Recommendations for the Phase 6 Watershed Model from the Wetland Expert Panel

Friday, December 2, 2016

Webinar

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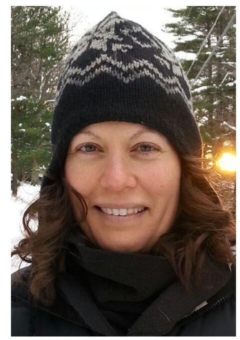
- **This is being recorded. A link to the recording will be posted to the CBP calendar page for this webinar.**

Today’s speakers

Jeremy Hanson
Panel Coordinator
Virginia Tech
Chesapeake Bay Program Office

Kathy Boomer
Panel Member
The Nature Conservancy



Erin McLaughlin
Panel Member
MD Dept. of Natural Resources

Ralph Spagnolo
Panel Co-Chair
EPA Region 3

Overview

- Bottom-line summary
- Background about the expert panel
- Phase 6 wetland land uses
    - Proposed Wetland Classes
    - Proposed Wetland Condition Classes (Natural, Restored, Enhanced, Created)
- Panel's Proposed Framework:
    - Wetland Retention Efficiencies
    - Estimating Delivered Loads
- Timeline
- Questions and Discussion

Bottom-line summary

- Two new land uses for nontidal wetlands added for Phase 6: "Floodplain" and "Other" (approved Fall 2015)
  - No land use for tidal wetlands, which are simulated in estuarine model, not Watershed Model
- Four wetland BMP categories for Phase 6
  - **Wetland restoration (re-establishment)**
  - Wetland creation (establishment)
  - Wetland enhancement
  - Wetland rehabilitation
- Present report provides suggested definitions for the four categories, but only effectiveness values for Wetland Restoration at this time. Preliminary placeholder values for Creation, Enhancement and Rehabilitation have been adopted until a future panel can recommend improved estimates for Phase 6. This webinar and the requested review of report is focused primarily on Wetland Restoration BMP recommendations for Phase 6.

What is an expert panel?

- Group of experts charged with review of nonpoint source BMPs' estimated effectiveness to reduced nutrients and sediment, or related tasks (e.g., land uses)
- All expert panels follow the Water Quality Goal Implementation Team's *Protocol for the Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Watershed Model*, AKA the "BMP Protocol"
  - http://www.chesapeakebay.net/publications/title/bmp_review_protocol
- BMPs are revisited as new science becomes available

Panel membership

Name	Role (post-CWP)	Organization
Erin McLaughlin	Panel member	Maryland Department of Natural Resources (MD DNR), Wetland Work Group Co-Chair
Steve Strano	Panel member	Natural Resource Conservation Service (NRCS)
Judy Denver	Panel member	U.S. Geological Survey (USGS)
Ken Staver	Panel member	Wye Research and Education Center
Kathy Boomer	Panel member	The Nature Conservancy
Pam Mason	Co-Chair	Virginia Institute of Marine Science
Dave Davis	Panel member	Virginia Department of Environmental Quality (VA DEQ)
Jeff Hartranft	Panel member	Pennsylvania Department of Environmental Protection (PA DEP)
Ralph Spagnolo	Co-Chair	USEPA Region 3
Jeff Thompson	Panel member	Maryland Department of Environment (MDE)
Tom Uybarreta	Panel member	USEPA Region 3
Quentin Stubbs	Panel member	USGS, CBPO
Rob Brooks	Panel member	Pennsylvania State University
Dr. Jarrod Miller	Panel member	University of Maryland (UMD) Extension
Michelle Henicheck	Panel member	VA DEQ
Denise Clearwater	Panel member	MDE
Panel support		
Jeremy Hanson	Panel Coordinator	Virginia Tech, CBPO
Jennifer Greiner	HGIT Coordinator	US Fish and Wildlife Service (USFWS), CBPO
Kyle Runion	Support	CRC, CBPO
Aileen Molloy	Support	Tetra Tech
Jeff Sweeney	CBPO Modeling and WTWG rep	USEPA CBPO
David Wood	CBPO Modeling rep	CRC, CBPO
Peter Claggett	GIS Support	USGS, CBPO
Brian Benham	VA Tech Project Director	Virginia Tech

Panel charge at a glance

- Evaluate and make recommendations for new land uses and loading rates in Phase 6 Watershed Model
- Revisit existing Phase 5.3.2 definition and effectiveness estimates for Wetland Restoration BMP
- Consider whether Creation, Enhancement, and Rehabilitation should be distinguished as separate, new BMPs and provide recommendations
- Provide other information related to the recommendations as described in charge and BMP Protocol (e.g., reporting, tracking, BMP verification)

Phase 6 land uses and loading rates

CBWM: Wetlands as a Land Use/Land Cover (LULC) Class

- Wetlands did not have their own LULC class in the Phase 5 Watershed Model; lumped in as part of Forest land use
- Panel was asked to evaluate new LULC class and associated loading rates for wetlands for Phase 6 Model
- Strong desire from Wetland Workgroup to represent wetland LULC classes explicitly based on landscape position, if available science supported new land uses

CBWM: Wetlands as a Land Use/Land Cover (LULC) Class

- Why two land uses?
- Why loading rate = forest loading rate?

Justification for land uses

- Wetlands provide important ecosystem functions and contributions are unique from other LULC classes.
- Wetland ecosystem function depends on landscape position.
- Adequate wetland inventories are available for all Bay states
  - NWI has coverage of full Bay watershed; some jurisdictions have more recent data. Furthermore, having explicit land uses increases incentive for maintaining or improving datasets.
- Wetlands present unique and significant BMP opportunities to advance water quality and habitat goals. For the current watershed management model:
  - Existing, natural wetlands are considered to provide full water quality benefits.
  - Restored wetlands result in LULC conversion and wetland acreage gains ;
  - Enhancement and Rehabilitation restores function and is assumed to occur when wetlands are restored.
  - Constructed wetlands, due to highly engineered nature, are not considered in the review.

Table 7. Land use classes and relative loading rates for nontidal wetlands in the Phase 6 Watershed Model

Wetland land uses for Phase 6 Watershed Model	Relative Loading Rate (TN)	Relative Loading Rate (TP)	Relative Loading Rate (Sediment)
Floodplain Wetland	100% Forest	100% Forest	100% Forest
Other Wetland (non-floodplain)	100% Forest	100% Forest	100% Forest

Justification for loading rate

- With respect to water quality, wetlands act as transitional zones: water chemistry and nutrient fluxes strongly depend on wetland source waters. Therefore few studies evaluate wetlands as nutrient or sediment sources to estimate wetland loading rates. Studies tend to focus on the retention of the wetland and the change between inputs and outputs.
- Panel and Wetland Workgroup agreed it was most reasonable to keep loading rate for new wetland land uses equivalent to the forest land use for Phase 6 loading rate, given its low loading rates and that, across all LULC classes, this LULC is most comparable to wetlands.

Developing the Phase 6 BMPs

Phase 5 Wetland Restoration BMP

- The Chesapeake Bay Program currently defines the agricultural wetland restoration best management practice (BMP) as:
  - Reestablishment (restore)—Manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former wetland. Results in a gain in wetland acres.
  - Establishment (create)—Manipulation of the physical, chemical, or biological characteristics present to develop a wetland that did not previously exists on an upland or deepwater site.
  - Results in a gain in wetland acres.
  - The literature search for this practice focuses only the water quality benefits that wetlands provide and literature on the wildlife, mitigation wetlands, and natural wetlands are not considered.
- A more broad-based definition is provided by the CBPO when wetland area or drainage area is unreported:

  "Agricultural wetland restoration activities reestablish the natural hydraulic condition in a field that existed before the installation of subsurface or surface drainage. Projects can include restoration, creation and enhancement acreage. Restored wetlands can be any wetland classification including forested, scrub-shrub or emergent marsh."

CBWM Phase 6: Estimating Wetlands Water Quality Benefits – Importance of Condition

- Wanted to better distinguish types of practices (re-establishment, establishment, enhancement, rehabilitation) and give appropriate science-based credit
- To do this, additional BMPs were needed for Phase 6; one Wetland Restoration BMP could not properly account for all practice types
- The panel ran out of time to determine appropriate effectiveness estimates for new Phase 6 BMPs: Creation, Enhancement, and Rehabilitation. Each of these practices warrants equal time and deliberation that was given to Restoration BMP but there are placeholders to allow incorporation of these new categories in the Phase 6 calibration.

Some caveats about the panel's recommended Phase 6 BMP definitions

- **The examples in the right-hand column are not intended to be comprehensive – nor limiting or restrictive – as some projects or practices could count under a different category depending on the design, site location, or other specific factors of the project. The table is intended to help clarify how a type of practice is most likely to be categorized under the Panel's Phase 6 BMP definitions.**
- The categories (in Table 2) are not listed in any particular order or hierarchy.
- Other existing CBP-approved BMPs (e.g., Stream Restoration) are unaffected. Care must be taken to avoid double counting (don't report the practice twice under different BMPs. Choose the BMP that best describes the specific site area)

Wetland BMP category definitions (Table 2)

Proposed BMP Category	**Proposed CBP Definition (for Phase 6 CBWM)**	**CBP will count the BMP acres as...**	**Practice and Project Examples**
Restoration	**Re-establish** The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former wetland.	Acreage gain (toward Watershed Agreement outcome of 85,000 acre wetland gain and in Phase 6 annual progress runs)	Restore hydrology to prior-converted agricultural land (cropland or pasture); elevate subsided marsh and re-vegetate; ditch plugging on cropland; Legacy Sediment Removal NRCS Practice 657
Creation	**Establish (or Create)** The manipulation of the physical, chemical, or biological characteristics present to develop a wetland that did not previously exist at a site.	Acreage gain (toward Watershed Agreement outcome of 85,000 acre wetland gain and in Phase 6 progress runs)	Modifications to shallow waters or uplands to create new wetlands. Placement of fill material or excavation of upland to establish proper elevations for tidal wetland; Hydrologic measures such as impoundment, water diversion and/or excavation of upland to establish nontidal wetlands NRCS Practice 658

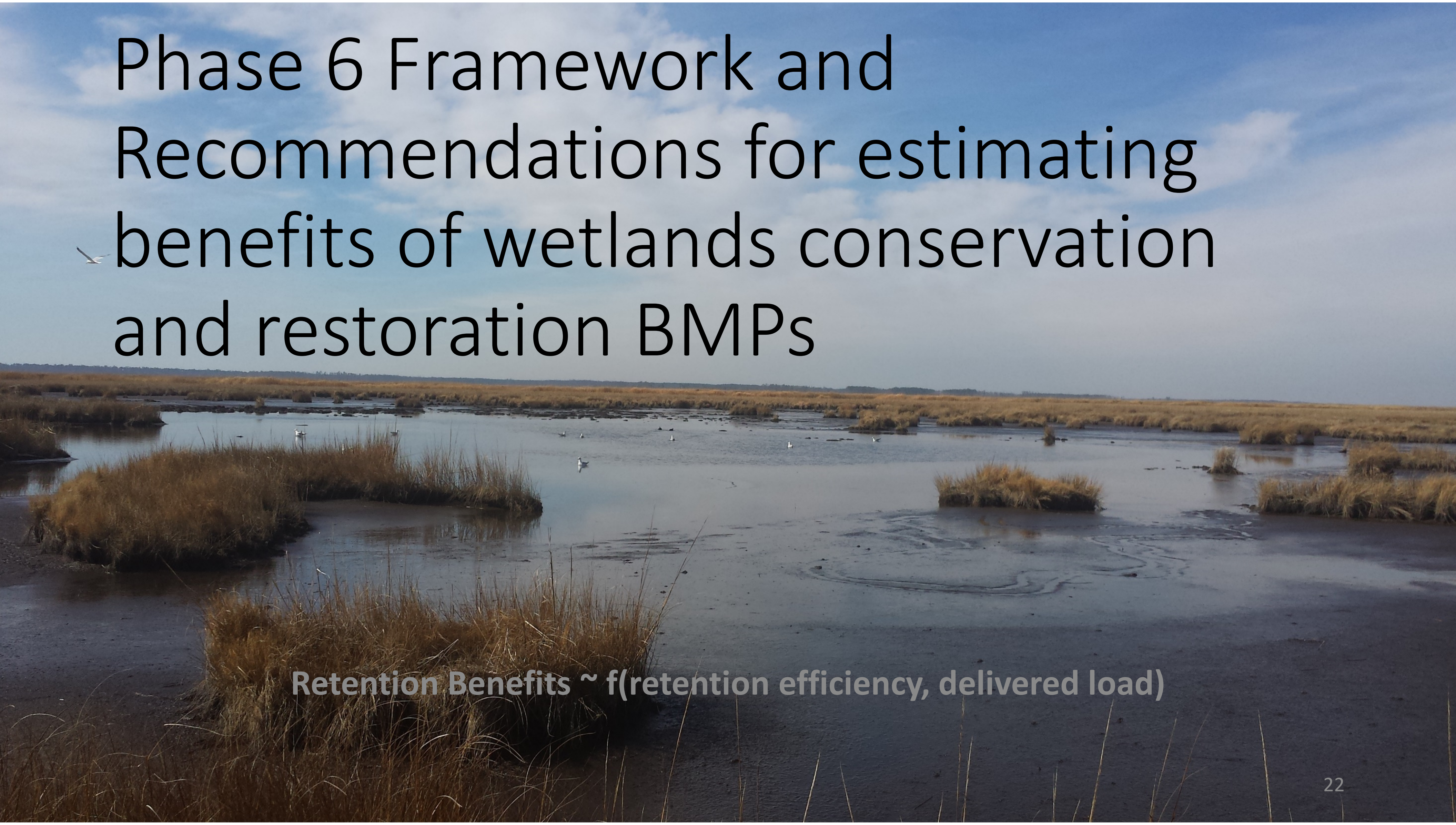
Wetland BMP definitions (Table 2, continued)

Enhancement	**Enhance** The manipulation of the physical, chemical, or biological characteristics of a wetland to heighten, intensify, or improve a specific function(s).	Function gain (toward 150,000 acre outcome <u>and</u> Phase 6 annual progress runs)	Flood seasonal wetland for waterfowl benefit; regulate flow velocity for increased nutrient uptake; <u>invasive species removal</u> NRCS Practice 659
Rehabilitation	**Rehabilitate** The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded wetland.	Function gain *(toward 150,000 acre outcome <u>and</u> Phase 6 annual progress runs)*	Restore tidal flow to degraded wetland; ditch plugging in a forested wetland area; *re-establishing needed vegetation on cropland with wetland hydrology; native wetland meadow planting*; moist soil management*; <u>invasive species removal, floodplain reconnection</u> May include some NRCS Code 657 practices . *<u>Moist soil management should only be counted if there are predominantly native wetland plants; and site can sustain itself as wetland without active management, meaning whether water control structure is operated or not</u>.

Summary of how they will work in P6 CBWM

- Use panel's definitions and categories for Phase 6 to replace Phase 5 "Wetland Restoration" BMP
  - For Phase 6 **Wetland Restoration**: Land use change plus apply panel's new efficiency to new upland acre ratios. Update if changes made as result from review/approval process of full report.
  - For Phase 6 **Wetland Creation**: Land use change plus apply Phase 5 efficiencies using Phase 5 upland acre ratio (1:1 acres). Update based on future panel.
  - For Phase 6 **Wetland Enhancement**: Apply Phase 5 efficiencies using Phase 5 upland acre ratio (1:1). No land use change since it is a gain in function. Update based on future panel.
  - For Phase 6 **Wetland Rehabilitation**: Apply Phase 5 efficiencies using Phase 5 upland acre ratio (1:1). No land use change since it is a gain in function. Update based on future panel.

Phase 6 Framework and Recommendations for estimating benefits of wetlands conservation and restoration BMPs



Retention Benefits ~ f(retention efficiency, delivered load)

Review of Wetland Retention Efficiencies: Phase 5 Wetland Restoration BMP

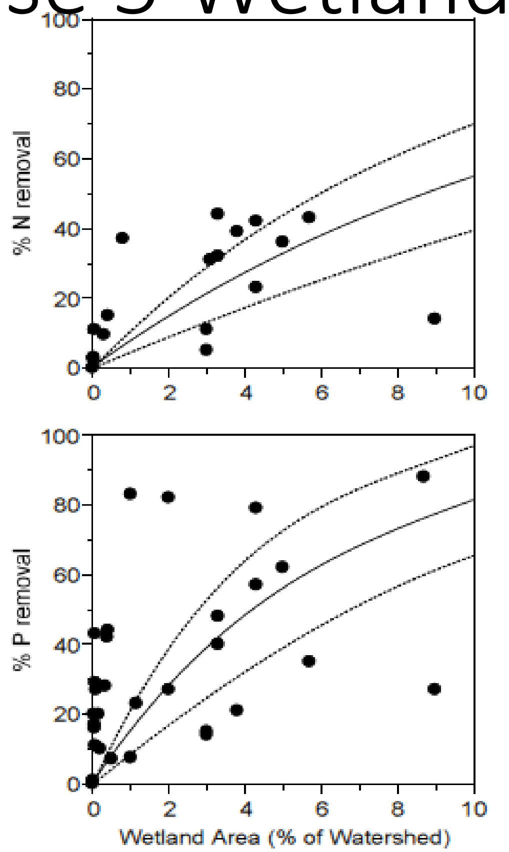


Figure 2. Literature review data points for wetland nutrient removal efficiency based on the wetland area as a proportion of the watershed. (STAC 2008).

Geomorphic Province	TN Removal Efficiency	TP Removal Efficiency	TSS Removal Efficiency
Appalachian	7%	12%	4%
Piedmont and Valley	14%	26%	8%
Coastal Plain	25%	50%	15%
Average	16.75%	32.18%	9.82%

- Reduction efficiencies based on kinetic equation for TN and TP; fit to literature data. 15% rate set for sediment on CP, adjusted based on TP rate.
- 1%, 2% and 4% wetland area is assumed for each respective HGMR

Placeholder functional gain wetland BMPs for Phase 6

*For Functional Gain practices (**Wetland Enhancement** and **Wetland Rehabilitation**)*

- *Type of reduction*: Treatment of upland acres (1 acre treated per 1 acre enhanced or rehabilitated).
- *Frequency*: Cumulative
- *Credit duration*: 15 years (?)
- *Eligible P6 land use(s):* Nontidal wetland – Floodplain; Nontidal wetland – Other

	TN removal (%)	TP removal (%)	TSS removal (%)	Upland acres treated
Restoration*	42	40	31	See Table 4
Creation**	16.75	32.18	9.82	1
Enhancement**	**16.75**	**32.18**	**9.82**	**1**
Rehabilitation**	**16.75**	**32.18**	**9.82**	**1**

Placeholder for Wetland Creation in Phase 6

- ***Wetland Creation***.
  - *Type of reduction*: This practice is a gain in acreage, so it is a land use change plus treatment of upland acres. Creation will treat 1 upland acre per acre of created wetland, using the current Phase 5 efficiencies as placeholder.
  - *Frequency*: Cumulative.
  - *Credit duration*: 15 years (current credit duration for Phase 5 Wetland Restoration)
  - *Eligible land uses*: All agricultural land uses and land use groups.

	TN removal (%)	TP removal (%)	TSS removal (%)	Upland acres treated
Restoration*	42	40	31	See Table 12
Creation**	**16.75**	**32.18**	**9.82**	**1**
Enhancement**	16.75	32.18	9.82	1
Rehabilitation**	16.75	32.18	9.82	1

Wetland Restoration for tidal areas: use existing Shoreline Management BMP

- Tidal restoration practices will be credited in estuarine model, not the Watershed Model. Tidal re-establishment TN, TP and TSS reductions will be reported as Shoreline Management using protocols 2, 3 and 4:

		TN (lbs/ac)	TP (lbs/ac)	TSS (lbs/ac)
Protocol 2 – Denitrification	Acres of re-vegetation	85	NA	NA
Protocol 3 - Sedimentation	Acres of re-vegetation	NA	5.289	6,959
Protocol 4 – Marsh Redfield Ratio	Acres of re-vegetation	6.83	0.3	NA
Sum of protocols 2-4	**Acres**	**91.83**	**5.589**	**6,959**

Background Materials for Proposed Approach to Estimating Wetland Water Quality Benefits

Summary of Proposed Wetland BMP Function across the Chesapeake Bay Watershed

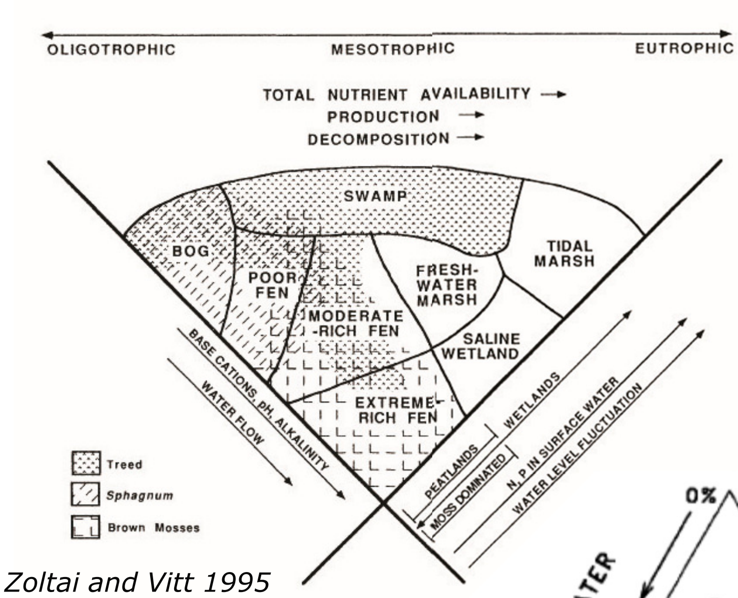
I. Summary of Current, Paradigms Related to Wetland WQ Function

II. Logic Framework behind Proposed Wetland BMP Efficiencies

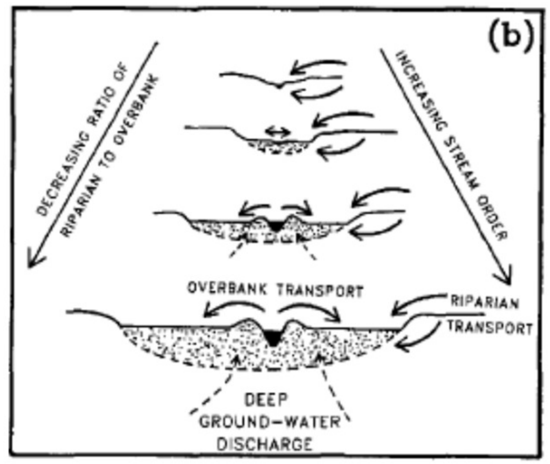
Summary of Proposed Wetland BMP Function across the Chesapeake Bay Watershed

	% Efficiency			Upland Acres Treated		Watershed Model HGMR
Physiographic Province	**TN**	**TP**	**TSS**	**Other Wetlands**	**Floodplain Wetlands**	
Appalachian Plateau	**42**	**40**	**31**	**1**	**2**	Appalachian Plateau Siliciclastic
Appalachian Ridge and Valley				**1**	**2**	Valley and Ridge Siliciclastic
Blue Ridge				**2**	**3**	Blue Ridge
Piedmont				**2**	**3**	Piedmont Crystalline Mesozoic Lowlands
Inner Coastal Plain				**4**	**6**	Western Shore: Coastal Plain Uplands Coastal Plain Dissected Uplands
Outer Coastal Plain- Poorly Drained				**1**	**2**	Eastern Shore: Coastal Plain Uplands
Outer Coastal Plain- Well Drained				**2**	**3**	Eastern Shore: Coastal Plain Dissected Uplands
Coastal Plain Lowland				**2**	**3**	Coastal Plain Lowlands
Karst Terrain				**2**	**3**	Piedmont Carbonate Valley and Ridge Carbonate Appalachian Plateau Carbonate

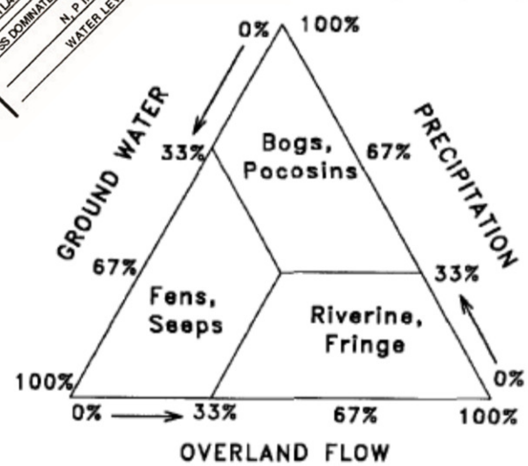
Modeling Wetland Function across the Chesapeake Bay Watershed: Current Paradigms

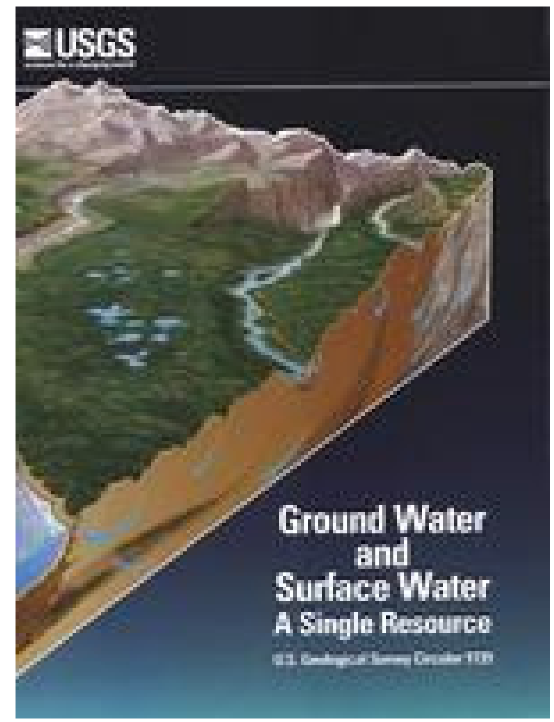


Zoltai and Vitt 1995



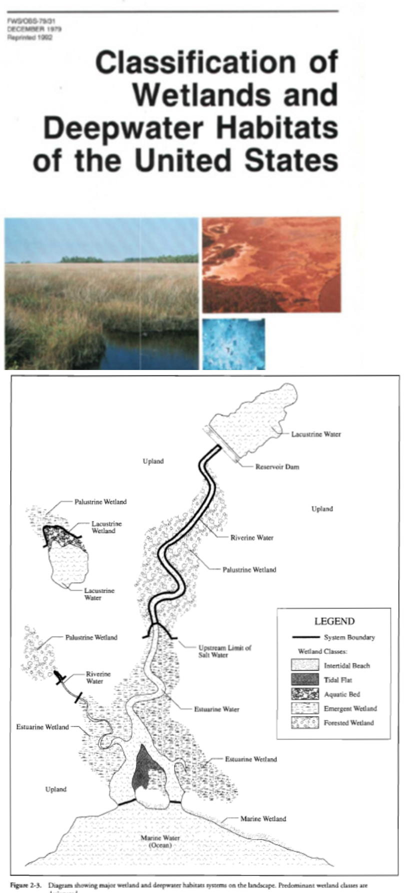
Brinson 1993

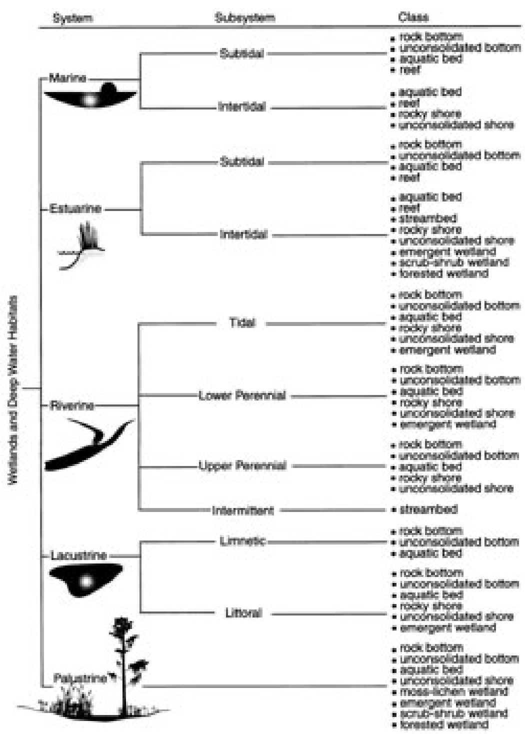




Winter 1998

Modeling Wetland Function across the Chesapeake Bay Watershed: Current Paradigms

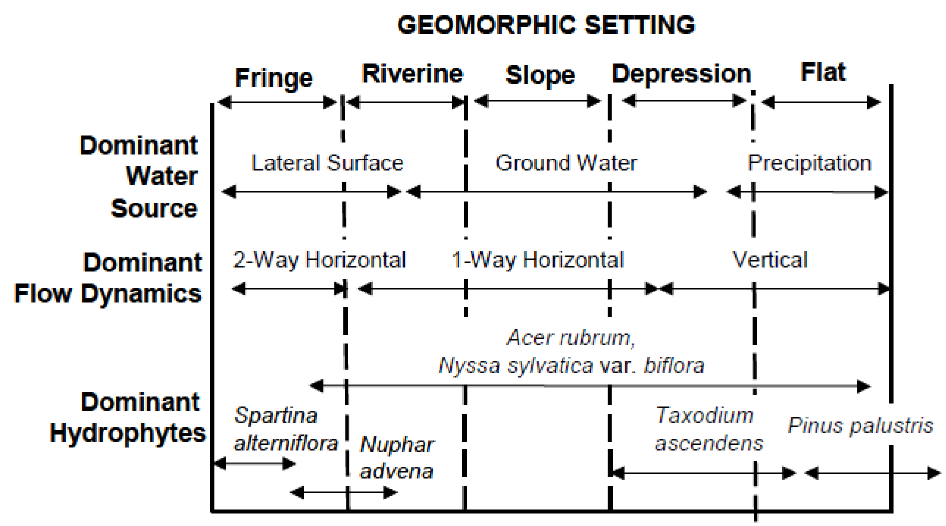




Cowardin et al 1979

PROPOSED HYDROGEOMORPHIC CLASSIFICATION FOR WETLANDS OF THE MID-ATLANTIC REGION, USA

Robert P. Brooks[1], Mark M. Brinson[2], Kirk J. Havens[3], Carl S. Hershner[3], Richard D. Rheinhardt[2], Denice H. Wardrop[1], Dennis F. Whigham[4], Amy D. Jacobs[5], and Jennifer M. Rubbo[1]



2011

Modeling Wetland Function across the Chesapeake Bay Watershed: Current Paradigms

Water Quality Functions of Riparian Forest Buffers in Chesapeake Bay Watersheds

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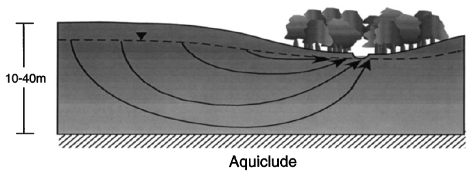
ABSTRACT / Maryland, Virginia, and Pennsylvania, USA, have agreed to reduce nutrient loadings to Chesapeake Bay by 40% by the year 2000. This requires control of nonpoint sources of

OUTER COASTAL PLAIN FLOW SYSTEM
Well-Drained Upland



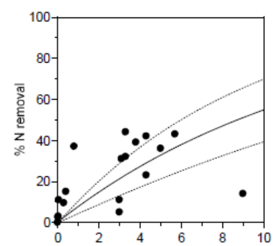
Water Quality Function	Expected Level	Critical Constraints	Restoration/ Enhancement
Removal of nitrate from groundwater	Low, primarily removal from shorter flow paths.	Bypass flow due to deeper aquifers. Long flow paths surface in stream channels.	Concentration on headwater areas. Zone 1 important for nitrate removal.
Removal of sediment and sediment-borne pollutants	High/Medium	Concentrated flow must be converted to sheet flow.	On larger streams, focus on filtering eroded sediment. Enhance functions of Zones 2 & 3.
Removal of dissolved phosphorus	Medium/Low	Dissolved P control is limited. Focus on P load in surface runoff.	Increase vegetation uptake and accretion. Enhance existing forest and grass strips.

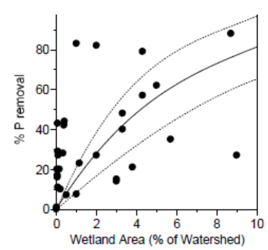
Quantifying the Role of Wetlands in Achieving Nutrient a Sediment Reductions in Chesapeake Bay

Chesapeake Bay Program STAC Responsive Workshop
Sponsored by the Chesapeake Bay Program's
Land Growth and Stewardship, and Living Resources Subcommittees

November 2008
STAC Publication 08-006

Based on April 4, 2007 Workshop





Wetland Restoration and Wetland Creation Best Management Practices (Agricultural)

Definition and Nutrient and Sediment Reduction Efficiencies

For use in calibration of the Phase 5.0 of the Chesapeake Bay Program Watershed Model

Consulting Scientist

Tom Jordan, Ph.D.
Smithsonian Environmental Research Center
Chemical Ecologist

Synthesize and Consensus Agreement by

Tom W. Simpson, Ph.D.
University of Maryland/Mid-Atlantic Water Program
Project Manager

And

Sarah E. Weammert
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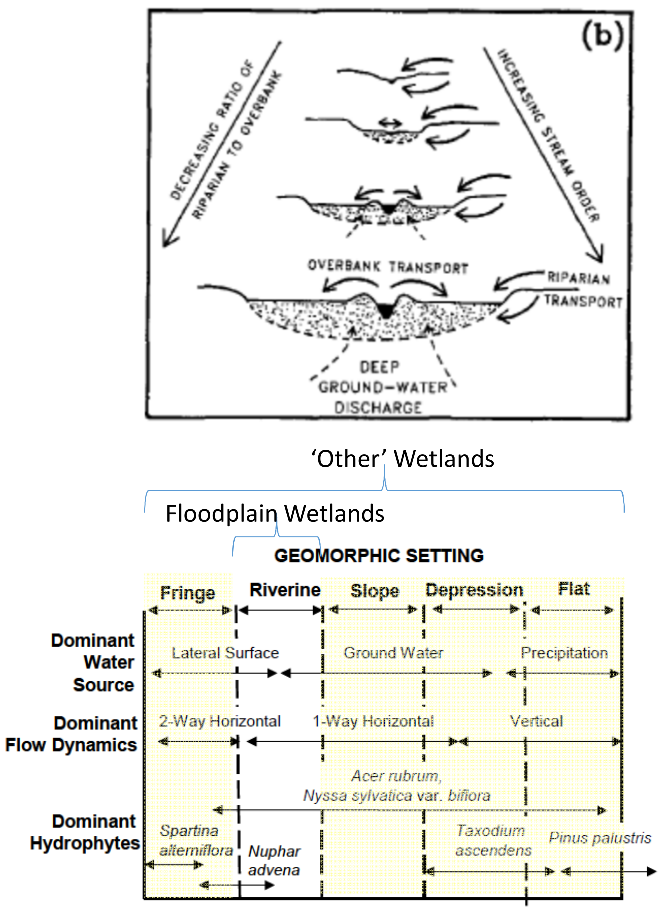
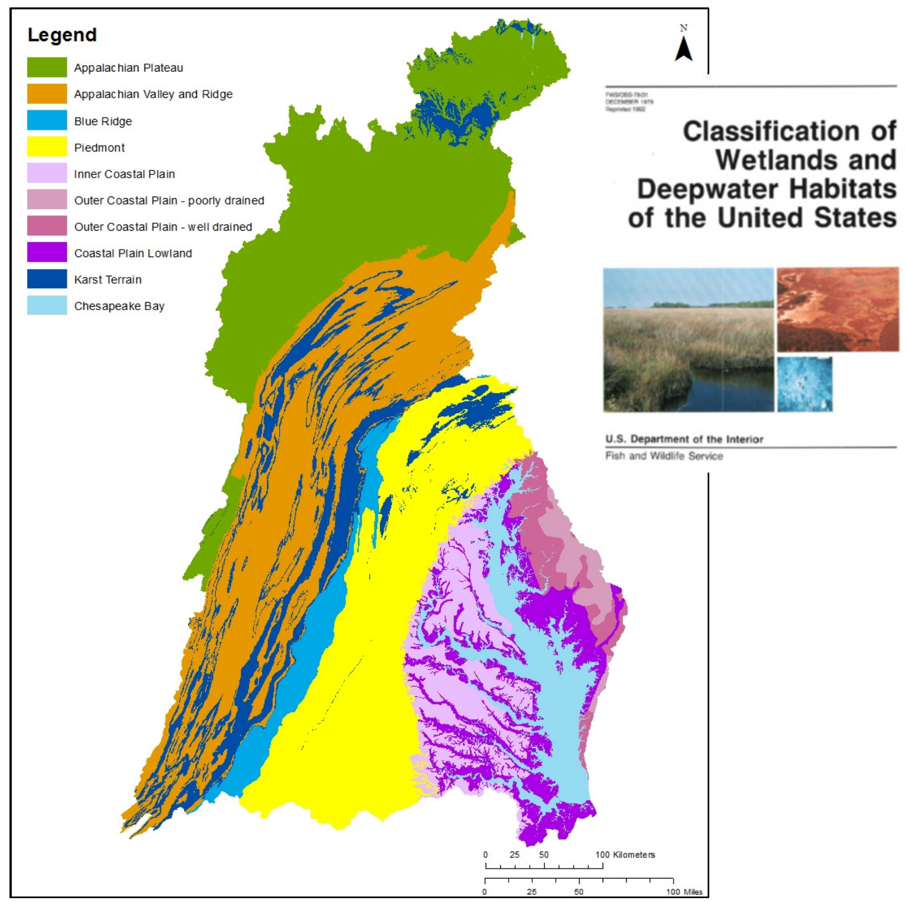
Project Leader

Geomorphic Province	TN Removal Efficiency	TP Removal Efficiency
Appalachian	7%	12%
Piedmont	14%	26%
Coastal Plain	25%	50%

Logic Framework behind Proposed Wetland Retention Estimates





Logic Framework: Wetland WQ Function f(initial concentration, reaction rate)

Retention Efficiency Factors:

–Amount/rate of contamination in inflow (surface- and ground-waters)

–portion of contaminated water that actually intersects carbon-rich substrate rather than by-passing wetland system

} Initial concentration

–soil carbon availability

– water chemistry, temperature

} Retention Efficiency

Literature Review: Wetland Retention Efficiencies

Wetland Type	Vegetation Type	TN % Reduction Mean Range Median (#)	TP % Reduction	TSS % Reduction
Headwater/ Depressional	ALL	33% -8-97 34% (9)	25% -15-94 10% (13)	28% -30-75% 37% (6)
Floodplain	ALL	44% -8-94 38% (24)	37% -41-100 29% (24)	32% -15-95 14% (7)
All except constructed	Forest, mixed and unknown	47% -8-97 59% (16)	45% -47-100 43% (44)	37% -15-95 32% (8)
All except constructed	Emergent	39% -8-89 36% (20)	31% -15-100 30% (20)	25% -30-75 27% (7)
All except constructed	ALL	42% -8-97 39% (36)	40% -47-100 41% (64)	31% -30-95 27% (15)

Wetland WQ Function:
Reaction Rate ~ BMP Efficiency

TN removal (%)	TP removal (%)	TSS removal (%)
42	40	31

- Mean reduction efficiency from literature (excluding constructed wetlands). Average of 36 values for TN; 64 for TP, and 15 for sediment.
- Appendix A: Tabular summary of measured retention efficiencies.

Logic Framework: Wetland WQ Function f(initial concentration, reaction rate)

Retention Efficiency Factors:

–Amount/rate of contamination in inflow (surface- and ground-waters)

–portion of contaminated water that actually intersects carbon-rich substrate rather than by-passing wetland system

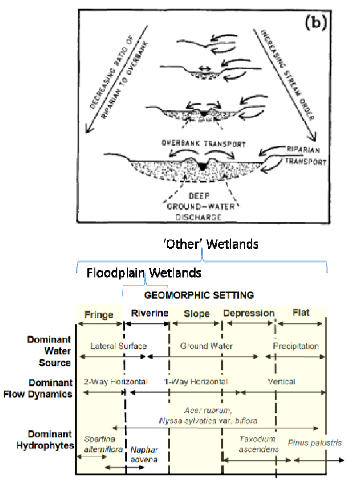
Initial concentration

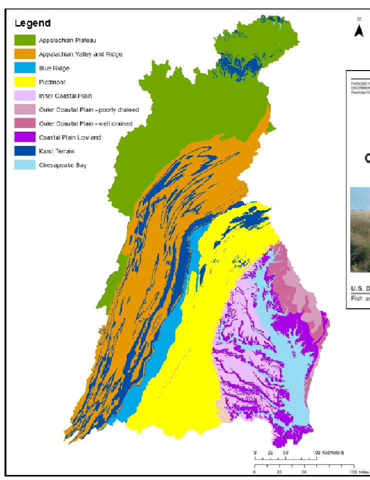
–soil carbon availability

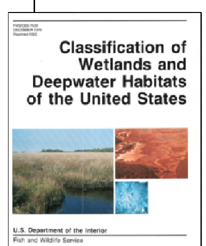
– water chemistry, temperature

Retention Efficiency

Logic Framework: Wetland Forms and Distributions across the Chesapeake Bay Watershed







Physiographic Province	Other Wetlands			Floodplain Wetlands
	Flats	Depressional Wetlands	Sloping Wetlands	
Appalachian Plateau		-moraine depressions	- Aquifer outcrops - Small tributary riparia	-valley floors, above bedrock outcrops
Appalachian Ridge & Valley		- Aquifer outcrops - Fractured rock springs	- Small tributary riparia - Slope breaks	- Medium to large waterways
Blue Ridge		- Ridgetops	- Fractured bedrock outcrops - Riparia	- Tributary confluences - Medium to large waterways
Piedmont			- Fractured bedrock outcrops - riparia	Eroded stream/river terraces
Inner Coastal Plain			- Small streams, floodplain edges	Small to large waterways
Outer Coastal Plain - Poorly drained uplands	Watershed divides	Watershed divides	- Small (natural and artificial) tributary riparia	Small to large waterways
Outer Coastal Plain - - Well drained uplands			- Small tributary riparia	Small to large waterways
Coastal Plain Lowlands	Watershed divides		- Small (natural and artificial) tributary riparia	Bottom lands
Karst terrain - Appalachian Plateau - Appalachian Ridge & Valley - Piedmont		Tubular springs	Outcrops, slope breaks, springs	

Wetland WQ Function: Initial Concentration

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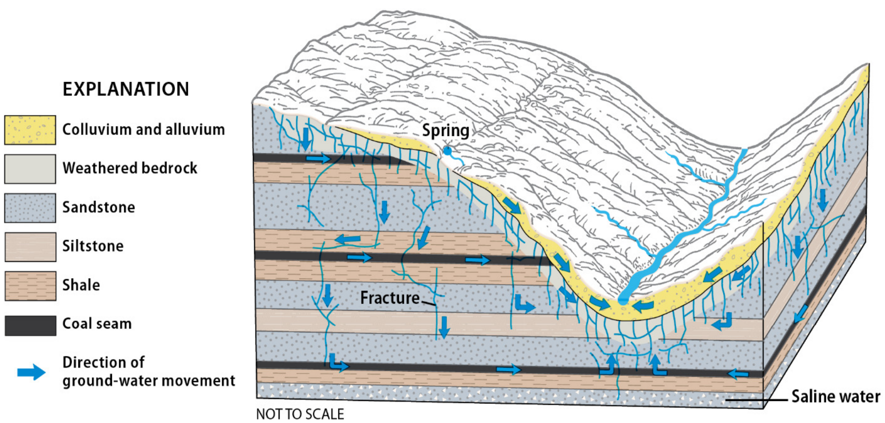
f(impacted acres and wetland hydrologic connectivity)

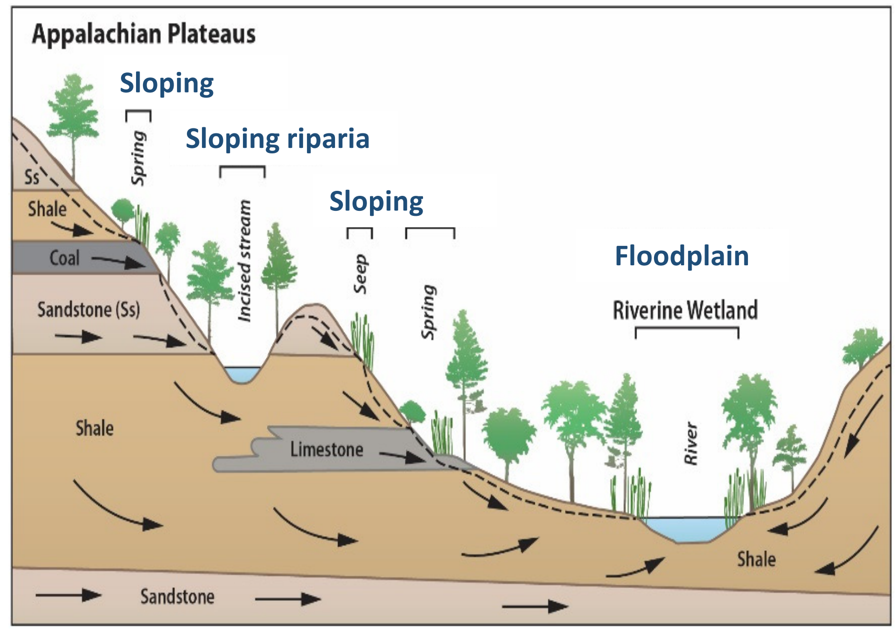
Physiographic Province	Other Wetlands			Floodplain Wetlands
	Flats	Depressional Wetlands	Sloping Wetlands	
Appalachian Plateau		L – variability in hydrologic settings & predominant forest cover	L – confined aquifer discharge not likely contaminated	L - predominant forest cover and greater likelihood of hyporheic exchange rather than wetland discharge
Appalachian Ridge & Valley		L – small contributing area; predominant forest cover	L – confined aquifer discharge not likely contaminated; predominant forest cover	L - predominant forest cover and greater likelihood of hyporheic exchange rather than wetland discharge
Blue Ridge		L – small contributing area; predominant forest cover	H - Surficial aquifer and heavy human impacts	M – Incised, more infrequent events; potential deep aquifer by-pass
Piedmont			M - Surficial aquifer and heavy human impacts	M – Incised, more infrequent events; potential deep aquifer by-pass
Inner Coastal Plain			H - Surficial aquifer and heavy human impacts	H – well connected, more frequently flooded
Outer Coastal Plain - Poorly drained uplands	L – small contributing area; flat hydraulic gradient predominant forest cover	L – small contributing area; flat hydraulic gradient predominant forest cover	M – Small contributing area, but surficial aquifer important and heavily influenced by human impacts	M – well connected, frequently flooded but potentially limited exchange due to flat hydraulic gradients
Outer Coastal Plain - - Well drained uplands			L – Deep aquifers with strong potential to bypass contaminated waters	H – well connected, more frequently flooded
Coastal Plain Lowlands	L – small contributing area; flat hydraulic gradient predominant forest cover		H – well connected, more frequently flooded	M – well connected, frequently flooded but potentially limited exchange due to flat hydraulic gradients
Karst terrain* - Appalachian Plateau - Appalachian Ridge & Valley - Blue Ridge & Valley		H – Strong potential for contaminated discharge.	M – Strong potential for contaminated discharge, but potential for rapid flow-through & short contact time	L/M – see floodplain descriptions above, respectively

Appalachian Plateau

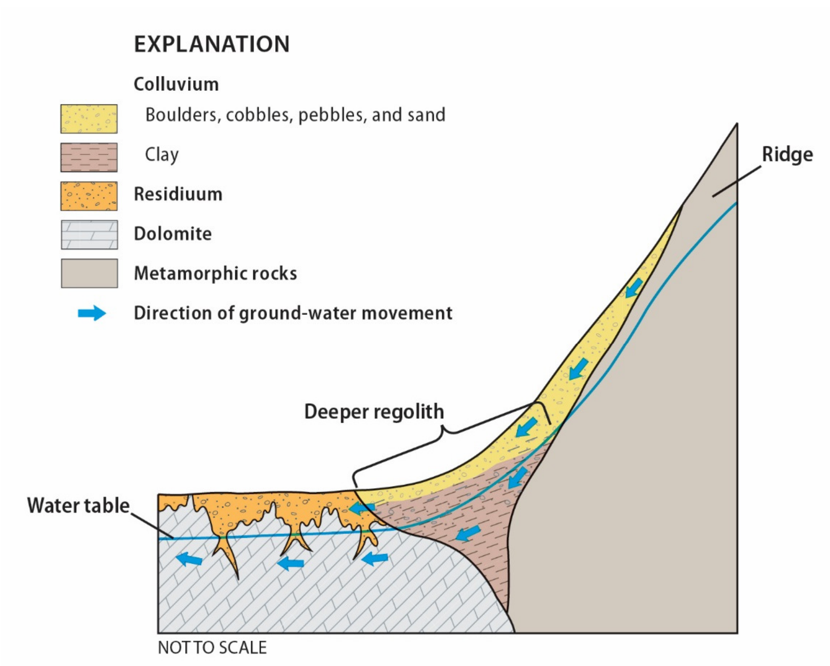


Topography and shallow fracture systems determine ground-water movement in the aquifers of the Appalachian Plateaus. Water infiltrates weathered bedrock and moves mostly through near-surface factures; some water moves in a steplike fashion vertically along deeper fractures and horizontally through fractured sandstone or coal beds. Because of the absence of deep ground-water circulation and regional flow systems, saline water is at shallow depths.

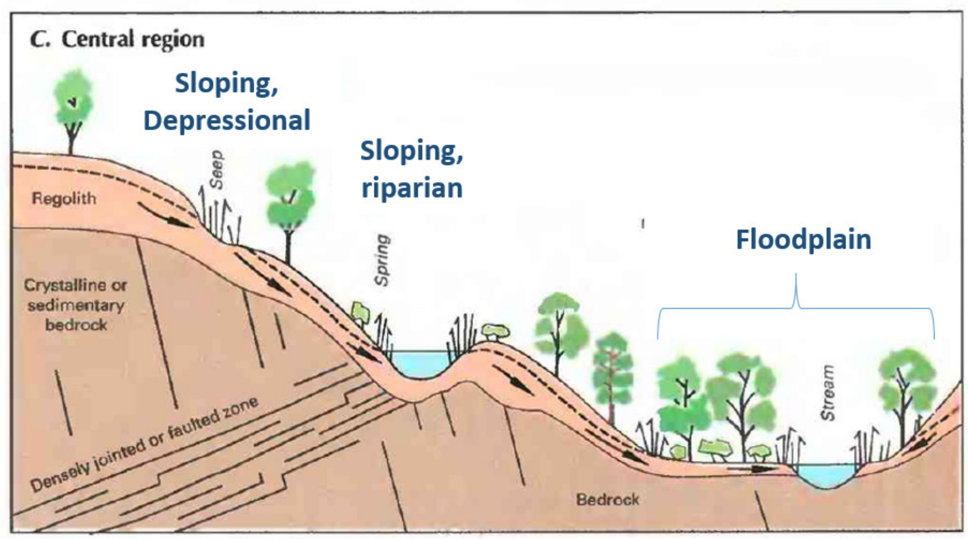
Modified from Harlow, G.E., Jr., and LeCain, G.D., 1993, Hydraulic characteristics of, and ground-water flow in, coal-bearing rocks of southwestern Virginia: U.S. Geological Survey Water-Supply Paper 2388, 36 p.



Ridge and Valley

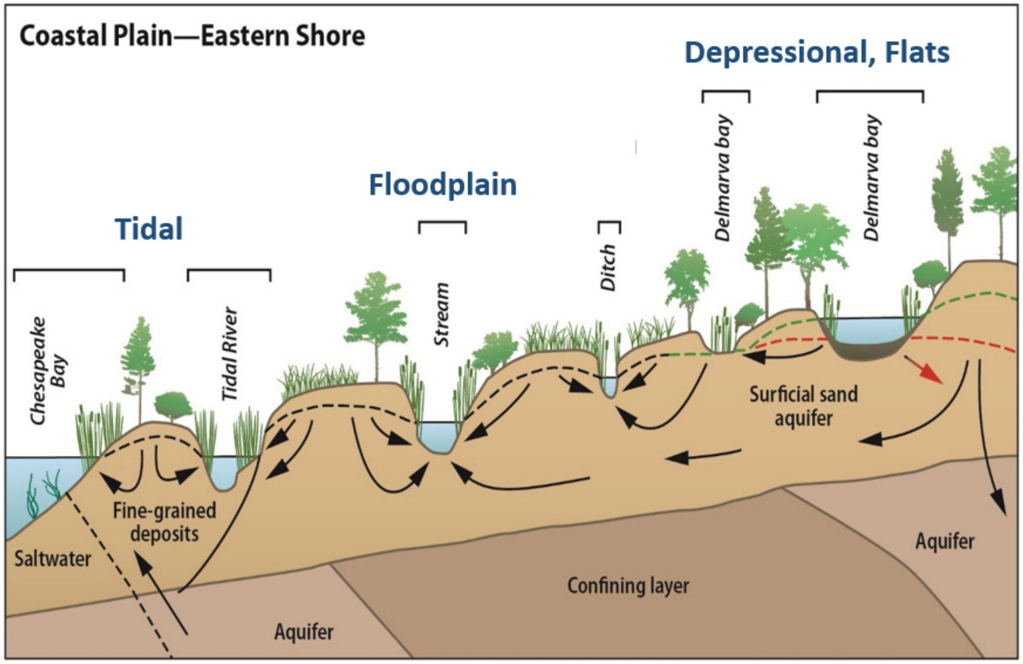


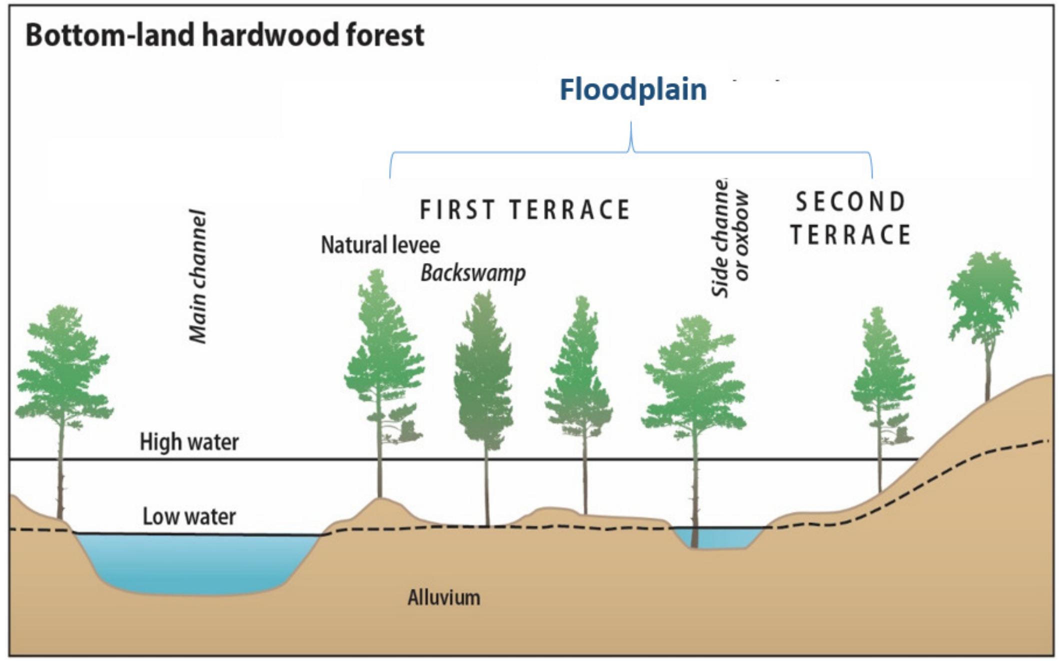
Modified from Nutter, L.J., 1974a, Hydrogeology of Antietam Creek Basin: U.S. Geological Survey Journal of Research, v. 2, p. †249-252.



Modified from Fretwell et al 1996. National Water Summary on Wetland Resources. USGS Water-Supply Paper 2425.

Coastal Plain





Wetland WQ Function: Initial Concentration

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f(impacted acres and wetland hydrologic connectivity)

Physiographic Province	Other Wetlands			Floodplain Wetlands
	Flats	Depressional Wetlands	Sloping Wetlands	
Appalachian Plateau		L – variability in hydrologic settings & predominant forest cover	L – confined aquifer discharge not likely contaminated	L - predominant forest cover and greater likelihood of hyporheic exchange rather than wetland discharge
Appalachian Ridge & Valley		L – small contributing area; predominant forest cover	L – confined aquifer discharge not likely contaminated; predominant forest cover	L - predominant forest cover and greater likelihood of hyporheic exchange rather than wetland discharge
Blue Ridge		L – small contributing area; predominant forest cover	H - Surficial aquifer and heavy human impacts	M – Incised, more infrequent events; potential deep aquifer by-pass
Piedmont			M - Surficial aquifer and heavy human impacts	M – Incised, more infrequent events; potential deep aquifer by-pass
Inner Coastal Plain			H - Surficial aquifer and heavy human impacts	H – well connected, more frequently flooded
Outer Coastal Plain - Poorly drained uplands	L – small contributing area; flat hydraulic gradient predominant forest cover	L – small contributing area; flat hydraulic gradient predominant forest cover	M – Small contributing area, but surficial aquifer important and heavily influenced by human impacts	M – well connected, frequently flooded but potentially limited exchange due to flat hydraulic gradients
Outer Coastal Plain - - Well drained uplands			L – Deep aquifers with strong potential to bypass contaminated waters	H – well connected, more frequently flooded
Coastal Plain Lowlands	L – small contributing area; flat hydraulic gradient predominant forest cover		H – well connected, more frequently flooded	M – well connected, frequently flooded but potentially limited exchange due to flat hydraulic gradients
Karst terrain* - Appalachian Plateau - Appalachian Ridge & Valley - Blue Ridge & Valley		H – Strong potential for contaminated discharge.	M – Strong potential for contaminated discharge, but potential for rapid flow-through & short contact time	L/M – see floodplain descriptions above, respectively

Wetland WQ Function: Initial Concentration ~ f(impacted acres and wetland hydrologic connectivity)

Physiographic Province	Other Wetlands	Floodplain Wetlands
Appalachian Plateau	1	2
Appalachian Ridge & Valley	1	2
Blue Ridge	2	3
Piedmont	2	3
Inner Coastal Plain	4	6
Outer Coastal Plain - Poorly drained uplands	1	2
Outer Coastal Plain - - Well drained uplands	2	3
Coastal Plain Lowlands	2	3
Karst terrain* - Appalachian Plateau - Appalachian Ridge & Valley - Blue Ridge & Valley	2	3

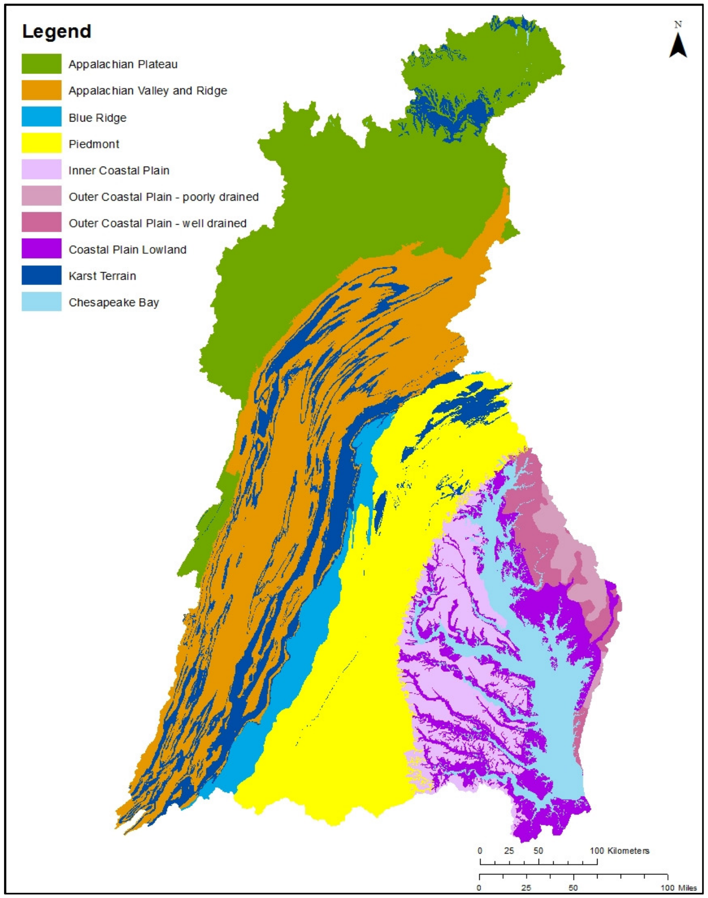
- Other wetlands with low treatment potential due to small contributing area predominanted by forest and/or strong potential for contaminated water to by-pass the wetlands: 1 ACRE
- Other wetlands with high treatment potential, located in heavily impacted watersheds and having strong likelihood for hydrologic contact: 4 ACRES
- All other wetlands: 2 ACRES
- Floodplain wetlands with additional overbank delivery: 150% of Other

Wetland WQ Function: Initial Concentration ~ f(impacted acres and wetland hydrologic connectivity)

Physiographic Province	Other Wetlands	Floodplain Wetlands	Lowrance et al 1997 TN, TP, TSS
Appalachian Plateau	1	2	
Appalachian Ridge & Valley	1	2	Sandstone/shale: M/H, H/M, M/L Valleys: MH, H/M, M/L
Blue Ridge	2	3	
Piedmont	2	3	Thin Soils, Shales: H, H/M, M/L Schist/Gneiss: M, H/M, M/L
Inner Coastal Plain	4	6	H,H/M, M/L
Outer Coastal Plain - Poorly drained uplands	1	2	M/H, H/M, M/L
Outer Coastal Plain - - Well drained uplands	2	3	L, H/M, M/L
Coastal Plain Lowlands	2	3	L/M, H/M, M/L
Karst terrain* - Appalachian Plateau - Appalachian Ridge & Valley - Blue Ridge & Valley	2	3	L, H/M, M/L

Physiographic subregions for non-tidal wetland restoration

Physiographic Subregion described by panel	**Watershed Model HGMR(s)**
Appalachian Plateau	Appalachian Plateau Siliciclastic
Appalachian Ridge and Valley	Valley and Ridge Siliciclastic
Blue Ridge	Blue Ridge
Piedmont	Piedmont Crystalline Mesozoic Lowlands
Inner Coastal Plain	Western Shore: Coastal Plain Uplands Coastal Plain Dissected Uplands
Outer Coastal Plain- Poorly Drained	Eastern Shore: Coastal Plain Uplands
Outer Coastal Plain- Well Drained	Eastern Shore: Coastal Plain Dissected Uplands
Coastal Plain Lowland	Coastal Plain Lowlands
Karst Terrain	Piedmont Carbonate Valley and Ridge Carbonate Appalachian Plateau Carbonate



Summary of Proposed Wetland BMP Function across the Chesapeake Bay Watershed

	% Efficiency			Upland Acres Treated		Watershed Model HGMR
Physiographic Province	**TN**	**TP**	**TSS**	**Other Wetlands**	**Floodplain Wetlands**	
Appalachian Plateau	**42**	**40**	**31**	**1**	**2**	Appalachian Plateau Siliciclastic
Appalachian Ridge and Valley				**1**	**2**	Valley and Ridge Siliciclastic
Blue Ridge				**2**	**3**	Blue Ridge
Piedmont				**2**	**3**	Piedmont Crystalline Mesozoic Lowlands
Inner Coastal Plain				**4**	**6**	Western Shore: Coastal Plain Uplands Coastal Plain Dissected Uplands
Outer Coastal Plain- Poorly Drained				**1**	**2**	Eastern Shore: Coastal Plain Uplands
Outer Coastal Plain- Well Drained				**2**	**3**	Eastern Shore: Coastal Plain Dissected Uplands
Coastal Plain Lowland				**2**	**3**	Coastal Plain Lowlands
Karst Terrain				**2**	**3**	Piedmont Carbonate Valley and Ridge Carbonate Appalachian Plateau Carbonate

Reporting, tracking and verification

- Wetland Workgroup developed flowcharts for each of the five states for wetland restoration reporting

- Each year, the NEIEN coordinator for each state will compile this information and submit it to Chesapeake Bay Program

- Installing entity must keep records of all wetland restoration projects and perform initial verification that project was installed to design specifications

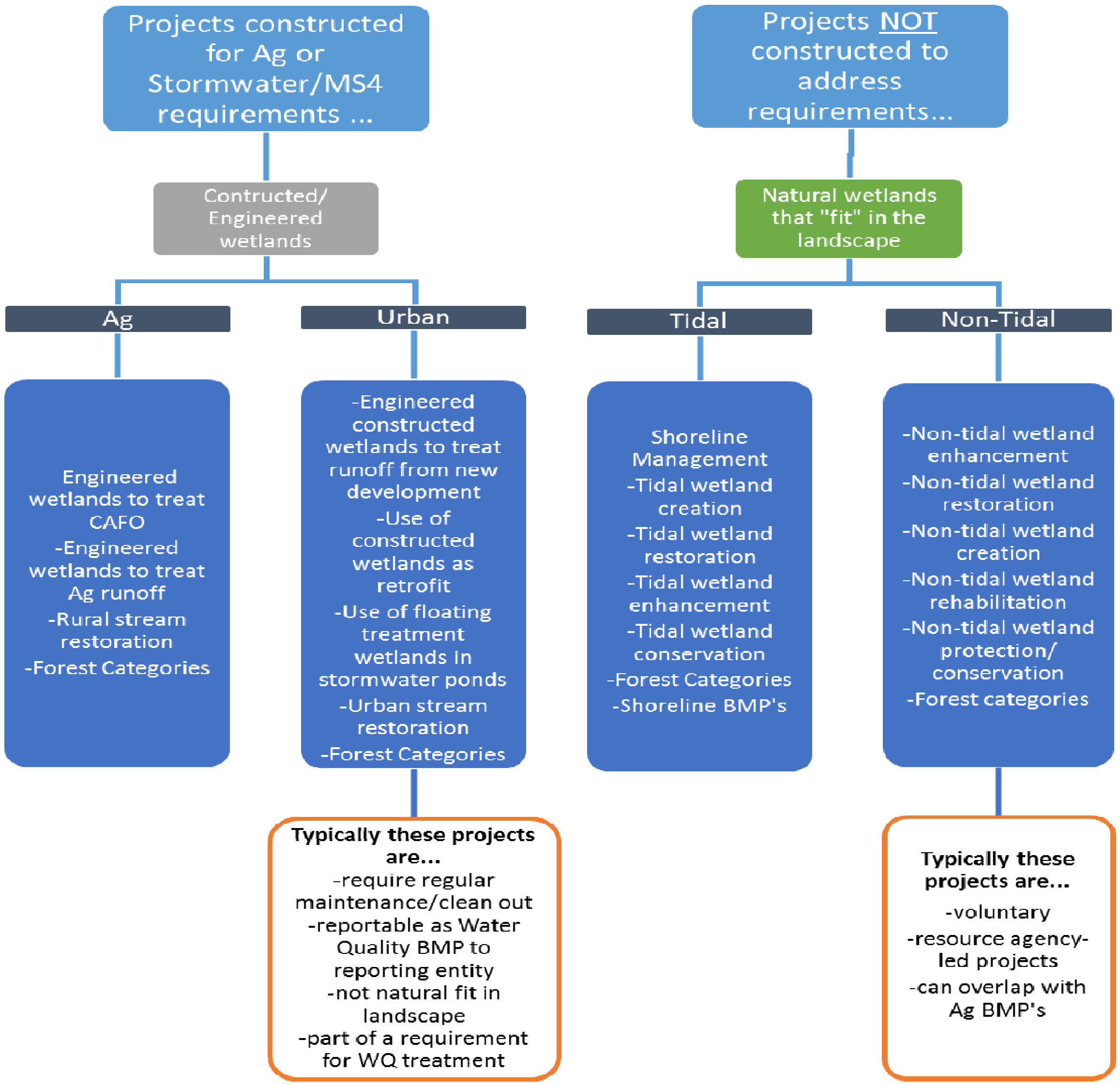
Updates to NEIEN Reporting

- NEIEN has been updated for Phase 6 to reflect the 4 categories of wetland BMPs. Appendix C provides more information for NEIEN reporting.
    1. Acreage gain – Reestablishment
    2. Acreage gain – Establishment
    3. Functional gain – Enhancement
    4. Functional gain – Rehabilitation

- State databases must be also be updated to accommodate the enhancement and rehabilitation categories

Verification

- Verification is required to ensure wetland restoration projects are performing as designed.
- Initial verification – as-built survey
- Onsite monitoring for 3 years following construction is recommended.
  - Vegetation, hydrology, soils
- Aerial imagery/remote observations for long-term monitoring
- Existing BMP verification guidance for wetlands is available online as part of the CBP's adopted BMP Verification Framework at: http://www.chesapeakebay.net/about/programs/bmp/verification_guidance



Projects constructed for Ag or Stormwater/MS4 requirements ...
Contructed/ Engineered wetlands
Ag
Urban
Engineered wetlands to treat CAFO
-Engineered wetlands to treat Ag runoff
-Rural stream restoration
-Forest Categories
-Engineered constructed wetlands to treat runoff from new development
-Use of constructed wetlands as retrofit
-Use of floating treatment wetlands in stormwater ponds
-Urban stream restoration
-Forest Categories
Typically these projects are...
-require regular maintenance/clean out
-reportable as Water Quality BMP to reporting entity
-not natural fit in landscape
-part of a requirement for WQ treatment
Projects NOT constructed to address requirements...
Natural wetlands that "fit" in the landscape
Tidal
Non-Tidal
Shoreline Management
-Tidal wetland creation
-Tidal wetland restoration
-Tidal wetland enhancement
-Tidal wetland conservation
-Forest Categories
-Shoreline BMP's
-Non-tidal wetland enhancement
-Non-tidal wetland restoration
-Non-tidal wetland creation
-Non-tidal wetland rehabilitation
-Non-tidal wetland protection/ conservation
-Forest categories
Typically these projects are...
-voluntary
-resource agency-led projects
-can overlap with Ag BMP's

Potential ancillary benefits or unintended consequences

- There are numerous benefits associated with wetlands and wetland restoration beyond their ability to reduce nutrients and sediment:
  - Vital habitats for waterfowl, fish, other animals and plants
  - Flood control, water storage, storm abatement and aquifer recharge
  - Carbon sequestration, reduction of toxic pollutants
- While many benefits are possible, these practices should not be implemented at sites with existing high quality habitat resources, nor should high quality wetlands be converted or altered for sake of nutrient and sediment reductions in the modeling tools.
- There are federal, state and local requirements that minimize risk of extraneous wetland BMPs, but practitioners and other stakeholders should not take such safeguards for granted on assumption.

Potential ancillary benefits or unintended consequences (continued)

- It should also be emphasized that the panel's recommended effectiveness estimates for nitrogen, phosphorus and sediment – and ratios of upland acres treated – have associated uncertainty. The same can be said for other BMPs used for annual progress reporting.
- Comparisons and decisions between selection of BMPs for implementation at specific sites – for example, between riparian forest buffer or wetland restoration – should carefully consider more factors than the current TN, TP and TSS reductions in the modeling tools alone. Reflection on not only other possible habitat benefits or costs, but also risks for unintended negative consequences and the uncertainty in the current science for the BMP that may warrant revisions to the effectiveness estimates in future years.

Future research or management needs

1. Promote standardized approach to monitoring wetland function and measuring retention efficiencies based on wetland type, location, and condition.
2. Improve understanding (and mapping) of subsurface features that affect near-surface groundwater transport in different hydrogeologic settings of the Chesapeake Bay Watershed.
3. Explore the use of the SPARROW model (and others) to assess the overall role and magnitude of impact that existing wetlands have at the watershed scale. Such an analysis would serve as an informative next step toward understanding the effect of wetlands as sources, sinks, or both across the Chesapeake Bay region, as well as providing a comparison with forest land.

    Explore refining (floodplain and other) wetland loading rates.

Future research or management needs

4. Develop or enhance accounting systems/tools that better capture the multiple co-benefits of wetland practices (and other BMPs).
5. Given need for practitioners to assess and select BMP practices to address their interests and needs, and the potential confusion caused of the plethora of possible practices, the panel recommends development of materials to further clarify selection and use of the CBP approved practices for reporting purposes.

Timeline

- **Tuesday November 22:** Report released for expedited review and comment
- **Friday December 2, 10:00AM-12:00PM:** This webinar.
- **Wednesday December 7:** Comments and feedback on the report are due to Jeremy Hanson by COB. Email written comments to jchanson@vt.edu. Email or call with questions (410-267-5753).
- **Tuesday, December 13, 1:00-3:00PM**: **Wetland Workgroup**, **joined by Watershed Technical Workgroup**. Present and discuss comments received and revisions made to report; seek Wetland Workgroup approval followed by seeking Watershed Technical Workgroup approval.
- **Thursday, December 15**: Agriculture Workgroup (Tentative, not confirmed). Informational briefing and discussion of recommendations for AgWG.
- **Monday, December 19, 10:00AM-3:00PM**: Water Quality Goal Implementation Team, joined by Habitat Goal Implementation Team. Seek WQGIT and HGIT approval of report.



Questions?

Photos by the Chesapeake Bay Program
http://www.flickr.com/photos/29388462@N06/sets/

Thank you for participating!

Contact Jeremy with any questions or comments on the report by close of business, December 7th

jchanson@vt.edu

410-267-5753

Recording and other information can be found on the CBP calendar:

http://www.chesapeakebay.net/calendar/event/24625/