SESWA Regional Seminar
NEW CONSTRUCTION vs. RETROFITS
Tools in the Toolbox

Doug Beisch - Principal

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March 31, 2017

Differences between NSPS and Legacy Load Reductions

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NSPS – New Source Performance Standards

- Represent load reductions or BMPs which are intended to offset a new source
- Tend to have more rigorous design guidance and requirements
- May dictate/influence site layout and density
- Proscriptive based on manuals/permits

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Retrofits and Legacy Load Reductions

- Tend to be driven by TMDLs or other Watershed-based Initiatives
- Citing and sizing in a built environment can be challenging
- Process is often opportunistic and more creative
- Selection is typically phased approach

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Screening Process - Retrofitting

GIS Screening

- Identify Opportunities
- Prepare Mapping for Review

Desktop Analysis

- Review of visual footprint, topo, etc.
- Decide on whether proceeds to field recon

Rapid Field Recon

- Evaluate Constraints in field
- Photo-document
- Measurements (not survey grade)

Prioritization

- Assess Costs and Crediting Metrics
- Rank based on qualitative indicators
- Prioritize based on client and stakeholder weighting and other factors

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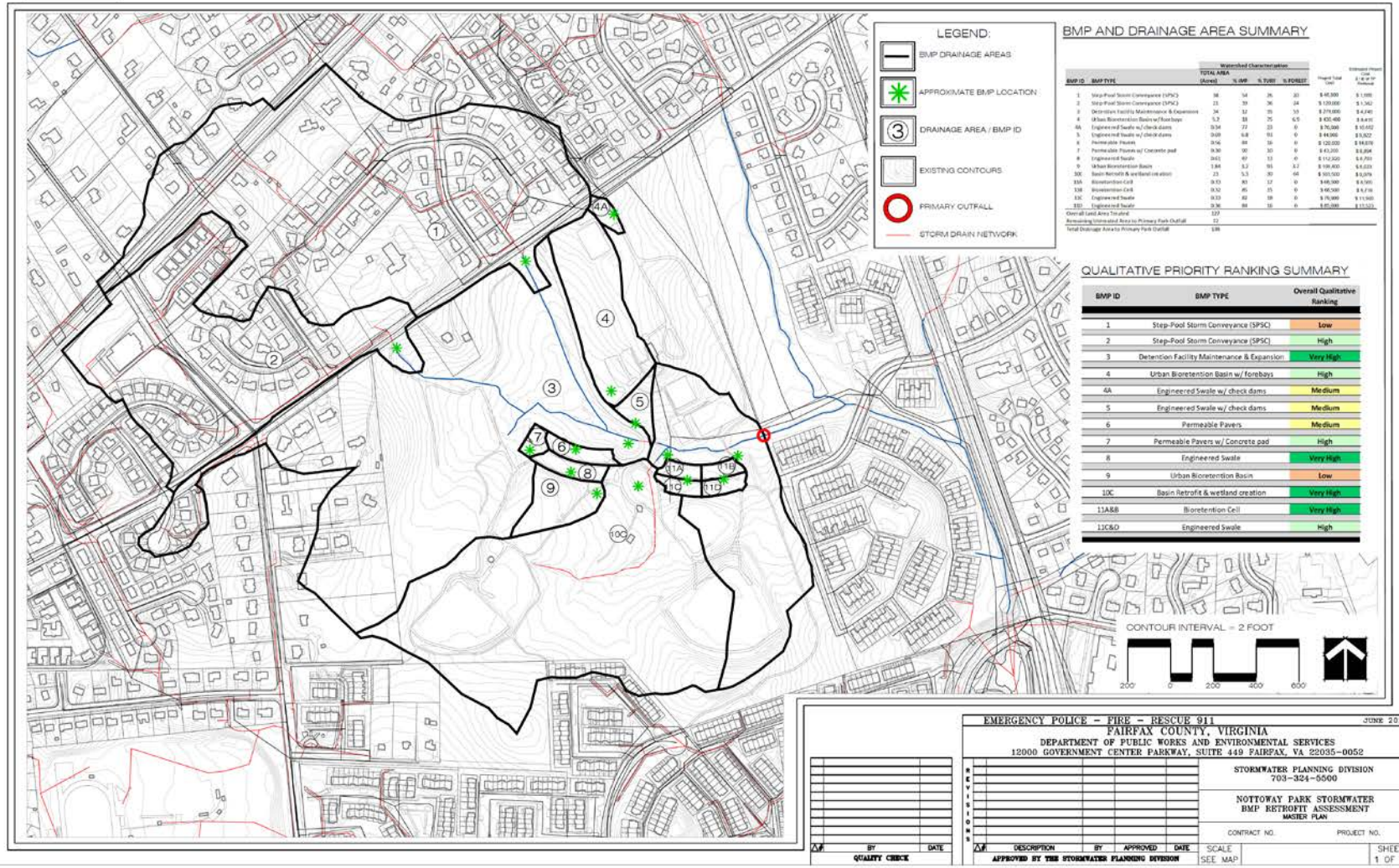
NOTTOWAY PARK – BMP RETROFIT ASSESSMENT

MASTER PLAN



BMP AND DRAINAGE AREA SUMMARY

BMP ID	BMP TYPE	Watershed Characterization: TOTAL AREA (Acres)	% IMP	% TURF	% FOREST	Unused Total Cost	Estimated Project Cost (1 & 10 Yr Removal)
1	Step-Pool Storm Conveyance (SPSC)	38	54	26	20	$ 45,500	$ 1,000
2	Step-Pool Storm Conveyance (SPSC)	21	39	36	24	$ 120,000	$ 1,562
3	Detention Facility Maintenance & Expansion	24	32	35	33	$ 275,000	$ 4,240
4	Urban Bioretention Basin w/ forebays	5.2	33	25	6.5	$ 420,400	$ 8,615
4A	Engineered Swale w/ check dams	0.54	77	23	0	$ 70,200	$ 10,652
5	Engineered Swale w/ check dams	0.69	6.8	93	0	$ 44,900	$ 5,922
6	Permeable Pavers	0.56	84	16	0	$ 120,000	$ 14,078
7	Permeable Pavers w/ Concrete pad	0.38	90	10	0	$ 43,200	$ 6,804
8	Engineered Swale	0.61	47	53	0	$ 112,200	$ 9,793
9	Urban Bioretention Basin	1.84	3.2	95	1.7	$ 199,800	$ 6,023
10C	Basin Retrofit & wetland creation	23	5.3	39	64	$ 501,500	$ 5,079
11A&B	Bioretention Cell	0.43	83	17	0	$ 48,500	$ 9,565
11B	Bioretention Cell	0.32	85	15	0	$ 46,500	$ 5,716
11C	Engineered Swale	0.23	82	18	0	$ 70,000	$ 11,565
11D	Engineered Swale	0.36	84	16	0	$ 85,000	$ 13,021
Overall Land Area Treated		127					
Remaining Untreated Area to Primary Park Outfall		22					
Total Drainage Area to Primary Park Outfall		105					

QUALITATIVE PRIORITY RANKING SUMMARY

BMP ID	BMP TYPE	Overall Qualitative Ranking
1	Step-Pool Storm Conveyance (SPSC)	Low
2	Step-Pool Storm Conveyance (SPSC)	High
3	Detention Facility Maintenance & Expansion	Very High
4	Urban Bioretention Basin w/ forebays	High
4A	Engineered Swale w/ check dams	Medium
5	Engineered Swale w/ check dams	Medium
6	Permeable Pavers	Medium
7	Permeable Pavers w/ Concrete pad	High
8	Engineered Swale	Very High
9	Urban Bioretention Basin	Low
10C	Basin Retrofit & wetland creation	Very High
11A&B	Bioretention Cell	Very High
11C&D	Engineered Swale	High

EMERGENCY POLICE – FIRE – RESCUE 911

JUNE 2013

FAIRFAX COUNTY, VIRGINIA

DEPARTMENT OF PUBLIC WORKS AND ENVIRONMENTAL SERVICES

12000 GOVERNMENT CENTER PARKWAY, SUITE 449 FAIRFAX, VA 22035-0052

STORMWATER PLANNING DIVISION
703-324-5500

NOTTOWAY PARK STORMWATER BMP RETROFIT ASSESSMENT
MASTER PLAN

CONTRACT NO. PROJECT NO.

SCALE: SEE MAP

SHEET 1 OF 14

Δ#	BY	DATE
	QUALITY CHECK	

Δ#	DESCRIPTION	BY	APPROVED	DATE
	APPROVED BY THE STORMWATER PLANNING DIVISION			

REVISIONS

SCHEMATIC PLAN NOTTOWAY PARK BMP/LID RETROFIT

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QUICK STATS SUMMARY TABLES:

This section provides a 'Quick Stats' summary of the contributing drainage area and proposed BMP retrofit. The first table provides a characterization of the contributing watershed, initial estimates of the BMP surface area, typical storage depth, and volume reduction and TP removal efficiency performance. The second table provides initial estimates of the pollutant loading, estimated load reductions based on both the Virginia Runoff Reduction Method (VRRM) and the Chesapeake Bay TMDL Guidance approved by EPA. It also estimates capital construction costs at a planning level, based on typical unit costs, annual operation and maintenance (O&M) costs as a percentage of construction costs, and finally the cost-effectiveness of the retrofit on a capital construction cost basis. The costs presented here only consider the BMP itself and do not consider the related costs such as additional earthwork to tie into grade, demolition or relocation of existing infrastructure, soft costs, or debt servicing of O&M costs. As such, these estimates should be considered conceptual planning level only.

A. Watershed and BMP Characterization

Approx. Treated Land Area (Acres)	Approximate % Impervious	Approx. % Turf	Approx. % Forest	Proposed BMP Type	Approximate BMP Linear Feet Required, per BMP Clearinghouse Specs[1] (LF)	Approximate Linear Feet Provided, per BMP Clearinghouse Specs (LF)	Typical Equivalent Storage Depth[2] (ft)	BMP Performance[1] Vol.(%)	TP Rem.(%)
37.64	54%	26%	20%	Step-Pool Storm Conveyance (SPSC)	100	100	N/A	N/A	N/A

[1] VRRM guidance not available. MDE Guidance used for Ches Bay pollutant reduction quantification purposes.

B. Pollutant Load and Cost Characterization

VRRM		CHESAPEAKE BAY PROTOCOL					COST METRICS			
Estimated Existing TP Pollutant Loading, VRRM (lbs/yr)	Estimated TP Load Reduction w/ BMP, VRRM (lbs/yr)	Ches Bay BMP Classification (RR or ST?)	Retrofit Removal Adjustor Curve Removal[2] (%) TP	TN	TSS	Estimated TP Load Reduction, Ches Bay Protocol[2] (lbs/yr)	Typical Capital Construction Cost Unit Price ($/LF)	Capital Construction Planning Cost Estimate[1] ($)	Typical Annual O&M Planning Costs as % of Construction Cost	Estimated Cost-Effectiveness on a Capital Construction Cost Basis ($/lb)[3]
49.64	N/A	ST	4%	2%	4%	1.99	$400	$48,000	N/A	$1,688

[1] Capital Cost is broad estimate. Includes additional 20% for planning and engineering. Does not consider all design specifics or proximity to roadway.

[2] Chesapeake Bay Protocol #4 specifies classying RSC as a Stormwater Retrofit project. Therefore, the MDE RSC Design Specification example was used to very roughly estimate storage volume that may be provided with practice. Actual design and calculations not peformed; these values are order of magnitude estimates only.

[3] Based on information from Stormwater Planning Division, using an annualized cost factor for a 20-year project life with 3% interest rate.

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QUALITATIVE PRIORITY RANKING MATRIX:

The section utilizes a qualitative ranking system to summarize several of the core elements presented in the two previous sections. A color coding format is used to assign each category a value of: very low, low, medium, high, or very high for easy and quick comparison to other proposed retrofitting opportunities. The assignment of color coding is subjective and not weighted based on other factors. Categories are labeled so that the classification of very high is desirable for all outcomes. For example, a result of "Very High" for the Affordability of Construction Costs, Pollutant Load Reduction Capacity, and Public Acceptance are desirable outcomes for all of these categories.

Qualitative Priority Ranking Matrix

	Very Low	Low	Medium	High	Very High
Ability to Treat Significant Land Area					
Ability of Retrofit to Address Existing Problems					
Pollutant Load Reduction Capacity Relative to D.A. (VRRM)					
Pollutant Load Reduction Capacity Relative to D.A. (Ches Bay Guidance)					
Additional Ancillary Benefits					
Public Acceptance					
Few Constraints (high = no or few constraints)					
Affordability of Capital Construction Planning Costs [v. high = low cost] ($)					
Affordability of Annual O&M Planning Costs [v. high = low cost] ($)					
Cost-Effectiveness[1] [v. high = high load reduction at low cost] ($/TP lb)					
Overall Ranking					

[1] on a capital construction cost basis

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NOTTOWAY PARK – BMP RETROFIT ASSESSMENT

BMP #4 – URBAN BIORETENTION WITH FOREBAYS

WATERSHED AND BMP NARRATIVE DESCRIPTION:

This section summarizes watershed characteristics and the BMP(s) proposed to treat the drainage area in a narrative format.

Watershed Characterization:
The contributing drainage area includes two parking bays on a moderate hillside that use wheel stops and do not have curb and gutter. The watershed is of moderate size at approx. 5 acres, the vast majority of which is turf grass. It captures approx. 1/2 of the road-way and carries it to an inlet at the location.

Existing Problems:
The soil in between the existing parking bays has only light vegetation and is currently eroding some with sediment buildup in the parking lot at low spots. There is some organic debris buildup at the low-end of the parking lot and pooling is occuring at the entrance to the parking lot due to a low spot.

BMP Description and Primary Purpose:
A bioretention basin, fitted with two sediment forebays are proposed to treat existing parking lot, roof and turf area. A roadside ditch along the main park roadway and along the parking lot entrance may also be retrofitted with check dams to reduce approaching hillside velocity prior to entering the system. Plantings in the parking bay median to stabilize the soil should be employed. The primary purpose is to treat the existing parking bays and attenuate runoff volume.

Water Quality Benefits:
The level of impervious is limited, but turf area is large. Therefore, Ches Bay reductions will be relatively small, but VRRM reductions would be measurable.

Ancillary Benefits:
The practice could reduce existing ponding at the entrance to the parking lot and reduce sediment buildup in the parking lot. Additionally plantings would improve aesthetics. The bioretention could serve as a nice amenity along the park roadway, if wildflowers, redbud and other nice plantings are used.

Anticipated Public Reaction:

Constraints:
An existing turn-around at the entrance to the parking bay would limit the BMP footprint. This would classify be relocated. In addition, there is a fence line along the parking entrance roadway that could limit regrading of a swale to the bioretention facility. Existing tree roots at the bottom of the parking bay would limit grading to induce more positive drainage. Possible future addition of parking lot bay.
Special Considerations:
The Fairfax County Conceptual Development Plan for the park indicates that a future parking bay will be constructed in this location. This would severely limit the utility of this practice.

Data and Coordination Needs:
Survey of existing utilities, spot elevations, invert of storm drains. Clarification from County on likelihood of future parking bay construction.

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5.19	18%	75%	7%	Bioretention Basin w/ FB	3,711	3,800	2.15	80%	50%

[1] VRRM Performance Metrics
[2] Includes 3 ft bioretention soil, 1 ft gravel sump, and 1 ft ponding depths with void ratios equal to 0.25, 0.4, and 1, respectively

B. Pollutant Load and Cost Characterization

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4.01	3.58	RR	85%	79%	91%	3.41	$4.0	$182,400	1.5% ($2,736.000)	$8,416

[1] Capital Cost only includes bioretention facility. Demolition and reconstruction, adjustment of inlet, re-paving of entrance are not included. Includes additional 25% for planning and engineering.
[2] Based on information from Stormwater Planning Division, using an annualized cost factor for a 20 year project life with 3% interest rate.

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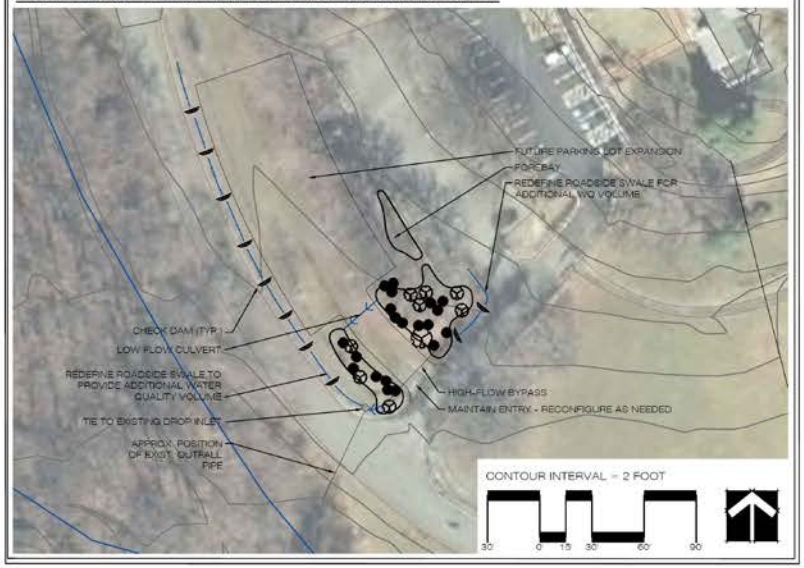
Cost-Effectiveness[1] (v. high = high load reduction at low cost) ($/TP lb)					
Overall Ranking					

[1] on a capital construction cost basis

PROPOSED BMP RETROFIT AND CONTRIBUTING DRAINAGE AREA



SITE IMAGE #1:

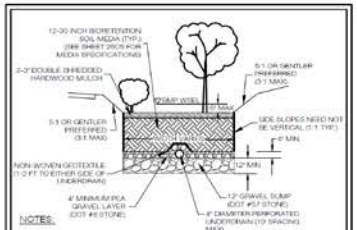
Asphalt path draining to grassed swale and drop inlet

SITE IMAGE #2:

Parking lot runoff

SITE IMAGE #3:

Median between parking lots



TYPICAL DETAIL - BIORETENTION FILTER (CROSS SECTION)
(ADAPTED FROM FAIRFAX COUNTY PUBLIC FACILITIES MANUAL) NOT TO SCALE

LOCATION MAP:

BY	DATE
QUALITY CHECK	

EMERGENCY POLICE – FIRE – RESCUE 911 — JUNE 2013

FAIRFAX COUNTY, VIRGINIA
DEPARTMENT OF PUBLIC WORKS AND ENVIRONMENTAL SERVICES
12000 GOVERNMENT CENTER PARKWAY, SUITE 449 FAIRFAX, VA 22035-0052

REVISIONS				
Δ#	DESCRIPTION	BY	APPROVED	DATE

APPROVED BY THE STORMWATER PLANNING DIVISION

STORMWATER PLANNING DIVISION
703-324-5500

NOTTOWAY PARK STORMWATER BMP RETROFIT ASSESSMENT
INDIVIDUAL BMP

CONTRACT NO. | PROJECT NO.

SCALE: SEE MAP | SHEET: 5 OF 14

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Innovative/Emerging Approaches

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Issues in Urbanized Areas

- Historical/Legacy Urbanization
- Minimal Stream Functions and Values
- Surface Practices Cost Prohibitive/Innefective
- Forces Watershed-based Approaches

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Stream Restoration

- Reduces Nutrients and Sediments
- Protect Property and Infrastructure
- Improves Ecology
- Non-land Consumptive

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Nutrient and Sediment Loadings are dramatically affected by urban stream restoration

Stream and Shoreline Restoration can affect multiple objectives:

- Protect Property & Infrastructure
- Improve Flood Conveyance
- Ecological Functions & Values
- Compatible with Park/Trail systems
- Not (as) Land-Consumptive
- Enhance Aesthetics

Stream Restoration/Stabilization

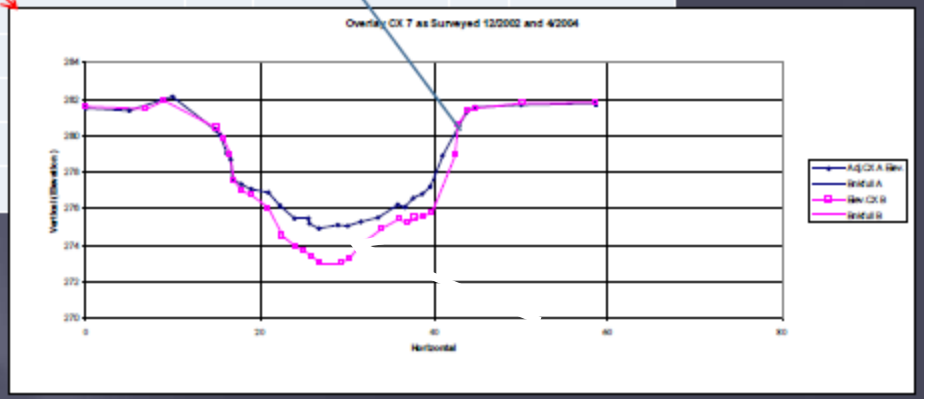
- Treatment Mechanisms:
  - "Pass through" physical, chemical, and biological treatment of the improved natural system
    - *Research ongoing, not covered herein*
  - Reduction in bank erosion = reduction in nutrients associated with the bank sediment
    - *Standard Methodologies under development*

Stream Restoration/Stabilization Nutrient Reduction

- Detailed Studies:
  - Sediment Transport Modeling
  - Physical Sampling
- Simpler, more practical methods
  - BANCS Method (Rosgen)
  - Maryland Guidance
  - City of Baltimore Dept. of Public Works
  - "Sediment Wedge" Calculations
    - Measured Historical Bank Erosion Rates
    - Predictive Geomorphology (Channel Evolution Model)
    - Stable Channel Hydraulic Analysis

Data for local curve for Stony Run

Stream Bank No.	NBSS Rating	Avg. Erosion Rate	NBSS Rating	BEHI Rating
1-1L	2	0.1	Moderate	High
1-1U	4	0.156	Very High	Moderate
1-2U	5	0.343	Extreme	High
3-1U	4	0.182	Very High	High
4-1U	4	0.515	Very High	High
4-2U	5	0.206	Extreme	Moderate
5-1U	4	0.171	Very High	High
3-1L	0.01	0.01	Very Low	Moderate
4-1L	4	0.48	Very High	High
5-1L	5			
5-2L	4			
5-3L	4			
6-2L	4			
7-1L	5			



Source: CWP: Urban Stream Restoration Expert Panel, 2012

Stream Erosion

- Typical Bank-line Sediment Conc. btw: 100-200 mg/kg TP
- Scale of the problem can be staggering (1000s of tons of sediment/yr from degraded urban stream channels)

Pre-Restoration

CBWM reflects up to 600 lb/ac of sediment generated by the most urbanized watersheds

Shoreline Nutrient Reductions

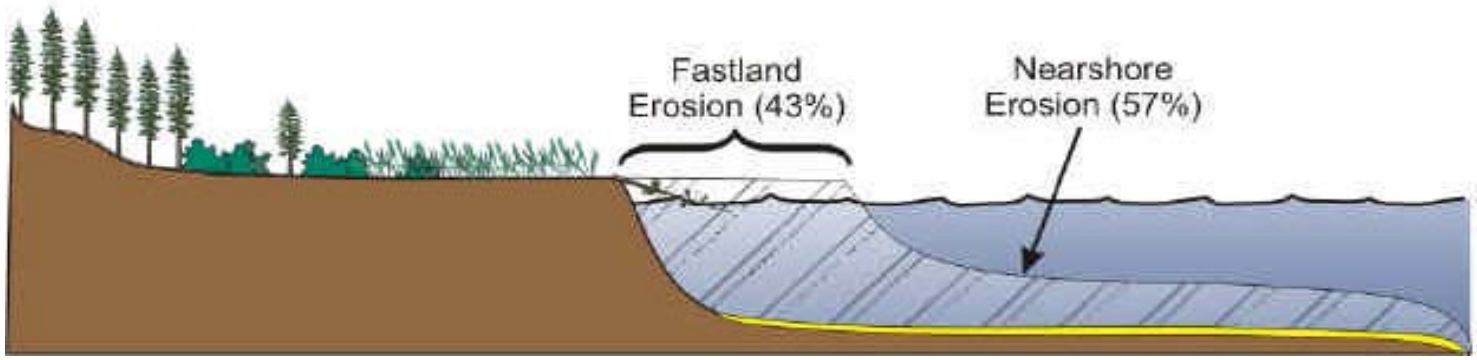
Similar to Stream Restoration

Shoreline Erosion = Sediment Load = Nutrient Load

- Sediment from Bank and Nearshore Material
- Nutrients Attached to Sediment
  - Nitrogen
  - Phosphorus

Shoreline Stabilization Stops the Erosion

Sediment & Nutrient "Removal" Credit



Source: Maryland Geological Survey/Chesapeake Bay Program (modified from USACE,1990)

Examples of Shoreline Stabilization Practices

Conventional

- Bulkheads
- Seawalls
- Riprap Revetments

- Living Shorelines
  - Marsh Sills
  - Nearshore Breakwaters with Beach Nourishment

No one solution is appropriate for all cases – site specific

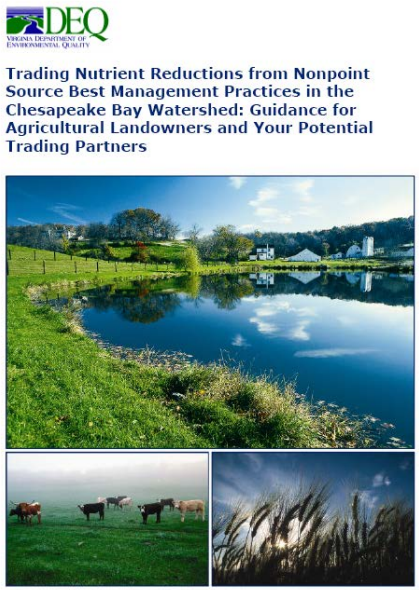
Source: Google Imagery (www.googlemaps.com)

Shoreline Nutrient Reductions: Past Research

- Numerous Studies from 1970s – Present
  - USACE
  - Virginia Institute of Marine Science (VIMS)
  - Virginia Dept. of Conservation and Recreation (DCR)
  - Chesapeake Bay Program
  - Maryland Dept. of the Environment

Agricultural Nutrient Offsets

- Significant Federal Support at EPA/USDA
- Agricultural Trading Guidance and Support Available
- Offset Credit Generation generally constrained to Land Conversion
- Service area defined (similar to mitigation banking)



Non-traditional Surface Water Quality Offsets

- Land/Mine Reclamation
- Pollution Abatement
- Nutrient Management
- Large scale ecological improvements (constructed/ created wetlands)

Questions?

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