



CAST Upgrades

APRIL 25, 2022, WATER QUALITY GOAL IMPLEMENTATION TEAM
OLIVIA DEVEREUX, DEVEREUX CONSULTING, INC.



Outline

- Uses of CAST and the Dynamic Model
- Timeline for development of software upgrades
- Timeline for two-year data and BMP updates, following the two-year current guidance from the Management Board
- Updates requested
 - Transparency in BMP annual reporting
 - BMP Benefits and Eco-System Services
 - Integrating land use views in CAST
- Software naming convention

Model Uses

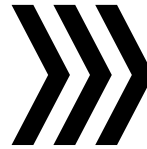
Dynamic Watershed Model

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 6

- 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



https://cast.chesapeakebay.net

Chesapeake Assessment Scenario Tool

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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

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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](#)

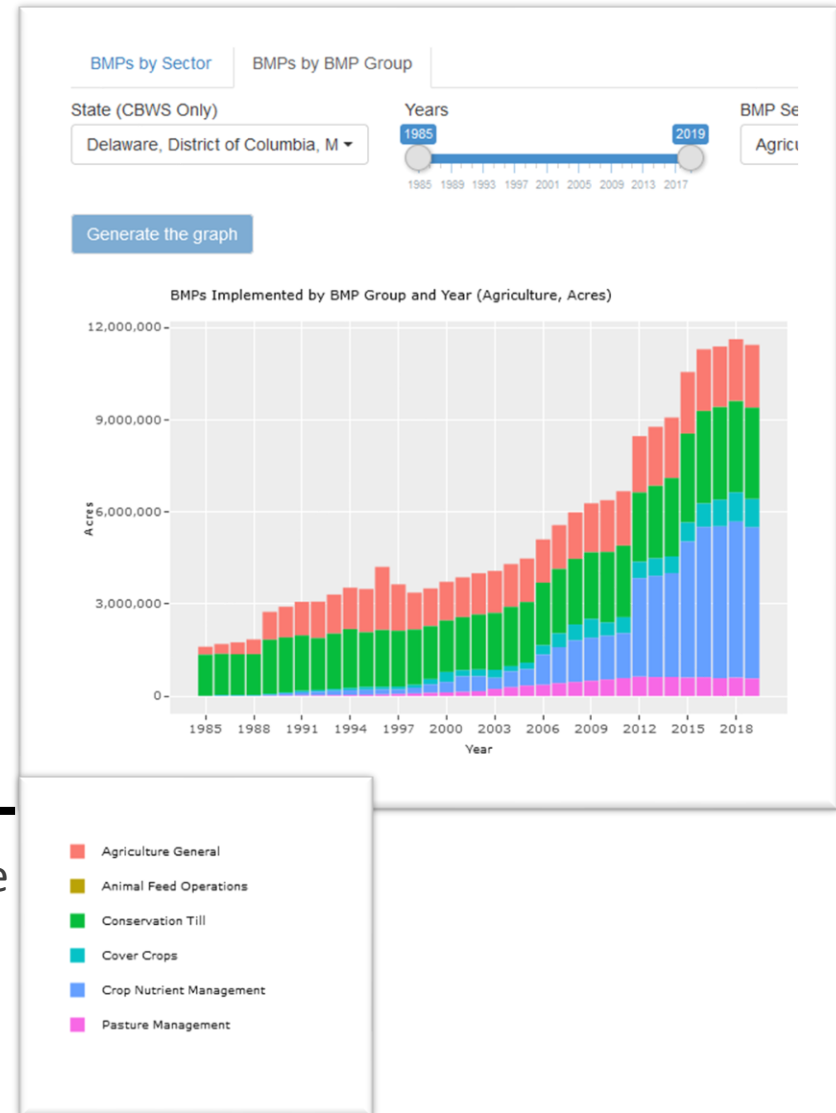
TRACK PROGRESS
View helpful information on verification, river trends, how to submit progress data via NEIEN, and modeling Federal facilities.
[Track Progress](#)

Chesapeake Bay Program Office Software Release: 6.10.1

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

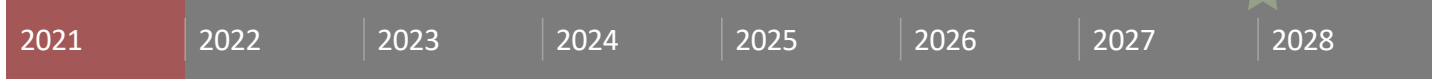
CAST Uses

- Uses are the same in Phase 7 as Phase 6
 - Estimates the official scenario loads for informing progress assessments and for planning WIPs
 - Used by local governments and their contractors for developing implementation plans for MS4s and local TMDLs
 - Answers questions about the effect of different BMPs on loads, the impact of land use development over time, and to identify the geographical location where BMPs will reduce the most load
-
- *Does not* provide time variable inputs to the Estuary model
 - *Is not the calibration tool (CalCAST)*, but uses the calibration output for the delivery factors



Agricultural Census Released by NASS
February 22, 2024

**New Planning Target
with Any New Model Phase**
January 5, 2028



Evaluations

Evaluations
Annual and Phase 3 WIPs are evaluated in the version of CAST that is currently in use.

CAST Upgrades

CAST Upgrades
Include new features, updated BMP history, newly approved BMPs.

**Watershed Model
(dependent on MWG / Team)**

Phase 7 Development and Review
December 30, 2027

Phase 7 Release
April 3, 2028

**Land Use
(Dependent on the LUWG / Land Data Team)**

Change Product from 2013 Available and Approved
December 9, 2024

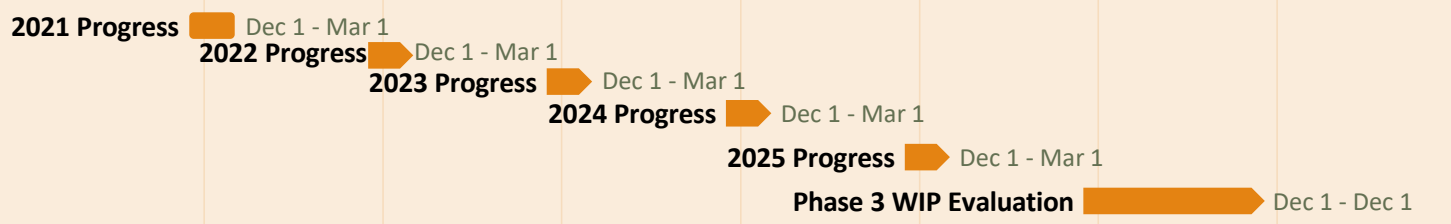
All Years, New Data Available and Approved
November 8, 2025

Agricultural Census Released by NASS
February 22, 2024

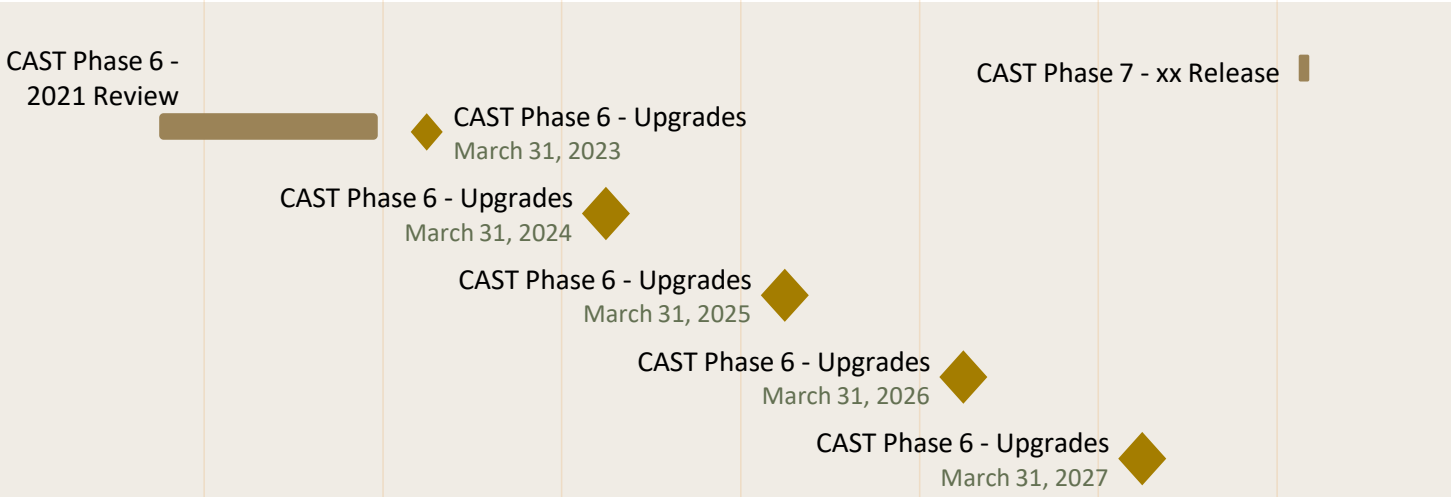
New Planning Target (with Any New Model Phase)
January 5, 2028



Evaluations



CAST Upgrades



Watershed Model (dependent on MWG / Team)



Land Use (Dependent on the LUWG / Land Data Team)

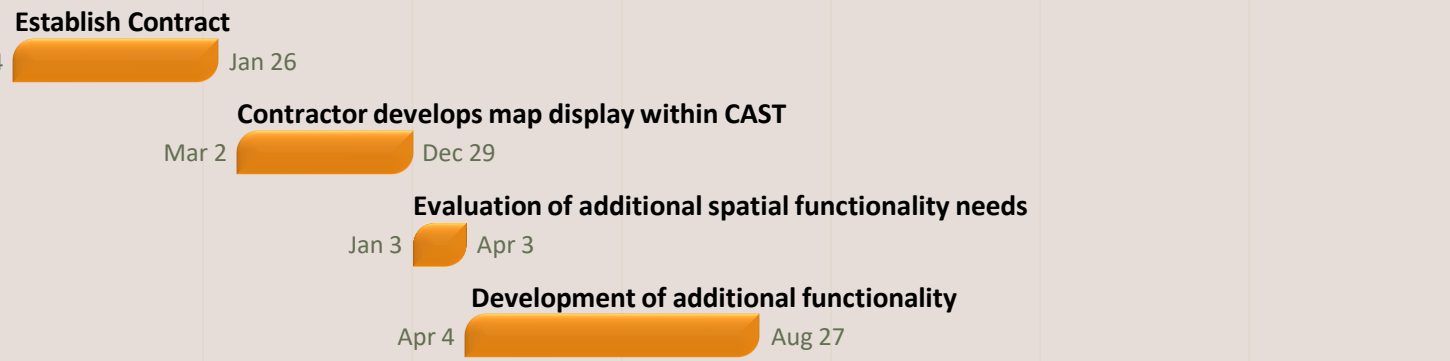


CAST Timeline

*contingent on funding and staff availability



Land Use Views



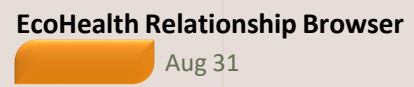
BMP Reporting Transparency



CAST-General



EcoSystem Services & Co-Benefits



Evaluations

- Evaluations are made in the version of CAST that is current
- CAST is released with a new BMP history and updated source data every two years, once the annual progress scenario is finalized
 - Progress is finalized around March of each year
 - The progress BMPs are used in the new version of CAST
- The CAST version that was used when EPA reviewed your WIP is still the one that is used for official purposes.
- There is always a copy of your WIP BMPs and wastewater in the current version of CAST



Updates Requested

- 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**

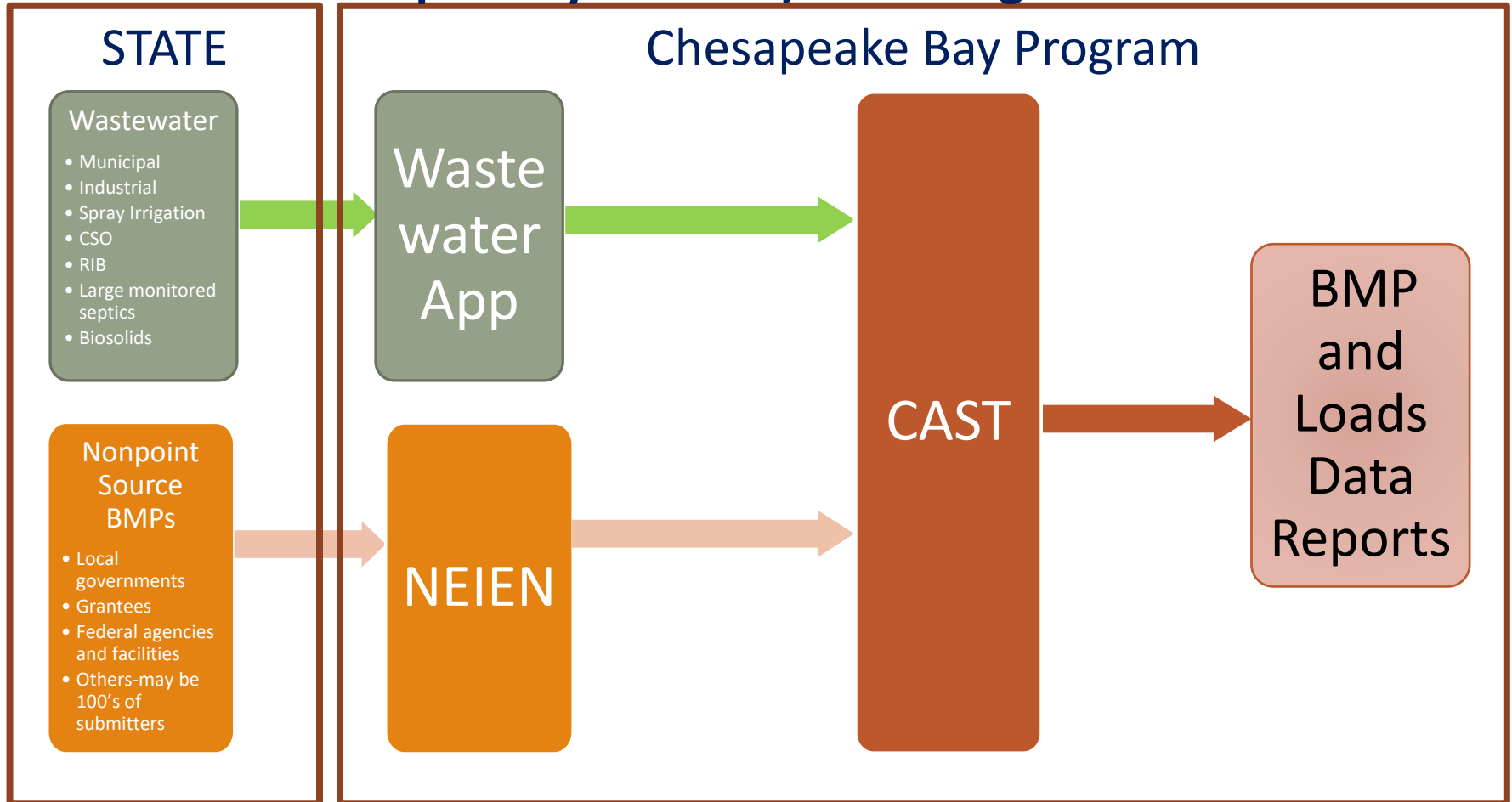
**Protect &
Restore Water
Quality**

**Maintain
Healthy
Watersheds**

**Foster
Chesapeake
Stewardship**

**Enhance
Partnering,
Leadership
& Management**

Transparency in NEIEN/CAST Progress data



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	A	B	C	D	E	F	G	H	I
1	ERROR_MESSAGE	submission_id	SUBMISSION_DATE	transaction_id	YEAR	state_unique_id	agency_code	state_code	bmp_name
2	The status of the BMP is Draft, Retired or NA.	2955.00000	11/18/2020 10:27:48	_33efa163-37aa-436a-9cff-6abf9ce57c8e	2010.00000	MTD-2011-000038624	2017125-116	VA	Proprietary
3	The status of the BMP is Draft, Retired or NA.	2955.00000	11/18/2020 10:27:48	_33efa163-37aa-436a-9cff-6abf9ce57c8e	2010.00000	MTD-2011-000038623	2017125-116	VA	Proprietary

NEIEN BMP Errors

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B7091 VDH-2008-00001

	A	B	C	D	E	F	G	H
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NEIEN Inspection Report

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A1 ErrorMessage

	A	B	C	D	E	F	G	H
1	ERROR_MESSAGE	state_unique_id	agency_code	state_code	bmp_name	life_span	GEOGRAPHY_NAME	im

CAST Land BMP Submission Errors

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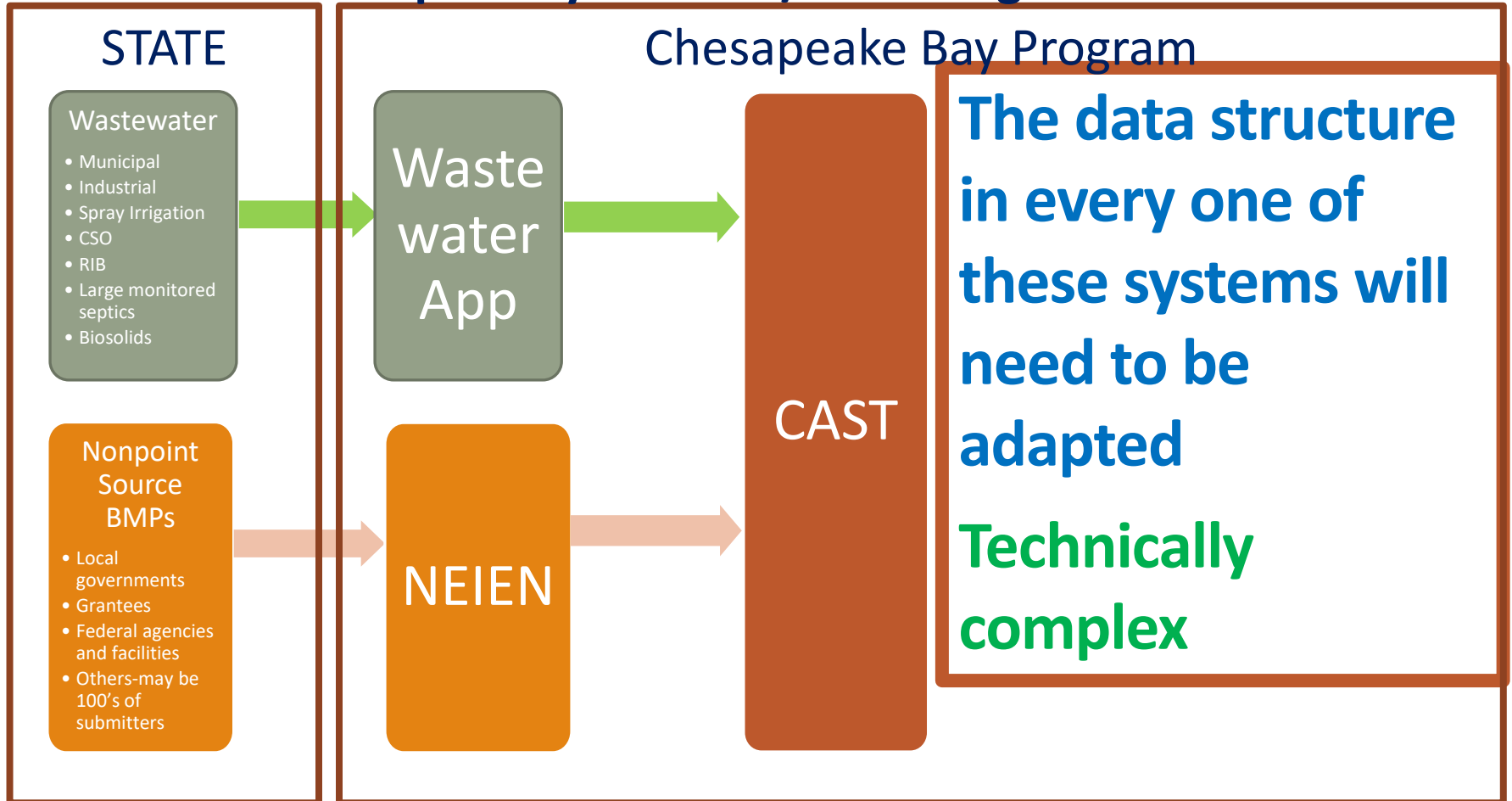
File Home Insert Page Layout Formulas Data Review View Help ACROBAT Team

A1 StateAbbreviation

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
1	StateAbbr	Geograph	Geograph	Agency	BMPShort	BMP	BMPType	Unit	Sector	FromLoad	ToLoad	So	AmountSu	AmountBe	AmountNc	AmountCr	Excess	TotalAmol	Cost
2	MD	md	Maryland	Departmen	impsurred	Impervious	Landuse	C Acres	Developed	Non-Regul	Non-Regul		16.857	0.055	16.802	16.802	0.000	16.857	#####
3	MD	md	Maryland	Departmen	impsurred	Impervious	Landuse	C Acres	Developed	Non-Regul	Non-Regul		60.664	0.556	60.108	60.108	0.000	60.664	#####
4	MD	md	Maryland	Departmen	impsurred	Impervious	Landuse	C Acres	Developed	Non-Regul	Non-Regul		7.178	0.071	7.107	7.107	0.000	7.178	#####
5	MD	md	Maryland	Departmen	impsurred	Impervious	Landuse	C Acres	Developed	MS4 Road	MS4 Turf	C	0.180	0.006	0.174	0.174	0.000	0.180	#####
6	MD	md	Maryland	Departmen	impsurred	Impervious	Landuse	C Acres	Developed	MS4 Buildi	MS4 Turf	C	0.041	0.002	0.039	0.039	0.000	0.041	2350.879
7	MD	md	Maryland	Departmen	impsurred	Impervious	Landuse	C Acres	Developed	MS4 Tree	MS4 Tree	C	0.024	0.001	0.023	0.023	0.000	0.024	1356.906
8	MD	md	Maryland	Departmen	impsurred	Impervious	Landuse	C Acres	Developed	CSS Road	CSS Road		0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	MD	md	Maryland	Departmen	impsurred	Impervious	Landuse	C Acres	Developed	CSS Buildi	CSS Buildi		0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	MD	md	Maryland	Departmen	impsurred	Impervious	Landuse	C Acres	Developed	CSS Tree	CSS Tree		0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	MD	md	Maryland	Departmen	urbstrm	Urban Stre	Pound Red	Feet	Natural	Stream Be	Stream Be		#####	0.000	#####	#####	0.000	#####	#####
12	MD	md	Maryland	Departmen	nonurbstr	Non Urban	Pound Red	Feet	Natural	Stream Be	Stream Be		78.000	0.000	78.000	78.000	0.000	78.000	8216.520
13	MD	md	Maryland	Departmen	shoreurb	Urban Sho	Pound Red	Feet	Natural	Shoreline	Shoreline		#####	0.000	#####	#####	0.000	#####	#####
14	MD	md	Maryland	Departmen	wetpondwe	Wet Ponds	Efficiency	Acres Trea	Developed	Non-Regul	Non-Regul		13.797	0.000	13.797	13.797	0.000	13.797	#####
15	MD	md	Maryland	Departmen	wetpondwe	Wet Ponds	Efficiency	Acres Trea	Developed	Non-Regul	Non-Regul		57.854	0.000	57.854	57.854	0.000	57.854	#####
16	MD	md	Maryland	Departmen	wetpondwe	Wet Ponds	Efficiency	Acres Trea	Developed	Non-Regul	Non-Regul		4.150	0.000	4.150	4.150	0.000	4.150	5461.716
17	MD	md	Maryland	Departmen	wetpondwe	Wet Ponds	Efficiency	Acres Trea	Developed	Non-Regul	Non-Regul		19.105	0.000	19.105	19.105	0.000	19.105	#####
18	MD	md	Maryland	Departmen	wetpondwe	Wet Ponds	Efficiency	Acres Trea	Developed	Non-Regul	Non-Regul		75.366	0.000	75.366	75.366	0.000	75.366	#####

CAST Credited v. Submitted Report

Transparency in NEIEN/CAST Progress data



BMP Reporting System Updates

The NEIEN post-processor is under full review

This will allow the CAST Development Team to make recommendations on ways to recode it to simplify analyses while meeting Partnership requirements for annual progress scenarios

NEIEN is currently on the EPA Environmental Information Exchange Network

- <https://www.epa.gov/exchangenetwork>
- OpenNode2
- Uses SOAP technology

Possibility of Transitioning to Virtual Exchange

- <https://exchangenetwork.net/virtual-exchange-service/>
- Uses RESTful web service
- Does not affect use, but does make the system more stable

Could move to a stand-alone service that is not part of the EPA Exchange Network

- Benefit is expanded options for de-duplicating data and allow more flexible services

Handling Data

A vegetable seller has the following vegetables in his cart. Help him by counting the vegetables. Write the number correctly in the list.



Q1. Count the vegetables and write the correct number in the list below.

brinjal	
pumpkin	
tomato	
cauliflower	
Bell pepper	
onion	

BMP Benefits and Ecosystem Services

Ecosystem Health Quantification (Ryann Rossi project)

- Quantifies ecosystem health outcomes by the amount of CAST – Water Quality BMP implemented
- EcoHealth Relationship Browser

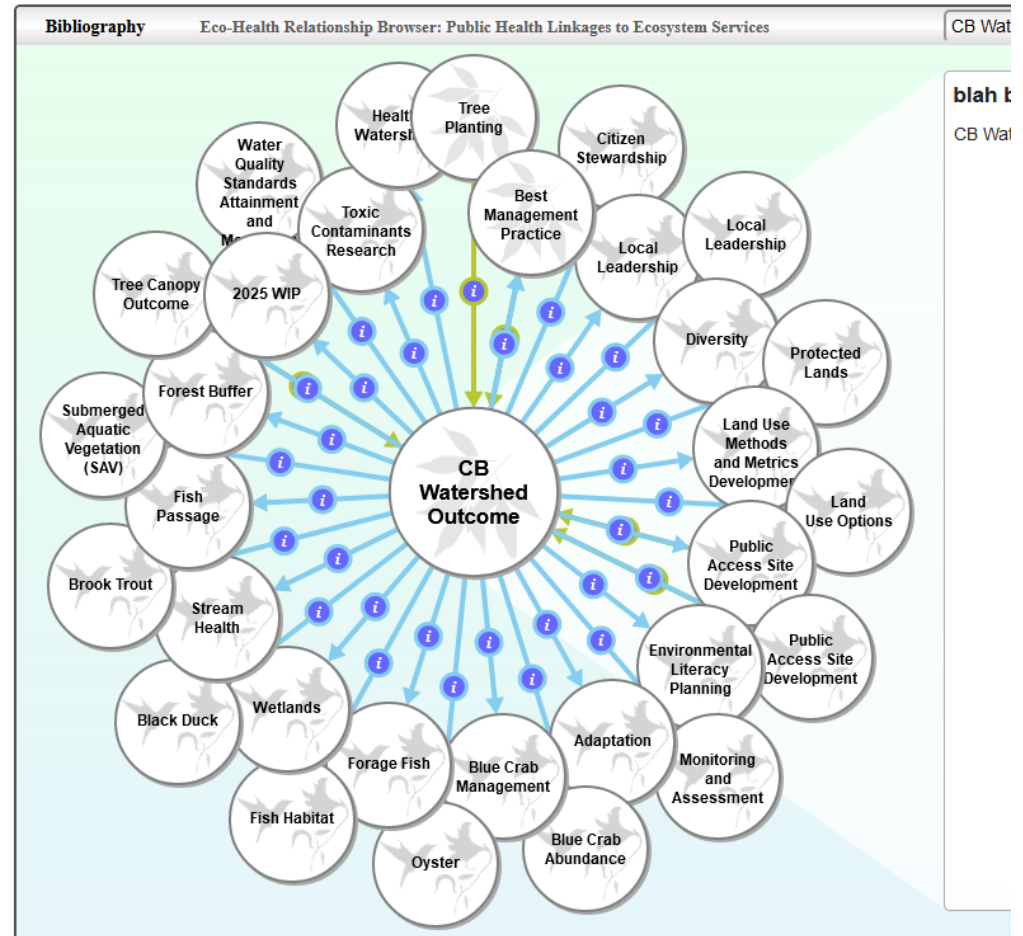
Wetland Functional Benefits

- Wetlands Outcome
- Black Duck Outcome

Carbon-USDA Comet Data

Eco-Health Relationship Browse

Click on the topic bubbles to explore. Click on the linkages (*i*) to view the relationship between elements



A

Integrate the land use with the TN, TP, and TSS planning and assessment functionality

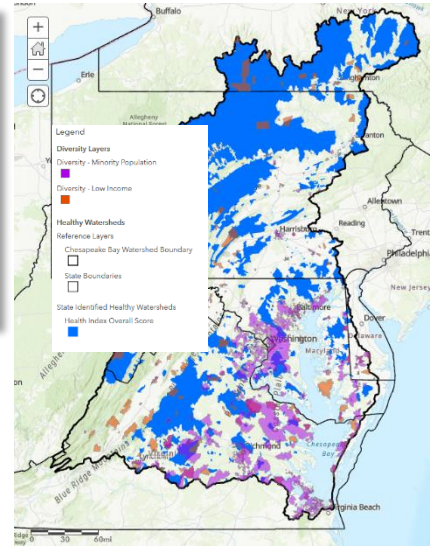
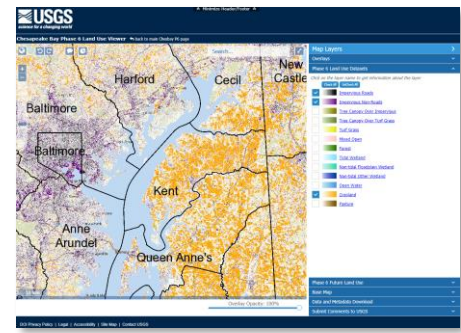
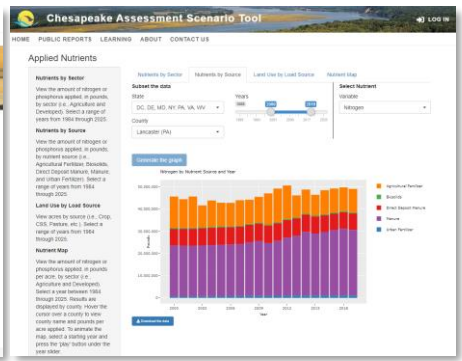
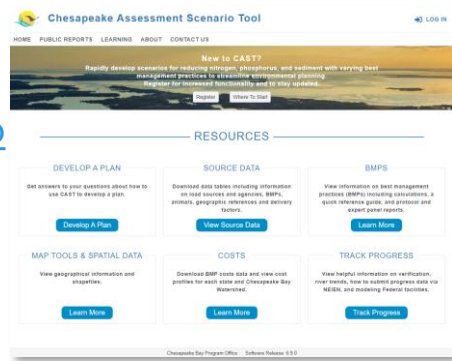
- Explore nutrient sources, application rates, and land use patterns: cast.chesapeakebay.net/TrendsOverTime/NutrientsApplied

- Explore BMP implementation patterns by source sector and geography: cast.chesapeakebay.net/TrendsOverTime/BMPs

- Explore BMP cost profiles: cast.chesapeakebay.net/Documentation/CostProfiles

- The Chesapeake Bay Phase 6 Land Use Viewer can be used to explore land use patterns throughout the watershed is accessible from: cast.chesapeakebay.net/Documentation/MapToolSpatialData

- The Chesapeake Bay Watershed Model Phase 6 Map Viewer includes a variety of data to guide management, including information on nutrient inputs, healthy watersheds, and aquatic resources is accessible from: cast.chesapeakebay.net/Documentation/MapToolSpatialData



Above: Screenshots of online tools and resources that can help guide effective watershed management.

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

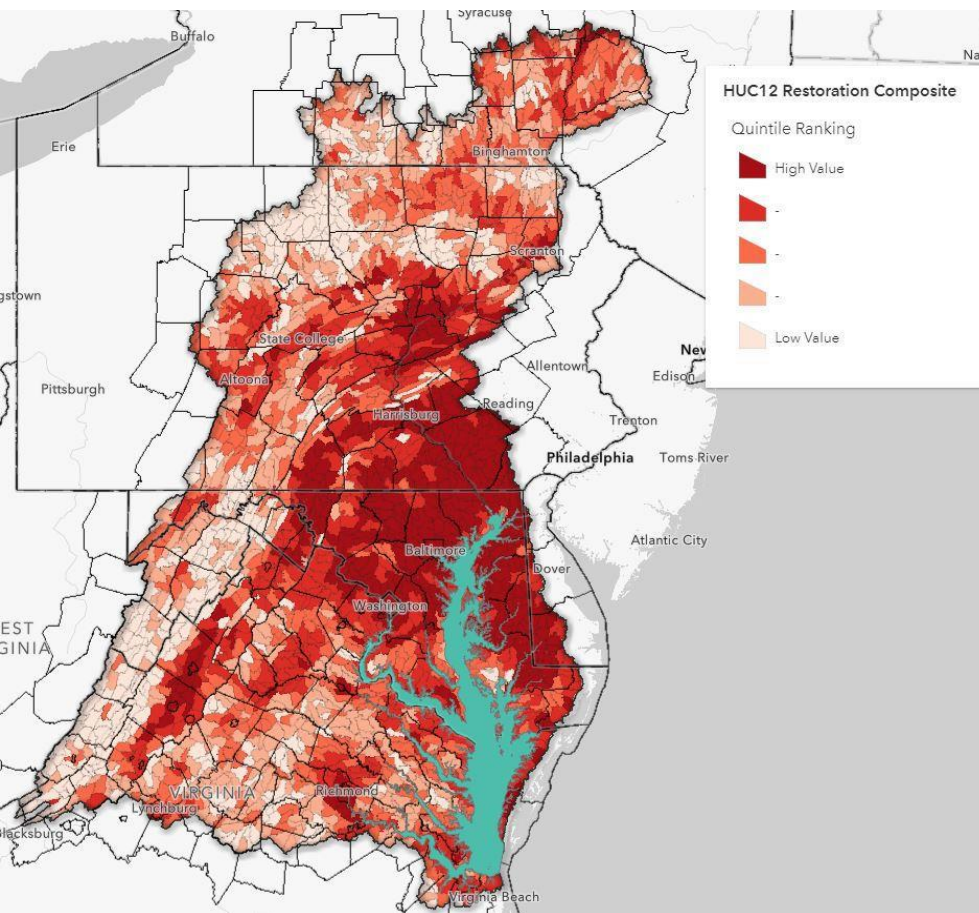


Figure 4 shows the composite restoration map of places where multiple outcomes can be met for water-quality improvements, toxic contaminants, and habitat connectivity. These outcomes were selected by the GITs.

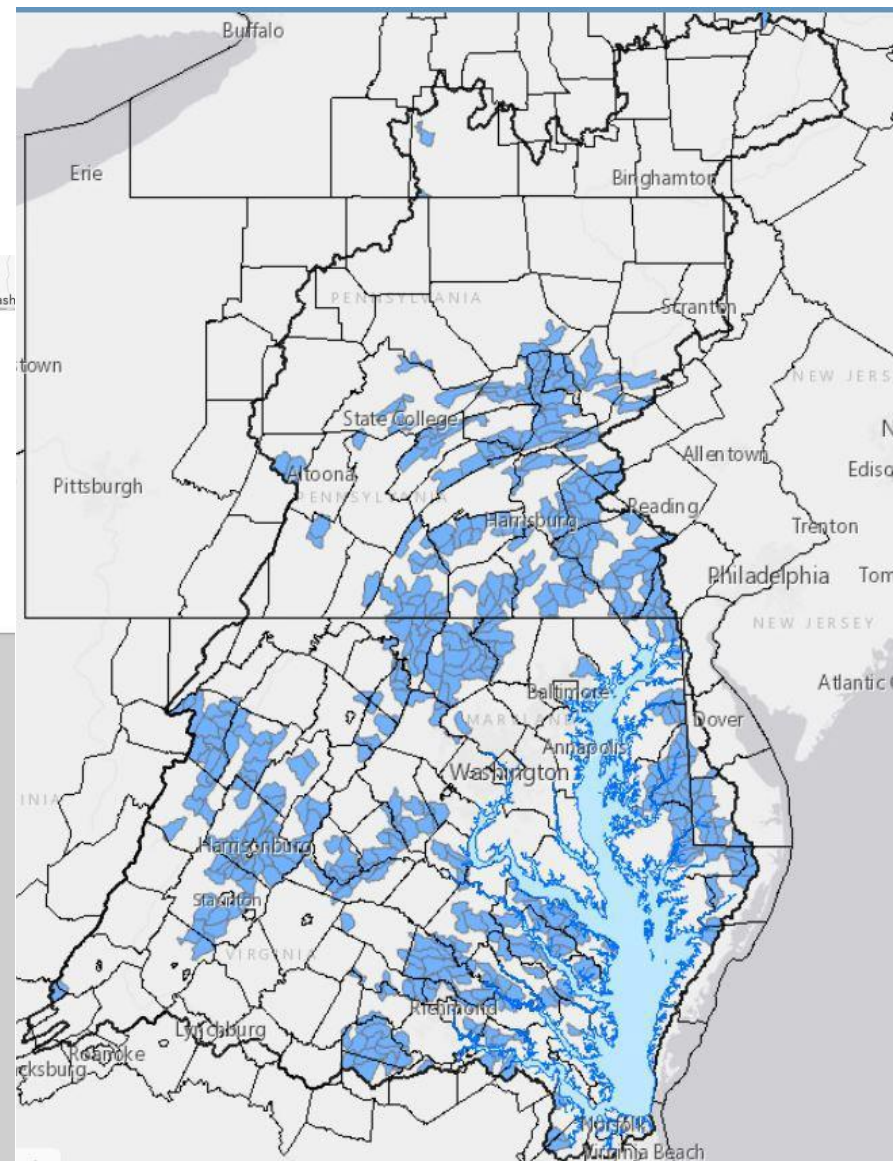


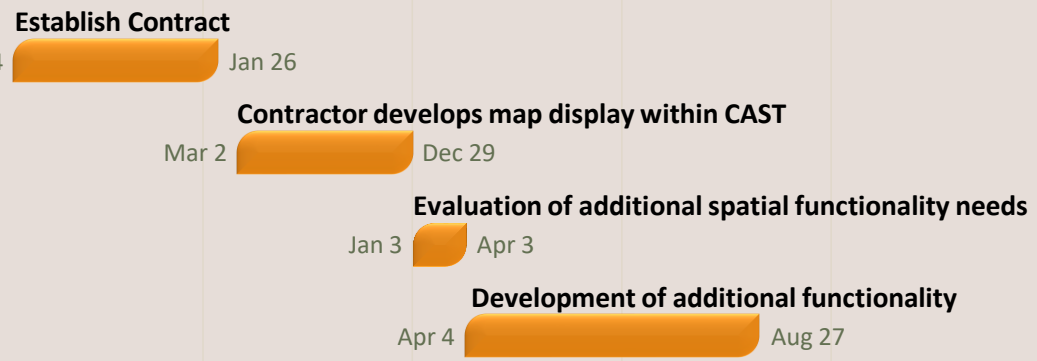
Figure 3. Ranking by states for places to get the highest reduction of nitrogen loading to the Bay and local water-quality improvements (from the Chesapeake Agricultural Priority Watersheds tool).

CAST Timeline

*contingent on funding and staff availability



Land Use Views



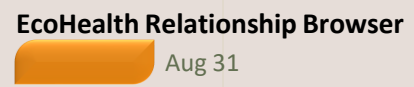
BMP Reporting Transparency



CAST-General




EcoSystem Services & Co-Benefits



Software Version Naming Convention

- Release is contingent on progress being finished so we can include those BMPs.
- Old Method is “CAST-21”
- New Method is “Phase 6 – 7.2.0”
- No longer named after years

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Chesapeake Bay Program Office Phase 6 - 7.2.0



Model Documentation

ABOUT CAST
MODEL DOCUMENTATION
UPGRADE HISTORY



Suggested Citation

Chesapeake Bay Program. 2020. Chesapeake Assessment and Scenario Tool (CAST) Version 2019. Chesapeake Bay Program Office, Last accessed [Month, Year].

CAST-21 version

BMPs in progress scenarios are pulled from the National Environmental Information Exchange Network (NEIEN), and used to update that year's progress data. This means that new inspections, new cumulative BMPs in any year, and new annual BMPs are used for that year's progress. The prior years' progress scenarios are not updated. However, when changing to a new version of CAST, all years' progress scenarios are updated to include new BMP history.

- [Fact Sheet](#)
- [Understanding Chesapeake Bay Modeling Tools](#)
- [Comparison of Loads and Inputs Between CAST-19 and CAST-21--Data Visualization Tool](#)
- [Technical Documentation of the Change Between CAST-19 and CAST-21](#)

CAST-19 version

CAST-17d is updated to CAST-19 with changes to data and BMPs used in the Phase 6 model for the milestone period. This follows the Principals' Staff Committee decision of July 9, 2018 that changes are made only in advance of the two-year milestone period. The decision can be found in the July 9, 2018 [PSC meeting minutes](#). These changes were agreed to by the WQGIT and its workgroups. The changes are limited in scope so that they do not: 1) impact modeled runoff during the 1993-1995 critical period; or 2) alter the base conditions (land uses, septic, animals, etc.) from 1984 through 2013. Preservation of these estimates enables a consistent assessment of how new management actions and changes in base conditions have influenced loads over time.

- [Fact Sheet](#)
- [Understanding Chesapeake Bay Modeling Tools](#)
- [Comparison of Loads and Inputs Between CAST-17d and CAST-19--Data Visualization Tool](#)
- [Technical Documentation of the Change Between CAST-17d and CAST-19](#)
- [Comments from the Jurisdictions and the Chesapeake Bay Program Responses](#)

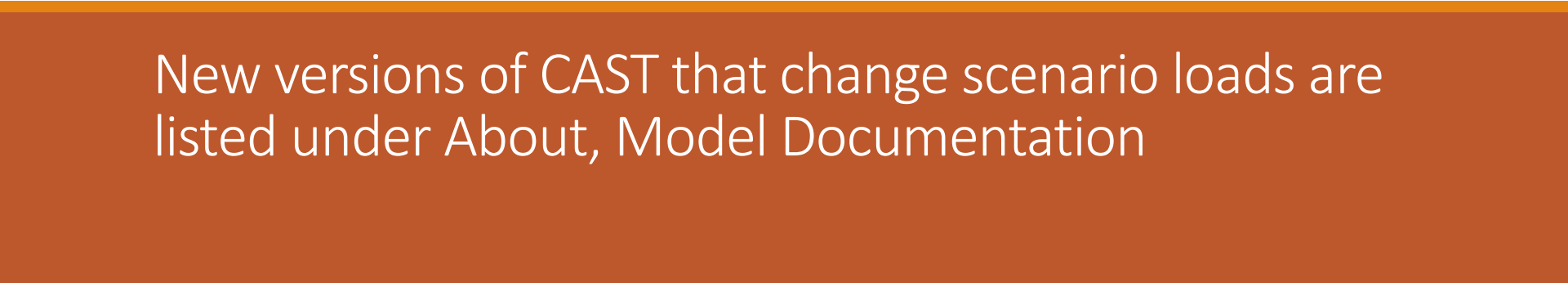
Climate Change

Results of updated methods, techniques, and studies that are used to develop an estimate of pollutant load changes (nitrogen, phosphorus, and sediment) due to 2025 climate change conditions. [Planning targets](#) for the TMDL, climate change, and Local Area Planning Goals are available.

[Climate Change Documentation](#)

Phase 6 Dynamic Watershed Model and CAST-17 documentation

The documentation is for the dynamic and time-averaged Watershed Model. CAST is the same as the time-averaged Phase 6 Model. Creating and running scenarios in CAST is simply using an on-line interface to the time-averaged Model. Due to the length of the documentation, it is divided into sections. [Click on the links below to read through the different portions of the documentation.](#)



New versions of CAST that change scenario loads are listed under About, Model Documentation

UPGRADE HISTORY

ABOUT CAST
MODEL DOCUMENTATION
UPGRADE HISTORY



Update released on April 7, 2022

- Version Phase 6 - 7.2
- Search feature will be added to easily find resources throughout the CAST website.
- There will be a new filter when selecting geographic scale for reports and scenarios. Before selecting your geography, there will be a box to check whether you would like the full geography, or CBWS only.

Update released on February 14, 2022

- Version Phase 6 - 7.1.0
- Minor bug fixes and added administrative user functionality.
- BMPs in CAST were pulled from NEIEN on 2/14/22.

Update released on January 11, 2022

- Version Phase 6 - 7.0.1
- All fields in BMP files will be converted to lowercase. All non-alphanumerics will continue to be removed from the state unique identifier field.

Update released on January 5, 2022

- Version Phase 6 - 7.0.0
- **Faster run times:** CAST has a new architecture and design that will greatly speed up scenario runs. Users will not see anything new in terms of the interface or data. The part that will be noticeable is the increase in scenario run speed.
- There is a new naming protocol for versions. The time-variable watershed model phase serves as the prefix and the application version serves as the version number. These upgrade notes serve as the ready reference for changes. The Bay Program Partnership made the decision to have CAST data updates every two years. While the naming is no longer following the year, such as CAST-19, there is still the intention to follow the update schedule of every two years until the Partnership decides otherwise.

Update released on November 1, 2021

- This release is of a review version of CAST-21, the new version of CAST. Only a few users have access to this version. Access for all users is provided upon request. All users will be switched to the new version on January 1, 2022.
- **Updates will change the loads in all scenarios and years. This includes your own scenarios, scenarios shared with you, and public scenarios.** Public scenarios and the shared scenarios owned by CBP Admin are recalculated for you. You need to transition and run your own scenarios from CAST-19 to CAST-21 using the "Migrate Scenarios" button on the Scenarios page. Once you move your scenarios, run the scenario to see the new loads. Just click on the green run arrow next to the scenarios. Multiple scenarios can run simultaneously.
- The official Phase III WIPs are those loads from the CAST version in which they were developed. The loads change in all scenarios, including the WIPs, in this new version. The BMPs from the Phase III WIPs are available in the scenario "WIP 3 CAST-21 Version". The loads from the original version of the WIPs are available in the scenario "WIP 3 Official". The 2025 Phase III Planning Targets do not change. The milestone goals do change. The 2009 progress changes since the entire history of BMP implementation is re-run with each new version of CAST. With the 2009 starting point adjustment, the trajectory to the 2025 planning target endpoint shifts. As we get closer to 2025, the effect of the shift is less than earlier years since we are closer to the anchored 2025 target. The milestone goal steps up with each cycle (80% in 2021, 90% in 2023). Use the CAST [Planning Target](#) tool to compare planning targets to public scenarios.
- The detailed changes between CAST versions are documented on the About menu under [Model Documentation](#). That page includes [graphs](#) showing the changes in loads and acres.
- The changes that impact loads include:
 - BMPs submitted, including in the TMDL critical period, are updated. This update impacts multiple estimates including the BMPs credited through the 2017 land use (except for forest buffers, tree and forest planting, which is 2002), the amount of nutrients applied to meet crop needs, and the historic manure transport of total phosphorus through 2016.
 - The agricultural land use total acres are now determined by the Land Data Team's change product from 2013 rather than the USDA Agricultural Census total acres.
 - Agricultural and urban fertilizer sales data are updated to include data reported to American Plant Food Control Officials (AAPFCO) through 2016. The missing fertilizer for 2013 and 2014 was corrected.
 - New fertilizer sales data results in new urban fertilizer application rates for the years 2013 through 2025.
 - The 2013 – 2025 land use acres, septic systems, and sewer service areas are updated.
 - Maryland biosolids are updated. The amount for other jurisdictions is simply carried forward for all future years.
 - Pennsylvania updated their combined sewer overflow reductions.

<https://cast.chesapeakebay.net/About/UpgradeHistory>'s insignificant facilities wastewater data was updated for 2014-2020



Upgrades of all types are described in detail under About, Upgrade History Model version history is listed here

Agricultural Census Released by NASS

February 22, 2024

New Planning Target (with Any New Model Phase)

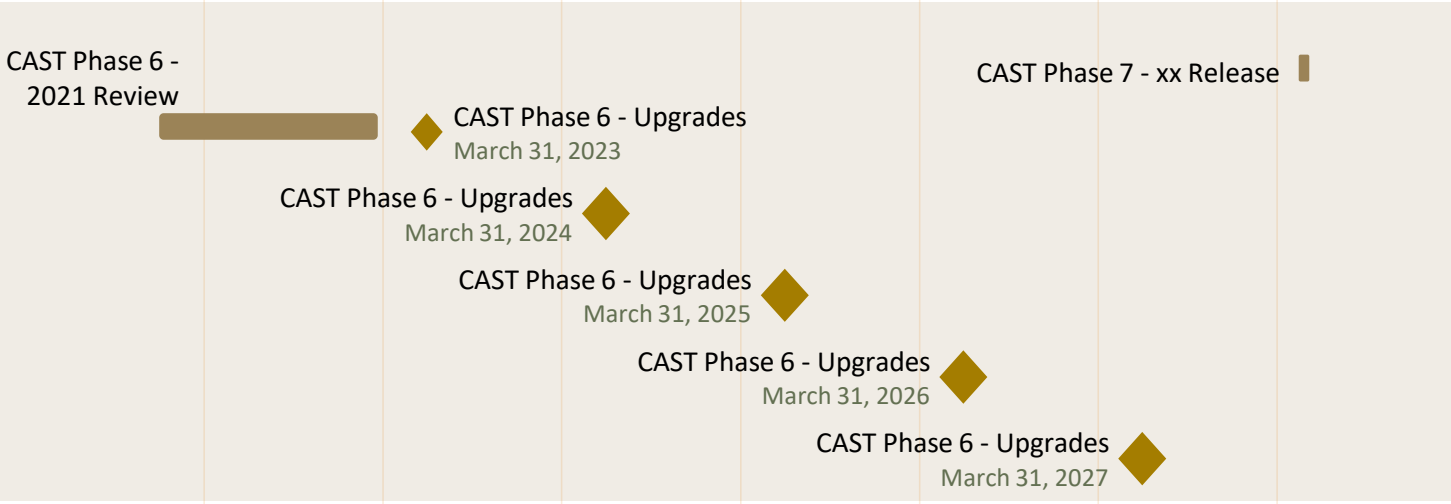
January 5, 2028



Evaluations



CAST Upgrades



Watershed Model



Land Use





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