Using Return on Environment Concepts in NPS Programs

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USEPA R3
Some Terms
Ecosystem Services

- Specific work that the natural environment performs that provide benefits to humans

- Examples
  - remove pollutants from water (clean drinking water)
  - increase habitat for pollinators (food production)
  - increase groundwater recharge (drought avoidance)
  - provide trails through parks and open space (health)
Biophysical Measure

- Quantify the ecosystem service
  - metric tons of sulphur removed
  - cubic meters of runoff avoided
  - gallons of groundwater returned to aquifer
Eco-Price

- the economic value that the ecosystem service benefit provides, e.g.,
  - one pound of nitrogen removed improves downstream water quality by $0.30 per 1,000 gallons
  - one acre of wetland reduces flooding downstream and saves the community $5,500 per acre
  - one acre of forest contributes groundwater recharge to aquifers that would cost $2,300 to replace from another source
## Return on Environment: Forest

<table>
<thead>
<tr>
<th>Ecosystem Service</th>
<th>Biophysical Measure</th>
<th>Ecoprice</th>
<th>ROE / acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimize runoff</td>
<td>2000 gallons per acre</td>
<td>$0.05 per gallon</td>
<td>$100</td>
</tr>
<tr>
<td>Sulphur removal</td>
<td>2 metric tons per acre</td>
<td>$5.30 per metric tons</td>
<td>$10.6</td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td>4.5 metric ton per acre per year</td>
<td>$18 per metric ton</td>
<td>$81</td>
</tr>
<tr>
<td>Source water protection</td>
<td>18,000 gallons per acre</td>
<td>$0.03 per gallon</td>
<td>$540</td>
</tr>
<tr>
<td><strong>Total Eco-price for one acre of forested land</strong></td>
<td><strong>--</strong></td>
<td><strong>--</strong></td>
<td><strong>$731.6</strong></td>
</tr>
</tbody>
</table>

(sample values only)
Return on Environment

- Specific action or land cover: sum the eco-prices for all ecosystem services benefits provided by given land cover or given restoration action

- Total ROE: Multiply the eco-price per spatial unit times the total spatial extent of the land feature
Carbon County, Pennsylvania
Total ROE is $800 million per year
Why ROE?
To Change the Conversation

- Ecosystem services are provided by nature free of charge. Whatever is perceived as free tends to get overused—until it is depleted

- ROE provides a common language for presenting benefits to the public—everyone speaks ‘dollar’
To Challenge Perception Versus Reality

- Perception of Environmental Programs
  - taxes, fees, expenditures, costs, losses, debit
  - begrudgingly supported or actively opposed

- Reality of Environmental Programs
  - investments, capital preservation, assets, asset restoration, wealth generators, job creators
  - we are in the business of preserving and re-creating our natural capital assets—income producers
## Calculate Financial Return

### Annualized Investment Return on Environmental Restoration Project

<table>
<thead>
<tr>
<th>Measure</th>
<th>Investment (dollars)</th>
<th>Total Annual Return (dollars)</th>
<th>Time Period (years)</th>
<th>Total $ Returned (dollars)</th>
<th>Gain from Investment (dollars)</th>
<th>Return (percent)</th>
<th>Annualized Return (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream restoration project</td>
<td>$225,000</td>
<td>$57,000</td>
<td>20</td>
<td>$1,140,000</td>
<td>$915,000</td>
<td>307%</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Annual benefits from project</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pollutants removal benefits</td>
<td>$15,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>recreation value (brook trout)</td>
<td>$12,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>avoided downstream flooding</td>
<td>$30,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total annual return</td>
<td>$57,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Financial return is defined as the Gain / Initial Investment / Time Period.
My Goal for NPS Restoration Projects

This project was completed for $225,000 by the Clean Streams Agency. It produces $57,000 per year in cleaner water, flood avoidance and recreation value, for an average annual financial return of 15%. For comparison, the average annual return for the S&P 500 Index is about 10%.
New EPA Slogan

BUILDING, PRESERVING AND RESTORING AMERICA’S WEALTH SINCE 1969
Ways We Currently Recognize the Value of Ecosystem Services

- wetlands banking
- purchase conservation easements versus constructing new expensive water treatment plants
- tax reduction for keeping land forested
Selected ROE Projects
Maryland ROE Analysis
State of Maryland: Substantial Investment in Applying ROE

- DNR hired a PhD in environmental economics
- Created a statewide analysis that calculates ROE at 30-meter resolution
- Estimated total economic value considering seven ecosystem services: air pollutant removal; net carbon sequestration; groundwater recharge; surface water protection; flood prevention and stormwater mitigation; nitrogen removal and wildlife habitat
- Results shared with public and for policy makers to use in purchase and restoration projects online via Parcel Evaluation Tool
## Maryland Parcel Evaluation Tool

### Ecosystem Service Assessment Report

<table>
<thead>
<tr>
<th>Ecosystem Service Name (and biophysical unit)(range)</th>
<th>Annual Parcel-Level Values*</th>
<th>Annual Per-Acre Values**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Biophysical</td>
<td>Economic</td>
</tr>
<tr>
<td>Air Pollution Removal: Carbon Monoxide (CO) (kg per year) (0-1.35 kg per acre per year)</td>
<td>15.78</td>
<td>$0.42</td>
</tr>
<tr>
<td>Air Pollution Removal: Nitrogen Dioxide (NO₂) (kg per year) (0-9.01 kg per acre per year)</td>
<td>105.95</td>
<td>$1.47</td>
</tr>
<tr>
<td>Air Pollution Removal: Sulfur Dioxide (SO₂) (kg per year) (0-6.67 kg per acre per year)</td>
<td>40.65</td>
<td>$0.21</td>
</tr>
<tr>
<td>Air Pollution Removal: Ozone (O₃) (kg per year) (0-34.35 kg per acre per year)</td>
<td>670.80</td>
<td>$84.72</td>
</tr>
<tr>
<td>Air Pollution Removal: Particulate Matter (PM₁₀) (kg per year) (0-8.34 kg per acre per year)</td>
<td>210.43</td>
<td></td>
</tr>
<tr>
<td>Air Pollution Removal: Particulate Matter (PM₂₅) (kg per year) (0-1.80 kg per acre per year)</td>
<td>7.38</td>
<td>$30.83</td>
</tr>
<tr>
<td>Carbon Sequestration (mT per year) (0-4 mT per acre per year)</td>
<td>5.57</td>
<td>$2,012.34</td>
</tr>
<tr>
<td>Groundwater Recharge (m³ per year) (445 - 1235 m³ per acre per year)</td>
<td>13961.17</td>
<td>$10,272.00</td>
</tr>
<tr>
<td>Nitrogen Uptake Potential Index (1 = low to 3 = high)*</td>
<td>2.00</td>
<td>$3,122.00</td>
</tr>
<tr>
<td>Stormwater Mitigation Potential Index (1 = low to 5 = high)*</td>
<td>3.09</td>
<td>$34,715.00</td>
</tr>
<tr>
<td>Wildlife Habitat and Biodiversity Potential Index (0 = low to 100 = high)*</td>
<td>17.83</td>
<td>$12,411.00</td>
</tr>
<tr>
<td>Surface Water Protection</td>
<td>No Data</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

**Total Annual Economic Value**

<table>
<thead>
<tr>
<th>Annual Economic Value</th>
<th>Biophysical</th>
<th>Economic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>null</td>
<td>$296.35</td>
</tr>
</tbody>
</table>

*Values are approximate and may vary.

**Values are calculated per acre.
Total Ecosystem Service Benefits
Economic Value ($/yr)

<table>
<thead>
<tr>
<th>Ecosystem Services Total Value</th>
<th>$ yr⁻¹</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>&lt; $0.01</td>
<td>5,641.56</td>
</tr>
<tr>
<td>Maximum</td>
<td>$1,293.00</td>
<td>0.36</td>
</tr>
<tr>
<td>Average</td>
<td>$375.46</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>$8,029,887,859.00</td>
<td>1,924,834.86</td>
</tr>
</tbody>
</table>

Total Ecosystem Service Benefits ($/yr)

- < $200
- $200 - $400
- $400 - $600
- $600 - $800
- > $800

0 12.5 25 50 Miles
Total Eco-values Per Acre By Land Category

- Forests: $1,546
- Coastal Wetlands: $2,623
- Freshwater Wetlands: $2,292
- Protected Lands: $2,500
- All Other Lands: $1,717

$ per acre per year
Total Eco-values Per Acre By Jurisdiction

$ per acre per year
Statewide ROE for Maryland is approximately $8 billion per year!
Keystone Conservation Trust and Audubon Pennsylvania

- have calculated total ROE for about six counties in PA
- similar methodology to Maryland, used land cover and tied eco-price to pixels; summarized across study areas
- collaborated with MD DNR; similar but not identical
- considered outdoor recreation value, avoided healthcare costs and more
- Results are staggering: example: Carbon County’s natural environment is worth over $800 million dollars per year
- Working with communities to create riparian buffers and Green Ribbon landscapes, purchase open space, incorporate into comprehensive plans, reforesting parcels, and better manage public works programs
Potential Use of ROE in the NPS World
Value of Applying ROE in the NPS World

- Ability to fully value and communicate the benefits of environmental investments
- Ability to compare apples to oranges
  - stream restoration project A or project B
  - public education programs versus hands on projects
  - restoration or preservation
- Could provide justification for purchasing lands or easements
### Restoration Versus Preservation Using §319 Funds

<table>
<thead>
<tr>
<th>Restoration</th>
<th>Preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restore a degraded or impaired system to healthier state</td>
<td>Preserve an intact ecosystem via purchase or easement</td>
</tr>
<tr>
<td>Currently receives the vast majority of §319 funds</td>
<td>Not currently the focus of §319 funds; we simply assume that the intact systems will remain</td>
</tr>
<tr>
<td>Methodologies to calculate ROE on BMPs not as robust, but could be developed</td>
<td>Methodologies currently exist to estimate ROE values</td>
</tr>
<tr>
<td></td>
<td>ROE could provide the rationale for using §319 funds to preserve; would need to be written into your NPS Management Plan</td>
</tr>
</tbody>
</table>
Calculating Return on Preservation

### Annualized Investment Return on Environmental Restoration Project

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<th>Annualized Return (percent)</th>
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</thead>
<tbody>
<tr>
<td>Forested tract easement purchase</td>
<td>$200,000</td>
<td>$78,000</td>
<td>30</td>
<td>$2,340,000</td>
<td>$2,140,000</td>
<td>970%</td>
<td>32%</td>
</tr>
</tbody>
</table>

- **Annual benefits from project**
  - Pollutants removal benefits: $8,000
  - Groundwater recharge: $15,000
  - Avoided downstream flooding: $55,000
  - Total annual return: $78,000

**ROE** = (Gain from Investment less cost of investment) / cost of investment / years
Closing
Summary

- People do not value what is ‘free,’ therefore, assigning economic values to the natural environment is essential.

- Applying ROE to the NPS could improve public perception about what we do.

- Methodologies currently exist to estimate ROE for specific land covers: wetlands, forests, riparian buffers, farmland. ROE could provide justification for preservation projects.

- Methodologies should be developed to estimate ROE on BMPs.

- ROE can help guide NPS program decisions.
Action Items

- develop ROE calculators for BMPs and use them to evaluate restoration projects
- use ROE to guide restoration projects to those with the greatest economic return
- post ROE return at the project site and in public outreach
- develop ROE calculator for current land covers across the state or across a watershed
- incorporate ROE findings into A-I watershed-based plans
- incorporate preservation into state NPS management plans
- use ROE to evaluate restoration versus preservation
- form national work group for NPS-ROE collaboration
Credits and Resources

Thanks to Elliott Campbell, PhD, and Rachel Marks, Maryland Department of Natural Resources, and to John Rogers and Jeanne Ortiz, Keystone Conservation and Audubon partners for sharing methodology and resources.

Helpful Websites to explore

- EPA Enviroatlas at [https://www.epa.gov/enviroatlas](https://www.epa.gov/enviroatlas)
Questions