Ecosystem Service Benefits of Conservation and Restoration

Scientific, Technical Assessment, and Reporting (STAR)/Beyond 2025

Chesapeake Bay Program

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Ecosystem Services?

Broadly- "*Benefits gained by people from the environment*"

Practical definition for inclusion in decision making-

"*Benefits gained by people from the environment that are not already being paid for in a market and are contributing to a marginal increase in human well-being*"

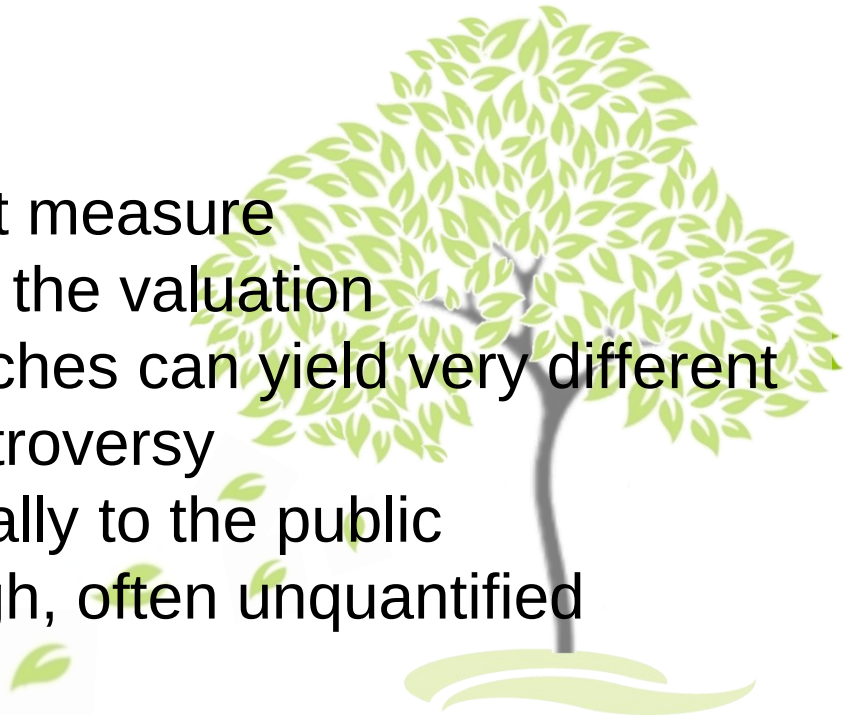
MD DNR has developed information to quantify Ecosystem Services from natural lands and restoration opportunities

Why Use Ecosystem Services?

- Integrate ecology and people through economics
- Objective measure of how people benefit from the environment, applicable to any measurable benefit
- Well established discipline with many different accepted approaches to quantification
- Can be spatial in nature
- Dollar values resonate with certain decision makers

Why Not?

- Economic benefit is an imperfect measure
- Difficult to consider equity within the valuation
- Many different accepted approaches can yield very different results, not without criticism/controversy
- Difficult to communicate, especially to the public
- Uncertainty in values is often high, often unquantified
- Breadth vs. depth tradeoffs



Mapping Ecosystem Services

- Ecosystem Services vary spatially across the landscape
- ES vary in the biophysical supply of the service (e.g. amount of carbon that is sequestered, water being recharged to aquifers)
- ES vary in the way and amount that people benefit (e.g. number of people and value of infrastructure vulnerable to flooding)
- We consider both sources of variation when mapping ES in Maryland

Ecosystem Services Mapped

Air pollution mitigation- USFS i-Tree landscape

Carbon sequestration- USFS i-Tree and MD DNR

Groundwater recharge- USGS National Hydrography Dataset (1 km)

Nitrogen Removal- USGS SPARROW model w/ literature removal rates by loading/ecosystem type

Flood Prevention/Stormwater mitigation- Index of Mitigation Potential (EPA/MD DNR)

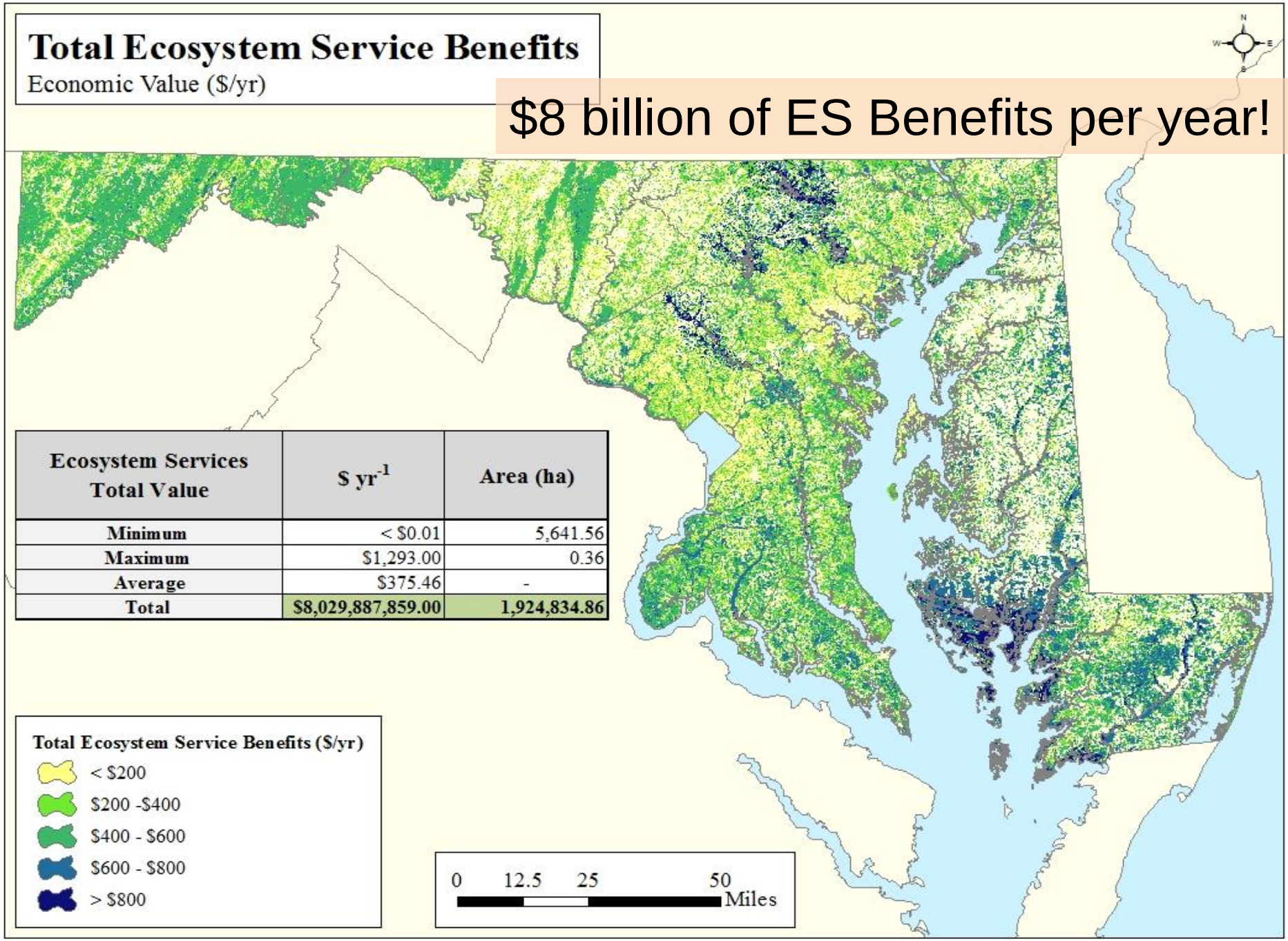
Wildlife- Habitat Quality Index, MD DNR

Valuation Methodology: Eco-Price

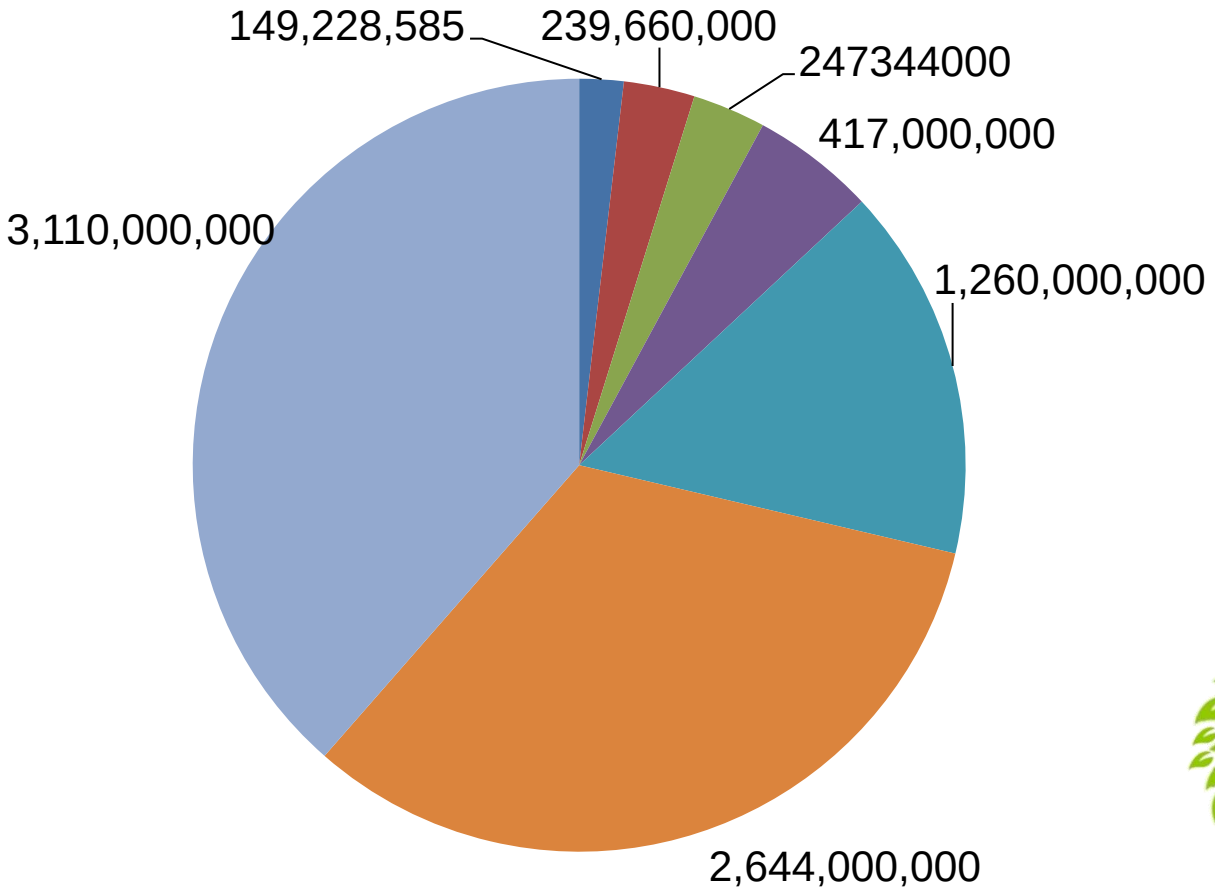
- Ecosystem services are paid for in many different ways
- People view responsibility for providing ecosystem services to be a collective obligation
- We look at the many different ways society invests in protecting or replacing the environment
  - In a regulatory market
  - Cost of restoration
  - Through mitigation fees
  - Cost to regulate

Assesses the Social Value for decision making

≠ Market Value


Total Ecosystem Service Benefits
Economic Value ($/yr)
$8 billion of ES Benefits per year!
N
W
E
S
Ecosystem Services Total Value | $ yr-1 | Area (ha)
Minimum | < $0.01 | 5,641.56
Maximum | $1,293.00 | 0.36
Average | $375.46 | -
Total | $8,029,887,859.00 | 1,924,834.86
Total Ecosystem Service Benefits ($/yr)
< $200
$200 -$400
$400 - $600
$600 - $800
> $800
0 12.5 25 50
Miles

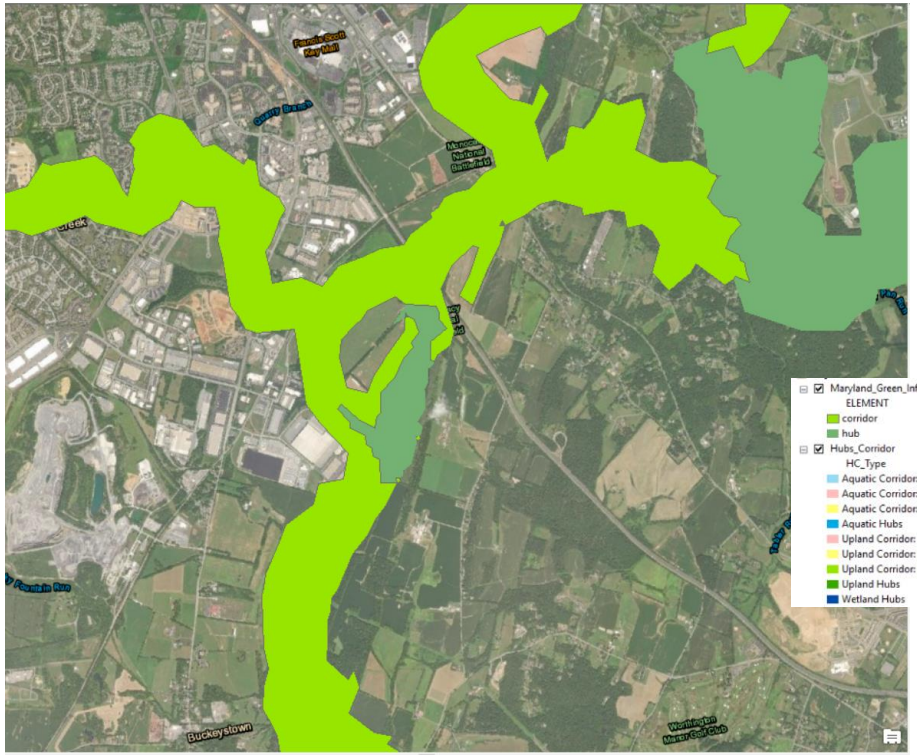
Ecosystem Service Totals



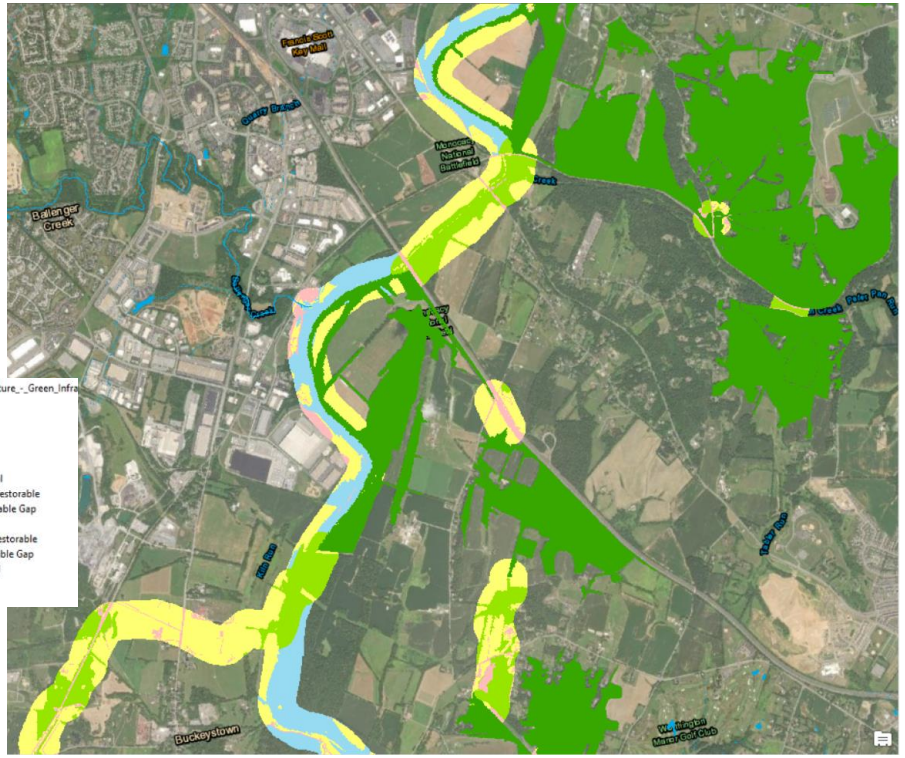
Units= $ per year

New Project
Updating Maryland's Green Infrastructure

Existing GI Hubs and Corridors



New GI Hubs and Corridors



Collaboration with the Chesapeake Conservancy Conservation Innovation Center

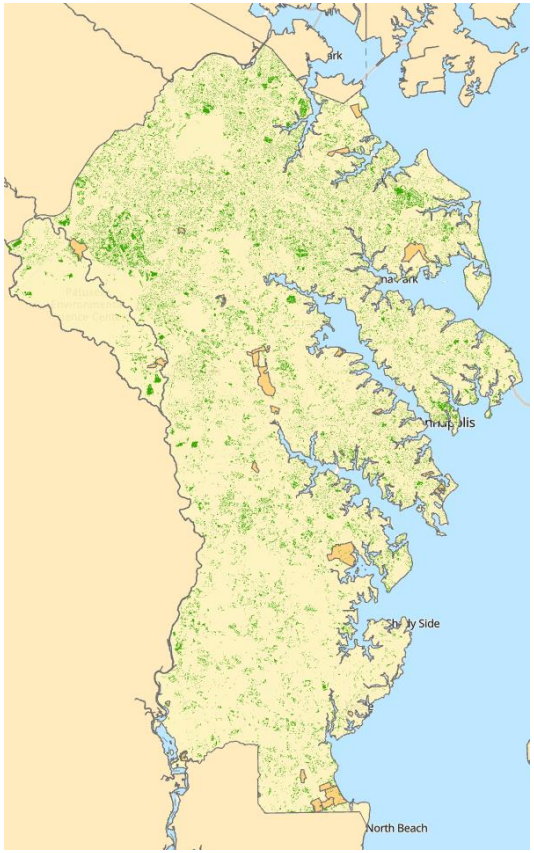
Mapping and Scoring Potential Restoration Co-benefits

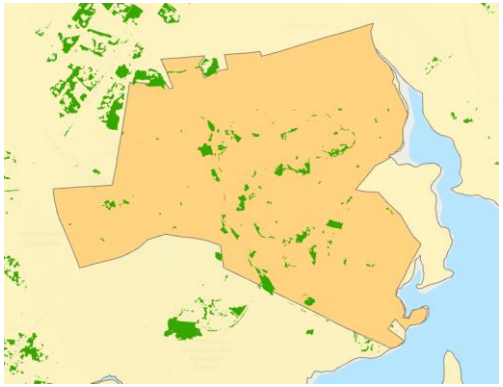
- **Develop and implement a restoration co-benefit scoring approach that is consistent with DNR's Ecosystem Service Valuation methodology for select restoration practices**
  - **Ecosystem Services Considered**
    - Carbon sequestration
    - Air quality benefits
    - Climate Resilience- ~~flooding~~ and heat
    - Water supply protection
    - Wildlife habitat

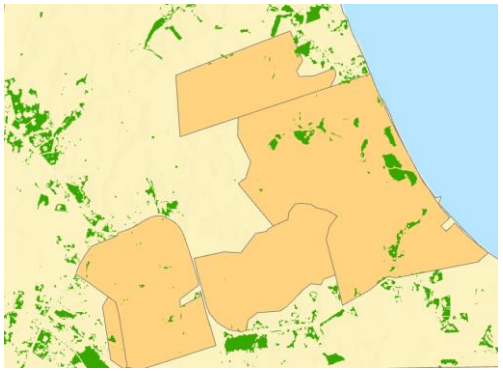
Also mapping social vulnerability

Tree Planting Opportunities

- Leveraged Chesapeake Conservancy “Plantable Area” data, created as part of the the Maryland Forest Technical Study
- We can look at different thresholds to narrow down potential tree planting opportunities
- This map looks at contiguous areas greater than 1 acre
- Note, this data does not include planting opportunities on agricultural lands

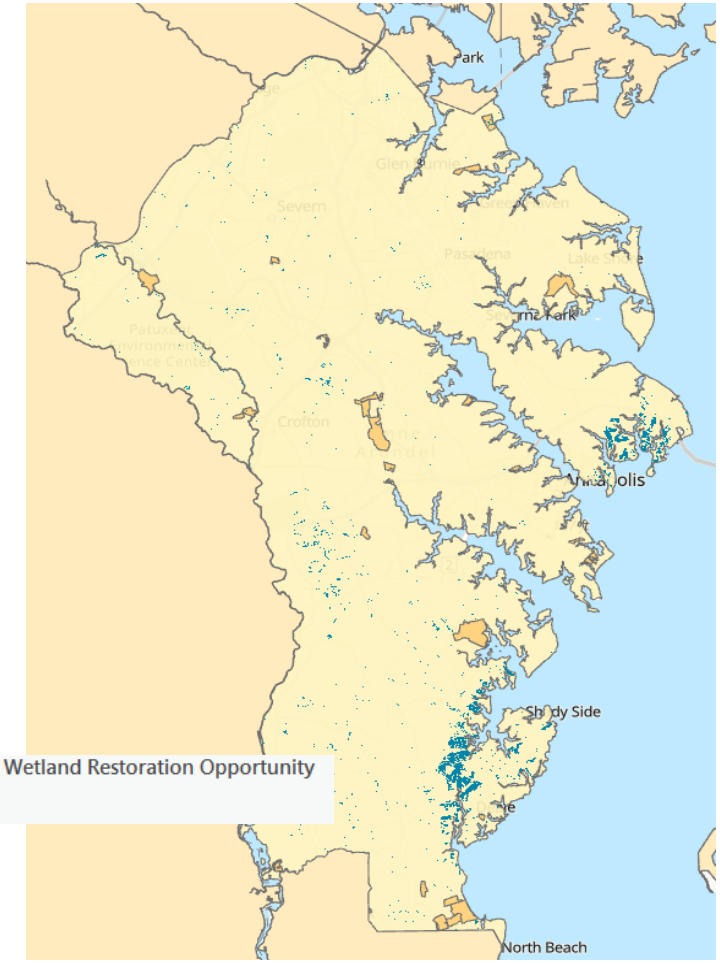


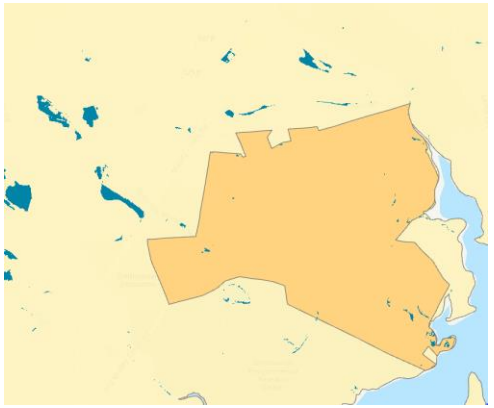


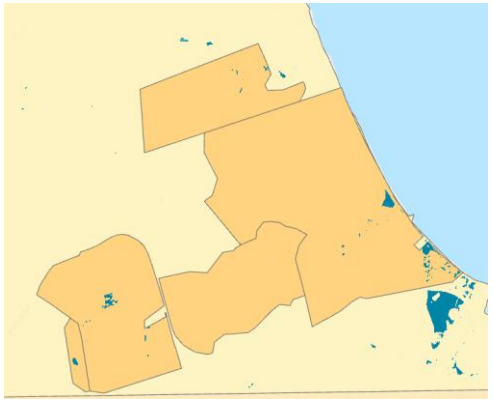


Wetland Restoration Opportunities

- Leveraged the “absolute factors” of the Watershed Resources Registry (WRR) model, to consider :
  - Soil type
  - Size of parcel
  - Prior land-use
- Includes areas projected to transition to wetlands due to sea level rise

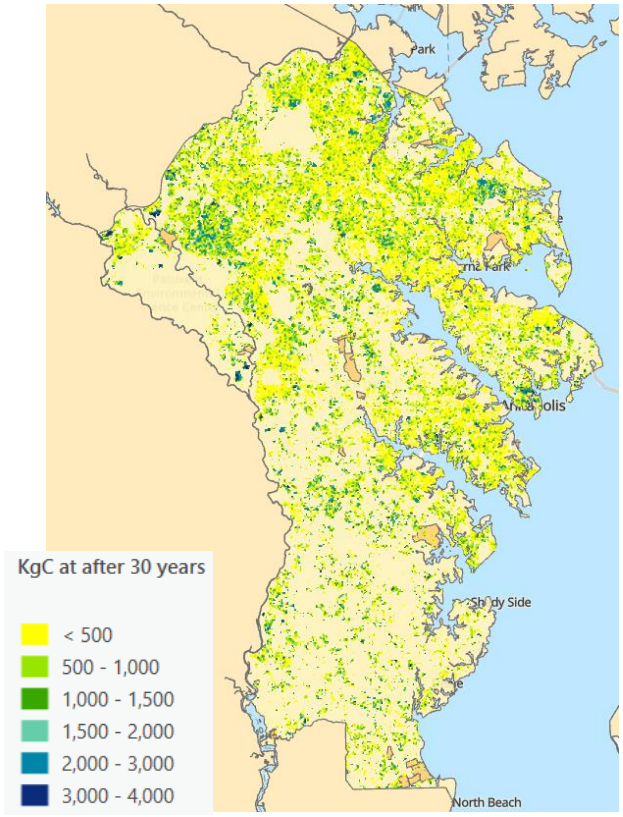


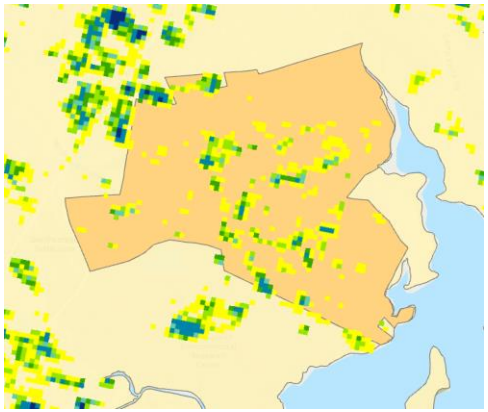


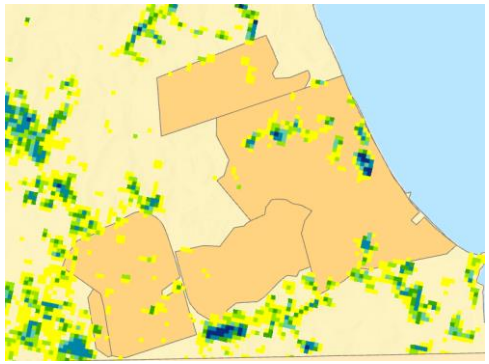


Carbon Sequestration Potential Carbon (kg in 30 year)

- Combined the plantable area analysis with UMD model of potential carbon sequestration through tree planting over different time periods (showing 30 years year)
- Larger planting opportunities with better site conditions will sequester more carbon
- Doesn't consider planting densities or species (assumes native species community similar to nearby sites)

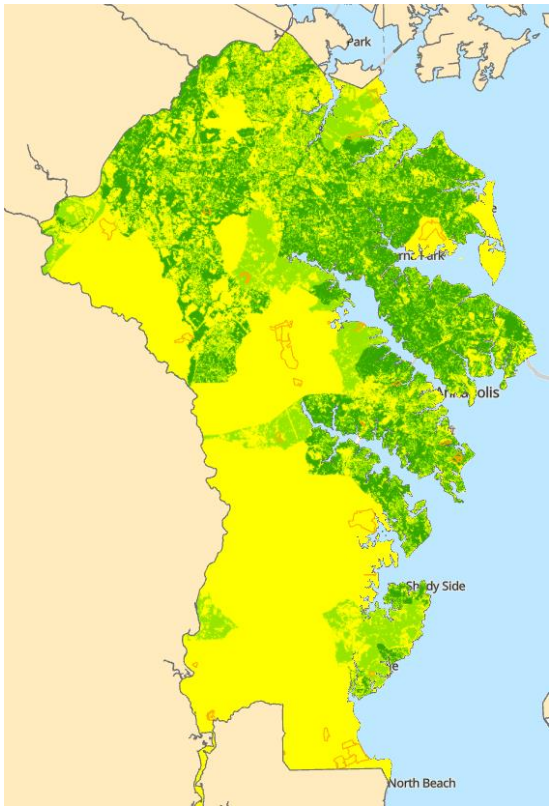


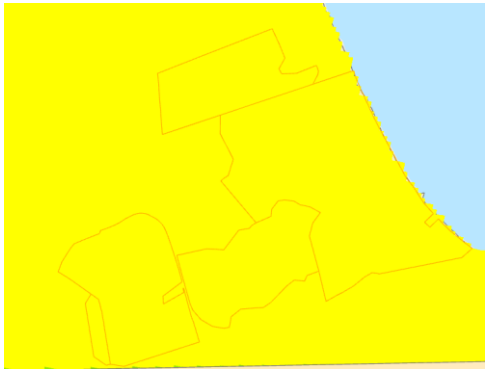


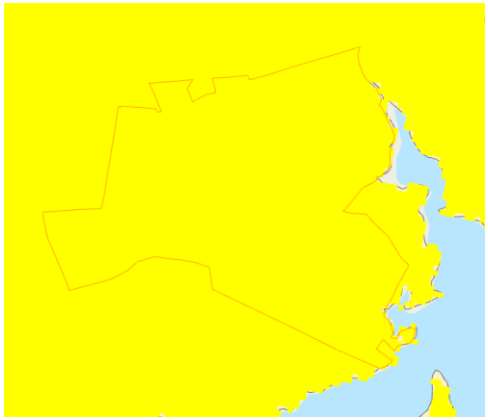


Air Quality

- Based on the i-Tree Landscape tool for air pollutant removal rates by tree canopy and the economic value of that removal from avoided health costs in nearby population (based on census block)
- We applied those rates to the tree planting opportunity areas

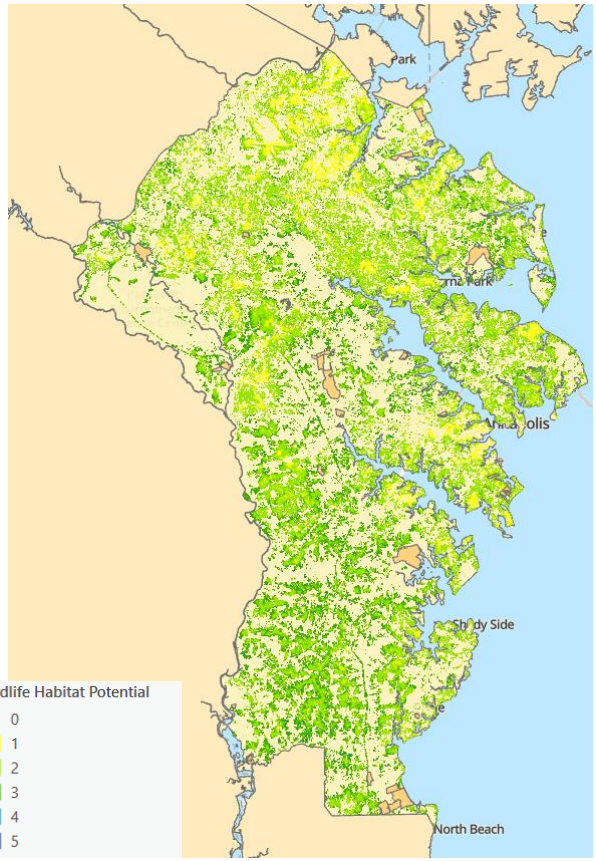


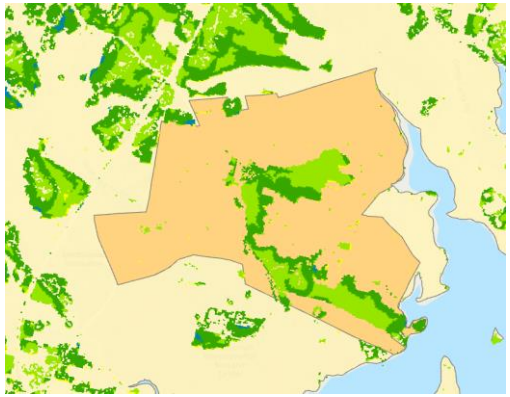


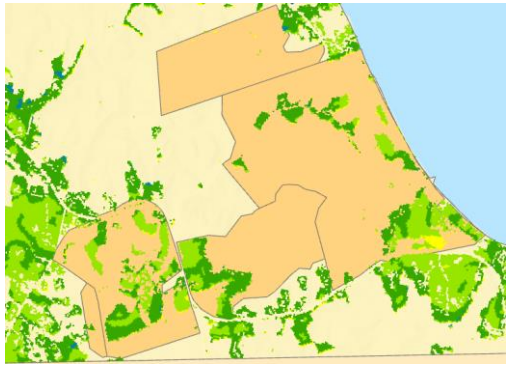


Wildlife Habitat Potential

Areas that are not currently forest or wetlands, but are located closer to existing habitat are given higher ranks, proximity to developed lands brings down the score

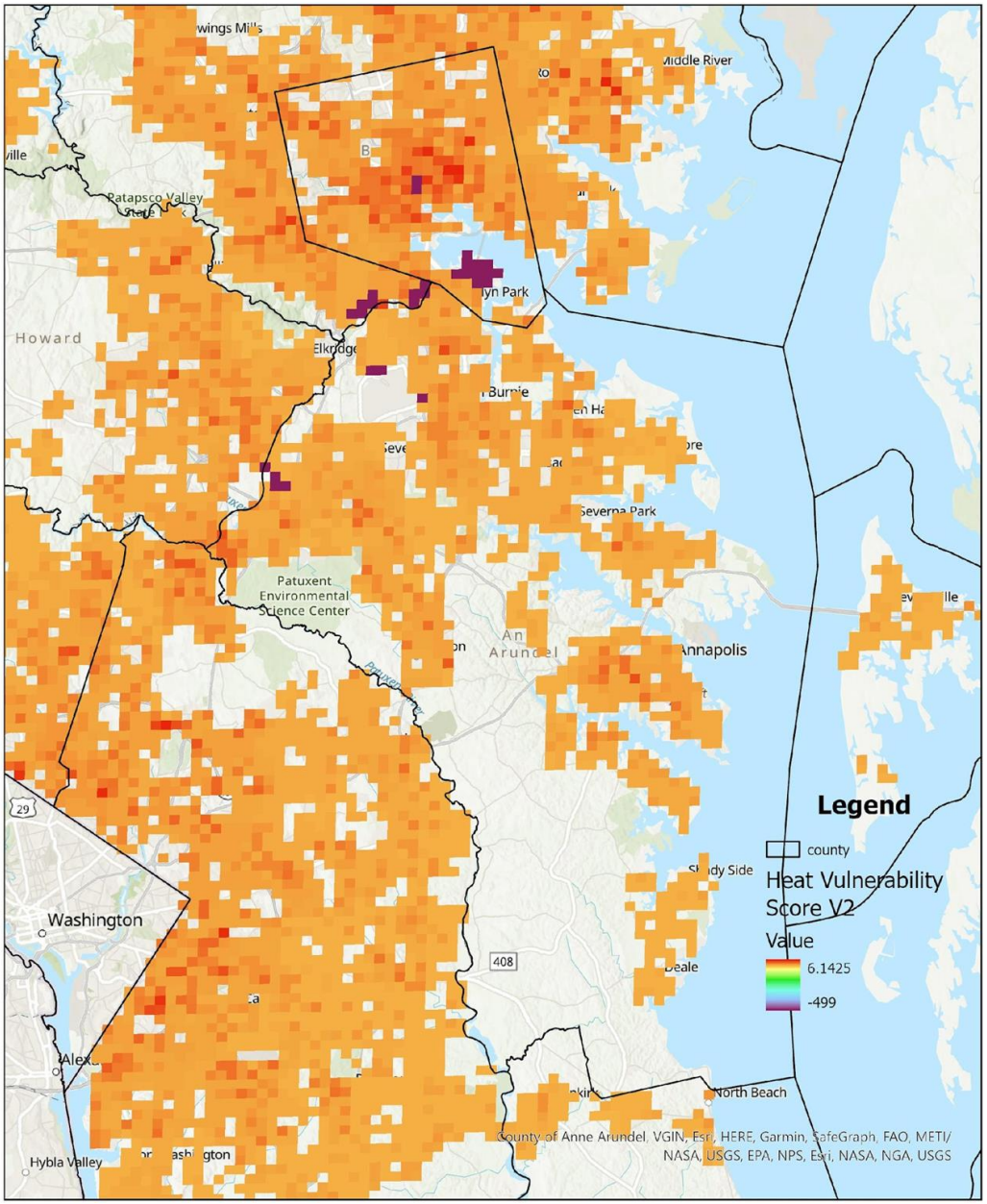






Climate Resilience: Heat Vulnerability

- Combination of dangerous heat days from recent years (2019, 2020, 2021) and the CDC Social Vulnerability Index
- Factors have some correlation, but does identify particular problem areas within developed regions
- Could help target tree planting programs



Summary

Conservation Benefits

Parcel Evaluation Tool: Ecological Benefit Ratings & Ecosystem Services

Maryland's Green Infrastructure

Restoration Benefits

Mapping Restoration Opportunities Across Maryland

Mapping and Scoring Potential Restoration Co-Benefits

Mapping and Scoring Potential Restoration Climate Resiliency Benefits

Education and Communication

Taken together, these advancements will ensure that our decision making processes incorporate the latest understanding of how our investments can help to reduce impacts of a changing climate, maximize resiliency and other co-benefits

Ecosystem Services in the Chesapeake Bay Watershed

- All States in the watershed have had ecosystem service studies done for at least a sub-region
- Studies used different methodology, are not directly comparable, and typically 1 off
- National Datasets, federal tools like the Enviro-Atlas and Watershed Resource Registry make a CB wide assessment possible that is consistent and could be maintained regularly
- Valuation would require additional research
- CBP/Partners should be intentional regrading the intended use/applications, methodological approach, scale and acceptable uncertainty

Other CB Watershed Ecosystem Service Resources

- PA
  - Kittatinney Ridge Return on Environment- https://kittatinnyridge.org/explore/roe/roe-studies/
  - Philadelphia Urban Decision Making https://penniur.upenn.edu/initiatives/urban-ecosystem-services-and-decision-making
- VA
  - Piedmont Environmental Council https://conservationtools.org/library_items/1131-The-Economic-Benefits-of-Virginia-s-Natural-Goods-and-Services
- WV
  - Urban Forests in West Virginia https://wvforestry.com/pdf/TC%20USA%20Canopy%20Coverage%20Publication%20-%20Summary.pdf
- DE
  - Economic Value of Nature and Ecosystems in the Delaware River Basin https://www.wrc.udel.edu/research/economic-value-of-nature-and-ecosystems-in-the-delaware-river-basin/
- NY
  - Urban Ecosystem Services https://www.sciencedirect.com/science/article/abs/pii/S2212041616300729 https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.2390

Beyond 2025: Thoughts/Discussion Points

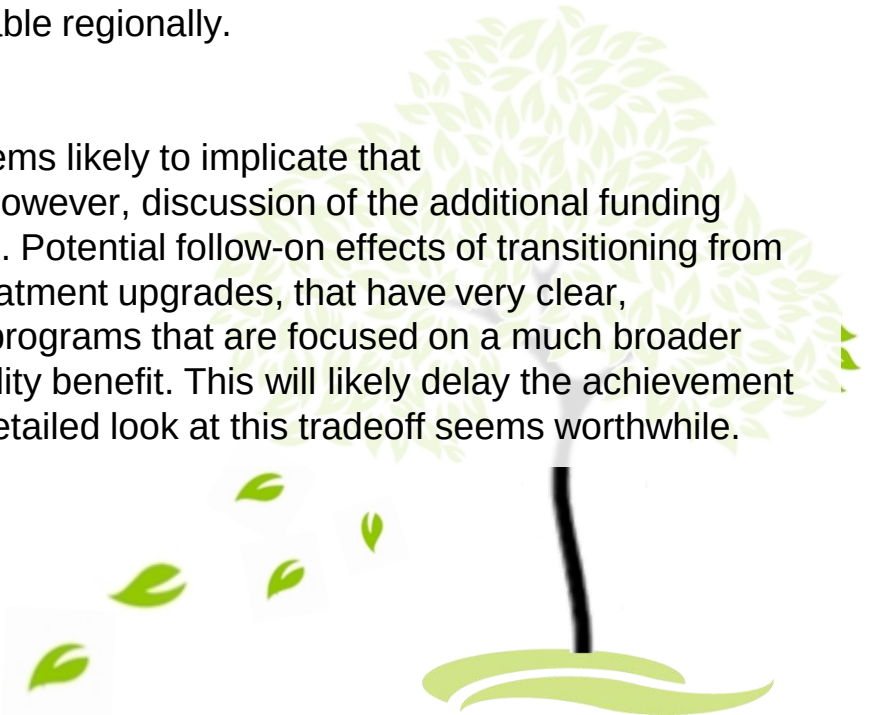
Seeks to better integrate people and ecological goals, ecosystem services are one approach that does this but should not be the only tool applied

Systems approach needed, additional to ES- assessment of non-linear impacts, relative benefits, tradeoffs

Ecosystem Services can be a valuable tool, but there is no one standard approach, can agreement be found on what approach to use, funding allocated to make it happen and to maintain/update

Tradeoffs between depth and breadth- localized, “deep” studies have less uncertainty, but typically the results can only be applied locally or to a single issue and frequently only address a subset of services. “Broad” studies have uncertain results, but if done well are internally consistent (i.e. relative magnitudes of services) and consider many more services and are applicable regionally.

Potential Cost Tradeoffs
Beyond 2025 is broadly reassessing the watershed and seems likely to implicate that expansion of Bay program activities and goals is needed. However, discussion of the additional funding That will be required for expansion has not been happening. Potential follow-on effects of transitioning from water quality focused programs, particularly wastewater treatment upgrades, that have very clear, measurable, relatively low-cost benefits to water quality to programs that are focused on a much broader suite of benefits but have higher costs per unit of water quality benefit. This will likely delay the achievement of water quality goals but have greater overall benefits. A detailed look at this tradeoff seems worthwhile.



More Information

- The GreenPrint Map and Parcel Eval
  http://geodata.md.gov/greenprint/

- Chesapeake & Coastal Service Ecosystem Service Website
  http://dnr.maryland.gov/ccs/Pages/Ecosystem-Services

- Maryland Ecosystem Service Webinar
  https://www.youtube.com/watch?v=56mDu3lH0- 0&feature=youtu.be

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