USGS Chesapeake Bay Studies:

An overview of science used to inform management activities

May 15th, 2025

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Outline:

1. Overview of USGS Chesapeake Bay Studies
2. Selected Highlights of Recent Science

Visit the USGS Chesapeake Bay studies website: usgs.gov/cba

The USGS provides objective science to support natural-resource decision making

The USGS delivers **actionable intelligence** to decision makers about human interactions with natural Earth systems.

Our **policy neutral** science is designed to address partner needs that align with Department of Interior priorities.

The USGS is organized into five Mission Areas:

USGS Chesapeake Bay Studies:
informing management of the nation's largest estuary

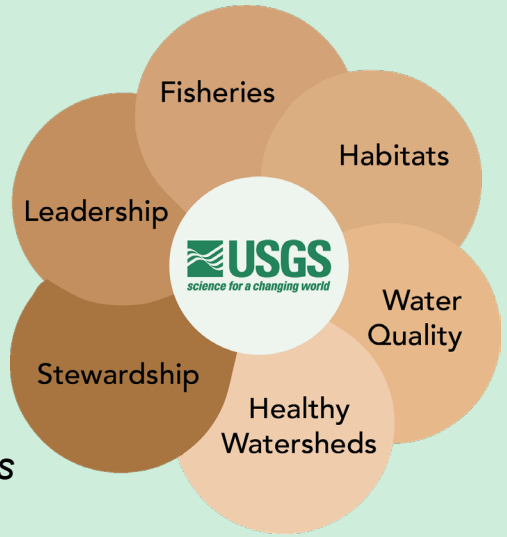
We are a leading provider of **data-driven insights** about the condition of the Chesapeake Bay watershed's lands, waters, fish, and wildlife.

Our **science** and **collaborative work** with partners helps inform management activities designed to:

- Provide clean water for people
- Improve fish and wildlife habitat
- Promote recreational opportunities
- Protect the economic value of the region

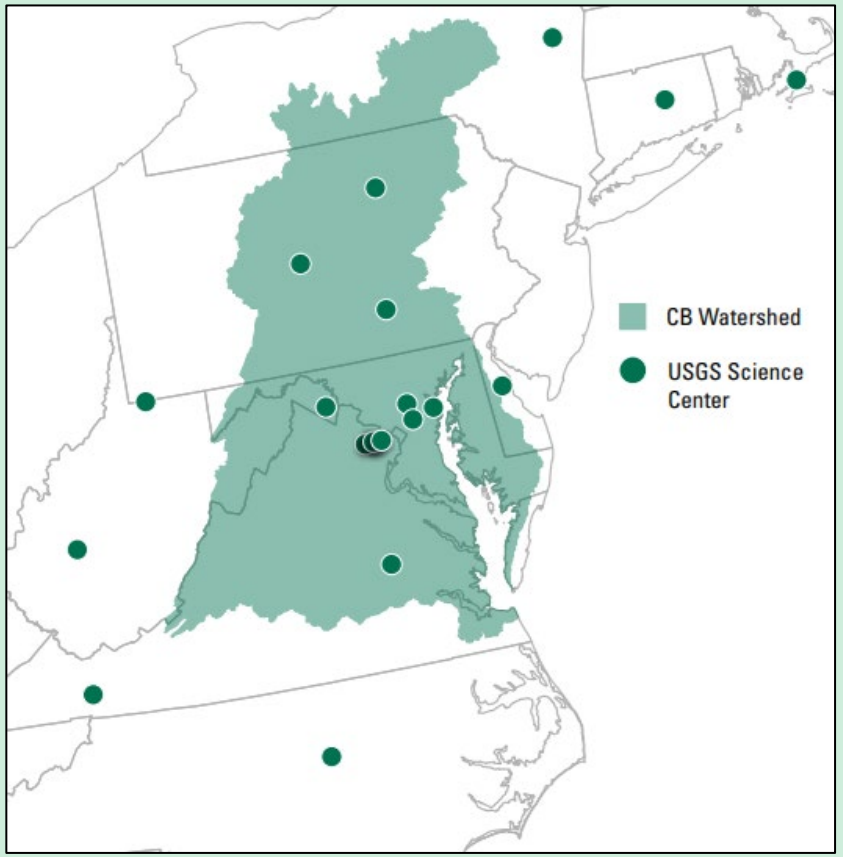
Our science addresses needs of Chesapeake Bay Program (CBP) partners working to achieve goals of the Chesapeake Watershed Agreement.

Chesapeake Bay Program
Science. Restoration. Partnership.



Conceptual diagram showing how USGS addresses the needs of the six CBP goal teams.

We are a team of interdisciplinary scientists working throughout the Chesapeake region



Visit the USGS Chesapeake Bay studies website: usgs.gov/cba

CBP: Beyond 2025

We are providing guidance and feedback as the CBP revises goals and outcomes.

We are evolving the USGS Chesapeake science strategy (2026 – 2035) to remain aligned with CBP priorities

Proposed CBP structure:
4 Goals and 21 Outcomes

USGS science alignment

Clean Water

1. Water Quality Standards Attainment and Monitoring
2. Reducing Excess Nutrients and Sediment
3. Toxic Contaminants

Lands and Watersheds

4. Healthy Forests
5. Land Use Decision Support
6. Protected Lands
7. Adaption

Habitats and Wildlife

8. Blue Crab Sustainability
9. Oysters
10. SAV
11. Brook Trout
12. Fish Habitat
13. Wetlands
14. Stream Health
15. Fish Passage

Engaged Communities

16. Public Access Development
17. School District Planning
18. Student Experiences
19. Stewardship
20. Workforce
21. Local Leadership

Selected Highlights of Recent Science

Clean Water

1. Nutrient and Sediment Loads and Trends
2. Using Water-Quality Monitoring Data to Inform Management
3. Best Management Practices Effects
4. Toxic Contaminants

Habitats and Wildlife

5. Measuring and Predicting Stream Health
6. Factors Affecting Stream Health
7. Marshes and Coastal Wetlands
8. Osprey Populations and Stressors
9. Avian Influenza in Wild Birds and Risks to Poultry
10. Invasive Blue Catfish

Lands and Watersheds

11. Mapping Land Use/Cover
12. Mapping Protected Lands

Engaging Communities

13. Decision Support Tools

USGS Chesapeake Bay Studies

science to inform management

Clean Water

1. Nutrient and Sediment Loads and Trends
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3. Best Management Practice Effects
4. Toxic Contaminants

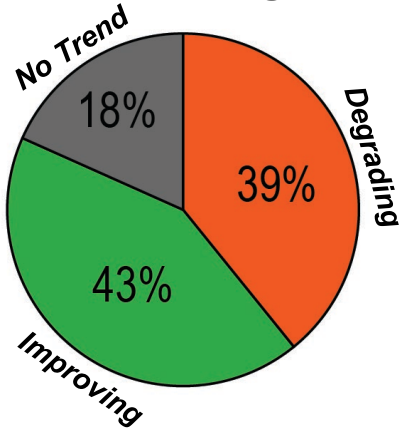
Nutrient and Sediment River Loads

We compute loads and trends in nontidal rivers to document how amounts of nitrogen, phosphorus, and suspended sediment are changing over time.

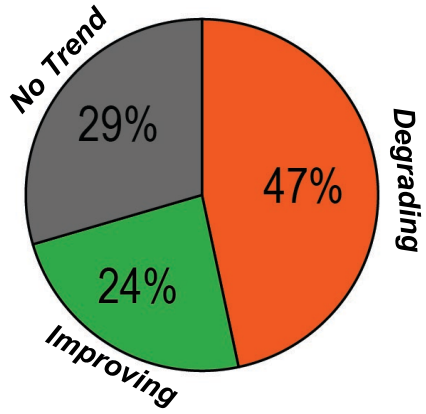
Loads and trends are computed from monitoring data collected from the nontidal monitoring network (NTN).

We recently computed NTN loads and trends through water year 2023.

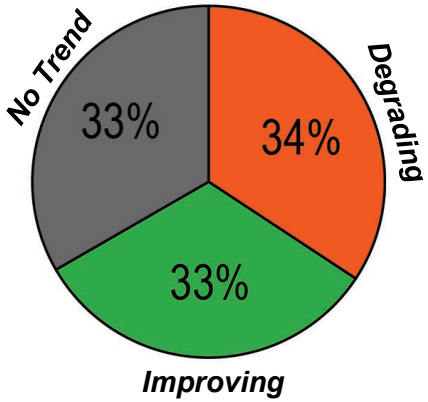
Total Nitrogen



Total Phosphorus



Suspended Sediment



Pie charts showing the percentage of NTN stations with improving, degrading, or no trend results, from 2014 - 2023.

Visit our project website to learn more about NTN results:

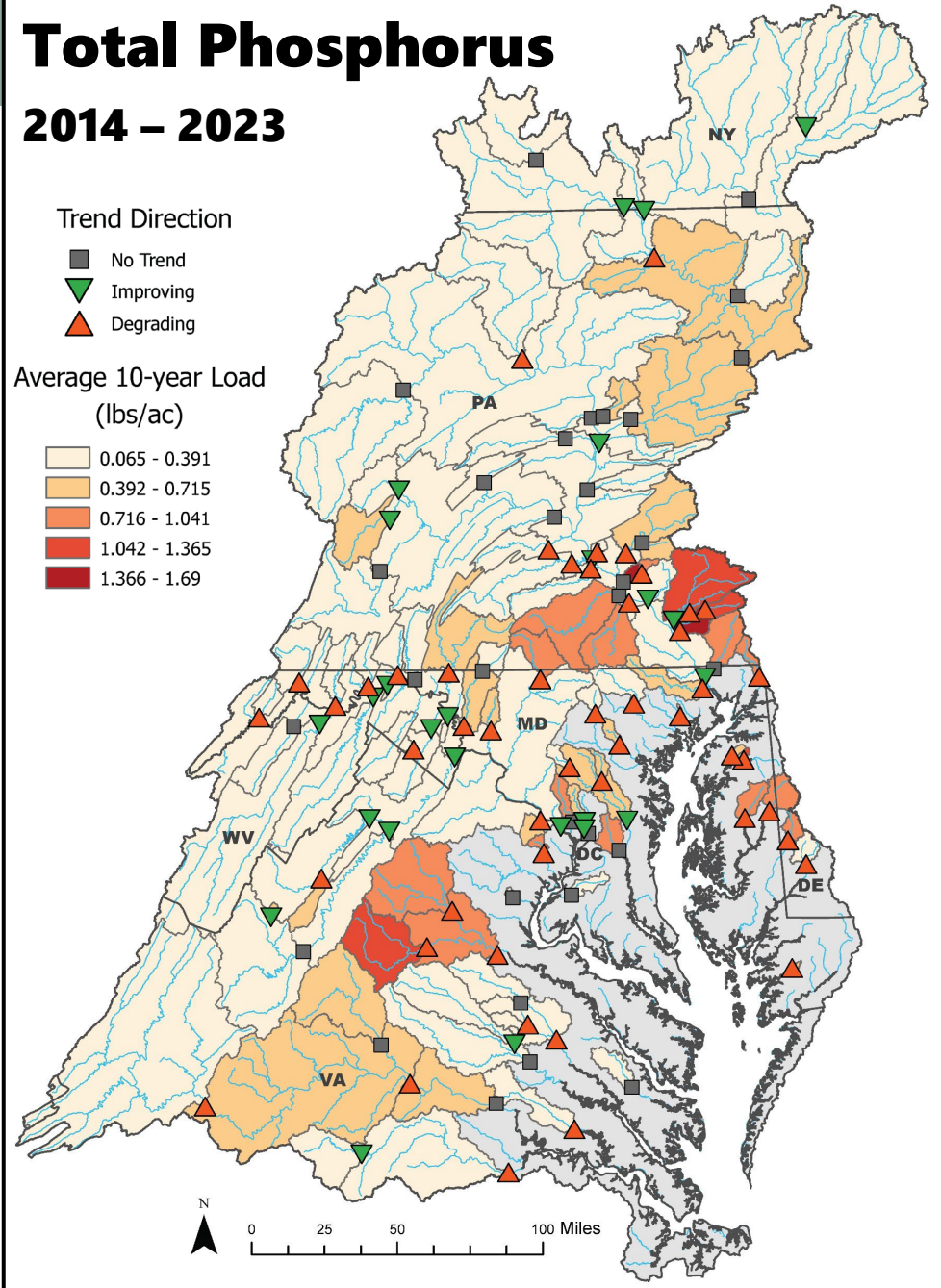
usgs.gov/CB-wq-loads-trends

Visit our interactive geonarrative to explore these results:

va.water.usgs.gov/geonarratives/ntn

Total Phosphorus

2014 – 2023



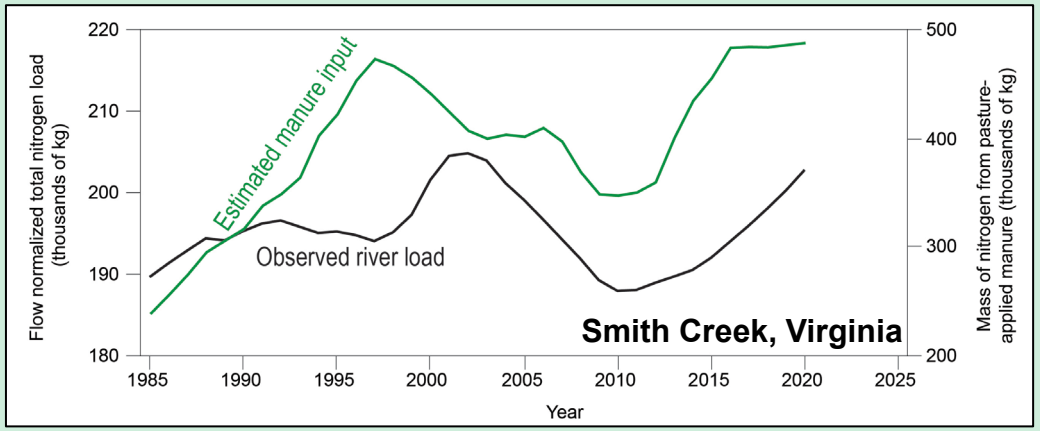
Map of total phosphorus per-acre loads and trends from water years 2014 through 2023.

Using Water-Quality Monitoring Data to Inform Management

We are using water-quality monitoring data to explain trends and to assess progress towards meeting nutrient and sediment goals.

What's driving nutrient-load trends?

Some trends are explained by factors such as point-source discharges, atmospheric deposition, manure and fertilizer inputs, and/or climatic conditions.

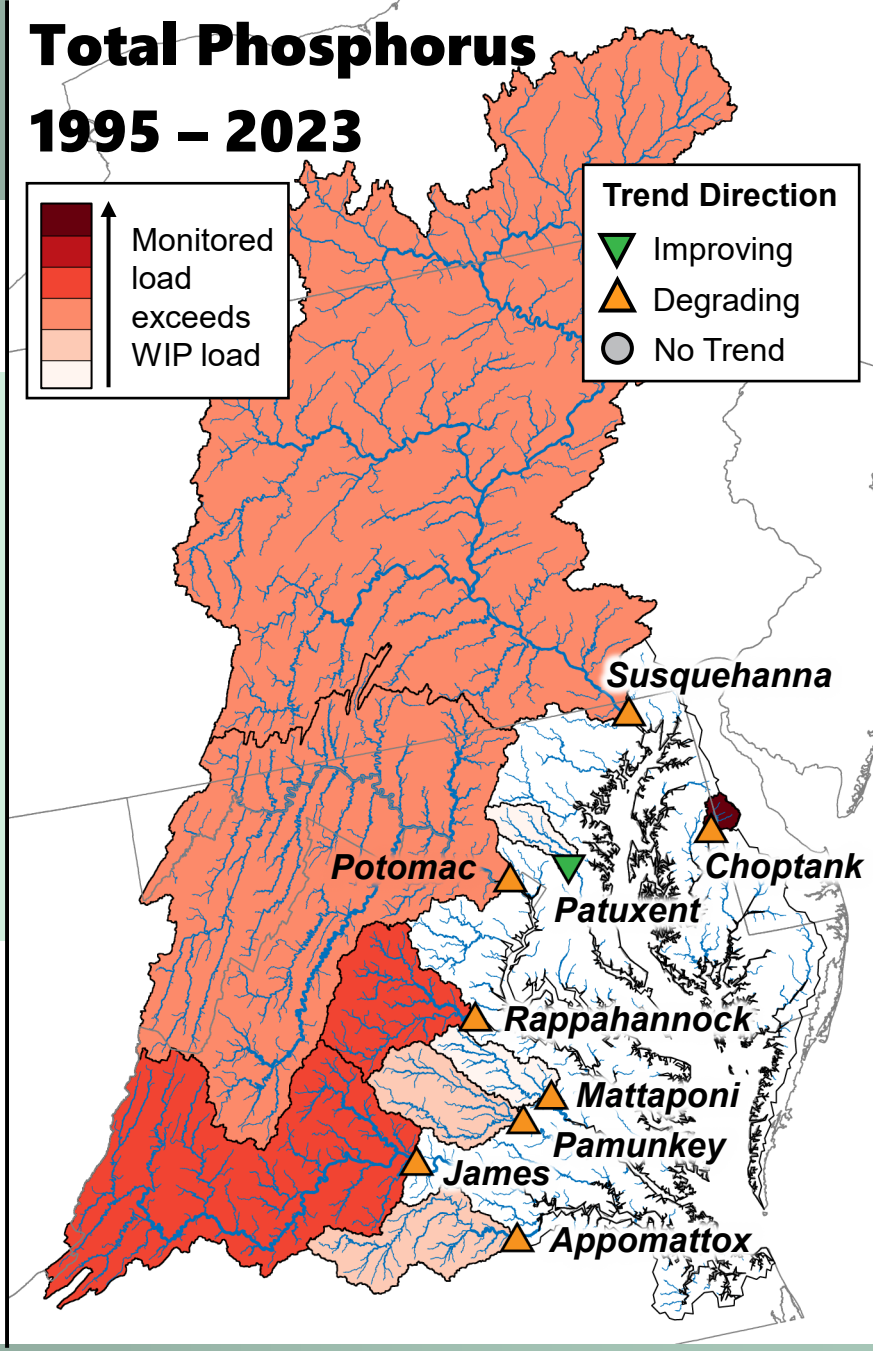


Graph showing the relation between observed total nitrogen load and estimated manure inputs in an agricultural watershed[1].

Monitored loads are often higher than WIP loads

WIP loads are the expected river loads if **W**atershed **I**mplementation **P**lans were fully implemented.

Improving trends are needed in areas that exceed WIP loads to meet water-quality goals.



Map of total phosphorus trends from 1995 through 2023 and relation to WIP loads.

USGS science for a changing world

[1]doi.org/10.1111/1752-1688.13197

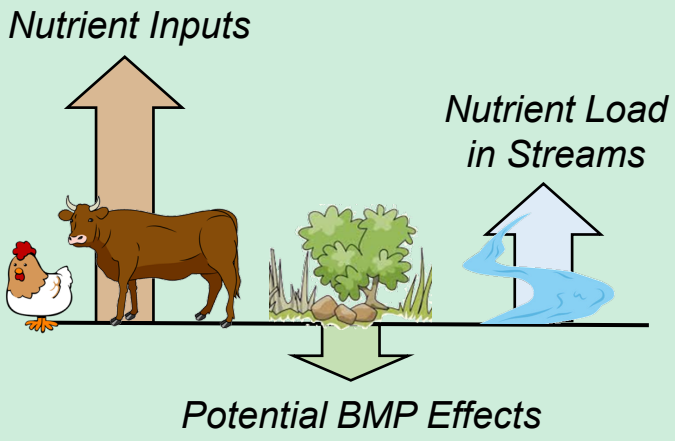
Best Management Practice Effects

We are using monitoring-based studies to evaluate the effects of best management practices (BMPs) on water quality and ecology.

BMP effects aren't always clear

BMPs can have beneficial and detrimental effects on in-stream biology and stream health[1].

The ability of BMPs to reduce nitrogen and phosphorus may be offset by increased agricultural activities[2].



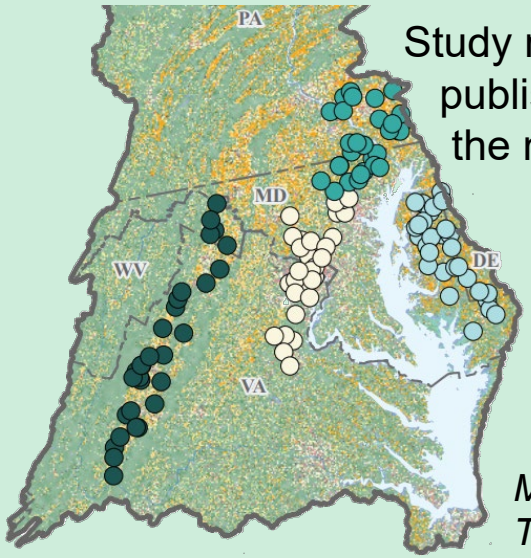
We're learning more about BMPs in agricultural areas

In 2024, we started a new water-quality study in five small agricultural watersheds[3]. Small streams may be more responsive to BMPs than large rivers.

Photo of partners meeting at a small agricultural monitoring station.

We're studying how BMPS affect the health of streams throughout the watershed

From 2021 through 2025, the USGS "Stream Team" measured stream-health conditions throughout the Chesapeake Bay watershed to evaluate BMP effects[4].



Study results will be published over the next 1-2 years.

Map of Stream Team study sites.

[1] usgs.gov/centers/chesapeake-bay-activities/science/agricultural-and-urban-management-practices-have-hidden

[2] usgs.gov/centers/chesapeake-bay-activities/science/new-insights-reducing-nutrient-and-sediment-loads

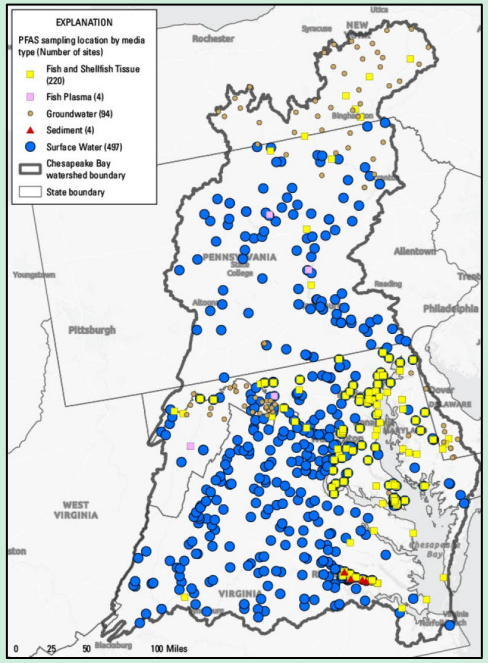
[3] usgs.gov/small-ag-monitoring

[4] pubs.usgs.gov/fs/2024/3030/fs20243030.pdf

Toxic Contaminants

We are studying the occurrence, magnitude, accumulation and ecological effects of toxic contaminants.

PFAS



We are studying PFAS prevalence and sources in surface waters throughout the watershed.

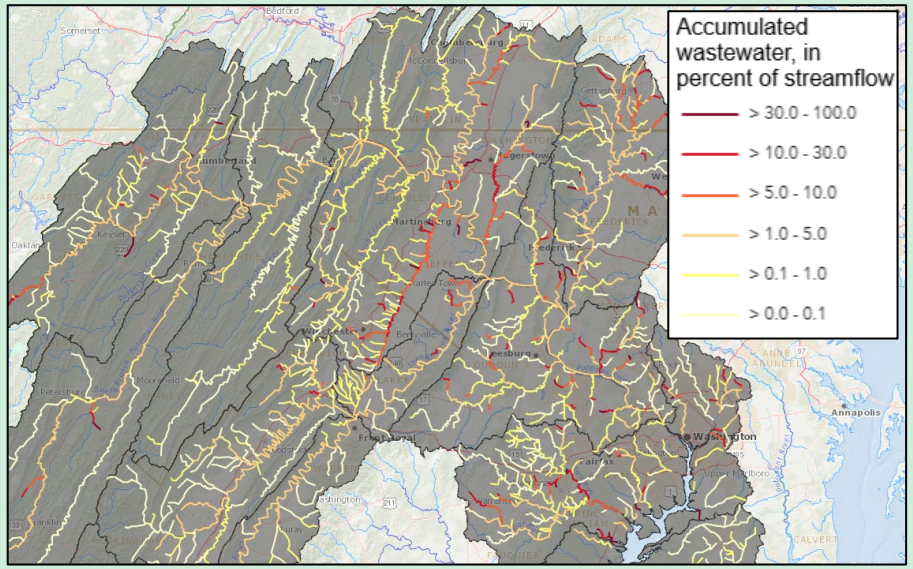
Map of PFAS collection locations from 2018 – 2023.

Photo of a USGS researcher sampling fish tissue.

We found PFAS in smallmouth bass tissues throughout the watershed[1].

Pesticides

In the Potomac River watershed, we found higher pesticide concentrations in streams with larger amounts of accumulated wastewater[2].



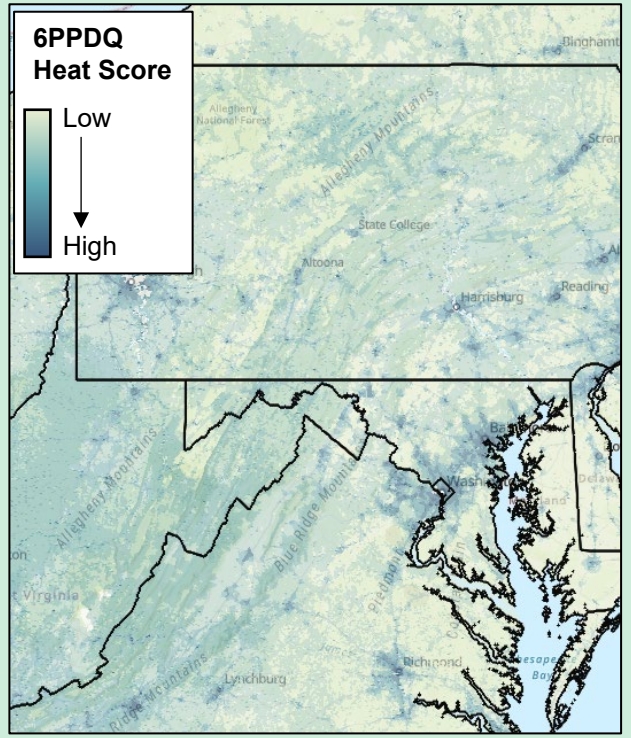
Map of accumulated wastewater in Potomac River watershed streams.

View the Potomac accumulated wastewater map:

va.water.usgs.gov/webmap/potomac-wastewater

6PPD-Quinone

We are sampling rivers for 6PPD-Q, a compound used to prevent tire wear. 6PPD-Q has been linked to mortality in fish like brook trout[3].



Preliminary heat map of 6PPDQ.

Preliminary information subject to revision. Not for citation or distribution

[1]usgs.gov/centers/chesapeake-bay-activities/science/and-polyfluoroalkyl-substances-pfas-found-smallmouth-bass

[2]usgs.gov/centers/chesapeake-bay-activities/science/new-study-highlights-role-wastewater-and-landscape

[3]usgs.gov/programs/environmental-health-program/science/6ppd-quinone

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science to inform management

Habitats & Wildlife

5. Measuring and Predicting Stream Health
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Measuring and Predicting Stream Health

We are using monitoring data and models to assess key indicators of nontidal stream health:

- ***Streamflow***
- ***Water Temperature***
- ***Nutrients***
- ***Sediment***
- ***Salinity***
- ***Physical Habitat***
- ***Aquatic Insects***
- ***Fish***

We are using monitoring data collected throughout the watershed to summarize the status (current condition) and trend (changes over time) of stream-health indicators.

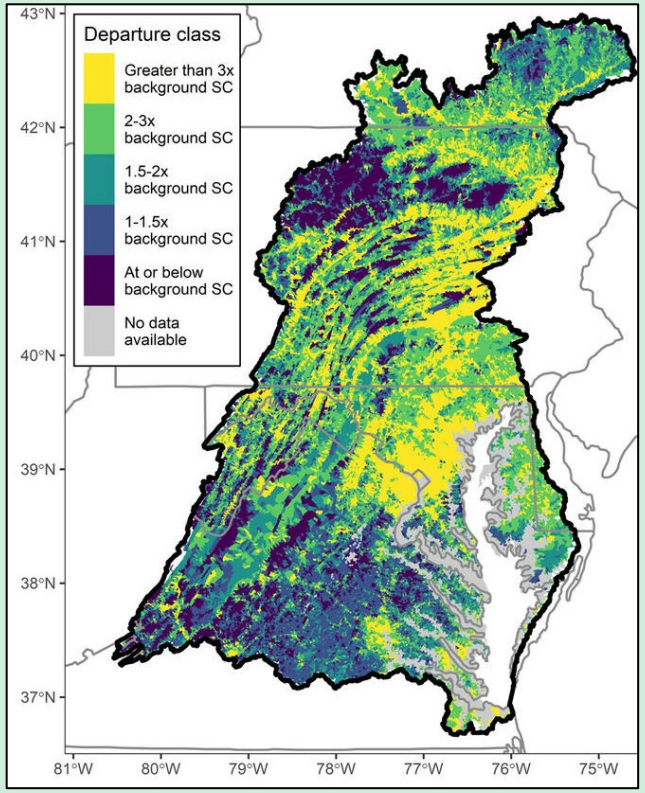
A USGS report on this topic will be published next year.

Learn more: usgs.gov/CB-status-trend

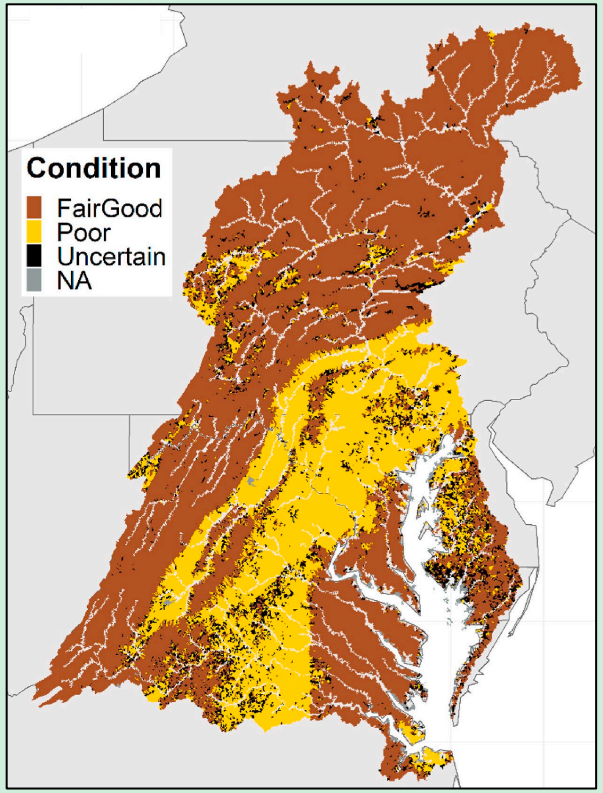
Photo of a USGS researcher collecting in-stream data.

We are using models to predict stream-health indicators in unmonitored streams throughout the watershed.

Explore our results: usgs.gov/chesapeakeassessments



Map of predicted salinity in Chesapeake streams, relative to background levels[1].



Map of predicted aquatic insect condition in Chesapeake streams, from a benthic macroinvertebrate index of biotic integrity[2].

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[1]usgs.gov/centers/chesapeake-bay-activities/science/road-salt-elevates-salinity-above-background-levels

[2]doi.org/10.1016/j.jenvman.2022.116068

Factors Affecting Stream Health

We are studying the factors affecting fish and aquatic-insect abundance to inform effective management strategies.

Smallmouth Bass (SMB)

We found that SMB young-of-year populations decrease as the percentage of wastewater effluent increases in Shenandoah River streams[1].

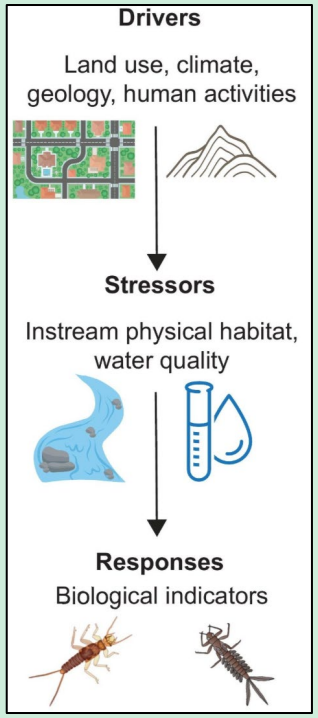
We found that adverse molecular and cellular changes can occur in SMB from contaminants associated with developed and agricultural lands[2].

Photo of a USGS researcher collecting a SMB blood sample.

Aquatic Insects

We found that the biological health of Chesapeake Bay streams (as measured by benthic macroinvertebrates) is affected by water-quality and physical habitat conditions[3].

- Key stressors included: water temperature, specific conductance, and stream-channel alterations.
- The effect of these stressors varied across the watershed.



Conceptual diagram of causal relations between landscape drivers, in-stream stressors, and biological responses.

[1]usgs.gov/centers/chesapeake-bay-activities/science/wastewater-reuse-may-be-detrimental-smallmouth-bass

[2]usgs.gov/centers/chesapeake-bay-activities/science/new-study-highlights-linkages-among-land-use-water

[3]doi.org/10.1016/j.ecolind.2025.113501

Marshes and Coastal Wetlands

We are working to understand how and where marshes and coastal wetlands are drowning. Our work can help prioritize management areas and identify which actions are most effective.

Photo of sediment spraying, a management action to increase elevation and prevent marsh loss.

- We use field-based studies to verify rates of marsh loss, upland transgression and evaluate management-practice effects.
- We develop geospatial web tools to assess marsh health, predict future marsh change, and inform management priorities.
- We study how changes in coastal habitat affect migratory waterbirds.

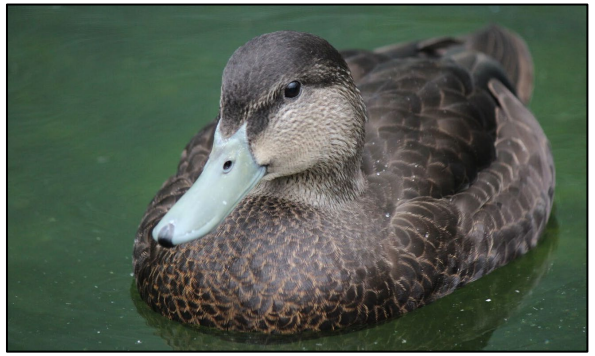
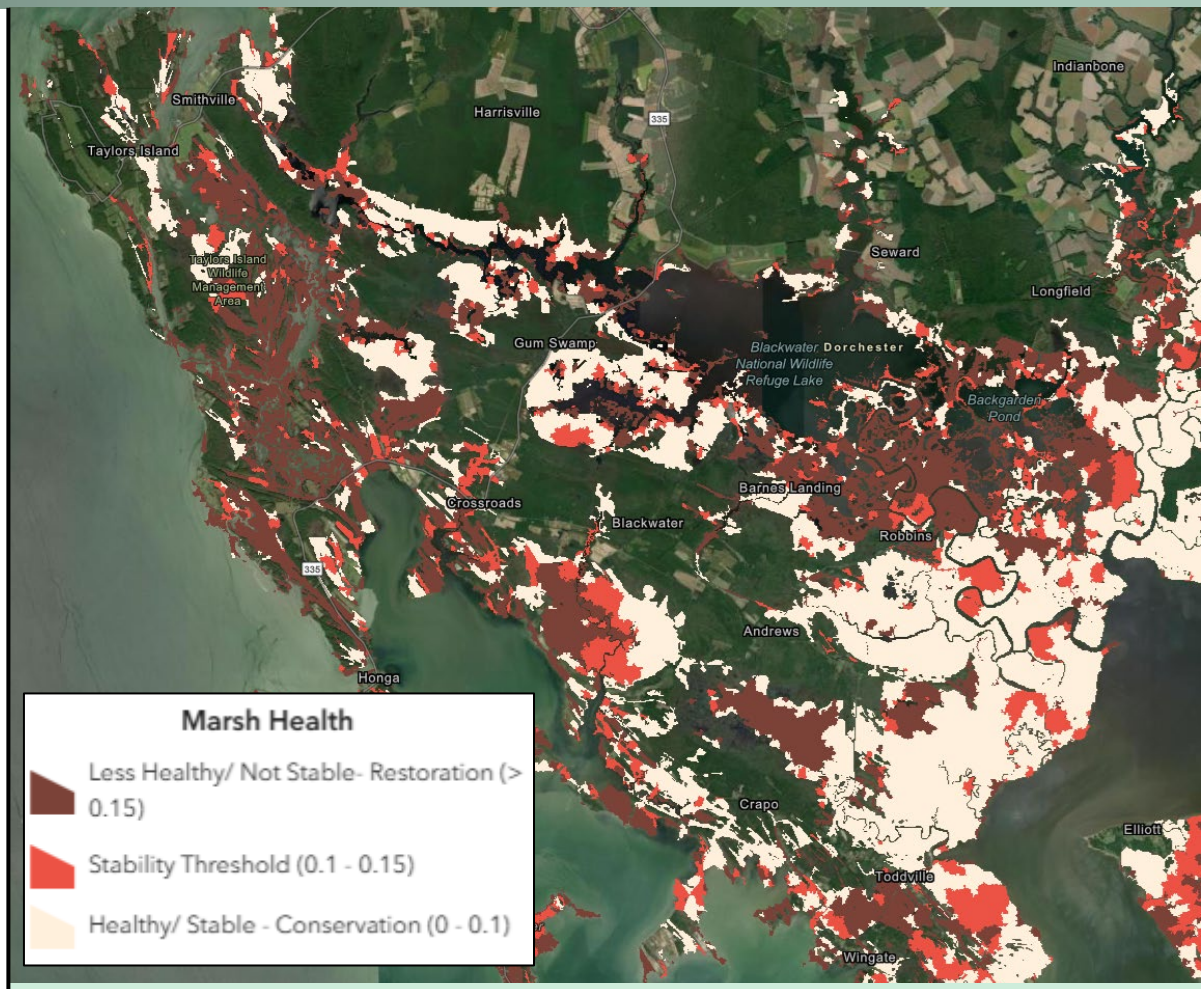


Photo of an American black duck.

An upcoming paper will summarize future predictions of marsh cover in the Chesapeake under different sea-level rise scenarios.



Map showing marsh health in and around the Blackwater National Wildlife Refuge based on the Unvegetated / Vegetated Ratio (UVVR).

Explore our science with the Marsh Adaption Project map:
gis.chesapeakebay.net/climate/marshadaptation/tiers1-2

Osprey Populations and Stressors

We are monitoring populations of osprey in the Chesapeake Bay to understand factors affecting osprey reproductive success.

Our study:

- Compiles and evaluates historic data on osprey populations, reproduction, food habits, and environmental characteristics over the past 50 years.
- Determines osprey reproductive rates needed to sustain local populations.
- Uses game cameras to document fish delivered to osprey nests to determine brood-provisioning rates.

Photo of an osprey recorded by a game camera.

Photo of a USGS researcher observing an osprey nest.

Recent concerns about Chesapeake Bay osprey populations have attracted local and regional media coverage.

News stories about Osprey in the Chesapeake Bay Journal (left) and Washington Post (right) from September 2024.

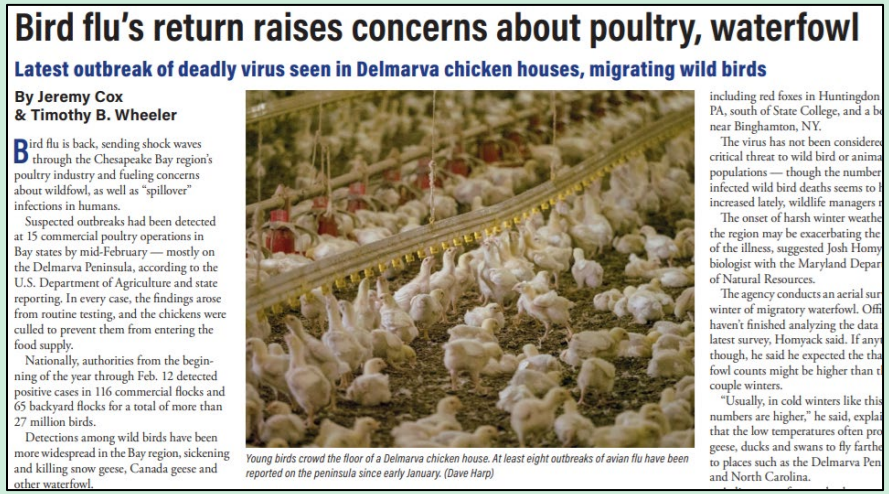
Learn more about our study:

usgs.gov/centers/eesc/science/osprey-pandion-haliaetus-population-and-availability-menhaden-brevoortia

Avian Influenza in Wild Birds and Risks to Poultry

We are learning how the avian influenza virus (AIV) infects wild birds and can spread from wild birds to domestic poultry.

- We are studying the spread, prevalence, and persistence of AIV strains in wild birds[1]
- We are documenting factors affecting the transmission of AIV from wild birds to domestic poultry[2]
- We are modeling the risk of AIV transmission from wild birds to domestic poultry at national and local scales[3].



Bird flu's return raises concerns about poultry, waterfowl

Latest outbreak of deadly virus seen in Delmarva chicken houses, migrating wild birds

By Jeremy Cox
& Timothy B. Wheeler

Bird flu is back, sending shock waves through the Chesapeake Bay region's poultry industry and fueling concerns about wildfowl, as well as "spillover" infections in humans.

Suspected outbreaks had been detected at 15 commercial poultry operations in Bay states by mid-February — mostly on the Delmarva Peninsula, according to the U.S. Department of Agriculture and state reporting. In every case, the findings arose from routine testing, and the chickens were culled to prevent them from entering the food supply.

Nationally, authorities from the beginning of the year through Feb. 12 detected positive cases in 116 commercial flocks and 65 backyard flocks for a total of more than 27 million birds.

Detections among wild birds have been more widespread in the Bay region, sickening and killing snow geese, Canada geese and other waterfowl.

Young birds crowd the floor of a Delmarva chicken house. At least eight outbreaks of avian flu have been reported on the peninsula since early January. (Dave Harp)

including red foxes in Huntingdon PA, south of State College, and a b near Binghamton, NY.

The virus has not been considere critical threat to wild bird or anima populations — though the number infected wild bird deaths seems to l increased lately, wildlife managers

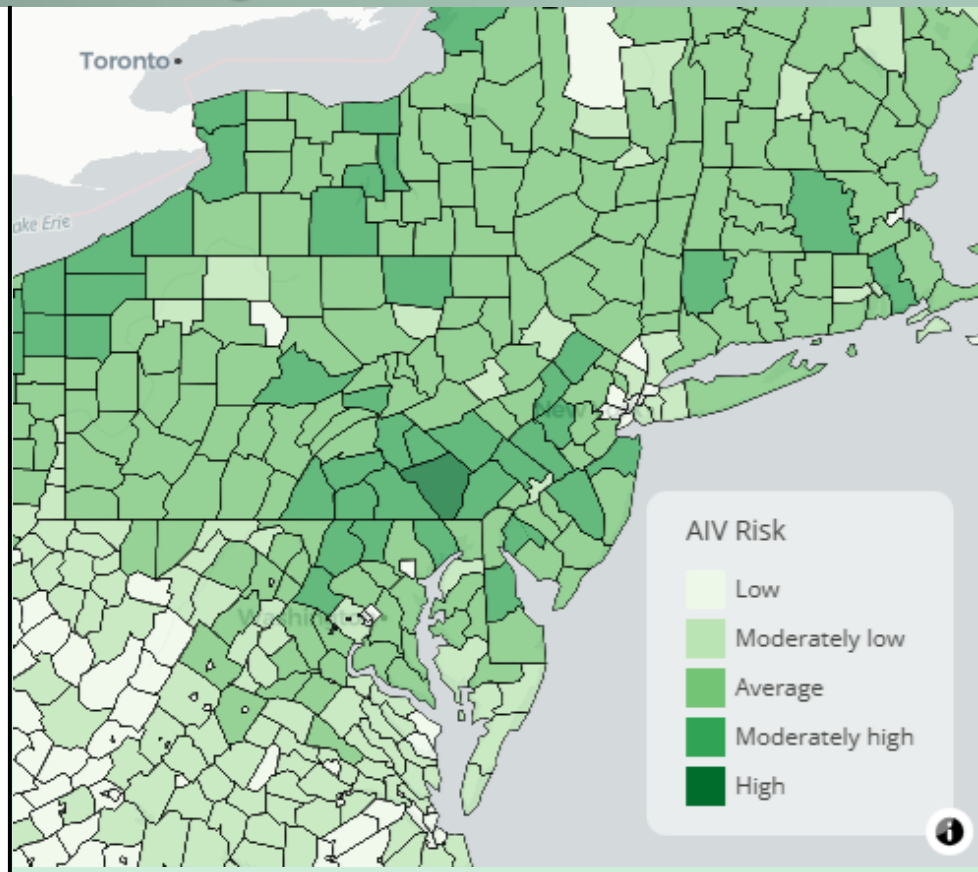
The onset of harsh winter weathe the region may be exacerbating the of the illness, suggested Josh Homy biologist with the Maryland Depar of Natural Resources.

The agency conducts an aerial sur winter of migratory waterfowl. Offi haven't finished analyzing the data latest survey, Homyack said. If anyt though, he said he expected the tha fowl counts might be higher than t couple winters.

"Usually, in cold winters like this numbers are higher," he said, explai that the low temperatures often pro geese, ducks and swans to fly farthe to places such as the Delmarva Pen and North Carolina.

News story about bird flu in the Chesapeake Bay Journal from January 2025.

Concerns about AIV are on the rise, as the Chesapeake region is home to both large wild bird populations and domestic poultry operations.



Map showing the transmission risk of AIV from wild birds to domestic poultry for week 20 (May 12 – 18).

View our interactive AIV risk map:

eesc.usgs.gov/aiv/indexus.html

Next year, we plan to release an updated AIV risk map for the Chesapeake region.

[1] usgs.gov/centers/eesc/science/avian-influenza-spread-prevalence-and-persistence

[2] usgs.gov/centers/eesc/science/avian-influenza-dynamics-chesapeake-bay-region

[3] usgs.gov/centers/eesc/science/advancing-risk-modeling-highly-pathogenic-avian-influenza

Invasive Blue Catfish

We are evaluating how invasive blue catfish may disrupt Chesapeake restoration efforts.

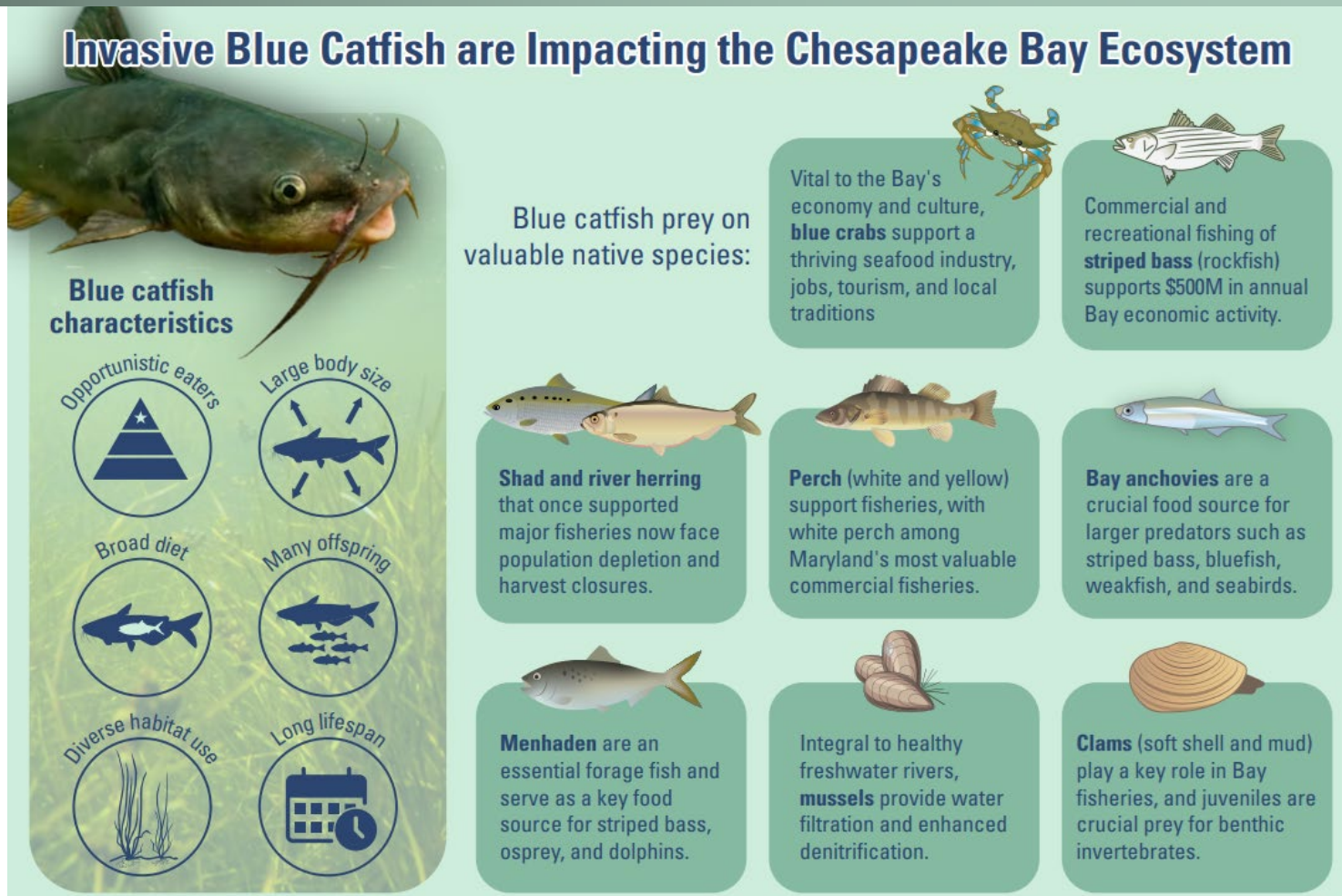
We are:

- Assessing blue catfish population dynamics, ecosystem impacts, and management strategies.
- Coordinating and communicating our work with resource managers, and other partners.

Photo showing the contents of a blue catfish stomach, which often includes crabs, clams, mussels, and fish.

Learn more about our blue catfish work:

- usgs.gov/centers/eesc/science/population-monitoring-and-removal-strategies-blue-catfish-ictalurus-furcatus
- usgs.gov/centers/eesc/news/detecting-presence-pfas-invasive-blue-catfish



pubs.usgs.gov/fs/2024/3033/fs20243033.pdf

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science to inform management

Lands & Watersheds

11. Mapping Land Use/Cover
12. Mapping Protected Lands

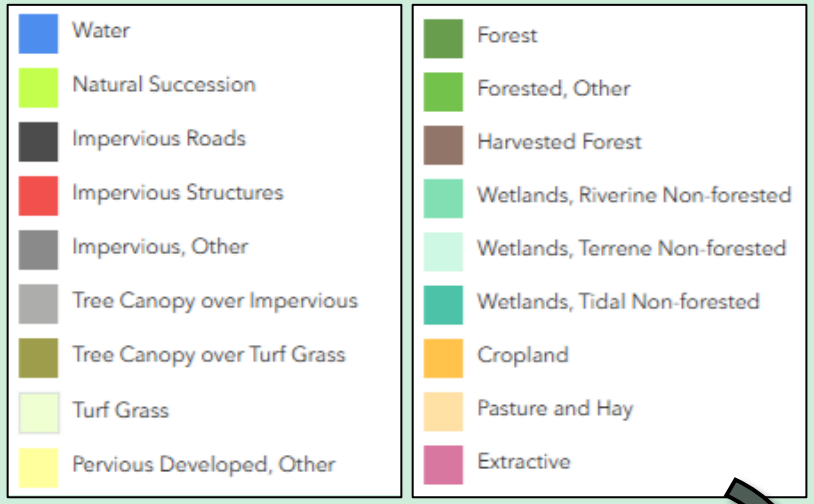
Mapping Land Use/Cover

We are mapping the Chesapeake Bay watershed in high-resolution detail to understand current conditions and how conditions have changed through time.

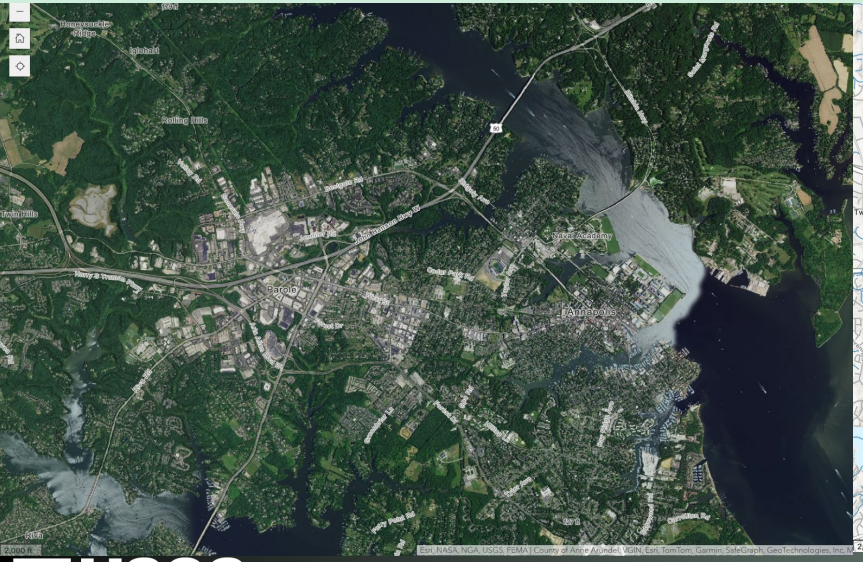
Some of our products include:

- 1-meter land use/cover data mapped for years 2013/14, 2017/18, and 2021/22
- Hyper resolution streams
- Estimated land use/cover changes from 1985 and predicted changes through 2100

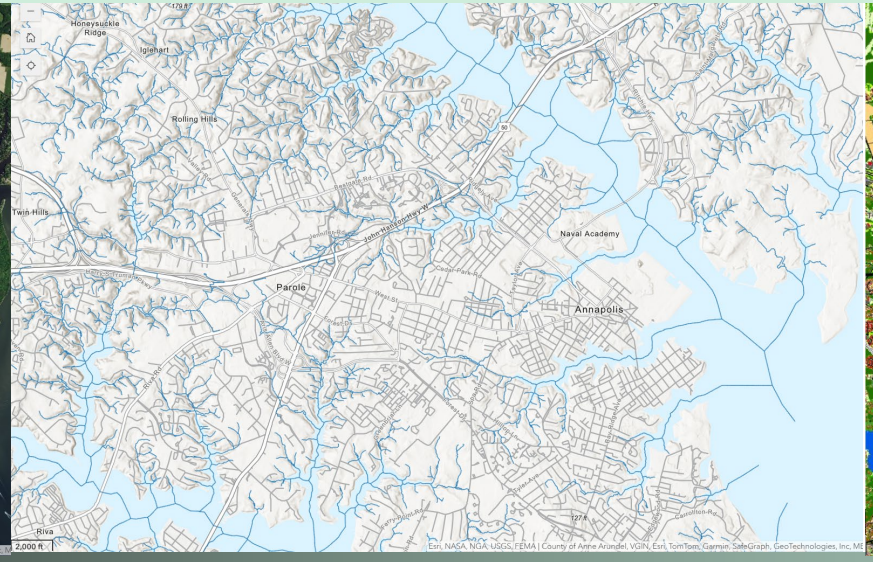
These products provide accurate information for resource managers and watershed modelers.



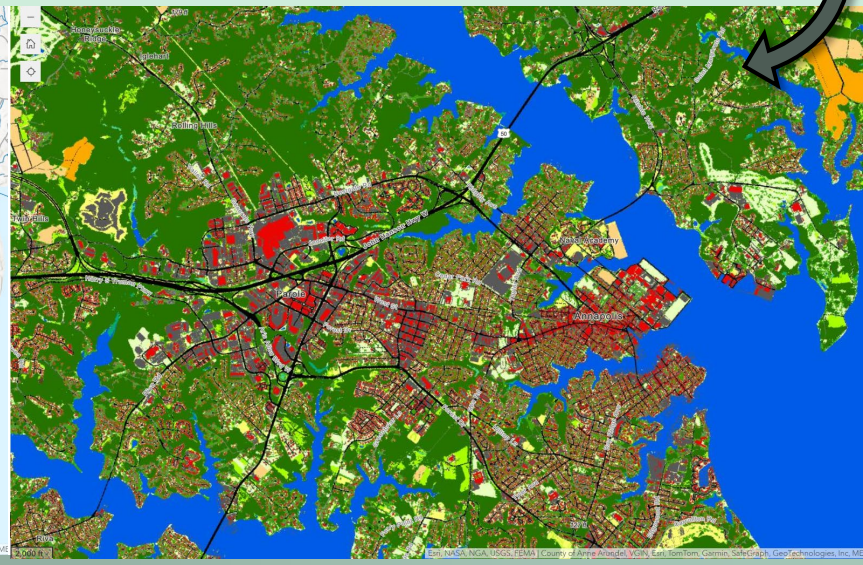
2021/2022 Aerial Imagery



2021/2022 Hyper Resolution Streams



2021/2022 1-meter Land Use / Cover

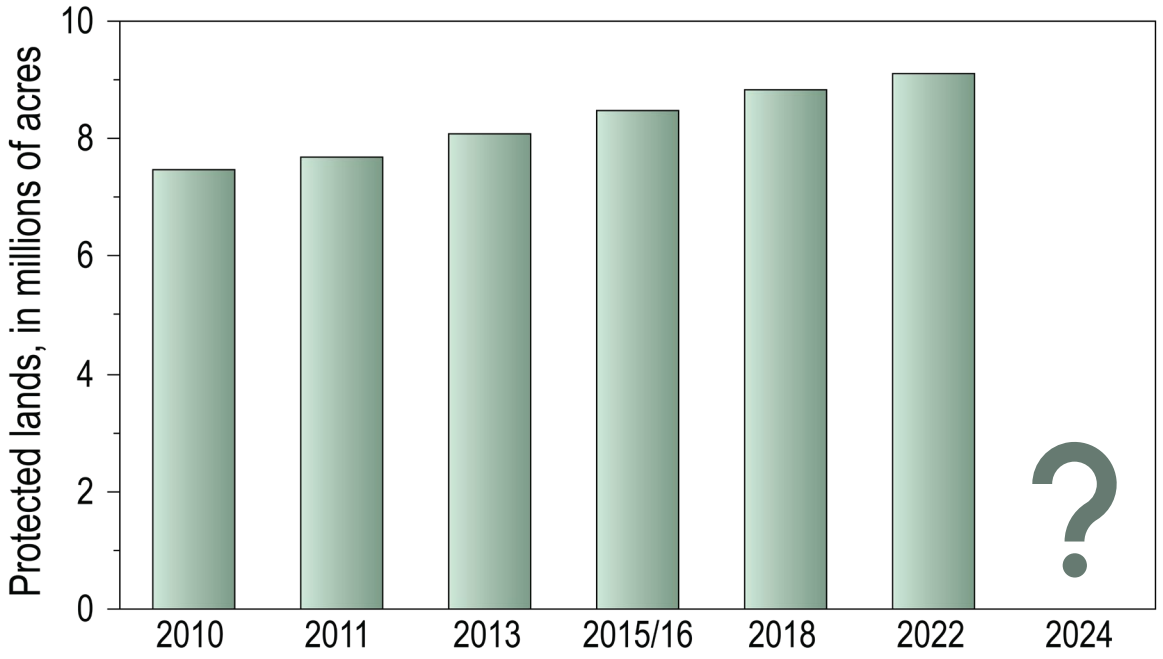


2021/2022 data are available online: lulc-viewer.cicapps.org

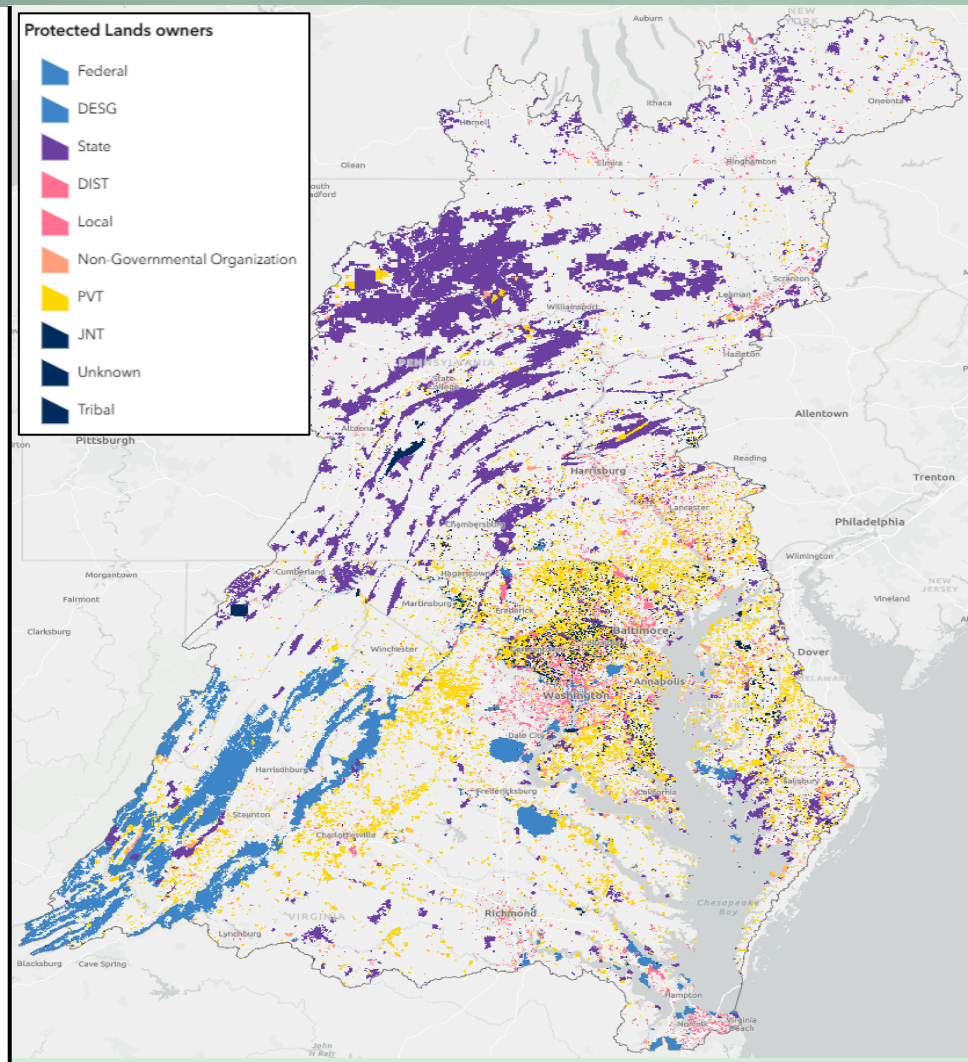
Mapping Protected Lands

We are tracking land protection throughout the Chesapeake Bay watershed.

We are creating a new 2024 protected lands indicator to continue tracking protected lands over time.



The 2024 protected lands indicator will be released this summer.



The protected lands dashboard provides detailed information about protected lands:

gis.chesapeakebay.net/protectedlands/dashboard

Map showing protected lands in the Chesapeake Bay watershed.

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science to inform management

Engaging Communities

13. Decision-Support Tools

Decision-Support Tools

We are providing science-based web products to help partners evaluate watershed conditions, target resources, and address management priorities.

Chesapeake Data

data.chesapeakebay.net

Data, decision-support tools, and other resources for a wide range of Chesapeake topics.

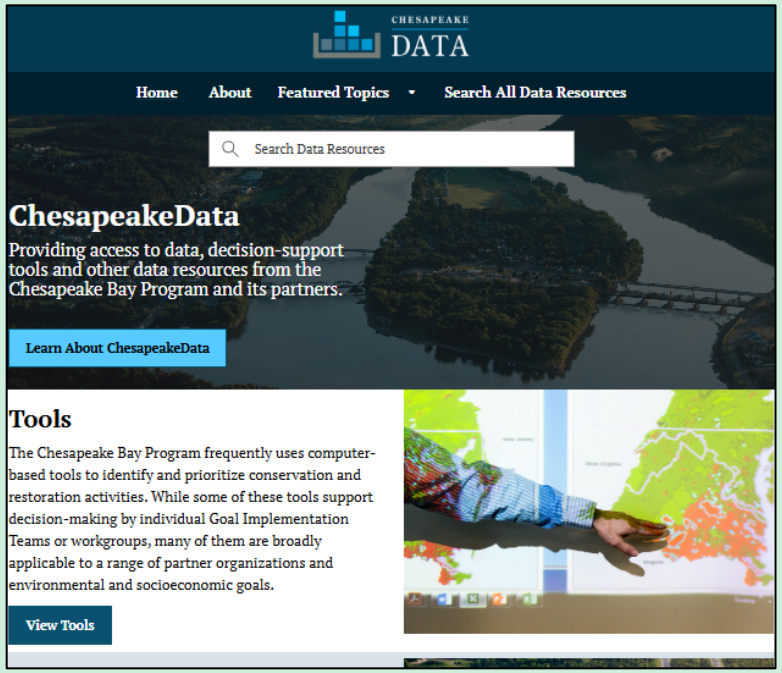
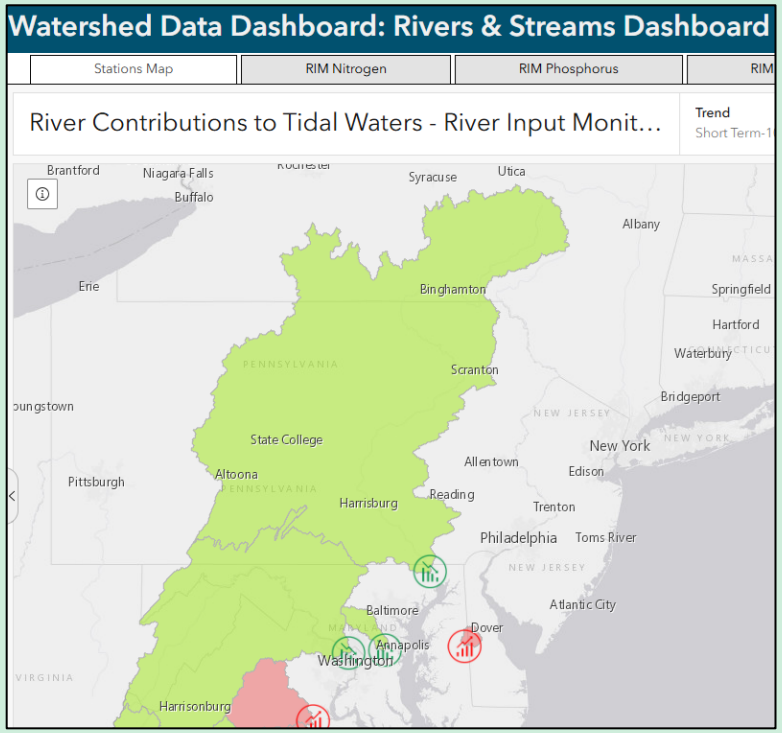


Image of the Chesapeake Data homepage.

Watershed Data Dashboard

gis.chesapeakebay.net/wip/dashboard

Information to guide water-quality and watershed-planning efforts.

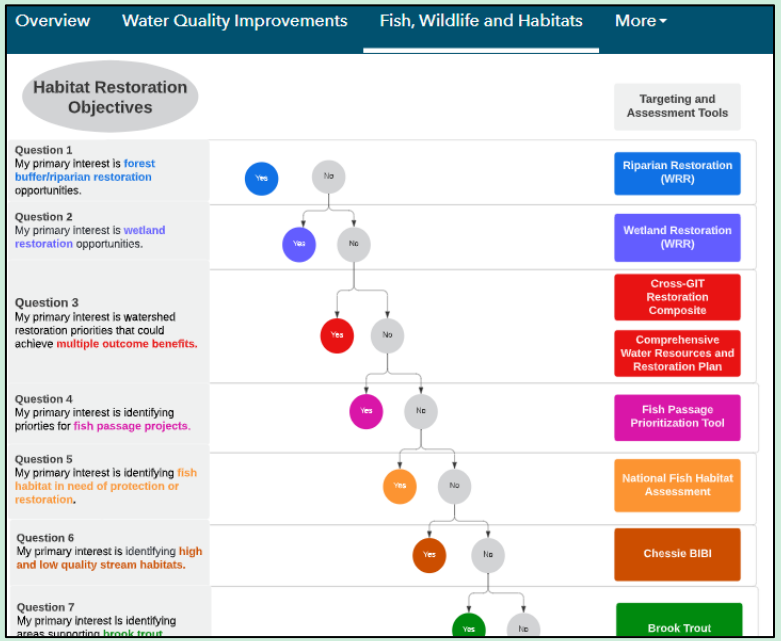


Map showing watershed nutrient trends.

Decision-Support Portal

gis.chesapeakebay.net/targeting

A collection of maps and applications to inform strategies to address multiple Chesapeake goals and outcomes.



Framework for matching resource questions with web applications.

We are actively seeking user feedback to improve the decision-support portal. Please email John Wolf (jwolf@usgs.gov) if you'd like to share your thoughts.

USGS Chesapeake Bay Studies:

An overview of science used to inform management activities

May 15th, 2025

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Visit the USGS Chesapeake Bay studies website: usgs.gov/cba