

Fundamentals of Nutrient Trading

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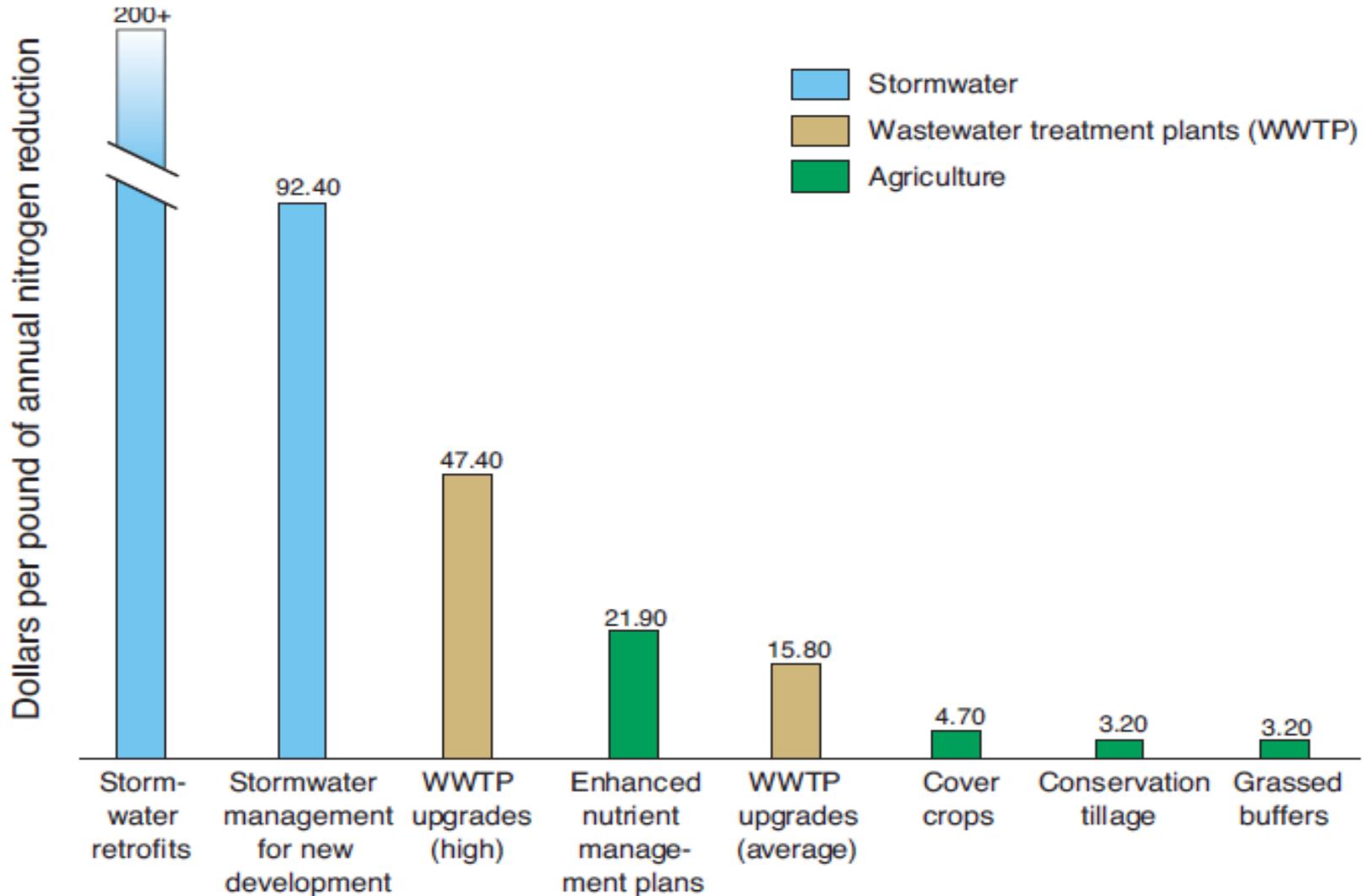
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Estimated costs of TMDL compliance in Maryland

- **Watershed implementation plans (WIPs)**
 - MDE estimates that compliance with total maximum daily load (TMDL) in 2025 will cost \$14.4 billion in Maryland
 - Urban stormwater management = \$7.4 billion
 - Local government covers the majority of this expense
 - Municipal wastewater treatment = \$2.4 billion
 - Septic systems = \$3.7 billion
 - Agriculture = \$0.9 billion

Variation in abatement cost per pound N



Urban stormwater BMPs

Bioretention pond



Bioswale



Green roof



Permeable pavement



Agricultural best management practices (BMPs)

Cover crops



Conservation tillage



Regulated sources

- **Clean Water Act (CWA)**
 - Focus mainly on point sources (PS) that discharge from pipe
 - Wastewater treatment plants (WWTPs)
 - Municipal separate stormwater sewer systems (MS4s) starting in 1987
 - National Pollution Discharge Elimination System
 - NPDES permits set regulated baseline for each entity
- **Pollution standards do not allow flexibility**
 - Each entity must meet the pollution standard
 - Some entities have higher abatement costs than others

Nutrient trading

- **Cost-effectiveness**
 - Lower overall cost of meeting the same environmental goal
 - Variation in abatement costs needed to create potential gains from trading
- **Voluntary participation and flexibility**
 - **Without trading**: Internal options only
 - **With trading**: Combination of internal options or offset credits allowed
- **Incentives**
 - Provides incentives for entities that already meet regulatory baseline to reduce pollution even further and sell offset credits
 - May spur innovative technologies

Other trading programs

- **Air quality trading**
 - Sulfur dioxide (SO₂) trading program
 - Kyoto protocol for trading CO₂ and other greenhouse gases
- **Market-based approaches for land conservation**
 - Transferable development rights (TDR) programs
 - Calvert County
 - Montgomery County
 - Forest mitigation banking
 - Maryland's Forest Conservation Act (FCA)

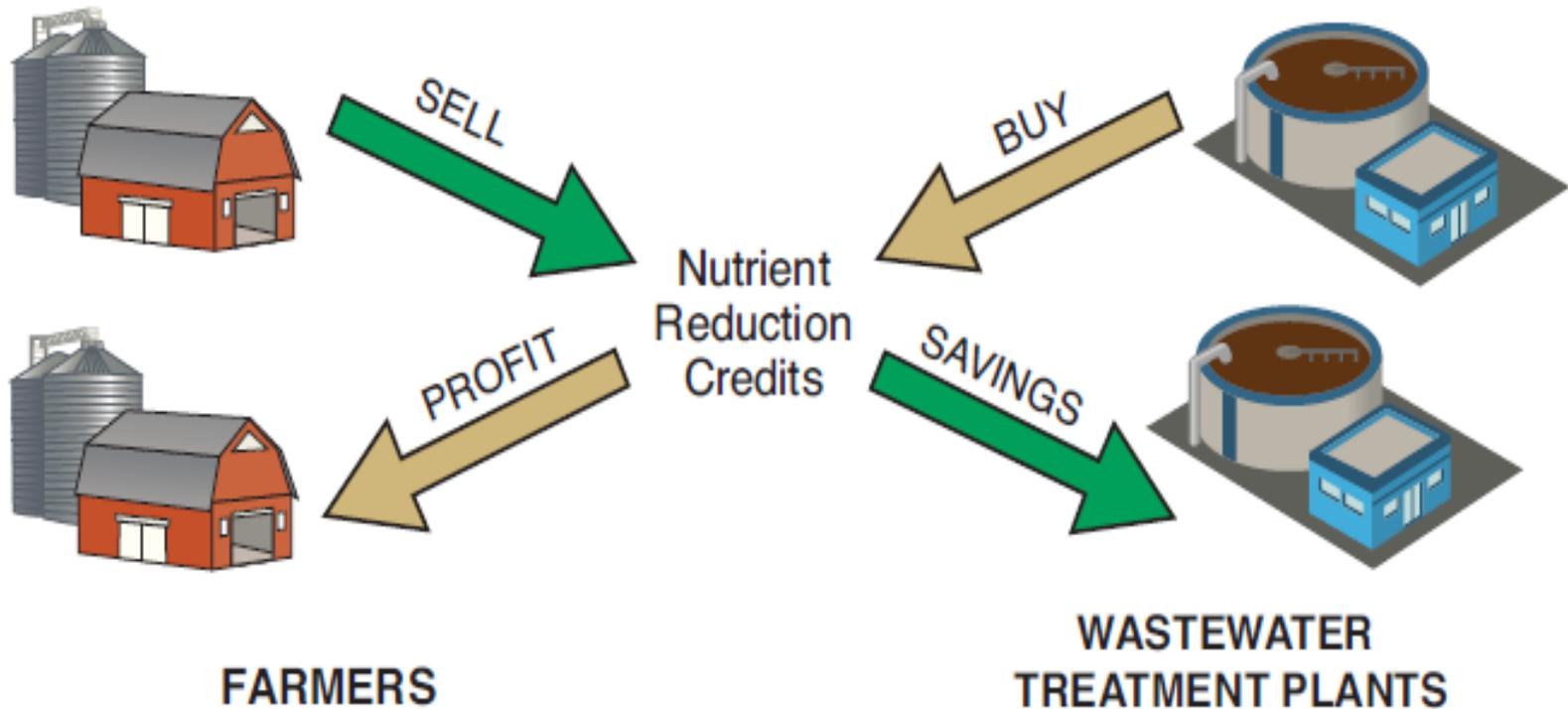
SO₂ trading program

- **Sulfur dioxide (SO₂) trading program**
 - Clean Air Act Amendments (1990)
 - Allowed large coal-fired power plants to trade SO₂ pollution credits
 - Meet goal to reduce SO₂ (and acid rain) at lower cost
- **PS-PS trading**
 - Within sector trading between regulated point sources (PS)
 - Allows trading in time and smooth upgrading schedule
- **Why did SO₂ trading program work?**
 - Air emissions mixed broadly (large markets)
 - Easier to monitor and verify emissions at large point sources
 - Lower transaction costs

Cross sector (PS-NPS) trading

Treatment plant (point source)

Farm (non-point source)



Example on PS-NPS trading

- **Without trading**

- Point source (PS): wastewater treatment plant
 - Permit requires annual reduction of 1000 pounds of N
 - Annualized abatement cost = \$30 per pound N
- Total costs without trading = \$30,000

- **With trading**

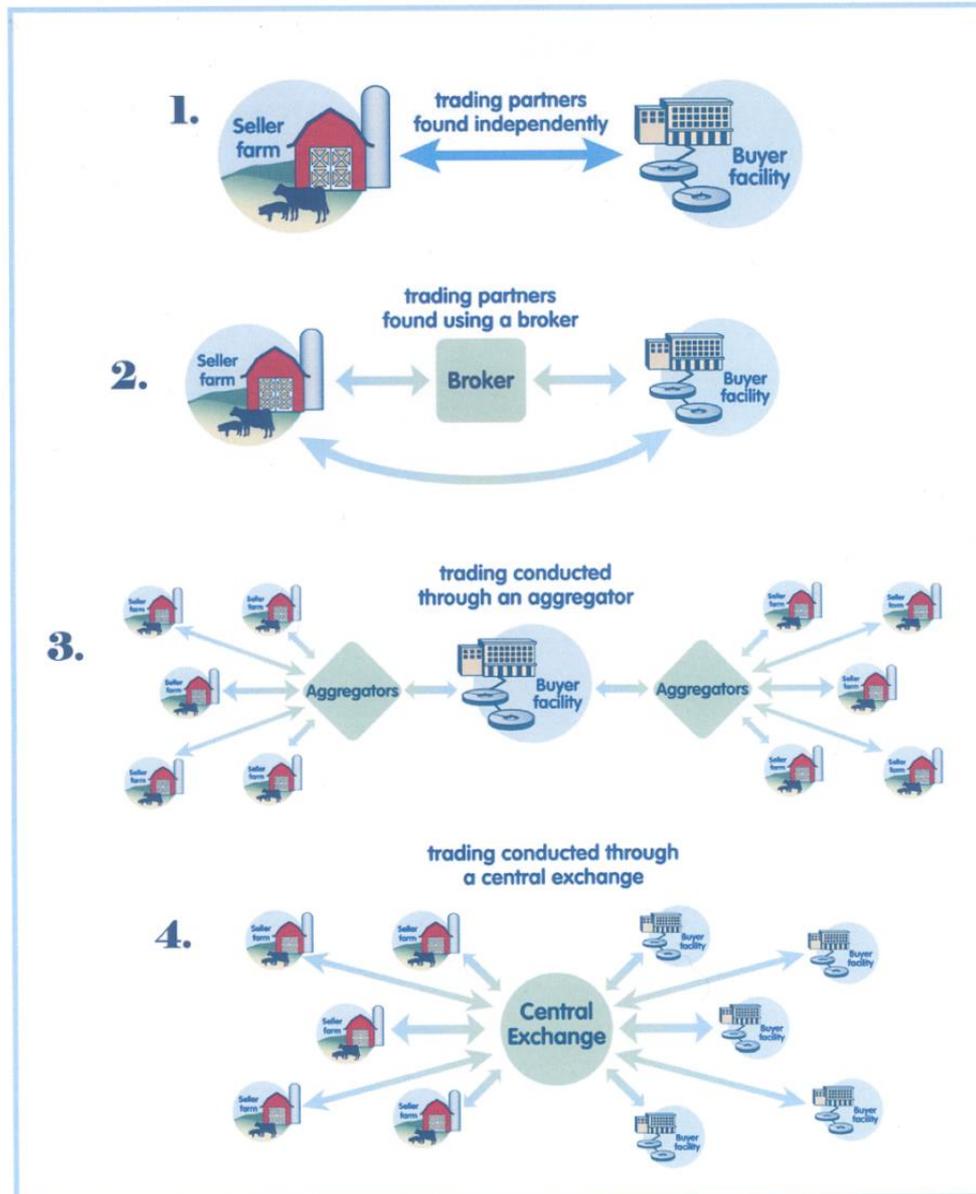
- Assume agriculture adopts best management practice (BMP)
 - Agriculture sells offset credits at annualized cost = \$10 per pound N
- Assume treatment plant uses mixed strategy
 - Internal upgrade costs (50%) = 500 pounds N * \$30 per pound = \$15,000
 - Purchase offsets (50%) = 500 pounds N * \$10 per pound = \$5,000
- Total costs with trading = \$20,000

- **Potential gains from trading = \$10,000**

Agriculture

- **Agricultural best management practices (BMPs)**
 - Cost-share programs to incentivize BMP adoption
 - Federal programs (EQIP, CRP, CREP, CSP)
 - State program (MACS)
- **Baselines for agricultural operations**
 - Agriculture does not require NPDES permit (except CAFOs)
 - Baseline level of pollution load must be achieved before eligible to participate
 - Only reductions below the baseline can be traded as pollution credits
- **Tradeoff setting the baseline**
 - Strict baseline can generate additional reductions that would not occur otherwise but also discourages participation
 - Farmers far from baseline need to adopt more practices at their own costs before being eligible to participate

Market structures



Market structures

- **Bilateral negotiation**

- Individual buyers and sellers make contracts
- Price set through negotiation (like used car market)
 - May likely involve brokers or aggregators

- **Reverse auction**

- Clearinghouse ranks all bids based on lowest cost per pound nutrient reduction
- Bidding behavior
 - Higher bid leads to higher payment but lower chance of being awarded funding
- Cost-effective mechanism to reveal BMP cost

Challenges for nutrient trading

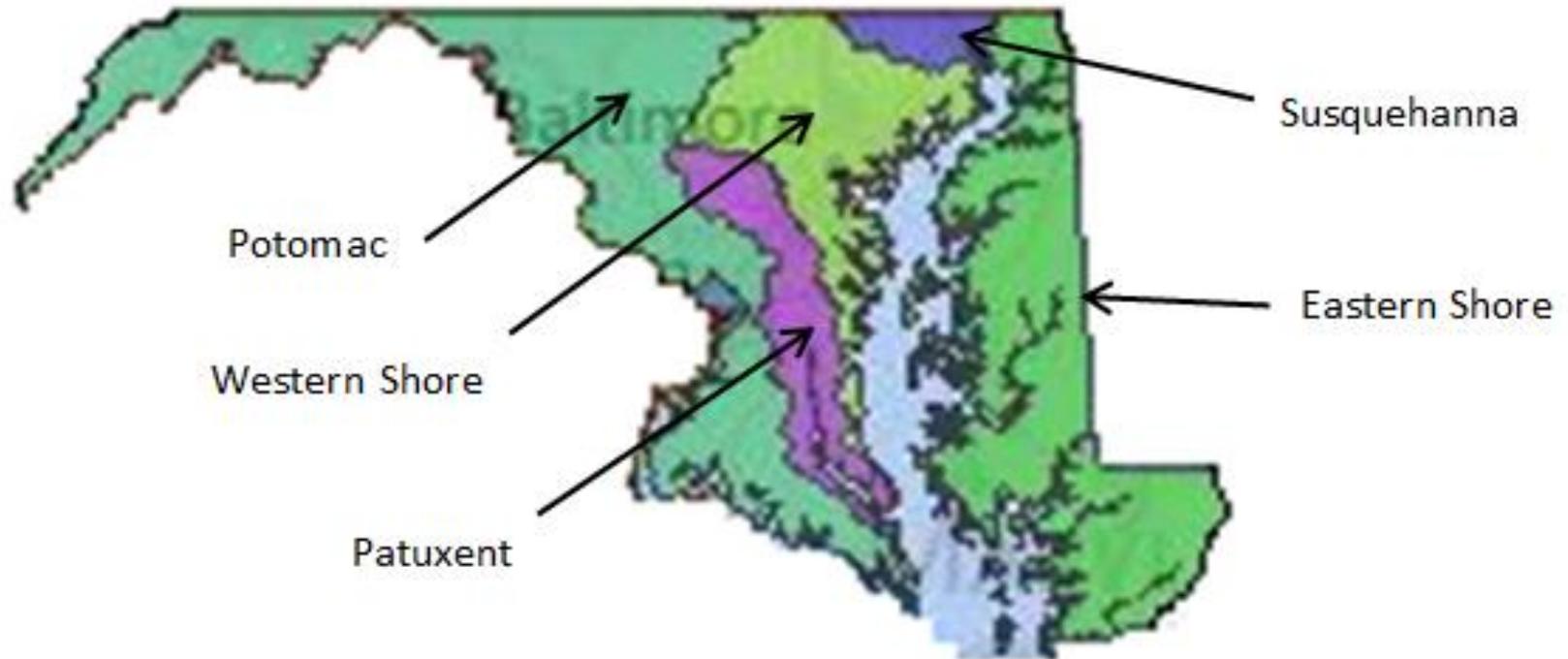
- **Transaction costs**
 - Finding and negotiating with trading partners
 - Monitoring and verification costs
- **Estimating pollution reductions for agricultural BMPs**
 - Average BMP efficiencies calculated based on expert panels and site-specific conditions (soil, slope, management)
 - Actual nutrient reductions may vary from average BMP efficiencies temporally and spatially
- **Liability for buyers**
- **Pollution hotspots**

Trading ratios

- **Safety factor to address uncertainty in load estimates**
 - Example with trading ratio at 2:1
 - 2 credits from seller (agriculture) = 1 credit for buyer (treatment plant)
- **Insurance pool for buyer**
 - NPDES permit requires buyer to be liable if purchased credits from individual agricultural BMP fail
 - Additional credits from high trading ratio creates insurance pool to reduce risk of buyer liability
- **But high trading ratio or strict baseline may reduce market activity**

Trading basins

- **Geographic restrictions on trading with the same basin or watershed**
 - Trades between sources only in same basin or watershed
 - Reduces pollution hotspots



Western Shore, Eastern Shore and Susquehanna combined into single trading zone.

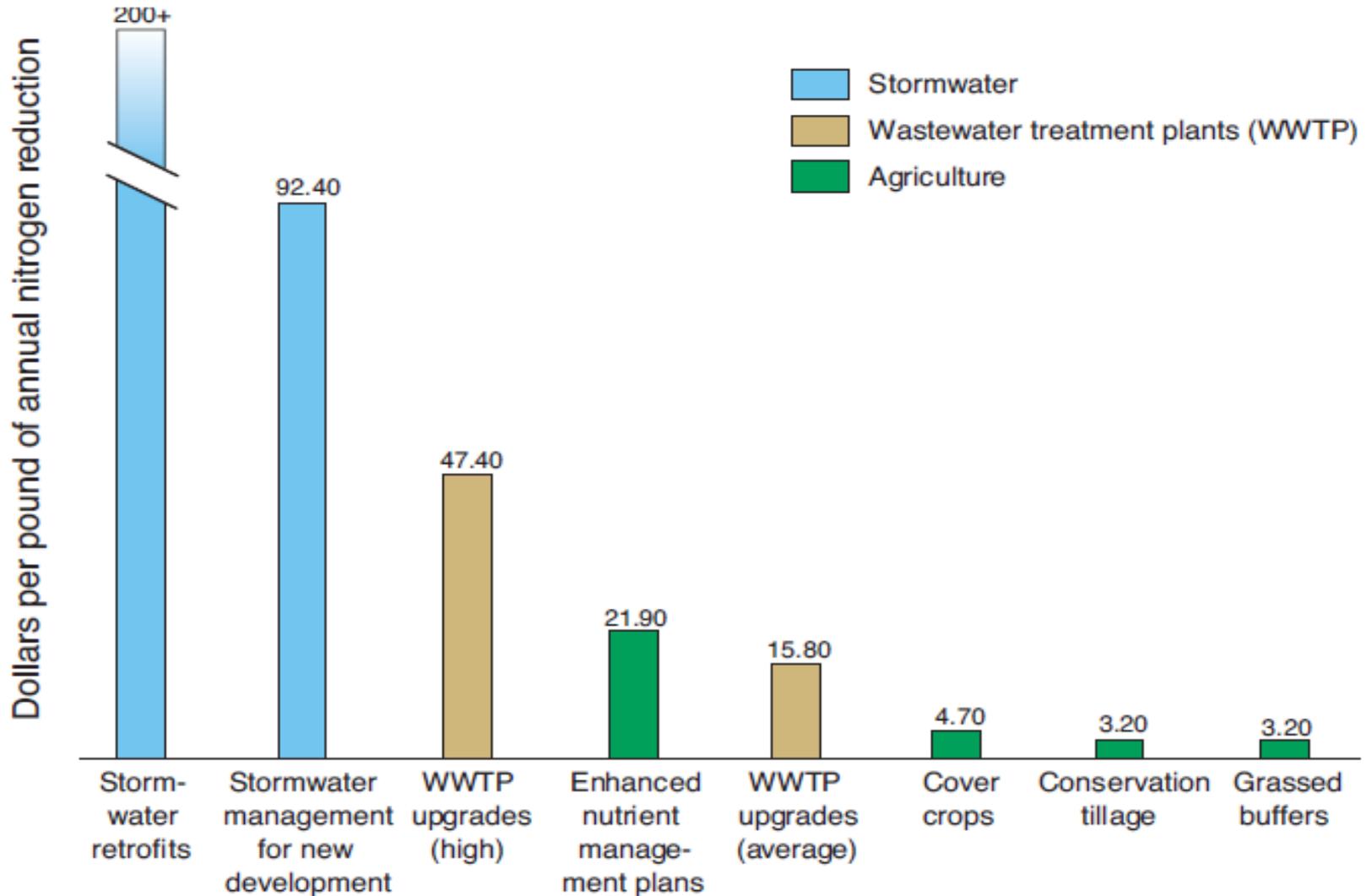
Delivery ratios

- **Accounts for differential delivery to the Bay between two sources located in different river segments**
 - Example: Subwatershed A is located farther from the Bay than Subwatershed B, leading to differential loading rate
- **Delivery ratio used to assess equivalence between sources**
 - Reduces pollution hotspots

Why nutrient trading can play role in MD

- **Maryland has large urban sectors**
 - Large cost of compliance with TMDL in urban sectors
 - Urban stormwater management = \$7.4 billion
 - Municipal wastewater treatment = \$2.4 billion
 - Septic systems = \$3.7 billion
- **Population growth in urbanized areas**
- **Significant variation in abatement costs between sectors**
 - Potential gains from trading

Variation in abatement cost per pound N



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