TRENDS IN STREAM RESTORATION CREDITING AND IMPLEMENTATION IN THE MID-ATLANTIC REGION

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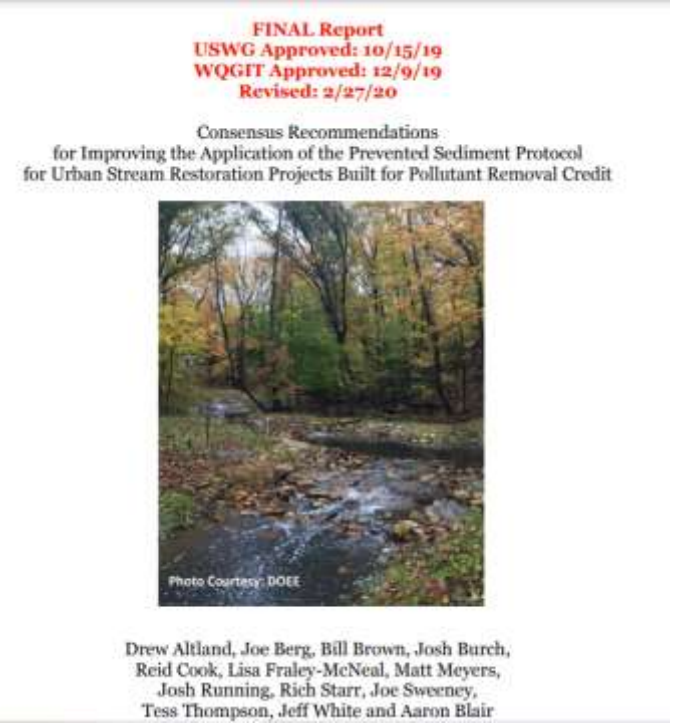
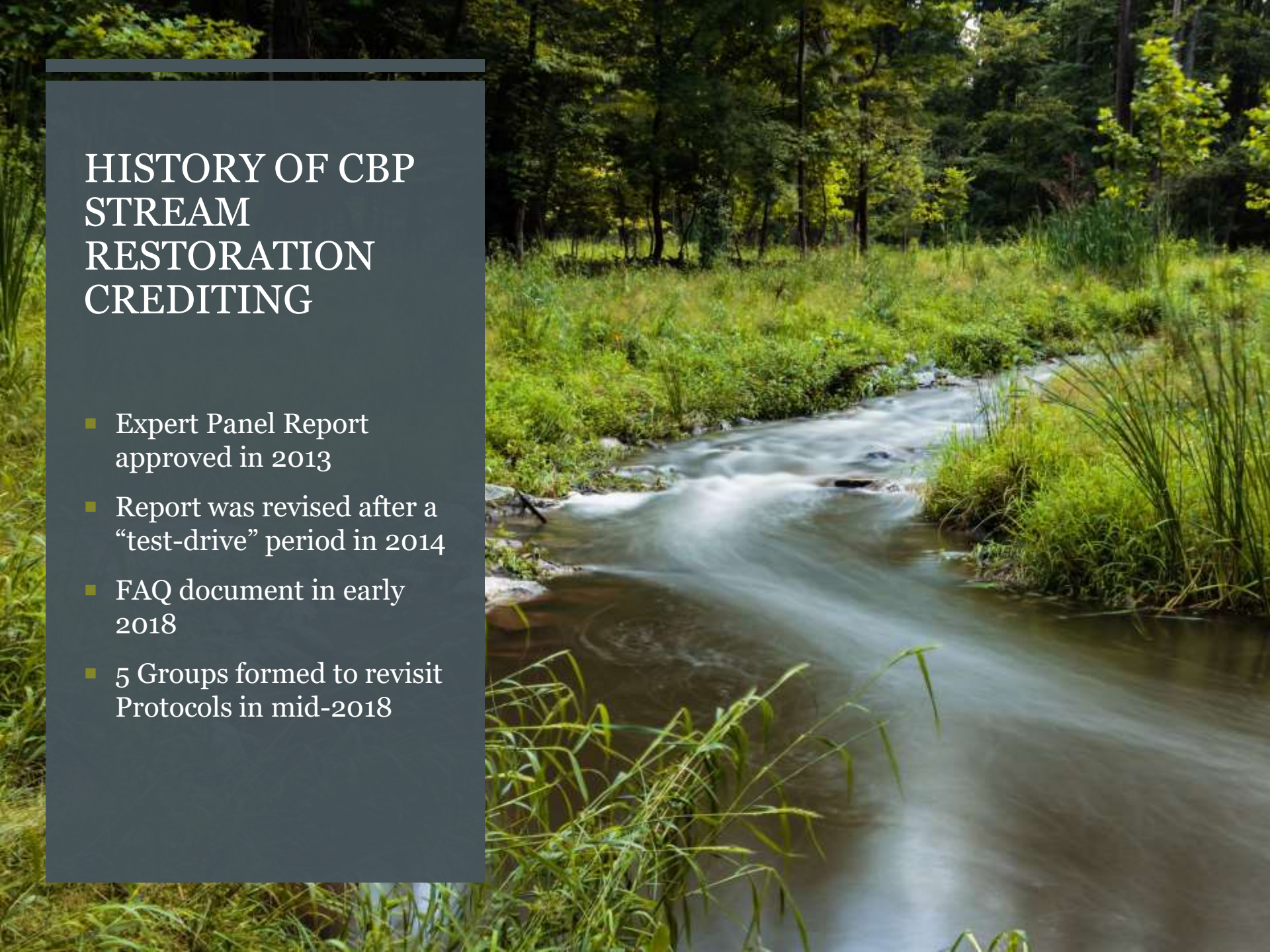
CHESAPEAKE BAY BMP CONTEXT

- BMP Expert Panel Reports Define "Crediting Protocols" for projects under the Bay TMDL
- The basic elements of the reports:
  - Key Definitions,
  - Qualifying Conditions,
  - How to Calculate Pollutant Reductions
  - Literature Review of Supporting Science
  - Verification, Tracking and Reporting Requirements
- There are dozens of available BMPs, with thousands of flavors



HISTORY OF CBP STREAM RESTORATION CREDITING

- Expert Panel Report approved in 2013
- Report was revised after a “test-drive” period in 2014
- FAQ document in early 2018
- 5 Groups formed to revisit Protocols in mid-2018



Group 1 (Verification)	
Name	Affiliation
Rich Starr	Ecosystem Planning and Restoration
Kathy Hoverman	KCI
Tim Schueler	Hazen and Sawyer
Kip Mumaw	Ecosystem Services
Neely Law	Center for Watershed Protection
Meghan Fellows	Fairfax County, DPWES
Sandra Davis	US Fish and Wildlife Service
Jennifer Rauhofer	Stormwater Management Consulting
Josh Burch	DOEE
Scott Cox	PADEP

Table 1: Outfall Restoration Crediting Team	
Name	Affiliation
Ray Bahr	MDE
Stephen Reiling	DOEE
Tracey Harmon	VDOT
Brock Reggi	VADEQ
Karen Coffman	MDOT SHA
Ryan Cole	MDOT SHA (alternate)
Elizabeth Ottinger	US EPA Region 3
Carrie Traver/Aaron Blair	US EPA Region 3
Alison Santoro	MD DNR
Ted Brown	Biohabitats
Chris Stone	Loudoun County, VA
Erik Michelsen	Anne Arundel County
Neil Weinstein	LID Center
Nick Noss	PA Turnpike Commission

Table 1. Membership for Group 3	
Name	Affiliation
Drew Altland	RKK
Lisa Fraley-McNeal	Center for Watershed Protection
Joe Berg	Biohabitats
Rich Starr	Ecosystem Planning and Restoration
Josh Running	Stantec
Matt Meyers	Fairfax County, VA DPWES
Bill Brown	PADEP
Jeff White	MDE
Josh Burch	DOEE
Reid Cook	RES Consultants
Aaron Blair	EPA
Tess Thompson	Virginia Tech
Joe Sweeney	Water Science Institute

Table 1. Roster for Group 4	
Name	Affiliation
Joe Berg	Biohabitats
Drew Altland	RKK
Bill Stack	CWP
Scott Lowe	McCormick Taylor
John Hottenstein	Bayland Consultants
Jeremy Hanson	Virginia Tech
Sujay Kaushal	University of Maryland
Joel Moore	Towson University
Jens Geratz	Anne Arundel County DPW
Sean Crawford	Bayland Consultants
Josh Burch	DOEE
Jeff Hartranft	PADEP BWEW
Denise Clearwater	MDE Wetlands and Waterways
Paul Mayer	EPA Region ORD
Durelle Scott	Virginia Tech
Greg Noe	USGS
Chris Becraft	Underwood and Assoc

THE STREAM RESTORATION PROTOCOLS

1. Prevented sediment

2. In-stream denitrification

5. Outfall and Gully Stabilization

3. Floodplain reconnection

4. The “tweener” Dry Channel RSC

PROTOCOL 1: PREVENTED SEDIMENT

- Approved: February 2020
- Full Report: https://chesapeakestormwater.net/download/9928/

Load Reduced = Annual Streambank Erosion Rate × Soil Nutrient Concentration × 50% Efficiency Factor

PROTOCOL 2: DENITRIFICATION DURING BASEFLOW

Approved: October 2020

Full Report: https://chesapeakestormwater.net/download/10032/

Load Reduced = Define EHZ Area × Unit Denit Rate × Site Adjustment Factors

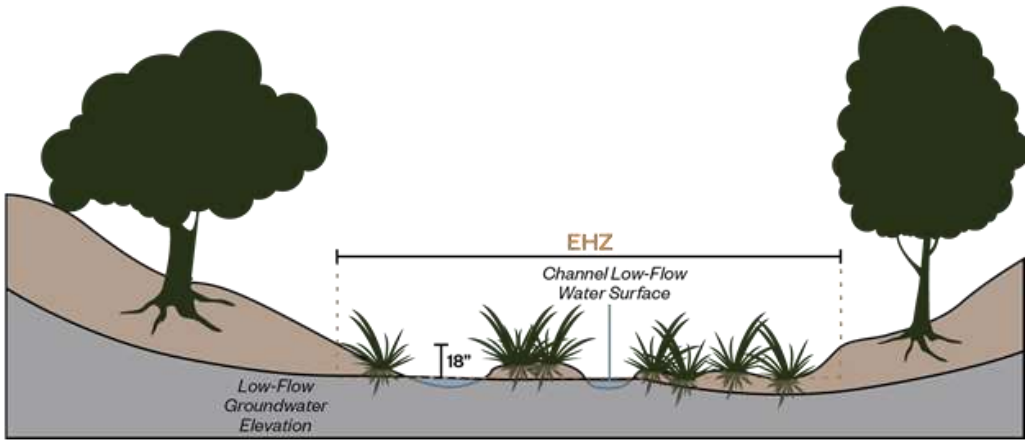
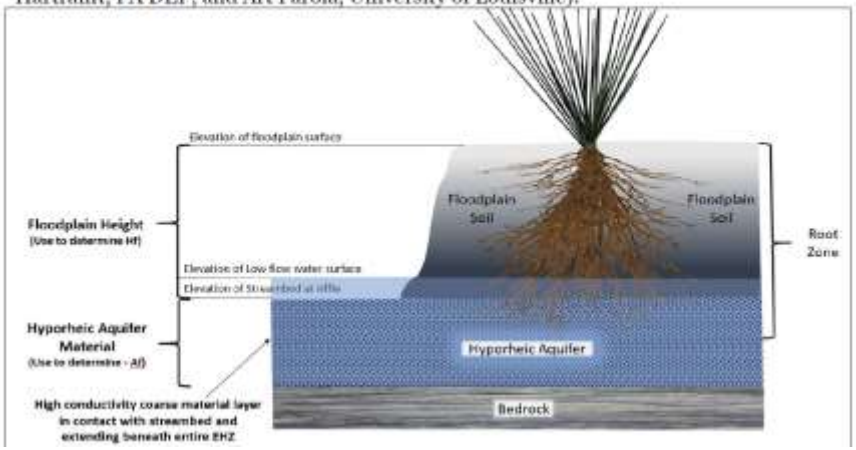


Figure 4. Illustration of site-specific discount factors for Protocol 2 (Courtesy: Jeff Hartranft, PA DEP; and Art Parola, University of Louisville).

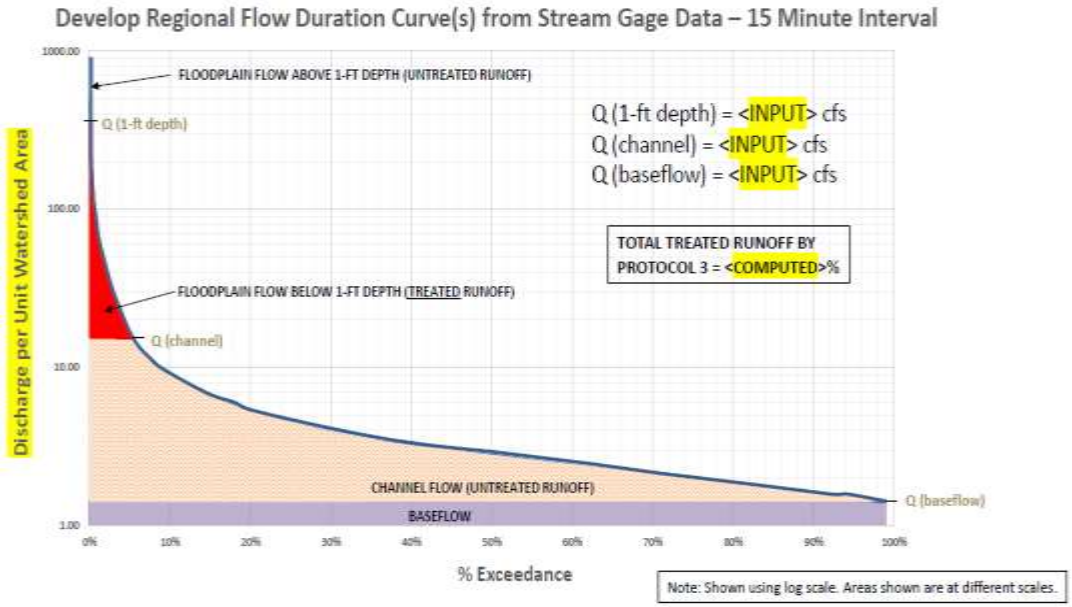


PROTOCOL 3: FLOODPLAIN RECONNECTION

Approved: October 2020

Full Report: https://chesapeakestormwater.net/download/10032/

Define Project Area and Elevations → **Compute Contributing Flows or Loads** → **Compute Flow Vol Diverted to Floodplain** → **Define Effect of Floodplain Treatment**



PROTOCOL 5: OUTFALL AND GULLY STABILIZATION

Approved: October 2019

Full Report: https://chesapeakestormwater.net/download/9714/

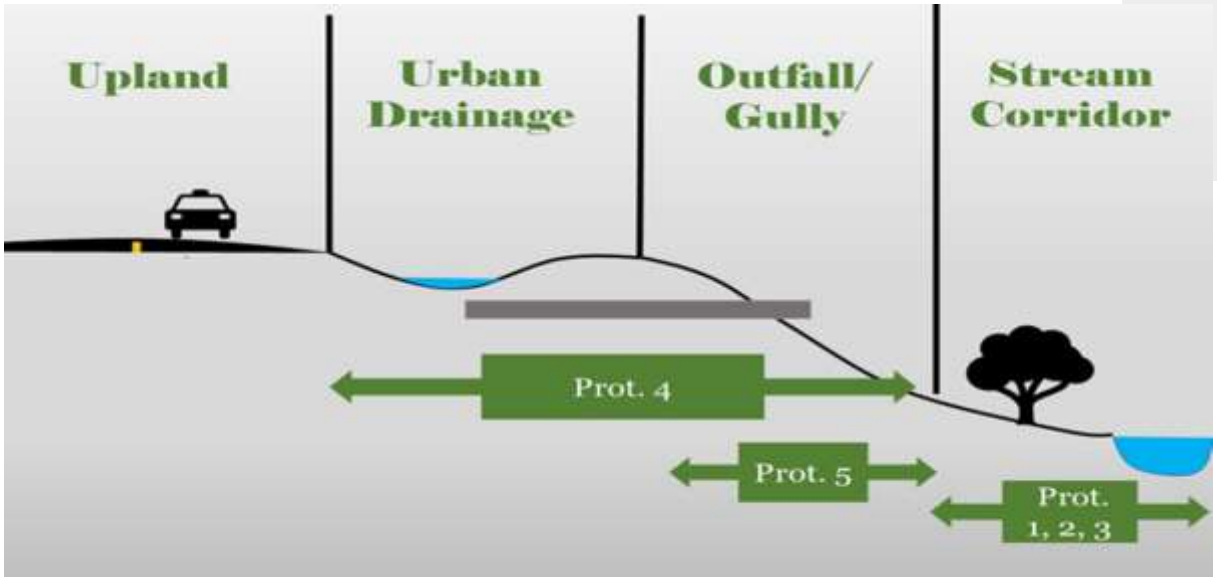
Addressing erosion driven by vertical incision.

Often caused by:

- Uncontrolled runoff upstream,
- Migrating nick points,
- Poor slope stabilization or energy dissipation structures.

1.

Courtesy: MDOT SHA



NEW QUALIFYING CONDITIONS

- Specific limits to bank armoring
- Project must meet applicable floodplain management requirements in the stream corridor
- Project must evaluate the duration of floodplain ponding in the context of the restoration goals
- Project must demonstrate consideration of potential unintended consequences of the restoration

THREE ARMORING CATEGORIES

Stream restoration projects that are primarily designed to protect public infrastructure by bank armoring or rip rap **do not** qualify for a credit.

Non-Creditable Armoring	***Creditable w/ Limits***	***Creditable Armoring***
• Concrete Retaining Wall • Sheet Piling/Planking • Gabion • Engineered Block Walls • A-Jacks • Dumped Rip Rap	• Localized stone toe protection • Boulder Revetments • Non-biodegradable soil stabilization mats • Imbricated Rip Rap	• Root wad Revetments • Live stakes/coir logs • Soil lifts • Riffle-weir series (including cobble in appropriate physiographic regions) • Berm-pool cascades • J-hooks and cross-veins

DEALING WITH THE DEFAULTS

Original EPR

- Nutrient Concentration Default Rates
- Bulk Density Example Being Used as Default
- Over-Use of Default Nutrient and Sediment Reductions

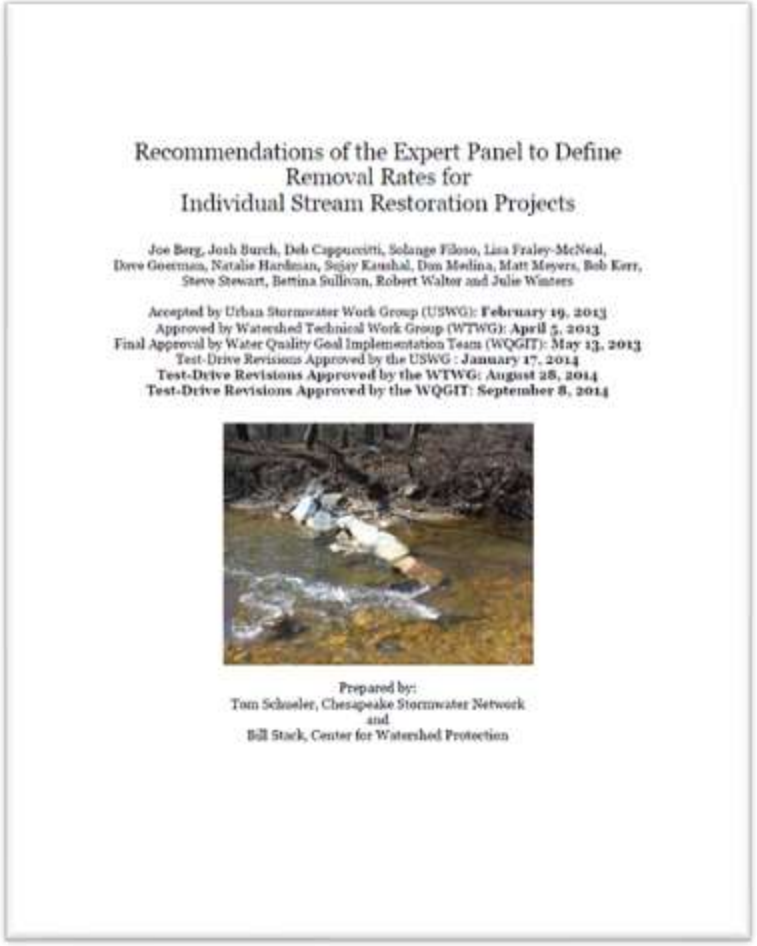
New Guidance

- Site Specific Monitoring for Bulk-Density and Nutrient Concentration
- Recommended Field and Lab Methods
- Phase out of default reporting
- Separate section on planning level estimates

WHAT WE'VE LEARNED

- We've seen a ton of innovation in response to this process, but also plenty of cut corners. Early and frequent communication with stakeholders is increasingly important. So is training.
- Nutrient and sediment reductions were meant to be one outcome of restoration (not the only). They provide a great incentive but it is hard to get the horses back in the barn.
- Qualifying Conditions are critical to help guide users to better project selection – but are not perfect.
- Calculated reductions are only as good as the site-level monitoring conducted. But striking the right balance is tricky.
- Long-term maintenance and verification is critical to project success and should consider the implications of climate change.

A short history of the unintended consequences caused by pollutant reduction crediting for stream restoration in the Chesapeake Bay watershed: 2010-2022



Recommendations of the Expert Panel to Define
Removal Rates for
Individual Stream Restoration Projects

Joe Berg, Josh Burch, Deb Caputo, Solange Filoso, Lisa Fraley-McNeal, Dave Goerman, Natalie Hardenan, Sejay Kaushal, Dan Medina, Matt Meyers, Bob Kerr, Steve Stewart, Bettina Sullivan, Robert Walter and Julie Winters

Accepted by Urban Stormwater Work Group (USWG): **February 19, 2013**
Approved by Watershed Technical Work Group (WTWG): **April 5, 2013**
Final Approval by Water Quality Goal Implementation Team (WQGIT): **May 13, 2013**
Test-Drive Revisions Approved by the USWG : **January 17, 2014**
Test-Drive Revisions Approved by the WTWG: August 28, 2014
Test-Drive Revisions Approved by the WQGIT: September 8, 2014

Prepared by:
Tom Schueler, Chesapeake Stormwater Network
and
Bill Stack, Center for Watershed Protection

#1: EXPLOSIVE GROWTH IN STREAM RESTORATION IN THE MID-ATLANTIC

- Triggered hundreds of miles of stream projects in the mid-Atlantic in the last decade
- Municipalities have several hundred more miles in the design/permitting pipeline (2 to 5 years)
- Private sector restoration “industry” has been fundamentally transformed in both +/- ways
- Caused sharp increases in construction costs, but also improvements in project management

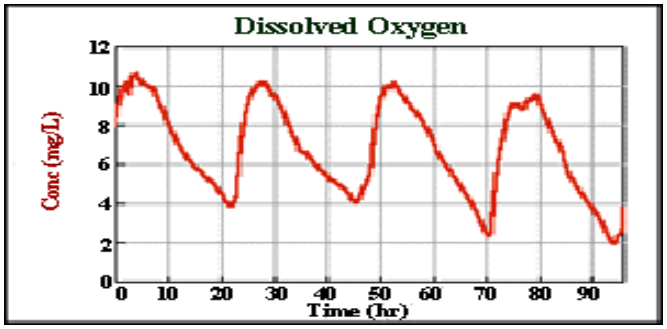
#2 SOME PROJECTS PRODUCED ENVIRONMENTAL IMPACTS AND LIMITED STREAM OUTCOMES

Project Stream Channel

- Depleted Dissolved Oxygen
- Iron Flocculation
- Warmer Summer Stream Temps
- More Instream Primary Production
- Turbidity During Construction
- Initial Decline in Benthic IBI

Floodplain/Downstream

- Project Tree Removal
- Post Project Tree Loss
- Vector for Invasive Plant Species
- Shift in Wetland Type/Functions
- Increased Flooding
- Initial Decline in Downstream IBI
- Upstream Blockage for Aquatic Life

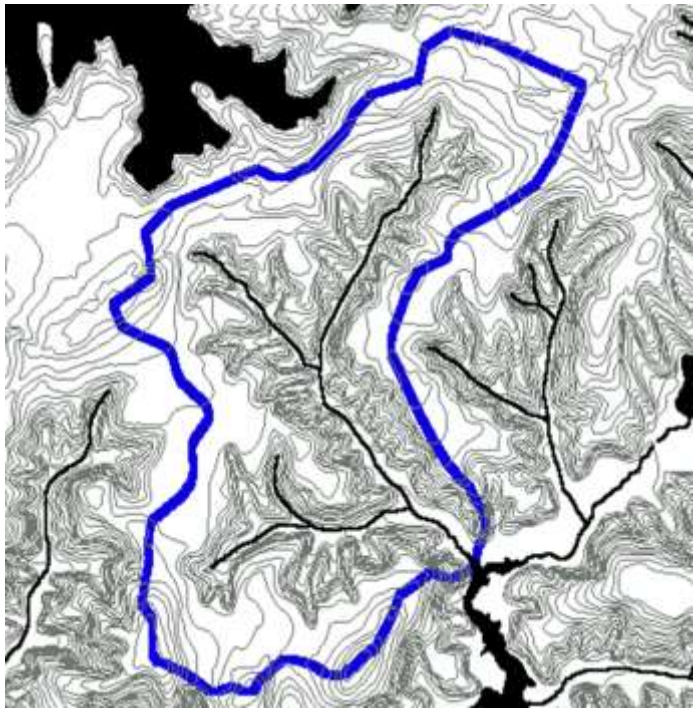


#3: TRIGGERED A WAVE OF ORGANIZED COMMUNITY OPPOSITION TO PROJECTS AND STRESSED OUT STREAM REGULATORS

- Project construction looks like hell to most suburban citizens, especially if any tree clearing or heavy-duty channel armoring is involved
- Permit agencies were not prepared for the wave of new permit applications and struggled on how to properly review new restoration design approaches
- Eventually led to more streamlined restoration permits and 25 best practices for individual projects

#4: SHIFT IN WHERE STREAM PROJECTS ARE LOCATED TO MAXIMIZE POLLUTANT REDUCTION AND REDUCE COST

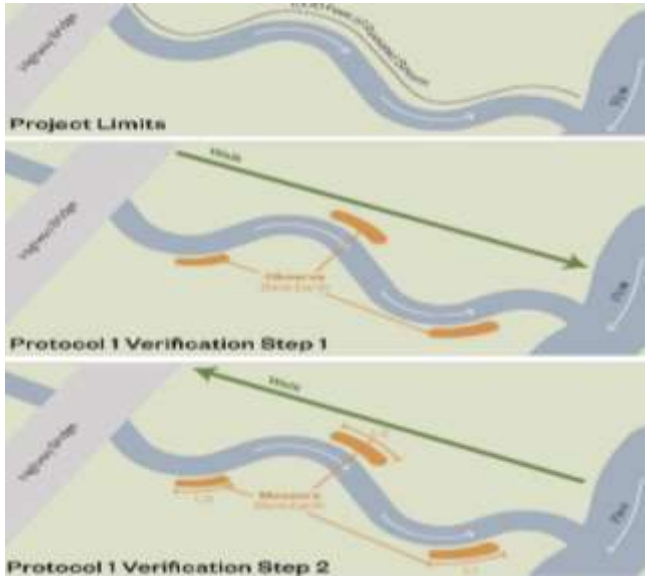
- Eroding stormwater outfalls at the top of the urban steam network
- From suburban watersheds to more rural applications in the ex-urbs (especially to make room for LSR and other floodplain reconnection projects)
- Initial tyranny of P-1 (prevented sediment) protocol drove many urban and suburban projects, but gradual shift to floodplain reconnection, where room is available (P-2 and P-3 updates helped).
- Shift to pay for performance contracts, venture capital, and multiple project site assessments



#5: CREATED PRESSURE TO DEVELOP PRACTICAL METHODS TO INSPECT AND VERIFY THE PERFORMANCE OF INDIVIDUAL PROJECTS

Methods jointly developed by the public and private sector: https://chesapeakestormwater.net/download/9621/

- Protocol-specific visual indicators
- Rapid field inspection, followed by a forensic investigation for failing projects
- Numeric triggers to define failure and corresponding management actions to preserve (or lose) credit

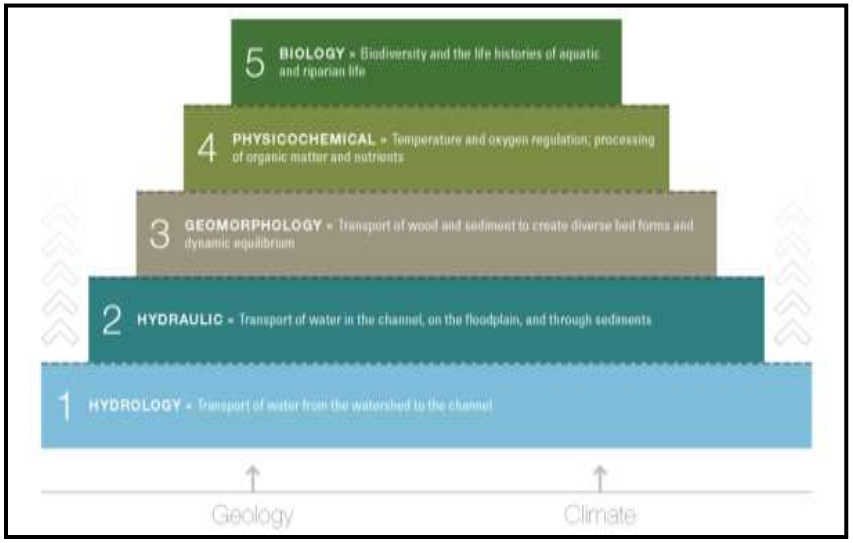


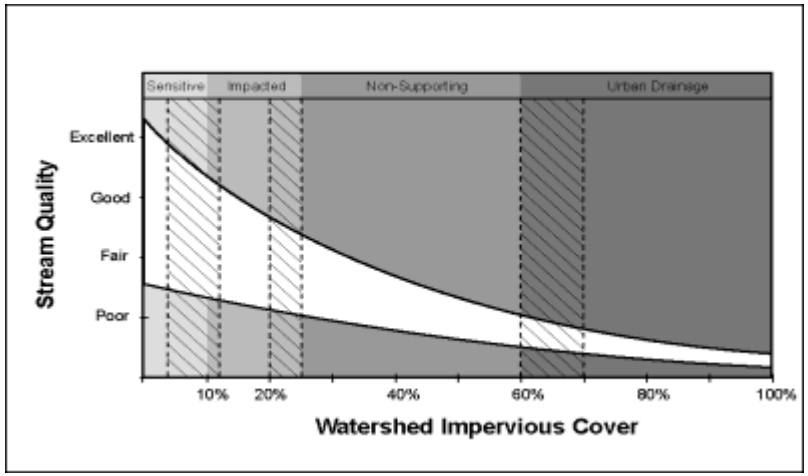
Status	% Failing *
Functioning	**0 to 10% of reach**
Showing Major Compromise	**20 to 40% of reach**
Project Failure	**50% or more of reach**

Defining Loss of Pollutant Reduction Function for Protocol 1	
Criteria for Loss	**Key Visual Indicators**
Evidence of bank or bed instability such that the project delivers more sediment downstream than designed,	• Severe bank undercutting (bare earth exposed) • Incising bed (bed erosion evident) • Flanking or downstream scour of channel structures • Failure or collapse of bank armoring practices

#6: THE FRUSTRATING QUEST TO DEFINE ACCEPTABLE LEVELS OF FUNCTIONAL UPLIFT FOR PROJECTS OVER TIME

- The core functional assessment framework was solid (although focused more on stream functions than floodplain ones).
- Actual implementation of uplift monitoring on projects has been slow and un-even
- Fair amount of research funding for this type of monitoring in the CB watershed in recent years
- Still unclear on what the upper limit expectations for WQ & biologic uplift for urban and rural stream projects
- Looks like a quest that your professional groups should join in the coming years!





#7 STREAM RESTORATION PRACTICES ARE EXTREMELY VULNERABLE TO CLIMATE CHANGE

- Outdated design parameters (width, depth, meander radii, etc.)
- Poor reference site selection
- Rising stream temps may be shifting ecological uplift potential
- Design principles are shifting – impacts of climate change are still not well understood

Projected Increase in Future 24 Hour Design Storms Compared to Current Storms

City	2 Year Storm	10 Year	100 Year Storm
Virginia Beach VA	+ 13%	**+ 8%**	**+ 13%**
Annapolis, MD	+ 14%	**+ 17%**	**+ 9%**
Harrisburg. PA	+ 14%	**+ 16%**	**+ 14%**

Source: MARISA as included in CSN (2021)
Your local values can be accessed from the tool, along with confidence intervals\
Median Projected Precipitation Depths (In.) for 2050-2100 (RCP 4.5)

WHAT'S NEW AT CSN IN THESE DAYS?

- Unified Guide to Stream Restoration Protocols
- Chesapeake Urban Stormwater Professional (CUSP) Training
- Impact of Extreme Rainfall and Warming on Stormwater BMPs
- 2023 BUBBAs Awards and Baywide Stormwater Partners Retreat

Q & A
and Audience Discussion