

Achieving Nutrient and Sediment Reduction Goals in the Chesapeake Bay

An Evaluation of Program Strategies and Implementation

Recovery of the Chesapeake Bay from the ecosystem disruption caused by excess nutrient and sediment inputs, primarily from agriculture, urban runoff, wastewater, and air pollution, will require profound changes in the management of resources in the Bay watershed. In recent years, the Chesapeake Bay Program has enhanced accountability of its partner states, for example by establishing two-year milestones for progress. However, numerous challenges affect the consistency and accuracy of the tracking and accounting of nutrient reduction practices.

Opportunities also exist to improve support for applications of adaptive management. Because public support is vital to sustaining the program, it is important to help the public understand lag times and uncertainties associated with water quality improvements and to develop program strategies to better quantify them.



Credit: Ben Schumin

As North America's largest and most biologically diverse estuary, the Chesapeake Bay is home to thousands of plants and animals and is also an important commercial and recreational resource. The Bay's ecosystem has been shaped by human influences for many hundreds of years, but over the past century these influences have become more pronounced. Excessive inputs of nitrogen, phosphorus, and sediment from human activities and land development in the watershed have disrupted the ecosystem, causing degraded habitats and harmful algal blooms that impact the survival of fish, shellfish, and other aquatic life.

The Chesapeake Bay Program—a cooperative partnership between the U.S. Environmental Protection Agency and the six states and the District of Columbia that lie in the Bay watershed—was established to address the adverse effects caused by pollutants entering the Bay.

The program has established water quality goals for the Bay to limit loadings of pollutants, which enter the Bay from sources such as agriculture, urban runoff, wastewater discharge, and air pollution. As part of efforts to improve the pace of progress and increase accountability in the Bay restoration project, a two-year milestone strategy that focuses on incremental, short-term commitments from each of the Bay jurisdictions was introduced. The two-year milestone strategy complements longer-term efforts to reach the total maximum daily load (or TMDL) of pollutants that the Environmental Protection Agency allows in the Chesapeake Bay.

Developed at the request of the Environmental Protection Agency and with additional funding from Virginia, Maryland, Pennsylvania, and the District of Columbia, this report evaluates the two-year milestone strategy, assesses existing adaptive management

applications, and discusses strategies that could help the Chesapeake Bay Program meet its nutrient and sediment reduction goals.

Tracking and Accounting

Accurate tracking and accounting of the use of best management practices—efforts made to reduce nutrient and sediment inputs to the Bay—is of paramount importance because the Chesapeake Bay Program relies on these data to estimate current and future nutrient and sediment loads to the Bay. However, many Bay jurisdictions are struggling with limited resources, complex and rapidly changing data collection and reporting protocols, data privacy constraints, and quality assurance and control needs; therefore, tracking and accounting of best management practices is not consistent across the Chesapeake Bay watershed. Furthermore, given that some best management practices are not tracked in all Bay jurisdictions, current accounting cannot be viewed, on the whole, as accurate. The committee concluded that independent auditing of the tracking and accounting at state and local levels would be necessary to ensure the reliability and accuracy of the data reported.

Electronic reporting systems are likely to improve the quality of reporting and ease the jurisdictions' tracking and accounting burden but may currently be delaying assessments of implementation progress. Because implementation data are now reported electronically to a region-wide system, several jurisdictions noted that their own data are then less accessible for their assessments of state-level progress. Some Bay jurisdictions have mechanisms in place to compile progress updates as needed, but others have to wait approximately nine months after the end of the reporting period for a summary of best management practice implementation from the Chesapeake Bay Program.

Tracking describes approaches to document the implementation of **best management practices**, efforts by farmers, developers, local governments, and others use to reduce nutrient and sediment inputs to the Chesapeake Bay.

Accounting describes the process of analyzing and reporting practice information, and quantifying the estimated resulting load reductions.

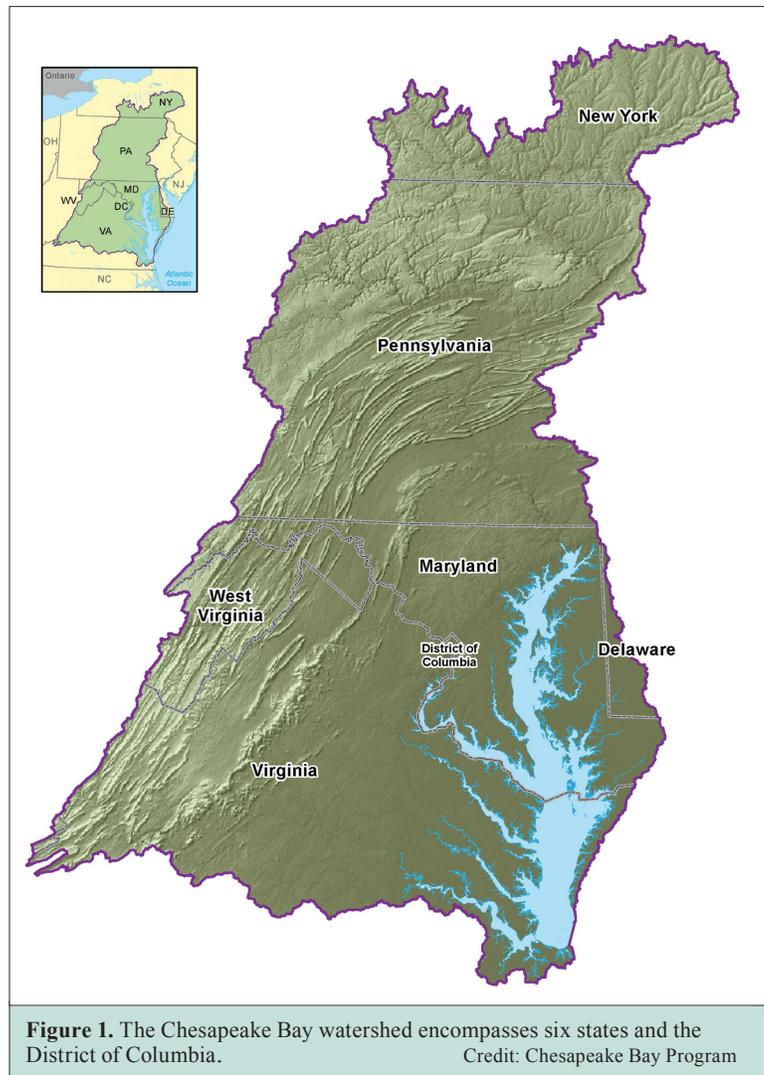


Figure 1. The Chesapeake Bay watershed encompasses six states and the District of Columbia. Credit: Chesapeake Bay Program

Two Year Milestones

In the past, Bay recovery goals were set in decadal increments that did not specify steps on how to achieve the necessary pollution reductions. To accelerate progress in Bay restoration, the Chesapeake Bay Program introduced two-year milestones for implementing nutrient and sediment control practices. This strategy requires Bay jurisdictions to meet short-term implementation goals, with frequent assessments of the pace of progress. However, the milestone strategy does not guarantee that implementation goals will be met, and the consequences of failing to reach the two-year milestone goals are not clear.

The jurisdictions participating in the Chesapeake Bay Program reported mixed progress toward their first milestone goals. However, the committee was largely unable to assess the likelihood that the Bay jurisdictions will meet their ultimate nutrient load reduction goals with the data provided. Nearly all jurisdictions have insufficient data to evaluate

implementation progress relative to their nutrient reduction loads. Without timely updates and synthesis of progress, most jurisdictions lack the information necessary to make the mid-course corrections that are pivotal to the milestone strategy.

Adaptive Management

Since 2008, the Chesapeake Bay Program has advocated for the use of adaptive management at both state and federal levels as a way to enhance overall management of the program and to strengthen scientific support for decision making. However, the committee did not find any evidence of formal adaptive management efforts for nutrient and sediment reduction. Instead, the current two-year milestone strategy is best characterized as a trial and error process of adaptation in which learning is serendipitous, rather than an explicit objective. Effective adaptive management involves deliberate management tests, a carefully planned monitoring program, assessment of the results, and a process by which management decisions are modified based on new knowledge. Successful application of adaptive management requires careful assessment of uncertainties relevant to decision making, but the partners have not fully analyzed uncertainties inherent in nutrient and sediment reduction efforts.

Without sufficient flexibility of the regulatory and organizational structure within which Chesapeake Bay Program nutrient and sediment reduction efforts are undertaken, adaptive management may be problematic. Truly embracing adaptive management requires recognition that factors such as the total maximum daily loads, load allocations, or even water quality standards, may need to be modified based on what is learned through the management tests.

Strategies to Meet Restoration Goals

Achieving implementation of all needed nutrient and sediment reduction practices by the target date of 2025 will not be easy for most areas of the Bay watershed. Jurisdictions will not only have to make significant reductions in current inputs to the Bay, but they will also need to make additional efforts to limit impacts of growth and development over the next 15 years. In addition, future climate change may impact the response of the Bay to reduced loads.

Even after water quality projects are implemented, it will take some time for the full benefits to be realized in the Bay. Helping the public understand the lag times and uncertainties associated with water quality improvements, and developing program strategies to quantify them, is vital to sustaining public interest in the program, especially if near-term Bay response does not meet expectations.

To reach long-term load reduction goals, Bay jurisdictions and the federal government will need to prepare for the challenges ahead and consider a wide range of possible strategies, including some that are receiving little consideration today. The committee identified strategies with unrealized potential to encourage further consideration and exploration among the Chesapeake Bay Program partners and stakeholders.

Opportunities in Agriculture

Research has shown that animals use only about 30 percent of the nitrogen and phosphorus in their feed, with the remainder excreted in their waste. Implementing a carefully planned diet tailored to meet the specific nitrogen and phosphorus requirements of the animal in each phase of growth will minimize nutrient loss and therefore reduce nutrient inputs to the environment. An alternative would be to limit the extent of livestock farming operations in the watershed, an option that has negative socioeconomic consequences but serves an example of the bold actions and difficult policy decisions that may be needed to restore the Bay ecosystem.

Box 1. Individual Responsibility

Enhancing the individual responsibilities of watershed inhabitants, through education, incentives, or regulations, could contribute to the success of Bay restoration. Ways in which residents of the Bay area can help include:

- Reducing use of lawn fertilizers, as discussed in the text. Improved application strategies, including slow release fertilizers and avoiding application during heavy rainfall, could also reduce nutrient loading.
- Ensuring regular maintenance of septic systems, with replacement of failing systems. Septic systems can be upgraded to include nitrogen removal capability, although the technology can be costly to install and generally requires specialized operation and maintenance services. Without upgrades, some benefits in pollutant load reductions can be attained with proper septic system maintenance practices, such as inspection and regularly scheduled pumping every three to five years.
- Reducing stormwater runoff and, therefore, the amount of nutrients and sediment washed into the Bay. For example, rain barrels can be used to collect stormwater that can water gardens during dry spells, and landscaping techniques, such as using pervious pavement, can promote the infiltration of water into the ground.

The committee also noted that voluntary, incentive-based programs can be an effective means to encourage the implementation of best management practices. Identifying an incentive that has value to the landowner is a key to the success of this strategy. A system of presuming compliance with water quality standards in exchange for voluntary implementation, maintenance, and reporting of best management practices by farmers has proven to be a powerful incentive in restoration projects in other areas of the country.

Opportunities in Urban and Suburban Areas

An estimated 215 million pounds of nitrogen fertilizer are applied to lawns in the Bay watershed each year. Restricting nitrogen and phosphorus lawn fertilizers is a cost-effective way to reduce nutrient pollution. Several states within the Bay watershed have taken some actions to address fertilizer runoff, through education and certification of lawn-care professionals, but communities could also adopt regulations to restrict fertilizer applications. Additionally, communities could restrict land-use changes that increase nutrient loads.

Cross-cutting Opportunities

Although the Chesapeake Bay has realized substantial benefits from the Clean Air Act, additional air pollution controls, in both urban and

agricultural settings, could also help reduce nitrogen loading to the Bay. More stringent controls of nitrogen emissions from all sources would benefit both the Bay and the people who reside in its watershed.

Strengthening Modeling Capabilities

Establishing a Chesapeake Bay Modeling Laboratory would ensure that the Chesapeake Bay Program would have access to a suite of state-of-the-art models that could be used to build credibility with the scientific, engineering, and management communities. The Chesapeake Bay Program relies heavily on models to set restoration goals and evaluate nutrient control strategies. A modeling laboratory that brought academic scientists and engineers together with Chesapeake Bay Program modelers could be used to enhance the quality of the simulations and bring critical review and new ideas. An important component of the work of a modeling laboratory would be the integration of monitoring with modeling efforts. Joint research investigations focused on evaluating the success of the Bay recovery strategies, for example studies on the role of lag times in the observed pollutant loads and Bay responses, could be centered in the laboratory.

Read or purchase this report and locate information on related reports at
<http://dels.nas.edu/wstb>

Committee on the Evaluation of Chesapeake Bay Program Implementation for Nutrient Reduction to Improve Water Quality: **Kenneth H. Reckhow** (*Chair*), RTI International, Research Triangle Park; **Patricia E. Norris** (*Vice Chair*), Michigan State University; **Richard J. Budell**, Florida Department of Agriculture and Consumer Services; **Dominic Di Toro**, University of Delaware; **James N. Galloway**, University of Virginia; **Holly Greening**, Tampa Bay Estuary Program, St. Petersburg; **Andrew N. Sharpley**, University of Arkansas; **Adel Shirmohammadi**, University of Maryland; **Paul E. Stacey**, Great Bay National Estuarine Research Reserve, Durham, New Hampshire; **Stephanie E. Johnson** (*Study Director*), **Michael J. Stoeber** (*Research Associate*), National Research Council.

The National Academies appointed the above committee of experts to address the specific task requested by the U.S. Environmental Protection Agency. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.



For more information, contact the Board on Water Science and Technology Board at (202) 334-3422 or visit <http://dels.nas.edu/wstb>. Copies of *Achieving Nutrient and Sediment Reduction Goals in the Chesapeake Bay: An Evaluation of Program Strategies and Implementation* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

*Permission granted to reproduce this brief in its entirety with no additions or alterations.
Permission for images/figures must be obtained from their original source.*