Conowingo Watershed Implementation Plan

DRAFT

Prepared by the Center for Watershed Protection, Inc

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List of Acronyms

BMP	Best Management Practice
CAP	Countywide Action Plan
CAST	Chesapeake Assessment Scenario Tool
CBC	Chesapeake Bay Commission
CBP	Chesapeake Bay Program
CIT	Conowingo Implementation Team
CWIP	Conowingo Watershed Implementation Plan
CWP	Center for Watershed Protection, Inc.
DO	Dissolved Oxygen
GIS	Geographic Information System(s)
MDE	Maryland Department of the Environment
MPA	Mid-Point Assessment
MS4	Municipal Separate Storm Sewer System
NEIEN	National Environmental Information Exchange Network

NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
PA DEP	Pennsylvania Department of Environmental Protection
PFP	Pay for Performance
PSC	Principals' Staff Committee
QAPP	Quality Assurance Project Plan
RFA	Request for Application(s)
TMDL	Total Maximum Daily Load
US EPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
WIP	Watershed Implementation Plan

Executive Summary

Established in 1983 with the signing of the first Chesapeake Bay agreement, the Chesapeake Bay Program Partnership, currently consisting of the seven jurisdictions in the watershed (Delaware, the District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia), the U.S. Environmental Protection Agency and the Chesapeake Bay Commission, has set a goal to restore Chesapeake Bay by 2025. This restoration framework is driven by federal Clean Water Act requirements and a 2010 Total Maximum Daily Load (TMDL) that sets pollution reduction targets for each Bay jurisdiction necessary to achieve water quality standards.

Appendix T of the 2010 TMDL recognized that the Conowingo Reservoir was filling up with sediments and nutrients, resulting in increased pollution flowing over the dam into the Chesapeake Bay. The TMDL also recognized that the reservoir's ability to capture sediment and nutrients (i.e., its trapping capacity) is affected by sediment transport into the reservoir, scour removal events, and sediment trapping efficiency. Due to the uncertainty with these factors, the TMDL assumed that Conowingo Reservoir's trapping capacity would continue through 2025. The TMDL (EPA, 2010, Appendix T, page T-5) also stated that "if future monitoring shows the trapping capacity of the dam is reduced, then EPA would consider adjusting the Pennsylvania, Maryland and New York 2-year milestone loads based on the new delivered loads" (US EPA, 2010).

In 2017, as part of the Chesapeake Bay Program's phased planning process, there was a Mid-Point Assessment (MPA) to evaluate jurisdictions' progress in achieving 60 percent of the necessary 2025 pollution reductions. The MPA also adopted the latest science and monitoring information in an updated Phase 6 suite of modeling tools used to measure restoration progress. This new science demonstrated that Conowingo Reservoir was effectively full, reducing dissolved oxygen concentrations in the bay due to an additional 6 million pounds of nitrogen and 260,000 pounds of phosphorus pollution. The Principal Staff Committee (PSC) agreed to address these Conowingo pollution loads through a separate Conowingo Watershed Implementation Plan (CWIP) that all jurisdictions would work collectively to achieve by pooling partnership resources and by reducing implementation costs through targeting pollution reduction practices in the most effective areas. The PSC also agreed the CWIP must incorporate innovations in financing that leverage both private capital and market forces to reduce restoration costs.

This draft CWIP provides the PSC, CWIP Steering Committee Members, EPA, and stakeholders with a first phase adaptive strategy that will build upon of CWIP implementation successes, challenges, and innovations in CWIP pollution loads. The CWIP realizes the PSC's vision as a collaborative approach that complements jurisdiction WIPs by accelerating the pace of restoration, recognizing water quality and ecosystem protection as cost-effective, setting the stage for financing innovations that can help reduce costs and stimulate investments in clean water, and fostering healthy competition in ecosystem restoration markets.

This draft CWIP presents a set of best management practice (BMP) implementation scenarios for review and evaluation by the CBP Partnership and the public. These scenarios vary in the geographic area covered and BMP types included and offer alternatives to previously presented scenarios. These alternatives seek to reduce the overall cost of implementation while meeting nitrogen reduction targets by expanding the suite of BMPs and geographic scale of the planning area. A common theme across the scenarios is the targeting of BMP implementation to the most effective areas for improving conditions in the Bay. More specifically, implementation is targeted to those areas where actions to reduce nutrients locally have the greatest impact on increasing dissolved oxygen in the deep water/deep channel areas of the Bay (i.e., the areas where achievement of water quality standards is most difficult). Table 1 provides a comparison of the characteristics and results of each scenario.

Table 1. CWIP BMP Scenarios

Scenario	**Geographic Extent**	**BMPs Included**	**Total Nitrogen Load Reduction (lbs/year)**	**Total Annualized Cost**
Scenario 1: Constrained	Susquehanna River Basin + Western Shore and Eastern Shore Geobasins (PA and MD only)	Constrained to the following BMPs selected by the PSC: Wetland restoration, forest buffers, stream restoration, living shorelines, bioswales	6.0 million	$367.8 million
Scenario 2: Enhanced WIP III	Susquehanna River Basin + Upper Quartile of Most Effective Land River Segments	Full suite of WIP III BMPs, represented at 25% above WIP III implementation levels	6.0 million	$235.9 million
Scenario 3: N-Effective, Baywide	Bay-wide	8 most cost-effective agricultural BMPs	6.4 million	$51.0 million
Scenario 4: N-Effective, Susquehanna	Susquehanna River Basin	8 most cost-effective agricultural BMPs	6.6 million	$51.0 million
Scenario 5, N-Effective + Urban Equity	Susquehanna River Basin	8 most cost-effective agricultural BMPs + 2 cost-effective urban BMPs	6.6 million	$51.3 million

Since the BMP scenarios developed for the draft CWIP specifically target nitrogen, these scenarios come close to but do not all achieve the phosphorus goal. The States are on progress to exceed the 2025 phosphorus target and as a result the phosphorus target for the Conowingo was not a priority. The additional phosphorus load reductions from WIP III could potentially be applied to the Conowingo. Alternatively, these scenarios exceed the nitrogen target and the additional nitrogen reductions could be substituted for phosphorus through the nutrient exchange process. The implementation strategies presented here are not place-based and, once a final scenario is selected, CWIP implementation will rely upon a phased and cooperative multi-jurisdictional effort that includes field assessment to identify specific locations for and types of BMPs. This draft CWIP serves as a starting point for outreach and coordination with local stakeholders on a phased implementation framework that begins with web-based outreach to reach the widest audience, followed by more targeted outreach in the selected geographies that is aligned with the jurisdiction's outreach strategies for WIP III.

A central focus of the CWIP is to promote flexible, cost-effective, and innovative approaches to address both CWIP financing needs and load reductions, as well as to accelerate green infrastructure practices that maximize co-benefits, particularly climate change resiliency and mitigation co-benefits. The CWIP also recognizes that in-water practices, such as reservoir dredging and reuse, submerged aquatic vegetation and a restored aquatic ecosystem also have pollution reduction benefits that must be further explored and utilized. Such BMPs may be explored in subsequent versions of the CWIP and are not included in this draft as additional information is needed with these innovative practices.

The CWIP identifies opportunities and contingencies for reducing Conowingo loads that are either underway or should be further explored, including:

1. Identifying, leveraging or expanding market mechanisms, like pollution trading, that can be scaled up to accelerate restoration progress
2. Using in-water practices like dredging and reuse of dredged material for beneficial uses like living shorelines or other innovative end products and developing nutrient reduction crediting science and frameworks for restored aquatic ecosystems like submerged aquatic vegetation, oysters and other filter feeders like shad, menhaden and freshwater mussels
3. Implementing other cost-effective BMP opportunities across all sectors (wastewater, agriculture, developed, air) with additional pollution reduction capacity

The draft is intended to initiate discussion with the CWIP Steering Committee and stakeholders, providing the opportunity for feedback on the direction of the strategy and guidance on adjustments and modifications as the partnership initiates the implementation process. A financing strategy to implement the CWIP will be available in 2021. As implementation advances, the CWIP will utilize annual progress evaluations, 2-year milestones, and continued public engagement to adaptively manage this collaborative effort in a way that complements and adds value to the watershed-wide restoration effort.

Introduction

The Conowingo Watershed Implementation Plan (CWIP) is developed to address the additional nutrient loads entering the Chesapeake Bay that were not previously addressed by the 2010 Chesapeake Bay total maximum daily load (TMDL) as a result of the Conowingo Reservoir reaching dynamic equilibrium. When the Chesapeake Bay TMDL was established in 2010, it was estimated that the Conowingo Dam would be trapping sediment and associated nutrients through 2025. New information has discovered that this is not the case, and the reservoir behind Conowingo Dam has now reached dynamic equilibrium (USACE and MDE, 2015) whereby more nitrogen and phosphorus are now entering the Chesapeake Bay than was estimated when the TMDL was established.

No jurisdictions were assigned the responsibility to achieve these additional reductions when the allocations were finalized in 2010. Even with full implementation of the seven Bay jurisdictions' Watershed Implementation Plans (WIPs), this additional pollutant loading will cause or contribute to water quality standards exceedances in the Chesapeake Bay. EPA documented (USEPA, 2018) that adjustments to sediment and associated nutrient load reduction obligations would be needed if monitoring showed the trapping capacity of the dam was reduced (US EPA, 2010, Appendix T).

On January 31, 2019 the Chesapeake Bay Program (CBP) Principals' Staff Committee (PSC) finalized a Framework for developing the CWIP (CBP, 2019a, Appendix C) and the CWIP Steering Committee more recently identified nitrogen load reductions (CBP, 2019b) as the primary goal since most of the Bay jurisdictions are projected to exceed the phosphorus goals. Central to this partnership framework is the premise that additional Conowingo load reductions are not allocated or subdivided among each jurisdiction, but rather will be achieved collectively by the jurisdictions working together through a flexible, adaptive and innovative CWIP approach.

The purpose of this draft CWIP is to present a set of best management practice (BMP) implementation scenarios for review and evaluation by the CBP Partnership and the public. The BMP types, geographic scale, nitrogen reductions achieved, and total cost of each scenario are presented so that the PSC can compare and select the most appropriate path forward for CWIP implementation. The outreach strategy presented in the draft CWIP will be further refined once a final implementation scenario/strategy is selected. The implementation strategies presented here are not place-based and CWIP implementation will rely upon a phased and cooperative multi-jurisdictional effort that includes field assessment to identify the specific locations for and types of BMPs. The Programmatic and Numeric Implementation Commitments section of this draft describes potential approaches to implement the CWIP given available resources, current programs and a market-driven approach. The Financing Strategy in this draft contains a placeholder to be completed when the financing strategy to implement the CWIP is available in 2021.

Background

The Conowingo Reservoir is located in the lower portion of the Susquehanna River basin. The Susquehanna River basin has a 27,500 square mile drainage area that is largely (77%) in Pennsylvania with 22% of its area in New York and 1% (281 sq. miles) in Maryland. The River itself is 444 miles long, originating in Cooperstown, New York, and flowing through Pennsylvania and Maryland before emptying into the Chesapeake Bay near Havre De Grace, Maryland. The reservoir was constructed in 1928 and is owned and operated by Exelon Corporation with a design capacity of 30,000 acre-feet. It is the most downstream of the four hydroelectric dams and their reservoirs located on the lower Susquehanna River (Figure 1).

The dams in the lower Susquehanna River have historically trapped and stored sediment and associated nutrients transported from the watershed, preventing these pollutants from reaching the Chesapeake Bay. Decades prior to the establishment of the 2010 Chesapeake Bay TMDL, scientists had concern over impacts to the Chesapeake Bay from the lower Susquehanna River dams filling, reaching their capacity. In 1995, it was determined that two of the three reservoirs, Safe Harbor and Holtwood, had reached their sediment trapping capacity. The 2010 Chesapeake Bay TMDL (EPA, 2010, Appendix T) also recognized that TMDL allocations may need to be reevaluated with Conowingo Reservoir infill. Comparison of bathymetry data from the Conowingo Reservoir (1996 to 2011) showed a thirty-three percent decrease in reservoir sedimentation equating to a ten percent increase in sediment load to the Bay from 20.3 – 22.3 million tons (USACE and MDE, 2015). The inability for these reservoirs to trap sediment results in sediment being transported downstream where the nutrients associated with the sediments adversely impact dissolved oxygen levels in the Chesapeake Bay.

Analyses of the sources of sediment being transported from the lower Susquehanna reservoirs finds that most of the load entering the Chesapeake Bay during storm events originates from the watershed, with smaller contributions from reservoir scour (USACE and MDE, 2015). Analyses find the three reservoirs are no longer trapping sediment and associated nutrients over the long term and accumulated sediment is being released episodically during high-flow storm events. USACE and MDE (2015) concluded that the dams have reached a state of dynamic equilibrium where there is no appreciable change in sediment transport through the Conowingo Reservoir over the periods of years to decades; rather, there are periodic releases of sediment during high flow events temporarily increasing the capacity of the reservoir, that subsequently continues to accumulate sediment until the next high flow event.

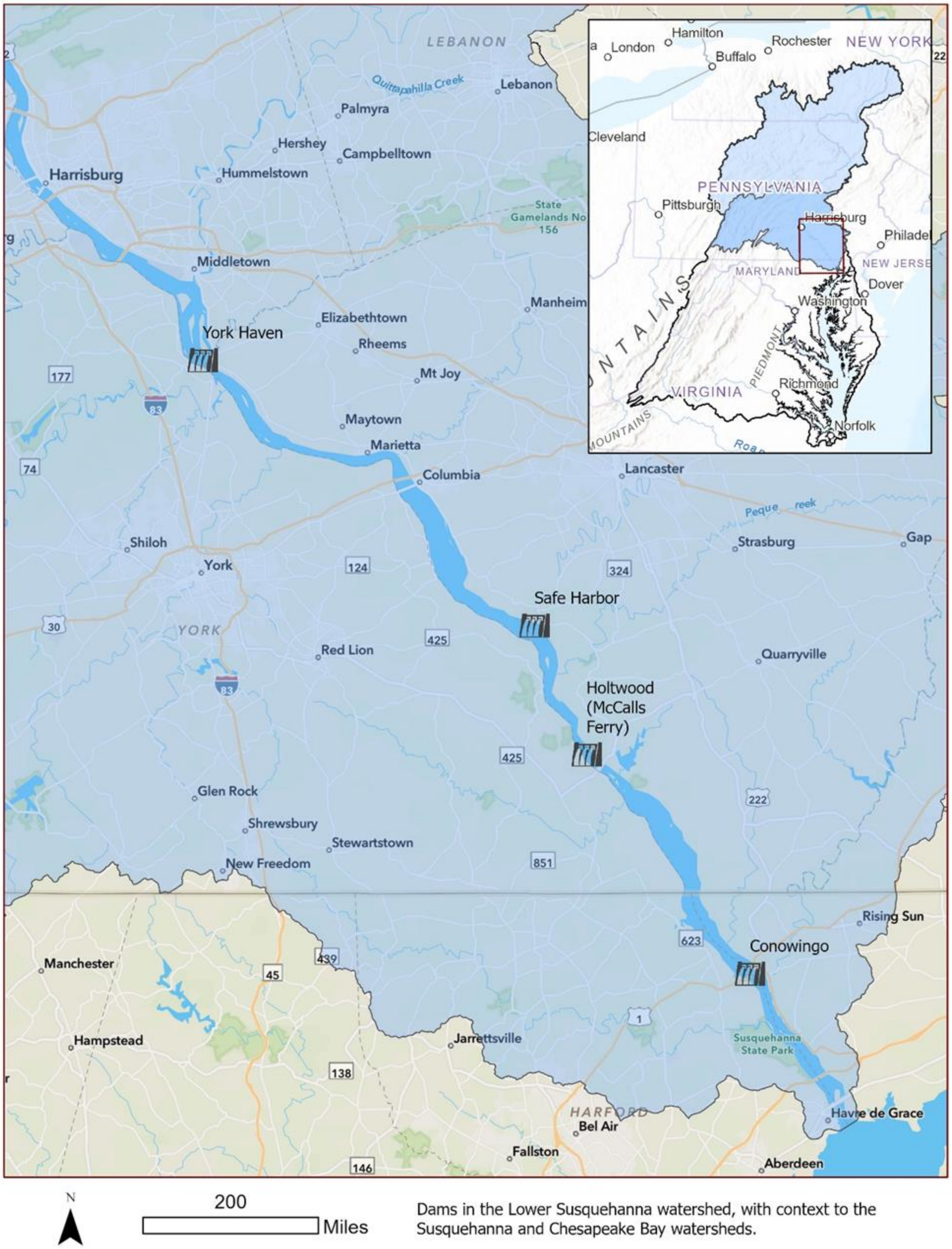


Figure 1. The Conowingo Reservoir in the Lower Susquehanna River Basin

The Chesapeake Bay Program Partnership (Partnership) estimates that, after fully implementing the Bay TMDL and the Phase III WIPs, an additional reduction of 6 million pounds of nitrogen and 0.26 million pounds of phosphorus is needed in order to mitigate the water quality impacts of Conowingo Reservoir infill (Appendix C). The CWIP Framework states that pollutant reductions to meet the Conowingo targets should come from the most effective areas within Bay watershed jurisdictions—that is, the geographic areas with the greatest influence on Chesapeake Bay water quality. If implementation were directed watershed-wide, or not targeted in the most-effective sub-basins, the total pollution reduction needed would increase. For example, it is estimated using the Phase 6 suite of modeling tools, that 7.28 million pounds of nitrogen would need to be reduced if implementation was distributed watershed-wide, rather than in the most effective areas (US EPA, 2018). Table 2 presents each jurisdiction's nitrogen and phosphorus load reduction responsibility if distributed watershed wide, based on the CBP partnership-approved methodology to equitably calculate load reductions.

Table 2. Additional nitrogen and phosphorus load reductions required for Conowingo Dam infill using the Phase 6 Suite of modeling tools.*

Jurisdiction	Nitrogen Load Reductions (M lbs./year)	Phosphorus Load Reductions (M lbs/year)
New York	0.32	0.011
Pennsylvania	3.31	0.113
Maryland	1.76	0.091
West Virginia	0.19	0.015
District of Columbia	0.00	0.001
Delaware	0.32	0.005
Virginia	1.38	0.155
Basin-wide	7.28	0.392

* Table reproduced from letter from the US EPA Region 3 Regional Administrator to the Principal's Staff Committee Members, October 26, 2018 (US EPA, 2018).

The decision by the PSC to develop a CWIP is based on the studies indicating that conditions in the watershed have changed since 2010, and that additional load reductions of nutrients are now needed to mitigate the water quality impacts of the Conowingo Dam infill on the Chesapeake Bay (USACE and MDE, 2015; Easton et al., 2017). This decision by the PSC was reached based on the following:

- At the December 2017 PSC Meeting, the PSC agreed to assign the total pollutant reductions attributed to the Conowingo Dam infill to a separate Conowingo Planning Target and to collectively develop a separate CWIP (USEPA, 2018).
- At the December 2017 PSC Meeting, all PSC jurisdictional members agreed to pool resources and to identify a process to fund and implement the CWIP (e.g., the allocation of future EPA Chesapeake Bay Implementation and Regulatory and Accountability Program grant funding to the seven Bay watershed jurisdictions) (USEPA, 2018).

- At the March 2018 PSC Meeting, the PSC agreed with EPA's request that the agency not have a member on the CWIP Steering Committee due to EPA's oversight role for the implementation of all the jurisdictions' WIPs, including the CWIP (USEPA, 2018).
- At the January 31, 2019 PSC Meeting, the PSC approved final revisions to a Framework for developing the CWIP (CBP, 2019a). The Framework is included as Appendix C.

Conowingo WIP Framework

The CWIP is not a jurisdictional WIP, similar to the WIPs in support of the Chesapeake Bay TMDL. The CWIP presents an opportunity to build on existing, successful programs, as much as is feasible, to avoid creating duplicative bureaucracies. The CWIP encompasses an adaptive management approach consistent with other WIPs that represents the collective agreement amongst the Partnership and a transparent, fair and equitable process for all stakeholders. The CWIP is based on the best available information and supporting analyses to achieve the designated nutrient reductions. The CWIP acknowledges the need to adapt its approach as new information becomes available throughout the implementation phase, while putting in place a process to monitor outcomes and transparently assess progress and redirect resources as necessary. As such, the CWIP will be updated as needed in recognition that programmatic and/or numeric commitments may need to be modified as part of the adaptive management process during the WIP timeframe through their two-year water quality milestone reporting process.

The Framework represents an agreement amongst all Bay jurisdictions that recognizes:

A. Trapping of pollutants by the Conowingo reservoir over the past 80+ years has benefited the water quality of the Bay, and it has also benefitted jurisdictions to varying degrees by lessening load reduction responsibilities. However, those benefits are greatly diminished.

B. No reservoir maintenance to restore trapping capacity has occurred over the life of the dam and the reservoir is now near full capacity.

C. The most cost-effective approach to mitigate current adverse water quality impacts of the Conowingo reservoir in a state of dynamic equilibrium are realized by pooling resources to pay for pollutant reduction practices in the most effective locations (i.e., the locations with the most influence on Bay water quality). Pollutant reduction practices placed in the most effective areas will limit the overall load reductions needed.

Geography of the Conowingo WIP

The CWIP Framework document (Appendix C) identifies four geographic options for assigning pollutant load reduction responsibilities. After considering these options, the CWIP Steering Committee agreed at its September 23, 2019 meeting to use the "Susquehanna + Most Effective Basins" option as the basis for the CWIP (CBP, 2109b). However, this draft presents a series of BMP scenarios for evaluation that also consider alternate geographies to address issues of cost and equity. The BMP scenarios presented here cover multiple geographic scales, which are described further in the Programmatic and Numeric Implementation Commitments section.

A common theme across all the geographic scales is that BMP implementation is targeted to the most effective sub-basins (referred to as Land River Segments) of the watershed to achieve an additional reduction of six million pounds of nitrogen and 0.26 million pounds of phosphorus to mitigate the water quality impacts of Conowingo Reservoir infill on the Chesapeake Bay. The methodology used to identify the relative effectiveness of each Land River Segment was developed by the Partnership and applied as part of the original TMDL allocations in 2010. The resulting maps of relative effectiveness were updated using the Phase 6 Chesapeake Bay Watershed Model, which reflects the condition of dynamic equilibrium of the Conowingo. These relative effectiveness maps represent the increase in dissolved oxygen that occurs in the deep water/deep channel areas of the Bay (i.e., the areas where achievement of water quality standards is most difficult) per pound of nutrient reduced in each local Land River Segment. The relative effectiveness accounts for the amount of nutrients produced locally, and the transport of these nutrients through the watershed into the tidal areas, then from the tidal areas to the Bay, resulting in multiple watershed and estuary delivery factors affecting dissolved oxygen (DO) levels in the Bay. Therefore, most-effective Land River Segments are not necessarily the areas within the upland drainage of the Conowingo Dam, nor closest to the Chesapeake Bay given the effect of local watershed characteristics on travel time, to include the impact of dams and impoundments. Further, delivery to the Bay from the estuary considers the Bay's circulation and bathymetry (depth), as well as other factors. Figure 2 presents the relative effectiveness map for nitrogen for the entire Bay watershed.

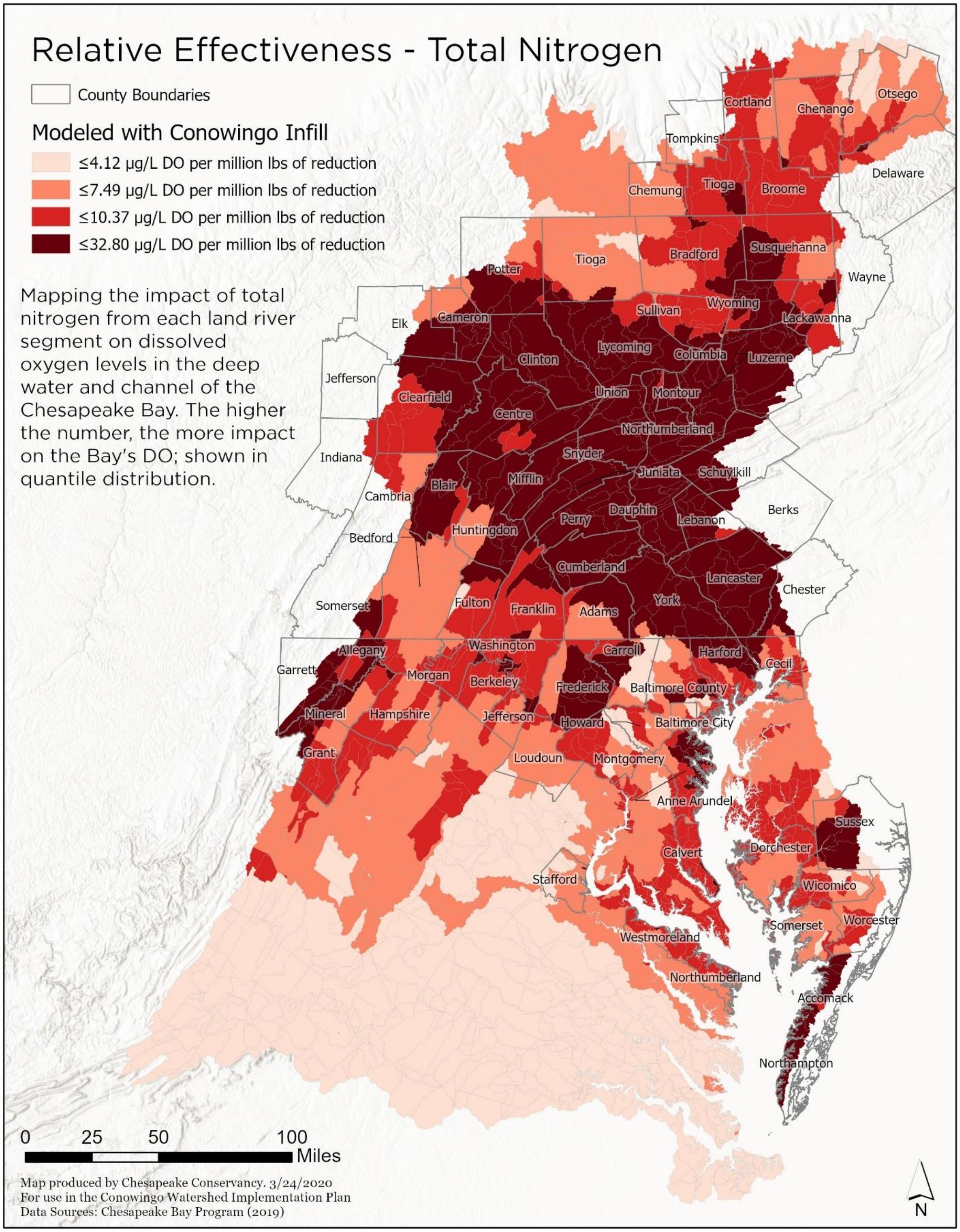


Figure 2. Relative Effectiveness of Reducing Nitrogen in Each Chesapeake Bay Land River Segment on Improving Dissolved Oxygen in the Bay

Roles and Responsibilities

The CWIP was developed through the guidance and recommendations of a Steering Committee, a subcommittee of the PSC. This committee is composed of a representative from each Bay jurisdiction and the Chesapeake Bay Commission (CBC). The membership of this committee is provided in Appendix A. EPA is not a formal member of this committee due to its oversight role as part of the Bay TMDL accountability framework. The decisions of the committee follow a list of guiding principles identified in Appendix A of the CWIP Framework document (Appendix C).

The roles and responsibilities of the EPA, Steering Committee, PSC and third-party grantees are defined in the Framework document (Appendix C) and the Cooperative Agreement between US EPA and the third-party grantees. Each of their roles as it pertains to the development and implementation of the CWIP are summarized below.

EPA will:

a. Evaluate the draft and final CWIP and provide biennial evaluations of the progress toward attaining the goals in the CWIP. EPA's evaluations, in consultation with the PSC, and any needed improvement will be used to determine if corrections or adjustments are necessary to attain the goals of the CWIP (e.g., whether the targets need to be re-evaluated or assigned to specific jurisdictions).
b. Issue a Request for Applications (RFA) for the third party and administer the subsequently awarded grant. Because EPA will be issuing the RFA, it cannot act as a third party.
c. Provide technical staff and contractor support such as modeling or GIS analysis to the CWIP Steering Committee.

The Steering Committee will:

a. Consist of a representative from each jurisdiction and the Chesapeake Bay Commission. Each Bay jurisdiction and the CBC may also solicit comments on the CWIP framework from key stakeholders.
b. Develop the CWIP with EPA staff and grantee support.
c. Guide the development of a financing strategy and implementation of the CWIP, working with the third party.

Guiding Principles

Fairness Principle: Strive for fairness, equity, and feasibility among state, local, and federal and other partners participating in the CWIP regarding level of effort, financing, tracking, resource sharing, and third -party access.

Governance Principle: Operate as an Action Team as defined in the document "Governance and Management Framework for the Chesapeake Bay Program Partnership". Strive for consensus using the Chesapeake Bay Program Partnership Consensus Continuum as described in the document. When consensus cannot be reached, the issue will be deferred to the PSC with a summary of the issue and the different options and opinions expressed by the members.

Consistency Principle: Ensure consistency with the EPA Phase III WIP expectations and CWIP framework documents.

Transparency Principle: Establish clear tracking, accountability and verification consistent with expectations for jurisdictions and to transparently demonstrate which practices are planned for, implemented and maintained in the CWIP vs state WIPs in order to avoid double-counting.

Efficiency in Innovation Principle: Implement the CWIP building on existing, successful programs, as much as is feasible, to avoid creating duplicative bureaucracies. At the same time, strive for innovation, leverage new technologies, and, where appropriate, develop new implementation approaches.

The PSC will:

a. Approve the final draft CWIP for submittal to EPA and the Partnership for review and comment.
b. Approve the final CWIP before posting on the CBP Partnership website in June 2020.
c. Review the progress of the CWIP Steering Committee in the development and implementation of the CWIP on a regular basis.

Third Party Grantee, herein referred to as the CWIP Implementation Management Team will, pursuant to EPA Cooperative Agreements:

a. Work with the Steering Committee to establish a timeline to implement the CWIP.

b. Develop draft and final CWIP documents, to include two-year milestones every two years, following the release of the final CWIP, that will articulate the programmatic, implementation and numeric commitments to achieve the necessary load reductions due to the Conowingo Dam infill.

c. Document approaches and strategies to select and implement BMPs to cost-effectively and efficiently achieve the necessary load reductions and create a BMP Opportunity Analysis that identifies catchment-scale locations of high-priority opportunities for the load reductions.

d. Facilitate the implementation of projects funded specifically in pursuit of CWIP goals or as identified through the financing framework.

> The BMP Opportunity Analysis will guide outreach and accelerate CWIP Milestone planning by identifying project-scale opportunities for BMP implementation. This opportunity analysis will utilize best available data and innovative GIS-based methods for remote identification of suitable locations for specific BMP implementation efforts.

e. Develop and implement tracking and reporting protocols and tools to readily track and verify creditable practices for the CWIP.

f. Work with the jurisdictions to develop and implement engagement strategies with local communities in the priority geographies to advise the Steering Committee on locally relevant and actionable load reduction strategies.

g. Develop a draft and final financial strategy to provide the administrative and financial resources to implement load reduction strategies.

> The CWIP Implementation Management Team is currently divided into three EPA funded activities:
>
> **Activity #1:** Develop and implement the CWIP (Center for Watershed Protection lead)
> **Activity #2:** Develop a Conowingo implementation financing strategy (Chesapeake Bay Trust lead)
> **Activity #3**: Track/ verify progress made in the implementation of the CWIP and report to EPA on an annual basis (Chesapeake Conservancy lead)

Accounting for the Impacts of Climate Change

According to the Partnership, the CWIP will be assigned additional load reductions due to the impacts of climate change. Recognizing these additional loads will impede progress improving the health of the Bay, the PSC agreed to a three-part approach for addressing climate change impacts in the Phase III WIPs and future two-year milestones. This approach is also applicable to the CWIP and included the following commitments:

1. Incorporate climate change in the WIPs by including a narrative strategy that describes the state and local jurisdictions' current action plans and strategies to address climate change.
2. Understand the science by refining the climate modeling and assessment framework; continue to sharpen the understanding of the science, the impacts of climate change, and any research gaps and needs.
3. Incorporate climate change into two-year milestones by no later than 2022-2023, start to account for additional nutrient and sediment pollutant loads due to 2025 climate change, and determine how climate change will impact the BMPs included in the WIPs and address these vulnerabilities. The PSC also acknowledged that jurisdictions could address additional nutrient and sediment pollutant loads due to 2025 climate change in the WIPs.

At such time the additional loads are assigned, the two-year milestone periods will be used to adjust the scale and scope of the load reduction strategies for those jurisdictions that have not previously addressed the additional loads. At the time of the release of this draft CWIP, the methods to address climate change and the WIPs following the Water Quality Goal Implementation Meeting February 10-11, 2020 are pending PSC approval. If additional reductions are assigned, they will be incorporated into the two-year milestone periods for the CWIP. An expanded list of creditable and reportable BMPs may be considered that provide an effective means to mitigate the effects of climate change.

A central tenet of the CWIP is to significantly scale up implementation of green infrastructure practices in the most effective areas to reduce nitrogen loads to the Bay. These green infrastructure practices can reduce the vulnerability of communities to the effects of climate change, making communities more resilient, healthier, and less susceptible to urban heat island effects while helping restore water quality and ecosystem functions.

Key features of these land based BMPs are that they provide enhanced storage capacity for flood mitigation of more intense and larger precipitation events, reduce emissions of greenhouse gases through carbon sequestration, and lower temperatures through shading and evapotranspiration. Focusing CWIP resources and funding to these practices may stimulate the development of versatile designs that provide multiple benefits to local communities.

As project implementation moves forward, two-year milestones and investment decisions on individual projects will be refined using the most up to date and available climate modeling data and assessment framework. The CWIP will function in concert with the overall Chesapeake Bay WIPs, which allows CWIP implementation to adjust to the impacts of climate change as the science evolves and advances.

Accounting for the Impacts of Growth

The geography of the CWIP extends across both local and state political lines. As a result, there is no organized or centralized entity responsible for growth management. Consequently, it is expected that the change in load reductions due to growth will be accounted for through the jurisdiction-specific Phase III WIPs' accounting processes.

Comprehensive Local, Regional, and Federal Engagement Strategies and Commitments

Consistent with the Framework for the CWIP, the engagement strategy adopts a Bay-wide effort to ensure that additional nutrient and sediment load reductions needed for a healthy Chesapeake Bay are achieved. The CWIP does not require the development of plans specific to local or priority geographies, rather an aggregation of targeted, priority implementation of practices, that together will achieve the necessary load reductions. The success of the CWIP requires participation from all six States and the District of Columbia to ensure accountability that all actions needed are taken within the agreed upon timeline, and consistent with the guiding principles. The engagement strategy will be carried out in concert with the Partnership and jurisdictions' governments and will engage with federal agencies, regional and local governments, quasi- and non-governmental organizations, private sector for-profits, and individual citizens. Overall, the strategies identified in the CWIP build upon the efforts by the Bay jurisdictions to develop the jurisdiction-specific Phase III WIPs. This ensures consistency in messaging and efficiency in the delivery of important communications to a variety of stakeholders. For example, a draft of Frequently Asked Questions (FAQ) document has been completed and provided in Appendix B.

There are four phases for local and regional stakeholder outreach developed by the CWIP Implementation Management Team. Consistent with the adaptive management approach, there will be a review and evaluation of the strategies and their effectiveness to achieve the desired level of engagement with the completion of each phase.

- Phase 1 (2019 – 2020): Planning phase for stakeholder outreach, development of general materials, and web-based outreach soliciting input on draft CWIP.
- Phase 2 (2020 – 2021): Outreach will focus on delivering the CWIP, collecting data on specific projects that will be implemented to achieve the two-year milestones and provide training to local stakeholders on the data tools produced as part of the CWIP to support project planning for implementation.

- Phases 3 – 4 (2021 – 2025): These phases include Years 3 through 6 where outreach will focus on reconvening stakeholders annually to review and evaluate progress and make recommendations on the next two-year milestones. The development of additional training and guidance documents may be pursued based on feedback from stakeholders to include input from the Steering Committee.

Federal and Partnership engagement will be achieved through the continuation of the CWIP Steering Committee. The success of CWIP implementation will require continuous input from Steering Committee members to provide guidance on adaptive management strategies and adjust strategies to reflect future changes in standards, policy, and Phase III WIP strategies. Steering Committee meetings may occur quarterly or monthly based on the needs of the CWIP.

Engagement and Communication Goals

The success of the CWIP requires fulfillment of the EPA expectation for all WIPs to include a comprehensive strategy to engage local, regional and federal partners in WIP implementation. The measures taken to adopt and implement nutrient load reduction strategies need to be representative of the available local capacity, technical and financial resources to achieve the desired outcomes. This requires broad-based local community support that is guided and coordinated by State agencies.

The CWIP Implementation Team (CIT) will advocate for local communities as an advisor to the Steering Committee to ensure that CWIP recommendations and products are locally relevant and actionable. As such, a central goal of the CWIP is to sustain communication and engagement of federal, state and local stakeholders involved in the development phase throughout its implementation. This will include both the public and private sector. A second goal is to effectively communicate and provide timely information about financing options to implement nutrient reducing strategies. A third goal is to develop broad-based support for implementation by addressing the needs and capacity of specific sectors, communities and organizations that are directly involved in implementation, tracking, and reporting.

Currently, web-based strategies have been developed for the entire watershed and in-person outreach strategies are developed for priority geographies of Pennsylvania and Maryland.

Strategies

Web-based

To communicate and interact with stakeholders and partners in all the Bay jurisdictions, the CWIP Implementation Team will utilize web-based strategies including webcasts and online meetings. These web-based platforms provide the ability to communicate with stakeholders and partners spread across a large geographic area and the flexibility to communicate when in-person meetings are otherwise not possible.

Draft CWIP Phase

A series of 3 webcasts will be delivered during the public comment period of the draft Conowingo WIP. These webinars will focus on the background need for the Conowingo WIP, the process of developing the draft CWIP, the priority watersheds, and implementation goals, and will also provide opportunity for questions and comments. Each of the three webcasts will focus on a specific state which will cover specifics on the implementation for that state.

Additionally, during the draft CWIP public comment period, the CIT will utilize online meeting platforms and conference calls to solicit feedback and engage in discussions with key partners and stakeholders. This technology can support presentations as well as data and document sharing, providing a reasonable alternative if in-person meetings are not possible.

Final CWIP Phase

After the final CWIP is approved the CIT will deliver at least one annual webcast to provide information on progress, strategy modifications and refinements, funding levels and priorities, milestone updates, available tools and resources, and success stories. The CIT will also develop a condensed presentation for integration as a component to other partner online presentations or webcasts, which could be delivered when requested.

Pennsylvania

PA DEP developed a phased approach[1] to implement the Phase III WIP through their Countywide Action Plans or CAPs. The CAPs assign each of the 43 counties within the Chesapeake Bay watershed into one of four tiers (Tiers 1 – 4), where each tier represents 25% of the pollutant load reduction for the Phase III WIP (Table 3). Four counties (Lancaster, York, Franklin and Adams) participated in a pilot CAP process with plans completed in 2019. The engagement strategy for the Pennsylvania portion of the CWIP aligns development of the CAPs for the Phase III with the CWIP outreach. The ongoing CAP process allows the CIT to interact directly with local stakeholders and state agency staff in the development of integrated strategies. This will allow the CIT to integrate the engagement strategy into the Phase III WIP strategy, creating efficiencies for all participants and ensuring consistent communication and fostering collaboration. Together the CIT and PA DEP will use the Phase III WIP two-year milestone process to align the CAP for Tiers 3 and 4 with the CWIP timeline in the identified priority geographies. Table 4 identifies the two-year milestone period and the schedule for counties identified by PA DEP to initiate their CAP process within that time period.

[1]This phased approach to implementing Pennsylvania's Phase III WIP is described at: https://www.dep.pa.gov/Business/Water/Pennsylvania's%20Chesapeake%20Bay%20Program%20Office/WIP3/Get Involved/Pages/Local-Government.aspx

Table 3. Pennsylvania counties and their Tiers for CAPs. Counties with an asterisk (*) next to them were part of the initial PA DEP pilot for CAP development.

Tier 1	Tier 2	Tier 3		Tier 4	
Lancaster*	Franklin*	Adams*	Schuylkill	Union	Potter
York*	Lebanon	Northumberland	Bradford	Chester	Somerset
	Cumberland	Perry	Juniata	Dauphin	Wyoming
	Center	Snyder	Clinton	Berks	Elk
	Bedford	Huntingdon	Tioga	Blair	Indiana
		Columbia	Susquehanna	Lackawanna	Cameron
		Mifflin	Clearfield	Luzerne	Wayne
		Lycoming	Fulton	Montour	Mckean
				Cambria	Jefferson
				Sullivan	Carbon

Table 4. PA DEP Proposed Draft Alignment of CAP development and the CWIP and the Chesapeake Bay Program Two-year Milestones (the milestone periods are based on July 1 – June 30).

Two-Year Milestone Period	Proposed Time Period to Develop CAPs and Integrate CWIP
2018 – 2020	Jan/Feb 2020: Center, Bedford, Cumberland, Lebanon
2020 – 2022	Late Fall 2020: Blair, Northumberland/ Montour, Lycoming, Union/Snyder, Luzerne

Audience (for stakeholder engagement workshops)

Emphasis will be placed on reaching out to targeted groups currently working on and/or familiar with local CAP development and implementation. This include, agriculture representatives, Cooperative Extension, USDA, Conservations Districts, county and municipal staff, land trusts, environmental and engineering consultants, watershed groups, state agencies, water authorities, local community leaders. These groups of people are specifically identified in the Community Clean Water Planning Guide and will be have relevant specialized knowledge, can speak on behalf of impacted landowners and industries, have connections to relevant groups, and have shown a willingness to engage. These groups will also be engaged during future outreach activities to share feedback on milestones and BMPs.

Communications and Timing

The CIT members, specifically the Chesapeake Conservancy with assistance from the Center for Watershed Protection, will lead the CWIP local area engagement in Pennsylvania. Information will be provided to PA DEP to share with local stakeholders as part of the County Clean Water Technical Toolbox for the CAPs. CIT members will join DEP staff at select County Action Plan meetings beginning in January 2020 to discuss the complementarity of CWIP with Phase III Chesapeake Bay WIP.

County Action Planning will continue beyond the delivery of the final CWIP; therefore, the CWIP Implementation Team will coordinate with DEP to conduct web-based outreach during the CWIP public comment period.

Active CAP Counties

Beginning January 2020 –: The CIT will integrate outreach to Tier 2 Counties through the County Action Planning process by coordinating with PA DEP and participating in County Action Plan meetings and phone calls with Action Plan coordinators/Leaders.

Other Counties

Beginning April 2020: CIT outreach to counties who are not currently going through the County Action Planning process with PA DEP will focus on providing the stakeholders with an understanding of how the CWIP is structured and how the development of CWIP two-year milestones will integrate with the County Action Plan process. Outreach in these locations will include webcasts, participating in regional partnership meetings as well as phone calls and in-person meetings with key stakeholders.

CWIP Milestone Planning in Pennsylvania

The CIT will coordinate milestone planning efforts with PA DEP as part of the engagement process, inclusive of the CAP process. Schedules for CWIP milestone draft and final delivery are to align with jurisdictional 2-year milestone targets.

Maryland

A Maryland specific outreach strategy has been developed in recognition that Maryland has completed county-based strategies as part of the Maryland Phase III WIP. The outreach strategy for the priority geographies in Maryland follows a process similar to the strategy developed for the Phase III WIPs. The CIT will communicate with Maryland Department of Environment and Maryland Department of Agriculture to ensure that communication efforts regarding CWIP and the Phase III WIP complement each other. The primary stakeholders identified for Maryland WIP and CWIP engagement strategies are the same and includes organizations that have a central role in project implementation. The organizations include county, municipal, federal and soil conservation district staff associated with source-sector specific organizations to include stormwater, agriculture, wastewater, septic and federal facilities.

Audience (for stakeholder engagement workshops)

Emphasis will be placed on reaching out to targeted groups currently working on and/or familiar with local WIP implementation. For the first round of stakeholder engagement workshops, invitees will be organizations and local government agencies actively working on WIP-related projects in the watersheds identified in the CWIP. These groups were selected because they have been or are currently engaged in WIP projects and reporting and because they have area strong understanding of the watersheds. These groups will also be engaged during future outreach activities to share feedback on milestones and best management practices (BMP). Invitees are to include:

- County Conservation District and USDA Natural Resources Conservation Service, local Maryland Department of Agriculture, Department of Public Works, and Planning staff currently doing WIP work.

- Key Maryland Department of Natural Resources staff that deal with land management or are doing WIP work.

- Local and regional watershed groups that are actively doing projects in cooperation with counties to meet WIP goals.

Although the meetings will be open to the public, the goal is to get feedback from those familiar with WIPs related to the draft CWIP strategy. It is anticipated that the meeting format will be the same for all three initial stakeholder workshops in Maryland. The anticipated format is:

- The CIT, led by the Harry R. Hughes Center and MD Sea Grant Extension in partnership with the Center for Watershed Protection, Inc. (CWP) with support from the Chesapeake Conservancy will start with introductory remarks, the history of and need for a Conowingo WIP, the identification of selected watersheds, and workshop objectives.
- CWP and the Chesapeake Conservancy will provide a technical overview regarding the BMP identification and selection process and the implementation opportunity maps that resulted from this process.
- The Harry R Hughes Center and MD Sea Grant Extension will facilitate breakout sessions for attendees' geography (e.g. county, watershed, other jurisdiction) and get feedback on initial concerns, potential for proposed BMPs, areas that are missing, constraints, and ongoing activities, which will be used to inform revisions to the next iteration of the draft Conowingo WIP.
- The Harry R Hughes Center and MD Sea Grant will compile feedback from all three workshops and provide to the Steering Committee through CWP.

The project team members will also coordinate closely with Activity Teams 2 and 3. These teams will be invited to present at the workshops and share status updates on their respective activities.

Communications

The CIT members will utilize its *Constant Contact* database it developed during the Phase III WIP process to send out initial workshop notices and can include the ability for respondents to ask questions that can be passed along to the CIT.

December 2019 – June 2020

During this timeframe outreach will focus on identifying project opportunities to reduce loads associated with the CWIP

December 2019 – **January 2020:** Front-load ***Constant Contact*** email addresses.
January 2020: Select three locations for Maryland Stakeholder Engagement Workshops (on hold due to COVID-19)
April – May 2020: Hold 3 web-based workshops with 1 focused specifically on Maryland.
March – June 2020: Provide workshop feedback to EPA and the CWIP Steering Committee

July 2020 – June 2021

Upon finalizing the CWIP and draft two-year milestones, outreach will focus on delivering the CWIP and collecting data on specific projects that will be implemented to achieve the two-year milestones. The CIT, led by the Harry R. Hughes Center, also organizes regular statewide WIP meetings and will allow for alignment of WIP III and CWIP meetings.

July – August 2020: Conduct a webinar to share the Final WIP.

October – December 2020: In-person regional engagement meetings to solicit input on two-year milestones due January 2021.
February 2021: Roll out of the BMP opportunity blueprint with support to local stakeholders on the data tools produced to support planning of projects to implement the WIP.

Years 3 - 6

During this timeframe outreach will focus on providing technical assistance to local stakeholders to support implementation and reporting of projects toward meeting the two-year milestones by providing access to partner-led and external training opportunities. The CIT will also reconvene local stakeholders in eight communities at the conclusion of each two-year milestone deadline to evaluate progress and make recommendations on the next set of two-year milestones.

Programmatic and Numeric Implementation Commitments

Conowingo Implementation Program Structure

The Conowingo Implementation Program is structured to dovetail and work in tandem with financing institution and existing state or grant programs to deploy implementation funds in the most efficient way possible while providing thorough review and oversight of project offers and contracts.

Implementation of projects funded for the purpose of reducing nutrient loads associated with the Conowingo WIP could occur through two primary pathways:

1. Existing State cost-share programs
2. Directly through Pay-for-Performance (or similar contracts)
3. In partnership with foundations/grant making organizations

Existing State Cost-Share Programs

To prevent the development of duplicative or redundant programs, implementation of the Conowingo WIP could take advantage of implementation programs identified in the jurisdictions' WIPs. The jurisdictional WIPs provide a complete list of programs currently in place with information on what areas of implementation the program covers. Each Bay jurisdiction has a network of programs that could be utilized based on the selected BMP strategy, while this document only focuses on a few key programs in each jurisdiction that are in-line with the Conowingo WIP implementation goals.

Pennsylvania

The Conservation Excellence Program is a grant program administered by the State Conservation Commission and provides technical assistance and project funding through a mix of grants, low-interest loans, and tax credits to help farmers and landowners implement conservation BMPs.

The Environmental Stewardship Fund is a dedicated fund used for environmental restoration and conservation and community revitalization projects. Funds from the Environmental Steward Fund are directed to: the Department of Agriculture, the Department of Environmental Protection, the Department of Conservation and Natural Resources, and PennVEST for water and wastewater treatment facilities, and grants to local governments and nonprofits.

Maryland

The Maryland Agricultural Water Quality Cost-Share (MACS) Program is administered by the Maryland Department of Agriculture and provides farmers with grants to cover up to 87.5 percent of the cost to install conservation measures known as BMPs on their farms to prevent soil erosion, manage nutrients and safeguard water quality in streams, rivers and the Chesapeake Bay. The MACS program provides implementation cost-share funding and support for more than 30 BMPs currently like grassed waterways, streamside buffers, and animal manure management systems.

Virginia

Agricultural BMP Cost-Share (VACS) Program: The cost-share program supports the use of various practices in conservation planning to treat cropland, pastureland, hay land and forested land. Some are paid for at a flat rate or straight per-acre rate. Others are cost-shared on a percentage basis up to 100 percent. In some cases, the United States Department of Agriculture (USDA) also pays a percentage. All practices in the program have been included because of their ability to improve or protect water quality.

The Virginia Conservation Assistance Program (VCAP): is an urban cost-share program that provides financial incentives and technical and educational assistance to property owners installing eligible BMPs in Virginia's Chesapeake Bay Watershed. Qualified sites include residential, commercial, or recreational lands with a proposed practice that addresses a water quality need.

Delaware

Delaware Chesapeake Bay Implementation Grant Program is a grant funding program for BMP implementation projects that reduce nutrient and sediment loads. The available funding is used to assist with implementation of BMP projects identified in Delaware's Chesapeake Bay Watershed Implementation Plan. The program prioritizes projects that demonstrate cost-effective approaches to measurable water quality improvements and targets cost-effective BMPs (e.g., forest buffers, water control structures, tree plantings, grass buffers, cover crops, and wetland restoration). Eligible applicants include: State agencies, county or municipal governments, conservation districts, not-for-profit organizations representing local governments, watershed organizations, community organizations, and/or homeowners' associations within the State of Delaware's portion of the Chesapeake Bay watershed.

New York

New York Agricultural Non-Point Source Abatement and Control Program is a cost-share grant program that provides funding to address and prevent potential water quality issues that stem from farming activities. Financial and technical assistance supports the planning and implementation of on-farm projects with the goal of improving water quality in New York's waterways. The program seeks to support New York's efforts to implement BMP systems that improve water quality and environmental stewardship. The program prioritizes water quality protection projects including nutrient management through manure storage, vegetative buffers along streams, and conservation cover crops. The program is a competitive grant program, with funds applied for and awarded through county Soil and Water Conservation Districts.

West Virginia

The West Virginia Agricultural Enhancement Program is administered by the West Virginia Conservation Districts with assistance from the West Virginia Conservation Agency. The program has been developed to assist the agricultural cooperators of West Virginia Conservation Districts with the voluntary implementation of BMPs on West Virginia agricultural lands in order to conserve and improve land and water quality. The program offers technical and financial assistance to implement priority BMPs. A primary objective of the program includes the reduction of nutrients and sediment from entering the States waters.

Program Support

Most of the jurisdictional implementation programs utilize conservation districts, local governments, and or local partners to deliver technical support and/or funding. As a result, the local programs have the technical and administrative ability to implement, track, and enforce BMPs and management plans in a manner that is consistent with Chesapeake Bay Program requirements and specifications. While the technical and administrative ability to implement these BMPs are, for the most part, already in place to implement projects, the capital and human resources to increase the rate of implementation to meet CWIP goals is not in place. Based on discussions with State agency staff, a ramp up of implementation above WIP III goals will require additional communication, outreach and/or incentives to allow implementation to move forward. Since the Conowingo WIP requires additional implementation beyond WIP III, costs associated with outreach and education will likely increase since the landowners who are currently or likely to be cooperators have already been integrated into WIP goal-setting and increasing implementation will require working with landowners that, to date, have not expressed significant interested in adopting some of the BMPs needed to achieve the WIP goals.

The cost of the CWIP implementation ramp up will likely vary across Bay jurisdictions and BMP types. However, based on discussions with State agency staff, it is estimated that local programs will need at least 8 - 15% of the BMP implementation costs to support the additional technical and administrative needs. This cost can be refined based on the selected implementation strategy.

Pay-for-Performance

The CWIP Implementation can also address the PSC's Efficiency in Innovation Principle by using Pay for Performance (PFP) solicitations and contracts to deploy implementation funding directly to the highest performing projects. These types of contract mechanisms align the incentives of permittees and implementers to cost-effectively produce and sustain pollutant load reductions that achieve water quality goals and could focus funding to large-scale conservation practices with desirable co-benefits. This implementation approach would link payments to pollutant load reductions, rather than, or in addition to, reimbursing expenses typical of grant-based funding programs, and minimizes risk of funding ineffective projects that do not deliver intended results (Praul, n.d.). The success of this approach for project implementation has been demonstrated by several jurisdictions and agencies in the Chesapeake Bay Watershed including programs administered by Anne Arundel County, Maryland Depart of the Transportation State Highway Administration, and Pennsylvania Department of Transportation. This project delivery strategy leverages existing programs and private sector capacity by providing access to CWIP funds through a future contracting process that will have well-defined metrics and goals. Further, PFP contracts can be structured to lessen the financial burden of public funds as project offerors seek practices to achieve measurable CWIP outcomes that are most nitrogen cost-effective and dovetail with the Chesapeake Bay load reduction outcomes. These contract solicitations can also be developed to account for secondary and co-benefits (habitat, flood control, etc.).

The PFP strategy can be utilized to incentivize the private sector to develop and demonstrate new implementation approaches that achieve additional efficiencies by assigning risk and adjustment factors to a variety of project opportunities. To allow for this flexibility and innovation, funding decisions would be informed through the use of "Project Tiers" to evaluate a level of risk associated with a variety of specific BMPs. This tier-based system allows stakeholders and project offerors the flexibility to innovate, optimize, and incorporate efficiencies into a variety of restoration strategies that are proven to offer nitrogen load reduction performance while taking risk factors into consideration. Figure 3 shows how specific BMPs are categorized into these project tiers.

Tier I- Lowest Relative Risk

Tier I projects are considered priority BMPs in the Conowingo WIP are mostly land based, and therefore easier to track and verify over time. They have established and approved Chesapeake Bay Program protocols and credit calculations. They are currently being widely implemented and likely have habitat and other co-benefits. These projects offer the lowest relative risk due to the ability to provide clear guidance on project specifications and credit and ease of tracking and verifying.

Tier II- Moderate Relative Risk

Tier II projects are either not land-based or more difficult to track, verify, and credit. They have or will soon have an approved Chesapeake Bay Program protocols and credit calculations. Currently, some are not widely implemented or the technical and site-specific requirements to identify and develop load reduction estimates for a specific project in the Conowingo WIP are not feasible at this time. These projects offer a moderate level of risk due to the ability to provide clear guidance on project specifications and credit but are more difficult to track and verify.

Tier III- High Relative Risk

Tier III is designed to provide a pathway for innovation and may or may not be land based BMPs but do not have an approved Chesapeake Bay Program protocol or credit at the time of this draft. However, these practices may be approved at some future point based on current research (STAC workshop recommendations) or an activity under study such as dredging. These practices may have significant potential for load reduction, but additional research and development will be required to document water quality improvement metrics. These projects offer the highest risk because there are no specifications or credit at this time, but pilot projects (such as the Maryland Dredging Pilot Project) could generate data to support a specification and credit in the future. These projects would be evaluated on a case-by-case basis based enough data and monitoring to document load reduction and the level of risk funders are willing to accept.

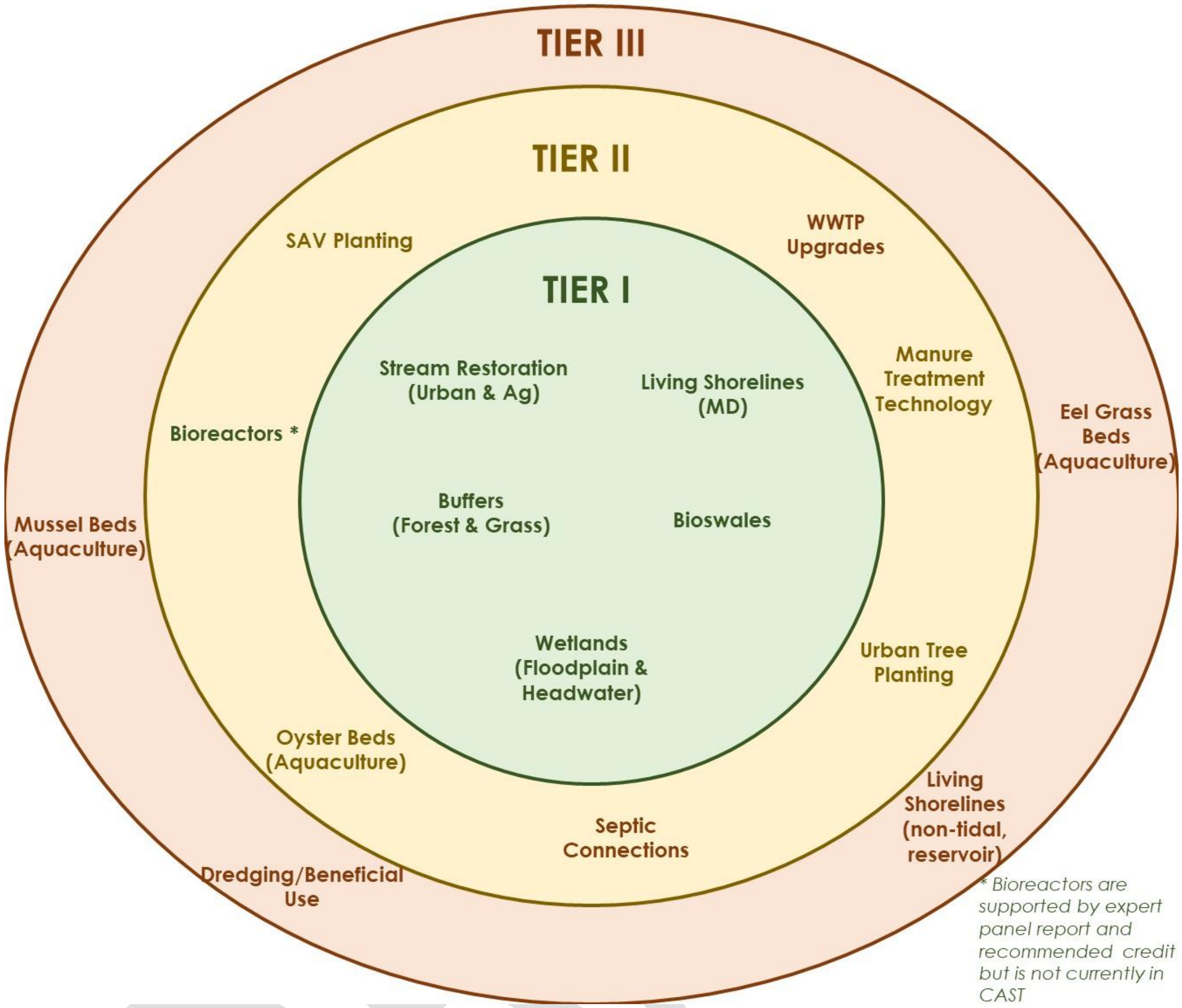


Figure 3. BMP project tiers matrix

Conowingo Implementation Team

The pay for performance strategy will use a management team (Conowingo Implementation Team, CIT) to:

- Evaluate project offers on a technical basis
- Evaluate project offers on a cost basis
- Develop and execute performance-based contracts
- Review, monitor, and track individual contracted project progress
- Confirm, verify, and track completed contracted projects
- Make payments based on the terms of the contrast
- Ensure the practices funded by the contract are tracked as CWIP projects and are not double counted.

The CIT will work with stakeholders, landowners, local jurisdictions, and the private sector to:

- Provide information and education to increase the awareness of the CWIP Implementation Program and the technical requirements of the PFP contract solicitation including the review process for priority practices that are eligible, metrics for evaluating project offers, and the process for including Tier II or Tier III practices in project offers.
- Provide GIS resources and information to help interested parties identify the most nitrogen cost-effective locations, through the BMP Opportunity Analysis (Appendix D)
- Provide case-study examples of successful projects (when available)
- Ensure coordination of CWIP implementation with WIP III implementation at the local and jurisdictional level

The CIT will be created and tasked with review and tracking for project investments at all stages of implementation with staff resources focusing on managing the program as opposed to managing the implementation of individual projects. The technical leads for the CIT are the Center for Watershed Protection and the Chesapeake Conservancy. As technical leads, these organizations provide direct support to stakeholders working to identify and implement Conowingo WIP projects. This may include the following:

- Assistance understanding contract solicitation requirements
- Educate interested parties on uncertainty, edge of tide, and exchange ratios when developing responses
- Site visits to review and document current conditions of specific sites
- Provide GIS products to facilitate project identification, review, verification and calculation of Conowingo WIP credit

The CIT would consist of members to that can fulfill the following roles and responsibilities:

Conowingo Implementation Program Manager: Oversee and manage the Implementation Team, participate in the technical review, act as a point of contact with the CWIP Steering committee and CBP, identify and contract with additional experts (as needed) to evaluate innovative project ideas, act as point of contact with project offerors, oversee project verification and documentation *(the Center for Watershed Protection will function in this role).*

Restoration Experts: Participate in the technical review by reviewing and commenting on the project approach, design, location, feasibility, and potential co-benefits. Restoration experts are individuals with a demonstrated track record of successful implementation of similar projects.

Civil Engineer: Participate in the technical review by reviewing and commenting on the project approach, design, location, feasibility, and potential co-benefits. Engineers are licensed or otherwise qualified experts with a demonstrated track record (*the Center for Watershed Protection with contractor support will function in this role).*

GIS Specialists: Participate in the technical review by using available data and tools to review specific solicitation responses for potential primary and secondary benefit and develop tools to help stakeholder and interested parties identify and assess nitrogen cost effective opportunities *(the Chesapeake Conservancy will function in this role)*

Modeler: Participate in the technical review by reviewing and double-checking modeled load reduction estimates provided in specific solicitation responses *(the Center for Watershed Program with support from EPA, and/or contractors will function in this role).*

Pay-for-Performance Contract Expert/Procurement Professional: Participate in the contract development and execution process, develop contract solicitation language and pay for performance contract language. (*a qualified contractor will function in this role).*

Funder Representative: Participate in the contract development and execution process, develops contract solicitation language, and pay for performance contract language, processes requests for payments, distributes funds. (This role will need to be further defined based on the financing strategy).

Outreach Specialists: Participate in outreach and education events developed for local stakeholders, landowners, and the private sector and provide information on contract solicitations and responses, CWIP tools and resources, and updates on progress or changes in the program *(the Chesapeake Conservancy, Center for Watershed Protection, University of Maryland Sea Grant Extension, and Harry R. Hughes Center will function in this role).*

The technical review process will require support from qualified contractors who have specific knowledge and skills in key areas. The CIT Program manager will identify potential contractors for each role using a request for qualification process to identify candidates that possess the required skills. The selection criteria will ensure there are no conflicts of interest by disqualifying any reviewers from consideration if they are part of a project offer in that cycle. Once qualified, potential contractors will provide hourly rate costs which will be used as the basis for competitive selection. The CIT Program Manager will provide a roster to EPA and the Steering Committee of all selected contractors with a brief resume for approval. Approved contractors will be compensated based on their approved hourly rate and a predetermined number of hours to participate in the review process.

Conowingo Implementation Program Process

The CIT Program Manager will solicit contracts one-time per year with payment terms tied directly to the CWIP nitrogen load reduction goals. The contract solicitation will require that project offers utilize Chesapeake Bay Program protocols and specifications in the responses and FieldDoc as part of the submittal process which will be evaluated for technical merit. Through the use of FieldDoc, project bids will document the location of the project which will allow the CWIP credit calculation to apply Edge of Tide and/or the Exchange ratios.

Exchange ratio is the adjustment factor applied to all projects located outside of the Susquehanna watershed to compensate for the adjusted level of effort required to achieve comparable results in the Susquehanna watershed.

Edge-of-Tide ratio is the adjustment factor applied to all projects to normalize loads based on delivery to the mainstem of the Chesapeake Bay. The appropriate factor shall be calculated using assessment tools consistent with the Chesapeake Bay Program modeling tools and accepted by the Partnership (Davis-Martin, 2017).

All project offers will be thoroughly evaluated by the Conowingo Implementation Team for technical merit and will take into account project location when evaluating the credit. The technical review approach will be similar to the Maryland Water Quality Trading Program which utilizes uncertainty ratios and Edge-of-Tide ratios to adjust for specific project types and locations. This analysis, which is consistent with methods used to define the priority basins, provides stakeholders and interested parties the ability to identify project locations within the selected Conowingo WIP geography that have the capacity to deliver the largest nitrogen reductions.

This approach supports the PSC's stated goal of developing a process by which preferred practices, targeted geographic locations and implementation projects will be selected and deployed and the PSC's Transparency Principle by providing a contracting mechanism for project implementation that can transparently document practices that are funded by and implemented for credit towards achieving Conowingo WIP goals.

Pay-For-Performance Project Selection Process

The CIT will develop an implementation process that is transparent and identifies cost-effective projects for implementation to make progress towards the CWIP load reduction of 6 million pounds of nitrogen. A six-step process is proposed from contract solicitation and technical review to project acceptance and verification (Figure 4). Each of these steps is described below.

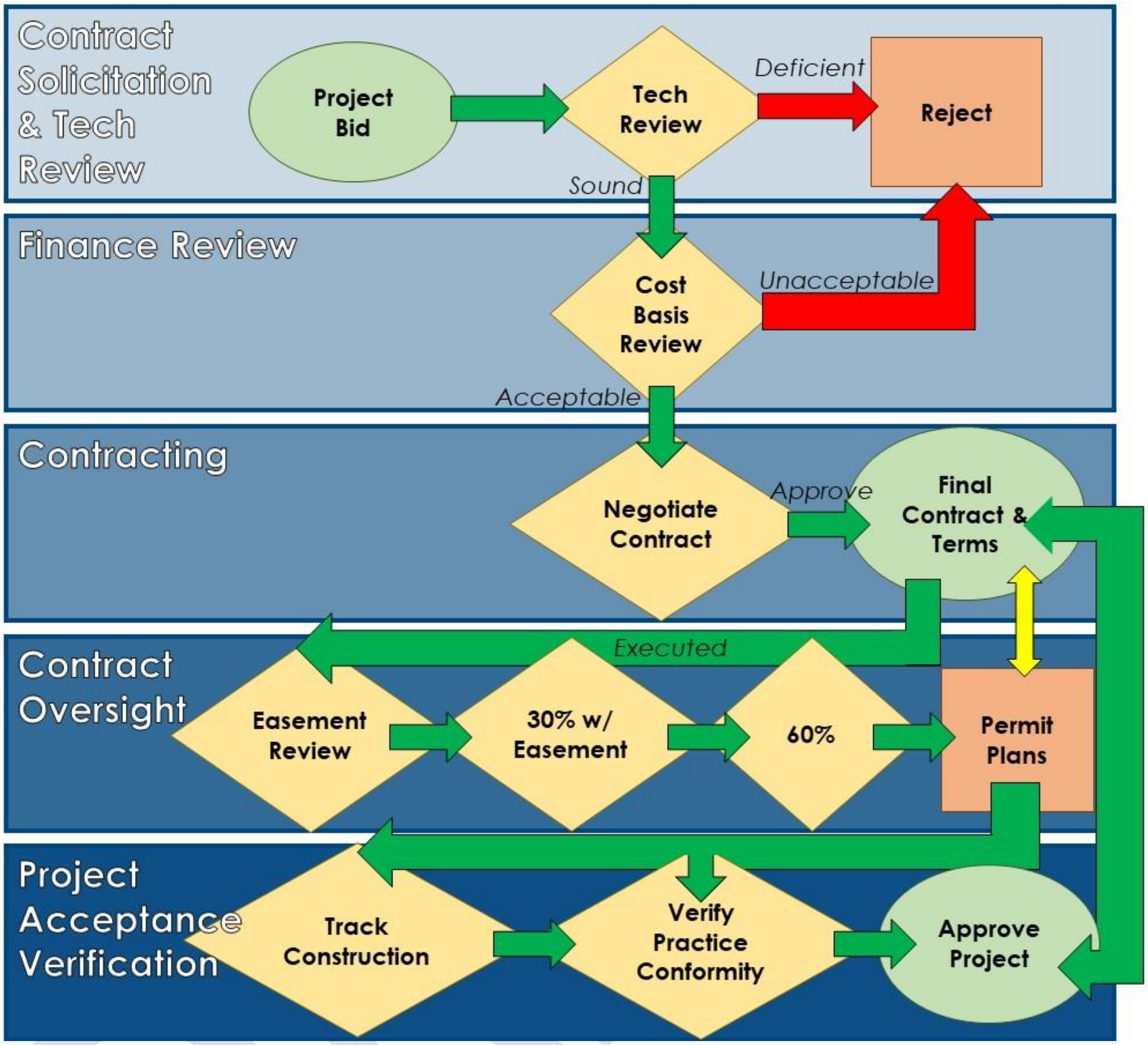


Figure 4. Pay-for-Performance project selection and verification process.

Solicitation Outreach

One time per year the CIT in conjunction with the Financing Institution will release a solicitation for project offers using the PFP approach. The solicitation will clearly outline the practices that are eligible as Tier I and the process to bring in Tier II projects, that total nitrogen is the target/goal, and the methods and metrics for calculating load reductions. Tier III projects, such as dredging and benefited recuse, are innovative projects that could produce cost-effective nutrient reductions but are not currently credited, as such these project opportunities would be evaluated separately and would include requirements for performance monitoring. The solicitation will also include key contract language and provisions. The CIT will utilize existing Pennsylvania County Action Team meetings, regional partnership meetings, WIP III meetings, other appropriate meeting venues and webinars to raise awareness of the Conowingo Implementation Program and the PFP solicitation details and requirements.

Project Offer Review

The CIT will review all submitted project offers. Project offers will be required to provide sufficient design detail and documentation consistent with Chesapeake Bay Program standards and protocols to determine if the design approach is sound, feasible, and creditable. This process will begin with a technical review which will evaluate the technical details of all projects including project location, BMP practice(s), design, credit calculation, feasibility, risk, co-benefits (if applicable) and easements/agreements. The process may include site visits to confirm and evaluate conditions at the proposed site. Any project deemed technically deficient in any area will be removed from consideration; projects deemed technically sound will move to the cost basis review. Based on the amount of funding available, the CIT will award contracts to the lowest responsive and responsible bidder (the bidder with the lowest cost who also meets all the required qualifications and submittal requirements) who proposes the BMP to reduce the most nitrogen from the Chesapeake Bay in the most cost-effective manner.

Contract Negotiation

The project offeror, the CIT, and the Finance Institution will negotiate and enter into a contract that uses nitrogen reduction as the primary metric of concern. Co-benefits as supplemental could also be integrated into the performance metric if desired. Contract language will need to be developed in conjunction with the Finance Institution to address payment terms, transfer of lability, performance standards, etc. Additionally, provisions could be included in contracts allowing the nitrogen reduction credit to increase with documented monitoring supporting the increases (e.g. stream restoration) and allowing for adjustments in payment based on the documented increased performance metrics.

Contract Oversight

The CIT will provide administrative oversight of the contracts to ensure adherence to the contract terms and timely delivery. Oversight would occur at specific phases of the contract work plan. This oversight would focus primarily on ensuring protocols and specifications are being followed to generate the contracted performance metrics.

Project Acceptance Verification

Once operational, the CIT will conduct site visits to verify that the contracted project has been implemented in manner consistent with the contract and the established standards and specifications. Once all project elements are verified, the project will be accepted for payment. Projects will be re-verified on a periodic basis to ensure credit generation throughout the length of the contract.

Coarse BMP Opportunity Assessment

As this CWIP serves as a starting point for outreach and coordination with local stakeholders, the CIT developed a Coarse BMP Opportunity Assessment that identifies the potential implementation opportunities associated with several priority BMPs at the county-scale to help inform the development of the CAST scenarios. The specific location and type of BMPs will be further refined in the BMP Opportunity Analysis which will be completed subsequent phases of the CWIP implementation as described in the Programmatic and Numeric Implementation Commitments section. The BMPs considered in this initial analysis were selected in consultation with the Steering Committee, as they address both developed and agricultural load sources, are accepted BMPs by the Partnership and data is available to map the extent of available area for future implementation. The BMPs included: wetland restoration, forested buffers, and living shorelines. The BMP opportunities analysis included the identification of areas within the Susquehanna + Most Effective Basins geography identified in the PSC Framework document where there is: 1) suitable watershed and land cover characteristics to implement wetlands, forested buffers, and living shoreline BMPs within the counties; 2) area within a specific landscape for the BMPs to have the greatest corresponding load reductions in the Chesapeake Bay and; 3) additional opportunities for nitrogen load reductions over and above the jurisdictions' Phase IIII WIP goals as estimated from the difference between the "E3" and Phase III WIP scenarios. The data sources and methods used to derive the BMP opportunities are included in Appendix C.

Figures 5, 6 and 7 illustrate the extent to which four of these BMPs may be implemented.

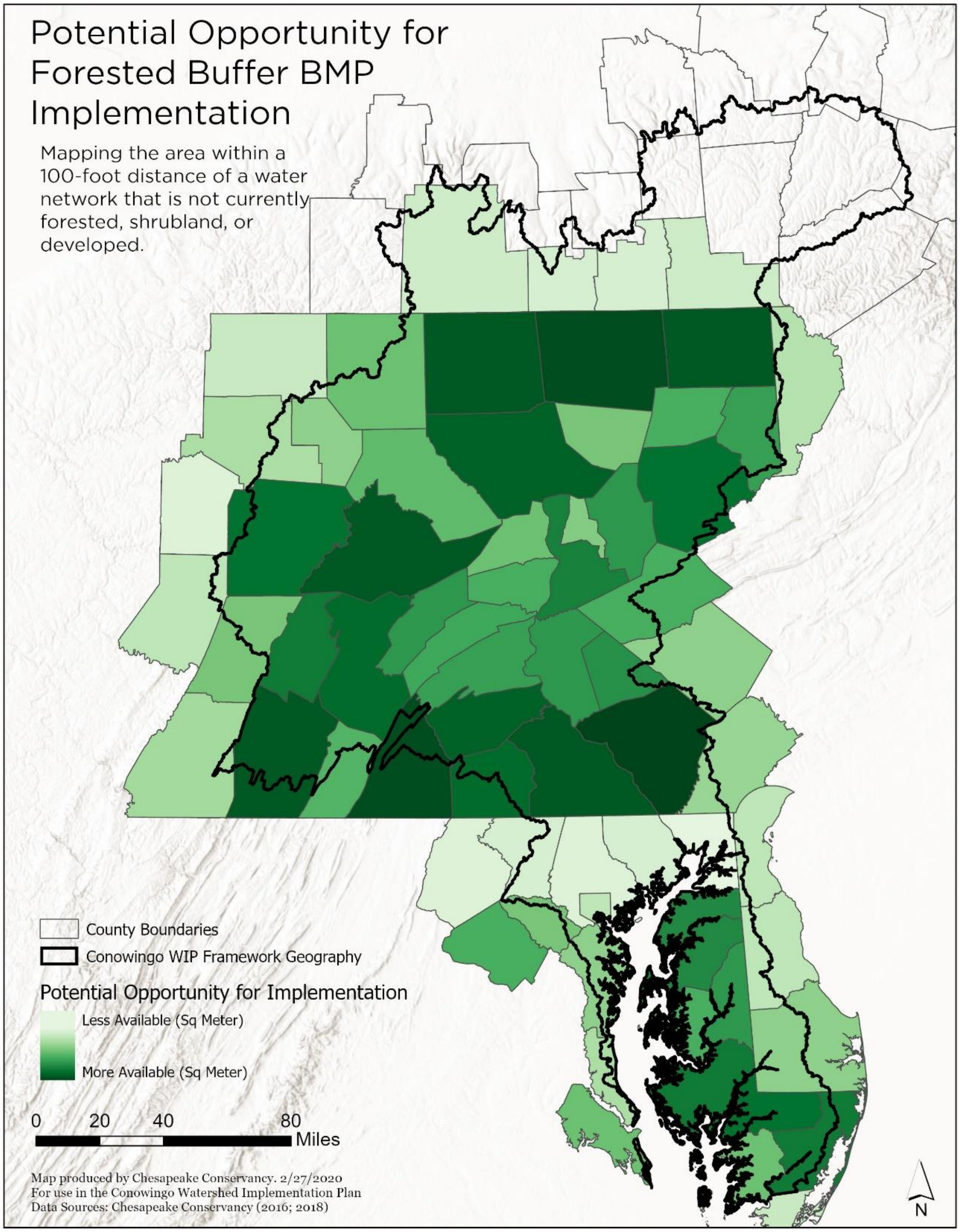


Figure 5. Opportunity to implement forest buffers within the Susquehanna + Most Effective Basins

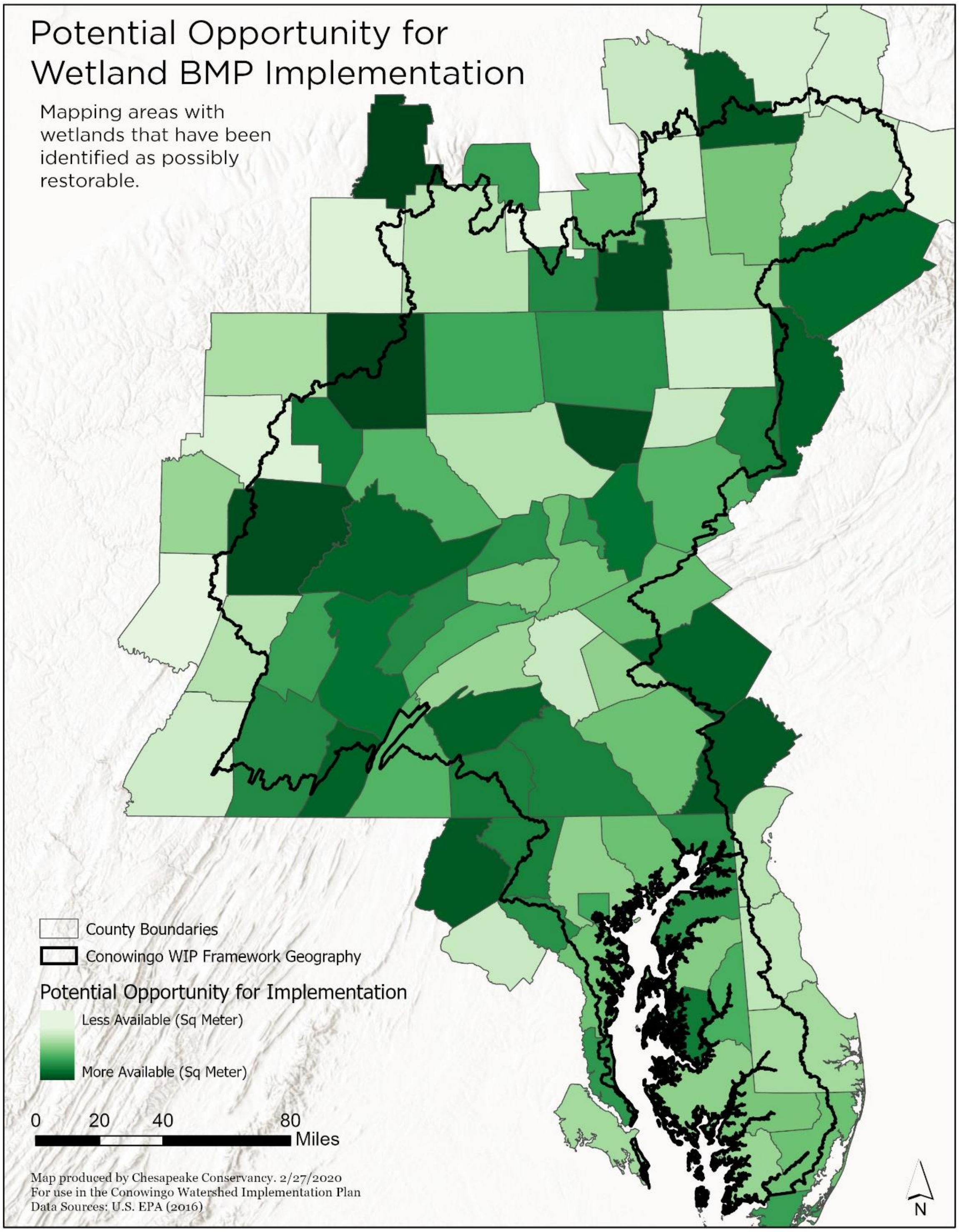


Figure 6. Opportunity to implement wetland restoration within the Susquehanna + Most Effective Basins

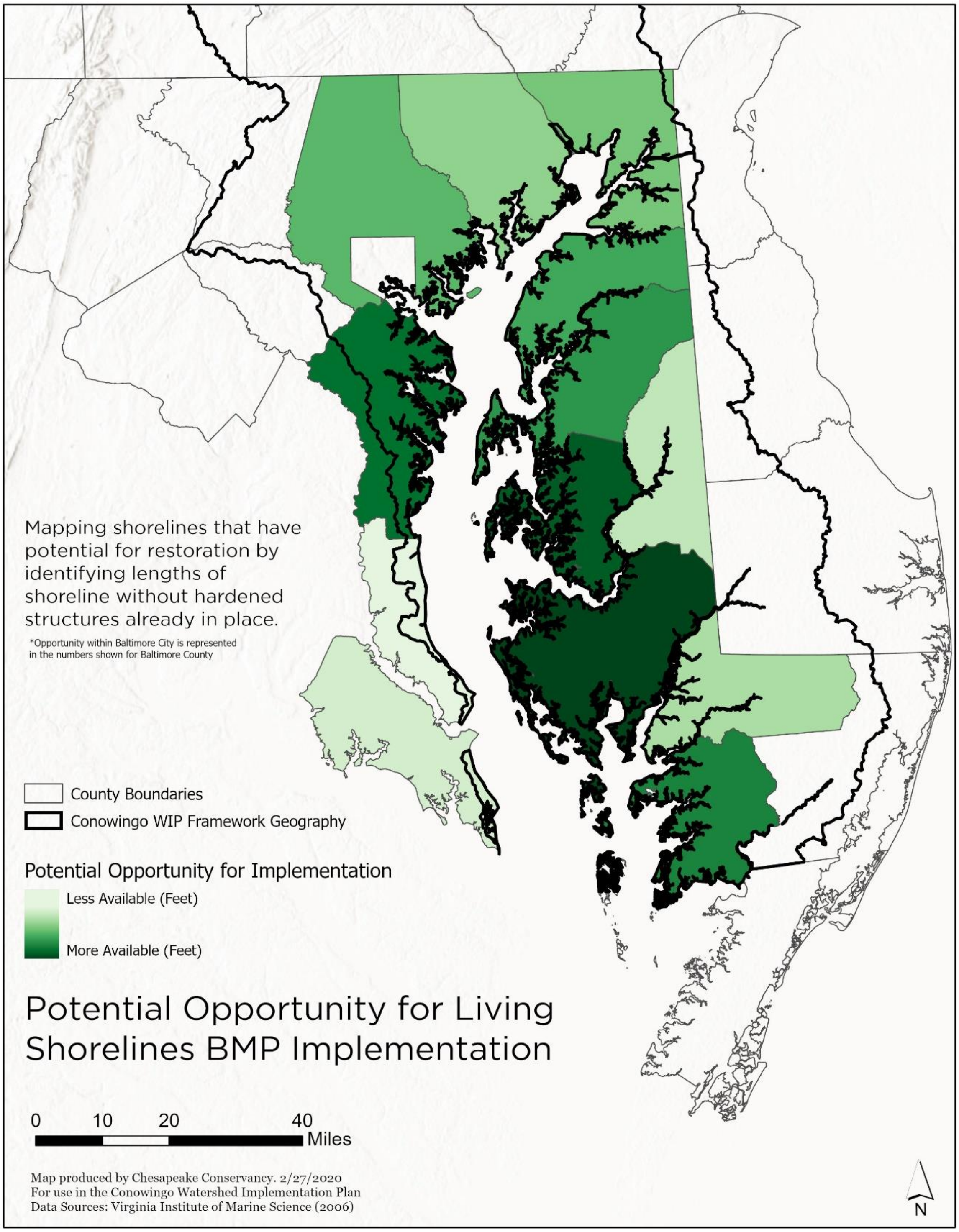


Figure 7. Opportunity to implement living shorelines within the Susquehanna + Most Effective Basins

CAST Scenarios

Scenario 1: Constrained

This scenario refines the BMP scenario from the previous CWIP draft by removing bioreactors and increasing forest buffers as a replacement for the bioreactors.

Scenario 1. Constrained Scenario	
Geographic Extent	Susquehanna River Basin (PA) + Western and Eastern Shore (MD) Geobasins
Primary BMPs	Forest Buffers, Wetland Restoration, Stream Restoration, Living Shorelines, Bioswales
States Included	Maryland, Pennsylvania
N Reduction	6,000,026
Total Annualized Cost	$367,838,818
Cost Per Pound	$61.31

Scenario 1 Geography

This geographic option, presented in the CWIP Framework as the "Susquehanna + Most Effective Basins," represents the entire Susquehanna Basin along with the major State basins that are most effective for improving DO in the Chesapeake Bay based on reducing phosphorus in the watershed. The top six most effective basins for phosphorus represent a statistical break in the data and when combined with the three Susquehanna basins provide a simple, consolidated boundary within which to target the CWIP. Figure 8 illustrates this geography, which includes the Susquehanna, Western Shore, and Eastern Shore (Upper, Middle, and Lower) geo-basins. This boundary was selected by the PSC as the geographic focus for the CWIP and was used to develop the initial CWIP BMP scenario. This scenario focuses BMP implementation on counties whose entire land area is fully contained within the boundary. This scenario excludes jurisdictions in New York and Delaware due low effectiveness, MS4 jurisdictions in Maryland outside the Susquehanna basin due to the amount of regulated land.

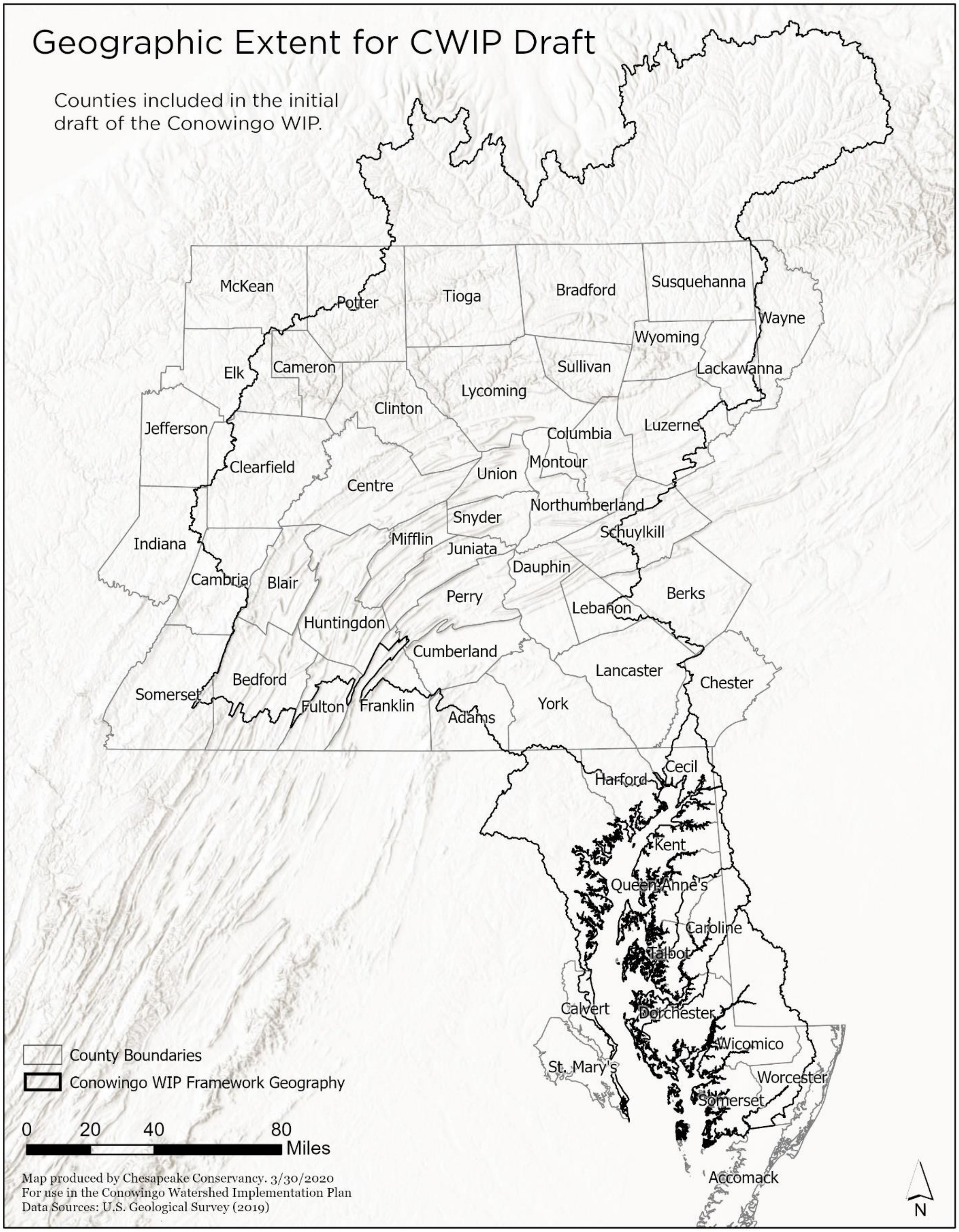


Figure 8. Scenario 1 Geography

Scenario 1 BMPs

This implementation scenario was developed to demonstrate the modeled nitrogen load reduction to the Bay based on BMPs that were selected collectively by the Steering Committee because they have the most capacity for additional implementation above their Phase III WIPs' commitments. Further, the BMPs address both developed and agricultural load sources, are accepted BMPs by the Partnership and data is available to map the extent of available area for future implementation (Table 5)

Table 5. Summary of acres of BMP implementation for Scenario 1

Proposed BMPs in Scenario 1 - Constrained Scenario				
Practice	**Unit**	**Maryland**	**Pennsylvania**	**Total**
Agriculture Practices				
Forest Buffers on Fenced Pasture Corridor	Acres in Buffers	8,580	95,804	104,384
Forest Buffers	Acres in Buffers	16,111	44,960	61,071
Wetland Restoration	Acres	6,586	34,326	40,912
Non-Urban Stream Restoration	Feet	419,995	2,959,918	3,379,913
Non-Urban Shoreline Management	Feet	773,022	-	773,022
Urban Practices				
BioSwale	Feet	2,415	12,137	14,552
Urban Stream Restoration	Acres	324,384	1,358,957	1,683,341

Scenario 1 Loads Results

The data sources and methods used to quantify the load reductions are included in Appendix E. This initial BMP implementation strategy achieves the required reduction of 6 M pounds annually (Table 6).

Table 6. Summary of Scenario 1 nitrogen load reductions

N LOADS FOR SCENARIO 1. CONSTRAINED SCENARIO				
STATE	**Sector**	**WIP 3 N EOT**	**WIP3 Plus 25 N EOT**	**N Reduction**
MD	Agriculture	13,840,672	12,989,629	851,043
	Developed	7,684,437	7,674,370	10,067
	Natural	6,271,233	6,089,006	182,227
	Septic	2,545,801	2,545,801	-
	MD Total	**30,342,143**	**29,298,806**	**1,043,337**
PA	Agriculture	39,428,949	35,123,923	4,305,026
	Developed	14,874,103	14,798,709	75,394
	Natural	17,459,042	16,882,773	576,269
	Septic	1,985,752	1,985,752	-
	PA Total	73,747,846	68,791,157	4,956,689
TOTAL		**104,089,990**	**98,089,964**	**6,000,026**

Scenario 1 Cost

Table 7 provides an overview of the costs associated with implementation of the BMP scenario identified in **Error! Reference source not found.**6. The annualized costs are derived from the Chesapeake Bay Program's Chesapeake Assessment Scenario Tool (CAST). This scenario is the least cost-effective option, largely because many agricultural practices were not incorporated, and due to efforts to restrict the loss of cropland.

Table 7. Summary of costs for BMPs Implemented in Scenario 1

Annualized Costs by State and Sector for Scenario 1. Constrained Scenario				
	Agriculture	**Developed**	**Natural**	**Total**
MD	7,127,298	2,388,661	55,299,681	64,815,641
PA	73,290,317	12,003,399	217,729,462	303,023,178
Total	80,417,615	14,392,061	273,029,143	367,838,819

These costs should be considered as initial estimates only and may change significantly on a per unit basis depending on how projects are financed and the scale at which the projects are implemented. As stated in the Pennsylvania Phase III WIP, there are other important sources of cost variability, including:

- Changes in technology, protocols, and/or credit inputs for BMPs. The cost structure to inputs for many of these practices has changed and continues to change as protocols are updated and the cost for raw materials, transportation, labor, etc. evolve.

- Design and scale can significantly drive cost estimate variation by several orders of magnitude. The use of full deliver contracting for CWIP implementation can drive the private sector to find efficiencies through design and create scalable implementation opportunities.

- Variation in Local costs. Although the CAST includes Maryland and Pennsylvania default costs the CWIP priority geographies are spread across as large geographic area and local economic conditions as well access to labor and materials.

- O&M assumptions and real costs. Each BMP has an estimated cost associated with O&M however design, location, materials, implementation methods, and weather are just a few factors that can impact both short- and long-term O&M Costs.

These costs do not include associated financial services costs or technical assistance costs provided at the local level to facilitate implementation of CWIP specific BMPs. Those additional costs will be identified during the outreach phase and with input from the Financing Strategy.

Scenario 2: Enhanced WIP Implementation

This scenario considers that there may be additional opportunity to implement WIP III BMPs which can be credited towards the CWIP. The scenario assumes a 25% increase in implementation of BMPs at the WIP III level of implementation within the geographic areas defined below.

Scenario 2. Enhanced WIP Implementation	
Geographic Extent	Susquehanna Basin Plus N-Effective LRSs outside the Susquehanna.
Primary BMPs	All BMPs at the WIP3 Implementation Level
States Included	Maryland, Pennsylvania, Delaware, New York, Virginia, West Virginia
N Reduction	6,098,728 lbs.
Total Annualized Cost	235,908,443
Cost Per Pound	$38.68

Scenario 2 Geography

This geography includes the entire Susquehanna River basin, along with additional Land River Segments in the top quartile for relative effectiveness (based on nitrogen reduction) in the Chesapeake Bay Watershed. The dark areas in Figure 9 highlight the upper quartile segments.

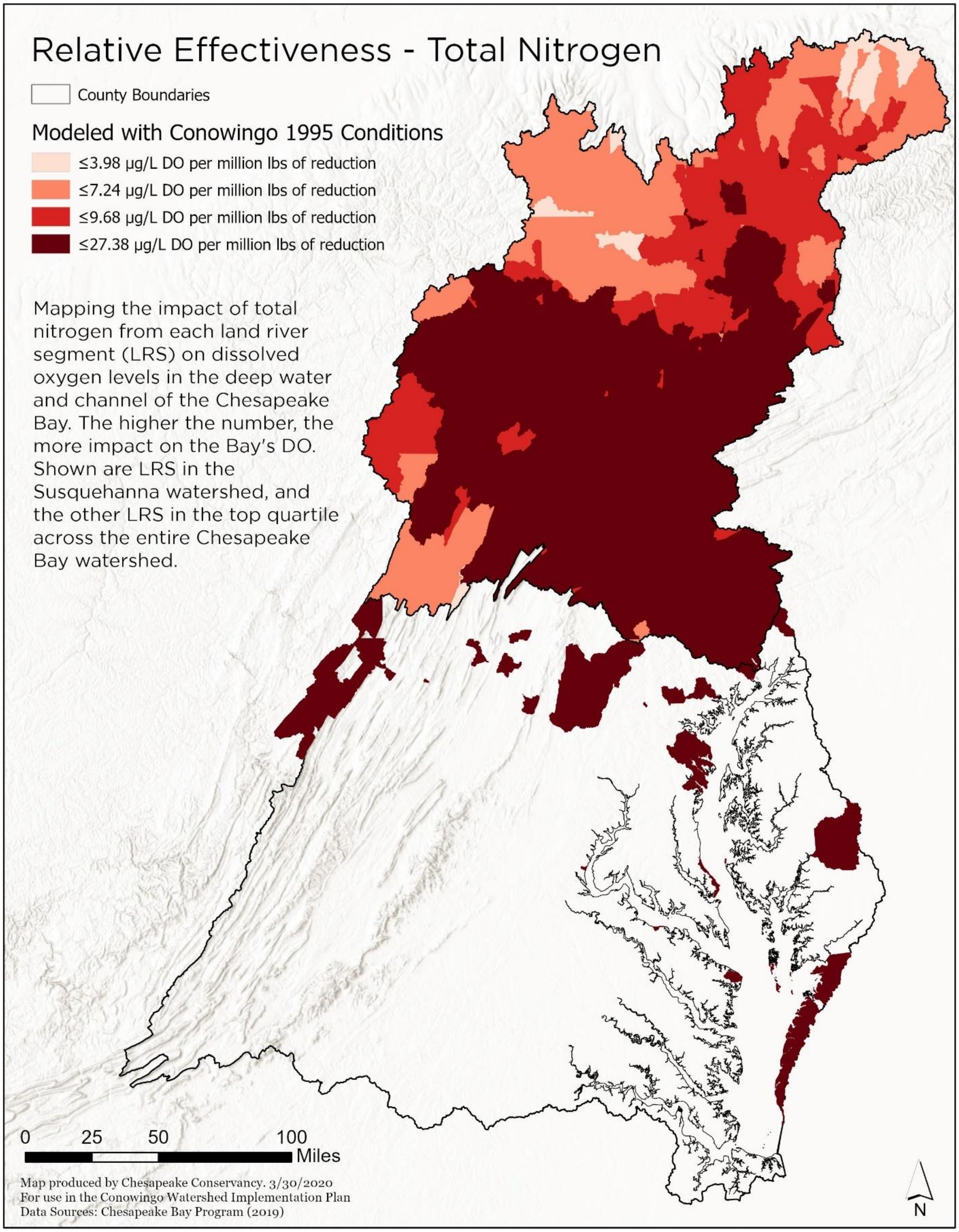


Figure 9. Scenario 2 Geography

Scenario 2 BMPs

This implementation scenario was developed to demonstrate the modeled nitrogen load reduction to the Bay based on BMPs that were selected by the States as part of their WIP III strategies. These BMPs address both developed and agricultural load sources, are accepted BMPs by the Partnership and data is available to map the extent of available area for future implementation. This scenario is used to illustrate the ability to achieve the needed load reductions by increasing the scale, scope, or number of projects. Additionally, this scenario could integrate with a strategy that involves participation in a trading program where load reduction credits are available from WIP III projects that exceed their individual project goals and produce additional tradable credit. The BMPs included in this scenario include those in the State WIPs, as well as others implemented prior to the WIP[2], and are provided in Appendix H.

Scenario 2 Loads Results

This BMP implementation strategy, as shown in Table 8, achieves the required reduction of slightly over 6 million pounds annually.

[2] The full suite of BMPs included in this scenario can be refined to reflect a narrower range of practices.

Table 8. Summary of Scenario 2 nitrogen load reductions

N LOADS FOR SCENARIO 2. WIP 3 IMPLEMENTATION PLUS 25%				
STATE	**Sector**	**WIP 3 N EOT**	**WIP3 Plus 25 N EOT**	**N Reduction**
DE	Agriculture	1,206,209	1,075,719	130,489
	Developed	264,208	250,857	13,352
	Natural	176,331	173,131	3,199
	Septic	56,121	53,468	2,653
	DE Total	**1,799,438**	**1,649,745**	**149,694**
MD	Agriculture	3,571,216	3,233,321	337,895
	Developed	2,147,369	2,099,466	47,903
	Natural	1,557,861	1,533,448	24,412
	Septic	837,096	825,800	11,296
	MD Total	**8,874,894**	**8,453,387**	**421,507**
NY	Agriculture	4,918,504	4,654,984	263,520
	Developed	1,398,622	1,248,440	150,182
	Natural	2,844,262	2,814,968	29,295
	Septic	176,675	176,675	-
	NY Total	**11,432,120**	**10,989,124**	**442,996**
PA	Agriculture	35,795,450	31,291,008	4,504,443
	Developed	14,064,630	13,847,623	217,007
	Natural	16,487,560	16,284,325	203,235
	Septic	1,767,113	1,722,399	44,714
	PA Total	**76,100,989**	**71,131,590**	**4,969,399**
VA	Agriculture	590,902	512,982	77,920
	Developed	132,627	125,614	7,012
	Natural	198,344	192,908	5,436
	Septic	28,758	27,046	1,712
	VA Total	**968,785**	**876,704**	**92,081**
WV	Agriculture	219,951	208,491	11,460
	Developed	148,966	148,234	732
	Natural	282,158	280,795	1,363
	Septic	27,776	27,279	497
	WV Total	**813,682**	**799,630**	**14,052**
TOTAL	***99,989,907.74***	***99,989,907***	***93,900,179***	***6,089,728***
1: The loads reported in this table are adjusted to equate to nitrogen reductions from the Susquehanna, using the methods described in Appendix E.				

Scenario 2 Cost

Table 9 provides an overview of the costs associated with implementation of the BMP scenario identified in **Error! Reference source not found.**8. The annualized costs are derived from the Chesapeake Bay Program's Chesapeake Assessment Scenario Tool (CAST). This option is more cost-Effective than Scenario 1 but has not been optimized to select the most cost-effective options.

Table 9. Summary of costs for BMPs implemented in Scenario 2

Annualized Costs by State and Sector for Scenario 2. WIP 3 Plus 25%					
	Agriculture	**Developed**	**Natural**	**Septic**	**Total**
DE	2,635,272	2,063,607	1,644,871	1,405,222	**7,748,972**
MD	4,160,624	11,394,309	11,247,559	4,177,592	**30,980,084**
NY	14,736,078	57,419,493	288,990	-	**72,444,561**
PA	41,749,277	45,334,120	22,519,019	6,211,214	**115,813,630**
VA	1,824,054	3,931,166	1,585,852	1,046,643	**8,387,715**
WV	180,534	286,337	15,115	51,495	**533,481**
Total	***65,285,839***	***120,429,032***	***37,301,407***	***12,892,165***	***235,908,443***

These costs should be considered as initial estimates only and may change significantly on a per unit basis depending on how projects are financed and the scale at which the projects are implemented. These costs do not include associated financial services costs or technical assistance costs provided at the local level to facilitate implementation of CWIP specific BMPs. Those additional costs will be identified during the outreach phase and with input from the Financing Strategy

Scenario 3: N-Effective, Baywide

This scenario includes only the most cost-effective BMPs for nitrogen reduction, all of which are applied on agricultural lands within targeted geographic areas of the Chesapeake Bay watershed described below.

Scenario 3. Bay-Wide Cost-Effective Agriculture	
Geographic Extent	N-Effective Segments Throughout the Bay Watershed
Primary BMPs	• Nutrient Application Management Core Nitrogen, Rate, Placement, and Timing • Conservation, High-Residue, and Low-Residue Tillage • Prescribed Grazing • Grass and Forest Buffers • Wetland Restoration • Soil and Water Conservation Plan • Manure Incorporation • Barnyard Runoff Controls
States Involved	Maryland, Pennsylvania, Delaware, Virginia, West Virginia
N Reduction	6,376,678 lbs./yr.
Total Annualized Cost	$50,989,853/yr.
Cost Per Pound	$7.99

Scenario 3 Geography[3]

This geographic option targets Land River Segments in the top quartile for relative effectiveness (based on nitrogen reduction) across the entire Bay watershed (Figure 10).

[3] The scenario presented was based on 1995 Modeling, and will be refined to reflect the Conowingo Infill N-effective basins reflected in Figure 2.

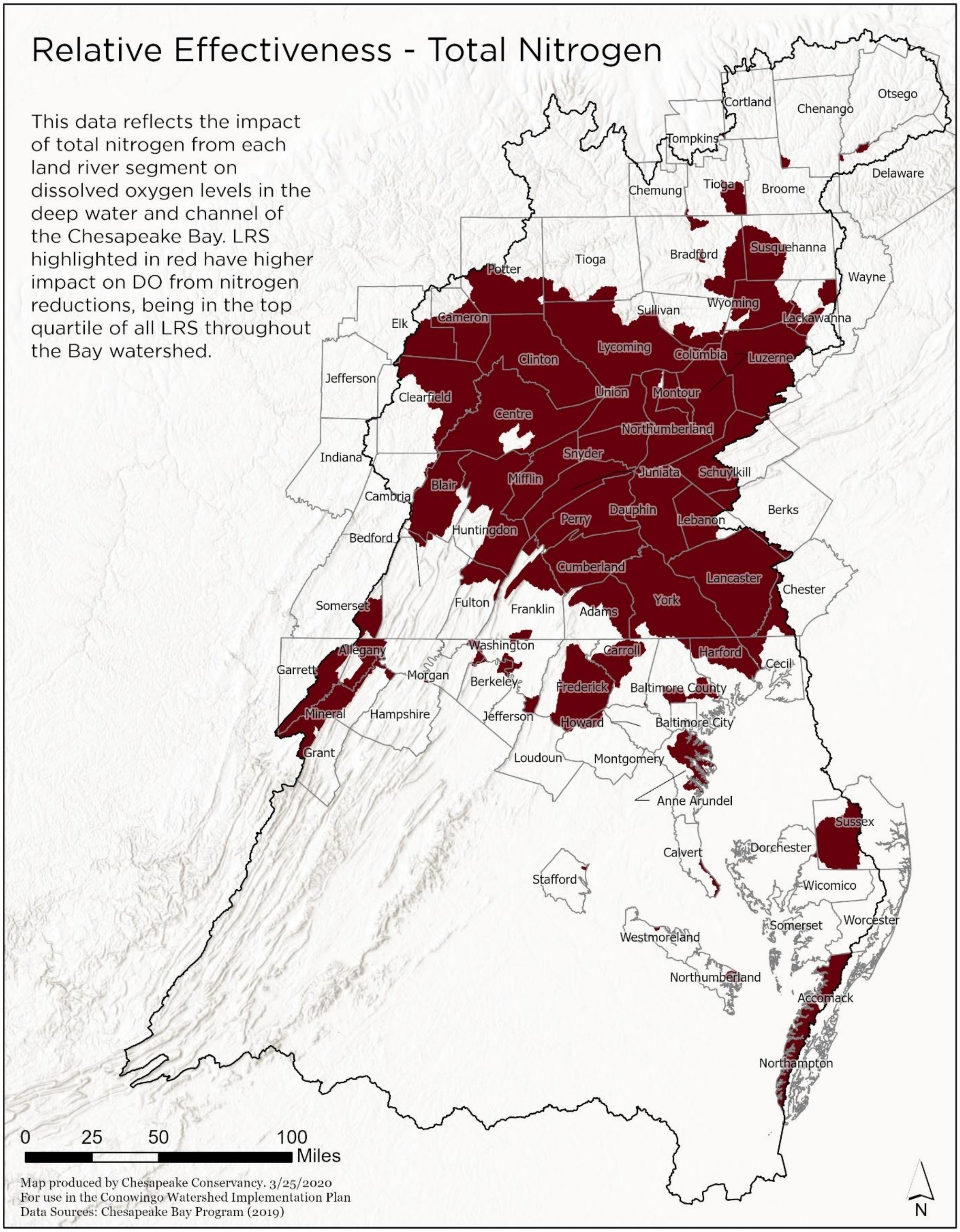


Figure 10. Scenario 3 Geography

Scenario 3 BMPs

This implementation scenario was developed to demonstrate the modeled nitrogen load reduction to the Bay based on the most effective BMPs for nitrogen. These BMPs only address agricultural load sources, are accepted BMPs by the Partnership and data is available to map the extent of available area for future implementation (Table 10). This scenario is used to an illustrate an approach that optimizes cost-effectiveness of BMP implementation.

Table 10. Summary of acres of BMP implementation for Scenario 3

BMPs Implemented in Scenario 3. Bay-Wide Cost-Effective Agriculture			
Practice	**Duration**	**Unit**	**Amount**
Nutrient Application Management Core Nitrogen	annual	Acres	497,108
Nutrient Application Management Rate Nitrogen	annual	Acres	680,286
Nutrient Application Management Placement Nitrogen	annual	Acres	230,891
Nutrient Application Management Timing Nitrogen	annual	Acres	644,867
Conservation Tillage	annual	Acres	160,978
High Residue Tillage	annual	Acres	63,263
Low Residue Tillage	annual	Acres	81,069
Prescribed Grazing	cumulative	Acres	127,102
Forest Buffers	cumulative	Acres in Buffers	11,882
Wetland Restoration	cumulative	Acres	14,480
Grass Buffers	cumulative	Acres in Buffers	46,762
Soil and Water Conservation Plan	cumulative	Acres	432,625
Manure Incorporation	annual	Acres	166,857
Barnyard Runoff Control	cumulative	Acres	1,309

Scenario Loads Results

This BMP implementation strategy, as shown in Table 11, achieves the required reduction of 6 M pounds of nitrogen annually. Reductions are achieved almost entirely within the agricultural sector, as these practices are overall the most cost-effective and represent a large percent of the area being considered.

Table 11. Summary of Scenario 3 nitrogen load reductions

Nitrogen Load Reductions for Scenario 3. Bay-Wide Cost-Effective Agriculture[1]				
STATE	**Sector**	**WIP 3 N EOT**	**WIP3 Plus 25 N EOT**	**N Reduction**
DE	Agriculture	2,104,913	2,104,332	581
	Developed	427,933	427,933	-
	Natural	316,614	316,589	25
	Septic	114,768	114,768	-
	DE Total	**2,964,228**	**2,963,622**	**606**
MD	Agriculture	14,379,353	13,080,247	1,299,106
	Developed	7,620,554	7,620,554	-
	Natural	6,230,638	6,184,525	46,113
	Septic	2,551,945	2,551,945	-
	MD Total	**30,782,491**	**29,437,272**	**1,345,219**
PA	Agriculture	42,335,501	37,608,018	4,727,483
	Developed	14,878,339	14,878,339	-
	Natural	17,575,268	17,410,473	164,795
	Septic	1,985,768	1,985,768	-
	PA Total	**76,774,876**	**71,882,598**	**4,892,278**
VA	Agriculture	7,619,879	7,496,459	123,420
	Developed	4,351,743	4,351,743	-
	Natural	5,013,391	5,008,026	5,365
	Septic	1,063,019	1,063,019	-
	VA Total	**18,048,032**	**17,919,247**	**128,785**
WV	Agriculture	2,407,593	2,398,867	8,726
	Developed	1,008,137	1,008,137	-
	Natural	2,176,604	2,175,540	1,064
	Septic	284,212	284,212	-
	WV Total	**5,876,547**	**5,866,757**	**9,790**
TOTAL		***134,446,174***	***128,069,495***	***6,376,678***
1: The loads reported in this table are adjusted to equate to nitrogen reductions from the Susquehanna, using the methods described in Appendix E.				

Scenario Cost

Table 12 provides an overview of the costs associated with implementation of the BMP scenario identified in **Error! Reference source not found.**11. The annualized costs are derived from the Chesapeake Bay Program's Chesapeake Assessment Scenario Tool (CAST). Default costs for Pennsylvania, Maryland, Delaware, Virginia, and West Virginia within the CAST tool were used to develop the cost estimates. A summary of the assumptions used to generate this estimate is provided in Appendix G.

Table 12. Summary of costs for BMPs implemented in Scenario 3

Annualized Costs by State and Sector for Scenario 3 - Bay-Wide Cost-Effective Agriculture	
	Agriculture
DE	--
MD	6,241,295
NY	--
PA	44,385,635
VA	169,432
WV	193,491
Total	**50,989,853**

BMP implementation in Delaware is minimal and the BMPs used in this scenario reduce overall costs so are listed as 0. These costs should be considered as initial estimates only and may change significantly on a per unit basis depending on how projects are financed and the scale at which the projects are implemented. These costs do not include associated financial services costs or technical assistance costs provided at the local level to facilitate implementation of CWIP specific BMPs. Those additional costs will be identified during the outreach phase and with input from the Financing Strategy.

Scenario 4: N-Effective, Susquehanna

This scenario is similar to Scenario 3 in that it includes only the most cost-effective BMPs for nitrogen reduction, applied on agricultural lands. However, scenario only applies BMPs within targeted geographic areas of the Susquehanna River Basin, as described below.

Scenario 4. Susquehanna Watershed Cost-Effective Agriculture	
Geographic Extent	N-Effective Land River Segments Within the Susquehanna Watershed
Primary BMPs	• Nutrient Application Management Core Nitrogen, Rate, Placement, and Timing • Conservation, High-Residue, and Low-Residue Tillage • Prescribed Grazing • Grass and Forest Buffers • Wetland Restoration • Soil and Water Conservation Plan • Manure Incorporation • Barnyard Runoff Controls
States Involved	Maryland, Pennsylvania, New York
N Reduction	6,615,658 lbs./yr.
Total Annualized Cost	$51,032,822/yr.
Cost Per Pound	$7.71

Scenario 4 Geography[4]

This geographic option targets those Land River Segments in the top quartile for relative effectiveness (based on nitrogen reduction) within the Susquehanna River Basin only (Figure 11).

[4] The scenario presented was based on 1995 Modeling, and will be refined to reflect the Conowingo Infill N-effective basins reflected in Figure 2.

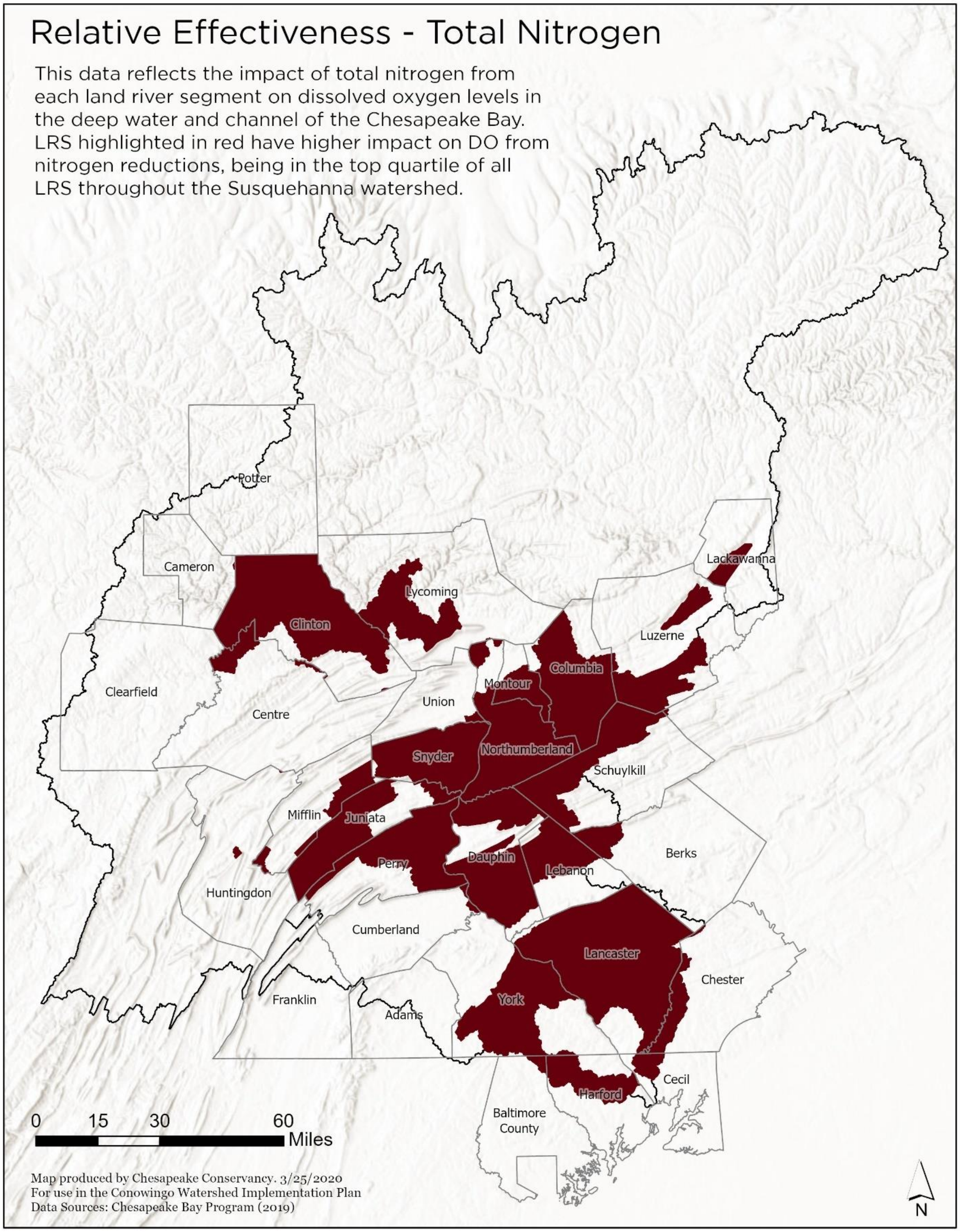


Figure 11. Scenario 4 Geography

Scenario 4 BMPs

This implementation scenario was developed to demonstrate the modeled nitrogen load reduction to the Bay based on the most effective BMPs for nitrogen (Table 13). These BMPs only address agricultural load sources, are accepted BMPs by the Partnership and data is available to map the extent of available area for future implementation. This scenario is used to an illustrate an approach that looks primarily at reducing the cost per pound of nitrogen reduced but is limited to the Susquehanna River Basin, which has the greatest relative influence on DO in the Bay.

Table 13. Summary of acres of BMP implementation for Scenario 4

BMPs Implemented In Scenario 4			
Practice	**Duration**	**Unit**	**Amount**
Nutrient Application Management Core Nitrogen	annual	Acres	305,137
Nutrient Application Management Rate Nitrogen	annual	Acres	668,563
Nutrient Application Management Placement Nitrogen	annual	Acres	227,905
Nutrient Application Management Timing Nitrogen	annual	Acres	673,548
Conservation Tillage	annual	Acres	214,027
High Residue Tillage	annual	Acres	45,579
Low Residue Tillage	annual	Acres	9,616
Prescribed Grazing	cumulative	Acres	94,269
Forest Buffers	cumulative	Acres in Buffers	22,729
Wetland Restoration	cumulative	Acres	12,479
Grass Buffers	cumulative	Acres in Buffers	24,117
Soil and Water Conservation Plan	cumulative	Acres	204,016
Manure Incorporation	annual	Acres	200,029
Barnyard Runoff Control	cumulative	Acres	755

Scenario 4 Loads Results

This BMP implementation strategy, as shown in Table 14, exceeds the required nitrogen reduction of 6 Million pounds per year, reaching almost 6.6 million.

Table 14. Summary of Scenario 4 nitrogen load reductions

N LOADS FOR SCENARIO 4. SUSQUEHANNA COST-EFFECTIVE AGRICULTURE				
STATE	**Sector**	**WIP 3 N EOT**	**WIP3 Plus 25 N EOT**	**N Reduction**
MD	Agriculture	783,258	628,688	154,569
	Developed	338,577	338,577	-
	Natural	261,156	254,545	6,610
	Septic	198,843	198,843	-
	MD TOTAL	**1,581,834**	**1,420,654**	**161,180**
NY	Agriculture	5,980,815	5,832,273	148,541
	Developed	1,398,622	1,398,622	-
	Natural	2,922,999	2,915,574	7,425
	Septic	176,675	176,675	-
	NY Total	**10,479,111**	**10,323,144**	**155,966**
PA	Agriculture	38,269,615	32,142,759	6,126,856
	Developed	13,936,730	13,936,730	-
	Natural	16,439,618	16,268,052	171,566
	Septic	1,724,857	1,724,857	-
	PA Total	**70,370,820**	**64,072,398**	**6,298,422**
	TOTAL	***82,431,764***	***75,816,196***	***6,615,658***

Scenario 4 Cost

Table 15 provides an overview of the costs associated with implementation the BMP scenario identified in **Error! Reference source not found.**14. The annualized costs are derived from the Chesapeake Bay Program's Chesapeake Assessment Scenario Tool (CAST), using a Chesapeake Bay cost basis. This option is also very cost-effective.

Table 15. Summary of costs for BMPs implemented in Scenario 4

Annualized Costs by State and Sector for Scenario 4 - Cost-Effective Agriculture in the Susquehanna Basin				
	Agriculture	**Developed**	**Natural**	**Total**
MD	1,073,475.53	3,813	-	1,073,475
NY	1,742,223.20	65,371	-	1,742,223
PA	48,216,777.10	5,133,682	348	48,217,124
Total	**51,032,475.83**	***5,202,867***	***348***	***51,032,822***

These costs should be considered as initial estimates only and may change significantly on a per unit basis depending on how projects are financed and the scale at which the projects are implemented. These costs do not include associated financial services costs or technical assistance costs provided at the local level to facilitate implementation of CWIP specific BMPs. Those additional costs will be identified during the outreach phase and with input from the Financing Strategy.

Scenario 5: N-Effective + Urban Equity

This scenario is the same as Scenario 4 except that it includes implementation of the most cost-effective urban BMPs for nitrogen removal.

Scenario 5. Susquehanna Watershed Cost-Effective Agriculture – Urban Equity	
Geographic Extent	N-Effective Land River Segments Within the Susquehanna Watershed
Primary BMPs	Agricultural • Nutrient Application Management Core Nitrogen, Rate, Placement, and Timing • Conservation, High-Residue, and Low-Residue Tillage • Prescribed Grazing • Grass and Forest Buffers • Wetland Restoration • Soil and Water Conservation Plan • Manure Incorporation • Barnyard Runoff Controls Urban • Forest Planting • Forest Buffers
States Involved	Maryland, Pennsylvania, New York
N Reduction	6,601,250 lbs./yr.
Total Annualized Cost	$51,298,783/yr.
Cost Per Pound	$7.77

Scenario Geography[5]

This geographic option is the same as for Scenario 4, targeting those Land River Segments in the top quartile for relative effectiveness (based on nitrogen reduction) within the Susquehanna River Basin (Figure 12).

[5] The scenario presented was based on 1995 Modeling, and will be refined to reflect the Conowingo Infill N-effective basins reflected in Figure 2.

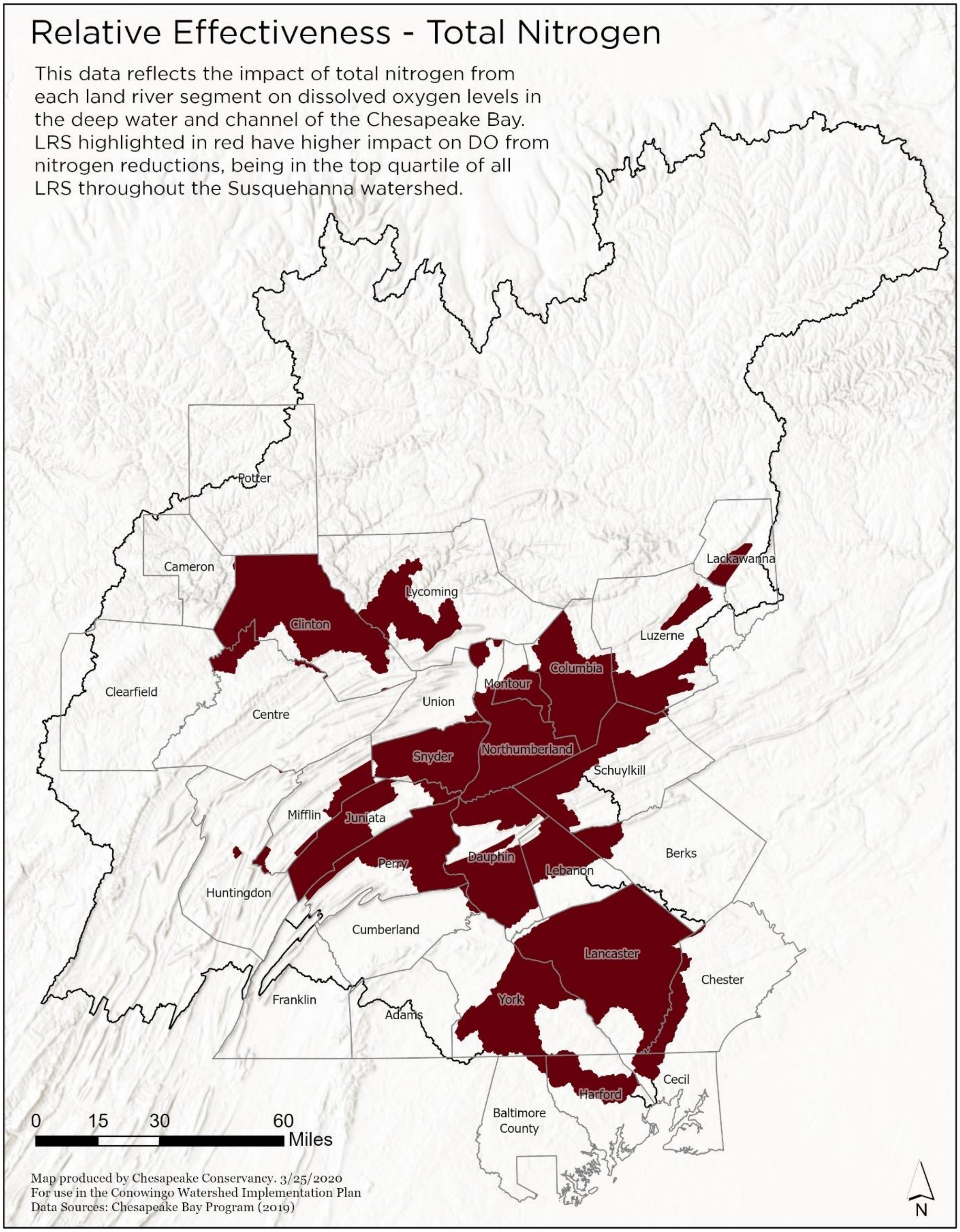


Figure 12. Scenario 5 Geography

Scenario BMPs

This implementation scenario was developed to demonstrate the modeled nitrogen load reduction to the Bay based on the most effective BMPs for nitrogen. These BMPs address both developed and agricultural load sources, are accepted BMPs by the Partnership and data is available to map the extent of available area for future implementation (Table 16). Similar to scenario 4 this scenario is used to illustrate an approach that looks primarily at reducing the cost per pound of nitrogen reduced limited to the Susquehanna watershed but adds in cost-effective urban practices to be more equitable in how the reductions are distributed across sectors. The Urban BMP scenario includes very aggressive use of urban forest planting and urban forest buffers, and can be expanded to include a broader suite of urban BMPs. However, urban land, and in particular urban land that is nonregulated by the MS4 program, represents a very small fraction of the total area of consideration.

Table 16. Summary of acres of BMP implementation for Scenario 5

BMPs Implemented In Scenario 5. Cost-Effective Agriculture + Urban Equity			
Practice	**Duration**	**Unit**	**Amount**
Agricultural Practices			
Nutrient Application Management Core Nitrogen	annual	Acres	305,137
Nutrient Application Management Rate Nitrogen	annual	Acres	668,563
Nutrient Application Management Placement Nitrogen	annual	Acres	227,905
Nutrient Application Management Timing Nitrogen	annual	Acres	673,548
Conservation Tillage	annual	Acres	214,027
High Residue Tillage	annual	Acres	45,579
Low Residue Tillage	annual	Acres	9,616
Prescribed Grazing	cumulative	Acres	94,269
Forest Buffers	cumulative	Acres in Buffers	22,729
Wetland Restoration	cumulative	Acres	12,479
Grass Buffers	cumulative	Acres in Buffers	24,117
Soil and Water Conservation Plan	cumulative	Acres	204,016
Manure Incorporation	annual	Acres	200,029
Barnyard Runoff Control	cumulative	Acres	755
Urban Practices			
Urban Forest Planting	annual	Acres	17,148
Urban Forest Buffers	annual	Acres	48,858

Scenario Loads Results

This scenario exceeds the Nitrogen target by over 600,000 pounds (Table 17). The agricultural BMP implementation was reduced by 5% to account for urban BMP implementation.

Table 17. Summary of Scenario 5 nitrogen load reductions

N LOADS FOR SCENARIO 5. SUSQUEHANNA COST-EFFECTIVE AG PLUS URBAN EQUITY				
STATE	**Sector**	**WIP 3 N EOT**	**WIP3 Plus 25 N EOT**	**N Reduction**
MD	Agriculture	783,258	640,063	143,195
	Developed	338,577	337,807	770
	Natural	261,156	255,091	6,065
	Septic	198,843	198,843	-
	MD TOTAL	**1,581,834**	**1,431,804**	**150,030**
NY	Agriculture	5,980,815	5,839,376	141,438
	Developed	1,398,622	1,393,111	5,510
	Natural	2,922,999	2,916,291	6,708
	Septic	176,675	176,675	-
	NY Total	**10,479,111**	**10,325,454**	**153,657**
PA	Agriculture	38,269,615	32,704,182	5,565,433
	Developed	13,936,730	13,299,229	637,501
	Natural	16,439,618	16,344,989	94,629
	Septic	1,724,857	1,724,857	-
	PA Total	**70,370,820**	**64,073,256**	**6,297,563**
	TOTAL	***82,431,764***	***75,830,514***	***6,601,250***

Scenario Cost

Table 18 provides an overview of the costs associated with implementation the BMP scenario identified in **Error! Reference source not found.**. The annualized costs are derived from the Chesapeake Bay Program's Chesapeake Assessment Scenario Tool (CAST). This option was also very cost-effective, relying on the most cost-effective options in both the agricultural and urban sectors.

Table 18. Summary of costs for BMPs implemented in Scenario 5

Annualized Costs by State and Sector for Scenario 5 - Cost-Effective Agriculture Plus Urban Equity				
	Agriculture	**Developed**	**Natural**	**Total**
MD	968,173	3,813	-	971,986
NY	1,613,846.37	65,371	-	1,679,217
PA	43,513,566	5,133,682	330	48,647,578
Total	***46,095,585***	***5,202,867***	***330***	***51,298,783***

These costs should be considered as initial estimates only and may change significantly on a per unit basis depending on how projects are financed and the scale at which the projects are implemented.

Financing Strategy

The Chesapeake Bay restoration effort overall is considered a test model for coordinating and implementing large-scale ecosystem restoration efforts. However, while a significant amount of resources has been applied to studying the impacts of eutrophication in the Bay and BMPs necessary to restore water quality, relatively little has been done to coordinate and advance innovative approaches for financing and implementing aggressive restoration programs. Specifically, there has been little effort to engage private industries and financing experts on how best to develop incentives for fostering more effective corporate stewardship, leveraging carbon markets, and accessing other private capital and financial markets. Given the increased loads associated with Conowingo infill and other restoration challenges on the horizon such as climate change, industries and industry leaders must be engaged in a substantive way to sustain restoration progress into the future.

This problem is not unique to any one Bay state or jurisdiction. All of the Bay jurisdictions could benefit from a codified, institutional approach to engaging leaders in finance and the key Bay industry sectors. There have been some regional efforts to engage financing experts on Bay Restoration. One noteworthy effort was the October 2004 report issued by the Chesapeake Bay Watershed Blue Ribbon Finance Panel established by the Chesapeake Executive Council in Directive 03-02 in December 2003. The Panel, comprised of distinguished and knowledgeable citizens from throughout the watershed, provided a comprehensive analysis of the sources of impairments to the Bay's water quality and living resources, the costs to remove those impairments and a series of recommendations to finance those costs. The principal recommendation was to establish a regional Chesapeake Bay Financing Authority to close an estimated $15 billion gap in public funds for the cleanup. It was further recommended to seek a $12 billion commitment from the federal government, to be funded over six years, with the remaining $3 billion in new funds to come from the Bay jurisdictions. The Report also included over twenty additional recommendations on potential funding sources and program actions to be taken by the Bay partners. Unfortunately, in the effort to respond to the primary recommendation for the Financing Authority, these additional recommendations were largely overlooked. Many of the recommendations, however, are innovative and of great potential value to the jurisdictions and the Bay Program.

Recognizing this need for innovations in financing, the PSC has directed that a key component of the Conowingo WIP implementation is to develop a financing strategy that complements jurisdictional WIPs, accelerates Bay restoration overall, and provides healthy competition in the marketplace that will stimulate innovation and science while lowering costs. Due to CIT and jurisdictional workload and funding, a draft financing strategy is scheduled for public review approximately a year after this Conowingo WIP will be finalized.

The Chesapeake Bay Trust is leading the effort to develop the CWIP financing strategy, which will be provided as a separate document when completed in March 2021. Recognizing that the CWIP BMP implementation strategy will need to evolve with time and the completion of a comprehensive financing strategy, adjustments may need to be considered to better align with the innovative financing tools and ideas contained within the financing strategy.

Contingency Plans and Opportunities

A contingency plan for the CWIP provides safeguards to ensure the nitrogen load reductions are achieved if the selected BMP implementation strategy is not sufficient to meet the stated goals in advance of the WIP timeline. The CWIP Implementation Team will work with the Steering Committee to evaluate actions needed given the options described in this CWIP. The annual reports on State-specific and Conowingo load reductions, the two-year milestones reporting on progress, along with the adaptive management approach, provide the necessary checks and balances throughout CWIP implementation to evaluate if alternative actions need to be taken. Any relevant future outcomes from Maryland's 401 Water Quality Certification for Conowingo Dam will be considered in this process, as appropriate.

The CWIP is developed with the option to introduce full delivery/pay-for-performance strategies to provide the opportunity for private capital to cover initial project implementation costs. This strategy maximizes CWIP resource flexibility by allowing investments in the most cost-effective projects and provide an opportunity for innovative projects while requiring the project offeror to demonstrate the amount of nitrogen load reductions achieved towards CWIP goals.

Alternative 1. Implementation Efforts Do Not Meet Load Reduction Targets

1A. Dredging. While modeling results from the USACE and MDE (2015) study notes that increasing or recovering the storage volume of the Reservoir provides limited and short-lived ecosystem benefits to the Chesapeake Bay at a high cost of dredging, MDE is funding a study and pilot project to evaluate this action further with results expected in late Summer/early Fall 2020. The results of this study will evaluate the beneficial reuse of sediments as a result of dredging and help the Steering Committee to evaluate the cost-effectiveness of this activity. The CWIP can be adjusted to incorporate feasible, cost-effective, creditable, and trackable load reduction measures identified in the study.

1B. Re-evaluate Priority Watersheds. The CWIP focuses implementation on priority watersheds within the Chesapeake Bay basin based on their relative influence on Bay water quality as well as efforts to align with existing jurisdictional planning and implementation. A BMP Opportunity Blueprint will identify the extent of implementation for the priority BMPs in each of these areas (and will be used to evaluate project offers). If the market to support implementation does not achieve the required level of implementation, or capacity of the current priority watersheds cannot meet the demand for implementation, the CIT will work with the Steering Committee, PSC, and EPA to identify additional effective sub-basins following the process outlined in the Framework.

1C. Other BMPs. The CIT may utilize an extended list of BMPs that meet the Partnership requirements as a creditable and reportable practice. Additional BMPs may be desired given the response or direction indicated by a market-driven approach, or if there is greater capacity for other BMPs given site-specific geographies.

At the time of CWIP development, the protocols for stream restoration were under review by the Partnership and consequently provided uncertainty to quantify the benefits of practice implementation in the BMP scenario geographies. The stream restoration protocols have been recently updated to provide clarifications on how to apply the protocols, information needed to be eligible for, and quantify the credit, and changes to the protocols to include a new, eligible practice (Protocol 5, Outfall Stabilization). The CWIP Implementation Team may explore methods to account for the benefits of this practice. This would require the CWIP Implementation Team propose generalized site conditions to quantify the nitrogen load reductions, along with input from the engagement process to understand the capacity to adopt this practice. Utilization of full delivery/pay-for-performance strategies would incentivize project offerors to identify, calculate, and provide site specific stream restoration data. Further, the focus of CWIP on nitrogen reduction will drive private sector stream restoration design to incorporate features that promote nitrogen processing.

Accountability, Tracking, Crediting

The CIT will work with the jurisdictions, the Partnership and the Steering Committee to track and report practices implemented and their associated load reductions for the CWIP. The intent is to use the existing reporting and tracking tools to create efficiencies and reduce redundancy or unnecessary bureaucracies given the well-established and familiar protocols available to the Partnership and restoration practitioners (e.g. project implementer). The protocols provide assurance and accountability that load reductions associated with practices implemented in the selected geographies are credited towards the CWIP while the tools will help streamline the process across multiple geographic scales that align with the Chesapeake Bay TMDL.

There are three levels, or tiers, for reporting to track practice implementation from the site specific-scale of implementation to the Chesapeake Bay-wide modeling scale. The tools used for each tier include Chesapeake Commons' FieldDoc, jurisdiction-specific databases, and the National Environmental Information Exchange Network (NEIEN). Each of these reporting tools will include common fields or metrics to track and report projects that meet CBP requirements and are credited towards the CWIP, rather than Phase III WIPs. The CIT is responsible for reviewing the accuracy and validity of the information given the steps described in the Quality Assurance Project Plan (QAPP), annually. Reports may also be provided to the jurisdictions based on their progress.

When a practitioner implements a project that will be tracked towards CWIP progress, they will be required to report the project through Chesapeake Commons' FieldDoc platform. This web-based tracking platform will allow the user to track practice implementation and assign it to both the CWIP program and other funding programs for reporting purposes. When a practitioner is done editing the project details and metrics, there will be a submission allowing them to report their practice to all attached programs. For a practice to be considered complete for CWIP reporting, a set of required metrics must be completed, including the information needed for a practice to be reported to the NEIEN, as well as a spatial footprint of the practice and a photograph of the project. These data will be utilized for a data validation check as outlined by the Activity 3 Team in a QAPP and approved by the CBP. An intermediate step may be taken at the State level, where projects reported in FieldDocs are input to a State-specific database that is then uploaded to NEIEN. The team may work with the State agencies to ensure the projects designated for the Conowingo are translated effectively.

Adaptive Management, Milestones, and Progress Reporting

The EPA will evaluate the draft and final CWIP and provide biennial evaluations of the progress toward attaining the goals in the CWIP. EPA's evaluations, in consultation with the PSC, will be used to determine if corrections or adjustments are necessary to attain the goals of the CWIP (e.g., whether the targets need to be re-evaluated or assigned to specific jurisdictions).

Development of the initial set of two-year milestones will be based on anticipated levels of funding both prior to and after the implementation of the Conowingo financing strategy. Two-year milestone goals can be developed with additional information from the Partnership related to anticipated funding levels for CWIP implementation prior to the implementation of the financing framework and may be integrated into future drafts of this plan. However, the results of the financing strategy will largely determine the rate and scale of annual implementation.

The CIT will work with the relevant State agencies to submit draft milestones to EPA by November 2021 and a final version by January 7, 2022. The milestone reporting is contingent upon funding available through the financing strategy or other sources to support implementation efforts.

An intermediate step may be taken at the State level, where projects reported in FieldDoc are input to a State-specific database that are then uploaded to NEIEN. In this case, the CWIP Implementation Team will work with the jurisdictions to ensure the projects designated for the Conowingo are translated effectively. This process will be done in a timely manner to ensure adequate time for review and submission by the jurisdictions before December 1 of each year. A unique identifier in NEIEN will denote the project is credited towards the CWIP, rather than the jurisdictions' Phase III WIPs, to ensure that proper crediting can be completed.

Timeline and Next Steps

The development of the CWIP is arranged to occur in stages with the Plan completed in June 2020, followed by a financing strategy in March 2021. The timeline is established to dovetail with the Phase III WIPs where the CWIP identifies priority BMPs in focal geographies to achieve the required nitrogen load reductions to ensure the health of the Chesapeake Bay remains on track. The implementation of the WIP is expected to continue beyond 2025 with opportunities to start implementation as funding becomes available. For example, implementation may begin as early as 2021 pending the availably of funding prior to the completion and implementation of the of the Conowingo financing strategy. The timeline shown in 19 identifies key periods of the WIP development and its implementation.

Table 19. Conowingo WIP development and implementation timeline.

Year	Key Decisions and Outcomes
2018	• October 28, 2018, the Chesapeake Bay Program (CBP) Principals' Staff Committee (PSC) approved a Framework for developing the CWIP. • Formation of the Steering Committee
2019	• Begin development of the CWIP (September) • Phase 1 Stakeholder Outreach
2020	• WIP approved with updated timeline • Conowingo Reservoir dredging analysis complete (June/July) • Finalized tracking and reporting protocols and tools (March/April) • Phase 2 Stakeholder Outreach • Draft financing framework • Begin design of the financing framework
2021	• Submit draft two milestone November 1 • Phase 3 Stakeholder Outreach • Financial strategy complete • Economic development investment plan complete • Draft plan for the financing framework • Project-specific BMP opportunity blueprint for priority geographies
2022	• Submit two-year milestones for 2022–23 incorporating climate change by January 15 • Phase 4 Stakeholder Outreach • Launch the financing framework • Implementation of investment activities (Winter)
2023	• Continued implementation of investment activities • Submit two-year milestone for 2024–2025 by November 1
2024 – 2025	• Continued implementation of investment activities • Submit two-year milestone 2024–25 by January 15

References

Chesapeake Bay Program (CBP). 2018. Framework for the Conowingo Watershed Implementation Plan. October 12, 2018 Final version.

Chesapeake Bay Program (CBP). (2019a, January 31). *Chesapeake Bay Program Principals' Staff Committee Meeting, Final Actions and Decisions*. Retrieved from: https://www.chesapeakebay.net/channel_files/36881/psc_actions-decisions_01-31-19_final.pdf

Chesapeake Bay Program (CBP). (2019b, September 23). *Conowingo WIP Steering Committee Meeting, Face to Face.* Retrieved from: https://www.chesapeakebay.net/channel_files/39794/conowingo_wip_actions_and_decisions_23.9.19_(1).pdf

Chesapeake Bay Program (CBP). (2019c, August 12). *Chesapeake Bay Program Principals' Staff Committee Conference Call, Final Actions and Decisions*. Retrieved from: https://www.chesapeakebay.net/channel_files/40423/i._psc_actions-decisions_8-12-19_final.pdf

Chesapeake Bay Program (CBP). (2020, January 24). *Chesapeake Bay Program Principals' Staff Committee, Program Update*. Retrieved from: https://www.chesapeakebay.net/what/event/principals_staff_committee_meeting_january_2020

Davis-Martin, J. (2017, December 4). Chesapeake Bay 2017 Midpoint Assessment – Policy Issues for Partnership Decisions: Water Quality Goal Implementation Team Meeting, December 4–5, 2017. Retrieved from: https://www.chesapeakebay.net/channel_files/25782/wqgit_dec_4-5_2017_mpa_policy_decisions_briefing_presentation_story_board-12.3.17_jsadd.pdf

Easton, Z., Scavia, D., Alexander, R., Band, L., Boomer, K., Kleinman, P., Martin, J., Miller, A., Pizzuto, J., Smith, D., & C. Welty. 2017. Scientific and Technical Advisory Committee Review of the Phase 6 Chesapeake Bay Watershed Model. STAC Publication Number 17-007. Edgewater, MD. Retrieved from: http://www.chesapeake.org/pubs/379_Easton2017.pdf

Praul, C. (n.d.). Technical Brief: Pay for Performance Contract Mechanisms for Stormwater Management. Prepared by: Environmental Incentives, LLC. South Lake Tahoe, CA. Retrieved from: https://www.enviroaccounting.com/payforperformance/FileResource/GetFileResourceForProgram/8c4d7d33-faba-4481-a642-49fba7ff83eb

U.S. Army Corps of Engineers, Baltimore District (USACE), & Maryland Department of the Environment (MDE). 2015. Lower Susquehanna River Watershed Assessment, Maryland and Pennsylvania. Prepared for: U.S. Geological Survey (USGS), Maryland Department of Natural Resources (MD DNR), the Susquehanna River Basin Commission (SRBC), USACE's Engineer Research & Development Center, U.S. Environmental Protection Agency (US EPA), & the Nature Conservancy.

U.S. Environmental Protection Agency (US EPA). 2010. Chesapeake Bay TMDL. Appendix T: Sediments Behind the Susquehanna Dams Technical Documentation – Assessment of the Susquehanna River

Reservoir Trapping Capacity and the Potential Effect on the Chesapeake Bay. Prepared by: Tetra Tech, Inc.

U.S. Environmental Protection Agency (US EPA). (2018, October 26). *Letter from United States Environmental Protection Agency, Region III, to the Principals' Staff Committee*.

Appendix A. Membership of the Conowingo WIP Steering Committee

JURISDICTIONAL REPRESENTATIVE	JURISDICTION
John Maleri/Katherine Antos	District of Columbia
Marcia Fox/Brittany Sturgis (Alternate)	Delaware
Matthew Rowe*/Dave Goshorn	Maryland
Ken Kosinski/Lauren Townley	New York
Jill Whitcomb*	Pennsylvania
Ann Jennings	Virginia
Teresa Koon	West Virginia
Mark Hoffman/Ann Swanson (Alternate)	Chesapeake Bay Commission
*Co-chairs	

Appendix B. Conowingo Watershed Implementation Plan Steering Committee Meeting Draft Conowingo WIP Outreach FAQ Document

November 21, 2019

Activity 1 Handout: Draft Conowingo WIP Outreach FAQ Document

Why do we Need to Reduce Pollution in the Chesapeake Bay?

The Chesapeake Bay is in poor health due to pollution from a variety of sources – including stormwater runoff, air emissions, wastewater, agriculture, development, and more. For many years, pollution that flowed into the streams and rivers of the Chesapeake Bay was not managed to meet water quality standards. At the same time the population in the 64,000-square mile watershed increased significantly – rising 43 percent between 1980 and 2017, from 12.7 million people to 18.2 million people. All of this has harmed water quality in the watershed.

In 2010, the U.S. Environmental Protection Agency (EPA) established the Chesapeake Bay Total Maximum Daily Load (TMDL), which set nitrogen, phosphorous, and sediment reduction goals so that the Bay would meet clean water standards by 2025. Sediment can smother aquatic life and pollutants such as nitrogen and phosphorus cause algae to grow in local waterways and the Chesapeake Bay that rob the waters of oxygen. To meet these goals the seven jurisdictions (Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia and the District of Columbia) that drain to the Bay developed Watershed Implementation Plans to help guide their Chesapeake Bay clean-up efforts

How Does a Watershed Implementation Plan Work?

Watershed Implementation Plans (WIPs) identify pollutant sources and methods to address those pollutants. This is done across three general tracks: first, they identify local pollution sources by category (such as urban, agriculture, forests, wastewater treatment plants, and septic systems); second, they identify the partners and resources that can help reduce pollution; and third, they identify the best strategies to reduce pollution to meet the 2025 goals.

Why is this WIP Focusing on the Conowingo Dam?

Jurisdictions throughout the Chesapeake Bay watershed have made progress cleaning up the Bay since the TMDL was established in 2010. However, recent scientific studies have shown that the dam's reservoir is nearing "dynamic equilibrium" which means it will no longer serves as a sufficient sink for sediment and other pollutants and what flows in above the dam will eventually flow out. The Chesapeake Bay TMDL WIPs did not account for the Conowingo Dam's reduced ability to trap upstream pollution. To address this problem the EPA-Chesapeake Bay Program, and the Bay jurisdictions have been working since [2017] to develop a WIP specific to the Conowingo Dam.

Is the Conowingo WIP Independent from WIPs Currently in Development in Other States?
Yes. When complete, the Conowingo WIP will be its own plan, independent of the individual WIPs currently being developed by each of the Bay jurisdictions.

How Will the Conowingo Dam WIP be Created?

To assist in the development of the Conowingo WIP, the most up-to-date data, modeling, and technology will be used to target and track restoration practices where they will have the most strategic impact. The Environmental Protection Agency contracted with the Center for Watershed Protection, the Chesapeake Bay Trust, and the Chesapeake Conservancy to assist in overseeing various tasks including coordination, project identification, and developing a financing strategy to reduce the total amount of Nitrogen delivered to the Chesapeake Bay.

Who Will Pay for the Practices in the Conowingo WIP?

New financing methods are being developed that will be designed to help expedite progress toward restoration of the Chesapeake Bay.

How Much Nitrogen Will Need to be Reduced as Part of the Watershed Implementation Plan?

Current estimates are that six million pounds of nitrogen need to be reduced as part of the Conowingo WIP. To meet this target, the Chesapeake Bay Program and partner jurisdictions are utilizing an approach called "most effective basins" that involve implementing projects on lands located both upstream and downstream of the dam. Based on the amount of pollutant load being delivered to the Bay and planned restoration efforts some watersheds downstream of the dam could offer restoration opportunities that deliver benefits to the Chesapeake Bay comparable to restoration opportunities located upstream of the dam. These cost-effective downstream restoration opportunities could also be included in the Watershed Implementation Plan if the cost per pound of nitrogen reduced is similar or better than reductions associated with projects upstream of the dam.

If you would like more information about the Conowingo WIP visit ***insert website address here***.

Bay Watershed Facts (for a call-out box):

Rivers and streams from Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia drain to the Chesapeake Bay.

The largest river that flows into the Chesapeake Bay is the Susquehanna River, which starts near Cooperstown, New York.

The land draining into the Chesapeake Bay is 64,000 square miles in size.

More than 100,000 streams, creeks, and rivers drain into the Chesapeake Bay.

Maps needed for the fact sheet:

Map of the overall Bay Watershed

Map of the most effective basins

Appendix C. Framework for the Conowingo Watershed Implementation Plan

October 12, 2018 Final

Framework for the Conowingo Watershed Implementation Plan

Objective: To document PSC approval on the Framework for developing the Conowingo Watershed Implementation Plan.

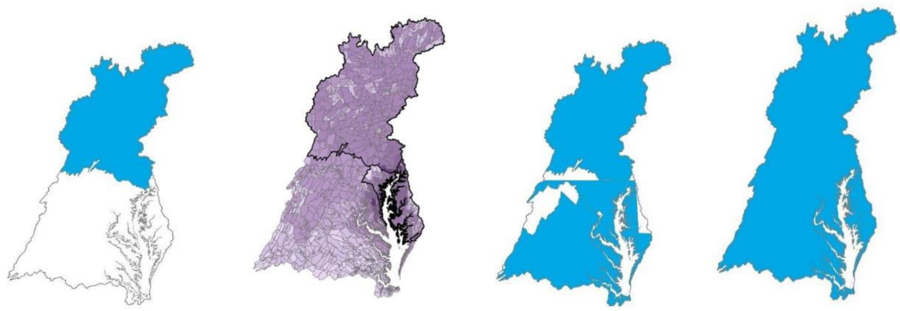
Background: When the TMDL was established in 2010, it was estimated that Conowingo Dam would be trapping sediment and associated nutrients through 2025. New research has determined this is not the case, and that the reservoir behind Conowingo Dam has now reached dynamic equilibrium. As a result, more sediment, nitrogen, and phosphorus are now entering the Chesapeake Bay than were estimated when the TMDL was established. Even with full implementation of the seven Bay jurisdictions' WIPs, this additional pollutant loading from Conowingo reservoir reaching dynamic equilibrium will cause or contribute to water quality standards exceedances in the upper Bay. This additional pollutant load must be addressed if the Bay's water quality standards, as they are currently written and implemented, are to be met. The Chesapeake Bay Program (CBP) partnership estimates that, after fully implementing the Bay TMDL and Phase I/II WIPs, an additional reduction of 6 million pounds of nitrogen and 0.26 million pounds of phosphorus is needed in order to mitigate the water quality impacts of Conowingo Reservoir infill. Although further analysis may alter the total nitrogen and phosphorus loads needing to be reduced, these current estimates are also based on reductions occurring in the most effective sub-basins of the watershed – that is, the geographic areas with the greatest influence on Chesapeake Bay water quality. If implementation were directed watershed-wide, including less effective areas, the total pollution reduction needed would increase.

It is also important to recognize that the Conowingo Dam, a hydroelectric facility owned and operated by Exelon, is currently undergoing a Federal Energy Regulatory Commission relicensing which requires a water quality certification from the state of Maryland pursuant to Section 401 of the Clean Water Act. Maryland has indicated that it is going to review the May 2017 application from Exelon for consistency with all applicable state water quality standards. Public comments received on the application signal a need for Exelon to be a key partner in addressing the downstream water quality impacts.

The CBP Partnership has identified four options for assigning pollutant load reduction responsibility among the Bay jurisdictions and has also signaled that Exelon should be held responsible for some portion of the reduction. The four geographic options under discussion are listed below and do not yet include an assignment to Exelon, which could be impacted by the outcome of Maryland's 401 Water Quality Certification. The four options are:

1. Susquehanna Basin Only – This option includes the area within the states of New York, Pennsylvania and Maryland that are in the Susquehanna River Basin that drain directly into the Conowingo Reservoir.
2. Susquehanna Basin + Most Effective Basins – This option includes the Susquehanna Basin (i.e. Option 1 above) plus those other basins within the Chesapeake Bay watershed within which best management practices are most effective at improving Chesapeake Bay water quality.

3. Susquehanna Basin + All of Maryland and Virginia – This option adds the Partnership states that benefitted most from the original calculation of the TMDL in 2010.
4. The Entire Chesapeake Bay Watershed – This option includes all seven jurisdictions in the Bay watershed.



(a) (b) (c) (d)

Figure 1 – Four options currently under consideration by the Bay Partnership for assigning responsibility for the additional reduction needed as a result of Conowingo infill. a) Susquehanna Basin, b) Susquehanna Basin + Most–Effective Basins (darker shades of purple = more effective basins within the watershed), c) Susquehanna Basin + All of Maryland and Virginia and d) Entire Chesapeake Bay Watershed.

There are also three options with respect to timing to account for these additional load reductions:

1. Now – The loading is incorporated now into the Phase 3 WIP and must be addressed by 2025.
2. Beyond 2025 – The loading is recognized as something that must begin to be addressed now, but the actual implementation will continue beyond 2025.
3. Post-2025 – The loading is not something that can be addressed now and will be re-visited once implementation of the Phase 3 WIPs is assessed post 2025.

After careful and extensive discussion of these options, the following conceptual approach was offered and agreed to by the CBP Partnership's Principals' Staff Committee (PSC) at its December 2017 meeting.

<u>Conceptual Approach</u>: Develop a separate and collaborative Conowingo Watershed Implementation Plan that provides details on how to reduce adverse water quality impacts to the Chesapeake Bay resulting from Conowingo Reservoir infill and provides a timeline at which it can be accomplished.

The recommended approach is in response to the recognition by all Bay jurisdictions that:

A. Trapping of pollutants by the Conowingo reservoir over the past 80+ years has benefited the water quality of the Bay, and it has also benefitted states to varying degrees by lessening load reduction responsibilities, but now those benefits are greatly diminished; and,
B. No reservoir maintenance to restore trapping capacity has occurred over the life of the dam and the reservoir is now near full capacity; and
C. The most cost-effective approach to mitigate current adverse water quality impacts, of the Conowingo reservoir at dynamic equilibrium, are realized by pooling resources to pay for pollutant reduction practices in the most effective locations (i.e., the locations with the most influence on Bay water quality). Pollutant reduction practices placed in the most effective areas (Figure 2) will limit the overall load reductions needed.

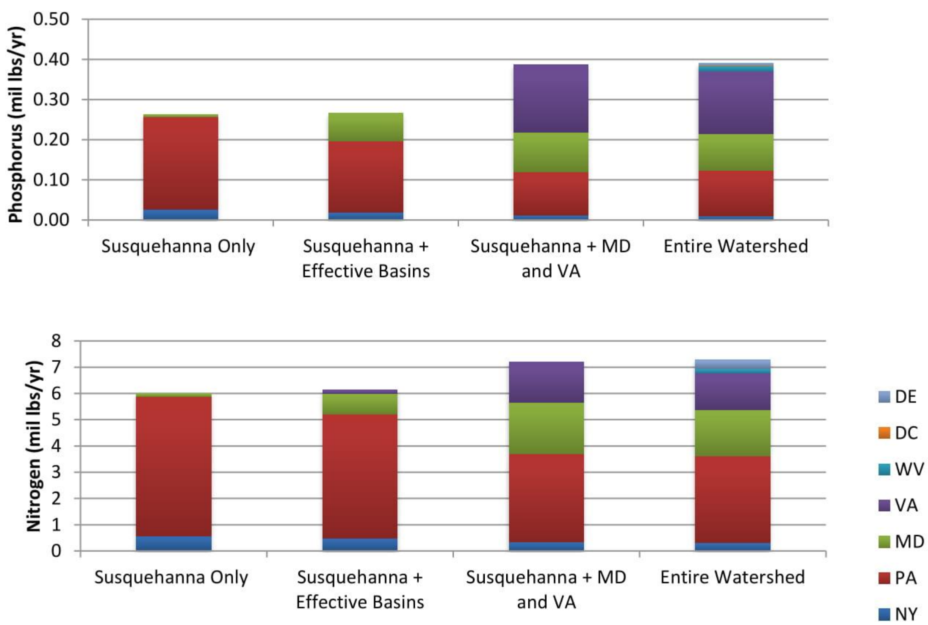


Figure 2 – Basinwide Conowingo targets developed using four different allocation options.

The Conowingo Watershed Implementation Plan (WIP) would include consideration of the following innovative components:

1. Establishing the Conowingo WIP Steering Committee as a subcommittee of the PSC. The

Conowingo WIP Steering Committee is composed of a representative from each Bay jurisdiction and the Chesapeake Bay Commission (CBC). This committee is responsible for developing and implementing the Conowingo WIP with assistance from a third party. The membership of this committee is in Appendix A. A list of guiding principles under which this Action Team will operate is included in Appendix C.

2. Creating a fund that members of the Conowingo WIP Steering Committee can use to work with the third-party awardee and install the most cost-effective practices in the most effective locations.
3. Incorporating the outcome of the Exelon CWA S. 401 water quality certification.
4. Developing a financing strategy to support development and implementation of the Conowingo WIP.
5. Developing a process by which preferred practices, targeted geographic locations and implementation projects will be selected and deployed.
6. Managing reservoir sediment through dredging and innovative and/or beneficial re-use based upon information from the Maryland pilot project.
7. Determining achievability and in what timeframe the needed load reductions will occur.

Although there are many specifics to this approach that remain to be discussed and agreed-upon, the PSC requested that more detail be provided on the following:

1. **<u>Pollutant Load Targets</u>: The total pollutant load targets attributed to Conowingo Reservoir infill would be assigned to a separate Conowingo Planning Target which all Bay jurisdictions would work collaboratively to achieve.**

   For the reasons described above, rather than adding those individual pollutant reduction targets to jurisdictions' existing Phase III planning targets, the recommendation is that the total pollutant reduction targets for nitrogen and phosphorus be assigned to the Conowingo WIP Steering Committee (i.e., the CBP Partnership will now have eight Targets: the seven Bay jurisdictions + Conowingo) with the latter to be achieved collaboratively by all relevant parties in a separate WIP. In other words, although the PSC may expect that reductions to meet the Conowingo pollutant reduction targets will come from the most effective areas in a subset of Bay jurisdictions, all Bay jurisdictions recognize the benefits of Conowingo's past pollutant trapping and, therefore, all agree to work together in implementing the agreed upon plan.

2. **<u>Funding options</u>: Partners would agree to contribute resources (e.g. funding, technical assistance, in-kind services, etc) into a pool to be managed collaboratively to achieve the necessary pollutant load reductions.**
   The unique and critical component to this proposed Conowingo WIP is pooling resources and the collaborative application of those pooled resources in the most cost-effective manners possible. Pooled resources would be phased in over a period of time. Key sources of initial funding are anticipated to be realized through the Exelon Water Quality Certification (anticipated May 2018) and additional federal funding sources (e.g., USDA , CWA 117 Innovative Nutrient and Sediment and Small Watershed Grants, Army Corps, USFW, NFWF Chesapeake Stewardship Fund, etc.) that can supplement current state WIP efforts. A financial strategy will be developed by the third party awardee and Steering Committee that identifies these initial sources of funding, as well as medium

and longer range funding sources that can be phased in over time as necessary to achieve the Conowingo pollution reduction targets. The strategy will consider leveraging state, local and private dollars and in-kind services or technical resources as well as reallocation of existing federal funds to the jurisdictions (e.g., CBIG, CBRAP, 319, WIP assistance funds) for Chesapeake Bay restoration. EPA will work with the partnership to help ensure that any reallocation of federal funds will not adversely impact state WIP efforts. The Conowingo WIP Steering Committee will also work with a third party (see below) to enlist other federal and non-federal funding sources or voluntary partnerships as well as define associated roles and responsibilities, including consideration of "pay for success" approaches.

3. **Implementing the Plan: Pooled resources would be managed by a third party, following RFP issuance by EPA's CBP Office, with guidance from the WIP Steering Committee to implement pollutant reducing practices in the most cost-effective manners possible independent of jurisdictional boundaries.**
   A third party would be charged with applying the pooled resources in the most cost-effective and pollutant load reduction-efficient locations in order to achieve the required Conowingo pollutant load reductions for the least cost. Reductions would come from existing CBP partnership-approved BMPs and other innovative components such as those listed above. Geographic targeting of BMP locations would be consistent with CBP partnership-approved models and watershed loading rates. Additionally, the third party would be charged with verifying and tracking all reductions following CBP partnership-approved protocols and pursuing or leveraging additional funding sources to implement the Conowingo WIP.

4. **Crediting Implementation**
   Practices funded with pooled dollars are credited to the Conowingo WIP pollutant reduction targets, regardless of where the practices were implemented or where the funding originated. The Conowingo WIP Steering Committee, with technical support from EPA's CBP and the third party, will develop a Conowingo credit calculation and tracking protocol that simultaneously considers opportunities to advance other state WIP efforts.

5. **Plan Development Schedule**
   The schedule is in Appendix B and subject to change. The Conowingo WIP Steering Committee will submit changes to this schedule to the PSC for approval.

6. **Roles and Responsibilities**

   I. EPA will:
      a. Evaluate the Conowingo WIP and provide biennial evaluations of the progress toward attaining the goals in the Conowingo WIP. EPA's evaluations, in consultation with the PSC, and any needed improvement will be used to determine if corrections or adjustments are necessary to attain the goals of the Conowingo WIP (e.g., whether the targets need to be re-evaluated or assigned to specific jurisdictions).
      b. Issue a Request for Proposal (RFP) for the third party and administer the subsequently awarded contract, grant or cooperative agreement. Because EPA will be issuing the RFP, it cannot act as a third party.

   c. Provide technical staff and contractor support such as modeling or GIS analysis to the Conowingo WIP Steering Committee.

II. The Conowingo WIP Steering Committee will:
   a. Consist of a representative from each jurisdiction and the Chesapeake Bay Commission (CBC). Each Bay jurisdiction and the CBC may also solicit comments on the Conowingo WIP framework from key stakeholders. EPA will not participate on this committee due to its oversight role as part of the Bay TMDL accountability framework
   b. Develop the Conowingo WIP with EPA staff and contractor support.
   c. Guide the development of a financing strategy and implementation of the Conowingo WIP, working with the third party.

III. The Third Party will:
   a. Provide facilitation, programmatic and technical assistance to the Conowingo WIP Steering Committee in the implementation of the Conowingo WIP.
   b. Develop a financing strategy with guidance from the Steering Committee and act as a fund manager, either using the shared dollars directly and/or awarding the funding to other parties to implement cost-effective pollution reduction technologies in areas having the most impact on Chesapeake Bay's water quality.
   c. Track/ verify progress made in the implementation of the Conowingo WIP and report to EPA on an annual basis.
   d. Pursue additional funding sources to sustain the Conowingo WIP and help meet associated pollution reduction targets.

IV. The PSC will:
   a. Approve the final draft Conowingo WIP for submittal to EPA and the Partnership for review and comment.
   b. Approve the final Conowingo WIP before posting on the CBP Partnership website in June 2019.
   c. Review the progress of the Conowingo WIP Steering Committee in the development and implementation of the Conowingo WIP on a regular basis.

APPENDIX A
Draft Conowingo WIP Guiding Principles for PSC Review
Prepared by: The Conowingo WIP Steering Committee
10/12/18 Version

1. **Fairness Principle**: Strive for fairness, equity, and feasibility among state, local, and federal and other partners participating in the Conowingo WIP regarding level of effort, financing, tracking, resource sharing, and third party access.

2. **Governance Principle**: Operate as an Action Team as defined in the document "Governance and Management Framework for the Chesapeake Bay Program Partnership". Strive for consensus using the Chesapeake Bay Program Partnership Consensus Continuum as described in the document. When consensus cannot be reached, the issue will be deferred to the PSC with a summary of the issue and the different options and opinions expressed by the members.

3. **Consistency Principle**: Ensure consistency with the EPA Phase 3 WIP expectations and Conowingo WIP framework documents.

4. **Transparency Principle**: Establish clear tracking, accountability and verification consistent with expectations for jurisdictions and to transparently demonstrate which practices are planned for, implemented and maintained in the Conowingo WIP vs state WIPs in order to avoid double-counting.

5. **Efficiency in Innovation Principle**: Implement the Conowingo WIP building on existing, successful programs, as much as is feasible, to avoid creating duplicative bureaucracies. At the same time, strive for innovation, leverage new technologies, and, where appropriate, develop new implementation approaches.

APPENDIX B – Schedule for Development
Conowingo Phase 3 Watershed Implementation Plan (WIP)

OPTION 1 --- CONCURRENT SUBMITTAL

December 2017 — Received PSC Approval on Conowingo WIP framework and the first cut of the Conowingo pollutant reduction targets to address this additional load.

March 2018 - March 2019 — The Conowingo WIP Steering Committee, including a representative from each jurisdiction and the Chesapeake Bay Commission work collaboratively to begin development of the Conowingo WIP to include: 1) finalizing the Conowingo WIP framework, pollution reduction target(s), and resource sharing commitments; and, 2) working with EPA, other federal partners, and the third party to develop a financing strategy that leverages technical assistance, in-kind services, and federal, state, local and potential private sector funding sources.

September 2018 — EPA prepares a draft RFP for an award of a cooperative agreement or contract to manage and oversee the pooled resources and to facilitate the development and implementation of the Conowingo WIP, as guided by the Conowingo WIP Steering Committee.

Sept. 2018 – March 2019 — EPA selects the RFP awardee and, building on the decisions made to date, the Conowingo WIP Steering Committee continues drafting the Conowingo WIP with support of the awardee to include a finance strategy for the Conowingo WIP, additional local government and public engagement strategies, identifying specific reduction practices and a timeline, funding sources, the methodology for addressing any identified gaps and provisions for contingencies.

April 1, 2019 — The Conowingo WIP Steering Committee submits a draft Conowingo WIP to the PSC for review and comment.

April 8, 2019 — The PSC submits comments to the Conowingo WIP Steering Committee.

April 12, 2019 — **States will post their Draft Phase III WIPs on their respective websites for Partnership review and comment.**

April 12, 2019 — DRAFT Conowingo WIP posted on the CBP website for a 30-day public comment period ending May 13, 2019.

June 7, 2019 — **Partnership Comments Due on States' Draft Phase III WIPs.**

July 5, 2019 — The Conowingo WIP Steering Committee addresses all comments and submits a final draft to the PSC for final review and comment.

July 19, 2019	The PSC submits any final comments to the Conowingo WIP Steering Committee.
August 9, 2019	**States will post their FINAL Phase III WIPs on their respective websites.**
August 9, 2019	**The CBP partnership will post the FINAL Conowingo WIP on its website**
October 1, 2019	The Conowingo Steering Committee and the third party will begin full plan implementation utilizing funding allocated to the plan for federal FY 2020.
??	Determine the role of Exelon in the implementation of the Conowingo WIP based on the outcome of Maryland's decisions regarding 401 certification and the resultant court cases.
Biennially	EPA to evaluate the effectiveness and progress of the Conowingo WIP, pursue additional funding sources to help with implementation, identify additional mitigation options and recommend options to the PSC, as necessary.
Summer 2023	The PSC will reevaluate and make any necessary corrections based on EPA's biennial evaluations of the Conowingo WIP implementation, recommendations from the Conowingo WIP Steering Committee and any other factors.
2025	Consistent with the 2014 Watershed Agreement and the 2010 TMDL, a goal will be to have all practices in place to achieve the necessary nutrient and sediment reductions by 2025.

Appendix D. BMP Opportunities Analysis

Map name	Brief Description	Map units	Datasets referenced	Methods used
Buffer Restoration opportunities	Total area of land suitable for buffer restoration within 100 ft. of water network.	Square Meters	• Land Cover: 1-meter land cover data classified using 2013 NAIP imagery; Chesapeake Conservancy & University of Vermont; 2016 • Water network (MD/PA): Lidar-derived water network combined with 2013 1-meter land cover data; Chesapeake Conservancy; 2018	Pixels from the high-resolution land cover dataset within 100 ft. distances of the water network were considered in the buffer analysis. Pixels classified as low vegetation, wetlands, or barren were considered buffer restoration opportunities. Area of buffer restoration opportunity is summed by county.
Living Shorelines opportunities	Total length of shoreline not already obstructed by the presence of a structure	Feet	• Maryland Shoreline Inventory: Shoreline Situation Report, Comprehensive Coastal Inventory Program, Virginia Institute of Marine Science, College of William and Mary; 2006	Line-of-sight assessment that describes the presence of shoreline structures for shore protection and recreational purposes. Unclassified shorelines identified as areas with potential opportunity for implementation. Length of opportunity is summed by county.
Wetland restoration opportunities	Lands currently in agriculture that naturally accumulate water due to topography and have historically had poorly draining soils	Square Meters	• Potentially Restorable Wetlands; U.S. EPA; 2016	Total land area identified as potential wetland restoration opportunities on agricultural land summed by county.
Urban BMP opportunities	Urban land outside of MS4 boundaries	Square Meters	• Urban Areas/Urban Clusters. U.S. Census Bureau. 2010 • Municipal Separate Storm Sewer System (MS4) Boundaries. Chesapeake Bay Program. 2019.	Area of urban land that falls outside of MS4 boundaries summed by county. These are potential locations for urban BMP implementation that is not already considered under current permitting processes.

Total nitrogen relative effectiveness	Change in dissolved oxygen (DO) that occurs in the Bay per pound of nutrient changed locally in the watershed	µg/L DO per million lbs of reduction	● Relative Effectiveness; Chesapeake Bay Program. 2019.	See Emily Trentacoste, Gary Shenk, or Jeff Sweeney at the Chesapeake Bay Program.
CAST analysis on Nitrogen loads	Theoretical opportunities for additional nitrogen reductions beyond projected Phase III WIP implementation	Pounds of Nitrogen delivered to edge of stream/year	● CAST Phase III WIP Final Scenario Report; Chesapeake Bay Program. 2019. ○ Projected nitrogen delivery to edge-of-stream after full implementation of Phase III WIPs. ● CAST 2010 E3 Scenario Report; Chesapeake Bay Program. 2017. ○ E3 - Everything by everyone everywhere, e.g. BMPs implemented to theoretical maximum extent resulting in the lowest possible loads that could be delivered to local streams	WIP 3 load - E3 load = theoretical nitrogen load available for reduction through CWIP implementation. Outputs for this layer are summed by LRS.

Appendix E. Data and Methods to Quantify the Nitrogen Load Reduction from BMP Implementation-Scenario 1

The Chesapeake Assessment Scenario Tool (CAST) was used to model pollutant load reductions all BMPs.

The initial CWIP analysis included CAST runs by land river segment for the priority geography areas only. However, the limited geography achieved only achieved one third of the 6-million-pound nitrogen load reduction. To enhance the nitrogen load reduction potential, increase the time efficiency of modelling, and to benefit the financing strategy to implement the BMPs, the geography of interest was expanded to the county scale.

The current analysis began with examining the full opportunity of implementing forest buffers, forest buffer-streamside with exclusion fencing, wetland restoration – floodplain, wetland restoration – headwater, urban stream restoration, nonurban stream restoration from WIP3 to E3. That analysis yielded a 9.3-million-pound nitrogen reduction. Therefore, best professional judgement was used to scale back the implementation of forest buffers to 65%, wetlands to 65%, and stream restoration to 90%. With this reduced implementation, the nitrogen reduction was reduced to 6.2-million-pounds.

The analysis herein, was developed to that 6-million-pounds of nitrogen reduction could be achieved in the area of interest. The analysis is not a definitive commitment but rather a planning document that shows the reductions are possible but may require implementation of different strategies, such as dredging, to accomplish the pollution reduction goals. Final BMPs will determined once a financing strategy is complete.

Determining opportunity

- An analysis of the Amount Credited in WIP3 subtracted from the Amount Credited in E3 was performed for the following practices in the Conowingo geography:
    - Forest Buffers
    - Forest Buffer – Narrow
    - Forest Buffer-Streamside with Exclusion Fencing
    - Forest Buffer-Narrow with Exclusion Fencing
    - Grass Buffers
    - Grass Buffer – Narrow
    - Grass Buffer-Streamside with Exclusion Fencing
    - Grass Buffer-Narrow with Exclusion Fencing
    - Wetland Restoration – Floodplain

- Wetland Restoration – Headwater
- Urban Stream Restoration
- Nonurban Stream Restoration

- To determine the area that bioswales could be applied to, analysis of each of the load sources classified as Nonregulated Developed land use was performed for each County within the Conowingo Geography.
    - 1% of that land acreage was calculated from these load source groups as a responsible assumption for this analysis. The 1% was based upon best professional judgement and…
        - Non-Regulated Buildings and Other
        - Non-Regulated Roads
        - Non-Regulated Tree Canopy over Impervious
        - Non-Regulated Tree Canopy over Turf Grass
        - Non-Regulated Turf Grass
- An analysis of the opportunity for non-urban shoreline management was performed by the Chesapeake Conservancy using Shoreline Inventory for Maryland from the Virginia Institute of Marine Science (VIMS). This data includes visual assessments of the shorelines which occurred in a locality-based series from 2002 to 2006.
    - Analysis was performed on the following counties in Maryland:
        - Cecil
        - Dorchester
        - Harford
        - Kent
        - Queen Anne's
        - Somerset
        - St. Mary's
        - Talbot
        - Caroline
        - Wicomico

Determining practices and areas for the input deck

- Acres (or feet for stream restoration) within the Conowingo Shell for WIP3 were subtracted from E3 for each of the practices excluding bioswales
  - This was done by county, practice, and load source using the Amount Credited values
- Any practice for which there were positive acres between the E3 – WIP3 analysis were kept
  - This removed all categories of grass buffers, forest buffer – narrow, and forest buffer – narrow with exclusion fencing from the analysis as there were no positive acres or feet available from E3 – WIP3.
  - The rest of the practices were kept
  - The available acres (or feet for stream restoration) for each practice by county by load source group were calculated

Creating the Model Runs

- An input deck was created using 100% of the available opportunity from the following:
  - Forest buffers
  - Forest Buffer-Streamside with Exclusion Fencing
  - Wetland Restoration – Floodplain
  - Wetland Restoration – Headwater
  - Urban Stream Restoration
  - Nonurban Stream Restoration
- Further, bioswales were entered to treat 1% of the Nonregulated Developed land use was performed for each County within the Conowingo Shell.
- Non-Urban Shoreline Management was entered based off of opportunity analysis that was performed by the Chesapeake Conservancy
  - To account for the age of the data and qualifying conditions for Living Shorelines the opportunity lengths were reduced by 50%.
  - Implementation assumed 10% of the adjusted opportunity that was determined by the Chesapeake Conservancy using VIMS data and entered as total feet into the input deck.
- The input deck was run in CAST along with the predetermined WIP3 Final deck available through the CAST administrator

Reports Generated

- Inputs were placed into the CAST model
- The CAST model determined that no BMPs in the input deck were invalid
- Reports for loads, and BMPs submitted versus credited were created for both the CWIP plus WIP3 and WIP3 runs individually

Quality Control

- Analysis of the BMPs Submitted versus Credited report was generated for both the WIP3 and the CWIP (plus WIP3) model runs. The CWIP (plus WIP3) Amount Credited values were subtracted from the WIP3 values.
- The difference in Amount Credited was compared to the values that were entered into the input deck.
- A small number of BMPs acres were not credited, primarily forest buffers. It was determined that the number of these acres were considered as insignificant.

Bioreactors

- An analysis of the opportunity for bioreactors was performed by the Center for Watershed Protection using USGS NHDPlus HR, USDA NRCS Soils, and MD Dept of Planning 2010 Land Use Land Cover data.
- The analysis extracted Depth to Water Table from NRCS soil survey then intersected the canals/ditches from NHD within the Conowingo Geography with the depth to water table and MDP land use data.
- Results were filtered to include only canals/ditches with a depth to water table <= 12" and within agricultural land.
- The average loading from the load sources categorized as Cropland were determined by summing the acres and EOT loads individually and then dividing the load by acres for the following:
    - Double Cropped Land
    - Full Season Soybeans
    - Grain with Manure
    - Grain without Manure
    - Other Agronomic Crops

- Silage with Manure
- Silage without Manure
- Small Grains and Grains
- Specialty Crop High
- Specialty Crop Low

- This provided an EOT calculation of the reduction

Stream Restoration

- CAST currently applies a default rate of 0.075 pound of nitrogen per linear foot of stream restoration per the "Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects" (pg. 14). However, the default rate was doubled to provide an estimate of the total nitrogen reduction. This was deemed reasonable given the update to the Stream Restoration Protocols and a new protocol that is under review by the Urban Stormwater Workgroup for Outfall Stabilization (Protocol 5).

Reducing from Full Opportunity

- Once the model results were generated, stream restoration doubled, and the reductions from bioreactors were included, there was approximately 9.3M pounds of nitrogen reduction calculated.
- An analysis was performed to reduce the suite of practices down from 100% of the opportunity from E3 – WIP3 down to a level that achieved closer to the 6M pound nitrogen goal.
- The following practices were reduced in acreage by 35% (65% of full opportunity)
    - Forest buffers
    - Forest Buffer-Streamside with Exclusion Fencing
    - Wetland Restoration – Floodplain
    - Wetland Restoration – Headwater
- The following stream restoration practices were reduced in feet by 10% (90% of full opportunity)
    - Urban Stream Restoration
    - Nonurban Stream Restoration
- The rest of the practices were unchanged.

- This resulted in the achieving a nitrogen goal of approximately 6 M pound.

Susquehanna Nitrogen Exchange Ratios

Nitrogen from the Susquehanna basin has a greater impact on dissolved oxygen in the Bay than the same nitrogen load from many other basins in the Chesapeake Bay. Table E1 summarizes the unit change in DO per million pounds of N for each of the basins considered in this study, along with the "Exchange Ratio" applied to equate loading from the Susquehanna and the geographies where each ratio is applied.

Basin	Unit Change per 1,000,000 pounds of N	Exchange Ratio (to Susquehanna N Load)	Geographies where Applied
Susquehanna	16.325	1.00	All PA Counties
Upper Eastern Shore	10.709	0.66	Kent, Queen Anne's and Cecil Counties in MD
Lower Eastern Shore	9.782	0.60	Somerset, Wicomico and Worchester Counties in MD
Middle Eastern Shore	11.244	0.69	All other MD Counties

Table E1: Change in Dissolved Oxygen per million pounds of Nitrogen

These ratios were applied to loads and load reductions included in this report. a "Susquehanna Equivalent N Load" would be calculated using the following equation:

L_{susq}=LxER

Where:

L_{susq} = Susquehanna Equivalent Nitrogen Load (pound/acre/year or pound/year)

L= Estimated Edge of Tide Load (pound/acre/year or pound/year)

ER=Exchange Ratio (From Table XX).

For example, if the loading rate for a particular land use in the Lower Eastern Shore is 10 pound/acre/year, the equivalent Susquehanna Equivalent N Load would be calculated as:

L_{susq}=10 pound/acre/yearx0.6, or 6.0 pound/acre/year

Appendix F. Summary of analysis to develop nitrogen load reductions for the BMP implementation strategy.

This information will be added following selection of the CAST scenario.

Appendix G. A summary of assumptions used to provide the cost estimates for the CWIP implementation strategy.

Cost Assumption were developed using data found with in CAST and summarized below (https://cast.chesapeakebay.net/Documentation/CostProfiles).

Stream restoration

- MD
    - Urban & Non-Urban Stream Restoration Protocols
        - $408.24/ft
        - O&M: $51.03/ft/yr
        - Total annualized cost per unit: $145.32
- PA
    - Urban & Non-Urban Stream Restoration Protocols
        - $408.24/ft
        - O&M: $51.03/ft/yr
        - Total annualized cost per unit: $145.32
- Stream Restoration Averaged
    - Urban & Non-Urban Stream Restoration Protocols
        - $408.24/ft
        - O&M: $51.03/ft/yr
        - Total annualized cost per unit: $145.32

Living shorelines

- MD
    - Urban Shoreline Management
        - $435.07/ft
        - O&M: $21.75/ft/yr
        - Total annualized cost per unit: $50.05
    - Non-Urban Shoreline Management
        - $85.23/ft
        - O&M: $0/ft/yr
        - Total annualized cost per unit: $6.84
    - Urban Shoreline Erosion Control Non-Vegetated
        - $856.33/ft
        - O&M: $42.82/ft/yr
        - Total annualized cost per unit: $98.53
    - Urban Shoreline Erosion Control Vegetated
        - $82.87/ft
        - O&M: $4.14/ft/yr
        - Total annualized cost per unit: $9.53

- Non-Urban Shoreline Erosion Control Non-Vegetated
  - $117.19/ft
  - O&M: $5.86/ft/yr
  - Total annualized cost per unit: $15.26
- Non-Urban Shoreline Erosion Control Vegetated
  - $15.20/ft
  - O&M: $0.76/ft/yr
  - Total annualized cost per unit: $1.98

▪ PA
- Urban Shoreline Management
  - $435.07/ft
  - O&M: $21.75/ft/yr
  - Total annualized cost per unit: $50.05
- Non-Urban Shoreline Management
  - $63.56/ft
  - O&M: $0/ft/yr
  - Total annualized cost per unit: $5.10
- Urban Shoreline Erosion Control Non-Vegetated
  - $856.33/ft
  - O&M: $42.82/ft/yr
  - Total annualized cost per unit: $98.53
- Urban Shoreline Erosion Control Vegetated
  - $82.87/ft
  - O&M: $4.14/ft/yr
  - Total annualized cost per unit: $9.53
- Non-Urban Shoreline Erosion Control Non-Vegetated
  - $139.66/ft
  - O&M: $6.98/ft/yr
  - Total annualized cost per unit: $18.19
- Non-Urban Shoreline Erosion Control Vegetated
  - $30.54/ft
  - O&M: $1.53/ft/yr
  - Total annualized cost per unit: $3.98

▪ Living Shorelines Averaged
- Urban Shoreline Management
  - $435.07/ft
  - O&M: $21.75/ft/yr
  - Total annualized cost per unit: $50.05
- Non-Urban Shoreline Management
  - $74.40/ft
  - O&M: $0/ft/yr

        - Total annualized cost per unit: $5.97
    - Urban Shoreline Erosion Control Non-Vegetated
        - $856.33/ft
        - O&M: $42.82/ft/yr
        - Total annualized cost per unit: $98.53
    - Urban Shoreline Erosion Control Vegetated
        - $82.87/ft
        - O&M: $4.14/ft/yr
        - Total annualized cost per unit: $9.53
    - Non-Urban Shoreline Erosion Control Non-Vegetated
        - $128.43/ft
        - O&M: $6.42/ft/yr
        - Total annualized cost per unit: $16.73
    - Non-Urban Shoreline Erosion Control Vegetated
        - $22.87/ft
        - O&M: $1.15/ft/yr
        - Total annualized cost per unit: $2.98

<u>Buffers</u>

- MD
    - Agriculture
        - Grass Buffer
            - $250.55/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $40.97
        - Grass Buffer, Narrow
            - $250.55/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $40.97
        - Grass Buffer, Streamside with Exclusion Fencing
            - $1,550.52/ac
            - O&M: $52/ac/yr
            - Total annualized cost per unit: $261.32
        - Grass Buffer, Narrow with Exclusion Fencing
            - $4,152.49/ac
            - O&M: $156.08/ac/yr
            - Total annualized cost per unit: $702.37
        - Forest Buffer
            - $1,756.64/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $100.33
        - Forest Buffer, Narrow

            - $1,756.64/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $100.33
        - Forest Buffer, Streamside with Exclusion Fencing
            - $11,506.45/ac
            - O&M: $52/ac/yr
            - Total annualized cost per unit: $652.70
        - Forest Buffer, Narrow with Exclusion Fencing
            - $31,021.16/ac
            - O&M: $156.08/ac/yr
            - Total annualized cost per unit: $1,758.31
        - Saturated Buffer
            - $4,676.50/ac
            - O&M: $78.06/ac/yr
            - Total annualized cost per unit: $453.32
    - Developed
        - Forest Buffer
            - $1,790.67/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $91.90
        - Grass Buffer
            - $430.51/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $55.75
- PA
    - Agriculture
        - Grass Buffer
            - $385.86/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $56.95
        - Grass Buffer, Narrow
            - $385.86/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $56.95
        - Grass Buffer, Streamside with Exclusion Fencing
            - $1,685.83/ac
            - O&M: $52/ac/yr
            - Total annualized cost per unit: $277.30
        - Grass Buffer, Narrow with Exclusion Fencing
            - $4,287.79/ac
            - O&M: $156.08/ac/yr
            - Total annualized cost per unit: $718.35

        - Forest Buffer
            - $2,929.92/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $157.35
        - Forest Buffer, Narrow
            - $2,929.92/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $157.35
        - Forest Buffer, Streamside with Exclusion Fencing
            - $12,679.72/ac
            - O&M: $52/ac/yr
            - Total annualized cost per unit: $709.73
        - Forest Buffer, Narrow with Exclusion Fencing
            - $32,194.44/ac
            - O&M: $156.08/ac/yr
            - Total annualized cost per unit: $1,815.33
        - Saturated Buffer
            - $4,660.61/ac
            - O&M: $78.06/ac/yr
            - Total annualized cost per unit: $452.04
    - Developed
        - Forest Buffer
            - $2,986.67/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $153.28
        - Grass Buffer
            - $524.44/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $67.92
- **Buffers Averaged**
    - Agriculture
        - Grass Buffer
            - $318.21/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $48.96
        - Grass Buffer, Narrow
            - $318.21/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $48.96
        - Grass Buffer, Streamside with Exclusion Fencing
            - $1,618.18/ac
            - O&M: $52/ac/yr

            - Total annualized cost per unit: $269.31
        - Grass Buffer, Narrow with Exclusion Fencing
            - $4,220.14/ac
            - O&M: $156.08/ac/yr
            - Total annualized cost per unit: $710.36
        - Forest Buffer
            - $2,343.28/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $128.84
        - Forest Buffer, Narrow
            - $2,343.28/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $128.84
        - Forest Buffer, Streamside with Exclusion Fencing
            - $12,093.09/ac
            - O&M: $52/ac/yr
            - Total annualized cost per unit: $681.22
        - Forest Buffer, Narrow with Exclusion Fencing
            - $31,607.80/ac
            - O&M: $156.08/ac/yr
            - Total annualized cost per unit: $1,786.82
        - Saturated Buffer
            - $4,668.56/ac
            - O&M: $78.06/ac/yr
            - Total annualized cost per unit: $452.68
    - Developed
        - Forest Buffer
            - $2,388.67/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $122.59
        - Grass Buffer
            - $477.48/ac
            - O&M: $0/ac/yr
            - Total annualized cost per unit: $61.84

<u>Wetlands</u>

- MD
    - Agriculture
        - Wetland Restoration, Floodplain
            - $403.64/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $93.71

        - Wetland Restoration, Headwater
            - $3,000/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $343.85
        - Wetland Creation, Floodplain
            - $3,228/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $365.82
        - Wetland Creation, Headwater
            - $3,228/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $365.82
    - Developed
        - Wet Ponds and Wetlands
            - $4,411.42/acre treated
            - O&M: $62.92/acre treated
            - Total annualized cost per unit: $329.91
        - Floating Treatment Wetland, 10% Coverage of Pond
            - $3,707/ac
            - O&M: $185/ac/yr
            - Total annualized cost per unit: $1,546.24
        - Floating Treatment Wetland, 20% Coverage of Pond
            - $7,415/ac
            - O&M: $371/ac/yr
            - Total annualized cost per unit: $3,093.85
        - Floating Treatment Wetland, 30% Coverage of Pond
            - $11,122/ac
            - O&M: $556/ac/yr
            - Total annualized cost per unit: $4,640.09
        - Floating Treatment Wetland, 40% Coverage of Pond
            - $14,829/ac
            - O&M: $741/ac/yr
            - Total annualized cost per unit: $6,186.34
        - Floating Treatment Wetland, 50% Coverage of Pond
            - $18,536/ac
            - O&M: $927/ac/yr
            - Total annualized cost per unit: $7,733.58
    - Natural
        - Wetland Enhancement
            - $726.45/ac

            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $124.81
        - Wetland Rehabilitation
            - $2,545.85/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $300.10
- PA
    - Agriculture
        - Wetland Restoration, Floodplain
            - $466.56/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $96.58
        - Wetland Restoration, Headwater
            - $2,781.64/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $319.62
        - Wetland Creation, Floodplain
            - $2,776.65/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $318.72
        - Wetland Creation, Headwater
            - $2,907.81/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $331.78
    - Developed
        - Wet Ponds and Wetlands
            - $4,418.64/acre treated
            - O&M: $63.02/acre treated
            - Total annualized cost per unit: $330.44
        - Floating Treatment Wetland, 10% Coverage of Pond
            - $3,707/ac
            - O&M: $185/ac/yr
            - Total annualized cost per unit: $1,546.24
        - Floating Treatment Wetland, 20% Coverage of Pond
            - $7,415/ac
            - O&M: $371/ac/yr
            - Total annualized cost per unit: $3,093.85
        - Floating Treatment Wetland, 30% Coverage of Pond
            - $11,122/ac
            - O&M: $556/ac/yr

            - Total annualized cost per unit: $4,640.09
        - Floating Treatment Wetland, 40% Coverage of Pond
            - $14,829/ac
            - O&M: $741/ac/yr
            - Total annualized cost per unit: $6,186.34
        - Floating Treatment Wetland, 50% Coverage of Pond
            - $18,536/ac
            - O&M: $927/ac/yr
            - Total annualized cost per unit: $7,733.58
    - Natural
        - Wetland Enhancement
            - $1,145.41/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $161.98
        - Wetland Rehabilitation
            - $2,781.64/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $319.62
- **Wetlands Averaged**
    - Agriculture
        - Wetland Restoration, Floodplain
            - $435.10/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $95.15
        - Wetland Restoration, Headwater
            - $2,890.82/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $331.74
        - Wetland Creation, Floodplain
            - $3,002.33/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $342.27
        - Wetland Creation, Headwater
            - $3,067.91/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $348.80
    - Developed
        - Wet Ponds and Wetlands
            - $4,415.03/acre treated
            - O&M: $62.97/acre treated

            - Total annualized cost per unit: $330.18
        - Floating Treatment Wetland, 10% Coverage of Pond
            - $3,707/ac
            - O&M: $185/ac/yr
            - Total annualized cost per unit: $1,546.24
        - Floating Treatment Wetland, 20% Coverage of Pond
            - $7,415/ac
            - O&M: $371/ac/yr
            - Total annualized cost per unit: $3,093.85
        - Floating Treatment Wetland, 30% Coverage of Pond
            - $11,122/ac
            - O&M: $556/ac/yr
            - Total annualized cost per unit: $4,640.09
        - Floating Treatment Wetland, 40% Coverage of Pond
            - $14,829/ac
            - O&M: $741/ac/yr
            - Total annualized cost per unit: $6,186.34
        - Floating Treatment Wetland, 50% Coverage of Pond
            - $18,536/ac
            - O&M: $927/ac/yr
            - Total annualized cost per unit: $7,733.58
    - Natural
        - Wetland Enhancement
            - $935.93/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $143.40
        - Wetland Rehabilitation
            - $2,663.75/ac
            - O&M: $44.65/ac/yr
            - Total annualized cost per unit: $309.86

<u>Bioswales</u>

- MD
    - Developed
        - Bioswale
            - $9,598.47/acre treated
            - O&M: $313.42/acre treated/year
            - Total annualized cost per unit: $864.54
- PA
    - Developed
        - Bioswale
            - $9,614.18/acre treated

        - O&M: $313.93/acre treated/year
        - Total annualized cost per unit: $865.95
    - Bioswales Averaged
        - Bioswale
            - $9,606.33/acre treated
            - O&M: $313.68
            - Total annualized cost per unit: $915.25

Appendix H. BMPs included in Enhanced WIP Scenario.