

# Identifying and Defining Levels of Meaningful Change in Ecosystem Services of the Chesapeake Bay and its Watershed

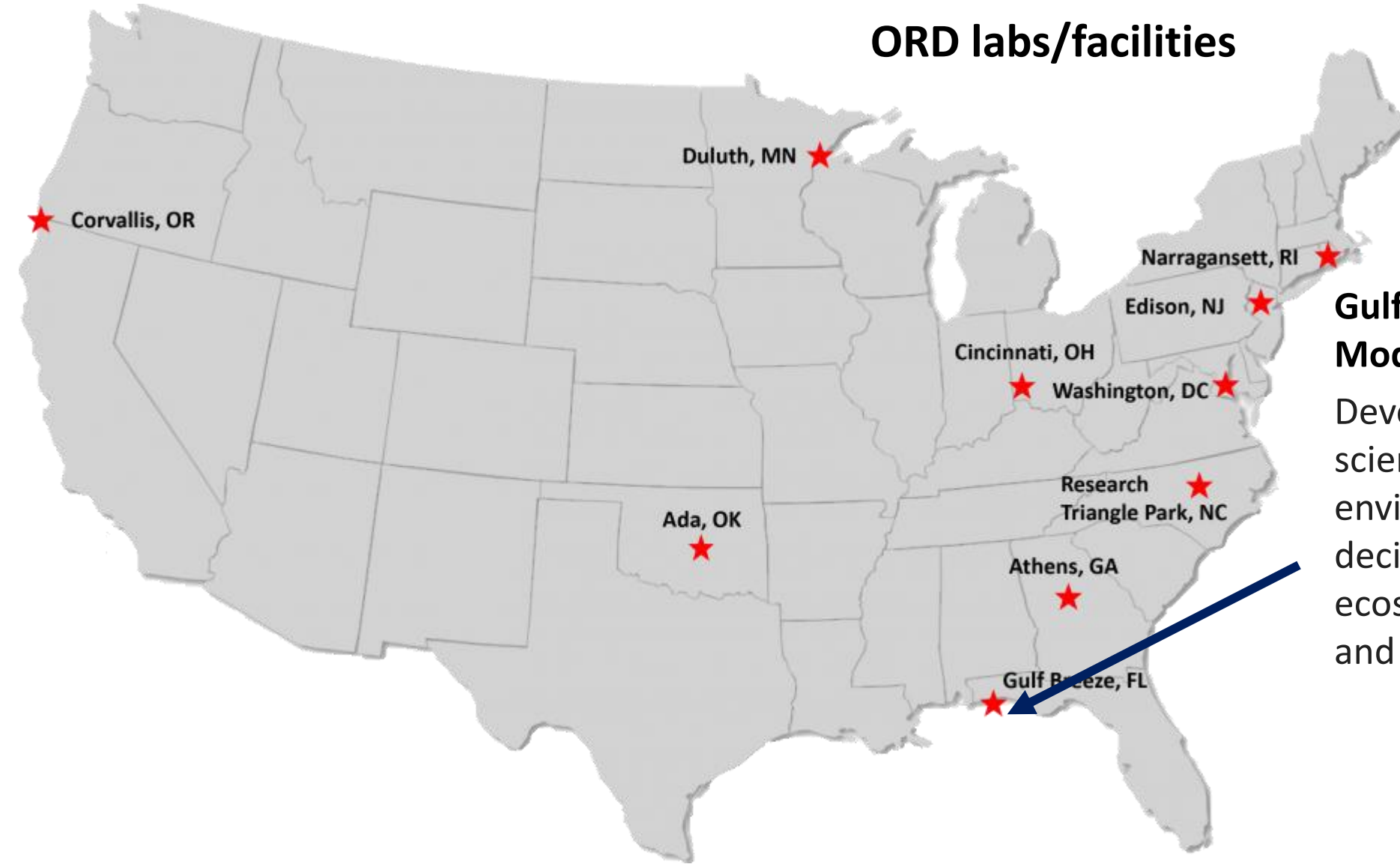
**Emily Trentacoste (EPA CBPO), Susan Yee (EPA ORD), Ryann Rossi (EPA ORD)**

**STAR Meeting  
5/28/2020**



# RESES: Research opportunity between EPA Regions & ORD

## ORD labs/facilities



### Gulf Ecosystem Measurement & Modeling Division

Develop tools and provide a scientific basis for sustainable environmental management decisions that maximize economic, ecosystem, and social outcomes and resiliency

# Identifying and Defining Levels of Meaningful Change in Ecosystem Services of the Chesapeake Bay and its Watershed

## **Need to be addressed:**

- Some BMPs in Watershed Agreement are behind on implementation – e.g. wetlands and forest buffers
- Need to enhance stakeholder buy-in of implementation of these practices, especially in headwater communities
- Want to be able to better communicate benefits associated with these practices, specifically beyond water quality
- Want to be able to quantitatively describe these benefits

# Identifying and Defining Levels of Meaningful Change in Ecosystem Services of the Chesapeake Bay and its Watershed

## **Objectives and goals:**

- Develop methodologies CBP can use to identify priority ecosystem services associated with restoration practices
- Quantify how ecosystem services change over levels of restoration practice implementation
- Communicate potential benefits and tradeoffs of restoration practices to stakeholders
- Communicate levels of restoration needed to achieve different desired levels of ecosystem services

# Identifying and Defining Levels of Meaningful Change in Ecosystem Services of the Chesapeake Bay and its Watershed

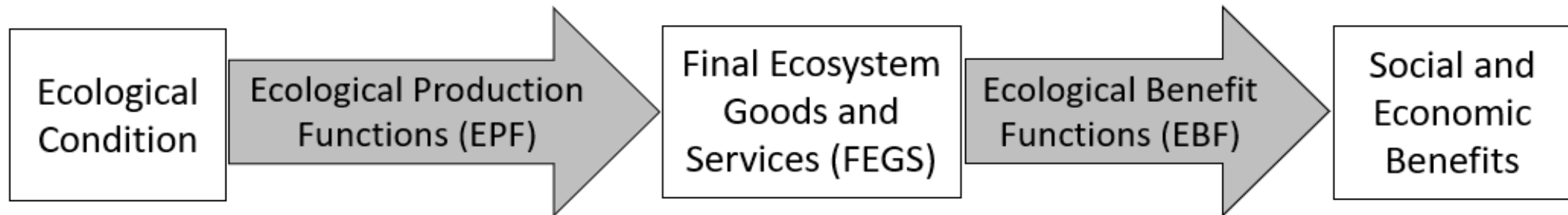
## **Possible end products:**

- Data lookup tables – provide quantifiable aspect of how ecosystem services change in response to levels of restoration; goal to be usable in CAST
- Fact sheets, maps or other communication materials – work with LLWG, LGAC and CWG to identify end-users and materials

**Problem:** Methods are needed to assess and communicate the potential social, economic, and environmental benefits of management actions to communities throughout the watershed

**Approach:** Provide a narrative and quantitative framework of how final ecosystem goods and services change along a gradient of changing condition as best management practices are implemented

## Restoration



## Beneficial Uses

# What are FEGS?

## Final Ecosystem Goods and Services (FEGS)

“**[biophysical] components of nature,** directly **enjoyed, consumed, or used** to yield human well-being” (Boyd & Banzhaf 2007)



# Why FEGS?

- Clarify what is meant and reduce ambiguity
- Directly relevant to stakeholders

## Intermediate Ecosystem Services

Habitat for fauna

Water quality

Water quantity

**What?**

**Where?**

**For who or  
for what?**

## FEGS

**Water salinity** in **groundwater** that local **farmers** depend on for irrigating crops

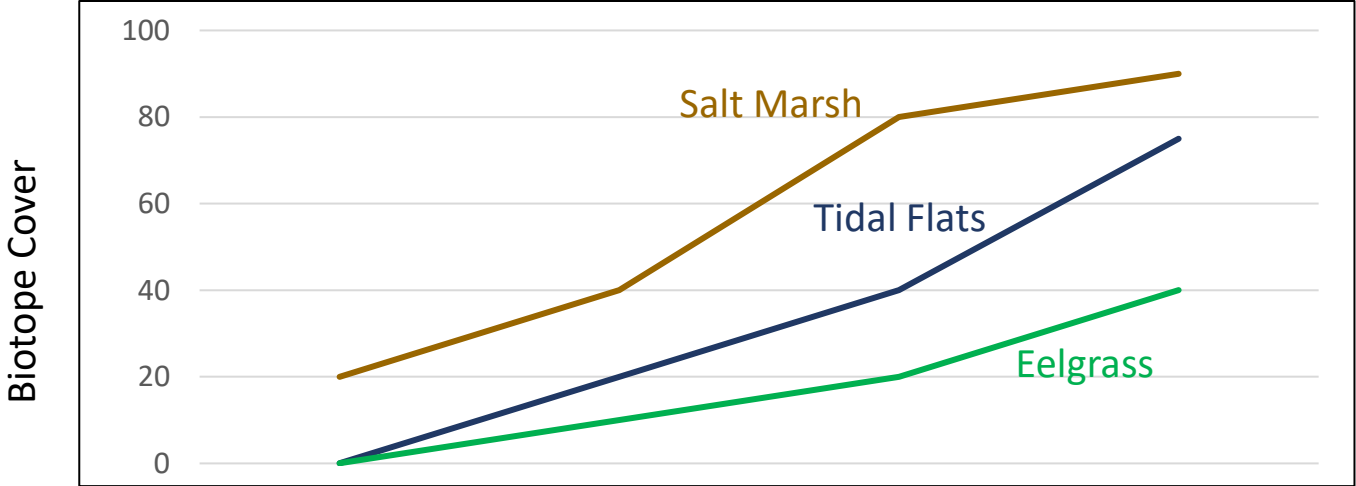
**Water temperature** in **local streams** used by **industrial processors** for cooling

**Water turbidity** in **coastal waters** that are visited by **snorkelers**

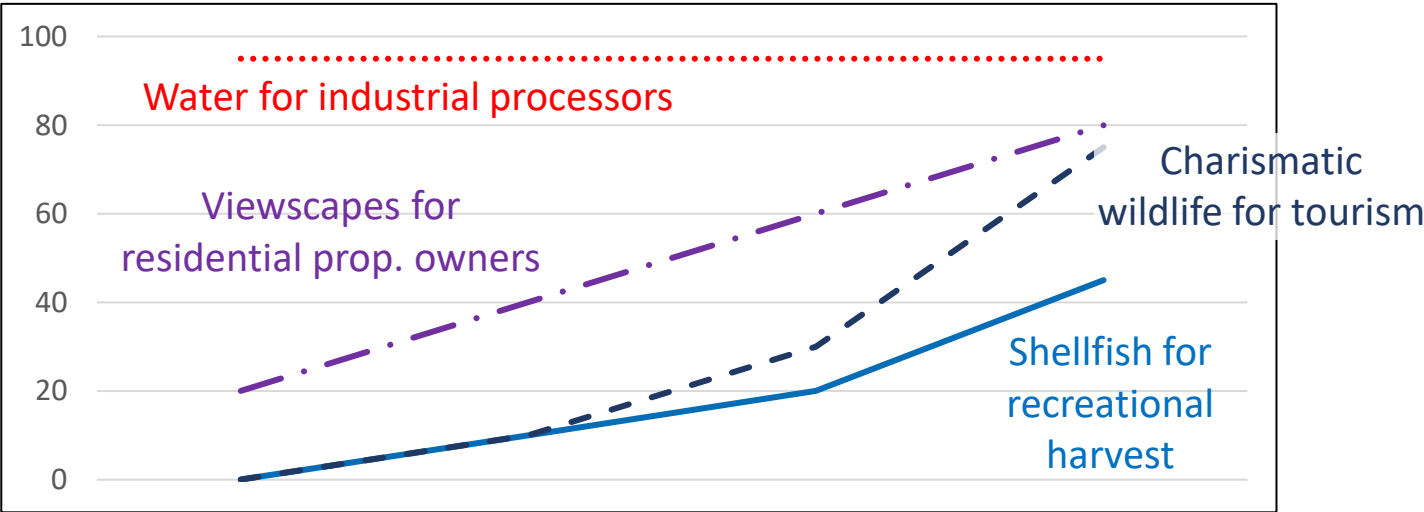


# Project Goal: Describe how ecosystem services may change as Best Management Practices to restore ecosystem condition are implemented

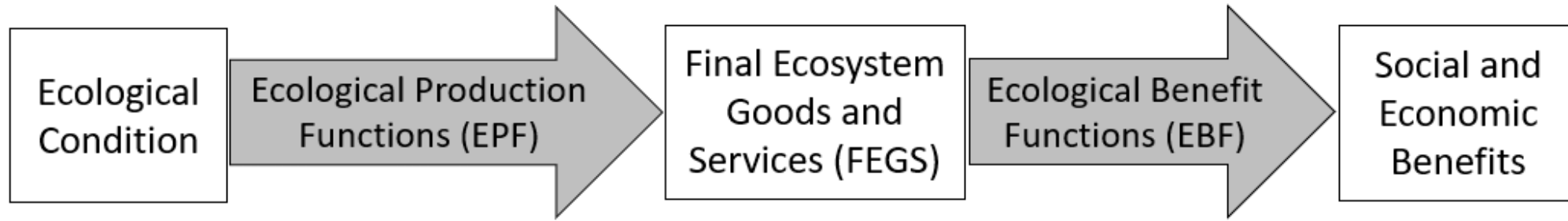
Biological condition



FEGS production



Restoration targets or timeline →



<b>Ecosystem Services Gradient Framework</b>	<b>Generic Process</b>	<i>FEGS Scoping Tool</i>
<b>What final ecosystem goods and services (FEGS) are relevant?</b>	Identify and prioritize FEGS with stakeholders	<i>FEGS-CS NESCS-Plus</i>
<b>How will we measure them?</b>	Identify FEGS metrics and indicators, and the biophysical attributes that provide them	<i>Invest</i>
<b>What FEGS could we have?</b>	Establish potential availability under a range of bio-physical conditions	<i>EPAH20 EnviroAtlas</i>
<b>What FEGS do we have now?</b>	Measuring, mapping, and ecological production functions (EPFs)	<i>EcoServices Modeling Library</i>
<b>What FEGS do we want?</b>	Evaluate co-benefits and tradeoffs	
<b>How do we get there?</b>	Identify impacts of management actions	
<b><i>What are the social and economic consequences?</i></b>	<i>Conduct and communicate benefits assessment using ecological benefit functions (EBFs)</i>	<i>Rapid Benefits Indicators Health Impact Economic value</i>

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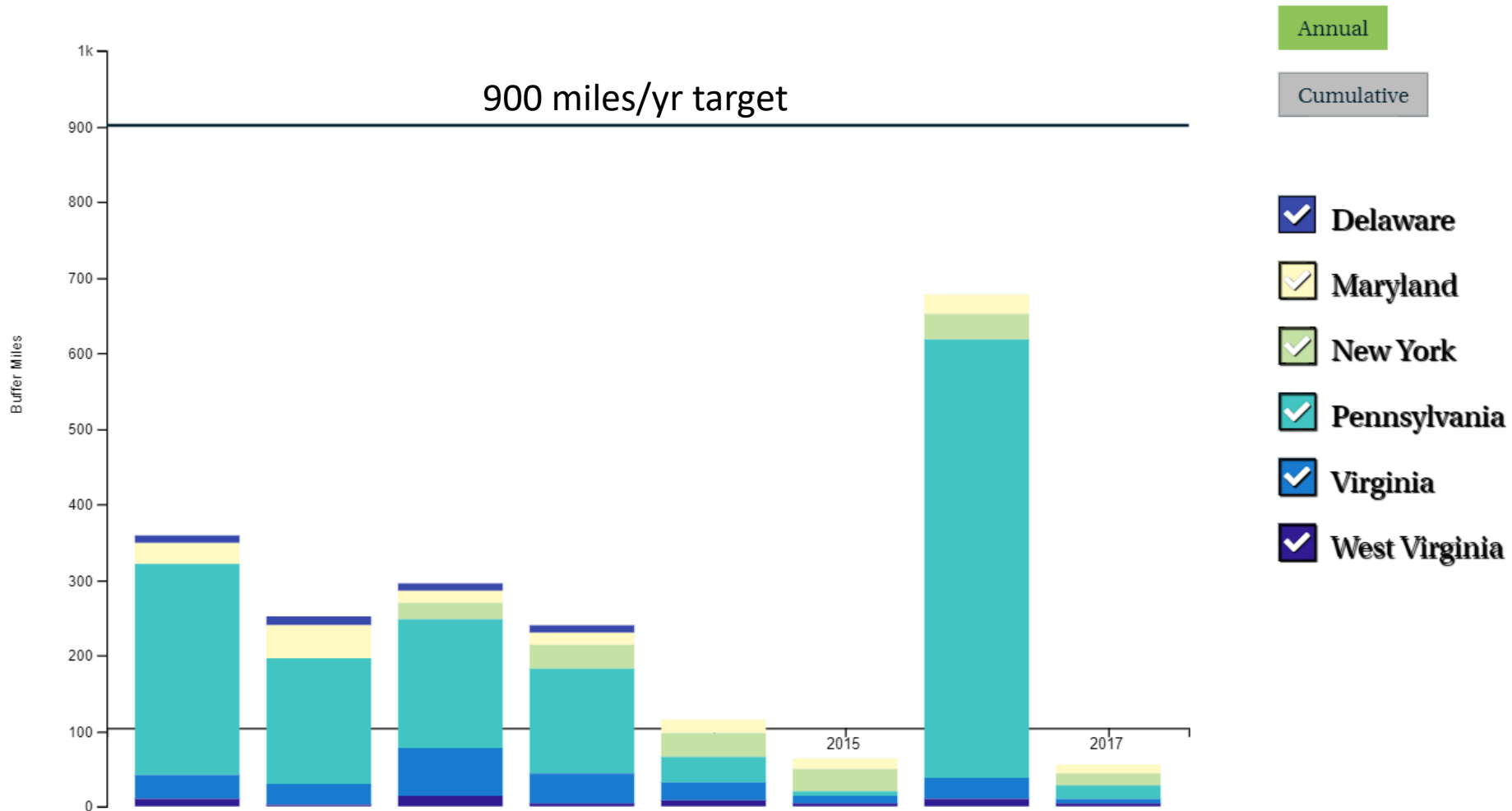
Ecosystem Services Gradient Framework	Generic Process	<i>FEGS Scoping Tool</i>
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# Selecting BMPs, FEGS and beneficiaries

- Working with CBP members and partners including Habitat GIT, STAR, Local Leadership WG, LGAC, Communications
1. Identify and scope BMPs for inclusion:
    - Associated with habitat and/or community resilience
    - Are part of Watershed Agreement and are lagging in implementation progress
    - Are relevant to headwater communities
    - Are likely to have readily available data for use in developing Ecosystem Services Gradients (e.g. land use data)

# 1. Identify and scope BMPs for inclusion

## Forest Buffers Planted (2010-2017)



<https://www.chesapeakeprogress.com/abundant-life/forest-buffers>

# 1. Identify and scope BMPs for inclusion

## First list:

- Agricultural Forest Buffers
- Agricultural Forest Buffers with Stream Fencing
- Agricultural Tree Planting
- Urban Forest Buffers
- Urban Tree Planting
- Wetland Creation
- Wetland Restoration
- Wetland rehabilitation
- Forest conservation
- Green infrastructure
- Urban stormwater practices



## After consultation with partners:

- Agricultural Cover Crops
- Agricultural Forest Buffers
- Agricultural Forest Buffers with Stream Fencing
- Agricultural Grass Buffers
- Agricultural Grass Buffers with Stream Fencing
- Agricultural Tree Planting
- Forest Conservation
- Urban Forest Buffers
- Urban Forest Planting
- Urban Impervious Surface Reduction
- Urban Tree Planting
- Wetland Creation
- Wetland Restoration

# Selecting BMPs, FEGS and beneficiaries

## 2. Identify CBP-relevant FEGS and beneficiaries associated with chosen set of BMPs

- Use ecosystem services tools like FEGS-CS and NESCS+ to identify ecosystem services associated with each BMP
- Use previous work by CBP to identify ecosystem services of interest
  - Local Priorities report
  - BMP Co-benefits scoring work
  - Local GIT working group presentation

# Identify CBP-relevant FEGS and beneficiaries associated with chosen set of BMPs

## FEGS-CS

Beneficiary Categories and Sub-Categories	Potentially Relevant NAICS Code(s)	General Beneficiary Description	FEGS	Examples of FEGS	Importance of FEGS to the Beneficiary	Potential Metric(s) and/or Indicator(s)
<b>21.01 Agricultural</b>						
21.0107 Foresters	113	Foresters introduce tree cultivars and nurture those cultivars as they grow into trees, which are harvested. The rotation for the tree crops may be as short as 10 years or many decades.	<ul style="list-style-type: none"> <li>soil</li> <li>open space</li> </ul>		<ul style="list-style-type: none"> <li>suitable soil in which trees can be cultivated (NOT cultivated trees themselves)</li> <li>suitable conditions (i.e., land) in which trees grow and to cultivate trees</li> </ul>	
<b>21.02 Commercial / Industrial</b>						
21.0201 Food Extractors	113, 114, 311, 312, 454	Food extractors utilize the natural abundance of edible organisms (i.e., non-cultivated or bred) for commercial use or sale. Includes commercial and native hunters (if legal). In aquatic environments, this beneficiary has potential contact with water.	<ul style="list-style-type: none"> <li>flora</li> <li>fauna</li> <li>fungi</li> </ul>	<ul style="list-style-type: none"> <li>garlic mustard, pawpaw, blackberries, maple sap</li> <li>deer, bear, rabbit, elk, grouse, turkey, boar</li> </ul>	<ul style="list-style-type: none"> <li>edible organisms (i.e., flowers, plants, etc.) or associated products (i.e., fruit, greens, tubers, berries, sap) for commercial use or sale</li> <li>edible organisms (i.e., birds, mammals, reptiles, etc.) for commercial use or sale</li> <li>edible organisms (i.e., mushrooms, shelf fungus, puffballs, etc.) for commercial use or sale</li> </ul>	

Classification system of final ecosystem goods and services with matrices developed for several environmental classes (e.g., forest, wetland).

## FEGS Scoping Tool

The screenshot shows the 'FEGS Scoping Tool 1.7.1 | BETA | US EPA' interface. The 'Weights' section is active, displaying a table of criteria and weights. The table has three columns: 'Color', 'Criterion', and 'Weight'. The criteria listed are: Magnitude & Probability of Impact, Level of Influence, Level of Interest, Urgency & Temporal Immediacy, Proximity, Economic Interest, Rights, and Fairness. Each criterion has a corresponding weight input field. The interface also includes sections for 'Project name', 'Edit project description', 'Weights' (0 of 9 criteria completed), 'Stakeholders', 'Beneficiaries', and 'Attributes'.

Color	Criterion	Weight
Blue	Magnitude & Probability of Impact	<input type="text"/>
Red	Level of Influence	<input type="text"/>
Green	Level of Interest	<input type="text"/>
Purple	Urgency & Temporal Immediacy	<input type="text"/>
Light Blue	Proximity	<input type="text"/>
Orange	Economic Interest	<input type="text"/>
Dark Blue	Rights	<input type="text"/>
Brown	Fairness	<input type="text"/>

Tool for decision-makers to help identify and prioritize stakeholders, beneficiaries and environmental attributes in the scoping phase of a project



# Identify CBP-relevant FEGS and beneficiaries associated with chosen set of BMPs

Use materials already produced by CBP to help inform lists

## Co-benefits identified in Tetra Tech work:

Best Management Practice	Forest Buffers	Additional Co-Benefits					
		Habitat Biodiversity	Brook Trout	Stream Health	Fish Habitat	Healthy Watersheds	Tree Canopy
Agricultural Forest Buffer	5	4	4.5	4	4.5	4	4.5
Forest Conservation	3.5	5	4	4	4	5	5
Forest Harvesting Practices	3.5	2	2	4	3	3	2
Narrow Forest Buffer	5	2.5	3.5	2	3.5	2	5
Streamside Forest Buffers	5	4	4.5	3	4.5	3	5
Urban Forest Buffers	5	5	5	4	4	3.5	4.5

Example from Forest Buffers co-benefit fact sheet

## Local Priorities based on EcoLogix Report

- Economic development
- public health and safety
- infrastructure maintenance and financing
- education

“The more a local elected official sees an action as addressing a local priority, the more likely that elected official is to take the action. Currently, Bay watershed restoration projects are not often viewed by local officials as relevant to local issues.”

-EcoLogix Group, 2017

# Identify CBP-relevant FEGS and beneficiaries associated with chosen set of BMPs



**Example table for Impervious Surface Reduction BMP (not exhaustive):**

Beneficiary	FEGS
Educators and Students	Open space and resources for learning
Electric and other Energy Generators	open space for infrastructure
Experiencers and Viewers	charismatic species * (birds)
Food and Medical Subsisters	edible fauna, flora
Food extractors	berries, fungi
Food pickers and Gatherers	berries, fungi
Fur / Hide Trappers and Hunters	small mammals
Hunters	deer population *
Military / Coast Guard	open space for infrastructure
Military / Coast Guard	open space for training
People Who Care (Existence)	Presence of environment for ethical reasons
People Who Care (Option /Bequest)	Presence of environment for future use
Pharmaceutical and Food Supplement Suppliers	Flora/fauna used in medicine or sold for medicinal purpose
Researchers	resources for research *
Residential Property Owners	open space for infrastructure
Residential Property Owners	pest risk
Timber, Fiber, and Fur / Hide Subsisters	small mammal populations, catch rates

# Identify relevant FEGS metrics, data and models



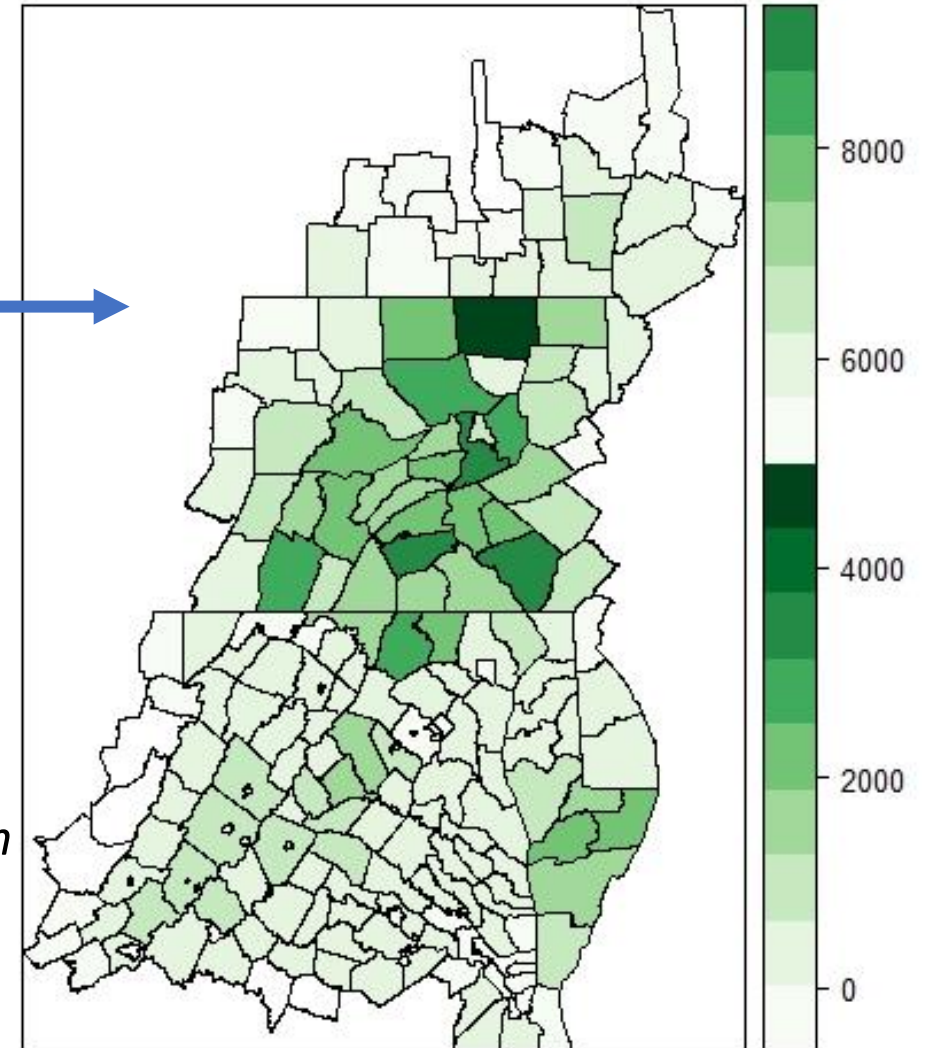
Use existing data:

- Credited acres of BMPs (CAST) 
- High res land cover (CB conservancy, NLCD) 
- EnviroAtlas data

Example models:

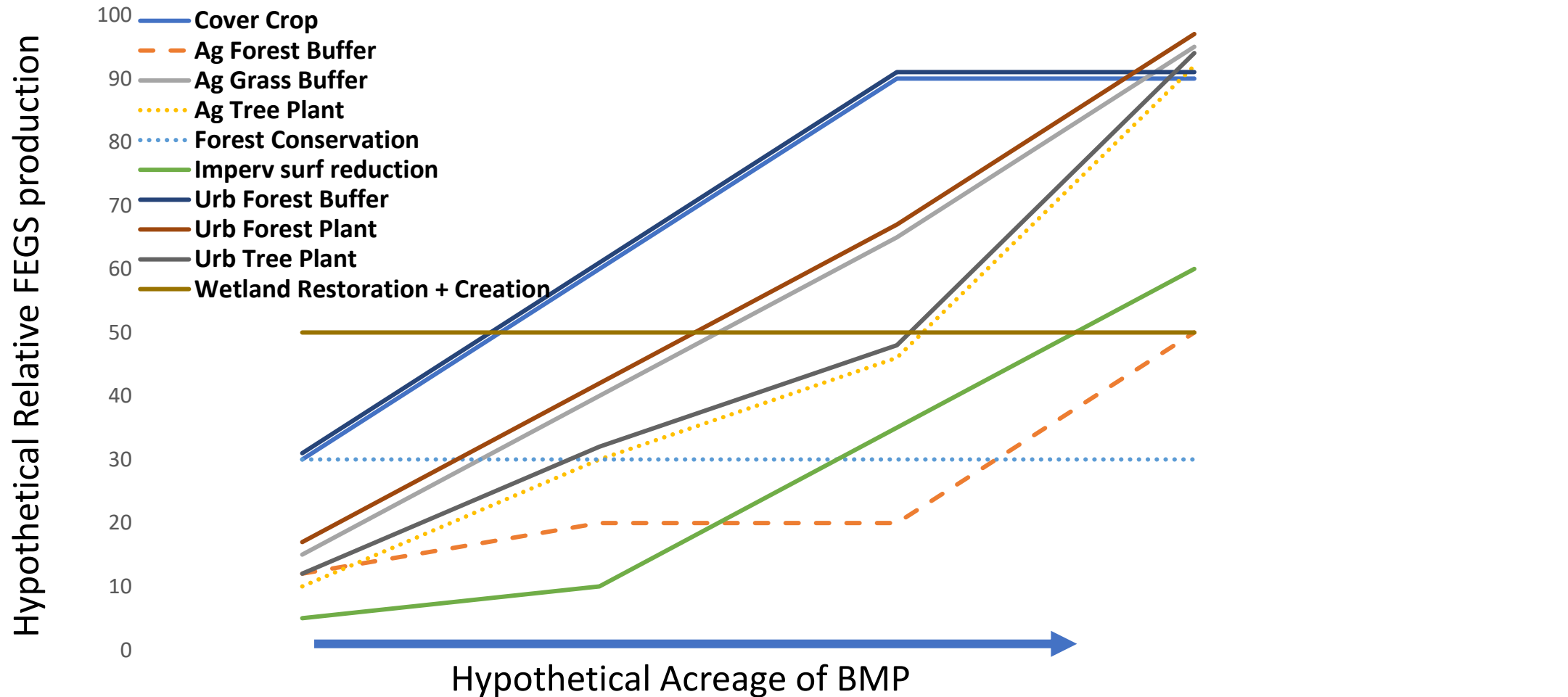
- **Relative pollutant removal** =  $\% \text{canopy cover} \times \text{deposition velocity} \times \text{pollutant concentration}$   
(Nowak et al, 2008, Russel et al, 2013)

WIP3 Ag Forest Buffer BMP (ac)



# Next steps

- Continue the iterative process of refining FEGS/beneficiary lists
  - Review of FEGS/beneficiary lists by partners in coming weeks
- Identify metrics and begin modeling (with continued feedback from project team and partners)



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