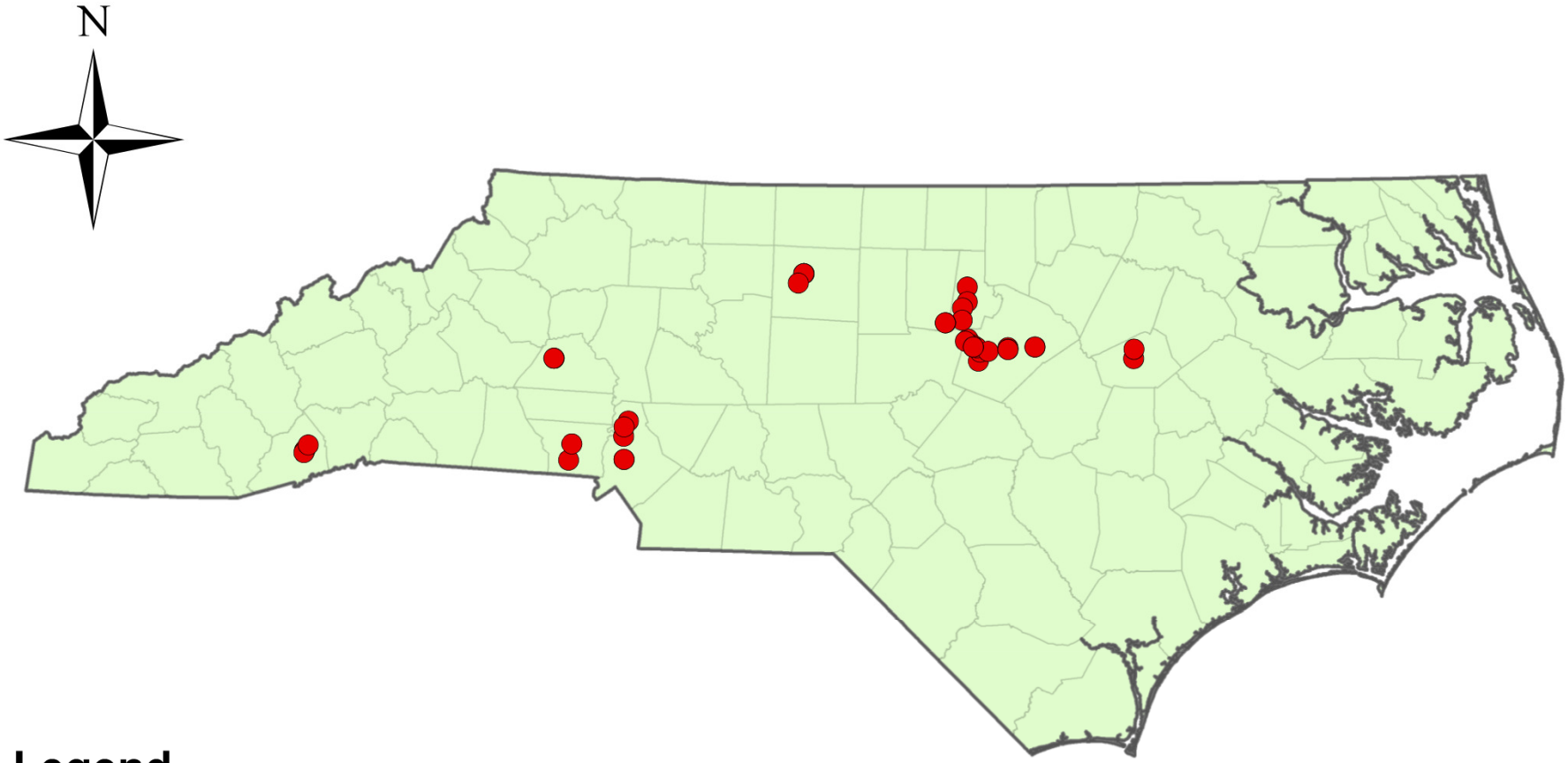
Research Objectives

Compare **soil media**, **drainage rate**, and **storage volume** of NC bioretention cells to design standards

What is the rate?

How do results affect waters of NC?

Site Selection (n=43)



Legend

- Site Location
- County Boundaries

0 50 100 200 Kilometers

Site Selection

Methods: Overview

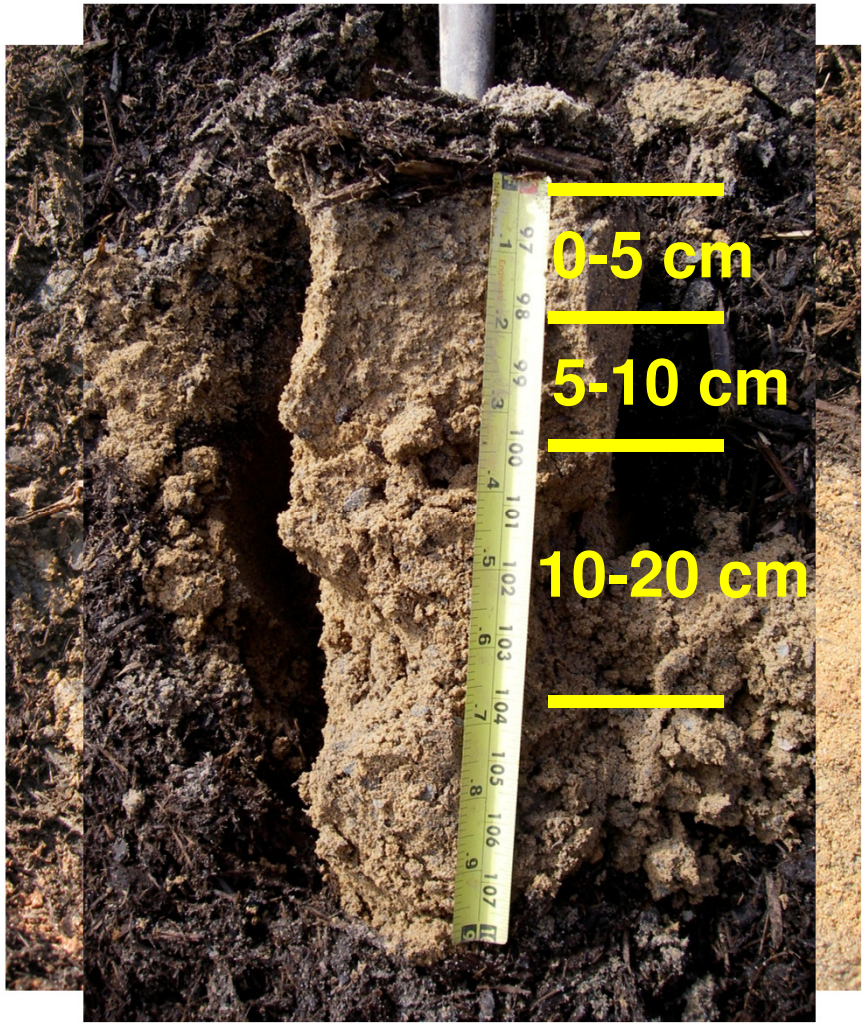
- Four-Step Field Assessment:
  1. Visual Inspection
  2. Soil Analysis
  3. Field Drawdown Test
  4. Surface Storage Survey
- Statistical Analysis of Findings with 95% Confidence Intervals

Methods: Visual Inspection

- Quantify frequency of issues requiring maintenance
- Soil profile description using Munsell® Soil Color Charts
- Identify hydric soils and redoximorphic features (indicators of prolonged saturation)

Methods: Soil Media Analysis

- Soil particle-size analysis (n = 360)
  - 3 replicates x 3 depths
  - Accumulation of fines?
- Permeability analysis (n = 240)
  - 6 undisturbed cores
  - Constant-head vertical saturated hydraulic conductivity method

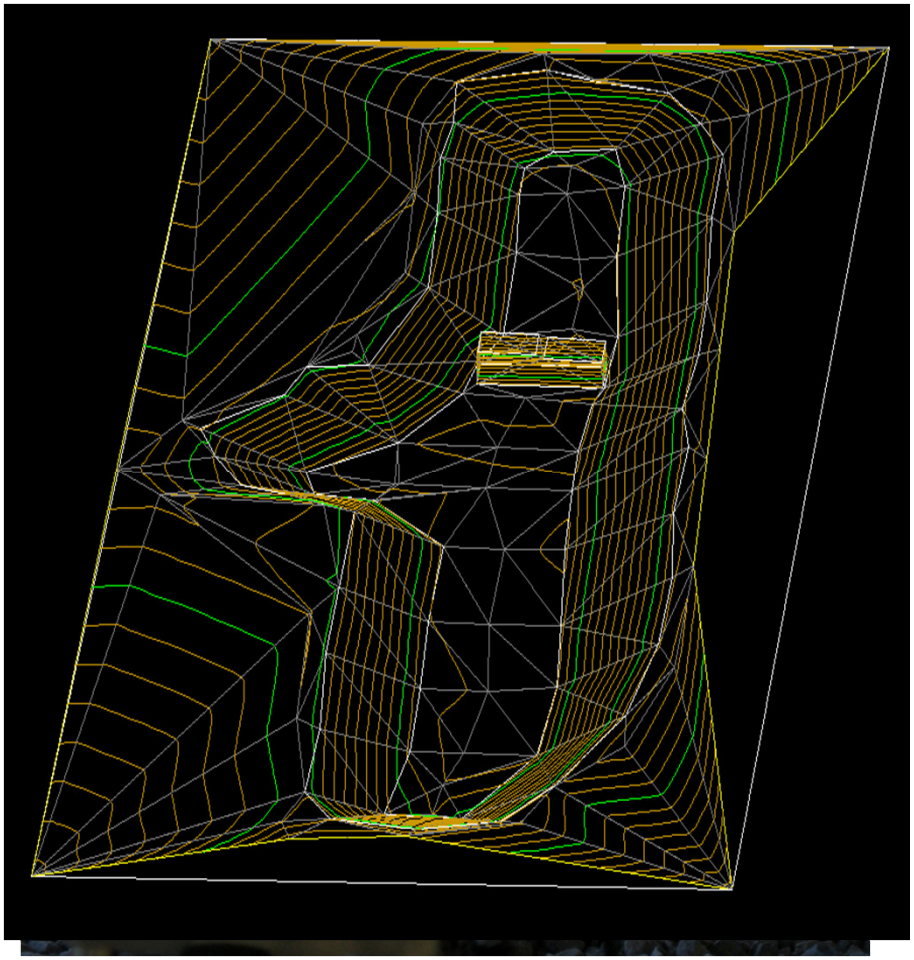
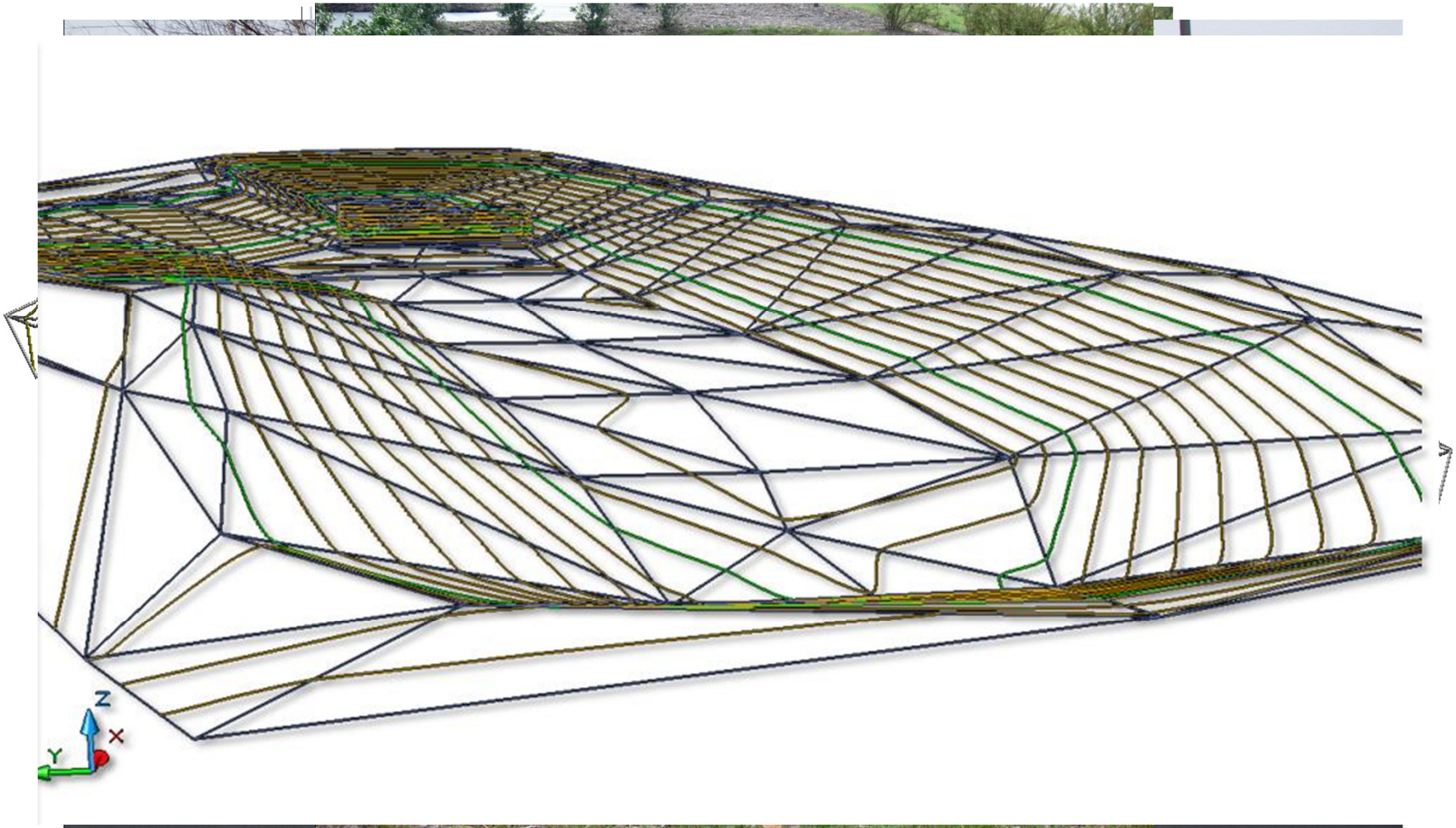


Methods: Field Drawdown Tests

- Monitored water level of seven cells during rain events
- Visually verified ponding
- Analyzed drawdown of surface water

Methods: Storage Volume

- Detailed topographic surveys (average 90 points per site)
- Storage volume calculated in AutoCAD®
- Compared with design (intended) storage volume



Methods: Storage Volume