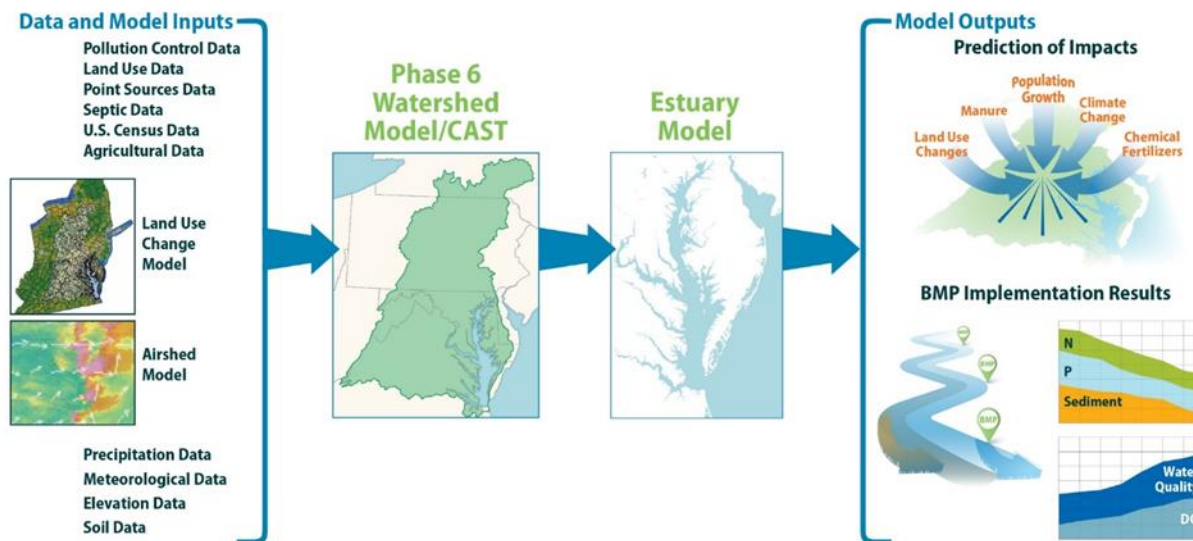


Plans for Updating Chesapeake Bay Program’s modeling suite

COG staff summary
Sept. 10, 2021

Chesapeake Bay Program staff and participants in its Modeling Workgroup are working on a comprehensive update to the suite of models that the program uses to track progress under the Bay TMDL and assess attainment of water quality standards

Current Chesapeake Bay Program Modeling Suite



The modelers have begun updating the current Phase 6 Watershed Model (CAST) into a Phase 7 version expected to be completed by 2024. They also have decided to replace the current estuarine model, known as the Water Quality and Sediment Transport Model, with an entirely new tidal water quality model that hopefully will improve the simulation of dissolved oxygen and other key water quality parameters in shallow waters, a weakness of the current model.

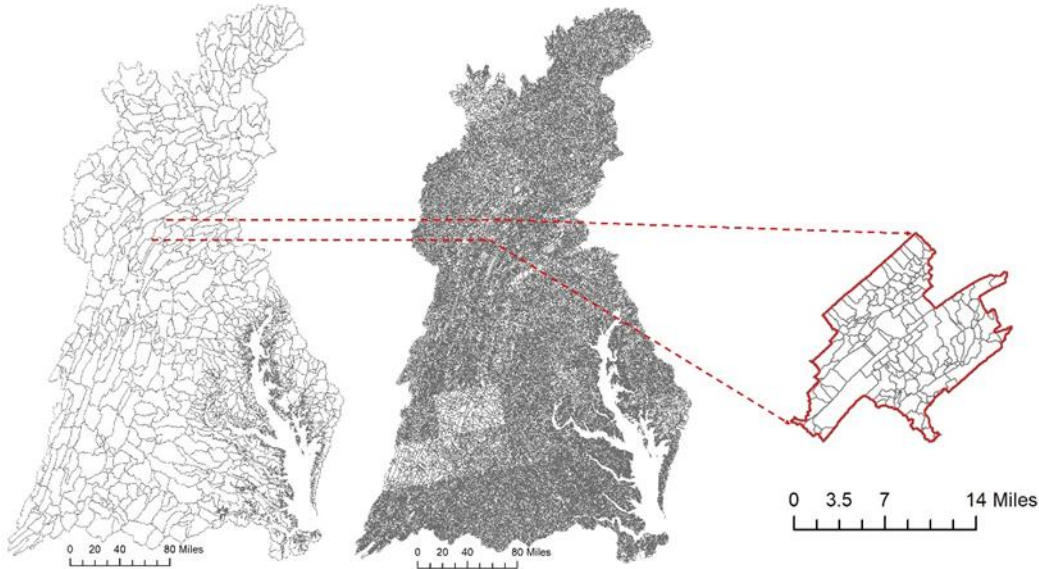
The modelers hope to complete their efforts so that the new modeling suite can be used to update the Bay Program’s prediction of 2035 climate change impacts in 2025. They also anticipate that the new models will be used to potentially update the Bay TMDL itself with new results for the levels of nutrient reduction needed to achieve water quality standards in the Bay. And it can be used to update existing and potentially create new TMDLs for the tidal water tributaries of the Bay.

Watershed Model Updates

Phase 7 of the Watershed Model, now in development, will feature new finer scale hydrology based on the National Hydrography Dataset 1:100000 (NHD100k). The new segmentation will improve model calibration and potentially will estimate load sources within counties on a roughly one-square-mile basis, as opposed to current output at the land-river segment.

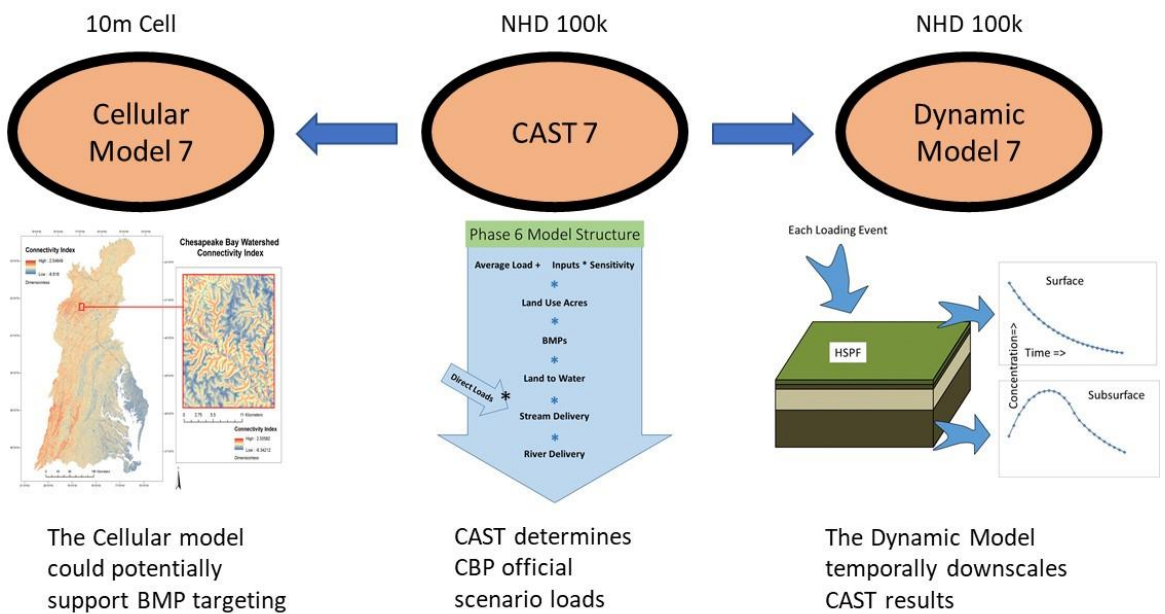
According to the modelers, some of the model input data needed to produce load estimates is also available at this finer scale, such as 10-meter information on sediment sources and transport in the landscape and land use. However, other inputs will remain only available at the county scale.

Segmentation for Phase 7 of the watershed model – to be based on the NHD100k scale will be much finer than segmentation of the Phase 7 model



The Bay Program will have to determine how and whether to use this finer-scale information in its model outputs. For example, the Phase 7 suite of models could include a 10-meter-based ‘Cellular Model’ of loss potential for nitrogen, phosphorus, and sediment, which would improve the delivery factors used in CAST and identify source areas with greater precision.

One proposal for a new Bay Program modeling suite featuring finer scale hydrology and other inputs



This finer-scale version of the watershed model could simulate all outputs at finer scale or could combine finer and coarser scales.

Watershed Model Schedule

Meeting the 2025 deadline for a new climate change assessment provides for only 3 years of development time for the new model, a shorter time frame than it took for previous major model upgrades. Therefore, the modelers are seeking Bay Program input on which features of the watershed model are the top priorities to upgrade.

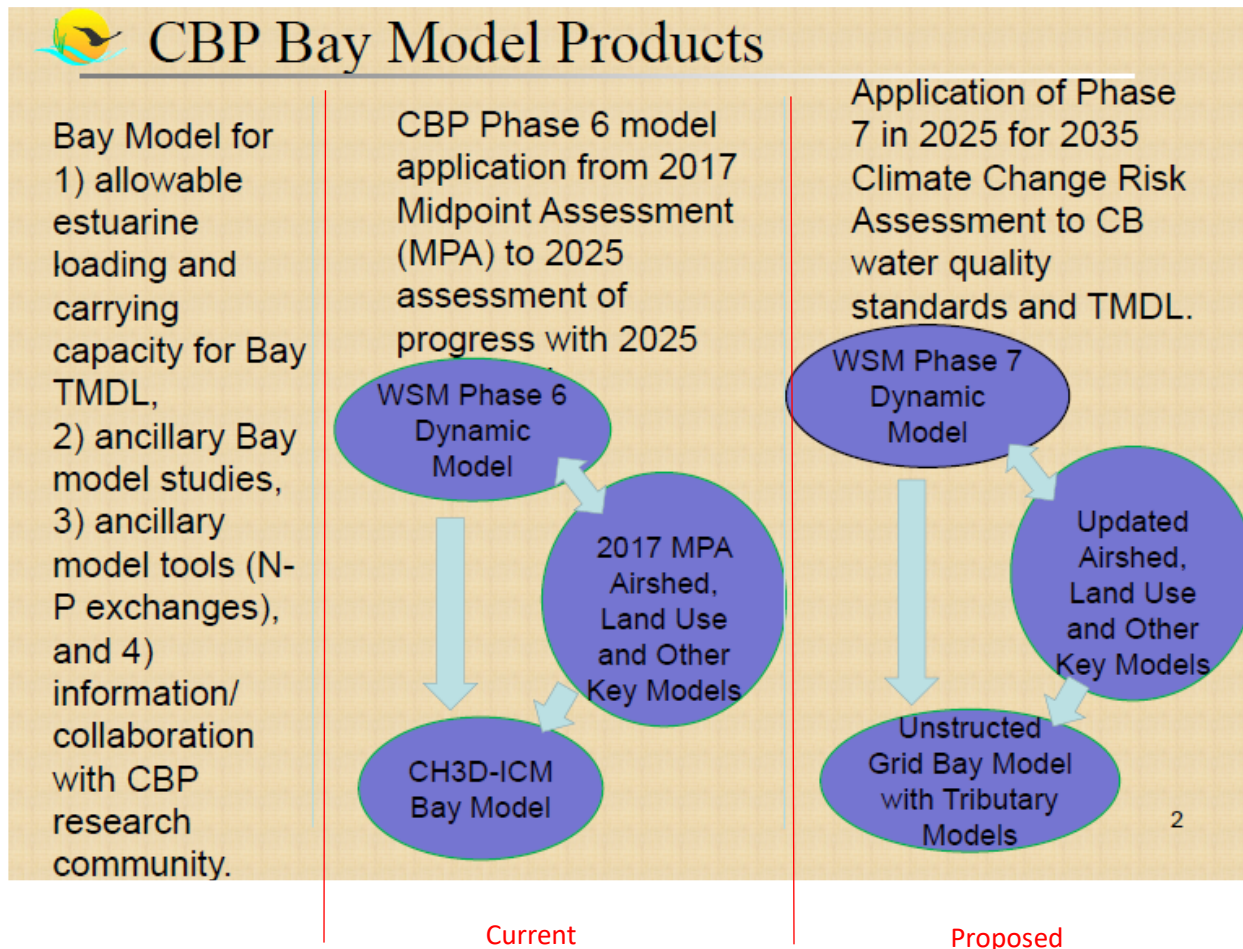
Potential elements to be upgraded in a Phase 7 Watershed Model

Potential Areas of Focus	Recommendations	Impacts Estuarine Model	Impacts CAST	Level of effort	Benefits
Finer-scale modeling	WQGIT, other GITs, STAC	✓	✓	High	Greater accuracy watershed modeling; Enables fine scale targeting of practices; Needed for some co-benefits
Spatially explicit CAST	Non-CB TMDL partners		✓	Medium	Enables CAST output on a fine scale
Physical process simulation	STAC, WQGIT other GITs, CBPO	✓	✓	Low-High	Greater watershed model accuracy overall
Nutrient Application calculation	CBPO		✓	Medium-High	Increases transparency of CAST scenarios; Reduces unintended consequences of model and data changes
Land use change 1985-2035	CBPO, WQGIT	✓	✓	High	Greater accuracy of land use changes through time. Allows direct use of fine-scale land use data in CAST
Improve climate change modeling	PSC, WQGIT	✓	✓	Low	Directly addresses PSC priorities; improves confidence in 2025 climate decision.
Uncertainty Quantification	WQGIT, STAC			Medium	Helps prioritize model updates; Incorporates trends in monitored data
Co-benefits and ecosystem services	WQGIT, other GITs, STAC		✓	Low-High	Helps partners develop comprehensive plans that benefit local citizens.
WQ standards Assessment	WQGIT, STAC			Low-Medium	Potential to assess all tidal oxygen standards and to delist segments

Estuarine Model Update

The Bay Program modelers have decided to move on from the longstanding Water Quality and Sediment Transport Model that simulates the main water quality parameters in the tidal waters of the Bay and has been used for decades. In creating a new tidal water model with an unstructured rather than a structure grid, they hope to improve the simulation of dissolved oxygen and other key water quality parameters in shallow waters, a weakness of the current model. They also plan to develop at least three separate, but inter-related, models of tidal tributaries that also will focus on improved simulation of water quality parameters in shallow waters.

Current and Proposed Suite of Bay Program Models



New Estuarine Model Schedule

2021 - Conduct RFA process to begin work on new main Bay model to replace current WQSTM

- Focus will be on simulation of DO, clarity and chlorophyll in shallow waters

2022 - Conduct RFA process to begin work on multiple tributary models, which also will focus on simulation of DO, clarity and chlorophyll in shallow waters

- Bay Program hopes to fund at least 3 such integrated tributary models

2023 - Begin to use inputs from new Phase 7 watershed model to inform tidal models

2024 - New unstructured grid model of tidal waters and associated tributary models operational by December

2025 - Apply the new models to assessment of 2035 climate change risk; re-examine loading targets based on new data for open water DO, clarity-SAV and chlorophyll water quality standards; redo the nitrogen-phosphorus trade-offs for tidal water

Beyond 2025 -- use models to update local tidal water TMDLs and to perform assessments of tidal waters that currently have or may need tidal water TMDLs