Nitrogen, Phosphorus, and Suspended-Sediment Loads and Trends Measured at the Chesapeake Bay Nontidal Network Stations

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on behalf of many investigators and partners
USGS

PSC Meeting
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USGS

Acknowledgements

- Load and Trend Analysis

  Jeff Chanat, Joel Blomquist, Mike Mallonee, Gavin Yang, Ken Hyer, Many Others!!, Mike Langland, Bob Hirsch

- USGS Nontidal Web Page (http://cbrim.er.usgs.gov/)

  Cassandra Ladino, Scott Phillips

- Water-Quality Monitoring Partners

U.S. Environmental Protection Agency

NY State Dept. of Env. Conservation

Susquehanna River Basin Comm.

DE Dept. Natural Resources and Env. Control

VA Dept. of Env. Quality

U.S. Geological Survey (All Bay States)

PA Dept. of Env. Protection

DC Dept. of the Environment

MD Dept. of Natural Resources

WV Dept. of Env. Protection

WV Dept. of Ag.

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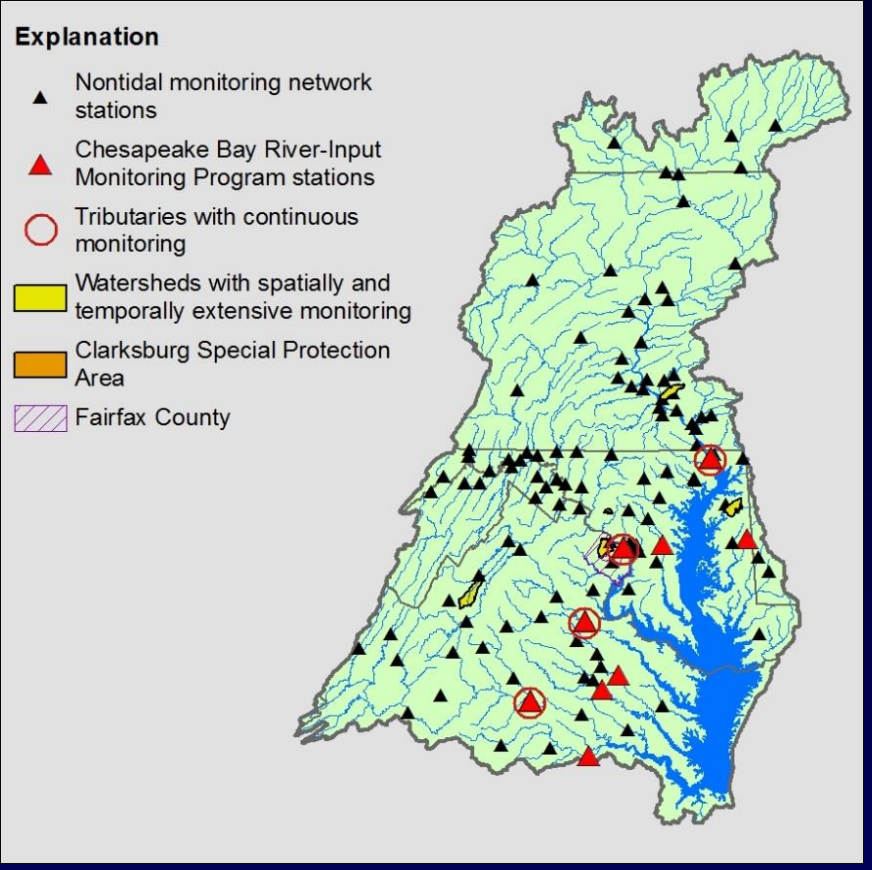
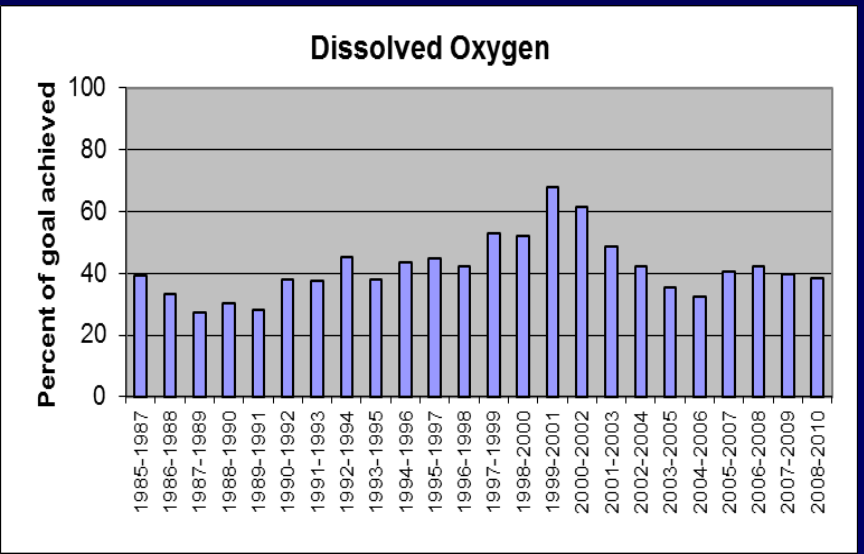
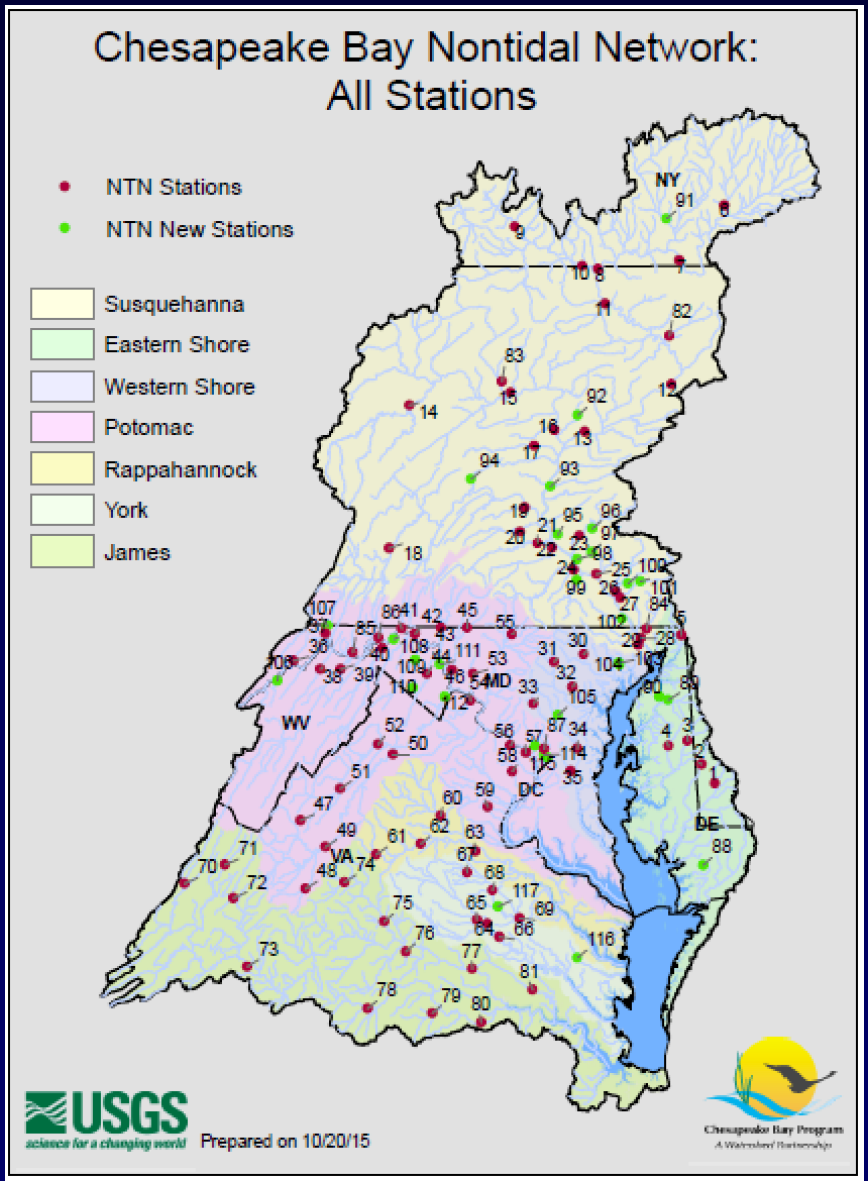




Measuring Water-Quality Improvements

- Practices implemented
  - BMP reporting for TMDL
  - Predicted improvements (WSM)
- Watershed monitoring
  - Nutrient and sediment
  - Loads and trends
- Attaining standards
  - DO clarity/SAV, and Chl.
- Explain: practices and water-quality changes

Chesapeake Bay Nontidal Monitoring Network



Collaborative CBP Effort

- 1985: River-Input Monitoring and selected sites
- 2004: PSC agrees on comparable methods
- TMDL expansion
- 117 stations
  - Range from 1 to 27,100 mi^2
- Nutrient and sediment samples
  - Monthly and storms
  - Streamflow
- Loads and trends computed
- First of its kind

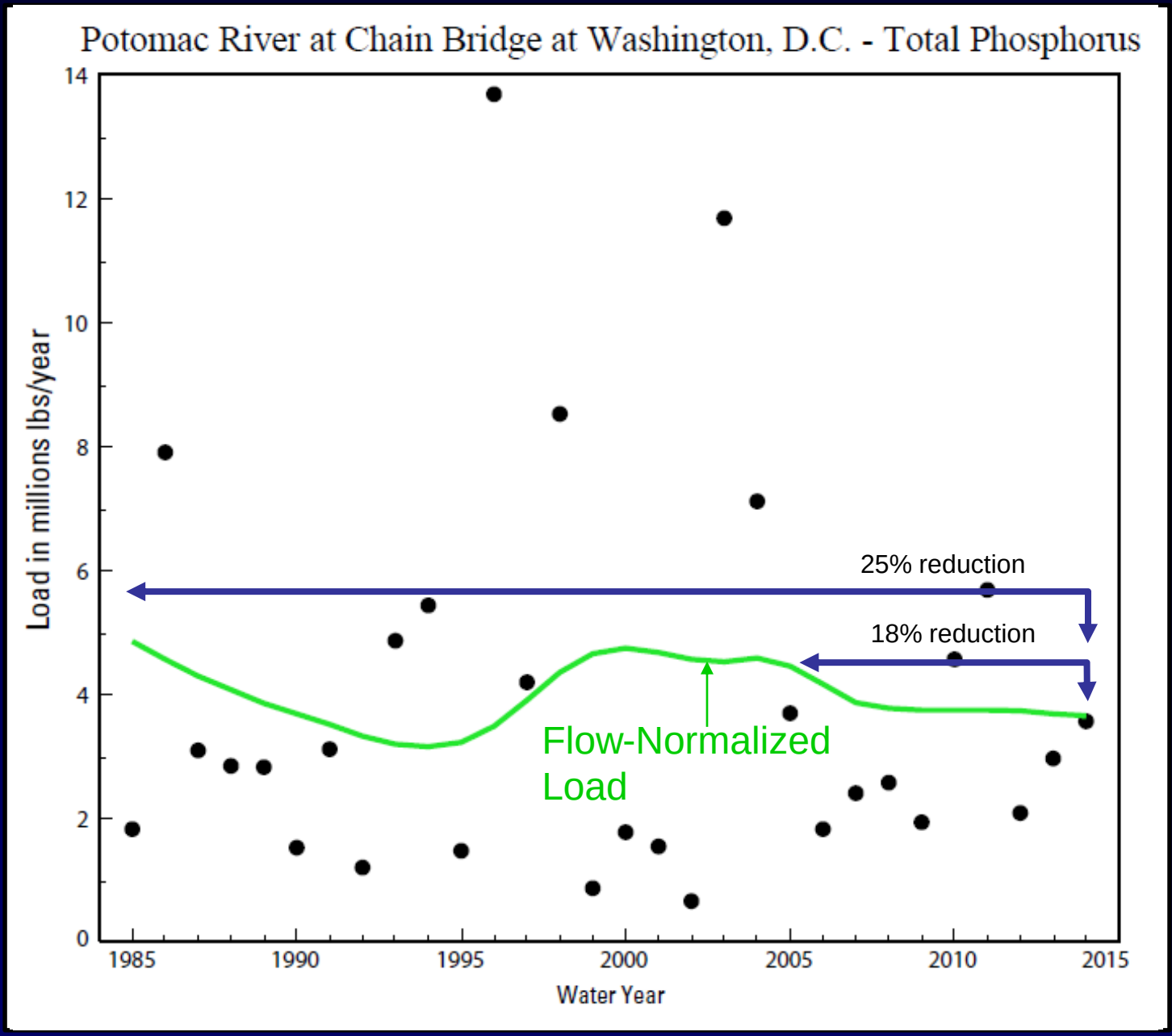
Load and Trends

- Annual loads
- Flow-normalized change

1985 to 2014: down 25%

2005 to 2014: down 18%

- Per acre loads



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Results: N, P and Sediment

- Loads
  - Per acre loads
- Trends
  - Directional change
  - Amount of change

Total Nitrogen
(loads per acre)

Range from 1.19 to 33.4 lbs/ac
Average load of 7.33 lbs/ac

(1) Low =
≤ 6.88 lbs/ac
52 of 81 stations

(2) Medium =
> 6.88 to ≤ 13.75
15 of 81 stations

(3) High Yields = ≥ 13.76
14 of 81 stations

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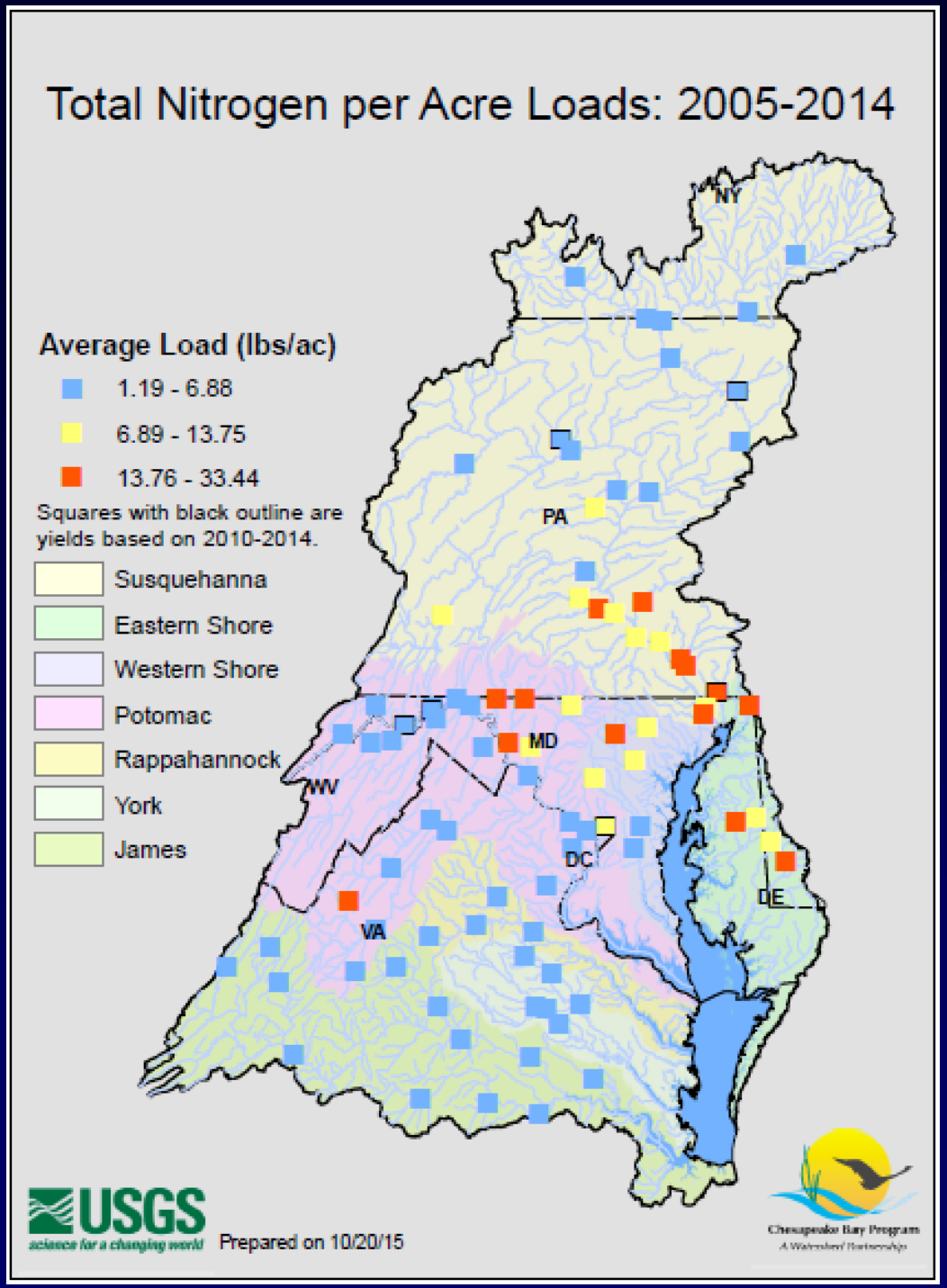

Total Nitrogen Trends (2005-2014)

Majority improving

- Improving Trends: 54%
- Degrading Trends: 27%
- No Trend: 19%

Results by major basin

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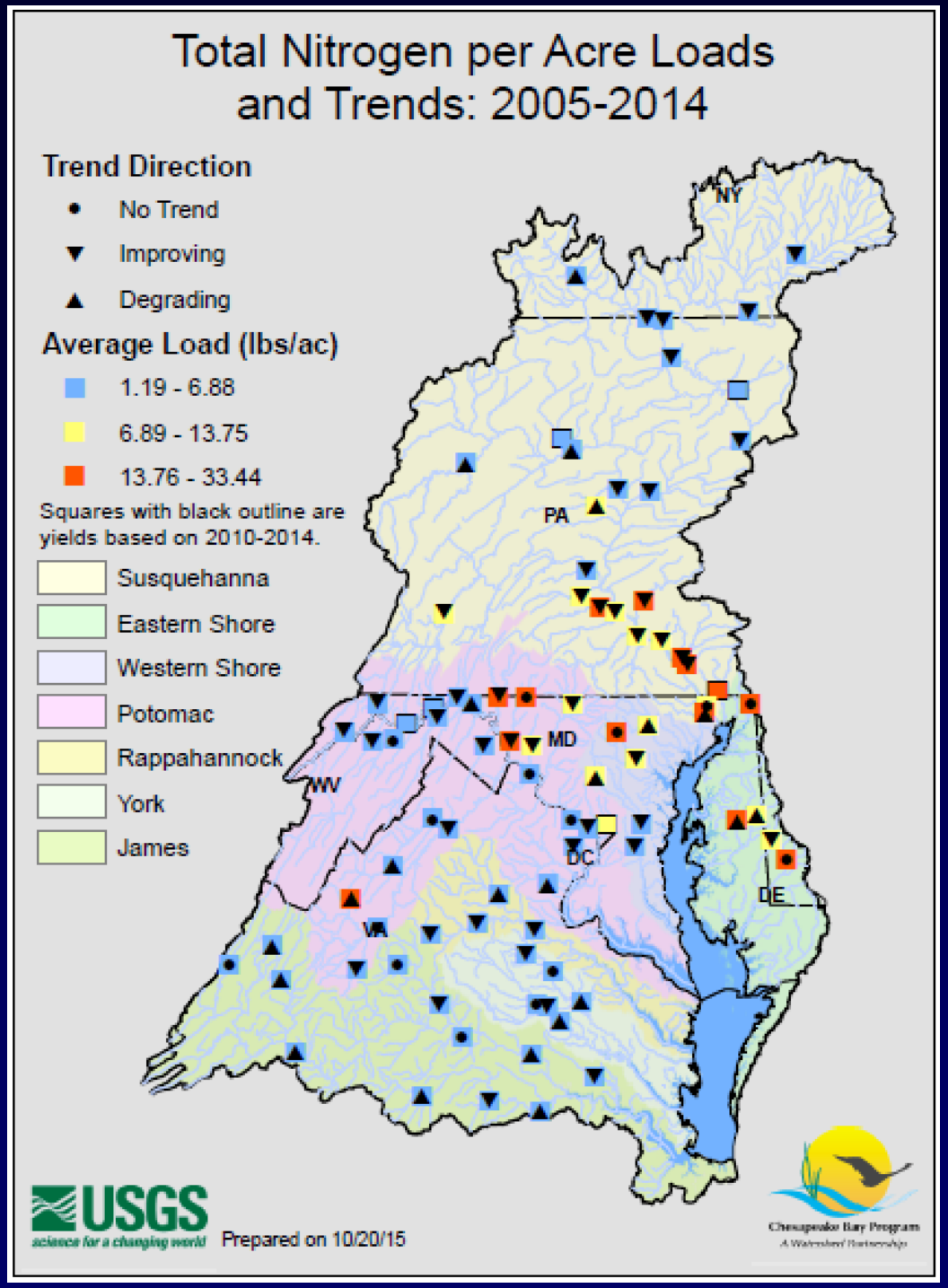

Amount of Nitrogen Change (2005-2014)

Improving Stations: Green

Range = -0.10 to -5.07 lbs/ac

Median = -0.68 lbs/ac (-10.0%)

Degrading Stations: Orange

Range = 0.04 to 1.21 lbs/ac

Median = 0.33 lbs/ac (7.84%)

Differs by watershed

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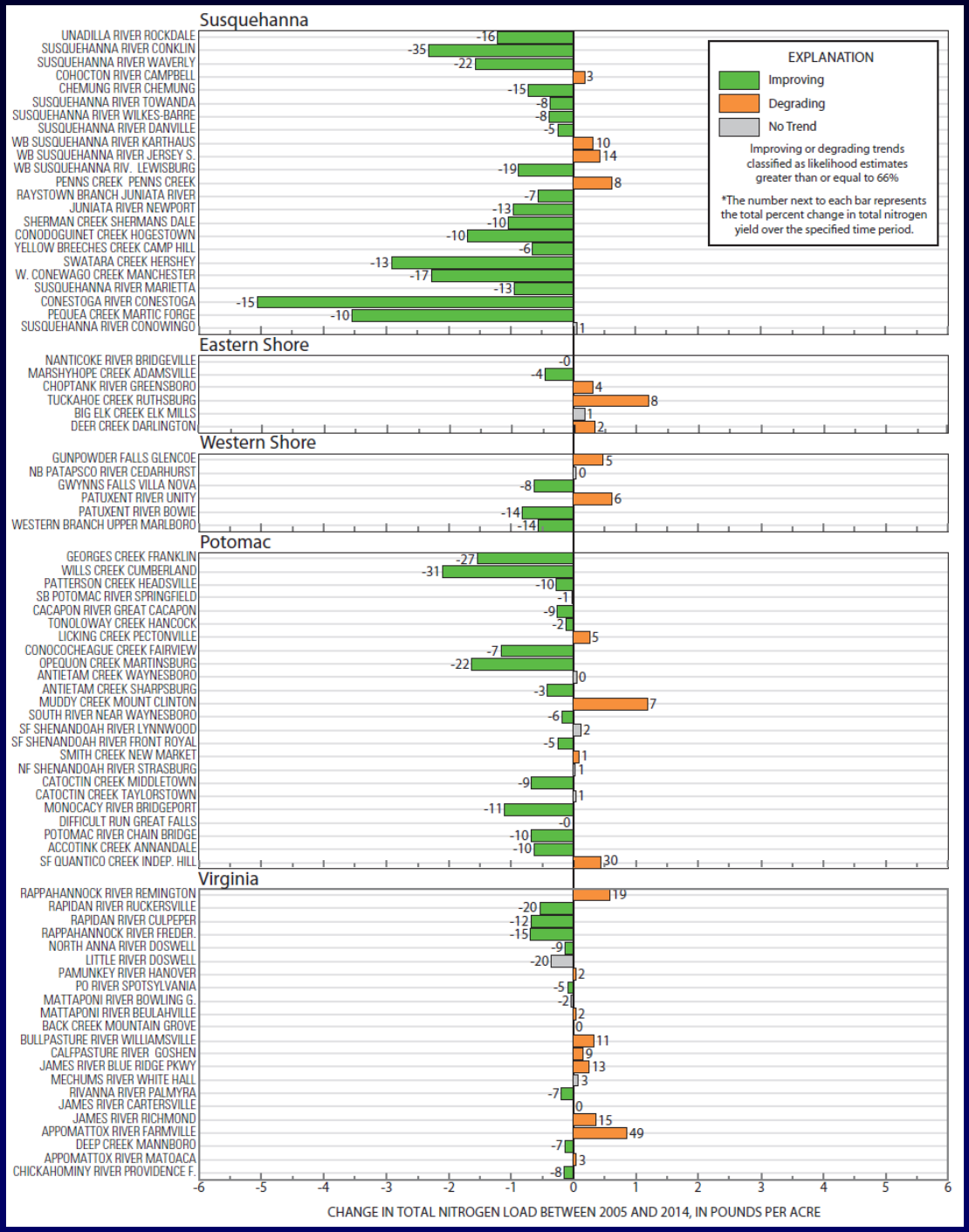

PHOSPHORUS

Total Phosphorus Loads and Trends (2005-2014)

Loads per acre

Range: 0.13 to 2.31 lbs/ac

Average: 0.52 lbs/ac

Trends: Majority improving

- Improving: 68%
- Degrading: 20%
- No Trend: 12%

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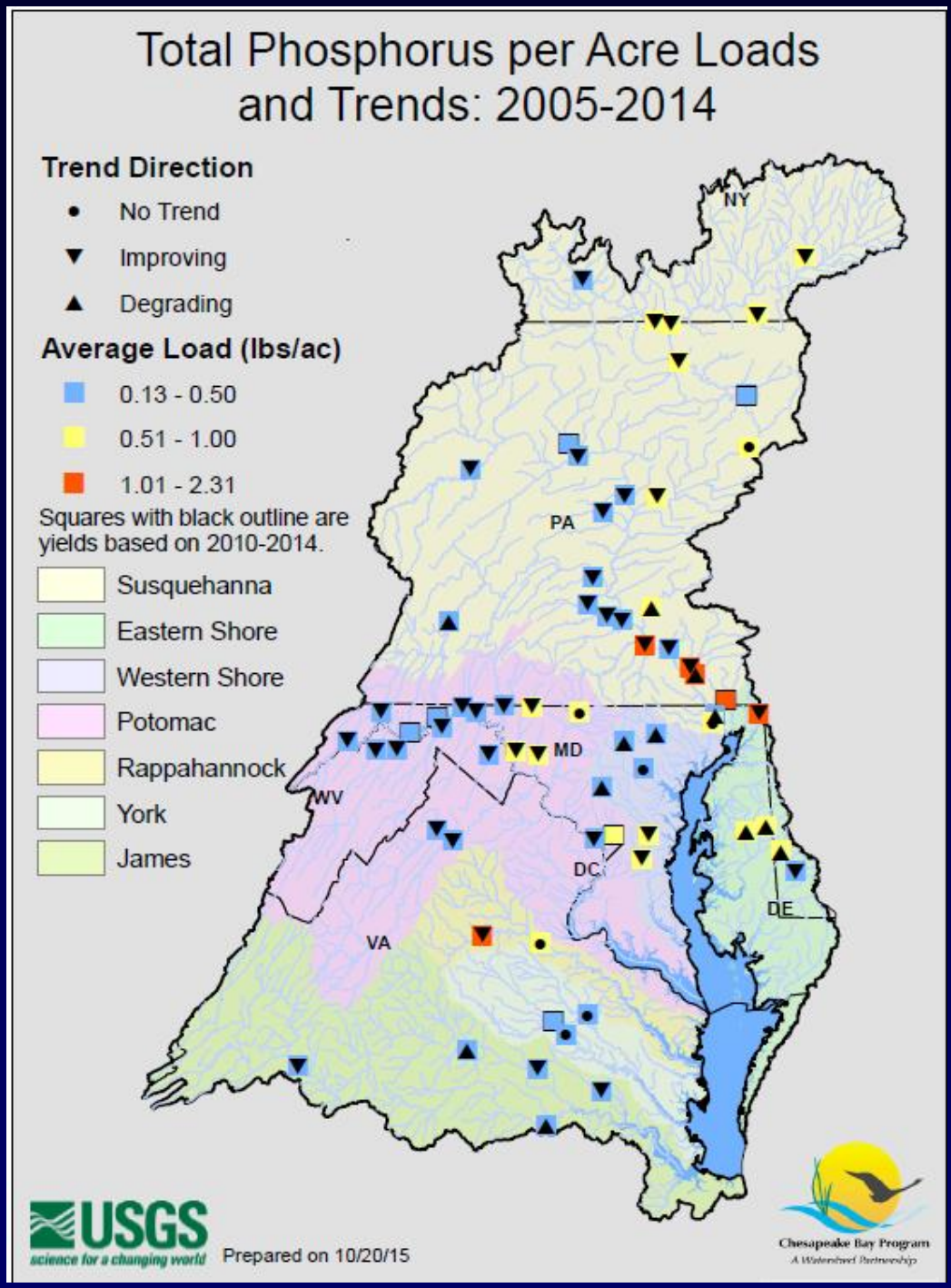

Amount of Phosphorus Change (2005-2014)

Improving Stations

Range = -0.014 to -1.08 lbs/ac

Median = -0.11 lbs/ac (-24.7%)

Degrading Stations

Range = 0.007 to 0.43 lbs/ac

Median = 0.07 lbs/ac (18.2%)

Differ by watershed

Download figure:
http://cbrim.er.usgs.gov/maps.html

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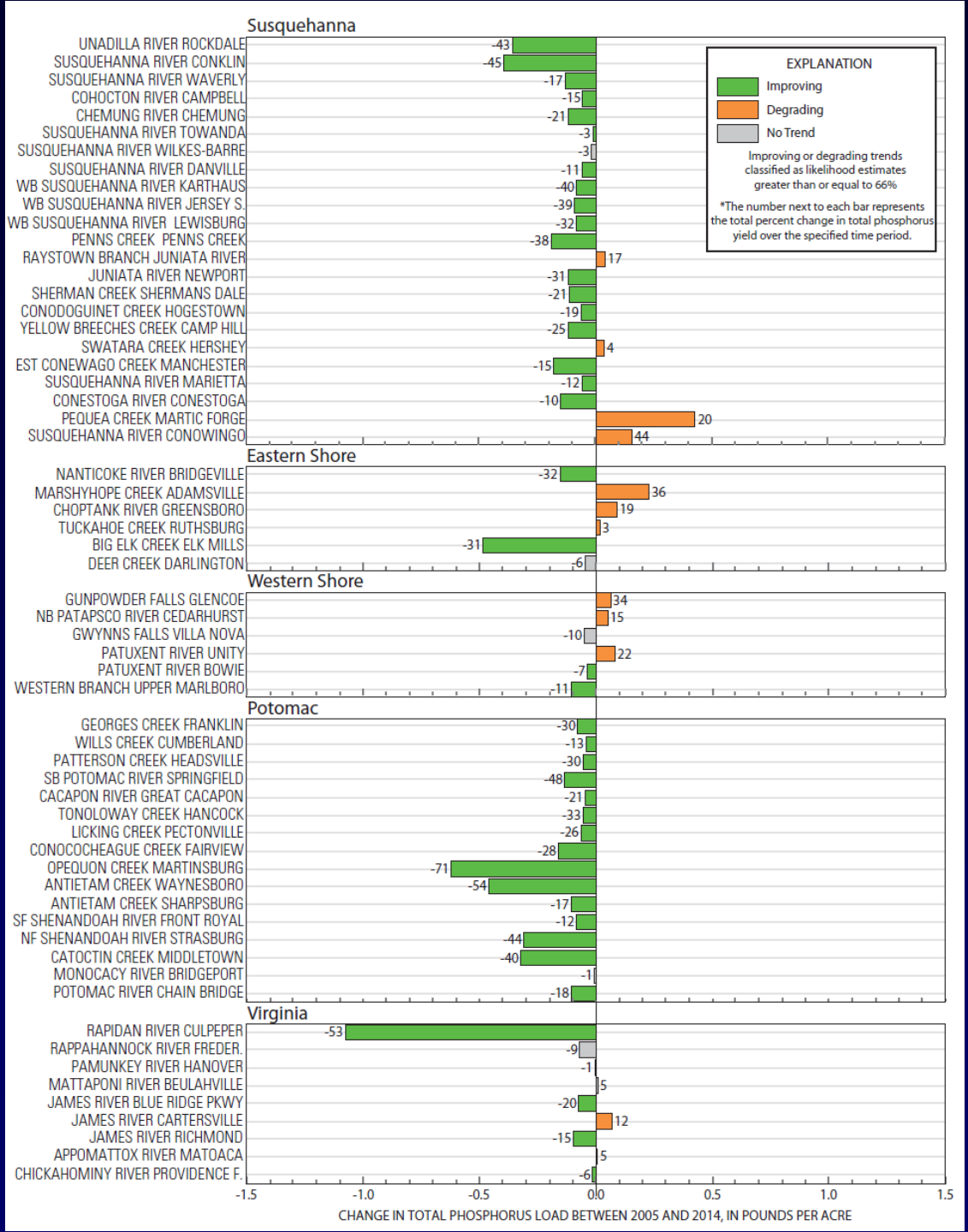

Suspended Sediment Loads and Trends (2005-2014)

Loads per acre

- Range from 18 to 2,206 lbs/ac
- Average load of 482 lbs/ac

Trends: Mixed Results

- Improving: 50%
- Degrading: 30%
- No Trend : 20%

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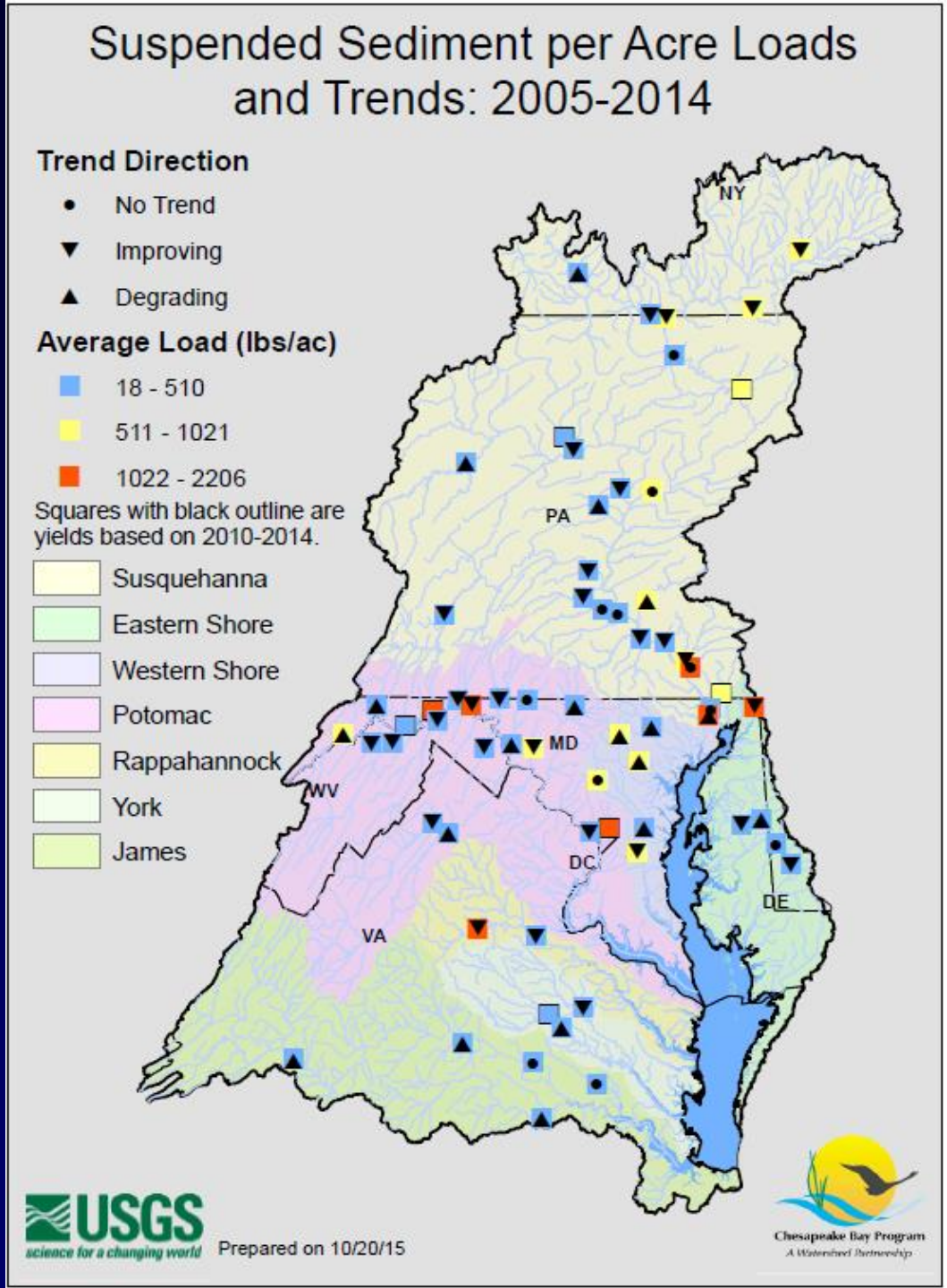

Amount of Sediment Change (2005-2014)

Improving Stations

Range = -8.11 to -1,490 lbs/ac

Median = -221 lbs/ac (-29.4%)

Degrading Stations

Range = 4.75 to 341 lbs/ac

Median = 118 lbs/ac (42.8%)

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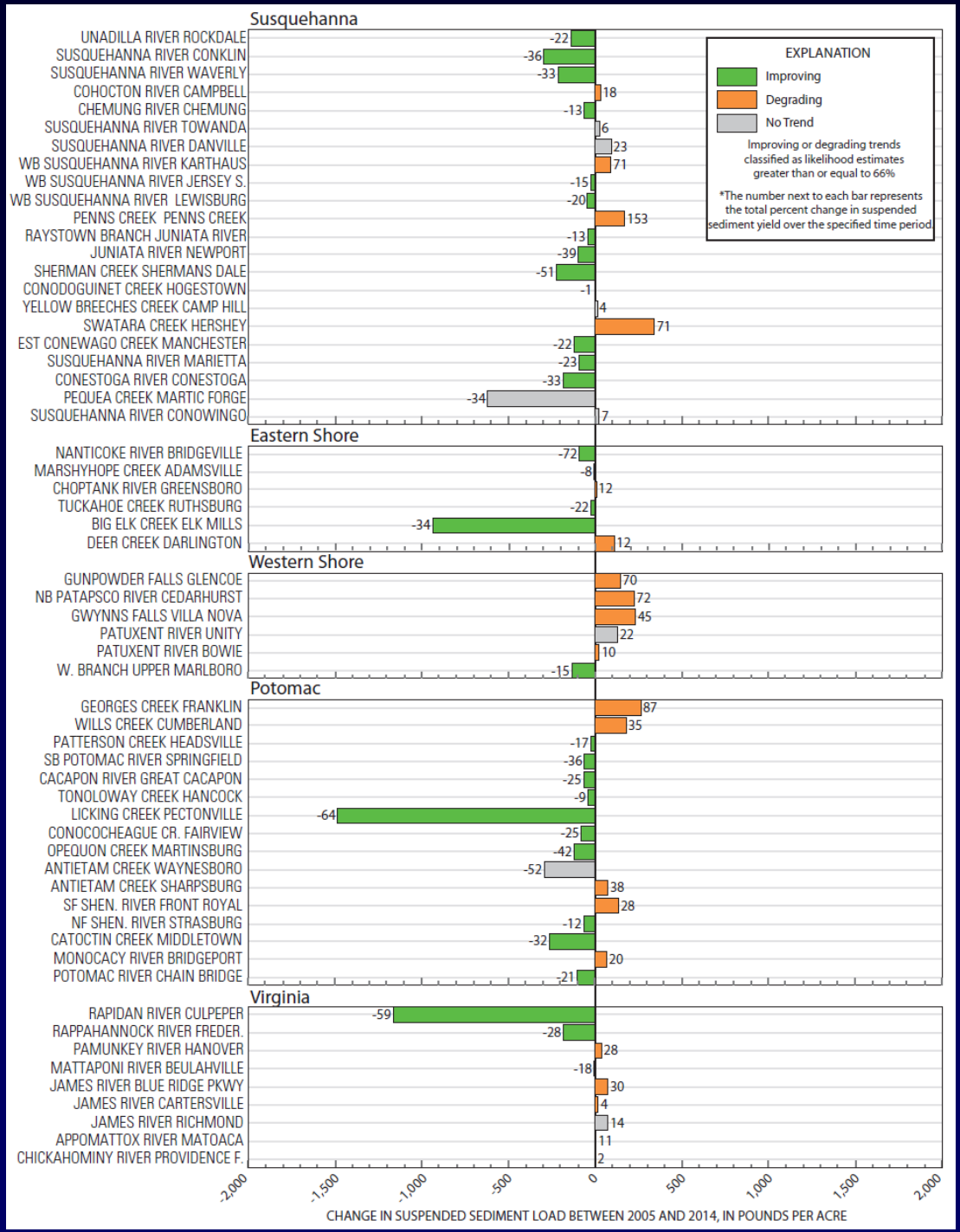
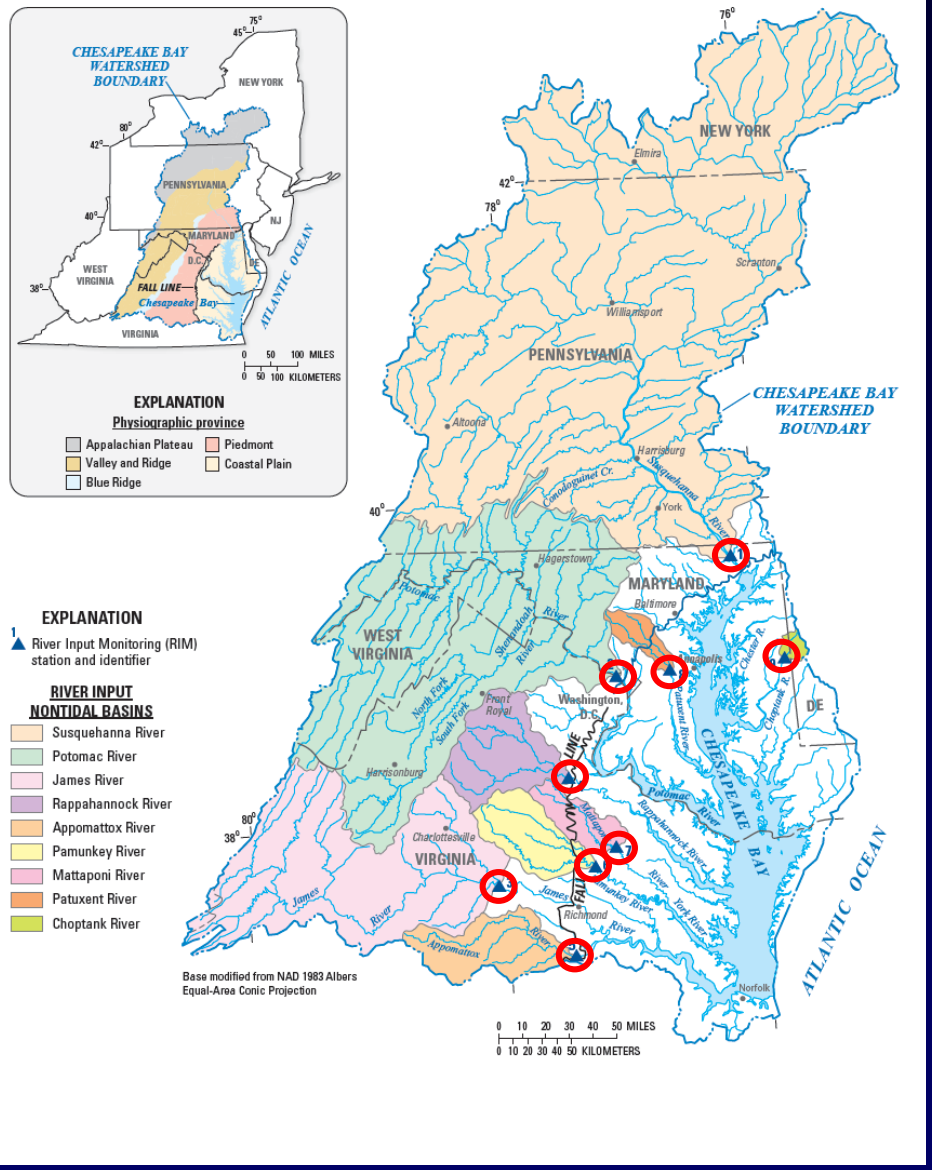


River Input Sites: Loads to tidal waters



- Monitor 78% of watershed
  - 9 sites
  - Upstream from several urban areas and WWTPs
- 3 basins dominate loading
- Less improvement for N, P, and Sediment

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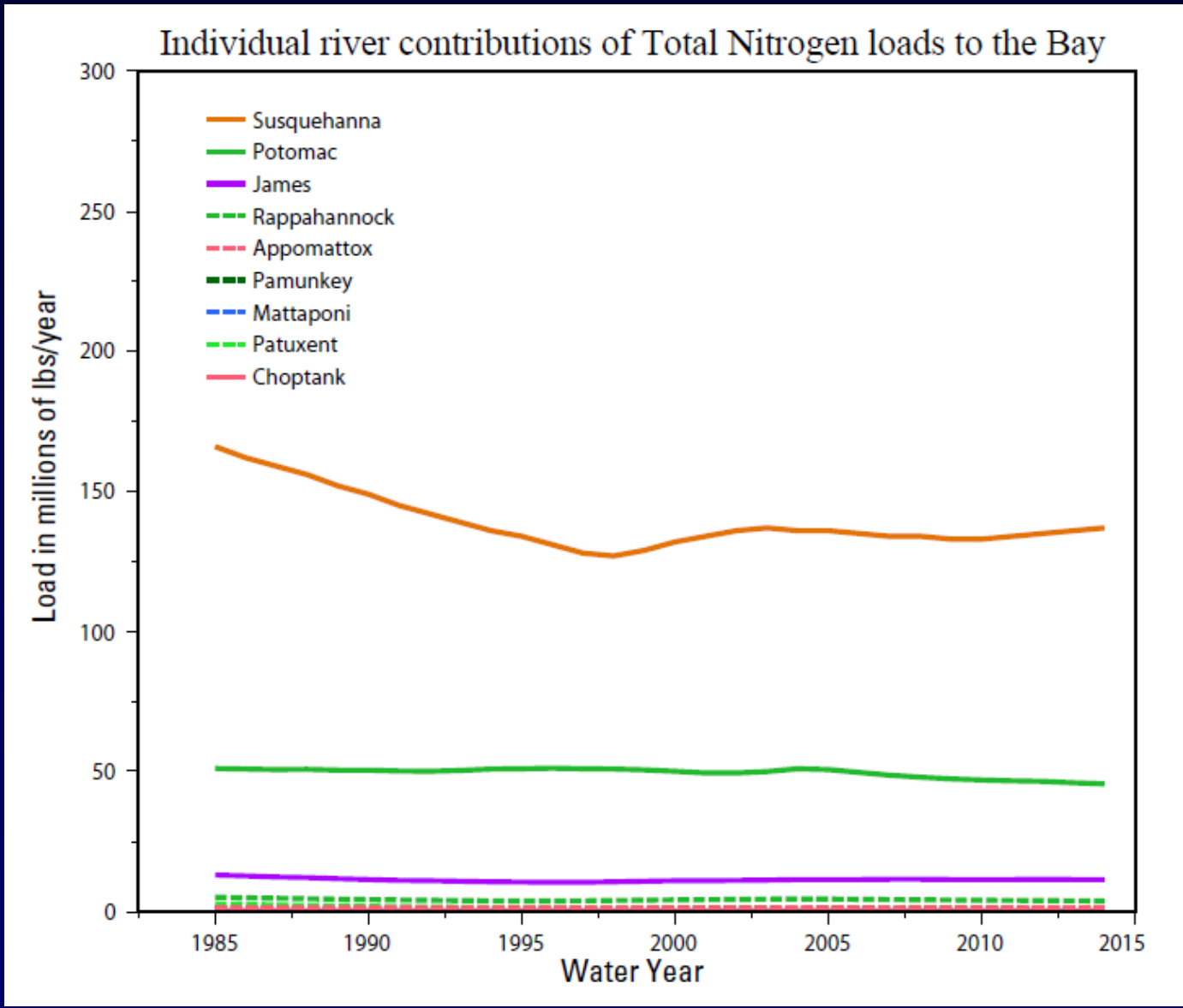
Change in Total Nitrogen
(9 RIM Stations)

2005-14

No trends: 2 (Susquehanna & James)

Improving: 3 (Potomac)

Degrading: 4



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Changes in Total Phosphorus

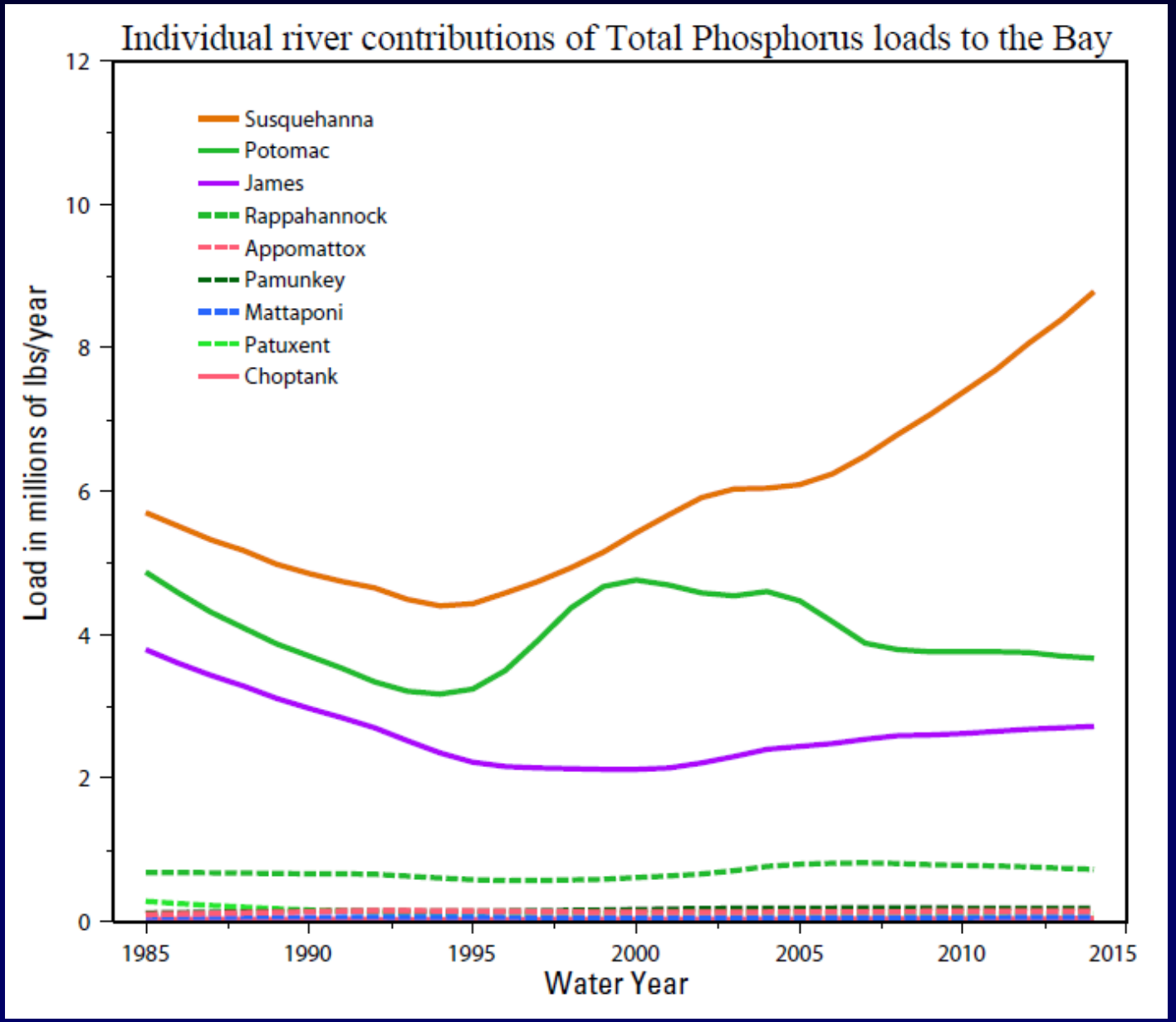
9 RIM Stations

2005-14

Degrading: 4 (Susquehanna and James)

Improving: 2 (Potomac)

No trends: 3



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Summary

- Watershed Trends in Loads
  - Nitrogen: Twice as many stations show improving trends as those showing degrading trends
  - Phosphorus: Over three times as many stations showing improving trends
  - Suspended Sediment: Mixed results
- RIM Stations: loads to tidal waters
  - Less improvements
  - Degrading conditions due to Susquehanna Reservoirs
- Explain water-quality change and BMPs
  - Milestone assessments and Phase 3 WIPs

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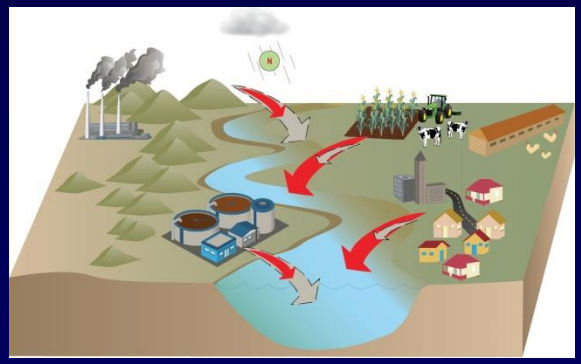
Explaining Trends

1. What Works
   - Upgrades to WWTPs
   - Reductions in air emissions
   - Some agricultural practices
2. Challenges
   - Response times
   - Development and intensified agriculture
   - Susquehanna Reservoirs
3. What we need
   - Location should guide restoration efforts
   - Stormwater management and monitoring



- UMCES, USGS, EPA (2014)

USGS

USGS Nontidal Web Page

http://cbrim.er.usgs.gov/

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Water-Quality Loads and Trends at Nontidal Monitoring Stations in the Chesapeake Bay Watershed

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Welcome

This web site is dedicated to providing water-quality load and trend results for the nontidal rivers of the Chesapeake Bay watershed.

What are the Objectives of the Chesapeake Bay Nontidal Monitoring Program?

- Quantify nutrient and sediment loads in the nontidal rivers of the Chesapeake Bay watershed. These loads are defined as the mass of nutrient or sediment passing a monitored location per unit time.
- Estimate changes over time (trends) in sediment and nutrient loads, in a manner that compensates for any concurrent trend in stream discharge. Trends estimated in this manner can indicate changes in the watershed, such as the effects of best management practices that cannot be attributed primarily to climatic fluctuation.

How the Program Works

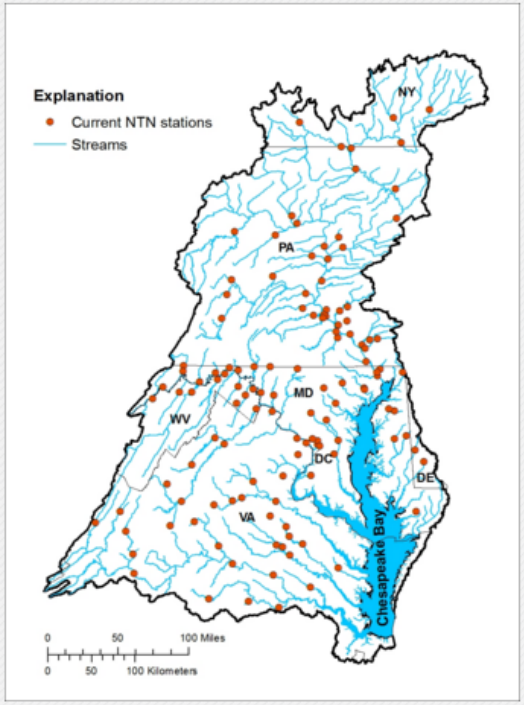
- Monitoring data are collected by numerous agencies through the nontidal monitoring partnership.
- Results are updated on even-numbered water years for the network of water-quality monitoring stations distributed throughout the Chesapeake Bay watershed.

What Data and Related Information Are Available?

Methods, data, results, and interpretations are available for

- Nutrient and sediment loads and yields (per-acre loads)
- Trends in nutrient and sediment loads

Load and trend results are available from the Chesapeake Bay nontidal monitoring network through the 2014 water year.



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