Regenerative Stormwater Conveyances: Giving Old, Perched Outfalls New Life

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SeSwA Southeast Stormwater Association

10th Annual Regional Conference

15 October 2015 Chattanooga, TN

Regenerative Stormwater Conveyances: Giving Old, Perched Outfalls New Life

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

SeSwA Southeast Stormwater Association

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10th Annual Regional Conference
15 October 2015 Chattanooga, TN

Problem

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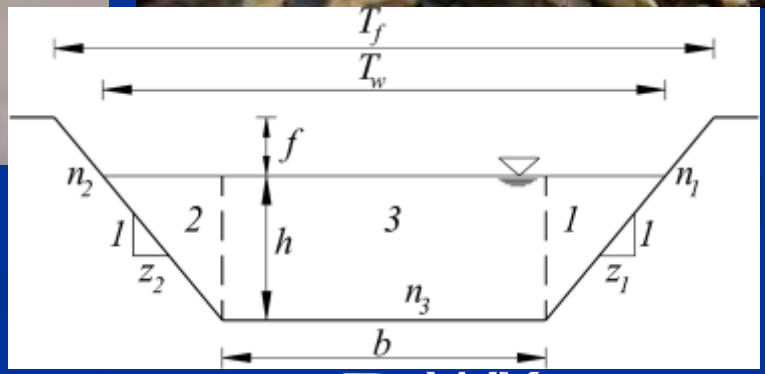
“Traditional” Design

Conveyance



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Discharge

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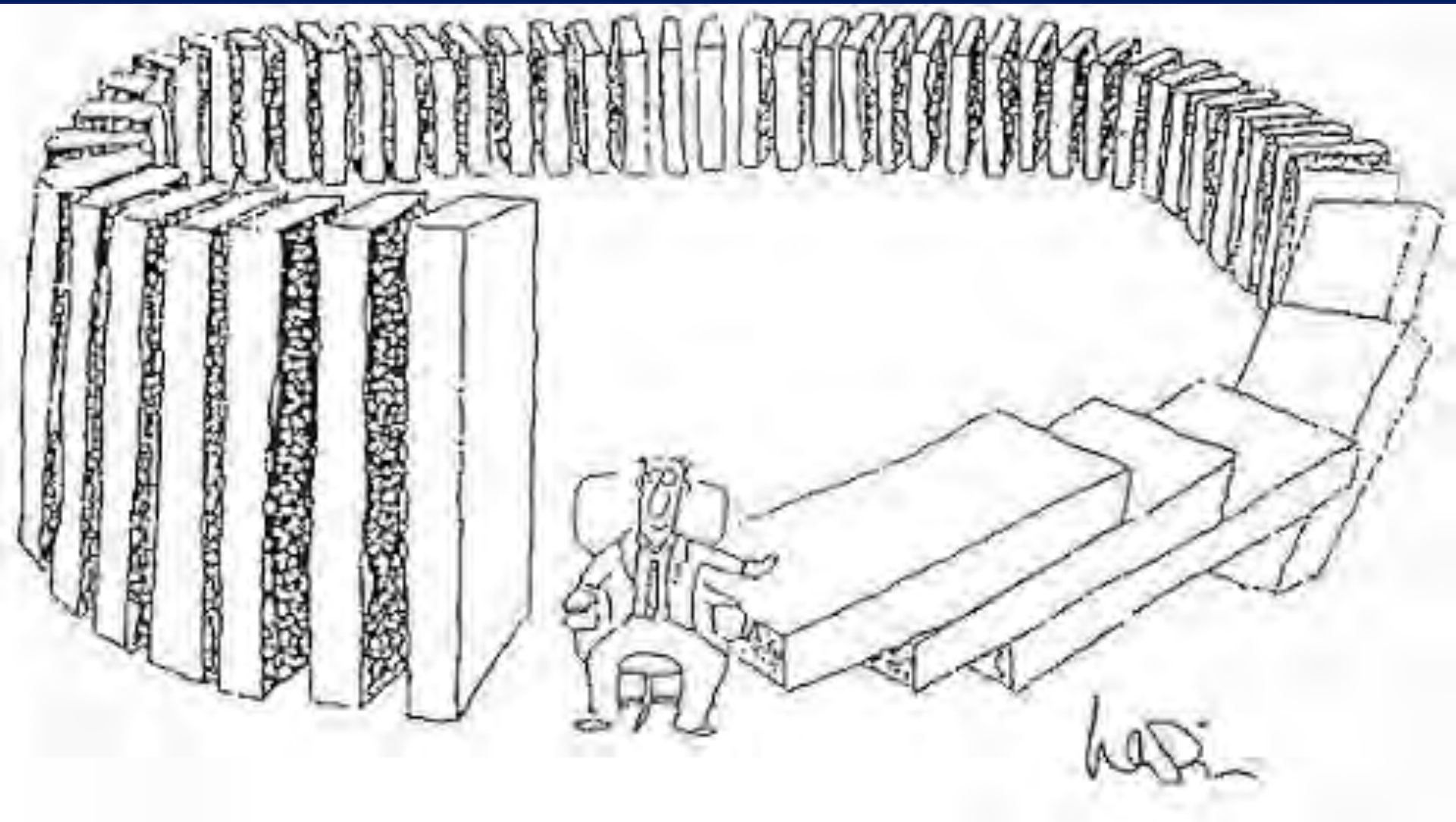
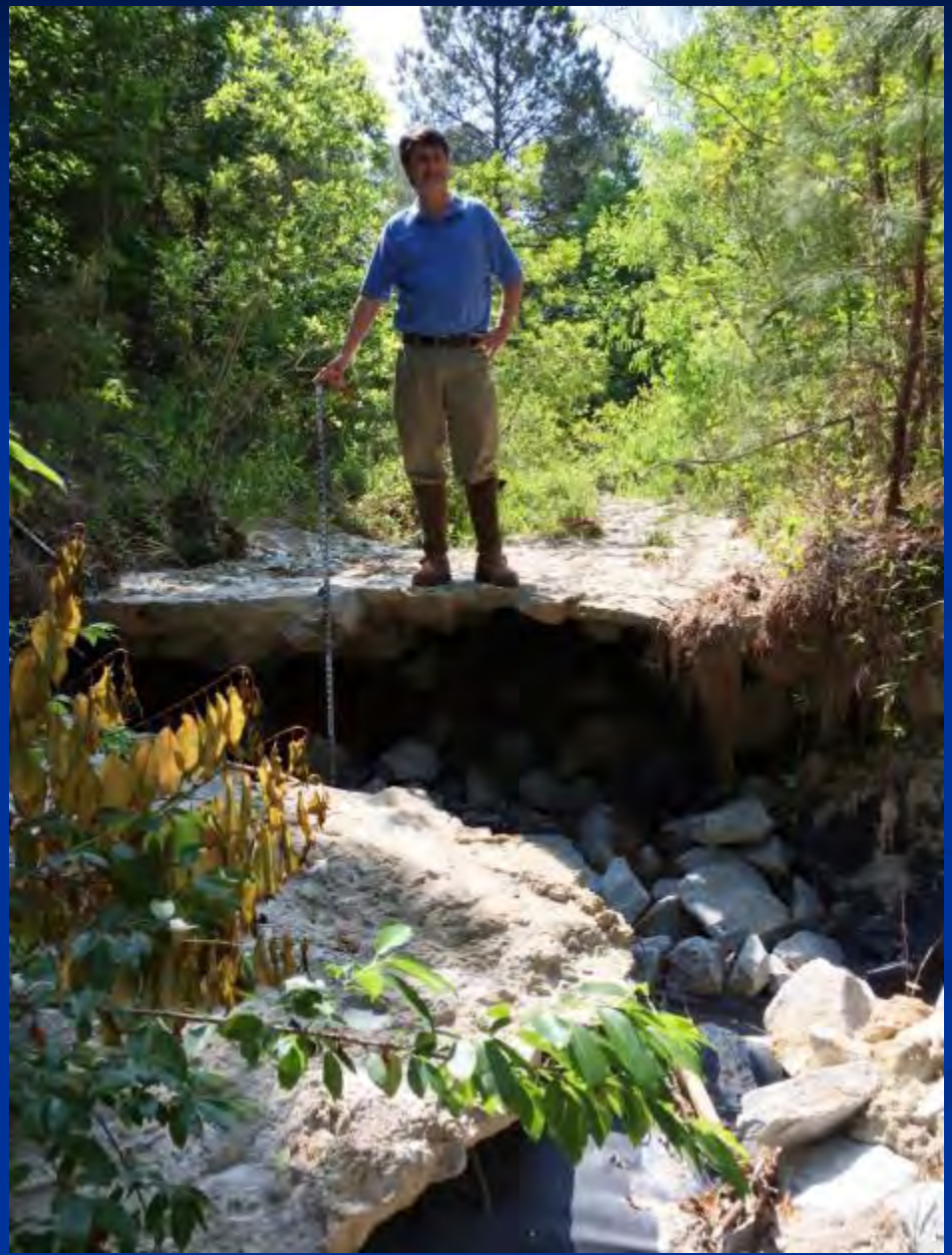
Unintended Consequences



Unintended Consequences



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Unintended Consequences

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Unintended Consequences

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Unintended Consequences

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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.

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¡GUILTY!

Solutions

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Modern Design

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Modern Design

Modern Design

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Modern Design

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Traditional Retrofits

- Quantity/velocity

OR

- Quality

NOT BOTH

- Expensive

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Traditional Retrofits

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Regenerative Stormwater Conveyance

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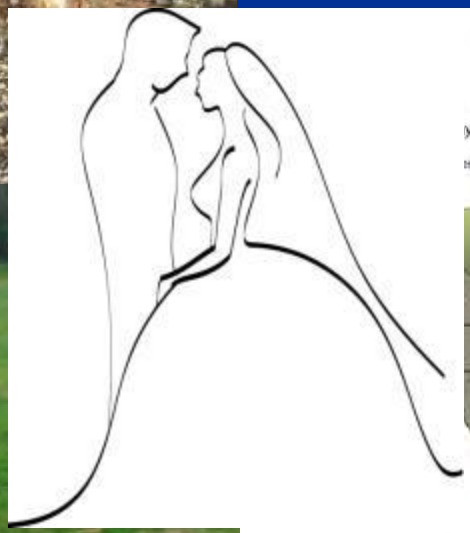

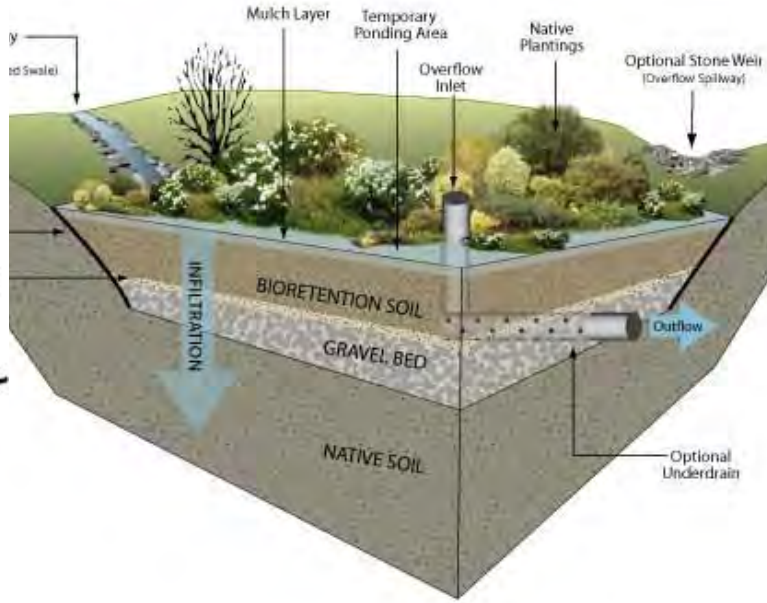

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Regenerative Stormwater Conveyance

Figure Obtained From:
Jane Hawkey, University of Maryland Center for Environmental Science

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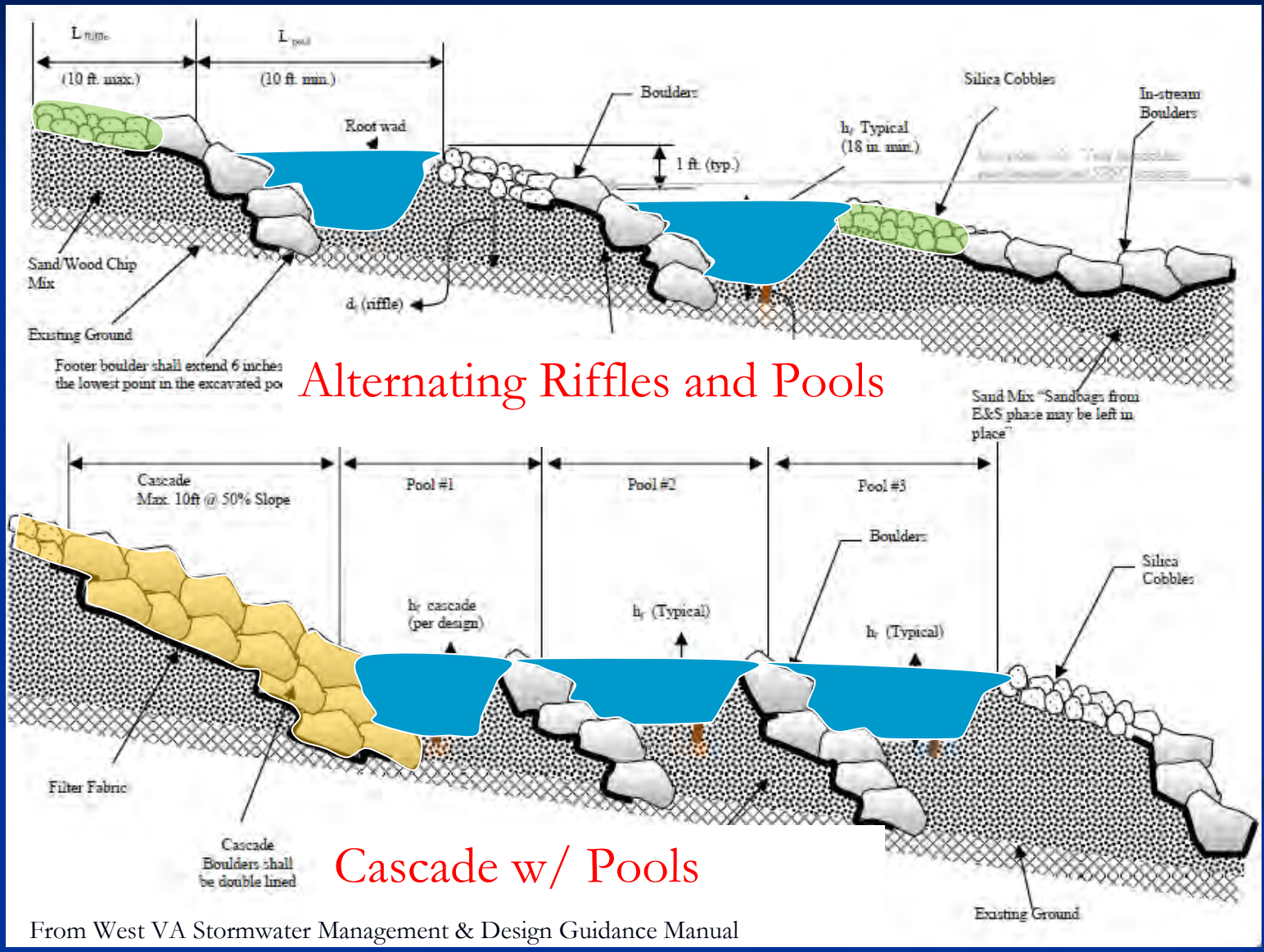
Sequencing



From West VA Stormwater Management & Design Guidance Manual

RSC – Two Birds, One Stone

From Piolo Pascual ABS Project

- Quantity/velocity

AND

- Quality

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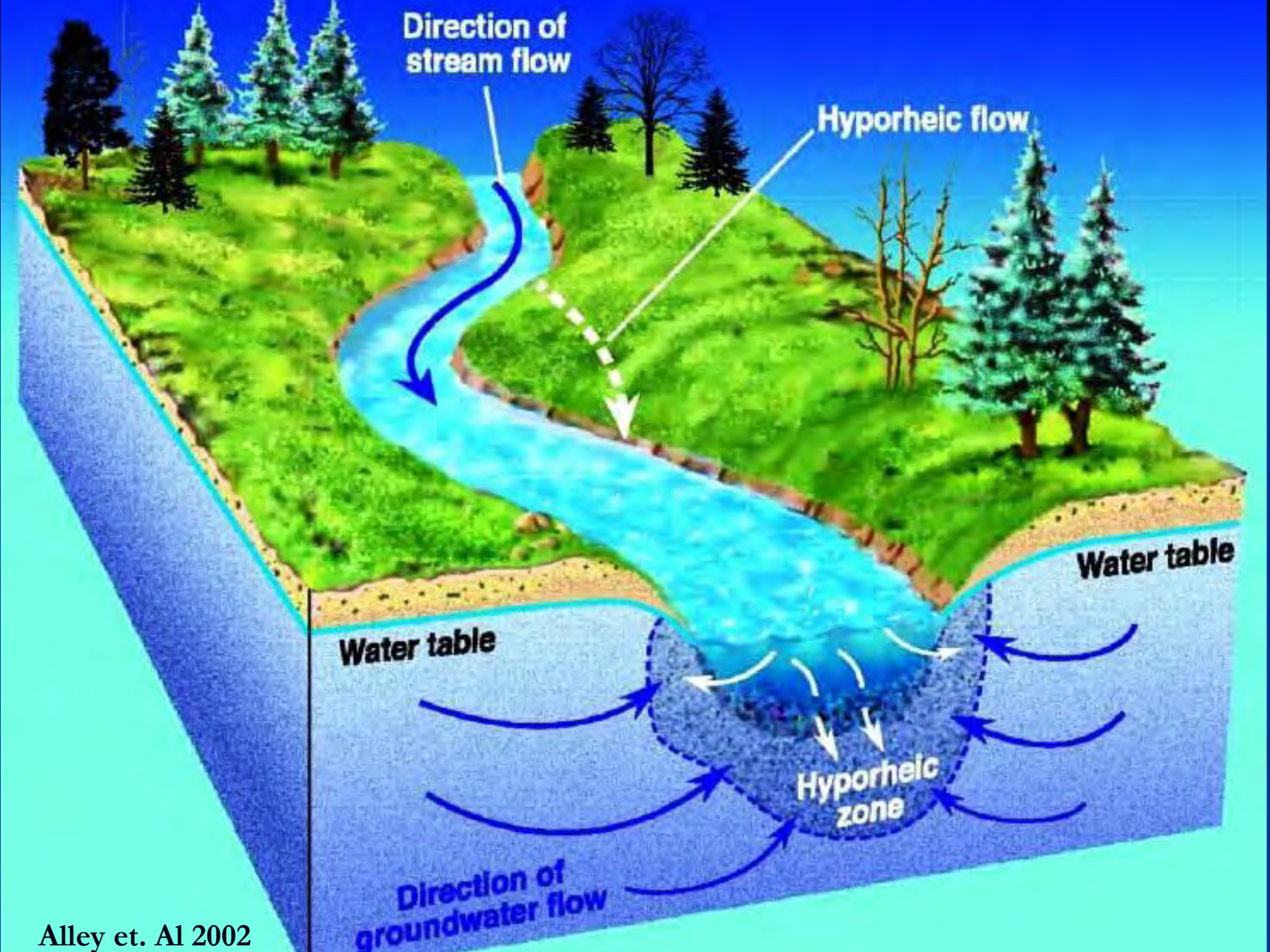

Alley et. Al 2002

Retrofit: RSC

Regenerative Stormwater Conveyance

Substrate

- Infiltration
- Detention
- Filtering
- Nutrient uptake

(anaerobic decomposition)

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Retrofit: RSC

Regenerative Stormwater Conveyance

Riffles, Pools and Cascades

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

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Retrofit: RSC

Regenerative Stormwater Conveyance

Riffles, Pools, and Cascades

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

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Retrofit: RSC

Regenerative Stormwater Conveyance

Vegetation

- Native
- Nutrient uptake
- Aesthetics
- Energy Dissipation
- Bank/substrate

Stabilization (root mass)

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Retrofit: RSC

Regenerative Stormwater Conveyance Effectiveness

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

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Retrofit: RSC
Regenerative Stormwater Conveyance Effectiveness

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

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Retrofit: RSC

Regenerative Stormwater Conveyance Effectiveness

- Traditional = 2-3 x RSC /unit treatment

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Retrofit: RSC

Regenerative Stormwater Conveyance Effectiveness

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Retrofit: RSC

Regenerative Stormwater Conveyance

Research

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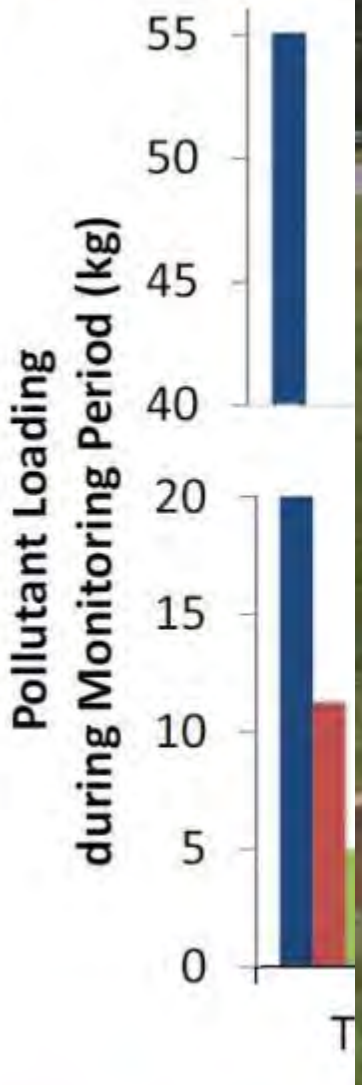
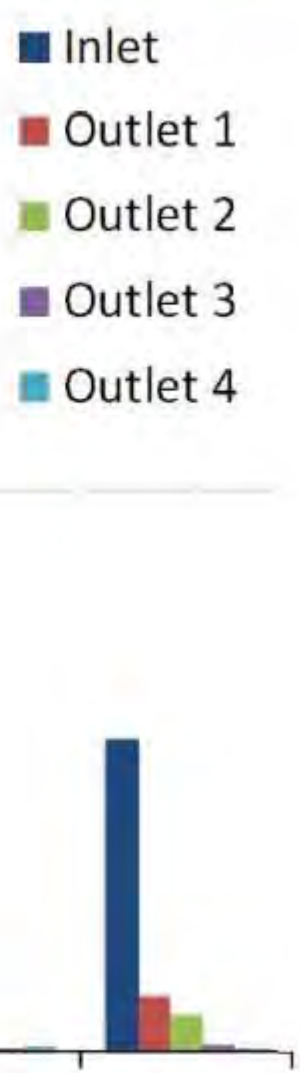
Total Po


Pollutant Loading
during Monitoring Period (kg)
55
50
45
40
20
15
10
5
0
T


Inlet
Outlet 1
Outlet 2
Outlet 3
Outlet 4
o-P
TSS
(x10^-2)

Retrofit: RSC

Regenerative Stormwater Conveyance

Modeling

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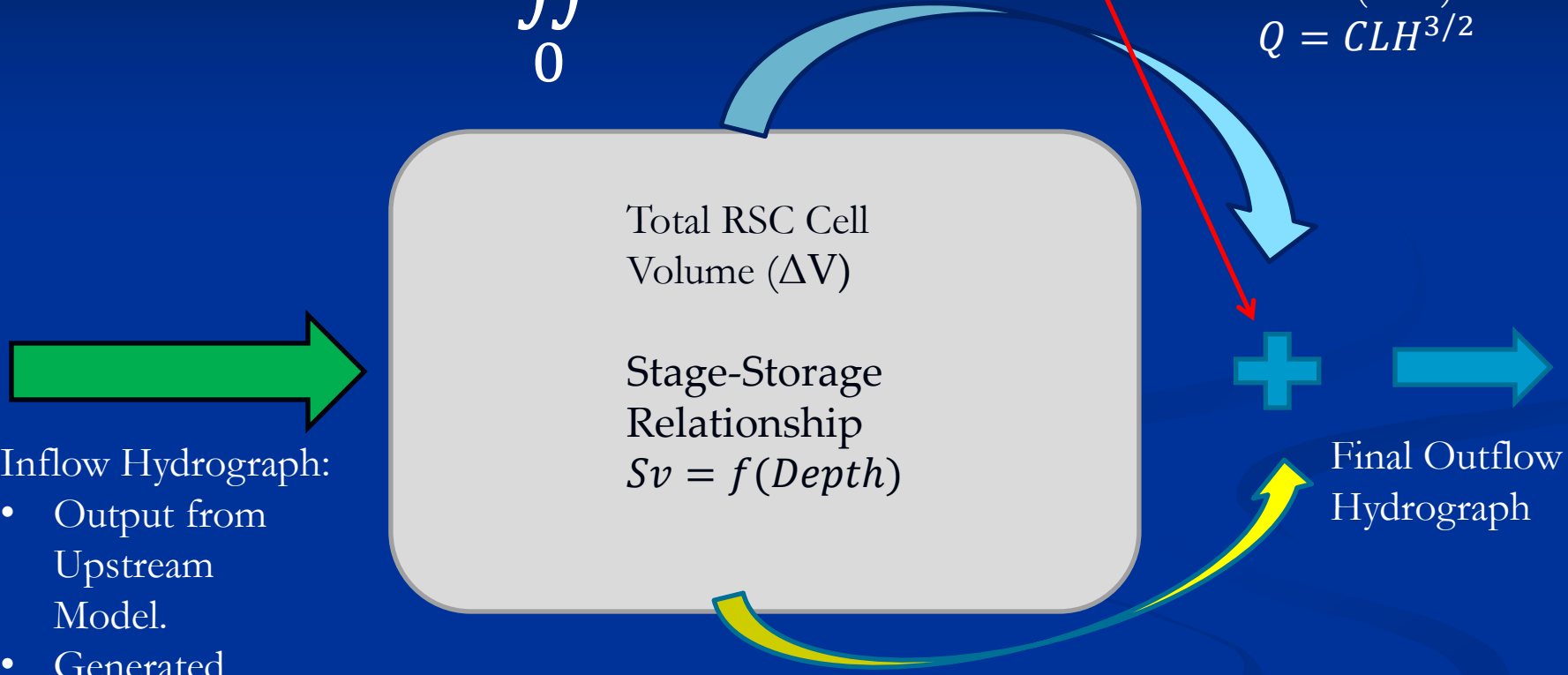
Conservation of Mass

$$\iint_0^{2\pi} r^2 \cos\theta \, dr \, d\theta$$

$Mass = Volume\ (V) * Density\ (\rho)$

$Volume\ (V) = Flow\ (Q) * dt$



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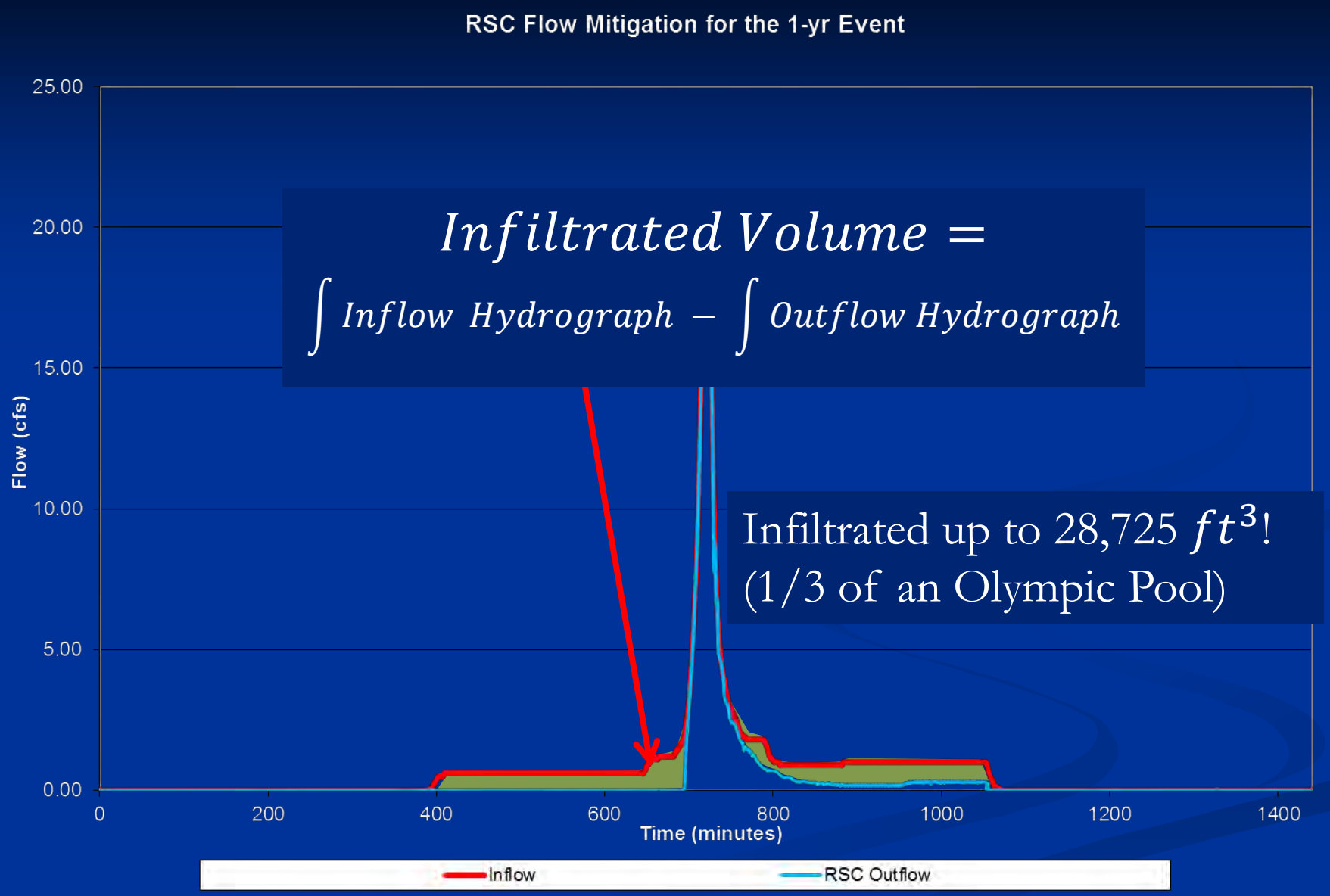

$$Infiltrated\ Volume = \int Inflow\ Hydrograph - \int Outflow\ Hydrograph$$

Infiltrated up to 28,725 ft^3!
(1/3 of an Olympic Pool)

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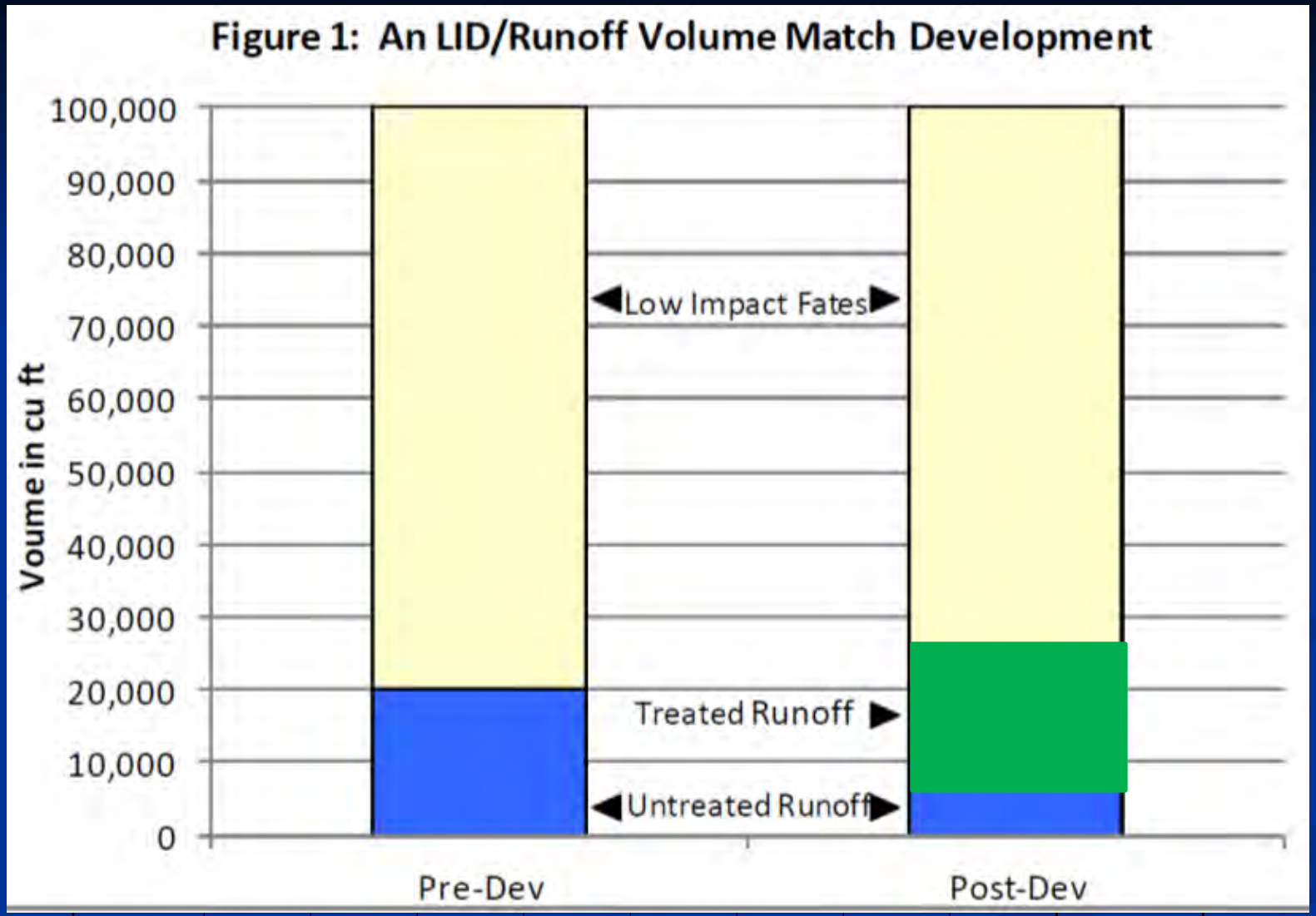

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Retrofit: RSC

Regenerative Stormwater Conveyance

Implementation

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Retrofit: RSC

Regenerative Stormwater Conveyance

Linda Lake

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Retrofit: RSC

Regenerative Stormwater Conveyance

Linda Lake

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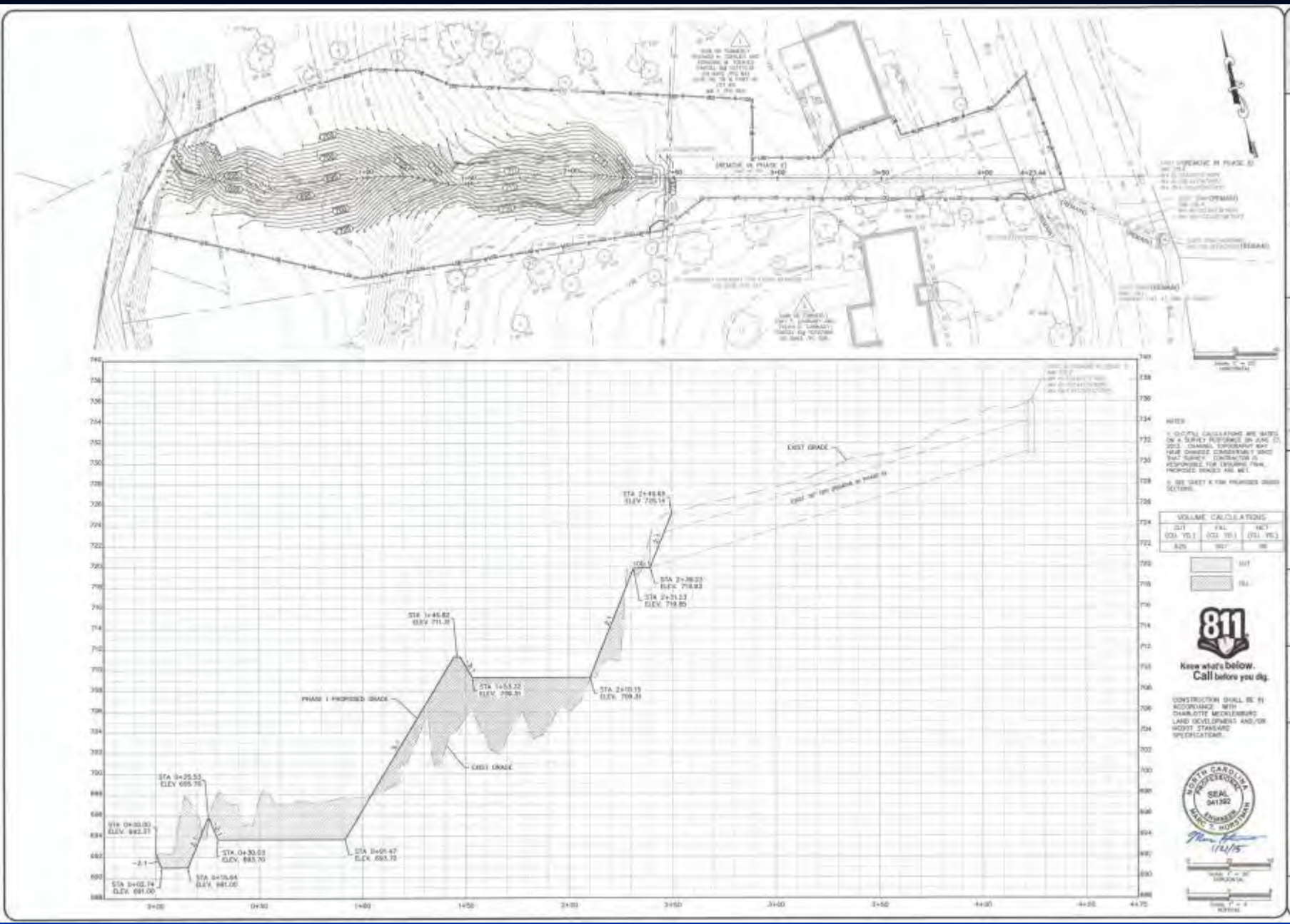
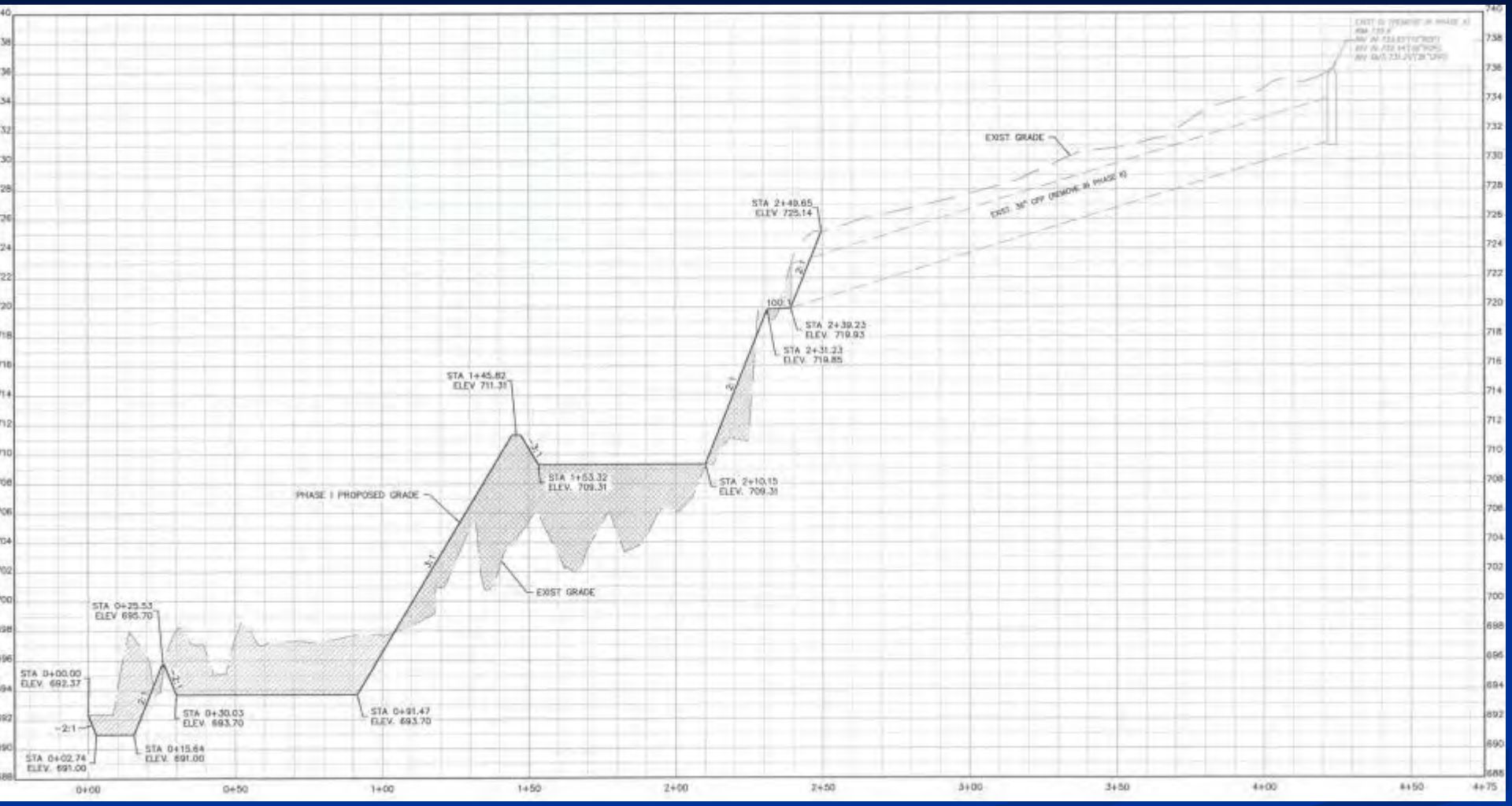
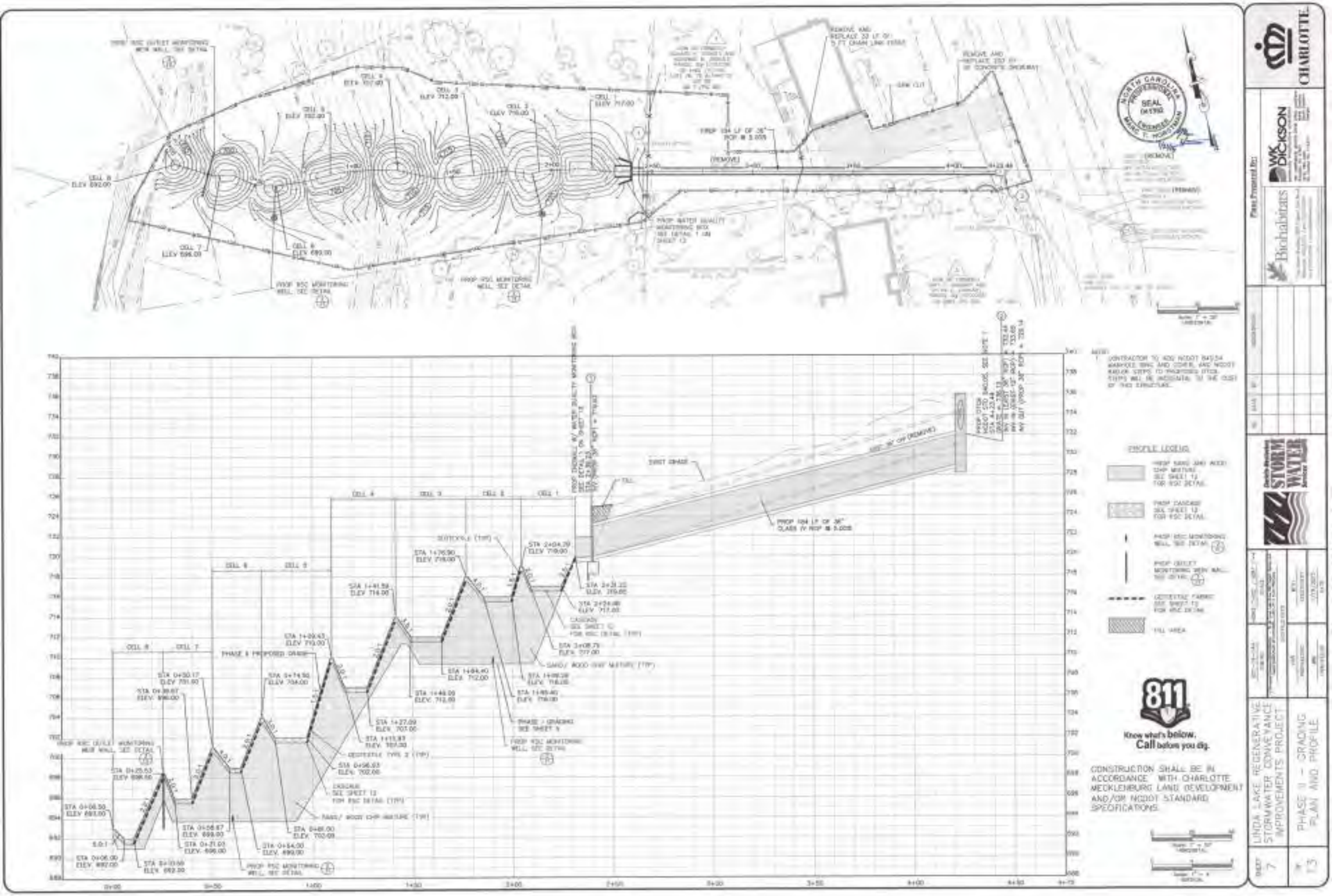
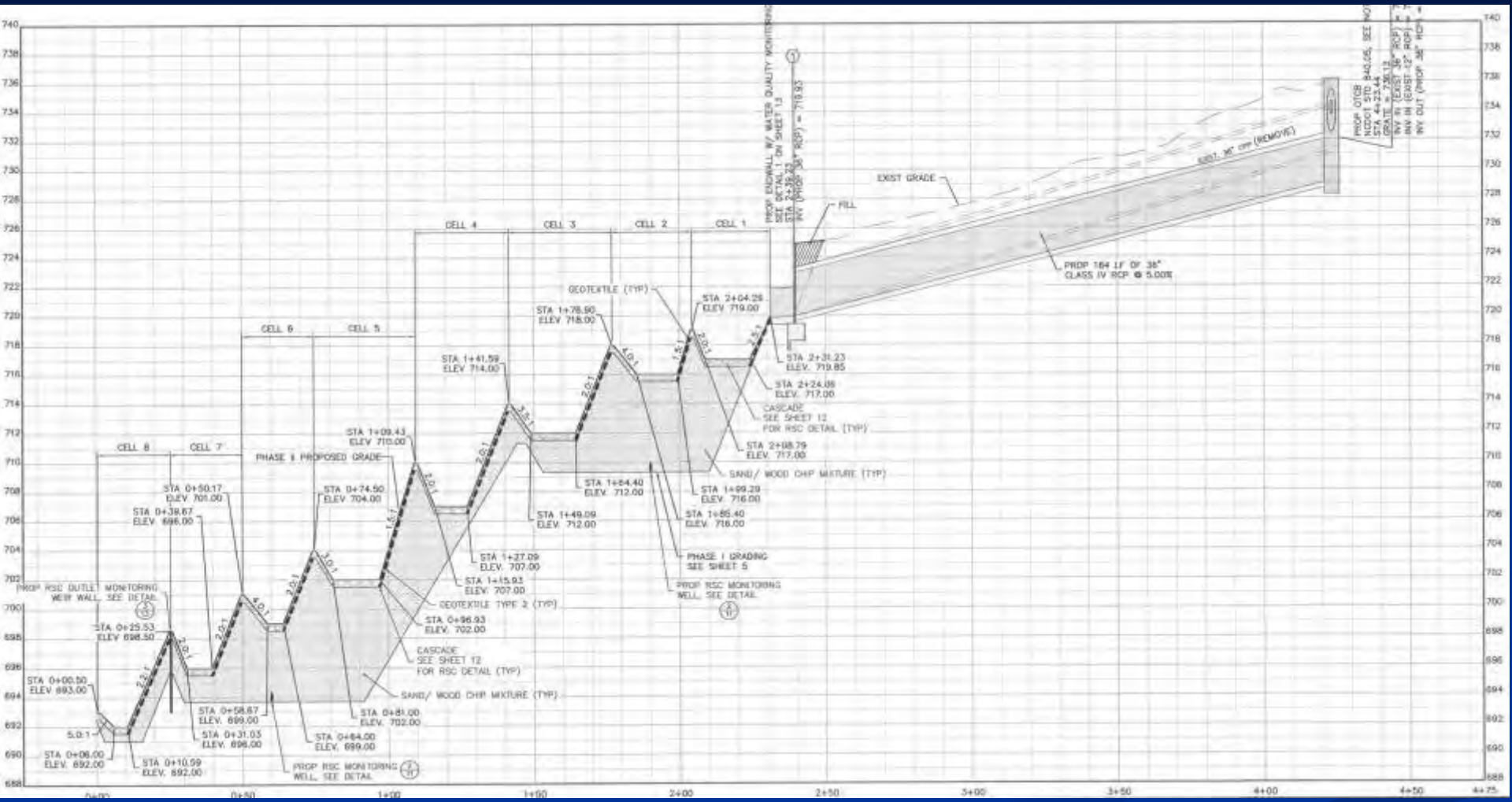
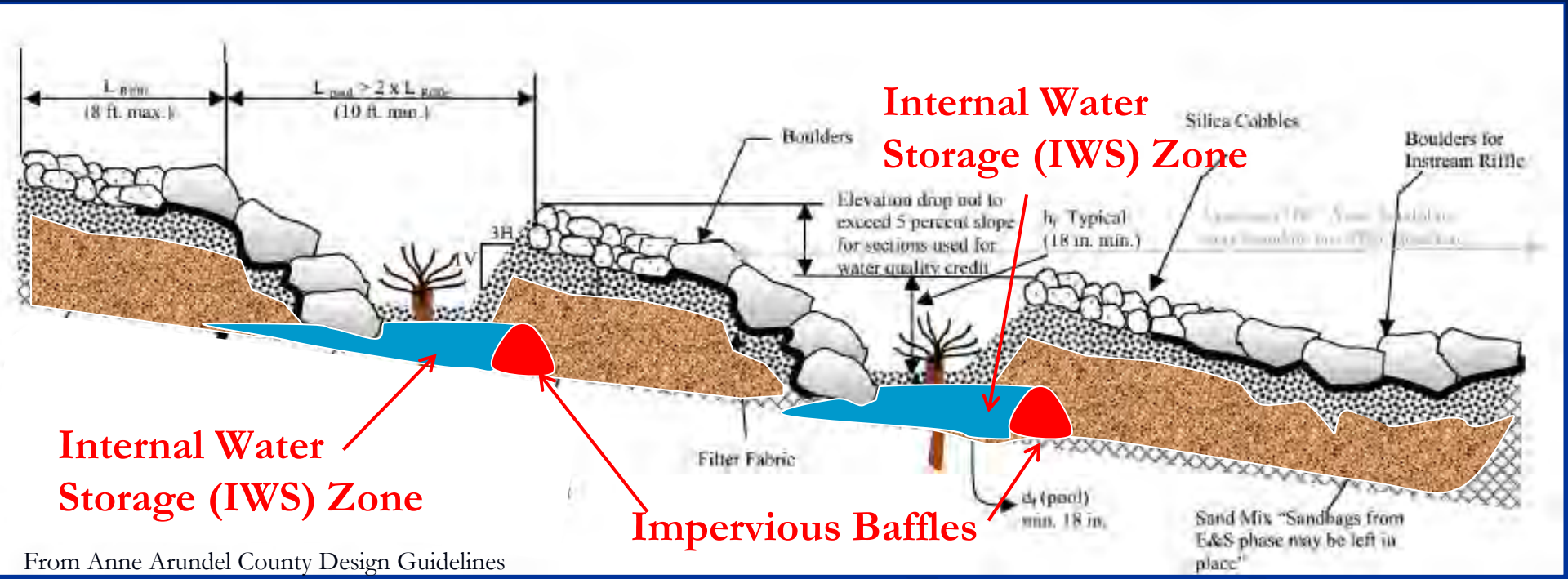

EXIST GRADE
PHASE 1 PROPOSED GRADE
STA 0+25.53
ELEV. 695.76
STA 0+30.00
ELEV. 692.37
STA 0+30.03
ELEV. 693.70
STA 0+02.74
ELEV. 691.00
STA 0+19.64
ELEV. 691.00
STA 0+95.47
ELEV. 693.70
STA 1+45.82
ELEV. 711.37
STA 1+53.22
ELEV. 709.31
STA 2+10.15
ELEV. 709.31
STA 2+18.49
ELEV. 705.14
STA 2+38.23
ELEV. 719.83
STA 2+51.23
ELEV. 719.85
VOLUME CALCULATIONS
CUT (CU. YD.)
FILL (CU. YD.)
NET (CU. YD.)
825
997
-98
CUT
FILL
811
Know what's below.
Call before you dig.
CONSTRUCTION SHALL BE IN ACCORDANCE WITH CHARLOTTE MECKLENBURG LAND DEVELOPMENT AND/OR NCDOT STANDARD SPECIFICATIONS.
NORTH CAROLINA
PROFESSIONAL
ENGINEER
SEAL
041392
MARC S. HORSTMANN
11/4/15
CHARLOTTE
WK DICKSON
Biohabitats
STORM WATER
LYNDA LAKE REGENERATIVE STORMWATER CONVEYANCE IMPROVEMENTS PROJECT
PHASE I – GRADING PLAN AND PROFILE
SHEET 5
OF 13


EXIST GRADE
STA 2+49.65
ELEV 725.14
2:1
100'
STA 2+39.23
ELEV. 719.93
STA 2+31.23
ELEV. 719.85
STA 1+45.82
ELEV 711.31
3:1
STA 1+53.32
ELEV. 709.31
STA 2+10.15
ELEV. 709.31
PHASE I PROPOSED GRADE
EXIST GRADE
STA 0+25.53
ELEV 695.70
STA 0+00.00
ELEV. 692.37
2:1
2:1
STA 0+30.03
ELEV. 693.70
STA 0+91.47
ELEV. 693.70
2:1
STA 0+15.64
ELEV. 691.00
STA 0+02.74
ELEV. 691.00
0+00
0+50
1+00
1+50
2+00
2+50
3+00
3+50
4+00
4+50
4+75


CHARLOTTE
WK DICKSON
Biohabitats
STORM WATER
PROFILE LEGEND
811
Know what's below. Call before you dig.
CONSTRUCTION SHALL BE IN ACCORDANCE WITH CHARLOTTE MECKLENBURG LAND DEVELOPMENT AND/OR NCDOT STANDARD SPECIFICATIONS.
LINDA LAKE REGENERATIVE STORMWATER CONVEYANCE IMPROVEMENTS PROJECT
PHASE II – GRADING PLAN AND PROFILE


CELL 8
CELL 7
CELL 6
CELL 5
CELL 4
CELL 3
CELL 2
CELL 1
PHASE II PROPOSED GRADE
EXIST GRADE
FILL
GEOTEXTILE (TYP)
GEOTEXTILE TYPE 2 (TYP)
SAND/ WOOD CHIP MIXTURE (TYP)
CASCADE
SEE SHEET 12
FOR RSC DETAIL (TYP)
PHASE I GRADING
SEE SHEET 5
PROP RSC OUTLET MONITORING WELL, SEE DETAIL
PROP RSC MONITORING WELL, SEE DETAIL
PROP 184 LF OF 36" CLASS IV RCP @ 5.00%
STA 0+00.50 ELEV 693.00
STA 0+06.00 ELEV. 692.00
STA 0+10.59 ELEV. 692.00
STA 0+25.53 ELEV 698.50
STA 0+38.67 ELEV. 696.00
STA 0+50.17 ELEV. 701.00
STA 0+58.67 ELEV. 699.00
STA 0+31.03 ELEV. 696.00
STA 0+64.00 ELEV. 699.00
STA 0+74.50 ELEV. 704.00
STA 0+81.00 ELEV. 702.00
STA 0+96.93 ELEV. 702.00
STA 1+09.43 ELEV 710.00
STA 1+15.93 ELEV. 707.00
STA 1+27.09 ELEV. 707.00
STA 1+41.59 ELEV. 714.00
STA 1+49.09 ELEV. 712.00
STA 1+64.40 ELEV. 712.00
STA 1+78.90 ELEV. 718.00
STA 1+85.40 ELEV. 716.00
STA 1+99.29 ELEV. 716.00
STA 2+04.29 ELEV 719.00
STA 2+08.79 ELEV. 717.00
STA 2+24.08 ELEV. 717.00
STA 2+31.23 ELEV. 719.85
5.0:1
2.0:1
3.0:1
4.0:1
1.5:1
0+50
1+00
1+50
2+00
2+50
3+00
3+50
4+00
4+50
4+75

Baffles & IWS Zones



From Anne Arundel County Design Guidelines

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

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Retrofit: RSC

Regenerative Stormwater Conveyance

Little Jackson Creek/Up Ditch

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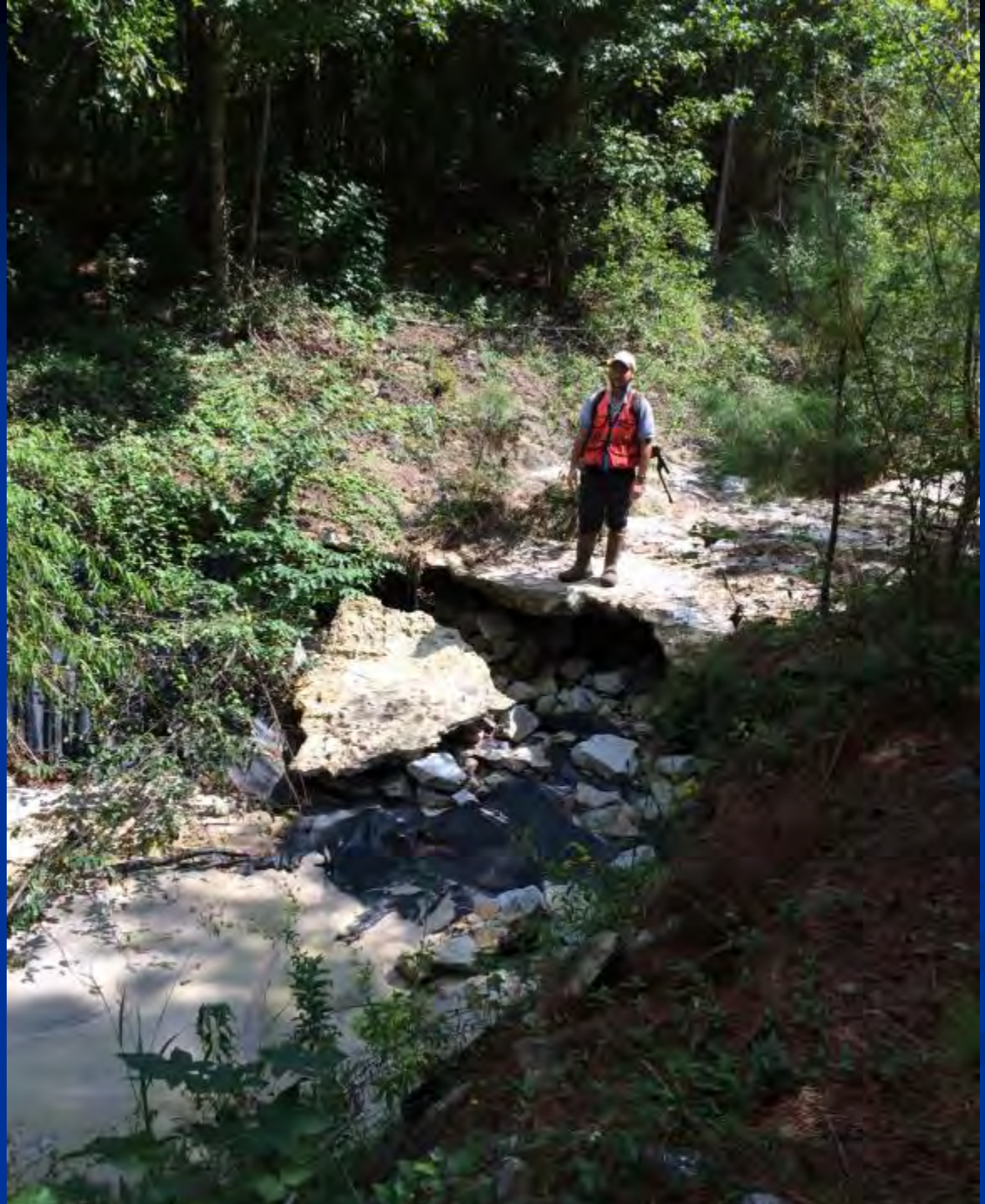

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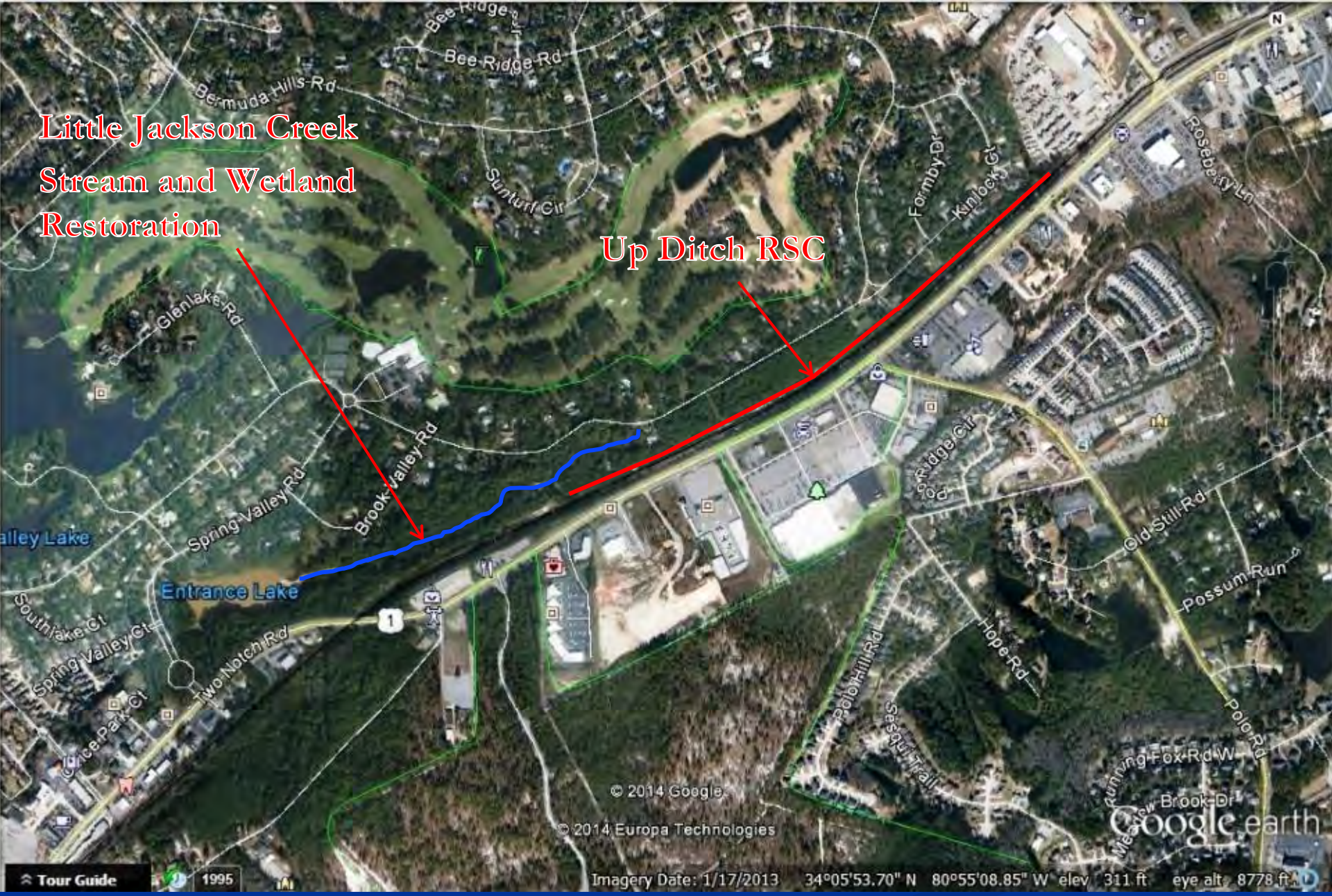
Entrance Lake
© 2014 Google
© 2014 Europa Technologies
1
Tour Guide
1995
Imagery Date: 1/17/2013 34°06'09.03" N 80°55'00.25" W elev 327 ft



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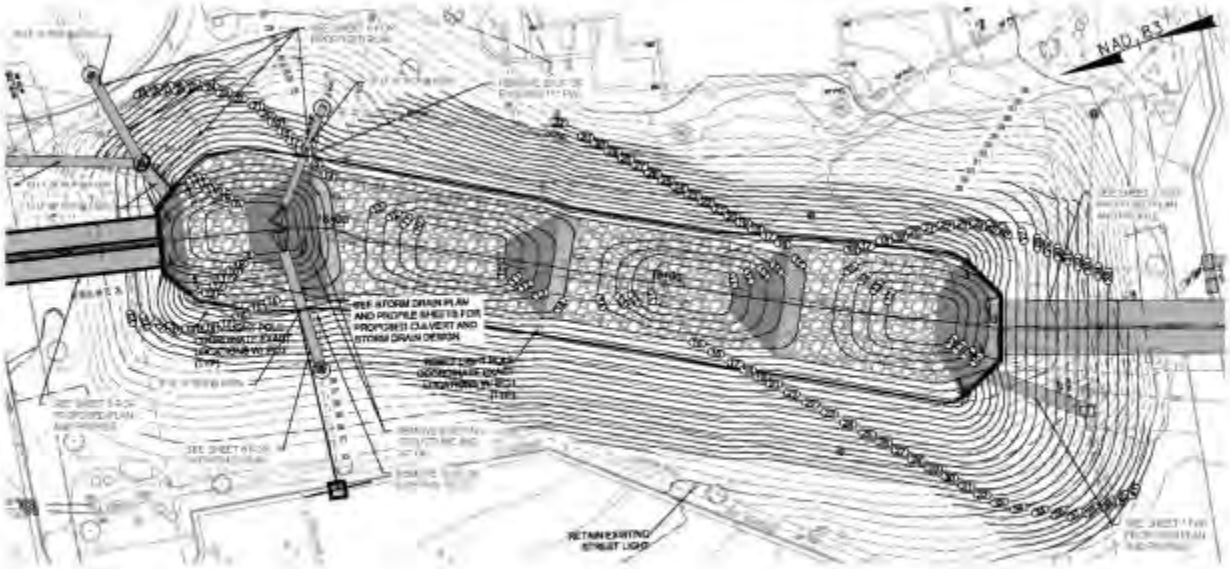
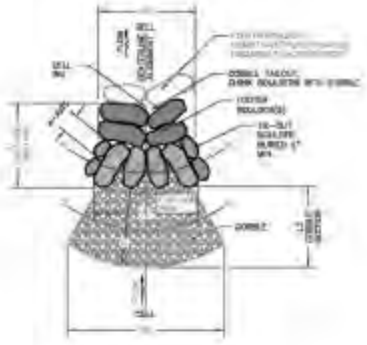
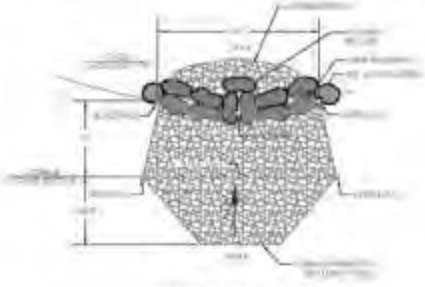
Greenville
NORTH CAROLINA



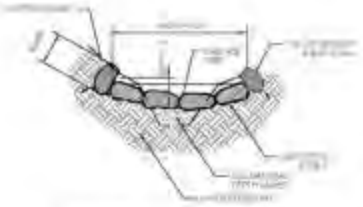
HORIZ
10 0 20



CASCADE - PLAN VIEW

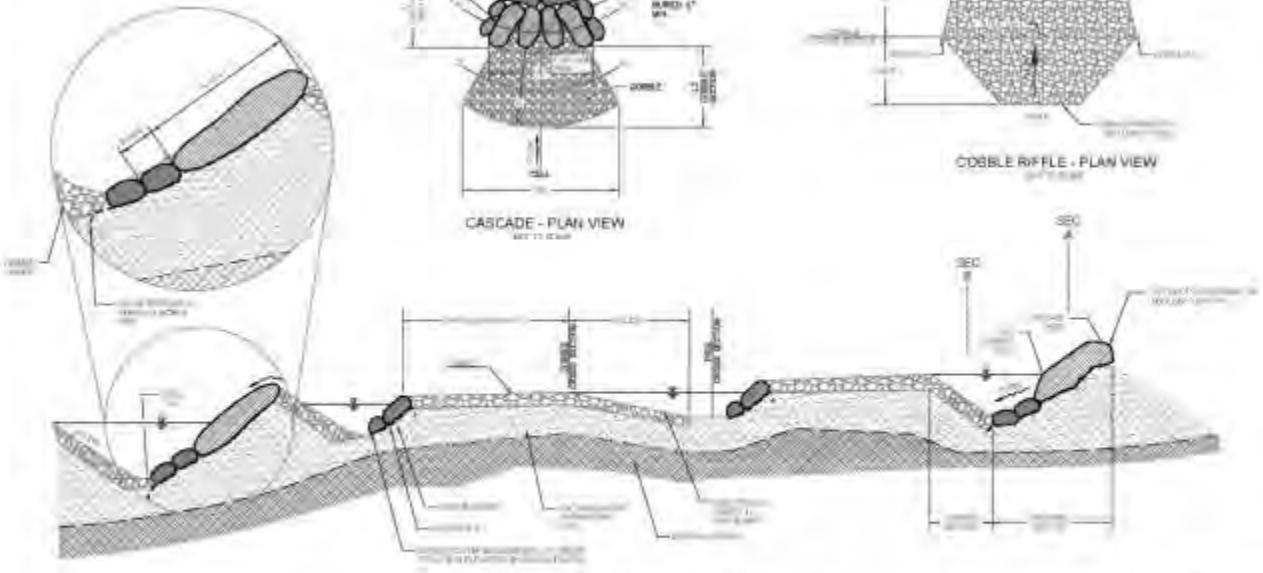


COBBLE RIFFLE - PLAN VIEW

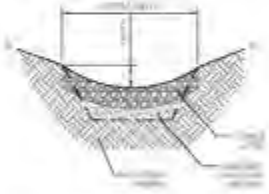


CASCADE CREST - SECTION A-A

LEGEND



CASCADE - CENTERLINE PROFILE



COBBLE GLIDE - SECTION B-B

BOULDER AXIS

1 REGENERATIVE STORMWATER CONVEYANCE (RSC) SYSTEM DETAIL

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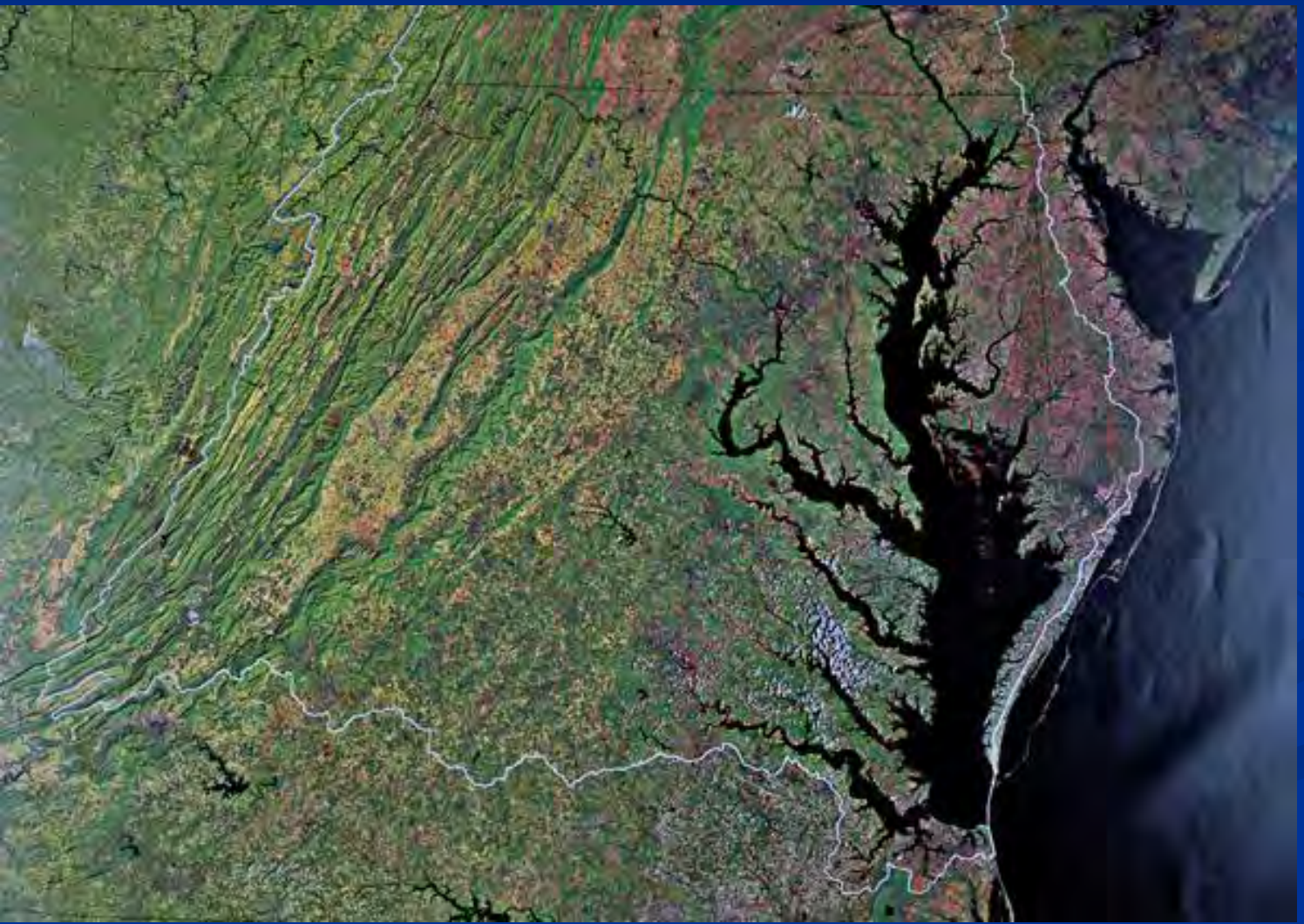
Path Forward



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Path Forward

NCDOT

Biofiltration Conveyance

West Virginia Stormwater Management and Design Guidance Manual

West Virginia Department of Environmental Protection
November 2012




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Charlotte-Mecklenburg STORM WATER Services

CHARLOTTE-MECKLENBURG STORM WATER DESIGN MANUAL

Original Edition – July 8, 1993

Revised Edition – January 1, 2014

Original manual, published July 8, 1993, was a cooperative effort of: Charlotte Chamber Design Manual Task Force, City of Charlotte Engineering Department, Mecklenburg County Engineering Department, Dibo and Associates and Ogden Environmental and Engineering Services

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Georgia Stormwater Management Manual

Volume 2

Technical Handbook

First Edition
August 2001

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