Stormwater Control & Stream Restoration: What Works and What Does Not V127

Rockville Science Day: April 21, 2024

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Photo by K. Bawer, 10/21/2021)

Full Disclosure

I have no direct or indirect financial interest in the practice of stormwater control or stream “restorations.”

AGENDA

- Drivers of stormwater control:
  - non-regulatory & regulatory
- Types of stormwater control projects:
  - out-of-stream & in-stream
- In-stream projects: stream “restoration” examples
- What does the science say?
- Cost
- Summary
- What can you do?

Solitaire Court, Gaithersburg video (3:44)

https://youtu.be/NvTvPnG6Qs8

Fall 2021

(https://youtu.be/NvTvPnG6Qs8)

Solitaire Court, Gaithersburg video (3:44)

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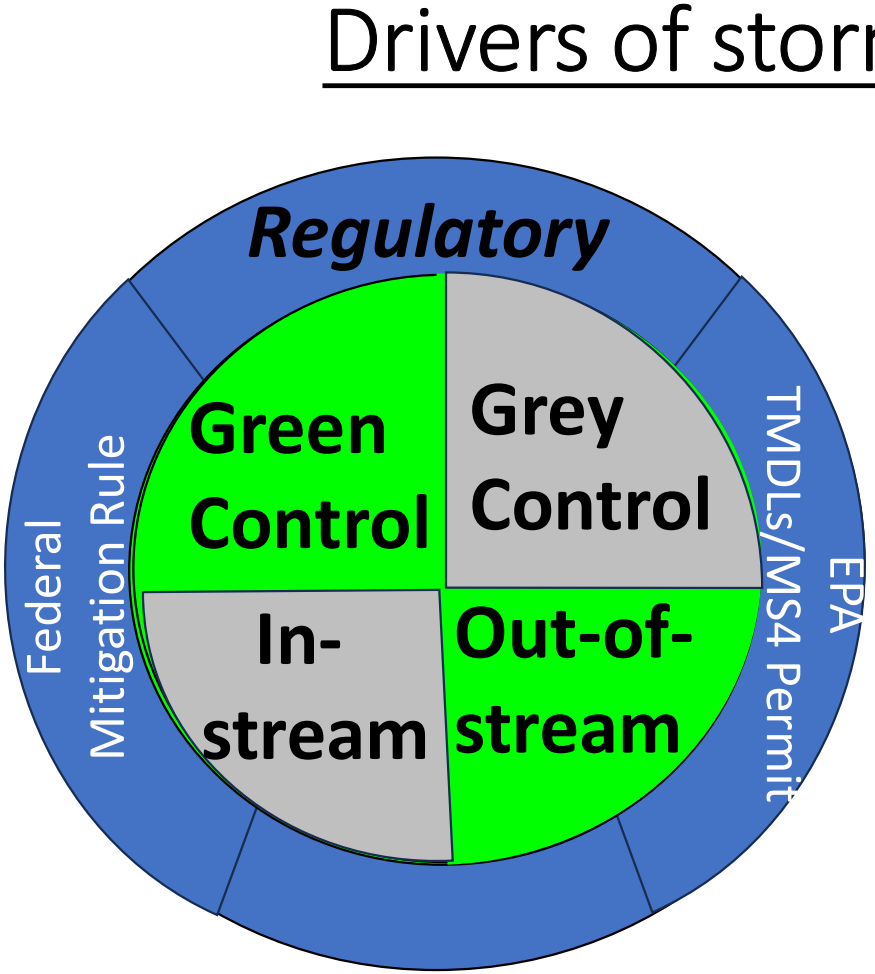
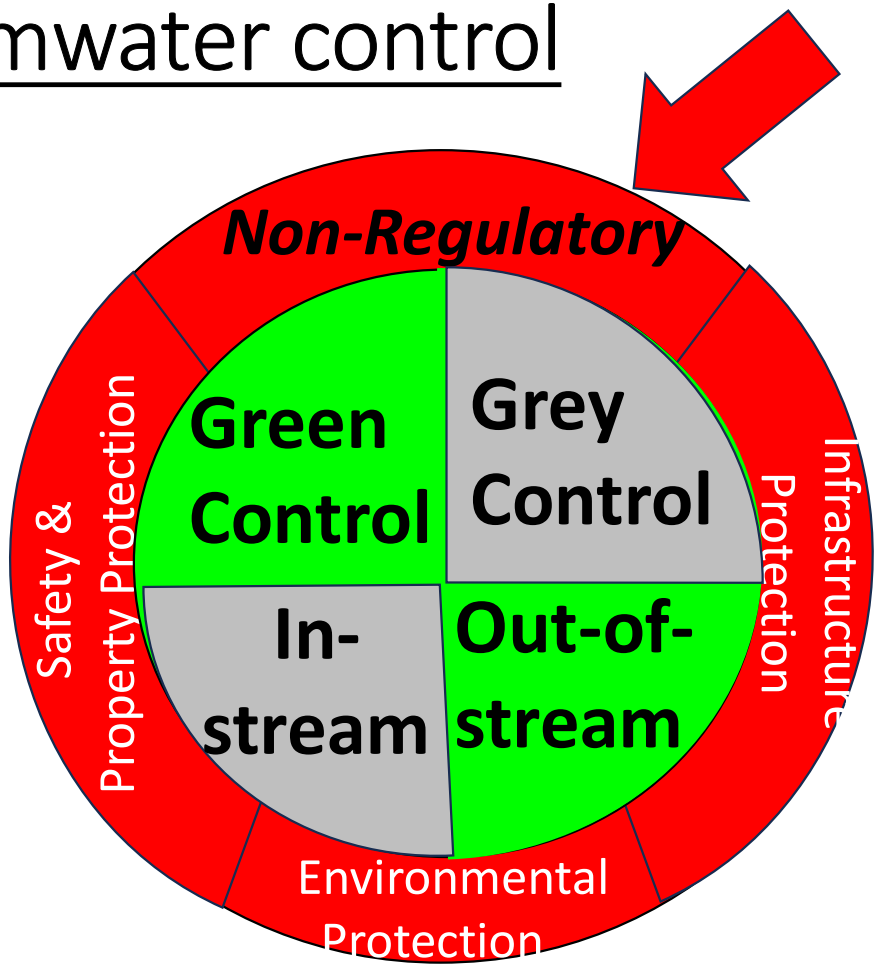
Drivers of stormwater control





The Need for Stormwater Control

Rock Creek Woods Apartments, 13205 Twinbrook Parkway, Rockville, 9/1/2021

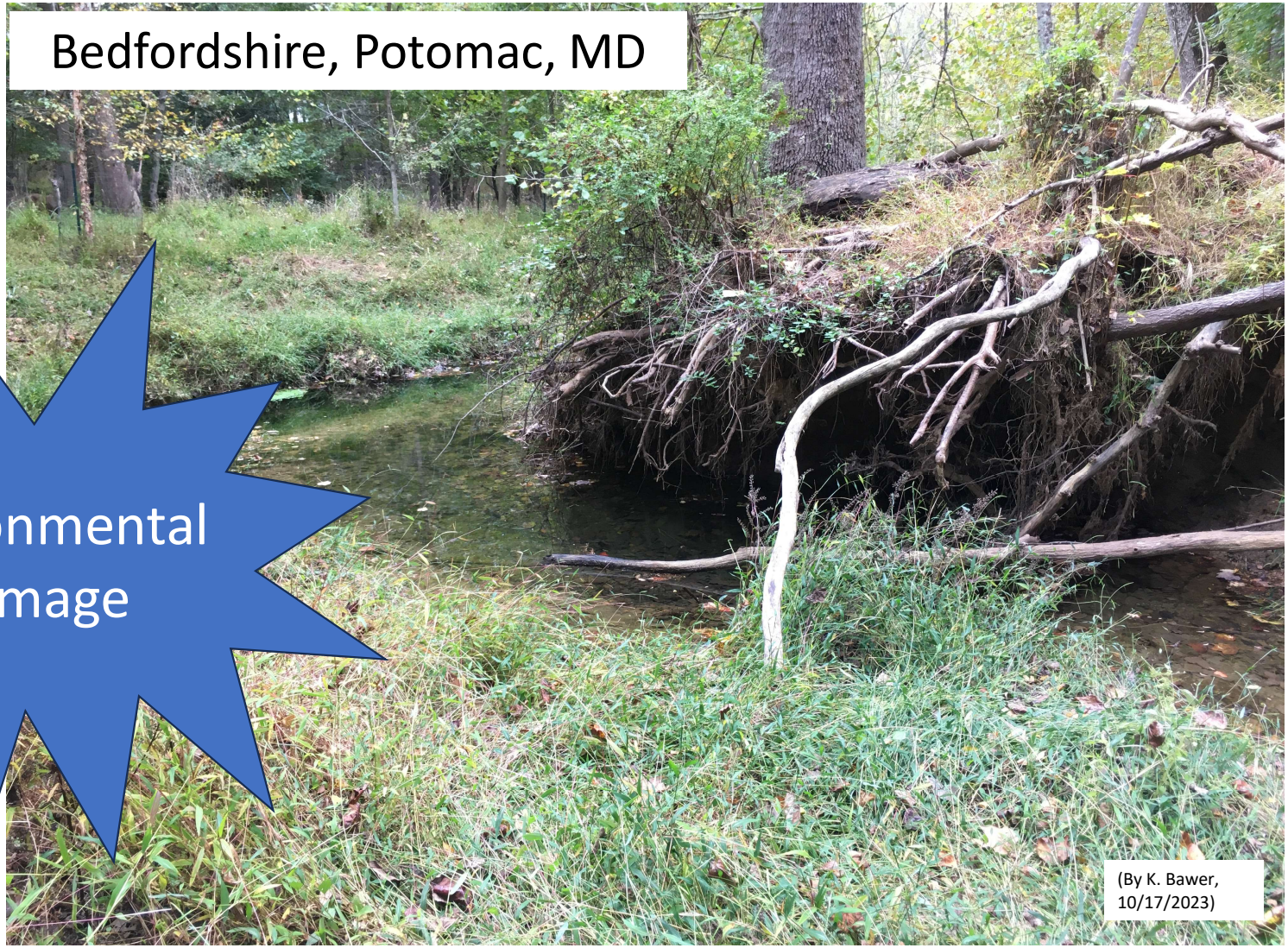
(WUSA video)

The Need for Stormwater Control

(from Robert Hilderbrand, U. of MD, presentation for Appalachian Lab Series on 3/4/2021)

Infrastructure protection

The Need for Stormwater Control



Types of stormwater control

Out-of-stream Stormwater Control

Tree Lined Street Neighborhood | Street trees, Tree line, Street pinterest.com

https://www.montgomerycountymd.gov/water/Resources/Files/restoration/green-streets/Fact_Sheet_G5_DennisAvenue_DNR.pdf

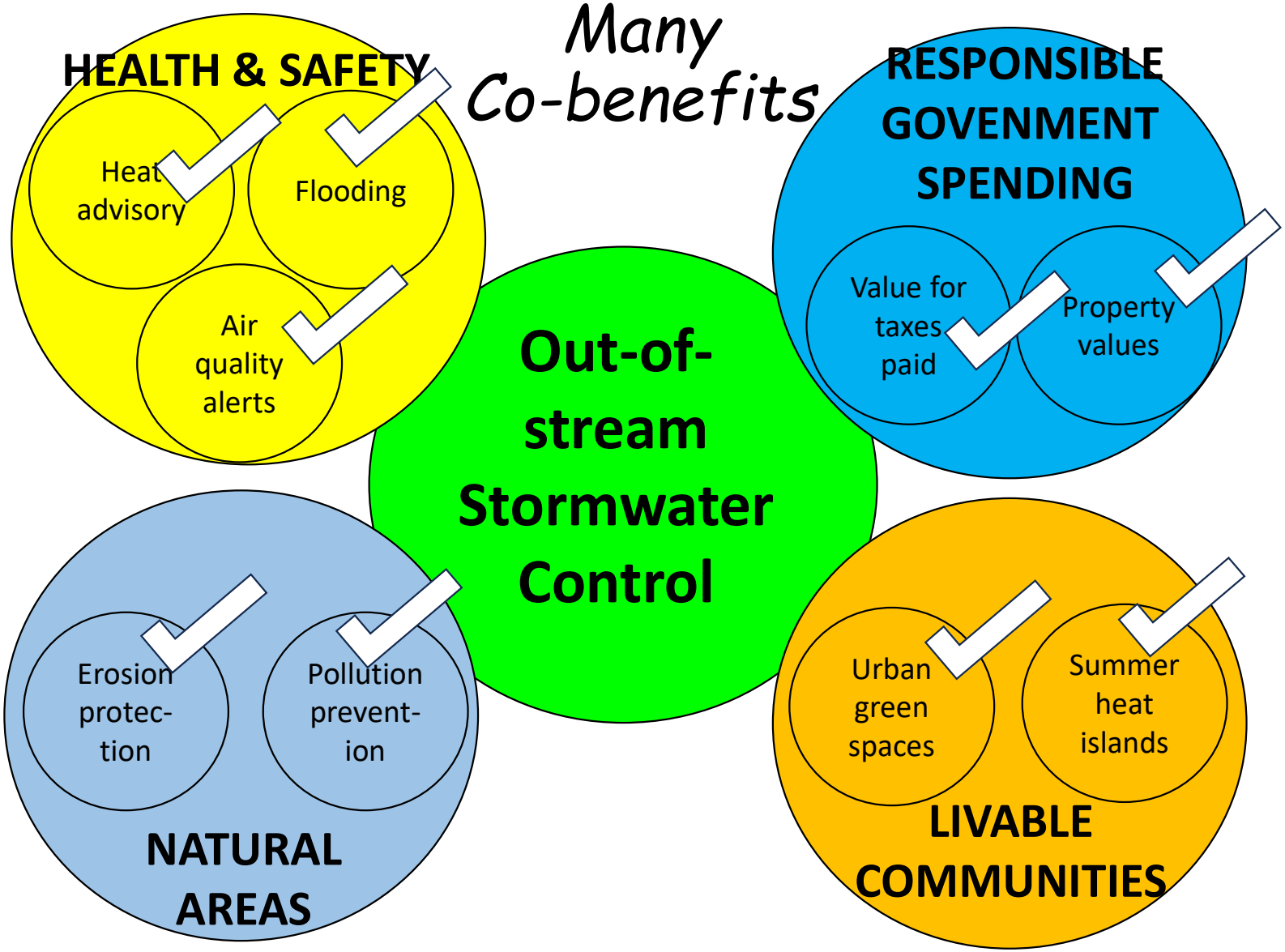
https://www.fergusonoss.com/p-product/r-tank-

DC's Blue Plains, Anacostia, & Potomac River Tunnel Projects

https://potomac.org/blog/4/1/2024-potomac-tunnel-updates

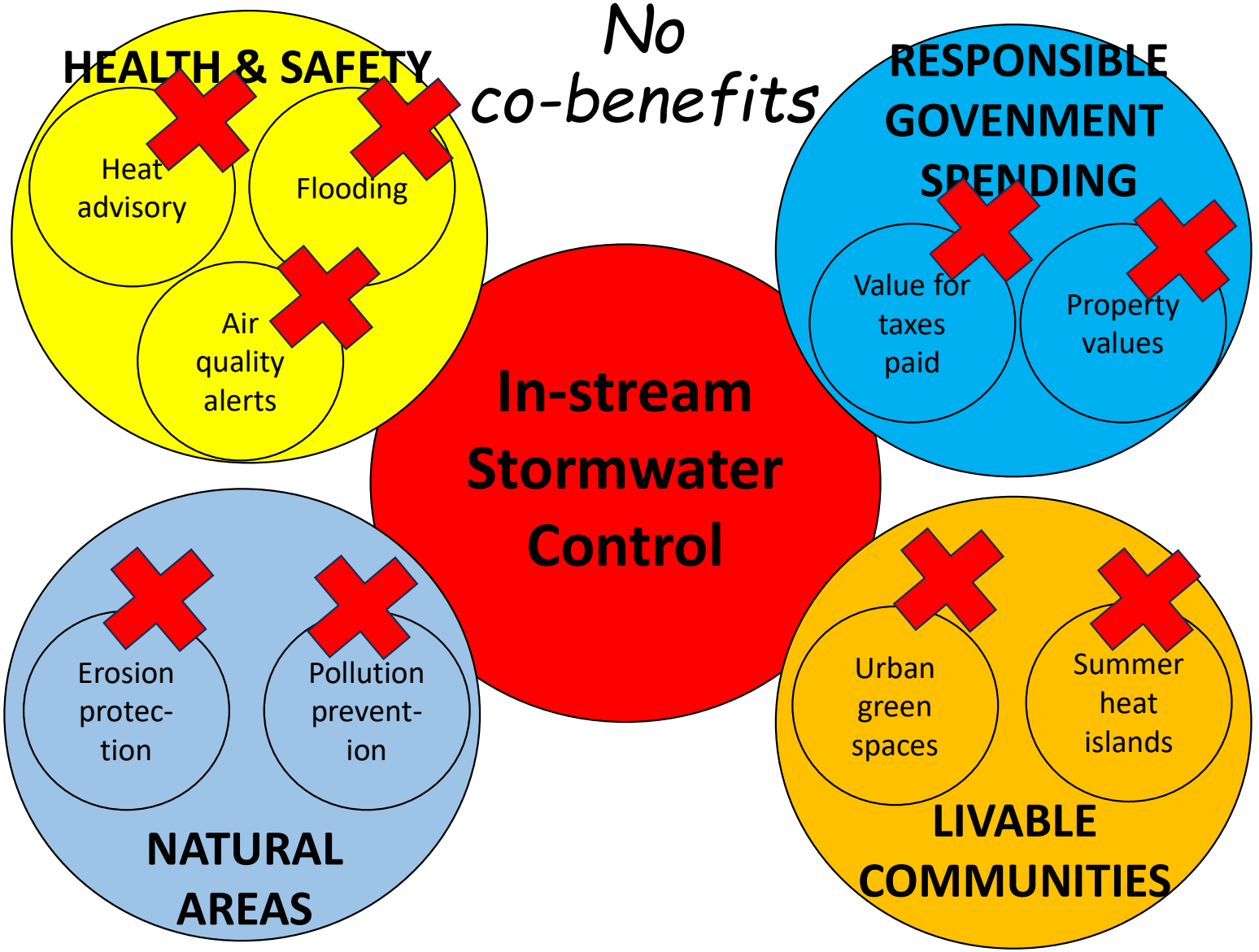
Out-of-stream Stormwater Control

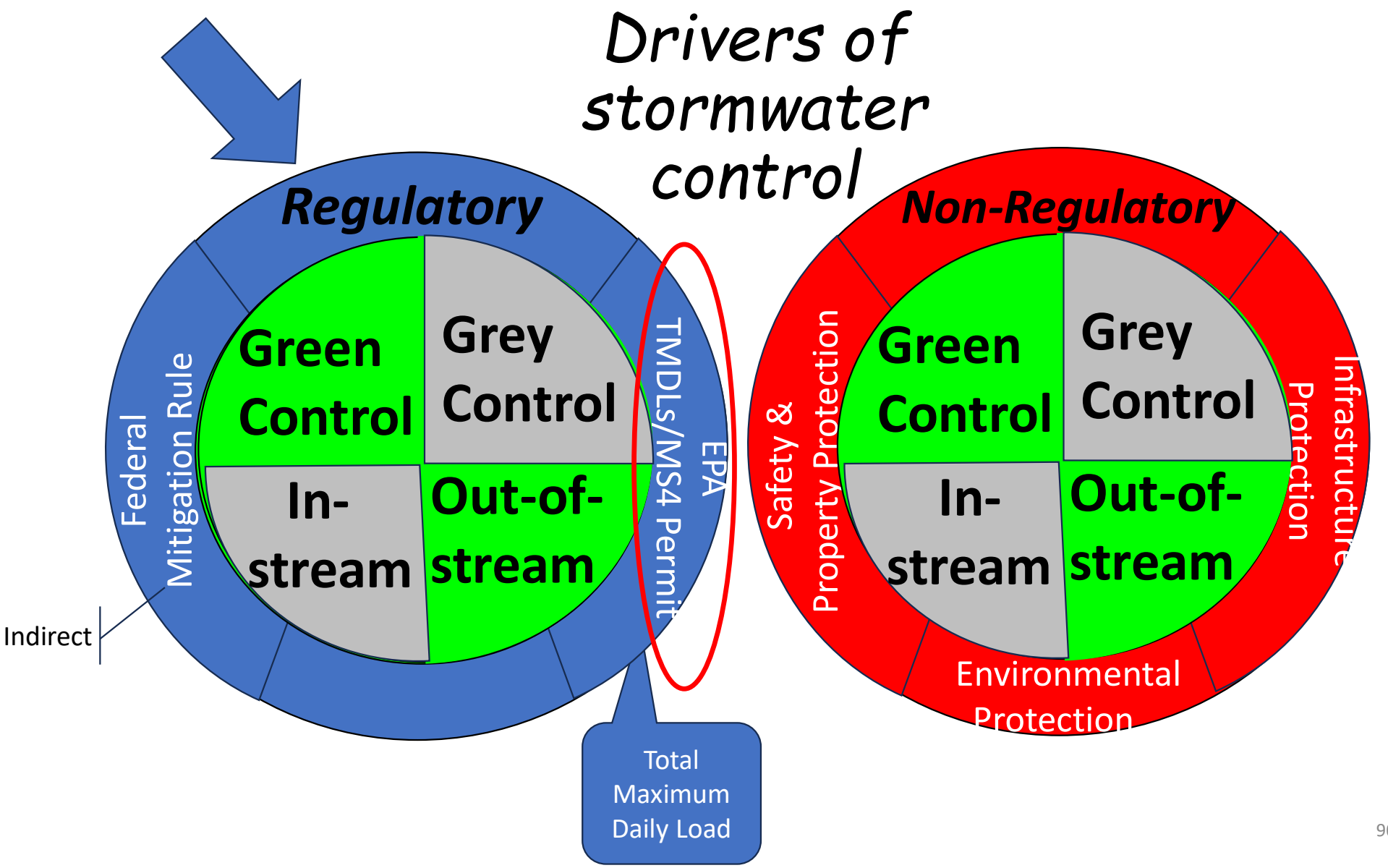
Alexandria's RiverRenew Tunnel Project


Many
Co-benefits
HEALTH & SAFETY
Heat advisory
Flooding
Air quality alerts
RESPONSIBLE GOVENMENT SPENDING
Value for taxes paid
Property values
Out-of-stream Stormwater Control
Erosion protec-tion
Pollution prevent-ion
NATURAL AREAS
Urban green spaces
Summer heat islands
LIVABLE COMMUNITIES

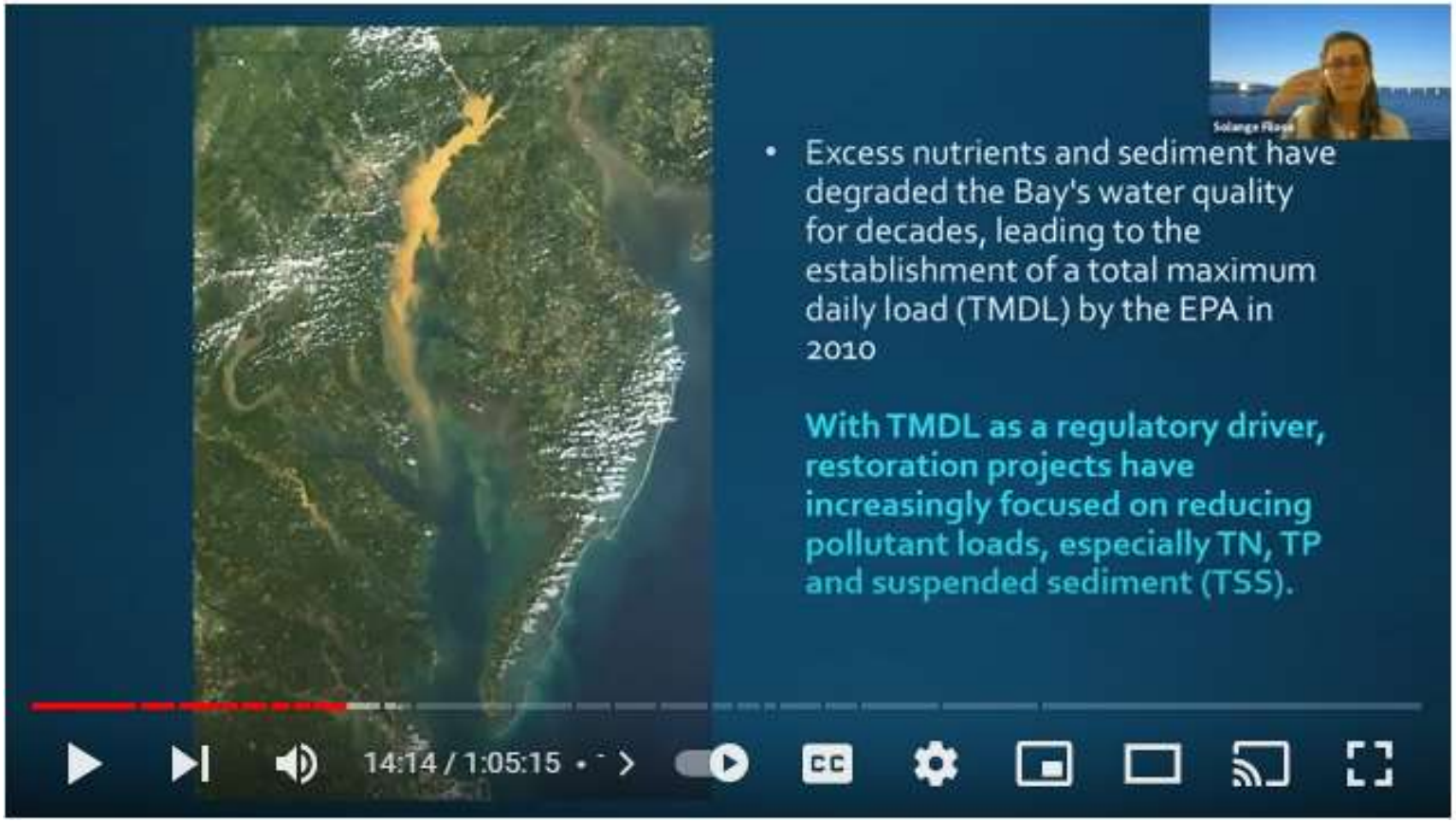
Types of stormwater control

In-stream Stormwater Control


No co-benefits
HEALTH & SAFETY
Heat advisory
Flooding
Air quality alerts
RESPONSIBLE GOVENMENT SPENDING
Value for taxes paid
Property values
In-stream Stormwater Control
Erosion protec-tion
Pollution prevent-ion
NATURAL AREAS
Urban green spaces
Summer heat islands
LIVABLE COMMUNITIES


Drivers of stormwater control
Regulatory
Non-Regulatory
Green Control
Grey Control
In-stream
Out-of-stream
Federal Mitigation Rule
TMDLs/MS4 Permit
EPA
Safety & Property Protection
Infrastructure Protection
Environmental Protection
Indirect
Total Maximum Daily Load

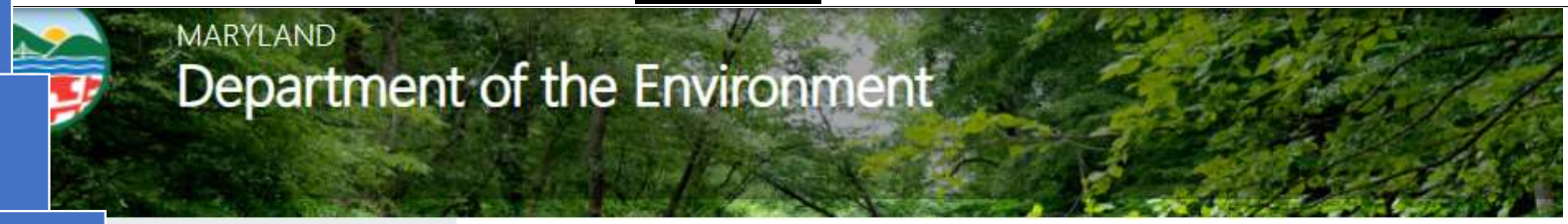
Problem: excess nutrients and sediment in Bay



("Stream Restoration: Is it Helping Our Streams and the Chesapeake Bay?" Solange Filoso, U MD, Chesapeake Biological Laboratory, April, 21, 2021, https://www.youtube.com/watch?v=1BowrQkMfaE)

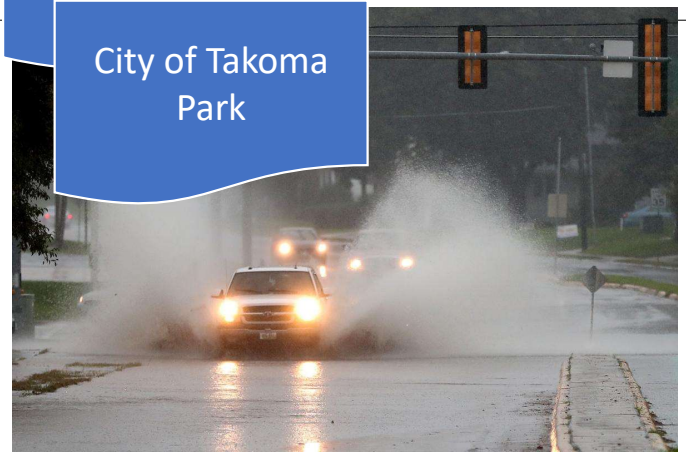
Direct Regulatory Drivers: MS4 Permits for urban/suburban areas

- Montgomery County
- Montgomery Parks
- City of Rockville
- City of Gaithersburg
- City of Takoma Park



Maryland's NPDES Municipal Separate Storm Sewer System (MS4) Permits

https://mde.maryland.gov/programs/Water/StormwaterManagementProgram/Pages/MS4-Landing.aspx)



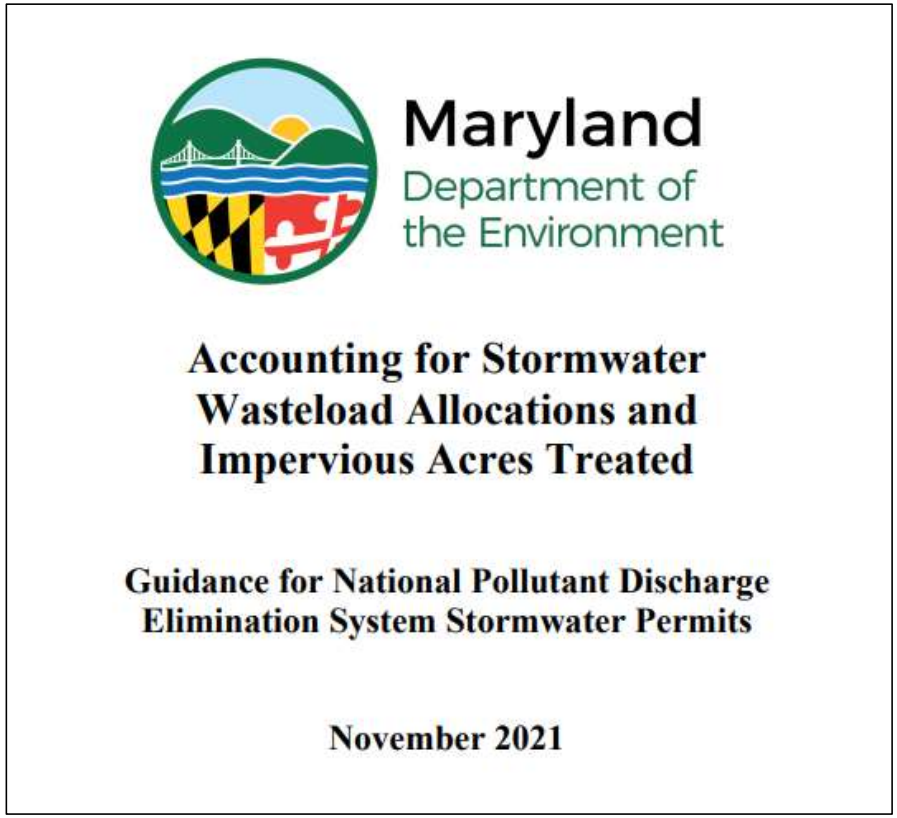
(From wcfcourier.com)

N, P, S

(https://www.youtube.com/watch?v=UwYk9x8ldw8)

Stormwater Control Practices

- MS4 Permit “Accounting Guidance” document.
- Long list of practices that can be used to meet the MS4 Permit.



https://mde.maryland.gov/programs/water/StormwaterManagementProgram/Documents/Final%20Determination%20Dox%20N5%202021/MS4%20Accounting%20Guidance%20FINAL%2011%2005%202021.pdf

Non-destructive, out-of-stream methods: all except one

Table 1. EIA_f and Load Reductions for Alternative BMPs

BMP	Load Reductions (lbs/unit/yr)			EIA_f
	TN	TP	TSS	
Advanced Sweeping				**Per Mile Swept**
1 pass/12 weeks	0.00	0.07	401	0.027
1 pass/8 weeks	0.26	0.14	802	0.059
1 pass/4 weeks	0.36	0.21	1,203	0.087
Spring 1 pass/1-2 weeks else monthly	0.36	0.28	1,404	0.106
Spring & Fall 1 pass/1-2 weeks else monthly	0.73	0.34	2,005	0.148
1 pass/2 weeks	0.73	0.34	2,206	0.156
1 pass/week	1.09	0.55	3,209	0.235
2 passes/week	1.46	0.69	4,211	0.304
Mechanical Broom Sweeping				**Per Mile Swept**
1 pass/4 weeks	0.00	0.00	20	0.001
1 pass/week	0.00	0.00	100	0.004
2 passes/week	0.00	0.00	201	0.008
Storm Drain Cleaning				**Per Ton Removed**
Organic	4.44	0.48	400	0.17
Inorganic	3.78	0.84	1,400	0.25
Floating Treatment Wetlands (% of pond wet surface area covered by FTW)				**Per Impervious Acre**
FTW1 (10%)	0.10	0.02	74	0.008
FTW2 (11-20%)	0.22	0.05	151	0.017
FTW3 (21-30%)	0.32	0.07	225	0.026
FTW4 (31-40%)	0.43	0.09	295	0.034
FTW5 (41-50%)	0.53	0.11	369	0.042
Land Cover Conversion				**Per Acre of Land Cover Converted**
Forest Planting	11.12	1.78	2,805	1.10
Riparian Forest Planting	14.34	2.50	4,411	1.50
Conservation Landscaping	5.24	0.53	0.00	0.37
Riparian Conservation Landscaping	6.75	0.74	0.00	0.50

BMP	Load Reductions (lbs/unit/yr)			EIA_f
	TN	TP	TSS	
Table 1 Continued				
Forest Conservation	10.57	1.10	2,465	0.46
Impervious Surface Reduction	6.96	0.45	5,241	0.71
Street Trees	3.10	0.76	1,404	0.40
Urban Tree Canopy Planting	3.20	0.50	206	0.28
Urban Soil Restoration of Compacted Pervious Surfaces (soil excavation depth in inches)				**Per Acre of Soil Treatment**
Level 1 (15 inches)	4.4	0.72	278	0.40
Level 2 (20 inches)	8.9	1.44	557	0.80
Urban Soil Restoration of Removed Impervious Surfaces (soil excavation depth in inches)				**Per Acre of Soil Treatment**
Level 1 (15 inches)	13.7	0.7	1,696	0.91
Level 2 (20 inches)	15.0	0.77	1,864	1.00
Septic[1]				**Per System**
Septic Pumping	0.00	0.00	0.00	0.02
Septic Denitrification	0.00	0.00	0.00	0.16
Septic to WWTP Connection	0.00	0.00	0.00	0.23
Shoreline Management[2]/Stream Restoration and Outfall Stabilization[3]				**Per Linear Foot**
Shoreline Management (Default Rate)	0.173	0.122	328	0.04
Stream Restoration (Planning Rate)	0.075	0.068	248	0.02
Outfall Stabilization (Planning Rate)	0.075	0.068	248	0.02
Elimination of Discovered Nutrient Discharges from Grey Infrastructure[4]				**Per Discharge**
Elimination of Eight Approved Discharge Types	Protocol	Protocol	0.00	Individually Calculated

The stream "restoration" loophole: Allows use of stream "restorations" as alternative to directly addressing stormwater pollution – gift to $25B industry

Non-destructive, out-of-stream methods (continued)

Table 2. Stormwater BMPs for Upland Applications

Runoff Reduction (RR) Practices		Stormwater Treatment (ST) Practices	
Manual Reference	**Practice**	**Manual Reference**	**Practice**
Infiltration		**Ponds**	
M-3	Landscape Infiltration	P-1	Micro-Pool Extended Detention (ED)
M-4	Infiltration Berm	P-2	Wet Pond
M-5	Dry Well	P-3	Wet ED Pond
Filtering Systems[1]		P-4	Multiple Pond
F-6	Bioretention	P-5	Pocket Pond
M-2	Submerged Gravel Wetland	**Wetlands**[2]	
M-6	Micro-Bioretention	W-1	Shallow Wetland
M-7	Rain Garden	W-2	ED Shallow Wetland
M-9	Enhanced Filter	W-3	Pond/Wetland System
Open Channel Systems		W-4	Pocket Wetland
O-1	Dry Swale	**Infiltration**[2]	
M-8	Grass Swale	I-1	Infiltration Trench
M-8	Bio-Swale	I-2	Infiltration Basin
M-8	Wet Swale	**Filtering Systems**	
Alternative Surfaces		F-1	Surface Sand Filter
A-1	Green Roof	F-2	Underground Filter
A-2	Permeable Pavement	F-3	Perimeter Filter
A-3	Reinforced Turf	F-4	Organic Filter
Other Systems		F-5	Pocket Filter
M-1	Rainwater Harvesting		

Notes:
[1] A dry channel regenerative step pool stormwater conveyance system is considered a stormwater retrofit by the CBP Stream Restoration Expert Panel. This practice may use the BMP code SPSD and use the same pollutant load reductions as a filtering practice. The impervious area draining to these practices may be considered treated in accordance with the design rainfall depth treated (P_E) for crediting purposes.
[2] Stormwater wetlands, infiltration trenches, and infiltration basins are ST practices unless designed according to Section VI.

(Copied from "Accounting Guidance" document)

Stream “restorations” don’t address the root cause

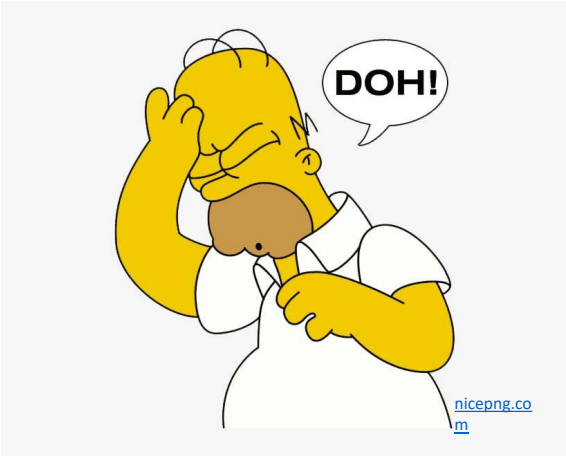
- Root cause of stream erosion: uncontrolled stormwater runoff from impervious upland surfaces (roofs, roads, parking lots, etc.)
- Firehoses into streams causing erosion.

(From wcfcourier.com)

(https://www.youtube.com/watch?v=UwYk9x8ldw8)

The folly of stream “restorations”

Doing a stream “restoration” instead of controlling stormwater BEFORE it enters a stream is like…



(xxx)

…trying to repair water-damaged furniture while the roof is still leaking.

Examples of BAD stream “restorations”

…they are ALL bad

Stream “Restorations” Don’t Restore Streams

Nature Forward (formerly ANS), Chevy Chase

(3/26/2021. downstream from Jones Mill Rd. Photos by K. Bawer)

“Stream Restorations” don’t restore streams

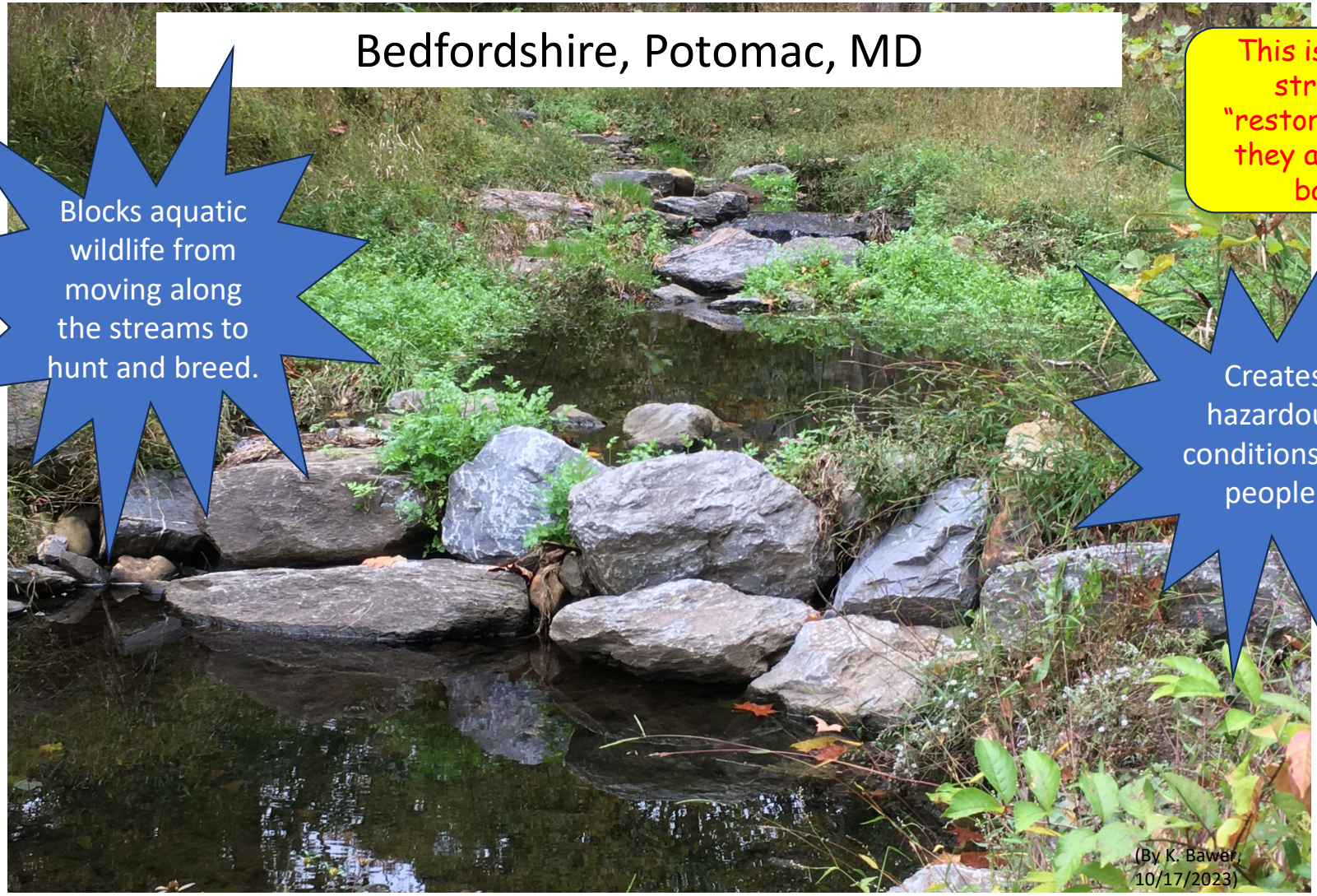
Falls Reach, Potomac, MD

This is a bad stream “restoration” – they are ALL bad!

Before Montgomery County DEP “stream restoration” on Falls Reach. (Photo by DEP)

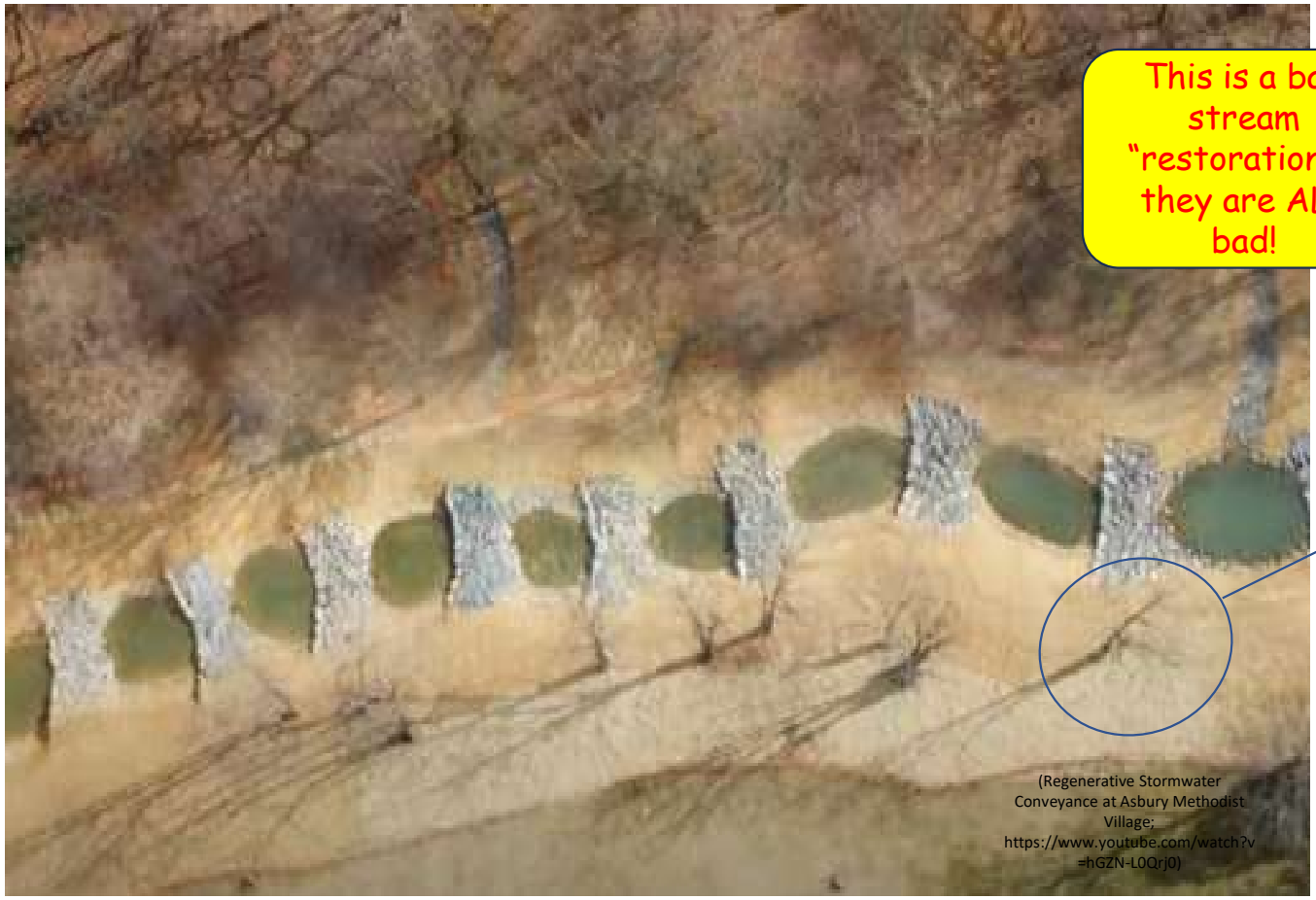
After “stream restoration” on Falls Reach completely destroyed the forest community in its footprint. (Photo by K. Bawer on 3/19/2019)

Stream “Restorations” Don’t Restore Streams



Stream "Restorations" Don't Restore Streams

Asbury Methodist Village, Montgomery County



Stream "Restorations" Don't Restore Streams

Upper Watts Branch, Rockville

(Stream "restoration" photo by City of Rockville)

clipartbest.com

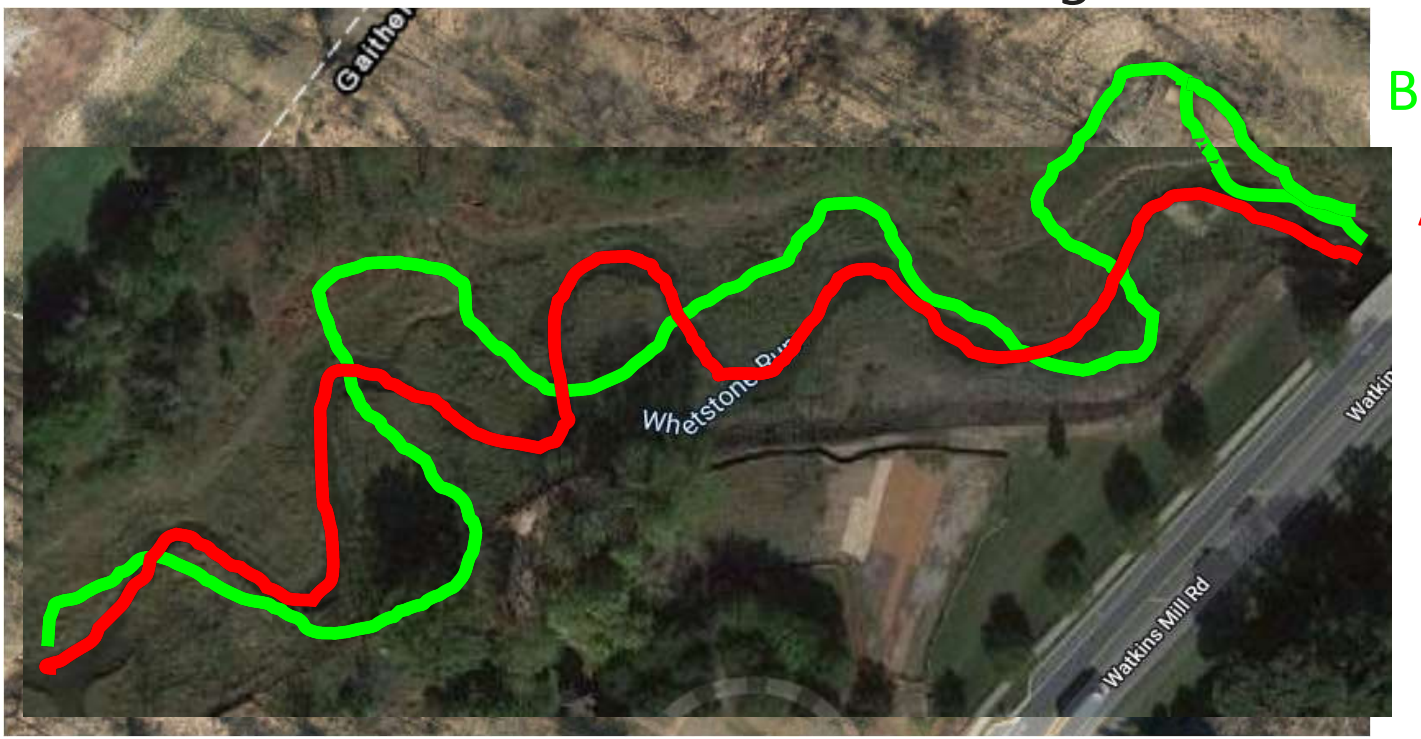
Stream “Restorations” Don’t Restore Streams

Whetstone Run, Gaithersburg

(Stream “restoration” in Blohm Park, Gaithersburg at Watkins Mill Rd. over Whetstone Run at the same location. Note the stream bank armor-plating on the right. (Left on 9/3/2020; right on 5/03/2021); by K.Bawer)

Stream “Restorations” Don’t Restore Streams

Whetstone Run, Gaithersburg



- Dug a whole new channel (red) and filled in the natural one (green).
- The more they engineer the stream, the longer the project, the more money they make. The jurisdiction also gets more MS4 permit credits.

Stream "Restorations" Don't Restore Streams

Solitaire Court, Gaithersburg

At this same location before construction, none of the houses were visible through the narrow strip of forest.

This is a bad stream "restoration" – they are ALL bad!c

Stream “Restorations” Don’t Restore Streams

Solitaire Court stream “restoration”, Gaithersburg

This is a bad stream “restoration” – they are ALL bad!

(https://www.gaithersburgmd.gov/government/projects-in-the-city/solitaire-court-stream-restoration-project)

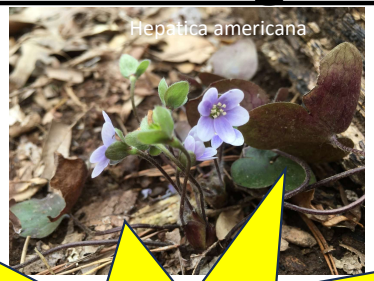
Impact of non-native invasive plants

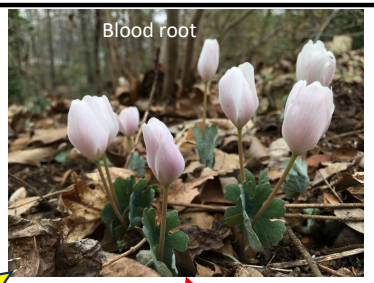
(By K. Bawer, 10/17/2023)

Collateral damage: wildflowers & animals destroyed

For DEP


American toad


Hepatica americana


Blood root


Twinleaf

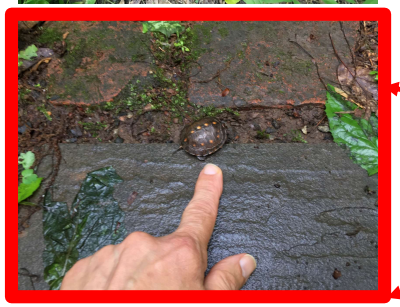

Toadshade trillium


Box turtle

This is what the greenwashing presentations don't talk about.


(By City of Rockville


Cranefly orchid



aviationpros.com


Strawberry bush


Grey tree frog


Rue anemone


Dutchmans breeches


Virginia bluebell


Wood frog

All photos by K. Bawer except middle)

Collateral damage at Whetstone Run stream “restoration”

What happens to aquatic life? See next slide

https://dnr.maryland.gov/fisheries/documents/Freshwater_Poster.pdf

Inkart.net

Pulverized by the pumps

"Aquatic life would either be prevented from passing the project reach or pulverized by the pumps." ("Stream Restoration Design", USDA National Engineering Handbook)

(https://www.youtube.com/watch?v=-4u8fJ5KtaA)

Bear Branch Stream Restoration, PG Co. – pump-around operations

Why Stream "Restorations" Fail

- They do not eliminate the cause of stream erosion

- Uncontrolled stormwater from impervious surfaces (roads, roofs, parking lots, etc.) firehosing into streams.

youtube.com

Stream "Restoration" Failures Examples

- Local jurisdictions conveniently neglect to tell the public that these projects fail.
  - Failure of physical stability.
  - Failure to improve water quality.
  - Failure to improve the stream biology
  - Some examples of physical failures…

Clipart-library.com

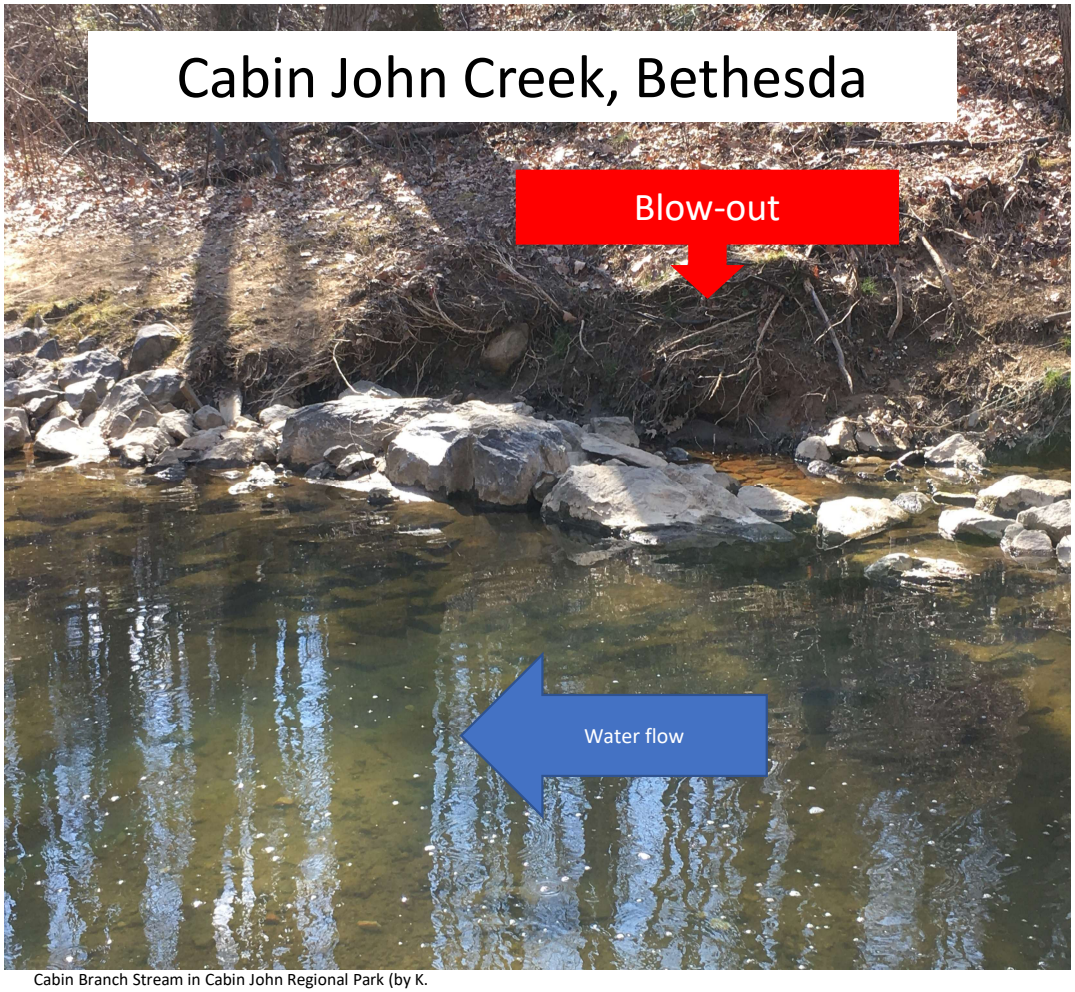
Stream “restorations” fail…

Josephs Branch, Kensington

Joseph’s Branch Stream (by K. Bawer,)

Joseph’s Branch during rainstorm (Photo by K. Bawer)

Stream “restorations” fail



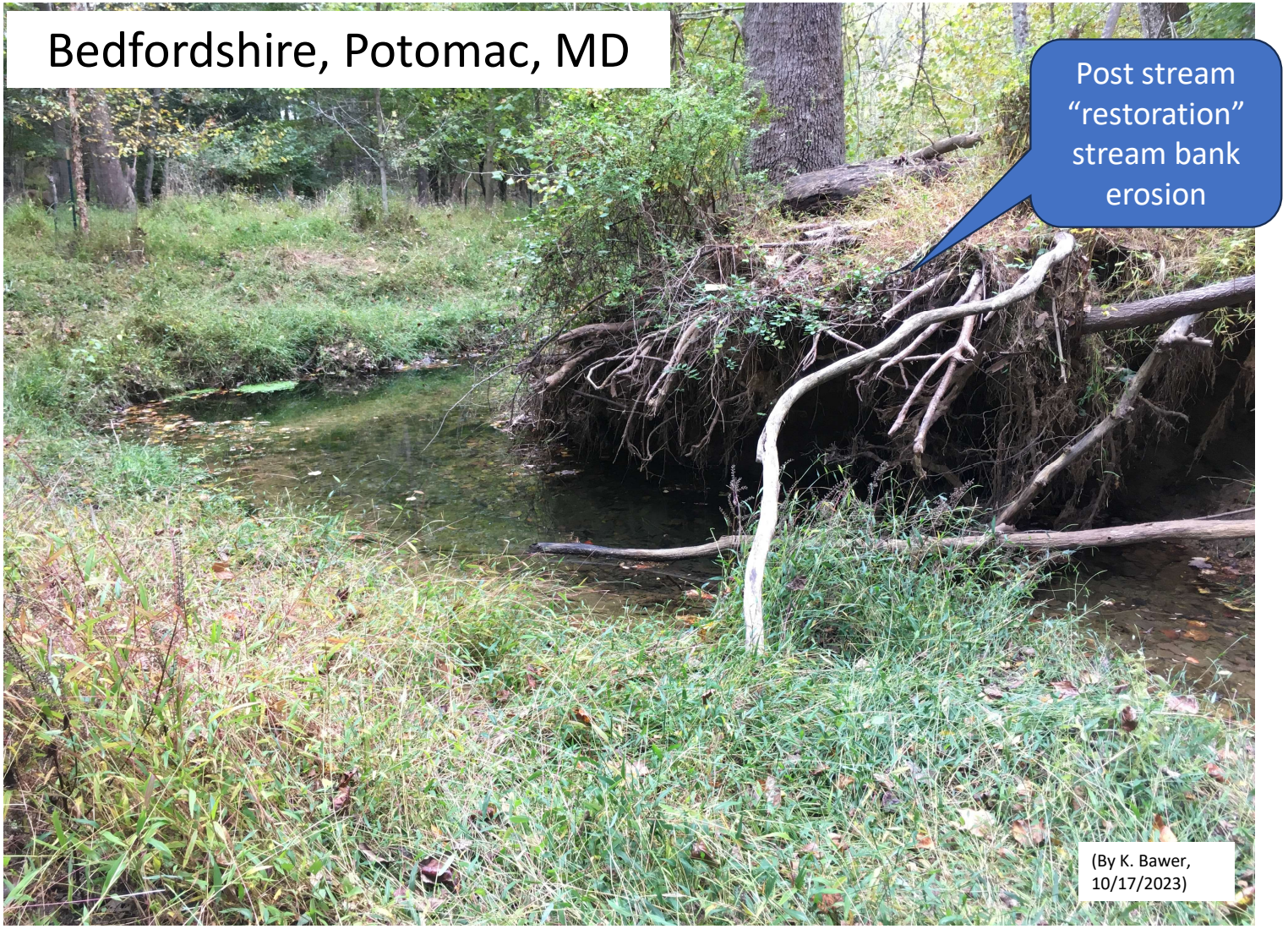
Cabin Branch Stream in Cabin John Regional Park (by K. Bawer, 3/19/2021)

Stream “restoration” fail

Long Branch, Takoma Park, 10/2/2021 (Photo by K. Bawer)

Stream “restoration” failures

Stream “restoration” failures



Stream “restoration” failures

Old Farm Creek Tributary, North Bethesda

Current Stream Condition

Scheduled to be repaired in 2024 for $800K

https://www.montgomerycountymd.gov/DEP/Resources/Files/downloads/restoration/oldfarm-creek-neilwood/WRE12-26%20Old%20Farm%20Creek%20Public%20Meeting%20Presentation%20Final.pdf

Stream “restoration” failures

Grosvenor Luxmanor Stream “Restoration,” North Bethesda, Mo Co

Existing Photos

Current Stream Condition

Existing Photos

Current Stream Condition

Wildwood Manor, south of I-270

https://www.montgomerycountymd.gov/water/Resources/Files/restoration/streams/grosvenor-presentation-wildwood-manor.pdf

Stream “restoration” failures

Lower Booze Creek, Potomac, MD
Two different locations.

$700K for original “stream restoration”

Lower Booze Creek - Erosion downstream of imbricated wall structure from original stream restoration.

$3.6M repair

THE SCIENCE

Scientific Evidence that Stream “Restorations” Don’t Work

Scientific Evidence that Stream "Restorations" Don't Work

Analysis of 644 projects by M. Palmer et al., University of MD:

Streambank stability does not improve more than a coin toss

- Page 259, Paragraph 2: "Stability was also assessed at the reach scale (N = 38; Table 2) primarily for projects that involved large-scale hydromorphic restoration actions that included channel reconfiguration. Less than half of these projects showed improvements in channel stability compared with prerestoration regardless of how stability was measured and even though many of the projects involved the use of large boulders or other materials to hold the banks in place." [emphasis added]
- Page 262, Section 5, Paragraph 1: "We show that a major emphasis remains on the use of dramatic structural interventions, such as completely reshaping a channel, despite growing scientific evidence that such approaches do not enhance ecological recovery, and the data we assembled (Table 2) suggest they are often ineffective in stabilizing channels when stability is the primary goal." [emphasis added]

Palmer, M. A., K. L. Hondula, and B. J. Koch, University of MD, 2014, "Ecological Restoration of Streams and Rivers: Shifting Strategies and Shifting Goals,", Annu. Rev. Ecol. Evol. Syst. 2014. 45:247-269. (https://akottkam.github.io/publications/Palmerpublications/Palmer2014a.pdf)

Scientific Evidence that Stream "Restorations" Don't Work

Analysis of 644 projects by M. Palmer et al., University of MD:

Water quality does not improve

- "Improvements in the five metrics within the water quality category were found for only 7% of the channel reconfiguration projects and for none of the in-stream channel projects (Table 2)."

Biology does not improve

- "Unfortunately, recovery of biodiversity was rare for the vast majority of stream restoration projects."

Ecology does not improve

- "We show that a major emphasis remains on the use of dramatic structural interventions, such as completely reshaping a channel, despite growing scientific evidence that such approaches do not enhance ecological recovery, and the data we assembled (Table 2) suggest they are often ineffective in stabilizing channels when stability is the primary goal."

Erosion does not stop

Palmer, M. A., K. L. Hondula, and B. J. Koch, University of MD, 2014, "Ecological Restoration of Streams and Rivers: Shifting Strategies and Shifting Goals,", Annu. Rev. Ecol. Evol. Syst. 2014. 45:247-269. (https://akottkam.github.io/publications/Palmerpublications/Palmer2014a.pdf)

Scientific Evidence that Stream "Restorations" Don't Work

Analysis of 40 projects by Robert Hilderbrand, University of MD:

Ecology does not improve

"There simply were few ecological differences between restored and unrestored sites. In fact, the unrestored sections upstream [from the restoration sites] were often ecologically better than the restored sections or those downstream of restorations." Hilderbrand, Robert H., et. al.,2020, "Quantifying the ecological uplift and effectiveness of differing stream restoration approaches in Maryland," Final Report Submitted to the Chesapeake Bay Trust for Grant #13141, (https://cbtrust.org/wp-content/uploads/Hilderbrand-et-al_Quantifying-the-Ecological-Uplift.pdf

"…restorations usually end up with no better, and often worse, benthic macroinvertebrate responses [which is an industry-standard for measuring in-stream biology] than were the stream left alone."
Personal communication on 3/6/2023

Scientific Evidence that Stream "Restorations" Don't Work

Analysis of 11 streams by Southerland et. al. that were converted to RSCs (regenerative stormwater conveyances), a type of stream "restoration"

Biology does not improve

- "…fish diversity in RSCs [a type of stream "restoration"] was lower than in high-quality sites…."
- "Fish indices of biotic integrity (IBIs) [an industry-standard for measuring in-stream biology] were also lower in RSCs than in high-quality sites…."

Southerland, Mark, et. al., 2021, "Vertebrate Community Response to Regenerative Stream Conveyance (RSC) Restoration as a Resource Trade-Off," Award: 18002 CBT Restoration Research Grant to Tetra Tech and UMCES-Chesapeake Biological Laboratory; https://cbtrust.org/wp-content/uploads/FINAL-Report-for-18002-Tetra-Tech-CBL-CBT-RR-Vertebrates-in-RSCs-30SEP2021-Submitted-to-CBT.pdf

Scientific Evidence that Stream "Restorations" Don't Work

Analysis of 30 projects by Carr et. al., Drexel University:

Ecology does not improve

"Our analysis of the differences between the ecological condition of restored sites and their paired reference reaches showed that the restored sites consistently scored lower in riparian habitat quality as well as the biotic integrity of both periphyton (i.e., attached algae) and benthic macroinvertebrate assemblages. These results clearly demonstrate that at the present time these stream reaches continue to exhibit the types of impaired conditions that originally made them candidates for restoration."

Carr, J., Hart, D., McNair, J., 2006, "Compilation and Evaluation of Stream Restoration Projects: Learning from Past Projects to Improve Future Success," The Patrick Center for Environmental Research, The Academy of Natural Sciences of Drexel University, Report Submitted to the William Penn Foundation. https://ansp.org/research/environmental-research/projects/restoration/

Mo Co DEP ecological results of stream “restorations”

Department of Environmental Protection

Clipart-library.com

“We have not seen benthic [macroinvertebrate or BMI] improvement in any of our stream restorations.”*

*(1/16/2024 DEP presentation to Stormwater Partners Network

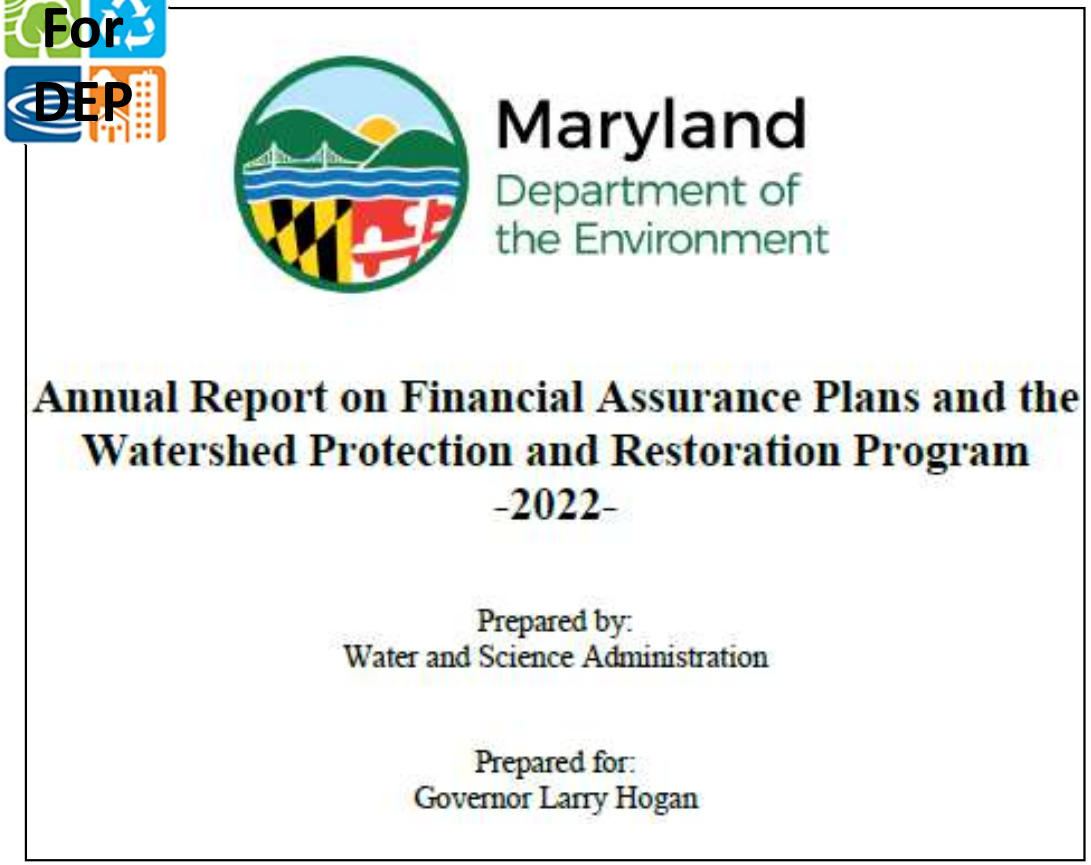
(BMIs are an industry standard measure of stream health.)

COST:

Out-of-stream stormwater control
vs.
Stream “restorations”

Cost: MDE Annual Report on Financial Assurance Plans

For DEP



https://mde.maryland.gov/programs/water/StormwaterManagementProgram/Pages/WPRPFinancialAssurancePlans.aspx

1. Green Roof, Extensive
2. Rainwater Harvesting
3. Dry Well
4. Shallow Wetland
5. Pocket Wetland
6. Surface Sand Filter
7. Dry Swale
8. Other
9. Redevelopment
10. Forestation on Pervious Urban (i.e., Forest Planting)
11. Riparian Forest Planting
12. Urban Tree Canopy
13. Septic Denitrification
14. Septic Connections to WWTP
15. Shoreline Management
16. Catch Basin Cleaning (i.e., Storm Drain Cleaning)
17. Mechanical Street Sweeping
18. Regenerative/Vacuum Street Sweeping (i.e., Advanced Street Sweeping)
19. Nutrient Credits [Trading]
20. Septic Pumping

20 different practices for MS4 Permits are MORE cost effective than stream "restorations."

SUMMARY – Reasons to incentivize out-of-stream stormwater control

1. They address a whole list of residents' concerns such as flooding, reducing heat islands, property values, urban green spaces, protecting natural areas.

A series of bioretention facilities were installed to treat runoff from the road and sidewalk.

(Photos by Montgomery County DEP)

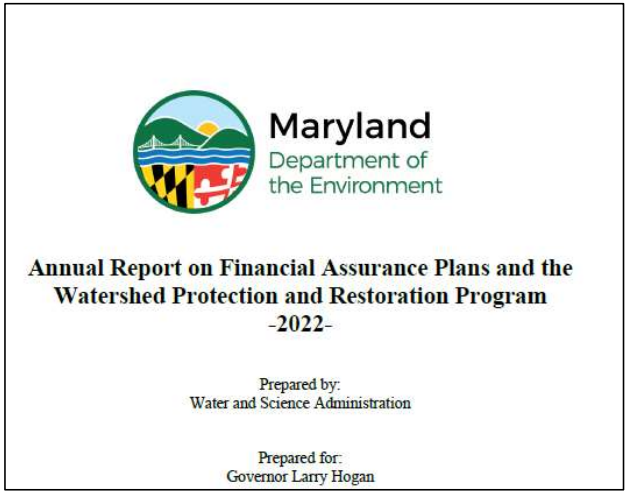
2. The alternative - stream restorations – don't do the above. Direct observations and science say they don't work to either stabilize streams or improve the ecology. Even MoCo DEP admits that none of their projects improved stream ecology.*

(Photo by City of Rockville)

*DEP presentation about Grosvenor stream "restoration" to Stormwater Partners Network on Jan. 16, 2024 in response to question.

SUMMARY, continued

3. There are 20 out-of-stream stormwater control practices that are less expensive that stream restorations


Maryland
Department of the Environment

Annual Report on Financial Assurance Plans and the Watershed Protection and Restoration Program
-2022-

Prepared by:
Water and Science Administration

Prepared for:
Governor Larry Hogan

4. Fix problem at the source: out-of-stream stormwater control is done in areas already disturbed – don't destroy natural areas.

Photo by K. Bawer, 10/21/2021)

What Can You Do?

- Make your opinion known:

- To your elected representatives (state & local) regarding legislation to incentivize out-of-stream stormwater control.

- To County Executive & County Council on the use of stream "restorations."

- To County Council on FY25 Capital budget before May vote: should funds be transferred from stream "restorations" to out-of-stream projects?

Questions?

("Stream restoration" in Upper Watts Branch, Rockville; photo by City of Rockville)

Contact Ken Bawer: kbawer@msn.com

BACKUP: Industry objections

- It is urgent that we fix the eroded gullies

(https://www.cwp.org/the-self-recovery-of-stream-channel-stability-in-urban-watersheds/)

Let eroded gullies & stream banks self-recover

- "It is expected that, with the reduced hydraulics [from erosive flows] within the catchment, these banks will continue a trajectory toward stability as indicated by reduced bank angles and vegetation establishment."* (https://www.cwp.org/the-self-recovery-of-stream-channel-stability-in-urban-watersheds/)

"The Self-Recovery of Stream Channel Stability in Urban Watersheds due to BMP Implementation," by Lisa Fraley McNeal, Bill Stack, et. al.

(https://www.cwp.org/the-self-recovery-of-stream-channel-stability-in-urban-watersheds/)

CENTER FOR
WATERSHED
PROTECTION

“The Self-Recovery of Stream Channel Stability in Urban Watersheds”

“ It is expected that, with the reduced hydraulics within the catchment, these banks will continue a trajectory toward stability as indicated by reduced bank angles and vegetation establishment.”

https://cwp.org/the-self-recovery-of-stream-channel-stability-in-urban-watersheds/

Reference

"The Self-Recovery of Stream Channel Stability in Urban Watersheds due to BMP Implementation" by Lisa Fraley McNeal, Bill Stack, et. al. https://cwp.org/the-self-recovery-of-stream-channel-stability-in-urban-watersheds/ and https://cbtrust.org/wp-content/uploads/Self_Recovery_of_Stream_Channel_Stability_Final_Draft_03-23-21.pdf

- … "[stormwater BMP] retrofits reduce the magnitude, duration and frequency of erosive flow rates." (p. 48)
- "…there is strong evidence that the channels below the treatment sites will stabilize and adjust as the frequency of erosive flows diminishes. This will likely translate to corresponding decreases in sediment erosion. (p. 52)
- "…, it is likely the channels are on a trajectory leading towards stabilization as anecdotal evidence (which includes photographs)…." (p. 52)

Legislation Ideas, not used yet