

Adaptive Management in Urban Stream Restoration & Green Infrastructure

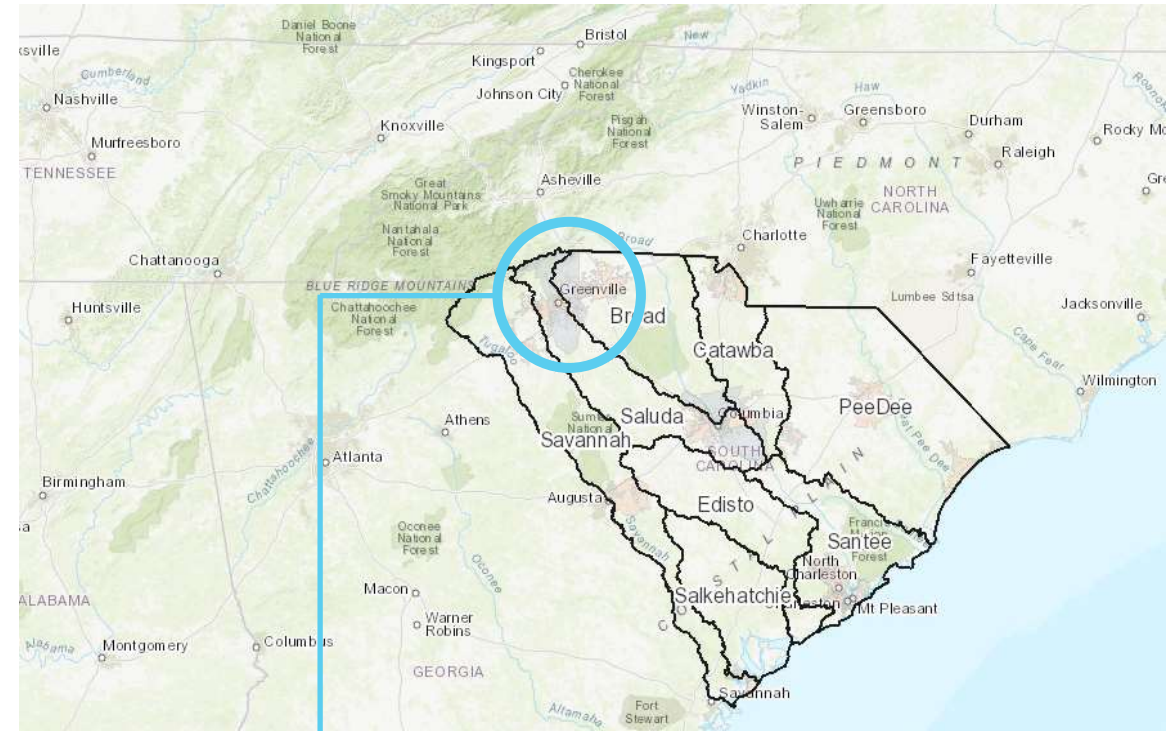
by: Jake McLean & Paul Dow



WILDLANDS
ENGINEERING

Outline

- Greenville Historic Background
- Drivers for Urban Stream and Green Infrastructure Projects in Greenville, SC
- Implemented Projects
- Stewardship and Adaptive Management



Greenville, South Carolina

Population: 70,000+

City Limits: 29 square miles

Watershed: Richland Creek --> Reedy River --> Saluda River

Concerns: Bacteria, sediment, nutrients, biological, urban pollutants

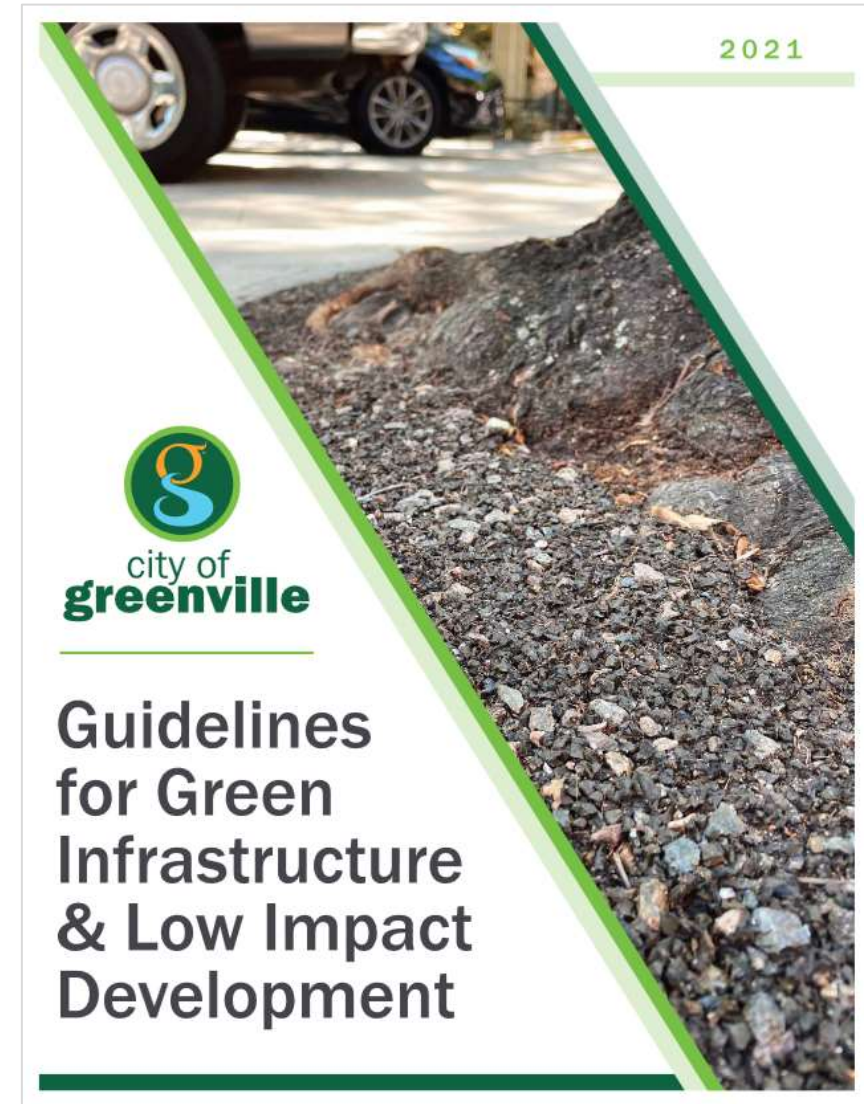






Drivers

- Treating Waterways as Infrastructure Assets
- Water Quality and Impairment
- Stormwater and Floodplain Policies and Regulation
- Maximizing the Benefit of Recreational Corridors
- Natural Systems Approach in Urban Reaches



Stream Asset Management

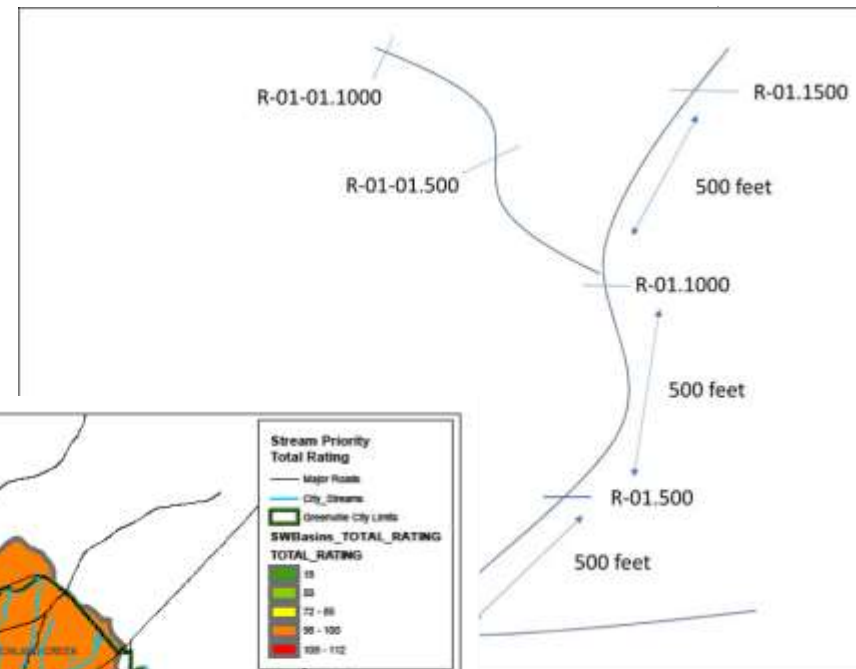
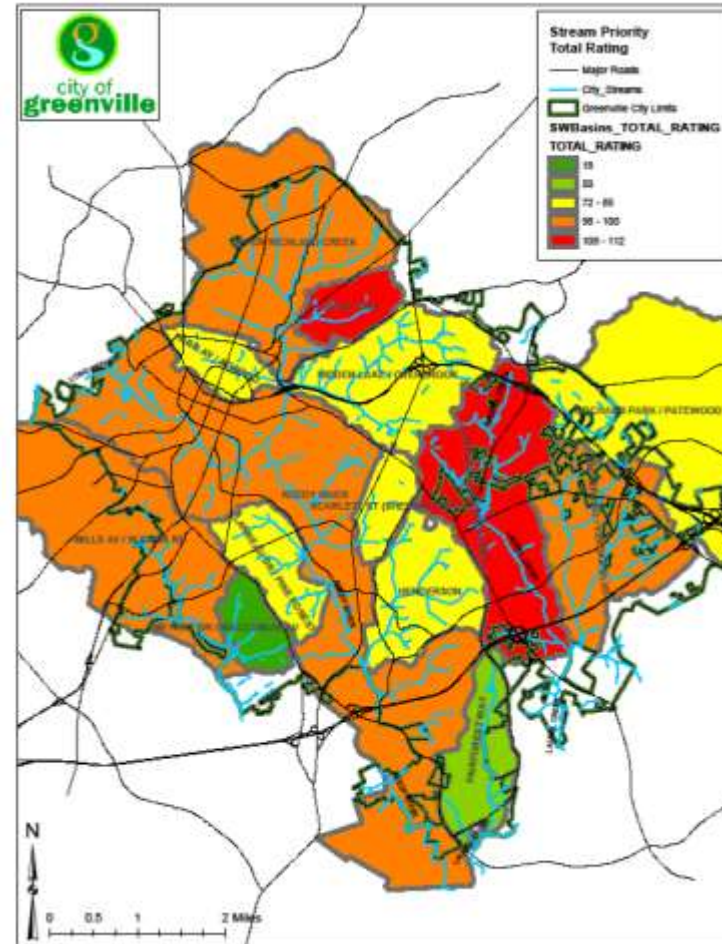
Prioritize Criticality of Basins

- LOF: Impervious %, # of Outfalls
- COF: Parks, Streets, Utilities

Field Surveys

- Survey123
- BEHI
- MS4
 - Dry Weather Screenings
 - Outfall Inspections
 - Utility Crossing Condition

Scoring and CIP Planning



Addressing Water Quality Impairments

- **Development Requirements**
 - LID & GI ,Buffers, Stormwater Treatment
- **Illicit Discharge**
- **Sanitary Sewer Rehab**
- **Stream Asset Management**
- **303(d) streams and urban runoff and erosion**
 - Richland Creek Watershed Management Plan







Stormwater and Floodplain Policies & Regulation

- **Establishment of Policies** (LOS, EOS, Asset Management)
- **Floodplain Modeling**
 - Updated Flood Maps
 - LOS Analysis
 - Gap Analysis
- **Asset Inventory and Condition Assessment**
- **Community Rating System (CRS)**
- **Land Management Ordinance**



Recreational Corridors



Education and Awareness

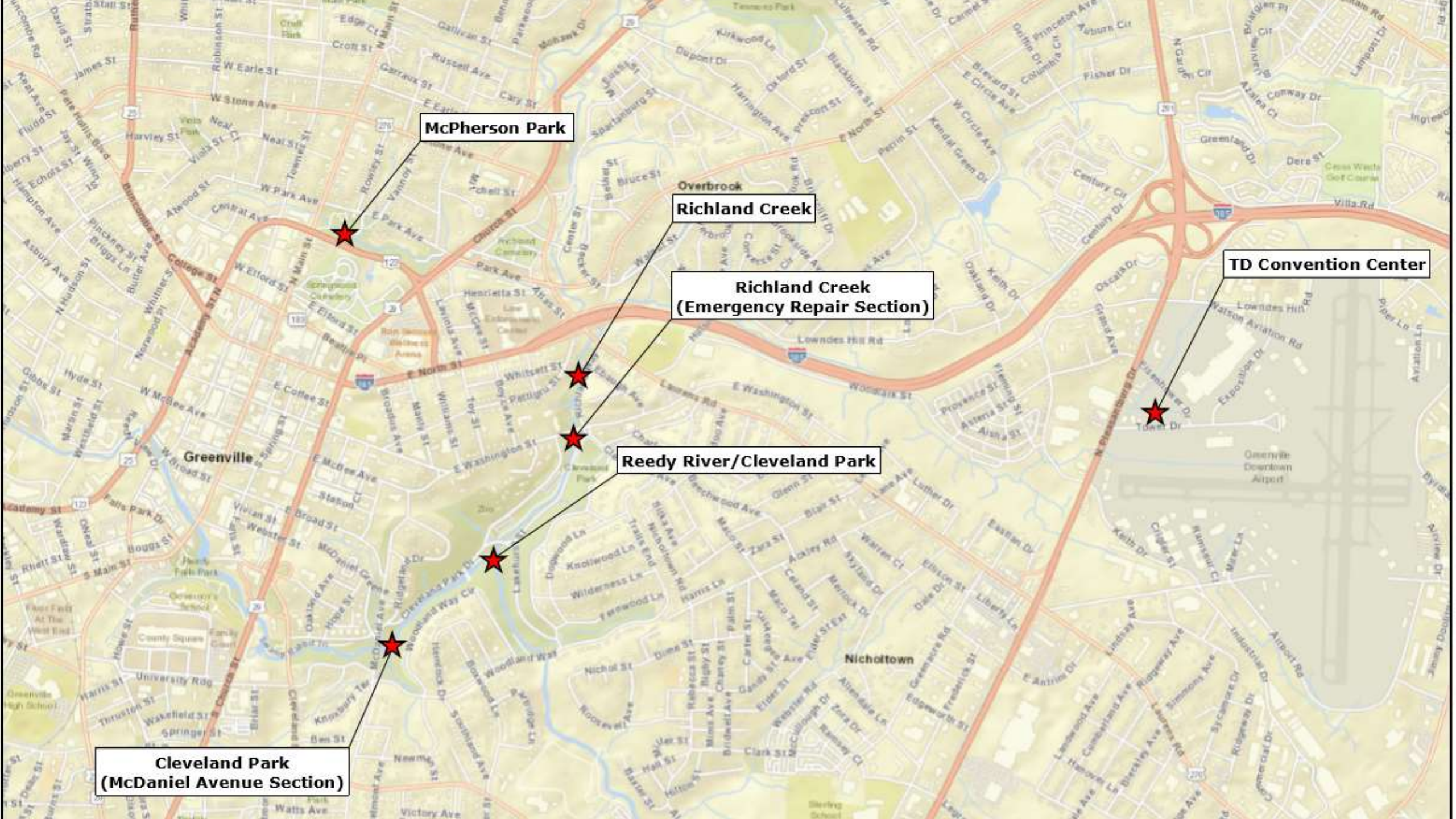
"Healthy root systems are key to stable streambanks, so we need everyone's help in this final stage. Please stay off the matting!"



Preserve and Protect Tree Canopy

- 2 tree giveaway events
- Have given away 400+ trees to community for free
- Community messaging and education on the importance of trees and replacing the tree canopy
- Tree planting workshop at public Work Session of City Council





McPherson Park

**Overbrook
Richland Creek**

**Richland Creek
(Emergency Repair Section)**

Reedy River/Cleveland Park

**Cleveland Park
(McDaniel Avenue Section)**

TD Convention Center

Project Activities

- Emergency repair - utility crossing
- Compensatory storage (FEMA)
- EPA 319 water quality improvements



Project Stewardship & Adaptive Management Planning

Stewardship

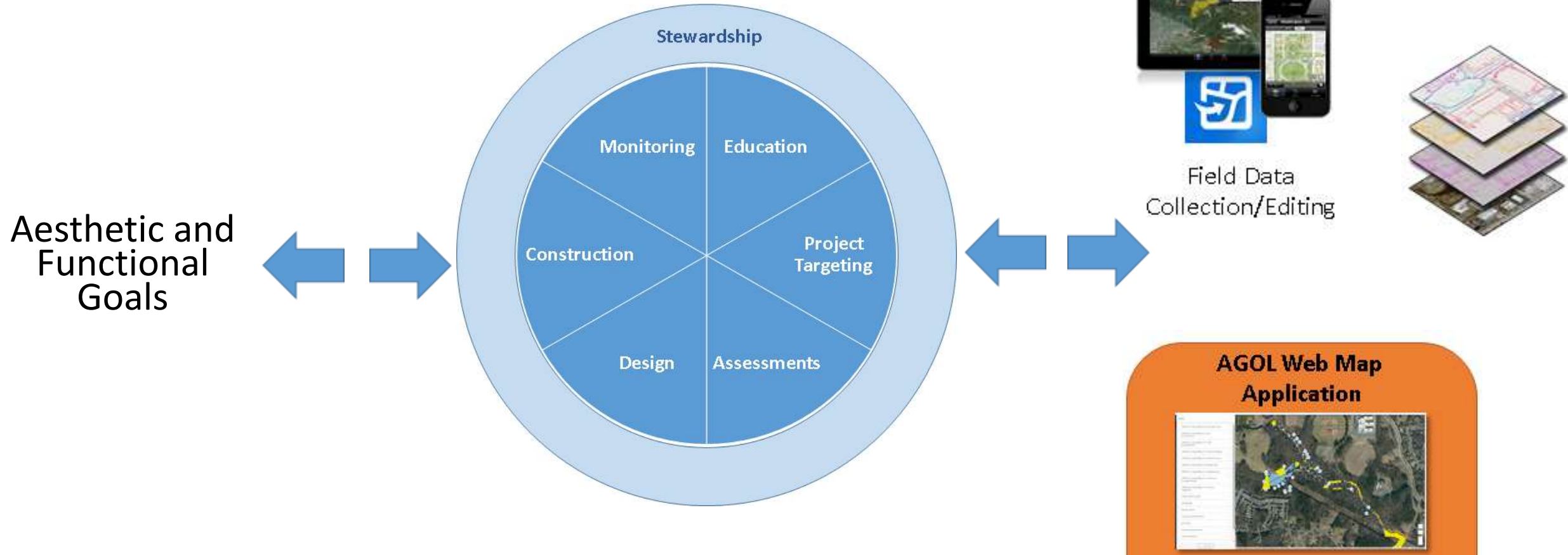
- OVERARCHING – Starts early, guides construction, continues
- HOLISTIC - Involves many disciplines and activities and integrates ecology with society
- Critical to project success(ion)
- Pays off to invest early in project

Adaptive Management Planning

- Identifies project components and challenges
- Creates framework for addressing challenges to achieve long-term goals
- Guides project activities throughout life of project



Requires a Vision and Data to Support Action





Activities & Considerations



Evaluate Challenges and Opportunities:

Invasives

Poor soils

Adjacent influences (land use, vegetation, hydrology, wildlife)



Identify Post-construction issues:

Overland flow and floodplain scour

Bank or bed instability

Vegetation issues

Encroachment (on easement or vegetation)

BMP maintenance



Considerations:

Management goals

Aesthetics, visible and physical access to streams

Ownership, use/access

Budgetary constraints

Education



Supporting Adaptive Management



Budgeting for activity

Assessment

Repairs

Maintenance



Information sharing

Maps & plans

Landowner information



Proactive efforts

Collect soil samples

Conduct kick-off, design-phase site walks, talk to stakeholders and caretakers of project (City staff)



Create schedule and status and plan update milestones



Greenville Post-Construction Adaptive Management

Document Components

- **Background**
- **Evaluation Criteria**
 - Stream
 - Floodplain/Upland
 - BMP
 - Plantings
 - Mowing Areas
 - Invasive Species
- **Post-Construction Assessment**
- **Maintenance Recommendations**



Assessment - Reedy River at Cleveland Park



Stream

Maintenance and Monitoring Areas



In-Stream Structure



Bank Stabilization



Overland Runoff and Floodplain Erosion



BMP Maintenance



Stream and Floodplain Planting



Mowing Areas



Invasive Species

Reedy River/Cleveland Park
 Post-Construction Stream Restoration Maintenance and Adaptive Management Plan
 City of Greenville

Maintenance Activities

- Early evaluation and maintenance by entity involved in design and construction: Wildlands
- Current year inspection 2022 by intern / volunteer
- In-house staff or subcontract work
- City has joined with of "Alliance" of local groups to combat invasives





In the Weeds with the 'Stew Crew'

Capacity Building • Technology • Design Feedback Loop • Benefits





Adaptive Management Program Building

- Ecology and ecosystem function
- Plant identification
- Conservation easement compliance
- Soil Science & Plant Physiology

EXPERTISE

- Communication & coordination
- Contracting
- Long-term vision & planning
- So many field skills

- Process management
- Data management
- Resource allocation
- Training

PROCESS

EXECUTION

- Staff
- Volunteers/Interns
- Contractors
- Collaboration
- Education



Wildlands Stewardship Support App

Issue Point

Subtype

- Misc
- Weed Occurrence
- Failed Structure
- Beaver Dam
- Soil Sample

Issue Line

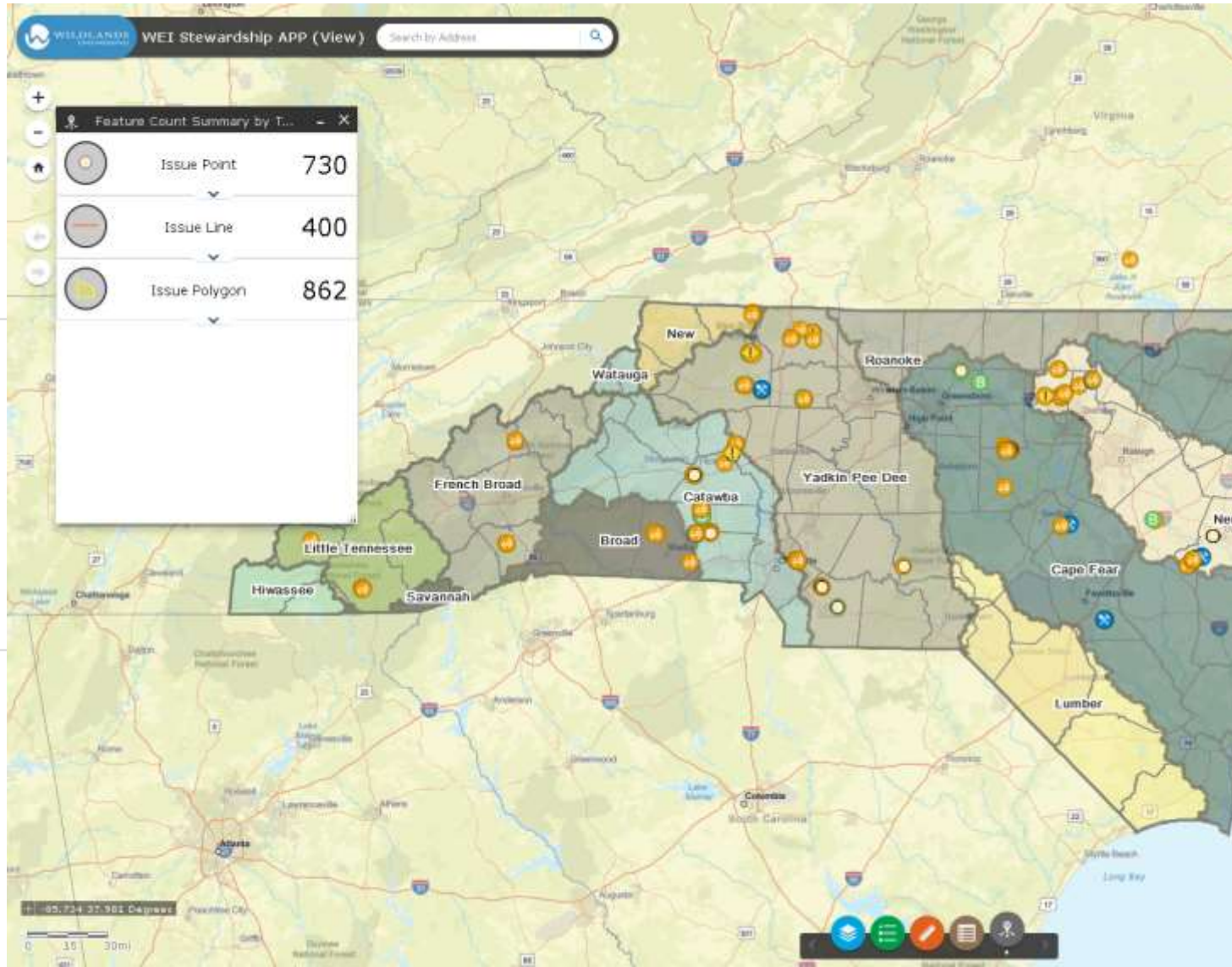
Subtype

- Misc
- Boundary Issue
- Channel Stability/Erosion
- In-Stream Vegetation
- Needs Livestakes

Issue Area

Subtype

- Misc
- Weed Occurrence
- Vegetation Issue
- CE Encroachment



- Project background information
- Tracking of issues and corresponding management
- Shared real-time data enables rapid and multidisciplinary response

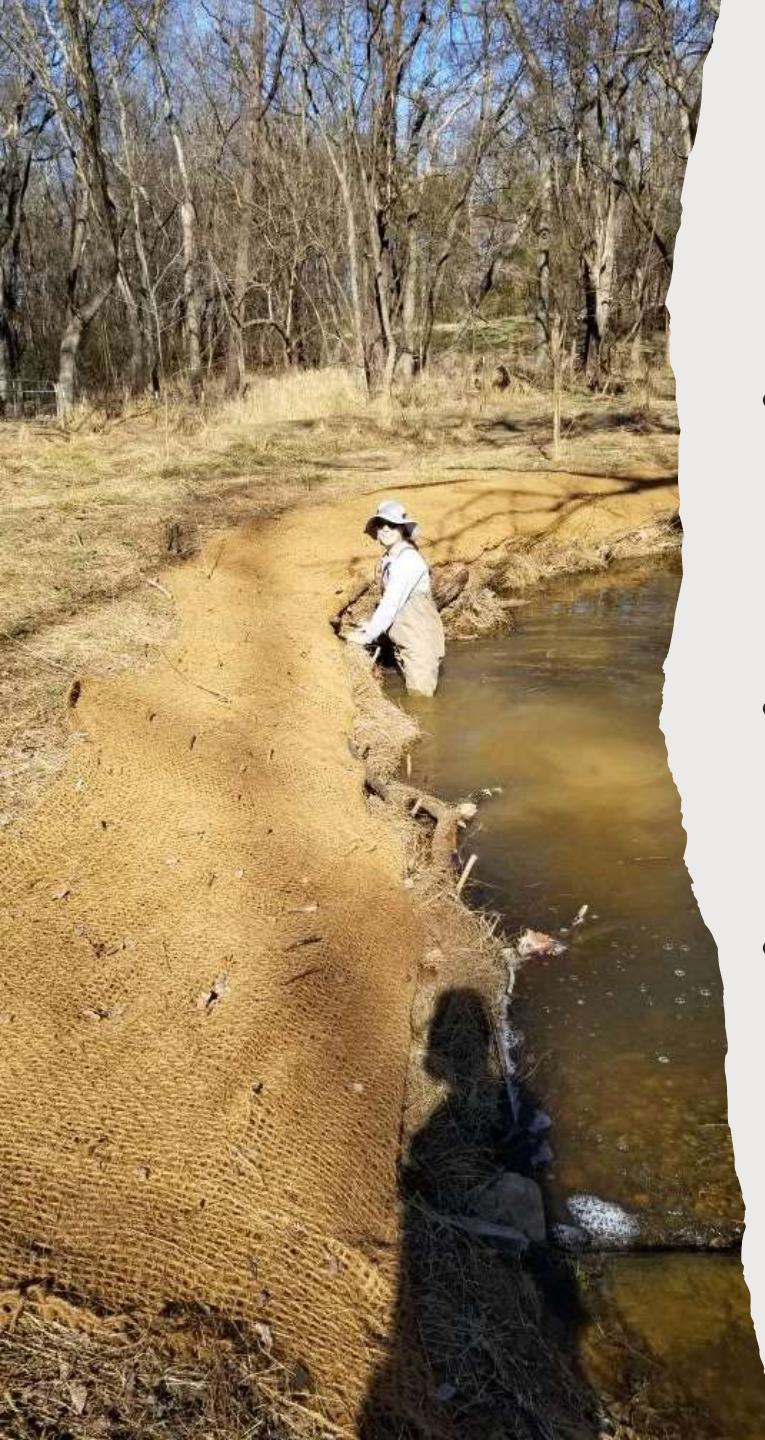


"Technology" for Adaptive Management



Design & Innovation Loop

- Post-construction interdisciplinary meetings to discuss performance and maintenance of projects
- Repetitive maintenance issues and root causes explored and addressed
- Innovation:
 - Seed and cover crop seed mixes
 - Hand repair and bioengineering
 - Soil management and amendment
 - Ideas that work!



Benefits of Adaptive Management

- More successful projects
- Increases visibility
- Less work over time
- Pollinate and educate
- Better design and implementation through feedback loop
- Advancing project support technology to meet life cycle needs





Thanks!

Paul Dow, PE, CFM | *City of Greenville* | pdow@greenvillesc.gov

Jake McLean, PE, CFM | *Wildlands Engineering* | jmclean@wildlandseng.com



WOODY BUFFER PLANTING
Large scale planting of native trees & shrubs is the most effective way to expand your riparian buffer. This approach quickly establishes a buffer but also requires many resources and doesn't meet constraints.

SOFT MARGIN EXPANSION
This approach foregoes planting woody vegetation and aims to expand with native grasses and pollinator friendly flowers. These "soft margins" can be established along areas like greenways where additional woody vegetation is not desired.

POLLINATOR HABITAT EXPANSION
Pollinators provide vital ecosystem services yet are decreasing in abundance due to human caused factors. Expanding pollinator habitat in riparian areas is a great way to benefit essential pollinator species while also promoting many of the City of Durham's water quality goals. Pollinator habitat can replace turf areas and requires less maintenance while providing an attractive landscape feature. City staff would work to remove existing turfgrass or other vegetation and seed a variety of native grass and flowers. These areas would only need to be mowed each October.

VEGETATION ISLAND ESTABLISHMENT
The continuous buffers established by large scale tree & shrub planting are often incompatible with other uses. One method to expand riparian buffers while preserving open space for other purposes is to create series of smaller "vegetation islands" that would still provide water quality benefits. Each island would be multi-tiered and set around one to two canopy trees. Multiple layers of smaller trees, shrubs, taller grass and flowers, groundcover, and vines would surround the larger trees to maximize aesthetics and niche space for wildlife. Species would be intentionally selected to promote wildlife and aesthetic values.

INVASIVE PLANT MANAGEMENT
Invasive plant species pose a serious threat to native riparian plant communities. Furthermore, some invasive plants, such as autumn olive (*Elaeagnus*), fix atmospheric nitrogen and release it into the soil where it can be taken up by waterbodies. Many invasive plant populations can be managed through mechanical & chemical techniques.

