

AGRICULTURAL MODELING TEAM BRIEFING

NOVEMBER 1, 2022

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11/1/2022

The screenshot shows the homepage of the Chesapeake Assessment Scenario Tool (CAST). The header includes the tool's name, a navigation menu with links to HOME, PUBLIC REPORTS, LEARNING, ABOUT, and CONTACT US, and a search bar. A prominent banner for new users encourages registration to develop scenarios for reducing nitrogen, phosphorus, and sediment. Below this, a 'RESOURCES' section is organized into six cards: 'DEVELOP A PLAN', 'SOURCE DATA', 'BMPS', 'MAP TOOLS & SPATIAL DATA', 'COSTS', and 'TRACK PROGRESS'. Each card contains a brief description and a button to access the resource. The footer identifies the site as being from the Chesapeake Bay Program Office, Phase 6 - 7.3.0.

Chesapeake Assessment Scenario Tool

HOME PUBLIC REPORTS LEARNING ABOUT CONTACT US

Search Cast...

New to CAST?
Rapidly develop scenarios for reducing nitrogen, phosphorus, and sediment with varying best management practices to streamline environmental planning.
Register for increased functionality and to stay updated.
[Register](#) [Where To Start](#)

RESOURCES

- DEVELOP A PLAN**
Get answers to your questions about how to use CAST to develop a plan.
[Develop A Plan](#)
- SOURCE DATA**
Download data tables including information on load sources and agencies, BMPS, animals, geographic references and delivery factors.
[View Source Data](#)
- BMPS**
View information on best management practices (BMPs) including calculations, a quick reference guide, and protocol and expert panel reports.
[Learn More](#)
- MAP TOOLS & SPATIAL DATA**
View geographical information and shapefiles.
[Learn More](#)
- COSTS**
Download BMP costs data and view cost profiles for each state and Chesapeake Bay Watershed.
[Learn More](#)
- TRACK PROGRESS**
View helpful information on verification, river trends, how to submit progress data via NEIEN, and modeling Federal facilities.
[Track Progress](#)

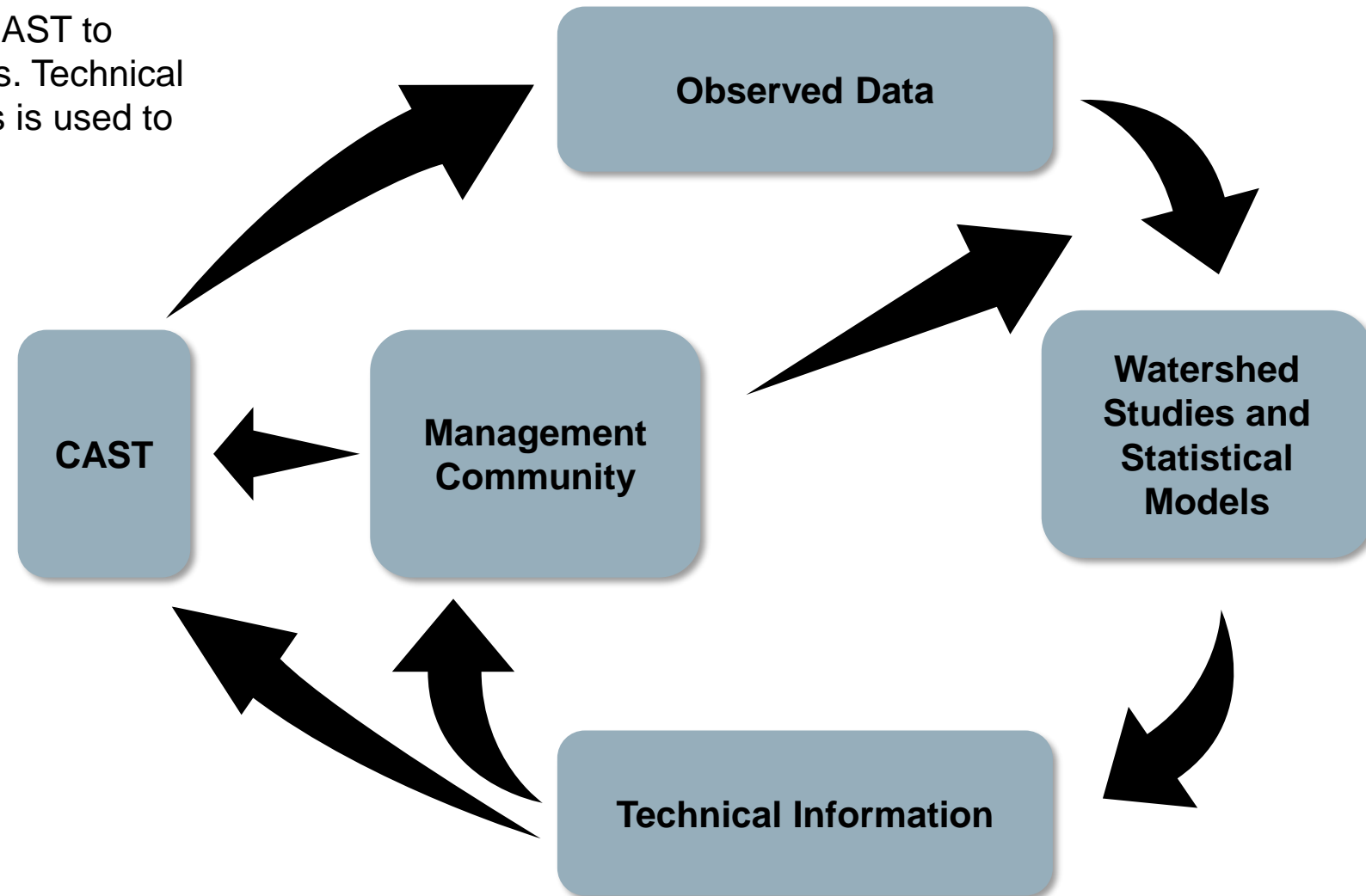
Chesapeake Bay Program Office Phase 6 - 7.3.0

<https://cast.chesapeakebay.net/>

The Chesapeake Bay watershed model (CAST) is a comprehensive synthesis of knowledge that can help direct management

The management community largely relies on CAST to understand and improve water-quality conditions. Technical information about water-quality loads and trends is used to improve and assess modeled predictions.

- **Observed data** are used to develop **watershed studies and statistical models**, based on priorities identified by the **management community**.
- **Watershed studies and statistical models** provide **technical information** that are communicated to the **management community** and used to improve **CAST**.
- The **management community** uses **CAST** to develop management strategies.
- **CAST** assesses predictions and performance against **observed data**.





Chesapeake Bay TMDL: Planning and Tracking

- Setting goals and tracking progress holds all our partners accountable for their work.
- Phase III Watershed Implementation Plans (WIPs) are the roadmap for how to get from 2017 to 2025
- The new model version, Phase7, will result in new planning targets for each state river basin, with a new implementation plan. This will guide us toward Bay restoration post 2025
- States use CAST to track best management practices (BMP) implementation toward the Bay TMDL, as required in the jurisdictions' grant guidance
- Pollutant load reductions (N, P, S) from BMPs are modeled in CAST, online at CAST.chesapeakebay.net
- CAST is the watershed model used for annual assessments and planning, and the official documentation of the model is on the CAST site
- CAST is named as the tool to develop the Maryland TMDL plans and is referenced in Virginia's TMDL implementation plan guidance

History

- The first version was launched in 2011 at the request of MDE to provide local jurisdictions, such as counties, with a tool to provide input into the Bay TMDL Phase II WIP process.
 - The Bay Program decided that the tool was useful and should become a Bay Program tool available to the entire Chesapeake Bay Watershed.
 - CAST can be accessed online for free. CAST has 1,500+ users
 - CAST is used to develop implementation plans and show the loads reduced for annual progress assessments
 - CAST allows local communities to generate results and can help states, local governments and others identify which pollution prevention strategies and conservation practices make the most sense, given their available resources.
- **Outcome: The model became more transparent and could be used by anyone**



Uses of CAST

- Planning tool to:
 - Develop a plan with multiple BMPs across a large area, not a single farm, and determine load difference from present condition
 - Understand the data that is used to inform CAST load estimates
 - Prioritize which BMPs have the most effect on loads
 - Evaluate cost effectiveness of BMPs
 - Assess where a BMP would have the most load reduction

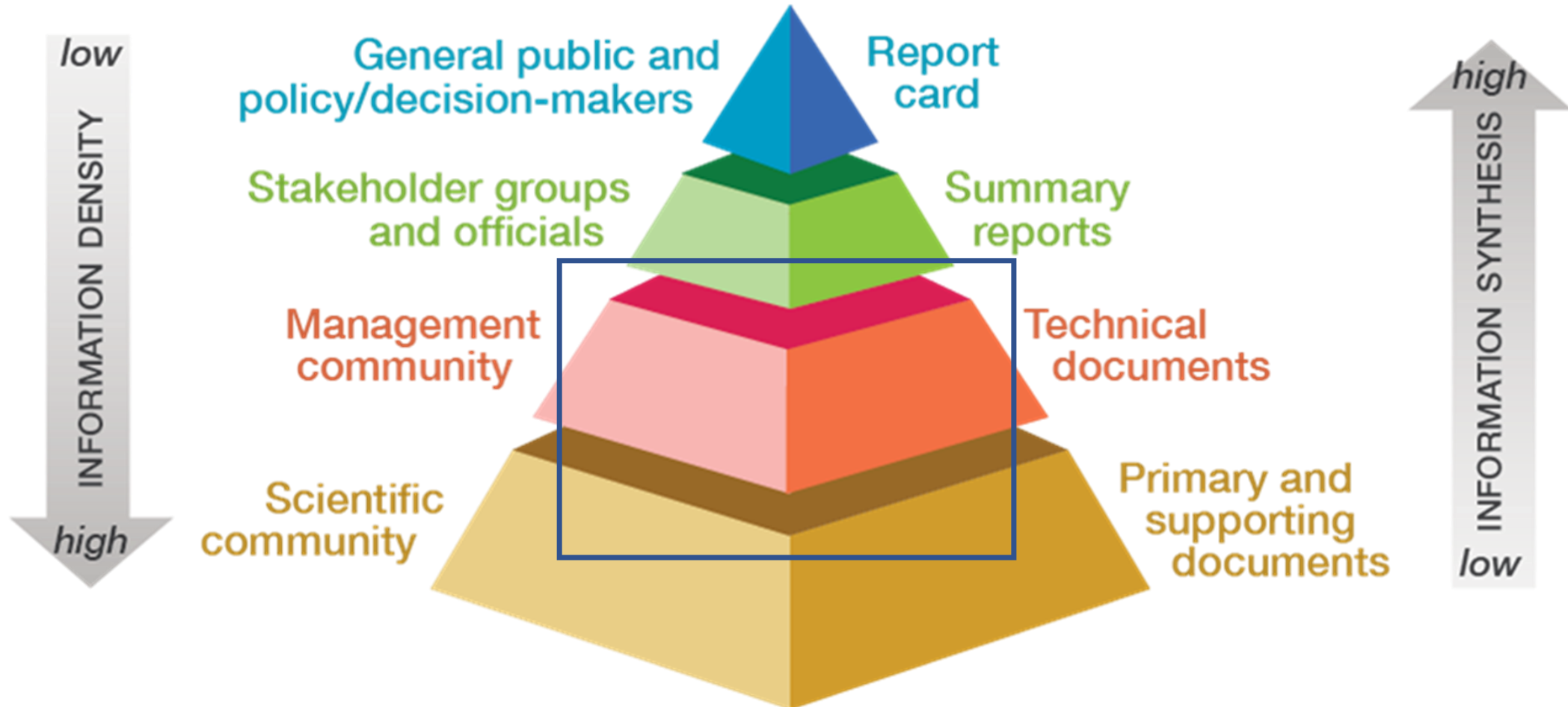
Who is CAST for?

Technical managers within jurisdiction agencies who plan and report for the 2010 Bay TMDL

Local watershed organizations

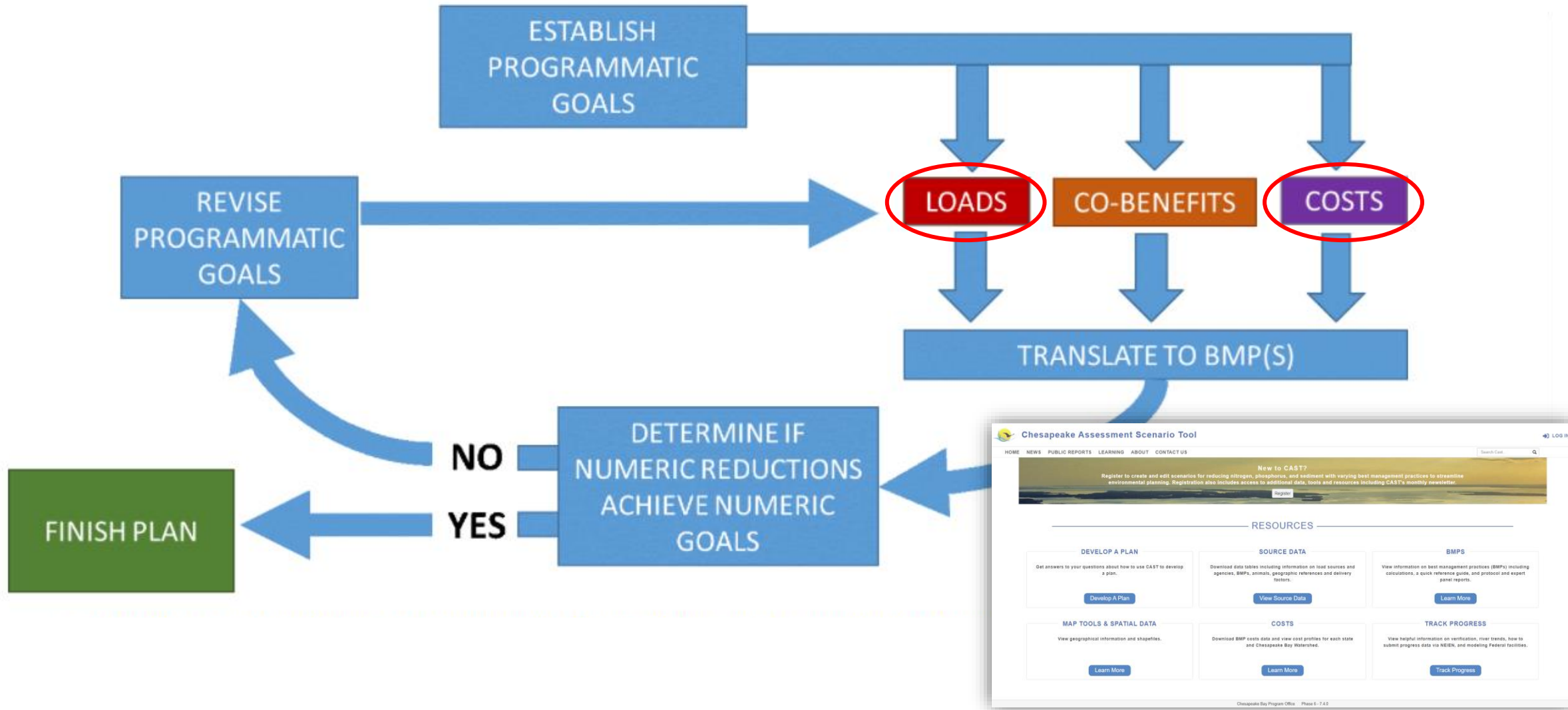
Local government planners

Federal, state, and academic researchers





Steps to Developing a Plan and Assessing Progress



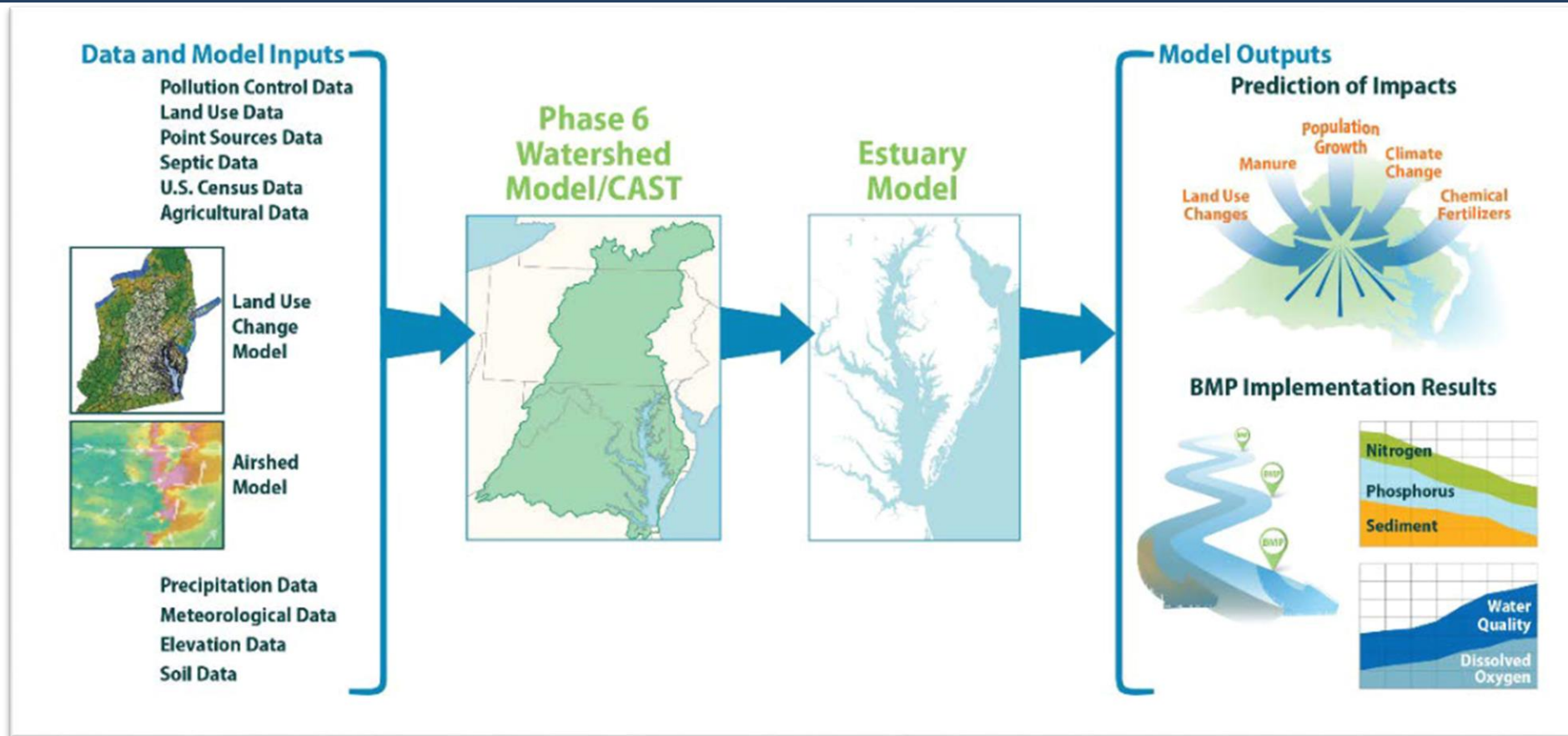
Typical Questions Answered with CAST

1. What is the load reduction from a BMP implemented in my community?
2. What is the current land use and land cover in my community and where can I quickly access these data?
3. How do I find out how my pollutant loads and land uses are projected to change for various 2025 development scenarios for my community?
4. Which BMPs are currently in the Model for my community?
5. How can I estimate which of those BMPs were implemented as part of my MS4 permit?

More Questions CAST Can Answer

6. How do I find out what the load reductions are from BMPs implemented and planned?
7. Which BMPs are most cost-effective?
8. What are the co-benefits associated with each BMP?
9. How can I show the results of my analyses in a way that makes sense to non-technical people?
10. Which BMP will give me the most load reduction?
11. Where should I target BMPs to generate the most load reduction?

Data Sources



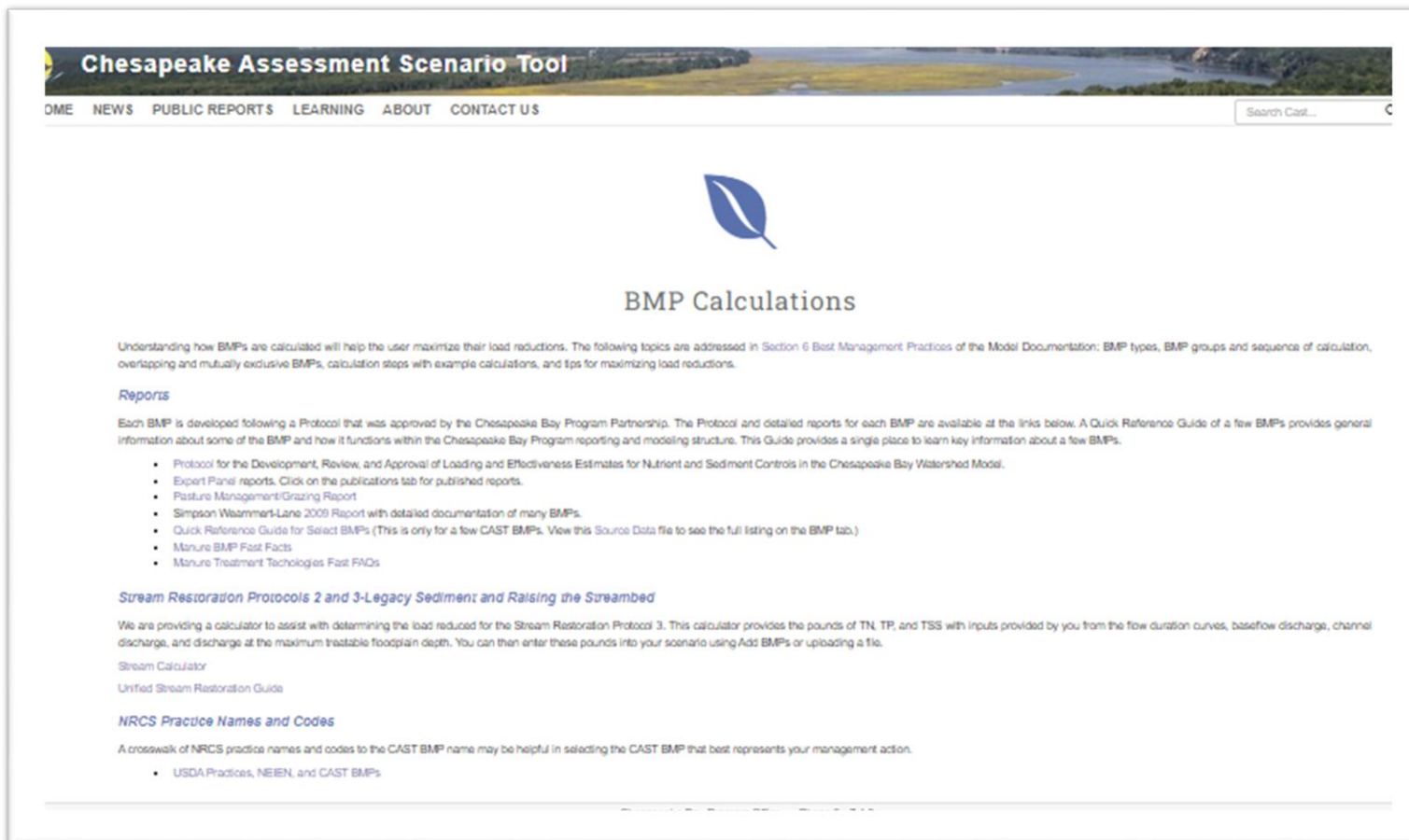
- Agricultural Census
 - Animals and feeding space
 - Crops/land use
 - Crop yield
- Chesapeake Bay Land Use – Land Change Model
- Onsite wastewater disposal systems
- Crop Nutrient Need and Availability

Current Geographic Scales

- Chesapeake Bay Watershed
- State
- County
- Major and minor basins
- Watersheds defined in hydrologic unit code scales of 4, 6, 8, 10, and 12 digits
- Land-River Segments
- In Virginia
 - Planning District Commission
 - Conservation Districts
 - Conservation District Areas



BMPs



The screenshot shows the homepage of the Chesapeake Assessment Scenario Tool (CAST). The header includes the title "Chesapeake Assessment Scenario Tool" and a navigation menu with links: HOME, NEWS, PUBLIC REPORTS, LEARNING, ABOUT, and CONTACT US. A search bar is located on the right side of the header. Below the header is a large image of a coastal landscape. In the center, there is a blue leaf icon and the text "BMP Calculations". Below this, there is a paragraph explaining that understanding how BMPs are calculated will help the user maximize their load reductions. The text mentions that the following topics are addressed in Section 6 Best Management Practices of the Model Documentation: BMP types, BMP groups and sequence of calculation, overlapping and mutually exclusive BMPs, calculation steps with example calculations, and tips for maximizing load reductions. There is a section titled "Reports" with a paragraph stating that each BMP is developed following a Protocol that was approved by the Chesapeake Bay Program Partnership. The paragraph mentions that the Protocol and detailed reports for each BMP are available at the links below. A Quick Reference Guide of a few BMPs provides general information about some of the BMP and how it functions within the Chesapeake Bay Program reporting and modeling structure. This Guide provides a single place to learn key information about a few BMPs. Below this paragraph is a bulleted list of links: Protocol for the Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Watershed Model; Expert Panel reports. Click on the publications tab for published reports; Pasture Management/Grazing Report; Simpson Warrum-Lane 2009 Report with detailed documentation of many BMPs; Quick Reference Guide for Select BMPs (This is only for a few CAST BMPs. View this Source Data file to see the full listing on the BMP tab.); Manure BMP Fast Facts; and Manure Treatment Technologies Fast FAQs. There is a section titled "Stream Restoration Protocols 2 and 3-Legacy Sediment and Raising the Streambed" with a paragraph explaining that they are providing a calculator to assist with determining the load reduced for the Stream Restoration Protocol 3. This calculator provides the pounds of TN, TP, and TSS with inputs provided by you from the flow duration curves, baseflow discharge, channel discharge, and discharge at the maximum treatable floodplain depth. You can then enter these pounds into your scenario using Add BMPs or uploading a file. Below this paragraph are links for Stream Calculator and Unified Stream Restoration Guide. There is a section titled "NRCS Practice Names and Codes" with a paragraph explaining that a crosswalk of NRCS practice names and codes to the CAST BMP name may be helpful in selecting the CAST BMP that best represents your management action. Below this paragraph is a bulleted list of links: USDA Practices, NEEN, and CAST BMPs.

- Information about BMPs
- Sources of BMP data
- Process for introducing new BMPs for use in scenarios
- Crosswalks to NRCS and other practice names

Comprehensive Source Data



[HOME](#) [NEWS](#) [PUBLIC REPORTS](#) [LEARNING](#) [ABOUT](#) [CONTACT US](#)

Search Cast...



Phase 6 Source Data

Download data tables including information on load sources and agencies, BMPs, animals, geographic references and delivery factors. The Source Data includes the following data tables:

- Load Source Definitions
- BMP Definitions
- Efficiency BMPs
- Load Source Conversion BMPs
- Load Reduction BMPs
- Animal BMPs
- BMP Units
- BMP Load Source Group
- Load Source Group Components
- BMP Animal Group
- Animal Group Components
- Geographic References
- Geographic Scale and Names
- Agencies
- Delivery Factors

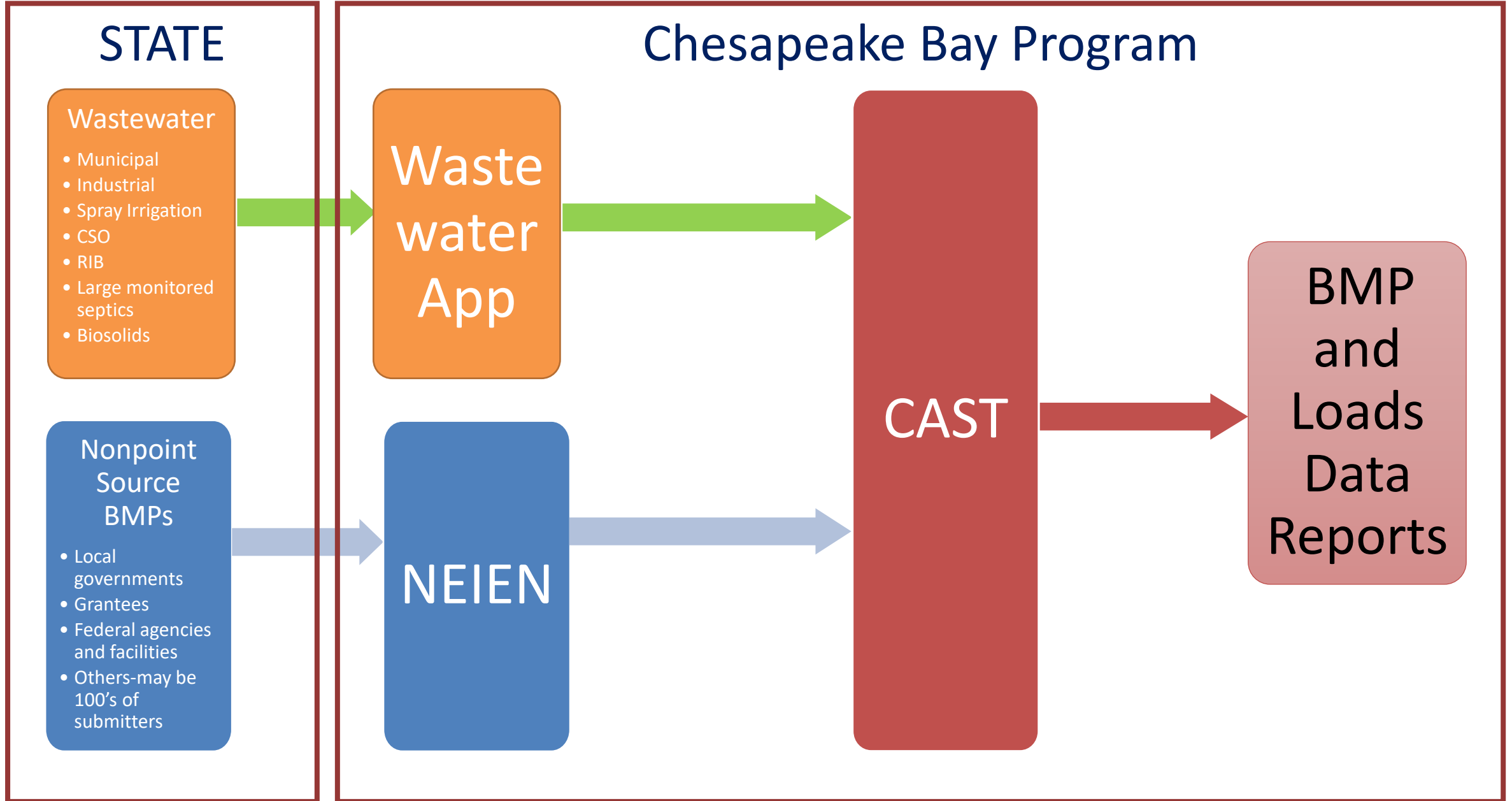
[Download Source Data](#)

Download data tables including the tables listed below. Note that actual crop nutrient applications vary depending on acres of the crop, application yield goal, nutrient management, and monthly timing, and type and amount of nutrients available. The tables provide the factors used to determine the nutrient application amounts that may be applied depending on the specific conditions in any scenario.

- Double cropped crops
- Crop and load source relationship
- Plant and harvest dates
- Developed land (turfgrass) nutrient pounds per yield
- Agricultural crop nutrient pounds per yield
- Crop nutrient application by month
- Crop nutrient uptake, removal, and nitrogen fixation
- Crop cover factor
- Crop cover fraction
- Sediment tons available to erode due to plowing, by crop type

[Detailed Crop and Turfgrass Source Data](#)

TMDL Progress data



COST PROFILES

My Cost Profiles ?



[View Documentation](#)

Add New Cost Profile

Clear Filters

Cost Profile Name	Edit	Download	Delete	
MD				^
pa				
Maryland_ExampleMaxCosts				
Lancaster				v

Shared Cost Profiles ?

Clear Filters

Cost Profile Name		Download	
West Virginia			^
Virginia			
Pennsylvania			
New York			
Watershed	CBP Admin		
Maryland	CBP Admin		
Delaware	CBP Admin		
District of Columbia	CBP Admin		v

Add Cost Profile

* Required field

Name *

Description *

(Max. characters 500)

Copy From Existing *

Select Cost Profile

Cost Formula *

Select Cost Formula

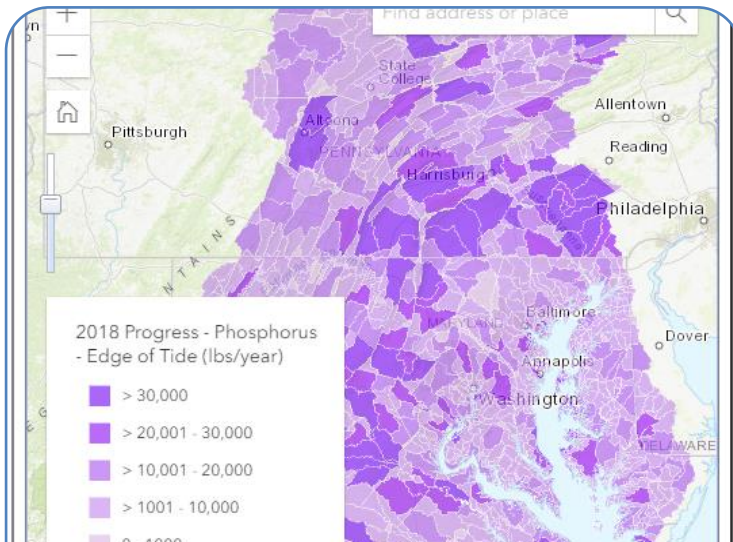
Share Cost Profile

Select How to Share

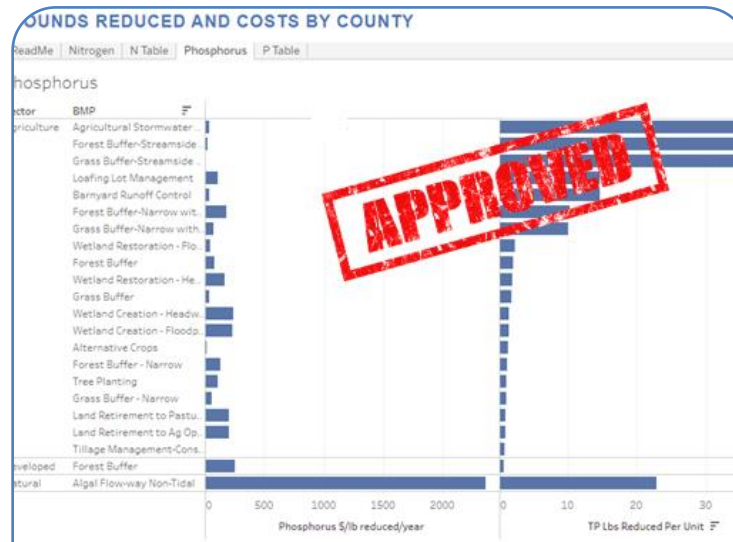
Save

Cancel

Targeting Reductions



Location



BMP



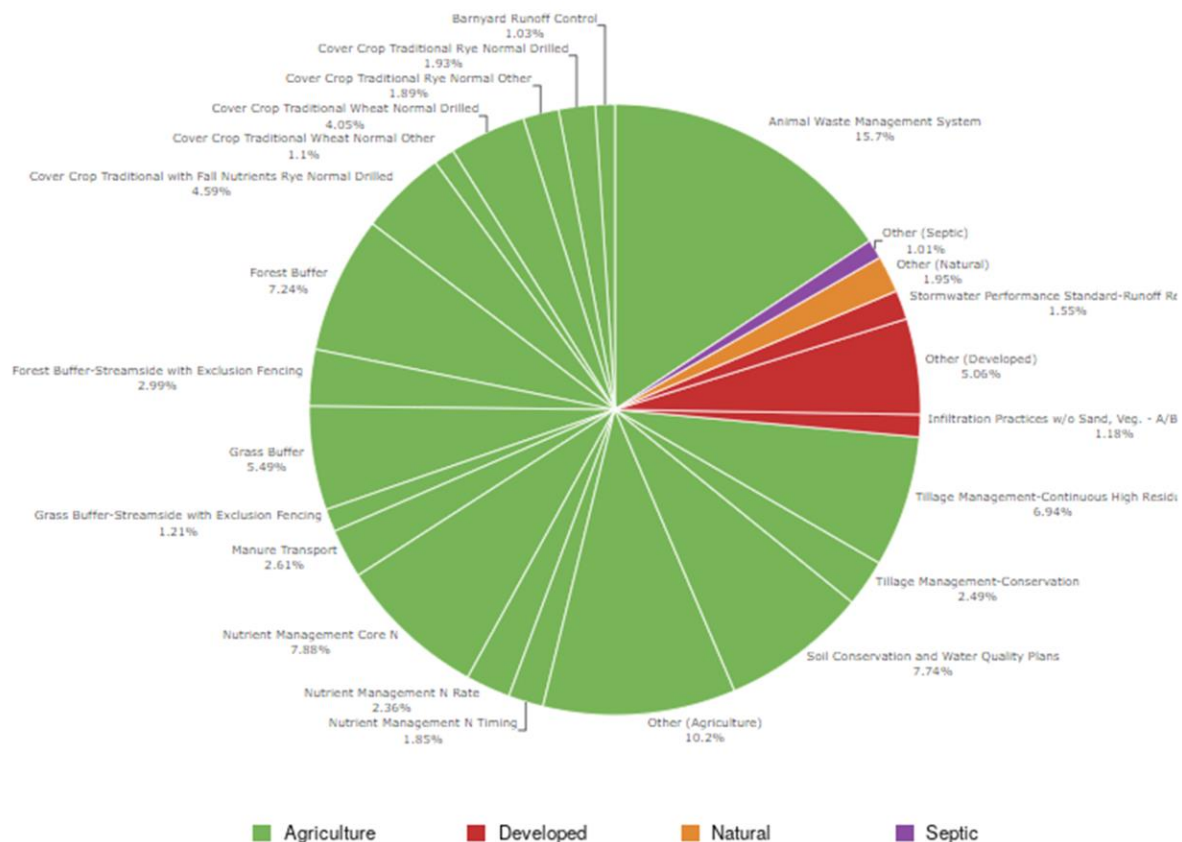
Land Use



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BMP Effectiveness for Nitrogen (Unweighted Percentages for Chesapeake Bay Watershed)



Percentages Based on Total Implementation

Total implementation percentages are the reduction in a nutrient for a specific BMP divided by the total reduction across all BMPs.

For each BMP, the formula for the unweighted percentage is:

$$P_T = 100 \times (\text{reduction in nitrogen for that BMP}) / (\text{reduction in nitrogen for all BMPs}).$$



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BMP Effectiveness

BMP Cost-Effectiveness

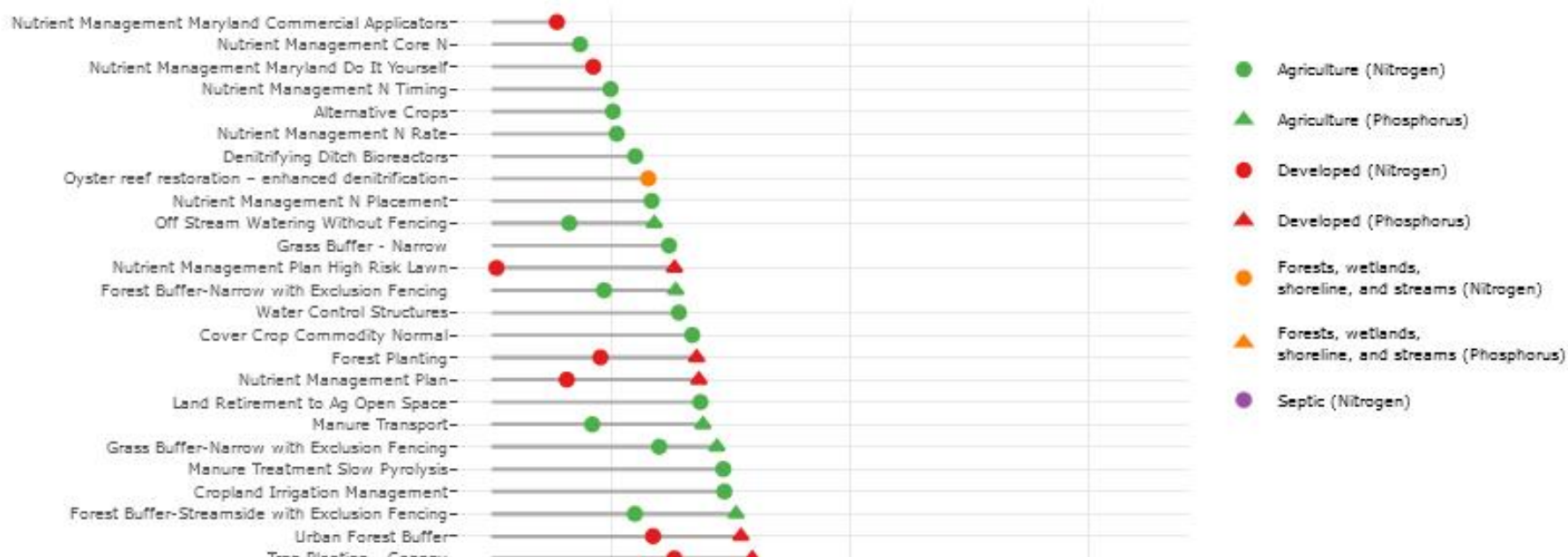
Most Implemented BMPs

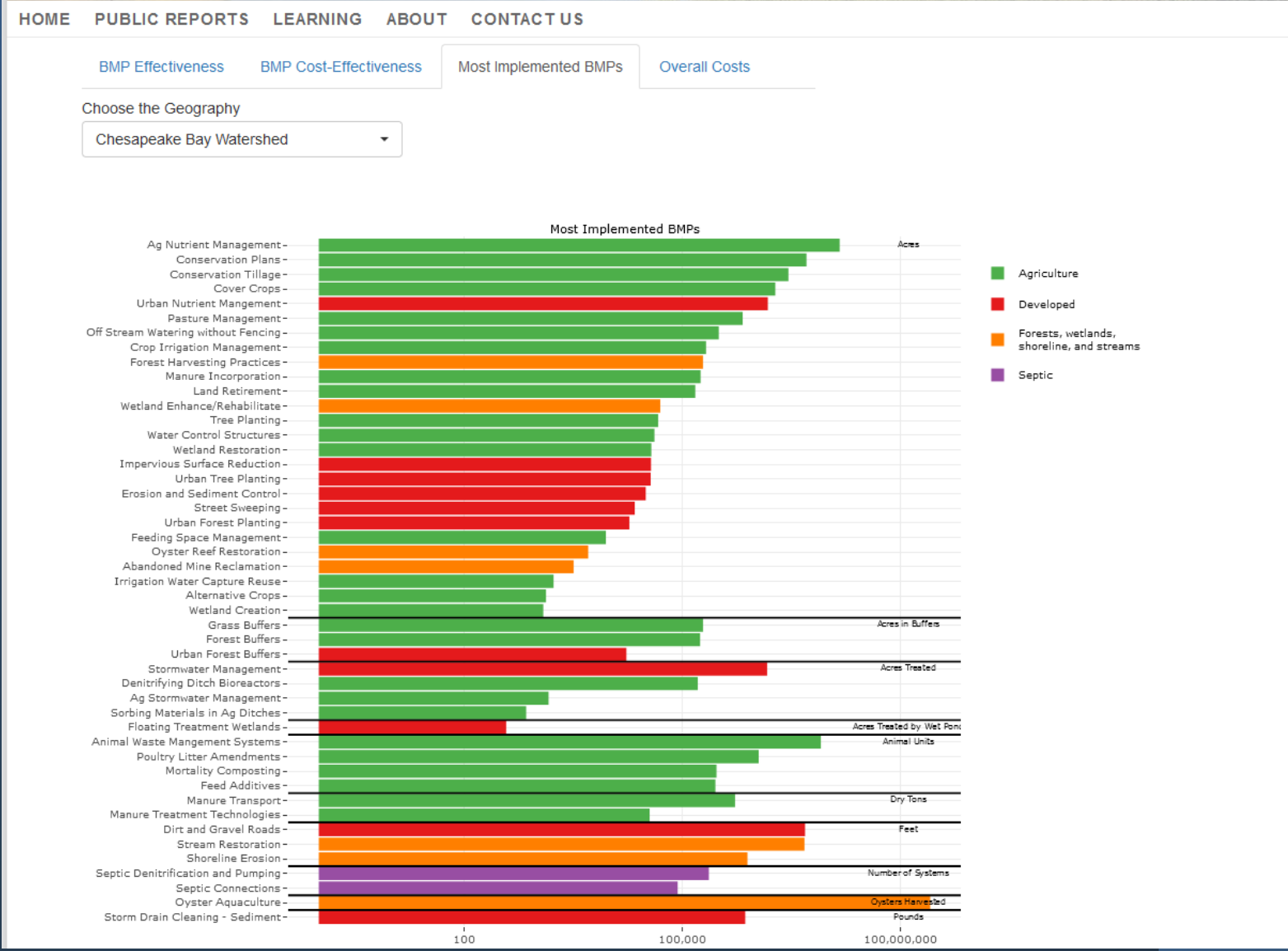
Overall Costs

Choose the Geography

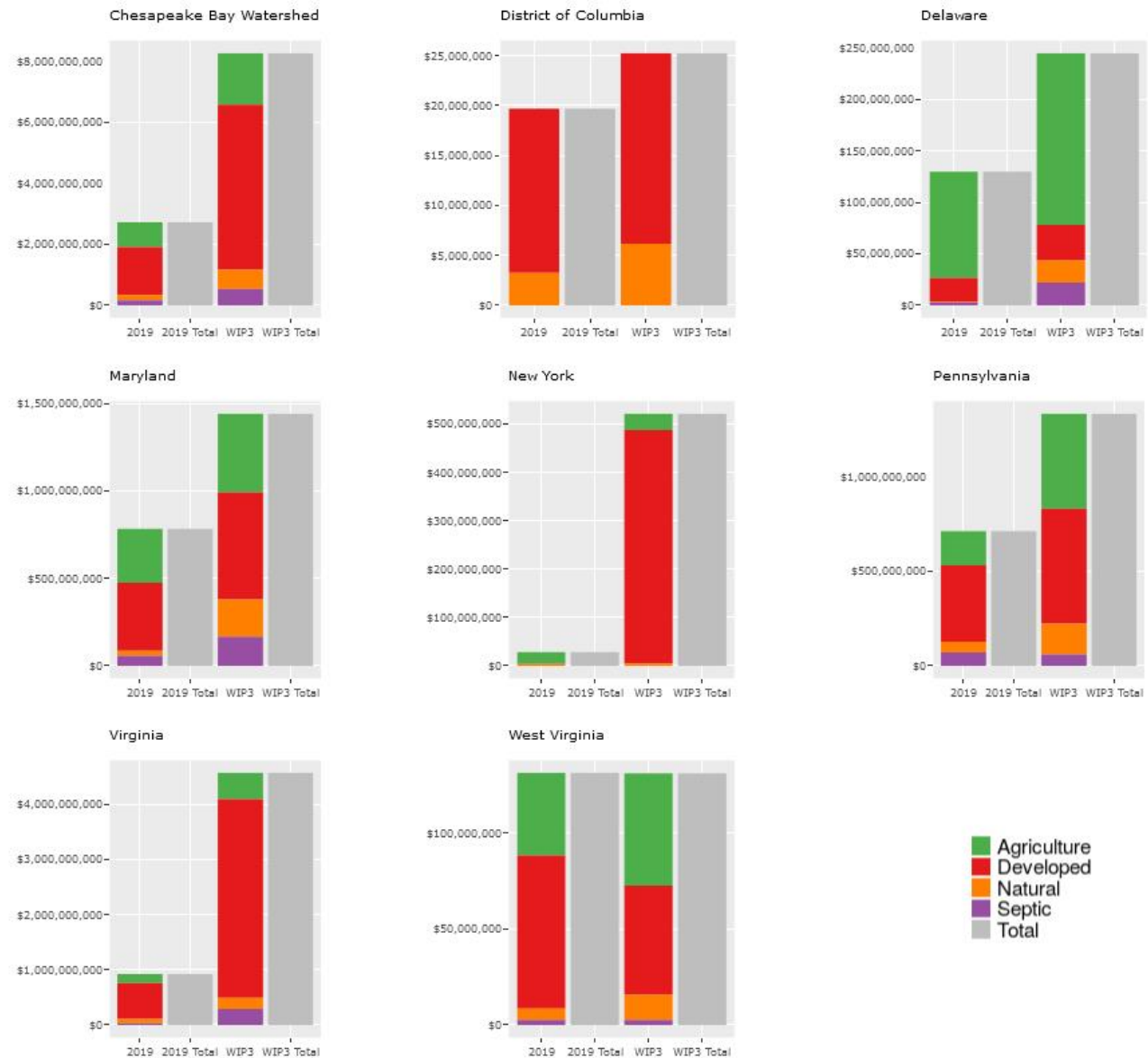
Chesapeake Bay Watershed

BMP Cost-effectiveness (N vs. P for Chesapeake Bay Watershed)





2019 and WIP3 Implementation Costs



Better Targeting CBP Resources to Achieve Multiple Outcomes: Approach and Tools

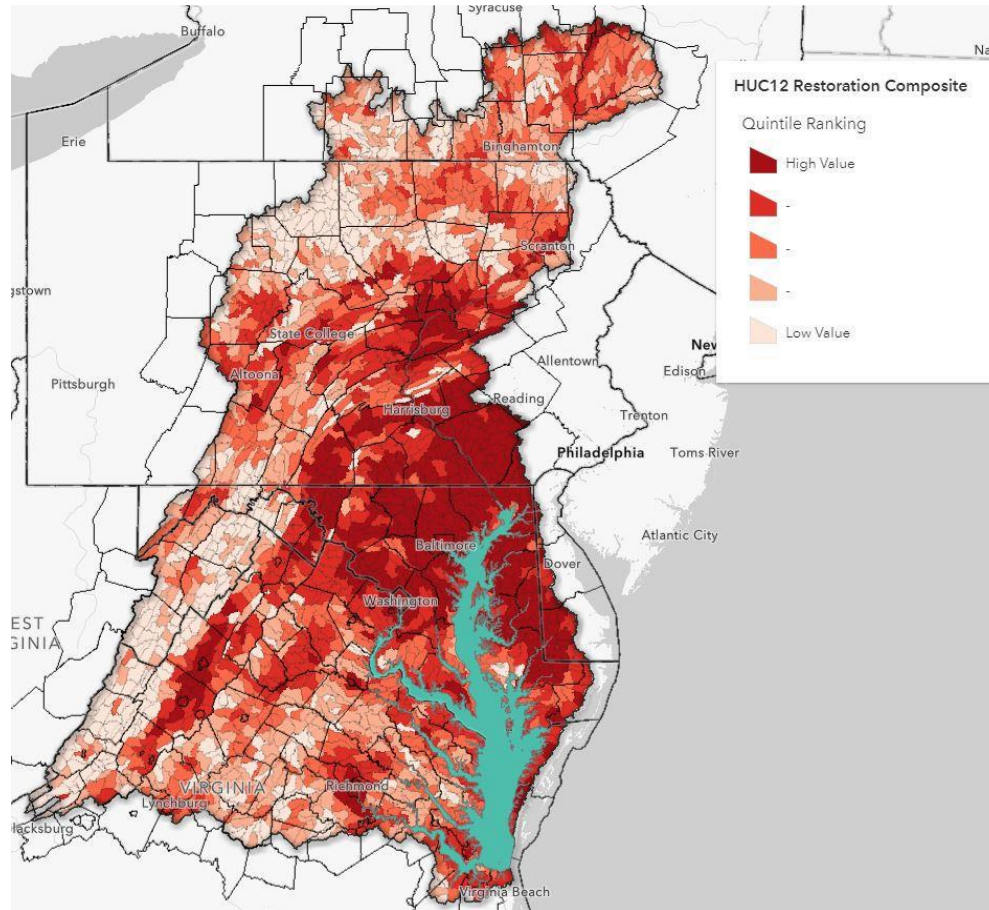


Figure 4 shows the composite restoration map of places where multiple outcomes can be met for water-quality improvements, toxic contaminants, and habitat connectivity. These outcomes were selected by the GITs.

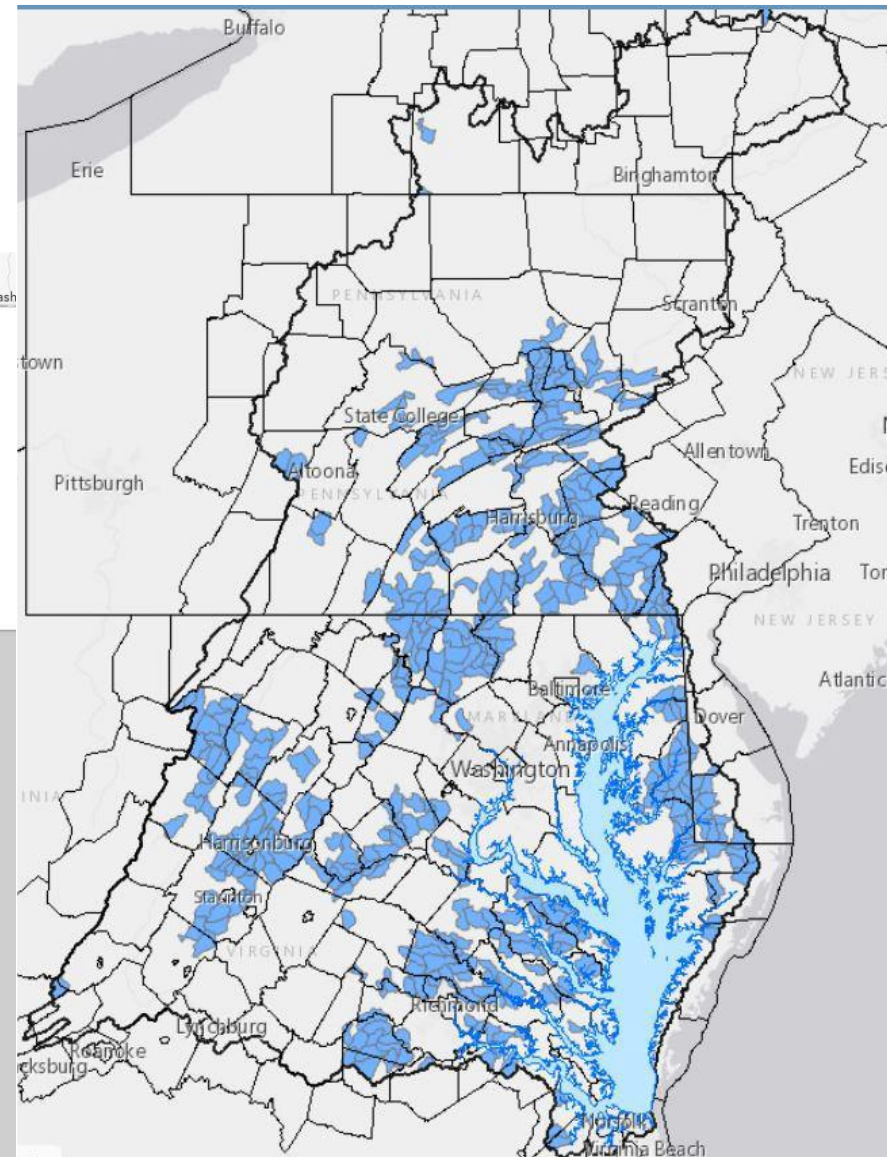


Figure 3. Ranking by states for places to get the highest reduction of nitrogen loading to the Bay and local water-quality improvements (from the Chesapeake Agricultural Priority Watersheds tool).

Use Results → Graphs to Evaluate Load Reductions

Chesapeake Assessment Scenario Tool olivia@devereuxconsulting.com
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GRAPH SCENARIOS

Create Graph

GRAPH SCENARIOS

Geographic Scale *

County

Geographic Area *

Search...

Kent, DE
New Castle, DE
Sussex, DE
Allegany, MD
Anne Arundel, MD
Baltimore, MD
Calvert, MD
Caroline, MD
Carroll, MD
Cecil, MD
Charles, MD
Dorchester, MD
Frederick, MD
Garrett, MD
Harford, MD
Howard, MD

Washington, DC

Agency *

Department of Defense X

Scenario 1 *

2016 Progress V14

Scenario 2

2017 Progress V9

Scenario 3

2018 Progress

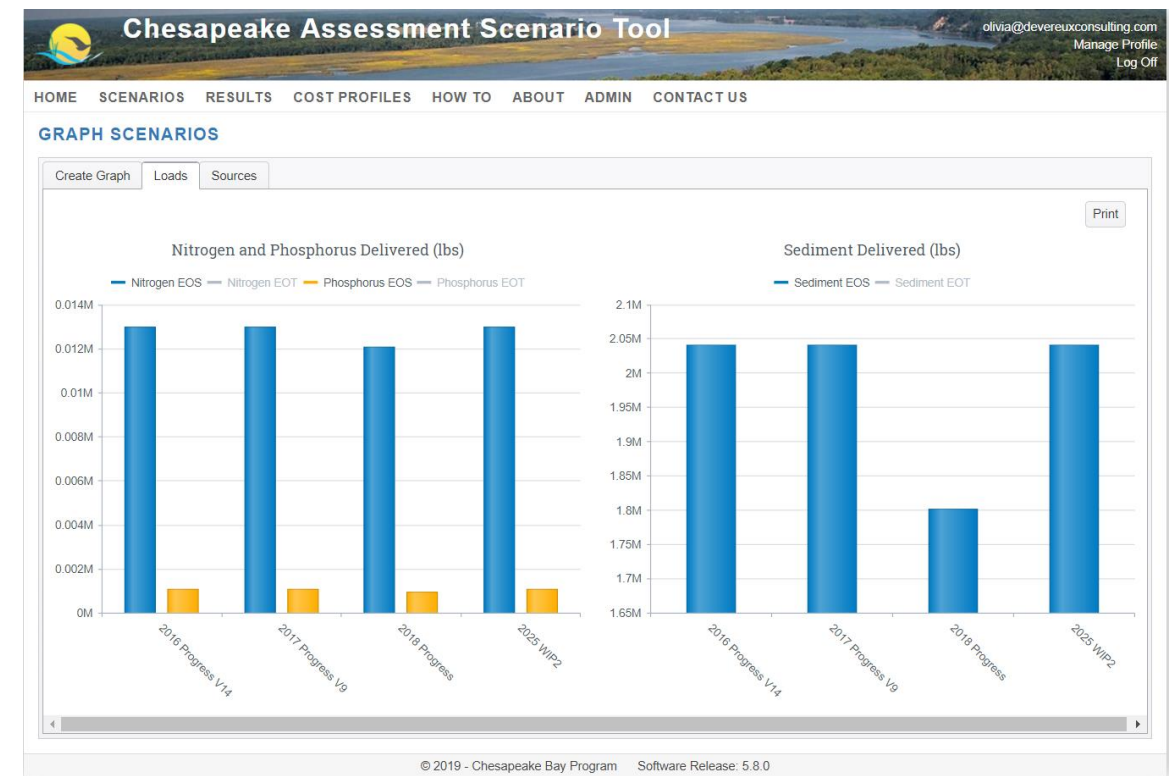
Scenario 4

2025 WIP2

Graph

View Documentation

© 2019 - Chesapeake Bay Program Software Release: 5.8.0





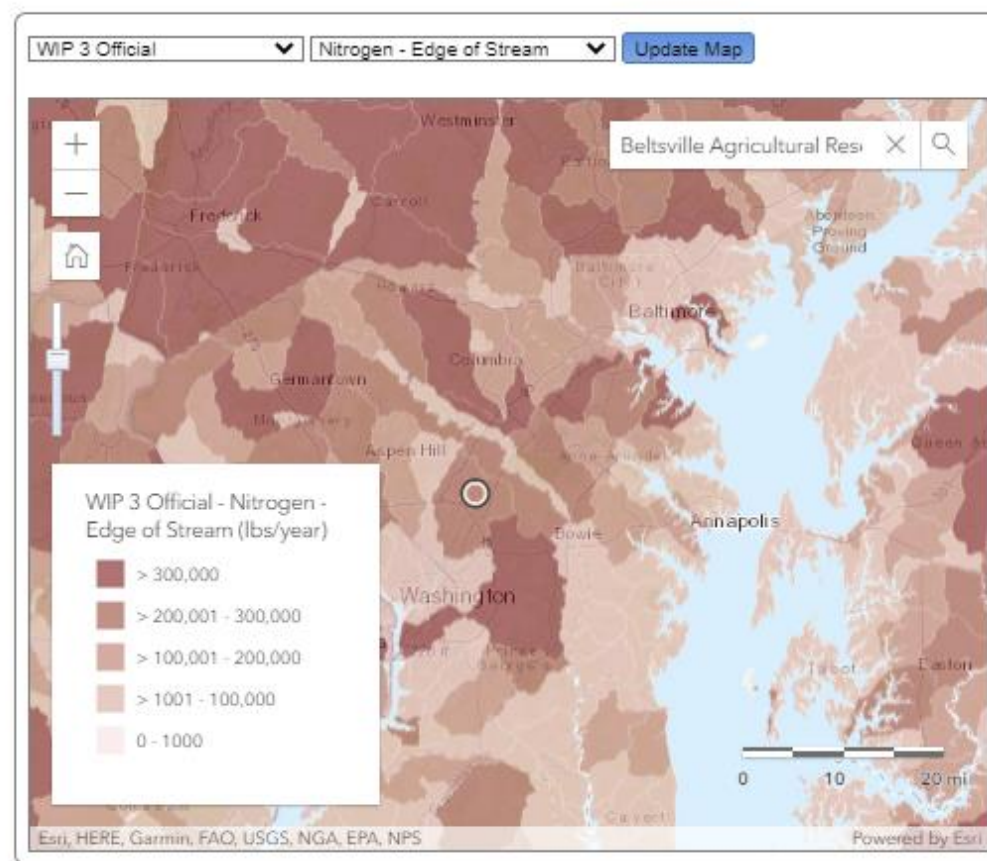
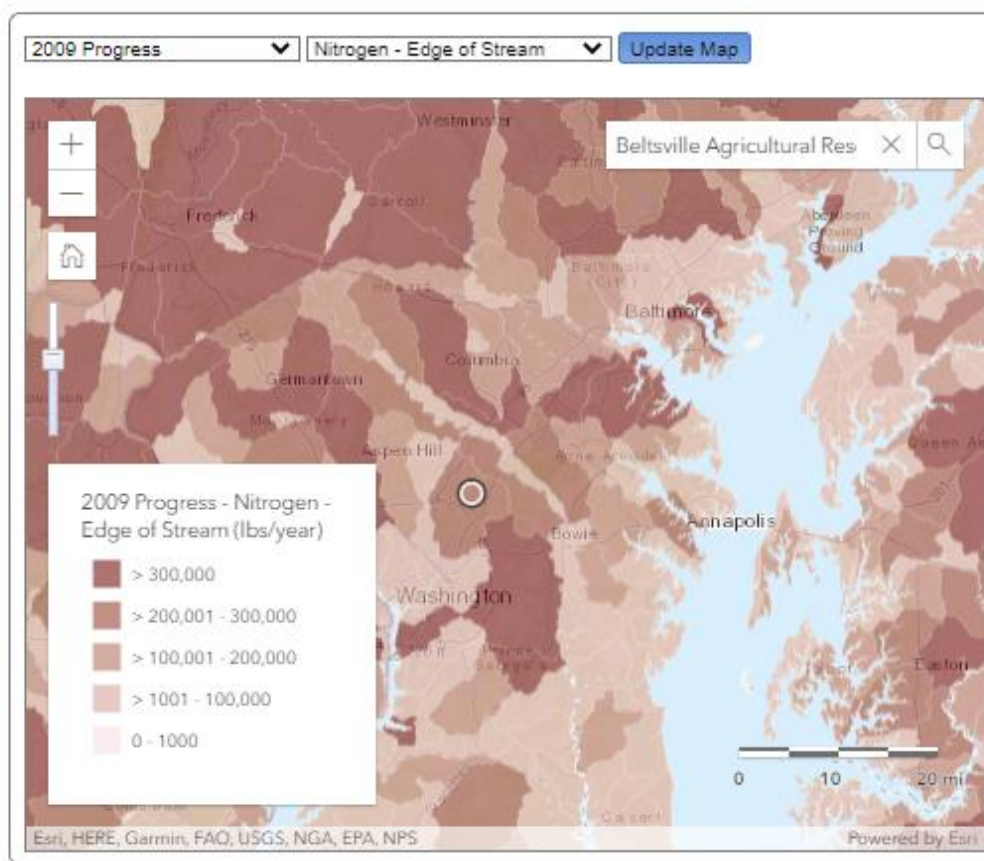
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PUBLIC REPORTS - COMPARE MAP

The publicly-shared scenarios include annual progress, no action, Everything by Everyone, Everywhere (E3) and the Phase 2 Watershed Implementation Plans (WIP2). These maps facilitate comparison of nitrogen, phosphorus, and sediment loads at either the edge-of-stream or edge-of-tide scale. Select a scenario and pollutant in each map to compare scenarios, then click a land-river segment for more details. View a full sized version of the map [here](#).



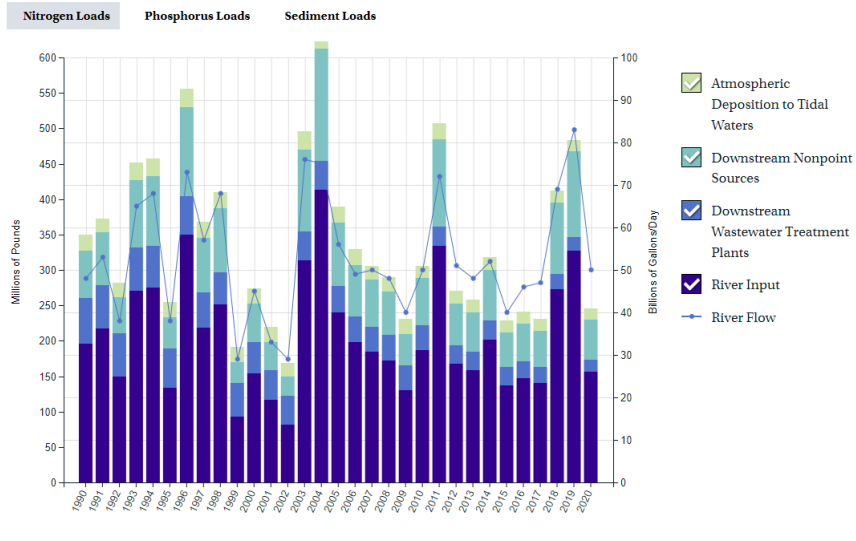
Ultimately, Progress Is Reflected in the Monitoring Data

<https://www.chesapeakeprogress.com/clean-water/water-quality>

Pollution Loads and River Flow to the Chesapeake Bay (1990-2020)

River and Watershed Input of Pollution Loads. Years denote the water year measured between October 1 and September 30.

[VIEW CHART](#) [VIEW TABLE](#)

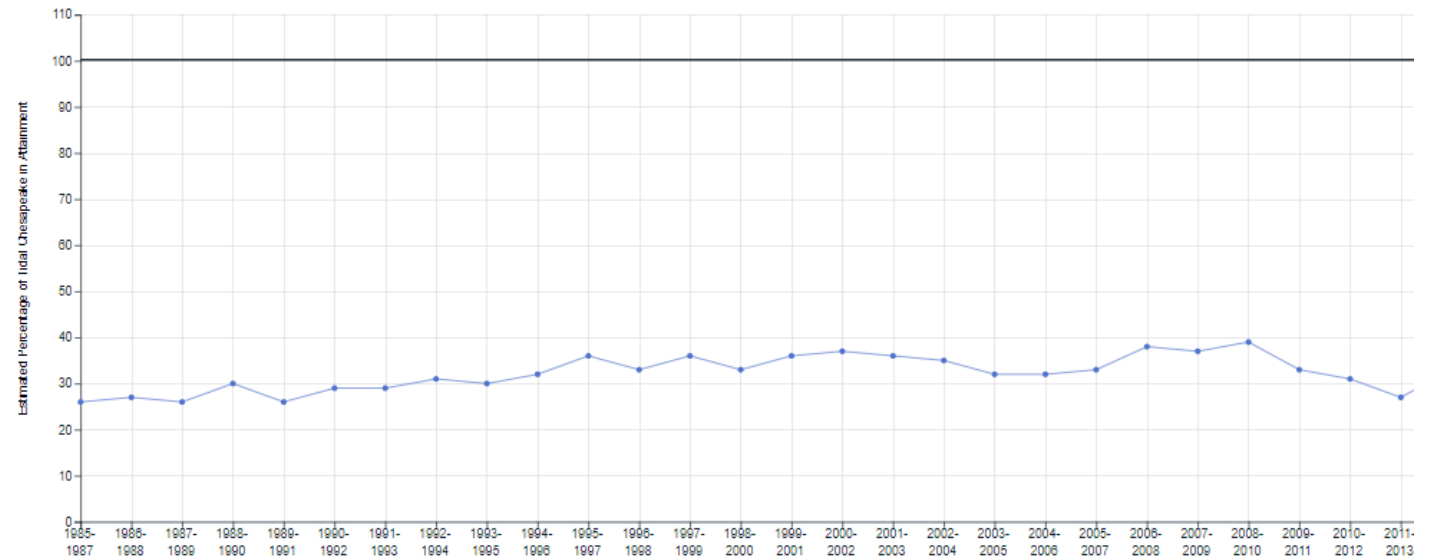


Downloads: [Data \(xlsx\)](#) [Methods \(pdf\)](#) [Screenshot \(png\)](#)

Water Quality Standards Attainment (1985-2020)

Water quality is evaluated using three parameters: dissolved oxygen, water clarity or underwater grass abundance, and chlorophyll a (a measure of algae growth).

[VIEW CHART](#) [VIEW TABLE](#)



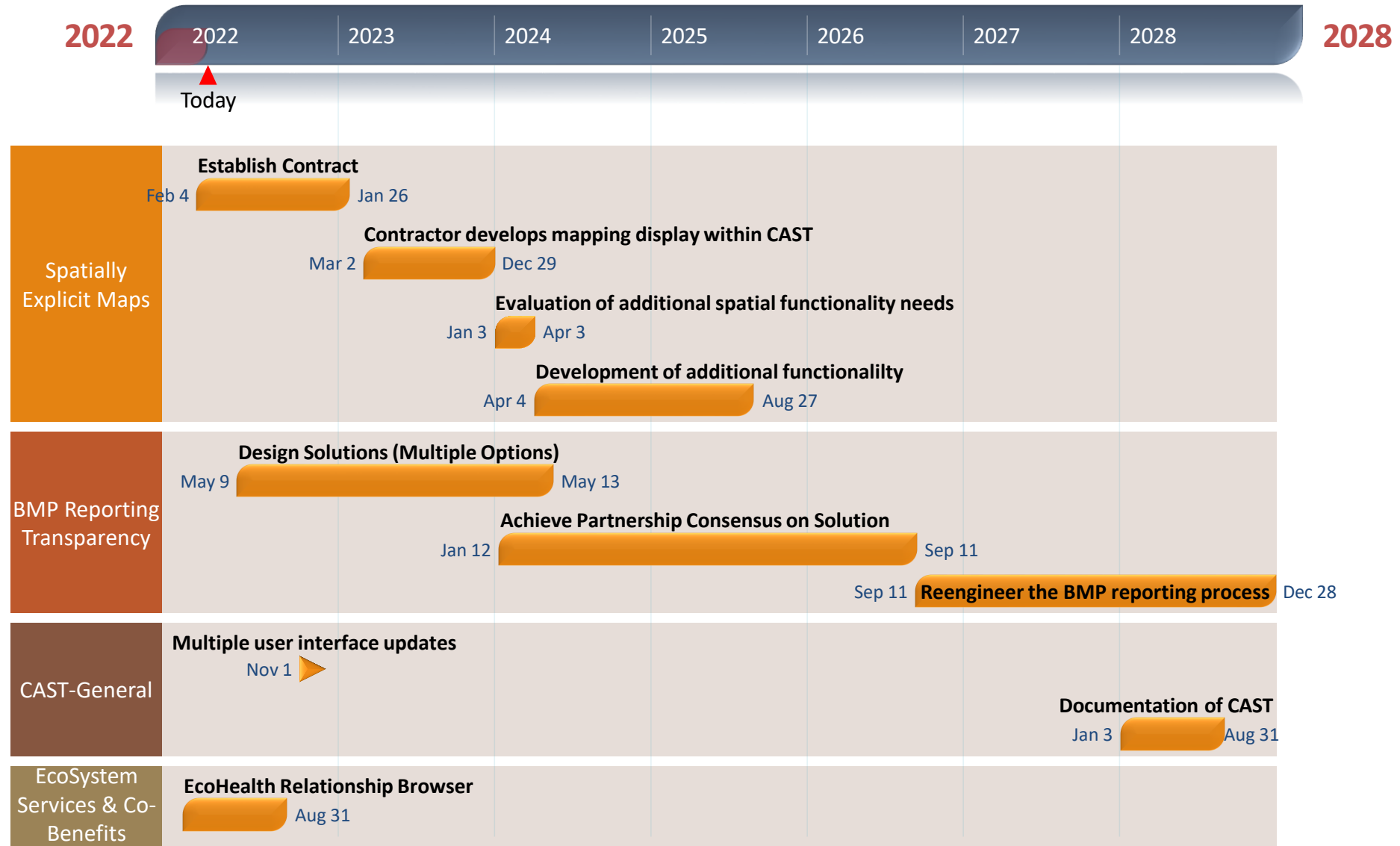
Planned CAST Enhancements

- Improved transparency in BMP annual reporting
- BMP Benefits and Eco-System Services
- Integrating land use views in CAST

Goal Implementation Teams					
Sustainable Fisheries	Protect & Restore Vital Habitats	Protect & Restore Water Quality	Maintain Healthy Watersheds	Foster Chesapeake Stewardship	Enhance Partnering, Leadership & Management

CAST Timeline

*contingent on funding and staff availability

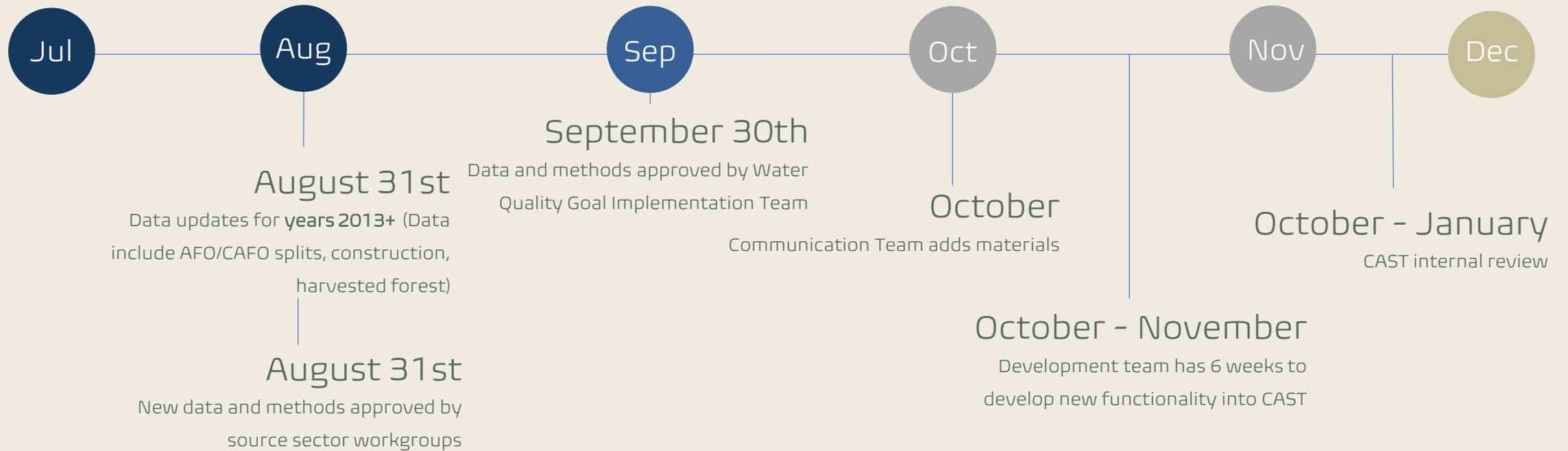


Updating CAST

- Scientific methods and data evolve over time, so new methods and data must be incorporated into its modeling tools.
- It was decided that with the development of each jurisdiction's milestones, the partnership would hold the assumptions set at the beginning of that 2-year milestone period constant. (Decision: WQGIT Dec. 2015 and Management Board Jan. 2016)
- Land uses are predicted at the beginning of the milestone period and these projections are not changed. At the end of the two years, new data approved by the partnership is incorporated into past and present progress runs.
 - BMP updates
 - Land use
 - Crop acres and yields
 - Animal numbers
- By holding assumptions constant for the milestone period and updating with new data and information every two years, the model more accurately reflects what is happening on the ground.

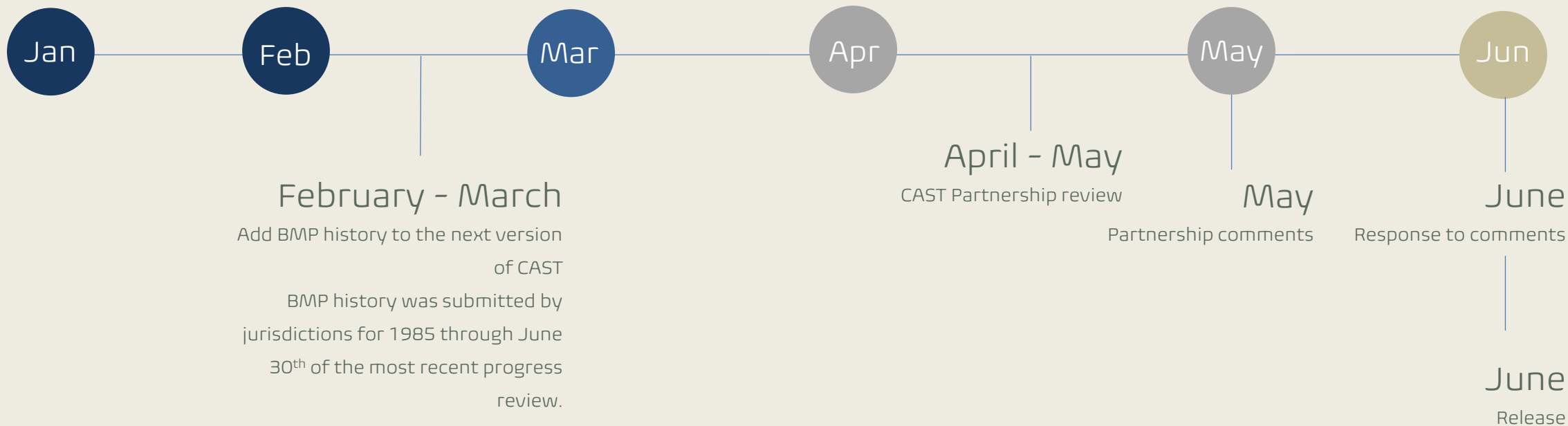
CAST Update Deadlines

2023



CAST Update Deadlines

2024



Differences between CAST and Dynamic Watershed Model

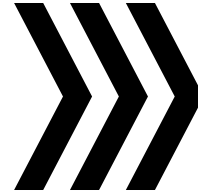
Dynamic Watershed Model

Incorporates the following in the calibration process and produces the data used in CAST

- Assess lag times in UNEC, and Modflow
- Determines river delivery factors
- Supplies average hydrology (storm/baseflow inches per year)
- Provides hourly input the Estuarine model

Data Analyses used in CAST

- Phase 5.3.2 for average loads and nitrogen sensitivity
- USGS Sparrow regression model for average loads, nitrogen sensitivity, land to water and stream delivery factors
- USDA CEAP/APEX Chesapeake model for average loads and nitrogen sensitivity
- APLE for phosphorus sensitivity
- RUSLE (equation, not software product) for sediment edge of field loads



- CAST is the model used for assessing impacts of BMPs
- CAST incorporates data from the time-variable, Dynamic Watershed Model

Resources Available

- CAST Home Page
 - [Developing Plans](#) includes steps, goals, co-benefits, financing resources
- CAST Contact Us for one-on-one user support
- CAST Learning
 - [User Documentation](#) > Getting Started
 - [Free Training Videos](#)
 - Monthly live webinars
- CAST BMP information in [Source Data](#)
- [Official model documentation](#)
- [BMP cost data](#)

Contact Us!



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