# Introduction

Chesapeake Bay restoration has been a priority for the State of Maryland, its citizens and Chesapeake Bay watershed jurisdictions since 1983 when the Chesapeake Bay Program (CBP) was founded, and the first watershed restoration agreement was signed. By the mid-1990s, Chesapeake Bay's water quality standards were still not being met and it was designated as impaired under the federal Clean Water Act (CWA) framework. In 2000, an updated agreement signed by leaders across the watershed including state governors, the Mayor of the District of Columbia, the EPA Administrator, and the Chair of the Chesapeake Bay Commission, committed to "correct the nutrient and sediment-related problems in the Chesapeake Bay and its tidal tributaries"[6] sufficient to remove it from the federal list of impaired waters by 2010. It was also agreed that if these voluntary commitments were not sufficient to restore the Bay by 2010, the CBP partnership would pursue the regulatory CWA approach and develop a Total Maximum Daily Load (TMDL). In the late 2000s, when it became clear that the voluntary water quality agreement had not fully restored the Bay, the CBP partnership transitioned to the regulatory CWA framework and began developing the Chesapeake Bay TMDL.

The TMDL quantifies how much pollution, specifically nitrogen, phosphorus and sediments, must be reduced to achieve Chesapeake Bay water quality standards. Water quality standards are the minimum regulatory requirements (e.g., dissolved oxygen, water clarity - see COMAR 26.08.02.03-3[7]) that Chesapeake Bay must meet to support healthy living resources like crabs, oysters and rockfish/striped bass. The TMDL is calculated using multiple computer models (watershed, estuarine, and water quality and sediment transport models) that simulate environmental conditions and are calibrated to field monitoring data. Since the TMDL does not specify how or where pollution reductions will be achieved, watershed implementation plans (WIPs) are also developed to identify to type, number and location of pollution reduction practices planned to restore water quality. The pollution reduction practices identified in those plans are then translated into scenarios that are run through the modeling framework to demonstrate that water quality standards will be achieved.

This current plan represents the third phase of the WIP to achieve Maryland's 2025 TMDL pollution targets and incorporates lessons learned from the Phase I and II WIPs. The Phase I WIP identified and accelerated the strategies and deadlines for practices to achieve 70 percent of the pollution reductions by 2017. This Phase I WIP was finalized in December 2010 commensurate with the development of the 2010 TMDL and during a time when EPA's scientific modeling framework was being updated. The Phase I WIP demonstrated achievement of pollution targets at the major basin scale (i.e., Eastern Shore, Potomac, Susquehanna, Western Shore and Patuxent basins) and was considered a starting point for finer scale planning during the Phase II process.

Maryland's Phase II WIP provided additional geographic resolution to implementation efforts and used the 2025 restoration date consistent with the TMDL. Originally, the Phase II WIP was intended to be developed at the county geographic scale; however, EPA decided in October 2011 to scale back its expectations for geographic specificity due to data and model limitations. Although the plans were again documented at the major basin scale, most local partners provided the state information at a county scale

[6] chesapeakebay.net/documents/cbp_12081.pdf
[7] .dsd.state.md.us/comar/comarhtml/26/26.08.02.03-3.htm

to form the basis of the basin scale plans. The county analyses were supported by the state's assigning stormwater pollution reduction targets at a finer level than is available in the EPA Bay watershed model. This underlying county scale of planning provided further assurance of implementation beyond that of the Phase I WIP because many of the implementation actions are conducted by county governments and soil conservation district offices operating at that scale.

After the Phase II WIP, the CBP partnership agreed to conduct a 2017 midpoint assessment (MPA) to evaluate jurisdictions' progress in achieving 60 percent of the necessary TMDL pollution reductions. Maryland exceeded the 60 percent MPA phosphorus and sediment goals in 2017 and was 36 percent of the way towards achieving the nitrogen targets. When upgrades are completed at its 67 major WWTPs, Maryland will exceed the 60 percent nitrogen goal. As of January 2019, upgrades are complete at approximately 90 percent of these plants (59 of 67 complete), with five of the eight remaining plants anywhere from 88-98 percent complete, two still in planning or design, and work on one plant not yet started.

The MPA was also used as an opportunity to incorporate improved science and monitoring results into the Chesapeake Bay modeling framework and develop updated 2025 pollution reduction targets. Using the Phase 6 modeling suite, an updated set of state-basin targets was established to ensure the attainment of water quality standards after implementation of the States' WIPs. Nutrient targets for each of Maryland's five major basins are provided in Table 2, and the process for calculating these targets is described in Appendix F.

***Table 2:*** *Maryland's Phase III WIP Pollution Targets by Major Basin in Million Pounds per Year.*

| Major Basin | Phase III WIP Target* *(Million lbs/yr)* | |
|---|---|---|
| | Nitrogen | Phosphorus |
| Eastern Shore of Chesapeake Bay | 15.6 | 1.29 |
| Patuxent River Basin | 3.1 | 0.30 |
| Potomac River Basin | 15.8 | 1.09 |
| Susquehanna River Basin | 1.6 | 0.05 |
| Western Shore of Chesapeake Bay | 9.6 | 0.95 |
| **Total** | **45.8** | **3.68** |

*****Phase III WIP reductions subject to change upon EPA review.

For the Phase I and II WIPs, Maryland used the allocation approach from the Chesapeake Bay TMDL to assign finer-scale goals for the Bay segment and county levels. This methodology was based on the portion of the load from a watershed that could theoretically be reduced, and assigning a consistent percent reduction to the reducible load from each watershed. For this Phase III WIP, and in recognition that there are varying levels of pollution reduction progress across sectors, Maryland has adopted a feasibility approach to achieve 2025 targets. In a practical sense, this means Maryland recognizes that accelerated progress in both the wastewater and agricultural sectors will be largely responsible for Maryland achieving its 2025 restoration targets. Since wastewater and agriculture are the two highest loading sectors, these planned accelerated reductions will be sufficient to achieve current 2025 targets. The stormwater and septic sectors are then required to continue making steady reductions over a longer term (beyond 2025) and contribute their fair share of reductions to the Chesapeake Bay restoration effort while factoring in affordability. For stormwater, reductions will occur over multiple five-year MS4 permit cycles. Septic system reductions will include a menu of practices, like septic upgrades, pumpouts, sewer connections, financial incentives, and a focus on public health priorities to ensure sector progress. Slowing and reversing loss of natural lands, and increasing and restoring natural filters, are also critical to Bay restoration as well as adapting to and mitigating climate change impacts. The natural lands, conservation plus and protection chapters (Appendices B and D) include strategies to protect and restore the state's natural filters. Maryland worked closely with local jurisdictions throughout the Phase III WIP process to develop this feasibility based approach and document local strategies in county summary documents (see Appendix C).

This Phase III WIP documents all of the strategies and commitments Maryland and local jurisdictions will put in place to achieve these basin targets by 2025. EPA has also established expectations[8] for what information should be included in each jurisdiction's WIP.

**These EPA Expectations include:**

1. Programmatic and Numeric Implementation Commitments between 2018 and 2025
2. Comprehensive Local, Regional, and Federal Engagement Strategies and Commitments
3. Adjustments to Phase III WIP state-Basin Targets and the Phase II WIP Source Sector Goals
4. Development and Implementation of Local Planning Goals
5. PSC Decisions on Accounting for Growth
6. PSC Decisions on Conowingo Dam
7. PSC Decisions on Climate Change

Although Maryland's Phase III WIP is designed to achieve the TMDL nitrogen, phosphorus and sediment targets, and be consistent with EPA's expectations, Maryland is also strongly committed to the broader goals outlined in the current (2014) Chesapeake Bay Agreement[9]. These include sustainable fisheries, vital habitats, reduction of toxic contaminants, healthy watersheds, land conservation, stewardship, public access, environmental literacy, and climate resiliency. Maryland participates on multiple goal implementation teams to implement and track related strategies. Many of the Phase III WIP sections or strategies also contribute to achieving these broader Bay restoration goals because of their close connection to water quality.

[8] epa.gov/sites/production/files/2018-06/documents/epa-phase-iii-wip-expectations-6-19-18.pdf and "Clarification of Accounting for Growth Expectations for the Phase III Watershed Implementation Plans (WIPs), February 5, 2019.

[9] chesapeakebay.net/what/what_guides_us/watershed_agreement

# Programmatic and Numeric Implementation Commitments between 2018 and 2025

This section provides an overall summary of the feasibility-based implementation commitments and associated pollutant reductions quantified using the Chesapeake Bay modeling tools. Maryland has 53 tidal subwatersheds (Figure 3) within the five major basins (Figure 4), each with specific water quality standards that must be achieved. The following Phase III WIP pollution reduction practices (Table 3) were input into the Bay watershed model, along with their geographic location, to calculate expected reductions of nitrogen, phosphorus and sediment into Chesapeake Bay’s tidal waters by 2025. The subwatershed pollution reductions were then summed up by pollutant-sector combination statewide (Tables 4-6) to determine if 2025 planning targets will be met. Maryland also projected the trajectories or pollution reduction trends after the 2025 date (Figure 5) to characterize expected future sector growth and associated increases in pollution loads. Detailed descriptions of pollution reduction programs and practices by sector are provided in Appendix B.

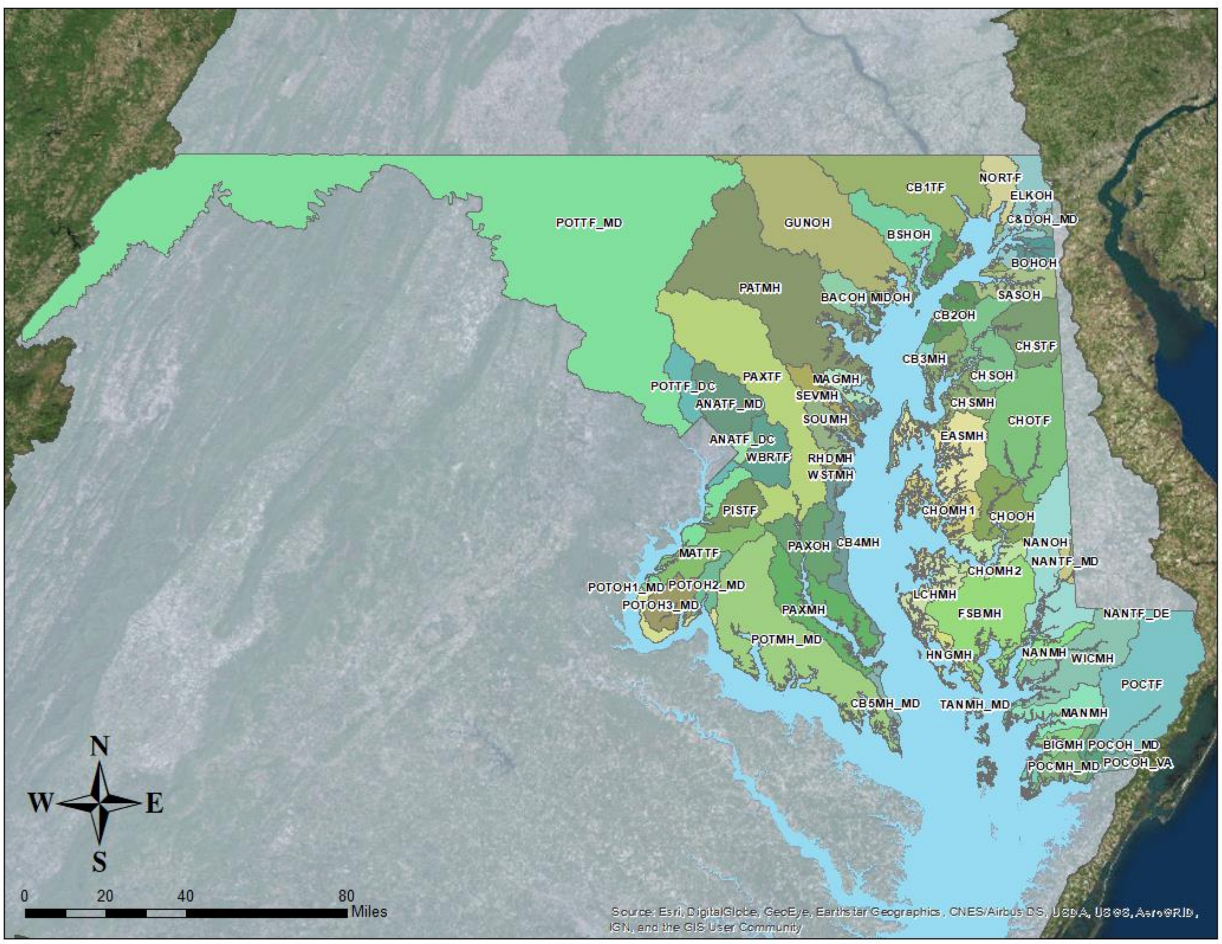


*__Figure 3:__ Maryland’s 53 tidal subwatersheds draining into Chesapeake Bay.*

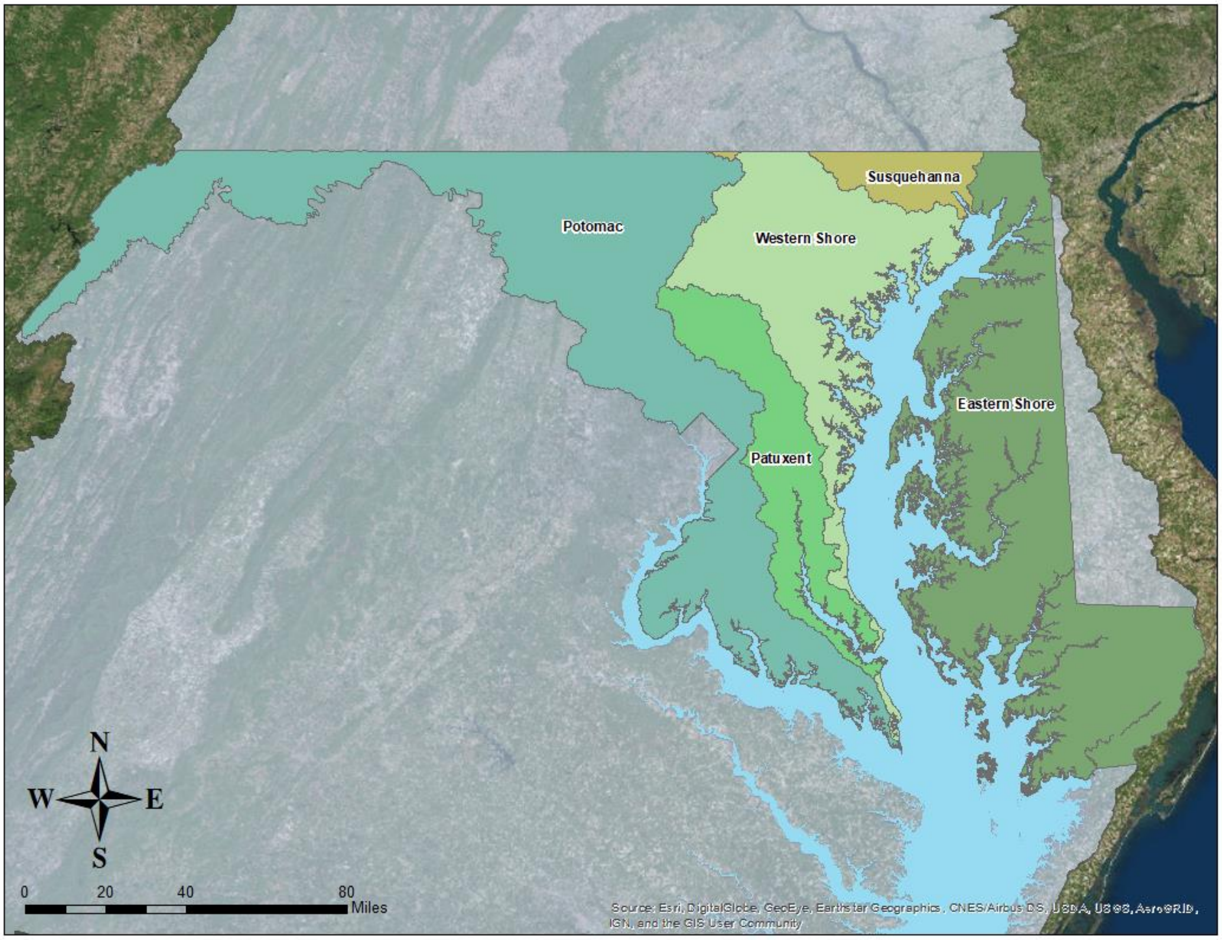


***Figure 4**: Maryland 5 Major Basins for which EPA has Assigned Pollution Targets.*

***Table 3:** Core Pollution Reduction Practices Input into the Chesapeake Bay Modeling Framework. NOTE: The table below is not intended to capture all practices, just the highlights. For details on each sector's strategies, please refer to Appendix B.*

| Sector | BMP Description | Lbs. TN Reduced | Lbs. TP Reduced | Annual Costs |
|---|---|---|---|---|
| Agriculture | Conservation Technical Assistance (1 million acres of Conservation Plans + Design & Oversight of all BMPs implementation) | 1.1 million/yr | 53,000/yr | $ 13,817,000 |
| | Nutrient Management Compliance | 1.6 million/yr | 76,000/yr | $ 3,100,000 |
| | Cover Crops (470,000 acres planted annually) | 2.3 million/yr | 2,000/yr | $ 25,500,000 |

| Sector | BMP Description | Lbs. TN Reduced | Lbs. TP Reduced | Annual Costs |
|---|---|---|---|---|
| **Agriculture** | Manure Transport (100,000 tons transported annually) | 228,000/yr | 26,000/yr | $ 2,000,000 |
| | Verification of existing BMPs | 87,500/yr | 1,500/yr | $ 500,000 |
| | Implementation of Additional BMPs (The Maryland Agricultural Water Quality Cost-Share (MACS) Program) | 652,000 | 10,600 | $ 9,275,000 |
| **Natural Lands** | Upland Tree Planting and Streamside Forest Buffers (1,150 acres) | 8,000 | 700 | $1,683,920 |
| | Wetland Restoration (175 acres) | 600 | 50 | $125,000 |
| | Stream Restoration (6 miles) | 2,500 | 2,250 | $3,172,520 |
| | Shoreline Management (Living Shoreline Technique) (3,000 ln ft) | 150 | 100 | $257,140 |
| | Oyster Aquaculture (350,000 bushels) | 10,000 | 1,000 | $2,500,000 |
| **Septic** | Best Available Technology (BAT) Upgrades (Based on roughly 920 BAT unit upgrades) | 40,000 | - | $10,100,327 |
| | Connection to Wastewater Treatment Plants (WWTP) (Based on roughly 1,600 sewer connections) | 16,800 | - | $1,296,899 |
| | Pumping (Not available until Septic Stewardship Plans developed by 2021) | - | - | TBD - Septic Stewardship |
| **Stormwater** | Complete current Phase 1 Municipal Separate Storm Sewer (MS4) permits restoration requirement (completion dates: 2018 and 2019) *Approximately 20,000 impervious acres* | 85,000 | 40,000 | $40,000,000 |
| | Complete new Phase 1 MS4 restoration requirement (completion dates: 2023 and 2024) *Approximately 17,500 impervious acres* | 90,000 | 12,500 | $40,000,000 |

| Sector | BMP Description | Lbs. TN Reduced | Lbs. TP Reduced | Annual Costs |
|---|---|---|---|---|
| Stormwater | Complete Current Phase 2 MS4 restoration requirement (completion date: 2025) *Approximately 3,000 impervious acres* | 15,000 | 5,000 | $5,000,000 |
| | Miscellaneous implementation on non-MS4 counties (i.e. trading, trust fund) *Approximately 400 impervious acres* | 5,000 | 500 | $5,000,000 |
| Wastewater | Complete Bay Restoration Fund (BRF)-Funded Enhanced Nutrient Removal (ENR) upgrades to 67 significant municipal wastewater plants | 4,000,000 | 100,000 | Fully Funded Pre-WIP III |
| | Continue funding ENR upgrades for non-significant municipal plants through the BRF (11 additional plants by 2025, for a total of 16) | 25,000 | 5,000 | $50,000,000 |
| | Provide Operations and Management (O&M) Grant through the BRF for facilities achieving nitrogen discharge concentrations of 3.0 mg/L | 425,000 | No planned additional planned reductions | $10,000,000 |
| | Incentivize higher treatment levels (beyond 3.0 mg/L of nitrogen) through water quality trading and the Clean Water Commerce Act (through 2021) | No estimate | No estimate | $10,000,000 |
| | Complete upgrades to federal significant municipal plant | 3,000 | 300 | No state costs |
| | Continue minor industrial reductions | No estimate | No estimate | No state costs |
| | Maintain achievement of significant industrial Waste Load Allocations | No additional reductions | No planned additional planned reductions | No state costs |
| | Implement sewer projects to address combined sewer overflows (CSOs), sanitary sewer overflows (SSOs) and inflow and infiltration (I/I) | 20,000 | 2,000 | $40,000,000 |

***Table 4:** Nitrogen: Statewide Current & Phase III WIP Loads by Source Sector.*

| Source Sector: Nitrogen | 2017 Progress (M lbs TN/yr) | Phase III WIP * (M lbs TN/yr) | Change in Load (M lbs TN/yr \| Percent) |
|---|---|---|---|
| Agriculture | 22.4 | 18.0 | -4.4 \| -20% |
| Natural ** | 8.1 | 8.1 | 0.0 \| 0% |
| Septic | 3.1 | 3.1 | 0.0 \| 1% |
| Stormwater *** | 9.4 | 9.2 | -0.2 \| -2% |
| Wastewater | 11.3 | 6.6 | -4.7 \| -41% |
| **Total** | **54.2** | **45.0** | **-9.2 \| -17%** |

***Table 5:** Phosphorus: Statewide Current and Phase III WIP Loads by Source Sector.*

| Source Sector: Phosphorus | 2017 Progress (M lbs TP/yr) | Phase III WIP * (M lbs TP/yr) | Change in Load (M lbs TP /yr \| Percent) |
|---|---|---|---|
| Agriculture | 0.65 | 0.47 | -0.17 \| -27% |
| Natural | 1.83 | 1.83 | -0.00 \| 0% |
| Stormwater *** | 0.67 | 0.58 | -0.09 \| -13% |
| Wastewater | 0.51 | 0.39 | -0.12 \| -24% |
| **Total** | **3.66** | **3.28** | **-0.39 \| -11%** |

***Table 6:** Sediment: Statewide Current and Phase III WIP Loads by Source Sector.*

| Source Sector: Sediment | 2017 Progress (M lbs TSS/yr) | Phase III WIP * (M lbs TSS/yr) | Change in Load (M lbs TSS/yr \| Percent) |
|---|---|---|---|
| Agriculture | 259 | 185 | -75 \| -29% |
| Natural | 6,903 | 6,903 | 0 \| 0% |
| Stormwater *** | 405 | 230 | -175 \| -43% |
| Wastewater | 7 | 9 | +2 \| +26% |
| **Total** | **7,575** | **7,328** | **-239 \| -3%** |

* Phase III WIP reductions subject to change upon EPA review.
** Includes atmospheric deposition of nitrogen to tidal waters.
*** Stormwater reductions include natural load reductions that are attributed to practices implemented by the stormwater sector.

These model outputs demonstrate that Maryland has sufficient practices across sectors to achieve its 2025 pollution targets. In fact, per Figure 5 below, Maryland is expected to remain below its nitrogen target out to the year 2047. With a feasibility based approach, however, progress is not even across sectors. The wastewater and agricultural sectors achieve the largest nitrogen reductions from 2017 progress levels, 41 percent and 20 percent respectively, while stormwater achieved a 2 percent reduction and septic sector loads increase by less than 1 percent.

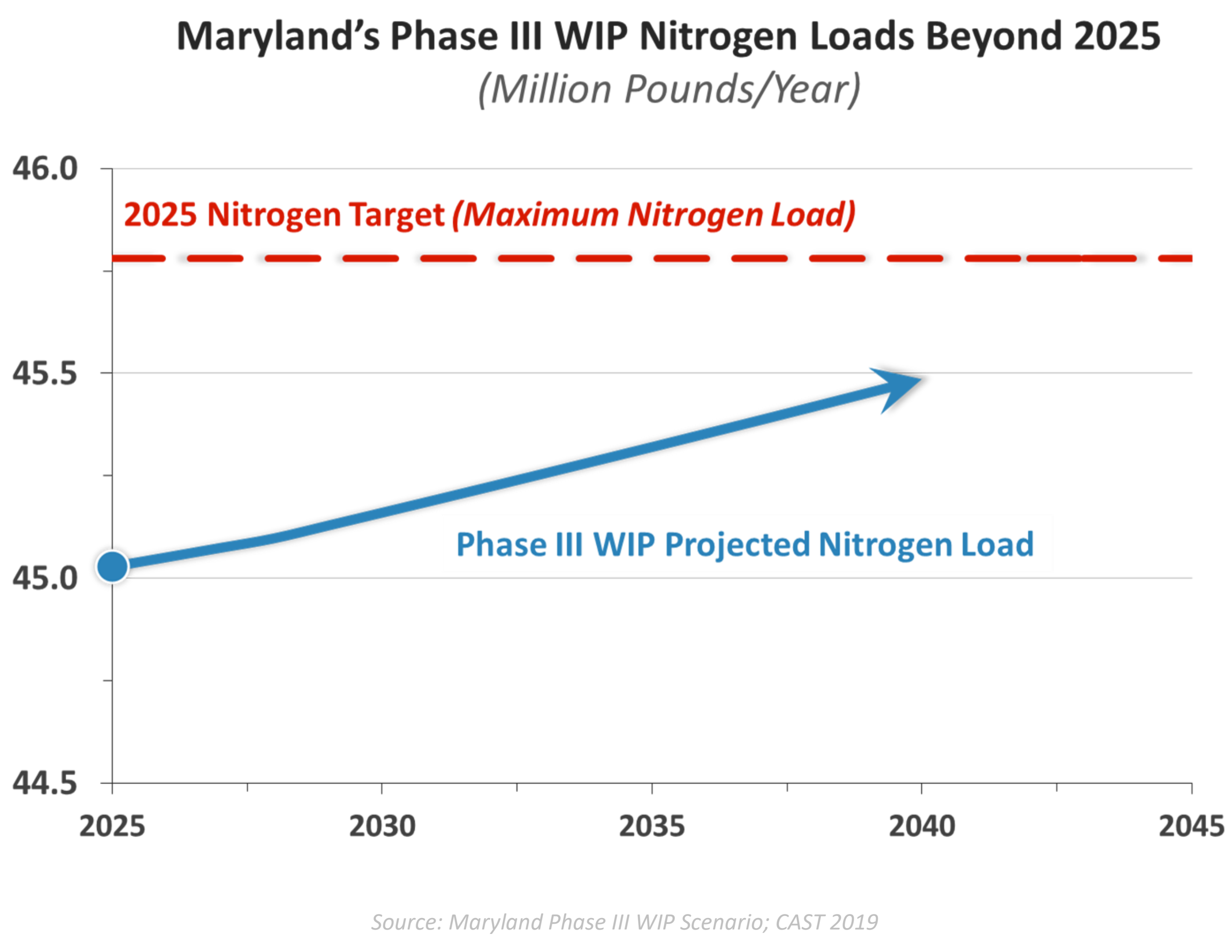


***Figure 5:*** *Total Nitrogen projected from Phase III WIP Strategies implementation. Shown relative to total nitrogen target (red line - 45.78 M lbs).*

# Comprehensive Local, Regional, and Federal Engagement Strategies and Commitments

## Engagement During WIP Implementation

Due to their central implementation roles, county, municipal, federal, and soil conservation district (SCD) staff who conduct implementation activities will be the primary stakeholders involved in Maryland's Phase III WIP implementation. Approaches to practitioner engagement will vary by pollution source sector. Appendix A lists specific engagement activities during WIP development.

The Maryland Department of Agriculture (MDA) held a meeting in each county, facilitated by the local SCD, to develop a revised county level plan that was ultimately incorporated into Maryland's Phase III WIP.

The Maryland Department of the Environment (MDE) held individual meetings with each county's public works staff to discuss county goals and Maryland's Phase III WIP. Engagement with Phase I MS4s occurred, and continues to occur, during permit renewal, as well as during review of required biennial financial assurance plans and annual progress reports. MDE staff continue to engage Phase II jurisdictions and facilities one-on-one and in small groups to discuss permit requirements and financial assistance. MDE engaged federal facilities through participation in the Federal Facilities Workgroup. A summary of U.S. Department of Defense implementation can be found in Appendix E. MDE, Maryland Sea Grant Extension, and NGOs engage non-MS4 communities.

MDE met with environmental health directors from all counties to discuss local onsite disposal goals and Maryland's Phase III WIP. Engagement with permitted wastewater facilities continues through the permitting process. Communication with this sector is also facilitated by the Maryland Association of Municipal Wastewater Agencies.

## Engagement and Communication Goals

It is critical that local government, the agricultural community, and other local partners were involved in developing the WIP to ensure the plans will be realistic, reflect local priorities, benefit local communities and clearly identify the resources (e.g., funding, technical support) needed to get the job done. To facilitate effective local engagement in the Phase III WIP process, EPA expected[10] the states to devise a strategy for engaging local, regional and federal partners in the development and implementation of the Phase III WIPs.

Key expected products from Maryland's continued local engagement will vary by sector, permit status and local needs. Specific types of engagement will be customized according to local needs and capacities. Engagement will primarily target partner groups most directly involved in implementation, including soil conservation districts, local governments and state agencies.

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[10] U.S. Environmental Protection Agency's Expectations for the Phase III Watershed Implementation Plans, June 2018.

Discussion of implementation funding will continue to be an important component of engagement activities. State and local partners will continue to refine funding strategies for achieving the Bay restoration goals and making further reductions after 2025.

# Strategies

## Target Audiences

Maryland's Phase III WIP will succeed only with policymaking and commitments that are coordinated with local leaders. Local elected officials and agricultural community leaders, (e.g., district managers and Maryland Association of Soil Conservation Districts boards), have particularly important roles. Engagement of local leaders will continue through correspondence from the governor's Chesapeake Bay Cabinet. MDE will continue to participate in Maryland Association of Counties and Maryland Municipal League conferences to keep local government leaders engaged and informed.

MDE staff will maintain key technical contacts knowledgeable in disciplines that inform WIP implementation, such as tree planting, climate change and urban source sector management. These technical partners will continue to share their experiences and identify model programs that have been successful.

Practitioners will continue to be the primary stakeholders involved in Maryland's Phase III WIP implementation. Broadly speaking, practitioners are county, municipal, SCD, Watershed Assistance Collaborative and National Fish and Wildlife Foundation staff who conduct implementation activities. Approaches to practitioner engagement will vary by pollution source sector, as described below.

MDA will continue to lead agriculture sector engagement, primarily through listening sessions and meetings, to identify barriers and opportunities in implementation and to track progress toward meeting WIP goals.

MDE will maintain contact with each county's public works staff to discuss local progress on stormwater. Additional sub-sector engagement will take place as described below.

Phase I permits in Maryland require the restoration of a percentage of a jurisdiction's impervious surface area. Nutrient reductions resulting from restoration and other permit requirements were incorporated into Maryland's Phase III WIP. Engagement will continue to occur during permit renewal, as well as during review of required biennial financial assurance plans and annual progress reports. In addition to regular phone calls and emails with stormwater managers, MDE staff will continue to participate in stormwater meetings organized by Maryland Association of Counties (MACo) to discuss Bay restoration and local water quality improvement.

MDE staff will continue to engage Phase II jurisdictions and facilities one-on-one and in small groups to discuss permit requirements and financial assistance. Nutrient reductions resulting from permit requirements were incorporated into Maryland's Phase III WIP. Permittees are also routinely engaged during their annual report reviews, which include constructive feedback from MDE staff.

Maryland Sea Grant Extension's watershed restoration specialists are trusted messengers for WIP implementation, especially for non-MS4 stormwater. Extension specialists assist communities with identifying funding, implementing restoration projects, BMP tracking, engaging community leaders and more. In addition, several NGOs facilitate communication about the WIP with local partners. MDE will continue to collaborate with these messengers on local engagement.

Engagement with environmental health directors will continue to identify barriers and opportunities in implementation and to track progress toward meeting WIP goals for onsite wastewater systems.

Engagement with permitted wastewater facilities continues through the permitting process. Communication with this sector is also facilitated by the Maryland Association of Municipal Wastewater Agencies.

# Key Local Challenges and Opportunities

## Maintenance and Verification

Much of the on-the-ground implementation to achieve Maryland's restoration targets occurs at the local government level. These local government partners are installing physical infrastructure, whether larger capital projects like upgrading wastewater plants or smaller scale stormwater retrofits designed to reduce pollution at its source. Like all infrastructure projects, pollution reduction practices must be properly installed and maintained to achieve their intended function. Maryland has approved verification protocols to ensure pollution reduction practices are working properly and can continue to be counted towards Bay restoration credit. [11] Local jurisdictions, soil conservation districts, and other partners who are implementing these projects on the ground have identified maintenance, verification, funding, programs and accounting as resource challenges that could impact restoration progress.

## Restoration Capacity

Local partners also need continued resources to build restoration capacity, whether in the form of permitting assistance, technical assistance, knowledge transfer, more dedicated staff, and/or financial incentives. These needs vary regionally, by sector, as well as within individual jurisdictions. Since there is no one-size-fits-all solution to local implementation challenges, ongoing local engagement and capacity building will be necessary throughout the implementation process to ensure restoration progress.

# Key Messages

Messages will be continuously re-evaluated based on new information on barriers, opportunities and progress. The following general messages are likely to remain important throughout WIP implementation.

- Continue to work with upwind states through key programs and partnerships, like the Regional Greenhouse Gas Initiative (RGGI), as well as through appropriate legal actions.
- Continue to work with upstream states and ensure EPA is holding all jurisdictions accountable.
- Make sure all watershed states do their part and are held accountable.

[11] Maryland BMP verification protocols are available at .mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/BMP%20Verification/MD_Verification%20Protocols_Master_Doc.pdf

- Maintain a strong commitment to restoration and resiliency.
- Invest in restoration practices that reduce increased pollution resulting from climate change, and consider their placement on the landscape so they can be maintained over time.
- Continue to support full funding at the federal, state and local levels for Bay and local waterway restoration and prevention of degradation.
- Make funding go further by using market-based and other innovative finance approaches to create a restoration economy.
- Implement the Clean Water Commerce Act and other mechanisms to fund cost effective nutrient reduction practices.
- Continue to support addressing pollution loads from Conowingo Dam through the CWIP and other strategies, including holding Exelon accountable.
- Continue steady restoration progress in the stormwater sector through ongoing MS4 restoration requirements over current and future permit cycles.
- Plan for continued implementation beyond 2025.

# Key Messengers

Key messengers are those entities that the state relies on to assist with delivering communications and engaging local governments around the Phase III WIP. In addition to the Departments of Environment and Agriculture, other important messengers and sources include the Maryland Department of Planning, Maryland Department of Natural Resources and numerous NGOs.

MDE's Office of Communications, working with its sister state agencies, the Chesapeake Bay Trust, and various other NGOs, will continue to support outreach efforts to the general public to raise public awareness of WIP implementation.

# Tools and Resources

Engagement will take place in the form of webinars, meetings, fact sheets, phone calls, written correspondence and training. Table 7 (right) lists the target audiences along with example activities for each. For more examples of engagement activities, see the section on WIP development engagement and communication. In addition, MDE will continue to update its Chesapeake Bay webpages[12] to ensure that WIP information is readily available to a broad audience at all times.

***Table 7:** Key Target Audiences and Associated Outreach Activities.*

| Target Audience | Activities |
|---|---|
| **Local leaders** | • Letters<br>• Workshops<br>• Conferences<br>• Meetings |
| **Practitioners** | • Workshops<br>• Webinars<br>• Surveys<br>• Meetings<br>• Emails |
| **Technical partners** | • Phone calls |
| **Other stakeholders** | • Meetings<br>• Emails |

[12] MDE's Chesapeake Cleanup Center: https://mde.maryland.gov/programs/water/TMDL/TMDLImplementation/Pages/cb_tmdl.aspx

# Adjustments to Phase III WIP State-Basin Targets and the Phase II WIP Source Sector Goals

In July 2018, the Chesapeake Bay Program Partnership agreed on nitrogen and phosphorus planning targets for the jurisdictions. The targets were established at a major basin scale so that Maryland received targets for the Eastern Shore, the Patuxent River Basin, the Potomac River Basin, the Susquehanna River Basin and the Western Shore. As part of its WIP development process, working with local jurisdictions to assess the feasibility of achieving reductions in different regions, Maryland adjusted the targets geographically. The adjustments followed a set of exchange rules established by the partnership in order to ensure that each of the jurisdictions' WIPs achieves a minimum water quality benefit. Maryland's Phase III WIP Targets are shown in Table 8. Appendix F provides a detailed description of the process used in establishing the final targets.

***Table 8:*** *Maryland's Phase III WIP Pollution Targets by Major Basin in Million Pounds per Year.*

| Major Basin | Phase III WIP Target* *(Million lbs/yr)* | |
|---|---|---|
| | Nitrogen | Phosphorus |
| Eastern Shore of Chesapeake Bay | 15.6 | 1.29 |
| Patuxent River Basin | 3.1 | 0.30 |
| Potomac River Basin | 15.8 | 1.09 |
| Susquehanna River Basin | 1.6 | 0.05 |
| Western Shore of Chesapeake Bay | 9.6 | 0.95 |
| **Total** | **45.8** | **3.68** |

***** Phase III WIP reductions subject to change upon EPA review.

# Development and Implementation of Local Planning Goals

Throughout the development of each phase of the state’s WIP, there has been significant interest in providing local planning goals for each jurisdiction by sector. There are many ways to do this, and the section below describes previous and current approaches to developing these goals.

In the Phase II WIP, Maryland used an equity based approach to setting local targets whereby each jurisdiction and pollution source sector was given a goal expected to achieve a similar percentage of pollution reductions. Through this approach, it was assumed that similar pollution reductions in each sector would require a similar level of effort. As Maryland implemented the Phase II equity approach, it became clear that different sectors have greater challenges implementing pollution reductions. Upgrades to stormwater and septic systems often require greater resources and include more roadblocks to implementation than other sectors, including private landowner permission, long planning horizons, preparation and approval of engineering plans and permits. Once in the ground, these practices achieve modest reductions relative to large capital projects like wastewater upgrades and will need to build up over time and long sustained efforts to make significant reductions.

Understanding these challenges, the state took a different approach in Phase III to setting local goals. The state met with local implementers like county governments and SCDs to understand their planned implementation efforts between now and 2025, as well as identify challenges and strategies that could increase the amount of work done in this timeframe. These local BMP planning scenarios were then given to the state to run through the Chesapeake Assessment Scenario Tool (CAST) model to determine the loads generated by the scenarios and set goals for each jurisdiction and sector for 2025.

This information was then brought together in county summary sheets (See Appendix C) that describe anticipated implementation across sectors planned to be met between now and 2025, and provide estimates of numeric nitrogen goals by sector for each county. The county summaries are components of the statewide strategy. It was also recognized that there would be an additional level of effort required beyond 2025 in order to achieve some sector goals and maintain others.

Maryland will use these goals as the basis for tracking local implementation progress through two-year milestones and the annual progress evaluations process. The primary mechanism for tracking Maryland’s overall progress will be the sector and basin targets. It is important to realize that although the primary goal of the WIP is to meet nitrogen, phosphorus and sediment goals, there are other benefits to implementation in these sectors. These conversations also focused on the important co-benefits that nitrogen, phosphorus and sediment reduction practices can provide to Maryland’s citizens. Such benefits include flood control, new public recreational spaces, sustainable infrastructure, climate mitigation, and aquatic resource improvements to local streams and waterways.

# Accounting for Growth

## Background

The EPA’s expectations for the Phase III WIP states that to be consistent with the 2010 TMDL, jurisdictions should describe how they are going to offset any increases in nutrient and sediment loads resulting from growth through 2025. EPA also expects jurisdictions to consider using NPDES regulations to offset or adjust source sector goals for new or increased loads, and to describe the programs and regulations that jurisdictions intend to implement to maintain existing beneficial land covers. EPA also gives jurisdictions the opportunity to factor updated future growth projections into their milestone commitments.

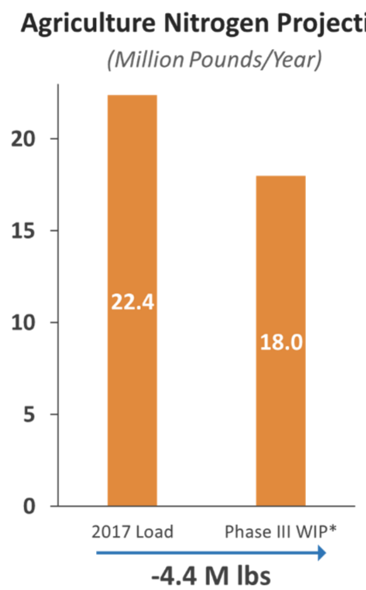
After completing the final Phase II WIP, an Accounting for Growth (AfG) Workgroup was established in 2013 to find common ground, clarify areas of disagreement and make recommendations for an AfG policy in advance of formally proposing regulations. The 2013 AfG workgroup achieved consensus on all but two key policy issues: (1) calculating allocation of loads for new development and determining associated offset requirements and (2) establishing the geographical boundaries for pollution trading. Nutrient trading regulations have been developed to address trading geographies while specific nitrogen offset requirements from growth have not been determined. The ultimate goal is to create a fair AfG program that is not unwieldy, expensive to administer, or difficult to explain.

Since Maryland does not have regulations in place to offset increased loads from new sector growth, the state is currently offsetting loads through accelerated pollution reductions in the wastewater and agricultural sectors. Maryland also has many land conservation, preservation and growth management programs that limit the impacts of growth to the natural environment. To sustain Chesapeake Bay restoration over the long term and accommodate projected growth, Maryland will need to implement an adaptive growth policy through the accountability and adaptive management framework that regularly revisits sector-loading trends and provides sufficient offsets to stay under the state’s pollution reduction targets.

## Trends

Maryland is expected to grow by approximately 15,000 households per year through 2045, resulting in additional nutrient pollution (Maryland Department of Planning, Projections and state Data Center, August 2017). The following sections discuss the pollution reduction and growth trends in each sector, as well as the programs in place to curtail growth in loads. Overall, Maryland currently projects that expected load reductions under the Phase III WIP will outweigh the growth in loads from development and agriculture past 2025 until 2047.

***Agriculture***




**Phase III WIP reductions subject to change upon EPA review*

***Figure 6:*** *Current and projected nitrogen loads to Chesapeake Bay from agriculture.*

According to SDAT, which tracks acres subject to the agricultural transfer tax, about 5,103 acres of farmland were lost in 2018. The annual loss of farmland has been historically low in Maryland since the Great Recession in 2008. During the housing boom of the early 2000s, annual loss was much higher. For example, in 2004, according to SDAT, 22,451 acres of farmland were lost. The Bay Program has projected continued loss of farmland through 2025.

***Forest Loss***

Current projections (CAST "current zoning" scenario for Maryland) estimate 3,000-acres of forest loss annually. Since forest is the lowest nutrient loading land use to the Chesapeake Bay and provides many co-benefits like carbon sequestration, shading/cooling of streams, and wildlife habitat; slowing and ideally reversing forest loss is critical to sustaining the health and restoration of Chesapeake Bay and Maryland's local waters over the long term.

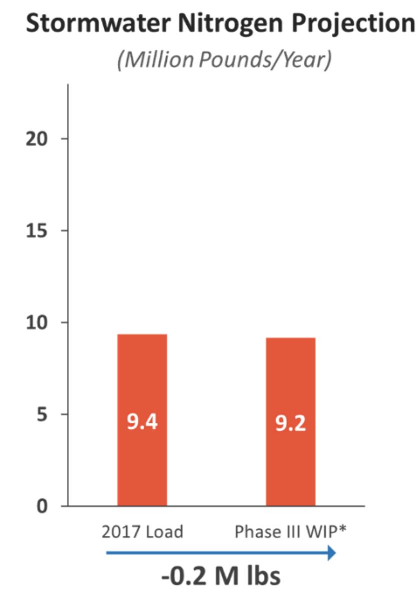
To minimize the loss of Maryland's forest resources during land development, the 1991 Forest Conservation Act (FCA) was enacted. Any activity requiring an application for a subdivision, grading permit or sediment control permit on areas 40,000 square feet (approximately 1 acre) or greater is subject to the Forest Conservation Act and will require a Forest Conservation Plan. During the first fifteen years of implementation FCA has been responsible for the review of 199,925 acres of forest on projects scheduled for development. Of those, 120,638 acres were retained, 71,885 acres were cleared, and 21,461 acres were planted with new forest. In other words, at least twice as many acres were protected or planted as were cleared.

The 2014 Chesapeake Bay Watershed Agreement has Vital Habitats goals that commit to both reforestation targets and a 2025 conservation goal focusing on forested lands to "protect an additional two million acres of lands throughout the watershed—currently identified as high conservation priorities at the federal, state, or local level—including 225,000 acres of wetlands and 695,000 acres of forest land of highest value for maintaining water quality." Additional information about Maryland's land conservation programs is provided in the Conservation Plus section, Appendix D. The natural lands section of the WIP (Appendix B) also identifies tree planting and riparian buffers goals to help meet Bay agreement goals.

***Stormwater***

Current projections (CAST "current zoning" scenario for Maryland) to 2025 estimate 900-acres of new impervious surfaces created annually as a result of new development. This results in an approximately 2 percent reduction in stormwater loads of nitrogen by 2025 (Figure 7). After agriculture and wastewater, stormwater is the third highest nutrient loading sector to the Bay at approximately 17 percent of the total nitrogen load. By 2025, nitrogen pollution from stormwater is estimated to comprise 20 percent of the total nitrogen loads to Chesapeake Bay.

To help address stormwater impacts from new development, the "Stormwater Management Act of 2007" (Act) became effective on October 1, 2007. Prior to this Act, environmental site design (ESD) was encouraged through a series of credits found in Maryland's Stormwater Design Manual. The Act requires that ESD, through the use of nonstructural best management practices and other better site design techniques, be implemented to the maximum extent practicable. ESD practices are designed to promote infiltration of stormwater into natural vegetation and soils, which helps reduce nitrogen discharges associated with new development.

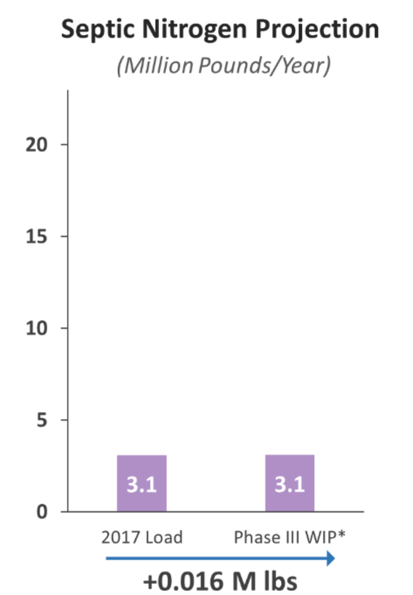



*Phase III WIP reductions subject to change upon EPA review

***Figure 7:*** *Current and projected nitrogen loads to Chesapeake Bay from stormwater.*

***On-Site Disposal Systems***

Current projections (CAST "current zoning" scenario for Maryland) estimate approximately 1,700 new on-site disposal systems (septic systems) annually. On average, approximately 1,200 septic systems annually are upgraded from conventional to best available technology (Maryland BAT database). This results in an increase of 16,000 lbs. of septic loads of nitrogen by 2025 (Figure 8). Although the septic sector is Maryland's smallest nutrient loading sector to the Bay at approximately 6 percent of the state's total nitrogen load, the septic sector is also the only sector with increasing pollution loads over time in Maryland's Phase III WIP; however, this increase is minimal. By 2025, Maryland's septic loads are expected to comprise approximately 7 percent of the overall nitrogen load to the Chesapeake Bay.



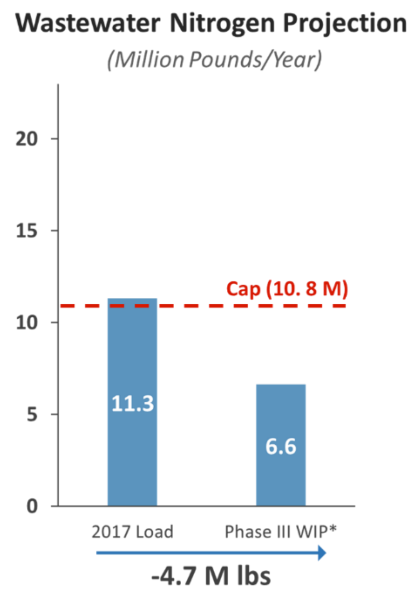

*Phase III WIP reductions subject to change upon EPA review

***Figure 8:*** *Current and projected nitrogen loads to Chesapeake Bay from septic.*

***Centralized Wastewater***

Maryland's 67 major wastewater treatment plants have NPDES total nitrogen, total phosphorus, and suspended solids permit limits to control the effluent concentration and volume of daily flow discharged from those facilities. The approved design capacities in Table 9 below are used as the basis for the loading limits. Since these major plants are not at full design flows and will all be upgraded to "best available technology," they are projected to be below their pollution cap in 2025 by approximately 4.1 million pounds (Figure 9). This projection also accounts for the assumption that wastewater flows will continue to grow by approximately 0.6 percent each year[13].

In short, over performance in the wastewater sector more than offsets anticipated growth in the urban sector. As Figure 9 shows, wastewater loads will be approximately 4.1 million pounds below its loading cap through a combination of better treatment performance (3.25 mg/L total nitrogen) than required under permit and operating below full design flows.




**Phase III WIP reductions subject to change upon EPA review*

***Figure 9:*** *Current and projected nitrogen loads to Chesapeake Bay from wastewater.*

***Table 9:*** *Design capacity and average daily flows for Maryland's major wastewater treatment plants.*

| WWTP | Approved Design Capacity (MGD) | Average Flow (MGD)* |
|---|---|---|
| Aberdeen | 4.000 | 1.774 |
| Annapolis | 13.000 | 7.160 |
| APG - Aberdeen | 2.800 | 1.670 |
| Back River | 180.000 | 167.824 |
| Ballenger/Mckinney | 6.000 | 5.167 |
| Blue Plains (MD Share) | 169.600 | 169.600 |
| Bowie | 3.300 | 1.978 |

[13] This estimate is based off of MDP's population projections published in August 2017. The percent increase is calculated assuming a constant percent growth over ten years, from 2015 to 2025, from 5.99M to 6.34M people. While the growth is presented as a statewide number, plant flow increases were based on county-specific projections from the same MDP analysis.

| WWTP | Approved Design Capacity (MGD) | Average Flow (MGD)* |
|---|---|---|
| Broadneck | 6.000 | 5.141 |
| Broadwater | 2.000 | 1.147 |
| Brunswick | 1.400 | 0.639 |
| Cambridge | 8.100 | 3.951 |
| Celanese | 2.000 | 1.239 |
| Centreville | 0.500 | 0.322 |
| Chesapeake Beach | 1.500 | 0.751 |
| Chestertown | 1.500 | 0.687 |
| Conococheague | 4.100 | 2.422 |
| Cox Creek | 15.000 | 11.986 |
| Crisfield | 1.000 | 0.711 |
| Cumberland | 15.000 | 14.317 |
| Damascus | 1.500 | 0.839 |
| Delmar | 0.850 | 0.506 |
| Denton | 0.800 | 0.422 |
| Dorsey Run | 2.000 | 1.500 |
| Easton | 4.000 | 1.946 |
| Elkton | 3.050 | 1.768 |
| Emmitsburg | 0.750 | 0.492 |
| Federalsburg | 0.750 | 0.381 |
| Frederick | 8.000 | 7.178 |
| Freedom District | 3.500 | 2.378 |
| Fruitland | 0.800 | 0.517 |
| Georges Creek | 0.600 | 0.712 |
| Hagerstown | 8.000 | 8.722 |
| Hampstead | 0.900 | 0.671 |
| Havre de Grace | 2.275 | 1.606 |
| Hurlock | 1.650 | 0.981 |

| WWTP | Approved Design Capacity (MGD) | Average Flow (MGD)* |
|---|---|---|
| Indian Head | 0.500 | 0.387 |
| Joppatowne | 0.950 | 0.789 |
| Kent Island | 3.000 | 1.436 |
| La Plata | 1.500 | 1.040 |
| Leonardtown | 0.680 | 0.392 |
| Little Patuxent | 25.000 | 19.131 |
| Marley-Taylor | 6.000 | 3.774 |
| Maryland City | 2.500 | 0.992 |
| Mattawoman | 20.000 | 8.527 |
| Mayo Large Communal | 0.820 | 0.534 |
| MCI | 1.600 | 0.950 |
| Mount Airy | 1.200 | 0.773 |
| Northeast River | 2.000 | 0.773 |
| Parkway | 7.500 | 6.062 |
| Patapsco | 73.000 | 56.089 |
| Patuxent | 7.500 | 5.110 |
| Perryville | 1.650 | 1.103 |
| Piscataway | 30.000 | 21.848 |
| Pocomoke City | 1.470 | 0.623 |
| Poolesville | 0.750 | 0.713 |
| Princess Anne's | 1.260 | 0.510 |
| Salisbury | 8.500 | 5.039 |
| Seneca | 20.000 | 8.628 |
| Snow Hill | 0.500 | 0.425 |
| Sod Run | 20.000 | 12.453 |
| Swan Point | 0.600 | 0.057 |
| Talbot Region II | 0.660 | 0.411 |
| Taneytown | 1.100 | 0.803 |

| WWTP | Approved Design Capacity (MGD) | Average Flow (MGD)* |
|---|---|---|
| Thurmont | 1.000 | 1.015 |
| Western Branch | 30.000 | 19.742 |
| Westminster | 5.000 | 4.049 |
| Winebrenner | 1.000 | 0.193 |
| **Total Volume** | **753.465** | **613.476** |

*Based on 2002-2004 data

# Strategies

**Accounting for Growth Strategy in the Phase III Watershed Implementation Plan**

Maryland has a four-pronged strategy to account for growth in the Phase III WIP. These strategies consider growth impacts not only out to the 2025 restoration deadline, but also those strategies that will address growth in loads beyond 2025. The following sections describe each of these four strategies.

1. *Projected 2025 Conditions Have Been Built into the 2025 Pollution Reduction Targets*

In developing the Phase III WIP to meet 2025 pollution reduction targets, the CBP's Principals Staff Committee (PSC) agreed in December 2017 to use 2025 projected conditions to account for growth impacts on land use and populations. What this means is that Maryland's Phase III WIP strategies have already accounted for projected 2025 growth in calculating each sector's load reduction. The CBP modeling team will confirm each jurisdiction's Phase III WIP pollution reduction practices on their 2025 forecasted conditions to ensure practices achieve restoration targets while accounting for growth.

2. *Maryland's Current Land Use Policy BMPs Conservation and Protection Plans Have Been Incorporated in the 2025 Land Use*

The CBP gave the states the opportunity to modify the future land use scenarios for projecting 2025 growth conditions to reflect existing and/or proposed conservation and protection efforts, such as agricultural and forest conservation, and growth management (e.g., local zoning). Since Maryland and local governments have many existing land use preservation and protection programs in place, these programs were included in a Conservation Plus scenario that was incorporated into the Bay model. This process allowed Maryland to take credit for the nutrient load reductions resulting from these programs. This credit helps to account for a certain portion of future projected growth in loads. More details on Maryland's Conservation Plus efforts can be found in Appendix D.

At this time, Maryland has worked to get load reduction credit for existing state and local Land Use Policy BMPs. Also, the possibility exists of getting additional credit for new Land Use Policy BMPs proposed to be implemented through 2025; however, Maryland has not yet determined the load reduction effect of new Land Use Policy BMPs, such as expanded and targeted land preservation programs.

3. *Maryland's Resource Protection Programs and Associated Strategies for Increasing Those Protections are Being Incorporated into the Phase III WIP*

In Appendix D, Maryland describes current natural and aquatic resource protection and conservation programs, as well as the strategies for programmatic improvement. While this represents more of a qualitative approach to dealing with growth and land change (because it is not quantified in the model), Maryland recognizes that protecting and conserving ecologically high functioning systems and the lands they depend is very cost effective relative to restoration.

4. *Adaptive Management to Address Growth in Loads Post-2025*

Overall, Maryland currently projects that expected load reductions under the Phase III WIP will outweigh the growth in loads from development and agriculture past 2025 until 2047. Through two-year milestones and associated progress evaluations, Maryland use an adaptive management process to ensure any growth in loads does not exceed restoration targets.

## Key Challenges and Opportunities

Once achieved, Maryland will need to maintain the Bay TMDL post-2025. When the anticipated load increases from both climate change and Conowingo Dam are considered in addition to growth, it becomes increasingly necessary to ensure that Maryland has a proactive and adaptive policy to address growth in loads. Maintaining the Bay TMDL after 2025 means that Maryland will need to continue to achieve sufficient load reductions to offset any increases in loads due to growth. Post-2025 load reductions can contain a variety of measures, including continued MS4 permit implementation, innovative WWTP technology improvements, land use policy BMPs (defined below, i.e., Conservation Plus) and accounting for growth policies. The types of post-2025 load reductions needed will depend on specific growth patterns and trends, and implementation of the adaptive management framework can help ensure that appropriate offsets are established.

# Maryland's Holistic Approach to Addressing Conowingo Dam's Pollution Impacts

Scientific analysis shows an additional reduction of six million pounds of nitrogen and 260,000 pounds of phosphorus is needed to mitigate the water quality impacts of the Conowingo Dam's lost trapping capacity. Science has demonstrated that this lost trapping capacity threatens the ability of both the state and the region to meet Chesapeake Bay clean up goals.

Maryland has made significant progress toward solving environmental problems stemming from the Conowingo Dam on the Susquehanna River. This progress includes recognition by the EPA of the CWIP multi-state strategy, including hiring a third-party fundraiser and project coordinator, and Maryland's selection of a winning bidder to carry out a pilot project for dredging, beneficial reuse and characterization of sediments behind the dam. These steps, along with a comprehensive set of environmental protection requirements issued by the Hogan administration to Exelon Corporation as conditions for dam relicensing encompass Maryland's multi-pronged, multi-state, and public/private strategy to address water pollution impacts associated with the Conowingo Dam.

Last year, the CBP partnership unanimously agreed on the need to develop an additional plan, known as the Conowingo Watershed Implementation Plan (CWIP), to specifically reduce pollution associated with the loss of the Conowingo Dam's capacity to trap sediment in the reservoir behind the dam. A key step was taken when the EPA issued a Request for Applications (RFA) for work on the CWIP. The EPA plans to award one to three cooperative agreements for work that will support the efforts of the watershed jurisdictions, along with other partners, to help restore the Bay. The work proposed by the RFA includes facilitating the development and implementation of a Conowingo WIP, the development of a comprehensive financing strategy and implementation plan, and the development of a system for tracking, verifying and reporting results. The CWIP timeline is still under development by the CBP partnership and will be released for public comment sometime after the jurisdictions' WIPs.

More recently, the Maryland Environmental Service (MES), in coordination with MDE and the Governor's Bay Cabinet, has selected the joint venture Northgate Dutra to carry out a pilot project to test the quality of sediment throughout the Conowingo reservoir, as well as dredge and beneficially repurpose a small portion of it to create a market for the cost effective recovery of potentially useful material that now threatens water quality in the river and Bay. The proposed pilot project schedule provides for the work to be substantially complete in 2019.

At the same time Exelon is seeking a 50-year federal license renewal for the dam's operation. Under federal law, and as part of the Federal Energy Regulatory Commission's relicensing process, Exelon is required to obtain a Clean Water Act, Section 401 Water Quality Certification from the state for the continued operation of the dam. The certificate enforces the requirement that the facility's operation comply with state water quality standards.

In 2018, the Hogan administration issued a comprehensive environmental plan for the Conowingo Dam, Susquehanna River and the Chesapeake Bay to drive major restoration and pollution prevention efforts upstream and downstream of the dam. The plan, contained in a Water Quality Certification issued by MDE, includes special conditions for the proposed dam relicensing and requires the applicant, Exelon Generation Company LLC, to reduce water pollution that flows from the dam to the river and, eventually, the Bay. The certification requires Exelon to improve conditions for aquatic life, including changes in its control of water flow from the dam and installation of equipment to improve migration of fish to upstream spawning areas. It also requires Exelon to improve its management of debris that collects at the dam, including conducting a feasibility study on a solar-powered trash collection wheel.

This multi-pronged, multi-state, public/private strategy to address impacts to Chesapeake Bay from Conowingo Dam ensures all appropriate partners are working together to solve this challenging pollution problem. More information regarding progress on these fronts will be provided to the public, as available.

# Climate Change

## Background: PSC Three-Part Strategy

The Chesapeake Bay region is projected to experience changes in temperature, sea level and precipitation as a result of climate change (Najjar, et al. 2010; Johnson et al., 2016). These changes are expected to affect nutrient and sediment loads to the Chesapeake Bay and, in turn, affect the Bay's health (Sinha et al., 2017, Wang et al., 2017; Irby, et al. 2018; Herman, et al. 2018; Linker, et al., 2018). Preliminary estimates of the additional Bay wide load reductions needed in response to climate change, on top of current reduction goals, are about 9 million pounds of nitrogen and 0.5 million pounds of phosphorus. Approximately 2.2 million pounds of the watershed-wide nitrogen loads are estimated for Maryland. The CBP Partnership is still refining these preliminary estimates, as described below.

In March 2018, members of the PSC, who represent the Bay-state governors, agreed to a three-part adaptive management process. This process recognizes that further information is needed to refine estimates of future changes in nutrient and sediment loads and their impact on Bay water quality. Similarly, additional information is needed to quantify changes in the effectiveness of many pollution control BMPs resulting from climate change.

**Briefly, the PSC's three-part strategy going forward includes:**

1. **Incorporate Climate Change into Phase III WIPs:** Include a narrative strategy in the Phase III WIPs that describes state and local jurisdictions' current action plans and strategies to address climate change.
2. **Understand Climate Change Science:** The CBP Partnership will sharpen the understanding of the impacts of climate change on the Bay and identify research needs, improve the understanding of BMPs, and refine nutrient and sediment load estimates for each jurisdiction in March 2021.
3. **Incorporate Climate Change into Milestones:** Bay states will account for additional nutrient and sediment loads, as well as improved understanding of BMPs, beginning in September 2021. These will be reflected in a Phase III WIP addendum and/or 2022-2023 two-year milestones.

Although climate adaptation is the primary climate-change-related directive for the Bay WIP, mitigation of greenhouse gases is also of pressing importance. Consequently, in developing Maryland's Phase III WIP, MDE staff sought to identify nutrient and sediment control strategies that can both help mitigate the increase in greenhouse gases and help adapt to anticipated climate impacts where possible.

# Trends

## Climate Science: Historic Trends & Projections

Greenhouse gasses, like carbon dioxide (CO2) and methane (CH4), trap the sun's heat in Earth's atmosphere (Wogan, 2013). This increased thermal energy is leading to gradual long term changes, or trends in the climate, such as increased air temperatures and dryer or wetter seasons, depending on the particular region. This greenhouse effect also is expected to cause more variable and extreme day-to-day weather like more intense storms, as witnessed in the one-in-a-thousand-year amounts of rainfall that occurred twice in old town Ellicott City, Maryland in 2016 and 2018. Maryland can also expect to experience periodic, intense dry spells and heat waves.

On the land, increased precipitation volume and intensity are expected to result in more nutrient and sediment runoff. For example, as of 2017, average annual precipitation in parts of Maryland have already increased as much as 10 percent compared to the first half of the 1900s (Easterling et al.). Maryland's average annual precipitation is projected to increase an additional 10 percent from current amounts by 2100 (Easterling et al.). In addition the effectiveness of BMPs to control pollution in runoff is expected to change due, in part, to more intense rainstorms. Watershed computer models are used by the CBP Partnership to estimate future changes like these on the landscape.

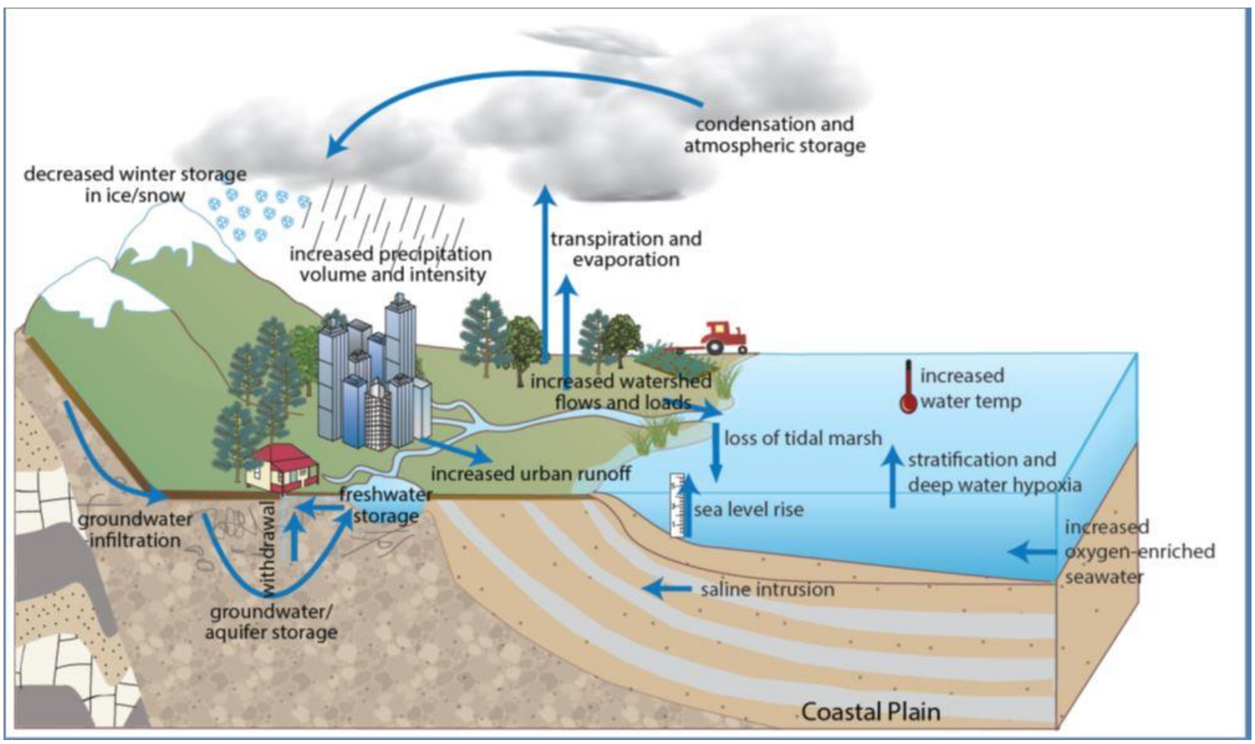



***Figure 10:*** *Key changes on the land and in the water that are expected to impact the Chesapeake Bay. (Source: CBP modified, Univ. MD IAN 2011).*

In Chesapeake Bay, more pollution runoff from the land, increased water temperatures, changes in salinity and sea level rise,[14] and changes in pH, among other things, are expected to interact in complex ways to change water quality (Figure 10, above). These changes will impact algal growth, water clarity and dissolved oxygen levels, all of which affect fish, crabs, oysters, and other living resources. Hydrodynamic and water quality modeling tools are used to estimate some of these changes in the Bay.

The costs to the economy and to human life and livelihood from climate-induced extreme weather are severe and increasing. Figure 11, below, sometimes called a Haywood Plot, and depicts by month and year, the accumulated number of weather-related disaster events costing more than $1 billion. Six of the last 10 years exceeded the average number of storms costing more than $1 billion. Years 2011 and 2017 tied for the national record of 16 $1 billion  storms, with 2017 setting record overall storm costs of $306.2 billion, shattering the previous record of $214.8 billion (CPI-adjusted) in 2005 from the impacts of Hurricanes Dennis, Katrina, Rita and Wilma[15].

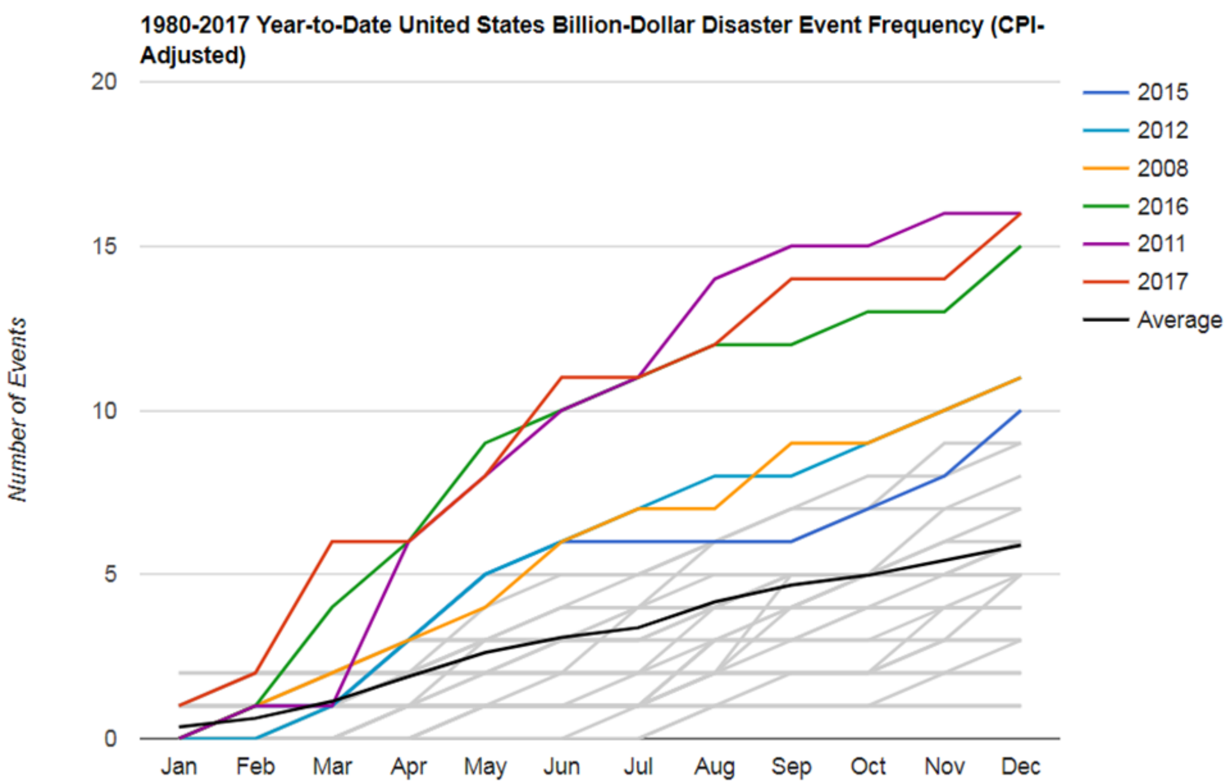



***Figure 11:*** *Cumulative Number of Disaster Events, in a given year, that Exceed a Billion Dollars in Damage. Source: Figure 14 and paragraph above from Smith, A B, NOAA Climate.gov.*

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[14] For planning purposes, the likely range (66% probability) of the relative rise of mean sea level expected in Maryland between 2000 and 2050 is 0.8 to 1.6 feet, with about a one-in-twenty chance it could exceed 2 feet and about a one-in one hundred chance it could exceed 2.3 feet. Later this century, rates of sea level rise increasingly depend on the future pathway of global emissions of greenhouse gases during the next sixty years. ( mde.maryland.gov/programs/Air/ClimateChange/MCCC/Documents/sea levelRiseProjectionsMaryland2018.pdf )

[15] **Smith, A B, NOAA Climate.gov**

These enormous costs are raising questions nationally and in Maryland about whether to build or rebuild in areas with repeat catastrophic weather events. As investments are made in BMPs to restore the Chesapeake Bay, the state must also be asking not only how individual practices function to reduce any increased nutrient loading resulting from climate change, but also where to locate them on the landscape so they persist over time.

In October 2018 the United Nation's International Panel on Climate Change (IPCC) issued a special report on a 1.5° degree centigrade (1.5°C) temperature increase from pre-industrial levels. It highlighted the devastating impacts that could be avoided by limiting the temperature rise to 1.5°C rather than 2.0°C. Limiting the rise to 1.5°C would require a 45 percent reduction of anthropogenic greenhouse gas (GHG) emissions from the 2010 baseline by 2030 and achievement of zero net emissions[16] by 2050 (UN IPCC 2018).

The urgency of this scientific finding has driven Maryland to elevate the importance of GHG mitigation in the Bay restoration strategy. Fortunately, broadening the lens to consider the intersection of climate mitigation, climate adaptation and nutrient reduction offers new management efficiencies and financing opportunities elaborated below.

# Strategies

This section identifies strategies that address both climate change management and Bay restoration. It also highlights Maryland's existing foundation of climate change plans, action strategies, legal authorities and governance structures. This extensive foundation will help assure integration of climate change management with Chesapeake Bay WIP implementation. The section closes with implementation guidance.

## 1. WIP Strategies that Address Climate Change

Maryland's Phase III WIP includes numerous actions that have the primary goal of reducing nutrients and sediments while also either mitigating or adapting to a changing climate. These state actions will also provide Maryland with the information to develop BMP implementation scenarios to more effectively address nutrient and sediment loads resulting from climate change. This section is organized to first identify general strategies that are widely applicable, then to highlight strategies that are specific to particular pollution source sectors.

### General Climate Strategies

Several strategies apply widely, such as developing new science and several aspects of funding the Phase III WIP. These general strategies are highlighted below.

[16] According to the IPCC definition, net zero emissions are achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period.

**Strategy 1: Climate Science & Research**

Maryland is committed to adopting improved climate science by including refined nutrient reduction goals in 2021, and BMP efficiencies into a future WIP addendum and/or two-year milestone commitments in 2022. In order to meet future load requirements, research may be needed to understand how future conditions may affect the state's ability to meet its targets. Below is a list of research topics that the state will pursue:

- **BMP site selection and design:** Maryland is committed to designing and siting BMPs that are expected to persist and perform in a changing climate. This commitment is reflected in early efforts, including 2013 guidance, *Best Management Practices: Preserving Clean Water in a Changing Climate*. Part of Maryland's strategy is to engage with the CBP partnership in ongoing BMP design and siting research[17] .

- **Trends Analyses:** Review current climate data and trends that may affect load targets; including sea level, precipitation patterns, temperature and ecosystem response.

- **Saltwater Intrusion:** Maryland will investigate the impact of saltwater intrusion on soil composition and the potential for nutrient leaching from soils. Maryland will investigate adaptation options, like salt-tolerant plants that soak or take up nutrients.

- **Beyond 2025:** Maryland acknowledges that climate conditions will continue to change after 2025, and anticipates that 2050 climate projections will be used to inform future Bay restoration strategy considerations.

**Strategy 2: Local Engagement and Education**

Maryland is committed to advancing the capacity of state and local government agencies, infrastructure organizations and businesses to develop and implement sound climate change initiatives, thus ensuring current and future public health, security and economic prosperity. To achieve this vision, the state, in partnership with the Association of Climate Change Officers, has established the Maryland Climate Leadership Academy.

The Maryland Commission on Climate Change (MCCC) workgroup on Education, Communication and Outreach (ECO) is another institutionalized avenue for local engagement. The MCCC Adaptation and Response Workgroup coordinates closely with Maryland's Bay restoration process and includes local engagement in its annual work plan.

[17] In 2017 a Chesapeake Bay Program Science and Technology Advisory Committee (STAC) Workshop Report, *Monitoring and Assessing Impacts of Changes in Weather Patterns and Extreme Events on BMP Siting and Design*, was released. Although it was inconclusive about the quantitative impacts of climate change on BMPs, it laid the foundation for continued evaluation of this subject.

**Strategy 3: Incentives and Funding**

Costs are anticipated to rise for at least four reasons. First, more frequent and severe extreme weather events will damage BMPs and necessitate more inspections and maintenance or replacement. Second, more BMPs will need to be installed to make up for an anticipated loss of BMP pollution reduction efficiency. Third, more BMPs will likely be needed to address increased future loads. Fourth, restoration actions will entail more complex multidisciplinary considerations, as exemplified in the *Climate Smart Framework and Decision Support Tool*, developed by the Chesapeake Bay Program. (Johnson, Z. 2018)

**The following are strategies that Maryland is committed to implementing:**

- **Existing Restoration Funding Sources:** Maryland is refining restoration and resource conservation grant prioritization criteria to favor projects that include climate co-benefits. This includes review criteria for state land conservation and preservation purchases.

- **Volkswagen Settlement Funding:** Maryland received $75.7 million in settlement funds from Volkswagen's illegal pollution emissions. Much of this money will be used to electrify transportation in Maryland, which will reduce $CO_2$ emissions while reducing nitrogen deposition to the Chesapeake Bay.

- **Coast Smart Construction Criteria:** The Coast Smart Construction Infrastructure and Design Guidelines were developed in 2014 to increase the resilience of state capital investments to sea level rise and coastal flooding. In 2018, legislation expanded the application of criteria to other projects and may create additional opportunity to implement resilient design. Coast Smart practices include identifying, protecting, and maintaining ecological features that may serve to buffer a project from the impacts of future sea level rise, coastal flooding, or storm surge. Protecting and maintaining these ecological features is a co-benefit to Bay restoration.

- **Innovative Technology Fund:** Maryland is committed to expanding the scope of eligible techniques and technologies to include consideration of climate aspects of projects that are proposed to the Innovative Technology Fund. Investment in the research, development and commercialization of various solutions that address climate mitigation will be investigated to help accelerate the adoption of climate resiliency and GHG mitigation solutions.

- **Climate Mitigation and Adaptation Synergies:** Many Bay restoration actions result in large amounts of GHG sequestration. These include protection and restoration of tidal wetlands and seagrass ecosystems (coastal blue carbon), forest conservation, forest management practices, conversion of non-forest to forest, riparian forest buffers and a variety of healthy soils practices (collectively called terrestrial carbon removal). Maryland commits to aligning its GHG reduction strategy (i.e., the Greenhouse Gas Reduction Act (GGRA) plan) with its Bay restoration strategy to generate mutually beneficial results that are greater than the sum of their parts:

    - Better alignment of management resources used to implement and track mutually beneficial practices can result in cost efficiencies and better outcomes.

  - Recognizing that the same action generates monetary value associated with both nutrient and carbon reductions should translate to greater public and private financing opportunities and incentive frameworks.

**<u>The following are preliminary ideas that Maryland will consider:</u>**

- **Water Quality and Climate Change Resiliency Portfolio:** The state is currently actively engaged in a variety of efforts to restore the Chesapeake Bay and improve Maryland's environmental and economic resilience to a changing climate. Many of the actions to achieve these two objectives are similar, yet are not coordinated to the degree they could or should be to maximize benefits to both. This effort will identify a long term portfolio of natural infrastructure projects that optimize water quality, living resources, GHG reduction and other environmental benefits while also reducing the risk posed by a changing climate to the commercial economies and recreational opportunities essential to Maryland's working coast. Having a pipeline of identified projects will better prepare Maryland and its communities to take advantage of existing and emerging funding opportunities that promote the use of natural infrastructure to build resilience to climate impacts. Some potential new funding opportunities are described below.

- **Climate Funding Sources:** There are climate and hazard mitigation oriented grants that have not traditionally been targeted for Bay restoration outcomes or for complementary water quality and climate benefits. These fund sources could be explored for their potential to achieve restoration co-benefits, similar to the Community Resilience Grant Program that funds climate resiliency projects with water quality benefits and the new Federal Emergency Management Administration job aid that will allow hazard mitigation grant funding to be used for restoration projects that build resilience.

- **Expansion of Maryland's Building Resiliency through Restoration Initiative:** Maryland could explore opportunities for expanding incentives for projects that will build resilience and reduce the vulnerability of communities and infrastructure from the impacts of extreme weather events, climate hazards and flooding.

- **Strategic Energy Investment Fund (SEIF)**: Sales of $CO_2$ credits generate funds that are used for investments in energy efficiency and clean and renewable energy. These investments reduce air emissions and associated land deposition, contributing to the state's climate and water quality goals. Administered by the Maryland Energy Administration, the potential exists for SEIF energy investments to potentially provide further co-benefits by leveraging energy efficiency grants with water quality financing (e.g., funding energy efficiency grants for wastewater treatment plants to increase their financial capacity to afford pollution controls).

- **Climate Cost Estimate and Funding Options:** Maryland could investigate options for achieving additional load reductions and identifying associated costs due to climate change. Then, as needed, options for generating additional revenue to cover any additional public sector costs could be explored. If any additional public sector costs are identified, options for funding would be outlined in September 2021 when Maryland submits its implementation strategy to reduce climate change loads in the Phase III WIP addendum and/or 2022-2023 two-year milestones.

- **Carbon Markets for Nutrient Reduction Practices:** The reduction of GHG emissions is being accomplished through Maryland's GGRA plan, which includes participation in the RGGI, a cap-and-invest framework for large fossil-fuel-fired electric power generators. Maryland could consider exploring the development of a carbon market that credits nutrient reduction practices with GHG co-benefits. This would augment programs that incentivize the implementation of BMPs associated with Bay restoration. Practices, such as cover crops, riparian buffers and conservation tillage not only provide water quality benefits, but also improve soil health and sequester carbon.

**Strategy 4: Accountability**

To ensure that Bay restoration planning and implementation integrates climate resilience co-benefits, Maryland is including the following accountability strategy elements:

- **Two-Year Milestones:** Maryland will document its commitment to adapting its Chesapeake Bay nutrient reduction strategies to climate change through specific actions in the state's two-year milestone framework.

- **Emerging (Long-Term) Strategies:** Maryland will identify incremental research and development steps in future two-year milestone commitments to ensure that emerging reduction strategy options remain on track.

- **Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change (Phase I & II):** This comprehensive strategy sets implementation targets for each adaptation action. The Adaptation and Response Workgroup of the MCCC oversees a review of progress on these implementation targets. WIP commitments will be aligned with this comprehensive strategy and its accountability tracking framework.

- **BMP Verification:** Maryland's BMP verification protocols provide the foundation for the likely increased frequency of inspection and maintenance that will be necessitated by the stresses of more extreme weather due to climate change (MDE 2016).

## Climate Change Strategy Highlights by Source Sector

### Agriculture Climate Strategies

- **Current WIP Strategies:**
  - Many traditional agricultural BMPs provide environmental benefits beyond water quality. Practices such as residue and tillage management, cover crops, crop rotations, composting, riparian buffers and biomass plantings, and rotational grazing, among others, support and enhance soil health. These practices have been shown to increase organic matter and sequester carbon in the soil, reduce soil erosion, promote nutrient cycling, improve water retention, and reduce competition from weeds and pests.

- **Contingency and Long-Term Strategies:**
  - Various innovative animal waste management technologies offer energy savings and GHG emissions reductions that are climate co-benefits.
  - Agricultural Wetland Incentives: Maryland could explore revising state investment prioritization criteria and policies to incentivize land conservation easements that promote conversion of flooded or salt-impacted agricultural lands to wetlands, where desired. The process could explore use of wetlands mitigation funds and public-private partnership opportunities with stakeholders that value diverse habitat for birds and other wildlife. Where appropriate, the introduction of salt-tolerant crops could be explored. Similar partnerships have helped accelerate trout habitat restoration and conservation in the state.
  - Cropland irrigation with wastewater effluent has the potential to reduce nutrients to the Bay while creating climate resiliency by assuring a reliable supply of water for crops. Although some degree of crop irrigation is currently occurring in Maryland, it is not currently being done as an explicit agricultural nutrient management practice.

- **Programmatic and Educational Outreach Strategies:**
  - In collaboration with conservation partners, MDA is currently developing a Healthy Soils Program focused on accelerating educational outreach and promotion of a wide variety of agricultural and climate management co-benefits.

**Wastewater Treatment Plant Climate Strategies**

- **Current WIP Strategies:**
  - Land application of wastewater treatment plant bio solids increase organic content of sandy soils, thereby increasing carbon and water retention.
  - Energy-saving pumps lower WIP wastewater treatment implementation costs in the long-run and reduce GHG emissions.

- **Contingency and Long-Term Strategies:**
  - Anaerobic digestion of food waste at WWTPs utilizes existing centralized facilities, provides an energy source, reduces a large waste stream to landfills, reduces GHG emissions, and offers a number of cost savings. For more information see https://archive.epa.gov/region9/waterinfrastructure/web/pdf/why-anaerobic-digestion.pdf.

**Septic System Climate Strategies**

- **Current WIP Strategies:**
  - Mounting solar panels on OSDS
  - Setbacks of OSDS to prevent flooding
  - Bermed infiltration pond removal in response to sea level rise

**Urban and Suburban Stormwater Climate Strategies, Including Erosion and Sediment Control**

- **Current WIP Strategies:** In addition to reducing nutrient and sediment pollution, the base mission of stormwater management provides climate resilience in the form of erosion control, groundwater recharge, flood control, and stream channel protection. Maryland is committed to adapting its stormwater program to climate change by maintaining and repairing critical stormwater management infrastructure and dams by establishing an emergency dam repair fund and a revolving loan dam fund.

- **Contingency and Long-Term Strategies:**

  - The state could explore establishing an emergency dam repair fund and revolving loan fund to be used for fortifying Maryland's stormwater management infrastructure for increased precipitation events. Fortifying these structures would also ensure continued nutrient processing and uptake that occurs in impoundments.
  - Stormwater BMP Siting and Design: Based on the outcome of research into how precipitation changes will affect stormwater design storms, Maryland is considering changes to its erosion and sediment control and stormwater programs.

- **Programmatic and Educational Outreach Strategies:**
  - Maryland will continue leveraging its funding to support projects that will inform how climate impacts will interact with stormwater management practices. The state could consider additional funding or other strategies that facilitate ongoing academic research into stormwater design guidelines for increased precipitation events.

**Conservation and Natural and Working Lands Climate Strategies**

- **Current WIP Strategies:** Conservation and management of natural and working lands reduce nutrient loading to the Bay and promotes climate resilience. Several intentional strategies include:

  - Forest harvesting on state lands utilize wider buffers; leaving half of the land out of active management zones; and variable-density harvesting, where some trees are left to provide habitat and seed source, and often is a combination of single trees (e.g., future snag or desired seed source) and some clumped leave-tree areas (e.g., a wetter area or clump of mast-bearing trees like oaks, hickory, or beech), as ways to sequester carbon.
  - Adaptive Silviculture for Climate Change collaborates with partners, including Baltimore City, to work on a regional effort to develop locally appropriate techniques. These current and future efforts create more diversity on the landscape providing enhanced resiliency.
  - The Sustainable Forestry Initiative, forestry boards and Forestry Stewardship Council are all evaluating sustainable forestry certification programs for opportunities to enhance climate resiliency. MDA, U.S. Forest Service, forestry stewardship councils and University of Maryland-Cooperative Extension are developing new conservation easement mechanisms to promote adaptation stewardship activities on private lands.
  - Program Open Space (POS) directs its funding towards GreenPrint Targeted Ecological Areas. Wetlands important for coastal resilience and climate change adaptation areas for future wetlands are noted as key ecological benefits.

- The Accounting for Maryland's Ecosystem Services framework provides economic values for seven non-market ecosystem services, including carbon sequestration, nitrogen removal, groundwater recharge, and stormwater mitigation/flood prevention, which have climate resilience value.
- Encouraging wider riparian buffers along stream corridors to allow for channel migration resulting from increased precipitation.

- **Contingency and Long-Term Strategies:**

  - Maryland could enhance shoreline suitability analyses and conduct property owner and marine contractor social marketing research to increase the rate of adoption of living shoreline erosion techniques. Living shorelines provide coastal communities resilience to sea level rise while reducing erosion and ecosystem benefits.
  - Maryland could evaluate the reuse of dredged material for living shorelines and other beneficial uses like marsh elevation enhancement (i.e., thin layer placement) that help communities respond to rising sea levels, sequester carbon and provide for possible commercial or recreational uses.

- **Programmatic and Educational Outreach Strategies:**

  - Modified programmatic operating procedures and outreach approaches based on findings of suitability analyses and social marketing research.
  - Development and implementation of climate and ecologically friendly maintenance plans for natural lands. Whether county/municipal/state parks, grass medians along state or county roads, or older stormwater management pond infrastructure, a certain level of vegetation maintenance is required to facilitate multiple uses, control invasives species, or preserve lines of sight for vehicular traffic and structural function. However, there are opportunities for certain portions of our natural lands to revert back toward forest lands or other lower nutrient loading land uses by no longer mowing them. This has multiple benefits of growing Bay friendly vegetation, sequestering more carbon in the vegetation matrix, while also reducing carbon emissions associated with mowing equipment. Cities, counties, state agencies and transportation agencies should develop and implement more robust natural land maintenance plans that are sensitive to lowering nutrient loads to the Bay, while also reducing climate emissions and saving maintenance dollars.

**Protection Climate Strategies**

- **Current WIP Strategies:** Protection and management of high quality and value non-tidal stream resources and those natural assets supporting such resources such as watershed forest cover, riparian buffers and wetland gains promote climate resilience while resulting in some of the lowest nutrient delivery to the Bay. BMP strategies include:

  - Moderate stream temperatures by protecting expanded forested riparian buffers in Tier II watersheds on state regulated streams.

  - Prioritize forest conservation, mitigation and restoration requirements, as well as quantify non-regulatory wetland gains, to increase carbon sequestration capacity. This includes working to conserve priority Conservation Reserve Enhancement Program (CREP) buffers in perpetuity, and restricting the conversion of virgin forest while incentivizing the redevelopment of existing commercial or industrial properties for energy projects such as solar farms.
  - Cross jurisdictional credit for joint projects have the capacity to increase the amount of headwaters restoration and reforestation projects, which in turn will increase carbon sequestration capacity as forests mature.

- **Contingency and Long-Term Strategies:**

  - Maryland could develop further justification for protection based on natural resource-based economics.
  - The state could recommend new or modifications of existing legislation, regulation, policy, ordinances, etc. based on the results of a gap/strength analysis.

- **Programmatic and Educational Outreach Strategies:**

  - Continue with existing regulatory requirements and non-regulatory initiatives.
  - Develop a methodology to identify existing and new opportunities to make outreach more efficient, and provide a consistent, consolidated message from state agencies.

**Accounting for Growth Climate Strategies**

- **Current WIP Strategies:** By establishing a framework to track the growth in loads and verify the functionality of BMPs, the current WIP strategy establishes a necessary foundation to account for and reduce the growth in loads associated with climate change.

## 2. Supporting state and Local Legislative, Governance and Strategic Climate Frameworks

For over a decade, Maryland has developed an extensive set of plans, action strategies, legal authorities and governance frameworks to mitigate and adapt to climate change. This foundational framework will enable more rapid progress on WIP implementation than would otherwise be possible. Elements of this framework are highlighted below.

### A. Legislative and Executive Actions

Maryland has historically been at the forefront of states taking action to address both the drivers and consequences of climate change, demonstrated by the state's policy record. The state has consistently advanced efforts to combat climate change with legislation and policy initiatives over the past decades. These include, but are not limited to the following brief history:

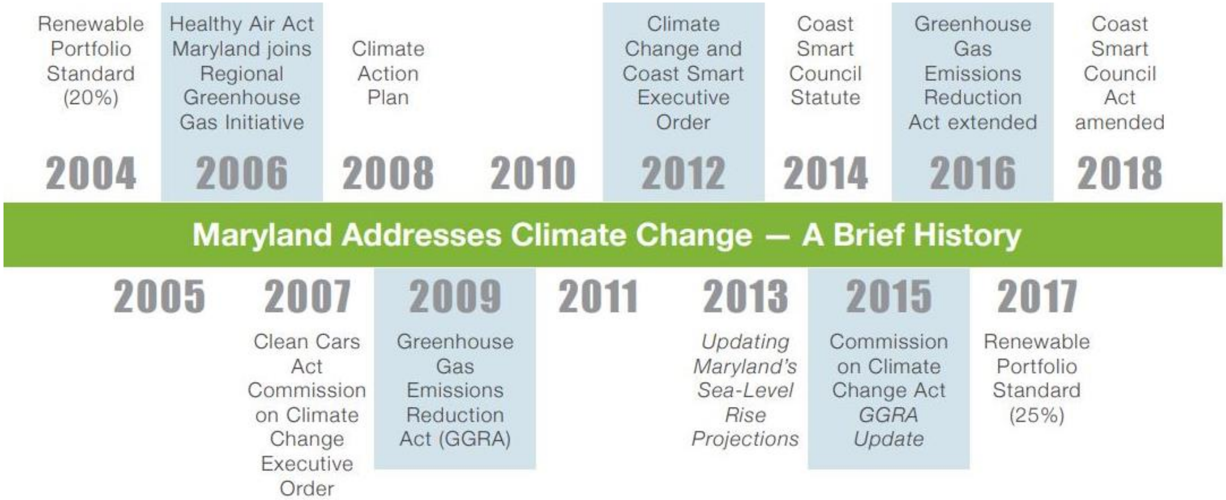


***Figure 12:*** *Brief History of Maryland's Climate Actions. Source: University of Maryland Center for Environmental Science (UMCES) Sea Level Rise Projections for Maryland 2018.*

## B. Governance Structures for Managing Climate Change

Maryland's commitment to addressing climate change is institutionalized in a variety of governance structures that span state, regional, national and international levels.

**State Level**

At the state level, the MCCC is charged with advising the governor and General Assembly "on ways to mitigate the causes of, prepare for, and adapt to the consequences of climate change". The MCCC was initially established by executive order in 2007 and codified into state law in 2015.

The MCCC consists of 26 members with wide representation, including state agency cabinet members, and is led by a steering committee. Maryland is aligning the climate aspects of it Bay restoration strategy with the four workgroups of the MCCC: the Adaptation and Response Working Group; the Education, Communication, Outreach Working Group; the Mitigation Working Group; and the Scientific and Technical Working Group. The MCCC, in concert with the governor's Chesapeake Bay Cabinet, is expected to play a central role in advancing Maryland's Chesapeake Bay climate adaptation actions.

The MCCC and its work groups annually put forth a set of recommendations and strategies, which will be aligned with the Bay restoration two-year milestones that address climate change. Details of the meetings and activities of the MCCC and its workgroups can be found at: mde.maryland.gov/programs/Marylander/Pages/mccc.aspx

**Regional Level**

Regionally, Maryland is a signatory to the 2014 Chesapeake Bay Watershed Agreement, which includes a Climate Resiliency Goal. Maryland is committed to this goal and the associated monitoring and assessment outcome and adaptation outcome.

Maryland is also a member of the RGGI, a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont to cap and reduce power-sector CO2 emissions.

**National & International Levels**

Nationally, and internationally, Maryland is a member of the U.S. Climate Alliance of 17 states and the territory of Puerto Rico, which is committed to doing their share towards meeting international climate agreements. These governance structures not only institutionalize leadership processes and coordination, they provide avenues for accelerated learning, technology transfer and adoption of best practices. They also support a framework of accountability.

### C. State and Local Climate Change Plans and Strategies

Maryland's commitment to addressing climate change is reflected, in part, by a variety of plans and strategies. Maryland's foundational adaptation strategies, which were developed by the Adaptation and Response Workgroup of the MCCC, are found within the *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change*:

- *Phase I: Sea Level Rise and Coastal Storms* (Johnson, 2008).
- *Phase II: Building Societal, Economic and Ecological Resilience* (Boicourt, 2010).

The Adaptation and Response Workgroup is tracking progress on the actions outlined in the comprehensive strategy. Many of these strategies relate to BMP implementation that reduce nutrient and sediment loads or slow the growth in loads by preserving natural lands.

Local Plans: In addition to state plans, six local government plans have been developed between 2008 and 2018 that either directly or indirectly address climate change impacts. In addition, 15 of Maryland's counties and Baltimore City have specifically mentioned climate change and/or the effects of climate change in their comprehensive plans (Maryland Department of Planning, 2018).

## 3. Implementation Guidance

Providing implementation guidance is part of Maryland's strategy for aligning Bay restoration and climate change management. Although technical materials and tools have been developed to guide restoration in the context of climate change, the field is new and rapidly evolving. Some of the latest information can be found at the following websites:

Maryland Commission on Climate Change: The commission coordinates climate change activities for the state including mitigation, adaptation, science and education, communication and public outreach.

Maryland Department of Environment: The Air and Radiation Administration leads the state's efforts on greenhouse gas mitigation.

Maryland Department of Natural Resources: DNR plays a significant role in climate adaptation, with an emphasis on mitigating coastal hazards and protecting and restoring the resilience of natural resources.

Chesapeake Bay Program Climate Resiliency Workgroup: The workgroup coordinates climate-related efforts to address climate resilience for the CBP Partnership as deemed a priority of the Chesapeake Bay watershed.

# Key Challenges and Opportunities

Climate change poses many significant challenges for achieving Bay restoration goals. However, given the circumstances, many opportunities exist to leverage commonalities between managing climate change and Bay restoration.

- **Chesapeake Bay Water Quality will be Affected by Climate Change:** Climate change is predicted to increase nutrient and sediment loads to the Chesapeake Bay, and will change water quality characteristics like water temperature, dissolved oxygen and clarity. The CBP partnership is committed to develop refined quantified estimates of these pollution loads and water quality impacts in 2021.

- **Pollution Control Practices will be Affected by Climate Change:** The BMPs used to control water pollution will likely become less effective at controlling extreme storm events and be subject to damaging stresses of climate change. The CBP partnership is committed to better understanding these impacts and making adjustments to management practices in 2022 via two-year milestone commitments.

- **The Cost of Achieving and Maintaining Chesapeake Bay Water Quality Goals will be Affected by Climate Change:** If the water quality impacts of increased nutrient and sediment loads are not offset by increased flushing of the Bay, as a result of climate change, then more restoration practices will be necessary. This, in addition to BMPs becoming less effective and requiring more maintenance, could result in an increase in the cost of restoring the Bay. In anticipation of this, Maryland is committed to investigating ways of funding the incremental increase in cost.

- **Bay Restoration Mitigates Greenhouse Gases in Addition to Adapting to Climate Change:** The main interest in accounting for climate change in the Bay WIP is to adapt to impending shocks of climate change. However, many restoration practices that sequester carbon in soil and plant matter have significant GHG mitigation benefits. Aligning Maryland's GHG reduction actions with Bay restoration actions offers the prospect of powerful financing synergies borne out the recognition of increased value for the same action.

- **Quantifying Maryland Specific Air Reductions:** Maryland has evaluated reductions in nutrient deposition from state-specific regulations and/or facilities, beyond federally mandated requirements. Although the particular reductions evaluated are modest, this line of inquiry has the potential to mutually benefit climate change and Bay restoration management goals.

  The evaluation revealed that delivered nitrogen loads to the tidal Chesapeake Bay from air emissions are a relatively small fraction of Maryland's total nitrogen emissions. For example, only about 4 percent of Maryland's oxidized nitrogen emissions end up in the tidal Chesapeake. Many physical and biological processes such as movement of airborne nitrogen outside the watershed, biological uptake and denitrification account for this low transport rate. These relatively minor delivered loads will have obvious management implications when it comes to targeting reductions in NOx emissions for the Phase III WIP. However, emission reductions of GHG will occur simultaneously with NOx emission reductions and by reducing GHG we reduce the future climate impact of increased nutrient loading. Thus air emission reduction strategies have a two-fold impact by slightly reducing land deposition of NOx and by combating future nutrient loading resulting from climate change.

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# Reasonable Assurance and Accountability Framework

Section 303(d) of the CWA requires that a TMDL be "established at a level necessary to implement the applicable water quality standard (WQS)." Federal regulations [40 CFR 130.2(i)] also define a TMDL as "the sum of the individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background". Section 7 of the 2010 Chesapeake Bay TMDL requires jurisdictions to provide reasonable assurance that the nonpoint source component of the TMDL, the LA, will be achieved. EPA does this to ensure that the voluntary nonpoint source reductions expected to occur are realistic and achievable and that the regulatory WLA is set at the appropriate level to achieve WQS.

## Balanced Approach of Regulations and Incentives

Maryland uses a balanced approach of regulations and incentives to ensure that WQS will be met and that the TMDL allocations are achievable. On the regulatory side, Maryland has many tools under both the federal CWA or state law that set numeric permit limits and restoration or other requirements for the regulated community. Some examples across sectors include: federal NPDES permit limits on WWTP pollution discharges; federal and state restoration requirements for areas under municipal separate storm sewer permits (MS4s), which require stormwater management retrofit practices; state requirements for agricultural nutrient management plans; and state BAT requirements for onsite (septic) systems in the Critical Area (within 1,000 feet of tidal shorelines). These regulatory tools are backed by effective compliance and enforcement programs that, where necessary, can implement legal backstops to ensure restoration progress.

At the same time Maryland has pollution sources that do not currently have regulatory clean up requirements, such as small communities with no Bay restoration requirements for pre-law stormwater discharges (non-MS4s), that play an important role in helping achieve Bay restoration targets and where financial incentives are critical to drive restoration progress. Some examples of incentive programs to drive restoration progress through voluntary efforts include: Maryland's cover crop program supported through the BRF; local stormwater remediation projects funded through the Trust Fund; operations and maintenance incentives to improve wastewater treatment performance beyond regulatory requirements; and, BRF to upgrade failing septic systems outside of the Critical Area.

It is also important to recognize that restoration progress, whether driven through regulations or incentives, is not even across sectors. Accelerated pollution reductions through wise use of enhanced technology and capacity at WWTPs as well as on farms are largely driving Maryland's success in meeting the 2025 Bay restoration targets. Challenges in the stormwater and septic sector, such as numerous distributed systems over large areas, many private property interests, longer implementation horizons, and required engineering plans and approvals, to name a few, limit restoration pace in these sectors. Therefore continued steady progress in both the stormwater and septic sectors is necessary to ensure that ongoing pollution reductions keep pace with any increased loads due to climate change and growth. Phase 1 and 2 MS4 permits now cover greater than 90 percent of Maryland's developed landscape and are legally enforceable mechanisms to ensure steady restoration progress in that sector over the longer term.

Continued steady progress in the septic sector will be assured through upgrades, sewer hookups and the recent septic stewardship law that helps local jurisdictions with septic maintenance through pumpouts.

# Locally-Driven Restoration and Leveraging Co-benefits

Chesapeake Bay restoration will not be assured without sufficient capacity and close collaboration with local partners. County governments, municipalities, SCDs, farmers, citizens, and nongovernmental organizations are the boots on the ground implementing restoration practices through permits or grant/incentive programs. To ensure the continued progress of our local partners, restoration practices must not only be cost effective and achievable, but also provide benefits to local communities and address local challenges like flooding. Maryland will also work closely with local partners to identify strategies that address barriers through the adaptive implementation process of two-year milestones, progress evaluations, accelerating strategies that are cost effective and meet local needs, while embracing a continuous improvement philosophy to build on successes and learn from shortcomings. Maryland is already forming a workgroup to improve technical assistance delivery to local partners, as well as working with those partners to develop a strategic implementation plan for addressing challenges.

# Financial Assurance, Creating a Restoration Economy and Driving Innovation

In FY00–18, the state spent about $8.4 billion on Chesapeake Bay restoration activities (Table 10), $3 billion of which has been appropriated within the last three years. This amount includes funding for activities that directly reduce nutrient and sediment inputs to the Bay (e.g., cover crops and WWTp upgrades), activities that indirectly support Bay restoration (e.g., monitoring, education, outreach), and activities that prevent or minimize future degradation of the Bay (e.g., land conservation). Recent actions that are important to highlight are 1) the full funding of the Trust Fund; 2) an increased focus on cost efficiency in both the BRF and Trust Fund; 3) the efforts toward the development of an operational Water Quality Trading Program; 4) the passage of the Clean Water Commerce Act, and; 5) progress on addressing the impacts of the pond behind the Conowingo Dam reaching its long term sediment and nutrient trapping capacity.

***Table 10:** Fiscal Year 2000 - Fiscal Year 2018 Maryland Bay Restoration Funding Summary.*

| Category | Total Fiscal Year 00 - Fiscal Year 18 Funding Amount (millions)* |
|---|---|
| Bay Cabinet Agencies (DNR,MDE,MDA,MDP,) Bay Restoration Funds | $4,774 M |
| Land Conservation(POS and Rural Legacy) | $615 M |
| Agricultural Land Preservation | $487 M |
| GO Bonds[18] | $1,583 M |
| Transportation[19] | $1,534 M |
| Education | $101 M |
| **Total** | **$8,414 M** |

Several very important caveats and approximations must be recognized in interpreting Table 10 above.

1. **Data is not consistent over time:** Records are less accessible and, therefore, reported funding amounts less reliable for the beginning of this time period than more recent years.
2. **Not all funding goes directly to reducing pollutant loads to Chesapeake Bay:** "Bay Restoration" involves a diversity of important functions beyond simply reducing the amount of nitrogen, phosphorus and sediment entering the Bay. For example, water quality monitoring is essential to track progress and direct future actions to the most cost effective practices; education and outreach are important to providing Maryland students and citizens with access to and appreciation for a restored Bay; and smart growth and land conservation programs minimize growth impacts and protect the Bay from future degradation. All of these examples (and others) are essential aspects to restoration, but do not directly result in reductions in pollutant loadings. As a result, it is inappropriate to simply divide the total cost presented in this report by the number of pounds pollutant reduction to get a dollar amount per pound reduced.
3. **Judgment calls are necessary in identifying a program as "Bay Restoration":** Many state agency programs and budget categories contribute to restoration, as well as other non-Bay related efforts. In an effort to remain as consistent as possible, only those programs that are estimated to have more than 50 percent of their activities related to Chesapeake Bay restoration are included in this analysis.

[18] Includes Maryland Department of the Environment Revenue Bonds issued in FY 2016.
[19] Includes Maryland Department of Transportation spending from FY 2009 through FY 2018.

Although the total funding by Maryland state agencies for Bay restoration varies from year to year, the total restoration funds for the first three years of the evaluated time period (FY00–FY02) was $882,327,165 while the total for the past three years of the period (FY16– FY2018) was $2,657,862,414, an increase of 201.2 percent. This increase was driven in part by the creation and subsequent funding increases in the two primary Bay restoration Special Funds: The Bay Restoration Fund and the Chesapeake and Atlantic Coastal Bays Trust Fund.

The preliminary estimates of overall state costs for key Phase III WIP strategies by sector are presented below in Table 11. These amounts do not account for the estimated $1.6 billion that local governments will be spending through 2025 to complete the current Phase 1 and 2 MS4 permits. Phase 1 jurisdictions are required to develop financial assurance plans demonstrating fiscal capacity to achieve their stormwater permit requirements. This table also does not include federal funding sources for Chesapeake Bay restoration, such as Chesapeake Bay Restoration and Accountability Grants, Chesapeake Bay Implementation Grants, or federal funding for the Chesapeake Bay Program.

***Table 11:*** *Preliminary estimates of annual state implementation costs by sector to achieve Bay restoration targets.*

| Sector | State's Estimated Sector Costs for Key Strategies* |
|---|---|
| Wastewater | $110-million/yr |
| Stormwater (does not include transportation) | $90-million/yr |
| Septic | $11.4-million/yr |
| Natural Lands | $7.4-million/yr |
| Agriculture | $54.2-million/yr |
| **Total** | **$273-million/yr** |

*Costs compiled from Table 1 WIP strategy costs

The key state funding programs for putting Chesapeake Bay restoration practices in the ground are identified below in Table 12. Comparing this funding to the costs above suggests Maryland has enough fiscal capacity to assure Chesapeake Bay's WQS will be met. However, it is important to realize these are preliminary estimates based on current year funding and estimated implementation costs. This analysis also does not factor in the substantial federal and local funding sources that also fund implementation efforts to achieve Maryland's TMDL targets. For these reasons a more in depth financial analysis is recommended in the near term to confirm Maryland's fiscal capacity to achieve 2025 TMDL targets.

*Table 12: Key state funding programs and amounts for Chesapeake Bay Restoration Projects.*

| Program(s) Name | State's 2019 Program Funding Levels |
|---|---|
| Bay Restoration Fund Wastewater & Water Quality Revolving Loan Fund | $306-million/yr* |
| Bay Restoration Fund Septic | $15-million/yr |
| Clean Water Commerce Act | $6-million/yr |
| Chesapeake and Atlantic Coastal Bays Trust Fund | $53-million/yr |
| Maryland Agricultural Cost Share | $9-million/yr |
| **Total** | **$389-million/yr** |

*Includes $150-million in revenue bonds. Successive years anticipated to be $22-million

In addition to traditional funding approaches, the Hogan administration is pursuing market-based strategies designed to stimulate a restoration economy and reduce costs. Nutrient trading is one such tool that allows non-mandated pollution reductions from one entity to be purchased by another entity. This creates a marketplace that will drive innovation across sectors to develop the most cost effective pollution reduction practices. At the same time, other innovative financing strategies like the Clean Water Commerce Act and the CWIP drive innovation by creating funding streams for the most cost effective practices and developing collaborative funding models like public-private partnerships to reduce public costs of restoration. Aligning Maryland's GHG reduction actions with Bay restoration actions that have significant carbon sequestration benefits can leverage and diversify financing to accelerate pollution reduction practices. Maryland is also actively pursuing water reuse technologies that help with long term water supply sustainability for our citizens, as well as reduce pollution loads to Chesapeake Bay[20].

# Accounting for and Leveraging Conservation and Protection Programs

One of the best ways to assure and sustain Bay restoration is by protecting Maryland's ecologically significant lands and wildlife resources. These protections preserve the lowest pollution loading land uses from reverting to higher pollution land uses that will set Maryland further behind in its restoration goals. Maryland is making sure its land conservation programs are fully accounted for in the Bay restoration effort while fully funding land conservation programs for future acquisitions. In 2019, Maryland has $253-million in its transfer tax programs, such as Program Open Space, to protect and conserve natural lands. Maryland is also reviewing current conservation and protection program effectiveness, through monitoring results and other measures, in achieving conservation and protection goals.

[20] mde.maryland.gov/programs/Water/waterconservation/Pages/water_reuse.aspx

# Holistic Ecosystem Management

Although Maryland's Phase III WIP is designed to achieve the TMDL nitrogen, phosphorus and sediment targets and be consistent with EPA's expectations, the state is also strongly committed to the broader goals outlined in the current Chesapeake Bay Agreement[21]: These include sustainable fisheries, vital habitats, reducing toxic contaminants, healthy watersheds, land conservation, stewardship, public access, environmental literacy and climate resiliency. These other watershed goals provide critical feedback loops to improve water quality, whether through restored fisheries providing nutrient uptake and water filtration services, nitrogen and carbon uptake in the plant tissue of submerged vegetation, or land-based practices like wetlands and forest buffers that capture and process nutrients before they enter surface waters. Maryland's commitment to this broader ecosystem management framework will help the state achieve its TMDL restoration targets while also maintaining the productivity of the Bay's living resources that strengthen local economies.

# Accountability and Adaptive Management Framework

The accountability and adaptive management framework that underpins Chesapeake Bay restoration is shown in Figure 13.

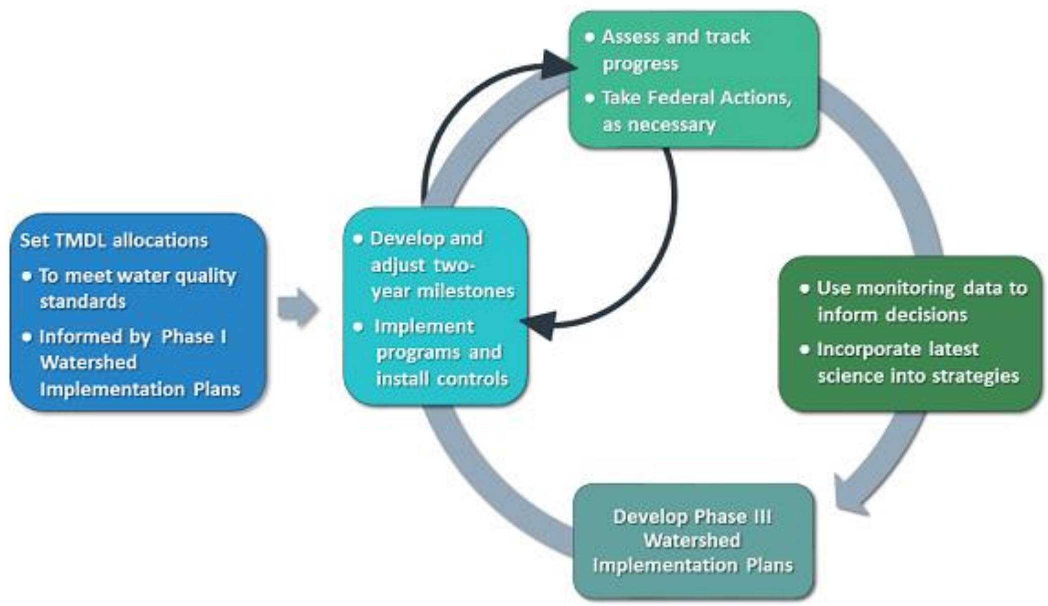


***Figure 13:*** *Chesapeake Bay TMDL Accountability Framework. Graphic courtesy of the EPA Chesapeake Bay Program web site at epa.gov/chesapeake-bay-tmdl/ensuring-results-chesapeake-bay.*

As part of this accountability framework, the CBP partners develop short term goals, called milestones, to ensure restoration progress. Milestones identify the restoration practices, programs, policies, and resources that state jurisdictions commit to implement over two-year periods. EPA then evaluates

[21] chesapeakebay.net/what/what_guides_us/watershed_agreement

progress that the state jurisdictions have made toward achieving their milestone commitments and takes appropriate federal actions, as necessary, to help state jurisdictions remain on track.

Maryland submitted its 2018-2019 milestones to EPA in January 2018 and expects to submit 2020-2021 milestones in January 2020. These milestones serve as key checkpoints on the way to restoring the Bay by 2025 and include annual evaluations to gauge progress. The milestones provide Maryland the opportunity to adaptively manage the restoration process, incorporate new science on restoration practices performance, and apply key lessons learned from Phase III WIP successes or failures along the way. Chesapeake Bay water quality and living resources data are also used to ensure results are being seen in the Bay, as well as to adjust, as necessary, to new science or changing conditions.

# Conclusion

There are both great challenges and great opportunities in restoring and protecting the Chesapeake Bay watershed and the rich natural heritage that defines the region. To do so, Marylanders must sustain the collective will to revive this national treasure, work to control costs and stimulate a restoration economy, leverage local and regional partnerships, implement restoration practices that achieve multiple benefits, promote and adopt innovation, adaptively manage and build on successes. Marylanders must also acknowledge that restoration success will require full commitment from upstream states, Maryland's continued strong leadership in the CBP partnership, and the U.S. EPA's maintenance of a strong restoration oversight and accountability role.

The Chesapeake Bay is a dynamic system influenced by natural ecosystem processes, as well as the multiple pressures of climate change, population growth, land use changes, and invasive species. Maryland and CBP's long term commitment to the science that informs policy and management actions, demonstrates effectiveness, and communicates restoration progress must be sustained into the future. As one participant keenly observed during the state's recent local engagement process: 2025 is not the end of restoration, but rather another milestone on the restoration journey.