Chesapeake Bay Restoration: Prioritizing Wetland Restoration & BMP Opportunities in the Pocomoke River Watershed

Photo Credit: H. Stevens http://ian.umces.edu/imagelibrary/
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.
• *Priority Bay wetlands and benthic habitats are restored* and resilient to climate change by 2030.

• *Water Quality in the Bay and its tributaries is improved by 2025* – specifically reductions in nutrients and sediment – to support healthy fisheries, freshwater and estuarine habitats, drinking water, and recreation.

• *Healthy and viable Bay fisheries* – including oysters, blue crabs, menhaden, striped bass, American eel and shad – *are restored by 2030* and sustained thereafter.
Designing Sustainable Habitats in the Face of Human Development, Climate Change, and Sea Level Rise

Discussion Overview:

1) Key issues and trending conditions: Water quality and wetland habitat enhancement in the Pocomoke River Watershed

2) Assessing Vulnerabilities and Opportunities: Science-based decision tools to optimize restoration investments

3) Identifying critical knowledge gaps and research needs: Decision tool assessments

5) Key challenges over the next decade

6) Recommendations
Chesapeake Bay TMDLs: Lower Eastern Shore TN Targets

Current and Target TN Loads (lbs/yr)

> 20% reduction requirement

http://www.chesapeakebay.net/maps/map/delivered_yield_of_total_nitrogen_agricultural_sources
Ag Targeting Concerns:

- Improve water quality
- Maximize crop yields (i.e., mitigate not eliminate stressors)
- Improve habitat quality
- Maximize cost effectiveness
- *Overtime*, improve capacity to manage resources
Adaptive Management

1: Clarify the Decision Context

2: Define Objectives & Evaluation Criteria

3: Develop Alternatives

4: Estimate Consequences

5: Evaluate Trade-Offs & Select

6: Implement & Monitor

Science Based Tools/Models
Management Alternatives:

- Riparian Buffers
- Filter Strips
- Floodplain Reconnection
- Targeted Wetland Construction/Restoration
## Adaptive Watershed Management

### Implement Monitor and Learn
- Protect Environment, Sustenance
  - ex: Reduce Nutrient & Sediment Loads by 20%; Others?
- Where? What? How Much?
- Alternatives:
  - Wetland Restoration
  - Restored Floodplains
  - Others?
- Predict Outcomes
  - Science Based Tools/Models

### Targeted Wetland Restoration: Ditch Plugs
- Terraced Wetlands

### Floodplain Reconnection
- Plugged!

### Table

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<th>Mass TP removed</th>
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BMP Targeting and Prioritization

Protect Environment, Sustain
Implement Monitor and Learn

Select targeted projects

Predict Outcomes

Where? What? How Much?

Alternatives:
- Wetland Restoration
- Restored Floodplains

Science Based Tools/Models

Targeted Wetland Restoration: Ditch Plugs

Terraced Wetlands

Floodplain Reconnection

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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)

> 20% reduction requirement.

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
BMP Implementation Challenge: Where, What, How Much?

Conceptual Approach:

I. Identify Opportunities

II. Compare Opportunities

III. Rank Opportunities

Restorable Ecohydrological Active Areas

Potential Priority Criteria:
- Nutrient Sources
- Sediment Sources
- Habitat Quality
- County Access
- Landowner Cooperation
- Soil Fertility
- Cost

Results:
Ranked/Summed opportunities to maximize return on $$ invested to install bmp’s and provide services.
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III. Rank Opportunities
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Wetlands (and BMP alternatives): Nutrient/Sediment Sink, Source, or Transformer?
A fluvial geomorphologist’s perspective:

e.g., Rosgen’s Stream Scheme (1996).
High Resolution Topography Data Derived from Light Detection And Ranging (LIDAR) Remote Sensing Data

Flood and Gutelius 1997
J. of Photogrammetry & Remote Sensing
High Resolution Topography Data Derived from Light Detection And Ranging (LIDAR) Remote Sensing Data

USGS 30 m DEM
(7 to 10 m vertical accuracy)

LiDAR 2m DEM
(15 cm vertical accuracy)
1. Improved stream mapping
2. Mapping soil wetness

If surface waters considered watertable outcrops (e.g., Winter 1999)...

... then land areas within 1.5m elevation of surface water more likely wet.

Map land surface relative to surface water
2. Mapping soil wetness

→ Land surface relative to surface water

Jensco et al. 2009; Also Murphy et al. 2007
3. Riparian/Floodplain Slope...because local topographic relief reflects hydrologic controls (Vidon and Hill 2004)
3. Predicted wetland hydrologic function
Variation in stream corridor function depends on physiographic province.
Variation in hydrologic alterations depends on physiographic province.
Conceptual Approach:

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BMP Targeting: Impact Assessment (Source Strength)
BMP Targeting: Load Assessment

\[ \sum (\text{MDP LULC acres} \times \text{EOS loading rate}) \]
BMP Targeting: Size / Design

< 75 acres: headwater restoration

Riparian restoration

> 300 acres: floodplain reconnection
Prioritizing Wetland Restoration Projects in the Pocomoke River Watershed
BMP Targeting and Prioritization

Protect Environment, Sustenance

Implement Monitor and Learn

Select targeted projects

Predict Outcomes

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Critical Knowledge Gaps & Research Needs:
Model Performance Evaluation

**CBP-HSPF Watershed Model**
Predicted Stream Water Budget

- **Surface Water**
- **Filtered**
- **Groundwater**

[Graph showing TN and TP retention over 0% to 100%]

STAC 2008:
- TN retention
- TP retention

Wetland Portion of the Watershed

Non-Point Source
- Agriculture
- Forest
- Septic
- Stormwater
Critical Knowledge Gaps & Research Needs:

Improve Nutrient & Sediment Source Assessments

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Nassawango River Watershed BMP Prioritization: Potential Nutrient and Sediment Sources
Critical Knowledge Gaps & Research Needs:

Determine Linkages between Wetland Function & Landscape Position

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

Critical Knowledge Gaps & Research Needs:

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Critical Knowledge Gaps & Research Needs:
Linkages between Wetland Function & Landscape Position

Interactions with Climate & Physiography

Dryer Climates, Steeper, Less Permeable Soils, Landscapes:

Wetter Climates, More Permeable Soils, Flatter Landscapes:

Stormflow — Ephemeral — Perennial — Base Level
Designing Sustainable Coastal Habitats
Scientific and Technical Advisory Committee

Workshop Goal: Design Sustainable Approaches and Initiatives for Coastal Wetland Habitat Restoration and Protection within the Chesapeake Bay Watershed
Recommendation: Use Structured Decision-Making to Identify Key Decision Tools and to Guide Monitoring/Research Programs

BMP Decision Framework:

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Implement & Monitor

Evaluate Trade-Offs & Select Implementation Strategy

Predict Outcomes of Mng’t Alternatives

Improve Surface Water Quality

Reduce Nutrient & Sediment Loads by 20%

Mng’t Options:
- Buffers
- Wetland Restoration
- Others?

Science Based Tools/Models

What? Where? How Much?
Recommendation: Link Spatial Scales by Regional Modeling of Local Processes

Nitrogen Removal

\[ \text{NO}_3^- \xrightarrow{\text{N}_2} \]

Sediment and TP Reductions

Sediment/TP
Recommendation: Shift STAC Research Priorities

- Before-After Control Impact studies
- Paired watershed studies
- Empirical watershed studies
- Integrated Field Studies
  - Provides opportunity to test model predictions
  - No more complicated than other study designs
  - Facilitates collaborations
  - Local Scale: Opportunity to generate local ‘credibility’
- Monitoring = Research Opportunity
Recommendation: Evaluate Trends in Habitat Suitability Related to Hydrogeologic Setting
Summary of Recommendations

• Promote Adaptive Watershed Management

• Prioritize research & monitoring to support AWM
  • Evaluate model predictions and embedded scientific hypotheses (e.g., source assessment, wetland function as a function of landscape position)
  • Evaluate effects of climate change & human impacts on regional water table dynamics.

• Integrate water quality and habitat goals
  • Environmental Flow Requirements