

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

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USGS

On behalf of many investigators and partners  
PA State Senate  
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# Acknowledgements

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

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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

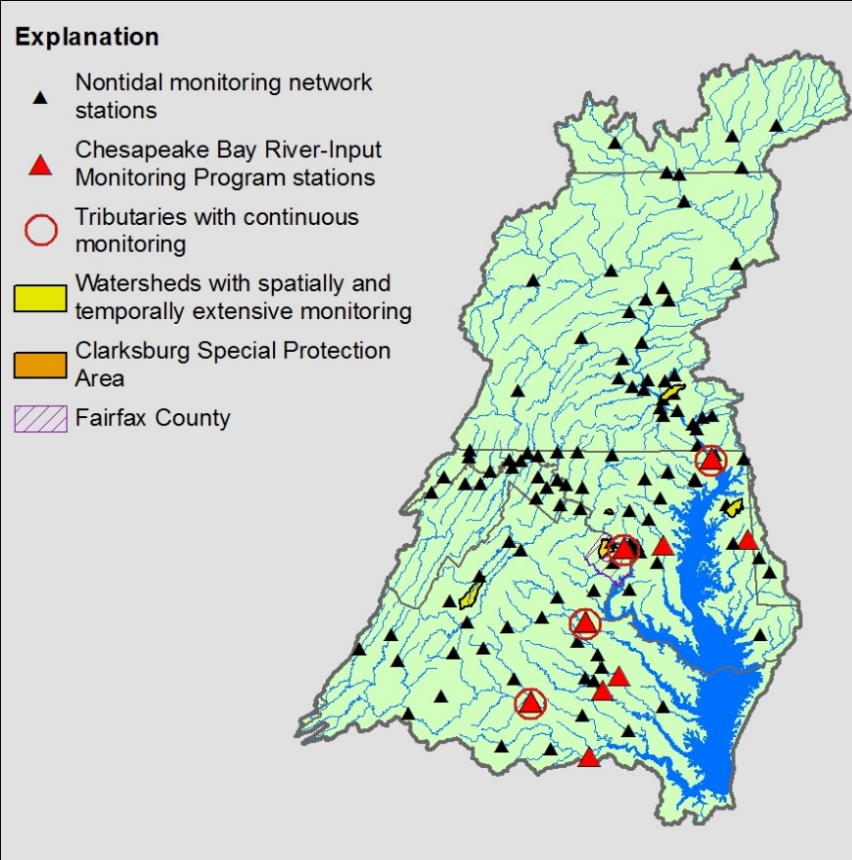
MD Dept. of Natural Resources

WV Dept. of Env. Protection

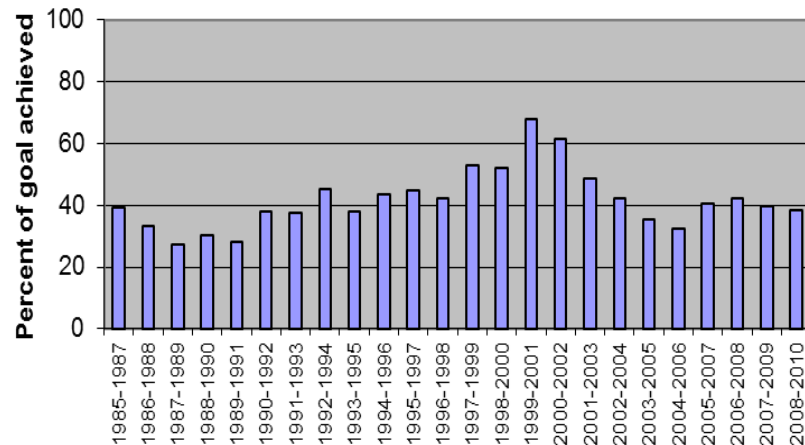
WV Dept. of Ag.

# 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



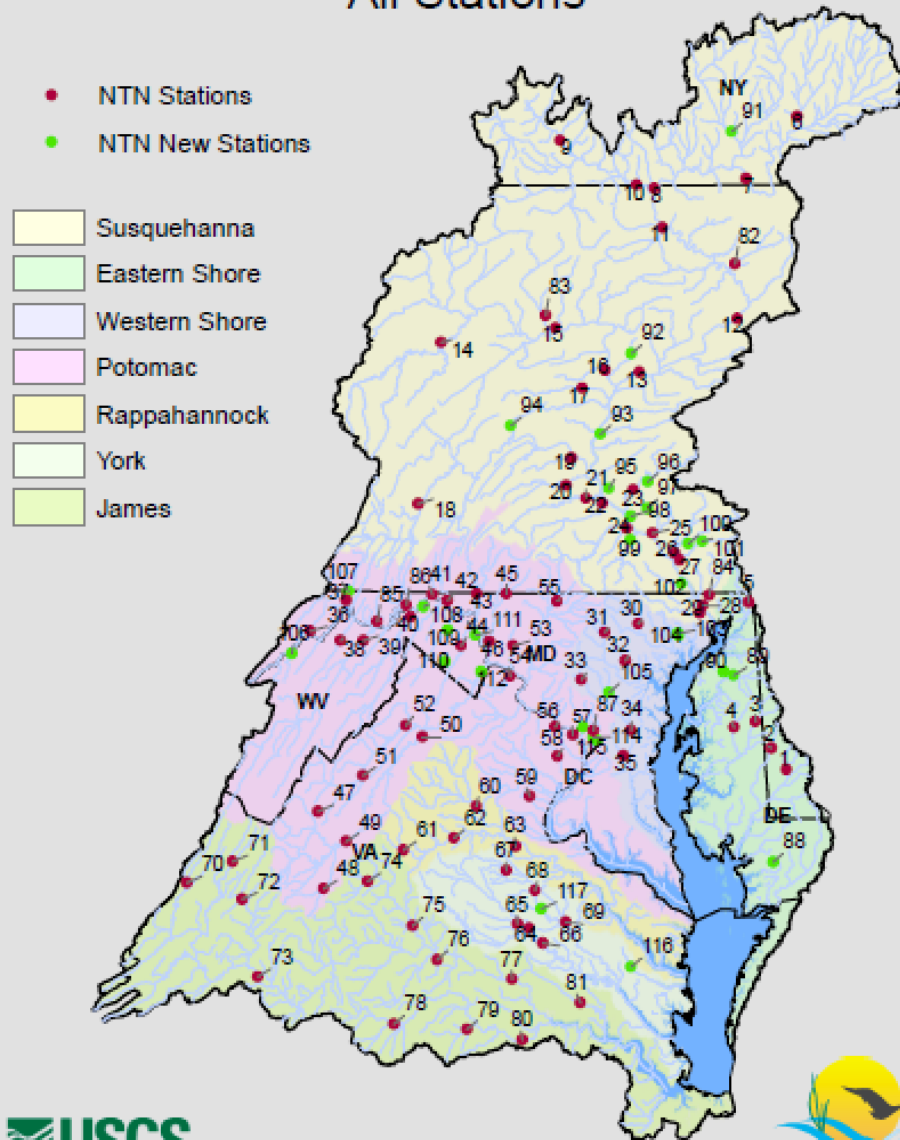
**Dissolved Oxygen**



# Chesapeake Bay Nontidal Monitoring Network

- 1985: River-Input Monitoring and selected sites
- 2004: agree on comparable methods
- TMDL expansion
- 117 stations
  - Range from 1 to 27,100 mi<sup>2</sup>
  - PA: 31 sites
- Nutrient and sediment collected
  - Monthly and storms
  - Streamflow
- Loads and trends computed
- First of its' kind

## Chesapeake Bay Nontidal Network: All Stations



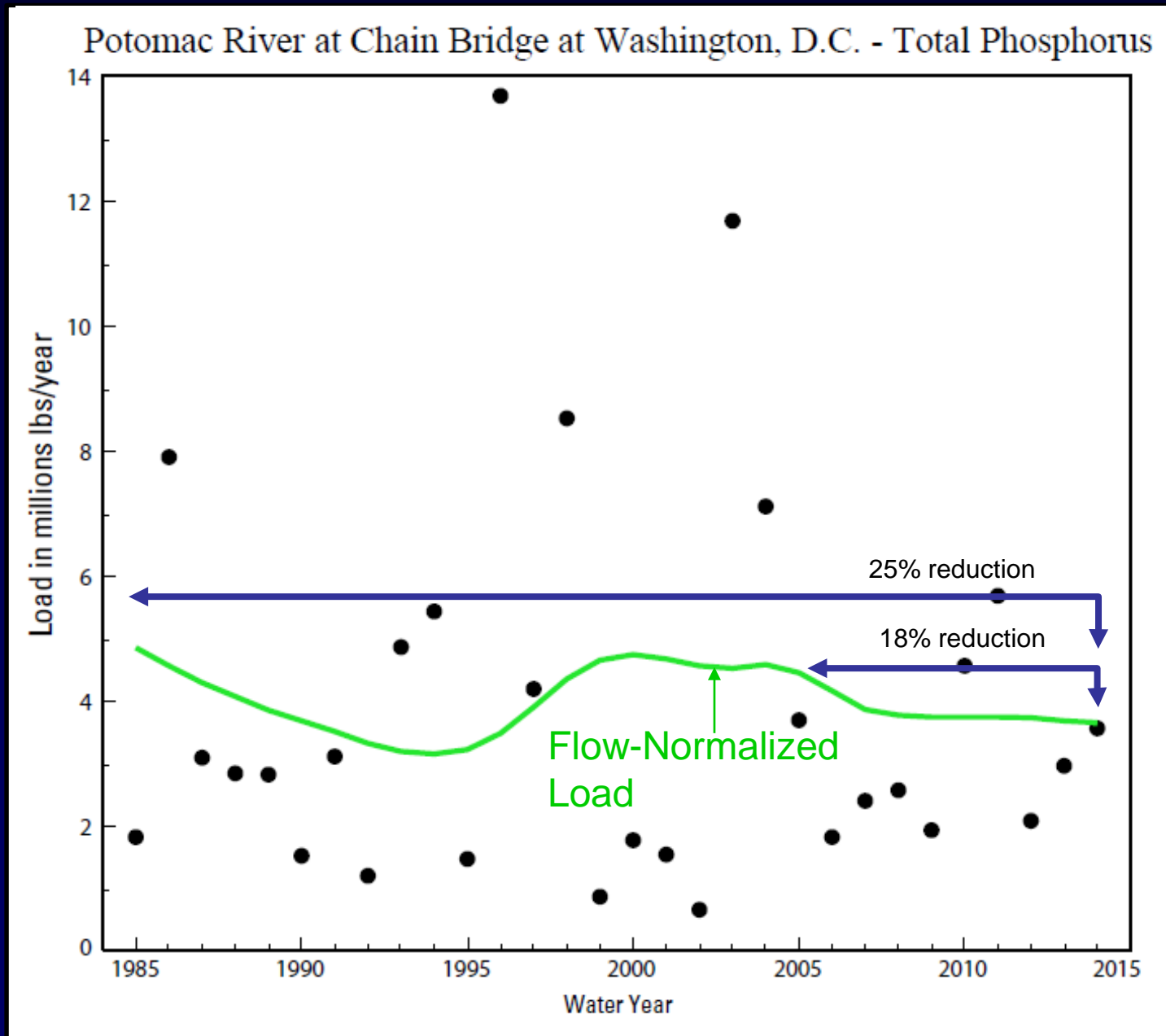
# Load and Trends

- Annual loads
- Flow-normalized change

1985 to 2014:  
down 25%

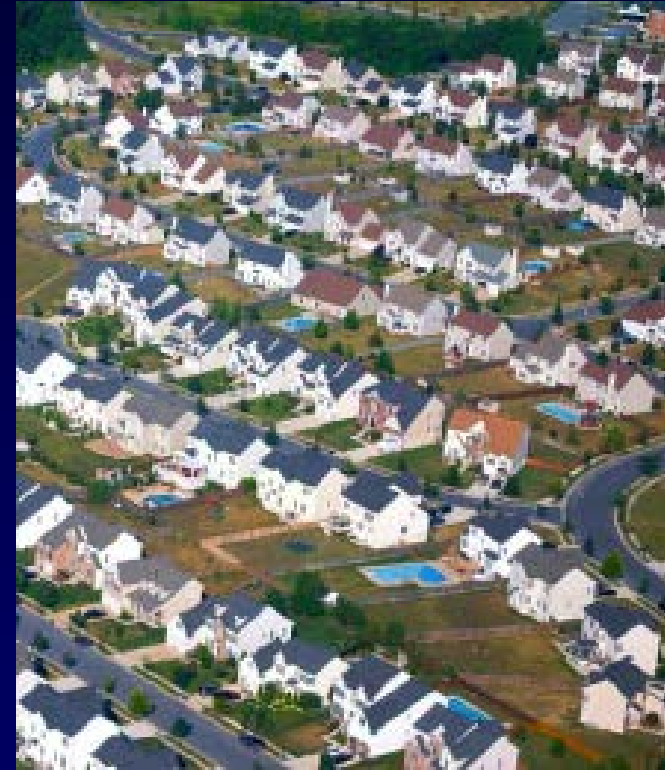
2005 to 2014:  
down 18%

- Per acre loads



# Results: N, P and Sediment

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



# Total Nitrogen (loads per acre)

## Bay watershed

- Range: 1.19 to 33.4 lbs/ac
- Average: 7.33 lbs/ac

## PA results:

- 3.3-33.4 lbs per acre
- 11.5 lbs per acre
- Highest in southern areas

## Total Nitrogen per Acre Loads: 2005-2014

### Average Load (lbs/ac)

1.19 - 6.88

6.89 - 13.75

13.76 - 33.44

Squares with black outline are yields based on 2010-2014.

Susquehanna

Eastern Shore

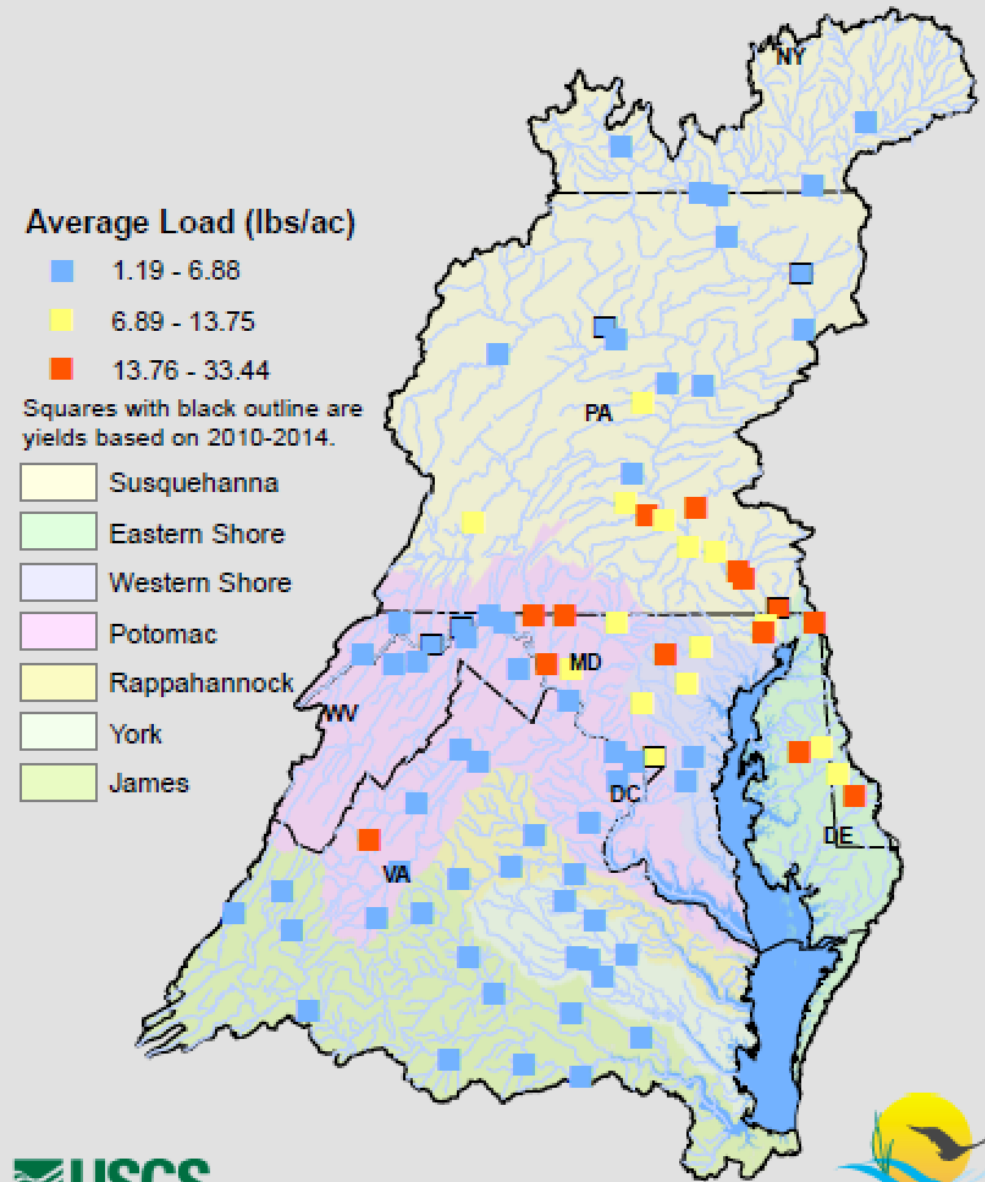
Western Shore

Potomac

Rappahannock

York

James



# Total Nitrogen Trends (2005-2014)

## Chesapeake Watershed

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

## PA: Majority improving

- Improving: 14
- Degrading: 3
- No change: 1



## Total Nitrogen per Acre Loads and Trends: 2005-2014

### Trend Direction

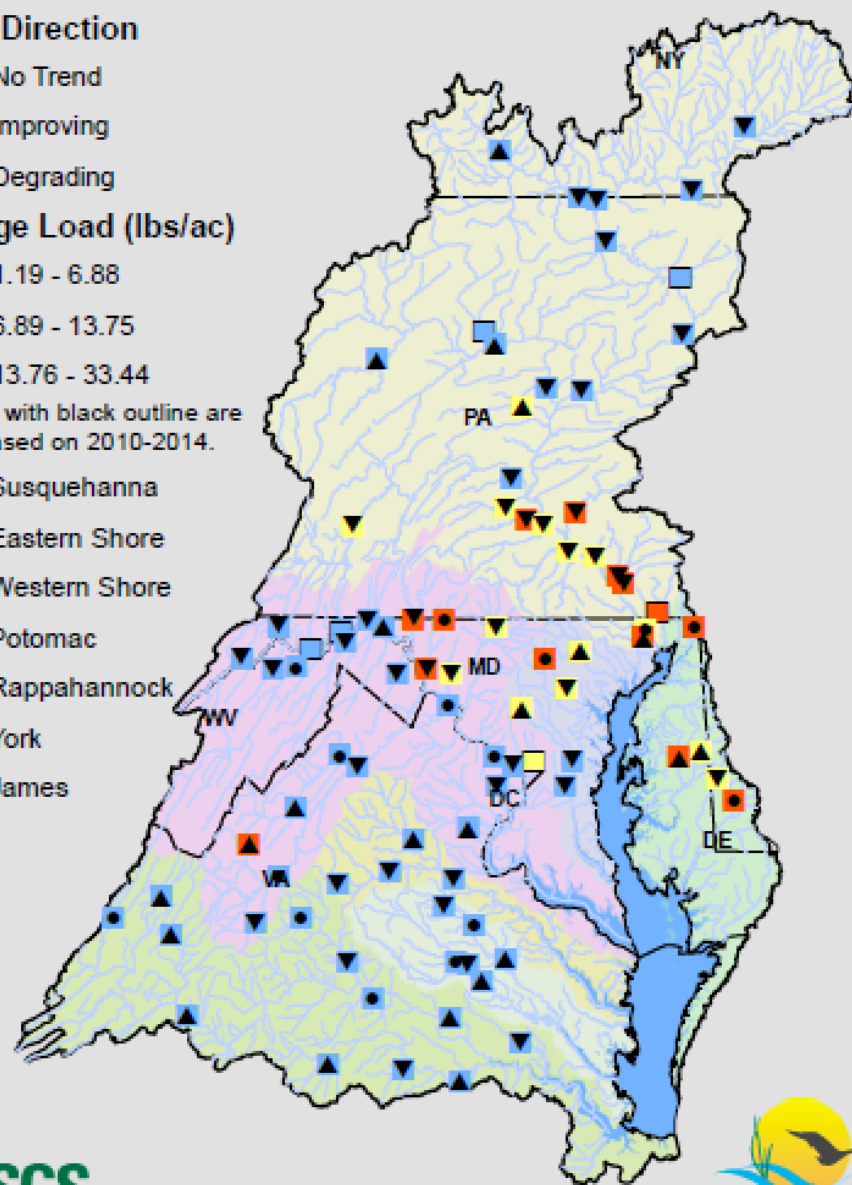
- No Trend
- ▼ Improving
- ▲ Degrading

### Average Load (lbs/ac)

- 1.19 - 6.88
- 6.89 - 13.75
- 13.76 - 33.44

Squares with black outline are yields based on 2010-2014.

- Susquehanna
- Eastern Shore
- Western Shore
- Potomac
- Rappahannock
- York
- James



Prepared on 10/20/15

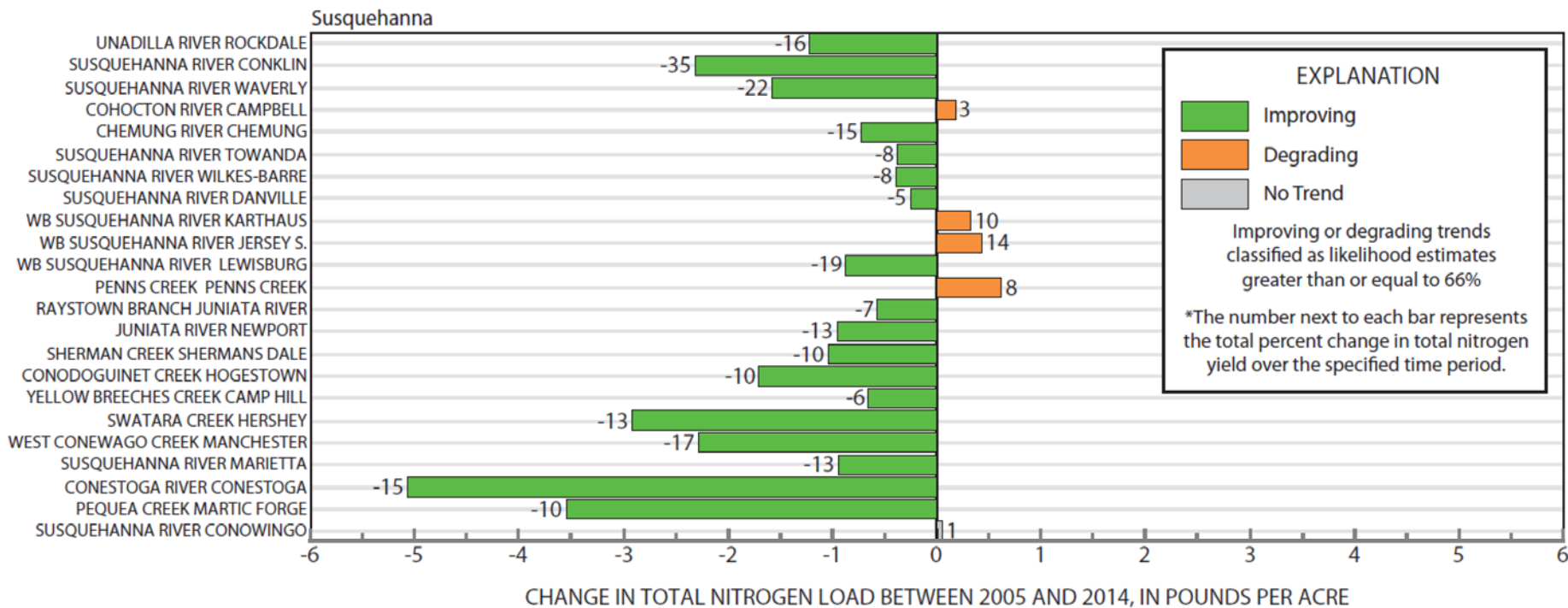


Chesapeake Bay Program  
A Watershed Partnership



# Changes in Nitrogen per Acre Loads: 2005-2014

## Susquehanna Watershed

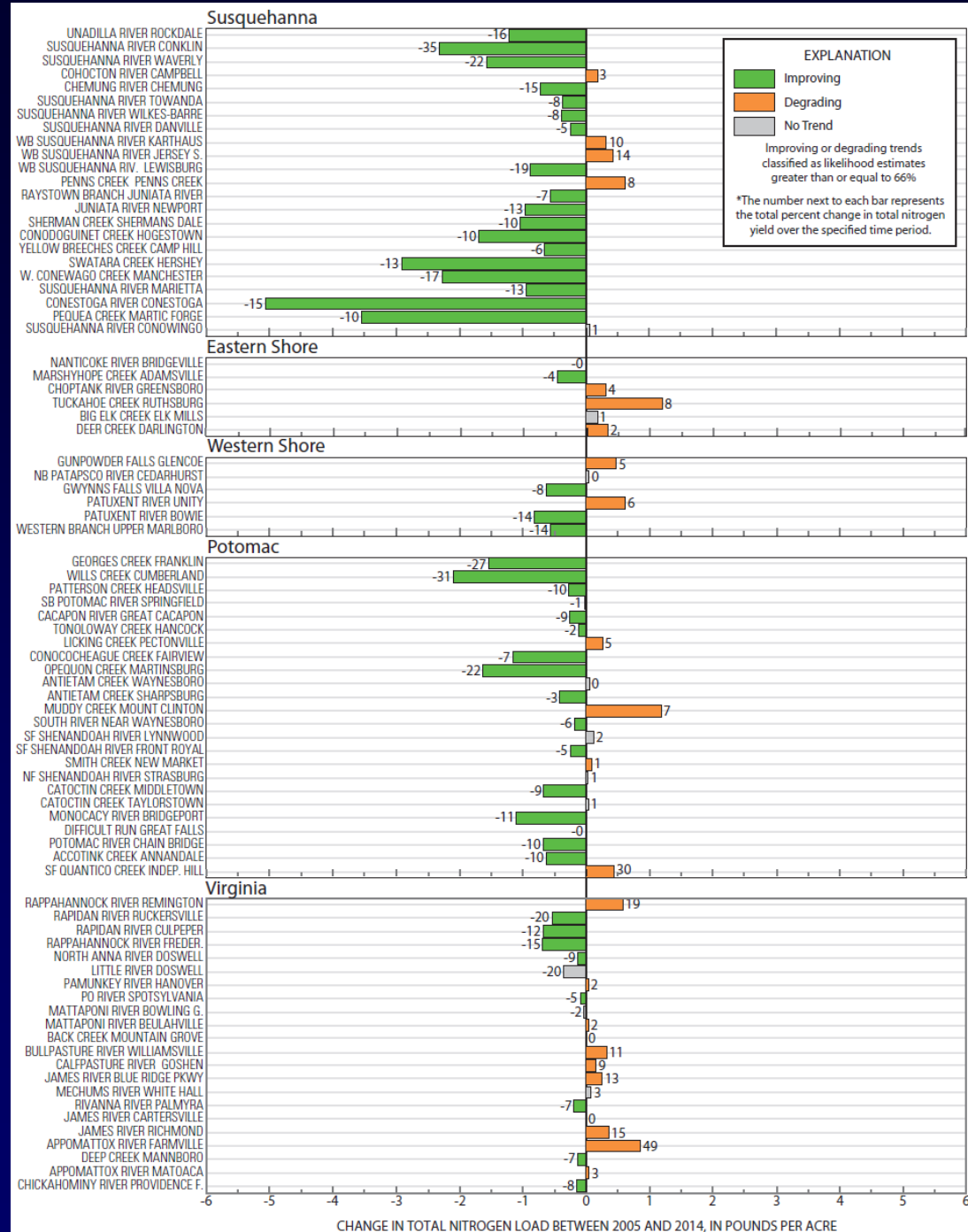


# Amount of Nitrogen Change (2005-2014)

**Improving Stations:**  
*Range = -0.10 to -5.07 lbs/ac*  
*Median = -0.68 lbs/ac (-10.0%)*

**Degrading Stations:**  
*Range = 0.04 to 1.21 lbs/ac*  
*Median = 0.33 lbs/ac (7.84%)*

**Differs by watershed**



# PHOSPHORUS



# Total Phosphorus Loads and Trends: (2005-2014)

Loads per acre

- Above average in PA
- Eastern part of basin

Watershed: Majority improving

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

PA trends: Similar trends



Prepared on 10/20/15

## Total Phosphorus per Acre Loads and Trends: 2005-2014

### Trend Direction

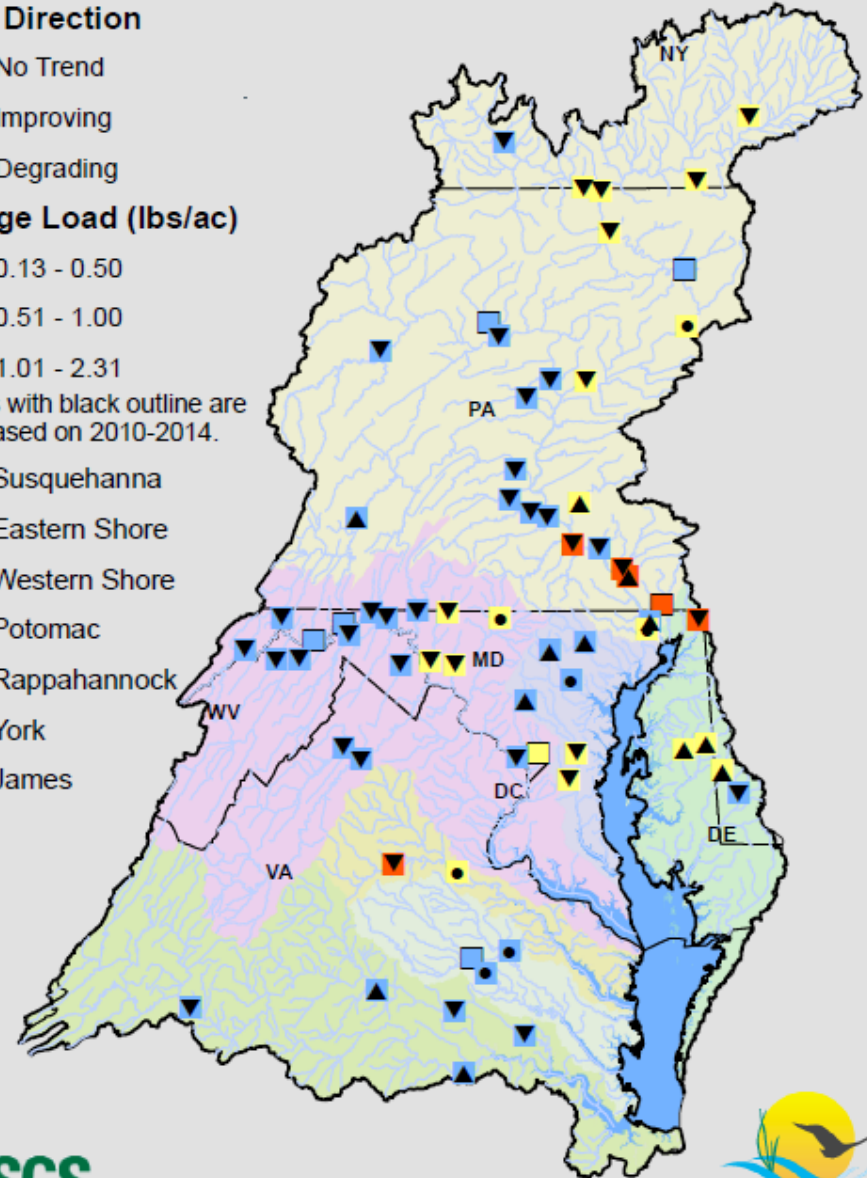
- No Trend
- ▼ Improving
- ▲ Degrading

### Average Load (lbs/ac)

- 0.13 - 0.50
- 0.51 - 1.00
- 1.01 - 2.31

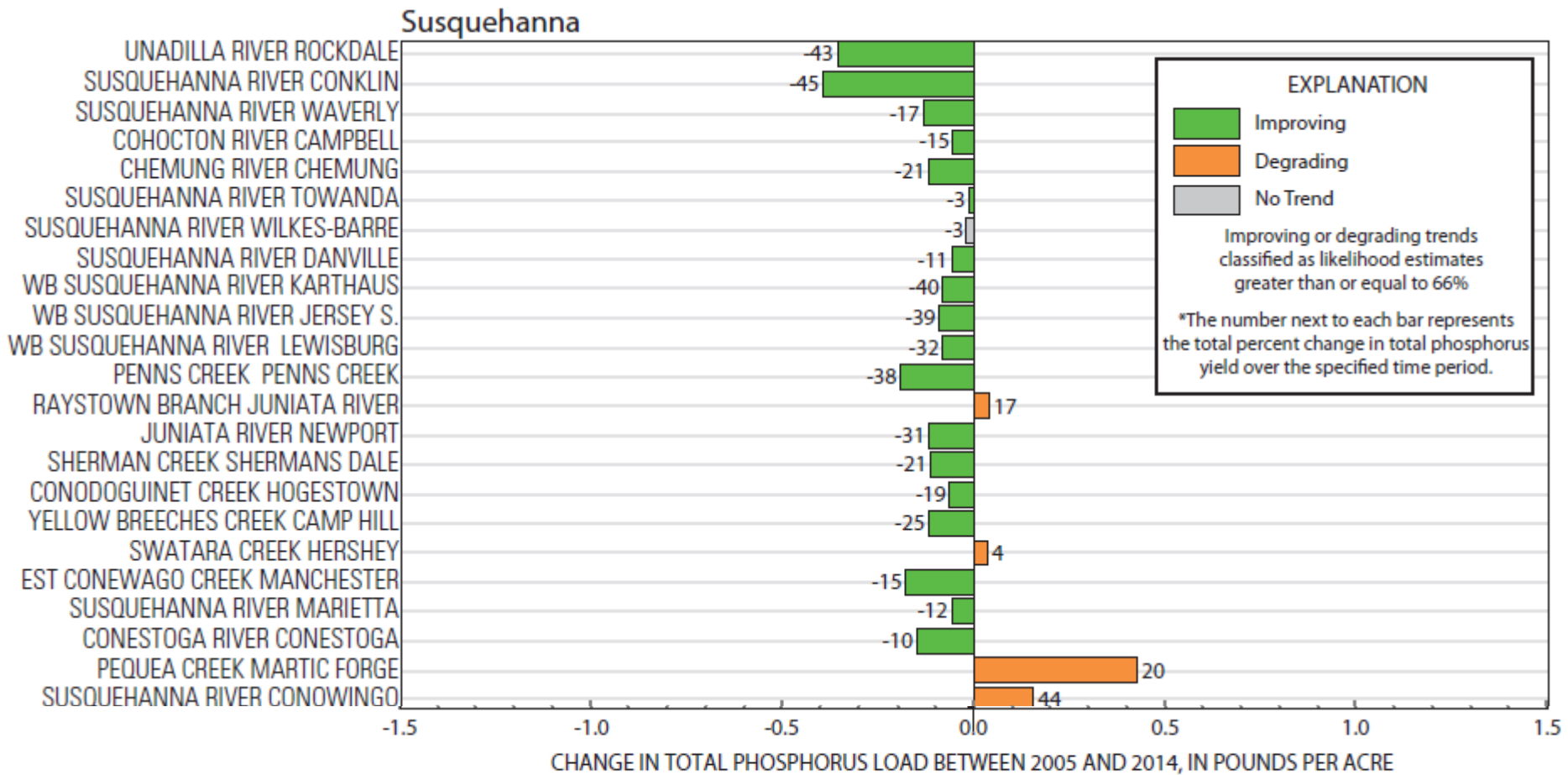
Squares with black outline are yields based on 2010-2014.

- Susquehanna
- Eastern Shore
- Western Shore
- Potomac
- Rappahannock
- York
- James



# Changes in Phosphorus per Acre Loads: 2005-2014

## *Susquehanna Watershed*



# Amount of Phosphorus Change (2005-2014)

## Improving Stations

Range = -0.014 to -1.08 lbs/ac

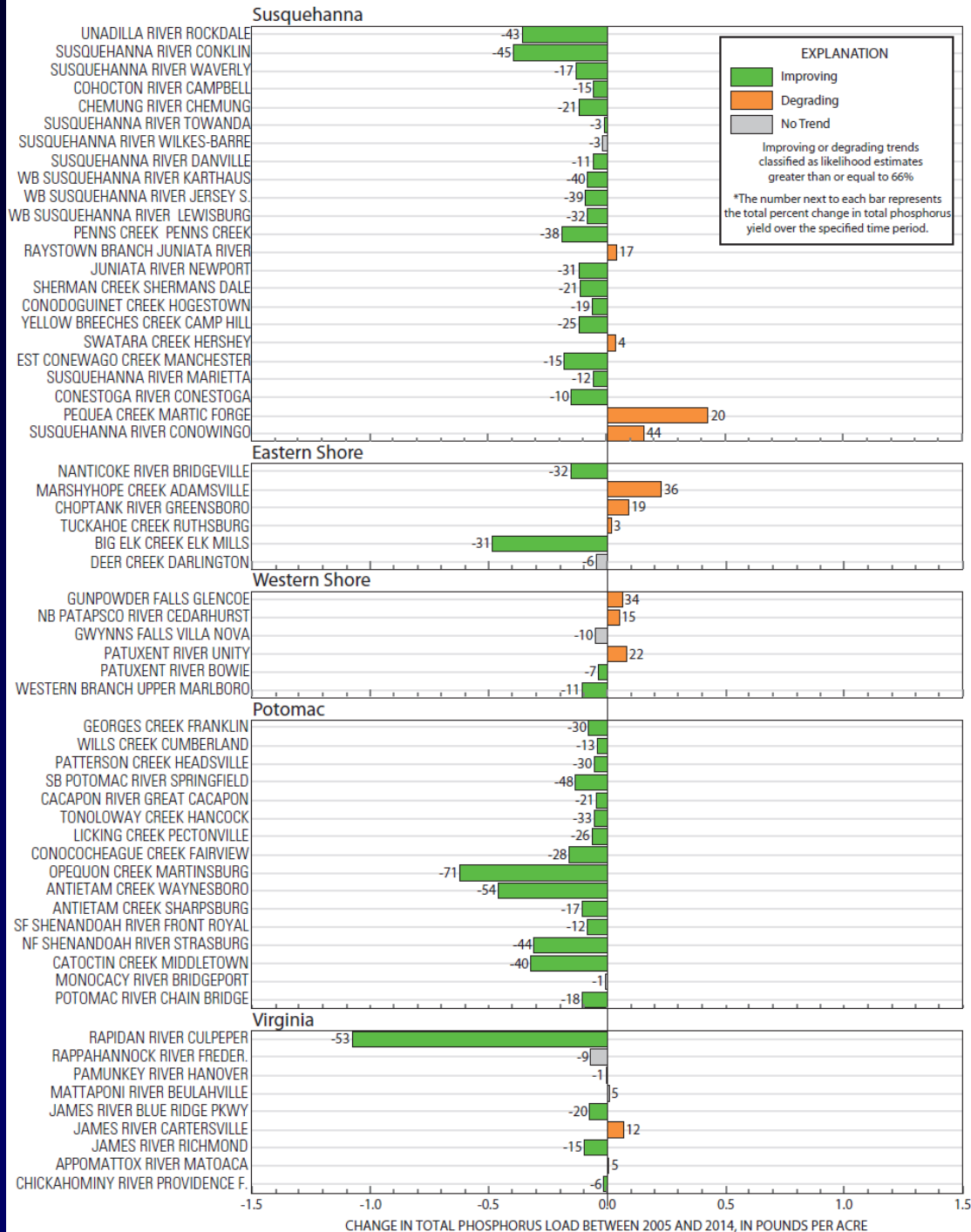
Median = -0.11 lbs/ac (-24.7%)

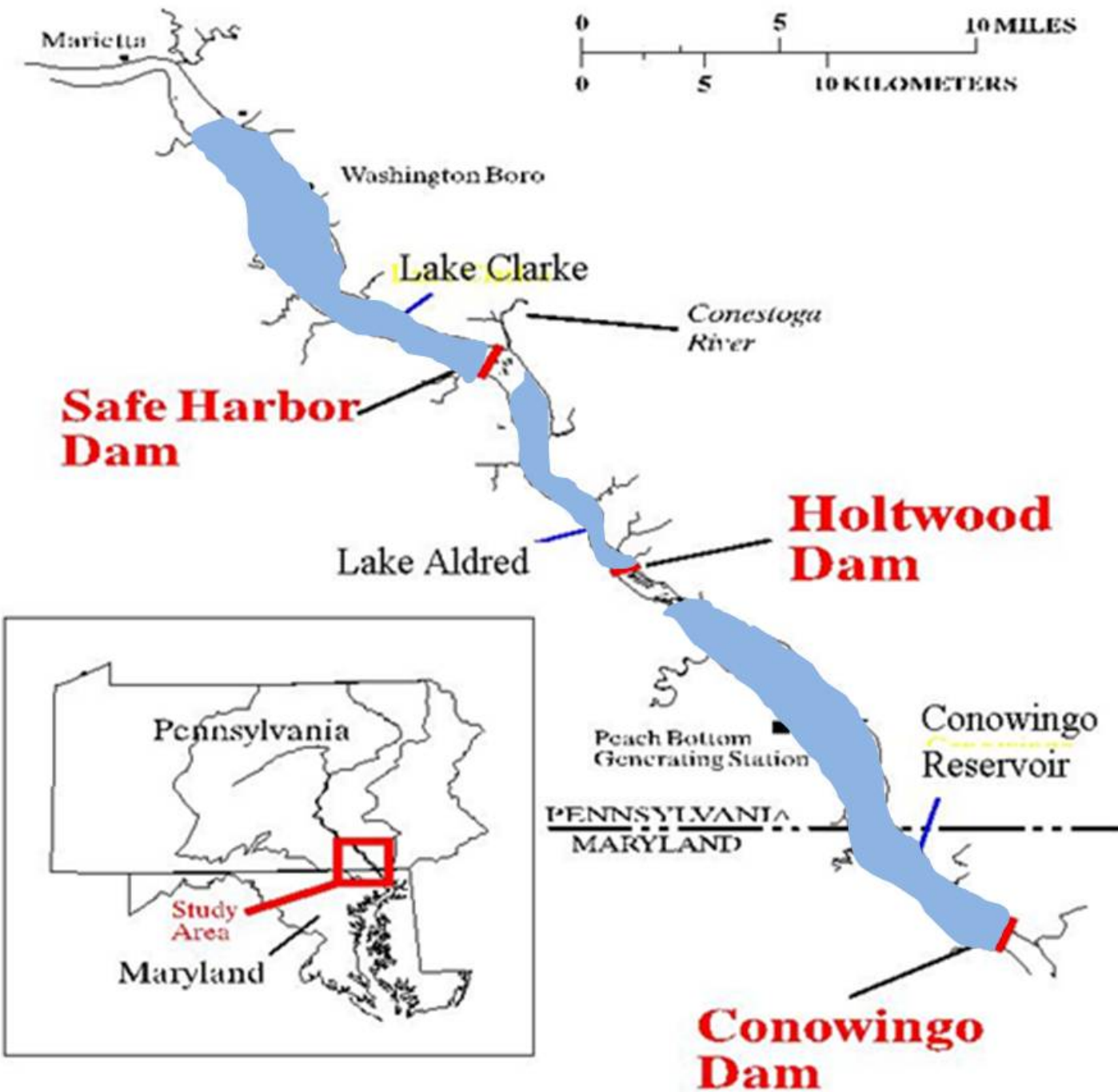
## Degrading Stations

Range = 0.007 to 0.43 lbs/ac

Median = 0.07 lbs/ac (18.2%)

## Differ by watershed





# 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%
- PA similar

## Suspended Sediment per Acre Loads and Trends: 2005-2014

### Trend Direction

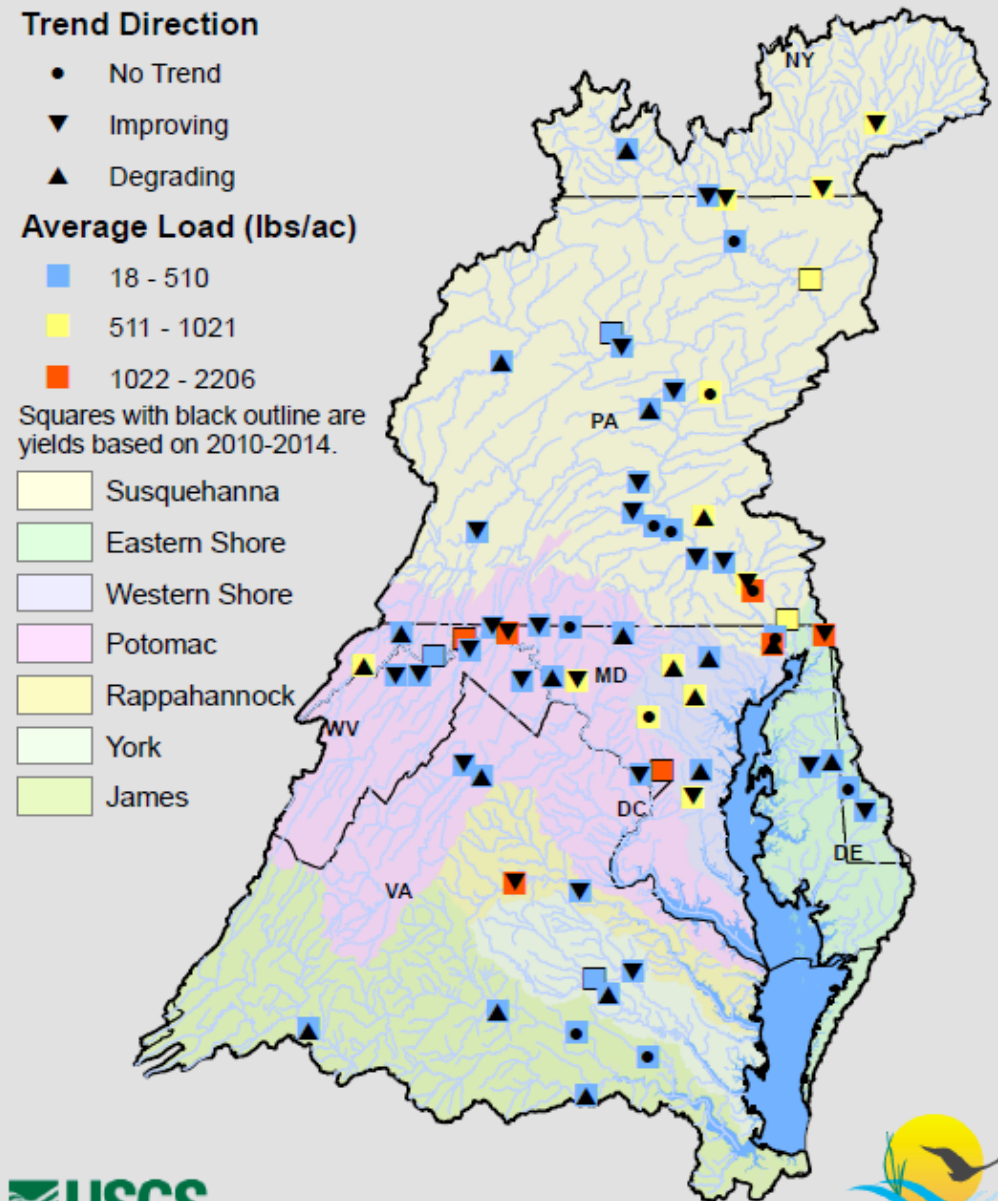
- No Trend
- ▼ Improving
- ▲ Degrading

### Average Load (lbs/ac)

- 18 - 510
- 511 - 1021
- 1022 - 2206

Squares with black outline are yields based on 2010-2014.

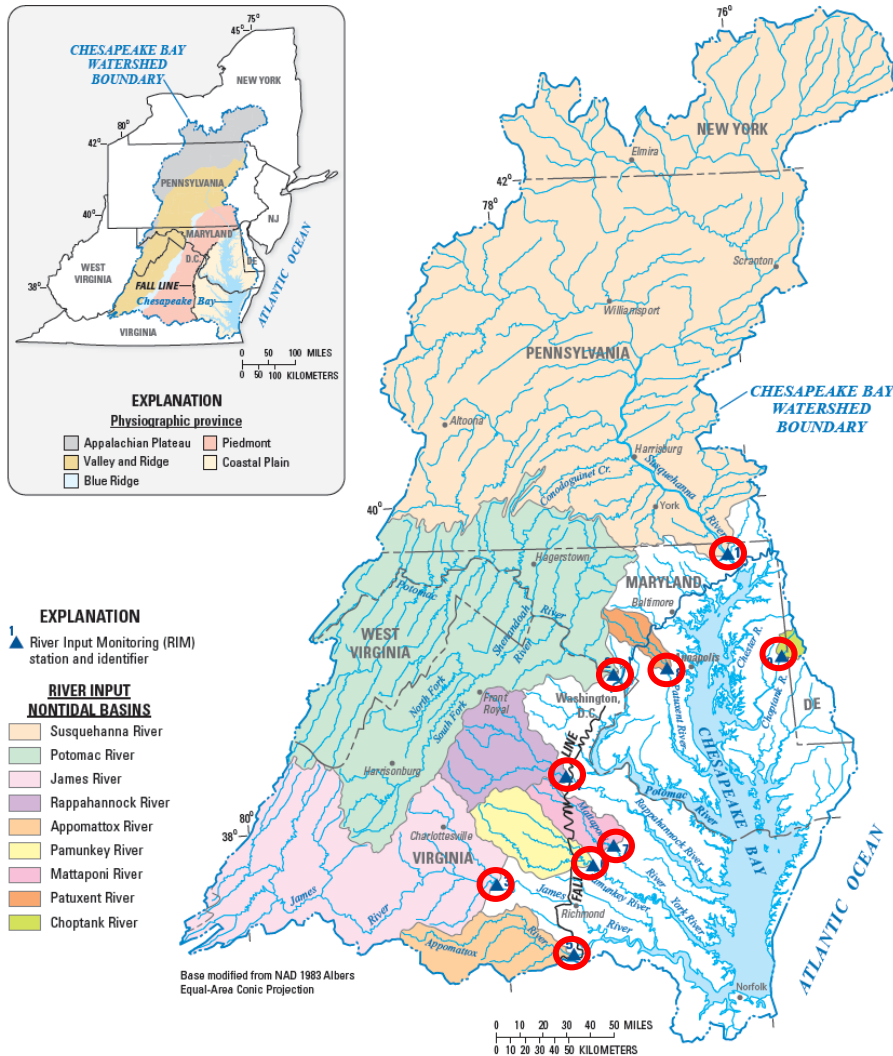
- Susquehanna
- Eastern Shore
- Western Shore
- Potomac
- Rappahannock
- York
- James





# 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



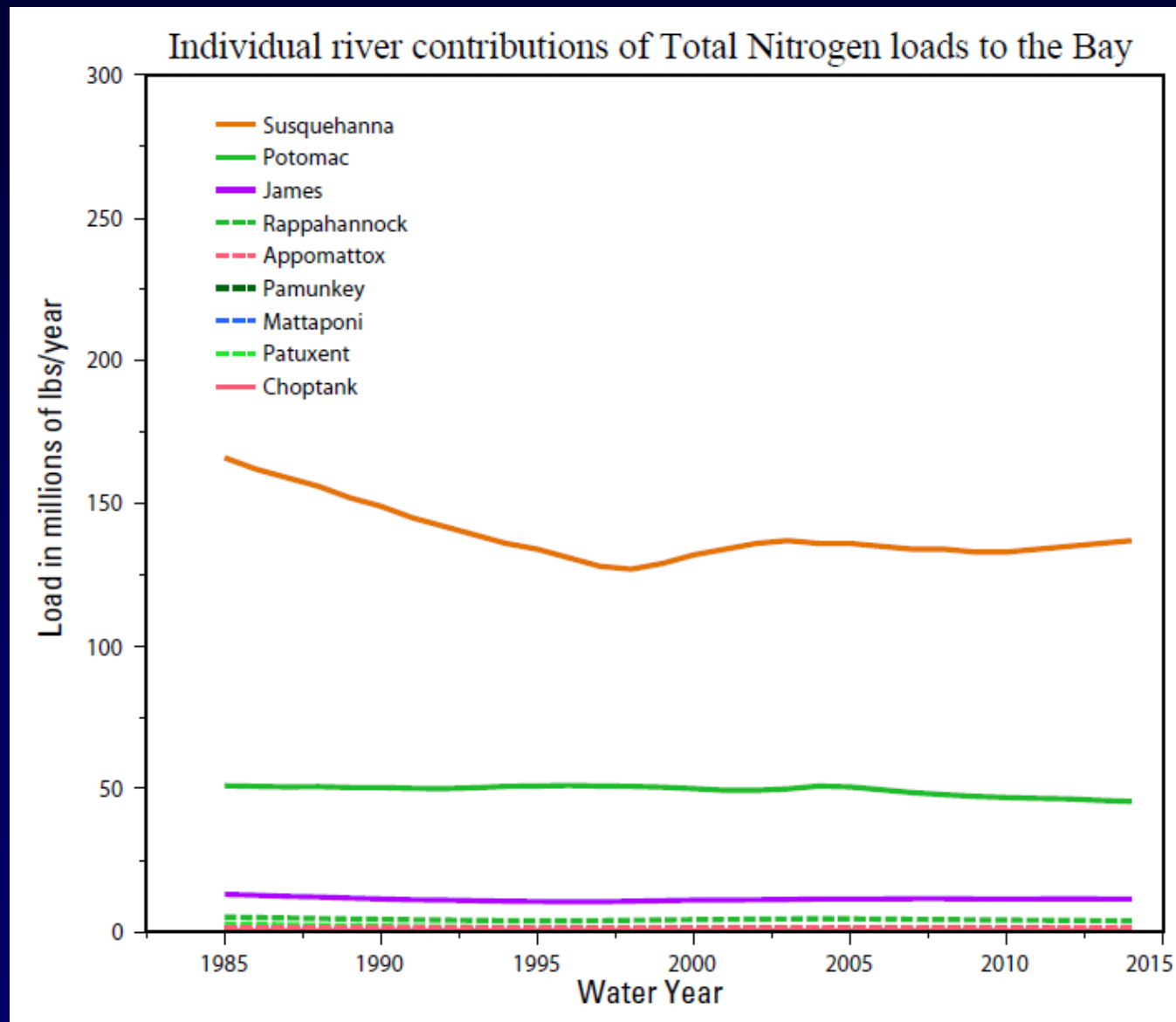
# Change in Total Nitrogen (9 RIM Stations)

2005-14

No trends: 2  
(Susquehanna  
& James)

Improving: 3  
(Potomac)

Degrading: 4



# Changes in Total Phosphorus

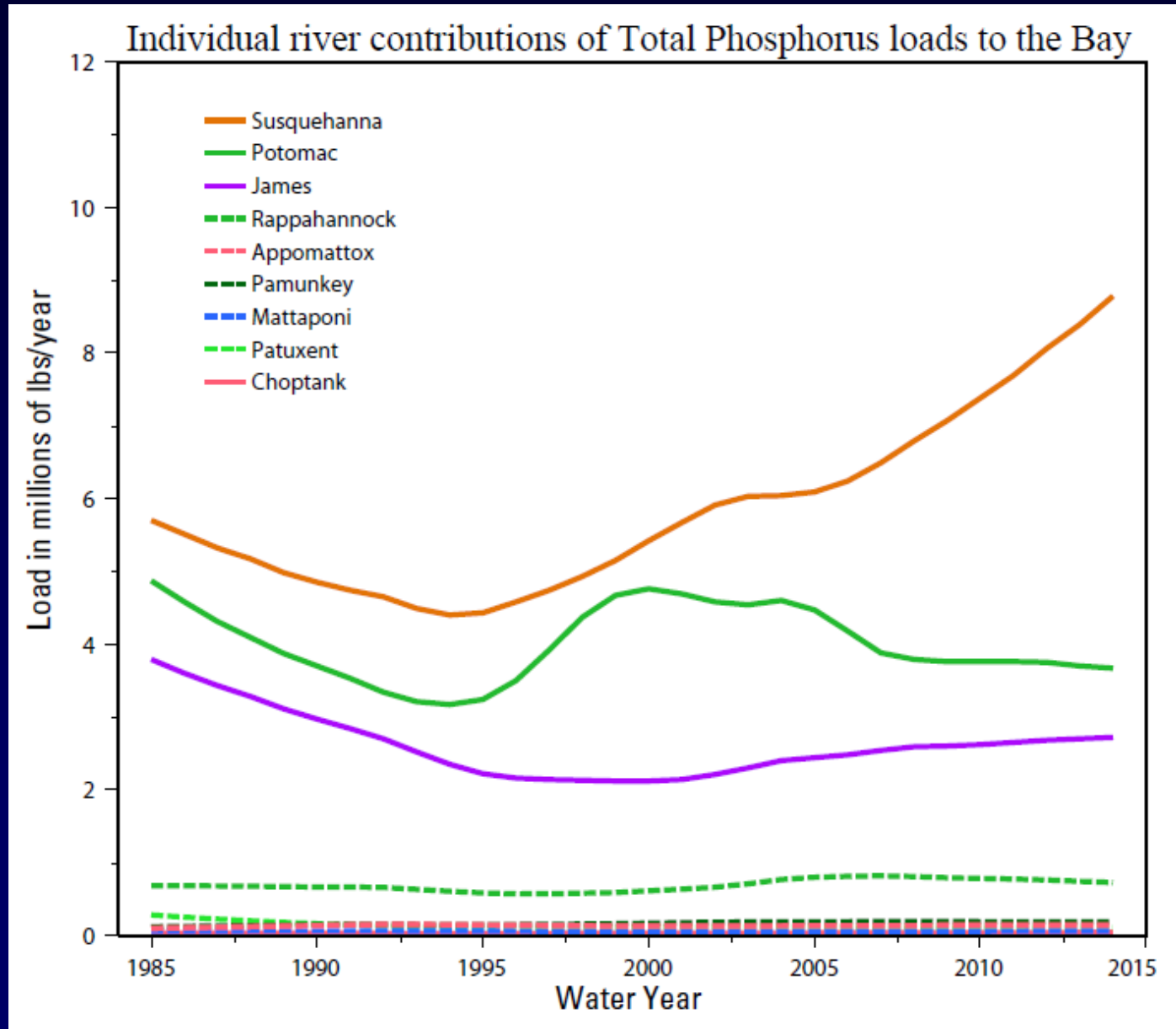
## 9 RIM Stations

2005-14

Degrading: 4  
(Susquehanna  
and James)

Improving: 2  
(Potomac)

No trends: 3



# Explaining Trends

## 1. What Works

- Upgrades to WWTPs
- Reductions in air emissions
- Some agricultural practices

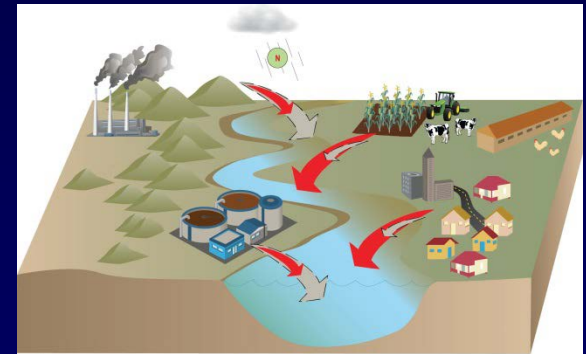
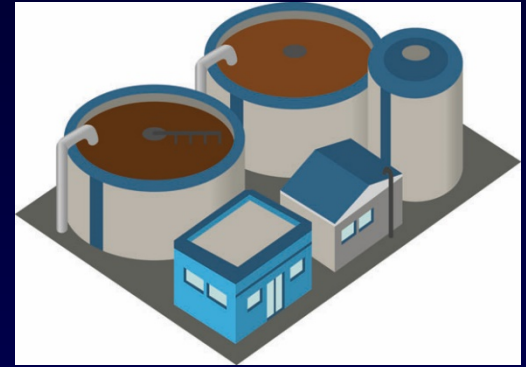
## 2. Challenges

- Response times
- Development and intensified agriculture

## 3. What We Need

- Location should guide restoration efforts
- Stormwater management and monitoring

- UMCES, USGS, EPA (2014)



# PA Highlights

- High loads per acre in some areas
  - Nitrogen: SE portion of basin
  - Phosphorus: eastern portion
- Improving trends
  - Total Nitrogen and Phosphorus
  - Mixed Results for Sediment
  - WWTP, air, selected ag practices
- Susquehanna Reservoirs counteracting improvements
  - TN: little change TP: worsening
- Other Challenges: development, intensified ag, lag times



# 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

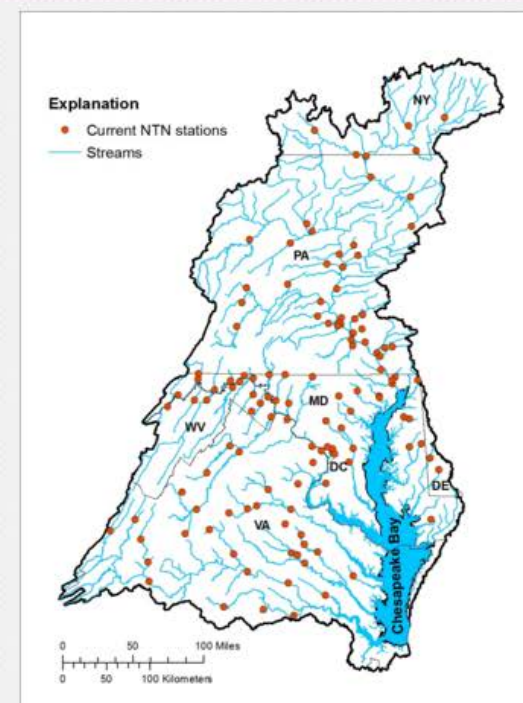
- Monitoring data are collected by numerous agencies through the nontidal monitoring partnership.
- Results are updated on even-numbered water years for the network of water-quality monitoring stations distributed throughout the Chesapeake Bay watershed.

## 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.



Click on the image above to access the interactive map