Maryland Department of the Environment

Allocation Methodology

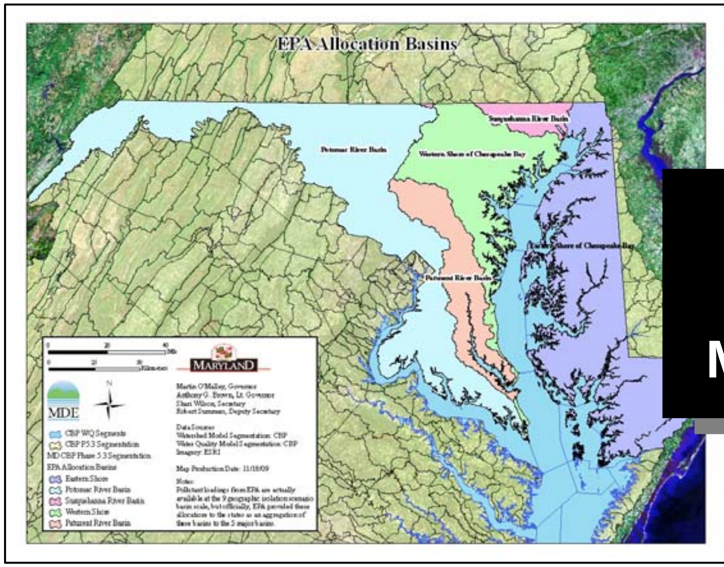
WIP Local

Technical Series #2

April 8, 2013

MD's Allocation Methodology

The black box between EPA basin targets and WIP county targets



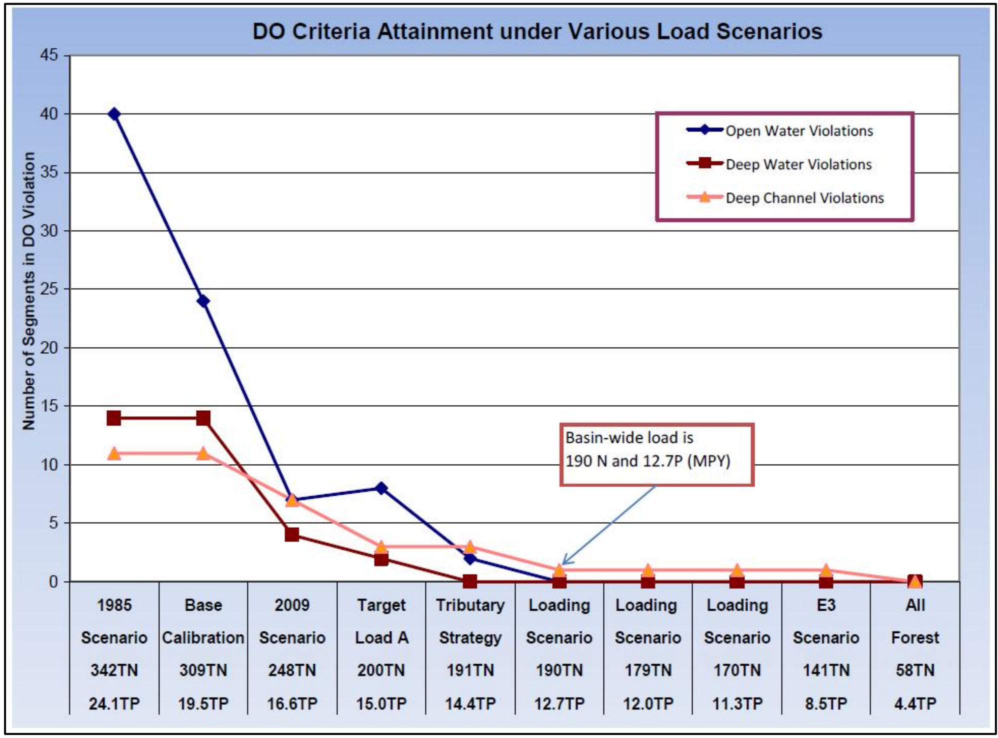
MD's Allocation Methodology

EPA Allocation to States

- Principles
  - Water quality and living resource goals should be achieved in all 92 segments
  - Basins that contribute the most should do the most (on a pound-per-pound basis)
  - All previous reductions in nutrient loads are credited toward achieving final cap loads
- Key Concepts
  - Relative Effectiveness
  - Controllable Load
  - Relating controllable load with relative effectiveness

EPA Principle #1

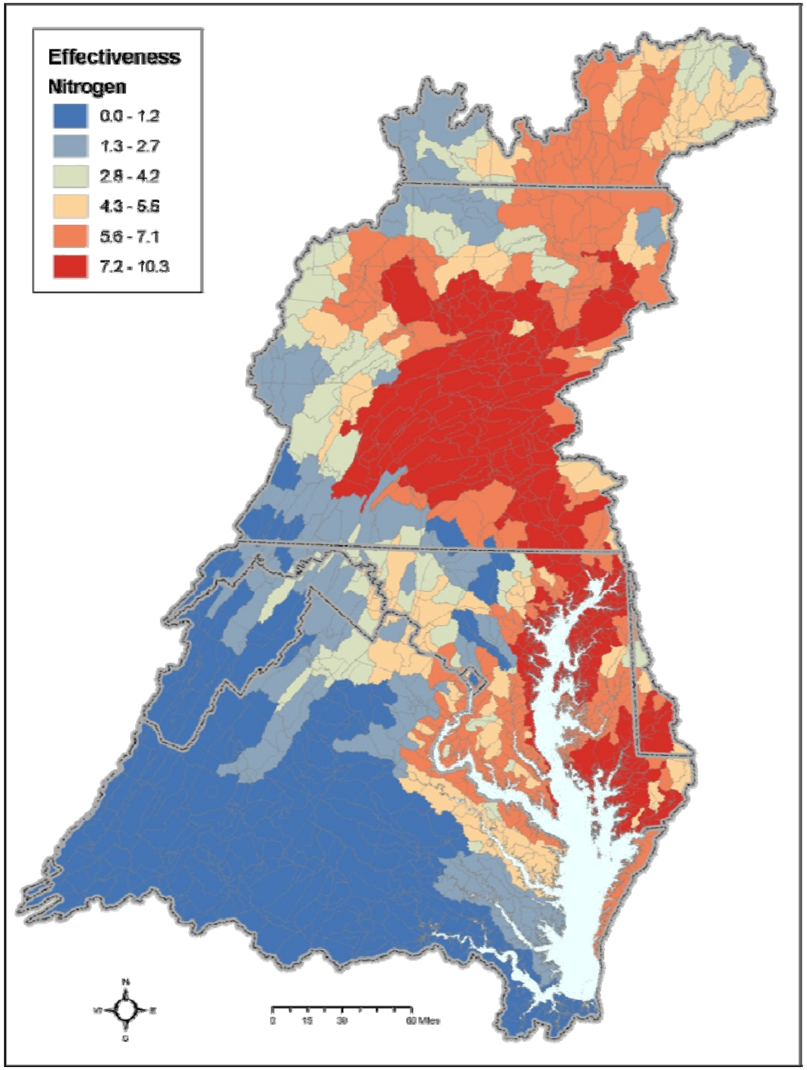
- Meet water quality criteria in all 92 Bay segments
- Incremental scenarios determine watershed-wide target loading
- As load is decreased, more bay segments show water quality attainment
- Last segments to come into attainment define critical area
- Critical segments drive allocation process



Source: Chesapeake Bay TMDL, Section 6.3
http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/FinalBayTMDL/CBayFinalTMDLSection6_final.pdf

EPA Principle #2

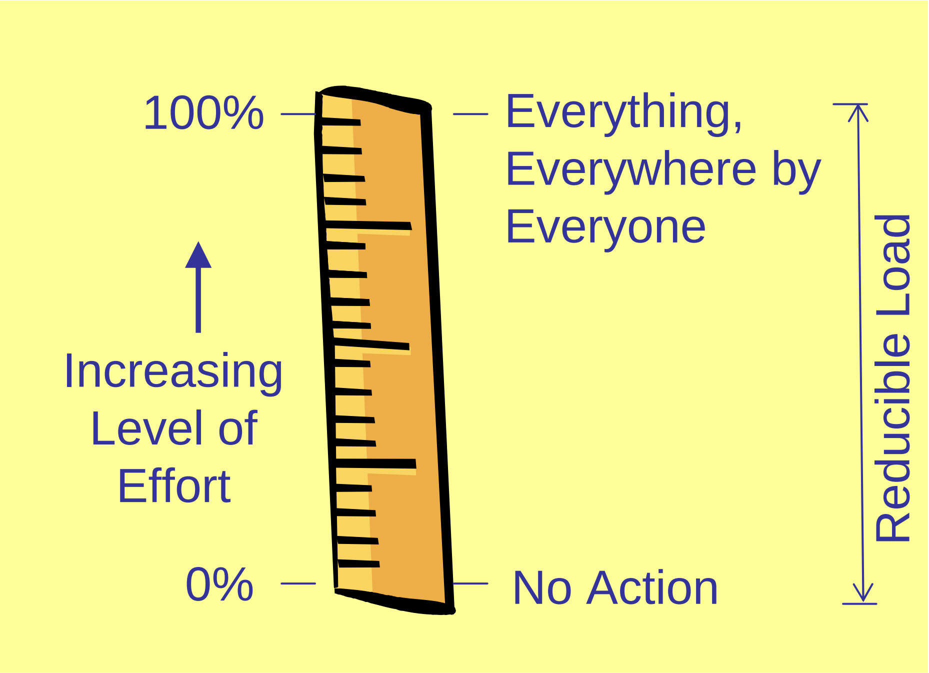
- Basins that contribute the most should do the most (on a pound-per-pound basis)
- Concept: Relative Effectiveness
  - Relative Effect of a Pound of Pollution on Bay Water Quality
  - DO increase / lb reduction Edge-of-Stream
- Based on water quality attainment in critical segments



Source: Chesapeake Bay TMDL, Section 6.3
http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/FinalBayTMDL/CBayFinalTMDLSection6_final.pdf

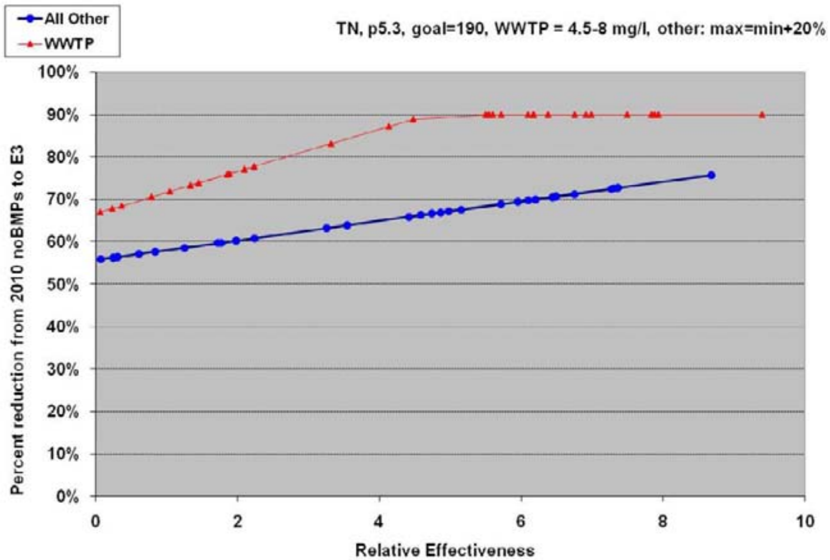
EPA Principle #3

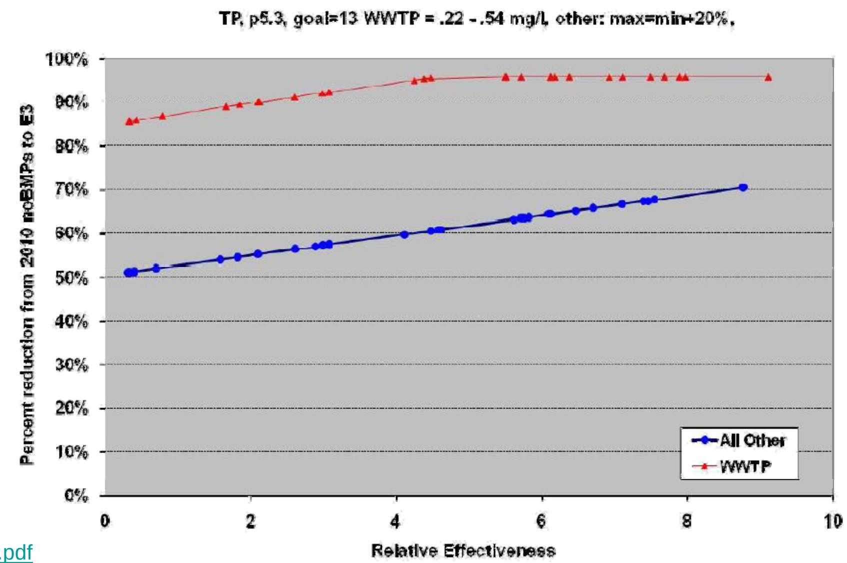
- Credit previous reductions
- Accomplished by calculating required reductions as a reduction from a No-BMP scenario
- Concept: Controllable Load
  - No Action (No-BMP) = Upper limit on loads
  - E3 = Lower limit on loads
- Provides equity among sectors



EPA Allocation to Basins/States

- Concept: Relating controllable load with relative effectiveness
- Greater impact = Higher reduction
- 2 Lines
  - Recognizes the difference in the ability to reduce between point source and non-point source
  - Wide disparity between basins in the fraction of load from WWTP (consider Western Shore)





Source: Chesapeake Bay TMDL, Section 6.3
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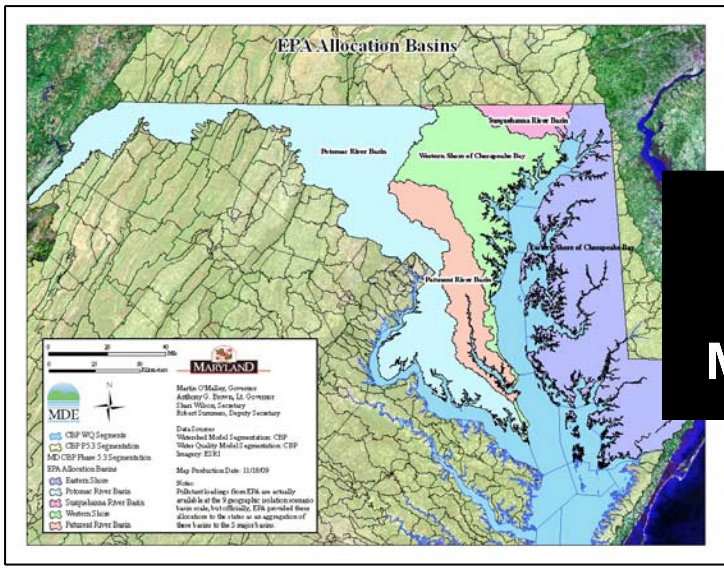
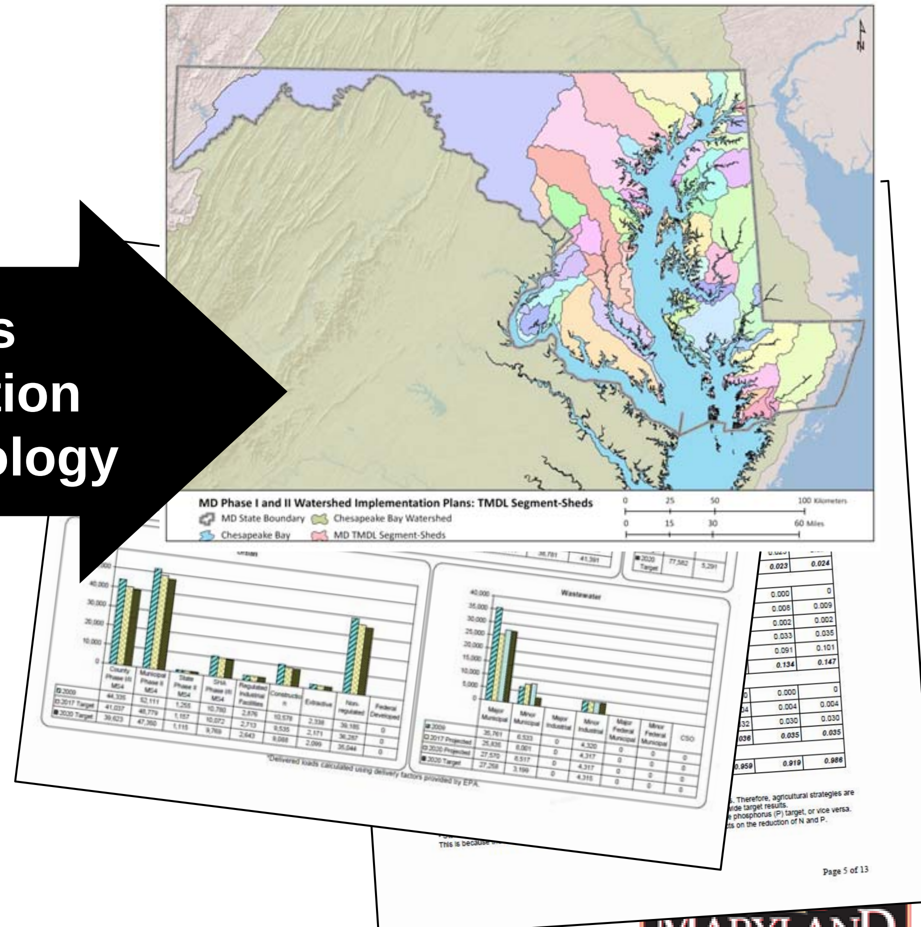
Where EPA's Allocation Process Ends MD's Begins



MD's Allocation Methodology



MD's Allocation Principles

- Meet water quality
- Credit past actions
- Equity among sectors
- Effectiveness of reductions

Meet Water Quality

- **EPA basin targets not reflective of MD WWTP achievements**
  - EPA: 4.5 mg/l N, 0.22 mg/l P
  - MD ENR: 4.0 mg/l N, 0.18 mg/l P
  - Essentially gives MD credit for WWTP gains
  - Consider Western Shore
- **Can't ignore EPA basin targets**
  - Distribution of basin targets achieve a specific water quality response (i.e., change in DO)
  - Water quality response needed for attainment in critical segments
- **MD Allocation Goals**
  - Match EPA statewide target load
  - Match the water quality response achieved by EPA basin targets

Meet Water Quality Statewide Target

- EPA Phase II targets for MD
  - 41.17 million lb/yr N
  - 2.81 million lb/yr P
- Set point source
- Remainder distribute to non-point source

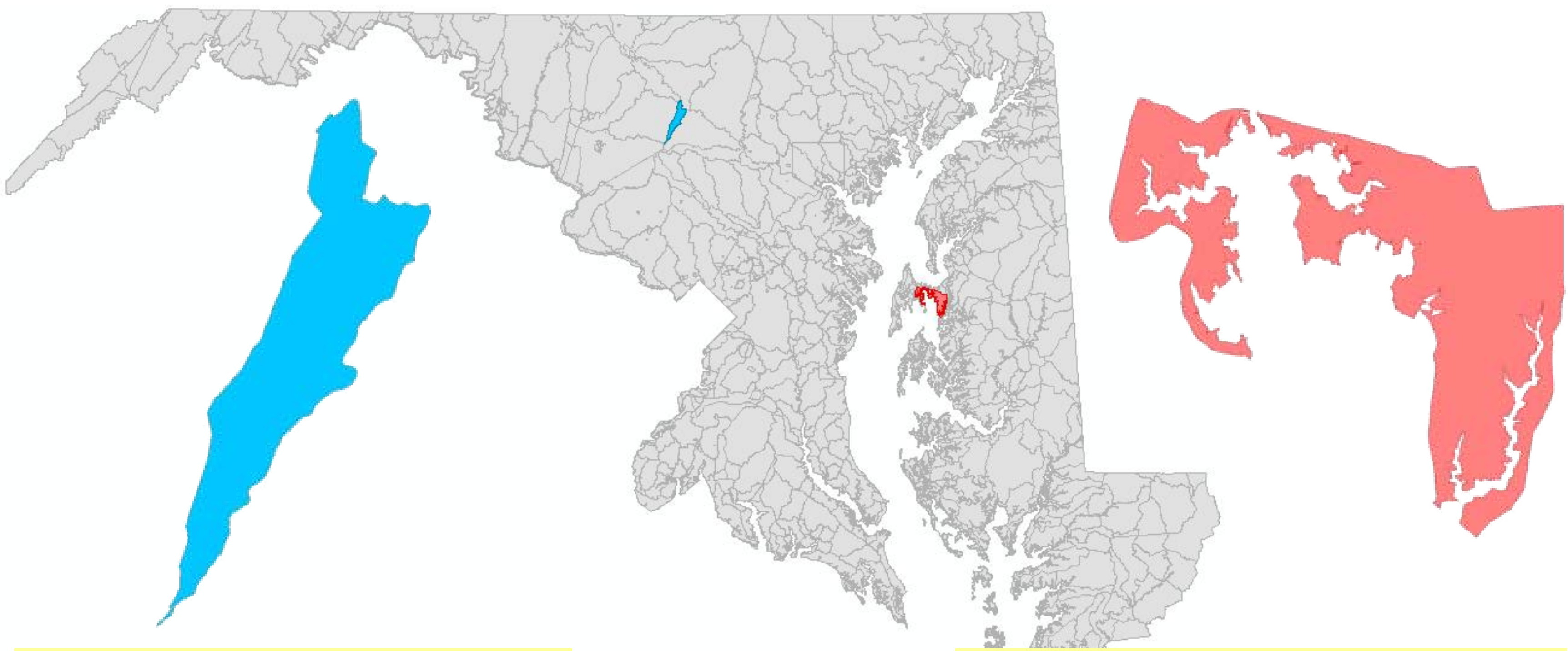
WWTP Allocation

- Major Municipal
  - ENR Cap Strategy
- Major Industrial
  - Tributary Strategy Cap
- Minor Municipal
  - Tributary Nutrient Reduction Goal
- Minor Industrial
  - Facility Concentration/Load Targets

NPS Allocation

- Urban, agriculture, septic and forest allocations based on the following
  - Credit past actions
  - Equity among sectors
  - Effectiveness of reductions

Example Land-River Segments

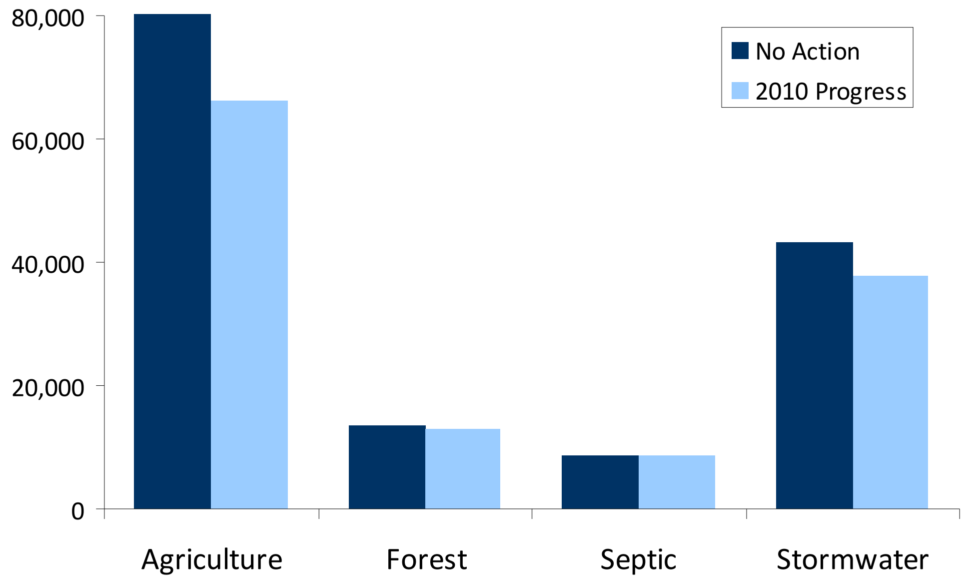


A24013PM1_3710_4040
Major Basin = **Potomac**
County = **Carroll**
8-digit = **Lower Monocacy**

A24035EU0_4610_0000
Major Basin = **Eastern Shore**
County = **Queen Anne's**
8-digit = **Kent Narrows**

Credit Past Actions

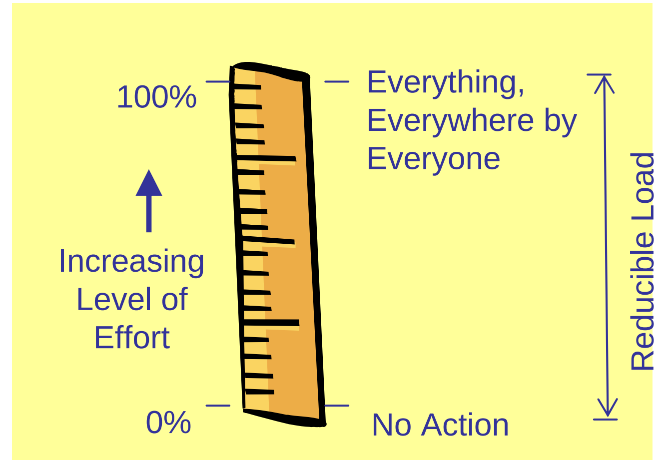
- Required reductions start from no action not current condition
  - No Action = load with no BMPs

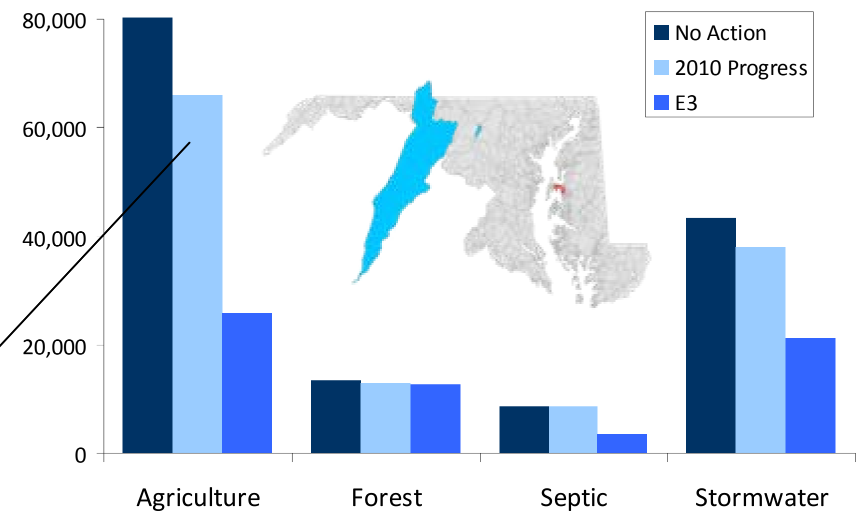


Equity Among Sectors

- Reducible Load
  - No Action = Upper limit
  - E3 = Lower Limit
- Level-of-effort:
  - Scaling the required reduction between No Action and E3 provides equity among sectors
  - Example: 2010 Ag load in plot represents 26% level-of-effort

$$\frac{80{,}000-66{,}000}{80{,}000-26{,}000} = 26\%\ \text{LOE}$$





E3 Assumptions

- Everyone (doing) Everything Everywhere
- "What-if" scenario of watershed conditions with the theoretical maximum practicable levels of managed controls on all pollutant load sources
- Every acre controlled by a suite of practices

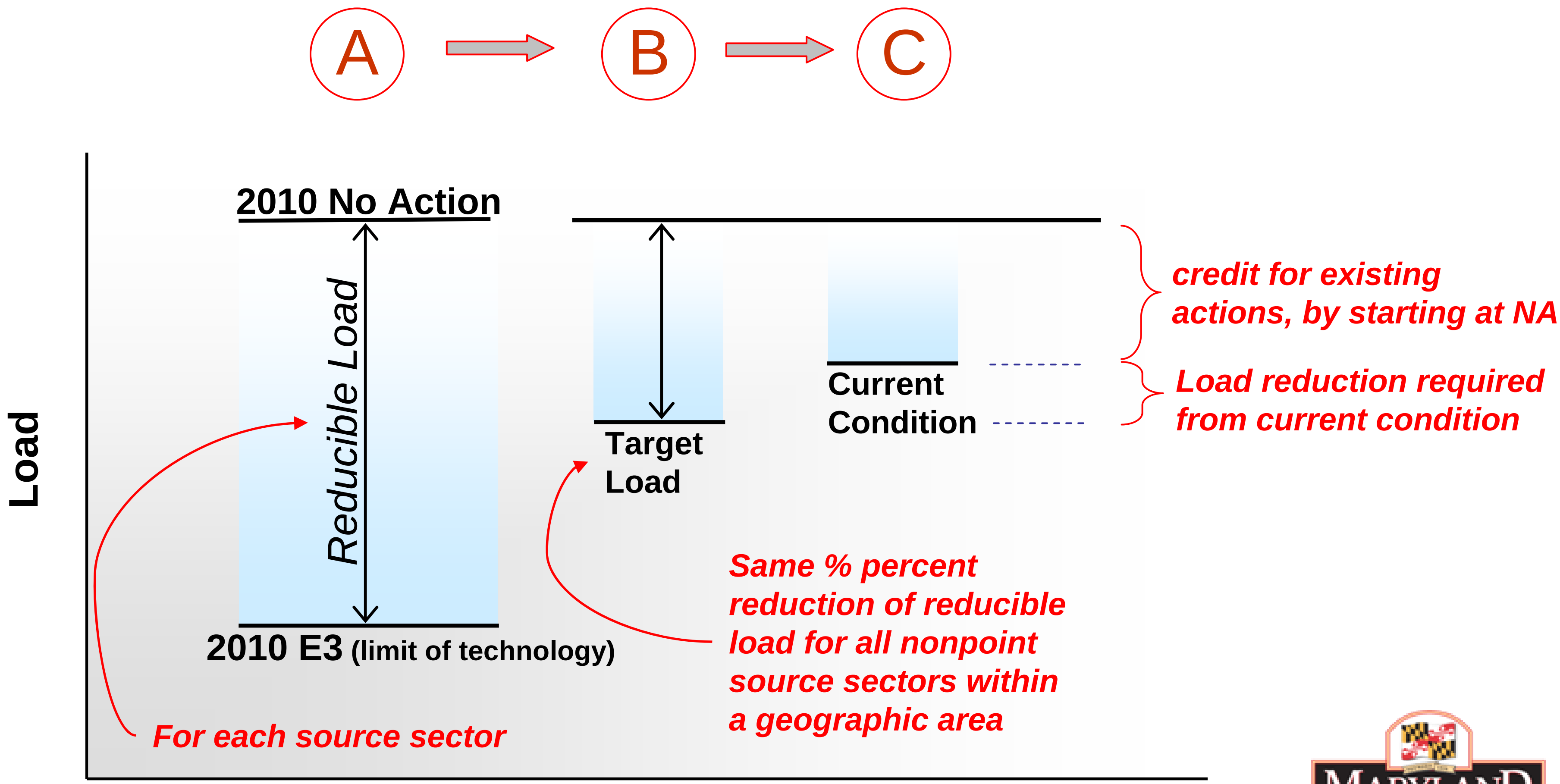
E3 Urban Practices

- E3 Forest conservation & urban growth reduction
  - All projected loss of forest from development is retained or planted in forest.
- E3 Riparian forest buffers on urban
  - 10% of pervious riparian areas without natural vegetation (forests and wetlands) associated with urban lands are buffered as forest for each modeled hydrologic segment in the Chesapeake Bay watershed.
  - The area of un-buffered riparian land is determined using the best available data: 1) 1:24K National Hydrography Dataset; and 2) 2001 land cover.
- E3 Tree planting on urban
  - Forest conservation and urban riparian forest buffers account for tree plantings in the urban sector.
- E3 Stormwater Management
  - Regions with karst topography (low permeability) and Coastal Plain Lowlands (high groundwater)
    - 50% of areas – impervious cover reduction.
    - 30% of area – filtering practices designed to reduce TN by 40%, TP by 60% and SED by 80% from a pre-BMP condition.
    - 20% of area – infiltration practices designed to reduce TN by 85%, TP by 85% and sediment by 95% from a pre-BMP condition.
  - Ultra-urban regions – defined as high- and medium-intensity land cover
    - 50% of areas – impervious cover reductions, e.g. cisterns and collections systems to capture rainwater for reuse.
    - 30% of area – filtering practices, e.g., sand filters, bio-retention, and dry wells.
    - 20% of area – infiltration practices, e.g., infiltration trenches and basins.
  - Other urban/suburban regions
    - 10% of areas – impervious cover reduction.
    - 30% of area – filtering practices, e.g. sand filters, bio-retention.
    - 60% of area – infiltration practices.
- E3 Erosion & sediment controls
  - Controls of the runoff from all bare-construction land use areas are assumed to be at a level so that the construction loads are equal to the nutrient and sediment edge-of-stream loads from pervious urban under E3 conditions.
- E3 Nutrient management on urban
  - All pervious urban acres are under nutrient management.
- E3 Controls on extractive (active and abandoned mines)
  - Controls of the runoff from all extractive land use areas are assumed to be to a degree so that the loads are equal to the nutrient and sediment edge-of-stream loads from pervious urban under E3 conditions.

Source: Chesapeake Bay TMDL, Appendix J
http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/FinalBayTMDL/AppendixJScenarios_final.pdf

MARYLAND

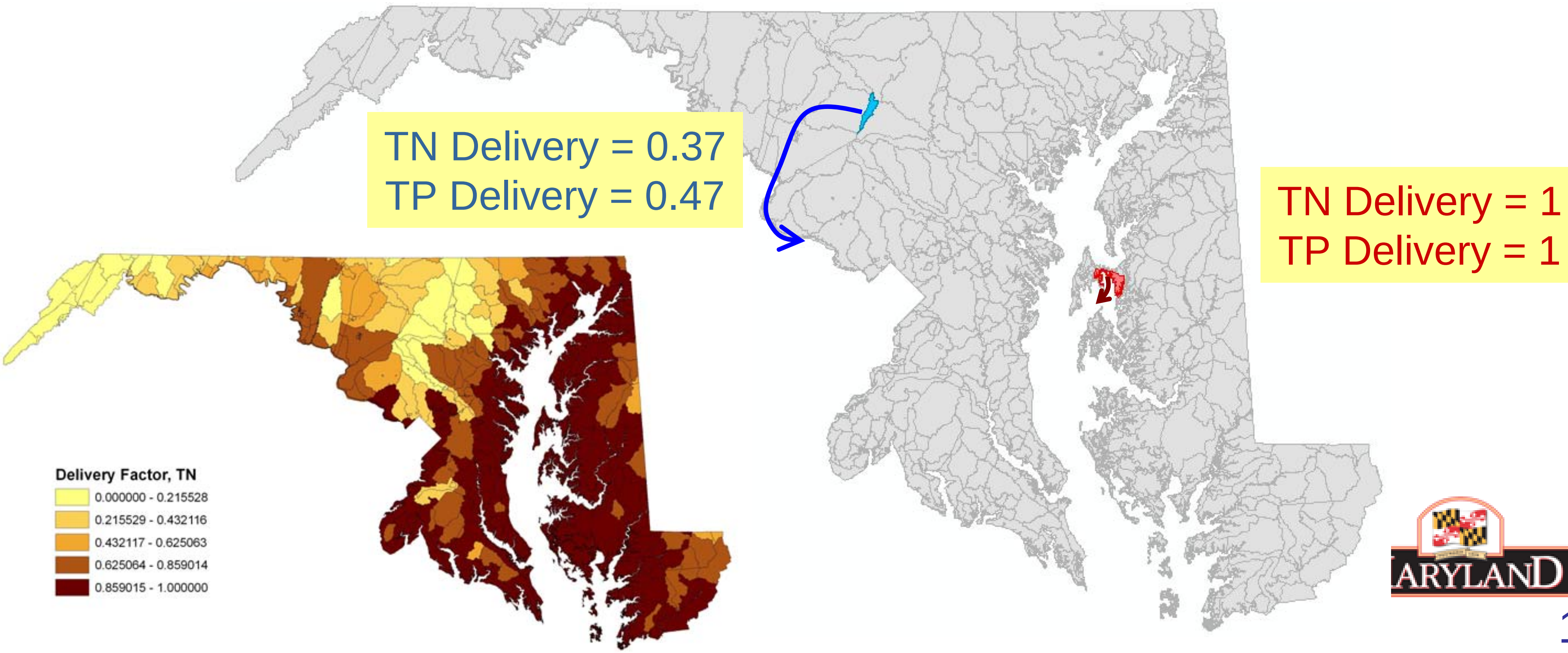
Equity and Crediting Existing Actions



Effectiveness of Reductions

Delivery Factor

- Fraction of edge-of-stream loads that are delivered to tidal waters
  - lb delivered / lb edge-of-stream
- Delivery factors calculated in the model
- Account for in-stream processes (e.g., denitrification, algal uptake, settling, scour, etc.)

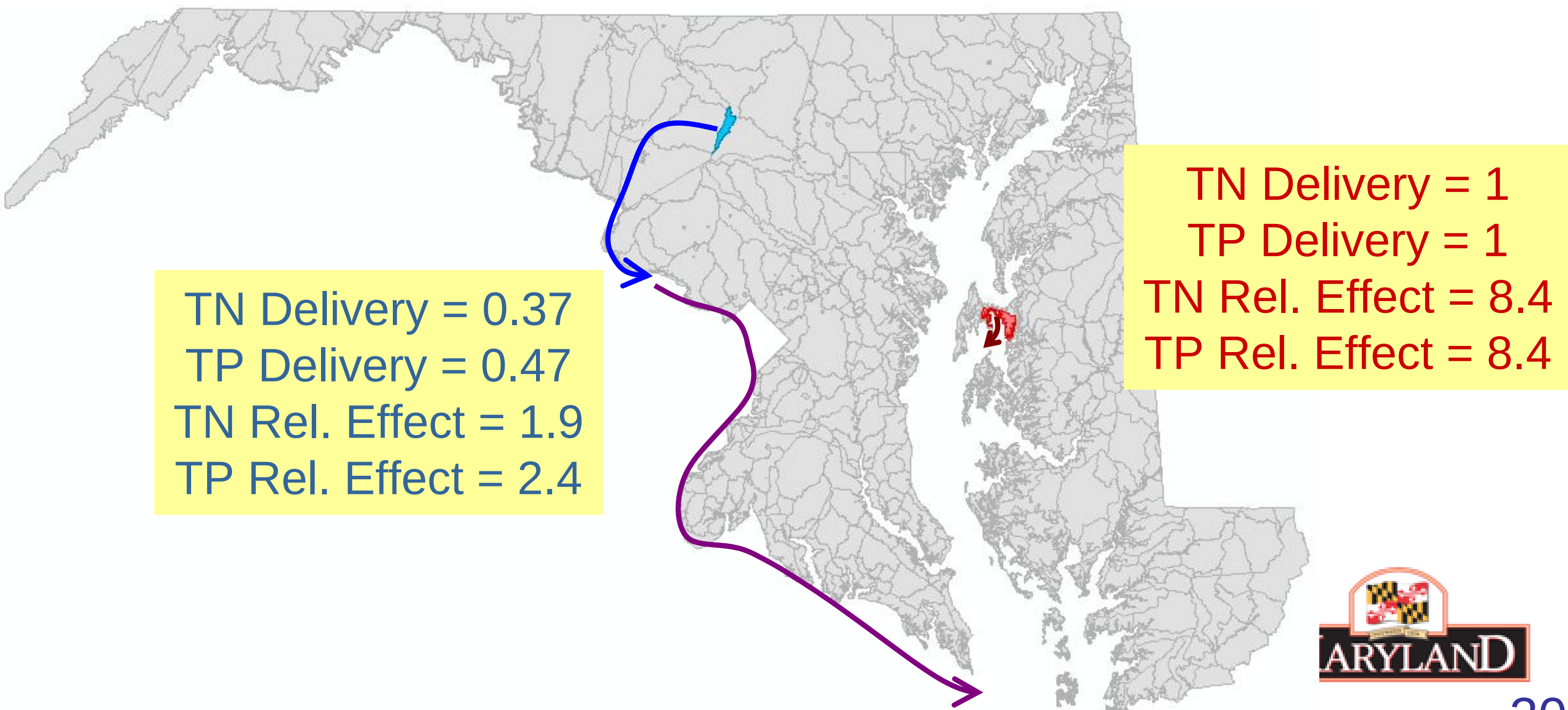


Effectiveness of Reductions

Relative Effectiveness

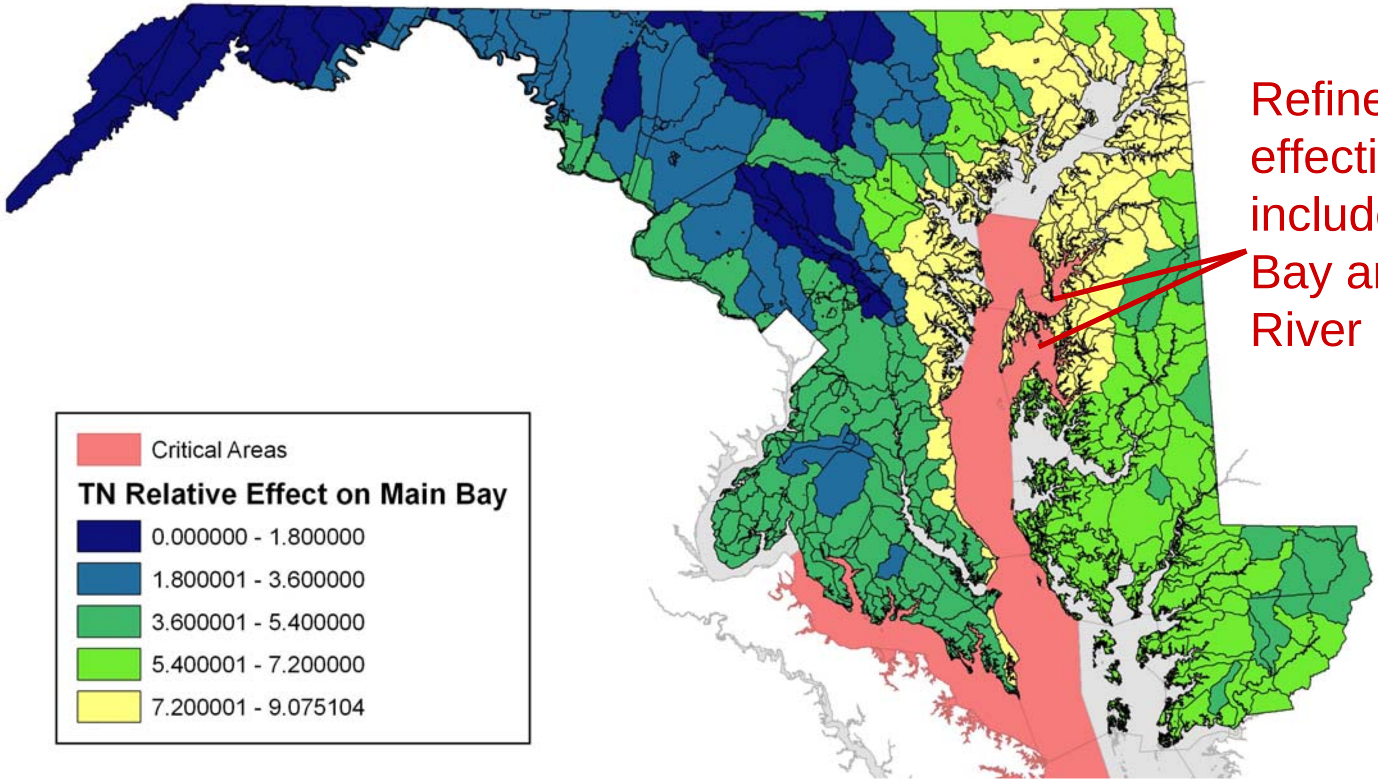
Overall Relative Effectiveness = Estuarine Relative Effectiveness x Delivery Factor

$$\frac{\Delta \text{DO}}{lb\ \text{EOS}} = \frac{\Delta \text{DO}}{lb\ \text{Del}} \times \frac{lb\ \text{Del}}{lb\ \text{EOS}}$$



Effectiveness of Reductions

- Significant difference in how load reductions from specific locations change dissolved oxygen of critical segments
- Relative effectiveness allows ranking of segments according to that DO impact
- Target more effective areas



Refined relative effectiveness to include Eastern Bay and Chester River

Meet Water Quality

Water Quality Response

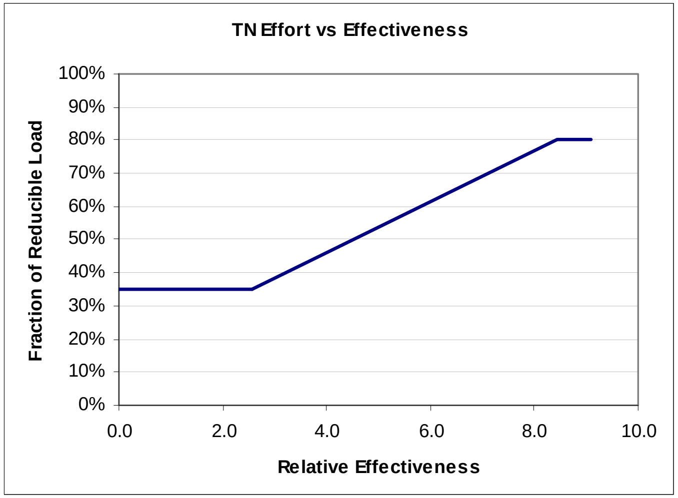
- Water quality response = absolute DO impact of the load

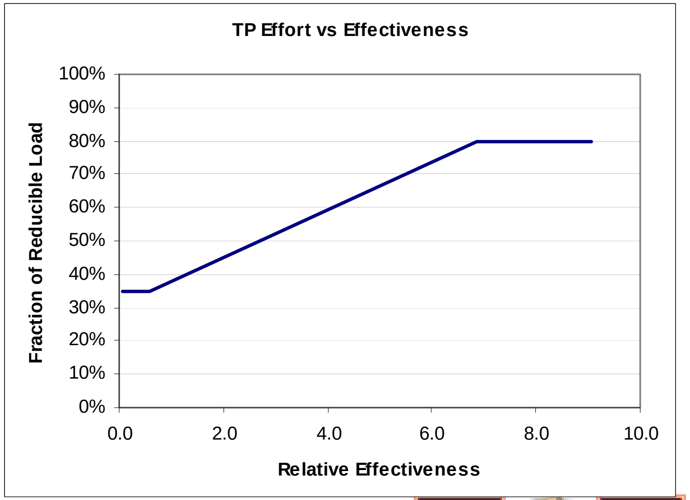
$$\underset{\Delta \text{ DO}}{\text{Water Quality Response}} = \underset{\frac{\Delta \text{ DO}}{lb \text{ Del}}}{\text{Estuarine Relative Effectiveness}} \times \underset{lb \text{ Del}}{\text{Delivered Load}}$$

- Sum across all segments must equal water quality response of EPA basin targets

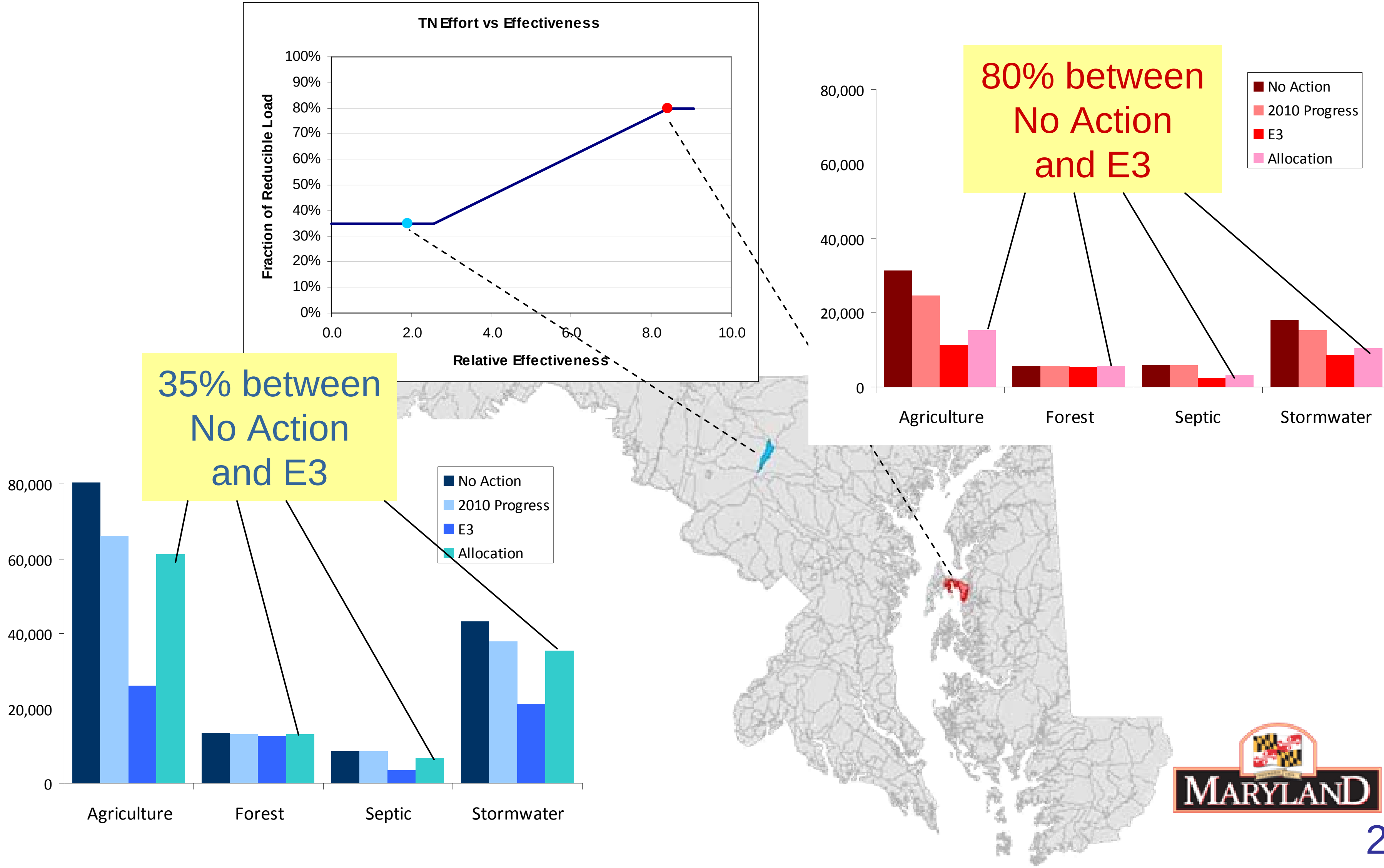
Relating Effectiveness to Reducible Load

- Higher level-of-effort required of segments with great impact
- Two constraints
  - Statewide target load
  - WQR equivalent to EPA basin targets
- Two variables
  - Slope of line
  - Vertical position of line (intercept)

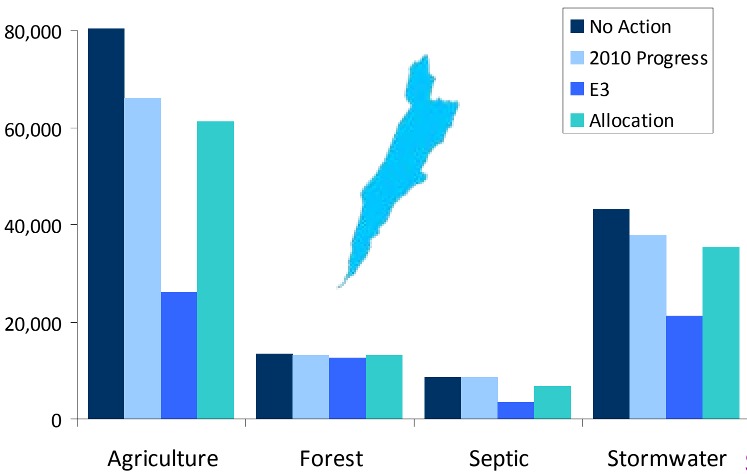


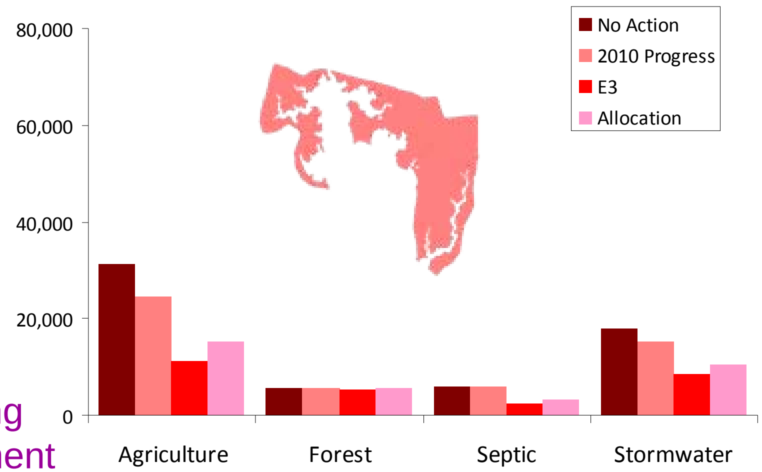


Relating Effectiveness to Reducible Load



Relating Effectiveness to Reducible Load





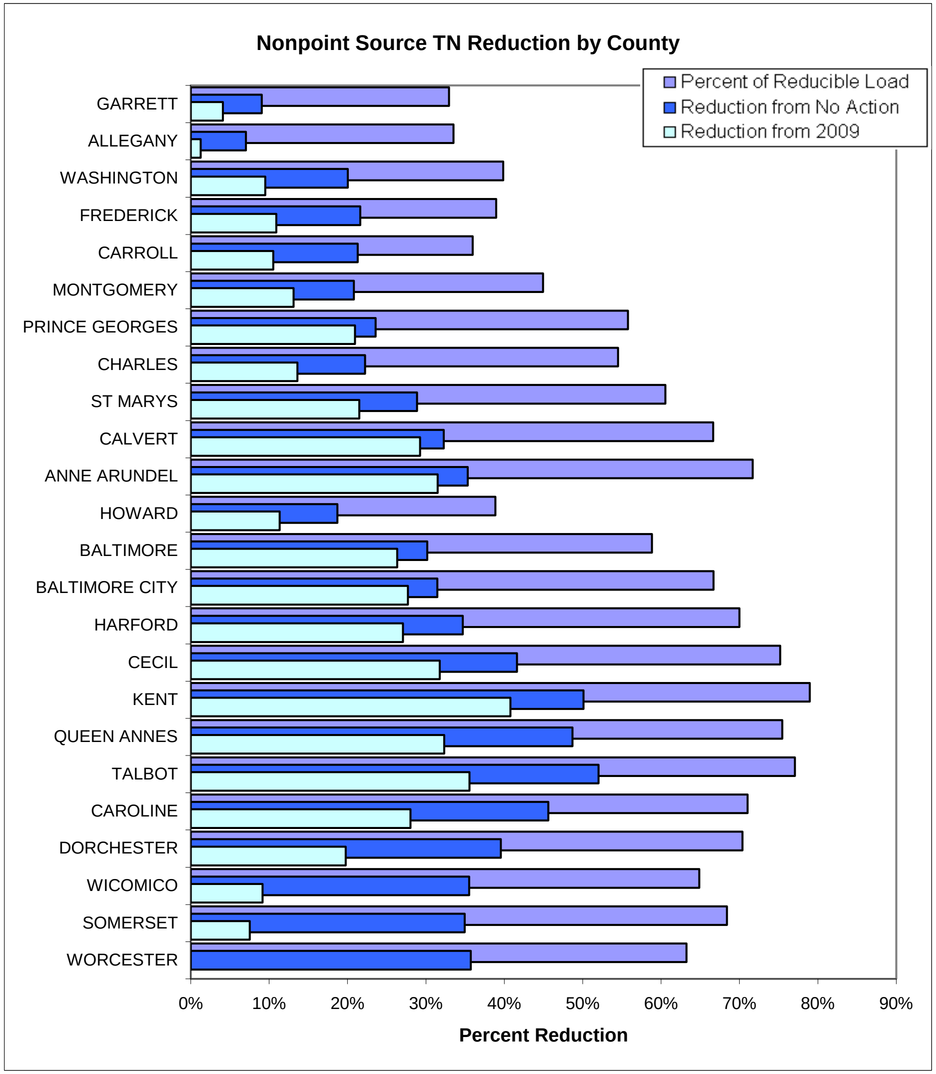
Equal effort among sectors within segment
More effort in segment with greater impact

35%	35%	35%	35%	Level-of-Effort	80%	80%	80%	80%
24%	2%	21%	18%	% Red. From No Action	51%	0%	48%	42%
7%	0%	21%	6%	% Red. From 2010	38%	0%	47%	32%

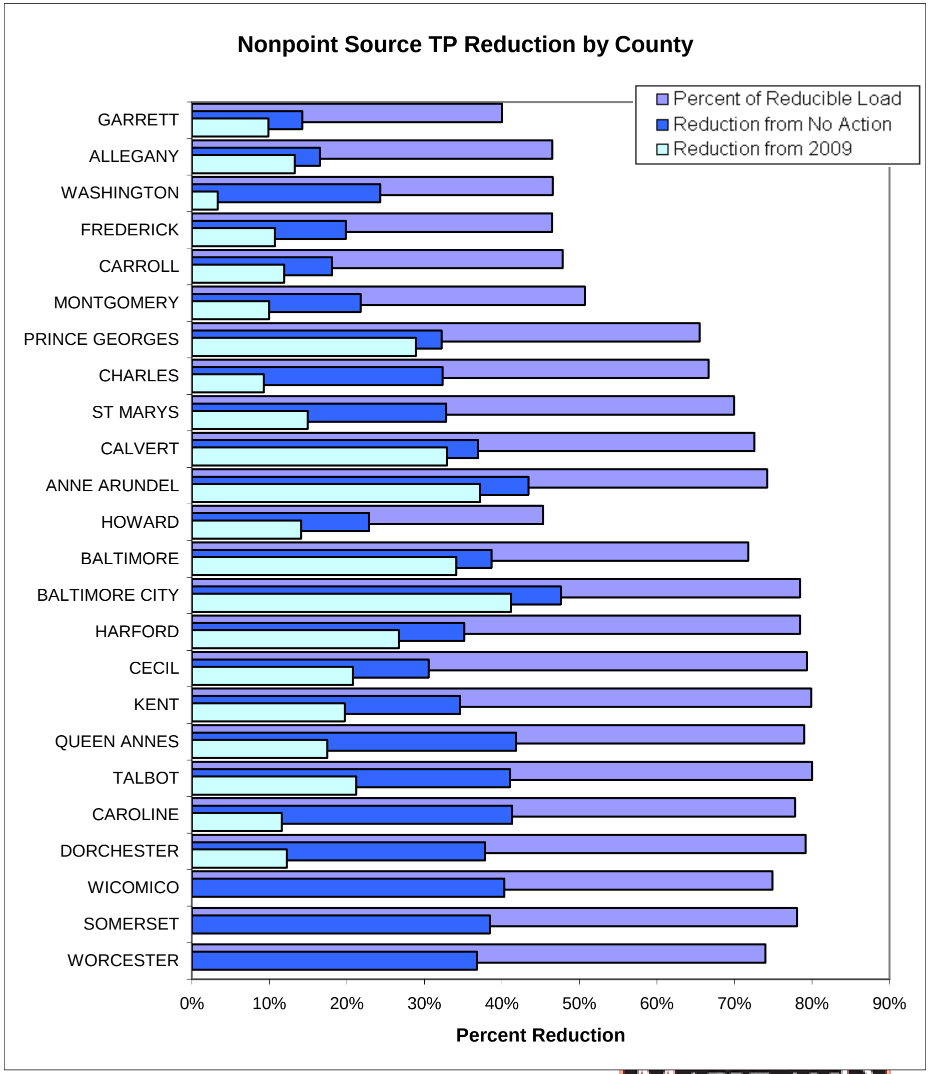
Recognize ability of sectors to reduce

Progress Credited

Result



Nonpoint Source TN Reduction by County
Percent of Reducible Load
Reduction from No Action
Reduction from 2009
GARRETT
ALLEGANY
WASHINGTON
FREDERICK
CARROLL
MONTGOMERY
PRINCE GEORGES
CHARLES
ST MARYS
CALVERT
ANNE ARUNDEL
HOWARD
BALTIMORE
BALTIMORE CITY
HARFORD
CECIL
KENT
QUEEN ANNES
TALBOT
CAROLINE
DORCHESTER
WICOMICO
SOMERSET
WORCESTER
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
Percent Reduction



Nonpoint Source TP Reduction by County
Percent of Reducible Load
Reduction from No Action
Reduction from 2009
GARRETT
ALLEGANY
WASHINGTON
FREDERICK
CARROLL
MONTGOMERY
PRINCE GEORGES
CHARLES
ST MARYS
CALVERT
ANNE ARUNDEL
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WORCESTER
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
Percent Reduction

Questions?