

The Self-Recovery of Stream Channel Stability in Urban Watersheds Due to BMP Implementation, Carroll County, MD

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Special acknowledgements

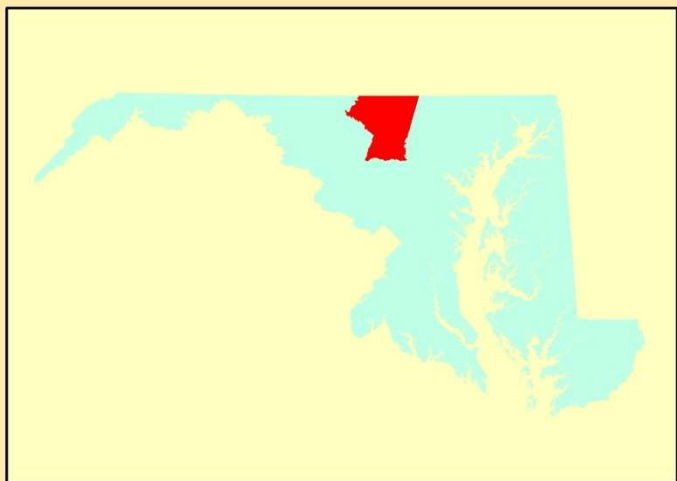
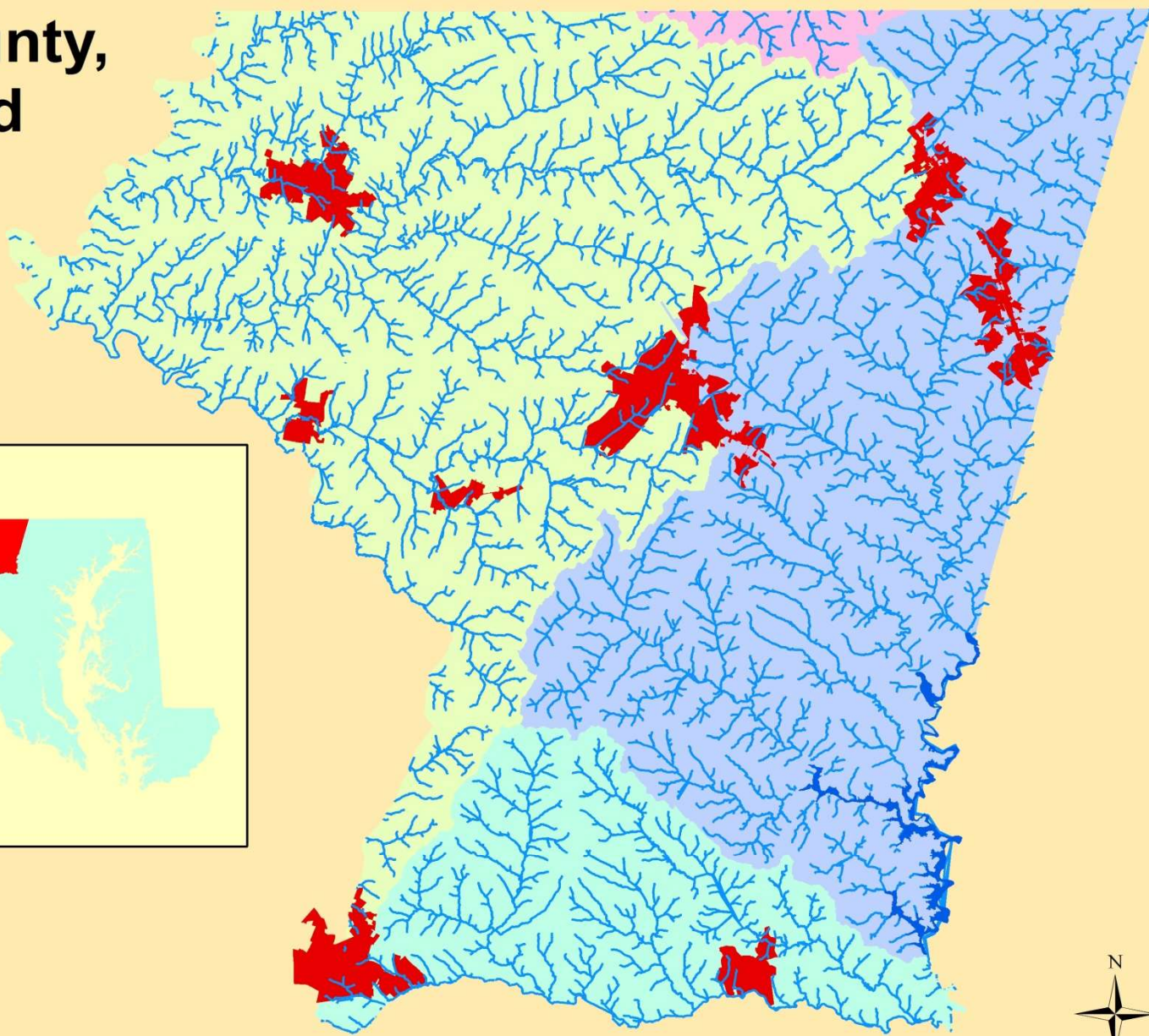
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Mark Secrist, FWS
Carroll County Survey



August 14, 2018



Carroll County, Maryland



-  Streams
-  Reservoirs
-  Corporate Limits
-  8-Digit Watersheds



Carroll County Sand Filter Design

Unique Design Characteristics:

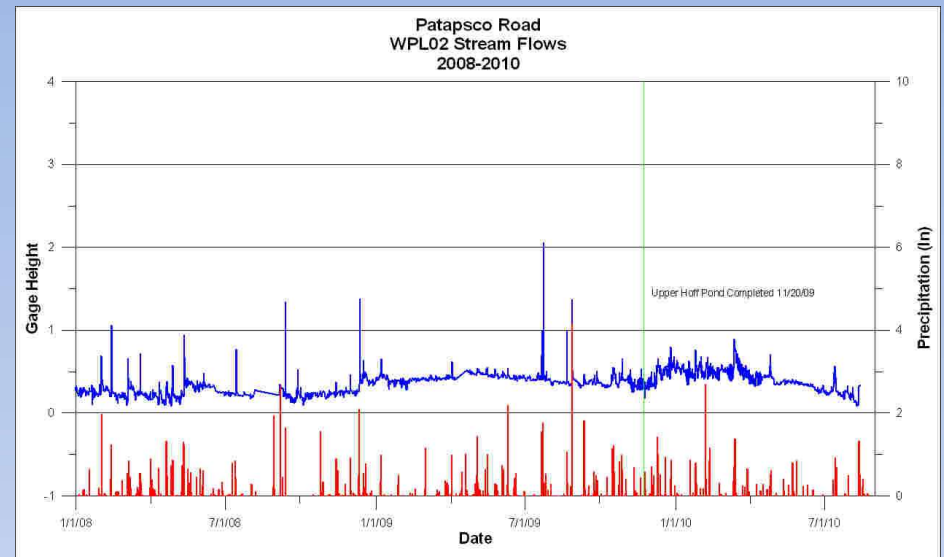
- No Riser - all design flows through sand control
- Drop Structures and Level Pipes
 - Turbulent to laminar flow
- Total Capture of 2 year storm, “difference in 10 year runoff volume”
 - Direct runoff difference – Meadow and Impervious
- Sand layer seeded w/ MDE mix
 - Prevents cracking/short circuiting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



Retrofit Monitoring

Data Collection:

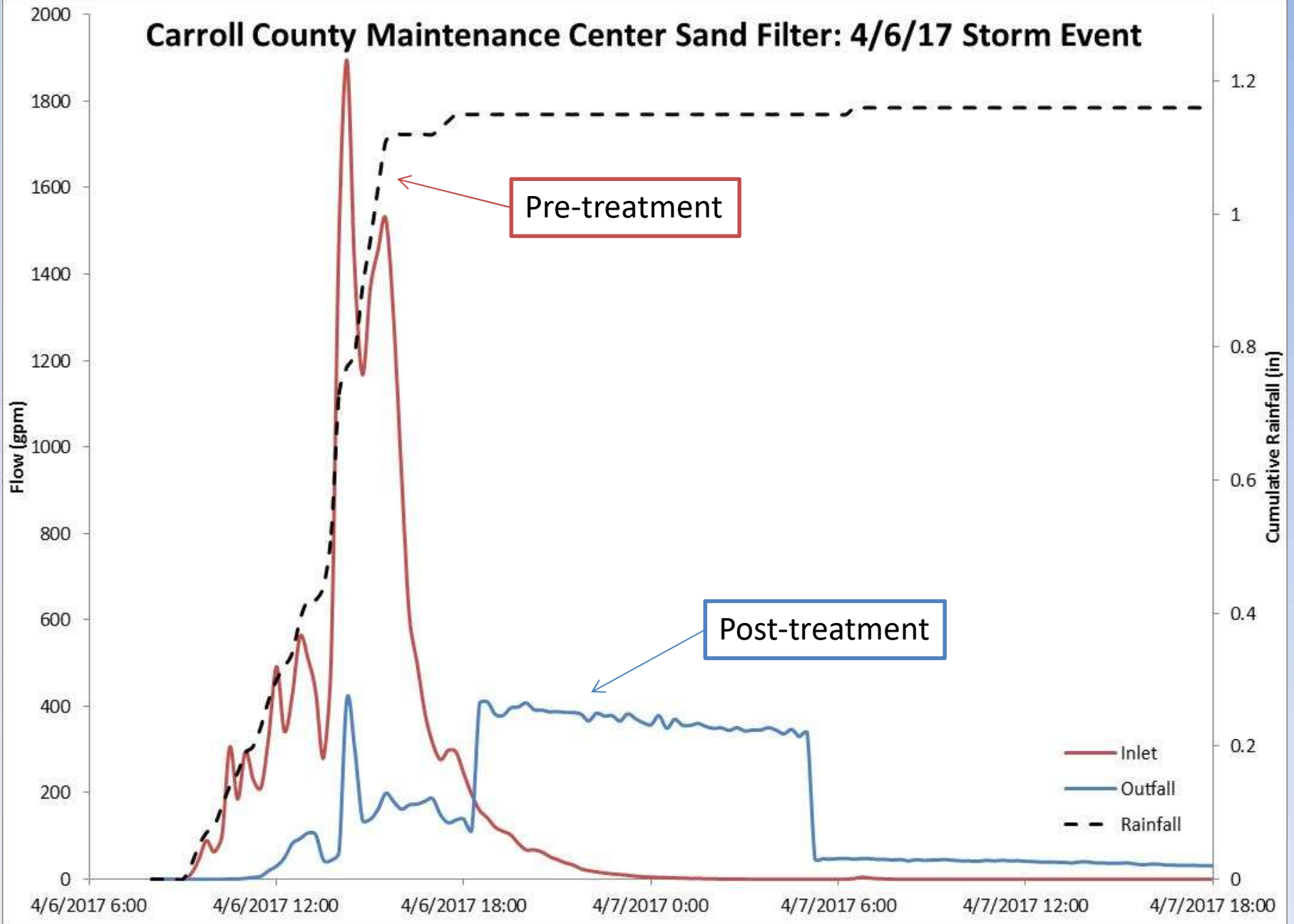
- Low flow discharge w/ grab
- Targeted storm events
- Stage height analysis/flashiness
- TSS, OP, NO32, TP, TKN
- Spring MBSS



Site	MBSS BIBI	
	2010	2015
WPL02	2.33	4.00



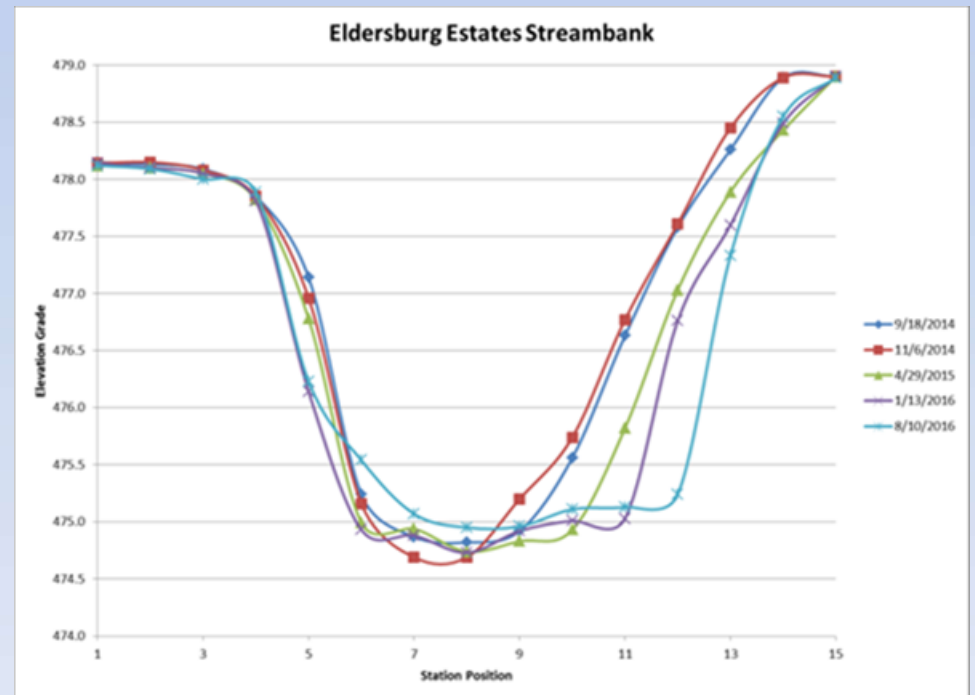
Carroll County Maintenance Center Sand Filter: 4/6/17 Storm Event



Urban Stormwater Work Group



- Cross Section Surveys
- Bank Pins
- Stage Height Analysis



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 Plan and QAPP

The self-recovery of stream channel stability in urban watersheds due to BMP implementation, Carroll County, MD

DRAFT September 29, 2016



Prepared For
Carroll County
Department of Land and Resource Management
Bureau of Resource Management

Gale Engles, Bureau Chief



**Prepared by the Center for Watershed
Protection, Inc.**

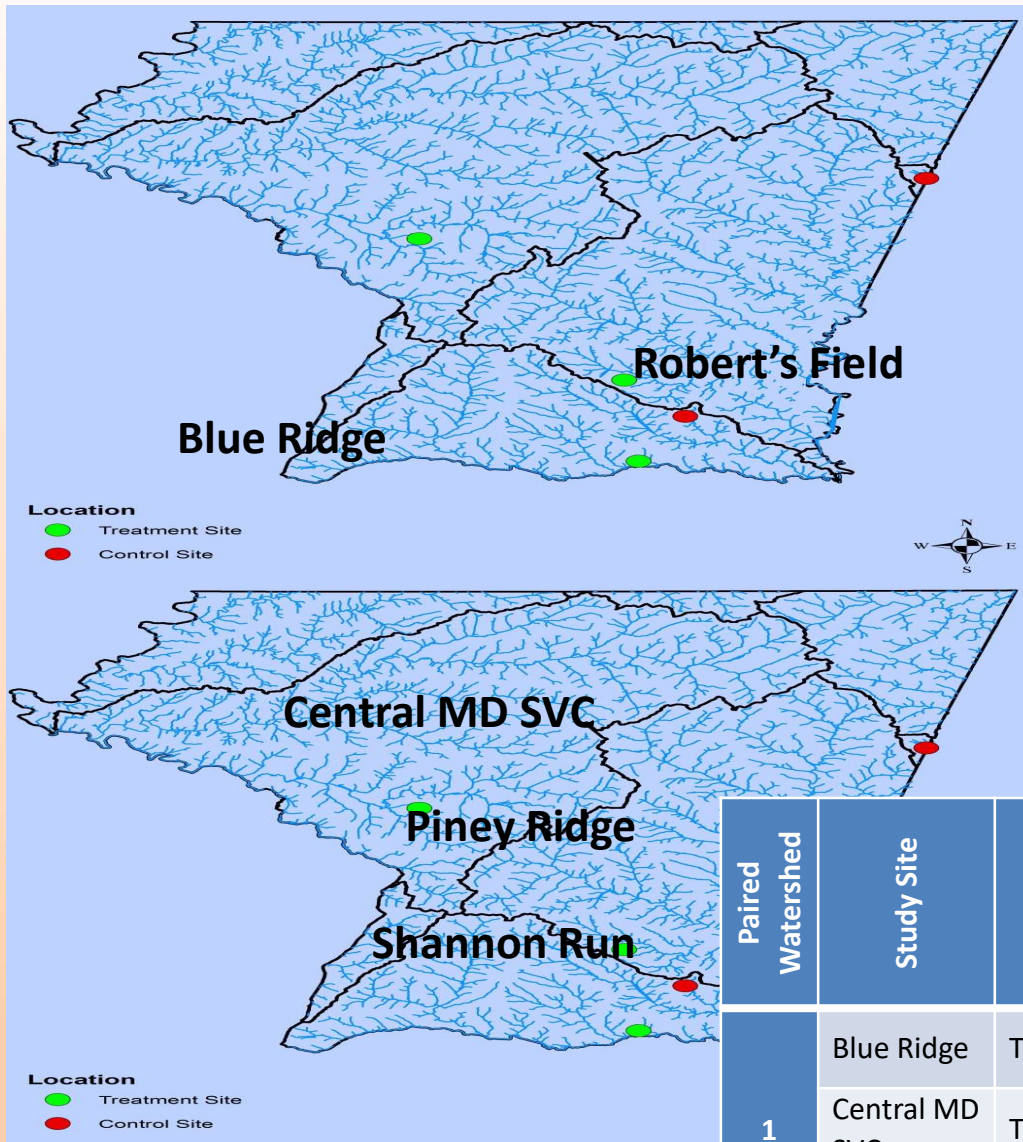
Bill Stack
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Lisa Fraley-McNeal



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WATERSHED
PROTECTION

Monitoring Locations

- Paired Watershed Study Design
- 3-YR project period , beginning July 1, 2016



Paired Watershed	Study Site	Treatment or Control	Drainage Area (ac)	Impervious Cover (%)	Study Reach Length (ft)	Existing BMP Type	Retrofit Type
1	Blue Ridge	Treatment	33.6	26.9%	145	Retention	Sand Filter
	Central MD SVC	Treatment	55.5	31.6%	325	Retention	Sand Filter
	Robert's Field	Control	28.8	37.4%	157	Extended Detention	N/A
2	Shannon Run	Treatment	209	20%	366	Retention	Wet Pond
	Piney Ridge	Control	89	34%	559	Retention	N/A

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



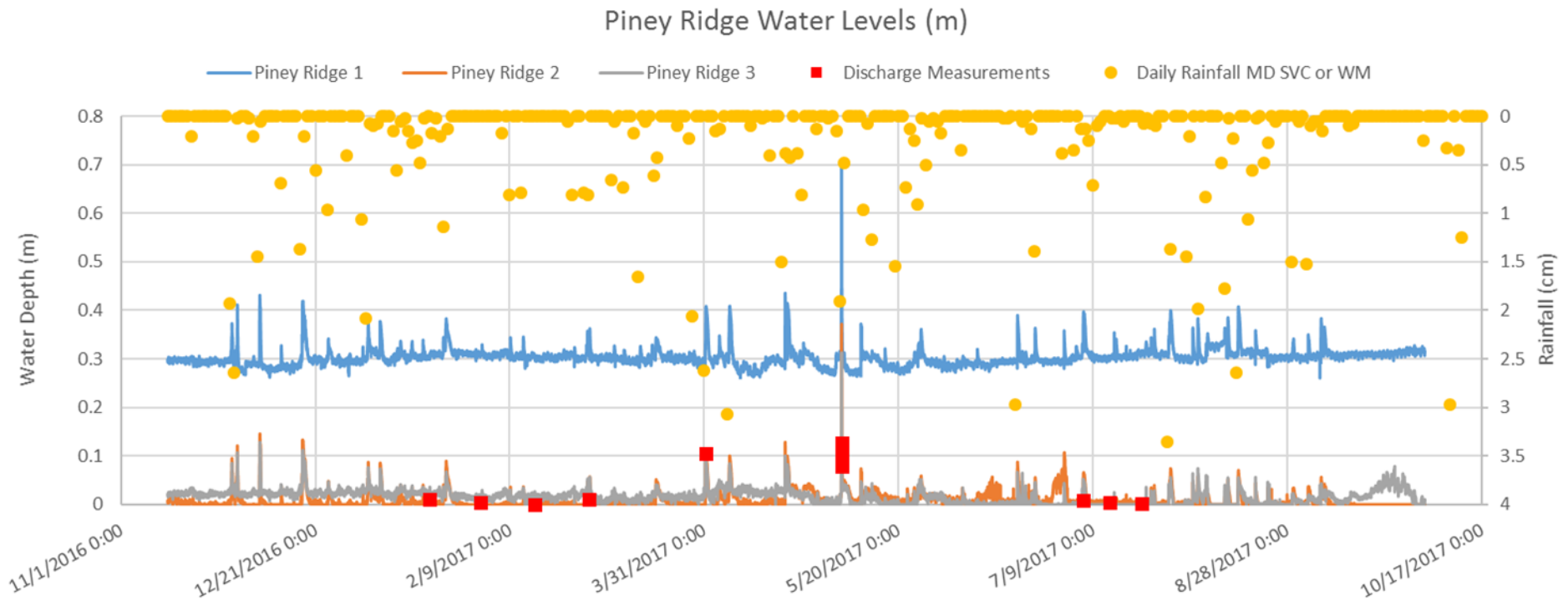
H3 Load Estimation

- BANCs
- Measured change in stream channel

PRE-TREATMENT PHASE

Hydrology-Hydraulics

Time series of stage and rainfall (Nov '16 – Oct '17)

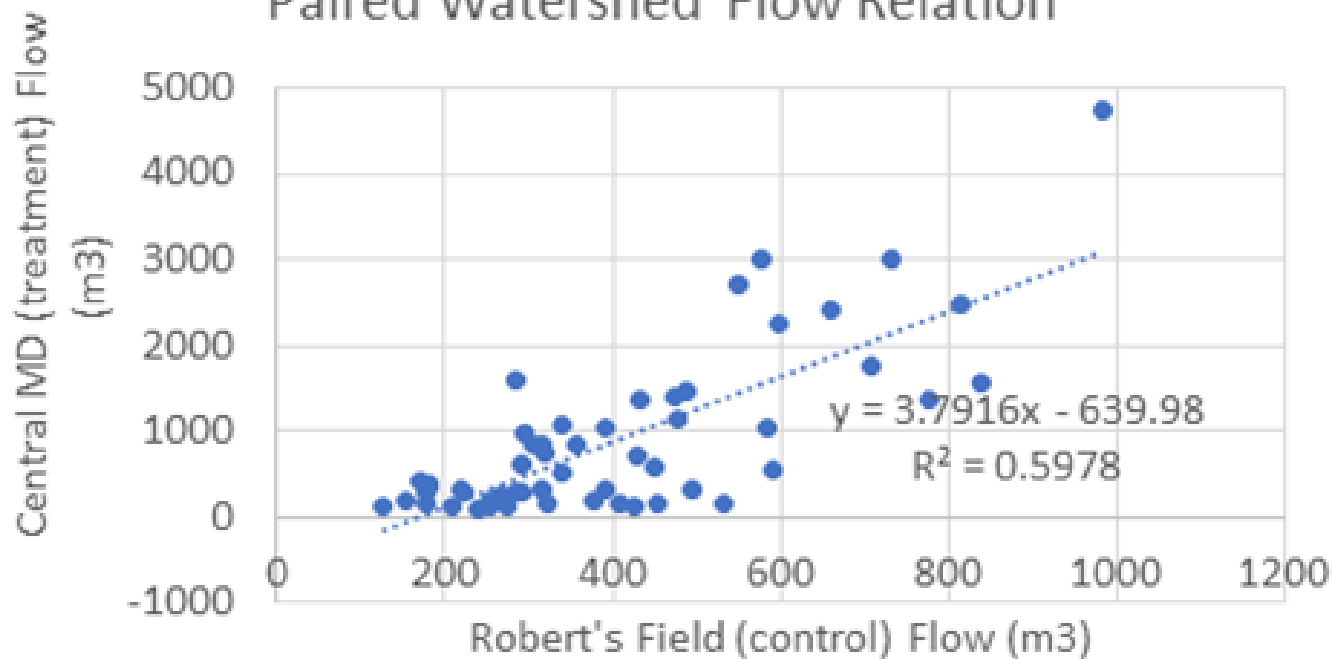


Pre-construction flow monitoring

(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

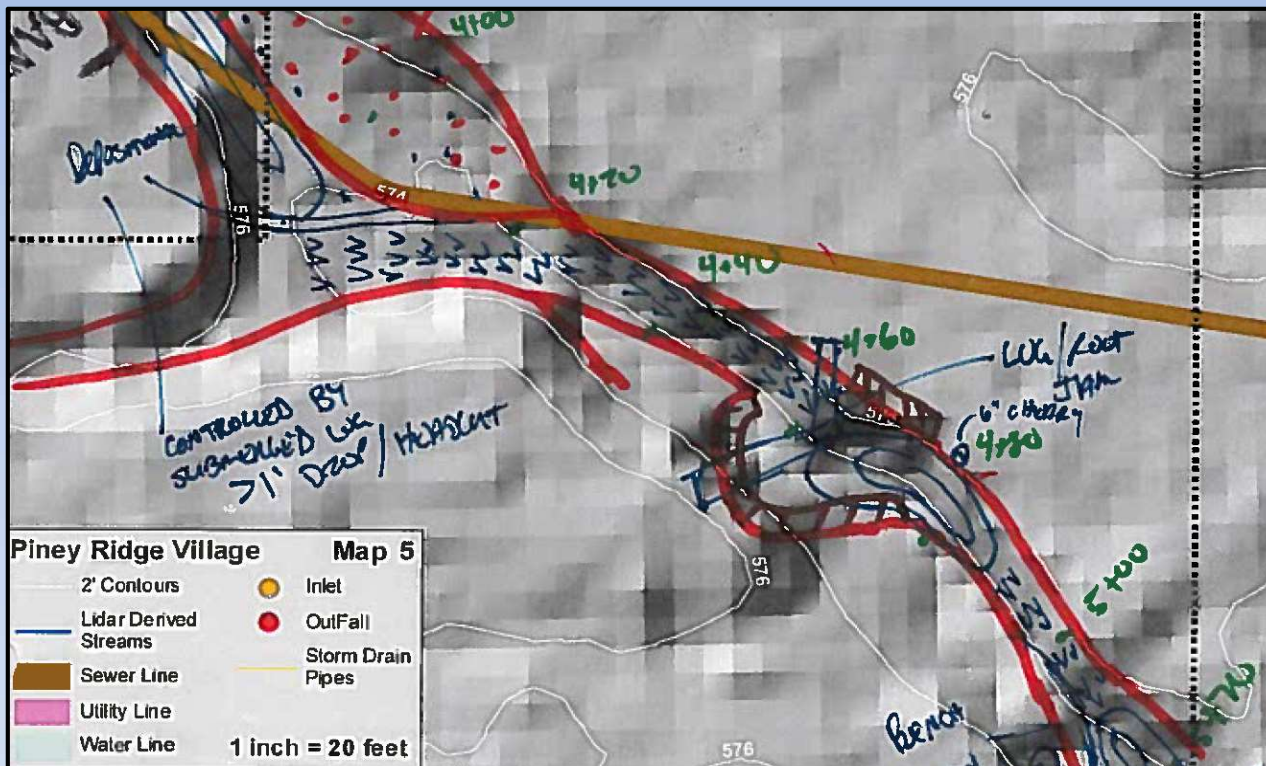
Paired Watershed Flow Relation



PRE-TREATMENT PHASE

Geomorphology

Geomorphic Mapping



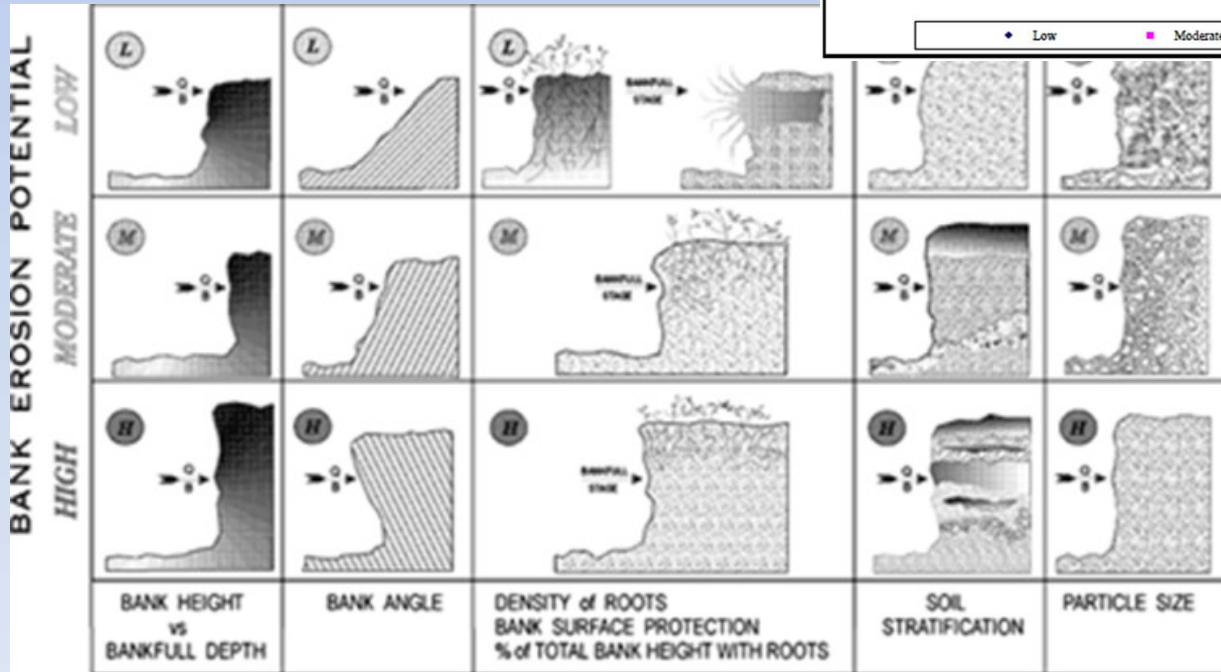
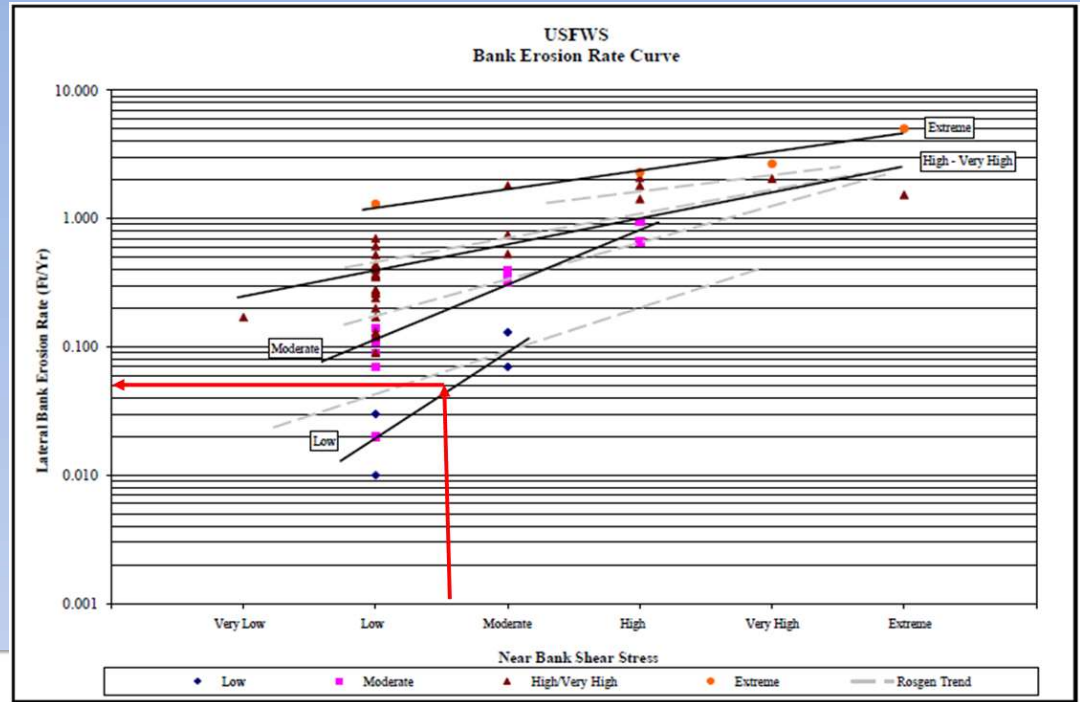
Cross-section locations were identified during this mapping effort, including representative facets along the reach, such as riffles, runs, and pools.

Map Components

- Channel conditions and stability
- Adjacent land uses/land cover
- Anthropogenic structures

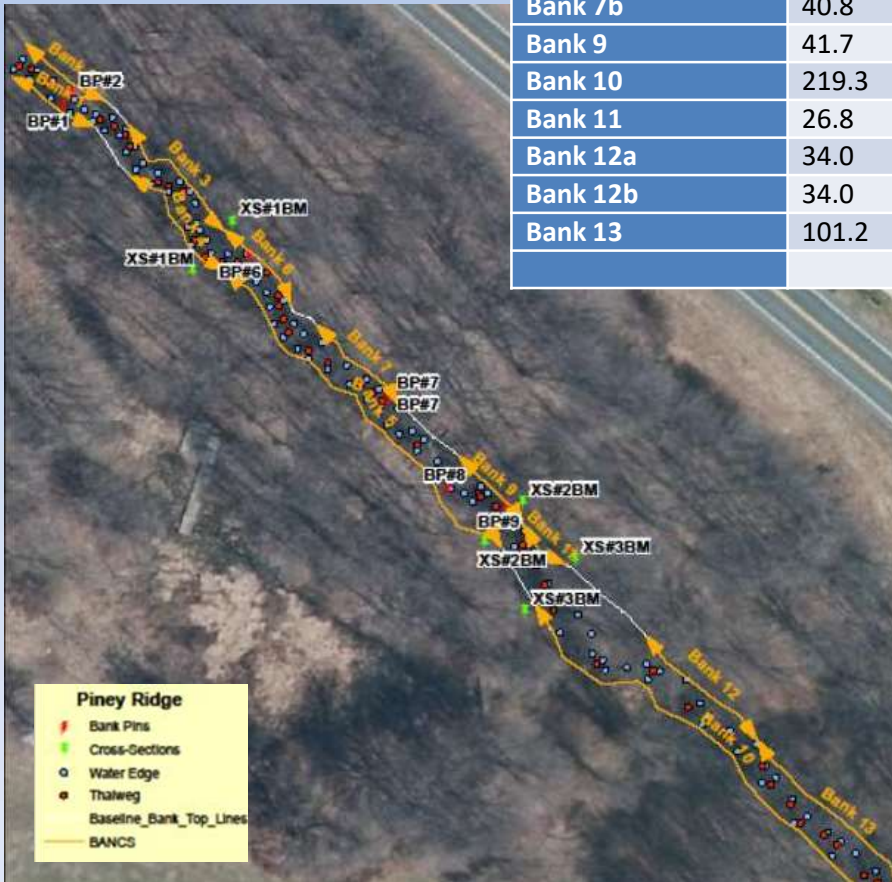
BANCS Assessment

- Bank Erosion Hazard Index (BEHI)
- Near Bank Stress (NBS)



Streambank Characteristics used to develop BEHI

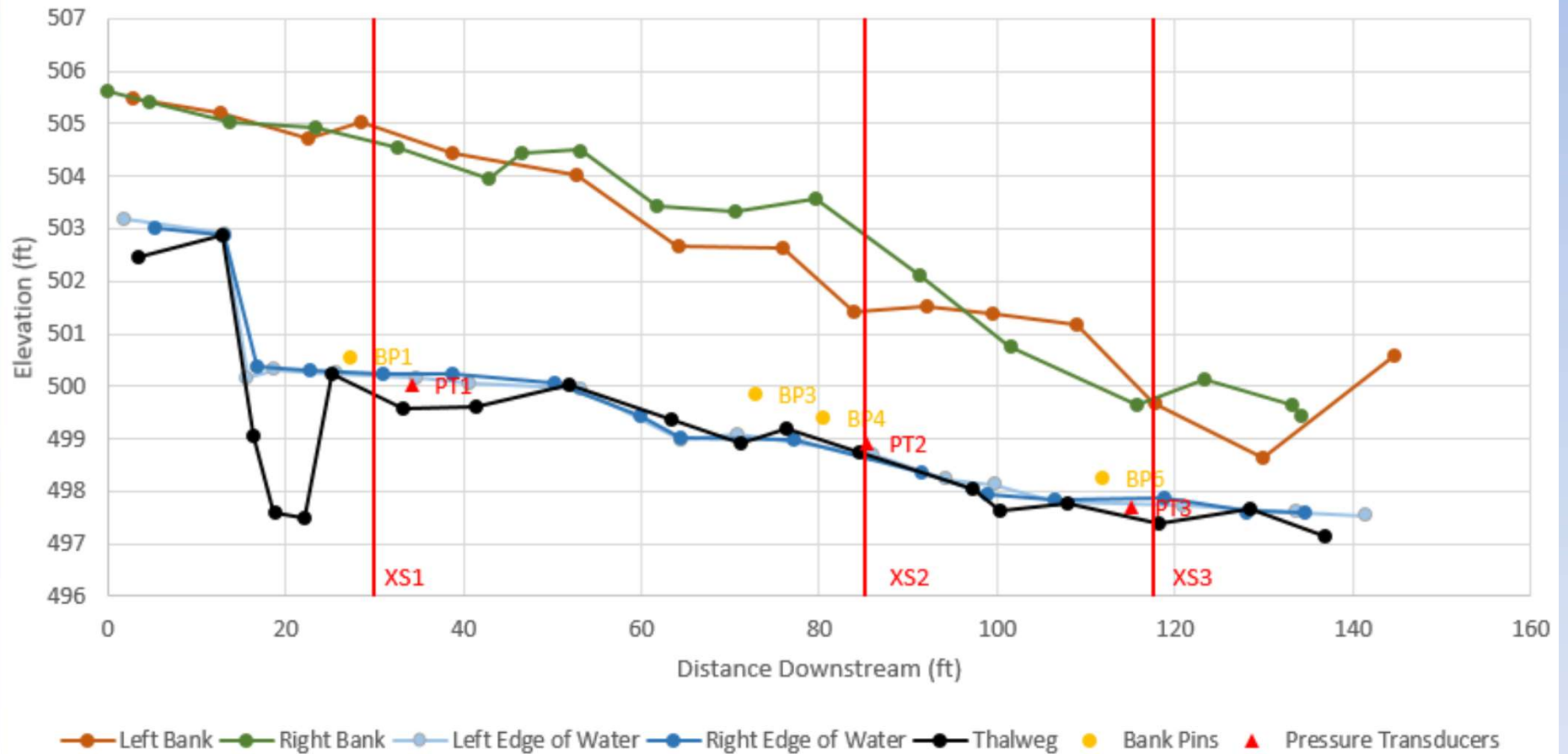
Study Site	Length (ft)	BEHI	NBS	Erosion Rate (ft/yr)	TN Load ¹ (lbs/yr)	TP Load (lbs/yr)	TSS Load (tons/yr)
Bank 1a	10.7	High	Moderate	0.64	1.14	0.53	0.50
Bank 1b	32.0	High	Low	0.40	2.14	0.99	0.94
Bank 2	43.4	Moderate	Low	0.13	0.76	0.35	0.33
Bank 3a	33.9	High	High	1.00	8.95	4.12	3.92
Bank 3b	33.9	High	Moderate	0.64	5.73	2.64	2.51
Bank 4a	45.2	High	High	1.00	11.02	5.07	4.83
Bank 4b	19.4	High	Very High	1.75	8.28	3.81	3.63
Bank 5	180.4	High	Moderate	0.64	25.73	11.85	11.29
Bank 6	44.9	Very High	High	1.00	10.32	4.75	4.53
Bank 7a	10.2	High	Low	0.40	1.02	0.47	0.45
Bank 7b	40.8	High	Moderate	0.64	6.55	3.01	2.87
Bank 9	41.7	High	Moderate	0.64	6.41	2.95	2.81
Bank 10	219.3	Very High	Low	0.25	12.03	5.54	5.28
Bank 11	26.8	High	High	1.00	5.60	2.58	2.46
Bank 12a	34.0	High	Very High	1.75	18.65	8.59	8.18
Bank 12b	34.0	High	Moderate	0.64	6.82	3.14	2.99
Bank 13	101.2	Moderate	Low	0.13	3.96	1.83	1.74
Total:				0.58	135.09	62.21	59.25



BANCS Assessment

Longitudinal Profiles

Blue Ridge Longitudinal Profile



Cross Section Surveys



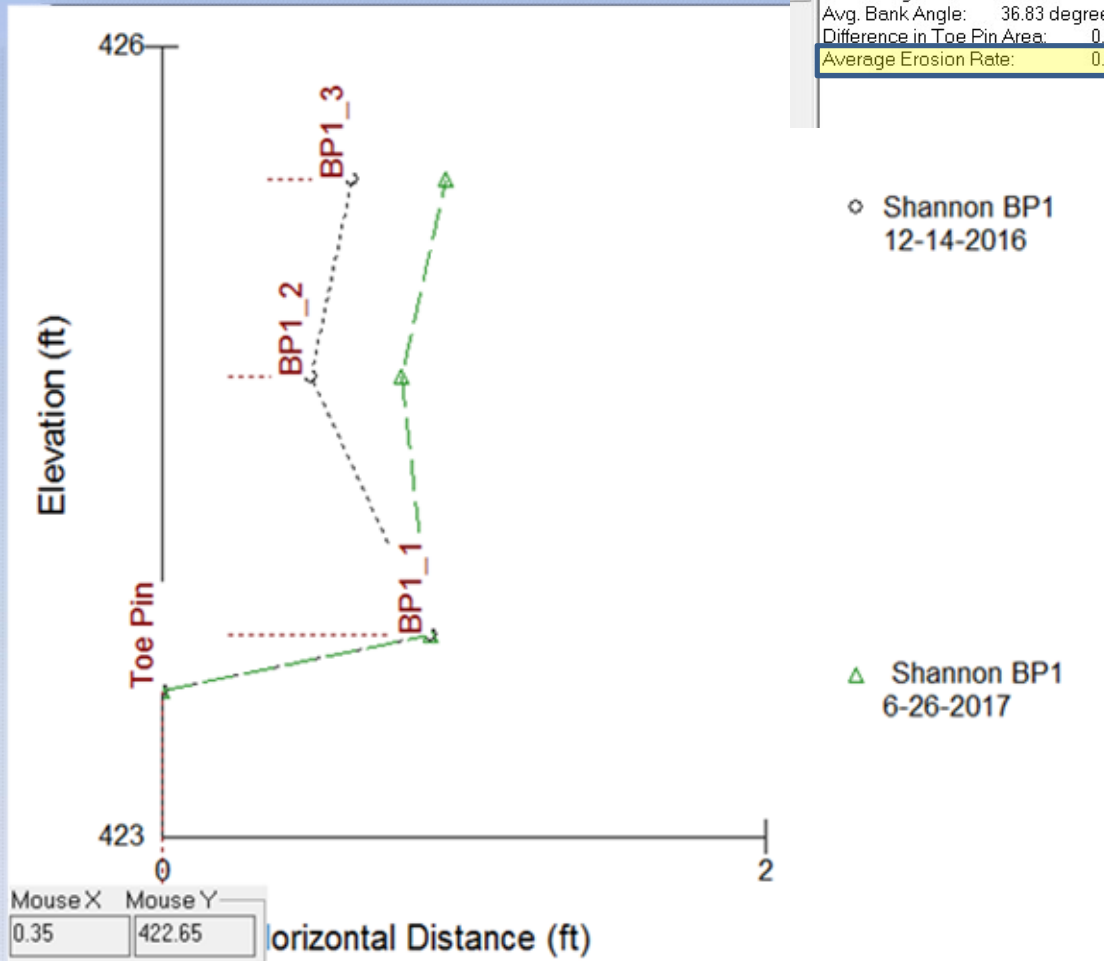
Bank Pins

Setup | Data | Graph | Summary | Photographs | Data Collection Date 12/14/2016

Bank Angle (decimal degrees): 36.8296901304 Calculate Average Bank Angle

Toe Pin Area: 1.19 square feet (used for erosion monitoring)
 Bank Height: 1.94 feet
 Avg. Bank Angle: 36.83 degrees

Overlay #1
 Toe Pin Area: 1.57 square feet (used for erosion monitoring)
 Bank Height: 1.94 feet
 Avg. Bank Angle: 36.83 degrees
 Difference in Toe Pin Area: 0.38 square feet
 Average Erosion Rate: 0.1959 feet



Project Schedule & Next steps

- Pre-treatment monitoring finished.
- Wrapping up pre-treatment data analysis.
- Construction completed at 1 treatment site and underway at the other 2 treatment sites.
- Post-treatment monitoring began the week of May 14th.

Construction

Central MD Service Center



Blue Ridge Manor



Blue Ridge Manor

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



Blue Ridge Manor

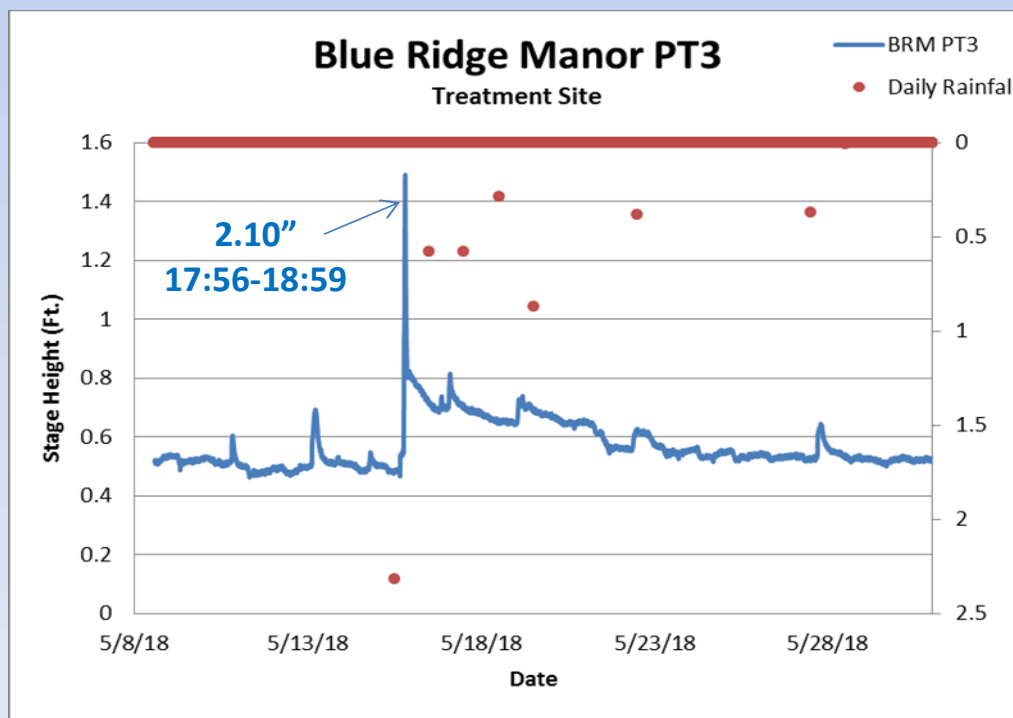
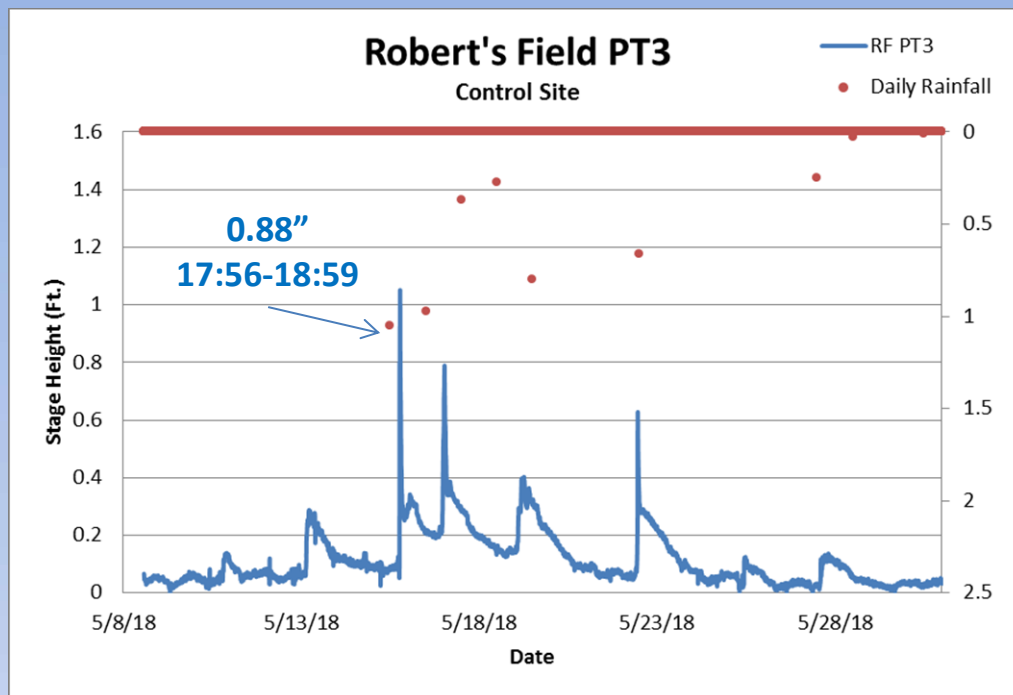
May 15, 2018



Receiving Stream

Blue Ridge Manor

May 15, 2018



**Robert's Field
(Control)**



June 2017



July 2018

**Blue Ridge Manor
(Treatment)**



Thank You!

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