Photo Credit: H. Stevens http://ian.umces.edu/imagelibrary/

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Advancing Monitoring Programs to Guide Land Management in the Chesapeake Bay Watershed

- **Before-After-Control Impact studies**
  - Requires long-term data sets
  - Lag time challenges
- **Paired watershed studies**
  - Difficult to find study pairs with and without conservation practices
- **Empirical watershed studies**
  - Large number of watershed required

✖ **Site studies of conservation practice performance**

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Discussion Roadmap

- TNC Mission, Bay watershed projects
- Adaptive Water Resource Management
  - Example: Pocomoke River Watershed

Integrated site studies… we can (must) do it!

The mission of The Nature Conservancy is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.

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TNC in the Chesapeake Bay Watershed

- Protect healthy waters across the Chesapeake watershed
- Enhance and expand priority habitats (e.g., oyster reefs)
- **Improve agricultural nutrient and sediment mitigation**

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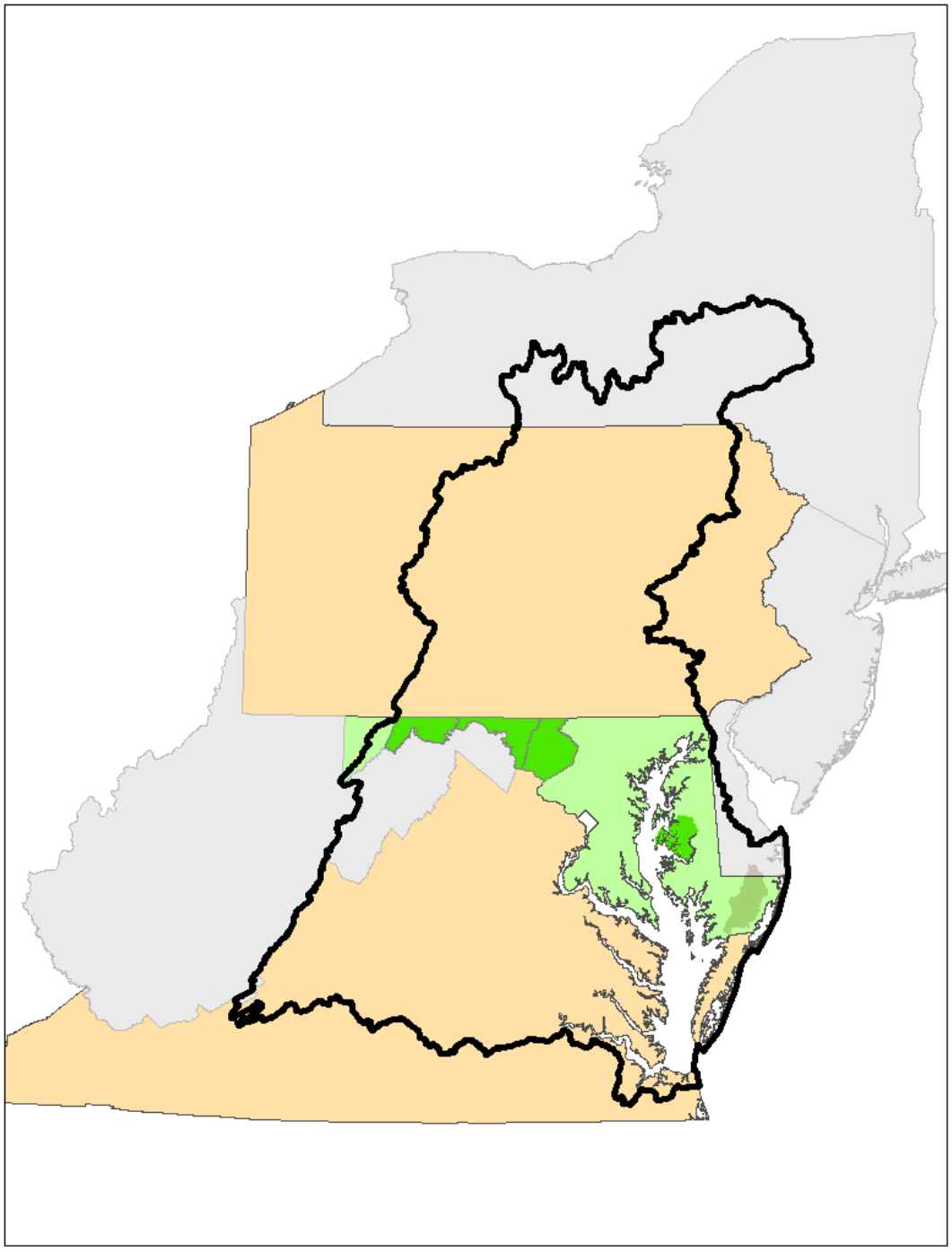
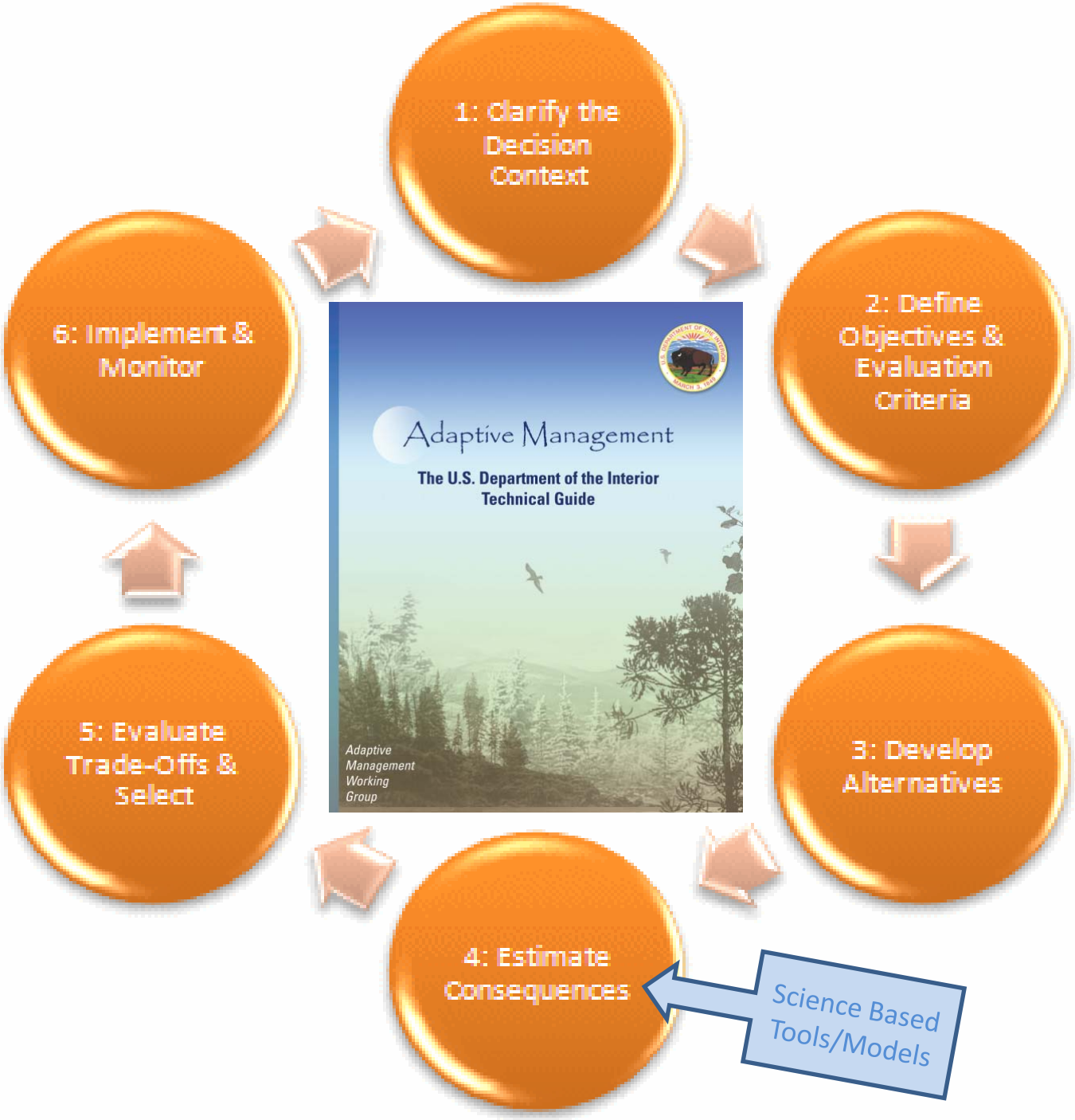
TNC Ag Restoration in the Chesapeake Bay Watershed: Where we work



Adaptive Management



Ag Targeting Goals:

- Improve water quality
- Improve habitat quality
- Biggest return on investment
- Mitigate (not eliminate) stressors
- *Overtime*, improve capacity to manage resources

Photo Credit: H. Stevens http://ian.umces.edu/imagelibrary/

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Chesapeake Bay Watershed Restoration Project

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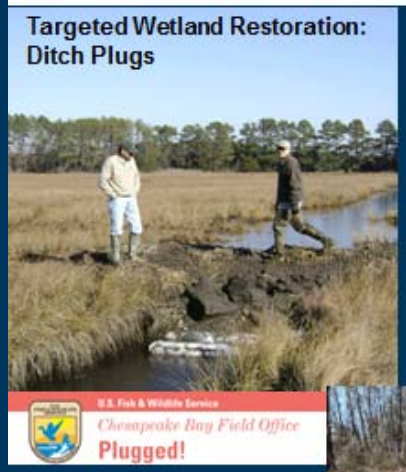
BMP Targeting and Prioritization



	Mass TN removed	Mass TP removed	Mass TSS removed	Farm Acres Lost	?Habitat Acres?	Cost
Target Wetland Restoration						
Floodplain Reconnection						
Terraced Buffers						
Combination						

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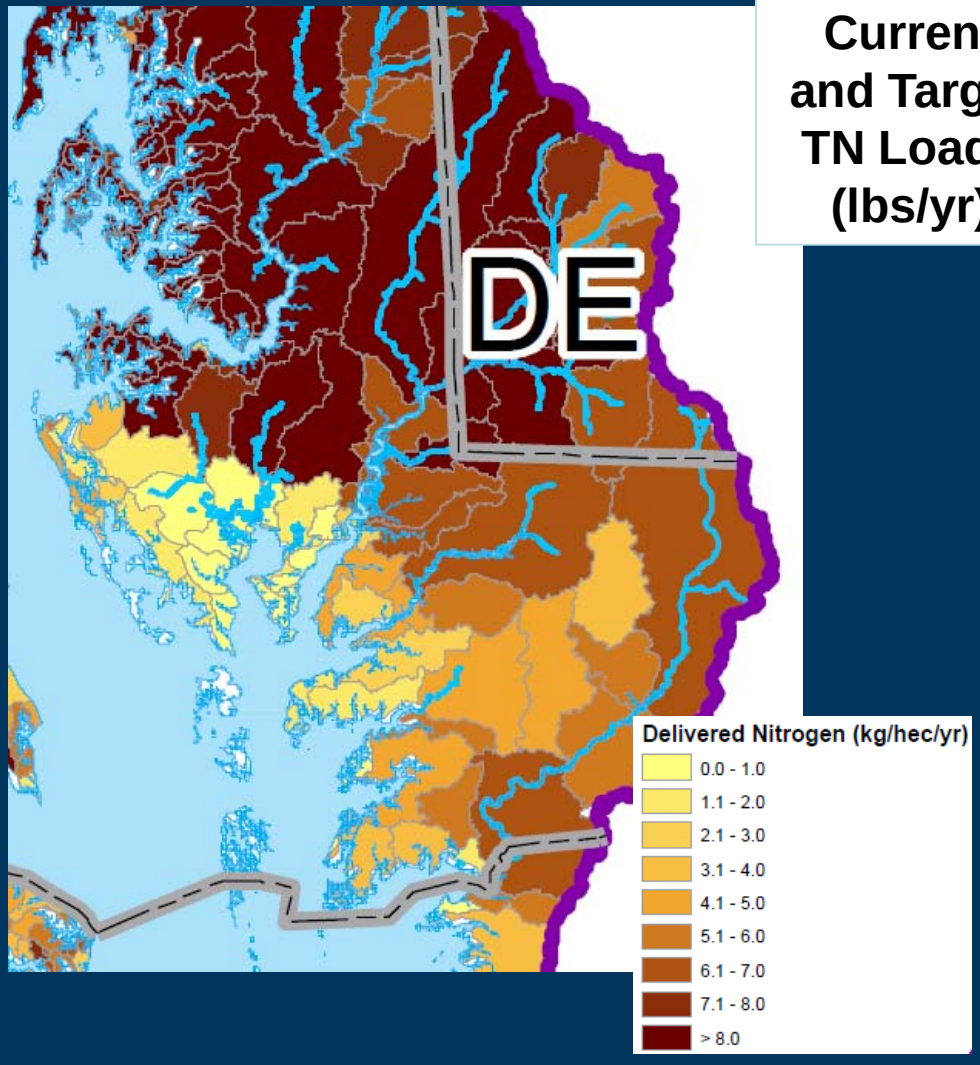
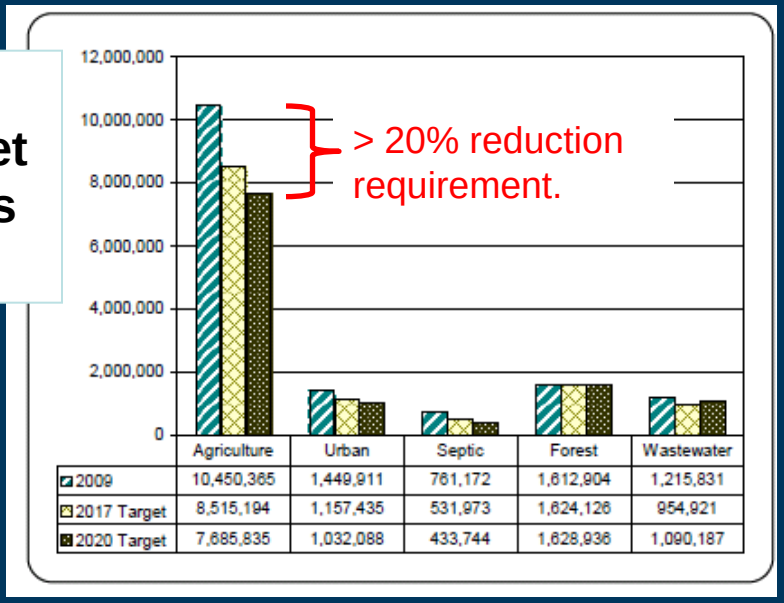
Science Challenge: Provide science-based tools (which can be tested and improved) to guide bmp placement and design.



Current and Target TN Loads (lbs/yr)



	Agriculture	Urban	Septic	Forest	Wastewater
2009	10,450,365	1,449,911	761,172	1,612,904	1,215,831
2017 Target	8,515,194	1,157,435	531,973	1,624,126	954,921
2020 Target	7,685,835	1,032,088	433,744	1,628,936	1,090,187

Additional Model Needs:

- Simple (Enhances landowner buy-in)
- Compliments or links to CBP-HSPF Model

http://www.chesapeakebay.net/maps/map/delivered_yield_of_total_nitrogen_agricultural_sources

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BMP Implementation Challenge:
Where, What, How Much?

Conceptual Approach:

I. Identify Opportunities

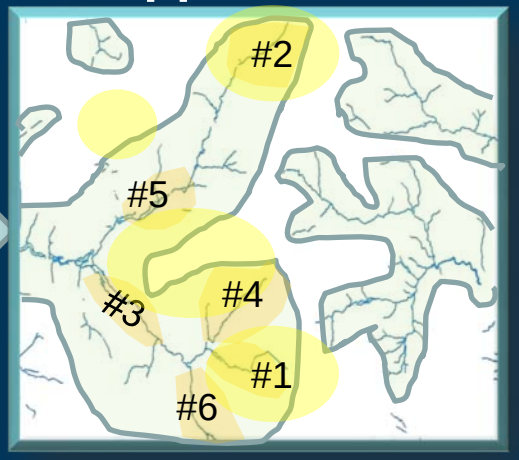
Restorable Ecohydrological Active Areas

II. Compare Opportunities

Potential Priority Criteria:

- Nutrient Sources
- Sediment Sources
- Habitat Quality
- County Access
- Landowner Cooperation
- Soil Fertility
- Cost

III. Rank Opportunities



Results:
Ranked/Summed opportunities to maximize return on $$ invested to install bmp's and provide services.

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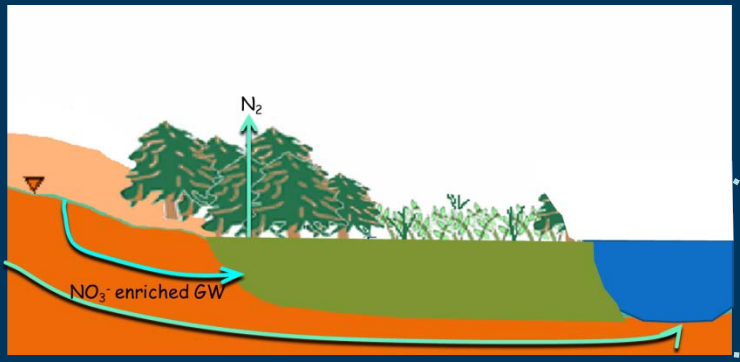
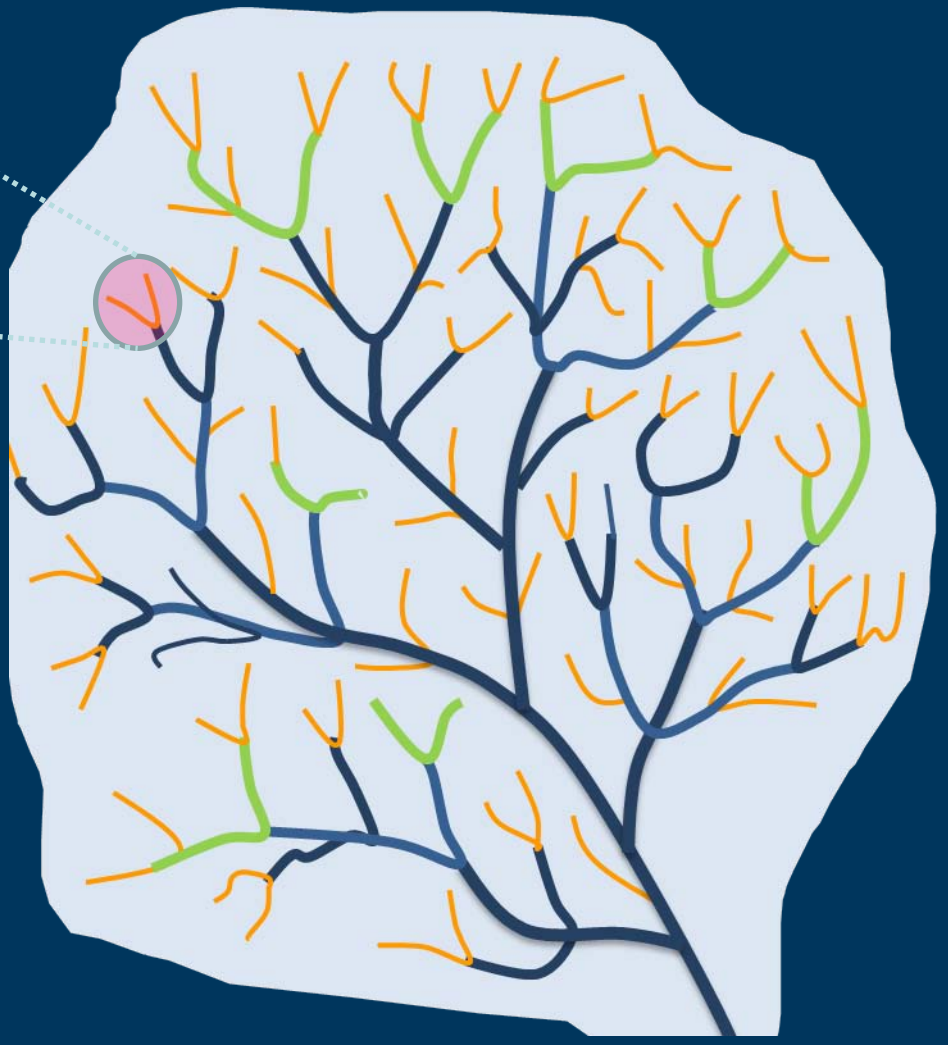
Targeting Tools

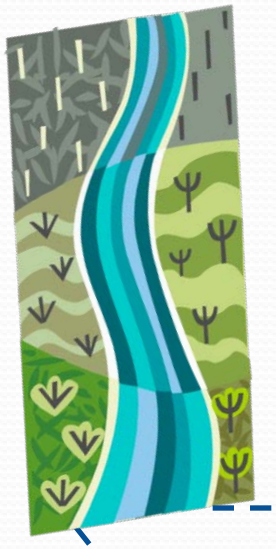




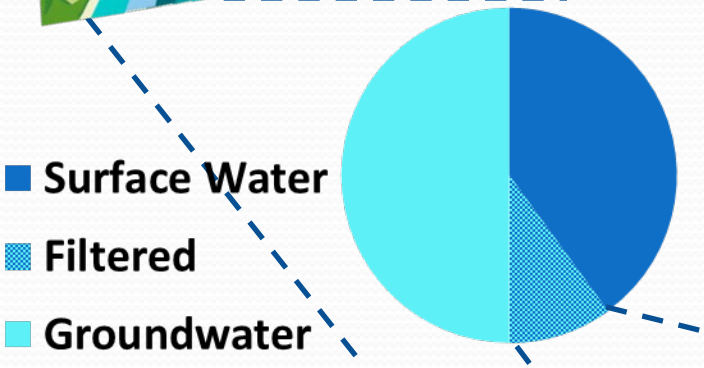
Key Decisions:

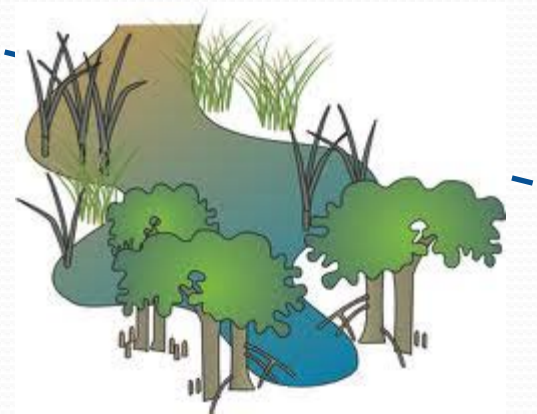
- Where should we target BMPs?
- What is the best BMP designs?
- How much do we need to manage?

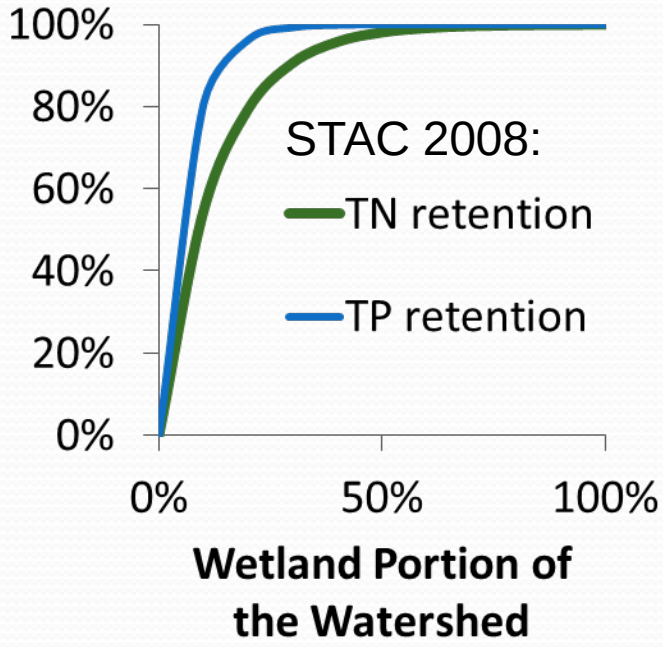
CBP-HSPF Watershed Model



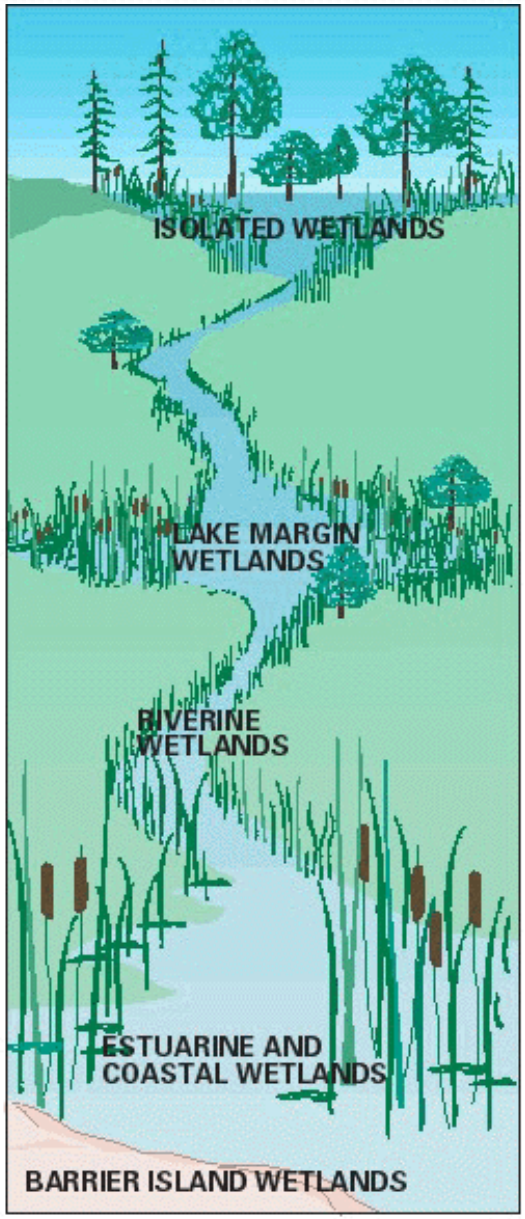
Predicted Stream Water Budget





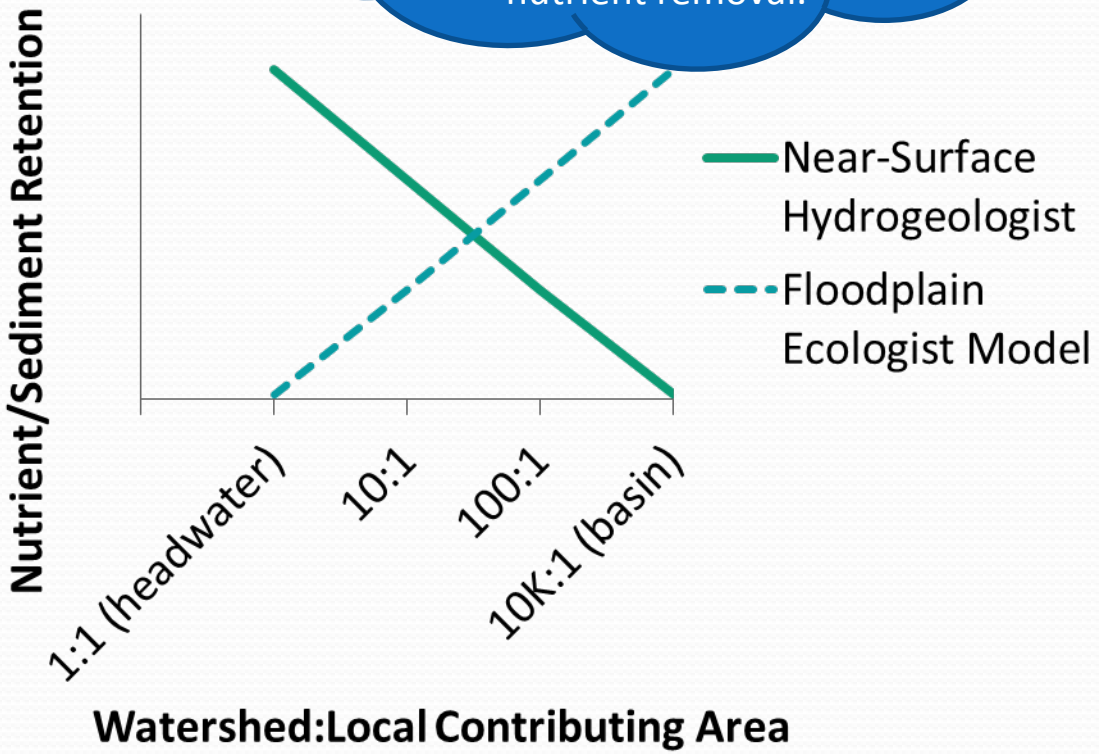


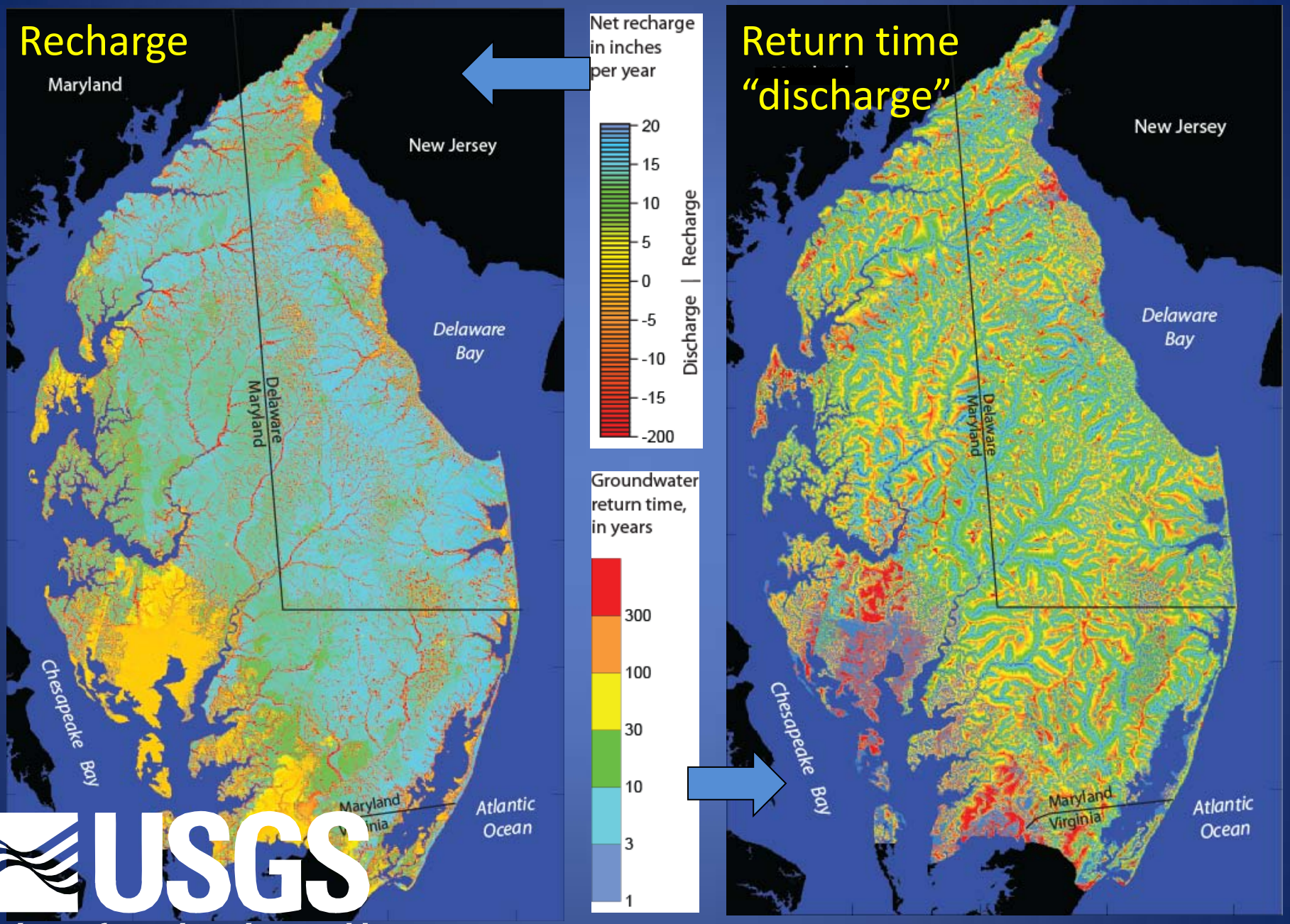
Wetlands: Nutrient & Sediment Sinks



Environmental Law Institute 1983; Brinson 1993

STAC 2008: Removal efficiencies decrease with increased variability of water flow, but floodplains offer best opportunities for nutrient removal.





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BMP Implementation Challenge:
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- Landowner Cooperation
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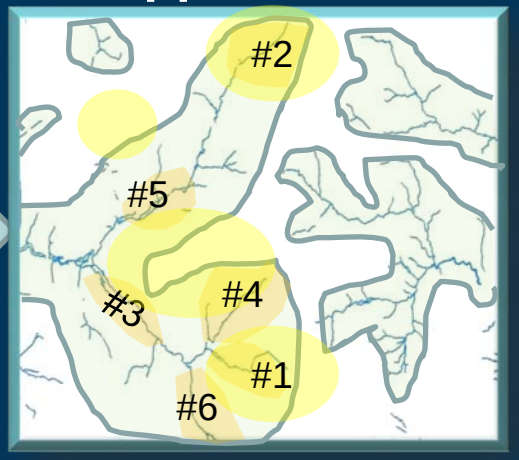
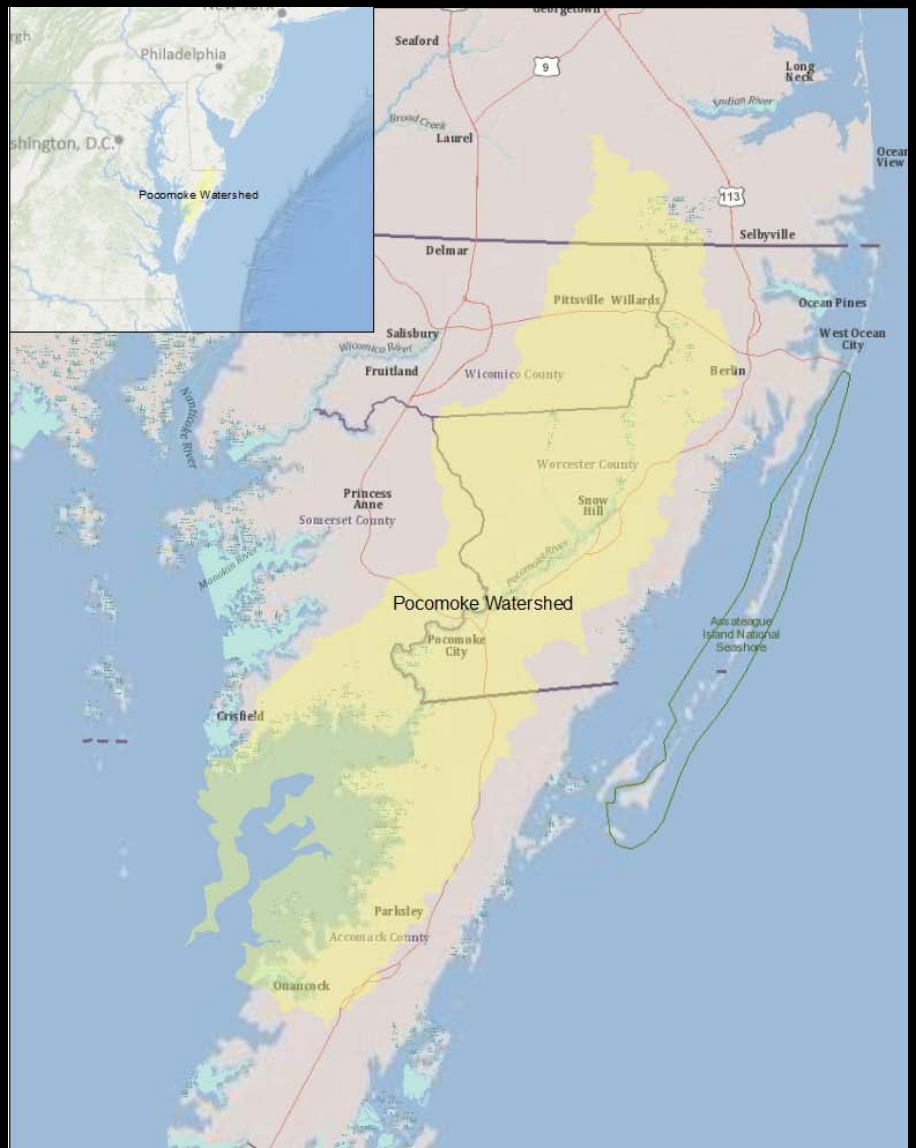


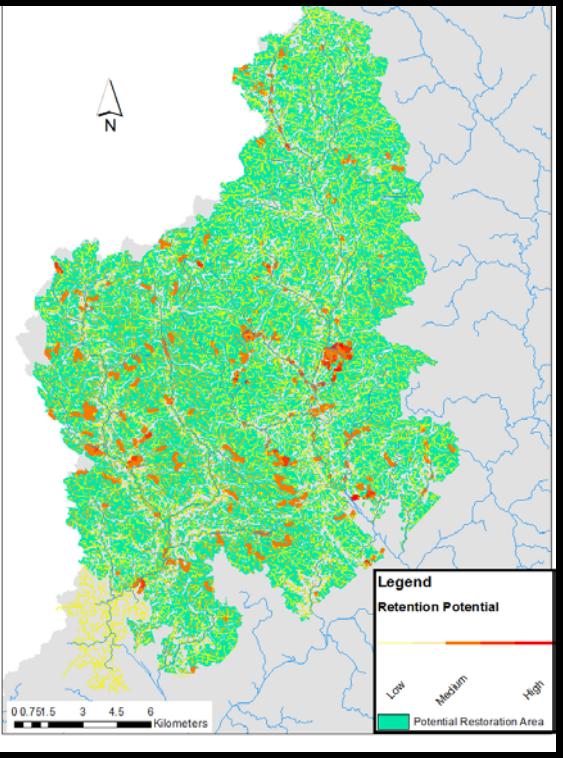
Results:
Ranked/Summed opportunities to maximize return on $$ invested to install bmp's and provide services.

Adaptive Management of Surface Water Resources in the Pocomoke River Watershed

- Identify and prioritize wetland restorations to improve water quality
- Develop landowner incentives and implement projects
- Initiate monitoring program to evaluate bmp and targeting tool performance



Identification and Prioritization of Potential Restoration Projects in the Pocomoke River Watershed



outcomes.xlsx - Microsoft Excel

File | Home | Insert | Page Layout | Formulas | Data | Review | View

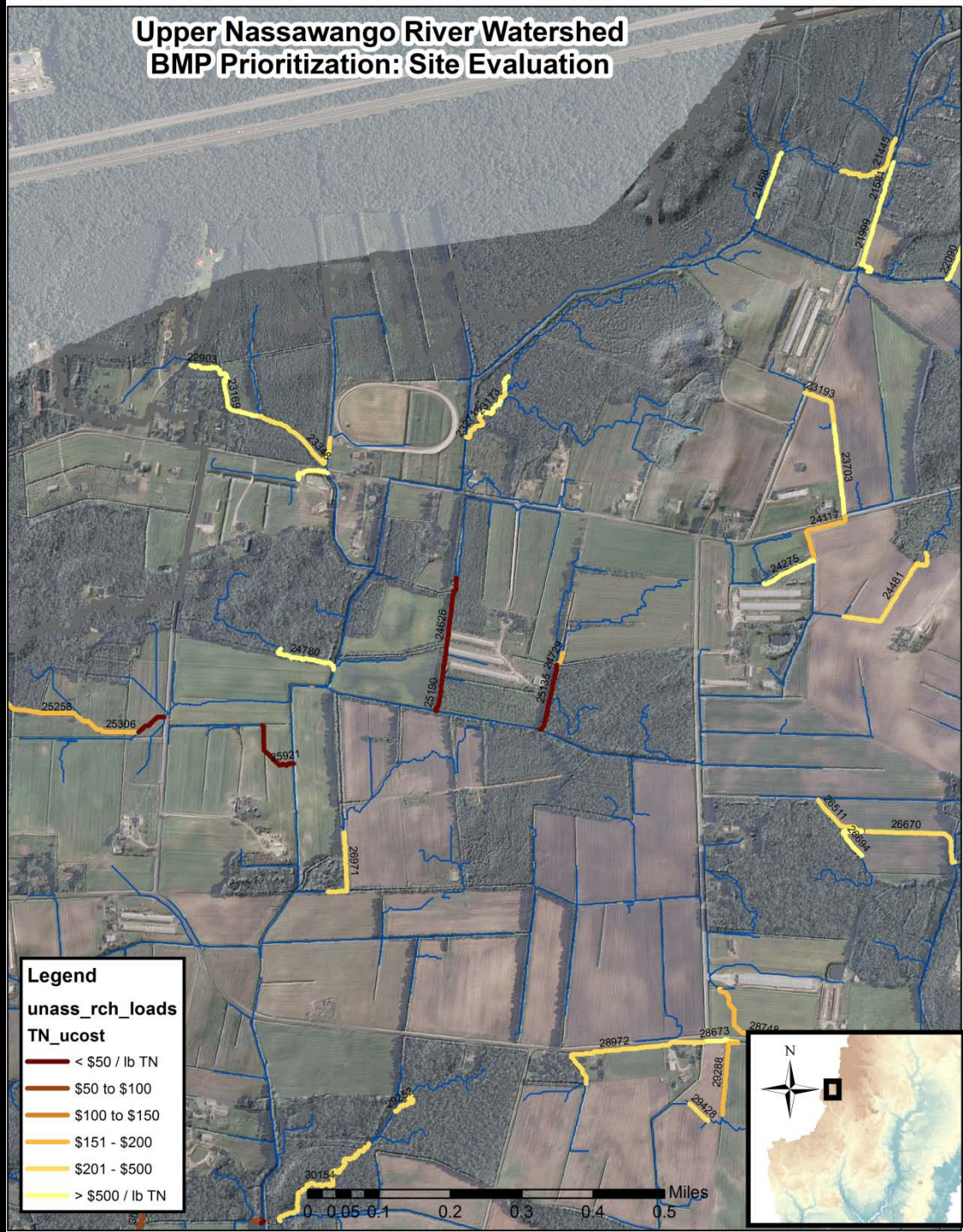
M5: 285

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Reach	Subbasin	Reach Length (ft)	Watershed Area (acres)	Retention Area (acres)	Restoration Type	Number of Owners	EOS TN (lbs/yr)	TN captured (lbs/yr)	EOS TP (lbs/yr)	TP captured (lbs/yr)	EOS TSS (lbs/yr)	TSS captured (lbs/yr)	Cost
2	6297	Nass	266	749.64	19.36	buffer	1	212,264	39,177	32,779	11,318	144,877	3,449	$104,544
3	6588	Nass	1043	28.88	5.58	plug	1	78,430	61,379	12,501	11,975	6,187	717	$3,232
4	6592	Nass	1260	292.3	6.31	buffer	1	193,895	30,415	30,546	9,111	47,800	662	$34,074
5	7232	Nass	492	85.19	2.82	buffer	1	140,458	32,306	22,332	9,352	15,881	285	$15,228
6	10123	Nass	1053	79.63	7.53	buffer	1	53,676	28,240	8,463	6,667	7,860	952	$40,662
7	6621	Nass	541	16.91	2.69	plug	1	45,920	32,842	7,319	6,779	3,622	346	$2,076
8	6685	Nass	669	213.19	3.91	buffer	1	187,775	25,308	29,688	7,706	27,376	398	$21,114
9	6796	Nass	164	10.99	10.91	plug	2	29,836	29,825	4,756	4,756	2,354	1,402	$5,364
10	6853	Nass	371	64.17	10.99	plug	1	35,353	26,218	5,550	5,216	10,176	1,180	$5,396
11	7521	Nass	285	211.73	57.31	buffer	3	2,573	2,270	79	78	49,722	6,616	$309,474
12	7146	Nass	318	34.26	7.57	plug	1	34,858	28,779	5,521	5,373	5,950	737	$4,028
13	7187	Nass	407	45.05	1.44	plug	1	105,532	23,529	16,810	6,853	9,050	158	$1,576
14	7401	Nass	640	60.82	11.55	plug	1	26,339	20,464	4,126	3,943	22,042	1,827	$5,620
15	6724	Nass	75	198.94	3.76	buffer	1	149,089	20,660	23,522	6,264	24,324	379	$20,304
16	10091	Nass	279	15.17	4.18	plug	1	32,188	28,537	5,125	5,069	2,535	239	$2,672
17	6881	Nass	561	9.43	5.96	plug	1	25,598	25,424	4,080	4,080	2,019	766	$3,384

outcomes | outcomes (2) | Sheet2

Ready

Identification and Prioritization of Potential Restoration Projects in the Pocomoke River Watershed



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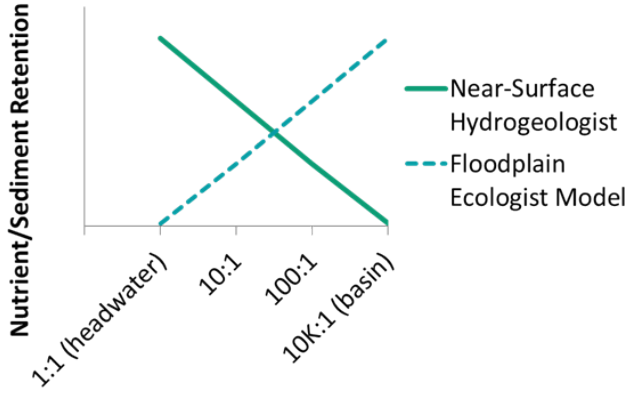
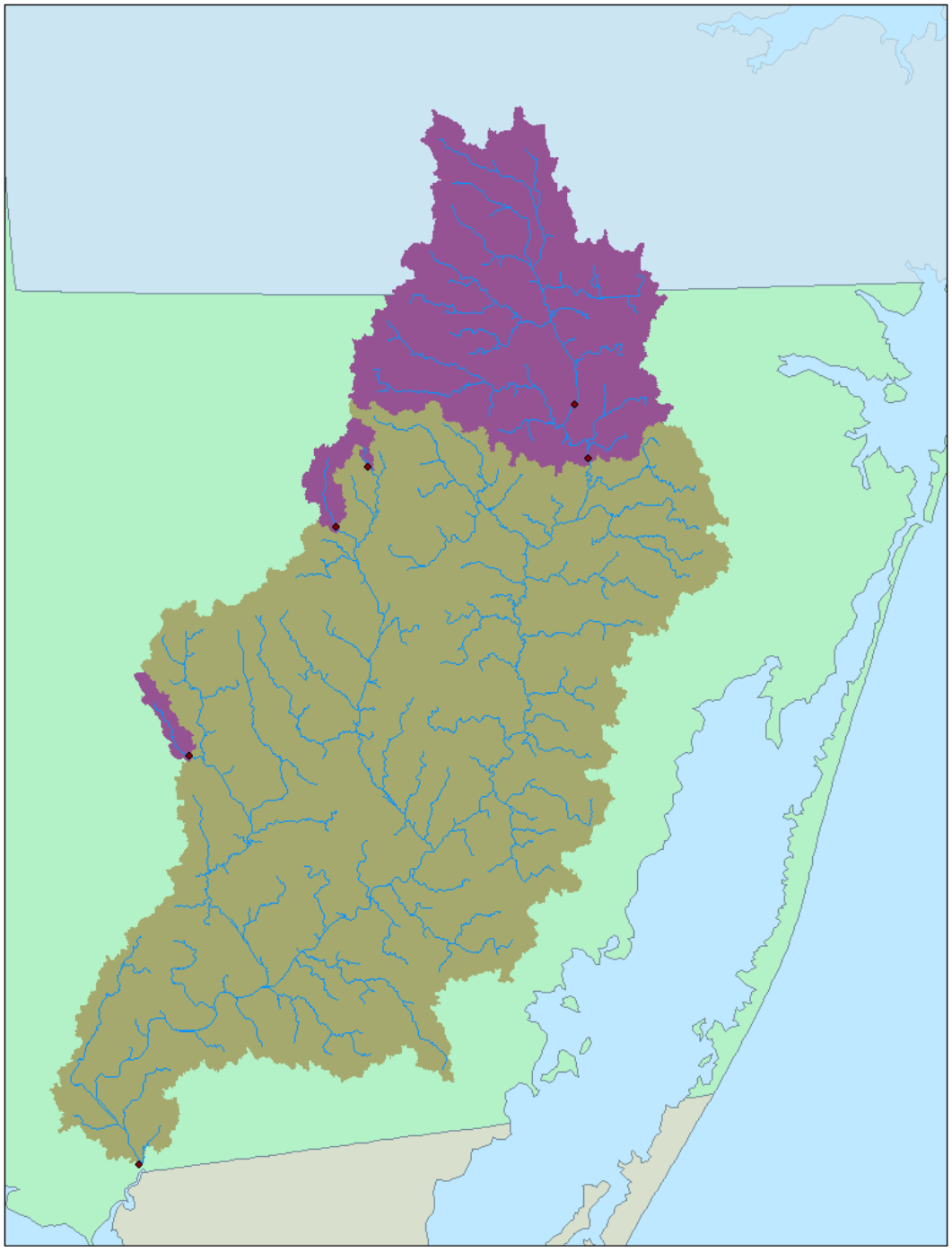
Example:

Pocomoke River Restoration





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Developing Monitoring Plans: Conceptual Guidance

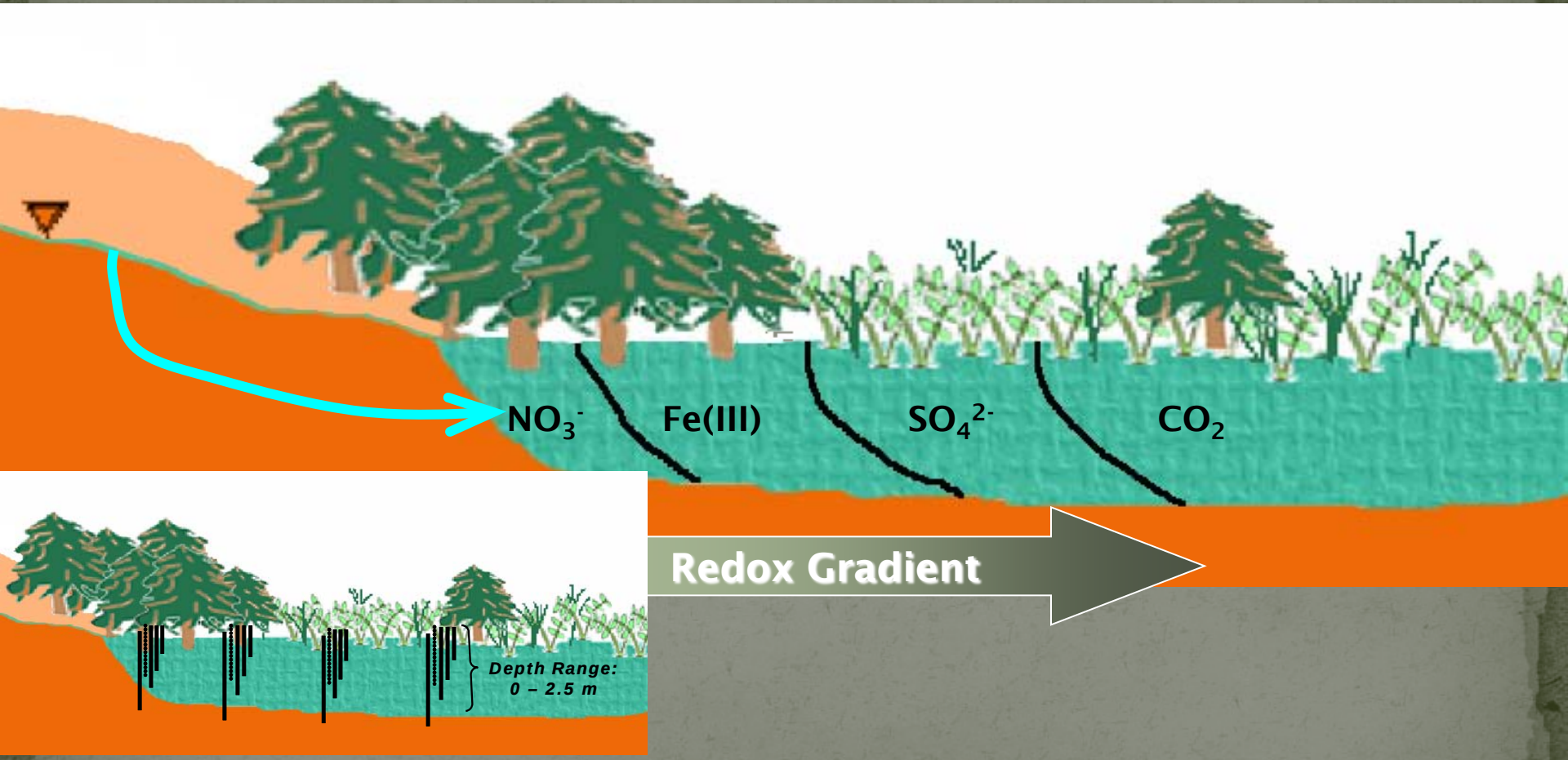
Example from TNC & Partners:

Understanding Variation in Ag BMP Performance

1. Develop site-scaled conceptual model (consistent with watershed assumptions)
2. Monitor to evaluate expectations
   - Measure hydrologic fluxes
     (Hydraulic gradients, conductivity)
   - Relate hydochemical gradients
     (Major ion chemistry and constituents of concern)

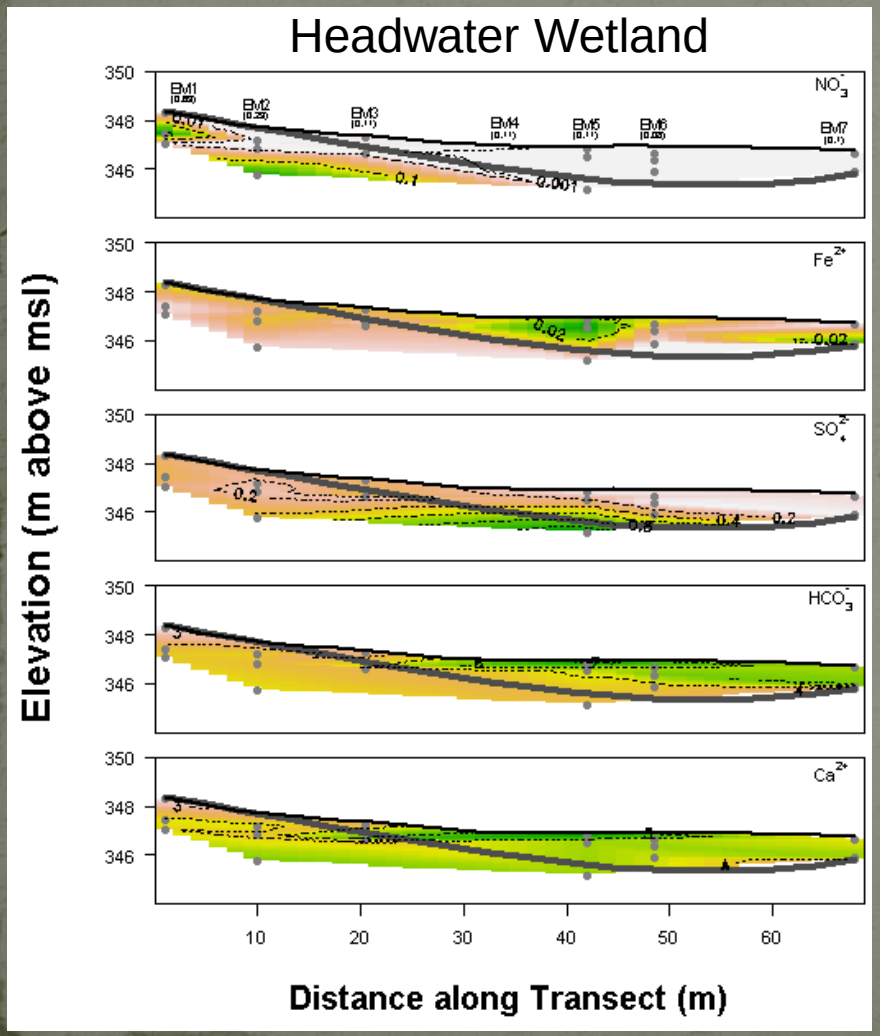
Results indicate transport times, biogeochemical processing, and bmp filtering effects.

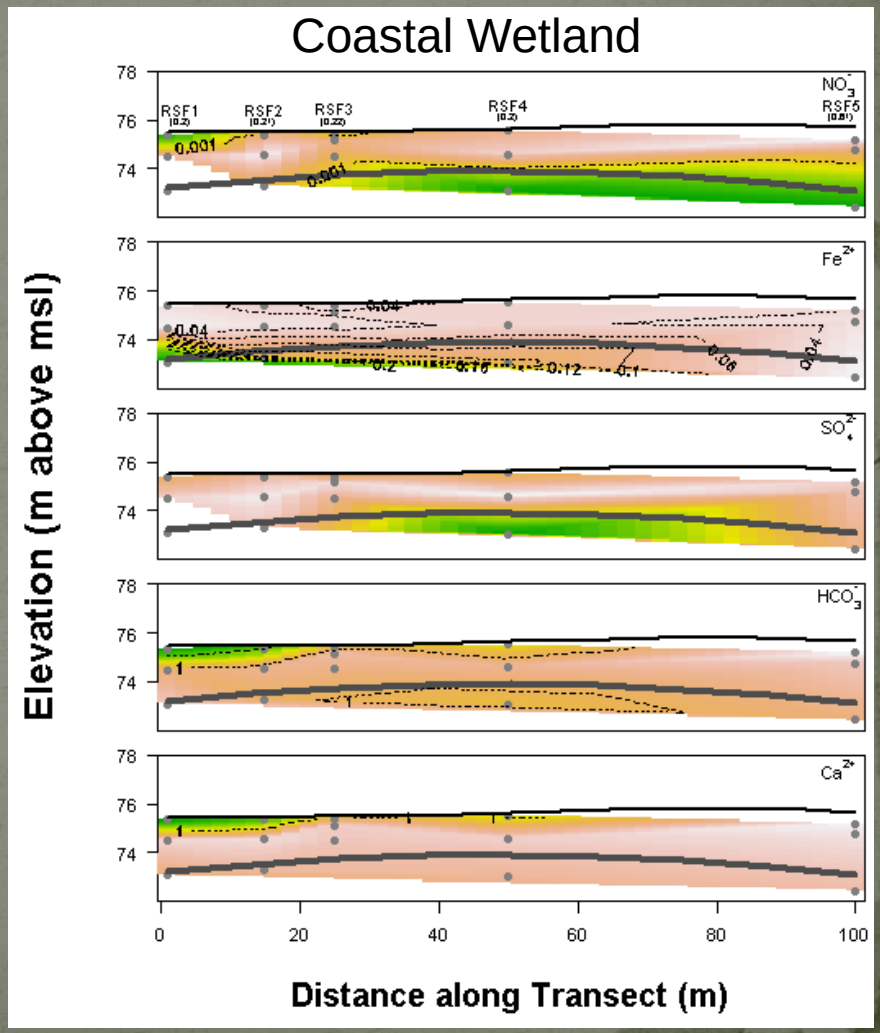
Ground-Water Effects on Plant Nutrient Availability in Wetlands



Dotted vertical bars indicate water table wells. Solid vertical bars indicate piezometers with 15 cm screens.

Hydrochemical (Redox) Gradients Linked to Wetland Hydrology





Boomer & Bedford 2008

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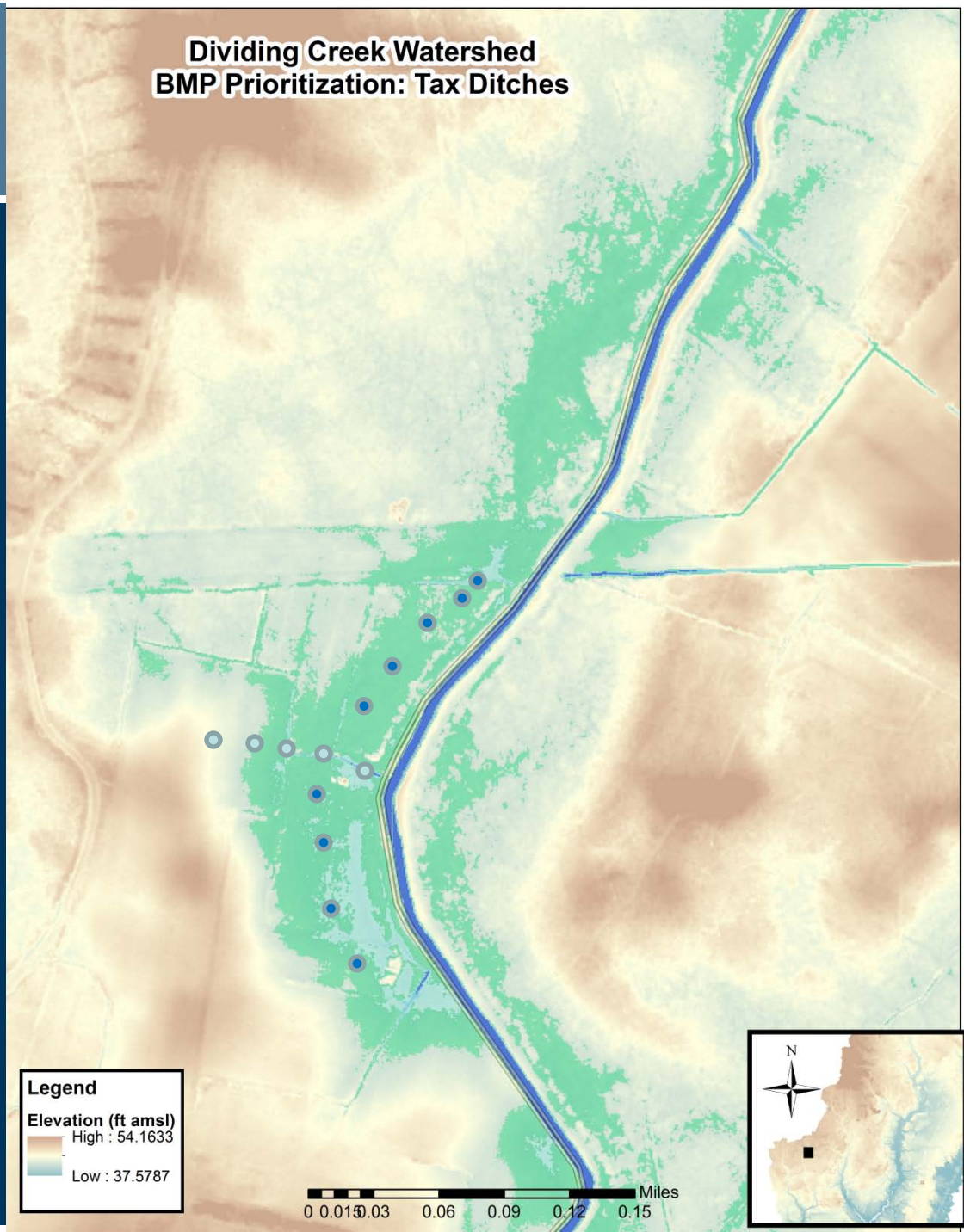
Monitoring Objectives:

- Continuously monitor groundwater and surface water dynamics to characterize rate, timing, frequency, and magnitude of exchange.
- Identify parallel hydrochemical gradients based on comprehensive geochemical analyses to fingerprint sources and evaluate flux rates.
- Monitor sediment deposition, characterize sediment texture and chemistry in relation to inundation patterns.



Quantifying the Role of Wetlands in Achieving Nutrient and 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

CBP Research Needs:

- Accurate wetland area assessment
- Wetland age assessment
- Pre- and post-BMP wetland condition and monitoring data

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Conclusions:

- ✖ Before-After Control Impact studies
- ✖ Paired watershed studies
- ✖ Empirical watershed studies
- **Integrated Field Studies**
  - Provides opportunity to test model assumptions
  - No more complicated than other study designs
  - Facilitates collaborations
  - Opportunity to generate local ‘credibility’
- **Monitoring = Research Opportunity**

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Integrated Field Research – Potential STAC Roles:

1. Identify information gaps
   * Resolve uncertainties by comparing model predictions with monitoring information
2. Develop conceptual monitoring guidelines
3. Provide guidance to grant programs and researchers
4. Recommend strategies for data centralization

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TNC MD/DC Partners:

Implementation & Research Partners:

- USGS
- USFWS
- NRCS
- MD DNR
- Talbot County
- Allegany County
- Appalachian Lab
- CBF

Whole Systems Conservation Partners:

- Pa, De, Va TNC
- USDA-ARS
- MDA
- EDF
- Trout Unlimited
- NFWF
- CBT
- Mid-Shore Riverkeepers
- Ducks Unlimited

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Chesapeake Bay Whole System Conservation