Not All Loads Are Equal

Assigning Regional Pollutant Reductions In A Multi-State TMDL

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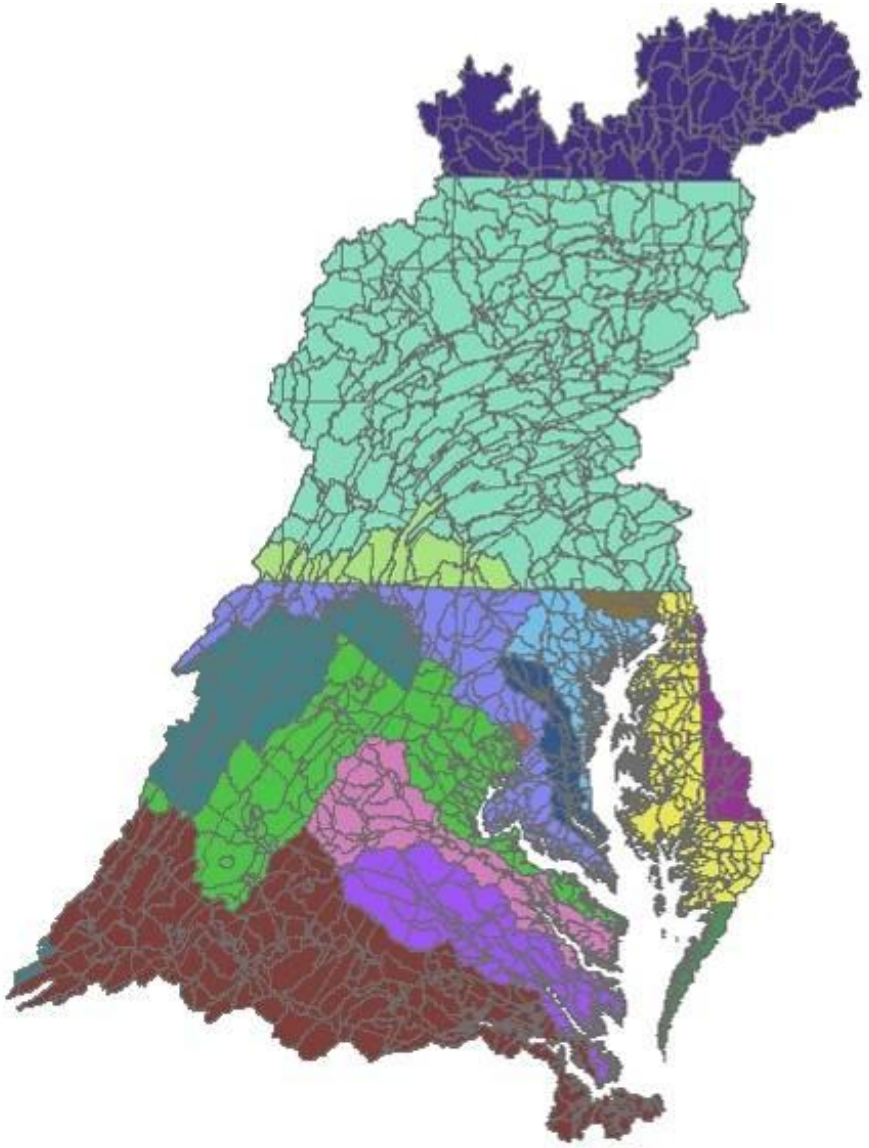
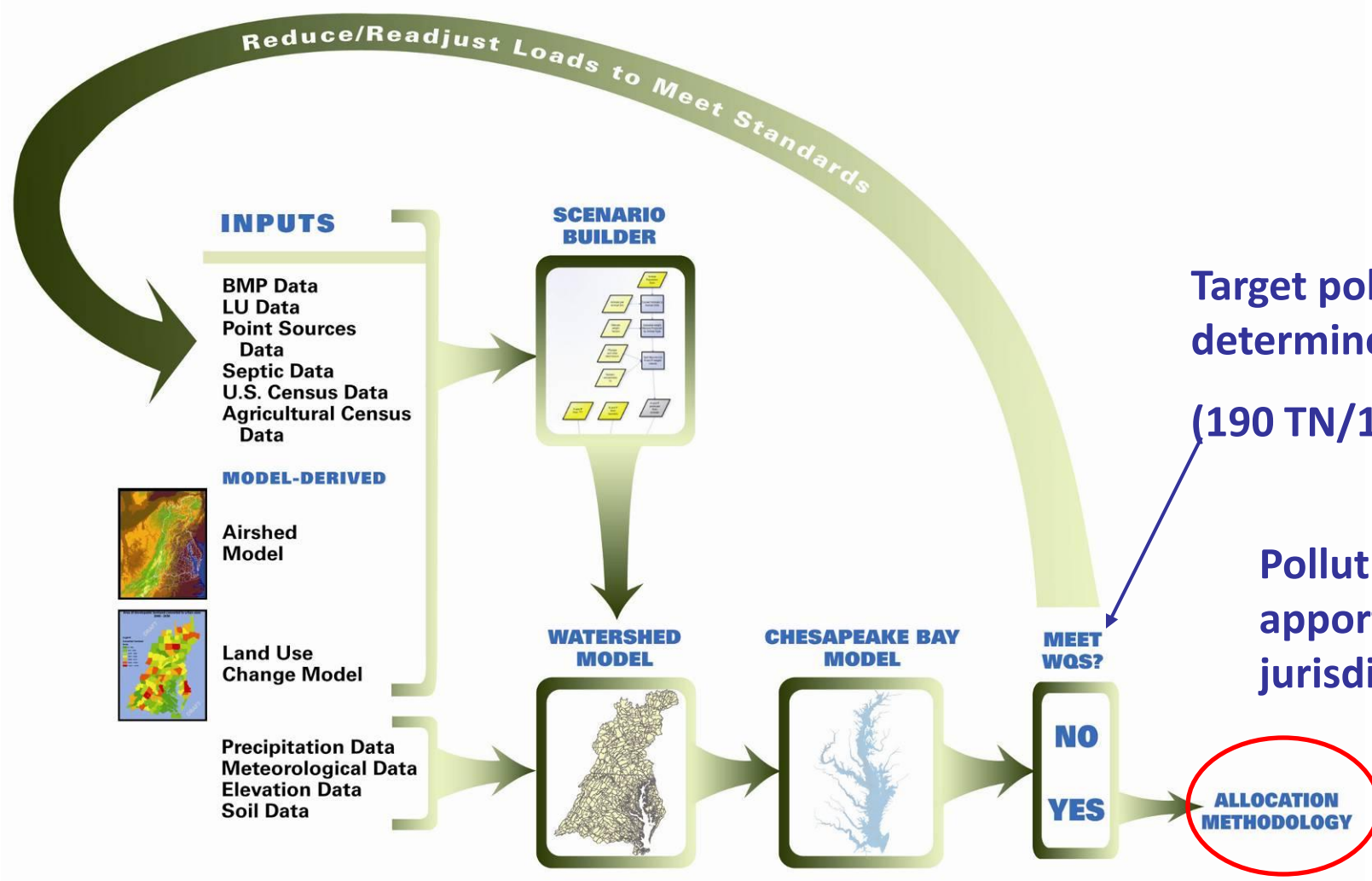


TMDL Development Process



Guidelines for Allocations

- Allocated N and P loads must result in attainment of water quality standards
- Major river basins that contribute most to the problem must do the most to resolve the problem.
- All tracked and reported reductions in nutrient loads are credited toward achieving final assigned loads.

Allocation Methodology

1. Determine **Controllable Load** (as percent of total load)

2. Use watershed model to determine **Overall Relative Effectiveness** of each major river basin-jurisdiction

3. Relate relative effectiveness & controllable load to needed controls

4. Distribute basinwide N and P loads by major river basin and jurisdiction

5. Result: Draft Basin-jurisdiction N and P allocations to achieve applicable WQS

Determining Controllable Load

- What if we had never put any nutrient controls in place?
  - "2010 No Action"
  - 356.6 mpy TN
  - 35.51 mpy TP
- What if we had done everything possible?
  - "2010 E3"
  - 140.6 mpy TN
  - 8.63 mpy TP

Table 6-4. Pollutant sources as defined for the No Action and E3 model scenarios

Model source	Scenario	
	No Action	E3 = Everyone Everything Everywhere
Land uses	No BMPs applied to the land	All possible BMPs applied to land given current human and animal population and land use
Wastewater Dischargers	Significant municipal WWTPs Flow = design flows TN = 18 mg/L TP = 3 mg/L BOD = 30 mg/L DO = 4.5 mg/L TSS = 15 mg/L	Significant municipal WWTPs Flow = design flows TN = 3 mg/L TP = 0.1 mg/L BOD = 3 mg/L DO = 6 mg/L TSS = 5 mg/L
CSOs	Non-significant municipal WWTPs Flow = existing flows TN = 18 mg/L TP = 3 mg/L BOD = 30 mg/L DO = 4.5 mg/L TSS = 15 mg/L Flow = 2003 base condition flow TN = 2003 load estimate TP = 2003 load estimate BOD = 2003 load estimate DO = 2003 load estimate TSS = 2003 load estimate	Non-significant municipal WWTPs Flow = existing flows TN = 8 mg/L TP = 2 mg TP/l BOD = 5 mg/L DO = 5 mg/L TSS = 8 mg/L Full storage and treatment of CSOs
Atmospheric deposition	1985 Air Scenario	2030 Air Scenario, max reductions

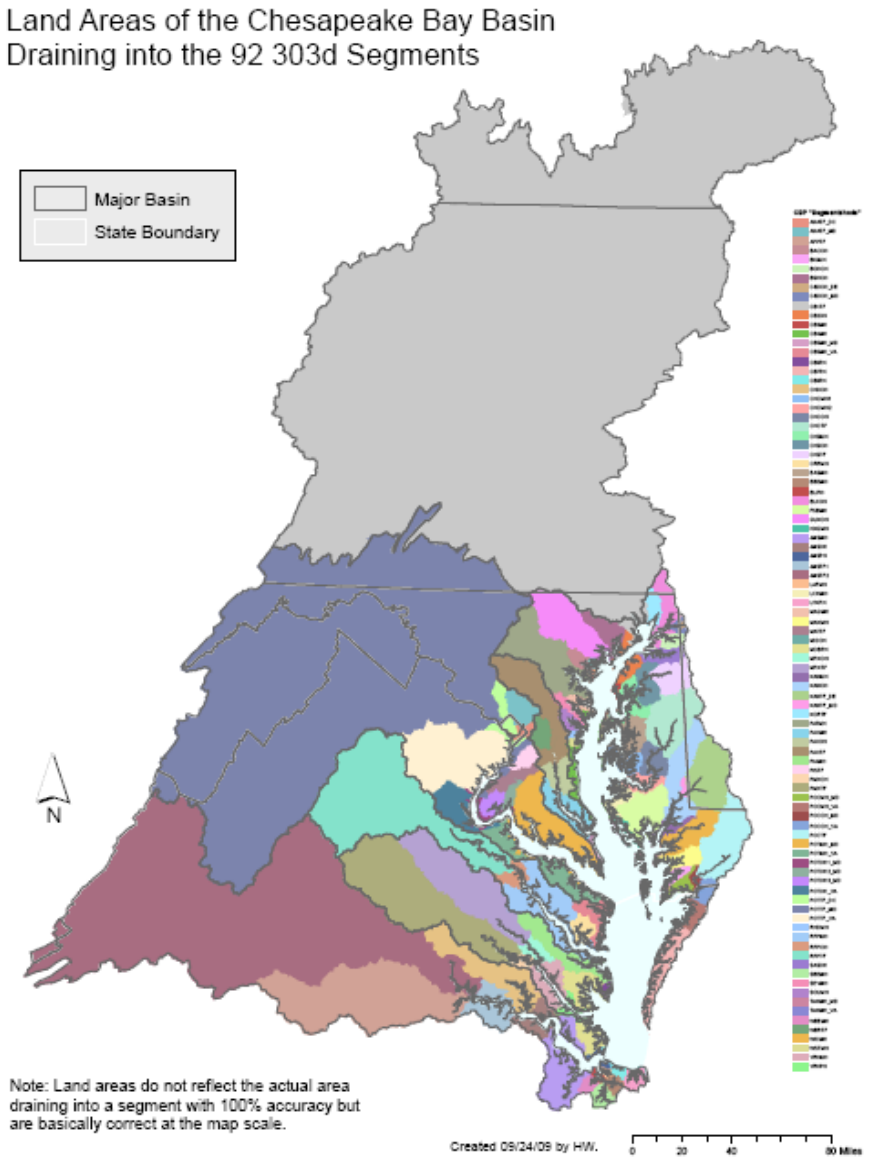
Source: EPA TMDL 29 December, 2010

Determining Relative Effectiveness

Overall Estuarine Effectiveness:

- Some regions of the watershed have a greater effect on water quality in the Bay than do others

- Expressed as improvement in low dissolved oxygen concentrations (mg/L) per edge-of-stream pound of nutrient (N or P) reduced



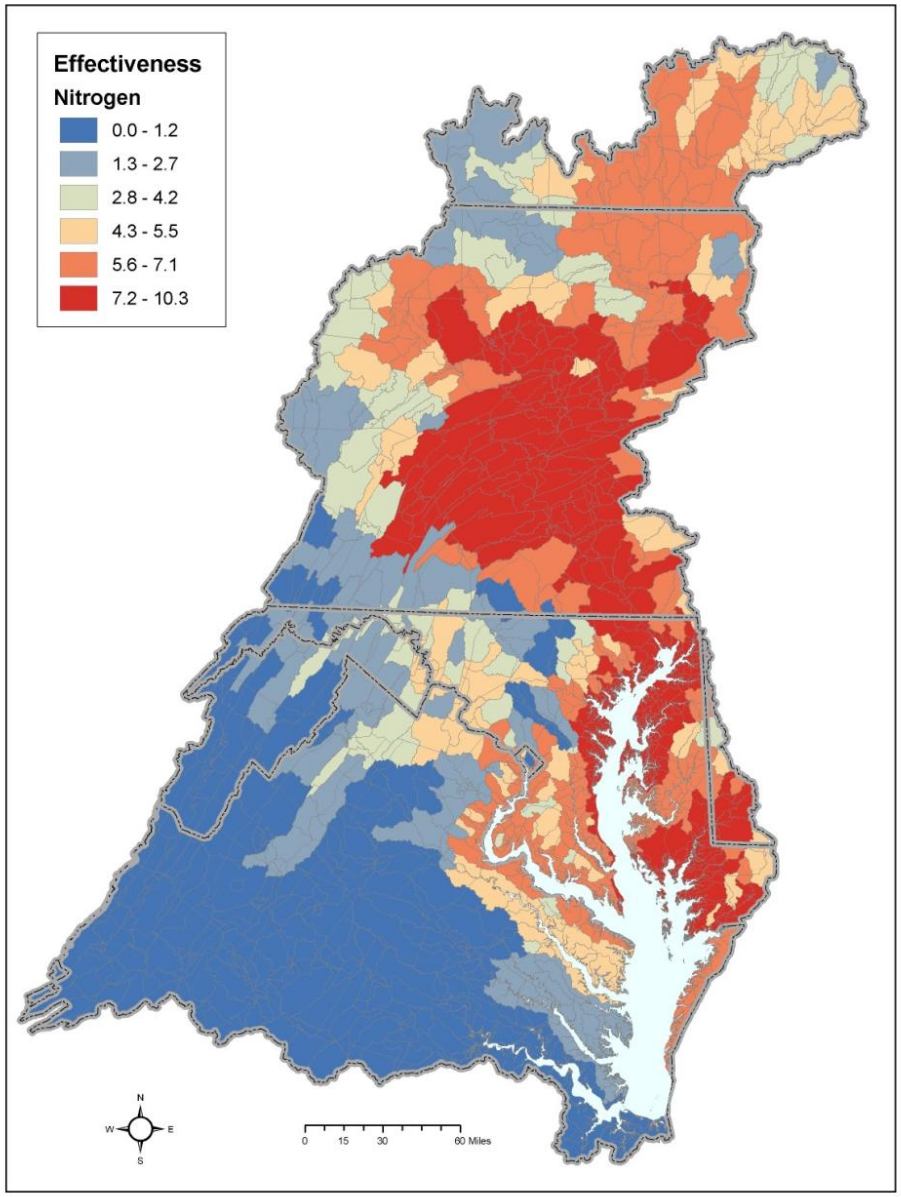
Determining Relative Effectiveness

Key factors:

Distance from Bay
- Riverine transport

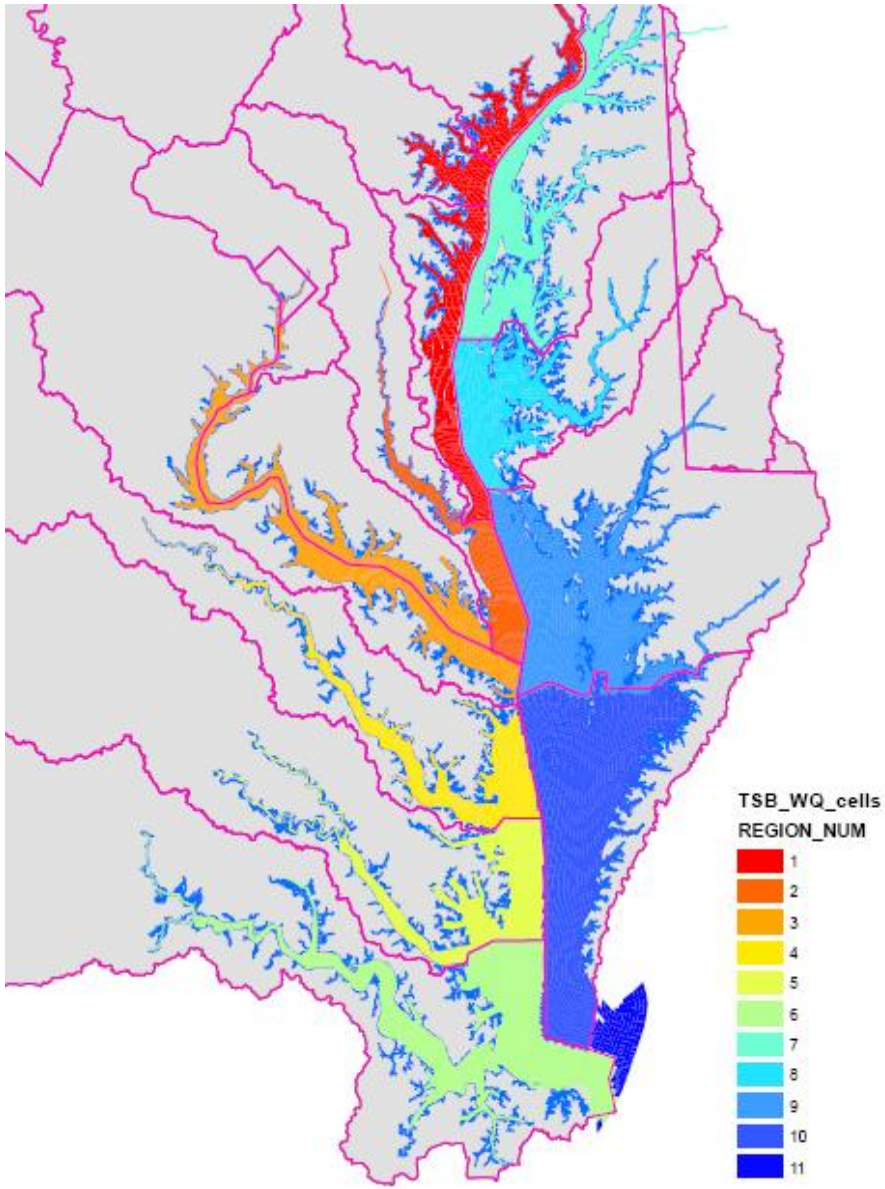
Position along mainstem
- Estuarine circulation

Location of Fall Line
- Presence of riverine estuary



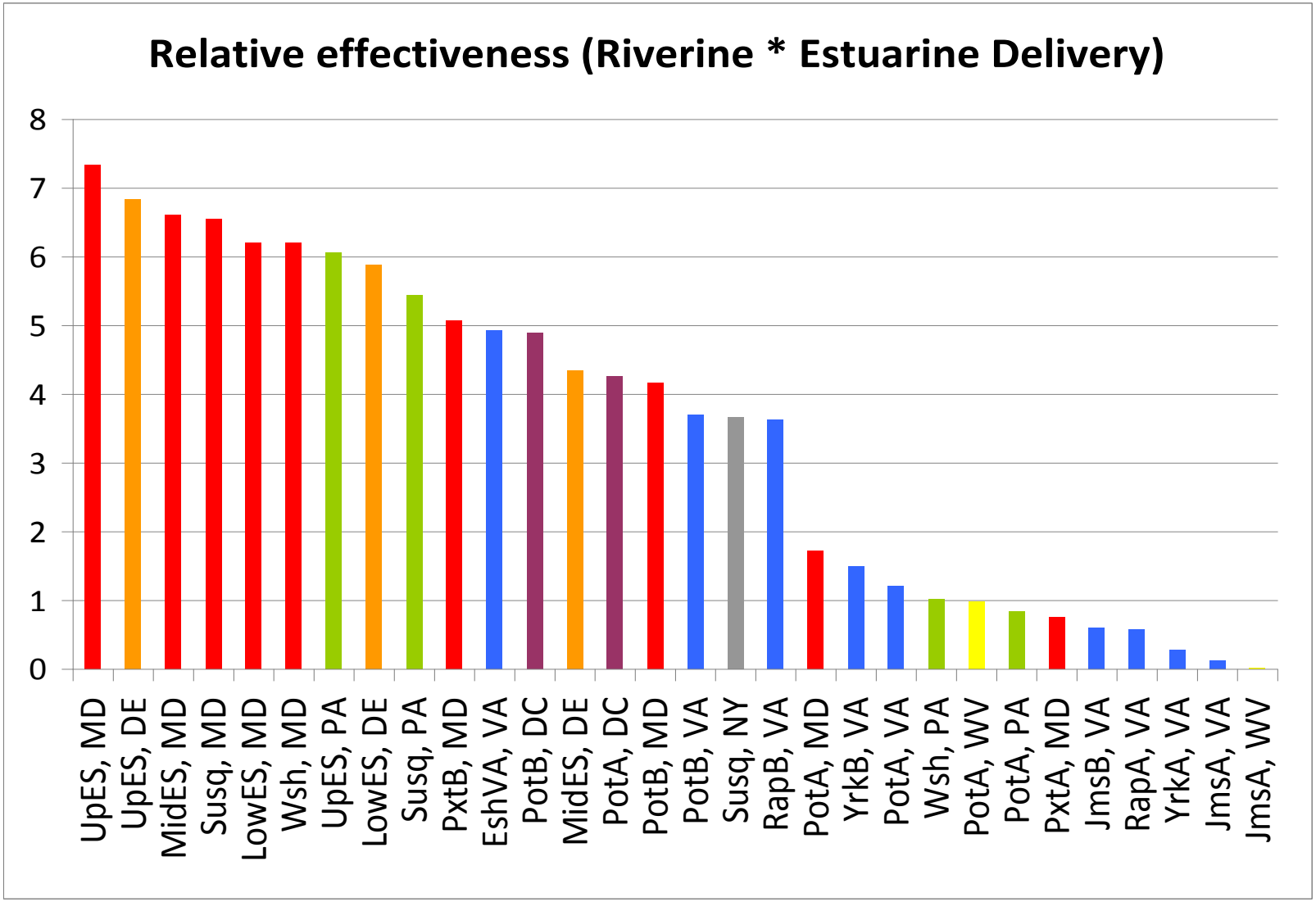
Determining Relative Effectiveness

- Using Watershed Model, set one basin at E3 loads and all other watersheds at calibration levels
- Record the increase in the 25th percentile concentration of DO during the summer criteria assessment period in the critical area
- Divide by the nutrient reduction to determine improvement of low DO concentrations per million lb reduction of nutrients



Determining Relative Effectiveness

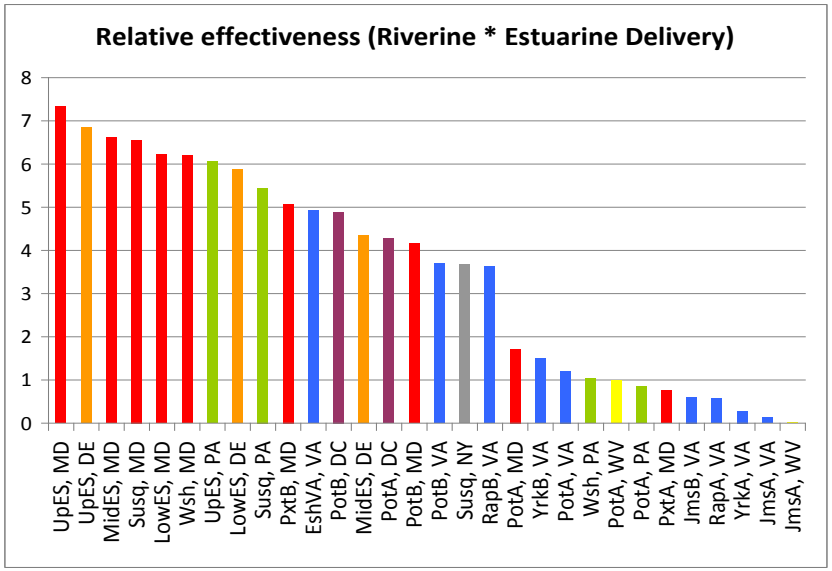
Major River Basin by Jurisdiction Relative Impact on Bay Water Quality

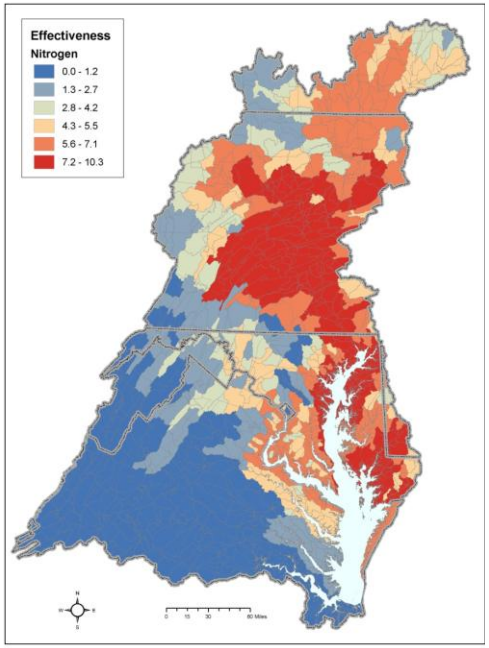


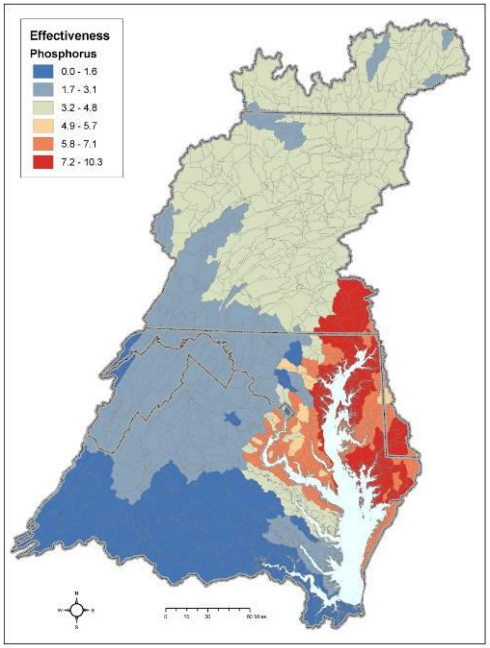
How to Distribute?

Controllable Load = No Action – E3

Pollution Diet = 190 mpy TN, 12.7 mpy TP







Math + stakeholder input = basin-jurisdiction load allocations

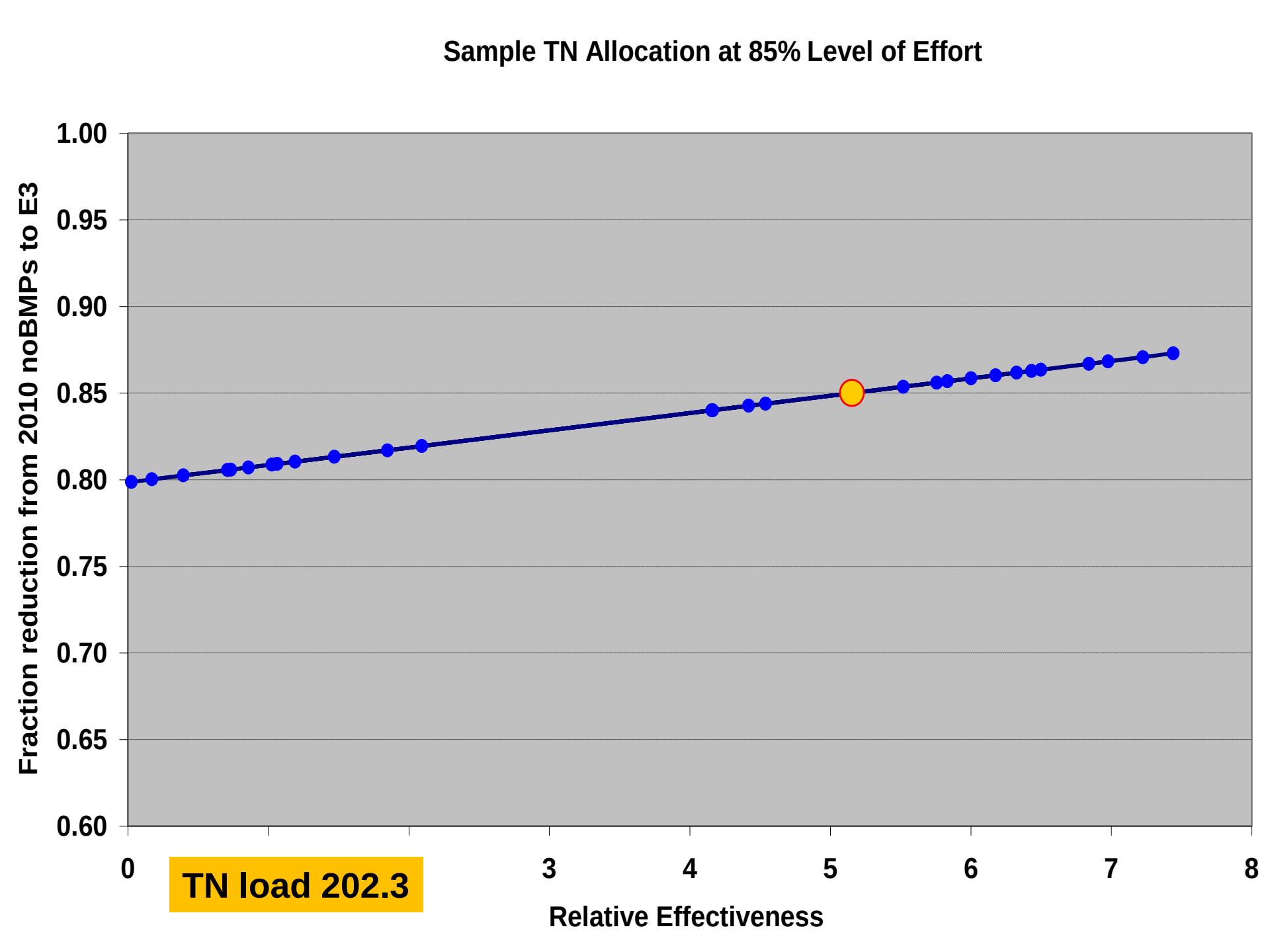
How to Distribute?

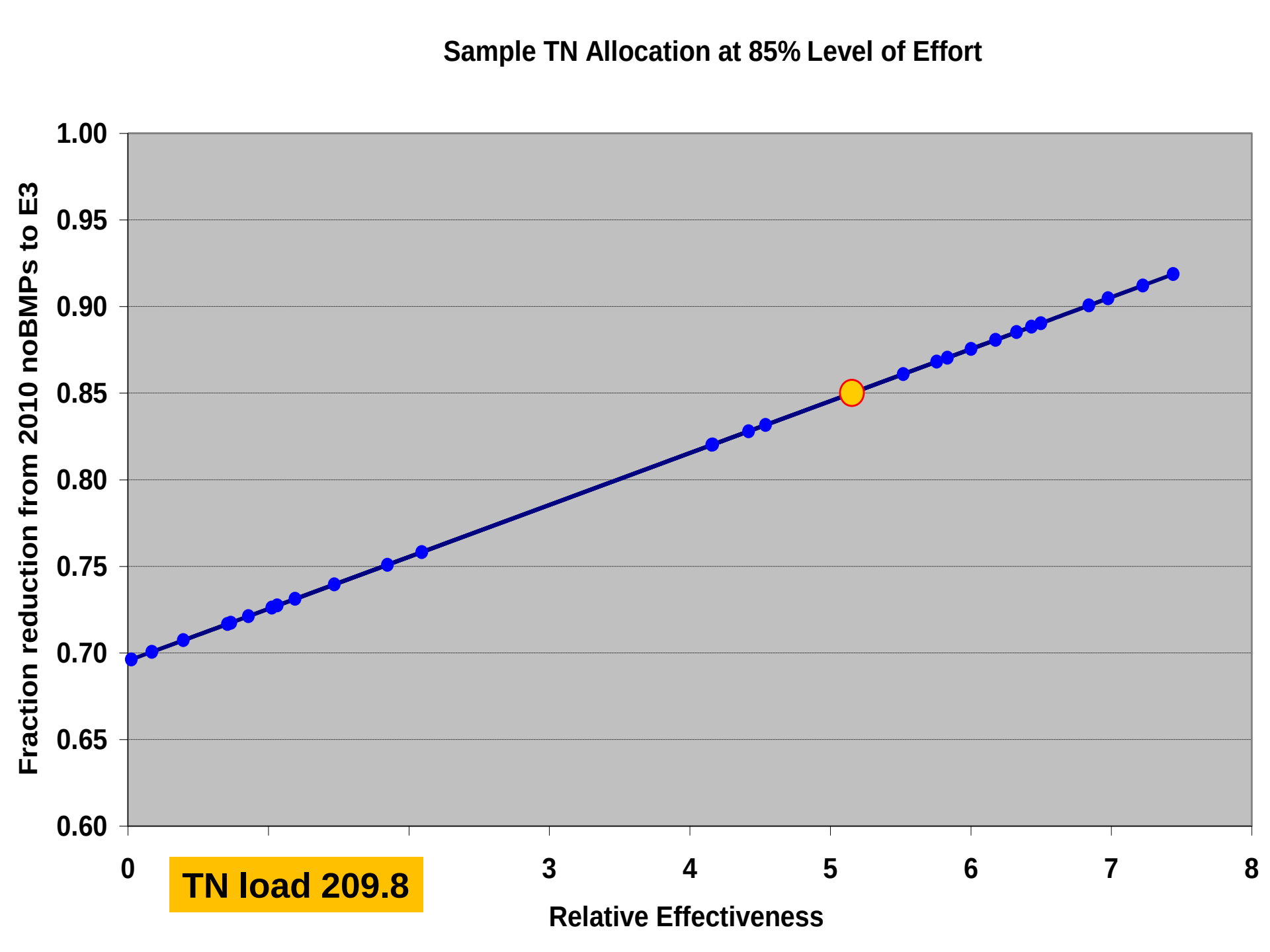
The Math

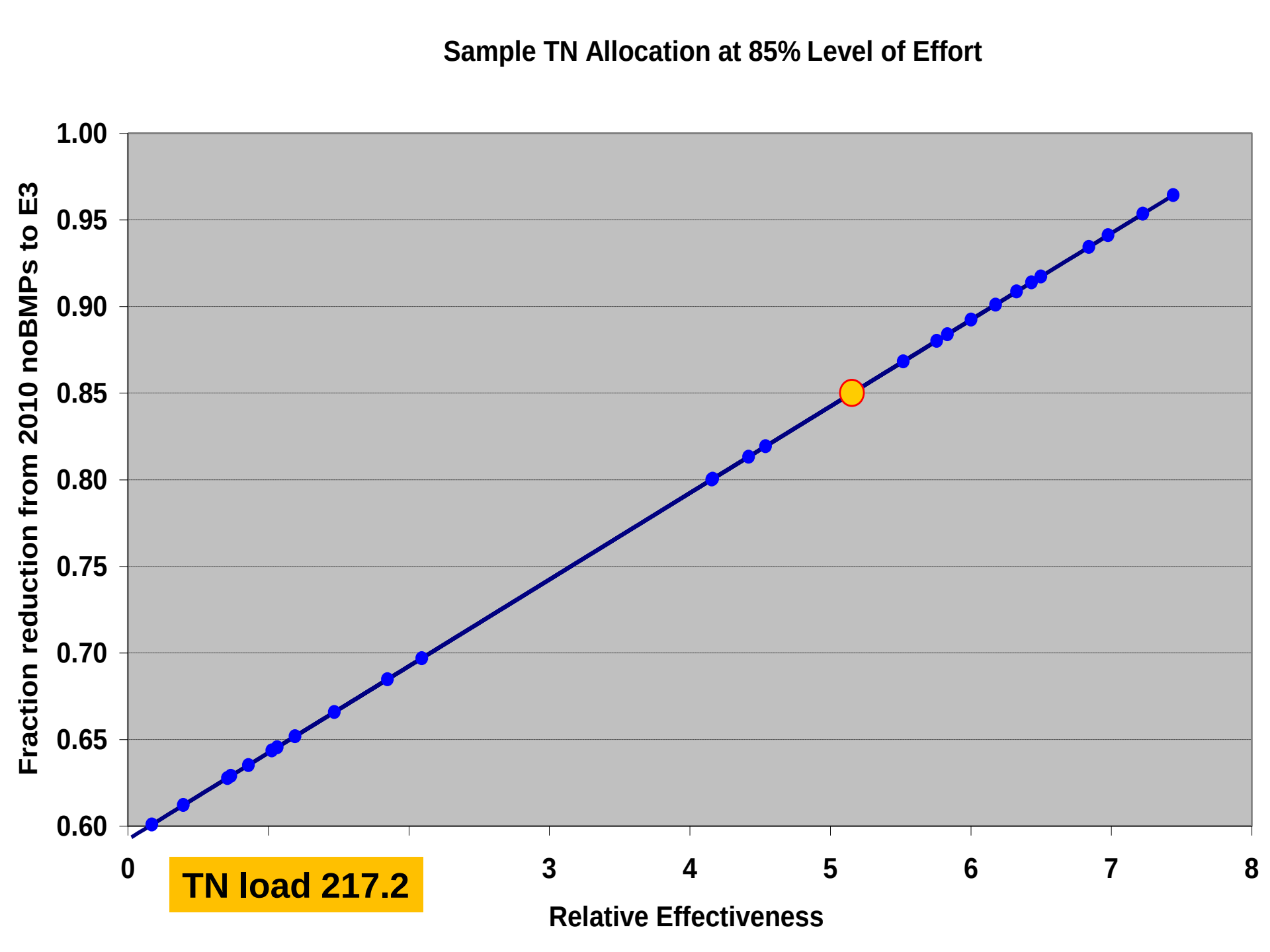
$$\sum\left(E3_i + \left(NoBMP_i - E3_i\right)\left(1 - mX_i - b\right)\right)EstuarineDelivery_i = C$$

Where

- X_i = relative effectiveness of a given jurisdiction basin, *i*
- $E3_i$ and $NoBMP_i$ = loads for jurisdiction-basin, *i*, for the two scenarios
- *m* and *b* = slope and y-intercept of line (the only unknowns)
- Changing the slope changes the relative effort required of different basins


Sample TN Allocation at 85% Level of Effort
Fraction reduction from 2010 noBMPs to E3
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0
3
4
5
6
7
8
TN load 202.3
Relative Effectiveness


Sample TN Allocation at 85% Level of Effort
Fraction reduction from 2010 noBMPs to E3
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0
3
4
5
6
7
8
TN load 209.8
Relative Effectiveness


Sample TN Allocation at 85% Level of Effort
Fraction reduction from 2010 noBMPs to E3
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0
3
4
5
6
7
8
TN load 217.2
Relative Effectiveness

How to Distribute?

Stakeholder Input

Stakeholder input coordinated through Chesapeake Bay Program's Water Quality Goal Implementation Team and Principals' Staff Committee

Some source categories are more easily controlled than others

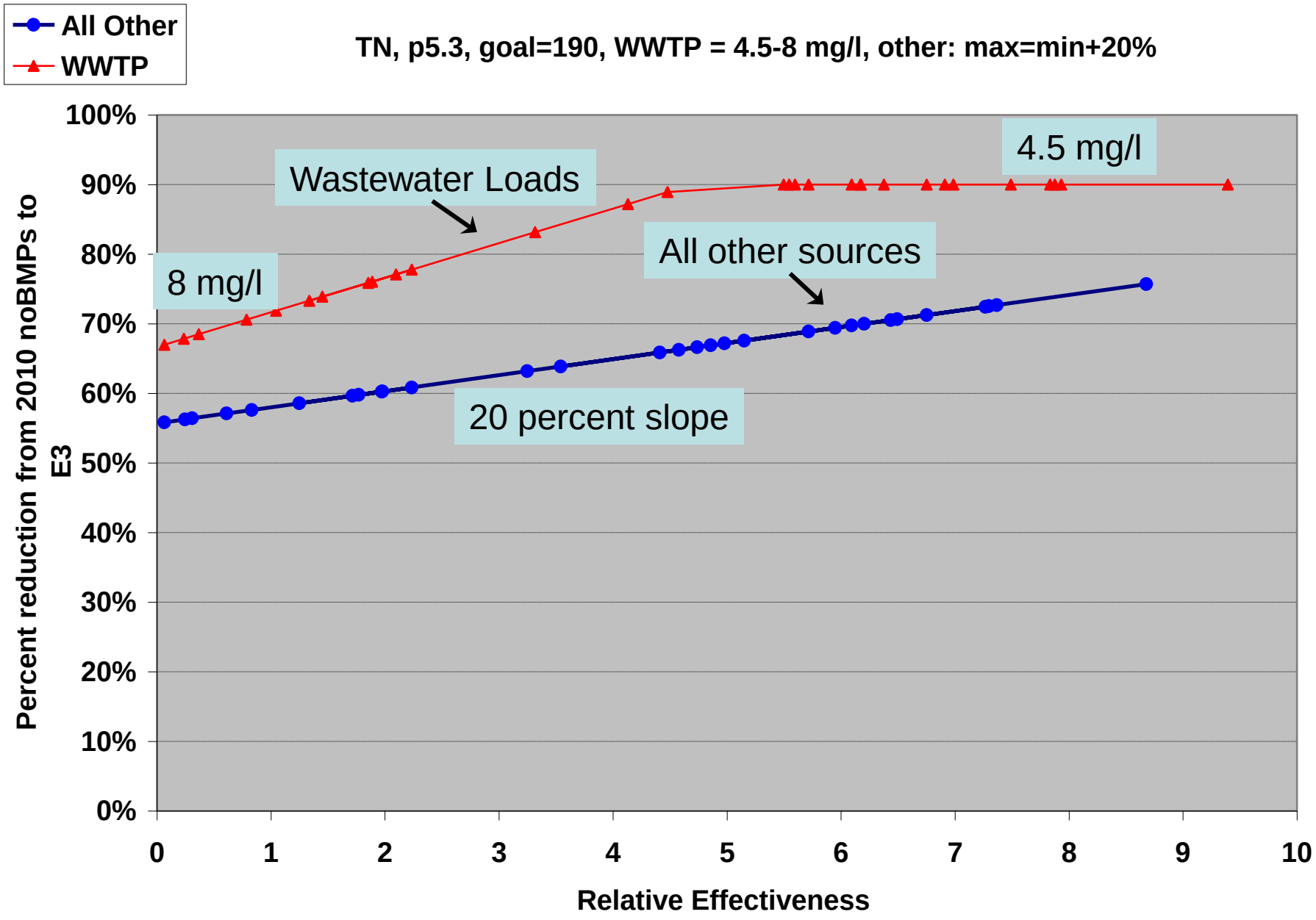
→ Separate out WWTP loads from All Other

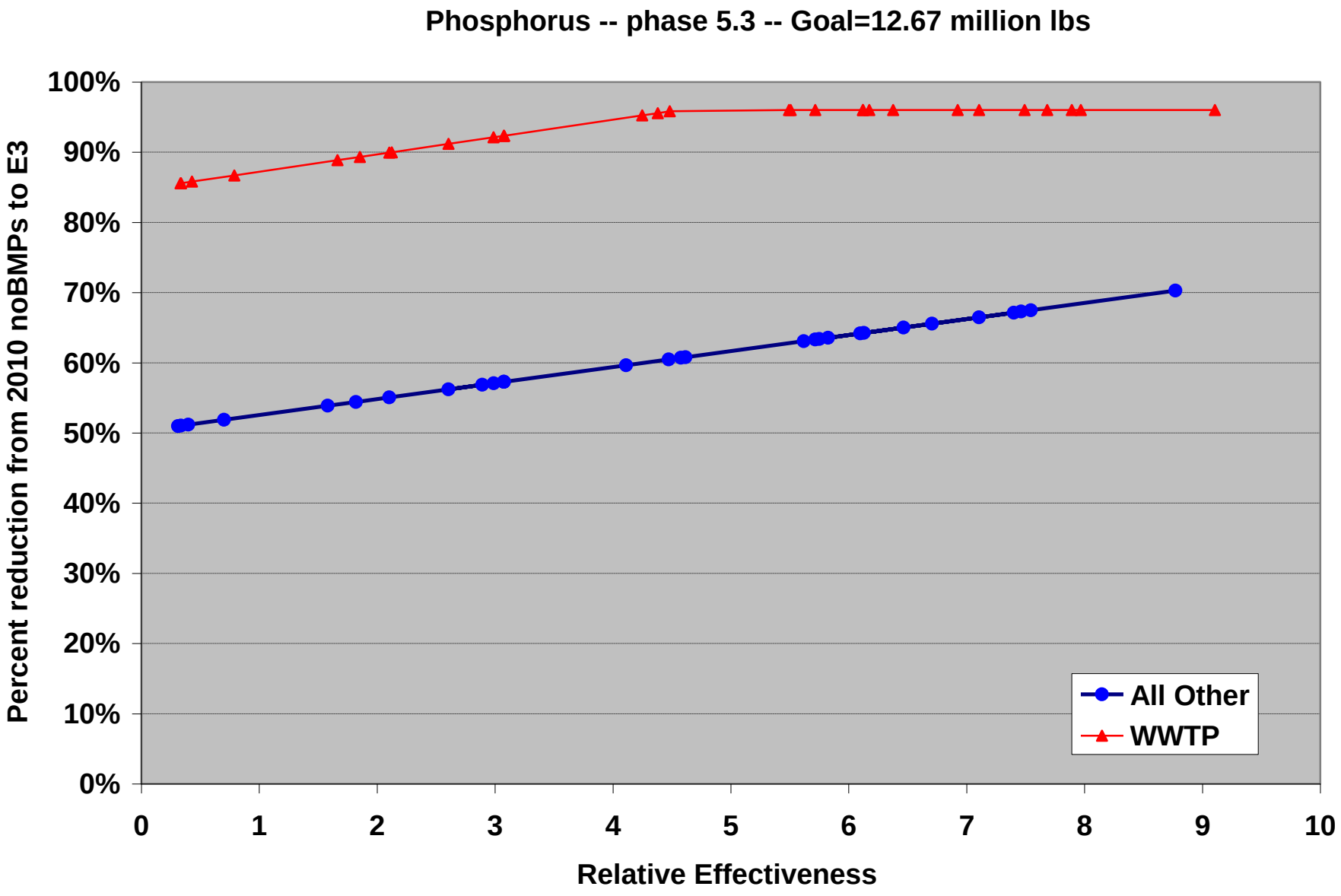
Maximum technology controls may achieve < 100% theoretically controllable load

→ No allocation requires 100% control of "controllable load"

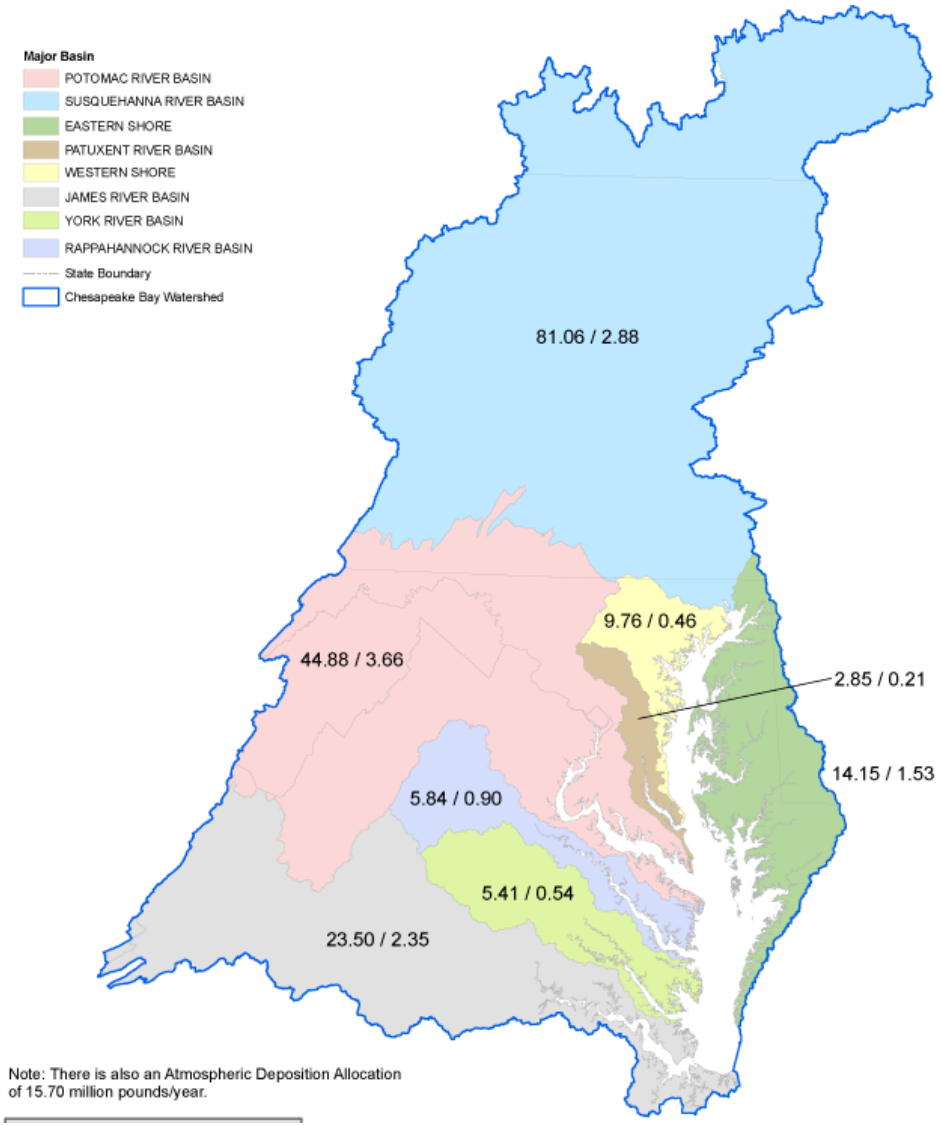
Shape of Allocation Lines

→ What combination resulted in distribution most acceptable to jurisdictions?

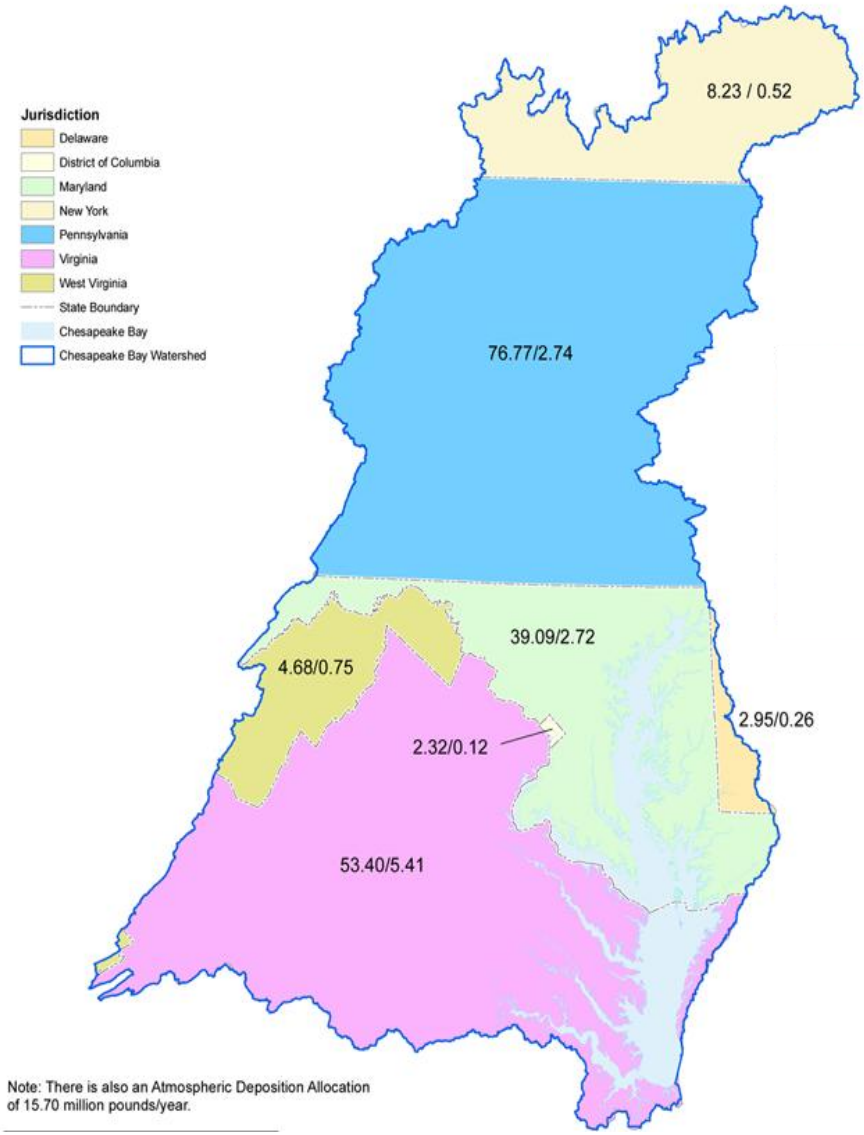

All Other
WWTP
TN, p5.3, goal=190, WWTP = 4.5-8 mg/l, other: max=min+20%
Percent reduction from 2010 noBMPs to E3
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1
2
3
4
5
6
7
8
9
10
Relative Effectiveness
4.5 mg/l
Wastewater Loads
All other sources
8 mg/l
20 percent slope


Phosphorus -- phase 5.3 -- Goal=12.67 million lbs
Percent reduction from 2010 noBMPs to E3
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1
2
3
4
5
6
7
8
9
10
Relative Effectiveness
All Other
WWTP

Pollution Diet
by River



Pollution Diet
by State



Thank You

Greater detail can be found in Section 6 and appendices J & K of the Chesapeake Bay TMDL

http://www.epa.gov/chesapeakebaytmdl/