How Nutrient Trading Can Help Restore the Chesapeake Bay

Background information on nutrient trading

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This document contains preliminary results from ongoing research and analysis. It is designed to inform timely discussion, obtain feedback, and influence ongoing deliberations on emerging topics.

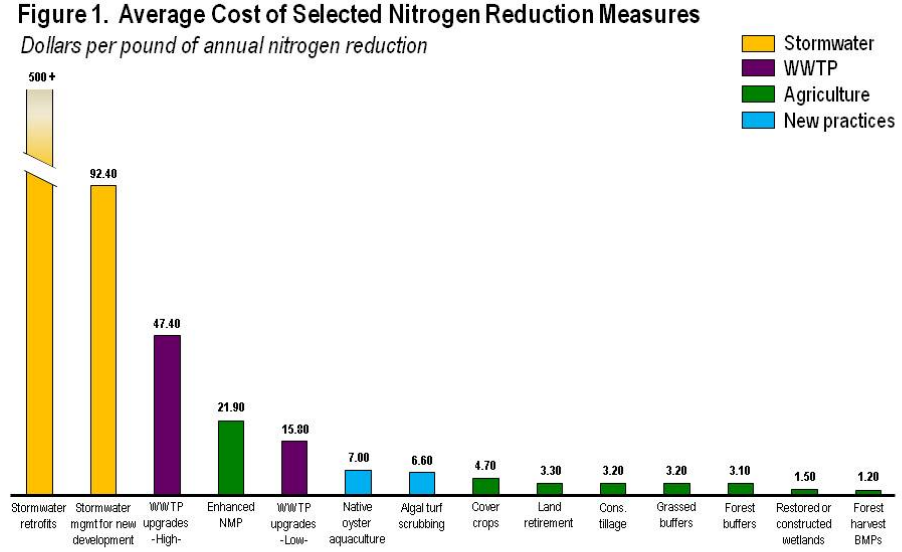
How Nutrient Trading Can Help Restore the Chesapeake Bay

Congress is considering proposals to revise and strengthen the Clean Water Act for the Chesapeake Bay region and improve the health of the region's streams, rivers, and wetlands. Senator Cardin's and Representative Cummings's proposed legislation, The Chesapeake Clean Water and Ecosystem Restoration Act of 2009, provides significant new resources and tools to help restore the Bay. Water quality trading for nutrients, or "nutrient trading", is one such tool. It could make it possible to achieve Bay restoration goals faster and at lower cost. It also could create an additional source of revenue for farmers.

Trading creates revenue opportunities and reduces cost. Nutrient trading is based on the fact that the cost to reduce nutrient pollution differs between sources (Figure 1). With trading, entities that are able to reduce their pollution below required levels are able to sell their surplus reductions to entities facing higher costs. Trading therefore allows those for whom it is cheaper to reduce nutrient pollution (e.g., farmers) to enjoy new revenue sources. It also allows those for whom it is more expensive to reduce nutrient pollution (e.g., municipal stormwater systems, wastewater treatment plants) to save money.

Figure 1. Average Cost of Selected Nitrogen Reduction Measures

Dollars per pound of annual nitrogen reduction



Note: Cost estimates do not take into account the baseline or minimum practices that agriculture will have to implement prior to selling credits. Depending on which practices farmers implement first, the costs of agricultural nutrient reduction measures may be higher or lower. Costs represent the costs of achieving the nitrogen reduction only. Actual credit prices under a nutrient trading program will be affected by market dynamics of supply and demand.

Sources: Agricultural BMPs: U.S. Environmental Protection Agency and Abt Associates Inc. *Preliminary*, 2009. *Chesapeake Bay: Next Generation of Tools and Actions to Restore the Bay: Preliminary Economic Analysis of Options*. Washington, D.C.: U.S. Environmental Protection Agency; WWTP upgrades: WRI analysis using plant upgrade costs; New practices: Maryland Department of Natural Resources, Fisheries Service, Oyster Advisory Commission. December 20, 2008 conference proceedings: Oyster restoration economic and ecologic cost offsets. Available online at: http://www.dnr.state.md.us/fisheries/oysters/mtgs/122007/meeting122007.html; New practices (cont'd): Suwanee River Algal Turf Scrubbing System Concept Design Report; Additional agricultural BMPs: Wieland, Robert, et al. 2009. *Costs and Cost Efficiencies for Some Nutrient Reduction Practices in Maryland*. Maryland Department of Natural Resources Coastal Program.

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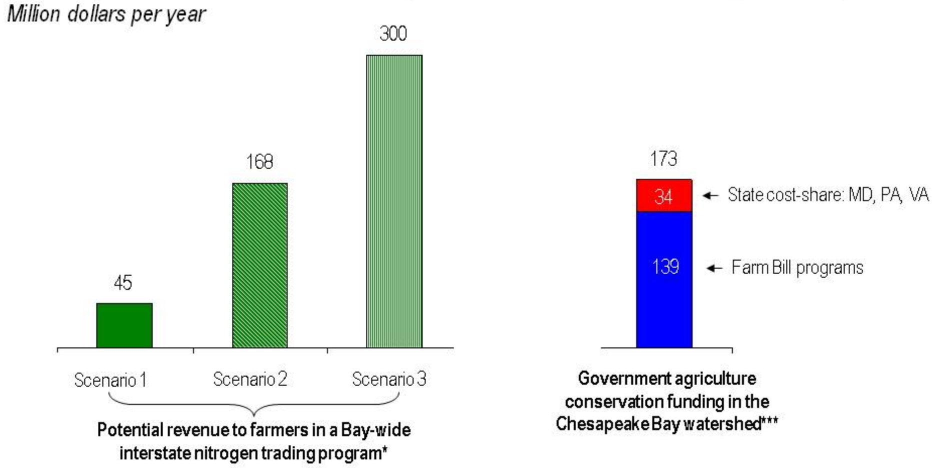
Trading accelerates pollution reduction. Trading encourages adoption of less expensive pollution reduction practices that are typically faster and easier to implement. Trading taps the most efficient, available reductions so states do not have to let construction schedules dictate compliance deadlines.

The cost-effectiveness of pollution-credit trading has been demonstrated. The 1990 Clean Air Act Amendments established an interstate trading program for sulfur dioxide emissions from power plants, allowing plants facing higher pollution reduction costs to purchase reductions from plants facing lower pollution reduction costs. Savings due to this trading program have been estimated to be 43-55%.

How could farmers benefit from nutrient trading? Farmers can earn additional revenue when they sell nutrient reduction credits generated by implementing practices that reduce fertilizer or manure runoff beyond baseline levels. Preliminary economic analysis indicates that the potential annual revenue to farmers from selling credits in a Bay-wide nitrogen trading program could be of a similar scale or greater than current annual government agriculture conservation funding in the Chesapeake Bay (Figure 2).

Figure 2. Potential Annual Revenue to Farmers from Bay-wide Nitrogen Trading is Same Scale as Current Government Agriculture Conservation Funding in the Bay

Million dollars per year



* Scenario 1: Credit price based on transactions in nascent PA nutrient market, $8/lb. Scenario 2: Credit price of $20/lb. Scenario 3: Credit price of $50/lb. Both scenario 2 and 3 credit prices account for potential baseline practices agriculture would have to implement prior to selling credits and opportunity costs, but assume no discounting or transaction costs. All scenarios assume credits are generated after agriculture baseline has been met. Credit demand is based on modeled wastewater treatment plant and stormwater program needs.

** Reflects financial assistance for implementing best management practices in the Chesapeake Bay watershed. Farm Bill programs include Environmental Quality Incentives Program, Agricultural Management Assistance, Farm and Ranchlands Protection Program, Wetland Reserve Program, Conservation Security Program, Conservation Reserve Program, Conservation Reserve Enhancement Program, and Chesapeake Bay Watershed Program. Figures are for 2009 fiscal year.

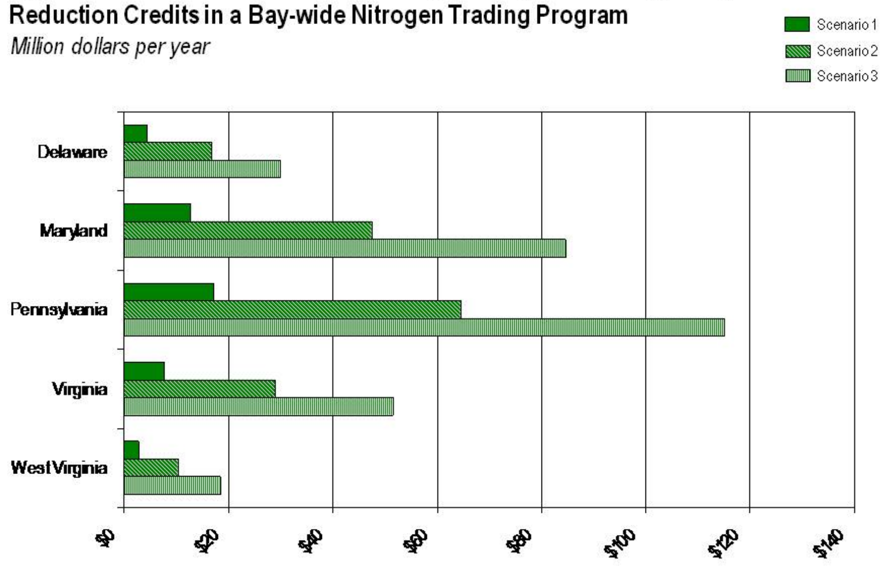
Note: Government agriculture conservation funding and revenue from interstate nitrogen trading program are not mutually exclusive. Rather, government agriculture conservation funding could be used to assist farmers to achieve baseline. Further nutrient reductions beyond the baseline that result from additional practices could be sold as credits.

Source: WRI analysis using data from the Chesapeake Bay Watershed Model phase 5.2, the U.S. Department of Agriculture, and the Chesapeake Bay Foundation. Version 11/30/09

It is important to note that ***these two sources of funding are complementary***. A farmer can use government agriculture conservation funds to help finance best management practices to achieve the farm's baseline nutrient levels. If the farmer implements additional practices that yield further nutrient reductions, the farmer could earn revenue by selling the reductions as nutrient credits.

A Bay-wide nutrient trading program could generate new revenue sources for farmers throughout the Chesapeake Bay region. Figure 3 summarizes the potential annual revenue to farmers by state from selling nitrogen credits. [See the appendix for descriptions of the scenarios]

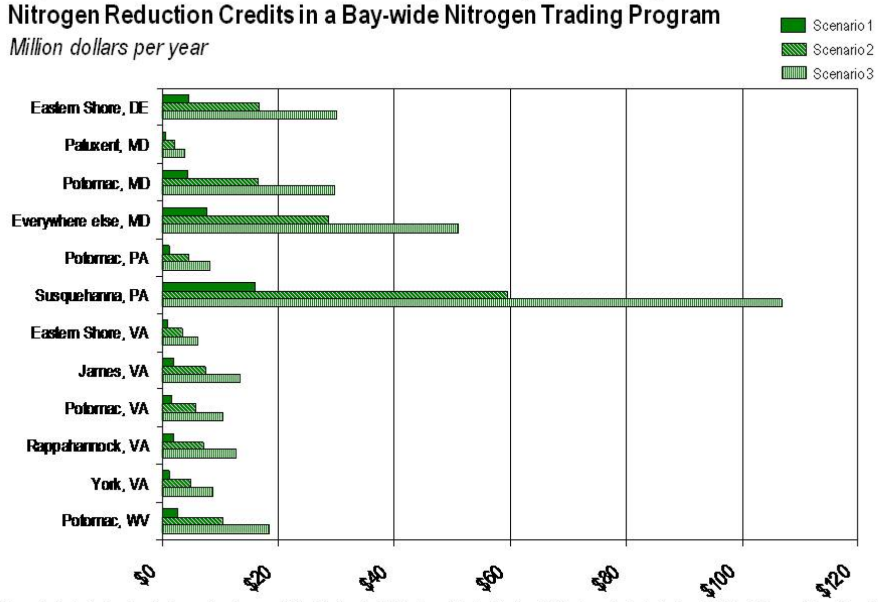
Figure 3. Potential Revenue to Farmers (by State) from Selling Nitrogen Reduction Credits in a Bay-wide Nitrogen Trading Program
Million dollars per year



* Scenario 1: Credit price based on transactions in nascent PA nutrient market, $8/lb. Scenario 2: Credit price of $20/lb. Scenario 3: Credit price of $50/lb. Both scenario 2 and 3 credit prices account for potential baseline practices agriculture would have to implement prior to selling credits and opportunity costs, but assume no discounting or transaction costs. All scenarios assume credits are generated after agriculture baseline has been met. Credit demand is based on modeled wastewater treatment plant and stormwater needs.
Source: WRI analysis using Chesapeake Bay Watershed Model phase 5.2. Version 11/30/09

Figure 4 summarizes the potential annual revenue to farmers by major river basin from selling nitrogen credits.

Figure 4. Potential Revenue to Farmers (by Basin) from Selling Nitrogen Reduction Credits in a Bay-wide Nitrogen Trading Program
Million dollars per year

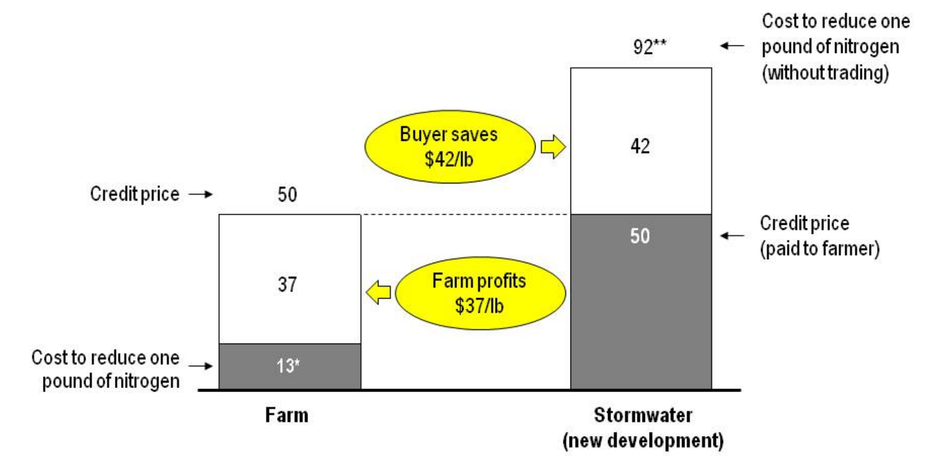


* Scenario 1: Credit price based on transactions in nascent PA nutrient market, $8/lb. Scenario 2: Credit price of $20/lb. Scenario 3: Credit price of $50/lb. Both scenario 2 and 3 credit prices account for potential baseline practices agriculture would have to implement prior to selling credits and opportunity costs, but assume no discounting or transaction costs. All scenarios assume credits are generated after agriculture baseline has been met. Credit demand is based on modeled wastewater treatment plant and stormwater needs.
Source: WRI analysis using Chesapeake Bay Watershed Model phase 5.2. Version 11/30/09

Which other stakeholders could benefit from nutrient trading? A Bay-wide, interstate nutrient trading program could generate benefits for other stakeholders in the Chesapeake Bay region, too. For instance:

- *Municipalities* can cost-effectively reduce urban runoff and meet load requirements through purchasing nutrient credits from farmers and others. Preliminary analysis by WRI indicates that trading could reduce costs to municipal stormwater system retrofits by billions of dollars, perhaps more than 50 percent relative to conventional nutrient reduction approaches. Figure 5 illustrates potential economic benefits of nutrient trading to both farmers and municipalities with regard to new development.

Figure 5. Benefits of a Trade between a Farm and a Stormwater Program
Dollars per pound of annual nitrogen load reduction



* Estimated average marginal cost to reduce one pound of nitrogen across four best management practices that are implemented after a farm's agricultural baseline is met. Each practice is modeled in each of five Bay states. Costs include implementation costs, operations and maintenance costs, and opportunity costs but analysis assumes no discounting or transaction costs. Data sources include Nutrient Net and Wieland, Robert, et al. 2009. "Costs and Cost Efficiencies for Some Nutrient Reduction Practices in Maryland." Maryland Department of Natural Resources Coastal Program.

** Average cost to reduce one pound of nitrogen from municipal stormwater management systems for new development in Maryland. MS4 retrofit costs may be higher. Based on: Wieland, Robert, et al. 2009. "Costs and Cost Efficiencies for Some Nutrient Reduction Practices in Maryland." Maryland Department of Natural Resources Coastal Program.

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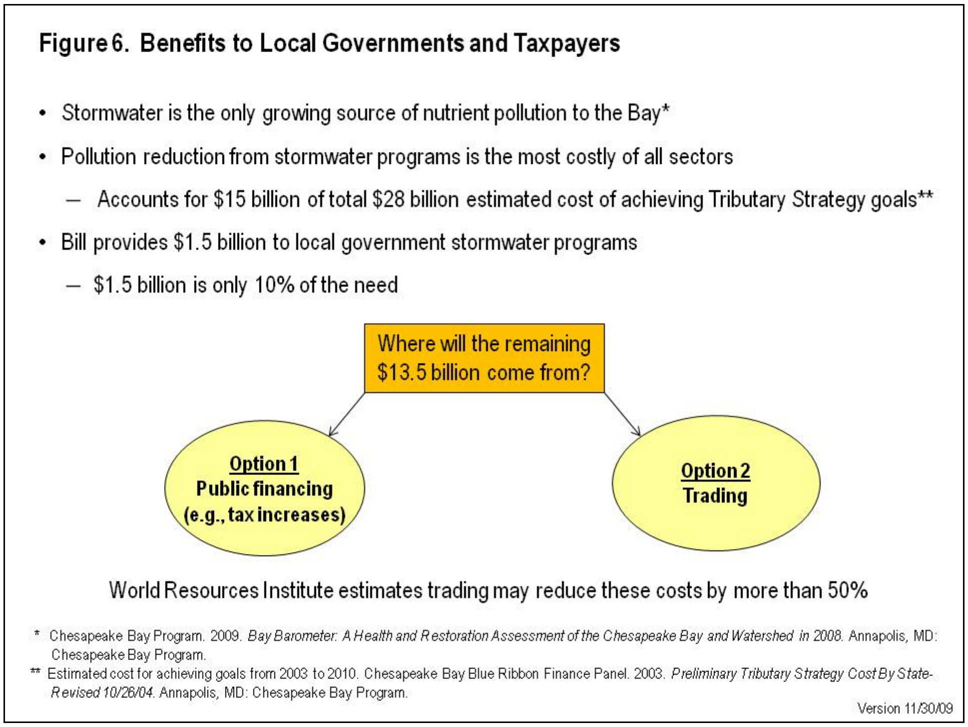
- *Utility ratepayers* can save money on their utility bills when wastewater treatment plants—most of which are publicly owned—meet their nutrient reduction obligations at lower cost.

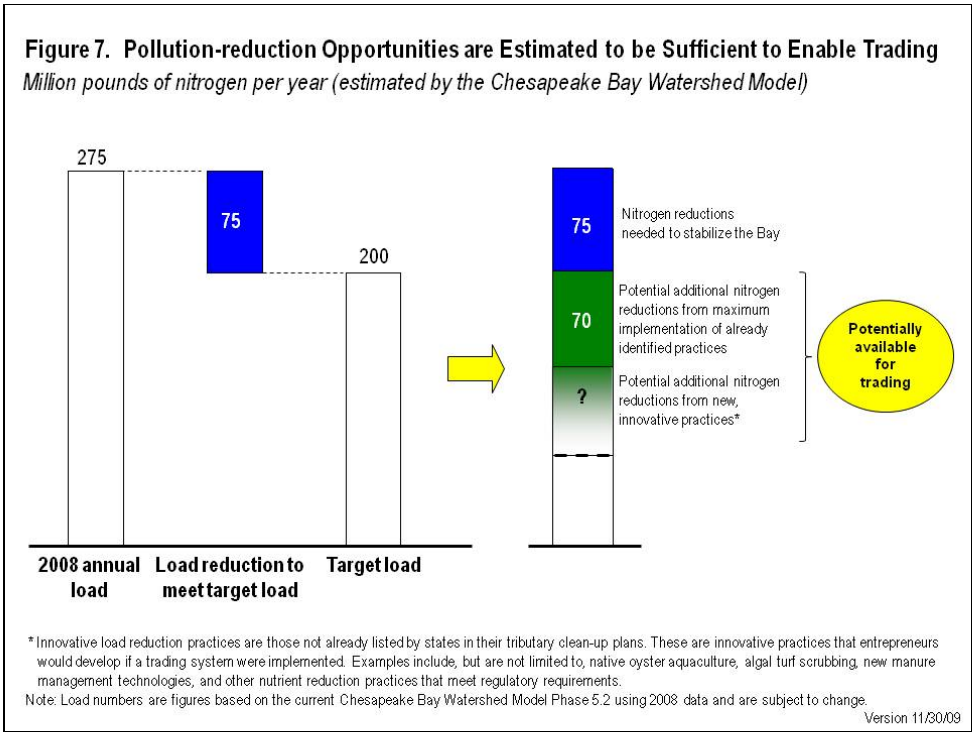
- *Wastewater treatment plants* can cost-effectively reach their nutrient reduction obligations by purchasing nutrient credits from those with lower cost reductions. In addition, plants can earn additional revenue by reducing nutrient discharges below permitted levels and selling the "surplus" reductions. Furthermore, as the region's population continues to grow, nutrient trading can allow for the expansion or addition of wastewater treatment plants without increasing pollution.

- *Entrepreneurs* can benefit by developing innovations that prevent nutrients from entering the water or that reduce nutrient concentrations in the water. Examples include new manure management technologies, native oyster aquaculture, and algal turf scrubbing.

- *Local governments and taxpayers* benefit from improved water quality in local rivers, lakes and streams, and from the more efficient use of taxpayer resources (Figure 6).



Pollution-reduction opportunities are estimated to be sufficient to enable trading. The current version of the Chesapeake Bay Watershed Model (Phase 5.2 using 2008 data) estimates that known pollution-reduction practices by current polluters could, if fully implemented, reduce nitrogen pollution by 145 million pounds per year—or 70 million pounds more than the preliminary target load needed to stabilize the Bay (Figure 7). Those 70 million pounds—plus potential additional reductions from innovative practices—could provide a source of tradable reductions. (Note: As the Chesapeake Bay Watershed Model is refined, these numbers may change and Figure 7 will be accordingly updated.)



Appendix: Background on the scenarios

Table 1 summarizes the model inputs for the scenarios referenced in Figures 2, 4, and 5. The economic analyses in this document are preliminary. WRI has research underway to refine these estimates and conduct sensitivity analyses as new data becomes available.

Table 1. Model Inputs for Scenarios

	Scenario 1	Scenario 2	Scenario 3
Credit price	• $8/lb of nitrogen. • Based on transactions in nascent Pennsylvania nutrient market	• $20/lb of nitrogen • Based on modeled implementation, operations & maintenance, and opportunity costs, as well as profit margin, of four agricultural practices (forest buffers, cover crops, grass buffers, and restored/constructed wetlands) across five bay states, *after* agriculture baseline for a farm (tributary strategy target reduction) has been met*	• $50/lb of nitrogen • Estimated average nitrogen reduction cost per lb for WWTP upgrades (based on data from 109 WWTPs in the Chesapeake Bay) is ~$16. Average for the 40 WWTPs with the highest nutrient abatement costs is $47.40. $50 is the estimated price that exceeds this subset's willingness to pay
Credit supply	• Nitrogen reductions generated by a variety of agriculture practices only after agriculture baseline for a farm (tributary strategy target reduction) has been met • Based on a conservative estimate of potentially available agriculture-based nutrient reductions after tributary strategy target has been met, using Chesapeake Bay Watershed Model Phase 5.2	• Same as scenario 1	• Same as scenario 1
Credit demand	• Wastewater treatment plants (WWTPs) in PA and WV projected to have nitrogen loads in excess of permit requirements over coming decade buy credits after point-point source trading has been exhausted • Municipal stormwater programs (MS4s) comprise 2/3 of urban runoff. MS4s purchase credits to achieve 40% of their load reductions required to meet tributary goal for urban runoff. Data based on Chesapeake Bay Watershed Model Phase 5.2 • Does not include potential demand from new development	• WWTPs: Same as scenario 1 plus new and expanded WWTPs in MD, PA, VA, and WV purchase credits to offset expansion. Data based on WWTP capacity data by river basin, projected population growth, and 100 gallons/day /person • MS4s: Same as scenario 1 but they purchase credits to achieve 70% of their load reductions required to meet tributary goal for urban runoff. Estimates do not include potential demand from new development. Including new development would increase the amount of credits purchased	• WWTPs: Only new and expanding facilities purchase credits (to offset expansion). Facilities with existing allocations choose to upgrade instead • MS4s: Same as scenario 2. Stormwater programs are the main buyers of credits since they have a higher "willingness to pay" and a greater potential for savings. Estimates do not include potential demand from new development. Including new development would increase the amount of credits purchased

* Implementation and O&M costs per practice are from Wieland, Robert, et al. 2009. *Costs and Cost Efficiencies for Some Nutrient Reduction Practices in Maryland*. Maryland Department of Natural Resources Coastal Program, and from the U.S. Department of Agriculture.
Note: All figures reflect delivered nitrogen