Regional Restoration Planning In the Delaware Estuary Ecosystem Valuation Along an Urban Waterfront (Philadelphia PA)

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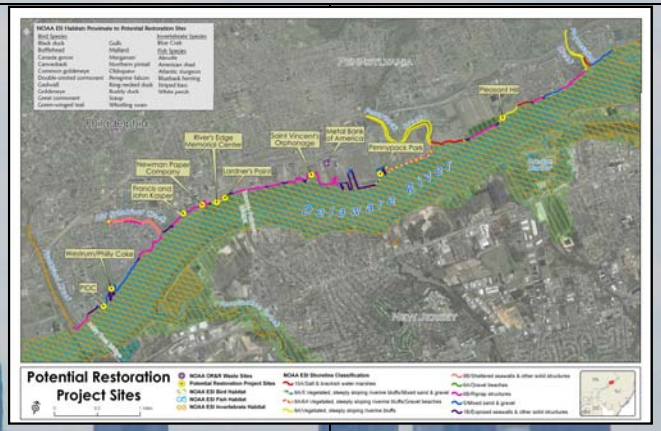
Introduction

- Regional Restoration Initiative (RRI) initiated by the Partnership for the Delaware Estuary, a National Estuary Program
  - Goals of initiative are:
    - Facilitate coordination among various conservation, enhancement, and restoration efforts underway
    - Apply scientific principles in evaluating ecosystem services resulting from different types of restoration efforts
    - Provide decision tools and a registry of high value projects for future restoration
    - Encourage ecosystem-based approaches that maximize natural resource benefits over long time scales within the Delaware Estuary and its watershed
  - Up to four case studies will be completed, including urban waterfronts, tidal wetlands, shellfish, and headwater streams
- Pennsylvania Environmental Council leading effort for ecological restoration along tidal Delaware River in North Philadelphia
- Restoration activities within urban corridor face many challenges, including:
  - High costs
  - Potential contamination
  - Infrastructure impacts
- Considering broader suite of ecosystem services shows restoration of urban areas provides substantially more benefits than traditionally realized
- Study evaluated this urban pilot area using BRM and VARM approaches in Delaware Estuary RRI and Habitat Equivalency Analysis (HEA) to quantify select ecosystem services

History of Delaware Estuary

1600s	Philadelphia founded (1682)
1700s	Industrial Revolution
1800s	Deepwater ports of Estuary are manufacturing centers
1840s	Recreational use in dramatic decline, waters contaminated
1900s	Upper Estuary fisheries devastated
1940s	Urban Delaware River one of most polluted reaches in world
1950s	Clean Water Act (1972) and increased federal, state, and local interest lead to improvements in water quality
1970s	Ongoing interest in enhancing ecosystem services provided by urban Delaware River
Present	



Basic and Value-Added Restoration Matrices

Basic Restoration Matrices (BRMs)

- BRMs identify current and potential restoration activities and options in various watershed regions
- Highlight areas of project need for various natural resources (habitats and fauna/flora)
- For pilot, initial list of potential restoration projects developed, using:
  - Existing registry of riverfront restoration projects compiled by Philadelphia Water Department
  - Local knowledge by PEC of potential riverfront restoration opportunities associated with the North Philadelphia Greenway
  - Site reconnaissance visits
- At each of sites, baseline quality of existing habitats and value to living resources qualitatively ranked (0 = N/A, 1 = low, 2 = medium, 3 = high)
- Similar evaluation made of potential restoration scenario
- Values summed and grouped into following categories to compare restoration uplift: wetlands, diversity of habitat and landscape complexity, birds/mammals/and herp habitat, fish and other aquatic habitat, and human use opportunities (recreation)
- Table 1 provides summary of BRM for three project examples

Value-Added Restoration Matrices (VARMs)

- VARMs build upon BRMs by including variety of value metrics, including ecosystem service provisions
- For this effort, adopted terminology from Millennium Ecosystem Assessment to categorize and identify ecosystem services:
  - Provisioning (habitat, biodiversity, and production)
  - Regulating (nutrient uptake/cycling, sediment stabilization, wave attenuation, and gas regulation)
  - Cultural (recreation and aesthetic values)
- Also adopted approach presented by National Research Council Committee on Mitigating Shore Erosion Along Sheltered Coasts in 2007 report
- Any shoreline restoration project will need to specifically address shoreline erosion
- Table 2 provides qualitative evaluation of ecosystem services from expanded list of coastal habitats and shoreline erosion mitigation techniques
- Table 3 identifies living resources (i.e. signature species) related to recreation and aesthetic values and qualitatively lists restoration activities that would attract or furnish habitat for these species
- Estimates of increased production (i.e., food and living resources) from different restoration scenarios along North Philadelphia Delaware Riverfront based on GIS information from the NOAA Environmental Sensitivity Maps

Table 1: Basic Restoration Matrix

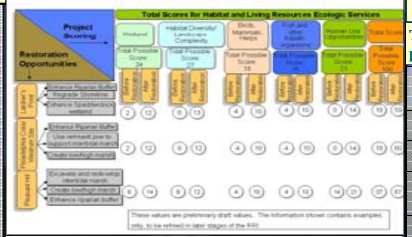


Table 2: Value Added Restoration Matrix
Ecosystem Service vs Shoreline Type

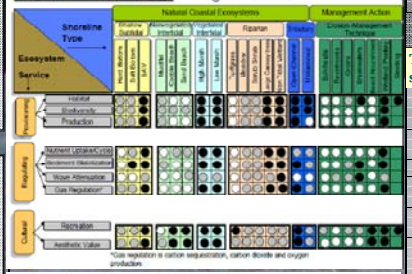
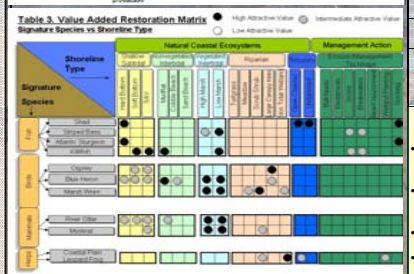


Table 3. Value Added Restoration Matrix
Signature Species vs Shoreline Type



For more information contact Simeon Hahn at Simeon.Hahn@noaa.gov or visit the NOAA Damage Assessment, Remediation, and Restoration Program (DARRP) Web site at http://www.darrp.noaa.gov.

Quantification of baseline services and services with shoreline restoration

- HEA may be used to determine benefits from restoring hardened shoreline
  - Used to scale injuries resulting from M/T *Athos I* oil spill as well as restoration projects, including projects along urban corridor of the Delaware River
  - Results in quantity known as discounted service-acre years (DSAYs), which provide means for comparing services provided by habitat under different scenarios (e.g., at baseline, after injury, following restoration)
  - *Athos I* analysis used productivity to assess services from the habitat types
- Assumptions made in *Athos I* spill extrapolated to this quantification, with adjustments
- Baseline service levels from different shoreline types quantified in reference to natural marsh habitat
- Table 4 summarizes:
  - Relative productivity values of each shoreline habitat type
  - Baseline marsh equivalent DSAYs of each shoreline type
- For analysis of potential restoration scenarios, shoreline of one habitat type converted into shoreline of another habitat type
  - For example, 10% of rip rap shoreline converted into marsh buffer would decrease length of rip rap shoreline by 10% and increase marsh shoreline marsh length by 10%
  - Created marsh habitat assumed to have 85% of value of natural marsh habitat
- Table 5 shows results of different shoreline conversion scenarios

Table 4. Values of shoreline types relative to natural marsh productivity and marsh equivalent DSAYs at baseline

Shoreline type	*Relative productivity (Marsh = 100%)*	*Baseline marsh equivalent DSAYs*	DE Bay and PA Shoreline ESI Types*
Manmade structure	10%	4	27.23 %
Rip rap	15%	68	35.01 %
Gravel beach (including mixed gravel/sand)	20%	70	26.84 %
Vegetated steeply sloping bank	25%	51	15.81 %
Natural marsh	100%	332	6.38 %

*Percentages do not sum to 100 since certain segments have two shoreline types (e.g., gravel beach and vegetated steeply sloping bank)

Table 5. Marsh equivalent DSAYs under shoreline conversion scenarios

Conversion scenario (to marsh buffer)	*DSAYs gained from baseline*	Uplift from conversion, %
10% seawall/manmade structure	76	14
10% rip rap	98	19
10% vegetated steeply sloping bank	44	9
5% seawall/manmade structure, 5% rip rap	87	17
5% seawall/manmade structure, 5% vegetated steeply sloping bank	60	11
5% rip rap, 5% vegetated steeply sloping bank	71	14
5% seawall/manmade structure, 5% rip rap, 5% vegetated steeply sloping bank	109	21

Next Steps

- Expand Upper Estuary Restoration workgroup to address technical, policy, and funding issues
- Further develop BRM and VARM matrices to identify, assess, and rank the suite of restoration opportunities in case study area
- Conduct landowner outreach to promote restoration opportunities
- Refine of ecosystem service valuation
- Identify opportunities to expand case study findings to other urban sites