The Self-Recovery of Stream Channel Stability in Urban Watersheds Due to BMP Implementation

Byron Madigan
Water Resources Supervisor
Carroll County Government

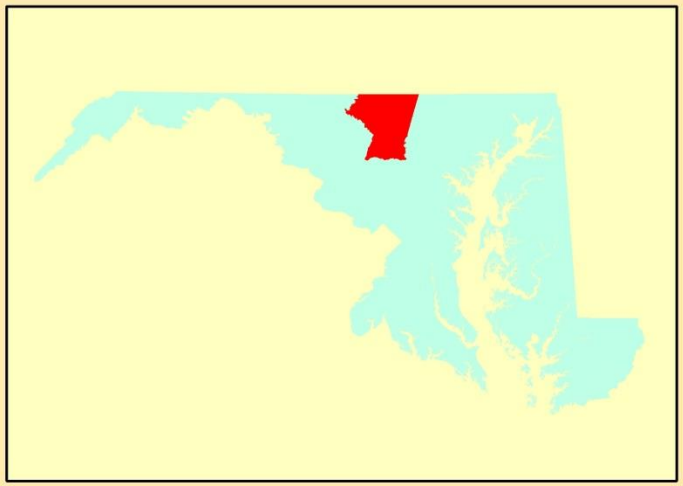
Partnerships…

- Chesapeake Bay Trust
- MD, Department of Natural Resources
- Center for Watershed Protection
- Carroll County Government

Special Thanks

- Ecosystem Planning & Restoration
- U.S. Fish and Wildlife Service

Carroll County, Maryland



Streams
Reservoirs
Corporate Limits
8-Digit Watersheds

N

0 2 4 8 Miles

Carroll County Sand Filter Design

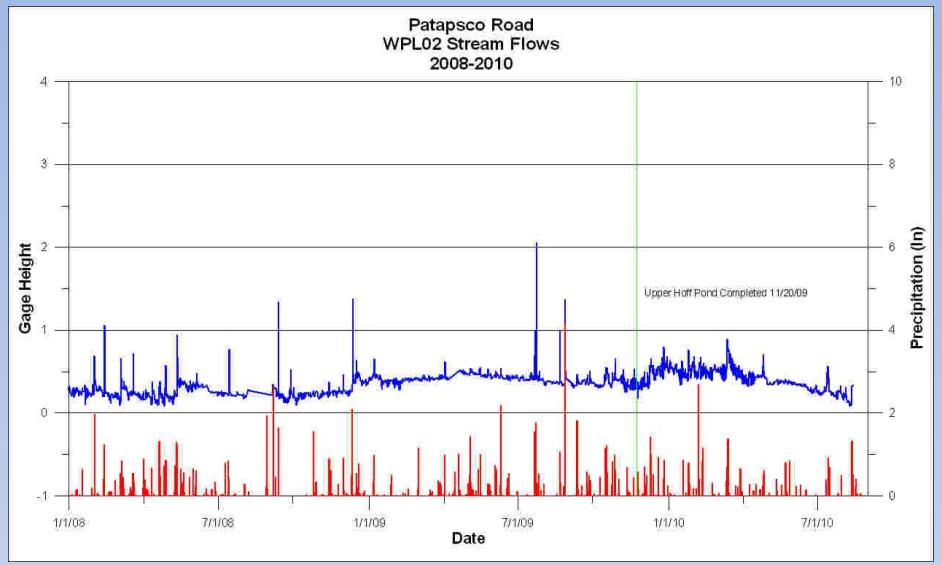
Unique Design Characteristics:

- No Riser - all design flows through sand control
- Drop Structures and Level Pipes
  - Turbulent to laminar flow
- Total Capture of 2 year storm, “difference in 10 year runoff volume”
  - Direct runoff difference – Meadow and Impervious
- Sand layer seeded w/ MDE mix
  - Prevents cracking/short circuiting of filter

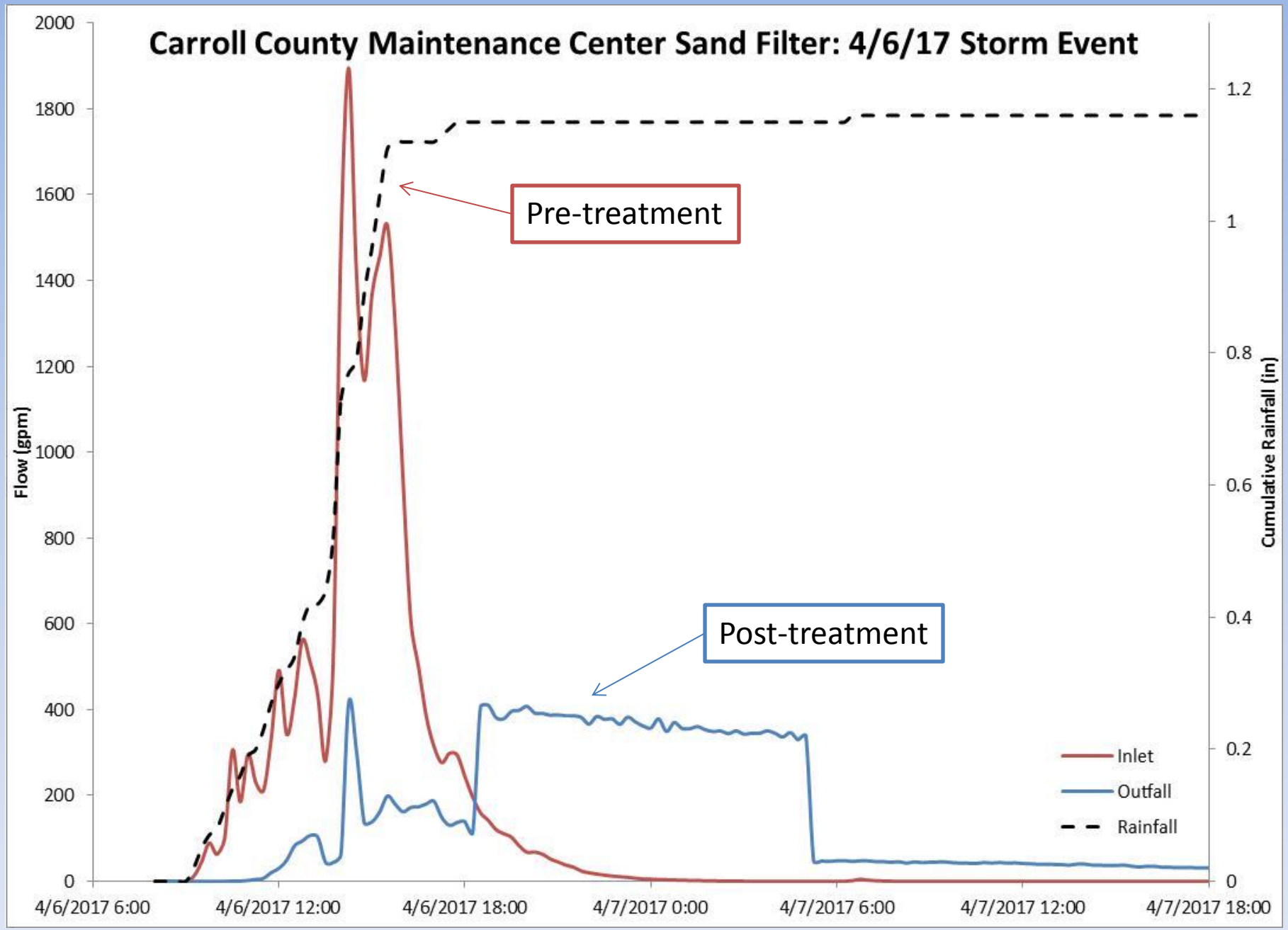
Retrofit Monitoring

Data Collection:

- Low flow discharge w/ grab
- Targeted storm events
- Stage height analysis/flashiness
- TSS, OP, NO32, TP, TKN
- Spring MBSS

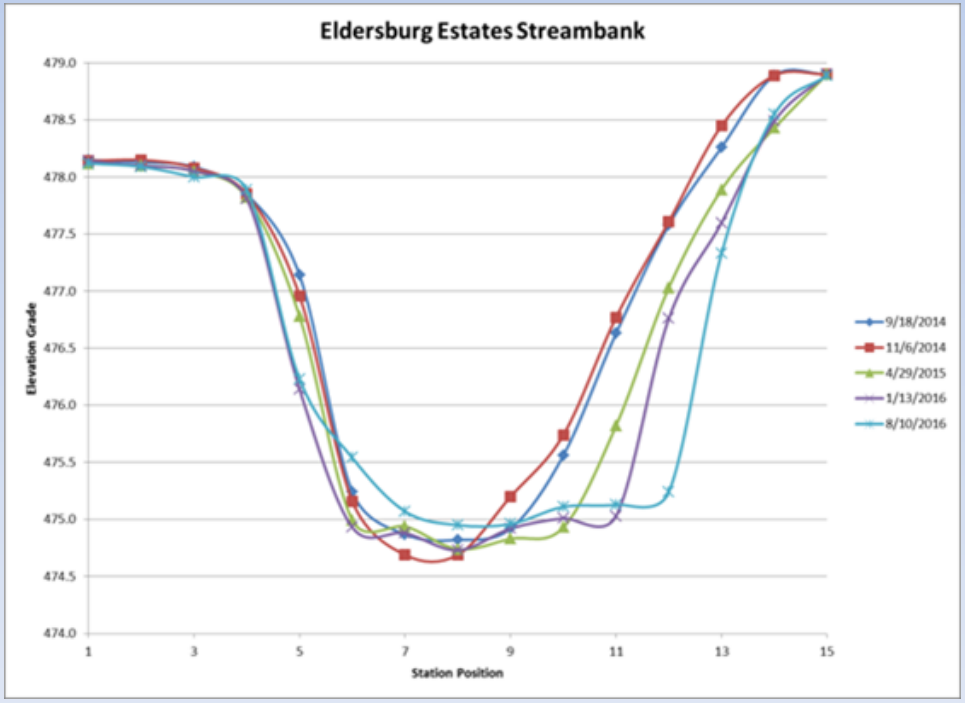


Site	MBSS BIBI	
	2010	2015
WPL02	2.33	4.00


Carroll County Maintenance Center Sand Filter: 4/6/17 Storm Event
Pre-treatment
Post-treatment
Flow (gpm)
Cumulative Rainfall (in)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1.2
1
0.8
0.6
0.4
0.2
0
4/6/2017 6:00
4/6/2017 12:00
4/6/2017 18:00
4/7/2017 0:00
4/7/2017 6:00
4/7/2017 12:00
4/7/2017 18:00
Inlet
Outfall
Rainfall

Urban Stormwater Work Group

- Cross Section Surveys
- Bank Pins
- Stage Height Analysis



Chesapeake Bay Program
Science. Restoration. Partnership.

Restoration Research Grant

Monitoring Plan Hypotheses:

Hypothesis 1

The implementation of BMPs as retrofits will modify the runoff response from the watershed (hydrograph) resulting in a reduction of the magnitude, duration and frequency of erosive flow rates that meet and or exceed Maryland Department of Environment (MDE) performance standards for stream channel protection.

Hypothesis 2

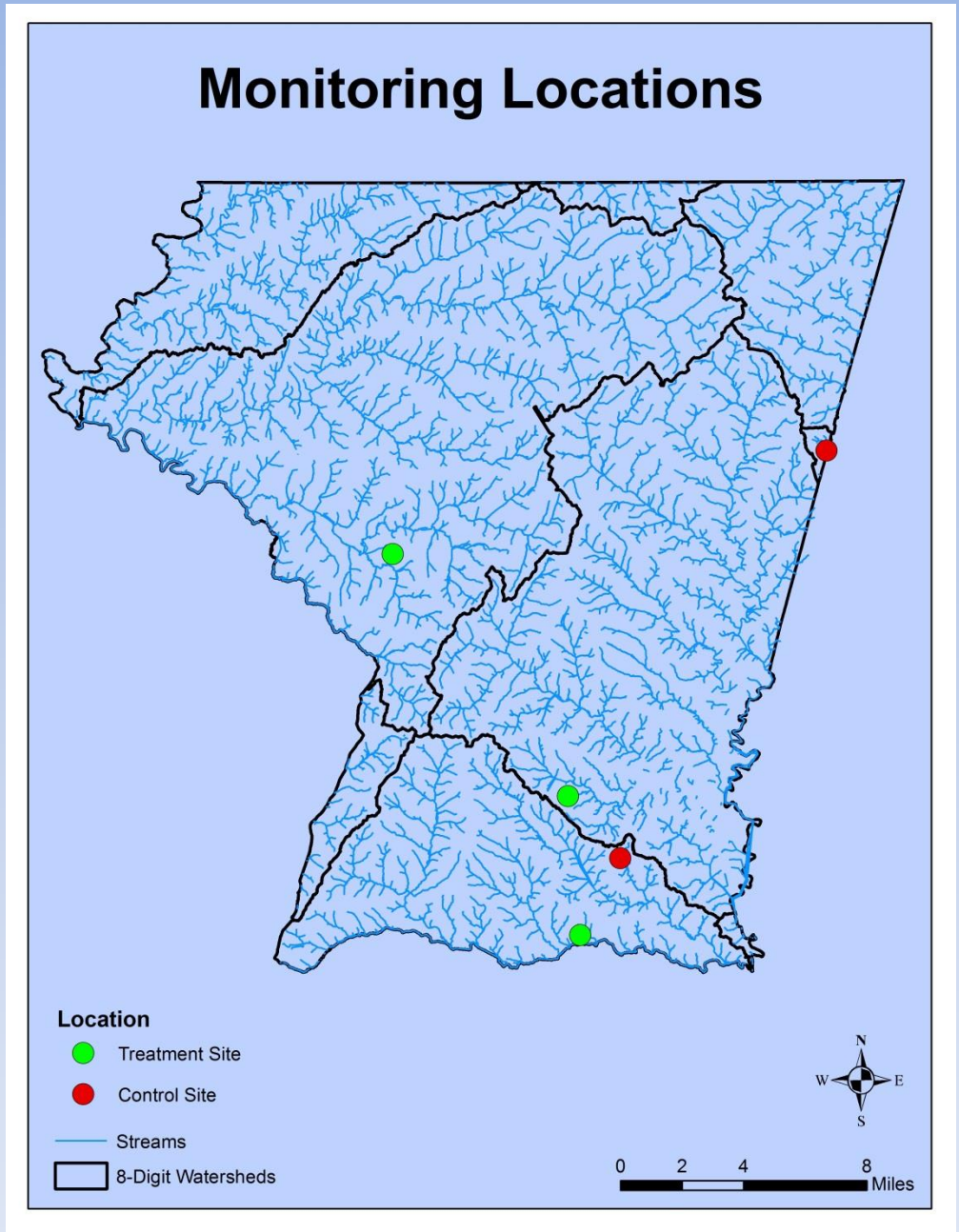
The implementation of BMPs as retrofits will create hydraulic conditions that lead to self-recovery of channel stability.

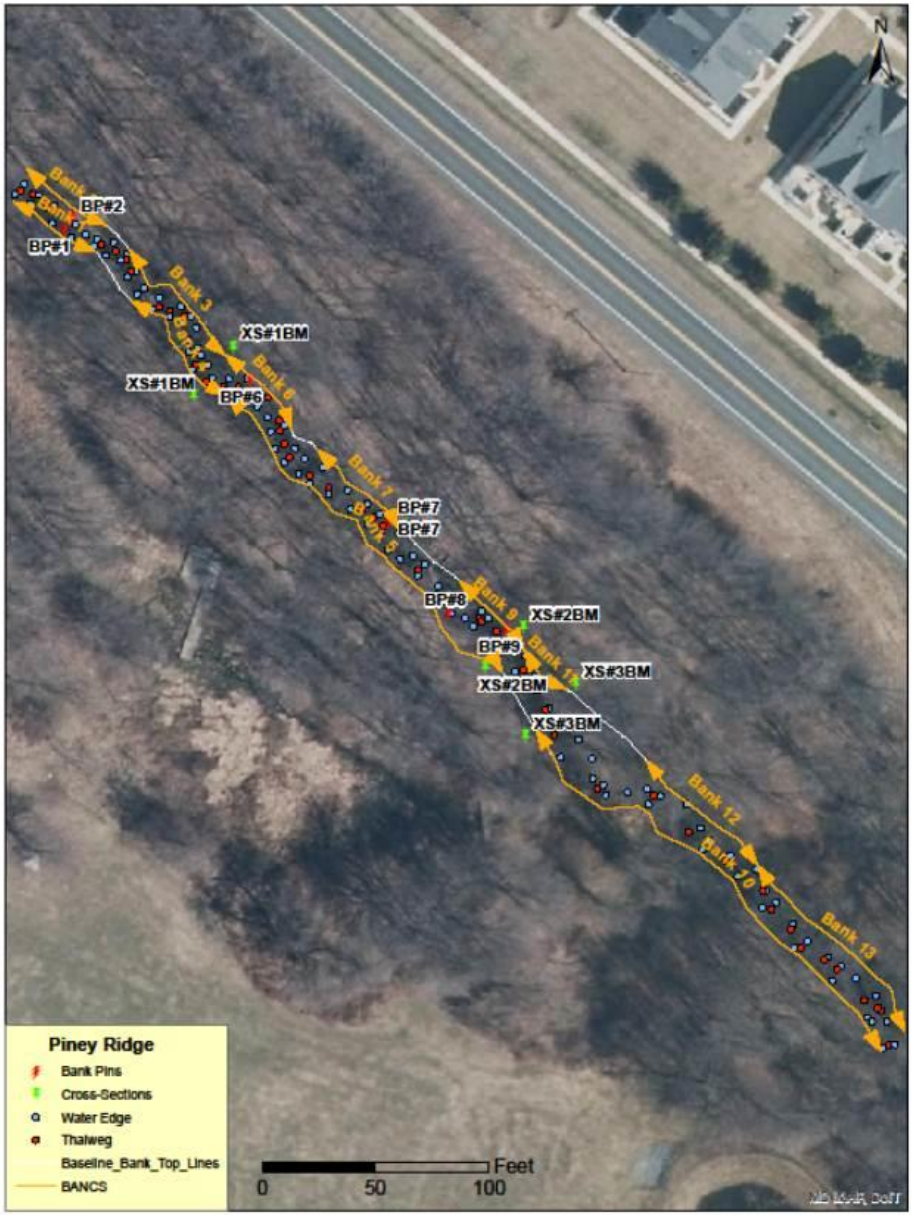
Hypothesis 3

The implementation of BMPs will decrease sediment loadings downstream as a result of reduced bank erosion rates.

Monitoring Approach

- Control Site Selection
- BANCS Assessment
- Geomorphic Mapping
- Equipment Install
  - Rain gauges/Pressure Transducers
- Survey Work
  - Bank Pins, Cross Sections, longitudinal profiles
- Flow Monitoring
  - Control/Treatment Relationship





Geomorphic Mapping

- BANCS Assessment
  - Bank Erosion Hazard Index (BEHI)
  - Near Bank Stress (NBS)
- Map Components
  - BANCS
  - Bank Pins
  - Cross Sections
  - Waters Edge
  - Thalweg
  - Top of Bank

CBT Restoration Research

Monitoring Setup

H1 Hydrology

- Rain gauge at 3 locations
  - MD Central
  - Roberts Field
  - Blue Ridge
- Pressure Transducers
- Flow measurements

H2 Geomorphology

- Monumented Cross Sections
- Longitudinal Profiles
- Bank Pins
- Pebble Count
- Bulk density
- Riparian Vegetation

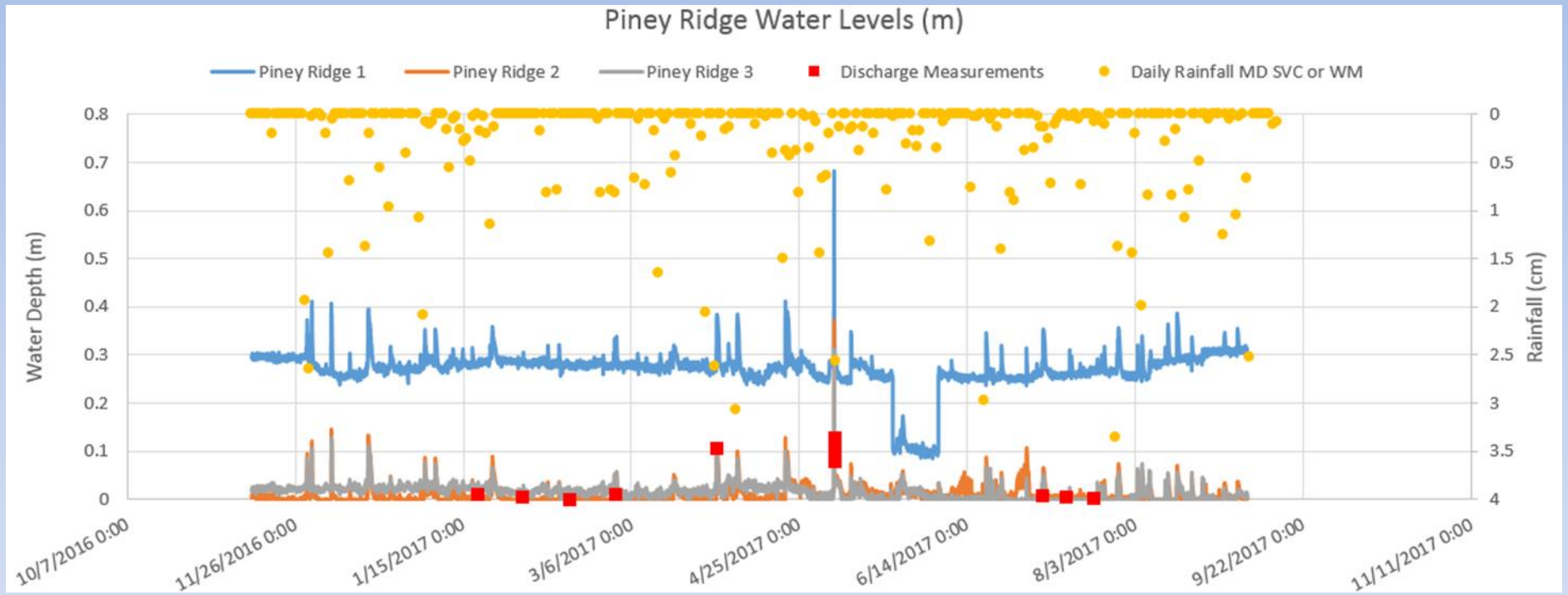
H3 Load Estimation

- BANCs
- Measured change in stream channel

PRE-TREATMENT PHASE

Hydrology-Hydraulics

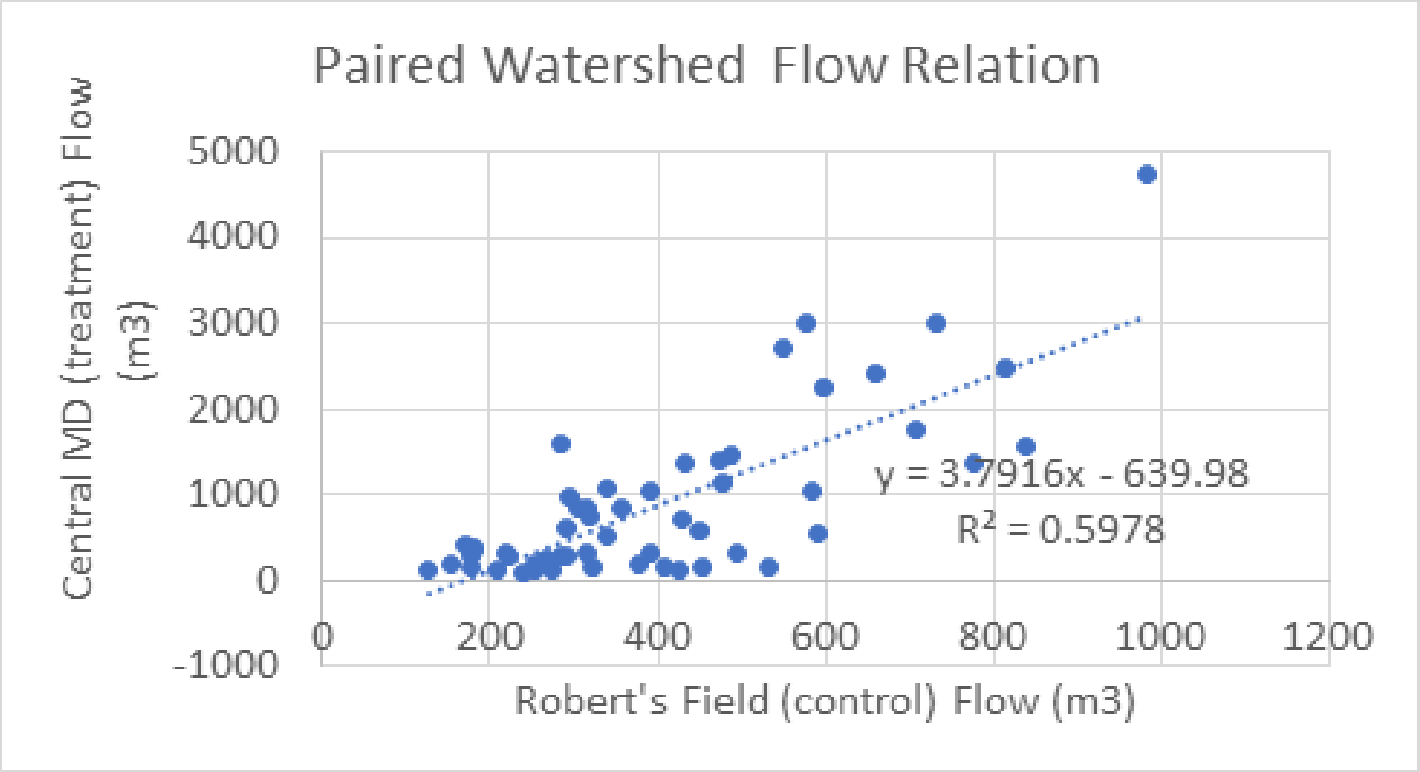
Stage Height Analysis



Pre-construction flow monitoring

(January 2017 – January 2018)

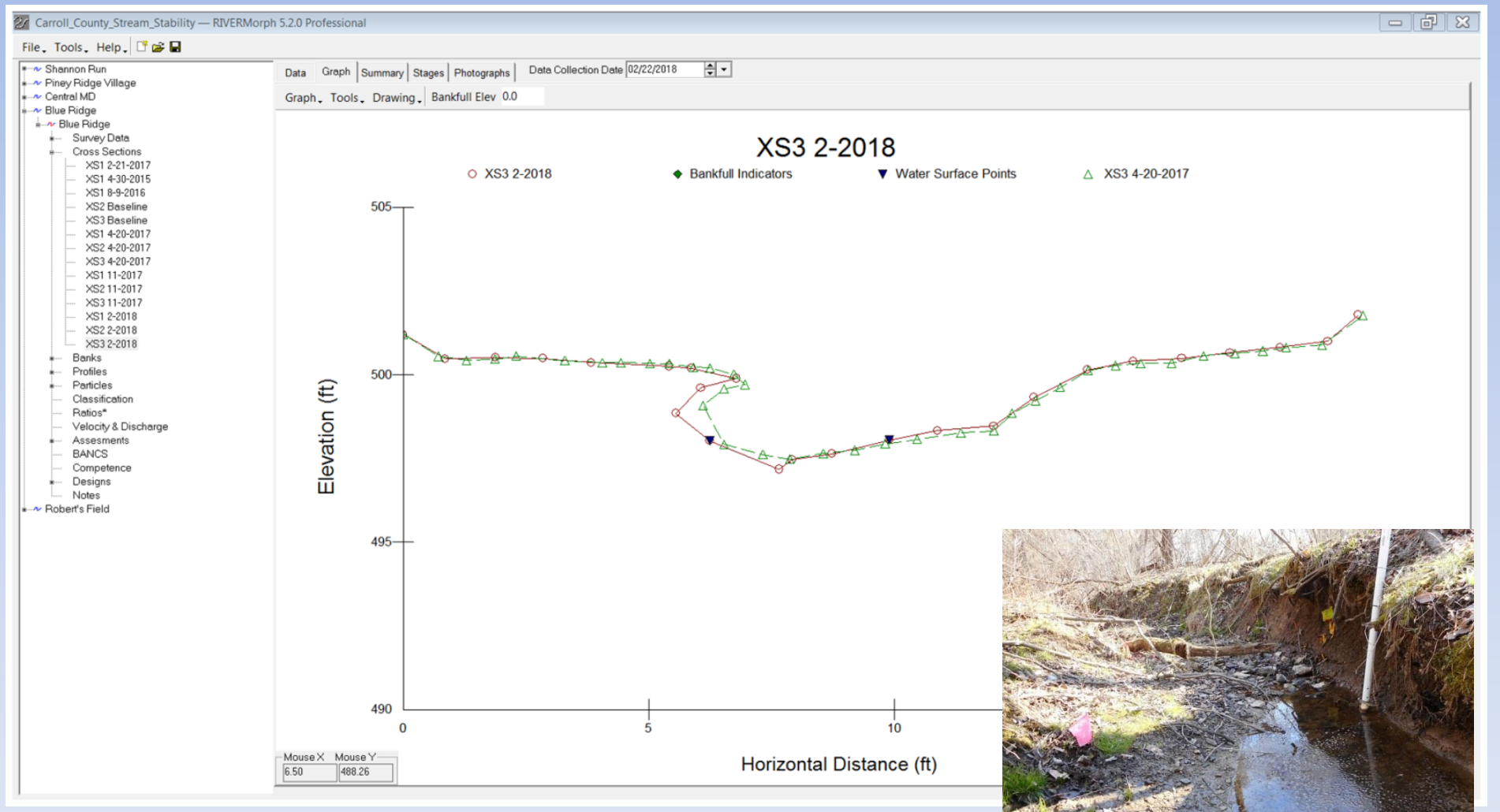
Site	# flow measurements	# storm events with measured discharge
Blue Ridge	7	3
Central MD	8	4
Robert's Field	8	4
Shannon Run	9	3
Piney Ridge	9	3



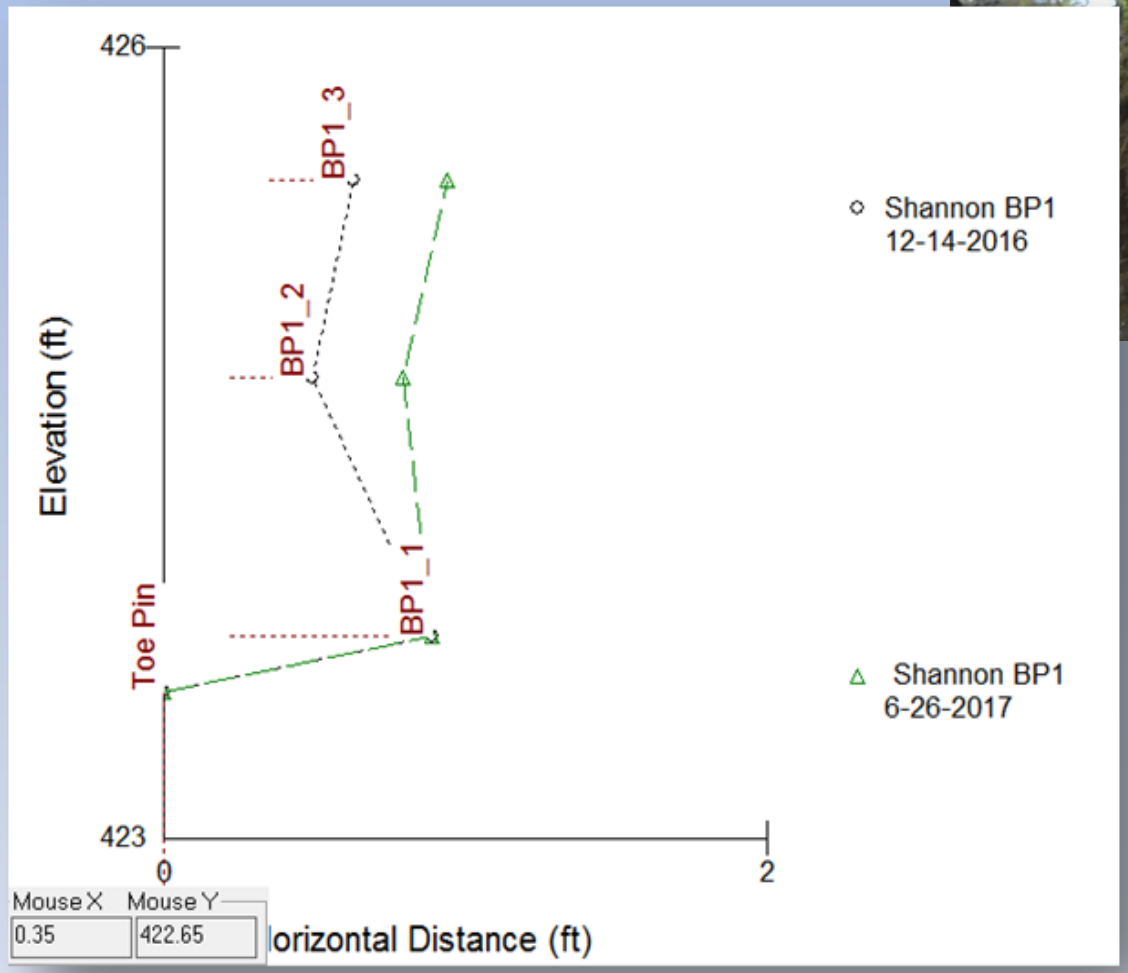
PRE-TREATMENT PHASE

Geomorphology

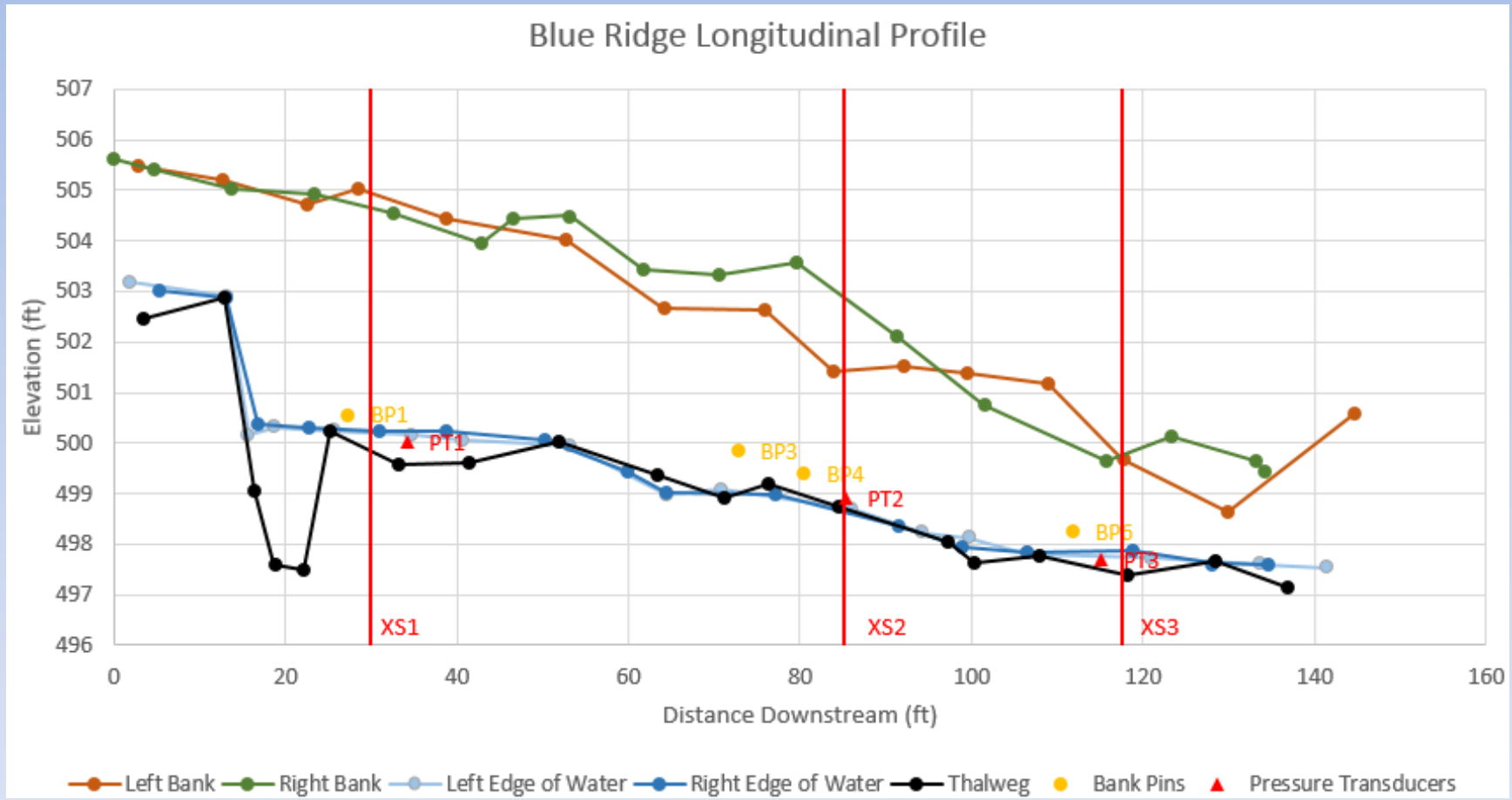
Cross Sectional Surveys



Bank Pins


426
423
0
2
Elevation (ft)
Toe Pin
BP1_1
BP1_2
BP1_3
Shannon BP1
12-14-2016
Shannon BP1
6-26-2017
Mouse X
Mouse Y
0.35
422.65
orizontal Distance (ft)

Longitudinal Profiles



Project Schedule & Next steps

- Pre-treatment monitoring at 3 study sites finished
- Construction underway/completed (2 of 3 treatment sites) no monitoring; 4- 6 months
- Pre-treatment data analysis
- Begin post-treatment monitoring late spring/early summer 2018

Construction

Central MD Service Center

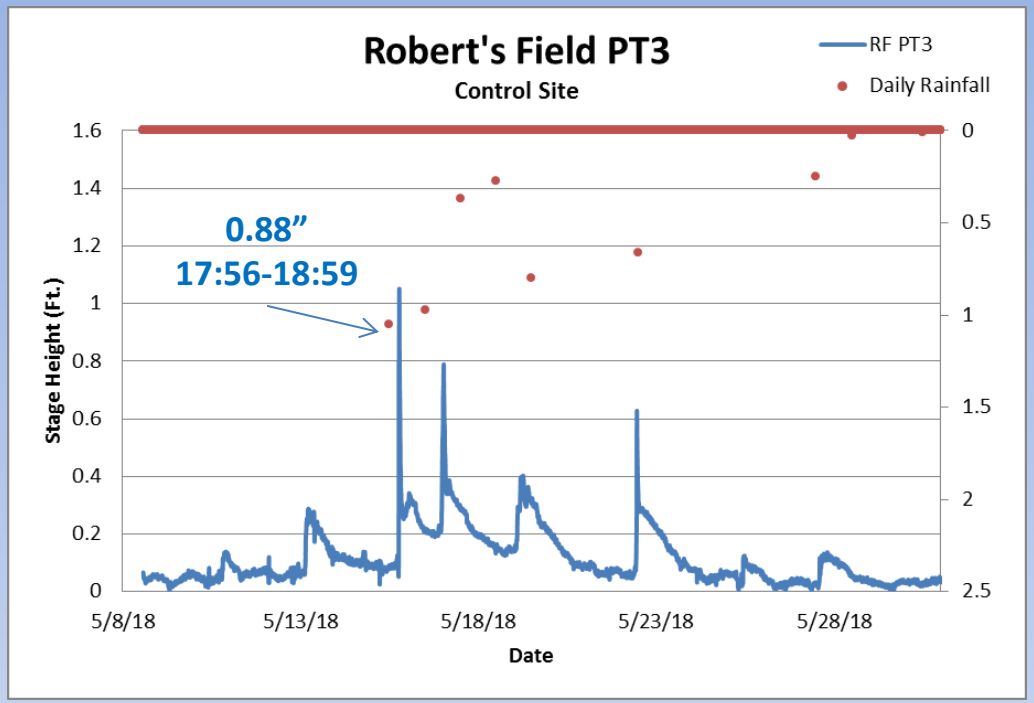
Blue Ridge Manor

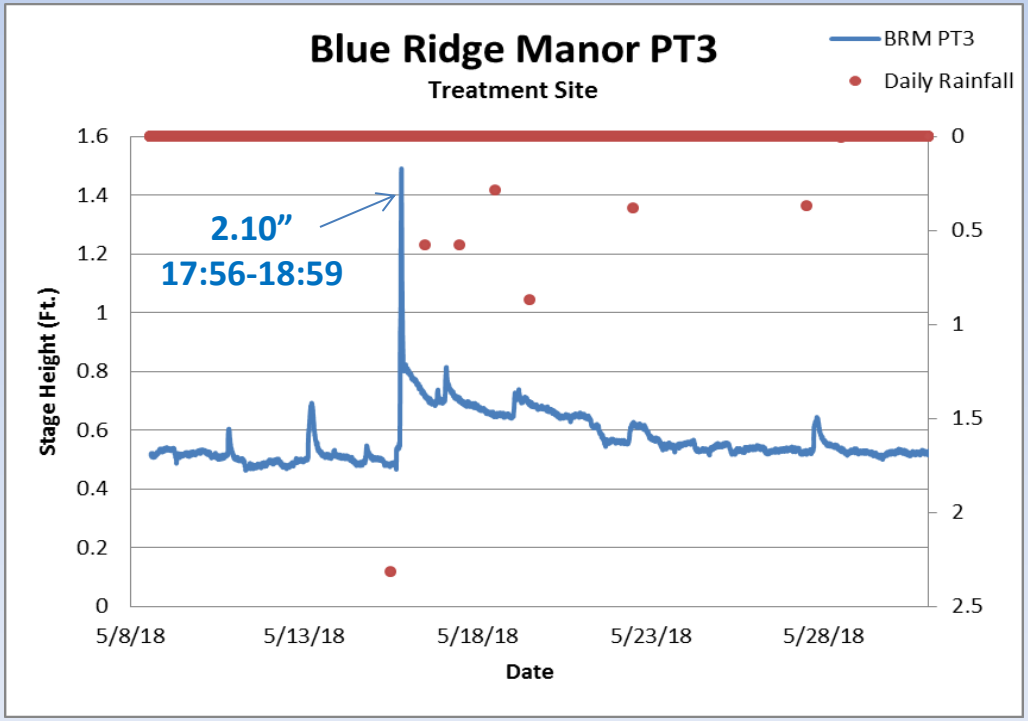
Blue Ridge Manor

- Drainage Area: 33.28 Acres
- Impervious: 9.03 Acres (27%)

Blue Ridge Manor

May 15, 2018





Receiving Stream

Blue Ridge Manor

May 15, 2018

Thank You!

Byron Madigan
Carroll County, Bureau of Resource Management
bmadigan@ccg.carr.org

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Provided by the Chesapeake Bay Trust
Restoration Research Program

Carroll County Translation Slides

What does this mean for me?

- Monitoring Purpose - provide Carroll County, MD with high quality data to evaluate the effectiveness of stormwater retrofits on the hydrogeomorphic changes in downstream stream channels and subsequent reductions in nutrient and sediments.
- Addresses MS4 question – “What affect do watershed BMPs have on stream stability and self-recovery?”
- Research addresses: 1) reduce runoff, 2) channel self-recovery, and 3) reduction of sediment loads
- Unique BMP sand filter design approach
- Previous Carroll County projects and research projects already demonstrating dramatic changes in flow outfalls between standard BMPs and sand filter BMP
- Still awaiting results for self-recovery of downstream receiving streams

What does this mean for me?

- What do I take from this if I am a practitioner:

BMP sand filter design approach requires less structures, provides greater volume control, and has lower maintenance costs. Monitoring banks stability of downstream receiving streams.

- What do I take from this if I am a regulator:

This approach may promote self-recovery of downstream receiving streams of sand filter BMPs. Consider allowing MS4 IC and TMDL Protocol 1 credits for self-recovered streams downstream of BMP.