Chesapeake Bay Restoration Spending Report

Minebank Run Stream Restoration Project
Photo Credit: Dana Havlik, MDOT State Highway Administration

A Report to the Maryland General Assembly pursuant to the 2021 Joint Chairmen's Report

December 1, 2021

Maryland Department of the Environment
Maryland Department of Natural Resources
Maryland Department of Agriculture
Maryland Department of Planning
Maryland Department of Budget and Management
Maryland Department of Transportation

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Executive Summary

Chesapeake Bay (Bay) lies at the core of Maryland's culture. While the costs and challenges of realizing a healthy and vibrant Bay are significant and complex, the environmental, social, and economic benefits of success are far greater. Maryland is committed to success, and we are well positioned to achieve our goal.

The following represents a summary of Maryland's approach and strategy toward realizing that goal in response to Joint Chairmen's Report of the 2021 General Assembly Session (pages 228 – 230) requesting that the Maryland Departments of Planning, Natural Resources, Agriculture, Environment, and Budget and Management, provide:

1. State Fiscal Year (SFY) 2021 spending on Chesapeake Bay Restoration and associated Bay health responses,
2. Projected SFY22 – SFY25 spending on Chesapeake Bay Restoration and expected Bay health responses,
3. A framework of needed regulations, revenues, laws, administrative actions and their resulting impacts on individuals, organizations, governments, and businesses SFY21 – SFY25 in order to realize a restored Chesapeake Bay,
4. An analysis of options for financing Chesapeake Bay Restoration,
5. An analysis of the cost effectiveness of existing Bay restoration fund sources, and
6. Updated information on Phase III Watershed Implementation Plan (WIP) implementation and the impacts of Conowingo Dam infill, growth, and climate change will be addressed.

It is critical to recognize that the responses to these questions are based on an extremely complex, unpredictable, and constantly evolving suite of scientific understandings, fiscal realities, and policy initiatives. The agencies have done their best at responding to the requests based on the current scientific, fiscal, and policy landscapes. These will undoubtedly change as time progresses, and responses must change accordingly if the state is to realize its goals.

The Chesapeake Bay Total Maximum Daily Load (TMDL) sets the pollution limits necessary to restore the health of the Bay and its tidal tributaries. The TMDL – developed in close collaboration with Maryland and all Bay watershed jurisdictions – sets regulated limits on the amount of nitrogen, phosphorus and sediment pollution that can enter the Chesapeake Bay and its tidal rivers, and still meet water quality standards. Maryland and the other six Chesapeake Bay watershed jurisdictions (Virginia, Pennsylvania, Delaware, West Virginia, New York, and the District of Columbia) are required by the U.S. Environmental Protection Agency (EPA) to implement sufficient pollution reduction practices by 2025 to meet the TMDL.

To provide reasonable assurance that the TMDL will be met, the EPA has directed each jurisdiction to develop WIPs that detail the actions the jurisdiction will take by 2025 to meet its TMDL. WIPs have been required since 2010. In August 2019, Maryland and the other Chesapeake Bay jurisdictions all submitted our Phase III WIPs, which detail the strategies for meeting the 2025 restoration targets. As part of the accountability framework for achieving the

2025 restoration targets, EPA and the Bay jurisdictions develop short-term goals, called milestones, to increase restoration work and ensure progress.

In addition to the suite of actions detailed in the WIP and 2-Year Milestones, all seven watershed jurisdictions, the federal government, and the Chesapeake Bay Commission, a tri-state legislative commission, signed the Chesapeake Bay Watershed Agreement in 2014, which commits the signatories to a wide variety of related Bay Restoration activities beyond the pollution reduction actions required by the TMDL (e.g., stewardship, environmental literacy, sustainable fisheries, climate resiliency, diversity).

In SFY00–21, Maryland spent approximately $13 billion on Chesapeake Bay Restoration activities, $5.4 billion of which has been appropriated within the last six years. This amount includes funding for activities that directly reduce nutrient and sediment inputs to the Bay (e.g., cover crops and wastewater treatment plant upgrades), activities that support the broader commitments of the 2014 Watershed Agreement (e.g., monitoring, education, outreach), and activities that prevent or minimize future degradation of the Bay (e.g., land conservation). **During the last 11 years of this effort (2010–2020), Maryland has successfully implemented actions to reduce the amount of nitrogen entering the Chesapeake Bay by approximately 11.2 million pounds.** The state's monitoring of water quality and habitat conditions in Maryland's streams, rivers, and the Chesapeake Bay show **increased resilience and improvements to our waters** as a result of these actions.

Under Maryland's Phase III WIP, which includes CAST 2019 model changes, the state needs to reduce its pollution to the Bay by more than 9 million pounds of nitrogen, and 0.1 million pounds of phosphorus from 2017 levels. These reductions will come primarily from the wastewater and agricultural sectors. By 2025, these sectors are expected to reduce their nitrogen loads from 2017 levels by 41%, and 20% respectively. Loads from the stormwater and septic sectors are anticipated to remain constant or slightly increasing, with reductions from implementation being offset by loads from new growth. It will be important, however, for the stormwater and septic sectors to increase implementation beyond 2025 in order to offset the impacts of expected future growth to allow us to remain under our TMDL.

The 2017 version of the Bay model used by Chesapeake Bay Program (CBP) to evaluate Maryland's Phase III WIP indicated that the nitrogen load reduction achieved by implementing the Phase III WIP would provide a surplus of 1 million pounds of nitrogen beyond the EPA target, and a surplus of 0.44 million pounds of phosphorus beyond the EPA target. These additional reductions not only provided Maryland with a margin of safety, but more importantly, provided a surplus that could be applied toward achieving climate change allocations. Moreover, 2019 updates to the Bay model indicate that the surplus has been reduced to about 0.394 million pounds of nitrogen and to 0.33 million pounds of phosphorus. Currently, Maryland and the other jurisdictions are amending their Phase III WIPs and/or developing 2022/2023 milestones to address the impacts of climate change quantified by CBP and assigned to the Bay jurisdictions in 2020. Finally, Maryland and the other Bay jurisdictions finalized a collaborative Conowingo WIP (CWIP) and financing strategy to address the estimated

6 million pounds of nitrogen entering the Bay as a result of the Conowingo Dam reaching "dynamic equilibrium" (no longer trapping sediment and nutrients as it has since its construction).

Meeting Maryland's existing Phase III WIP, and 2014 Chesapeake Bay Watershed Agreement commitments, addressing the impacts of climate change, implementing a CWIP, and offsetting future growth will be challenging, but not impossible. Maryland's Phase III WIP identifies seven "Guiding Principles" to ensure success in this effort which are balanced, feasible and locally-driven:

1. Balancing regulations and incentives.
2. Using wastewater treatment plant capacity wisely while driving long term and sustained progress in the slower paced sectors.
3. Creating a restoration economy and driving innovation.
4. Locally-driven restoration and co-benefits.
5. Accounting for and leveraging conservation and protection programs.
6. Holistic ecosystem management.
7. Accountability and adaptive management framework.

Central to success will be an emphasis on maximizing and continually improving the cost effectiveness of Maryland's three primary Chesapeake Bay Restoration funding programs: the Bay Restoration Fund (BRF), the Chesapeake and Atlantic Coastal Bays Trust Fund (Trust Fund), and the Maryland Agricultural Water Quality Cost Share (MACS) Program. Funds from these programs can, in turn, be leveraged with funds from more focused state programs (e.g., Program Open Space (POS), Water Quality Revolving Loan Fund (WQRLF)), federal programs (e.g., Conservation Reserve Enhancement Program (CREP)), local funds, and the private sector. Maryland has a strong tradition of remaining grounded in sound science while pushing the envelope on innovative policies (e.g., the recently re-enacted Clean Water Commerce Act) and initiatives (e.g., water quality trading, Transportation-Infrastructure Restoration Partnership, Grants Gateway, Innovative Technology Fund, recognizing and reacting to the co-benefits of stormwater mitigation projects), which place it in a strong position for success.

Introduction

A. Historical Perspective

In 2010, after decades of voluntary efforts to fully restore the Chesapeake Bay, the EPA established regulatory pollution load limits to restrict the three major pollutants in the Bay's waters: nitrogen, phosphorus, and sediment. These pollution loading limits, TMDLs, are science-based estimates of the amount of each substance that the Bay and its tributaries can receive daily and still meet standards for clean, healthy water. The pollution limits require the seven Chesapeake Bay watershed jurisdictions (Maryland, Virginia, Pennsylvania, Delaware, West Virginia, New York, and the District of Columbia) to have pollution reduction practices in place to achieve these limits by 2025. It is important to note, however, that full water quality improvements will not be realized until sometime after 2025 due to time lags between when the practices are implemented and when the ecosystem fully recovers.

To provide reasonable assurance that the TMDL pollutant limits will be achieved, the EPA directed jurisdictions to develop WIPs that detail the specific actions each jurisdiction will take to meet their 2025 limits. The EPA recognized that the level of detail it expects the jurisdictions to include in their WIPs would take time to develop, and that the scientific understanding and tools available to meet the goals were constantly evolving and, therefore, divided the process into three distinct phases with specific expectations:

- Phase I (submitted 2010): WIPs identified initial strategies and practices that each jurisdiction would begin implementing in 2010 to achieve 60% of the necessary pollutant load reductions by 2017.
- Phase II (submitted 2012): WIPs were a more detailed and geographically directed suite of actions as informed by two years of implementation and discussions with local officials. Like Phase I, the Phase II WIPs were focused on achieving 60% of the necessary pollutant load reductions by 2017.
- Phase III (submitted 2019): In 2017, CBP conducted a "mid-point assessment" during which EPA evaluated each jurisdiction's progress at achieving its Phase I and Phase II WIP commitments and applied new understandings of the science and updated models to identify necessary mid-course adjustments. Examples of some of the identified adjustments include an increased understanding about phosphorus saturated soils, the changing conditions (infill) behind the Conowingo Dam, increased loads due to growth, and water quality impacts due to climate change. Based on our new scientific understandings and lessons learned during the Phase I and Phase II WIP implementation, jurisdictions then submitted Phase III WIPs in August 2019 that detailed actions necessary to meet 100% of the necessary pollutant load reductions by 2025. Furthermore, the impacts to jurisdictions' Bay Restoration efforts due to climate change were not fully understood during the preparation of the Phase III WIPs. Climate change impacts and related strategies are currently being incorporated into the jurisdictions' Phase III WIPs through an addendum and/or incorporated into the

jurisdictions 2022-23 milestones. Maryland is required by statute (SB227) to submit an addendum to its Phase III WIP that describes how we will reduce climate-driven nutrient loads. Maryland is leveraging existing Phase III WIP wastewater strategies that include enhanced nutrient removal and continued operation and maintenance grants to incentivize superior performance. The expectation is that these existing strategies will result in overall average wastewater treatment plant concentrations of 2.85 mg/L nitrogen that will achieve increased climate loads. State staff have already vetted these strategies with the Maryland Association of Municipal Wastewater Agencies and will also include them in our 2022-23 Milestones due to EPA on January 15, 2022.

By successfully implementing the actions called for in its Phase I and Phase II WIPs, Maryland has made significant progress toward its ultimate 2025 TMDL pollution reduction goals. The pollution reduction practices implemented to date are accounted for in the Chesapeake Bay models which, when combined with the planned future pollution reduction strategies, help determine whether Maryland is on a trajectory to achieve it's 2025 restoration goals. **Figure 1 shows Maryland's modeled progress from 2010 to 2020, with projected reductions toward meeting its 2025 Phase III WIP nitrogen target with climate change allocation.** Figure 2 shows the 2010 and 2020 nitrogen contributions by source sector.

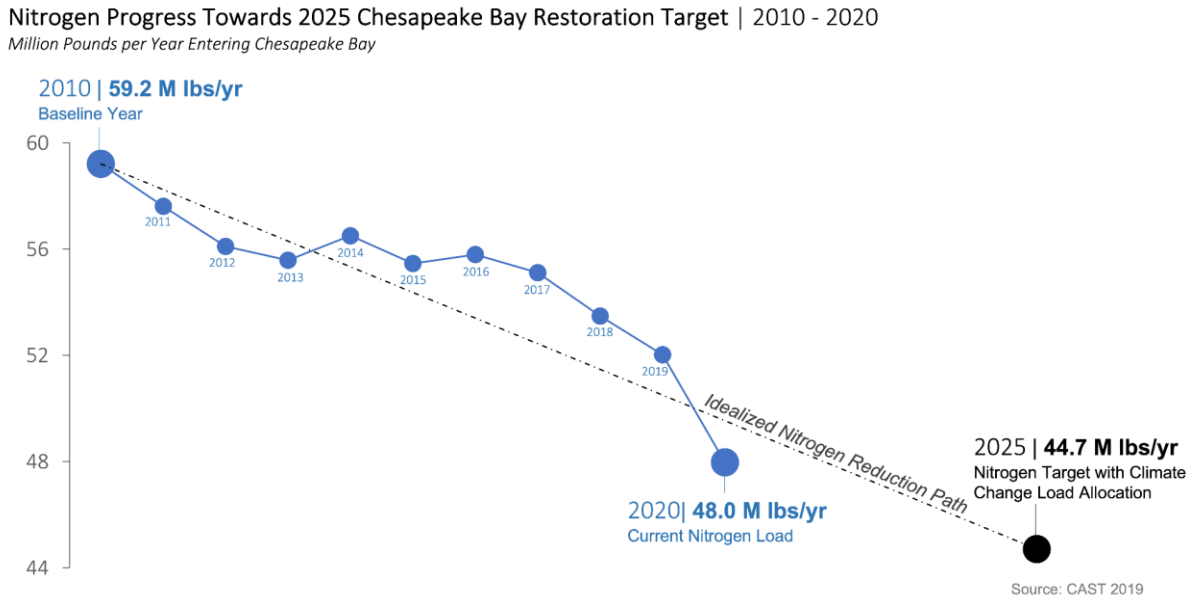

Figure 1. Modeled trends in Maryland's nitrogen loads to the Bay.

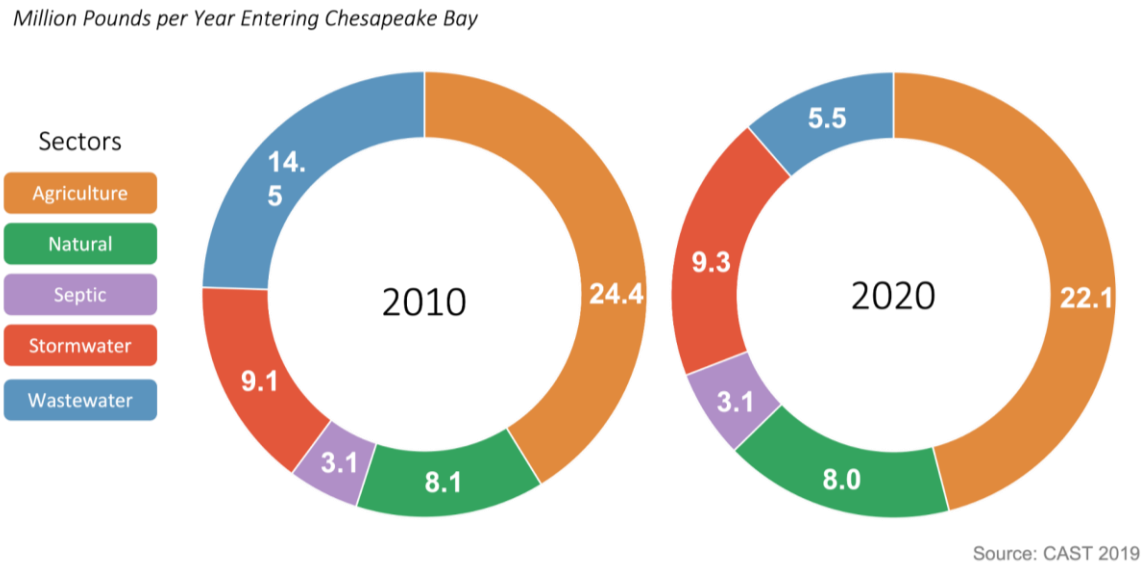

Figure 2. Maryland's modeled total nitrogen load delivered to the Bay by sector.

These past actions have addressed all pollutant sectors. Critical to realizing this progress has been Maryland's BRF and the Trust Fund and, in particular, the doubling of the BRF in 2012, and the full funding of the Trust Fund since 2017 by Governor Larry Hogan.

B. Looking Forward

As detailed in our Phase III WIP, **Maryland is on a path to achieving its share of the Chesapeake Bay pollution reduction targets by 2025.** Maryland's Phase III WIP accounted for projected growth in human and livestock populations, while still achieving a nitrogen load of 44.8 million pounds per year, and a phosphorus load of 3.28 million pounds per year by 2025, which exceeded our required targets by 1 million pounds of nitrogen, and 0.44 million pounds of phosphorus. Despite 2019 updates to the Bay model that show the Phase III WIP surplus has been reduced to about 0.394 million pounds of nitrogen and to 0.33 million pounds of phosphorus, Maryland is still providing a margin of safety toward meeting its Phase III WIP goals and to address further reductions associated with the impacts of climate change. However, as mentioned earlier, the recent (2019) Bay model updates indicate that the Phase III WIP pollution reduction surpluses will not be sufficient to offset additional climate change nutrient load reductions assigned to Maryland in 2020. The Maryland Department of the Environment (MDE) is currently drafting a Phase III WIP addendum and 2022-23 milestones that will describe strategies to meet the additional climate change pollution reductions, while continuing to provide an adequate margin of safety.

Maryland has divided its total pollution reduction targets among five major pollutant source sectors identified in Figure 2. While **the state is on track to reach its 2025 targets**, it is important to recognize that the pace of progress varies among sectors. This is due to the fact that the pollution reduction opportunities, planning constraints and costs vary widely between sectors. As a result, the stormwater and septic system sectors are expected to continue steady

implementation past 2025. Wastewater sector performance is planned to offset the slower pace of reductions in the stormwater and septic sectors allowing the state to meet its 2025 goals.

The remainder of this document is organized into four parts:

- Part I documents our progress to date - state spending on Bay Restoration from SFY00–SFY21, and the resulting changes in Bay health *(addresses 2021 JCR Section 21 request (1)).*
- Part II discusses where we still need to go - a general framework for implementing Maryland's Phase III WIP and meeting our required TMDL by 2025 *(addresses 2021 JCR Section 21 requests (2), (3), and (6)).*
- Part III describes how we are making the most of the Bay Restoration resources available to us - how we are maximizing the cost-effectiveness of existing state-funded programs *(addresses 2021 JCR Section 21 request (5)).*
- Part IV looks to the future and discusses several financing options under consideration that will help enable the state to better fund its water quality restoration obligations *(addresses 2021 JCR Section 21 request (4))*.

Part I - Where We Have Been: Bay Restoration Funding and Progress to Date (SFY00-SFY21)

A. Bay Restoration Funding

Since SFY07, the Governor's annual budget highlights have included a table of Chesapeake Bay Restoration Activities Funded in the Budget. A gross summary table of SFY00–21 Bay Restoration spending is provided below (Table 1), and a more detailed table is attached as Appendix 1. **In SFY00-21, the state spent about $13 billion on Chesapeake Bay Restoration activities, $5.4 billion of which has been appropriated in the last six years.**

Table 1. SFY00-21 Maryland Bay Restoration Funding Summary

Category	Total SFY00-21 Funding Amount
Bay Cabinet Agencies Bay Restoration Funds	$ 6,450 M
Land Conservation	$ 851 M
Agricultural Land Preservation	$ 674 M
General Obligation (GO) Bonds	$ 1,685 M
Transportation	$ 3,265 M
Education	$ 199 M
Total	**$ 13,124 M**

Several important caveats and approximations must be recognized in interpreting Table 1 and Appendix 1.

1. Data is not consistent over time: Records are less accessible and, therefore, reported funding amounts are 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; planned development and growth, and land conservation and preservation programs minimize growth impacts and protect the Bay from future degradation. All of these examples (and others) are essential aspects to Bay Restoration, but do not directly result in reductions in loadings to the Bay. (*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% of their activities related to Chesapeake Bay Restoration are included in this analysis.

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 (SFY00–SFY02) was $882,327,165 while the total for the past three years of the period (SFY19–SFY21) was $3,184,233,010, an increase of 261%. This increase was driven in part by the creation and subsequent funding increases in the two primary Bay Restoration Special Funds: the BRF and the Trust Fund.

B. Modeled Bay Restoration Progress 2000–2020 as per Reported Implementation

Maryland and the other Bay jurisdictions annually report to the EPA the number, type, and locations of pollution reducing Best Management Practices (BMPs) that they have implemented, maintained, and verified are working. The EPA then uses that information to estimate and track annual progress toward our nitrogen, phosphorus and sediment goals. This assessment looks at the modeled loads of nutrients and sediment originating from each jurisdiction that end up in the Chesapeake Bay. These estimates are produced with a watershed model that normalizes for weather fluctuations and accounts for any pollution management practices on the ground. *This model was updated in 2020 to a new version called CAST 2019. (As a result, the progress reported below in this year's Chesapeake Bay Restoration Plan report can be compared with progress reported in 2020, but cannot be directly compared to progress shown in reports prior to the 2020 report.)*

Figure 3 shows the modeled contributions of phosphorus and sediment loads to the Bay from Maryland's five source sectors in 2020. The total modeled nitrogen, phosphorus and sediment loads to the Chesapeake Bay from the Maryland portion of the watershed from 2010 to 2020 are displayed in Figure 4**. Based on the latest Bay model (CAST 19), Maryland's actions from 2010 through 2020 have reduced nitrogen loadings by 19%, phosphorus loadings by 11%, and sediment loadings have remained even/stable.**

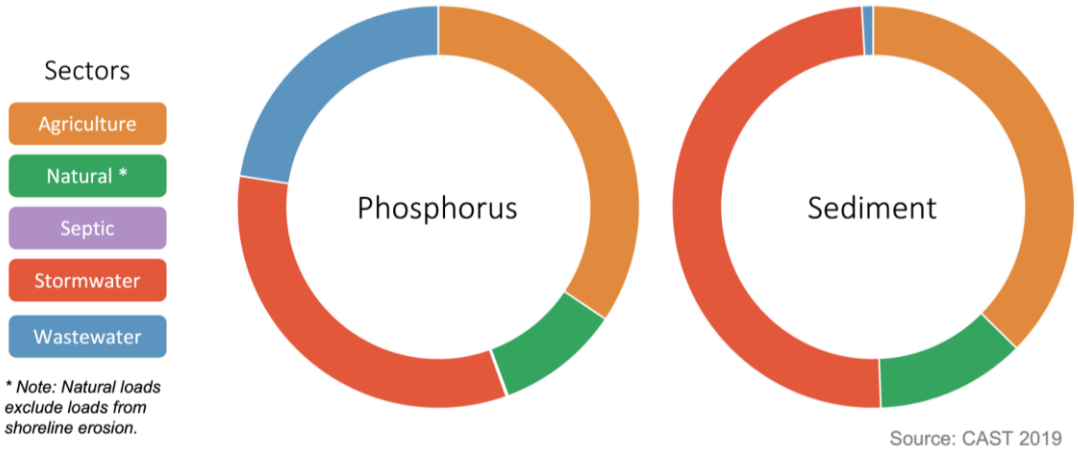

Figure 3. SFY20 source sector phosphorus and sediment contributions of Maryland's loads delivered to Bay.

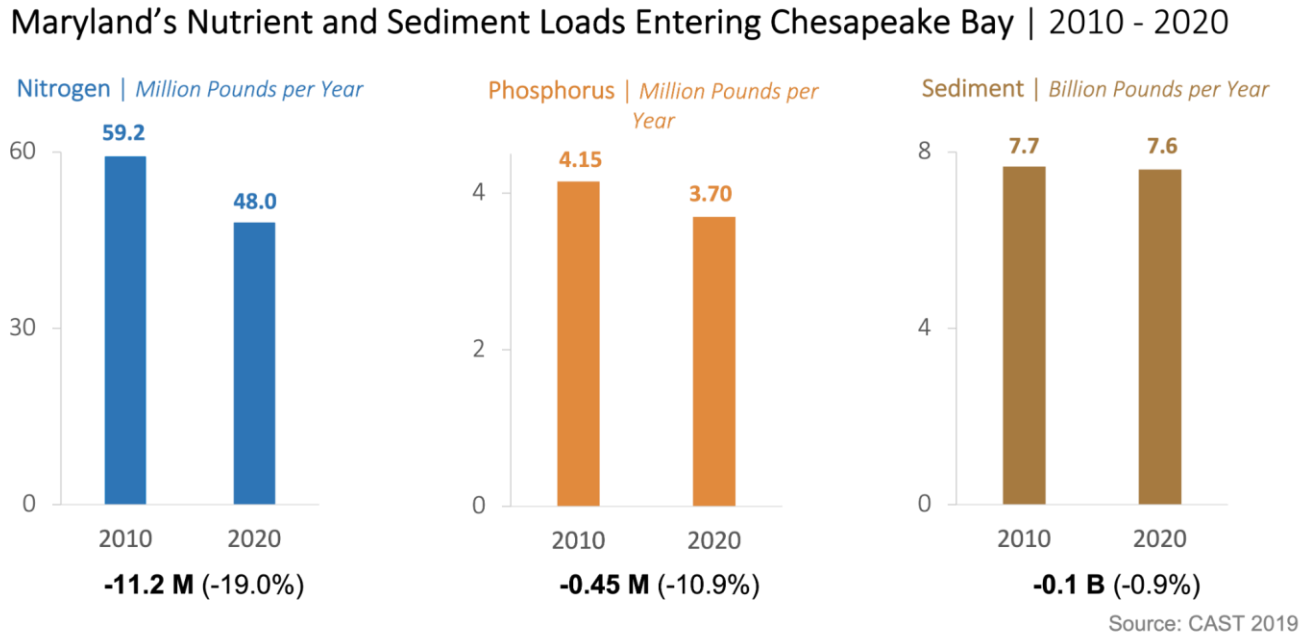

Figure 4. Maryland modeled loads of nitrogen, phosphorus, and sediment from SFY10 – 20.

Changes in loads can result from changes in conservation practices, land use, wastewater treatment, air deposition, animal population estimates, septic systems, and precipitation. A description of the changes that occur in each sector are as follows:

- **Agriculture:** This sector makes up the largest contribution of nitrogen and sediment to the Bay, yet it also continues to make steady reductions. The Maryland Department of Agriculture (MDA) continues to adopt new incentives to increase adoption of key conservation practices. For example, the addition of a new aerial seeding incentive for cover crops increased acres planted by 100,000 acres for fields that would have been too wet to plant. Financial incentives were also expanded for fencing, which resulted in an increase in prescribed grazing acres (10,250 acres). Soil Conservation and Water

Quality Plans acres remained steady, while the full transition to the Phosphorus Management Tool (PMT) increased tons of manure transported outside the watershed (62,000 tons) to further reduce the sector's phosphorus loading.

- **Wastewater:** This sector makes up Maryland's second largest contribution of nitrogen to the Bay, and it has achieved the largest reductions. Changes in the loads from wastewater treatment plants are a combination of the upgrades of municipal plants, treatment plant performance, performance incentives, population growth, and the impact of year-to-year rainfall variability.
- **Urban Stormwater:** This sector is Maryland's third-largest contributor of nitrogen to the Bay and is a substantial contributor of phosphorus. Atmospheric deposition is a major nitrogen source in the urban environment and implementation of air pollution reduction strategies in the region is a key driver of nitrogen reduction. Phosphorus reductions are due in part to fertilizer management. Since 2010, new development has to meet Environmental Site Design to the Maximum Extent Practicable, which minimizes nutrient and sediment pollution reaching the Bay from developed land. Currently, 33% of developed land is covered by stormwater management (SWM).
- **Septic Systems:** The septic sector has the least contribution of nitrogen to the Bay and contributes no phosphorus or sediment. In general, restoration practices, such as upgrades to Best Available Technology (BAT) and connecting failing septic systems to public wastewater treatment facilities have kept pace with the addition of loads from new systems. Future reductions are anticipated from the elimination of septic systems due to increase of connections to wastewater treatment plants. Additionally, at low elevations, there may be more failures of septic systems due to sea level rise and storm events; therefore, this may result in additional connections to wastewater treatment plants.

C. Chesapeake Bay Water Quality Monitoring Data

In order to understand the health of the Chesapeake Bay and track progress of restoration efforts, the state, through the Maryland Department of Natural Resources (DNR), regularly monitors tidal and non-tidal waters at 126 sites. Monitoring data provides highly accurate information on the amount of pollutants in our waterways today and in the past. Monitoring data cannot, however, identify the sources of the pollutants nor predict future pollutant loads resulting from planned pollutant reduction efforts, the impacts of climate change, growth, etc.; for that information we must depend on models.

Statistical analysis of monitoring data collected at both tidal and non-tidal stations from 1999 through 2020 demonstrates that the current impact of historical **Chesapeake Bay Restoration spending has resulted in significant reductions in nitrogen concentrations at 52% of stations (Figure 5), phosphorus concentrations at 55% of stations (Figure 6), and sediment concentrations at 29% of stations (Figure 7).** Due to COVID-19 restrictions on field sampling and laboratory closures, sampling in 2020 could not be completed in March, April and May. In response, DNR and MDE quickly consulted with the Maryland Department of Health to develop

COVID-19 protocols for state employees conducting field work. With those protocols in place, DNRs field crews resumed sampling at the end of May 2020, and continued to collect this very important data throughout the rest of the year. An evaluation by CBP partners determined that the missing data did not prevent the appropriate analysis of trends through 2020, but also indicated that had there been any additional missing months of data, it would have had an impact on the assessments. DNR's efforts in a regular year are critically important for management of Maryland waters, but **i**n **2020 they went well above and beyond to make sure the data could be collected.**

Flow-adjusted trends analysis was first implemented in 2017. This flow-adjusted method uses daily flow data from U.S. Geological Survey (USGS) gaging stations to include the impact of changes in river flow on the nutrients and sediments levels; higher nutrients and sediments are associated with high river flows. Changes in the levels of nutrients and sediments are flow adjusted by using flow as one of the factors that determines the differences between years. The flow-adjusted method is much more robust for determining the impact of changes in water quality over a long-time period, and for determining what changes over time have resulted from management actions, not due to changes in rainfall from one year to the next. When the results of the flow-adjusted method are compared to the results of the non-adjusted method there are some differences, especially when recent years of data (2018 and 2019) were record setting high flow years.

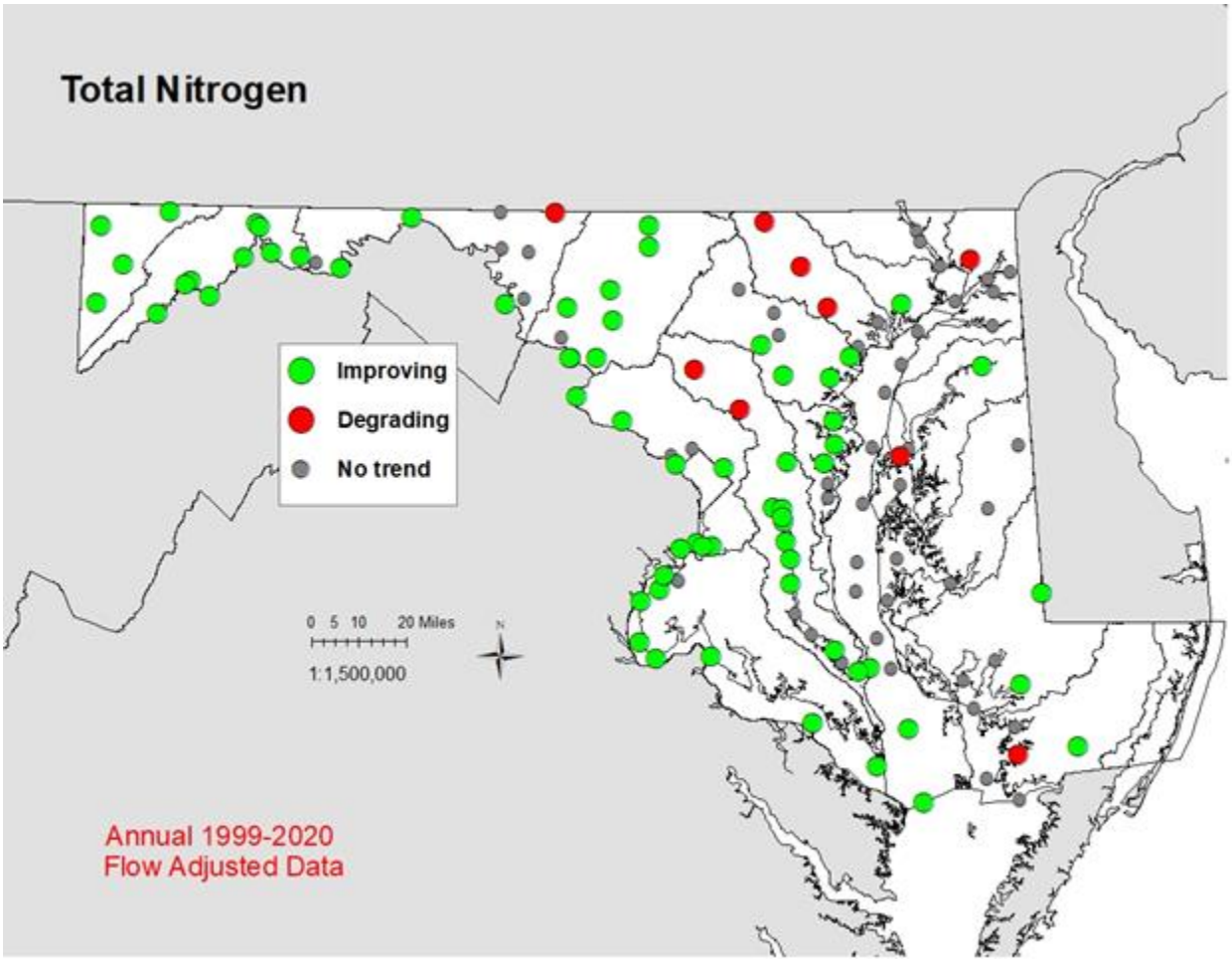

Figure 5. Trends in flow adjusted total nitrogen concentrations 1999–2020.

- 52% of stations (65 of 126) have improved nitrogen levels compared to 1999.
- 7% of stations (9 of 126) have degraded nitrogen levels compared to 1999.
- 41% of stations (52 of 126) do not have nitrogen levels that are significantly different from 1999.

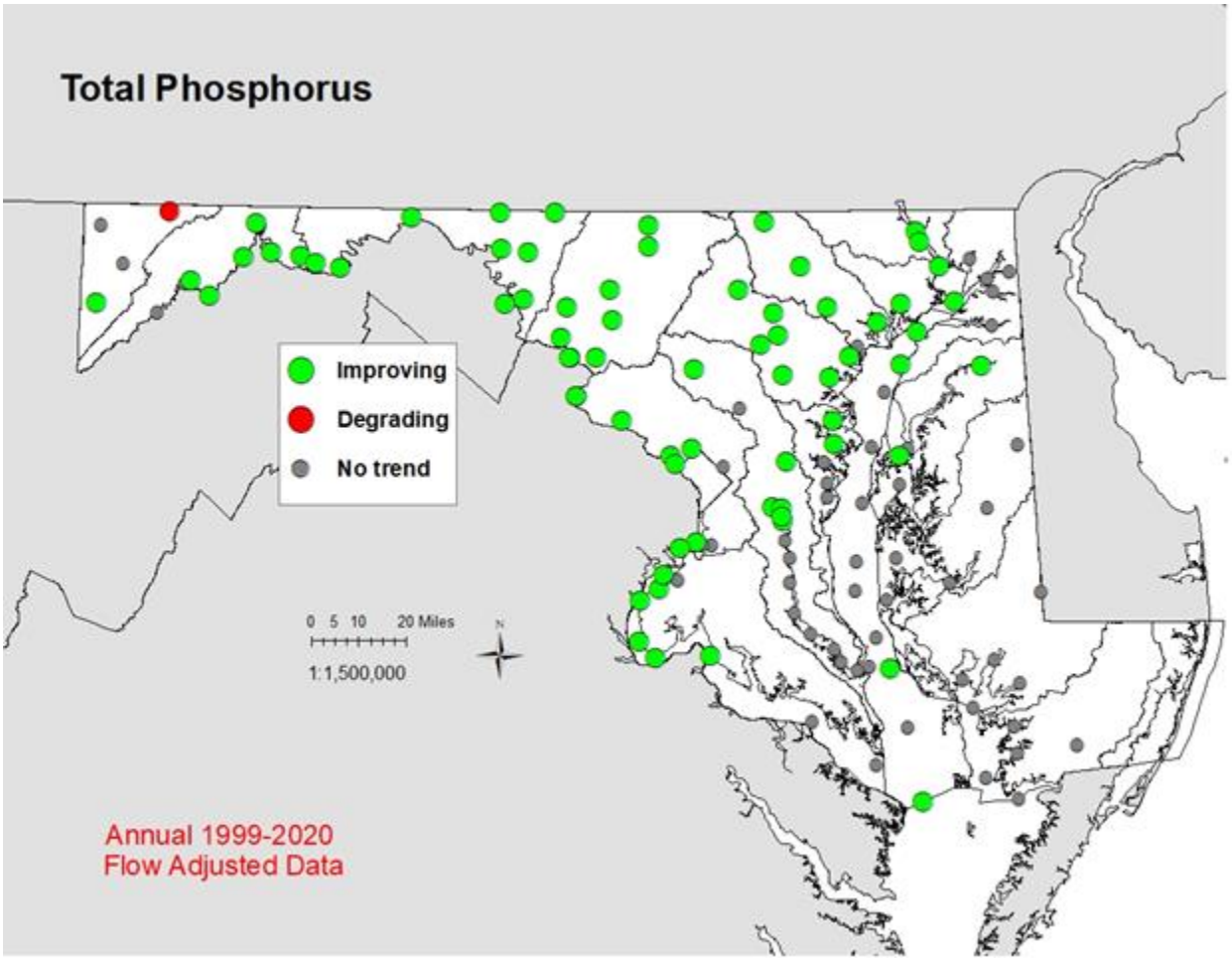

Figure 6. Trends in flow-adjusted total phosphorus concentrations 1999–2020.

- 55% of stations (69 of 126) have improved phosphorus levels compared to 1999.
- 1% of stations (1 of 126) has degraded phosphorus levels compared to 1999.
- 44% of stations (56 of 126) do not have phosphorus levels that are significantly different from 1999.

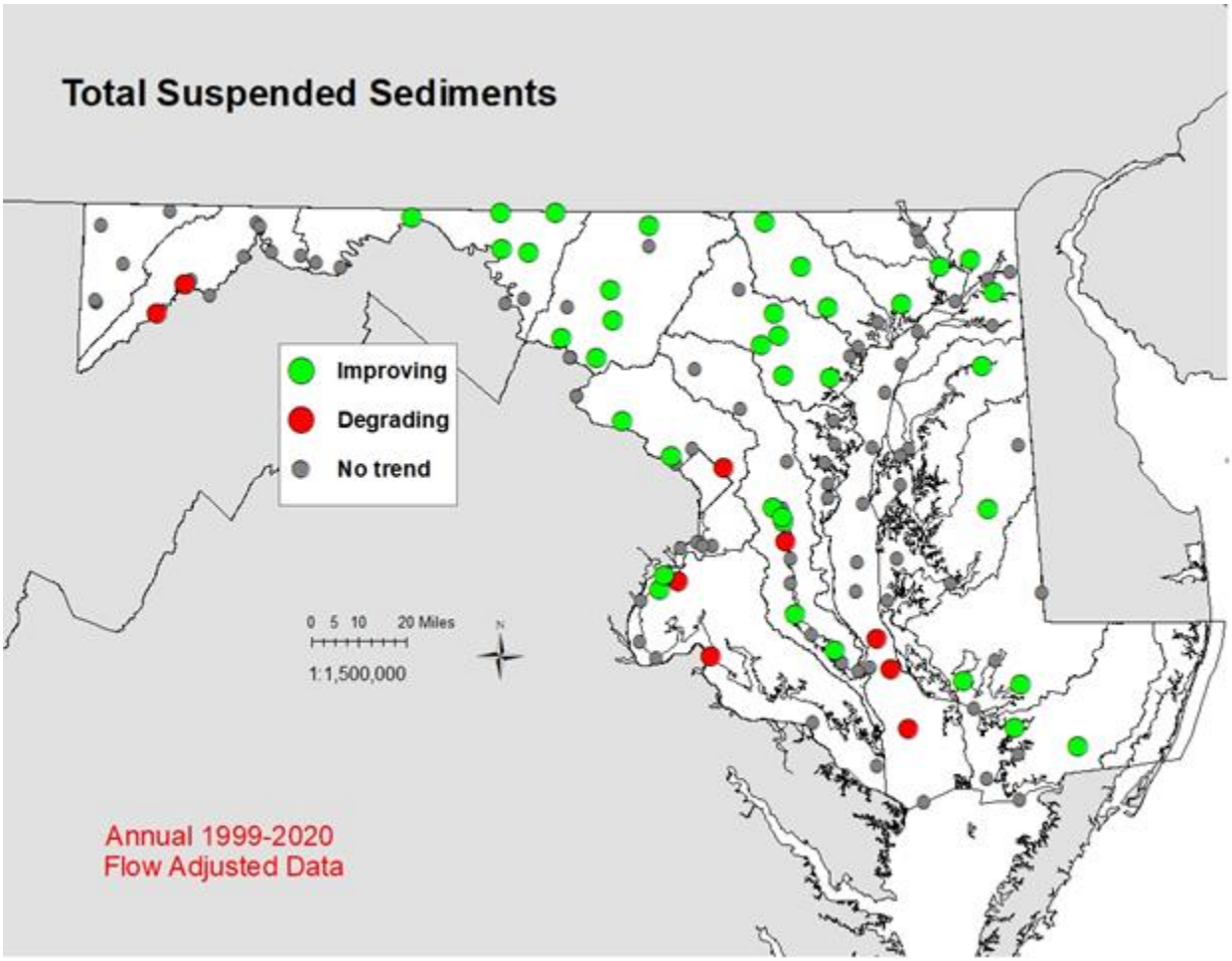

Figure 7. Trends in flow-adjusted total suspended sediment concentrations 1999–2020.

- 29% of stations (37 of 126) have improved sediment levels compared to 1999.
- 8% of stations (10 of 126) have degraded sediment levels compared to 1999.
- 63% of stations (79 of 126) do not have sediment levels that are significantly different from 1999.

Monitoring results confirm that most nutrient and sediment reductions occur in streams and rivers closest to where the management actions have been implemented. Moving downstream into the tidal tributaries, water quality improvements, especially in nitrogen levels, are more likely to be observed on Maryland's western shore where those reductions are associated with wastewater treatment plant upgrades. Conversely, water quality improvements on Maryland's Eastern Shore, which are dominated by diffuse nonpoint source impacts, have a more delayed response.

The main portion of the Bay will take longer to respond to our management actions, but **we are seeing improvements as we continue to implement and meet our reduction strategies**. For instance, Maryland's submerged aquatic vegetation exceeded 60,000 acres in 2017, following several years of increased abundance (Figure 8). However, record high rainfall and stream flows

into the Chesapeake Bay in 2018 and 2019 led to higher levels of nutrient and sediment pollution, changes in salinity, and poorer water clarity in many of Maryland's waterways. As a result, submerged aquatic vegetation declined in both 2018 and 2019. Habitat conditions remained poor in 2020, and underwater grass abundance declined 13% in 2020 (Figure 8). Despite these overall reductions, **localized improvements seen on the Susquehanna Flats and in Tangier Sound highlight the resilience of large, stable submerged aquatic vegetation beds.** Continued nutrient and sediment reduction actions are expected to result in greater submerged aquatic vegetation resiliency from extreme events in the future.

Submerged aquatic vegetation is a key indicator of Bay health since it quickly responds to improvements in water quality. As such, sustaining and increasing the habitat benefits of submerged aquatic vegetation is a vital Chesapeake Bay Agreement outcome. Maryland's progress toward this goal was measured against a target of 57,000 acres by 2017 (which was met in 2016 and 2017), and 79,800 acres by 2025.

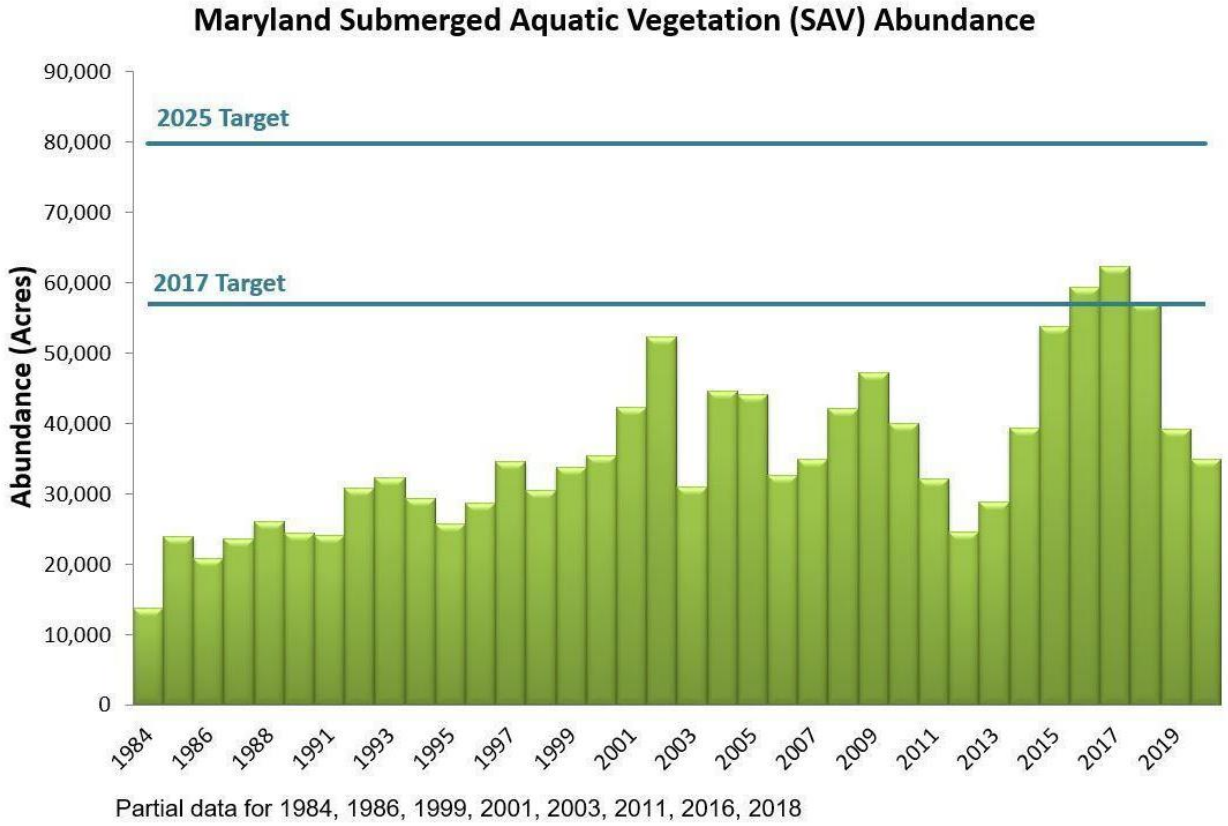

Figure 8. Total abundance of Submerged Aquatic Vegetation in Maryland's portion of the Chesapeake Bay and tidal tributaries, 1984–2020.

Maryland is also witnessing **signs of improved bottom dissolved oxygen levels in the mainstem Bay (Figure 9)**. Bottom dissolved oxygen is a key parameter for all aquatic resources and an indicator of overall Bay health. Further actions on nutrients and sediments will still be required to see continued improvement. Tidal water clarity (Figure 10) has worsened at some stations,

especially in the mainstem bay. Chlorophyll a, an indicator of algal concentration (Figure 11), has improved in upper portions of the larger rivers and in some of the smaller rivers, but has worsened in the middle portions of the larger rivers.

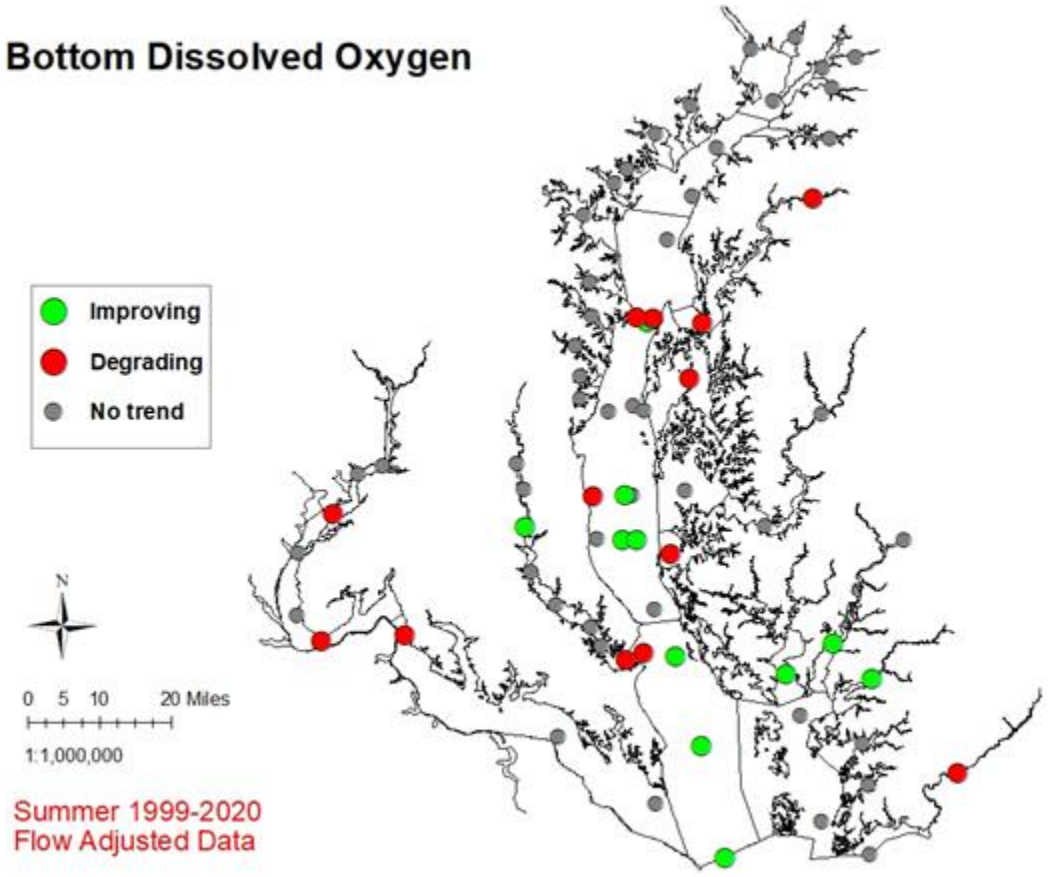

Figure 9. Trends in flow-adjusted bottom dissolved oxygen concentrations 1999 – 2020.

- 16% of stations (11 of 71) have improved dissolved oxygen levels compared to 1999.
- 18% of stations (13 of 71) have degraded dissolved oxygen levels compared to 1999.
- 66% of stations (47 of 71) do not have dissolved oxygen levels that are significantly different from 1999.

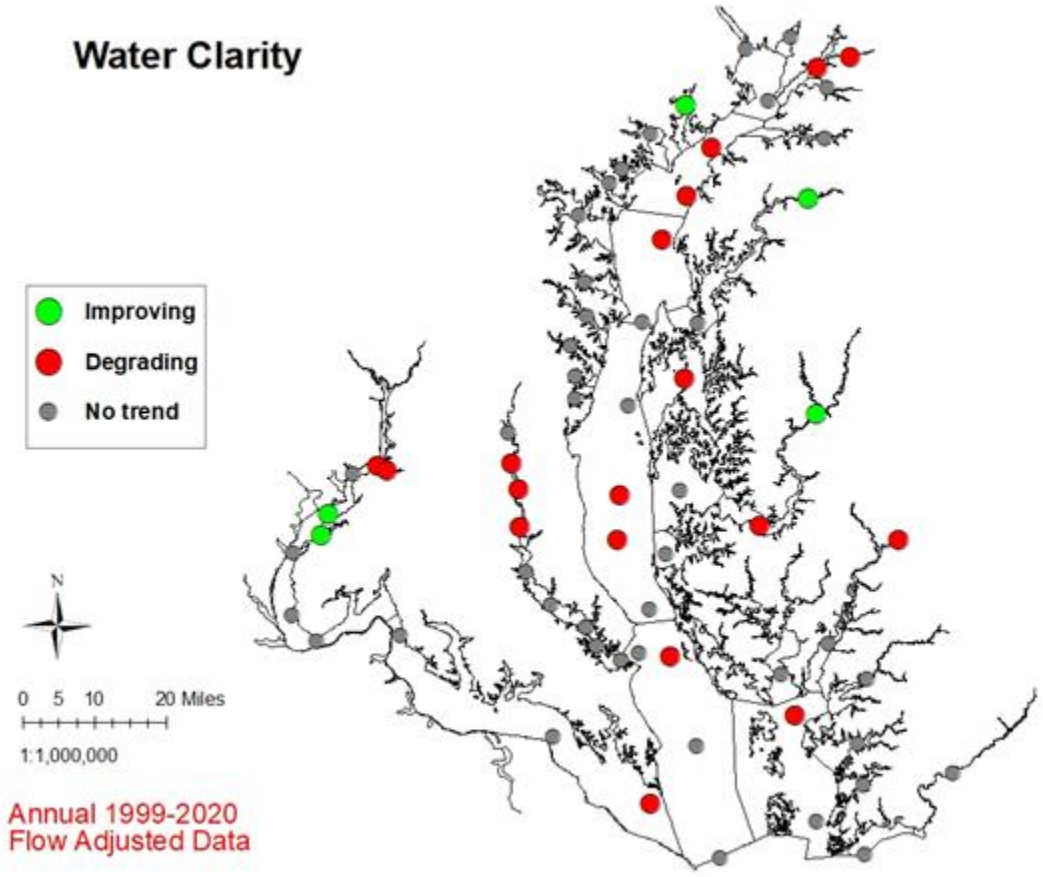

Figure 10. Trends in flow-adjusted water clarity concentrations 1999–2020.

- 8% of stations (5 of 66) have improved water clarity compared to 1999.
- 27% of stations (18 of 66) have degraded water clarity compared to 1999.
- 65% of stations (43 of 66) do not have water clarity that is significantly different from 1999.

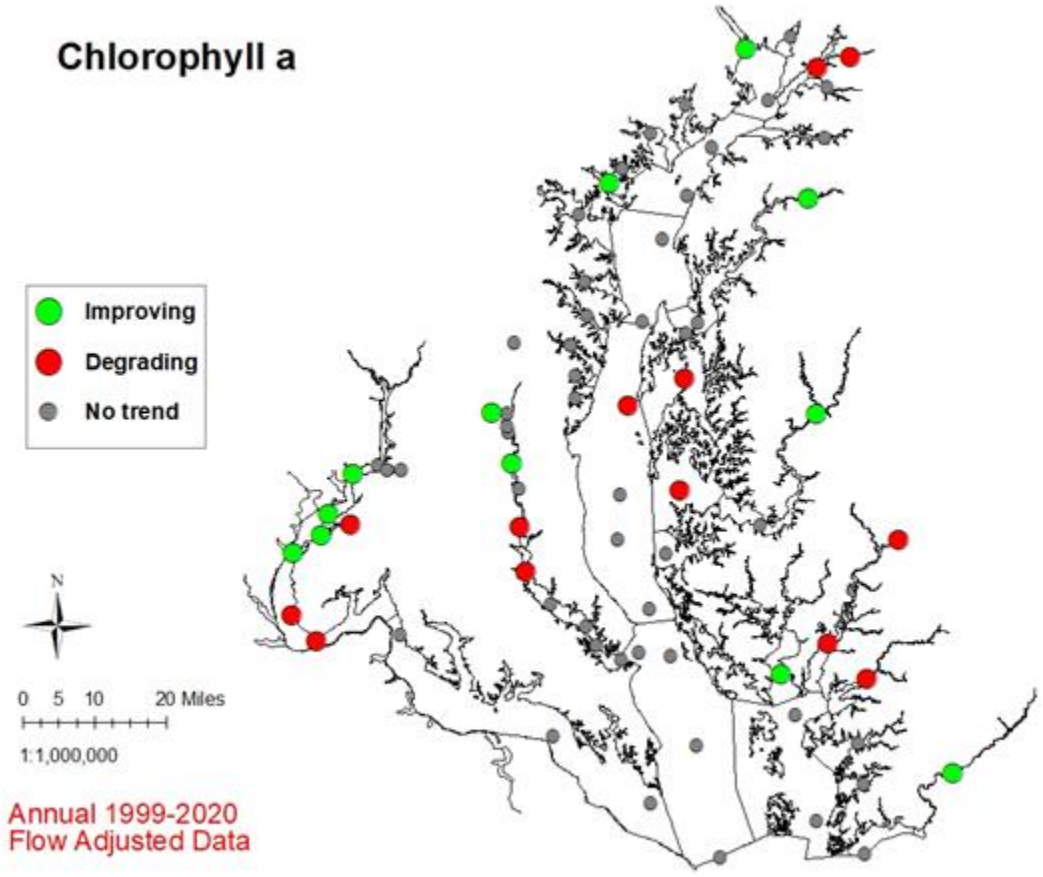

Figure 11. Trends in flow-adjusted chlorophyll *a* concentrations 1999–2020.

- 16% of stations (12 of 73) have improved chlorophyll *a* levels compared to 1999.
- 18% of stations (13 of 73) have degraded chlorophyll *a* levels compared to 1999.
- 66% of stations (48 of 73) do not have chlorophyll *a* levels that are significantly different from 1999.

Part II - Where We Still Need To Go: Maryland's Framework for Bay Restoration 2021 - 2025

The Phase I and Phase II WIPs effectively established the pollution targets, responsibilities, and initial strategies for achieving the required pollution reductions. The Phase III WIP (completed in 2019) uses lessons learned from Phase I and Phase II to refine those strategies, and identify the next steps to ensuring that the necessary policies, regulations, incentives, and financing structures are in place to achieve restoration success in the long term (2025 and beyond). This section of the report summarizes those strategies.

The following framework focuses on the necessary role of the state and the associated policies and financing resources needed for a successful restoration effort. Achieving pollution reduction targets will require the resources and engagement of multiple stakeholders and entities, public and private, working in concert over the coming years. **Due to the Bay's importance to our culture, identity and economy, Maryland has a unique leadership role in its restoration.** EPA leadership is also critical for holding all jurisdictions responsible for achieving and maintaining their final pollution targets. The following framework is intended to address Maryland's capacity to lead the restoration effort subject to several key technical parameters.

A. Background – Pollutant Source Sector Status

Under the Phase III WIP, which includes CAST 2019 model changes, the state plans to reduce its pollution to the Bay by more than 9 million pounds of nitrogen and about 0.1 million pounds of phosphorus from 2017 levels. These reductions will come primarily from the wastewater and agricultural sectors. Loads from the urban stormwater and septic sectors are anticipated to remain the same, with reductions from implementation being offset by loads from new growth.

1) Wastewater

In SFY20, wastewater represented about 11% of the nitrogen load in Maryland, and reductions in this sector—from 14.5 million pounds per year in SFY10 to 5.5 million pounds per year in SFY20—represent a true water quality financing success. The combination of firm, enforceable regulations coupled with a dedicated and consistent revenue stream from the BRF, has resulted in pollution reductions in the wastewater sector, and has provided room for future growth.

As of 2018, BRF upgrades to Maryland's 67 major wastewater treatment plants to Enhanced Nutrient Removal (ENR) have been fully obligated. As of October 2020, 64 upgrades of significant municipal plants were completed, with two under construction, and one in the planning phase. Minor wastewater treatment plants (less than 0.5 million gallons per day) are

also being upgraded using the BRF on a voluntary basis, and when the upgrade is cost-effective. As of September 2021, nine upgraded minors were in operation, six were in construction, and 16 were in design or planning stages.

With the substantial investments in advanced treatment systems at its municipal wastewater plants, the state is now considering ways to ensure that plants will fully utilize these technologies. The state has developed several performance incentive programs, such as the Wastewater Operations and Maintenance (O&M) Grant through the BRF, to ensure that it reaches the statewide annual average operational goal, established in the Phase III WIP, of 3.25 milligrams of nitrogen per liter in plant effluent, or lower as determined to meet the recently assigned additional nutrient load reductions needed to address 2025 climate change conditions. The SFY20 average municipal wastewater nitrogen concentration was 2.9 milligrams per liter, down from 7.5 milligrams per liter in SFY10. However, despite the significant load reductions realized in SFY20 at Maryland's largest wastewater treatment plants, due to operational challenges exacerbated by COVID 19-related staff shortages at the **Patapsco and Back River facilities, wastewater loads are anticipated to increase in reported SFY21 Bay TMDL progress results relative to SFY20 reported Bay TMDL Progress results.** This is considered a very serious matter that, if continued, could jeopardize Maryland's ability to achieve its Bay Restoration goals. MDE is taking enforcement actions to expeditiously bring these facilities back on track to perform at ENR levels or lower during SFY22.

Maryland's Phase III WIP and its climate change addendum assume that wastewater treatment plant performance will exceed permit requirements, and expect that plants will not be operating at full capacity by 2025. This should result in plant loads that are well below the allocations established in the Chesapeake Bay TMDL. This adequately compensates for the slower pace of reductions in the septic and stormwater sectors through 2025. As wastewater treatment plants approach design capacity as a result of population growth, it will be critical for continued reductions to occur in the other sectors, and to increase the transfer of loads from other sectors to the Natural sector using nature-based practices. Continued optimization and use of the Wastewater BRF O&M Grant is a priority strategy for achieving the aggregate average wastewater operational goal.

2) Agricultural Lands

In SFY20, nutrient loads from agricultural lands accounted for about 46% of the nitrogen loads in Maryland. Implementing nutrient management plans, soil conservation and water quality plans, planting cover crops, and maintaining buffers continue to be significant nutrient and sediment reduction practices for load reduction. Programmatically, MDA undertook key changes within the MACS Program that will accelerate adoption of high priority conservation practices, including:

- Recently passed legislation enables the MACS Program to provide up to 100% reimbursement for key practices identified in the WIP;
- Addition of new "natural filter" practices for MACS funding to expand in-field and edge-of-field buffers;

- Expanded funding for fencing and infrastructure to support grazing operations;
- Increasing the manure transport rate up to $28/ton; and
- Providing cost-share for poultry waste storage facilities at receiving grain operations able to utilize valuable organic and micronutrients from poultry litter.

In SFY21, MDA also piloted a Conservation Buffer Initiative to accelerate the adoption of riparian buffers through more flexible terms for management and contract length. **After one year, MDA expects nearly 200 additional acres of buffers through the pilot program.**

Additionally, the administration's Agricultural Phosphorus Initiative, which is providing solutions through implementation of the PMT, is now in full effect. Farmers with soil phosphorus levels of 150 or greater (Fertility Index Value) are now required to follow PMT guidelines. The department continues to prioritize support for those farms affected by PMT with manure transport assistance and the Animal Waste Technology Fund.

With the combination of agriculture initiatives, the sector anticipates meeting its sediment and phosphorus goals by 2025, including continuing to address and develop strategies to minimize the impact of legacy phosphorus concentrations. Moreover, Maryland farmers are being asked to further reduce nitrogen by 4.1 million pounds by 2025. Accomplishing this goal by 2025 will depend on the combination of technical assistance, provided by Maryland's Soil Conservation Districts (SCDs) and other conservation partners, coupled with state and federal financial incentives. Farmers rely on the technical expertise provided by SCDs to ensure resource concerns are being addressed, and to assist them in navigating various state and federal programs. MDA will continually evaluate best options to meet the needs of Maryland farmers, growers and producers.

The need to recruit and retain properly trained field staff remains a high priority of Maryland and all Chesapeake Bay jurisdictions. MDA's Office of Resource Conservation received 53 new permanent positions funded through the Trust Fund to help meet the agricultural technical assistance needs. However, due to the COVID-19 pandemic, MDA was unable to resume the hiring process until fall 2020. MDA was successful in hiring 23 planners and 14 technicians through two statewide recruitments. Further efforts were initiated for a third recruitment to fill the remaining vacancies.

3) Urban Stormwater

In SFY20, urban stormwater represented around 19% of Maryland's nitrogen loads to the Bay. Compared with the nutrient reductions from the state's farms and wastewater treatment plants, the pace of progress in reducing urban stormwater loads is more gradual since stormwater does not generally contain as many nutrients as other sectors. Controls to address stormwater pollution also cannot be rapidly deployed because they include longer planning and implementation horizons to scale up. Over the longer-term stormwater pollution is a critical piece of Maryland's plan for restoring the Bay and its non-tidal waters.

As opportunities for reductions on agricultural land become exhausted, and as wastewater plants reach capacity, urban stormwater will make up an increasing portion of the loads, and the potential nutrient reductions in the state. With population growth beyond 2025, and with additional reductions required to meet climate change reduction goals and Conowingo Dam infill, it may be impossible for the state to meet and maintain its targets. The result of these factors is that stormwater implementation will not account for a large portion of the 2025 nutrient reductions, but it will need to make continued, steady progress to and beyond 2025.

Implementing stormwater practices poses numerous challenges, including the decentralized nature of SWM, where practices must be constructed throughout the watershed instead of at a single, centralized location, and the significant amount of time that must be spent in planning, design, and permitting. One major hurdle faced throughout the Bay watershed is the cost of installing these practices. In the 2019 University of Maryland Center for Environmental Science (UMCES) study, "Cost Analysis of Stormwater and Agricultural Practices for Reducing Nitrogen and Phosphorus Runoff in Maryland," indicated the cost of reducing a pound of nitrogen through stormwater practices ranges from $384 per pound to over $10,000 per pound, with a mid-range practice costing around $1,500 per pound. In contrast, the median cost of reducing a pound of nitrogen through wastewater treatment plants upgrades is about $40 per pound, with further reductions using BRF O&M grant incentives estimated as low as $10 per pound.

Recognizing the necessity of SWM in maintaining Maryland's nutrient caps, while also understanding the price tag of implementation, the state is looking to optimize the cost-benefit relationship. This can be done not just by minimizing the cost of implementation, but also by maximizing the potential environmental impact — particularly by looking at effects beyond just nutrient reductions. Maryland's non-tidal streams, for example, are commonly impacted by sediment, flow-related stressors, temperature and channelization. In many cases these sorts of impairments cannot be addressed by any means other than managing urban runoff. Practices that address stormwater runoff may also be designed to address water quantity, such as by mitigating the impacts of flooding and other factors driven, in part, by climate change. These additional, non-nutrient impacts are referred to as co-benefits, and are a major focus of the Phase III WIP. By stacking multiple benefits and co-benefits, state and local governments can ensure that each dollar spent has a far-reaching impact. As this co-benefit framework guides the implementation process, watershed managers should be planning in a way that focuses on multiple objectives, rewarding long term planning rather than just meeting a near term goal.

Over 80% of impervious surfaces in Maryland are covered under stormwater National Pollutant Discharge Elimination System (NPDES) permits. The state has issued NPDES Municipal Separate Storm Sewer System (MS4) Permits for the regulated Phase I jurisdictions and Maryland Department of Transportation (MDOT) State Highway Administration (SHA). These permits require nutrient reductions associated with 20% impervious area restoration over the current five-year permit cycle and an additional 10% proposed for the next permit cycle. Phase I permittees that did not meet their restoration requirements have been required to pay penalties and operate under a legally enforceable consent order. The Phase II MS4 general

permits for small municipalities, and for state and federal facilities took effect in October 2018, and require 20% of permittees' impervious areas to be restored by 2025.

MDE has been working with both the regulated community and stakeholders on the next generation of Phase I MS4 permits to ensure a robust restoration pace in the stormwater sector while addressing local priorities and implementation challenges. MDE issued final permits for Anne Arundel, Baltimore, and Montgomery Counties, as well as Baltimore City, on November 5. At that time, MDE also issued its plan for advancing stormwater resiliency in MD to adapt to climate change impacts. Prince Georges county's permit is currency in draft and out for public review.

The department began issuing these permits in early 2020 and anticipates that, on average, the next generation Phase I permits will achieve 2% restoration each year for a total of 10% restoration over a 5-year permit cycle. Nutrient trading regulations have also been promulgated, which allow the purchase of lower-cost nutrient reduction credits by the stormwater sector to accelerate nutrient reductions to the Bay. In addition, recognizing the need for a consistent and efficient restoration project permit review process, the department worked with the U.S. Army Corps of Engineers to develop flexible permitting for restoration projects designed to provide ecosystem improvement.

4) On-Site Septic Systems

The septic sector contributes about 6% of Maryland's nitrogen load to the Bay. Similar to the urban stormwater sector, reductions from the septic sector are slower than those from wastewater and agriculture. Implementation in this sector faces many of the same challenges as the urban stormwater sector, with dispersed sources and significant costs for implementation. The 2019 UMCES cost study referenced above found that nitrogen reductions from septic practices cost between $130 and $330 per pound—lower than stormwater, but higher than agriculture or wastewater.

As with the urban stormwater sector, the state is looking for ways to increase the impact of this implementation by seeking practices that offer multiple co-benefits. In the case of septic systems, two of the most significant direct benefits, apart from nitrogen reductions, are public health and groundwater protection. Toward this end, the state agencies are pursuing "high-benefit" reductions in places with impacts to public health and drinking water quality. Additional strategies include accelerating the pace of septic connections to sewers in high-benefit areas to take advantage of the significant investments it has made in ENR treatment at Maryland's wastewater treatment plants. By maximizing the potential impact to public health and groundwater protection, these projects are also more likely to address needs of Maryland's disadvantaged communities where those concerns are more prevalent.

The state will continue to fund the upgrade of septic systems to BAT, targeted to failing and other systems in the Critical Area, and address about 1,000 systems per year. In 2018, the

legislature passed a bill establishing a new incentive for the proper operation and maintenance of septic systems. The bill authorizes financial assistance through the BRF to eligible homeowners in jurisdictions with a septic stewardship plan, to pump out septic tanks at least once every 5 years. As with the urban stormwater sector, it is anticipated that implementation of septic practices will need to continue well beyond 2025 in order to meet TMDL allocations and goals.

5) Clean Air Act Role

Atmospheric deposition is a major nitrogen source in the urban environment, and air pollution reduction strategies brought about by the federal Clean Air Act are a key driver of nitrogen reduction. Actions implemented from 2010 to 2020 through the Clean Air Act are expected to result in 6.5 million pounds of nitrogen reduction in the Bay. Credit for federal programs is applied across the watershed, rather than being given to any specific state, however through its Phase III WIP, Maryland has been investigating the potential for nitrogen reductions from state programs that it is implementing toward non-federal goals, such as climate change.

In addition, the state is pushing for tighter controls on nitrogen oxide emissions from upwind states (Pennsylvania), such as in its 2016 Clean Air Act Section 126 petition to EPA, and its 2019 petition to the Ozone Transportation Commission. While these would not result in WIP credit for Maryland, they could drive a significant air and water quality improvement for the Bay. Maryland is working closely with the CBP to ensure modeling tools account for these important reductions.

6) Conowingo Dam

When the TMDL was first published in 2010, it was estimated that Conowingo Dam would be trapping sediment and associated nutrients through 2025. New science has determined that this is not the case, and that the reservoir behind Conowingo Dam has reached capacity. As a result, more phosphorus, sediment and nitrogen are now entering the Chesapeake Bay than were estimated when the TMDL was written. **This additional pollutant load (estimated at 6 million pounds total nitrogen and 260,000 pounds total phosphorus) must be addressed if we are to meet the Bay's water quality standards.** Recognizing this reality, Maryland is leading a multi-pronged approach to address the Conowingo Dam's impacts. This includes:

1. Working with the CBP in developing a regional approach to address these impacts through a separate CWIP that pools resources from Bay jurisdictions to put pollution reduction practices in the most cost-effective locations. A Letter of agreement template has also been approved by the partnership to facilitate CWIP funding and CWIP milestones are also being developed and will be submitted to EPA in January 2022. This collaborative and alternative approach is exploring both financing and BMPs innovations to leverage different funding sources (state, federal, local, private, other) develop creditable nature-based and in-water practices to accelerate and expand restoration efforts; and

2. Conowingo Dam, a hydroelectric facility owned and operated by Exelon, underwent Federal Energy Regulatory Commission (FERC) relicensing, which required a federal Clean Water Act 401 Water Quality Certification from the State of Maryland to ensure that water quality standards will be maintained. Maryland negotiated a related $200-million settlement agreement requiring Exelon to reduce Conowingo nutrient pollution, and other ecosystem impacts such as fish passage and debris management. As of this writing, the first down payment of this settlement agreement has been received by the state. MDE is also in the process of wrapping up a stakeholder engagement process to receive public input on the type of nutrient reduction projects funded with settlement monies; and,
3. Maryland is also showing strong state leadership in addressing Conowingo impacts by implementing a sediment characterization and innovative reuse and beneficial use pilot project to provide better information on the quality of sediments behind the dam, dredging costs, dredged material reuse options, scaling, and feasibility as a solution for addressing Conowingo's impacts. The sediment characterization information is being used to categorize the dredged material according to Maryland's Innovative Reuse and Beneficial Use of Dredged Material Guidance Document to help determine environmentally safe and economically feasible reuse options. Maryland also performed a Conowingo dredging demonstration in October 2021, that included additional sediment characterization and reuse evaluation of dredge area sediments (Figure 12). This will be followed by an economic analysis to assess the market value of different Conowingo sediment reuses and modeling to simulate different dredging scenarios and their influence on Bay water quality. The overall pilot project should be complete in spring 2022, and the lessons learned will help expand our understanding of the pollution load reductions associated with dredging and the cost-effectiveness of dredging as a BMP.

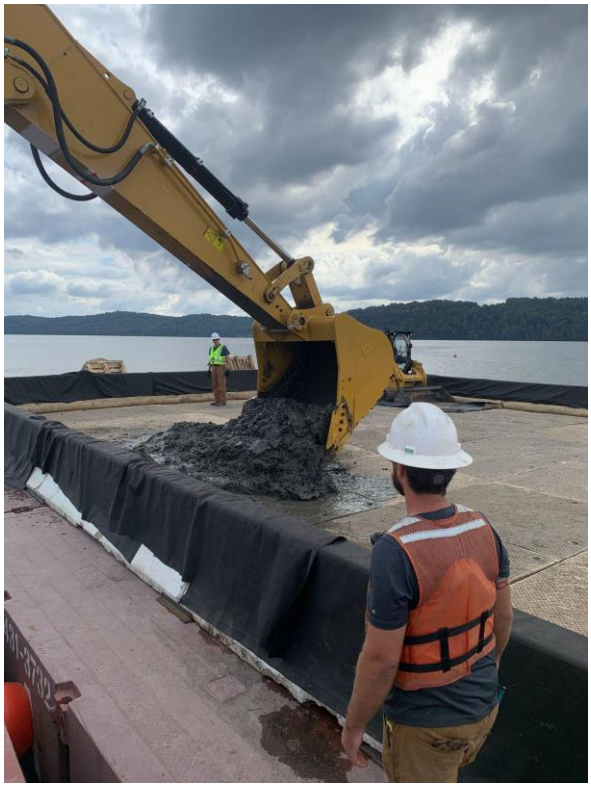

Figure 12: Dredging component of Maryland Innovative Reuse and Beneficial Reuse Pilot, October 9, 2021.

7) Climate Change

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).

The Chesapeake Bay TMDL and the Phase I, Phase II, and Phase III WIP planning targets were established based on 1995 climate conditions. In March 2018, the CBP Principal Staff Committee (PSC), who represent the Chesapeake Bay-state governors and the mayor of D.C., agreed that the Bay jurisdictions' Phase III WIPs would include a narrative strategy to address changes in climate between 1995 and 2025. As part of the same decision, the PSC agreed to refine the climate modeling and assessment framework based on improved understanding of the science of the impacts of climate change.

CBP further committed to adopting revised numerical climate change targets by 2021 using updated versions of the CBP's modeling tools. Changes were made to model inputs of rainfall, air temperature, wetland area, sea level rise, and ocean temperature and salinity. Watershed delivery of nitrogen, phosphorus, and sediment were modeled using improved processes to

capture the effects of climate changes on watershed loads. At its December 2020 meeting, the PSC approved the recommendation that jurisdictions will be expected to address additional nutrient loads due to 2025 climate change conditions in a Phase III WIP addendum and/or 2-year milestones beginning in 2022. EPA expects each jurisdiction to also submit a Bay model scenario that numerically demonstrates that the additional nutrient load reductions will address 2025 climate change conditions. According to the CBP, sediment targets for 2025 climate change conditions will be developed after the overall modeling scenario addressing 2025 climate change is finalized.

Maryland has already committed to additional nutrient load reductions beyond its Phase III WIP targets, equal to an additional 1.142 million pounds of nitrogen per year and 0.111 million pounds of phosphorus per year. The 2017 model used by CBP to evaluate Maryland's Phase III WIP indicated that the nitrogen load reduction achieved by implementing the WIP would provide a surplus of 1 million pounds of nitrogen and 0.44 million pounds of phosphorus beyond the EPA target. These additional reductions not only provided Maryland with a margin of safety, but more importantly, provided a surplus that could be applied toward achieving climate change allocations. Moreover, 2019 science updates to the Bay model indicate that Maryland's required Phase III WIP targets are only exceeded by about 0.394 million pounds of nitrogen and to 0.33 million pounds of phosphorus. Therefore, these Phase III WIP pollution reduction surpluses will not be sufficient to offset the additional climate change nutrient load reductions assigned to Maryland in 2020. Maryland is now facing a nitrogen load reduction deficit of about 750,000 pounds per year, but still has a surplus reduction of about 218,000 pounds of phosphorus. Maryland is currently drafting an addendum to its Phase III WIP detailing its climate allocation strategy, which will focus on a viable solution to address the gap caused by the combination of Bay model updates and Maryland's additional nitrogen reductions required to offset impacts from 2025 climate conditions. Maryland's primary strategy will rely on further improvements in the performance of the state's wastewater treatment plant operations.

8) Accounting for Growth in Loads

Maryland is expected to grow by approximately 14,100 households per year through 2045, resulting in increased nutrient pollution (Maryland Department of Planning, Projections and State Data Center, October 2021). Overall, Maryland projects that expected load reductions under the Phase III WIP will overcompensate for new loads from development and increased agricultural animal populations beyond 2045.

In developing the Phase III WIP to meet 2025 pollution reduction targets, the PSC agreed in December 2017 to use 2025 projected conditions to account for growth impacts on land use and populations. Consequently, Maryland's Phase III WIP strategies have already accounted for projected 2025 growth in calculating each sector's load reduction.

CBP allowed Bay jurisdictions to modify the future land use scenarios for projecting 2025 growth conditions to reflect existing and proposed conservation and protection efforts, such as

agricultural and forest conservation, and growth management (e.g., local zoning). Due to the fact that Maryland and local governments have many existing land use conservation, preservation and protection programs in place, the state included these programs in a Conservation Plus scenario and incorporated it into the Bay model. This process allowed Maryland to take credit for the nutrient load reductions from these programs. Moving forward, Maryland will work with CBP to develop periodic comparisons of projected increases in sector loads to actual increases in sector loads. When actual increases exceed projected increases, Maryland will assess whether and when additional BMP implementation is needed to compensate.

B. Maryland's Guiding Principles for Bay Restoration

The phased watershed planning and implementation approach for Chesapeake Bay Restoration is designed to be adaptive and allow jurisdictional flexibility based upon lessons learned throughout the implementation process. During development of the Phase III WIP, Maryland evaluated each pollution sector's progress in coordination with local governments and stakeholders responsible for on-the-ground implementation. We also reassessed Maryland's guiding principles for restoration to determine their continued applicability, effectiveness, as well as alignment with larger administration priorities and approaches for achieving and maintaining our 2025 restoration goals.

Prior to development of the Phase III WIP, Maryland's Chesapeake Bay Restoration framework was informed by the University of Maryland Environmental Finance Center (EFC) assessment of, a) Bay Restoration progress to date, b) necessary future progress to meet the 2025 goals, and c) available resources. The EFC's findings indicated "that the resources are in place to achieve interim and final restoration targets. In other words, no new state-based fees or taxes are required moving forward." The EFC's conclusion that Maryland had sufficient financial resources to achieve its interim and final pollution reduction targets were predicated on three caveats:

1. The state applies its expected excess wastewater treatment plant allocation (i.e., urban growth capacity) today to offset expected shortfalls in the stormwater and septic sectors, and then builds the capacity for growth back into the system;
2. Assume that the current level of regulation will be maintained within each of the four pollution sectors, and that enforcement will be consistent and effective; and,
3. Current state Chesapeake Bay grant programs are fully funded and applied in the most cost-effective manner possible.

While the conclusions, caveats, and recommended next steps of the EFC assessment were valuable and remain largely applicable today, they were based on an earlier version of the watershed model, different (Phase II) pollutant reduction targets, and an older suite of BMPs and associated efficiencies. Furthermore, the assessment did not take into account the impacts of climate change and Conowingo Dam, as they were not identified at that time. As a result, and building upon the solid foundation of the EFC report, Maryland developed an expanded set

of Bay Restoration guiding principles that will both get us to 2025, and maintain those pollution reductions into the future.

There will be no single action that will bring us success. Instead, we will need to rely on a diversity of practices, constant vigilance to and grounding in sound science, and the willingness and ability to constantly evaluate, innovate, and adapt approaches as our understanding of the environmental, financial, and social landscapes constantly change. In recognition of these realities, Maryland's Phase III WIP identifies seven guiding principles to meet our 2025 goals, and sustain a restored Chesapeake Bay into the future that is balanced, achievable, and locally-driven:

1. **Balancing regulations and incentives:** Maryland has many regulatory tools under the federal Clean Water Act and state law that set numeric pollutant discharge limits, restoration conditions, or other requirements on the regulated community. Maryland also has significant pollution sources within the non-regulated community that play an essential role in achieving and maintaining our Bay Restoration targets. Consistent with the EFC findings, Maryland will continue to use a balanced approach of both effective regulations and financial incentives to drive restoration progress across sectors by prioritizing areas that achieve the most pollution reductions for each dollar invested. This will continue to be backed by robust and effective compliance and enforcement.
2. **Using wastewater treatment plant capacity wisely while driving long term and sustained progress in slower paced sectors:** Accelerated pollution reductions from wastewater treatment plants and farms are the primary drivers of success in meeting our Bay Restoration targets. Consistent with the EFC report, Maryland continues to use its wastewater capacity to help attain our 2025 restoration goals. However, as Maryland's population grows, wastewater plant loads will increase from the growing use of public wastewater and must be offset by steady progress in reducing nutrient discharges from the stormwater and septic sectors.
3. **Creating a restoration economy and driving innovation:** In addition to traditional funding approaches, the Hogan administration is pursuing market-based strategies that are designed to stimulate a restoration economy and reduce costs. Examples of new approaches in place or currently under development include nutrient credit trading, the Clean Water Commerce Act, CWIP and Innovative and Beneficial Reuse Pilot, public-private partnerships, improved alignment of greenhouse gas reduction goals with Bay Restoration goals, and new water reuse technologies.
4. **Locally-driven restoration and co-benefits:** Chesapeake Bay Restoration will not be successful without sufficient capacity and close collaboration with local partners. Additionally, the state is working with those partners to develop a strategic implementation plan for addressing local restoration challenges.
5. **Accounting for and leveraging conservation and protection programs:** Protecting Maryland's ecologically significant lands, aquatic resources, and wildlife is among the most effective ways to sustain Bay Restoration. Maryland is ensuring its Bay Restoration effort fully accounts for land conservation programs, while funding land conservation programs for future acquisitions.

6. **Holistic ecosystem management:** While Maryland's Phase III WIP is designed to be consistent with EPA's expectations and achieve the TMDL nitrogen, phosphorus, and sediment targets, Maryland is also committed to the broader goals outlined in the 2014 Chesapeake Bay Watershed Agreement, which include sustainable fisheries, vital habitats, reducing toxic contaminants, healthy watersheds, land conservation, stewardship, public access, environmental literacy, and climate resiliency. Maryland's commitment to this broader ecosystem management framework helps the state achieve its TMDL restoration targets while maintaining the productivity of the Bay's living resources and supporting local economies.
7. **Accountability and adaptive management framework:** Consistent with CBP's Accountability and Adaptive Management Framework, Maryland develops short term milestones that identify practices, programs, policies, and resources to be implemented over two-year periods. EPA and Maryland evaluate our progress toward achieving these milestone commitments, and then take appropriate actions to improve progress during the next two-year period.

Another important component of Maryland's overall Chesapeake Bay Restoration strategy is to ensure other jurisdictions are doing their fair share and that EPA is holding all jurisdictions accountable to reducing their pollution loads. While Maryland and Virginia have reduced their annual nitrogen loads by a combined 59 million pounds since 1985, Pennsylvania has only reduced 12 million pounds, with 4 million of those coming since the establishment of the Bay TMDL in 2010. Under the Phase III WIP, Maryland and Virginia have 9 million pounds remaining to reduce, while Pennsylvania still has 37 million pounds to go. Furthermore, **Pennsylvania's Phase III WIP, its plan for 2025, leaves it 10 million pounds short of its CBP 2025 pollution reduction goal.** In light of Pennsylvania falling short of its commitment, and EPA's failure to ensure that jurisdictions achieve and maintain their goals, Maryland, Virginia, Washington D.C., Delaware, and others filed complaints in September 2020 to sue EPA. While Maryland's focus on the Chesapeake Bay is rightly directed toward the development, management and funding of its own environmental programs, the importance of a serious, sustained effort on the part of our CBP partners cannot be overestimated. **Maryland and its partners' legal actions to hold EPA and all jurisdictions accountable are critical steps on this path.** MDE continues to work with the other plaintiffs to ensure EPA uses all of their regulatory tools and backstop measures to address shortfalls in the Pennsylvania and New York Chesapeake Bay TMDL WIPs as well as progress toward their respective WIPs.

Achieving Maryland's nutrient and sediment reduction goals by 2025, and then remaining below those levels in perpetuity post-2025, was going to be undoubtedly challenging even before COVID-19. Now, with COVID-19 impacts, the restoration effort will face greater challenges. Continued flexibility and adaptive management in the face of these challenges will be the key to our success, particularly the adaptive and innovative financing approaches discussed in the following section. Infrastructure investments from federal and other sources could be critical factors to manage challenges, with particular opportunity for consideration of green stormwater infrastructure and suitable tree planting and wetland creation opportunities early in the project design phase.

Part III - Maximizing Existing Resources: Cost-Effectiveness of State Funded Programs

The following section briefly describes how the respective lead state agencies are implementing each of the three primary Bay Restoration funding sources (BRF, WQRLF, and the Trust Fund) as well as a variety of other efforts underway to maximize the cost-effectiveness of our Bay Restoration efforts.

A couple of important principles relative to this section:

- Multiple Water Quality Objectives: Multiple objectives, or co-benefits, are being considered in Maryland's WIP. Beyond low-cost nutrient and sediment reductions to the Bay, other water quality impairments are also a key consideration in funding projects. For example, streams are commonly impaired by flow-related stressors, such as temperature and sediment. These flow-related stressors are effectively managed through stormwater control measures and practices that bridge rural and urban sectors, such as riparian forest buffers and soil health. Bacteria impairments found in Maryland's streams and tidal tributaries may be addressed through implementation in the septic sector. In looking at the cost effectiveness of a practice, Maryland is working on improving measures to quantify the significant non-nutrient impacts of practices.
- Other Bay Agreement Outcomes: Beyond nutrient and sediment reductions, states are being asked to address other objectives of the 2014 Chesapeake Bay Watershed Agreement in their WIPs. A notable example is the need to install more resilient infrastructure and restoration practices in expectation of extreme weather to facilitate climate change adaptation. This can be more costly than the standard nutrient reduction alternatives that do not consider additional resilience. Similar issues of additional costs may be associated with striving to meet other Chesapeake Bay Agreement goals, rather than solely nutrient and sediment targets.
  One particular Bay Agreement Outcome that has received significant, renewed attention and focus is the Diversity Outcome, which seeks to increase engagement and participation by communities currently underrepresented in the Bay Restoration effort. In 2021, DNR established a partnership with the Chesapeake Bay Trust (CBT) with funding provided by EPA to launch the Capacity Building Organization-Capacity Building Initiative (CBO-CBI). This program will identify historically under-engaged community-based organizations that have not previously participated in two grant programs - the Watershed Assistance Grant Program and the Resiliency Through Restoration Initiative. Interested organizations will receive the technical assistance needed to develop robust proposals to these grant programs. This initiative will enhance the state's capacity to achieve Bay Restoration goals and regulatory requirements by making the collective body of organizations pursuing restoration projects more inclusive. **In April 2020, CBP formally accepted a "Diversity, Equity, Inclusion, and Justice" strategy to further progress toward that Outcome and, under Governor Hogan's leadership, the Executive Council signed a statement at their August 18, 2020 meeting reaffirming their**

commitment to increasing participation by underrepresented communities and charging the leadership with moving forward on implementation of the strategy. A draft implementation plan was released in fall 2021, providing a roadmap for achieving the recommendations outlined in the strategy. Maryland's Bay Cabinet agencies are currently exploring new opportunities to better engage these important stakeholders. One example is MDE's recent partnership with Moonshot Missions to build a Maryland Utility Peer-to-Peer network, which will provide supplemental technical assistance to water utilities in underserved communities with the goal to increase water sustainability, equity and affordability.

When considering the cost-effectiveness of Bay Restoration, it is also important to consider the return on investment (ROI) that a clean Bay provides, be it for boating, fishing, recreation, tourism, and increased opportunities for currently underserved communities within our watershed.

A 1989 report by the Maryland Department of Economic and Employment Development (now Labor) estimated the value of the Bay in excess of $33 billion annually and at a total value of $678 billion. The 2004 Chesapeake Bay Blue Ribbon Finance Panel estimated that in today's dollars, that value would now be in excess of $1 trillion. This 2004 report also cited estimates of $2 billion annually just for recreational boating activity in Maryland. As far as the costs of Bay Restoration, a Congressional Research Service Report estimated total costs of restoration from $7 billion for each state to $28 billion for the entire watershed. These estimates did not include ongoing maintenance costs for sustaining restoration.

A. Chesapeake Bay Restoration Fund

The BRF provides grants for projects that reduce nutrient and sediment loads to the Bay. The BRF is composed of two separate funds, the Septic Fund, and the Wastewater Fund. The Septic Fund pays for septic upgrades to BAT, and prioritizes these based on proximity to the Bay, which results in the most cost-effective reductions per pound of nitrogen. A 2019 Cost Effectiveness study by UMCES estimated the cost efficiency of BAT upgrades to be around $300 per pound. The septic ranking scheme also prioritizes failing systems, which provides the important co-benefit of protecting public health. The Septic Fund also pays for cover crops, another cost-effective practice, through MDA's Cover Crop Program.

Ten percent of the Wastewater Fund may be used to pay wastewater treatment plants that optimize their ENR operation after the upgrade and demonstrate high performance levels (those discharging nitrogen concentrations below 3 mg/L, and phosphorus concentrations below 0.3 mg/L). This program is highly cost-effective, generating reductions at an estimated $10 per pound of nitrogen. In 2021, the BRF regulations were amended and the BRF O&M grant can now be distributed in a way that pays for nutrient load reductions below the current grant threshold of 3 mg/l of nitrogen and 0.3 mg/l of phosphorus, in other words, providing additional grants to facilities achieving better than ENR.

The Wastewater Fund also pays for upgrades to minor wastewater treatment plants, sewer improvements to reduce overflows, and improve climate resiliency of the sewer system, septic connections, and stormwater projects. Projects are prioritized using the EPA-approved Integrated Project Priority System (IPPS), which evaluates which projects provide the most cost-effective nutrient reductions in dollars per pound. MDE has also worked with other state agencies to expand the IPPS to also factor in non-nutrient co-benefits such as public health benefit, sustainability and climate resiliency.

Maryland's Phase III WIP recognizes that as opportunities for low-cost nutrient reductions are used up, per pound costs will increase. As costs rise it will become increasingly important to ensure that the cost-benefit ratio is optimized—not just through lower costs, but by maximizing the benefits. This can be thought of as stacking co-benefits. Maryland's Bay Cabinet agencies will continue their work with our CBP partners to define and quantify non-nutrient co-benefits, and this work will be used to inform state project prioritization metrics, including subsequent iterations of the IPPS.

B. Water Quality Revolving Loan Fund

The WQRLF provides below market interest rate loans, and loan principal forgiveness (where applicable) to local governments and other eligible entities to finance water quality improvement projects. Since its inception in 1987 through June 2021, the WQRLF has provided approximately $3.28 billion in financing for water quality projects. The goal of the program is to achieve these improvements by reducing the amount of nutrients being discharged into the Chesapeake Bay. Projects eligible for funding include wastewater treatment plant improvements and upgrades, eliminating failing septic systems, combined sewer overflows and sanitary sewer overflows, nonpoint source projects such as urban stormwater control, and sewer system rehabilitation.

Projects submitted for consideration are rated and ranked using the IPPS, which prioritizes cost effective projects, along with co-benefits such as public health benefit, sustainability, and climate resiliency.

C. Chesapeake and Atlantic Coastal Bays Trust Fund

The Trust Fund allows Maryland to accelerate Bay Restoration by focusing financial resources on the most efficient, cost-effective nonpoint source pollution control projects in targeted areas of the state. The ability to award the maximum amount of Trust Fund resources to local partners through competitive measures is mandated in the Trust Fund's enabling statute and is critical to the fund's success at delivering quantifiable benefit to water quality. State agencies work with our local partners to administer the money in ways that leverage the funds to the greatest extent possible, target the funds geographically, engage the community at large, and hold everyone accountable.

Step 1: Incorporating science into decision making. The Trust Fund's explicit goal is to ensure the greatest environmental ROI. To that end, the Trust Fund is advised by a Scientific Advisory Panel, which reviews and advises on priorities and geographic targeting based on the latest scientific advancements. A Trust Fund targeting map was developed using the USGS SPARROW v4 model to apply the most current water quality data. The panel guidance and updates to the targeting map allow the Trust Fund to prioritize investments in specific watersheds and watershed areas, using projects and practices that provide the most cost-effective water quality benefits to the Chesapeake and Coastal Bays via reductions in nonpoint source nutrient and sediment loadings. Additionally, the state has created an online tool, FieldDoc.org, in collaboration with the National Fish and Wildlife Foundation and Chesapeake Commons, to ensure accurate and efficient returns on investment. During project proposals, applicants use FieldDoc to estimate nitrogen, phosphorus and sediment reductions. The land use loading rates and BMP effectiveness estimates within FieldDoc are consistent with CBP protocols and are required to calculate reductions for all proposal submissions.

Step 2: Prioritizing cost-effective projects through the project solicitation process. The Trust Fund has quickly become one of the most innovative and important water quality financing programs in the region. Its singular focus on reducing nonpoint sources of nutrient and sediment pollution makes it one of the only programs of its kind. The first step toward incentivizing cost efficiency was to prioritize efficiency through the competitive solicitation process. Competitive award processes allow state agencies to target funds for performance-based outcomes that have true, quantifiable benefit to the Chesapeake and Coastal Bays. Given that the restoration goal is to reduce pollutant loadings, the efficiency is measured in Trust Fund dollars per pound of pollutant reduced. This cost per pound metric guides decision making and has been made more reliable using FieldDoc. To aid in the annual competitive process, the state created the Chesapeake and Coastal Grants Gateway, which provides a one-stop location for partners seeking technical and financial support for projects that foster healthy ecosystems, communities, and economies that are resilient in the face of change. The Trust Fund dollars are awarded through the gateway along with other state and federal funding to allow for comprehensive project support and leveraging across financial programs leading to more cost-efficiency and project efficacy.

Step 3: Incorporating monitoring data into future decision making. The most logical outcome of adaptive decision-making is a system where data is used to inform future funding decisions by Trust Fund managers. The entire system requires data reporting requirements that are clearly established as part of the project monitoring protocols; in addition, a clear system for incorporating those data into future decision making must be established. To do this, the Trust Fund managers leverage the expertise of DNR to establish clear project monitoring protocols to ensure consistency among projects. Additionally, in SFY15, the Trust Fund partnered with CBT to create a pooled monitoring initiative and issue the Restoration Research Grant. The goal of this research program is

to answer several key restoration questions that are a barrier to watershed restoration project implementation. Answering these questions will ultimately lead to increased confidence in proposed restoration project outcomes, clarification of the optimal site conditions in which to apply particular restoration techniques, information useful to regulatory agencies in project permitting, and information that will help guide monitoring programs.

Step 4: Incentivizing cost-effectiveness at the project level. The Trust Fund has been working to predicate financing on performance rather than implementation rates. Perhaps the greatest benefit associated with the adaptive decision-making system of the Trust Fund is that it enables the state to shift its financing away from practice-based metrics of success to actual performance-based metrics. With a more accurate understanding of how well projects and practices mitigate nutrient emissions, it becomes more efficient to focus financing on that performance. This contrasts with how typical restoration investments are made where increasing units of practices installed is the primary financing goal. It is the hope that by increasing performance at any given price point, a project implementer has an opportunity to increase their return on investment. This incentive is much less impactful in the practice-based system because the reductions in cost could be at the expense of pounds removed from the system.

The Governor is authorized by the Trust Fund enabling legislation to dedicate approximately $50 million annually to the Trust Fund from Maryland's motor fuel and rental car tax revenues. In its early years, only a portion of this $50 million maximum was provided to the Trust Fund, but **Governor Hogan's administration made restoring Bay Restoration funding a priority, fully funding the Trust Fund in every year of his administration.** In addition, Governor Hogan ensured that the increase in funds were not only targeted for on-the-ground projects, but were made available to local partners through a competitive solicitation. Dedicating funds through the competitive processes in the Trust Fund meets legislative mandates while ensuring cost-effective solutions and measurable impact.

D. Increasing the Co-Benefits of Agricultural Implementation

In addition to reducing nutrient and sediment flows into the Chesapeake Bay and its tributaries, many of the agronomic and conservation practices used by Maryland's farmers, growers and producers have the potential to make a significant contribution to the state's climate change goals by sequestering carbon and reducing other greenhouse gas emissions.

The 2017 Healthy Soils Act charged MDA with the development of a healthy soils program to improve the health, yield, and profitability of Maryland's soils and promote the further adoption of conservation practices that foster soil health while increasing sequestration capacity. Since late 2019, the MDA Soil Health Advisory Committee has been meeting quarterly to consider the conservation practices and incentives that will be recommended for the Maryland Healthy Soils Program. The program's objective is to encourage the widespread

implementation of healthy soils practices. Concurrently, MDA, in collaboration with faculty from the University of Maryland and MDE, are evaluating tools to quantify those practices that are most effective in improving soil health by building soil carbon stocks. An initial menu of Maryland-specific practices were included in the 2030 Greenhouse Gas Reduction Act Plan update from MDE. As the Soil Health Advisory Committee finalizes its recommendations, MDA and MDE will refine the projected adoption (acres to be implemented) of soil health practices to capitalize on co-benefits for both water quality and carbon sequestration.

E. Increasing the Co-Benefits of Stormwater Implementation

Maryland's Phase III WIP Stormwater Sector Report states that "care should be taken to select specific restoration practices that provide both a nutrient reduction benefit for the Bay as well as address other important local stressors." These "important local stressors" can impact both aquatic life as well as human health and safety and include, but are not limited to, fecal bacteria, temperature, metals and other toxic pollutants, trash, increases in total stream flow and peak flow, and both riparian and interior watershed flooding. Further, Maryland's WIP states "A different way to maximize the impact of money spent on stormwater management is to expand the benefit across multiple water quality objectives." While current stormwater permit credits are based on nutrient and sediment load reductions for variable practices, Maryland is working with researchers from UMCES to develop crediting systems and protocols for these other water quality objectives that are systemic to urban watersheds. These systems and protocols that are in development could be applied in future stormwater permits. The first phase of this work utilizes the Capacity, Opportunity, Payoff, and Equity (COPE) strategy to assess the benefits of any particular water quality objective. COPE assesses the combined effectiveness of any given project at reducing the pollutant of concern, the number of people the project will benefit, the opportunity for providing a benefit based on project location, and the social vulnerability of the population the project will benefit. Phase I of this work is expected to be complete early in 2022.

F. Leveraging Private and Public Investments through the Innovative Technology Fund

Providing efficiency and cost effectiveness within the restoration effort requires innovative partnerships and financing structures. Through the Innovative Technology Fund (funded through the Trust Fund), the state is taking a lead role in financing the advancement of knowledge in the areas that most impact restoration programs, practices and policies. The goal of the Innovative Technology Fund is to support Maryland businesses that are developing new, cost-effective approaches to reducing nonpoint source pollution to the Bay. To achieve this goal, the Innovative Technology Fund works with both the Maryland Industrial Partnership to provide grants that develop and validate emerging restoration technologies, and with the Maryland Technology Enterprise to invest seed funding for direct commercialization efforts. Both programs co-invest with other funds to leverage additional resources for the startup and increase the cost-effectiveness of the state's investment. Co-investments with other

professional investors include the University System of Maryland Momentum Fund, Intelis Capital, the Exelon Climate Change Investment Initiative, the KCRise Fund, and GreenGen Ventures. To date the Innovative Technology Fund has invested $7.9 million with $9.7 million in private matches, supporting 50 new technologies and 40 Maryland businesses.

G. Trading Oyster Aquaculture Credits

An adult oyster feeds by filtering the Bay's water. In doing so, it helps to improve water quality by assimilating nutrients into its tissue and shell, removing sediment particles from the water column, increasing the availability of bioavailable nitrogen to bacteria and depositing particles that may become buried on the bottom.

Now recognized as a water quality improvement practice, MDE and DNR are implementing an oyster harvest verification process to allow participation in the Water Quality Trading (WQT) Program. This approach incentivizes the oyster aquaculture industry while providing a water quality improvement co-benefit. Many oyster aquaculture growers have participated in Maryland's WQT program, with several selling credits to buyers in the state. MDE is investigating new ways to promote the sale of these credits through new market platforms that will encourage participation from non-regulated entities through a more easily accessible marketplace. This effort is still under review by the state procurement office and efforts will be updated in 2022.

Additionally, Maryland continues to work with CBP to potentially include aspects of the public oyster fishery (i.e., the commercial harvest of wild oysters) and oyster reef restoration as verified water quality improvement practices. While no such practices have been approved to date, we are optimistic that the commercial harvest of wild oyster populations that have been enhanced with hatchery-produced spat and certain aspects of oyster reef restoration will move forward for potential approval in 2022.

H. Water Quality and Climate Change

Many of the implementation strategies that result in water quality improvements also provide climate change adaptation and mitigation co-benefits. This also applies to Maryland's Ocean Acidification Action Plan, adopted in 2021. These co-benefits include mitigating greenhouse gasses through the use of renewable energy or energy efficiency, and adapting to climate change by improving soil health, and utilizing natural filter BMPs such as wetland creation and tree planting. To capitalize on these water quality and climate co-benefits, state agencies have prioritized these implementation strategies leveraging the benefits with one project budget. This has been done with Maryland's Resiliency through Restoration Initiative; Water Quality and Climate Change Portfolio; and by synchronizing the beneficial use of dredged material in restoration projects that reduce flooding, stabilize shorelines and mitigate storm impacts.

I. MDOT-DNR MOU

In 2021, DNR and MDOT have executed a Memorandum of Understanding (MOU) that applies to all MDOT transportation business units and supports common objectives, including, but not limited to, Chesapeake Bay watershed restoration; climate resiliency, adaptation and mitigation efforts; and environmental compliance, stewardship and sustainability activities. The new MOU is intended to maximize the public benefit and efficient use of funding to support these common objectives.

J. Coast Smart Construction Criteria

The Coast Smart Construction Program (CSCP) Siting and Design Criteria are a set of guidelines aimed to enhance infrastructure resilience in coastal communities. CSCP applies to the construction or reconstruction of state or local capital projects and construction of highway facilities for projects that cost at least $500,000 and receive 50% or more state funding. To enhance resiliency of coastal infrastructure, the State of Maryland developed the Coast Smart Climate Ready Action Boundary (CS-CRAB) as the new boundary for CSCP applicability. The resiliency and protective measures put in place by the CSCP Siting and Design Criteria will ensure continuity of operations of critical and non-critical infrastructure in the face of rising sea levels and coastal flooding, which may serve as a protective factor for human health and public safety in these areas. When implemented, the guidelines protect and maintain ecological features that not only buffer projects from the impacts of future sea level rise, coastal flooding, or storm surge, but also provide water quality and habitat benefits.

K. Stormwater Public-Private Partnership

A unique public-private partnership involving the MDOT, MDE, Maryland Environmental Service (MES), the EPA Region III, Walmart and TNC/Opti Development Partners LLC (TNC/Opti), has been established to leverage cloud-based technology to optimize storage volume and infiltration within existing SWM ponds to reduce pollutant loads.

These high performance “smart” ponds are created by installing structural control components called Continuous Monitoring and Adaptive Control (CMAC) to achieve enhanced operation over a conventional SWM pond. **This demonstration project serves as a national model for innovative SWM program delivery and is the first of its kind implemented nationwide with a Department of Transportation.** Under the contract MDOT purchased 80.47 acres of impervious area treatment at a cost of $37,500 per acre, which includes the cost of monitoring, inspecting, operating and maintaining the smart ponds for 20 years. Between July 2020 and March 2021, CMAC control components were installed at three SWM ponds in Fruitland (16.10 ac), Hagerstown (47.82 ac) and Aberdeen (16.55 ac). Certification of the ponds was completed in summer 2021, and MDOT is currently working with MDE to designate the use of TMDL credits for specific MDOT business units to meet their individual MS4 permit requirements.

Going forward, MDOT and MES will work together to develop a White Paper outlining the lessons learned from this project. This paper will analyze benefits from this type of partnership as well as identify areas of improvement and suggestions to improve the process. It is anticipated this paper will be finalized by winter 2021.

L. MDOT Full Delivery Restoration

In 2017, the SHA issued a Request for Proposals (RFP) using a Fully Delivery contracting mechanism. The Full Delivery contract model integrates property acquisitions, design, permitting, construction and restoration (success) monitoring. This Full Delivery Stream Restoration RFP was also unique in its multiple contracts awarded from the single RFP. Nineteen contracts were executed totaling over 150,000 linear feet of restoration. Through October 2020, a total of 16 stream restoration projects were constructed with a total combined length of 132,818 linear feet at a cost of $62,396,684. This was a nearly 69% reduction in per acre treatment costs as compared to MDOT estimates in 2017 when average construction costs were $150,000 per impervious acre treated. The actual cost savings is much higher considering MDOT did not include planning, design and monitoring in their initial 2017 estimate.

Part IV - Planning for the Future: Implementing a Sustainable Chesapeake Bay Restoration Financing Strategy

Over the past 30 years, significant resources have been committed to studying threats to the Bay and its watersheds, identifying restoration opportunities, assigning and implementing restoration responsibilities. **From SFY00-21, more than $13 billion (Table 1) has been invested in Bay Restoration.**

Overcoming these barriers will require local, state, and federal leaders to look beyond traditional funding programs and tools to develop effective, sustainable, market-based financing strategies. Over the last several years, Maryland has also been engaging private sector conservation, restoration, and financing experts to review Maryland's Bay financing framework, develop and implement recommendations and approaches for creating efficiencies and scale, while harnessing market forces and private capital to sustain and grow Maryland's restoration economy into the future. These discussions are preliminary and, in many cases, will require close collaboration with partners. Some of these preliminary recommendations may include:

- Modifying Maryland's procurement codes to include environmental outcomes as a commodity, which state-funded programs (such as the BRF and the Trust Fund) can purchase.
- Modifying the state's Water Quality and Drinking Water revolving funds to better include green infrastructure projects.
- Expanding the Trust Fund criteria to include consideration of other environmental and social co-benefits beyond strictly nutrient and sediment reductions.
- Explore amending forest statutes to prioritize mitigation banks over in-lieu fee programs when off-site mitigation for loss is unavoidable.
- Adjusting current state policies to ensure that conditions of water quality agreements and easements with private landowners do not preclude those landowners from also participating in carbon sequestration markets.
- Better leveraging public dollars invested in Chesapeake Bay Restoration by bringing more private capital into the restoration effort. Some ideas for consideration include:
    - Pay-for-performance approaches where private entities assume some of the upfront risk in implementing restoration practices with public funds reimbursement over a longer term based upon pounds of pollution reduced;
    - Tapping into private markets that haven't been explored, such as philanthropic capital, and considering how to bring carbon accounting into the Bay Restoration effort so that restoration practices are primed to access carbon markets.

The Bay Cabinet recognizes that the state must continually keep the door open to and explore new, innovative approaches to Bay Restoration if we are to be successful. Innovation and flexibility within existing programs can also be mechanisms to promote cost-effective water

quality restoration solutions. The following are some innovative ideas under consideration within or in addition to existing programs. The following sections discuss strategies, challenges and opportunities within key Chesapeake Bay Restoration fund sources:

A. Bay Restoration Fund

This fund continues to be a pollution reduction driver. Between SFY05 and SFY21, the fund awarded $1.628 billion in grants for enhanced nutrient reduction at the state's major and minor wastewater treatment plants, sewer overflow abatement projects, SWM control measures, and septic connections to Biological Nutrient Removal or ENR wastewater treatment plants. With the major wastewater treatments plants fully funded, the fund will continue its emphasis on cost efficient nitrogen reductions to achieve Bay Restoration goals.

Increase emphasis on cost efficiency through the Revised IPPS. The system consists of four rating categories, which include Water Quality or Public Health Benefits, Compliance, Cost Efficiency, and Sustainability. Total scoring points were increased in cost efficiency to ensure that grant funded projects are providing the highest environmental benefits for the least dollars spent. The most points are still awarded to either the project's nitrogen reduction benefit or public health benefit. The revised scoring system is resulting in higher scores for projects that have a high nitrogen reduction or significant public health benefits and are also cost-effective at reducing nitrogen. The revised project rating system was used to select projects for the SFY23 budget cycle. The revised IPPS has led to more holistic scoring for each project application, as well as a stronger list and more diverse mix of projects selected.

Pay directly for nutrient reductions through the Clean Water Commerce Act. **During the 2017 session, the Clean Water Commerce Act was signed into law by Governor Hogan, which allows up to $30 million ($4, $6, $10, and $10 million in SFY18-21, respectively) of BRFs to purchase cost-effective nitrogen, phosphorus, and sediment load reductions.** This is expected to leverage market forces and provide the state with another mechanism to more cost effectively meet Bay Restoration goals. In SFY21, the department selected proposals from two wastewater treatment plants and one nonpoint source project to purchase annual reductions totaling to 26,116 pounds of nitrogen, 759 pounds of phosphorus and 900 tons of sediment. These reductions are to be achieved above the ENR goals. The Clean Water Commerce was reauthorized during the 2021 legislative session. The new iteration of the program has more robust funding ($20 million a year through SFY30) and an enhanced scope, including additional project eligibilities such as agricultural BMPs, and focus on additional benefits, including equity for overburdened communities, climate mitigation and resiliency, and improving local water quality in addition to Chesapeake Bay water quality.

Pay-for-performance at wastewater treatment plants. Ten percent of the Wastewater Fund may be used toward O&M grants, which pay wastewater treatment plants that optimize their ENR operation after an upgrade, and demonstrate high performance levels (discharging nitrogen concentrations below 3 mg/L and phosphorus concentrations below 0.3 mg/L). In

2021, the BRF regulations were amended and the BRF O&M grant can now be distributed in a way that pays for nutrient load reductions below the current grant threshold of 3 mg/l of nitrogen and 0.3 mg/l of phosphorus, in other words, providing additional grants to facilities achieving better than ENR. This provides an additional incentive for ENR wastewater treatment plants to further optimize their performance. MDE anticipates utilizing the full 10% of BRF wastewater funding (up to $11M) for this program going forward.

B. Chesapeake and Atlantic Coastal Bays Trust Fund

The Trust Fund was fully funded again in SFY22, with an allocation of $48.77 million. **Between 2009 and 2021, the fund has invested more than $553 million in efforts to improve the health of the Chesapeake Bay by advancing the implementation of local and state WIPs.** In SFY21, the fund targeted $47 million, and leveraged an additional $14 million awarded through a competitive process to accelerate state and local efforts to improve the health of the Chesapeake Bay.

As a transformative step forward, the Trust Fund's annual solicitation for projects began directly linking investments to water quality performance rather than implementation rates. By establishing pounds reduced per dollar spent as the primary criterion for selecting projects, the Trust Fund built an inherent incentive into the financing system to improve efficiency. The Trust Fund is the most impactful when it uses this cost-effective, performance-based framework through competitive processes to the greatest extent practicable to engage in implementation of nutrient and sediment reduction projects as dictated in the guiding legislation.

To continue to build on the Trust Fund's innovative structure to expand its reach and influence, it is essential that the Trust Fund be catalytic in nature, facilitating the flow of public and private capital and improving the effectiveness of other restoration policies and programs across the state, while ensuring the most water quality benefit for every dollar invested. In this effort, DNR introduced the Grants Gateway, a single point of entry for organizations seeking technical and financial assistance to restore local waterways, increase their resilience to climate impacts, strengthen local economies and develop the next generation of environmental stewards. Created to streamline the grant application process for government and non-governmental organizations as well as academic institutions, grants are made possible with funding through the Trust Fund, the Coastal Resiliency Program, the Waterway Improvement Fund, the National Oceanic and Atmospheric Administration and CBP. This streamlined application process allows Trust Fund managers to work closely with other state and federal sources to leverage funds and support comprehensive projects that achieve a myriad of co-benefits.

The Trust Fund managers are working to establish technical and financial support to assist with the ongoing maintenance and adaptive management needs of funded watershed projects. Many projects require periodic maintenance that some community partners are not well-equipped to perform or finance. Additionally, nature-based BMPs can require a period of adaptive management to best ensure how these dynamic systems respond to restoration and

increased storm events. In order to address these needs, the Trust Fund has begun to explore opportunities to provide technical and financial assistance aligned with post-construction sustainability.

There are several market-based financing pilots initiated through the Trust Fund in recent years that continue to advance, and are assessed for future consideration and fund growth. These include building cost-efficiency through project aggregation and pursuing pay-for-success models with private investment. Additionally, through financing for startups with Chesapeake Bay improving technologies, **the Trust Fund has helped support the development of 50 new technologies that improve water quality in the Chesapeake Bay, and is now also investing in climate technologies that mitigate nutrients loads attributed to climate change.** Recent co-investments with other professional investors has leveraged additional resources for the startup and increase the cost-effectiveness of the state's investment

C. Water Quality Trading

Following the adoption of trading regulations in 2018, Maryland implemented its WQT program, which creates a public market for nitrogen, phosphorus and sediment reduction credits to enhance the restoration and protection of the Chesapeake Bay and local waters by reducing the cost and accelerating the pace of nutrient and sediment reduction efforts. Credits can be purchased to meet pollution control requirements for permits at facilities where pollution control measures are infeasible or too expensive. Credit trading provides a means to ensure pollution controls are implemented in the most cost-effective manner possible. The first credits were certified under the program in February 2019, and the first trade was approved in March 2019. The first trade for credits from oyster aquaculture occurred in May 2020. In 2020, MDOT Maryland Port Administration (MPA) became the first state agency to generate and trade credits under this program. Trades have been used to meet industrial stormwater and municipal stormwater restoration requirements. **As of October 2020, 278,651 pounds of nitrogen reduction credit, 42,077 pounds of phosphorus reduction credit, and 10,499,219 pounds of sediment reduction credit had been certified through the program for CY19.** Maryland is continuing to work to promote additional supply and demand in the market through voluntary credit acquisition efforts.

D. Phase I MS4 Financial Assurance Plan requirements/review and implementation plans

In May 2015, revisions to Maryland's SWM law, signed by Governor Hogan, repealed the statewide mandate for stormwater fees, but preserved the authority of counties and towns to mandate such fees if they chose to do so. These revisions resulted in new fiscal reporting requirements for Maryland's Phase I MS4 jurisdictions, which include Baltimore City and Anne Arundel, Baltimore, Carroll, Charles, Frederick, Harford, Howard, Montgomery, and Prince George's counties. One of the new reporting requirements, financial assurance plans, are required to demonstrate how impervious surface restoration plans (ISRP) are going to be paid

for during the permit term. Each jurisdiction submitted comprehensive information on local SWM projects, costs, and budgets for meeting ISRP requirements, including:

- Annual Programs: street sweeping, inlet cleaning, storm drain vacuuming
- Structural Practices: wet ponds, swales, infiltration, dry wells, rain gardens, green roofs, permeable pavement, rainwater harvesting, submerged gravel wetlands
- Alternative Practices: tree planting, outfall stabilization, stream restoration

The 10 Phase I MS4 jurisdictions certified that they have sufficient revenue to fund 100% of the projected SFY19 and SFY20 costs to comply with ISRP requirements, meeting the stormwater law's criteria. The 10 Phase I MS4 jurisdictions have projected spending $450.1 million over the next two fiscal years.

E. The Maryland Agricultural Water Quality Cost Share Program

Since 1985, the MACS program has been the state's premier program to assist tenant farmers and farm owners with the implementation costs of BMPs to control water quality problems on their property. Helping farmers comply with regulatory requirements and meet Maryland's Chesapeake Bay Restoration goals remains at the heart of the program. Costs for installing BMPs vary depending on the area being protected, the scope of the problem, and local construction costs. BMP cost-share is up to 100% of eligible project costs. MDA continues to evaluate the program to ensure full alignment with WIP goals.

Between 1988 and 2021, MACS has provided cost-share on nearly 26,000 conservation practices to address water quality concerns on agricultural land in Maryland. During SFY21, this included 391 installed practices for a state investment of $3.8 million, not including cover crops. Also in 2021, the department continued to evaluate and refine program criteria and eligibility requirements. In addition, the department expanded the suite of conservation practices to better support rotational grazing systems and utilization of poultry litter to improve soil health. Concurrently, the department is partnering with conservation partners to advance project implementation and increase staff technical capacity to design and oversee project installations.

F. Transportation-Infrastructure Restoration Partnership

MPA worked collaboratively with MDE to refine the application process and register the first credits for stormwater projects under Maryland's new WQT program. Using data from water pollution control measures it constructed and operated in advance of Clean Water Act requirements, MPA worked with MDE to develop and refine the application process and registered the first innovative stormwater pollution control credits approved by MDE under the new program. MPA's environmental leadership team applied its pollution control expertise to help MDE demonstrate the benefits of nutrient trading and develop another important tool for water quality restoration.

G. Conowingo WIP Financing

The CWIP is sometimes referred to as an eighth WIP, separate from jurisdictional WIPs and where all the CBP partners are working collaboratively to fund and implement restoration practices in the most cost-effective way. Similar to jurisdictional WIPs, the CWIP is being developed using a phased approach, with the first phase focused on identifying the geography and type of restoration practices and the second phase focused on financing. The CWIP financing strategy is complete. Maryland is currently working with the participating jurisdictions to conduct a financing pilot that pools financing from different sources, leverages the institutional capacity of the Susquehanna River Basin Commission, and formalizes pay-for-performance where the private sector assumes some of the risk for implementing pollution reduction practices at scale that can provide efficiencies that reduce implementation costs. The Conowingo innovative financing approach provides a mechanism to scale up and accelerate Bay Restoration beyond traditional financing approaches. It also has the potential to spur innovation in pollution reduction practices that can further accelerate restoration progress.

These CWIP financing innovations are an important component of Maryland's overall approach for modernizing and diversifying Chesapeake Bay Restoration funding in light of COVID-19, and other challenges.

H. Paying for Performance and enlarging pool of bidders

Long-term costs are minimized by funding practices that are known to be the most efficient and by enabling innovation that reduces costs over the long term. Increasing the flexibility to propose alternative practices through competitive bidding is a tested approach to enhancing cost-effectiveness. In addition, paying for performance (rather than practices) can attract problem solvers who can reduce nutrient runoff control costs over the long term. Due to the fact that complexity of program design can limit participation, more complex competitive bidding and pay-for-performance programs are best used as complements to simpler pay-for-practice programs that enable widespread implementation of practices with demonstrated performance.

To enable a program that used competitive bidding to fund a wide variety of actions, multiple legal, regulatory and policy impediments would need to be addressed. Examples of such impediments include: 1) Sewer hookup policies (category change process is cumbersome); 2) variability in local health department rules can hinder use of successful low impact development and water reuse techniques; 3) concerns about nutrient credit accounting create confusion as to who owns credits. Solutions include: a) Streamlining approval processes for innovative techniques, including working with the CBP to rapidly establish reduction efficiencies of new practices; b) evaluating approaches to manage risk of underperformance (e.g., state self-insuring, portfolio rules to limit proportion of high risk practices, or establishing assurance bonds); c) Developing standardized agreements to use to reduce risk to innovators, such as safe harbor agreements for landholders.

To address public concerns that the most cost-effective nutrient reduction practices may not provide equivalent social benefits, cost-effectiveness can be measured using outcome measures that integrate multiple concerns and co-benefits. Alternatively, separate programs can be used to achieve goals that are not complementary. For example, the most cost-effective stormwater reduction practices may not be the most cost-effective nutrient reduction practices. Therefore, creating separate funds to achieve distinct goals can enhance overall cost-effectiveness of spending.

I. Enabling innovation in stormwater practice design by reducing financial risk

An impediment to innovation in the stormwater sector is a concern of industry that anything out of the ordinary will take a long time to get permitted or may be denied a permit, since novel practices may not have state-recognized performance criteria on nutrient and water volume reductions. Some innovative practices have performance data from elsewhere or may be sufficiently similar to existing practices to provide confidence in performance. Yet, these promising practices may never be proposed because they create risk or uncertainty. The state has several processes in place to enable innovation in the urban sector.

To enable innovation for addressing restoration requirements found in local MS4 permits, the state considers approving new practices when proper documentation and monitoring information are provided to verify performance claims. The policies and procedures for approving innovative stormwater practices are found in MDE's "Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated, Guidance for National Pollutant Discharge Elimination System Stormwater Permits". MDE works closely with the CBP workgroups and MS4 jurisdictions to enable the use of innovative technologies in a manner that is equitable and consistent with other activities in the Chesapeake Bay region.

Stronger incentives to promote innovation that meet multiple Bay Restoration goals would be to offer expedited permit options for innovative approaches that both meet a minimum threshold of performance information and offer substantial ancillary public benefits. Benefits include those derived from energy savings, aesthetics, air quality or habitat. Such approaches are in place in a few jurisdictions around the country and these case studies could be examined for lessons learned. As detailed above, Maryland is currently working to develop crediting systems for these other benefits.

J. Leveraging Co-Financing Opportunities

Over the past few years, DNR has worked with the state's Department of Housing and Community Development (DHCD) to leverage funding through the Community Legacy, Project C.O.R.E. and other managed funding by their sister agency. This opportunity allowed the Trust Fund and DHCD managers to address urban runoff in underserved communities in a cost-

effective and efficient manner in finding ways to remove blight, enhance park equity and provide green space while also addressing water quality. Two examples have been fully realized in Baltimore City: Archway Park in Druid Heights Neighborhood and a community park in the Darley Park neighborhood. DNR will continue to participate in the DHCD application review process to identify more opportunities for co-financing. Along with these demonstration projects, DNR in partnership with University of Maryland School of Public Health has developed and updated the park equity mapping tool to help guide long range planning and investment strategies for equitable access to green space. The mapping tool is built upon Census data as well as local and state park information. The tool takes into account physical and social barriers to park access and can be used by private and public partners to identify areas underserved by park infrastructure and amenities. These identified areas are often also potential sites for tree plantings, recreation enhancements, and water quality improvements that can improve community health and social outcomes.

Additionally, the Trust Fund is supporting work with the South Baltimore Gateway Partnership on the Middle Branch Resiliency Demonstration project with a $500,000 award for design and engineering of a 2,625 linear foot living shoreline and 12.42 acres of tidal marsh restoration to generate significant water quality improvements and resilience to coastal flooding, intense storm events, and sea level rise in the Baltimore Harbor. This effort is being leveraged with a significant investment by the City of Baltimore ($1.6 million for initial design and engineering phase). This is the first phase of a larger Middle Branch project that was recently awarded funding in the amount of $32.91 million from Federal Emergency Management Agency's Building Resilient Infrastructure and Communities program. The Trust Fund and Baltimore City investments are key local contributions to securing the federal award.

DNR also works to leverage the different state and federal funding sources it manages to the greatest extent possible. One approach has been to support the spectrum of local governments' water quality and climate resilience needs by using multiple funding sources to support project pathways. A good example has been the City of Hyattsville's use of DNR funds to build its resilience to stormwater flooding. Hyattsville received funding support from DNR to investigate known flooding problems in its Ward 1 neighborhood, evaluate how the flooding may become worse due to climate change, and develop a plan to reduce flood risk. The city engaged the Low Impact Development Center to perform this work, the funding for which was provided from federal funds managed by DNR. This project identified a stormwater BMP that had the potential to reduce flood volumes while also providing water quality benefits. The Low Impact Development Center applied for another grant from DNR to design this stormwater project, which was supported through DNR's Resiliency Through Restoration Program, which is funded through state capital funds. Once the design was in hand, the city applied for a third DNR grant to construct the project, which is being supported through the Trust Fund. By leveraging state and federal funds in this way, DNR is able to help partners understand their resilience needs, develop projects to address them, and implement those projects.

K. Comprehensive Water Quality and Climate Resiliency Portfolio

DNR is assembling a portfolio of projects focused on enhancing resilience to climate change stressors that will also leverage habitat, water quality and greenhouse gas reduction benefits. The portfolio will comprise a suite of restoration and conservation projects identified in close coordination with affected communities and public/private/nonprofit sectors. These projects will work together to optimize resiliency benefits and leverage important habitat, water quality, and greenhouse gas mitigation gains. This approach lends itself to longer budgeting timeframes, beyond a one-year cycle, for fiscal certainty, generates new financing opportunities with other partners and provides opportunities to better integrate green and grey infrastructure approaches. By February 2022, DNR will identify targeted resiliency areas with restoration and conservation potential that provide high value resiliency benefits for communities, economies, public lands, and important ecosystems. In close coordination with climate affected communities and public, private, and nonprofit partners, a portfolio of projects within these zones will be assembled over the next two years. This will complement an existing interim portfolio, drawn from prior Grants Gateway solicitations that are poised to take advantage of new federal and other emerging funding opportunities now.

Appendix 1

Chesapeake Bay Restoration Activities Funded in the Budget

Total Funds

	SFY21 Actual
Department of Natural Resources	100,757,038
Program Open Space	35,939,587
Rural Legacy	17,999,092
Department of Planning	6,240,498
Department of Agriculture	51,345,345
Maryland Agricultural Land Preservation Foundation	52,622,291
Maryland Department of the Environment	300,975,694
Maryland State Dept of Education	18,931
Maryland Higher Education	26,939,804
Maryland Department of Transportation	522,337,519
Total	**1,115,175,799**

Fund Type Summary

	SFY21 Actual
General Fund	38,161,470
Special Fund	412,466,043
Federal Fund	56,374,959
Reimbursable Funds	28,500,005
Current Unrestricted	24,578,415
Current Restricted	2,361,389
GO Bonds	30,396,000
MDOT	522,337,519
Total	**1,115,175,799**

Spending Category

	SFY21 Actual
Land Preservation	107,522,825
Septic Systems	22,695,498
Wastewater Treatment	255,819,998
Urban Stormwater	119,956,761
Agricultural BMPs	72,745,345
Oyster Restoration	13,144,416
Transit & Sustainable Transportation Alternatives	409,356,274
Living Resources	52,663,275
Education and Research	27,088,790
Other	34,182,617
Total	**1,115,175,799**

Note: This presentation only includes state agency programs that have more than 50% of their activities directly related to Chesapeake Bay Restoration. Funding related to salaries and fringes does not reflect health insurance or increment adjustments.