What is a model?

* Scenarios, or model simulations, of an ecosystem can estimate the impact of various changes or actions on water quality, wildlife and aquatic life.
* Model simulations, when combined with research and observations, provide best estimates based on the most up-to-date and corroborative science.

Why use a model?

* The Chesapeake Bay, its watershed and airshed are large and complex, so scientists and decision-makers rely on computer models for information about the ecosystem and the impact of efforts to reduce pollution and improve water quality.
* The models used by the Chesapeake Bay Program partnership play a key role in the process of understanding and managing nutrient pollution throughout the Chesapeake Bay watershed and airshed.
* The Chesapeake Bay Program partnership models can support development of planning targets and watershed implementation plans, or WIPs.

Chesapeake Bay Program models

* The Chesapeake Bay Program partnership uses a suite of computer models that are among the most sophisticated, studied and respected in the world.
* The Chesapeake Bay Program partnership applies state-of-the-art models of land use, the watershed, the airshed and the tidal Bay that are extensively peer-reviewed by the science community.
* These models provide a comprehensive view of the Chesapeake Bay ecosystem, from the depths of the Bay to the upper reaches of the watershed, including the land and the air deposition of nitrogen.
* The suite of modeling tools used by the Chesapeake Bay Program partnership include the Watershed Model, Estuary Model, Airshed Model and Land Change Model.
* The full Watershed Model is available online as the Chesapeake Assessment Scenario Tool, or CAST.
* The Estuary and Airshed models are open and free for anyone to use, although it is highly recommended that one has a familiarity and knowledge of how these models work to use them.

Airshed Model

* The Airshed Model uses information about nitrogen emissions from power plants, vehicles and other sources to estimate the amount of and location where reactive nitrogen oxides and ammonia are deposited on the tidal Chesapeake Bay and its watershed.
* Information from the Airshed Model on atmospheric nitrogen loads is used as input into the Watershed Model and Estuary Model.
* The Airshed Model is a national model run by the Environmental Protection Agency.

Estuary Model (Water Quality and Sediment Transport Model)

* The Estuary Model, also called the Water Quality and Sediment Transport Model, examines the effects that pollution loads generated by the Watershed Model and Airshed Model have on water quality in the tidal waters of the Bay.
* This model uses a water quality standard analysis system to examine model estimates of dissolved oxygen, chlorophyll *a* and water clarity to assess in time real-time the attainment of Chesapeake Bay living resource-based water quality standards.

Land Change Model

* The Land Change Model analyzes and forecasts the effects of urban land use and population on sewer and septic systems in the Chesapeake Bay watershed.
* The forecasts are based on reported changes from the U.S. Census Bureau in housing, population and migration; and land cover trends (including the conversion of forests and farmland to development) derived from analysis of high-resolution land cover data and satellite imagery.

Watershed Model

* The Watershed Model incorporates information about land use, fertilizer applications, wastewater plant discharges, septic systems, air deposition, farm animal populations, management practices, watershed characteristics, stream characteristics, weather and other variables to estimate the amount of nutrients and sediment reaching the Chesapeake Bay and where these pollutants originate.
* The Watershed Model divides the 64,000-square-mile Chesapeake Bay watershed into more than 2,000 segments delineating political and physical boundaries.
* The Watershed Model was built through a collaborative process through Chesapeake Bay Program partnership, which directed a development team made up of federal, academic, nonprofit and contractor staff.
* The Watershed Model uses multiple models and multiple lines of evidence to estimate the delivery of nutrients and sediment to the Chesapeake Bay.
* The Watershed Model can be used at the Chesapeake Bay watershed scale as well as smaller scales for state-developed Total Maximum Daily Loads (TMDLs).
* The success of the Watershed Model depends on the real world data that feeds it, which requires a partnership with many stakeholders in the states, local governments and science agencies.
* The Watershed Model helps connect monitoring data and the planning and implementation of restoration practices.
* The Watershed Model can generate simulations of the past, present and future state of the Chesapeake Bay watershed to explore potential impacts of management actions and evaluate alternatives based on a variety of factors (e.g., land uses and management actions).

Web-based models

* Currently both Virginia and Maryland have their own web-based modeling tool based on the Watershed Model, called the Virginia Assessment Modeling Tool (VAST) and Maryland Assessment Modeling Tool (MAST), respectively.
* The Chesapeake Bay Facility Assessment Scenario Tool, or BayFAST, is a web-based version of the Watershed Model that is geared toward facilities.

New features in the Phase 6 Watershed Model

* The Phase 6 Watershed Model is the most recent version of the Chesapeake Bay Watershed Model, replacing version 5.3.2 which has been used to set the 2011 planning targets and track the Phase II Watershed Implementation Plans.
* The Phase 6 Watershed Model brings more scientific and partnership input into the model than ever before.
* This new version of the model includes new science, new data and new inputs from the agriculture community.
* The Phase 6 Watershed Model will take into account policy decisions made about the Conowingo Dam, climate change and growth projections (including humans, animals, zoning and land use).
* The Phase 6 Watershed Model contains a more simplified structure that makes it easier to work with and understand.
* The new model contains almost double the amount of data than was in the Phase 5.3.2 version, including 10 more years of monitoring data.
* The model now includes over 30 years’ worth of monitoring data that can be used to calibrate or determine the accuracy of the land use and location simulations that it produces.
* Phase 6 contains a few new types of best management practices, or BMPs, as well as a few BMPs that have been re-analyzed for their effectiveness.
* The Phase 6 Watershed Model includes high-resolution land cover data, allowing for a one-by-one meter resolution of land cover data, which provides 900 times the amount of information as previously available.
* In the Phase 6 Watershed Model, all pollution loads will be identical between CAST and the Watershed Model because the calculation engine will be the same and only the interfaces will differ.
* With the unification of these modeling tools, the Maryland Assessment Scenario Tool (MAST) and the Virginia Assessment Scenario Tool (VAST) will be replaced by CAST.

How does the model work?

* Models are built on current and specific uses of land in the watershed, such as forests, farms and development.
* Land uses are determined by using authoritative sources, such as satellite imagery and the U.S. Department of Agriculture Census of Agriculture.
* Models are further refined by inputting land management features, such as cover crops on farm fields and stormwater controls in urban areas.
* The types and amounts of pollution that run off a particular land use are based on multiple lines of evidence including several existing regional models.
* Pollution loads are cross-checked with comprehensive reviews of the latest scientific literature.
* Delivery of these loads through the land and water is estimated based on observed data and measureable characteristics of the landscape.
* Pollution loads are further adjusted based on in-stream monitoring data, which increases accuracy for land use and location.
* Once the model is successfully simulating the past, details about conservation practices, management actions and pollution controls that may be implemented in specific places are entered into the model to estimate reductions from these factors.

Links

* [Chesapeake Assessment Scenario Tool (CAST)](https://cast.chesapeakebay.net)
* [Chesapeake Bay Facility Assessment Scenario Tool (BayFAST)](http://www.bayfast.org/default.aspx?AcceptsCookies=yes)