April 1, 2015 – AWRA 2015 TN WR Symposium, Nutrient Trading Seminar, Burns, TN

# Three Decades of the Chesapeake Bay Program, Its Impacts, and the Point Source's Perspective

Bill Meinert, PE, O'Brien & Gere





O'BRIEN & GERE

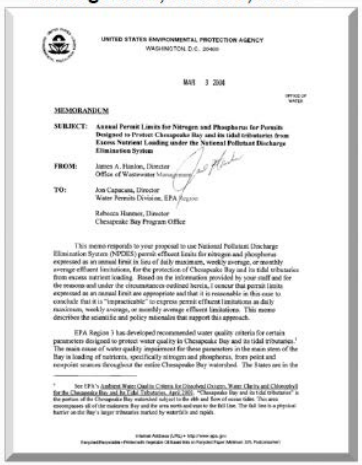
# Chesapeake Bay (6+ states (2 on Bay), 1 Region)

## Case Study: Chesapeake Bay

***Daily Maximum, Weekly Average and Monthly Average Limits Not Mandatory***

- Guidance from EPA Headquarters Office of Wastewater Management
- Annual Permit Limits for Nitrogen and Phosphorus for Permits Designed to Protect Chesapeake Bay
  - *"…permit limits expressed as an annual limit are appropriate and that it is reasonable in this case to conclude that it is "impracticable" to express permit effluent limits as daily maximum, weekly average, or monthly average effluent limitations."*

Jim Hanlon, Office of Wastewater Management, March 3, 2004



MEMORANDUM

SUBJECT: Annual Permit Limits for Nitrogen and Phosphorus for Permits Designed to Protect Chesapeake Bay and its tidal tributaries from Excess Nutrient Loading under the National Pollutant Discharge Elimination System

FROM: James A. Hanlon, Director
Office of Wastewater Management

TO: Jon Capacasa, Director
Water Permits Division, EPA Region
Rebecca Hanmer, Director
Chesapeake Bay Program Office

This memo responds to your proposal to use National Pollutant Discharge Elimination System (NPDES) permit effluent limits for nitrogen and phosphorus expressed as an annual limit in lieu of daily maximum, weekly average, or monthly average effluent limitations, for the protection of Chesapeake Bay and its tidal tributaries from excess nutrient loading. Based on the information provided by your staff and for the reasons and under the circumstances outlined herein, I concur that permit limits expressed as an annual limit are appropriate and that it is reasonable in this case to conclude that it is "impracticable" to express permit effluent limitations as daily maximum, weekly average, or monthly average effluent limitations. This memo describes the scientific and policy rationales that support this approach.

EPA Region 3 has developed recommended water quality criteria for certain parameters designed to protect water quality in Chesapeake Bay and its tidal tributaries.[1] The main cause of water quality impairment for these parameters in the main stem of the Bay is loading of nutrients, specifically nitrogen and phosphorus, from point and nonpoint sources throughout the entire Chesapeake Bay watershed. The States are in the

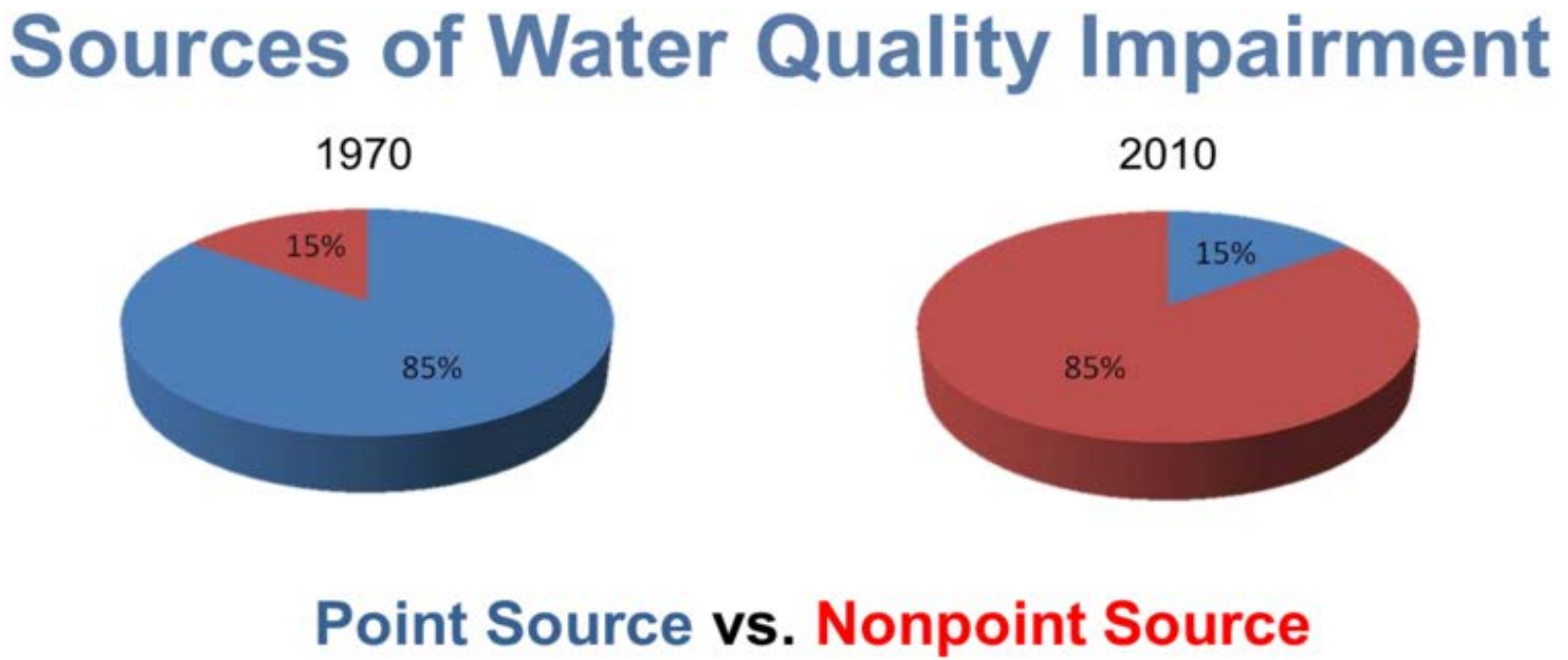
[1] See EPA's Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll for the Chesapeake Bay and Its Tidal Tributaries, April 2003. "Chesapeake Bay and its tidal tributaries" is the portion of the Chesapeake Bay watershed subject to the ebb and flow of ocean tides. This area encompasses all of the mainstem Bay and the area north and east to the fall line. The fall line is a physical barrier as the Bay's larger tributaries marked by waterfalls and rapids.

Internet Address (URL) • http://www.epa.gov
Recycled/Recyclable • Printed with Vegetable Oil Based Inks on Recycled Paper (Minimum 25% Postconsumer)

WERF Nutrient Removal

# Gulf of Mexico Watershed (33 States (5 on Gulf), Multiple Regions)

# Point Source down that much, or Non-Point now defined?




William Ruckelshaus, *A New Shade of Green*, The Wall Street Journal, April 17, 2010.

WATER'S WORTH IT

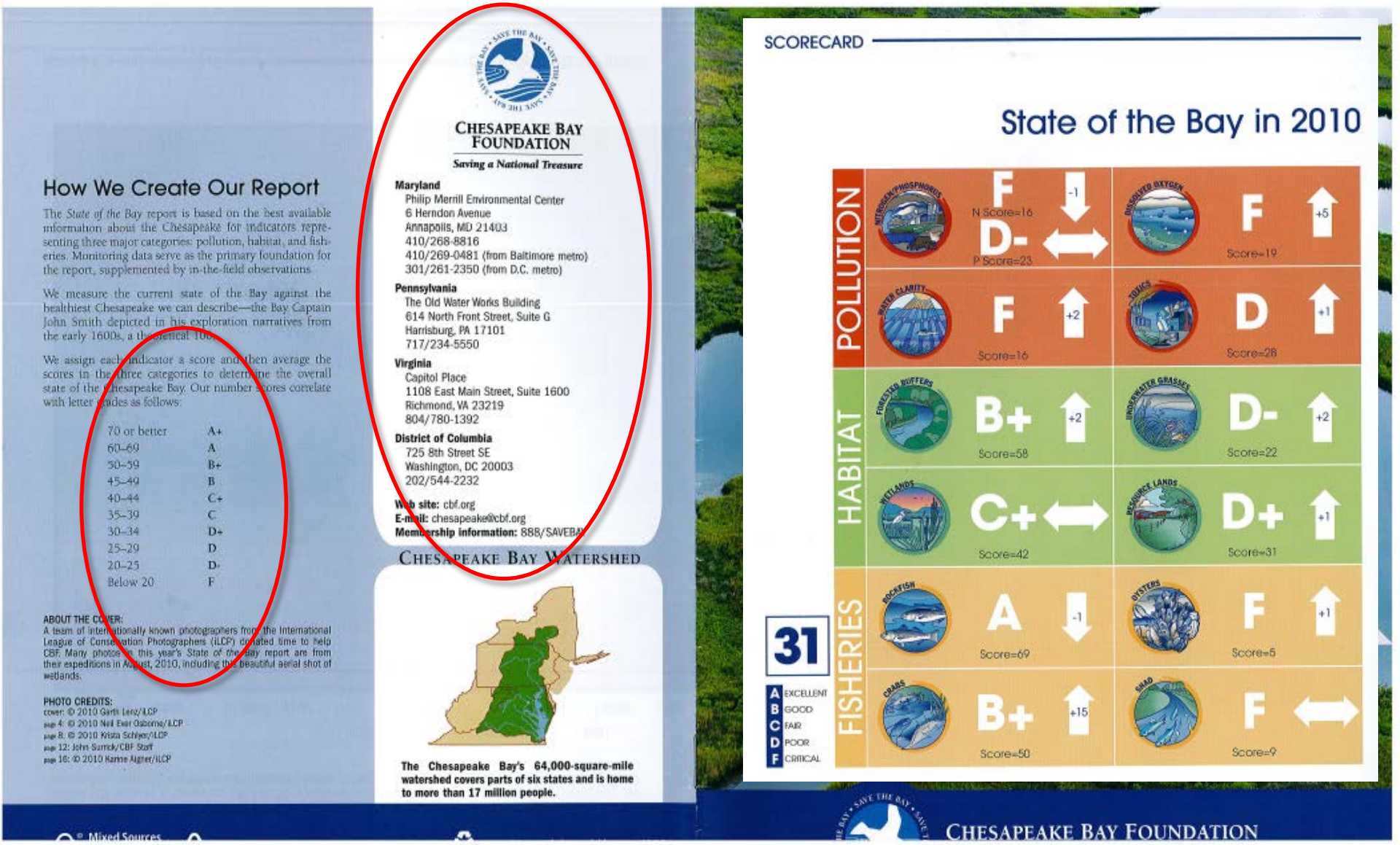
Water Environment Federation





O'BRIEN & GERE

# Chesapeake Bay Program – Point Sources, now Non-Point



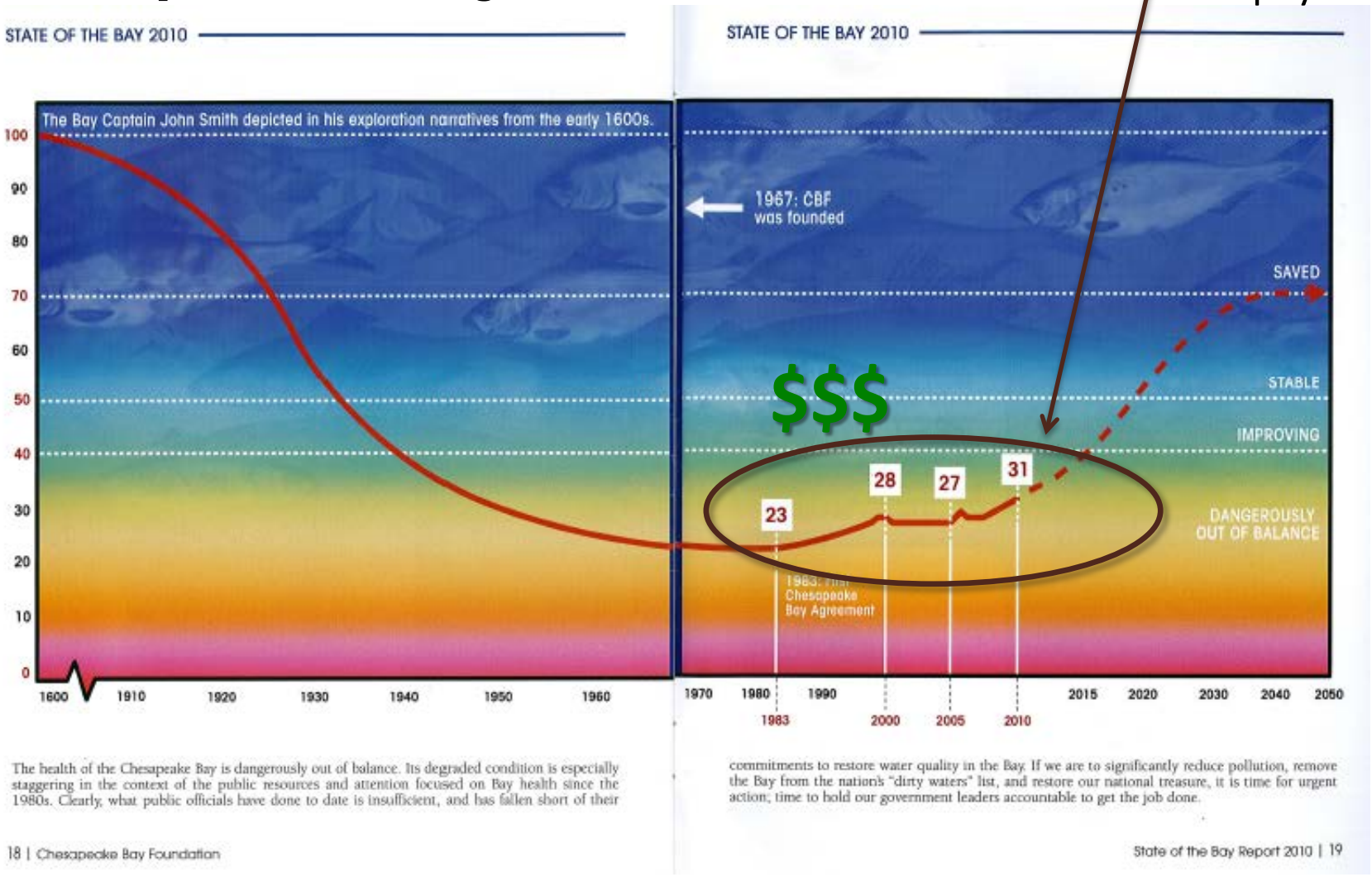



O'BRIEN & GERE

# Chesapeake Bay Program – Overcome, or be Overwhelmed?

- For the public, calibrating to the 1600s

A hard sell to rate payers



# Point Sources - Everything, Everywhere, Everyone?

- Early regulatory estimates of cost to treat at POTWs *(bids were higher)*

| PLANT | EXISTING (OR CURRENTLY DESIGNED) BNR PROCESS | ENR MODIFICATIONS | POUNDS TN REMOVED WITH ENR MODIFICATIONS (1) | ESTIMATED ENR COST (SEPT. 2004 ENG. NEWS RECORD COST INDEX) | COST PER POUND REMOVED (2) | COST PER GALLON TREATED (3) |
|---|---|---|---|---|---|---|
| Cambridge | Modified Ludzack-Ettinger (MLE) | Reconfiguration to Bardenpho | 123,257 | $1,750,000 | $0.96 | $0.22 |
| Seneca | Modified Ludzack-Ettinger | Increase in internal | | | | |
| Piscataway | Step Feed | Re | | | | |
| Parkway | 4-Stage Bardenpho | Re | | | | |
| Annapolis | 4-Stage Bardenpho | Meth | | | | |
| Ballenger | $A_2O$ | Ad | | | | |
| Marley-Taylor | Schreiber System | Inc | | | | |
| Freedom | Modified Ludzack-Ettinger | Re | | | | |
| L. Patuxent | | Addi | | | | |
| Cumberl | | Pro and reconfiguration to Bardenpho | 65,238 | $3,472,000 | | $0.99 |
| Sod Run | | | 194,523 | $28,000,000 | | $1.78 |
| Westminster | MLE/$A_2O$ | | 228,308 | $16,500,000 | | $1.10 |
| Hagerstown | Modified Johannesburg | | 304,410 | $22,568,000 | | $1.13 |
| Conococheague | Modified Ludzack-Ettinger | | 76,114 | $8,600,000 | | $1.72 |
| Frederick | $A_2O$ | | 133,940 | $8,900,000 | 46 | $1.11 |
| Bowie | VIP Oxidation Ditch | | NA | NA | NA | NA |
| Cox Creek | Modified Ludzack-Ettinger | | 104,528 | $9,900,000 | 66.37 | $1.41 |
| Back River | Modified Ludzack-Ettinger | | 50,228 | $1,000,000 | $0.55 | $1.75 |
| Salisbury | $A_2O$ Trickling Filter | | 228,308 | $26,107,000 | $7.69 | $1.74 |
| Hurlock | 4-Stage Bardenpho | | 2,739,690 | $250,850,000 | $6.15 | $1.39 |
| | | | 333,800 | $30,175,000 | $5.50 | $4.18 |
| | | | 50,228 | $6,200,000 | $8.50 | $3.76 |
| | | TOTAL | 5,714,000 | AVE. | $5.90 | $1.38 |
| | | | | MAX. | $30.29 | $4.18 |
| | | | | MIN. | $0.55 | $0.21 |

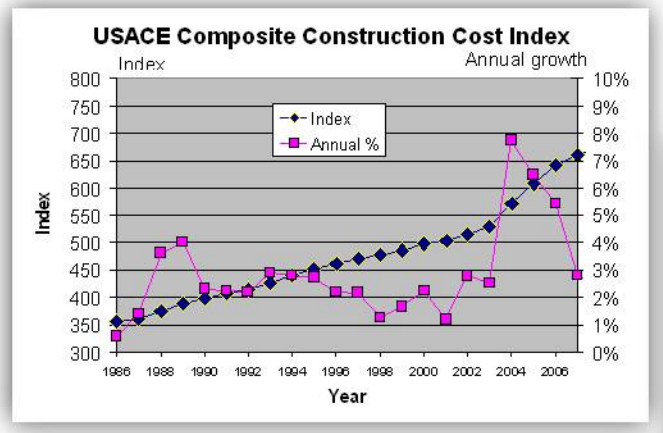
NOTES:

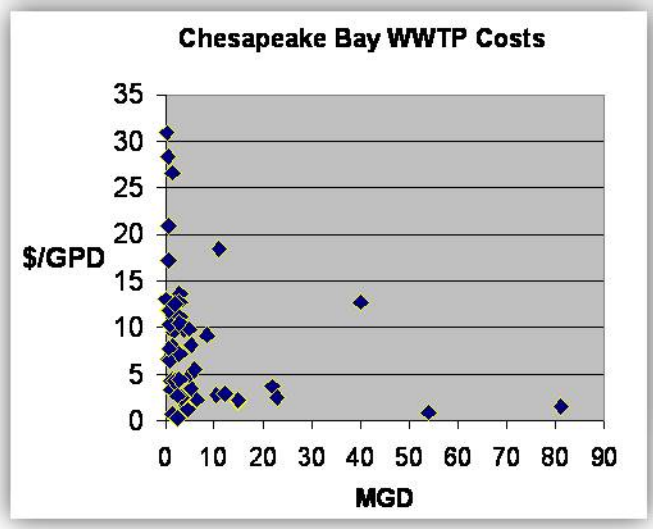
| | Cost per lb. removed | Cost per gal. treated |
|---|---|---|
| Avg | $ 5.90 | $ 1.38 |
| Max | $30.29 | $ 4.18 |
| Min | $ 0.55 | $ 0.21 |

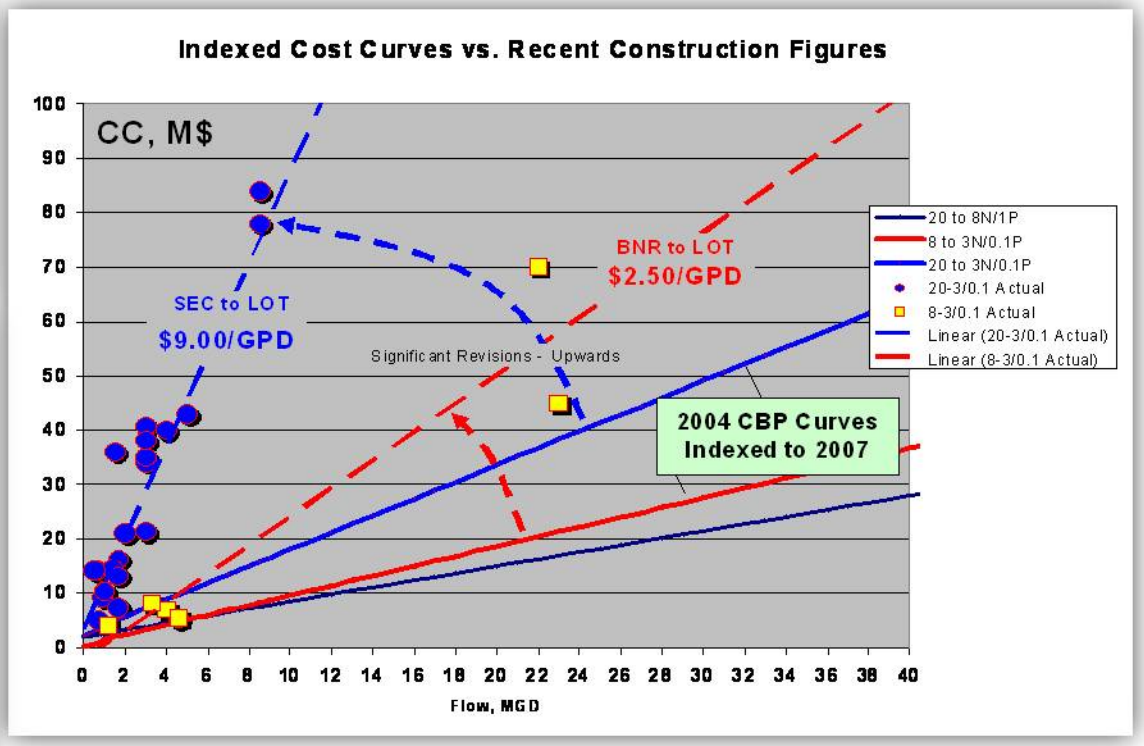
Total Pounds Nitrogen Removed with ENR: 5,714,000

# Point Sources - Everything, Everywhere, Everyone (cont.)

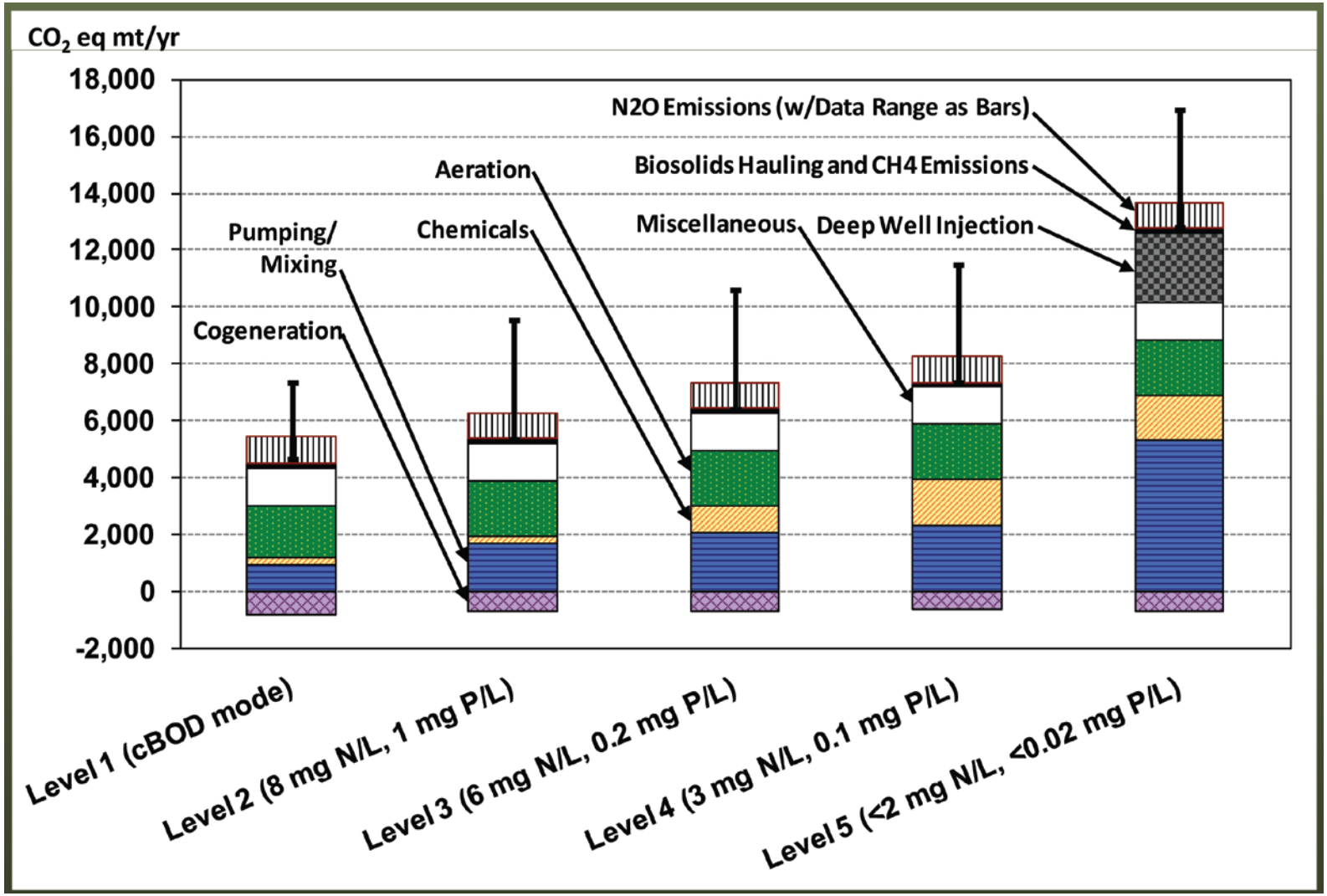
- Meet or Beat with Non-Point Controls? ($ per # nutrient removed)



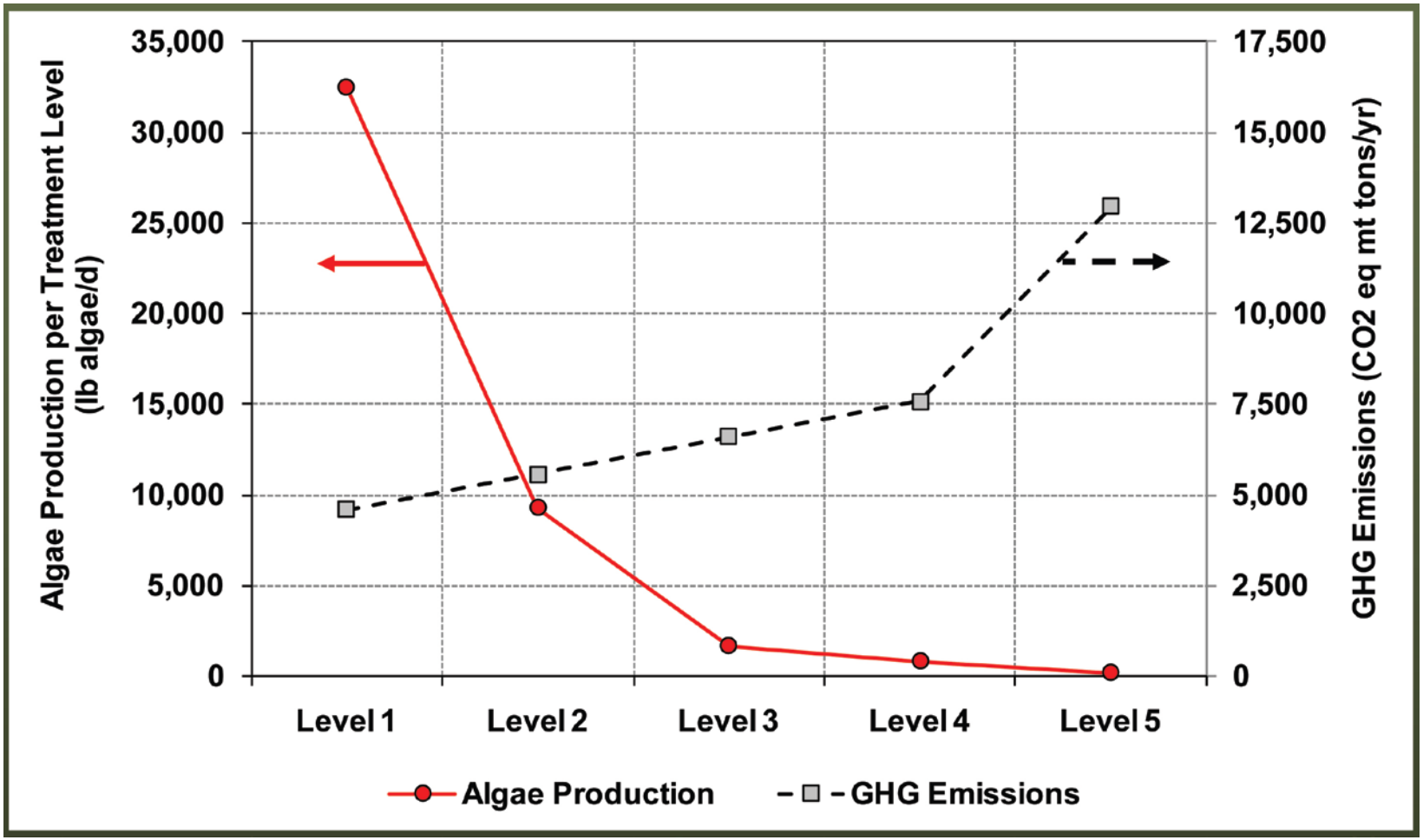



# Point Pushback - WERF Nutrient Removal *vs*. Sustainability Study



# Point Pushback - WERF Nutrient Removal *vs*. Sustainability Study



# “Point, Counter-point”

Will non-point source (NPS) measures work?

Will NPS measures work in both dry and wet years?

Who is the “permittee” with NPS?

Which is more technically and cost feasible?

*(A reality)* Which lobby is stronger?

Is Point Source (PS) more definable when it comes time to measure success?

Which regulatory branch is ready to take this issue on?

# Trading Programs

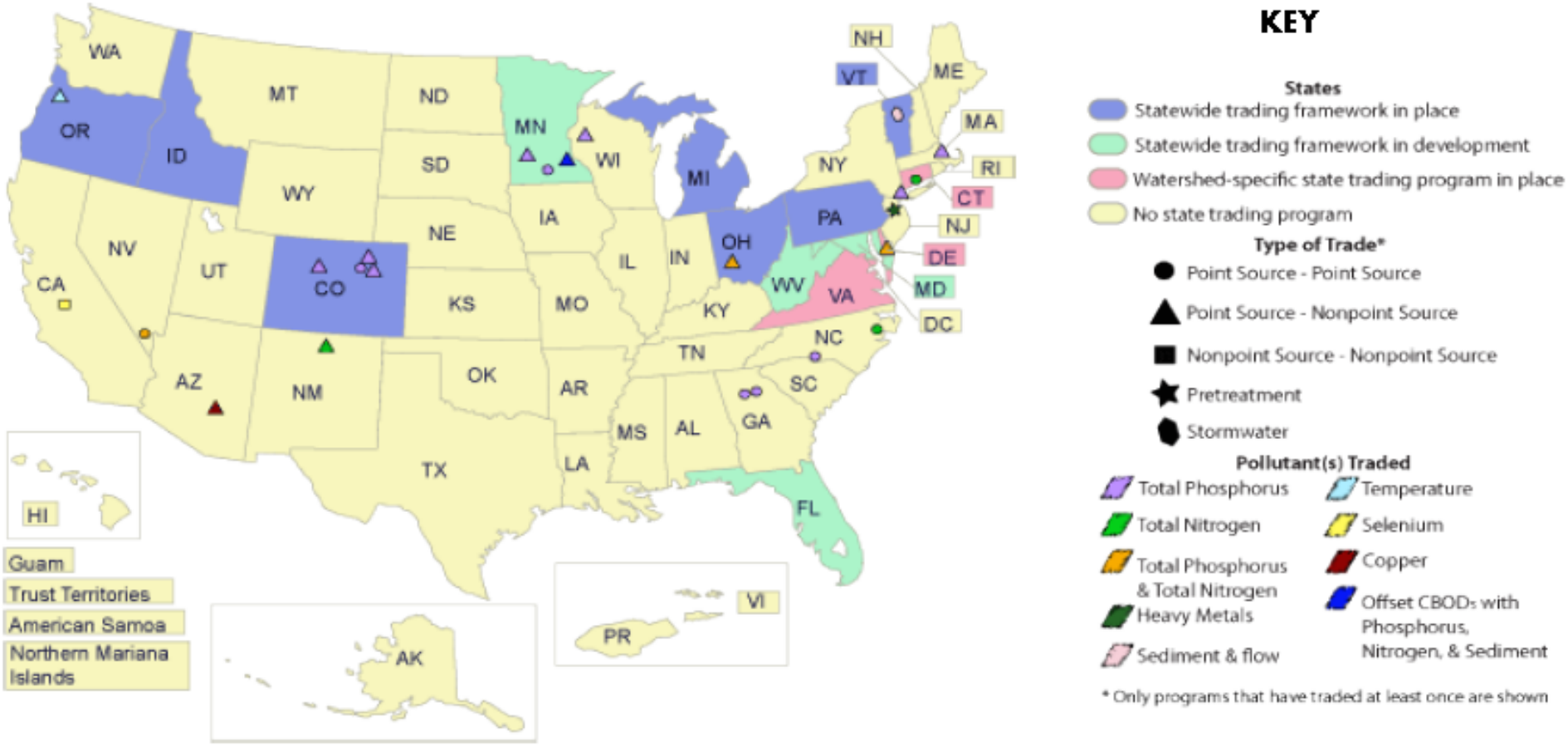


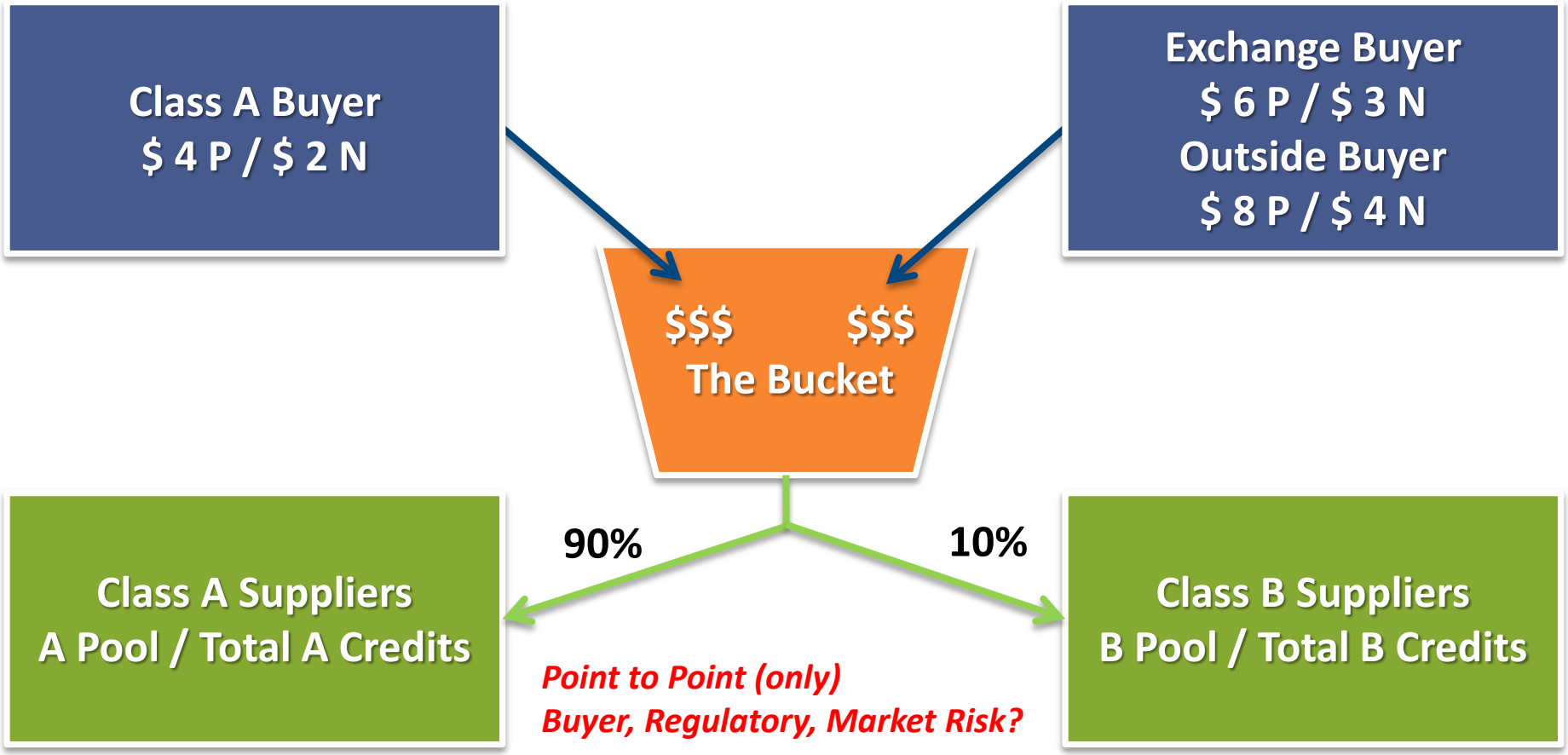

*Figure 1-2*
*EPA Map of State and Individual Water Quality Trading Programs*

Source
National Network on Water Quality Trading (EPRI)

# Nutrient Trading – Virginia

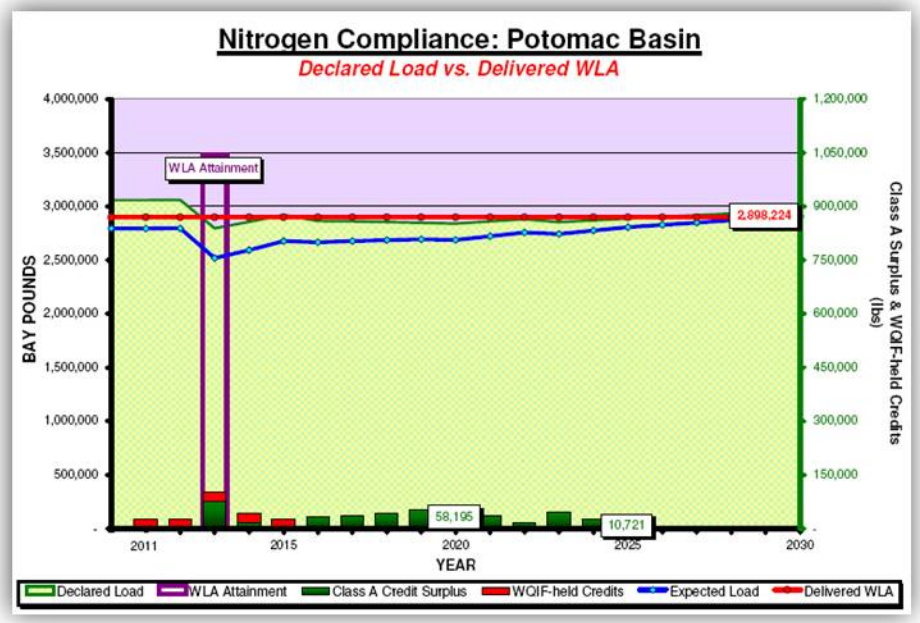
- *Circa 2006-2010* … Too many projects, too high of cost, less required
- Legislation -> "General Permit" -> Cash Flow and "The Bucket"

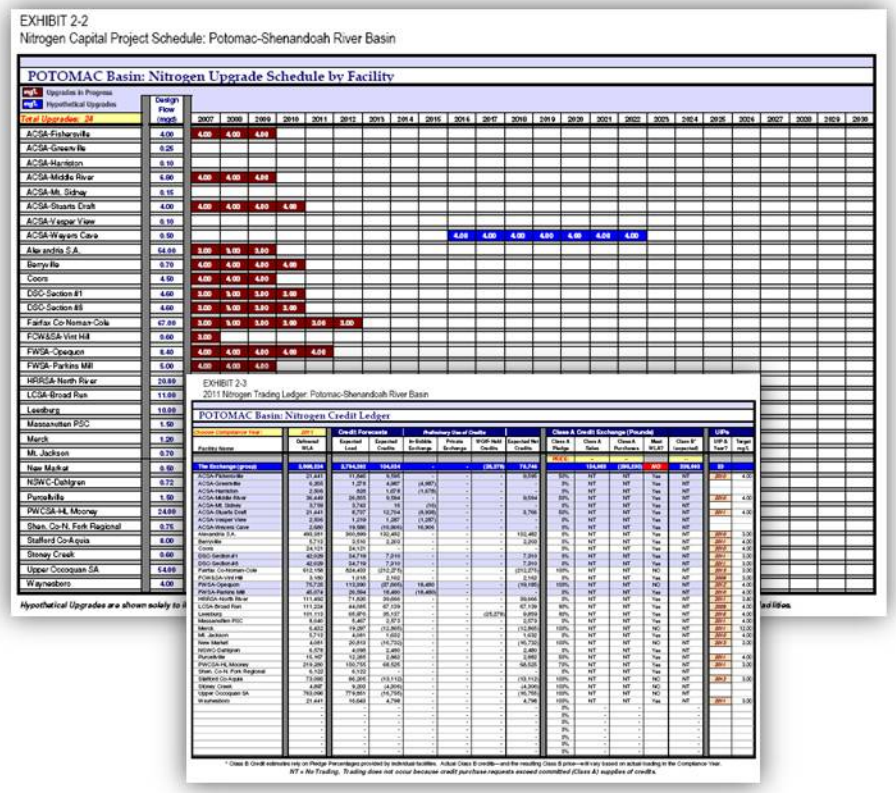
**Virginia Nutrient Credit Exchange Association - SOURCES OF FUNDS**



# Nutrient Trading – Virginia (cont.)

- **WHAT, HOW**
  - VNCEA participant, non-participant
  - Individual Permit, General Permit, Exchange
  - *Non-Point Trading?*



# Pennsylvania's Nutrient Trading

- Point, Non-Point, TN & TP
- Years of practice & use
- NPDES Annual Compliance
  - October "True-up"
- PennVest and PaDEP – Auctions
  - Registered Credits, Administration
  - PennVest Contracts, Forward & Spot
    - Option Pool and Premium
- Potomac and Susquehanna

**Nutrient Credit Trading Program (NCT)**

| Auction Application Enrollment Cut-Off Date | Auction Date - Type |
|---|---|
| February 12, 2014 | March 19, 2014 - Forward Auction |
| May 7, 2014 | June 11, 2014 - Forward Auction |
| August 6, 2014 | September 10, 2014 - Forward Auction |
| October 15, 2014 | November 5, 2014 - Spot Auction |


| Credit: SU-P-14 | | | | |
|---|---|---|---|---|
| Winners: | Bid/Offer | Total Quantity Won | Total Quantity Traded | Final Price ($) |
| Williamsport Sanitary Authority | BID | 2,000 | 2,000 | $ 2.00 |
| | | | | |
| YORK CITY SEWER AUTHORITY | OFFER | 2,000 | | |

- *Recent – PA missed reduction targets, EPA hold on NPDES renewals*
  - *Concern with "phantom trades" (Sale to WWTP, Ag < BMP)*



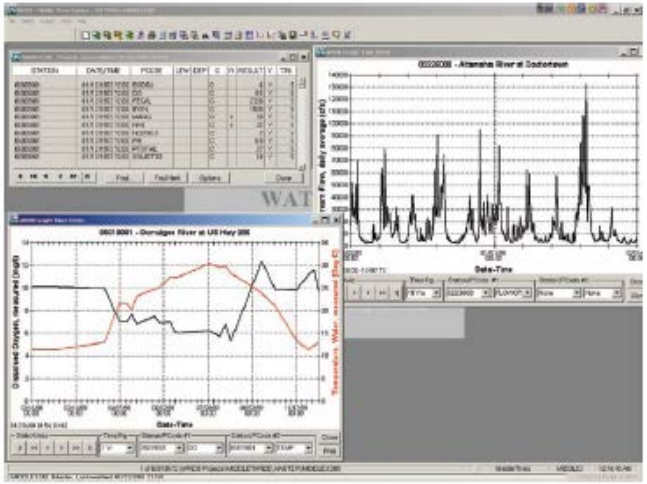
O'BRIEN & GERE

# Maryland's Trading Announcement


- 9/18/14 Announcement
  - Framework for "equitable trading"
  - Years in the making
  - Modeled in part after Pennsylvania's?
- Cross-sector nutrient trading program
  - MDE, MDA
  - Plants, farmers, stormwater, septics, industry
  - Restrictions imposed
    - Local water quality impairment
    - Non-MS4s (after BMPs)
- Certified verifiers
- Initial trades to attract brokers, buyers, and sellers

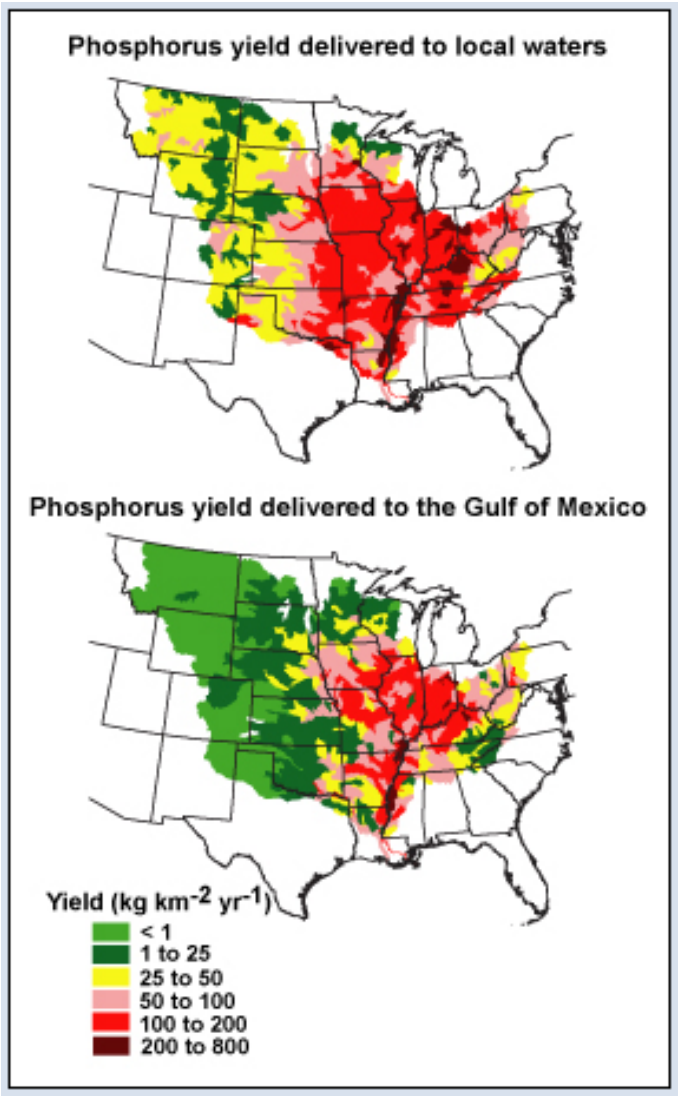
# Total Maximum Daily Load (TMDL)

- Watershed Planning
- Water Quality Goals
- Sources of Pollution, Reductions
- Sum = Individuals + Natural Background
  - Point Wasteload Allocations (WLA)
  - Non-Point Load Allocations (LA)
  - Margin Of Safety (MOS)



Mass Transport & Water Quality Simulations

**SPA**tially **R**eferenced **R**egressions **O**n **W**atershed attributes



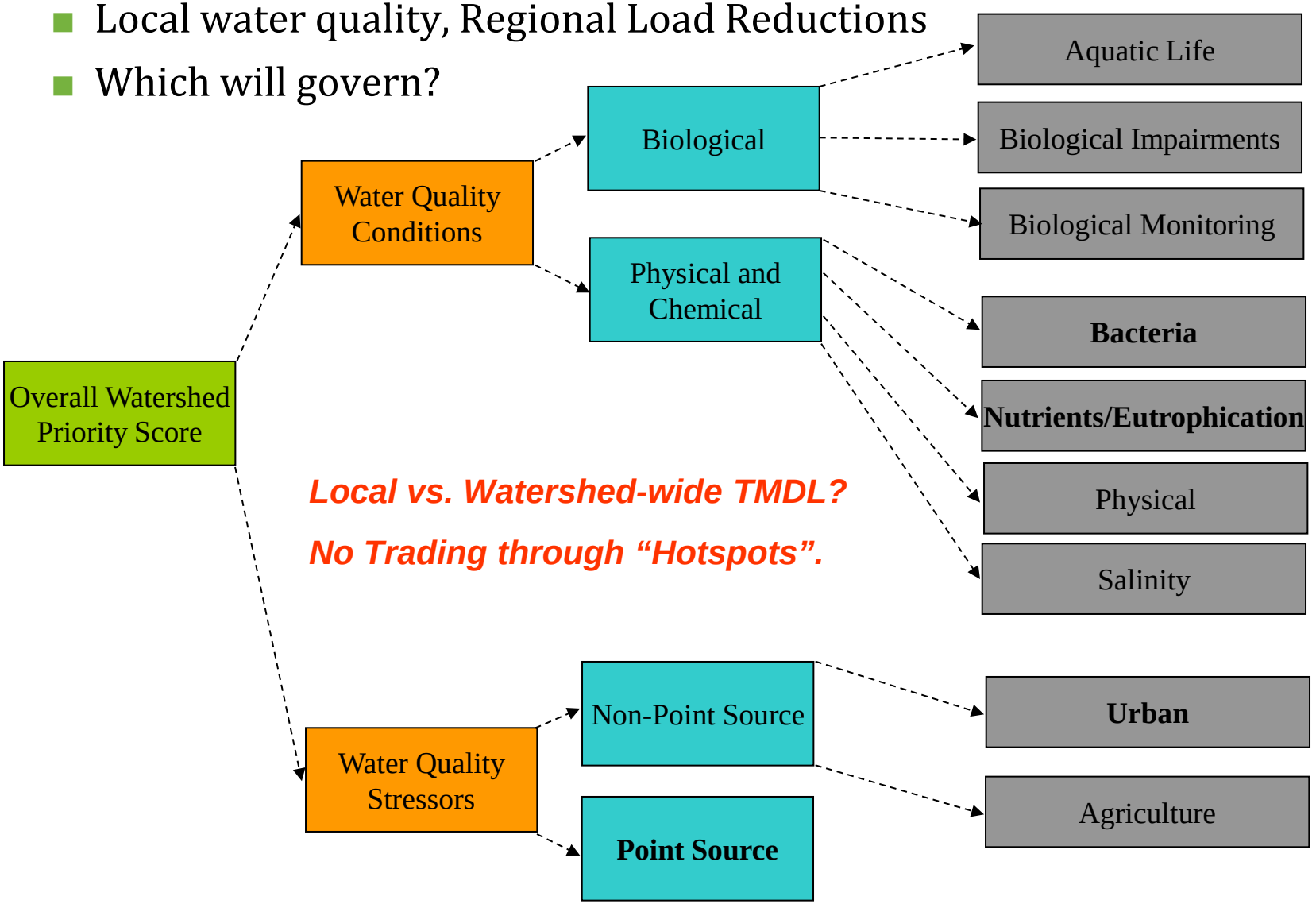
# Linking Land Use and Water Quality

- Attributing Causes to Effects
  - SPARROW 30,000' Regression Model
  - Local and Regional Water Quality
- Benefit-Cost Analysis
  - Measurement
  - Monetary, Non-Monetary
- Prioritization & Control of Funds

- *The jury is still out, in many respects*

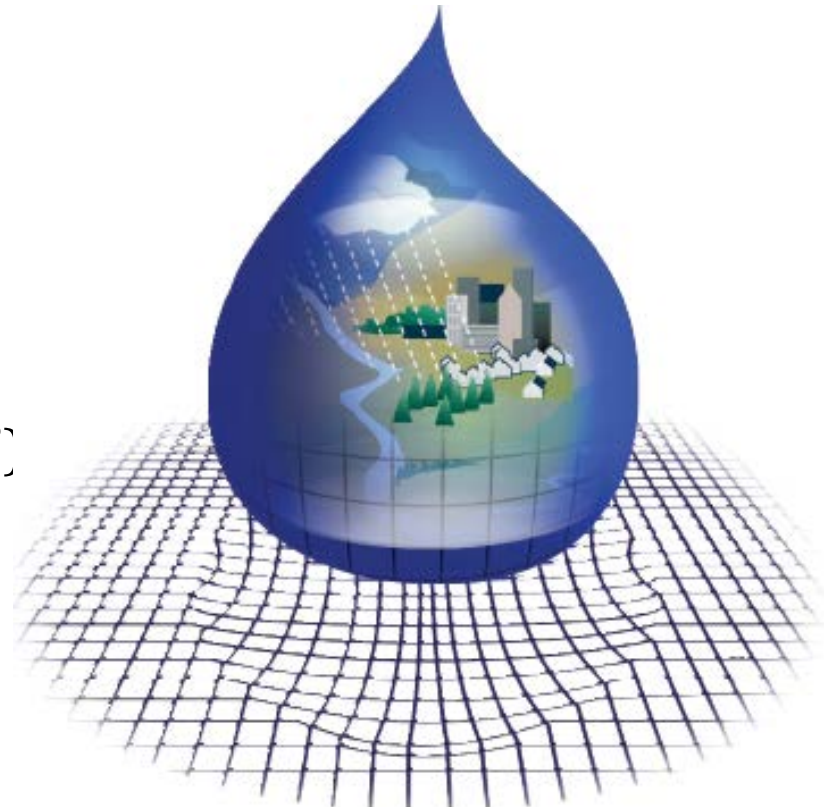
# Near-Field vs. Far-Field – State TMDLs, Large Watershed Programs

- Local water quality, Regional Load Reductions
- Which will govern?



# Water Quality Trading – Details, Details

- Agency Intent & Approval
  - Point, Non-Point
  - Baselines
- Eligible Pollutants
  - Sediment, Nutrients
- Translation (Modeling, "Delivery Factors")
  - Mass Transport & WQ Simulation
  - "Regional Interpretation" (Regression)
  - Narrative Criteria, Numeric Targets
- Geographic or Watershed Boundaries
  - Basins, States, Regions
  - "Hotspots"?
  - CSO Abatement
- Offsetting Loads (New, Expanded)
  - Fairness, Funding



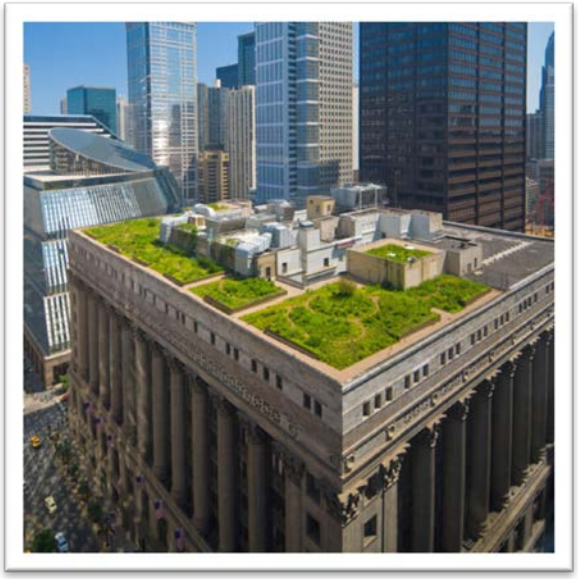
**Temporal Differences**
**Uncertainty**
**Extreme Events**
**"Competing" Programs**
**…**
***Adaptive Management***

# The Business Case for Green Infrastructure

- ***After 25 years of working on POTWs in the Chesapeake Bay, Non-Point Load Reduction is needed to move forward!***

- Robust deployment of GI will require private investment
- Widespread use of GI for stormwater management will require using GI on private property

- Public entities working with private entities
- Where Benefits > Costs, there is ROI
  - Capital, potentially lower life-cycle costs
  - Property values, reduced flood risk, etc.
- "Buzz"
  - Green, Sustainable, Triple Bottom-Line Benefits



# The Push is On … (Green Infrastructure Business Case)

- TMDL pressures for Bay Stormwater Management
  - Traditional Urban Retrofit difficult and costly
  - Pace of Controls – match redevelopment or maintenance schedules?
  - Affordability thresholds (2% of MHI?)
  - Limits on Municipal Financing Options
- EPA evaluating Public Private Partnerships (P3) as a means to accelerate Green, Bay and beyond
  - EPA "Faster, Cheaper, Greener" Initiative
    - Incentives and Drivers?
    - Performance-based Design Standards
    - Streamline BMP technology verification processes
    - Asset Management
- Stormwater Utilities being formed, User fees
- Establishing Stormwater credit and contracting markets


Contractual Agreement for Urban Retrofit "P3"

Financing
Planning
Design
Construction
Operation
Maintenance

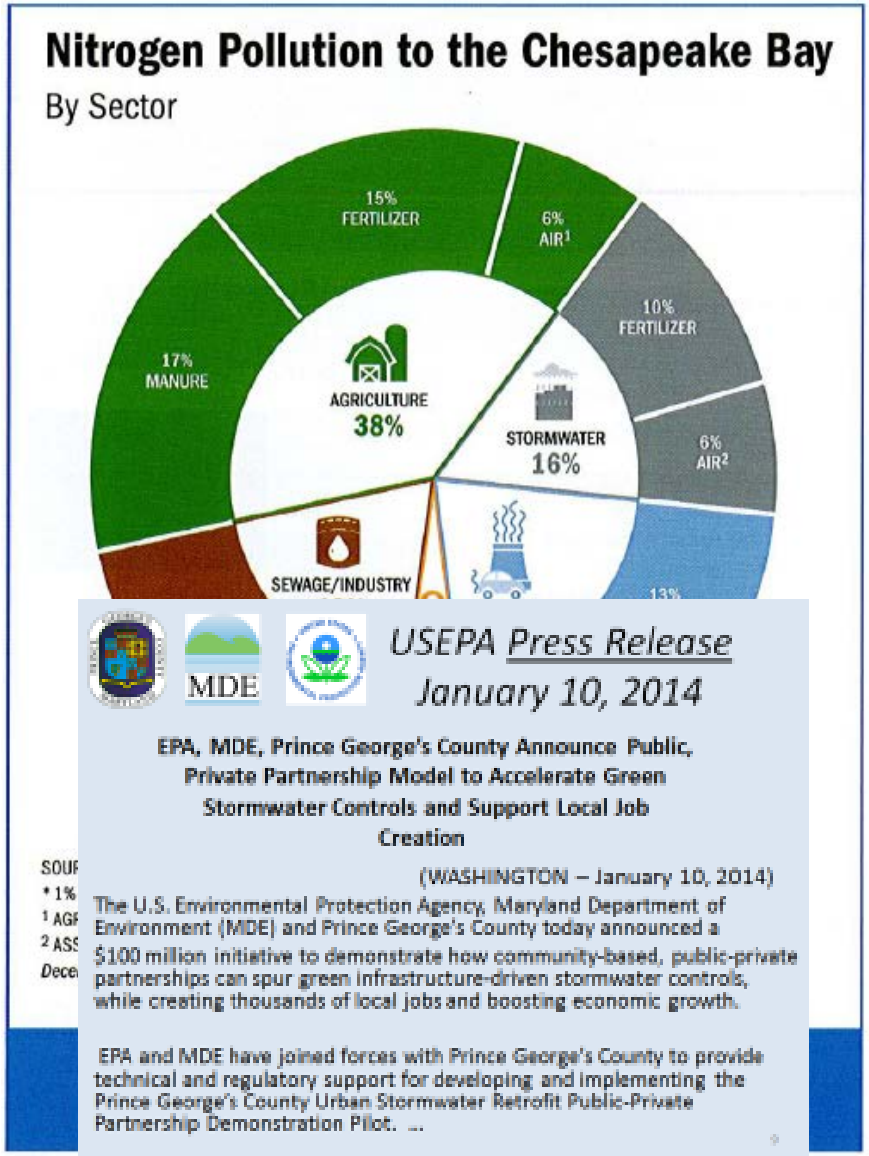
*Shared Risk?*

# Green vs. Gray Infrastructure – "Sustainability"?

- End of Pipe *(and Residuals Disposal)*
- Waterbody Use Attainability
- Visible Community Benefit

- Non-Point Program Development
  - BMPs - EPA, USDA, and WEF Pilots
  - Measurement & Verification

- Funding - Maryland example
  - Counties collect from All
  - "Flush" tax ($60/yr/EDU) - MDE
  - "Rain" tax ($85) – 8 Counties
    - Rural $170, Condos $34
  - Ex. Anne Arundel Co $900M projects



# The Promise of Green Infrastructure

## Green Infrastructure Practices Offer Cost-Effective Solutions

*American Society of Landscape Architect's Green Infrastructure Survey*

As part of its efforts to collect information about green infrastructure, EPA asked ASLA to collect case studies on projects that successfully and sustainably manage stormwater. ASLA members responded with 479 case studies from 43 states, the District of Columbia, and Canada. Not only do these projects showcase landscape architecture, they also demonstrate to policymakers the value of promoting green infrastructure policies. Green infrastructure and low-impact development (LID) approaches, which are less costly than traditional grey infrastructure projects, can save communities millions of dollars each year and improve the quality of our nation's water supply.

**Project type:**

| | |
|---|---|
| Institutional/Education | 21.5% |
| Open Space/Park | 21.3% |
| Other | 17.6% |
| Transportation Corridor/Streetscape | 11.9% |
| Commercial | 8.6% |
| Single Family Residential | 5.5% |
| Government Complex | 4.2% |
| Multifamily Residential | 3.7% |
| Open Space Garden/Arboretum | 2.9% |
| Mixed Use | 1.8% |
| Industrial | 1.1% |

**Green infrastructure type:**

| | |
|---|---|
| Retrofit of existing property | 50.7% |
| New development | 30.7% |
| Redevelopment project | 18.6% |

**Did use of green infrastructure increase costs?**

| | |
|---|---|
| Reduced costs | 44.1% |
| Did not influence costs | 31.4% |
| Increased costs | 24.5% |

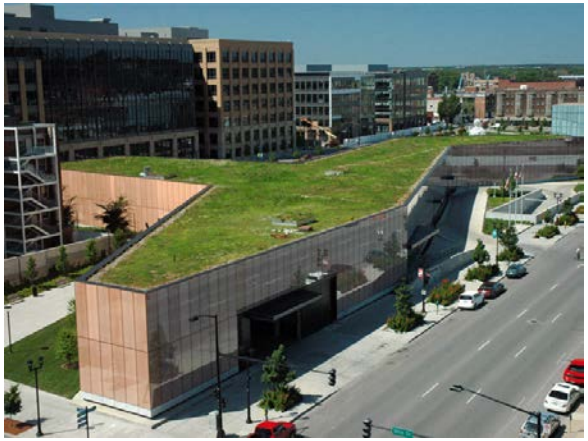
### Analysis

- Over 300 ASLA members and other practitioners responded with 479 case studies from 43 states, the District of Columbia, and Canada.
- 55 percent of the projects were designed to meet a local ordinance.
- 88 percent of local regulators were supportive of the green infrastructure projects submitted.
- 68 percent of the projects received local public funding.

*Details about the study and its results are available here: www.asla.org/stormwater*

Source
Banking on Green (2012)

# TMDL and Trading – Challenges and Decisions

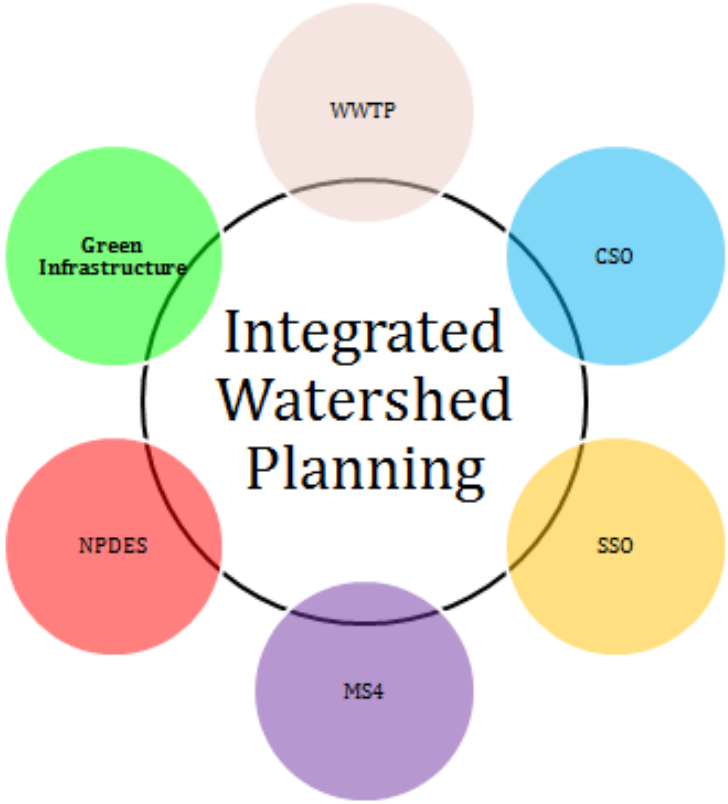


Source
Willamette Partnership (2014)

| TMDL Element | Trading Design Decision |
|---|---|
| Identification of the water body, pollutant of concern, pollutant sources, and priority ranking | Eligible pollutants; Buyer and seller types |
| Description of the applicable water quality standards and numeric water quality target | Underlying goals of trading |
| Loading capacity | Tools to quantify pollutant delivery, attenuation, and equivalency for credits; Potential sources of localized pollution concentrations; Trading areas |
| Wasteload allocations | Intent to trade; Credit units; Credit demand |
| Load allocations | NPS baseline levels |
| Margin of safety | Need for uncertainty ratios; Room for new and expanded discharges |
| Seasonal variation | Credit life |
| Reasonable assurances | NPS baseline expectations |
| Public participation & submittal letter | Intention to use trading to help meet TMDL |
| Monitoring plan to track TMDL effectiveness | Program effectiveness and adaptive management framework; QAPP |
| Implementation plans | Timing of meeting baseline; Eligible BMP types; Priority areas; Project review & tracking |
| Administrative record | Administrative record |

# Integrated Planning

- EPA Draft Framework – October 2011
- Series of national and regional workshops
- Community and stakeholder comments
- Final EPA Framework – June 2012
- Draft Affordability Framework – January 2013
- FAQ – July 2013
- Updated Draft Affordability Framework – October 2013




- … *No EPA-approved Integrated Plans yet?*
  - *First (2014-5), recently in Ohio?*

# TMDLs Cycling – Assessment Cycling, with Adaptive Management?


- Inception to 2010 TMDL
- 2017 Phase 1
- 2025 Phase 2

- *Sprawl? Stormwater? Ag?*

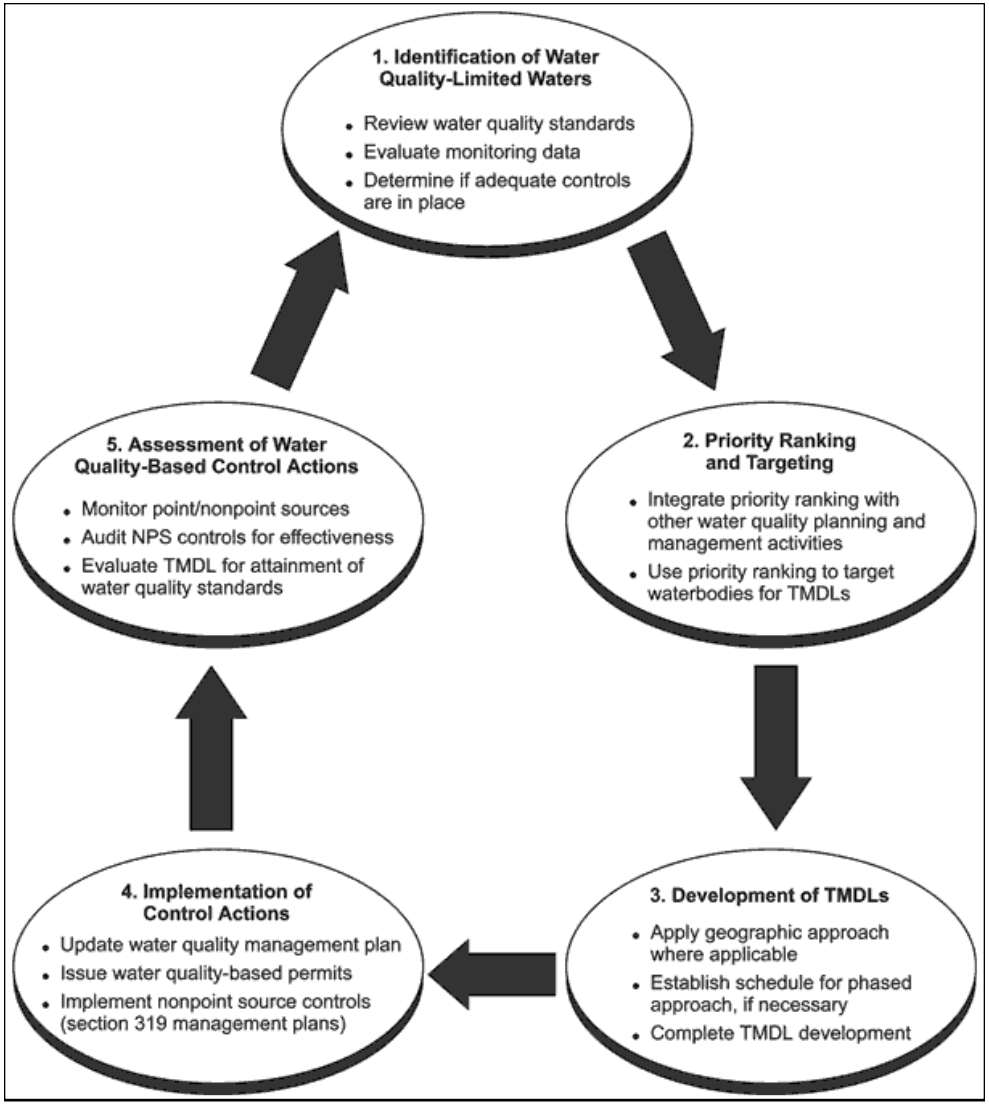



**Figure 1-1. General elements of the water quality-based approach (adapted from USEPA, 1991a)**

# Chesapeake Bay Program, 2010, and Beyond

- Initially a Voluntary Point Source Program
  - Grants, Low-Interest Loans
- Now an Involuntary TMDL-Based Program
  - Watershed Implementation Plans
  - Phase 1 and Phase 2 deadlines
- Point Sources done?
  - Wasteload caps, Nutrient recovery
  - Smaller, Indirects
- Nonpoint? (Ag, Stormwater/MS4, etc.)
  - BMPs
  - Trading Ratios
- Trading
  - Intra-State
  - Inter-State? Hotspots? Point-Nonpoint?

# Ohio EPA Non-Point, then Point, Nutrient Reduction Workgroups

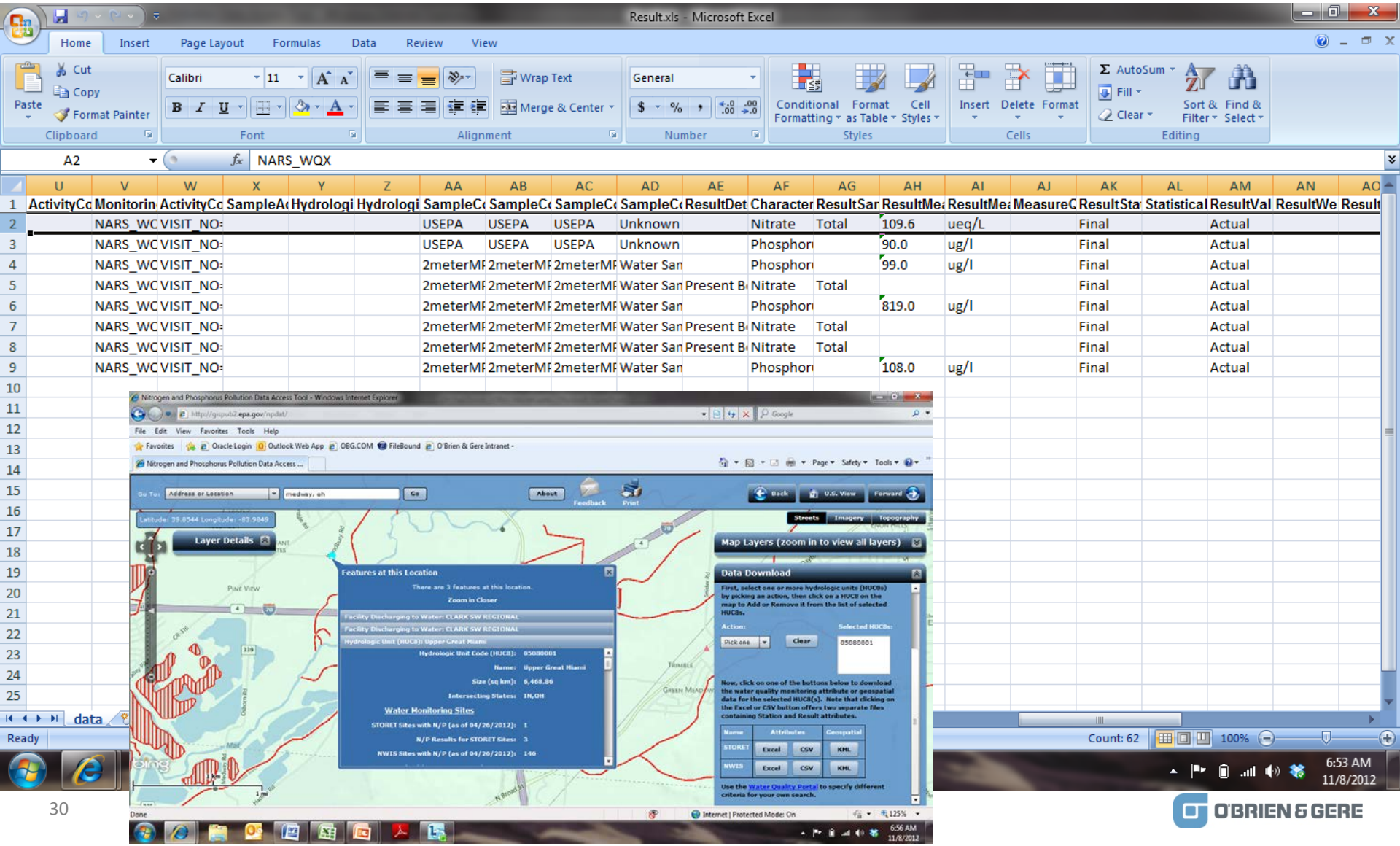
- 2012-5 Initial Discussions with some Stakeholders

## *Key Recommendations*

1. *Ohio EPA should develop a state-wide nutrient mass balance sheet that accounts for point and non-point sources of nutrients.*
2. *Ohio EPA should encourage and promote operational experimentation at wastewater treatment facilities aimed at achieving low cost nutrient removal.*
3. *Wastewater treatment plant owners should be prepared to determine cost effective means to achieve lower effluent limits wherever facilities are shown to be significant contributors to nutrient enrichment.*
4. *State government should appoint a panel of economic, financial, and policy experts to consider options for funding the implementation of Ohio's nutrient reduction strategy.*
5. *Ohio EPA should publish an annual report on nutrient loadings and resulting water quality conditions in our lakes and rivers.*
6. *Ohio EPA should integrate watershed management and green infrastructure planning with Ohio's nutrient reduction strategy.*

# Ohio Example - Watershed & Nutrient Data

- Ex – STORET Data for HUC-8 05080001 (Upper Great Miami) Mad River

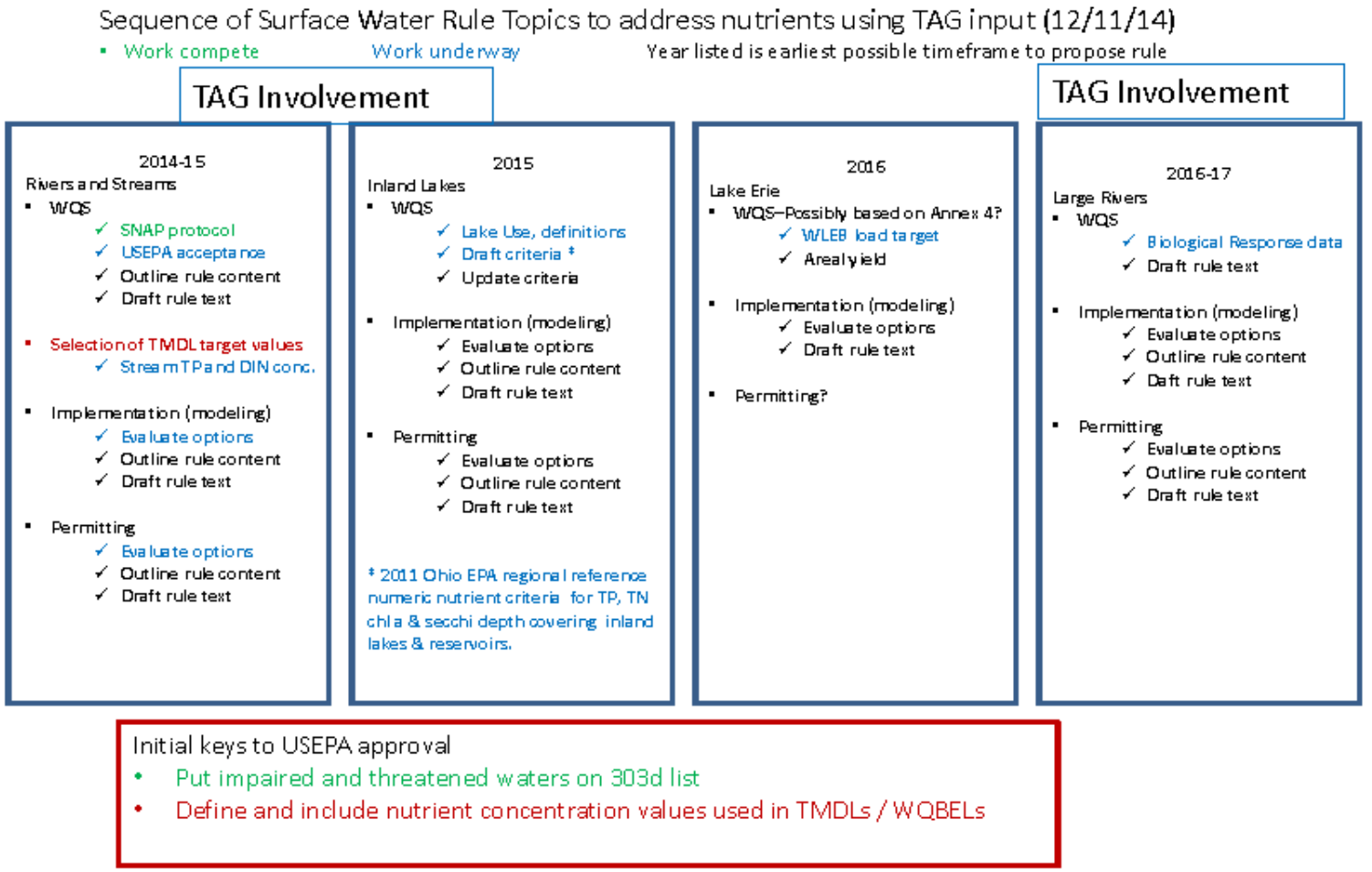





O'BRIEN & GERE

# Revising Assessment Tool – Weaving together Regulations, Trading

- Ohio's Stream Nutrient Assessment Procedure "SNAP", etc.
  - *Biological criteria, DO swing, Benthic chlorophyll, Trophic condition*



# QUESTIONS?

O'BRIEN & GERE

# THANK YOU

Bill Meinert, O'Brien & Gere

4201 Mitchellville Road, Suite 500, Bowie, MD 20716

(301) 731-1130, mobile (443) 474-7332, Bill.Meinert@obg.com

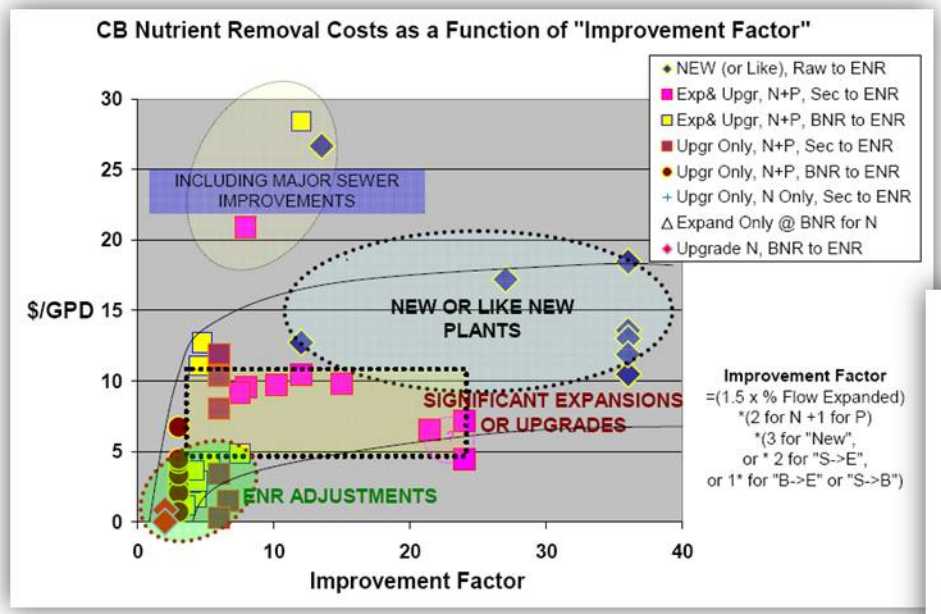


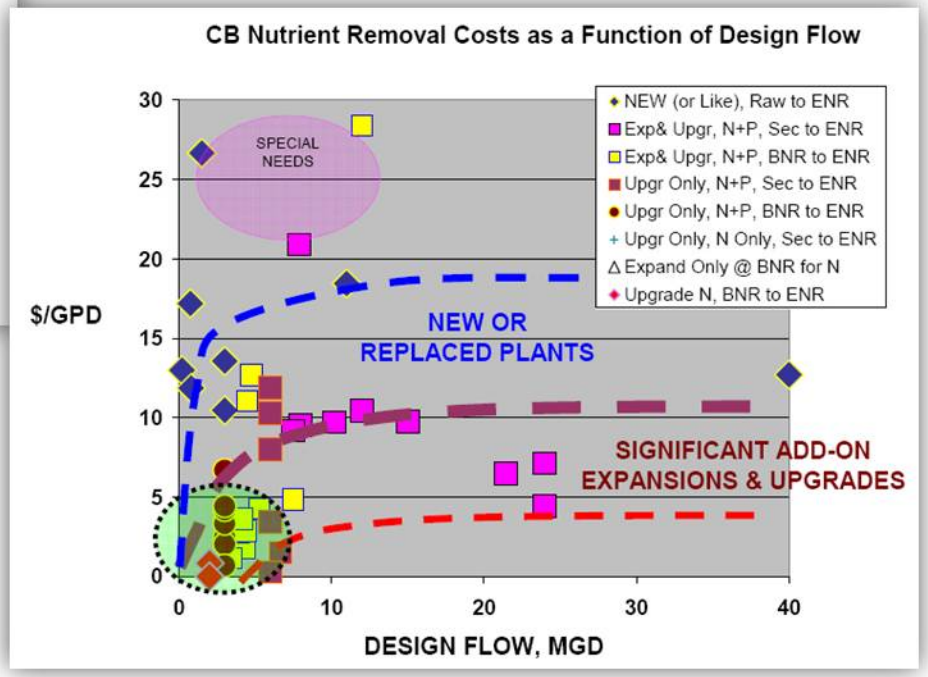


O'BRIEN & GERE

# Point Sources - Everything, Everywhere, Everyone (cont.)

- Chesapeake Bay Program experience (1990s, 2000s)



# The Promise of Green Infrastructure


- Leverage Joint Efforts
- Build and Share Knowledge
- Find, Encourage Best Ways

American Rivers
Thriving By Nature

NACWA
A Clear Commitment to America's Waters

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

AMERICAN SOCIETY OF LANDSCAPE ARCHITECTS

ACWA
Association of Clean Water Administrators

NRDC
THE EARTH'S BEST DEFENSE

EDF
ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

ISI
INSTITUTE FOR SUSTAINABLE INFRASTRUCTURE

Water Environment Federation
the water quality people

- *Lots of national backing*
  - *Working on the details*

# The Use(s) of Green Infrastructure

- CSO Abatement
  - Flow
  - Bacteria
  - Solids & Floatables
  - Sediment
  - *and Nutrients*
  - and …

*"Win-Win" – Better Operating Treatment Plants, Less Overflows, Flood Control, Overall Water Quality*

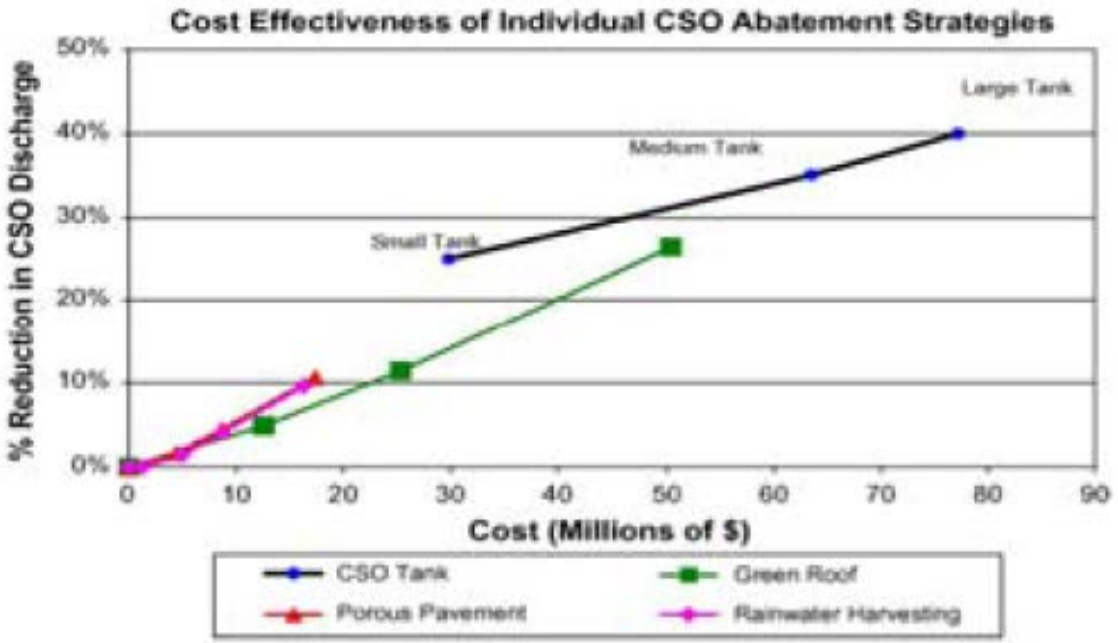
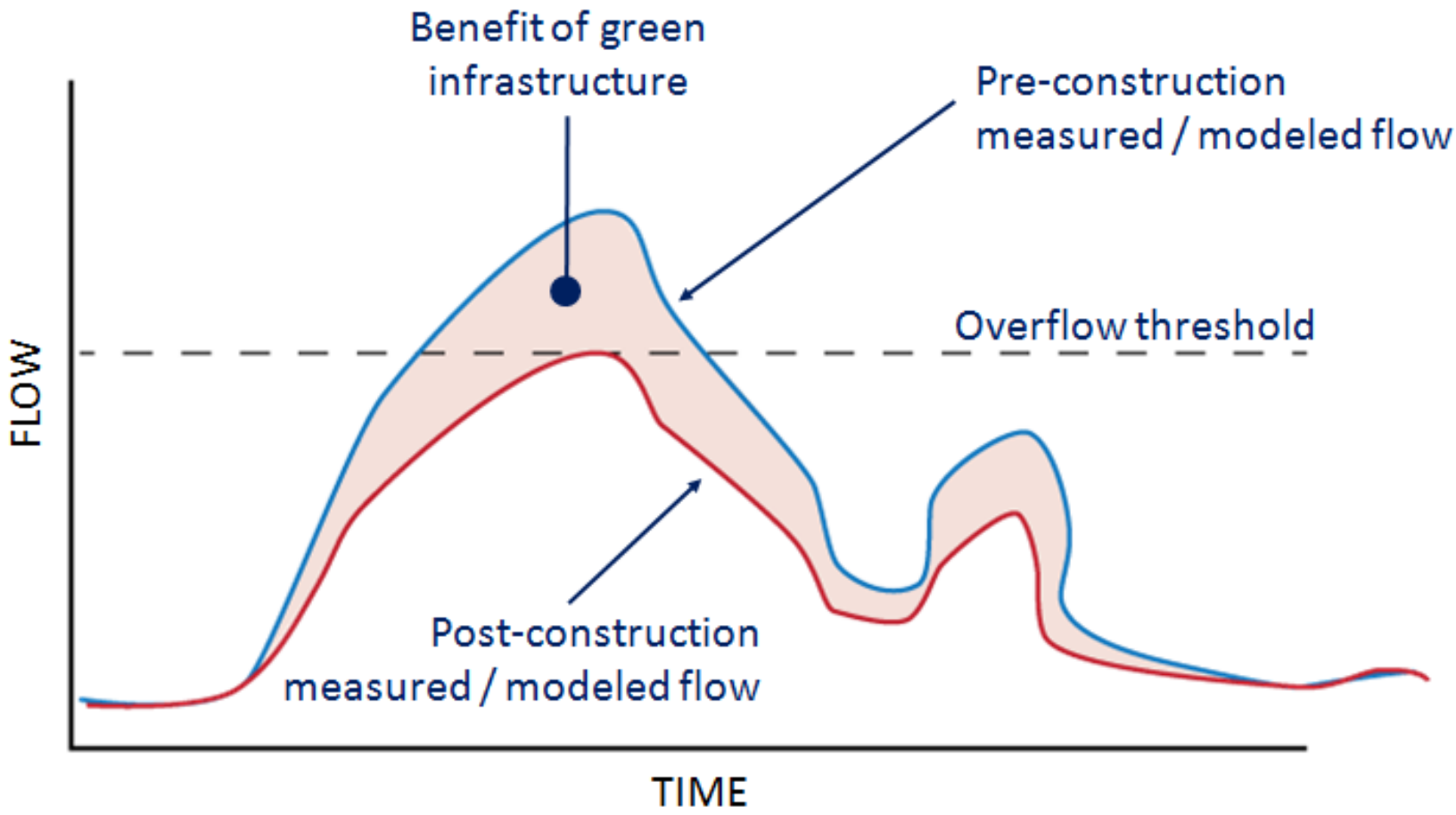



**Figure 3.** Comparison of General Green and Grey Options

Source: Montalto (2007)

# The Use(s) of Green Infrastructure

- CSO Abatement




- *Nutrients too?*

# Green Infrastructure Retrofit Objectives > CSO Abatement

## Poor Runoff Controls

**Soil Erosion**

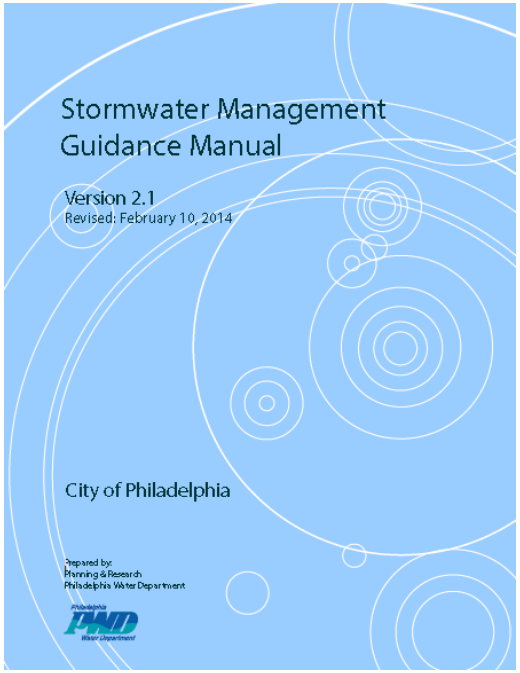
**Nitrogen, Phosphorus**

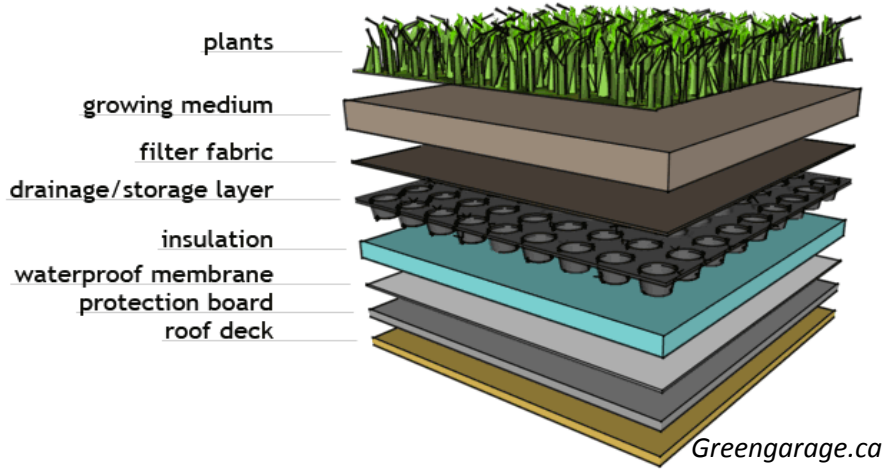
**Algae**

- Blue-green
- Cyanobacteria
- Taste & Odor
- Toxins

# Green Infrastructure Accreditation, Certification?

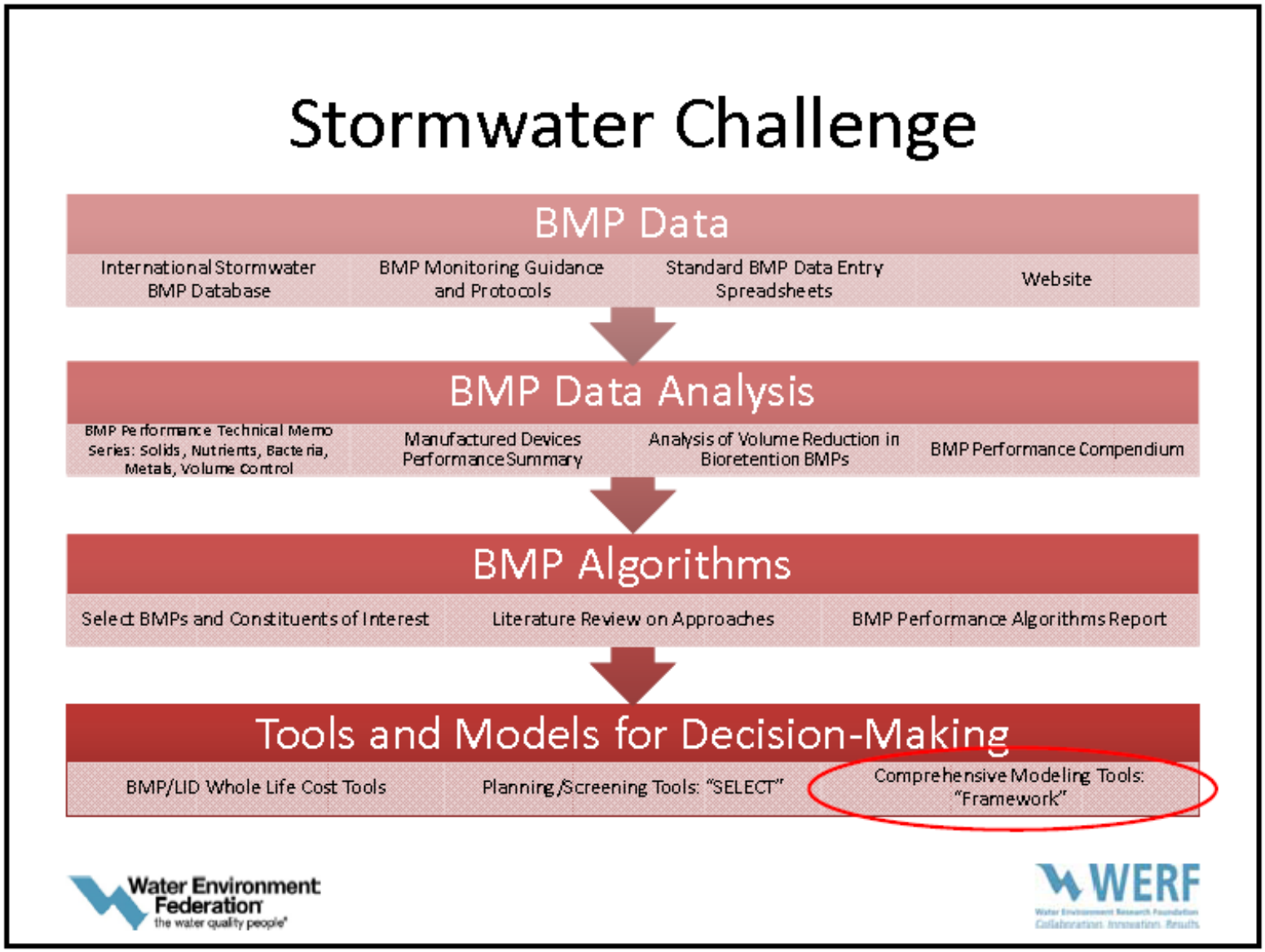
- Who?
  - USDA?  EPA?  WEF Stormwater?
- What?
  - Green House Gases (GHGs)?
  - Triple Bottom-Line?
    - Social, Economical, Environmental
- How Well?
  - Expected Performance?
- How Long?
  - Operation & Maintenance?
  - Expected Life?



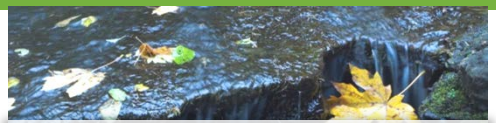

*Greengarage.ca*

# Green Infrastructure Accreditation, Certification? (cont.)




Source
WEF Webinar (8/6/14)

# Stormwater Management



**Stormwater Management**

**CSO Management**

**Erosion & Sediment Control / SWPPPs**

**Conveyance and Detention System Design**

**MS4 Permit Administration**

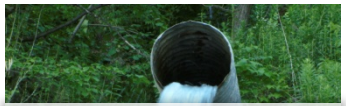
**Industrial SWPPPs**

**Dams Assessments**

**Stream Channel Improvements & Restoration**

**Green Infrastructure/ LID Design**

**Retrofits and Master Planning**



**Watershed Evaluations**
(Non-point Source Runoff)

# What is Green Infrastructure?

- The preservation and/or mimicking of existing hydrology
  - Remove Pollutants
  - Promote Natural Hydrology
  - Minimize Erosion

- Key technical terms are "Runoff Reduction Volume – RRv" and "Water Quality Volume – WQv"
  - RRv is managed by infiltration, reuse, and evaporation / evapotranspiration

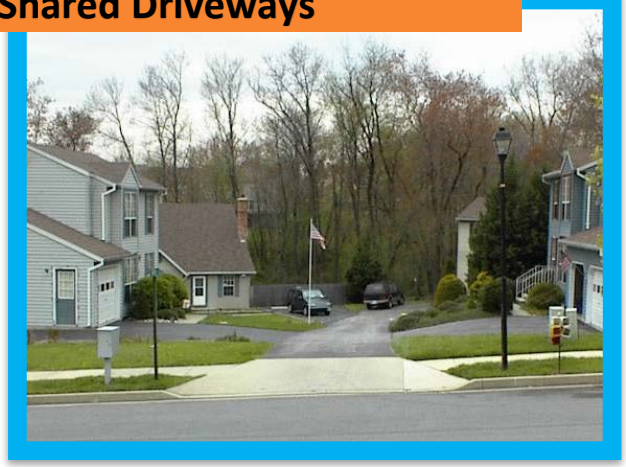
- *Goal: Treat stormwater runoff at the source vs. an end-of-pipe solution*

# What are the Options to Prevent Runoff?

- The first step is planning
  - Many options to "green the design"
  - Less impervious surfaces

- **Also…**
  - Roadway Reduction
  - Sidewalk Reduction
  - Parking Area Reduction

**Shared Driveways**



**Cul-de-sac Reduction**

*If the designer practices these items, it usually provides a more economical design that is Green and saves the Client money!*

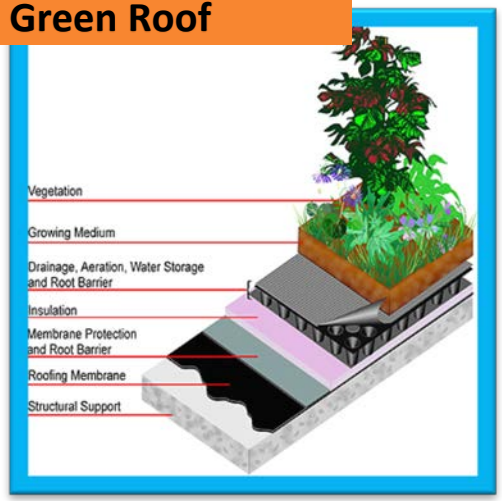
# What are Some of The Options to Reduce Runoff?

***Also…***

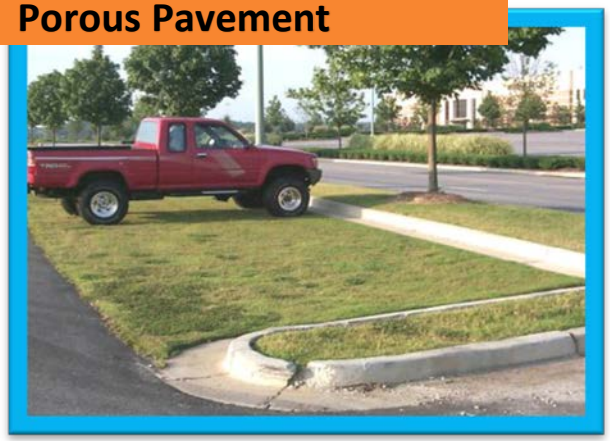
- Vegetated Swales
- Infiltration Practices
- Tree Plantings
- Disconnection of Rooftops
- Dry Swales
- Bioretention
- Stormwater Planters

**Rain Gardens**

**Green Roof**




**Porous Pavement**



**Rain Barrels/Cisterns**

# What is the Best Practice for a Site?

- Considerations for selection:
  - **Reduction of Volume**
  - Aesthetics
  - Cost
  - Regulatory Requirements
  - Maintenance Requirements