

## Regenerative Stormwater Conveyances: Giving Old, Perched Outfalls New Life



28 August 2016 Minneapolis, MN

**Scott Whalen, PE**

Vice President

**Marc Horstman, PE, PH, CFM**

Technical Manager



## Regenerative Stormwater Conveyances: Giving Old, Perched Outfalls New Life

- Problems
- Solutions
- RSCs
- Research
- Implementation
- Modeling
- Path Forward



28 August 2016 Minneapolis, MN



# Problem



## "Traditional" Design

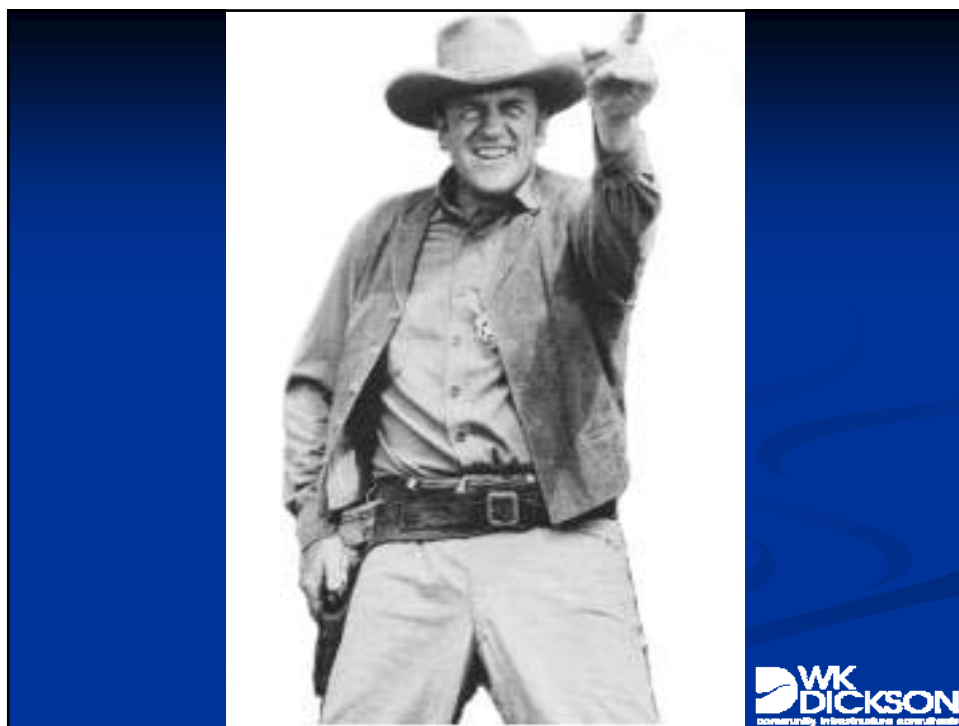


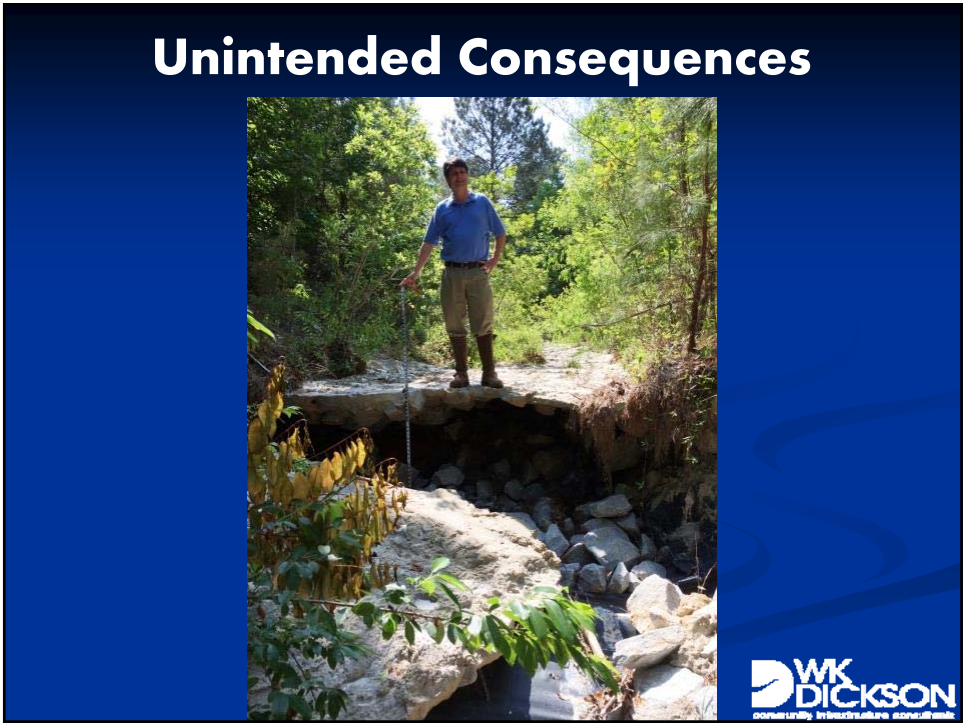
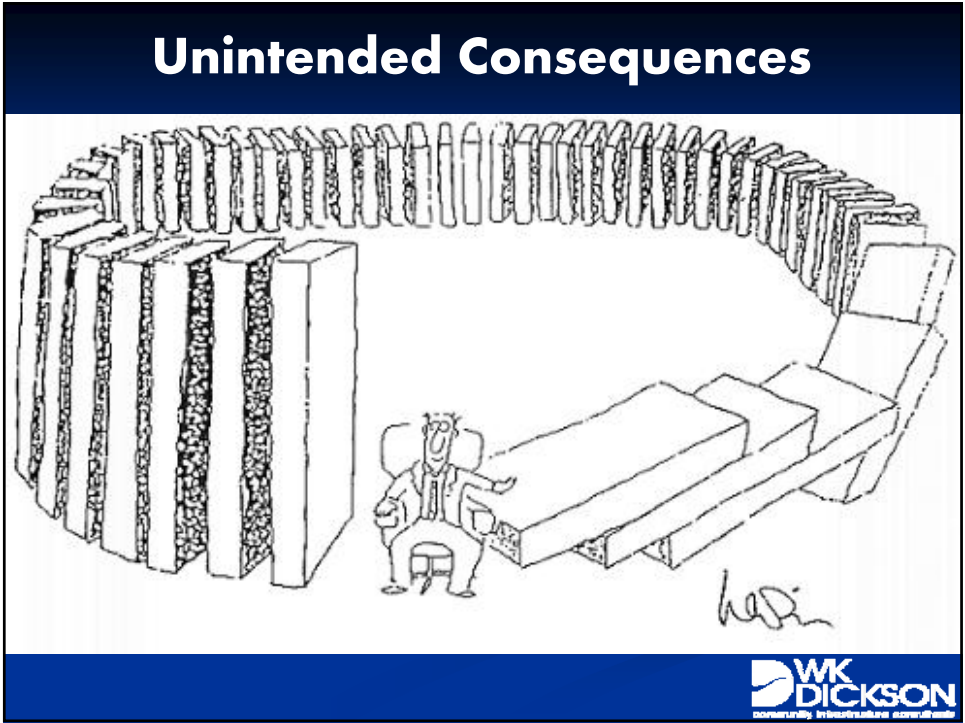
# Conveyance

The collage features four distinct images illustrating different conveyance methods: a wide concrete-lined channel with a fence, a natural-looking rocky stream bed, a stone wall channel in a grassy area, and a technical cross-section diagram of a trapezoidal channel. The diagram includes labels for top width ( $T_f$ ), bottom width ( $T_w$ ), flow depth ( $h$ ), channel slope ( $z_1$ ,  $z_2$ ), and Manning's roughness coefficients ( $n_1$ ,  $n_2$ ,  $n_3$ ). The bottom right corner of the collage contains the WK DICKSON logo.

# Discharge

The collage illustrates three different discharge scenarios: a pipe outlet with a stone check dam, a pipe outlet with a concrete wall, and a close-up of water flowing over a spillway. The bottom right corner of the collage contains the WK DICKSON logo.







## Unintended Consequences



## Unintended Consequences



## Unintended Consequences



## Unintended Consequences



## Unintended Consequences





# Unintended Consequences

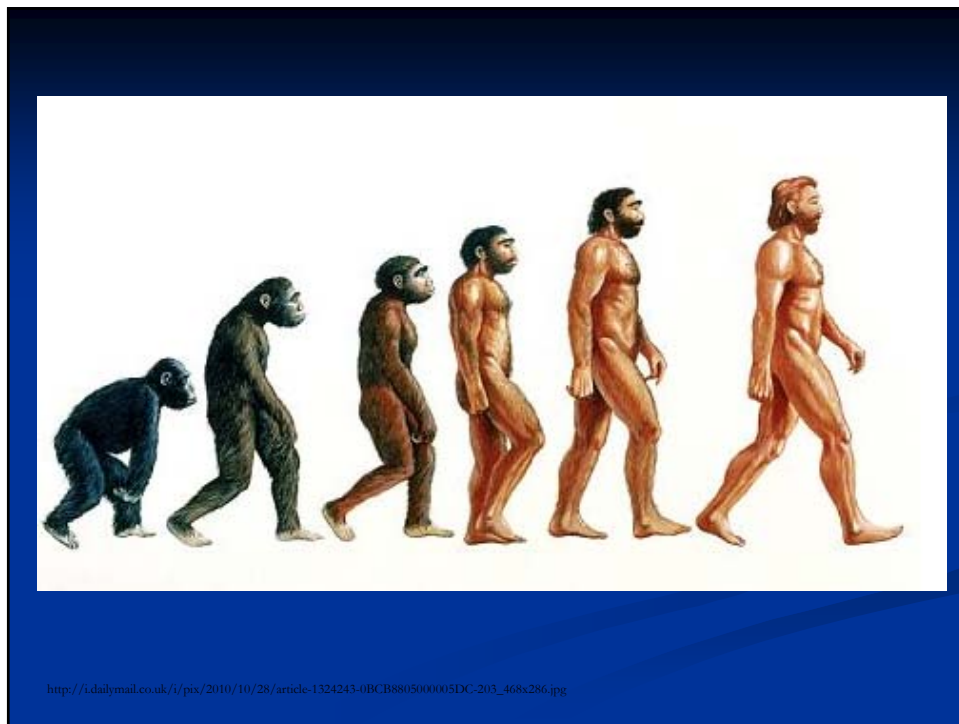


## HUNDREDS OF GALLONS GO



—Observer Staff Photo.  
**POURING PARTY STAGED**—Upper photo shows scandalous evidence of numerous officials, including Solicitor Carpenter and Chief of Rural Police Vic Fesperman, supporting themselves and their friends on liquor. Lower picture shows what happened to the “platform” a few minutes later.





# Solutions



The WK Dickson logo is located in the bottom right corner of the blue box. It features the letters 'WK' in a large, bold, white font above the word 'DICKSON' in a smaller, bold, white font. Below 'DICKSON' is the tagline 'community infrastructure consultants' in a very small, white font.

## Modern Design



## Modern Design



## Modern Design



## Modern Design



## Traditional Retrofits

- Quantity/velocity

**OR**

- Quality

**NOT BOTH**

- Expensive

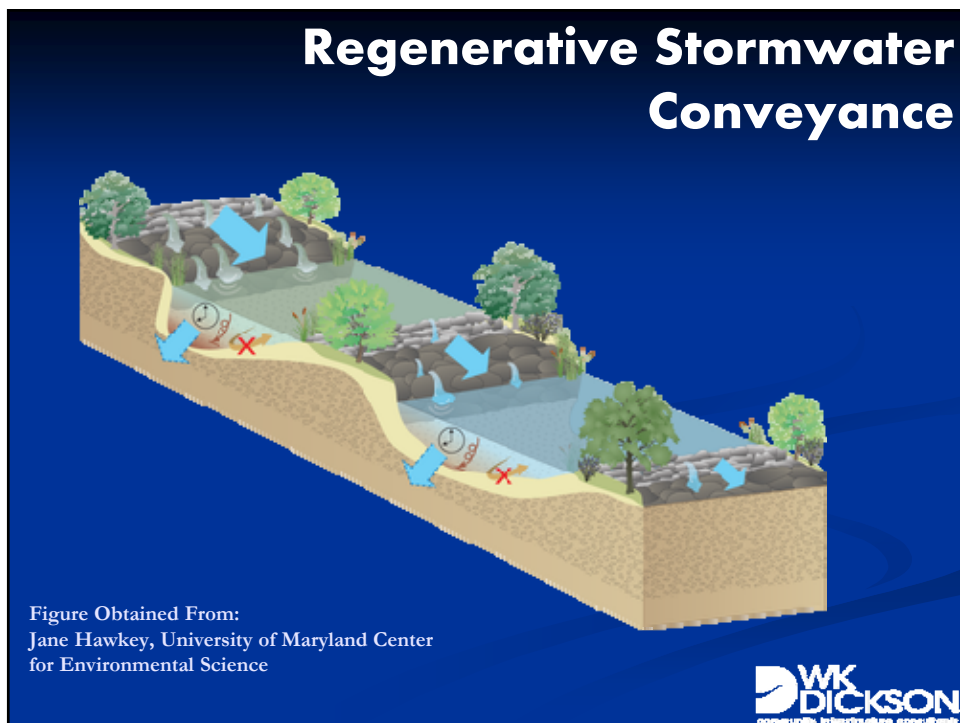


## Traditional Retrofits

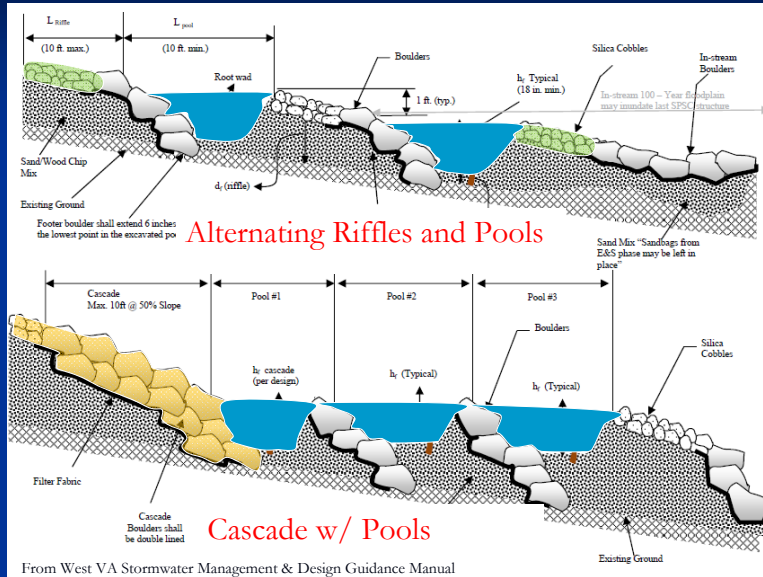




## Regenerative Stormwater Conveyance



# Sequencing



# RSC – Two Birds, One Stone



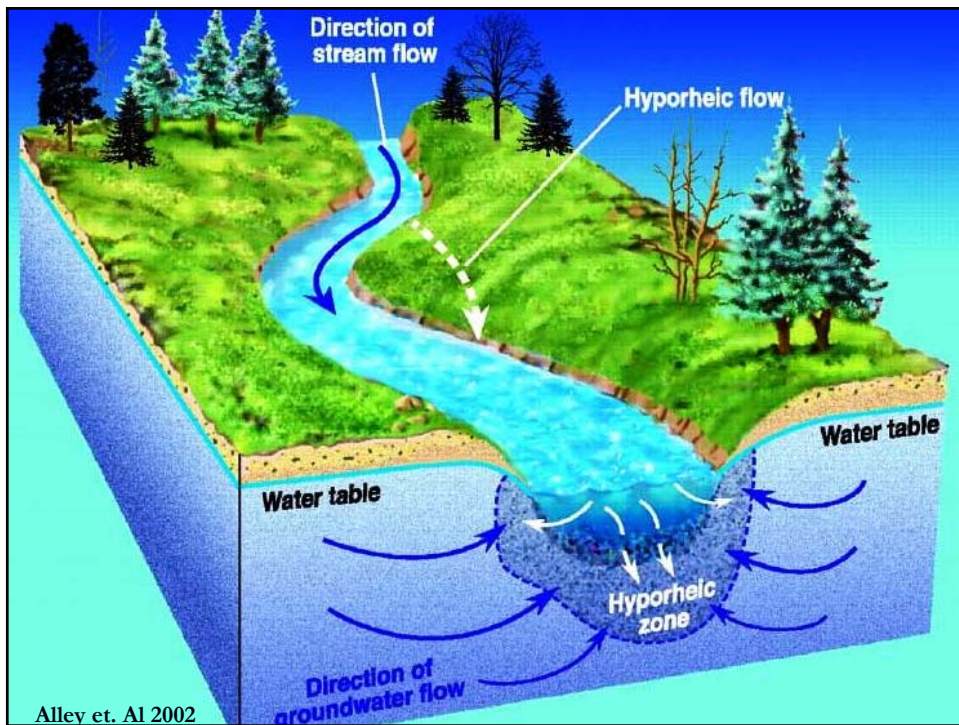
■ Quantity/velocity

AND

■ Quality







## Retrofit: RSC

### Regenerative Stormwater Conveyance

#### Substrate

- Infiltration
- Detention
- Filtering
- Nutrient uptake  
(anaerobic decomposition)







## Retrofit: RSC

### Regenerative Stormwater Conveyance

#### Riffles, Pools and Cascades

- Energy Dissipaters
  - Sedimentation
  - Reduce shear stress
    - Lateral and vertical erosion







## Retrofit: RSC

### Regenerative Stormwater Conveyance

**Riffles, Pools, and Cascades**

- Grade Control
- Storage
  - infiltration
- Widen flow path
  - infiltration


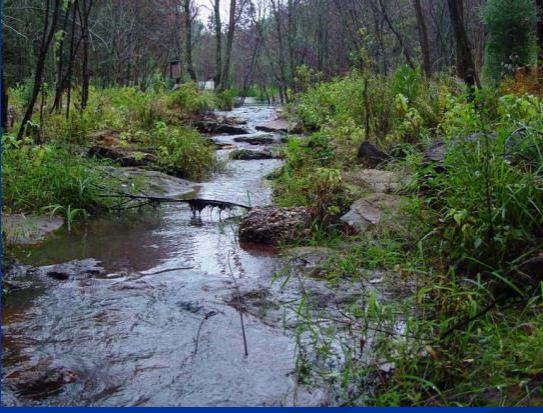


## Retrofit: RSC

### Regenerative Stormwater Conveyance

**Vegetation**

- Native
- Nutrient uptake
- Aesthetics
- Energy Dissipation
- Bank/substrate Stabilization (root mass)







## Retrofit: RSC

### Regenerative Stormwater Conveyance Effectiveness

- RSC
  - 70% TP
  - 70% TN
  - 90% TSS
- Bioretention
  - 45% TP
  - 35% TN
  - 85% TSS



## Retrofit: RSC

### Regenerative Stormwater Conveyance Effectiveness

- Quantity
  - Storage
  - Delayed Release
  - Velocity/sheer stress reduction



## Retrofit: RSC

### Regenerative Stormwater Conveyance Effectiveness

- Traditional = 2-3 x RSC  
/unit treatment



## Retrofit: RSC

### Regenerative Stormwater Conveyance Effectiveness



# Retrofit: RSC

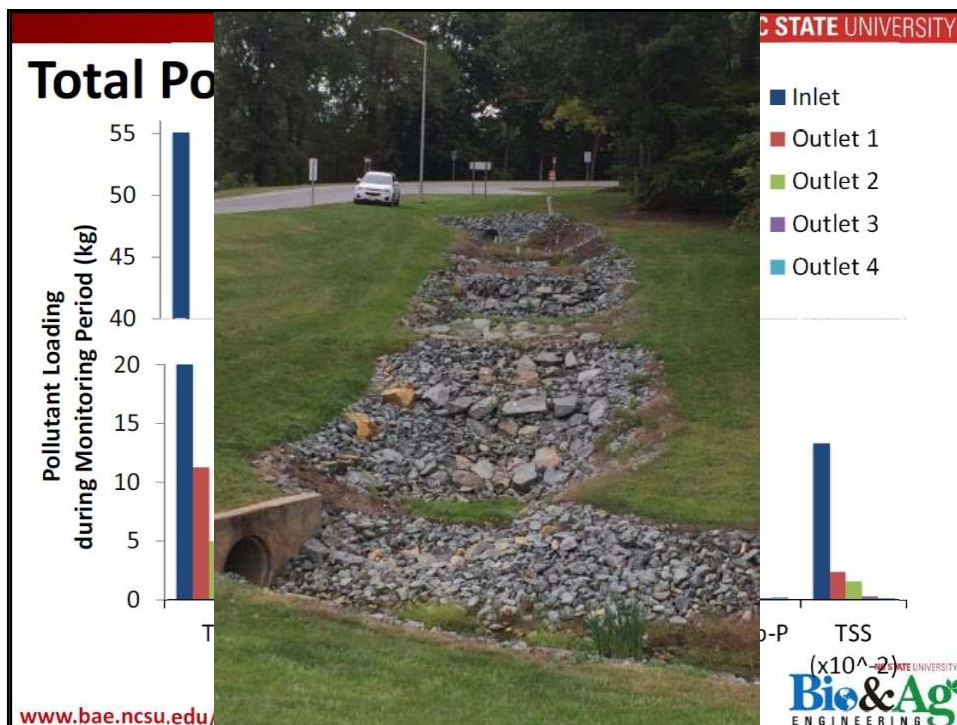
## Regenerative Stormwater Conveyance

# Research




WK DICKSON  
CONSULTING ENGINEERS ARCHITECTS



**Retrofit: RSC**  
**Regenerative Stormwater Conveyance**

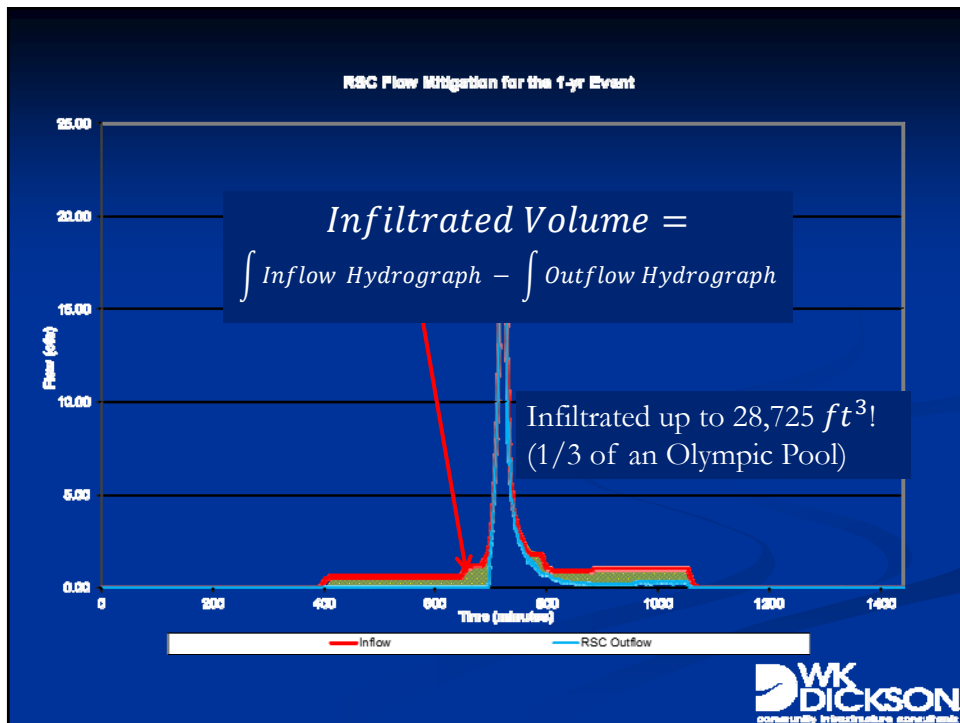
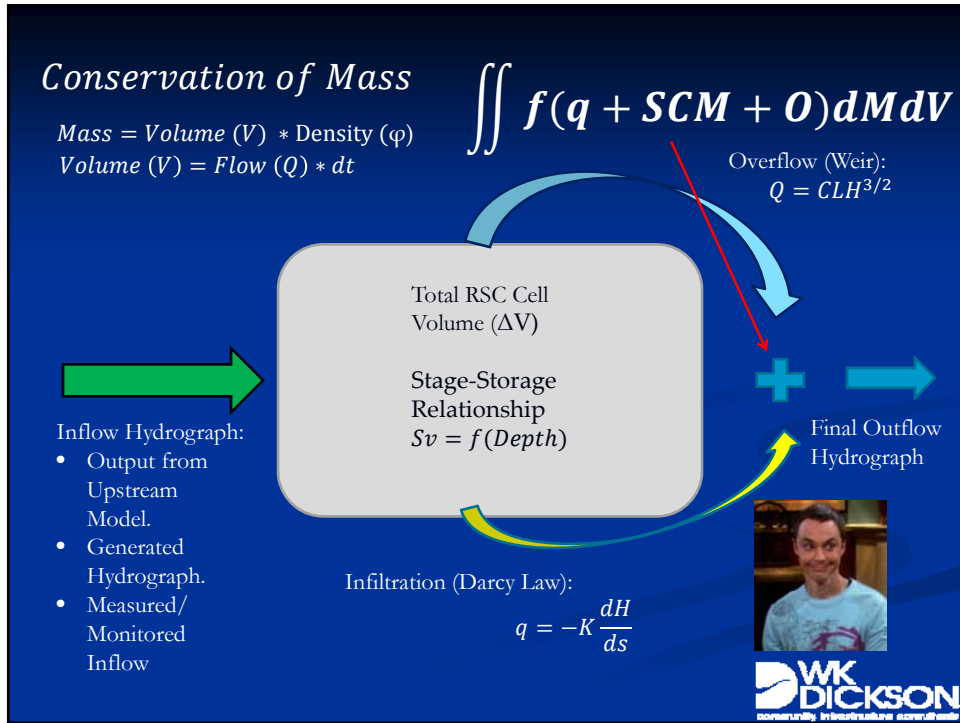
**Modeling**

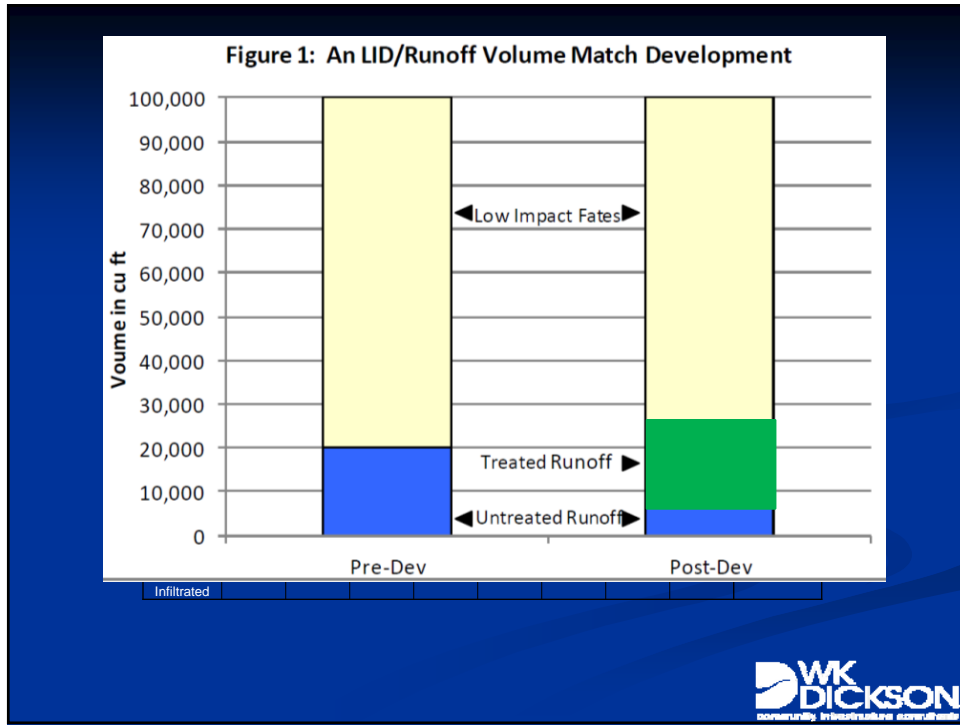


The logo for WK Dickson, a company specializing in water resources, is located in the bottom right corner of the blue slide. It features the letters 'WK' above 'DICKSON' in a bold, sans-serif font, with a stylized wave graphic to the left.









**Retrofit: RSC**  
**Regenerative Stormwater Conveyance**

**Implementation**

**Retrofit: RSC**  
**Regenerative Stormwater Conveyance**  
**Linda Lake**



The logo for Charlotte-Mecklenburg Stormwater Services features a stylized sun with rays on the left and wavy lines representing water below. To the right, the text "Charlotte-Mecklenburg" is in a smaller font, "STORM WATER" is in large, bold, green letters, and "Services" is in a smaller font below it, with wavy lines underneath.



The logo for WK DICKSON consists of a stylized "W" and "K" followed by the name "DICKSON" in a bold, sans-serif font. Below the name, the words "community infrastructure consultants" are written in a smaller font.

**Retrofit: RSC**  
**Regenerative Stormwater Conveyance**  
**Linda Lake**



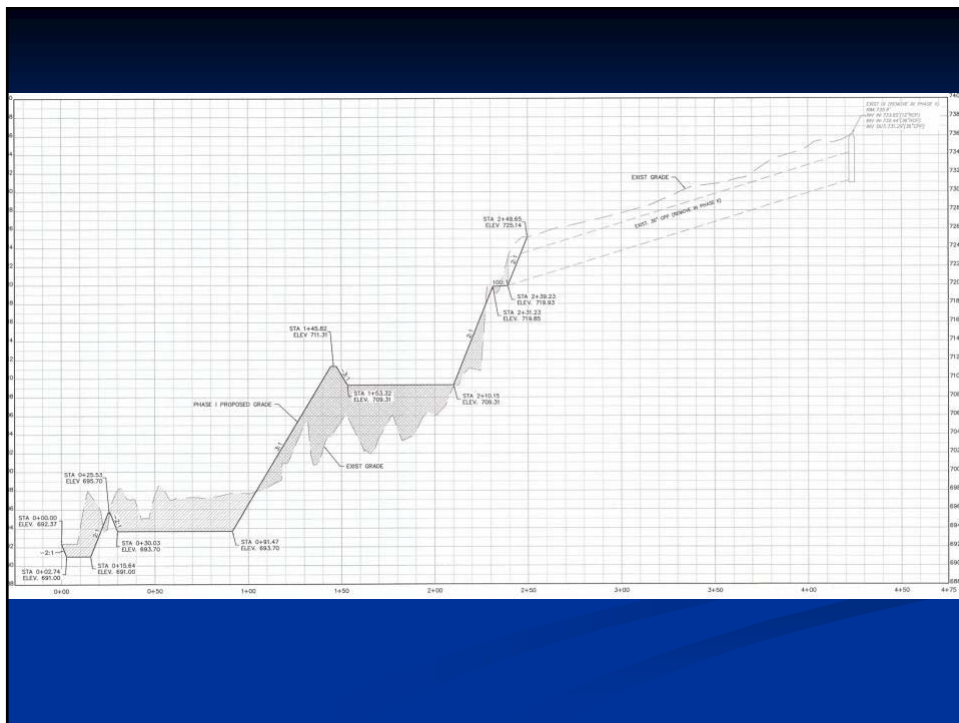
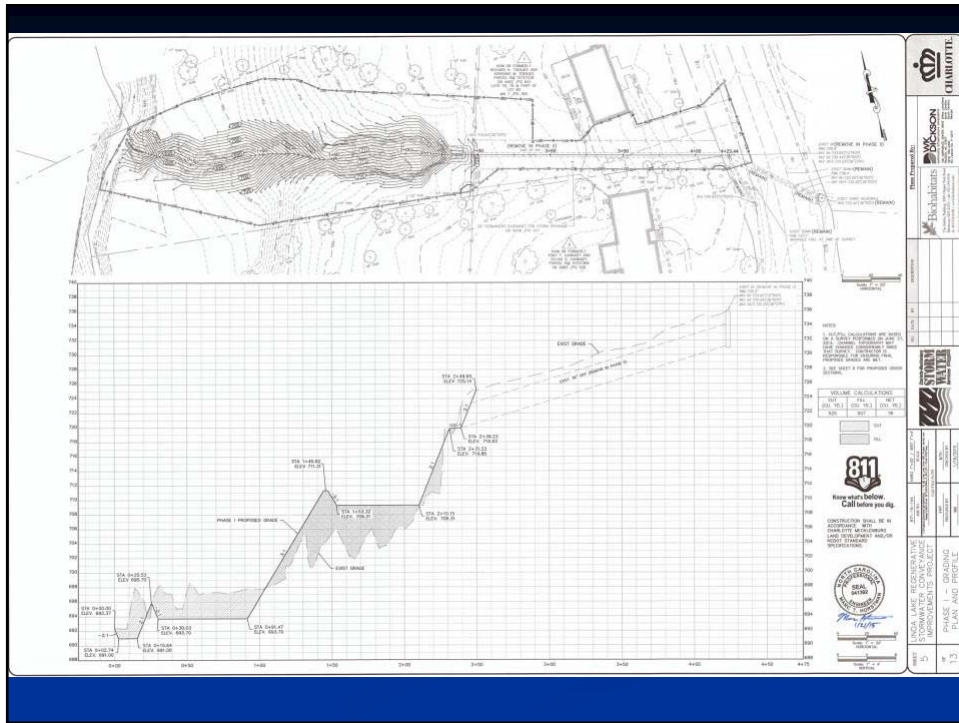
A detailed illustration of a pilot in a brown leather flight suit and goggles. He has a mustache and is smiling, giving a thumbs-up with his right hand. In his left hand, he holds a small, rectangular sign with the word "PILOT" written on it in a simple, blocky font.

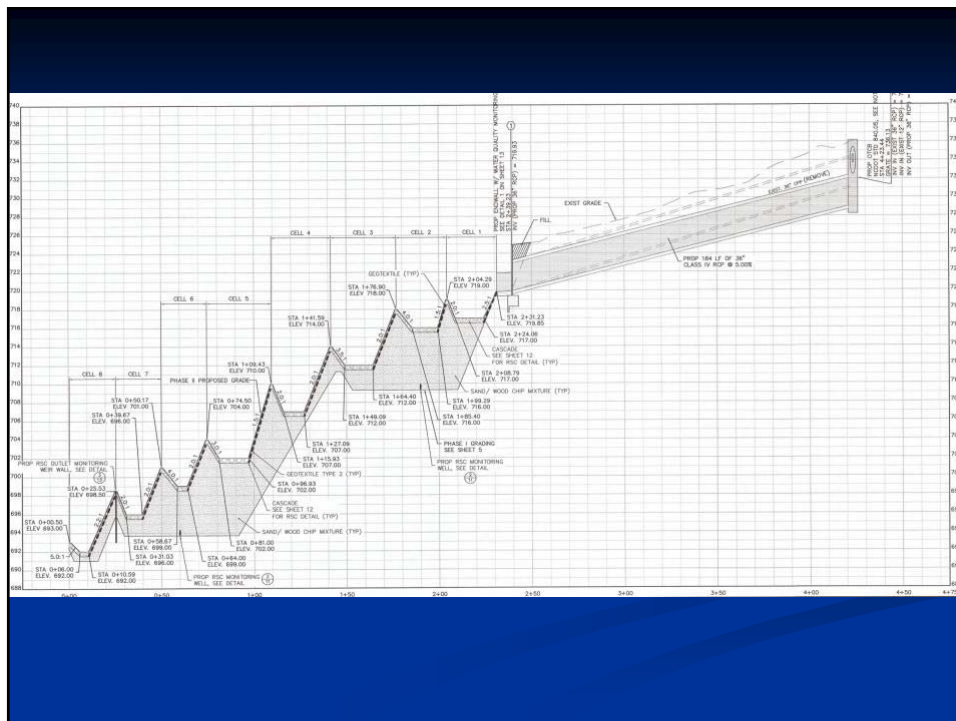
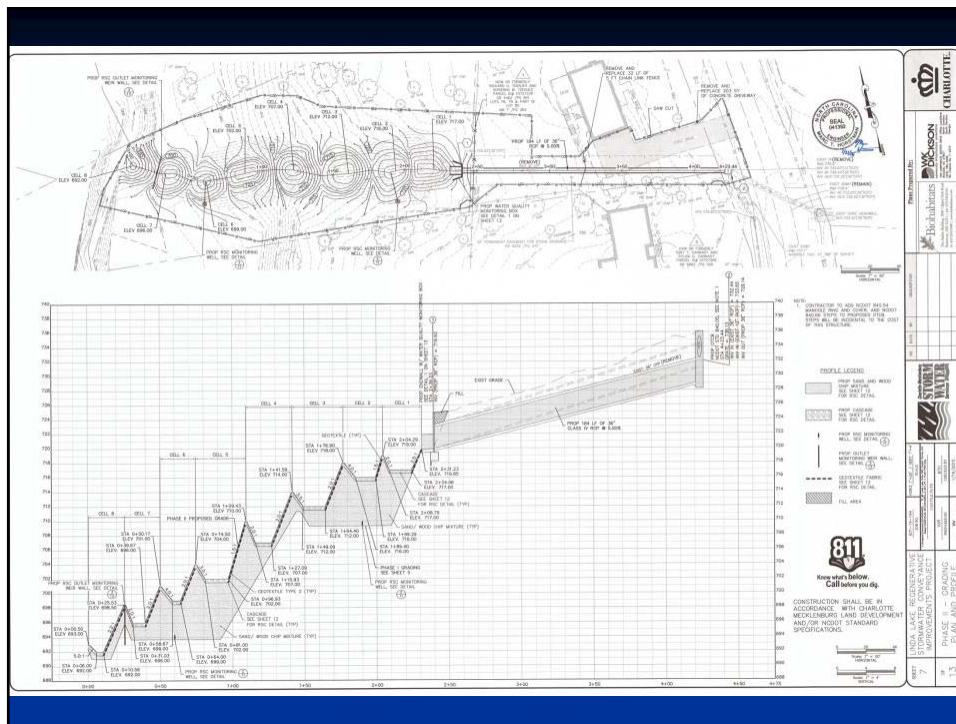


The logo for WK DICKSON consists of a stylized "W" and "K" followed by the name "DICKSON" in a bold, sans-serif font. Below the name, the words "community infrastructure consultants" are written in a smaller font.









## Baffles & IWS Zones

From Anne Arundel County Design Guidelines

- Mimic bio-retention and IWS zones
- Improve WQ performance

**WK DICKSON**  
community infrastructure consultants

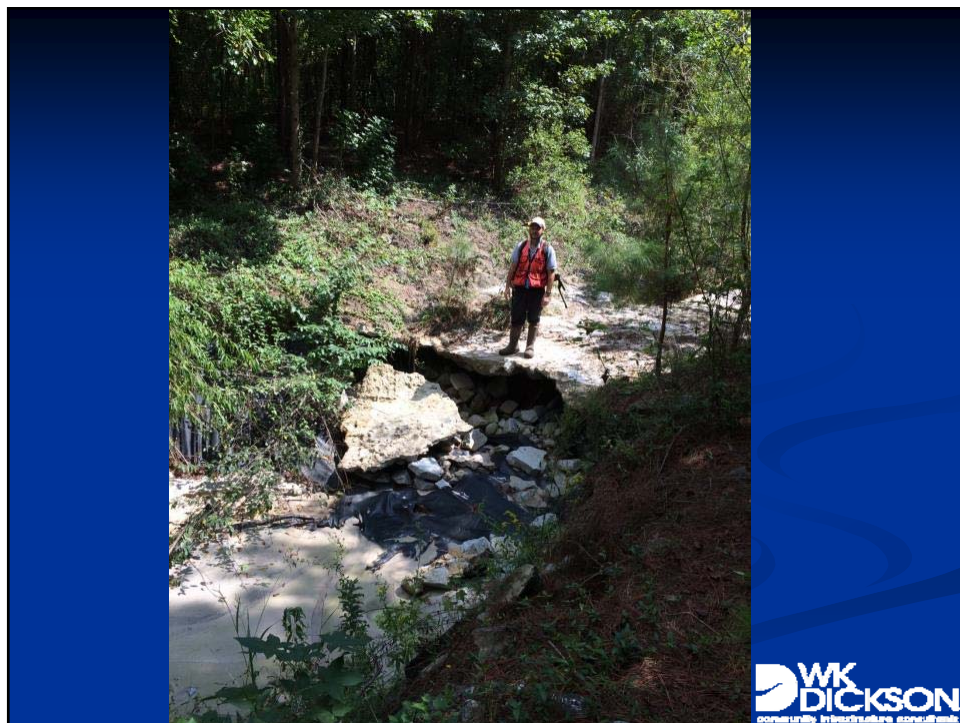
## Retrofit: RSC

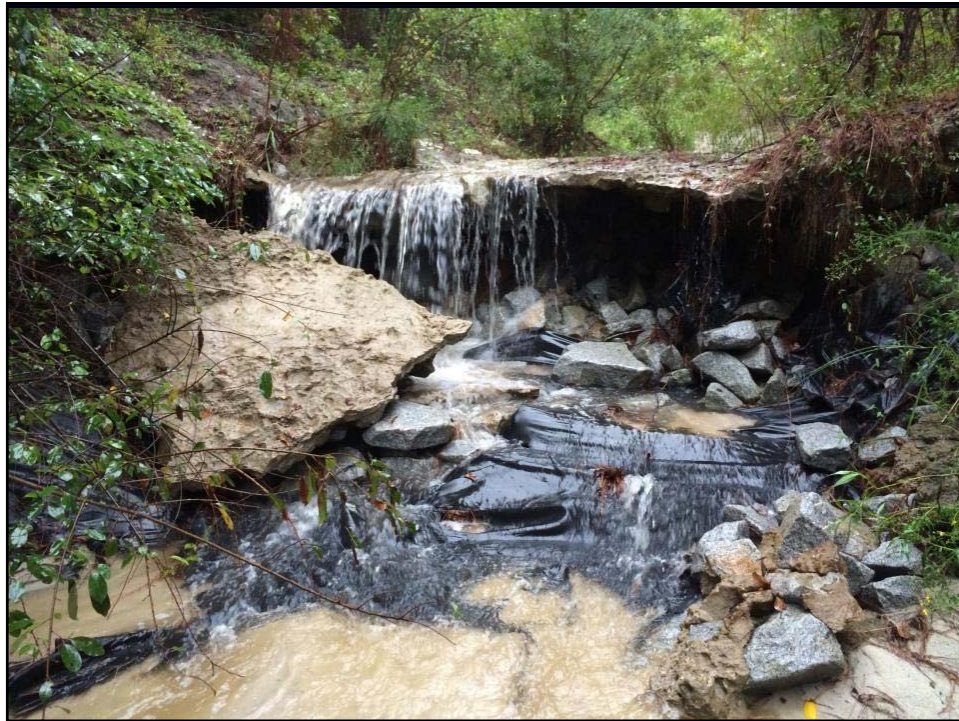
### Regenerative Stormwater Conveyance

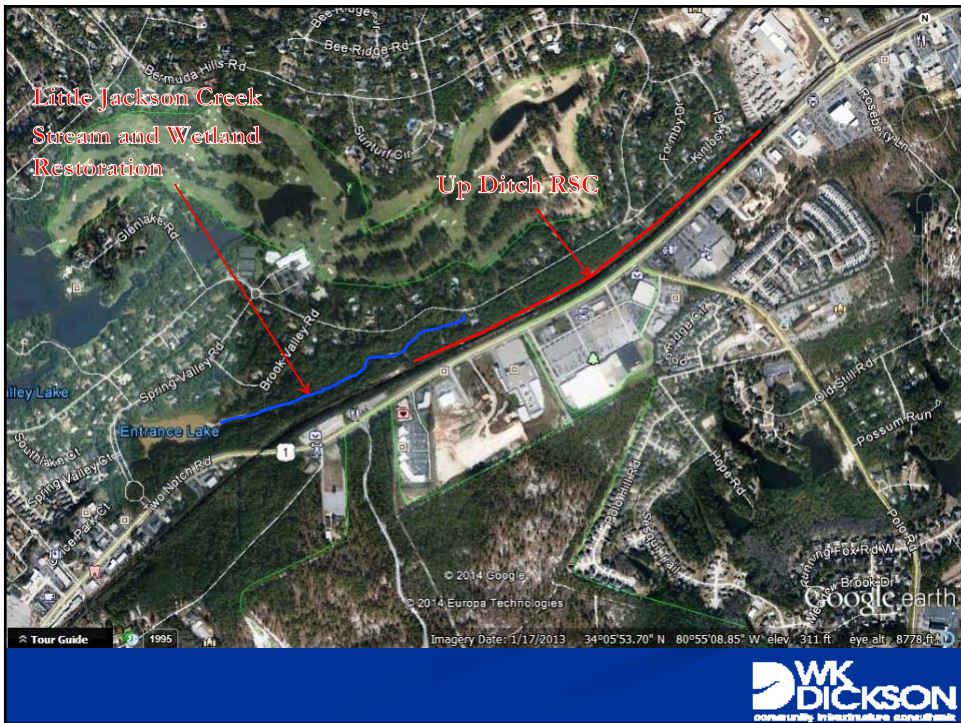
### Little Jackson Creek/Up Ditch

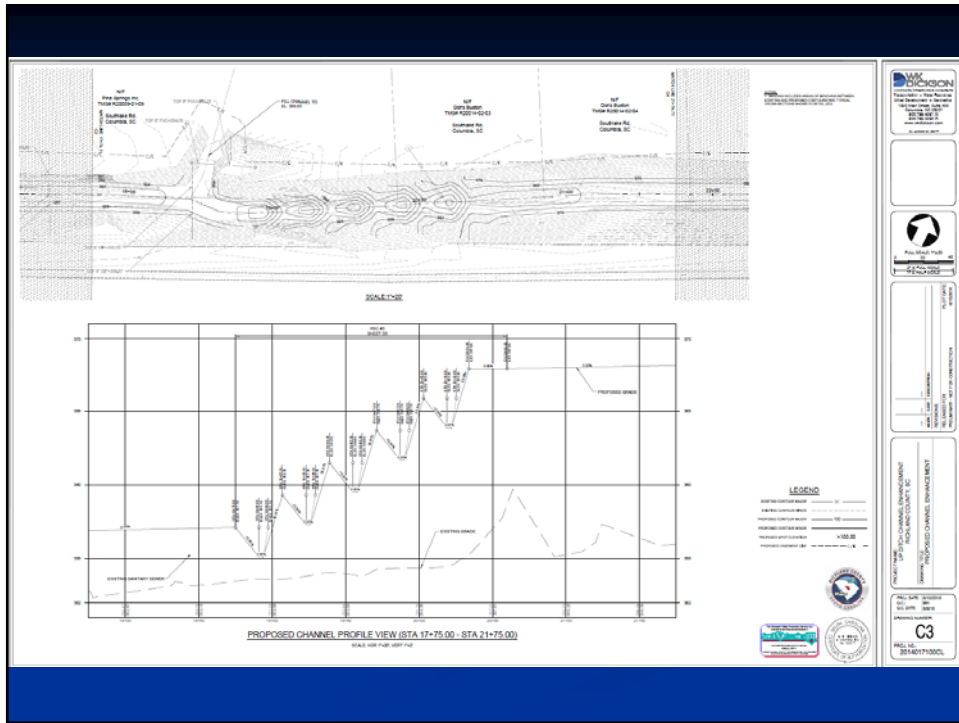
**WK DICKSON**  
community infrastructure consultants

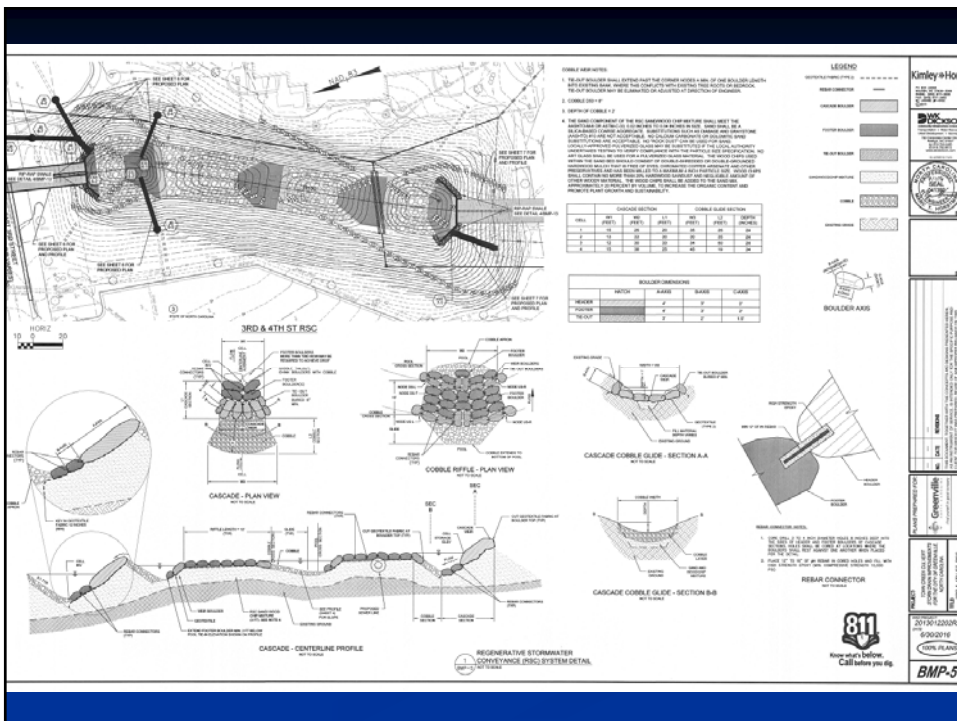






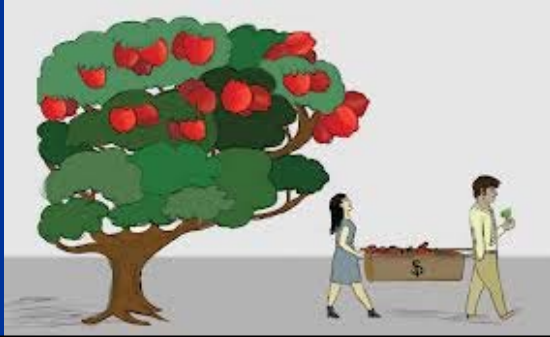









# Path Forward



The slide features a dark blue background with the title "Path Forward" in large white font. Below the title are three logos: "DMS Ecosystem Enhancement PROGRAM" with a green leaf icon, a red square icon containing a white castle, and the "RICHLAND COUNTY STORMWATER SERVICES" logo. An illustration shows a tree with red fruit and a person pushing a cart. The "WK DICKSON" logo is in the bottom right corner.



**NCDOT**

Biofiltration Conveyance



The slide features a dark blue background with the "NCDOT" logo and the text "Biofiltration Conveyance". Below the text are two photographs showing biofiltration structures: one is a long, narrow structure with a concrete curb, and the other is a wider structure with a concrete curb and a large pile of rocks.

Minnesota Pollution Control Agency

Minnesota Stormwater Manual

SpecialSearch > Minnesota Stormwater Manual test page 1 > Main Page > About the Minnesota Stormwater Manual > Main Page

### Minnesota Stormwater Manual

**Information:** Less than three years after being established, the Minnesota Stormwater Manual wiki recently surpassed 5 million hits. Taking advantage of this technology, we continue to update this manual as resources allow. We continue to value your input. If you have comments or suggestions on the format please send them to us using the *Help Improve this Page* box at the bottom of most pages or send an email to [Mike.Trojan@the.mPCA](mailto:Mike.Trojan@the.mPCA).

Welcome to the **Minnesota Stormwater Manual** website. This website was developed using *Mediawiki*, a wiki application that allows for easy editing and that has powerful search abilities. See [introduction to the wiki](#) for more information.

#### Introduction to the Minnesota Stormwater Manual

- [About the Minnesota Stormwater Manual](#)
- [Help](#)
- [Disclaimers](#)

#### Stormwater concepts and stormwater management

- [General Information: Overview, research, references](#)
- [Stormwater treatment concepts: Treatment train, BMP selection](#)
- [Alleviating compaction from construction activities](#)
- [Liners for stormwater management](#)

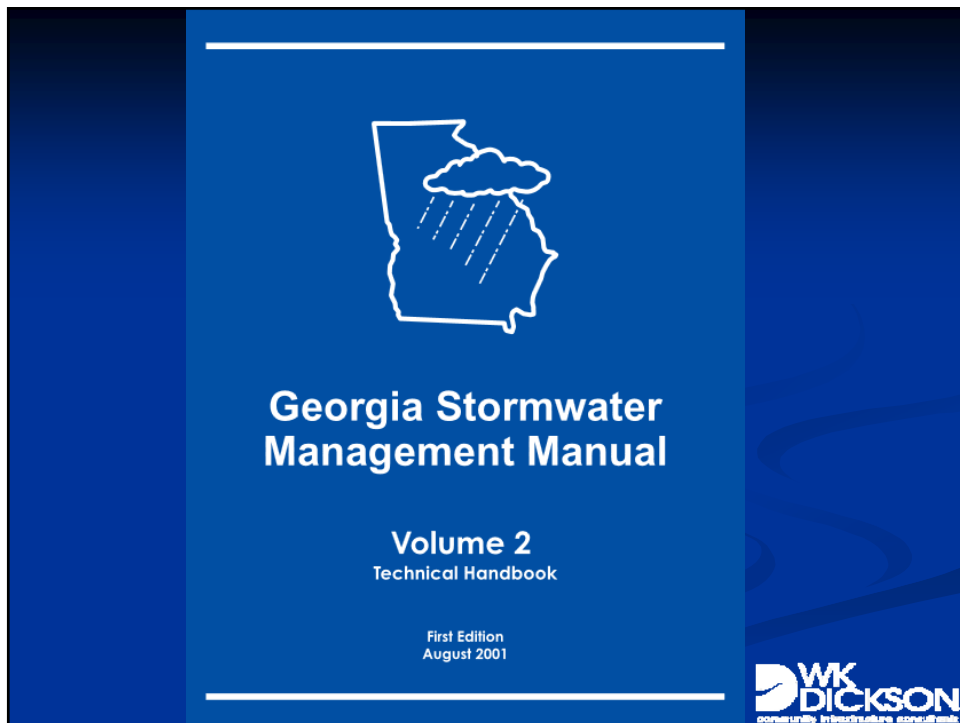
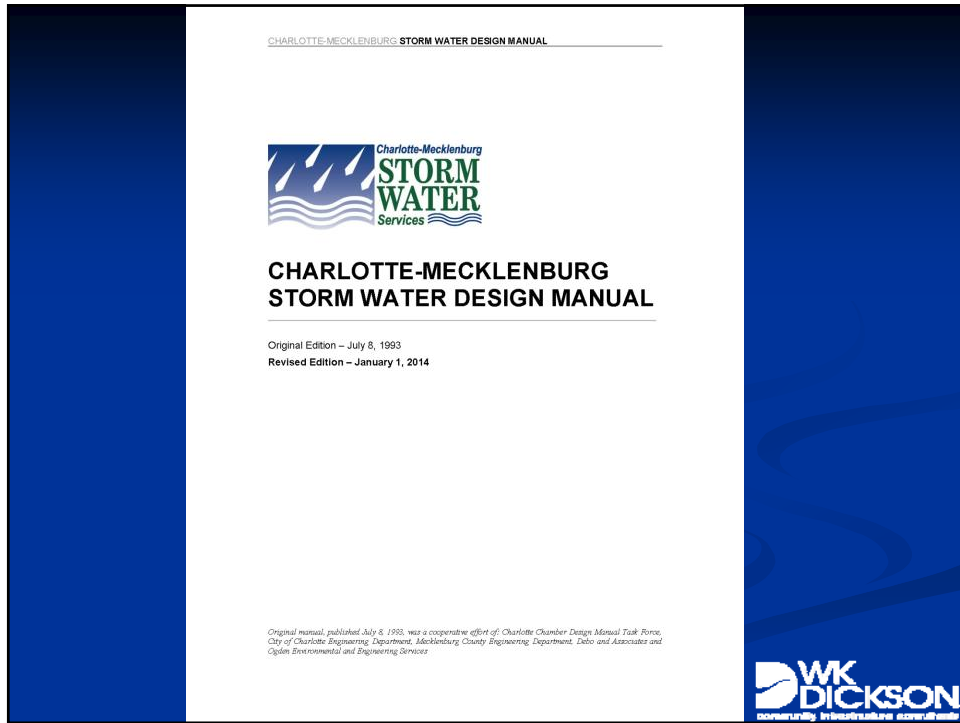
WK DICKSON  
community infrastructure consultants

## West Virginia Stormwater Management and Design Guidance Manual

West Virginia Department of Environmental Protection  
November 2012

WK DICKSON  
community infrastructure consultants







**Scott Whalen, PE**

Vice President

919-782-0495

[swhalen@wk dickson.com](mailto:swhalen@wk dickson.com)

**Marc Horstman, PE, PH, CFM**

Technical Manager

919-782-0495

[mhorstman@wk dickson.com](mailto:mhorstman@wk dickson.com)

