Nitrogen, Phosphorus, and Suspended Sediment:

Loads and Trends Measured from the Chesapeake Bay River Input Monitoring (RIM) Network

An update through water year 2024

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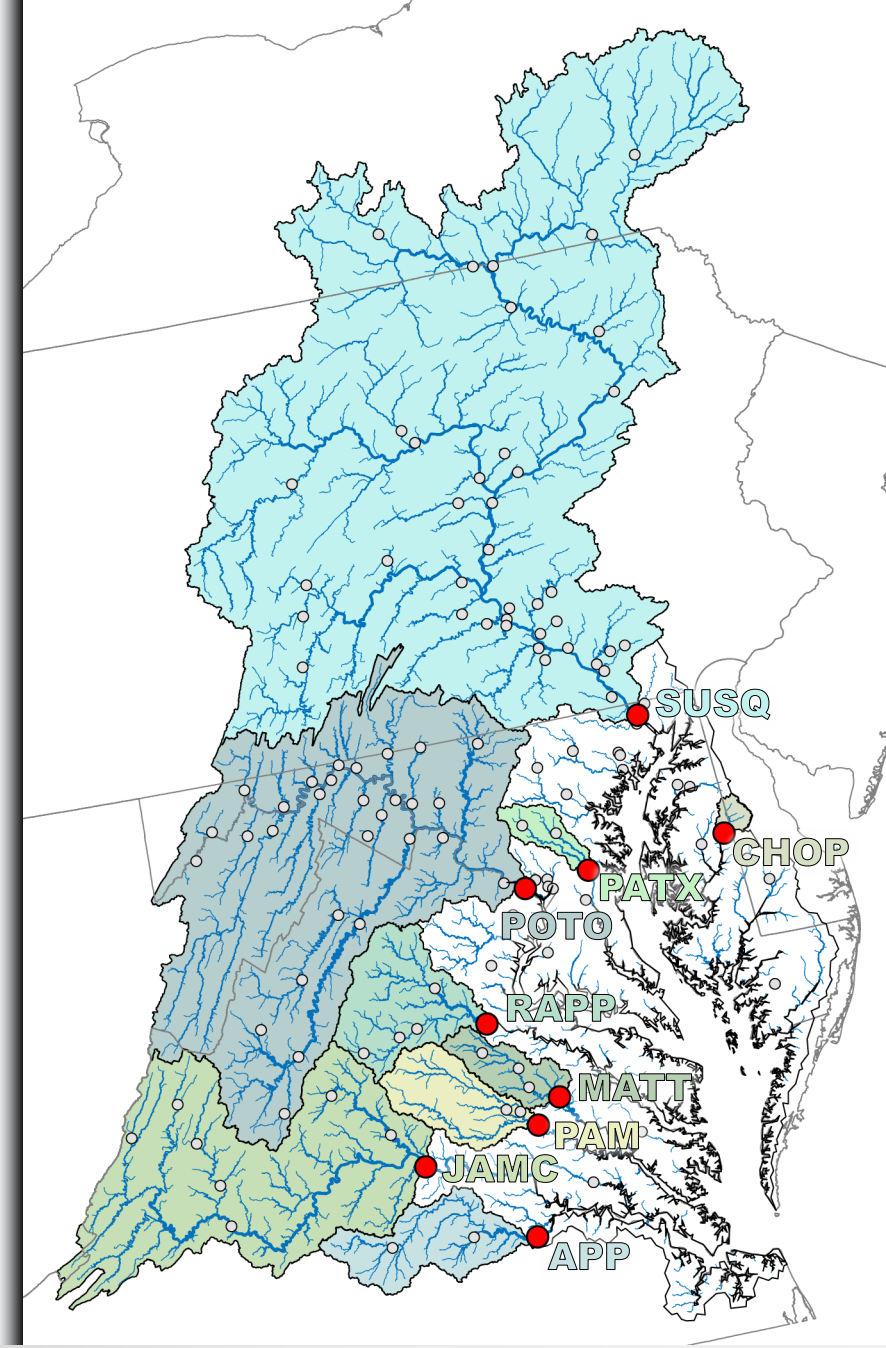
RIM loads and trends have been computed from monitoring data through water-year 2024[1].

This presentation will summarize the most recent RIM nutrient and sediment loads and trends.



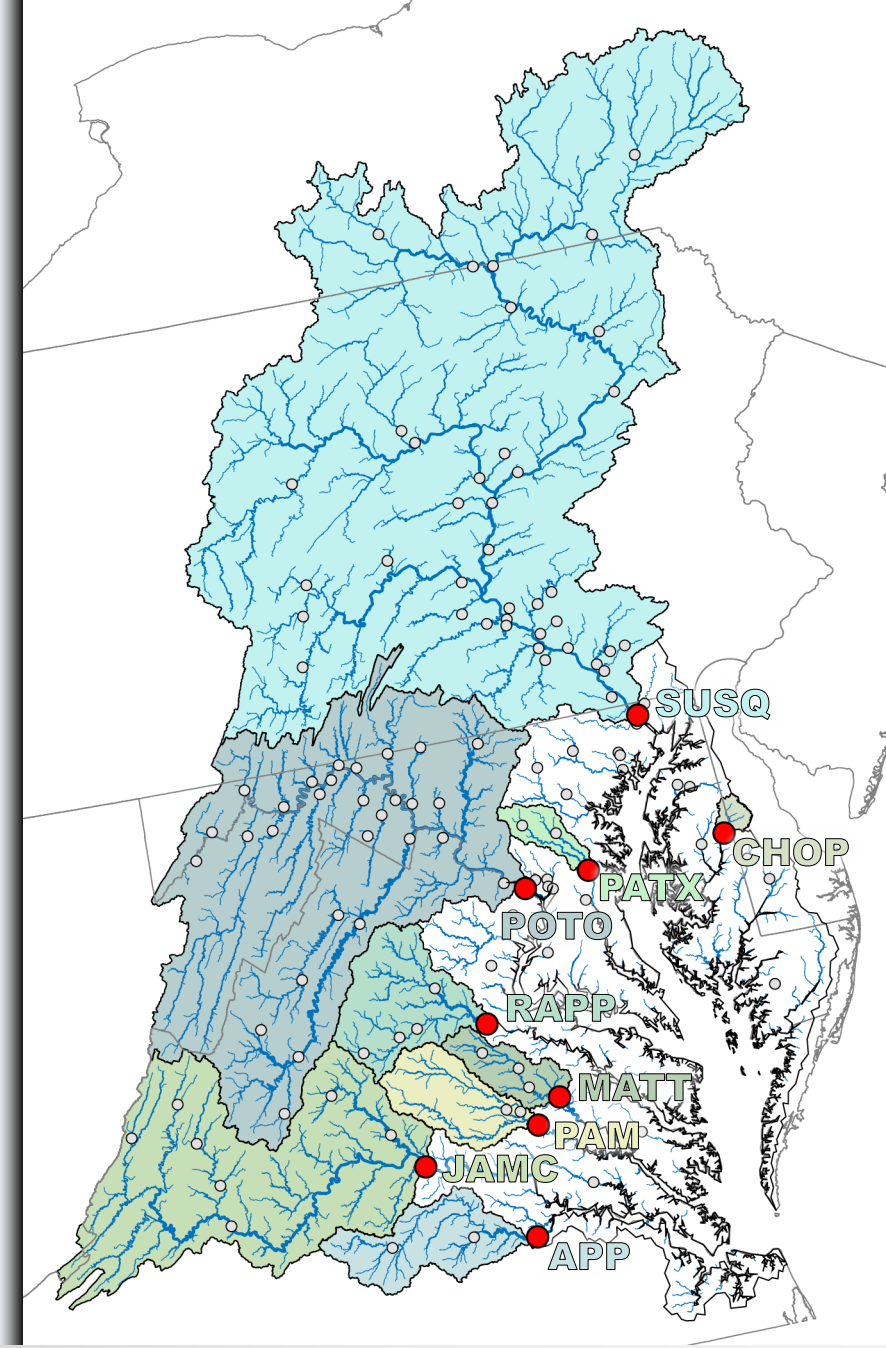
[1]Mason, C.A., and Soroka, A.M., 2025, Nitrogen, phosphorus, and suspended-sediment loads and trends measured at the Chesapeake Bay River Input Monitoring stations: Water years 1985-2024: U.S. Geological Survey data release, https://doi.org/10.5066/P14CG4D8.

Nitrogen, Phosphorus, and Suspended Sediment:

Loads and Trends Measured from the Chesapeake Bay River Input Monitoring (RIM) Network

An update through water year 2024

1. Overview of the RIM network
2. Per-Acre Loads (“Yields”) at the RIM stations
3. Trends at the RIM stations
4. Resources to learn more



Overview of the RIM network

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Background photo: Collecting a storm sample on the Appomattox River

The RIM network is used to assess water-quality conditions in the Chesapeake Bay watershed to inform management decisions

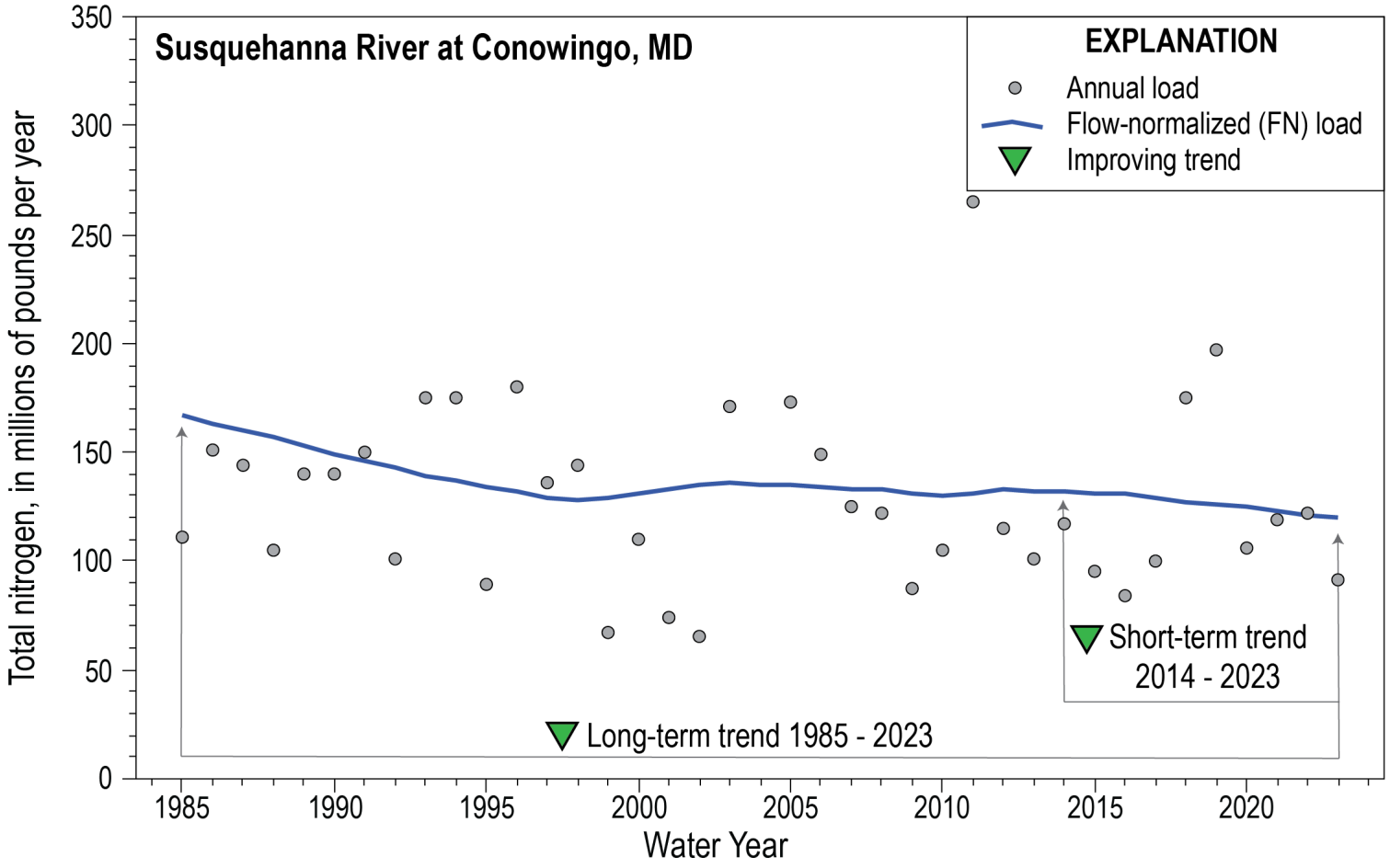
The goal of the RIM network is to compute the **load** and **trend**[1] of nitrogen, phosphorus, and suspended sediment delivered from 9 of the largest watershed tributaries to the Chesapeake Bay.

Load is the total amount of nutrients or sediment that is delivered over a time period (annually).

Flow-normalized (FN) loads remove most of the hydrologic variability associated with loads.

Trends are changes in FN load over time.

- **"Improving"** = a decrease over time
- **"Degrading"** = an increase over time
- **"No trend"** = no meaningful change over time



[1]Loads and trends are computed using WRTDS (Weighted Regressions on Time, Discharge, and Season).

Monitoring data are used to compute water-quality load and trends

The USGS collects monthly and storm-targeted water-quality samples from the 9-station RIM network.

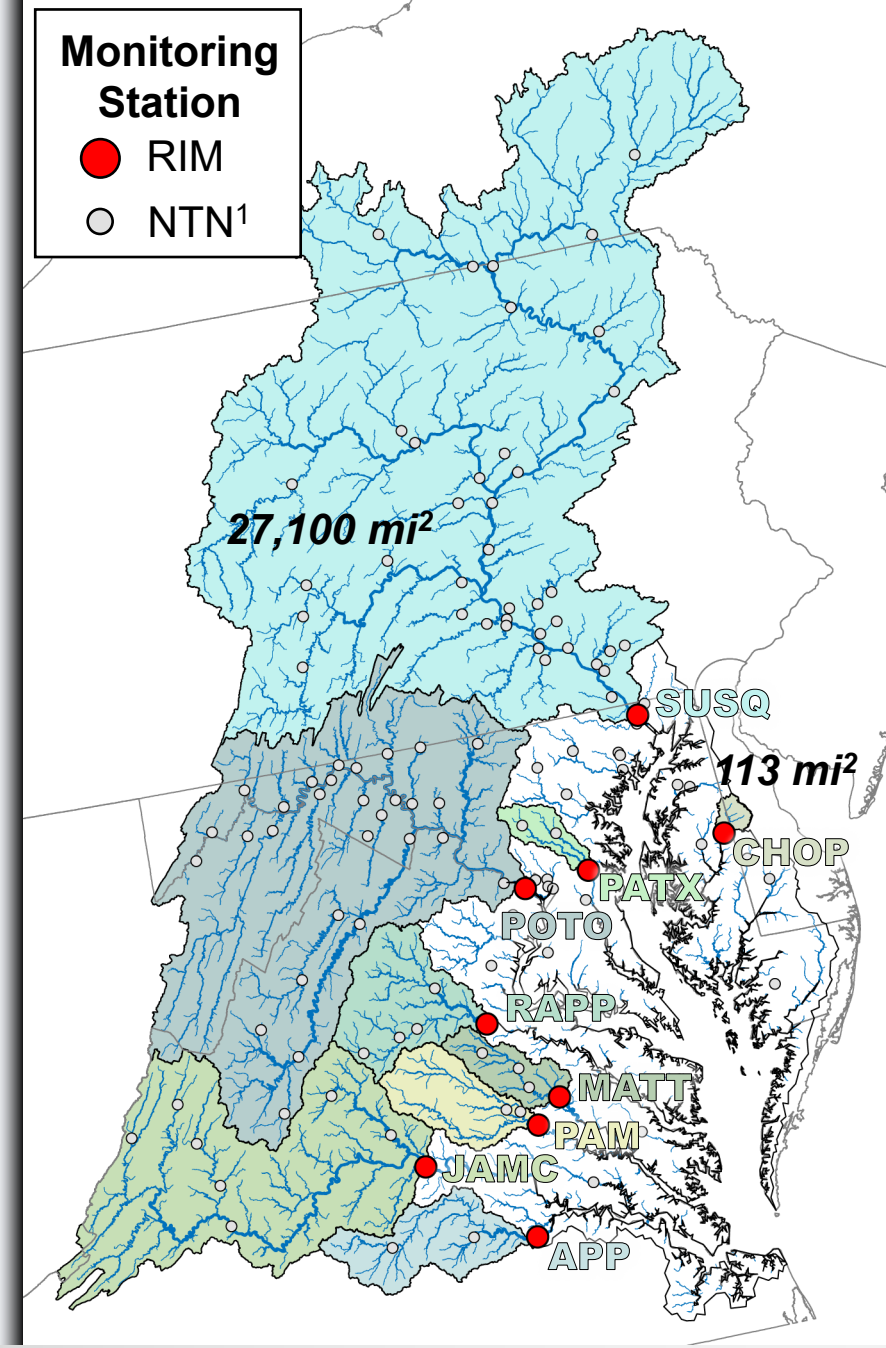
RIM stations represent about 78% of the Chesapeake Bay watershed area

Maryland

- **SUSQ:** Susquehanna River at Conowingo
- **CHOP:** Choptank River nr Greensboro
- **PATX:** Patuxent River nr Bowie
- **POTO:** Potomac River at Chain Bridge

Virginia

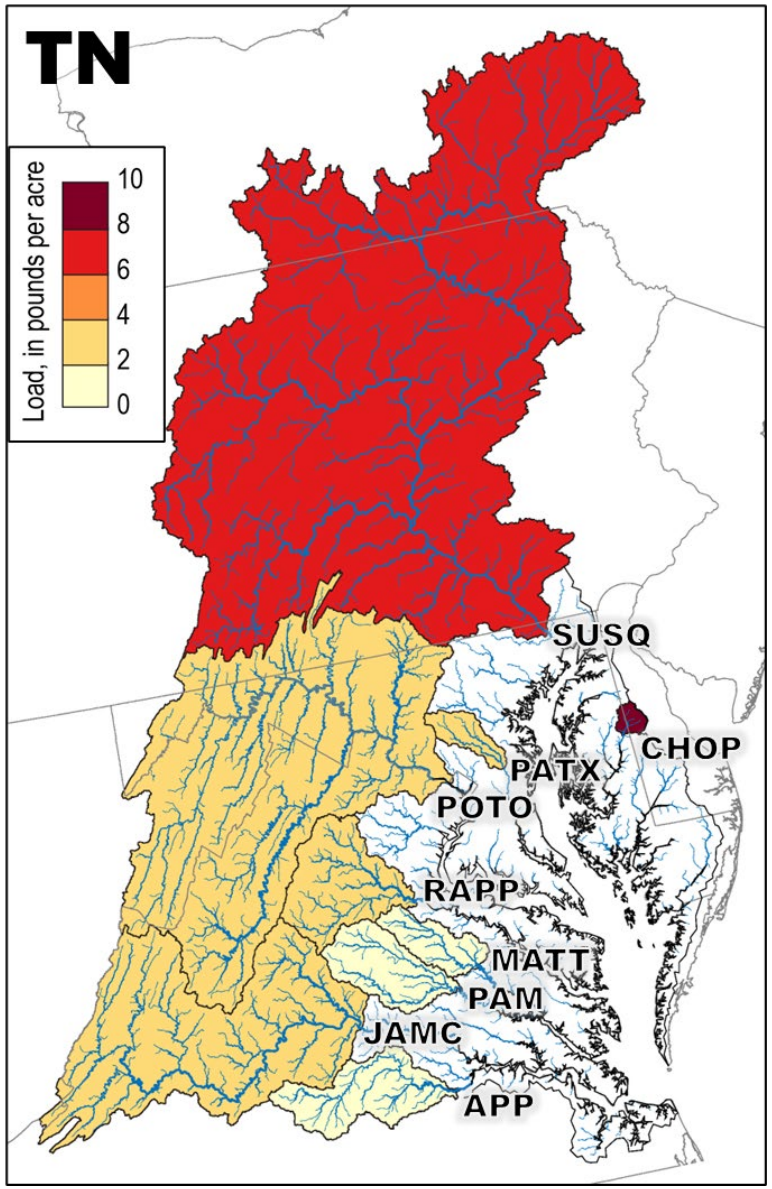
- **RAPP:** Rappahannock River nr Fredricksburg
- **MATT:** Mattaponi River nr Beulahville
- **PAM:** Pamunkey River nr Hanover
- **JAMC:** James River at Cartersville
- **APP:** Appomattox River at Matoaca

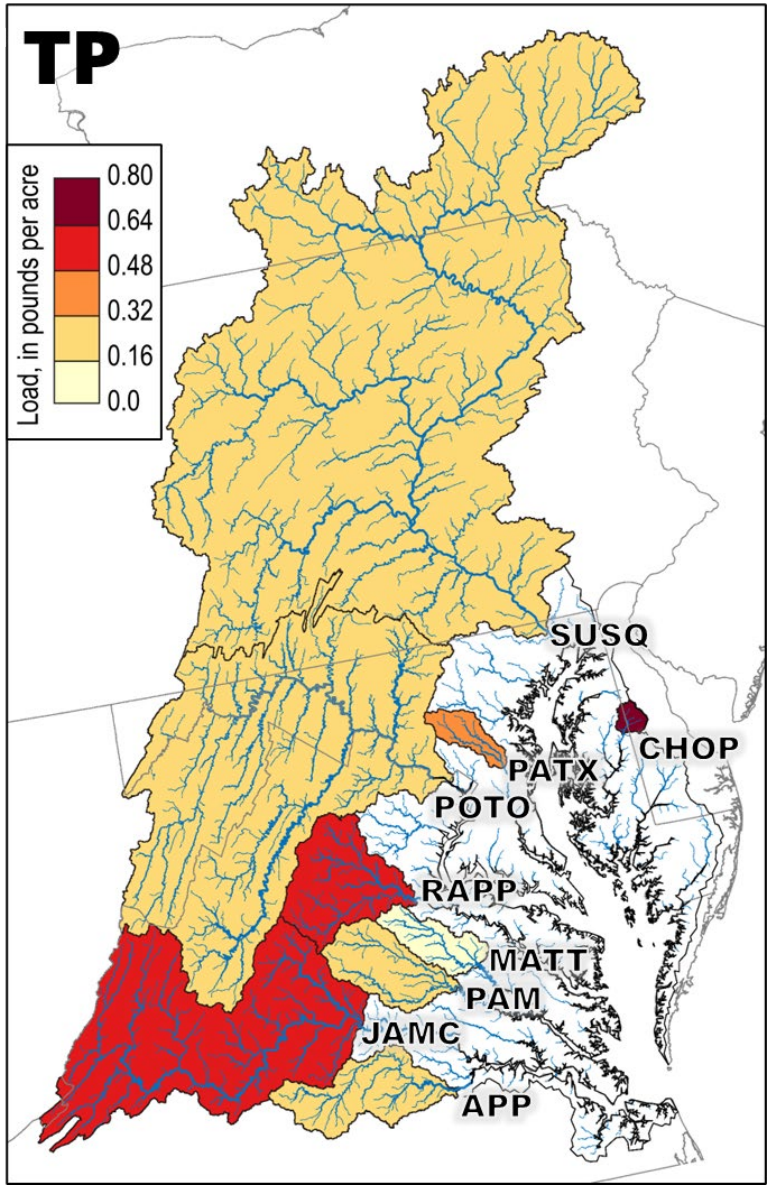


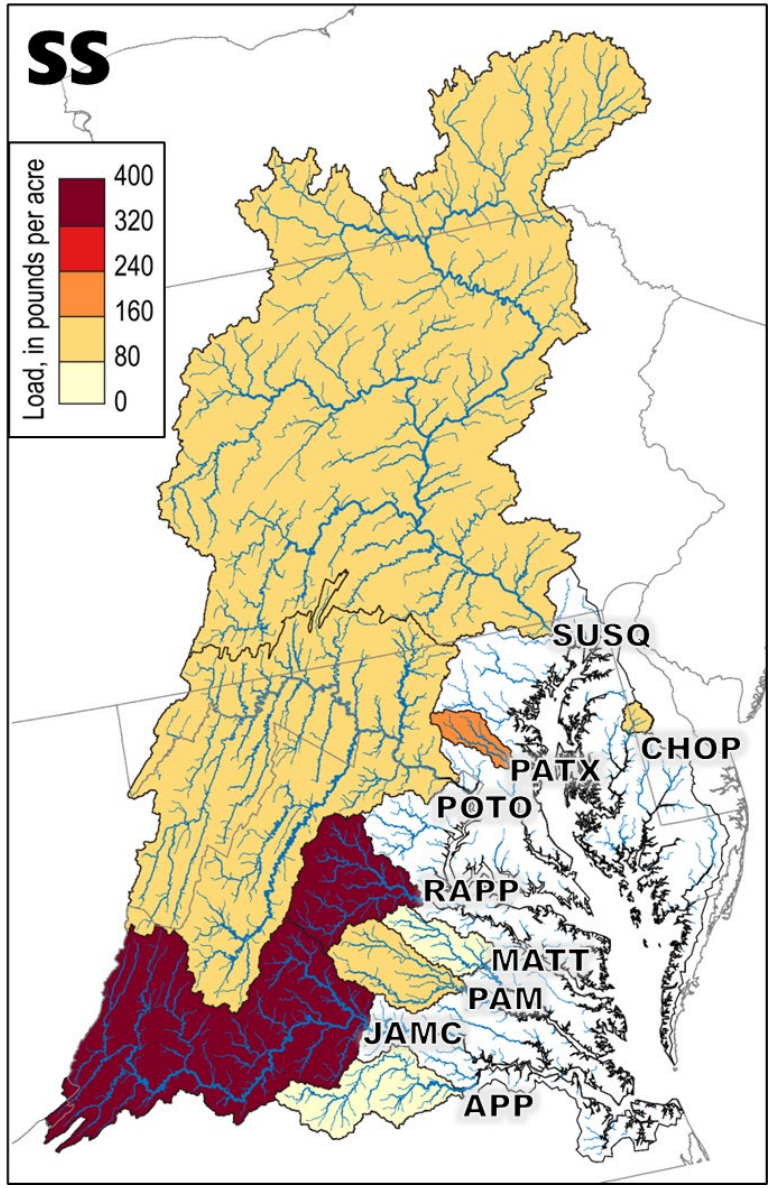
[1]NTN loads and trends are available through water year 2023: https://doi.org/10.5066/P13P4TWR.

Per-acre loads (yields) at the RIM stations

Per-Acre Loads: 2020 – 2024 Average (most recent 5 years of data)



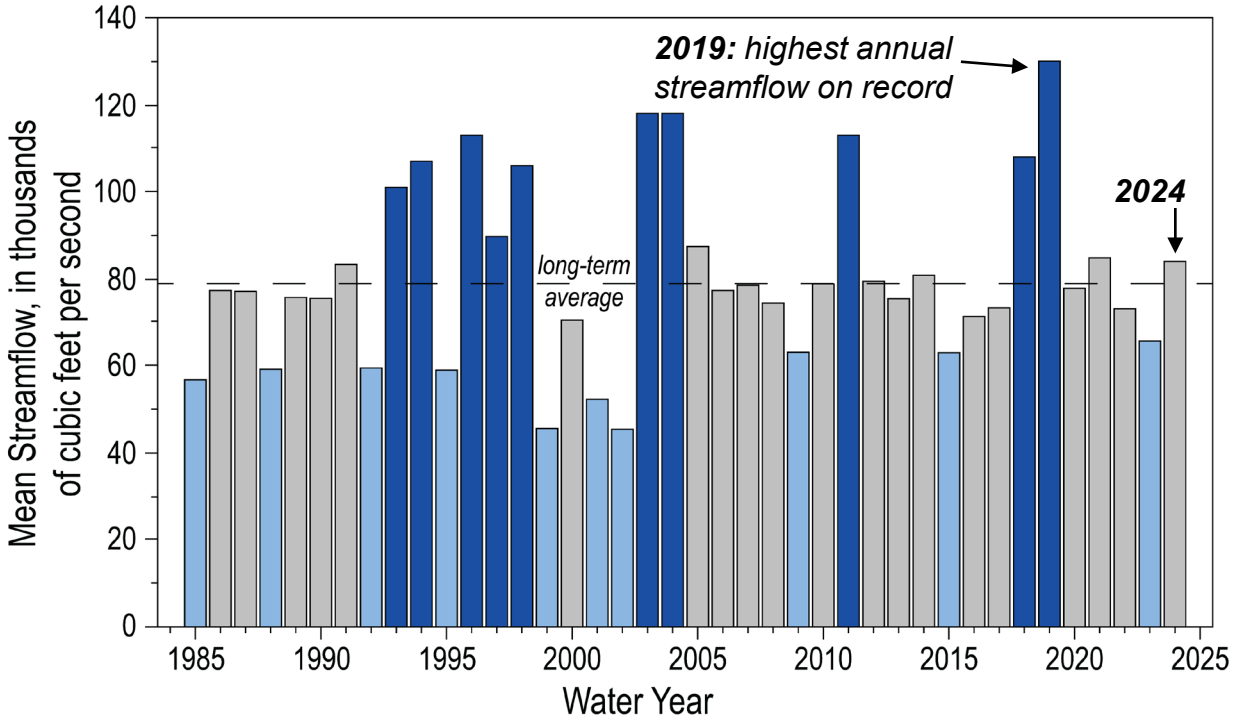




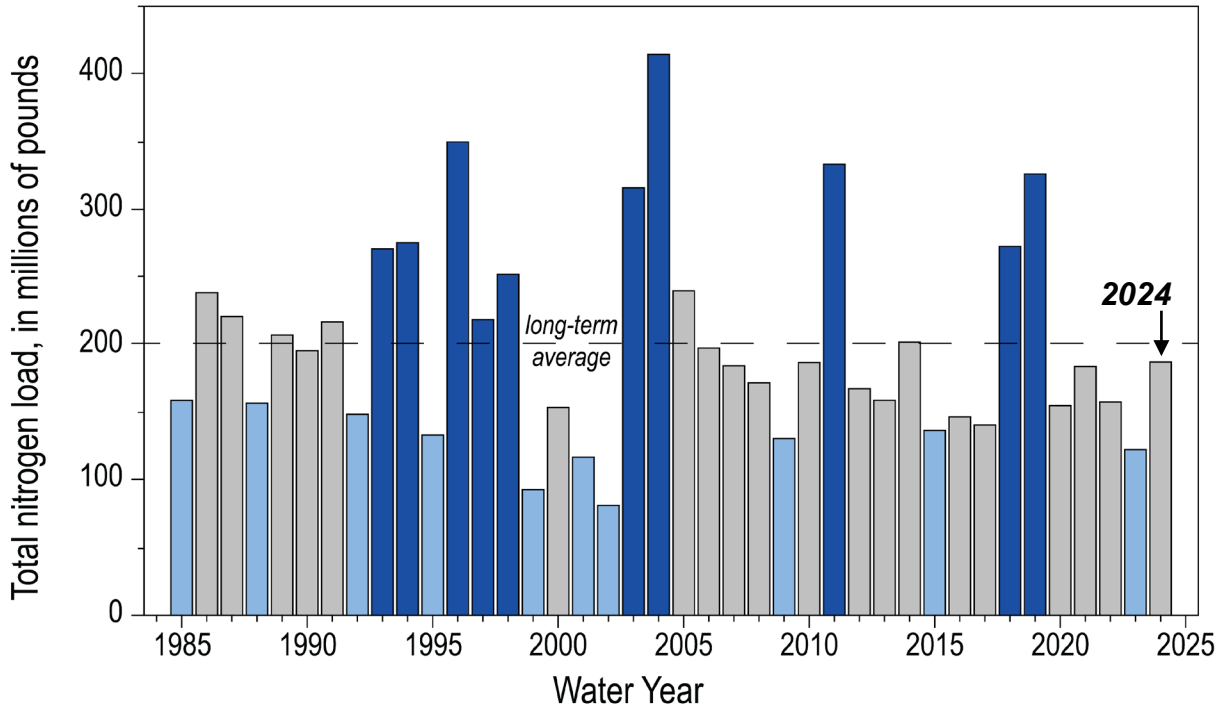

Trends at the RIM stations

In 2024, above average streamflow delivered below-average loads

The estimated annual-mean streamflow entering the Bay[1] in water year 2024 was about **4% higher** than the long-term average[2].



Loads of TN, NOx, TP, PO4, and SS from the RIM watershed in 2024 were **less** than long-term average[2] loads.



EXPLANATION

- Below 25th percentile of all annual observations
- Between 25th and 75th percentiles of all annual observations
- Above 75th percentile of all annual observations

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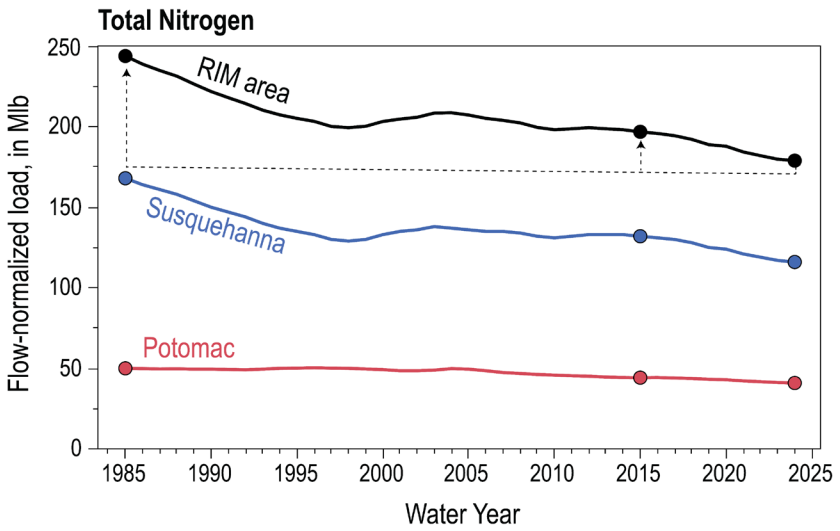
[1]Streamflow entering the Bay estimated from monitored and unmonitored watershed area: www.usgs.gov/centers/chesapeake-bay-activities/science/freshwater-flow-chesapeake-bay

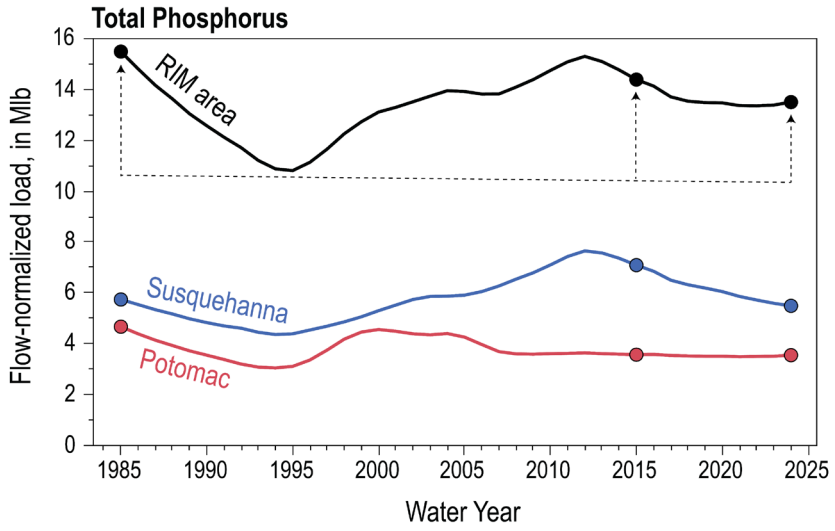
[2]Long-term average = 1985 – 2024.

FN nutrient and sediment loads have decreased from the RIM watershed area over time



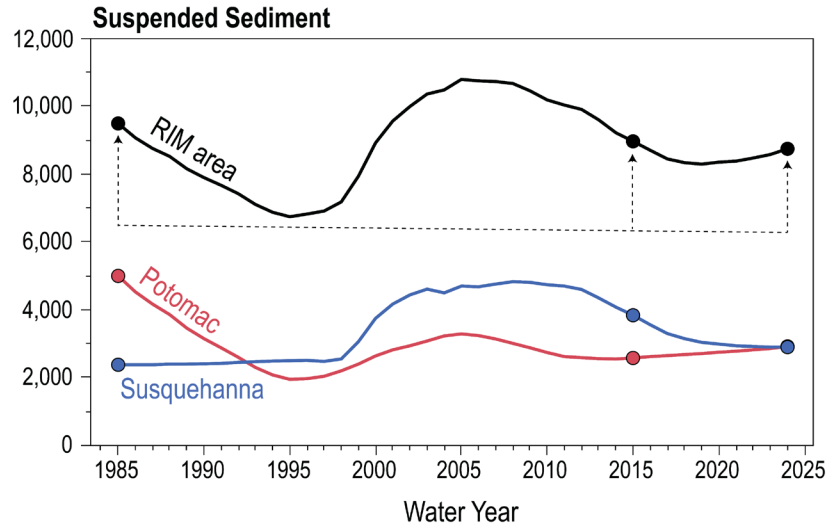
RIM FN total nitrogen loads

-9% from 2015 – 2024
-33% from 1985 – 2024



RIM FN total phosphorus loads

-6% from 2015 – 2024
-14% from 1985 – 2024



RIM FN suspended sediment loads

-3% from 2015 – 2024
-8% from 1985 – 2024

The Susquehanna and Potomac are the largest RIM watersheds. FN loads from these two stations typically represent 70 – 90% of the total RIM FN load.

The RIM network has a similar number of improving and degrading trend results

Trend Summary

- 13 trends have improved and 11 have degraded since 1985.
- 8 trends have improved and 12 have degraded since 2015.

Good News

- All trends improved at Susquehanna since 2015.
- TN trends improved at all MD RIM stations since 2015.

Concerns

- The Choptank has the highest TP per-acre load and a large TP increase since 2015.
- Other than the Pamunkey, loads were higher in 2024 than 2015 at all Virginia RIM stations.

	RIM Monitoring Station	Long term: 1985 - 2024			Short term: 2015 - 2024		
		TN	TP	SS	TN	TP	SS
Maryland RIM stations	SUSQ	-31.2%	-4.6%	+21.5%	-12.4%	-22.8%	-24.8%
	CHOP	-2.5%	+77.4%	-34.3%	-4.5%	+20.2%	-7.5%
	PATX	-69.5%	-66.8%	-44.0%	-21.0%	-5.5%	-4.5%
	POTO	-18.4%	-24.3%	-41.7%	-7.6%	-1.0%	+13.1%
Virginia RIM stations	RAPP	-15.6%	+31.2%	+50.0%	+7.3%	+7.6%	+1.7%
	MATT	-6.4%	+6.4%	+8.6%	+1.7%	+8.9%	+26.9%
	PAM	-1.3%	+59.2%	+36.3%	-3.9%	+1.0%	-9.9%
	JAMC	-8.0%	-22.1%	+40.3%	+11.2%	+25.8%	+20.9%
	APPO	+6.4%	+99.5%	+44.2%	+5.4%	+23.4%	+38.9%

Trend Direction Improving Degrading No trend

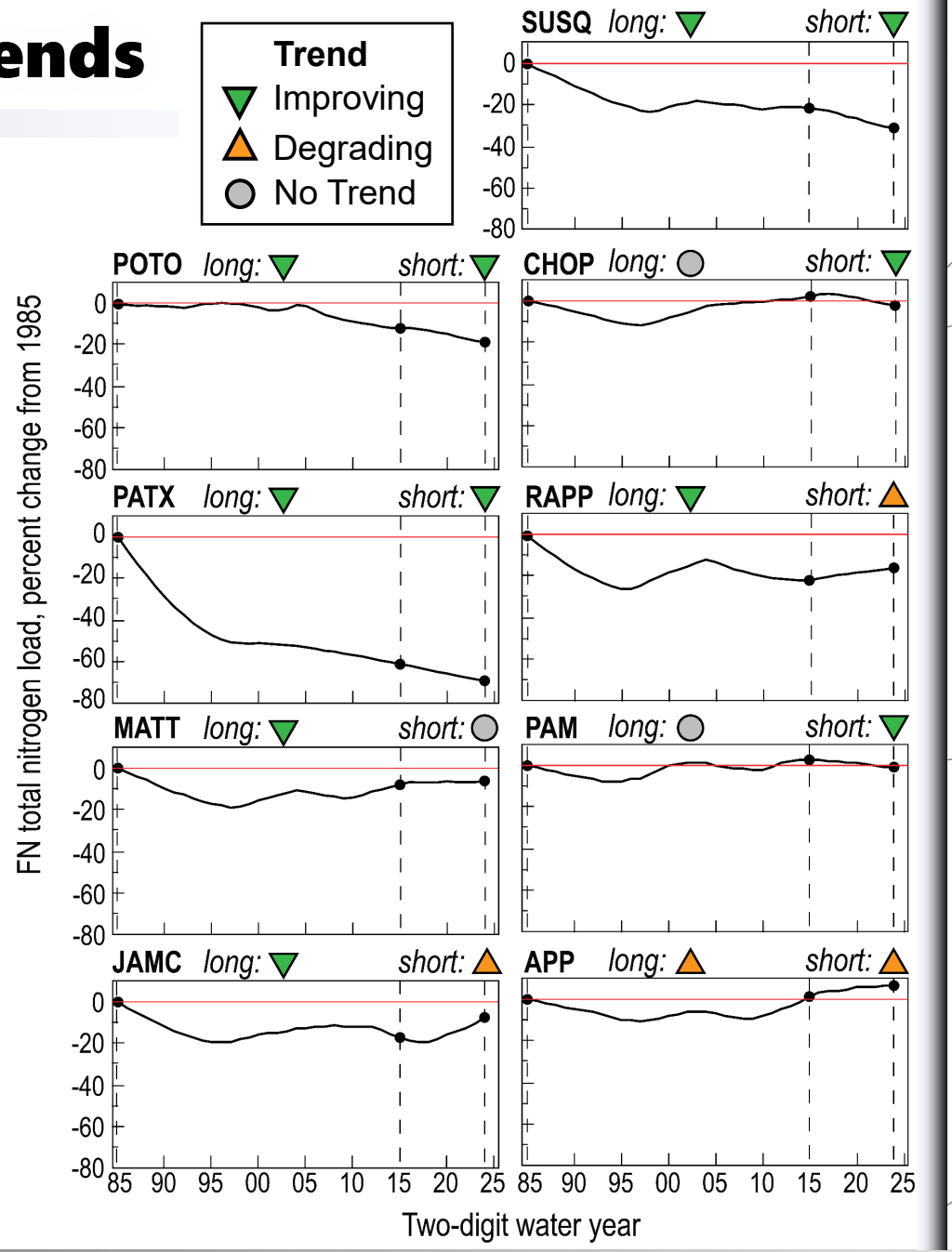
Total Nitrogen Trends

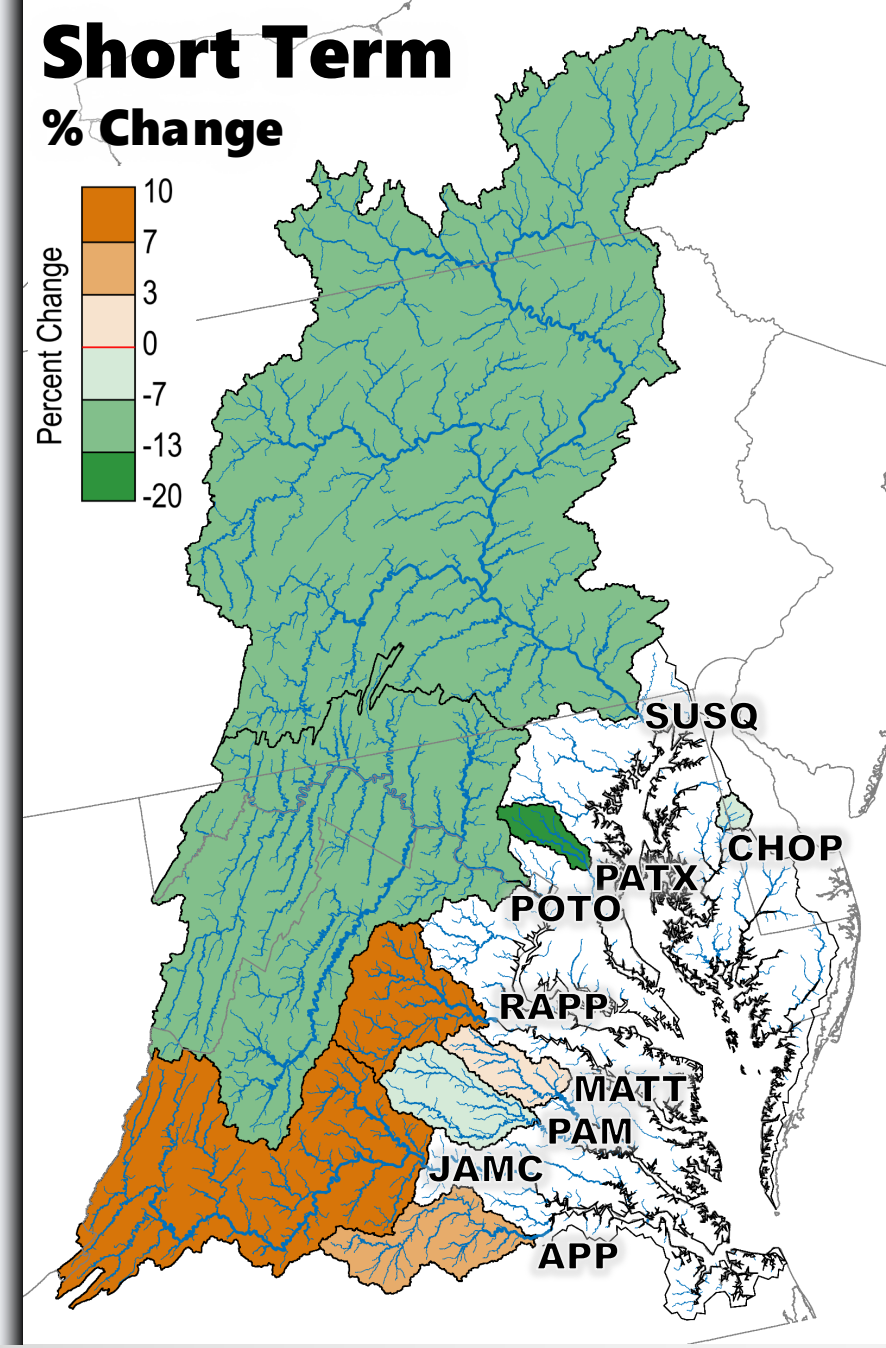
Since 1985:
- 6 stations have improved
- 1 station has degraded
- 2 stations have no trend

Since 2015:
- 5 stations have improved
- 3 stations have degraded
- 1 station has no trend

The largest percent decrease since 2015 has been at the Patuxent River (-21.0%).

The largest percent increase since 2015 has been at the James River (+11.2%).





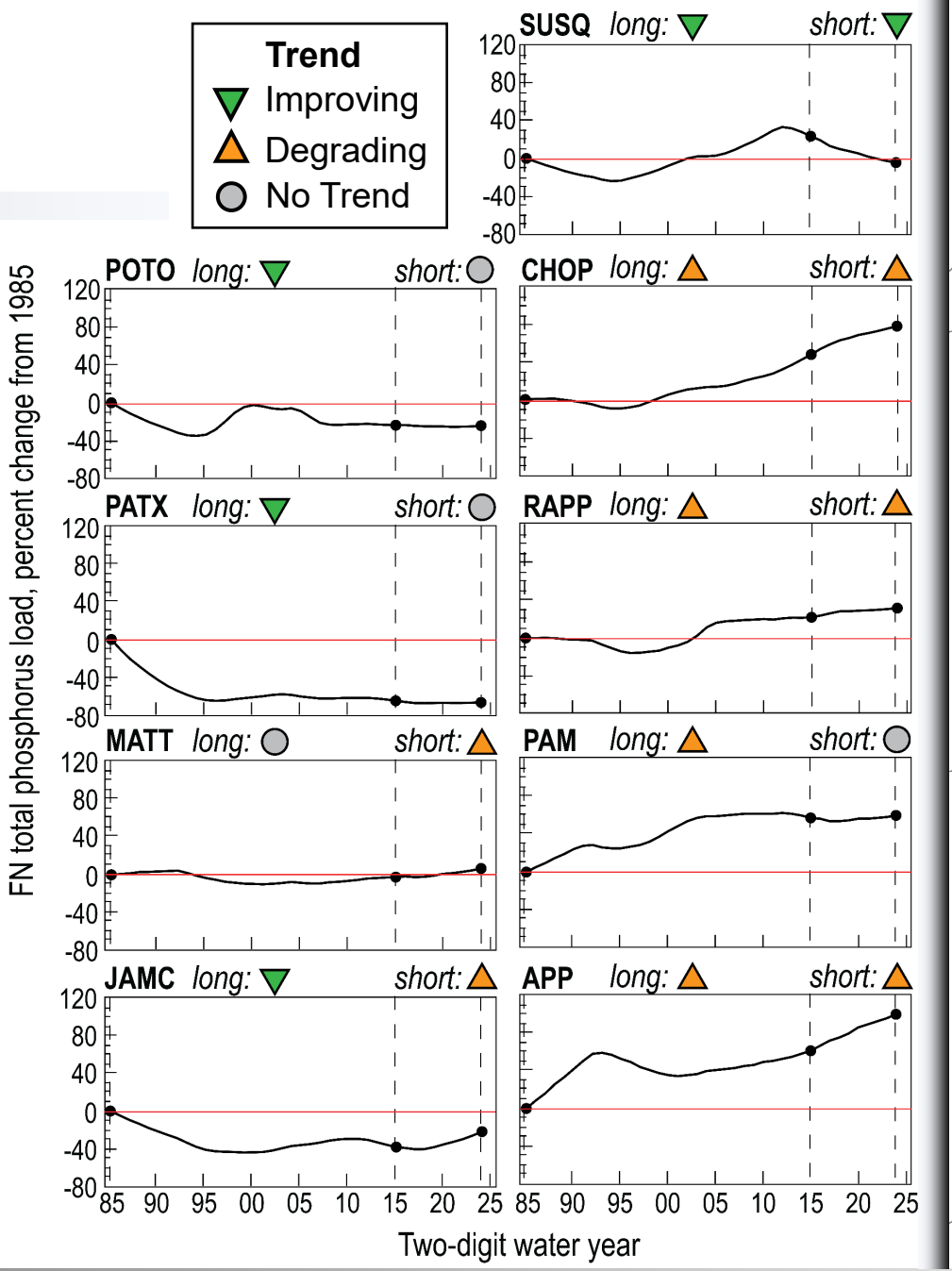
Total Phosphorus Trends

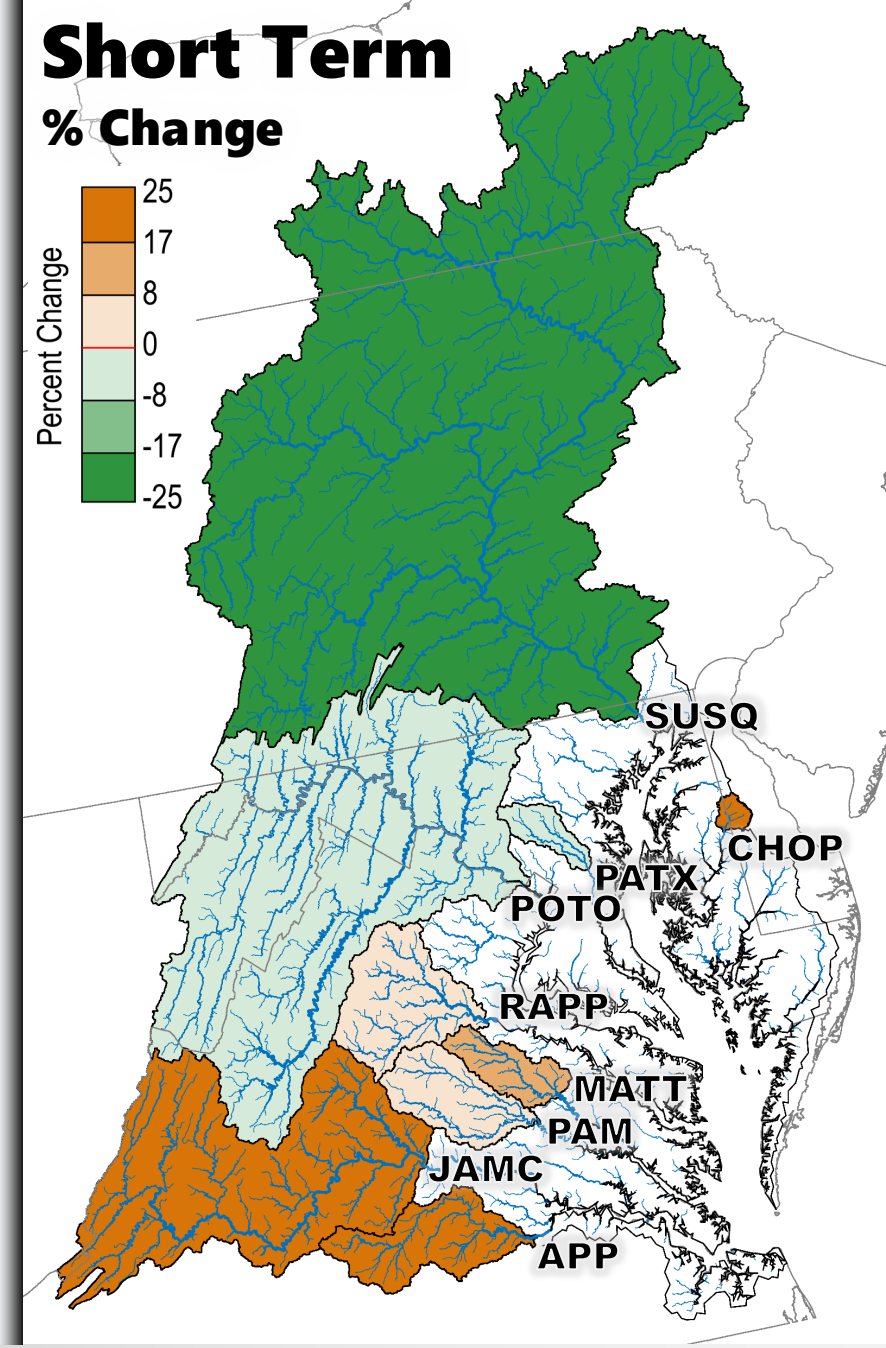
Since 1985:
- 4 stations have improved
- 4 stations have degraded
- 1 station has no trend

Since 2015:
- 1 station has improved
- 5 stations have degraded
- 3 stations have no trend

The largest percent decrease since 2015 has been at the Susquehanna River (-22.8%).

The largest percent increase since 2015 has been at the James River (+25.8%).





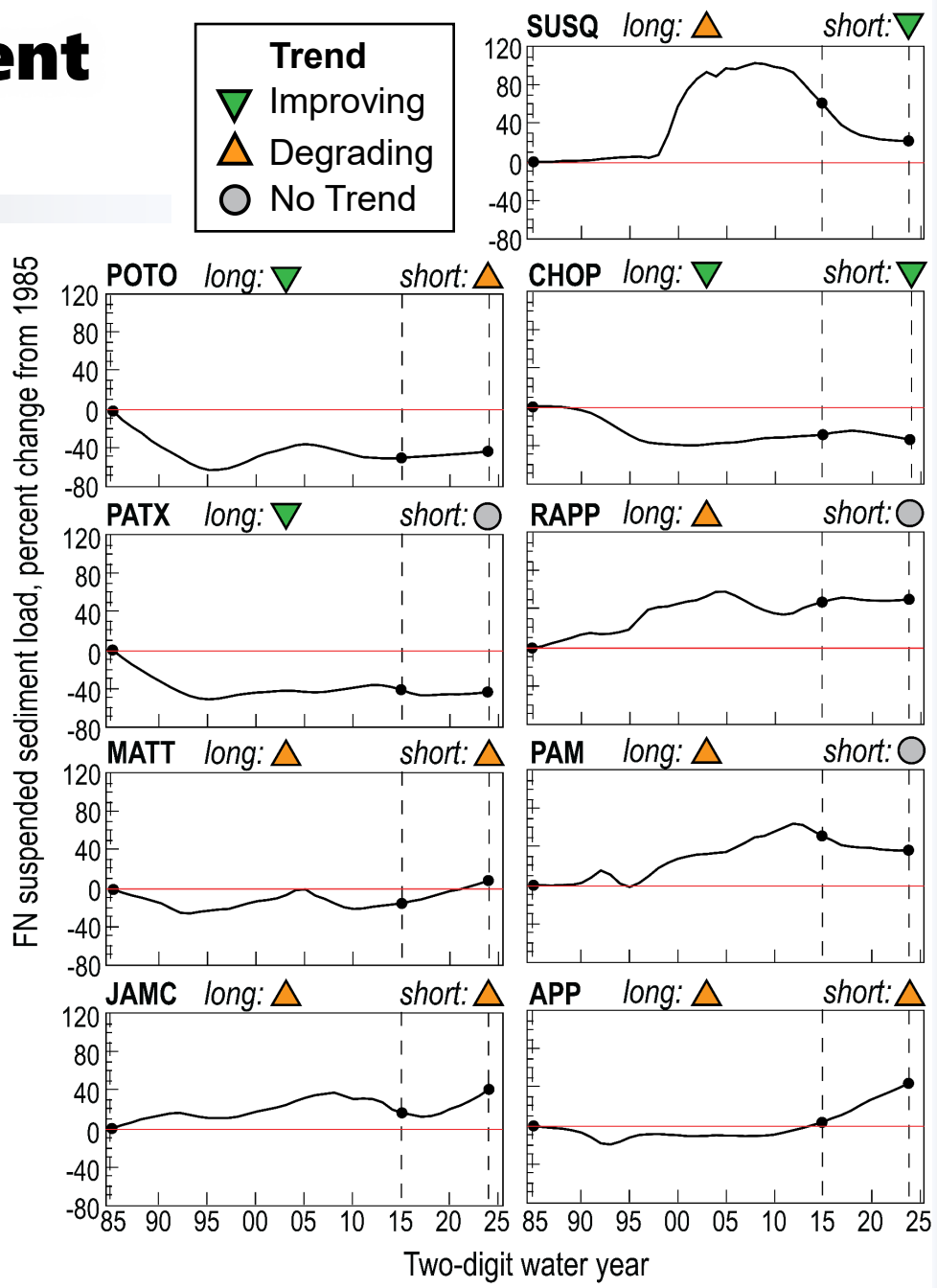
Suspended Sediment Trends

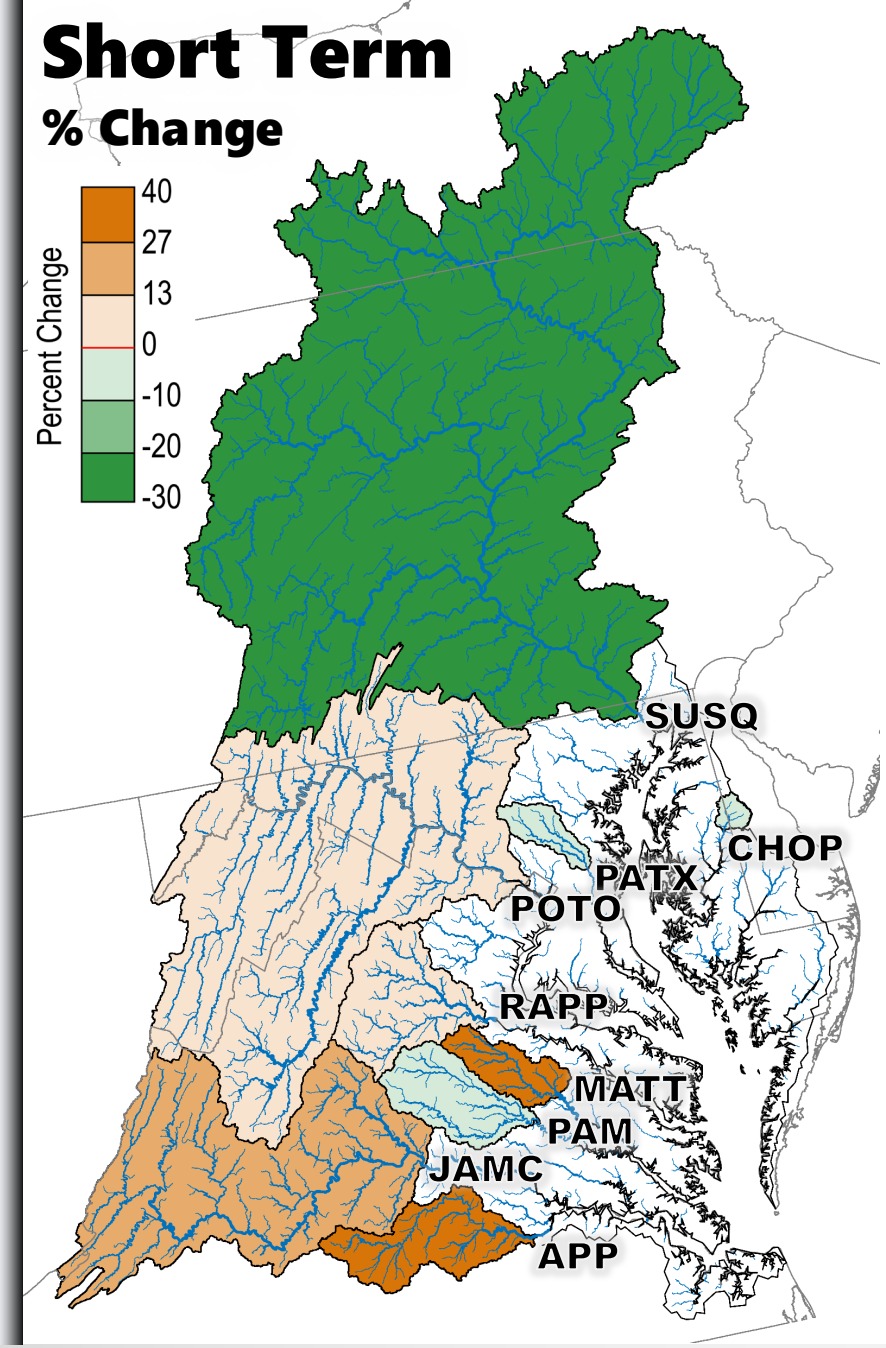
Since 1985:
- 3 stations have improved
- 6 stations have degraded

Since 2015:
- 2 stations have improved
- 4 stations have degraded
- 3 stations have no trend

The largest percent decrease since 2015 has been at the Susquehanna (-24.8%).

The largest percent increase since 2015 have been at the Appomattox River (+38.9%).





Watershed loads likely explain some tidal trends

Watershed Area

- RIM Watershed
- Chesapeake Bay

RIM Trend: Load
2015 – 2024
Flow Normalized

- Increase
- Decrease
- No Trend

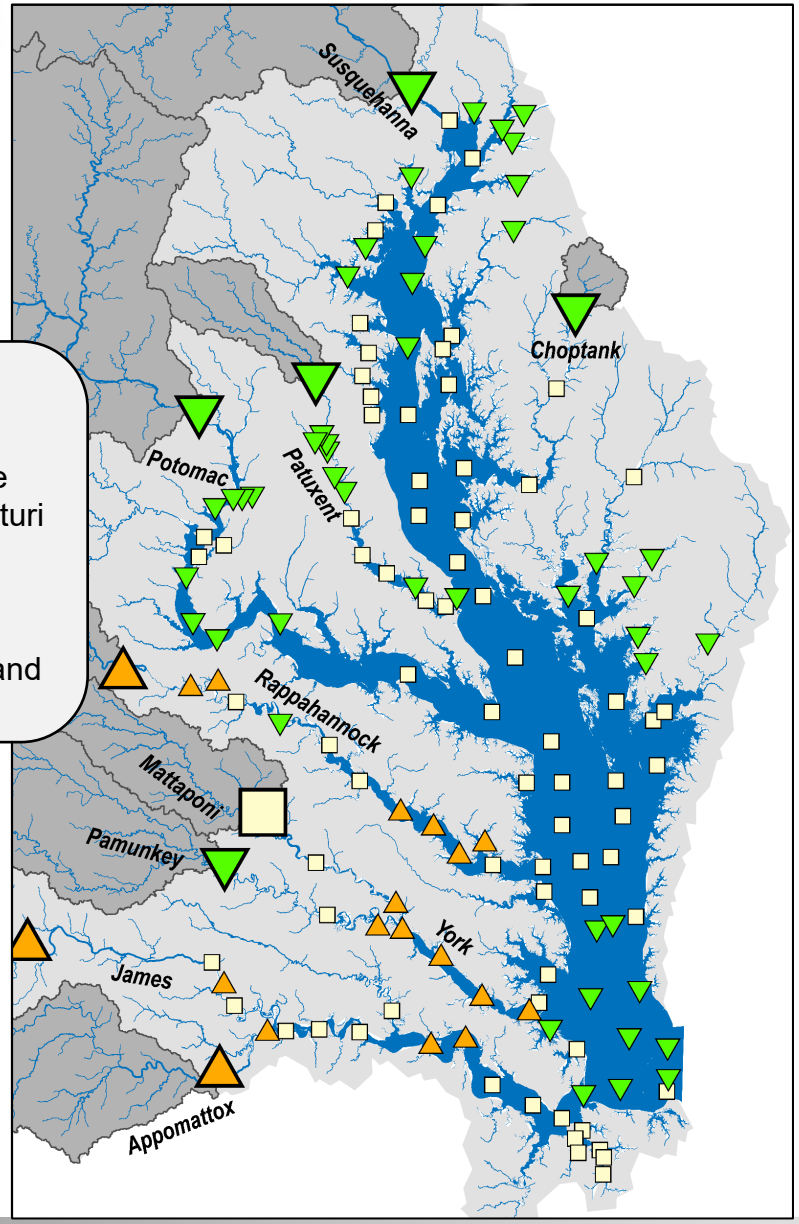
The tidal trends team:

Rebecca Murphy (UMCES/CBP), Renee Karrh (MDDNR), Mike Lane (ODU), Cindy Johnson (DEQ), Efeturi Oghenekaro, Blessing Edje and George Onyullo (DOEE); Mukhtar Ibrahim (MWCOG), Breck Sullivan (USGS), Kaylyn Gootman (EPA), and Gabriel Duran (CRC)

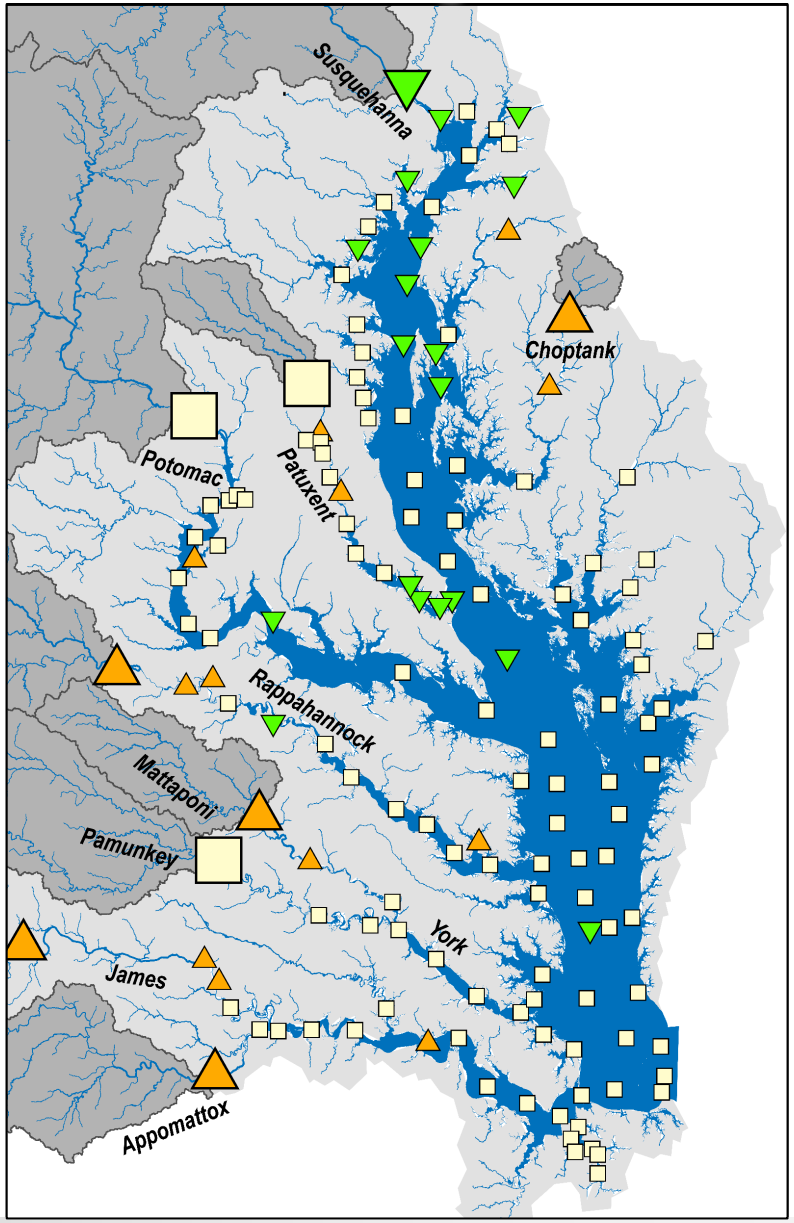
Tidal Trend[1]: Surface Concentration
2015/16 – 2023/24
Non-linear with Flow Adjustment

- Significant increase
- Significant decrease
- Possible or unlikely change

Total Nitrogen



Total Phosphorus



[1]Tidal water-quality trend results are available online: chesapeakebay.net/who/projects-archive/integrated-trends-analysis-team

Resources to learn more

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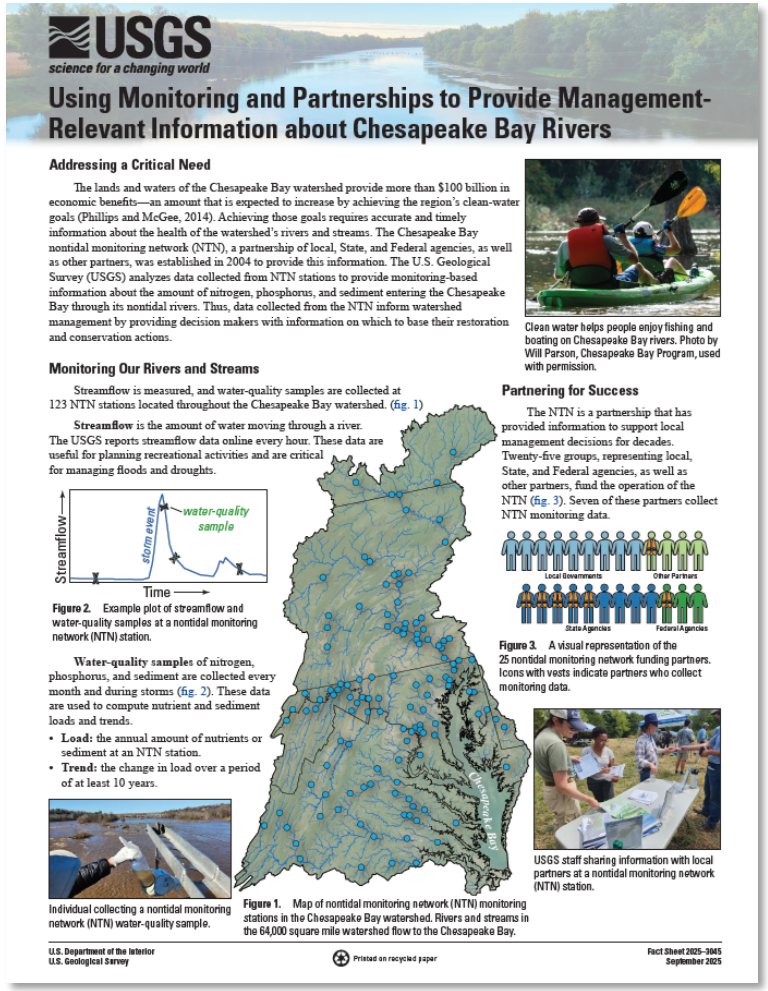
Background photo: stormflow at the Mattaponi River

Learn More!

The project website includes access to the most recent data and a summary of results: usgs.gov/CB-wq-loads-trends

A recently published fact sheet summarizes the importance of this monitoring network: [doi.org/10.3133/fs20253045](doi.org/10.3133/fs20253045)



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Using Monitoring and Partnerships to Provide Management-Relevant Information about Chesapeake Bay Rivers

Addressing a Critical Need

The lands and waters of the Chesapeake Bay watershed provide more than $100 billion in economic benefits—an amount that is expected to increase by achieving the region's clean-water goals (Phillips and McGee, 2014). Achieving those goals requires accurate and timely information about the health of the watershed's rivers and streams. The Chesapeake Bay nontidal monitoring network (NTN), a partnership of local, State, and Federal agencies, as well as other partners, was established in 2004 to provide this information. The U.S. Geological Survey (USGS) analyzes data collected from NTN stations to provide monitoring-based information about the amount of nitrogen, phosphorus, and sediment entering the Chesapeake Bay through its nontidal rivers. Thus, data collected from the NTN inform watershed management by providing decision makers with information on which to base their restoration and conservation actions.

Clean water helps people enjoy fishing and boating on Chesapeake Bay rivers. Photo by Will Parson, Chesapeake Bay Program, used with permission.

Monitoring Our Rivers and Streams

Streamflow is measured, and water-quality samples are collected at 123 NTN stations located throughout the Chesapeake Bay watershed. (fig. 1)

Streamflow is the amount of water moving through a river. The USGS reports streamflow data online every hour. These data are useful for planning recreational activities and are critical for managing floods and droughts.

Figure 2. Example plot of streamflow and water-quality samples at a nontidal monitoring network (NTN) station.

Water-quality samples of nitrogen, phosphorus, and sediment are collected every month and during storms (fig. 2). These data are used to compute nutrient and sediment loads and trends.

- **Load:** the annual amount of nutrients or sediment at an NTN station.
- **Trend:** the change in load over a period of at least 10 years.

Individual collecting a nontidal monitoring network (NTN) water-quality sample.

Figure 1. Map of nontidal monitoring network (NTN) monitoring stations in the Chesapeake Bay watershed. Rivers and streams in the 64,000 square mile watershed flow to the Chesapeake Bay.

Partnering for Success

The NTN is a partnership that has provided information to support local management decisions for decades. Twenty-five groups, representing local, State, and Federal agencies, as well as other partners, fund the operation of the NTN (fig. 3). Seven of these partners collect NTN monitoring data.

Figure 3. A visual representation of the 25 nontidal monitoring network funding partners. Icons with vests indicate partners who collect monitoring data.

USGS staff sharing information with local partners at a nontidal monitoring network (NTN) station.

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U.S. Geological Survey

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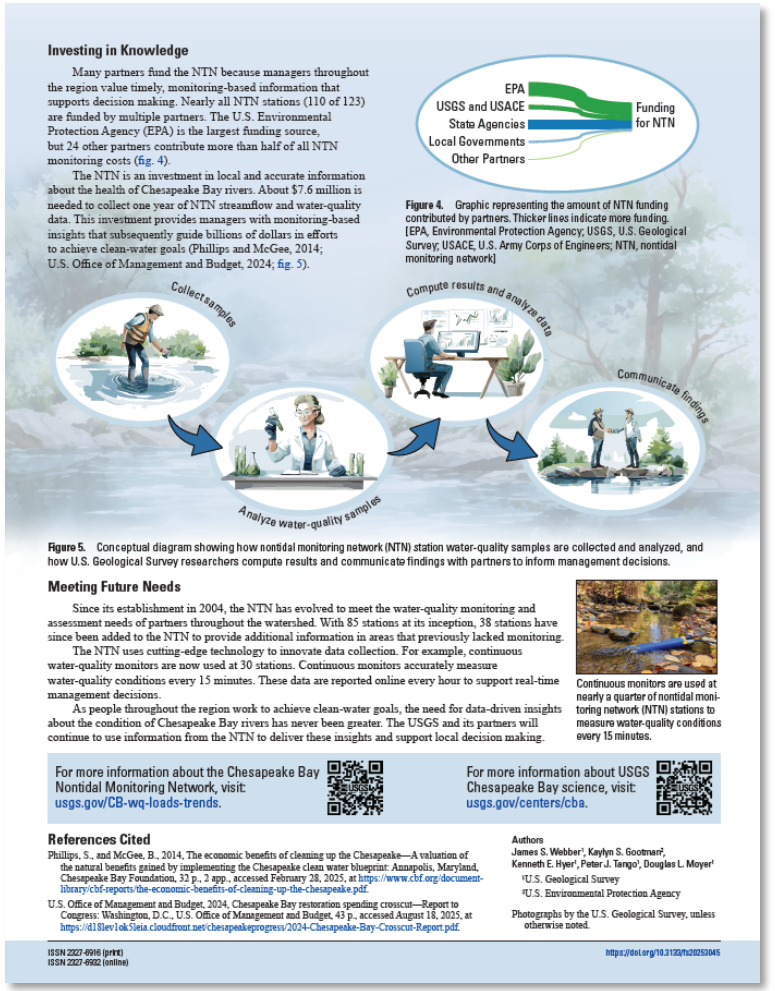
Fact Sheet 2025–3045
September 2025



Investing in Knowledge

Many partners fund the NTN because managers throughout the region value timely, monitoring-based information that supports decision making. Nearly all NTN stations (110 of 123) are funded by multiple partners. The U.S. Environmental Protection Agency (EPA) is the largest funding source, but 24 other partners contribute more than half of all NTN monitoring costs (fig. 4).

The NTN is an investment in local and accurate information about the health of Chesapeake Bay rivers. About $7.6 million is needed to collect one year of NTN streamflow and water-quality data. This investment provides managers with monitoring-based insights that subsequently guide billions of dollars in efforts to achieve clean-water goals (Phillips and McGee, 2014; U.S. Office of Management and Budget, 2024; fig. 5).

Figure 4. Graphic representing the amount of NTN funding contributed by partners. Thicker lines indicate more funding. [EPA, Environmental Protection Agency; USGS, U.S. Geological Survey; USACE, U.S. Army Corps of Engineers; NTN, nontidal monitoring network]

Figure 5. Conceptual diagram showing how nontidal monitoring network (NTN) station water-quality samples are collected and analyzed, and how U.S. Geological Survey researchers compute results and communicate findings with partners to inform management decisions.

Meeting Future Needs

Since its establishment in 2004, the NTN has evolved to meet the water-quality monitoring and assessment needs of partners throughout the watershed. With 85 stations at its inception, 38 stations have since been added to the NTN to provide additional information in areas that previously lacked monitoring.

The NTN uses cutting-edge technology to innovate data collection. For example, continuous water-quality monitors are now used at 30 stations. Continuous monitors accurately measure water-quality conditions every 15 minutes. These data are reported online every hour to support real-time management decisions.

As people throughout the region work to achieve clean-water goals, the need for data-driven insights about the condition of Chesapeake Bay rivers has never been greater. The USGS and its partners will continue to use information from the NTN to deliver these insights and support local decision making.

Continuous monitors are used at nearly a quarter of nontidal monitoring network (NTN) stations to measure water-quality conditions every 15 minutes.

For more information about the Chesapeake Bay Nontidal Monitoring Network, visit: usgs.gov/CB-wq-loads-trends.

For more information about USGS Chesapeake Bay science, visit: usgs.gov/centers/cba.

References Cited

Phillips, S., and McGee, B., 2014, The economic benefits of cleaning up the Chesapeake—A valuation of the natural benefits gained by implementing the Chesapeake clean water blueprint: Annapolis, Maryland, Chesapeake Bay Foundation, 32 p., 2 app., accessed February 28, 2025, at https://www.cbf.org/document-library/cbf-reports/the-economic-benefits-of-cleaning-up-the-chesapeake.pdf.

U.S. Office of Management and Budget, 2024, Chesapeake Bay restoration spending crosscut—Report to Congress: Washington, D.C., U.S. Office of Management and Budget, 43 p., accessed August 18, 2025, at https://d18lev1ok5leia.cloudfront.net/chesapeakeprogress/2024-Chesapeake-Bay-Crosscut-Report.pdf.

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What's Next?

Our team is computing loads and trends through **water year 2025** for all 123 network stations (which includes the 9 RIM stations). Results will be published late this calendar year.

We want to hear from you.
Your input informs our research!

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