ADAMS COUNTY
COMMUNITY CLEAN WATER TOOLBOX

A County-Based Action Plan for Clean Water

July 2018

ADAMS COUNTY COMMUNITY CLEAN WATER TOOLBOX

Resources to Help You Develop A County-Based Action Plan for Clean Water

Pennsylvania Watershed Implementation Plan (WIP) Local Planning Process to Meet Countywide Goals

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Pennsylvania Phase 3 Watershed Implementation Plan (WIP)
Local Planning Process to Meet Countywide Goals

Introduction

Welcome to your Community Clean Water Toolbox.

This document has been prepared to help you improve local water quality. This collaborative effort is being made throughout Pennsylvania's portion of the Chesapeake Bay Watershed. Each Pennsylvania county within the watershed will have a Toolbox with similar components tailored to that county's specific conditions.

What is the Toolbox?

This toolbox has been developed as a starting point for each county to use to improve local water quality. It contains useful and specific data and information relevant to your county to assist you with reaching local water quality goals.

No county is required to use every tool in this toolbox! You are encouraged to add other tools as fits your local situation. This toolbox serves as a *guide* to assist with collaborative efforts, *not* as a regulatory tool.

You also will find a variety of resources that may be helpful in the Toolbox's Appendices.

Appendix I: The Local Story: Opportunities to Improve Local Water Quality and Meet Countywide Goals

Information is available that can help inform local planning strategies. This information can help answer questions like:

- What is the water quality like in my area?
- How has it been changing?
- What are important sources of nutrients and sediments in my area?
- What opportunities exist to address these sources?
- Where geographically should we focus our efforts?

This Toolbox provides information to help answer those questions and to tell the local story of water quality in your county. In this Toolbox, you'll find information on local water quality, local sources and drivers of nutrients and sediments, best management practice information, and additional available resources.

The information in this Toolbox and the guidance provided for its use are meant to act as a starting point to help answer some common questions that arise during planning. Local groups can utilize whichever pieces of information they find most useful, supplement with their own local knowledge, and use the additional resources listed to find more information.

We hope this Toolbox gives you a foundation to build off in telling Adams County's local story and in identifying opportunities for meeting local goals.

Pennsylvania's Clean Water Goal

Pennsylvania Planning Targets

Year	Nitrogen (M lbs/year)		Phosphorus (M lbs/year)	
	Delivered to the Bay	Delivered to Local PA Waterways	Delivered to the Bay	Delivered to Local PA Waterways
1985(Actual)	122.02	183.88	6.046	14.857
2017 (Actual)	107.31	161.94	3.801	9.640
2025 (Final TMDL Planning Target)	73.18	110.88	3.044	7.619
Remaining Reductions to be Achieved Through Local Planning Goals *	34.31	51.06	0.757	2.021

*This table does not account for future (beyond 2025) pollution loads and potential impacts such as climate change, development and growth, and potential infrastructure or (cost of doing business) which may alter the amount of sediment reaching the Bay (currently held in place by the Conowingo Dam).

Adams County's Clean Water Goal

Countywide Goal for Adams County

Year	Nitrogen (lbs/year)	Phosphorus (lbs/year)
	Delivered to Local Adams County Waterways	Delivered to Local Adams County Waterways
1985(Actual)	5,374,250	593,352
2017 (Actual)	4,721,732	360,406
2025 (Final TMDL Planning Target)	3,226,929	320,897
Remaining Load to be Achieved Through Local Planning Goals *	1,494,803	39,509

The nitrogen and phosphorus planning targets for Pennsylvania in Figure 1 (above) are broken down into local planning goals for your county in Figure 2 (above). Added together across all counties, these goals will help Pennsylvania reach its assigned nutrient reduction planning targets.

Depiction of Adams County's Goal

Hypothetical Journey to Adams County's Goal

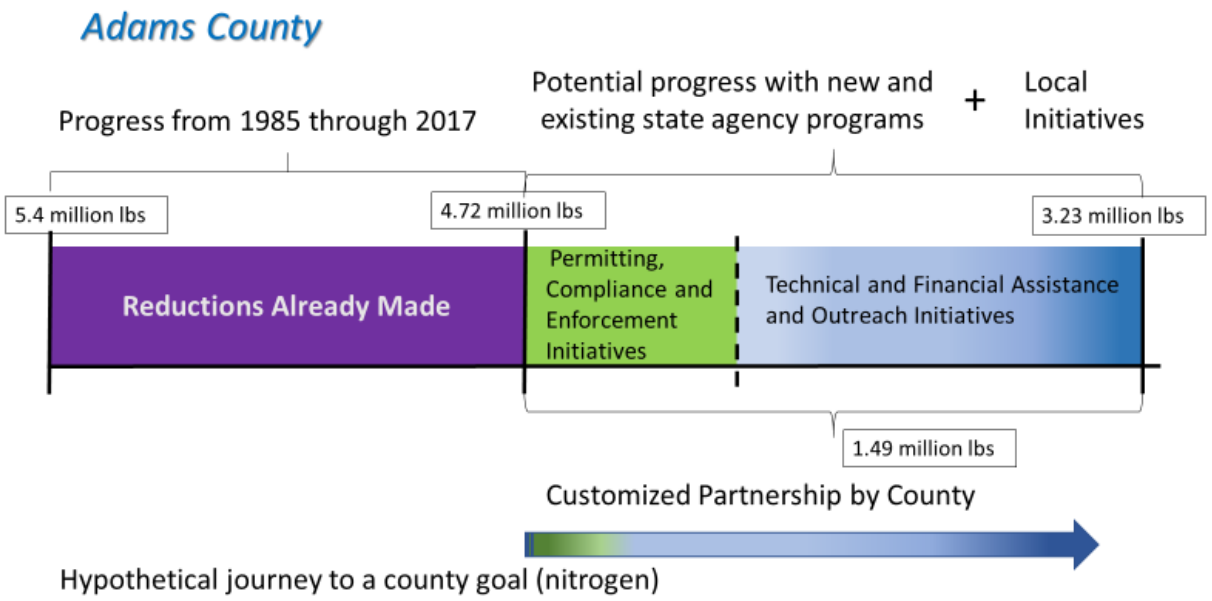


Figure 3 represents Adams County's hypothetical journey to countywide goals and overall water quality targets. Moreover, it represents Adams County's journey to clean water:

- The purple section represents the progress Adams County has made from 1985 through 2017.
- The green section depicts the estimated reductions that can be achieved between now and 2025 if all existing state agency permitting, compliance and enforcement initiatives are accomplished across the watershed. This will require ongoing effort to achieve these reductions through compliance. To be truly successful, these initiatives will also be more effective through additional assistance and collaboration at the local level.
- The blue section and the arrow across the bottom of the journey bar represent a series of technical, financial assistance and outreach initiatives that are now under development by the sector specific workgroups under the Phase 3 WIP Steering Committee. However, to be truly successful, these initiatives will need to be customized to each county's unique situation.
- Reductions from these initiatives will be estimated across the watershed, then customized as part of the individual countywide planning efforts to capture additional local resources and initiatives that can be added; as well as tailoring the watershed-wide initiatives to more effectively maximize these resources.
- The end result will be a countywide action plan for each county that identifies the customized partnership of local and watershed-wide initiatives that can be accomplished at the county level to reach the county planning target in the most effective manner.

A Summary of Adams County's Water Quality Story

Current Conditions of Adams County's Streams

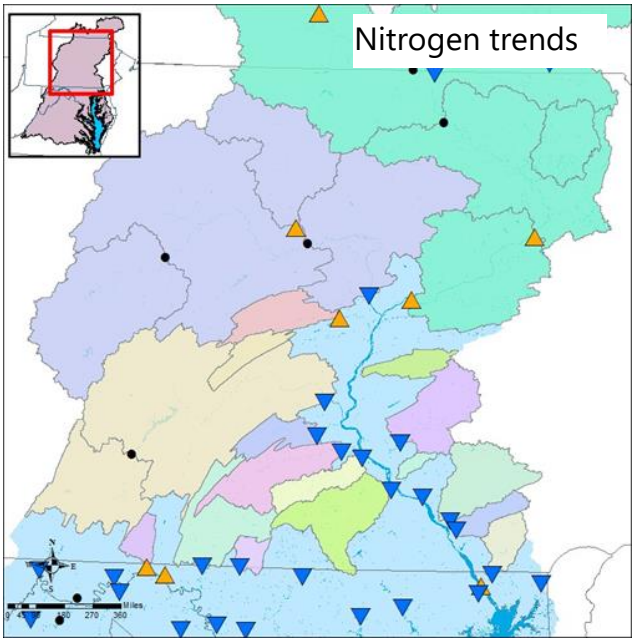
- ➢ Monitoring shows that streams in Adams County have elevated amounts of nitrogen, phosphorous and sediment.
- ➢ Water quality in Adams County's streams is changing over time:
  - The amount of nitrogen is going down in local streams, which means conditions are improving.
  - The amount of phosphorus has no trend over the last 10 years in both the Monocacy River and West Conewago Creek.
  - The amount of sediment has no trend over the last 10 years in both the Monocacy River and West Conewago Creek.

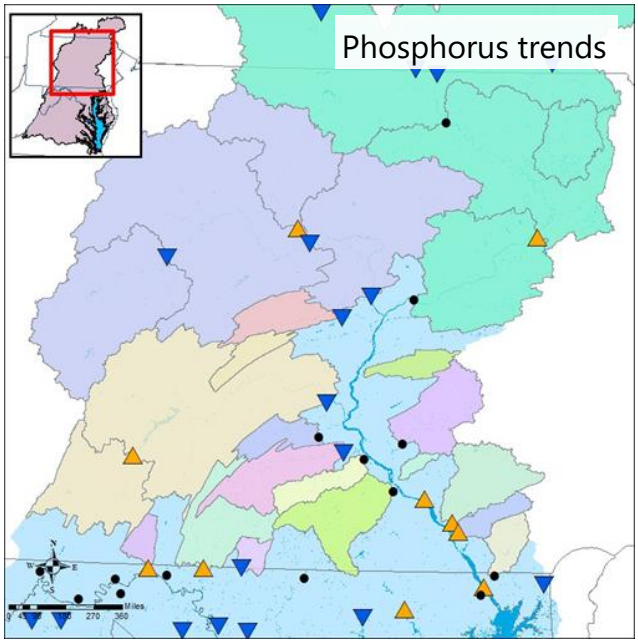
Sources of Nutrients & Sediment in Adams County

- ➢ It is estimated that most nutrients and sediment in Adams County's streams are coming from agricultural and developed/urban lands.
- ➢ Effective management will address the specific sources of nutrients and sediment in Adams County:
  - On agricultural lands, the majority of nutrients are applied to the land as fertilizer, so addressing this source will be important.
  - On developed/urban lands, the majority of nutrients entering local streams come from stormwater outside regulated municipal separate stormwater sewer system (MS4) areas, which may require outreach, financial programs, etc. to address the problems
  - Wastewater and septic contribute a small portion of the nutrients to local streams, but can be important locally.
  - Most of the phosphorus and sediment in local streams comes from overland runoff or streambank erosion during rain events; the most effective management practices reduce application of phosphorus to the land, reduce runoff, and reduce soil erosion.
  - In both agricultural and developed/urban areas, erosion of stream banks are important sources of sediment and nutrients to local streams.

Opportunities for Implementation in Adams County

- ➢ Marsh Creek and West Conewago Creek are effective places to manage nitrogen, phosphorus and sediment in Adams County.
- ➢ Some effective practices to address nutrients and sediment are currently being implemented in Adams County, such as conservation tillage and barnyard runoff control.
- ➢ There are many more opportunities within the county to increase implementation of effective practices such as basic and advanced nutrient management, cover crops, grass and forest buffers in agricultural areas, stormwater controls, and urban nutrient management in developed areas.





USGS. https://cbrim.er.usgs.gov

Water quality trends vary geographically and patterns are changing across Pennsylvania's Chesapeake Bay Watershed

Understanding Pennsylvania's regional water quality trends can put trends in local watersheds, like those in Adams County, in perspective.

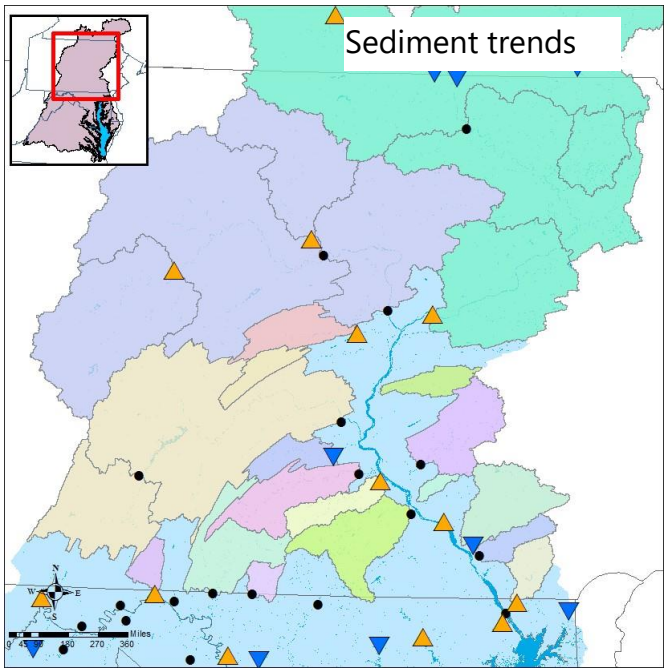
In addition to providing real-time water quality data, the USGS monitoring stations help to identify changes in water quality over time. These maps demonstrate nitrogen and phosphorus trends from 2007-2016.

- Blue downward triangles = improving conditions
- Orange upward triangles = degrading conditions
- Black dots = no trend

These results tell us that:

- Nitrogen levels in streams have been improving throughout the region with a few exceptions.
- Phosphorus levels show varying patterns depending on local watershed, reflecting local changes. Trends in the lower Susquehanna and Potomac are degrading.

Water quality trends for the USGS non-tidal stations are available at: https://cbrim.er.usgs.gov/summary.html.



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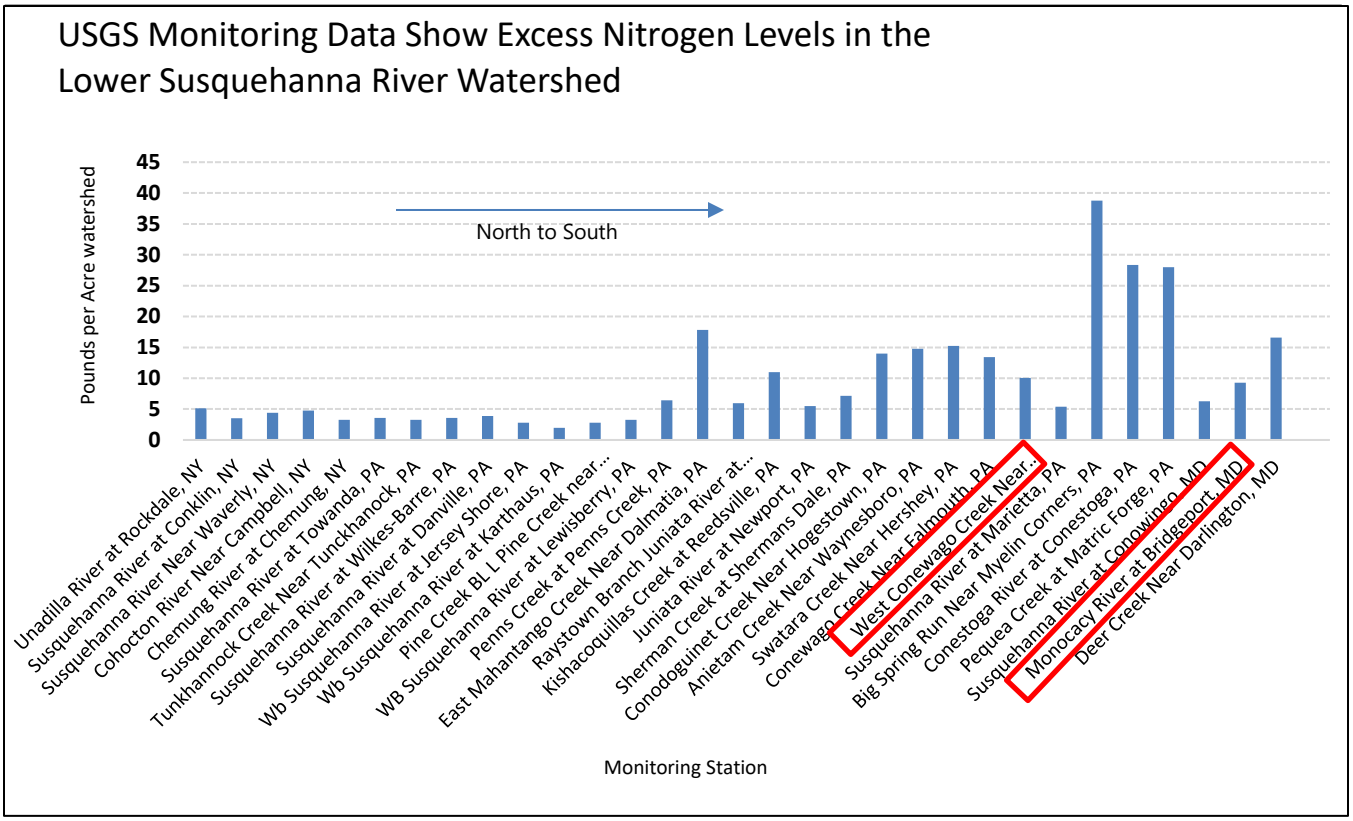
- Blue downward triangles = improving conditions
- Orange upward triangles = degrading conditions
- Black dots = no trend

These results tell us that:

- Sediment levels show varying patterns depending on local watershed, reflecting local changes. In many cases across the region these trends are degrading.

Water quality trends for the USGS non-tidal stations are available at: https://cbrim.er.usgs.gov/summary.html.



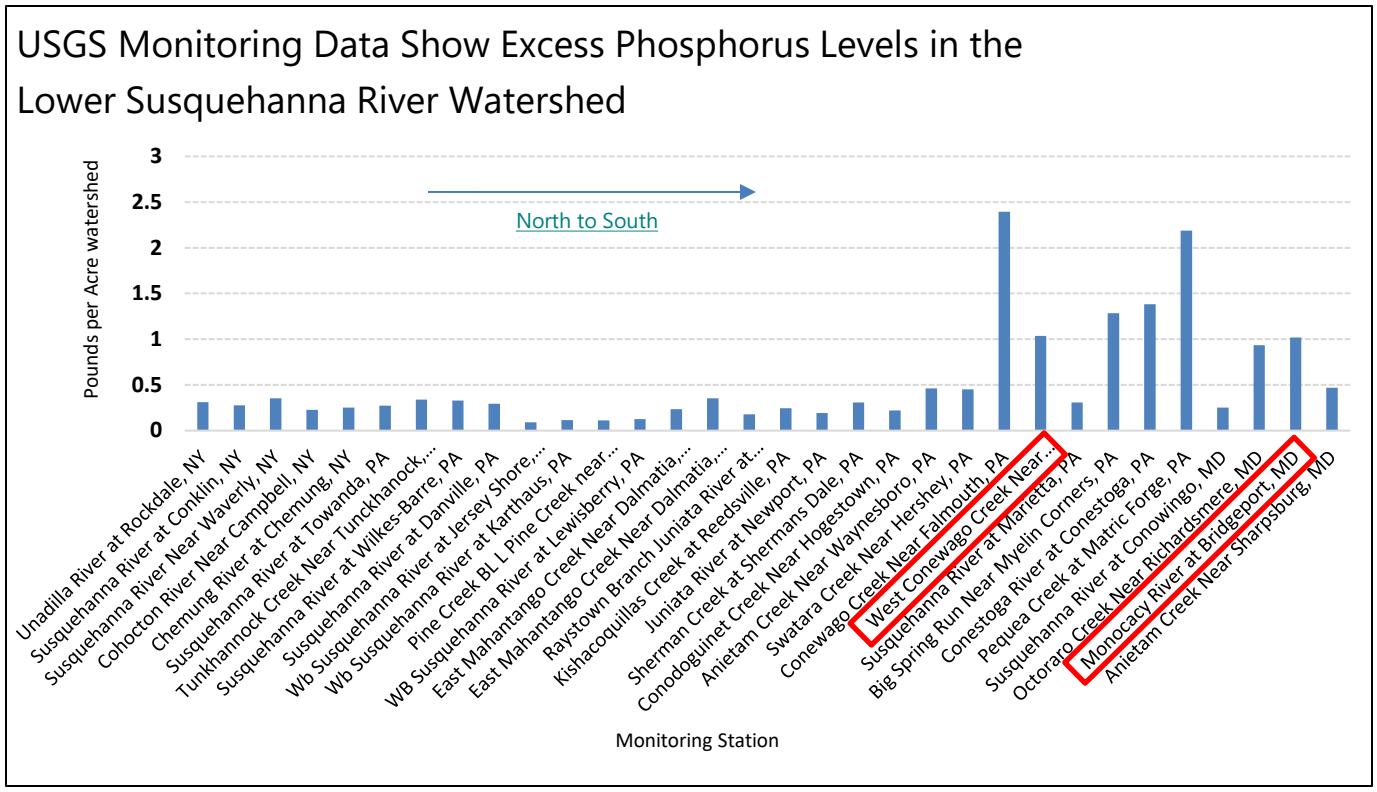
Source: USGS https://cbrim.er.usgs.gov/

Understanding where nutrients and sediment are highest across Pennsylvania streams can help focus planning efforts, especially in small watersheds.

In the graph above, the bars show the average annual pounds of nitrogen measured at monitoring stations divided by the acres of watershed draining into that station. The larger the bar, the more nitrogen there is in the watershed's streams relative to its size, and the greater the impact on streams.

Small watersheds in the Lower Susquehanna and Potomac, including those in Adams County, have some of the highest amounts of nitrogen relative to their size. These watersheds can be some of the most effective places to manage nitrogen.

Values in the graph above represent the average annual load per acre for the last 5 years. Data for the USGS non-tidal stations are available at: https://cbrim.er.usgs.gov/summary.html



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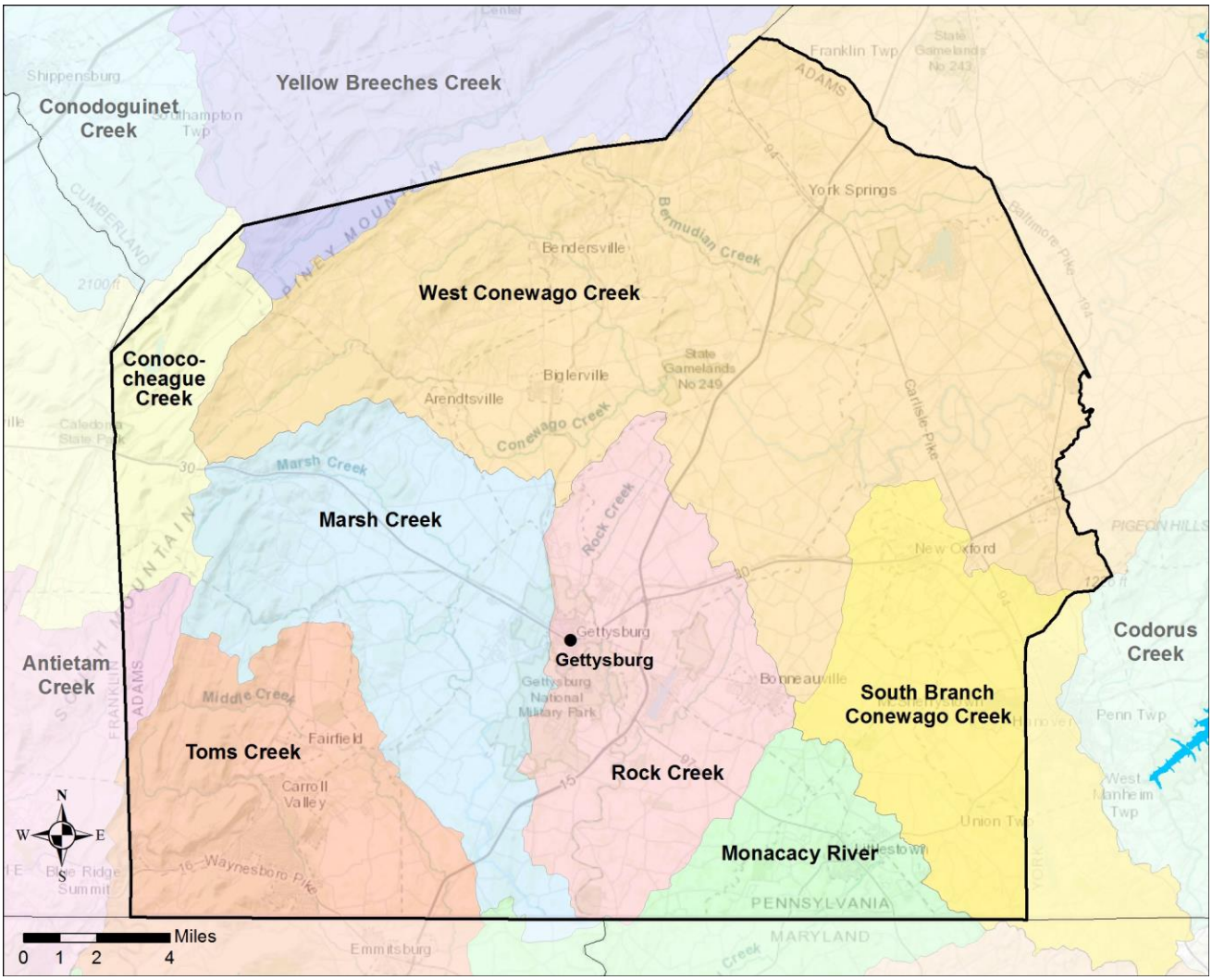
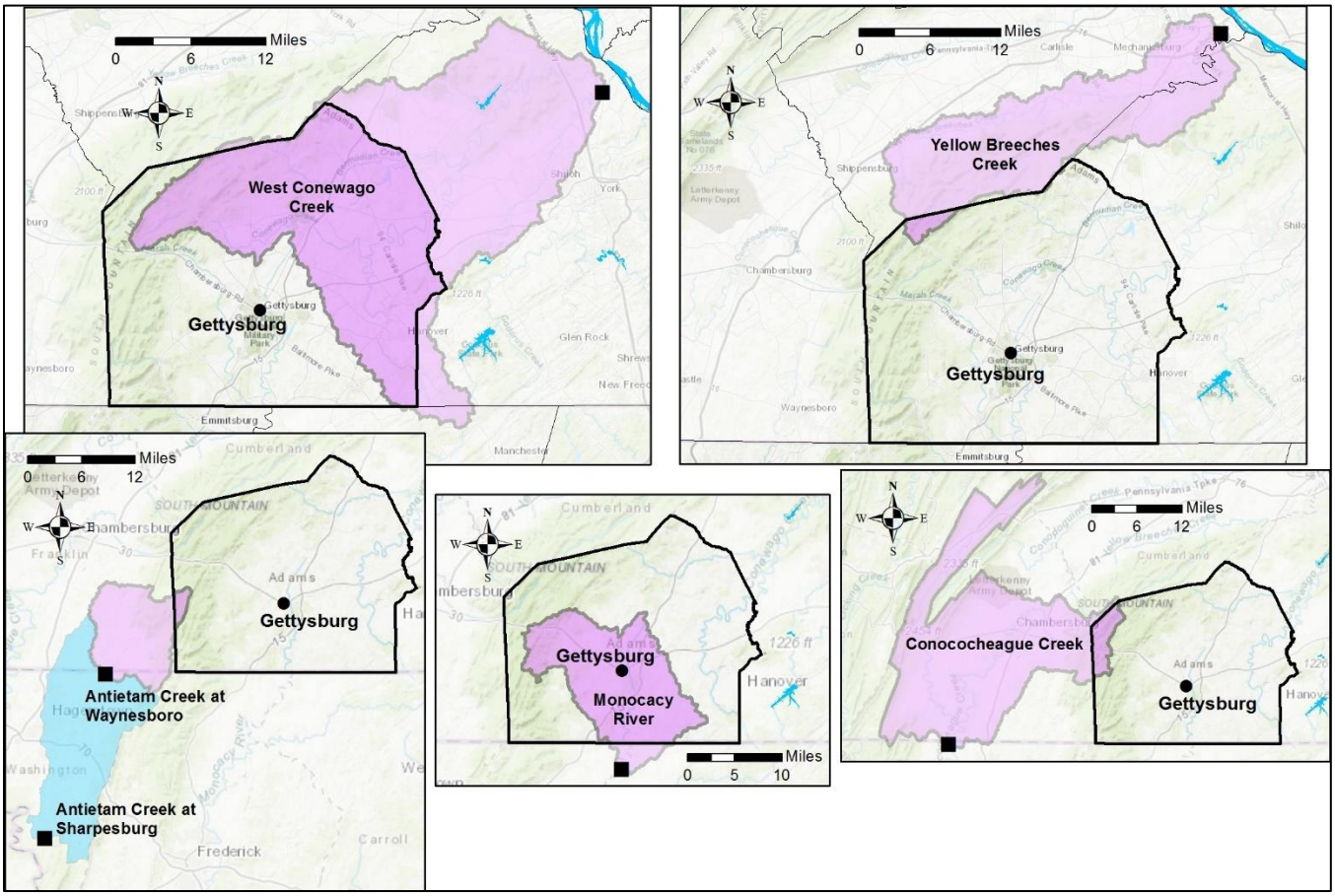
Adams County's Local Watersheds



The following pages provide in-depth information on local water quality in Adams County's monitored watersheds.



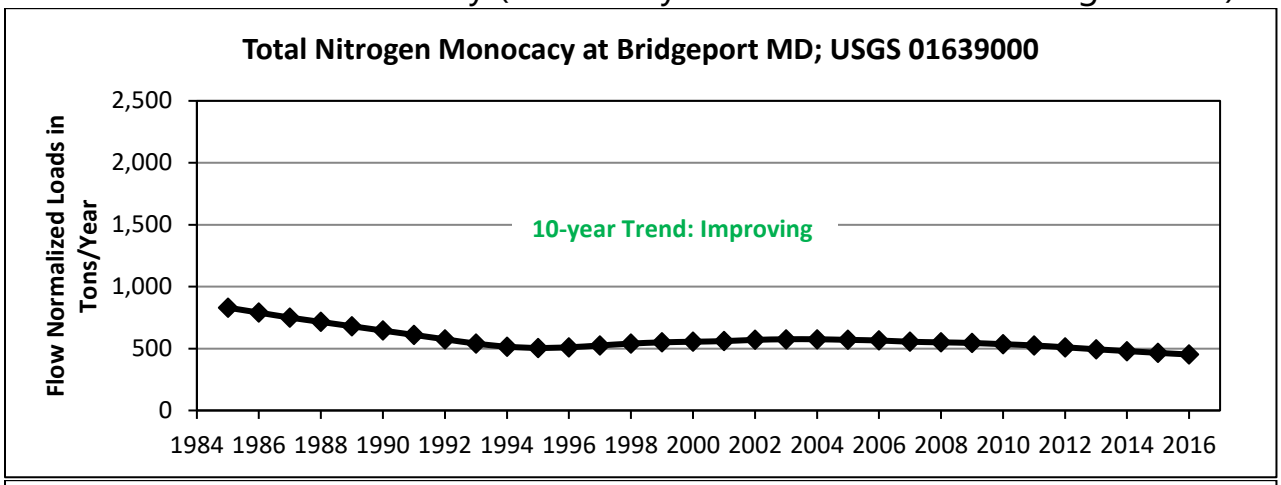
Five USGS monitoring stations (small squares) measure water quality in Adams County's watersheds. These maps depict the areas that drain into each of those monitoring stations.

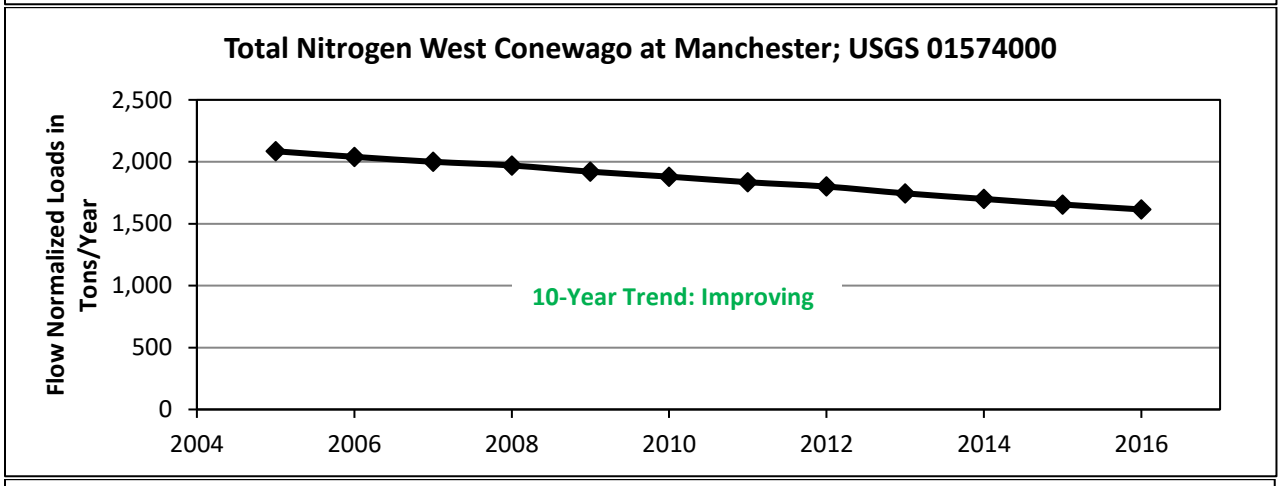
- The West Conewago Creek monitoring station covers almost half of Adams County, and about half the whole watershed is in Adams County.
- Monocacy River watershed covers a large portion of central Adams County, and most of the watershed is in Adams County.
- Three watersheds cover a small portion of the western edge of Adams County. Yellow Breeches Creek covers the northern portion, Conococheague Creek covers the western edge, and Antietam Creek covers the southern portion.

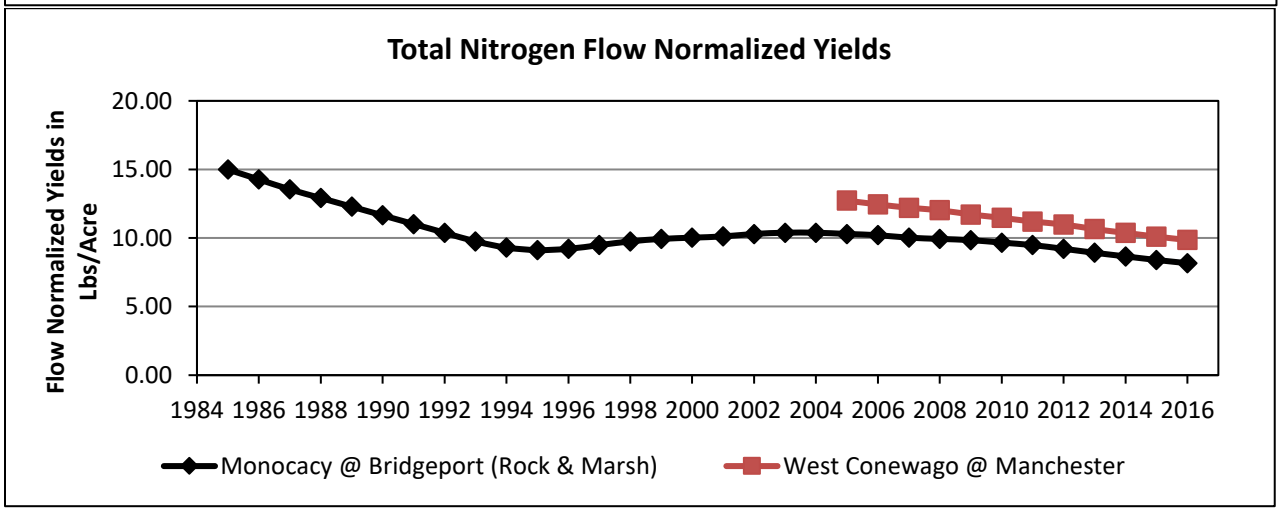
Water quality trends for the USGS non-tidal stations are available at:

https://cbrim.er.usgs.gov/summary.html.

Nitrogen levels have been improving (going down) over time in the two major watersheds in Adams County (Monocacy River and West Conewago Creek)





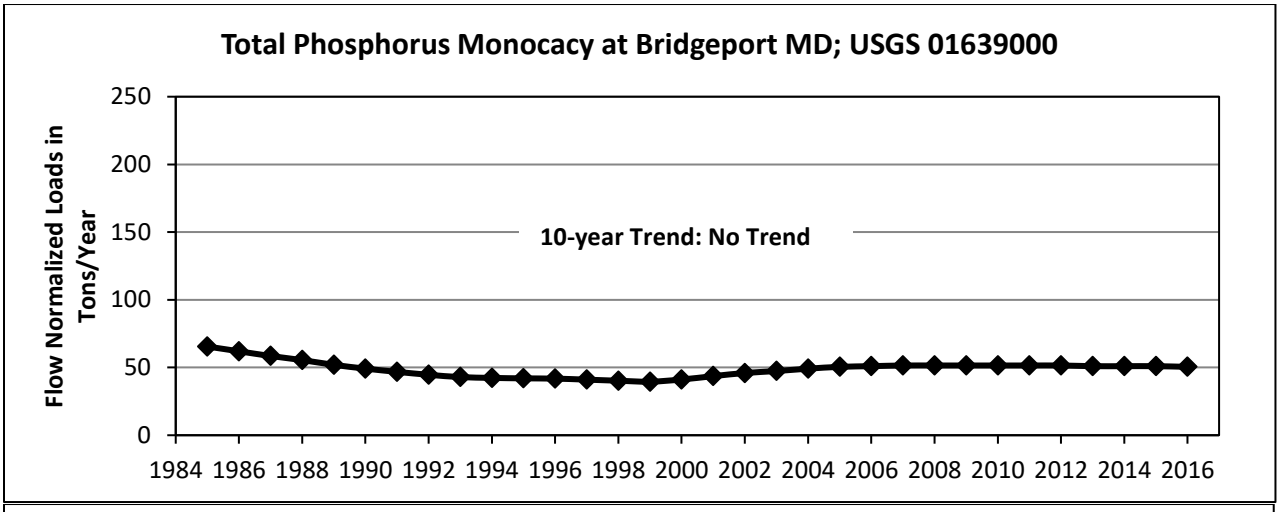


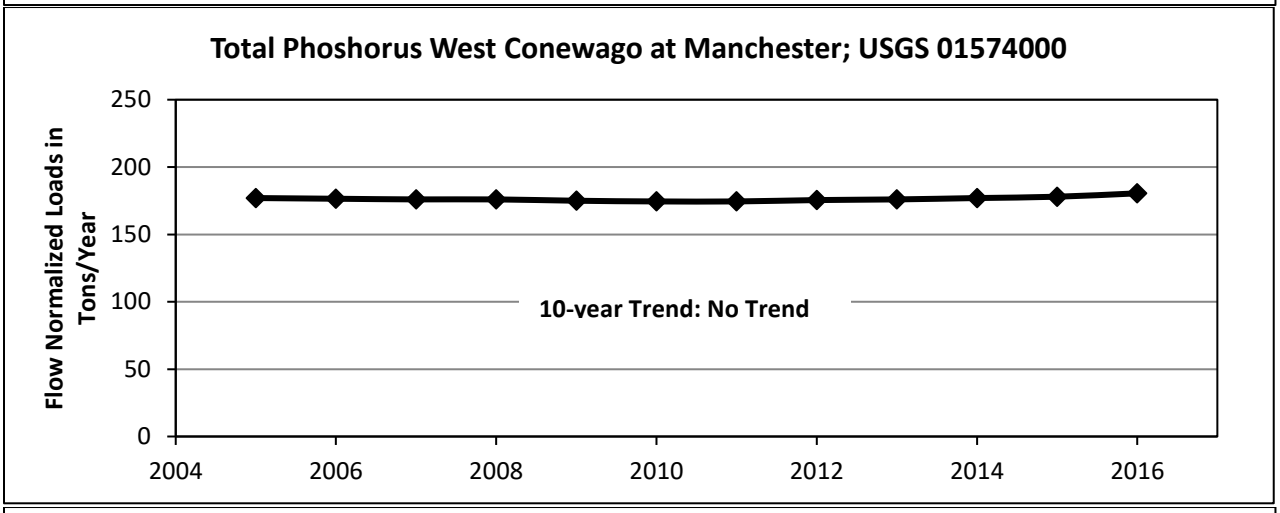
The two major monitored watersheds within Adams County show improving nitrogen trends (meaning that nitrogen is decreasing).

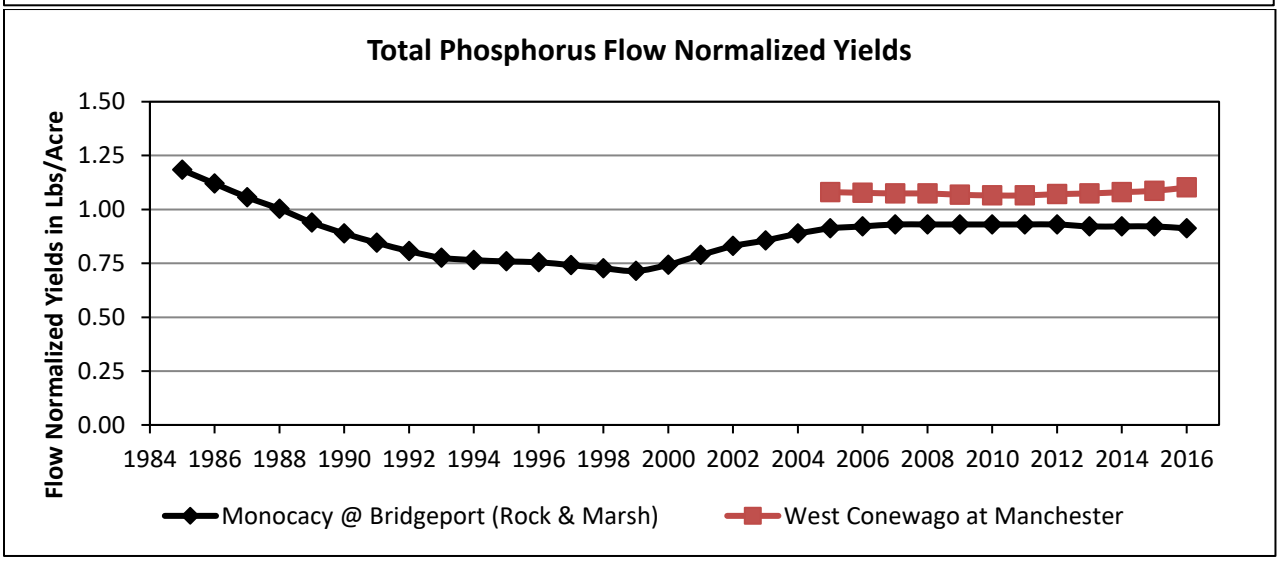
- Previously displayed are the two watershed that cover the majority of Adams County, Monocacy River and West Conewago Creek.
- West Conewago has higher nitrogen loads than the Monocacy River. This is partially due to its larger size.
- The previous graph (bottom) show that when size is taken into account, the nitrogen load per acre is still higher in West Conewago Creek.
- These watersheds would be effective areas to focus efforts.
- Decreasing nitrogen is a result of decreasing deposition of nitrogen from the atmosphere onto the watershed (a result of the Clean Air Act), wastewater treatment plant upgrades, and some agricultural practices.

The previous graphs take into account variability between years in river flow.
For more information, visit: https://cbrim.er.usgs.gov/summary.html.

Phosphorus levels in the two major watersheds in Adams County streams have shown no significant trends over the last 10 years.





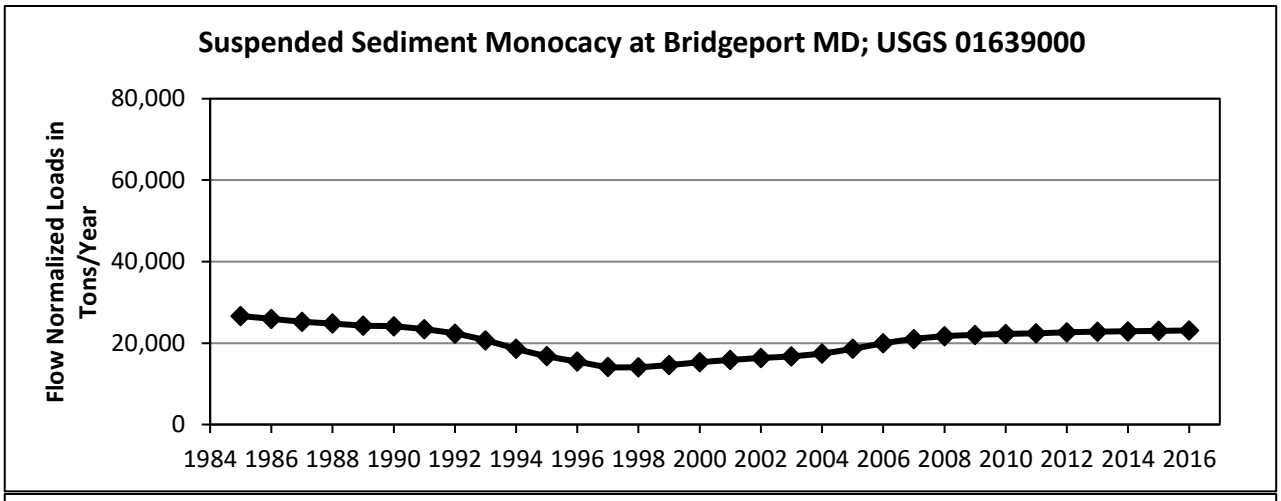


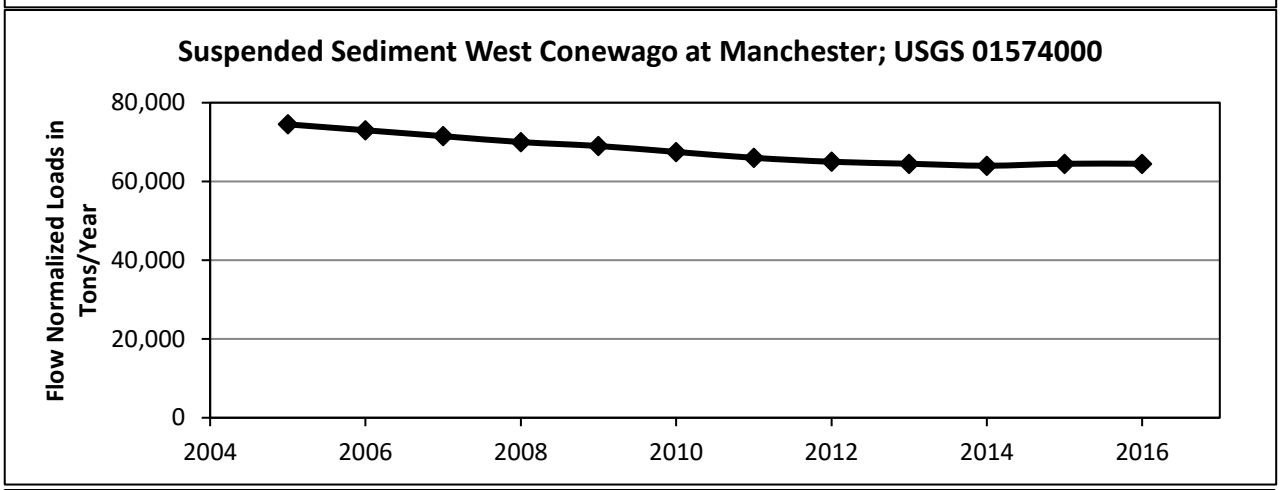
The two major monitored watersheds within Adams County show no significant phosphorus trends over the last 10 years.

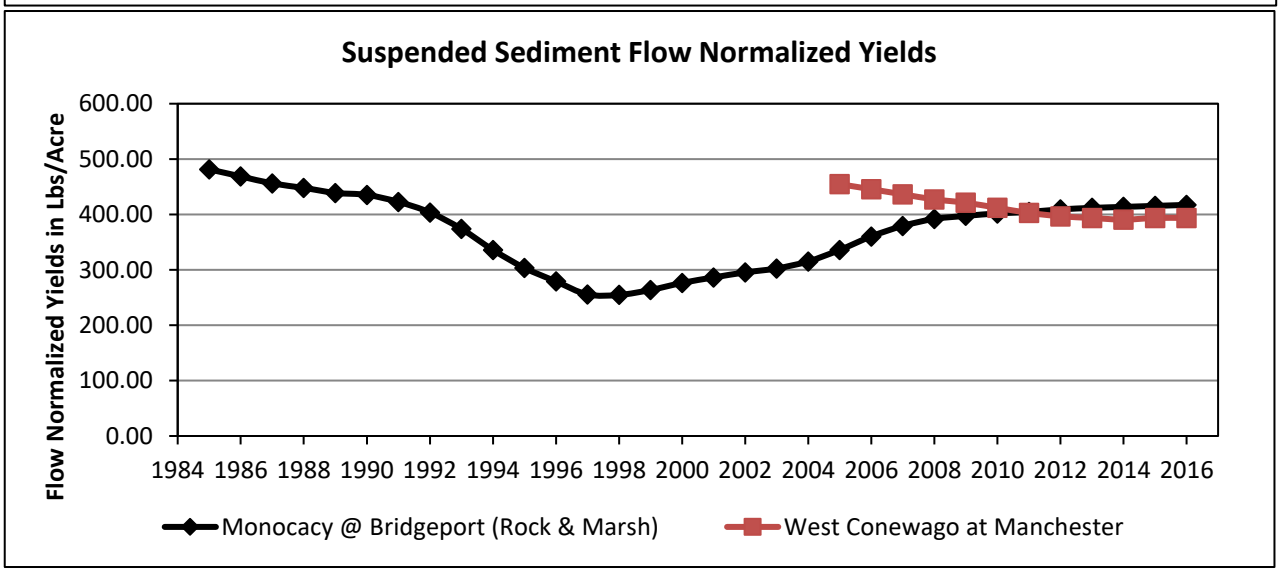
- Previously displayed are the two watershed that cover the majority of Adams County, Monocacy River and West Conewago Creek.
- West Conewago has higher phosphorus loads than Monocacy. This is partially due to its larger size.
- The previous graph (bottom) shows that when size is taken into account, the phosphorus load per acre of watershed is still slightly higher in West Conewago.

The graphs above take into account variability between years in river flow.
For more information, visit: https://cbrim.er.usgs.gov/summary.html.

Sediment levels in Adams County's streams show no significant trends over the last 10 years.



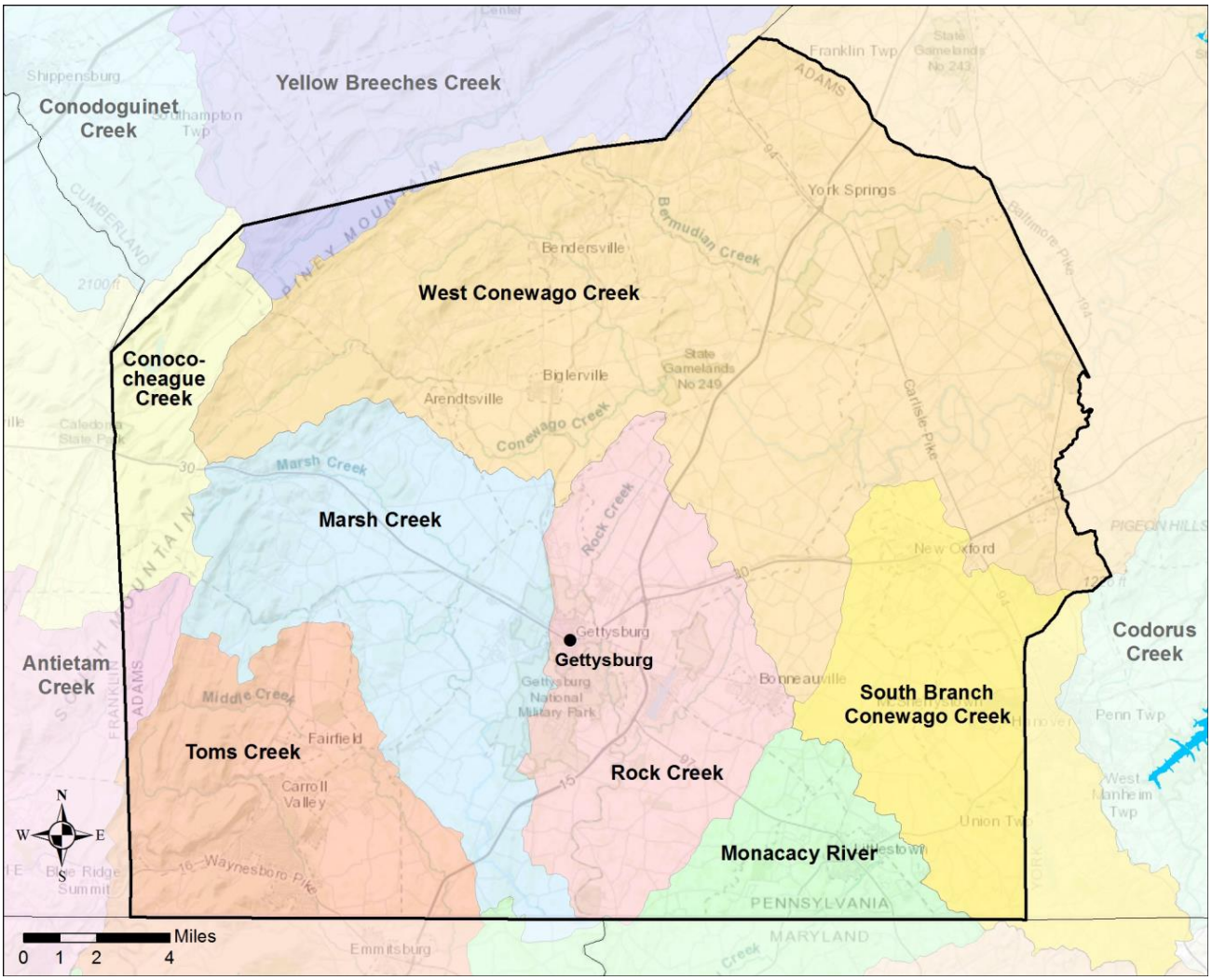




The monitored watersheds within Adams County show no significant sediment trends over the last 10 years.

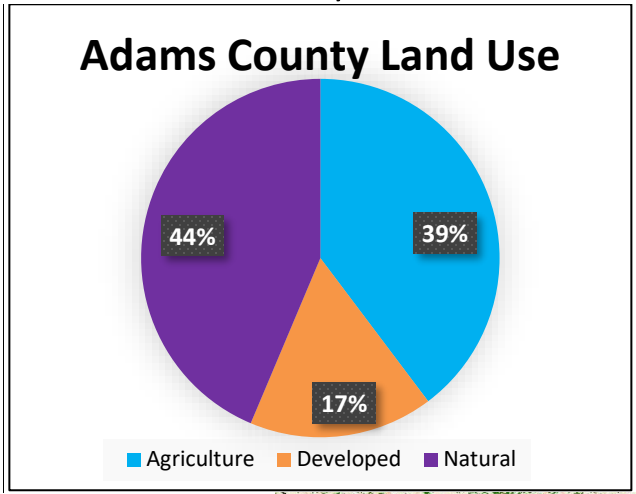
- Previously displayed are the two watershed that cover the majority of Adams County, Monocacy River and West Conewago Creek.
- West Conewago has higher sediment loads than Monocacy. This is partially due to its larger size.
- The previous graph (bottom) shows that when size is taken into account, the suspended sediment load per acre of watershed is still slightly higher in West Conewago.

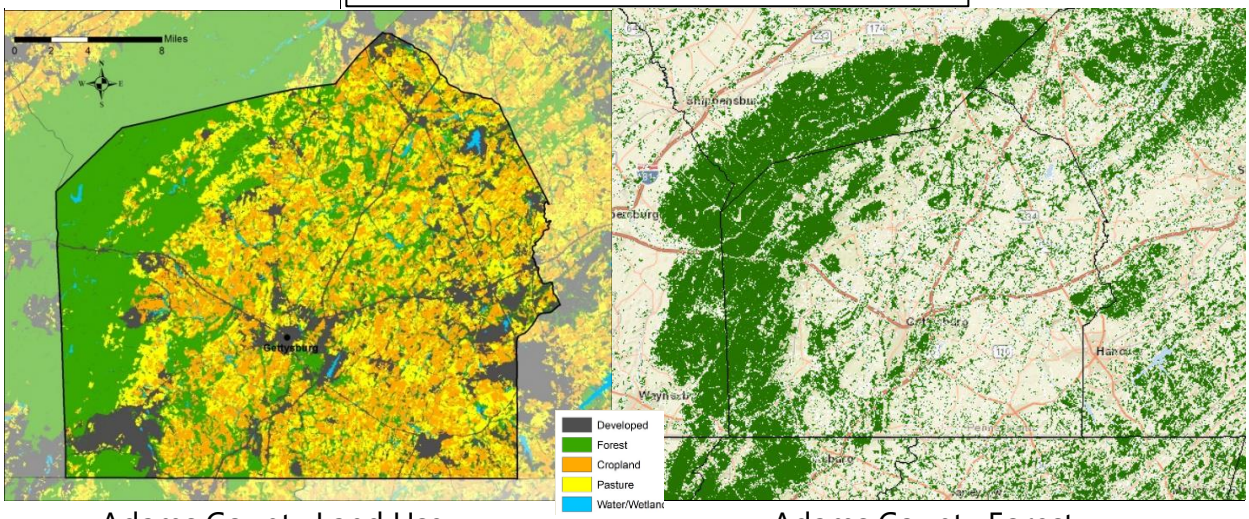
The graphs above take into account variability between years in river flow.
For more information, visit: https://cbrim.er.usgs.gov/summary.html.



Sources of Nutrients and Sediment in Adams County

Adams County has less forested land than most other Pennsylvania counties





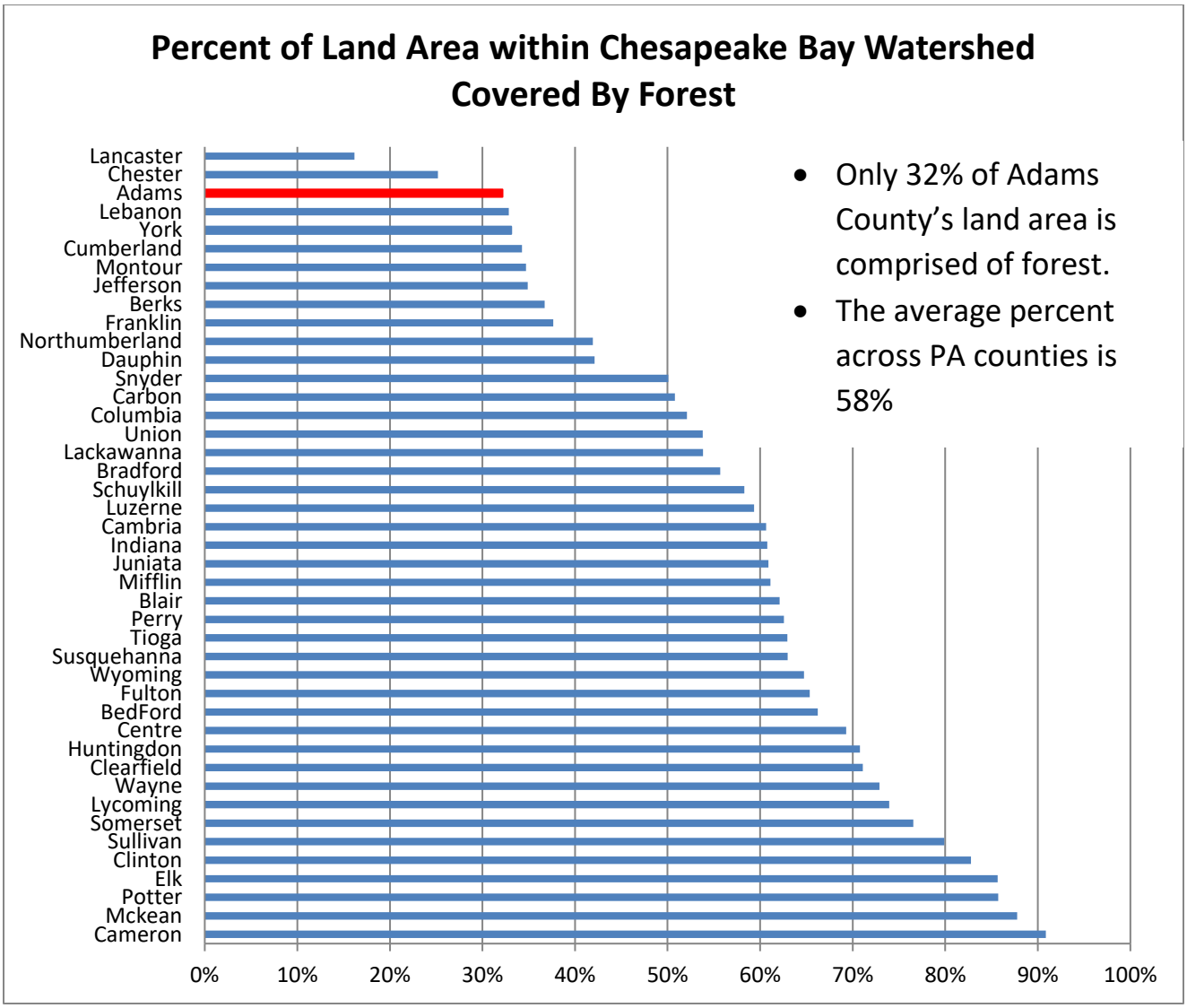
Adams County Land Use | Adams County Forest

Adams County has unique challenges in restoring water quality.

- Agricultural and developed land generate more nutrients and sediment than forested land. Adams County has unique local water quality challenges in part due to its high acreage of these land uses.
- The pie chart above shows the breakdown of land uses in Adams County. 56 percent of the county is agricultural or developed land, which is higher than most other counties in Pennsylvania.
- The maps above show the geography of land uses (left) and specifically the relatively small amount of forested land in the county (right).

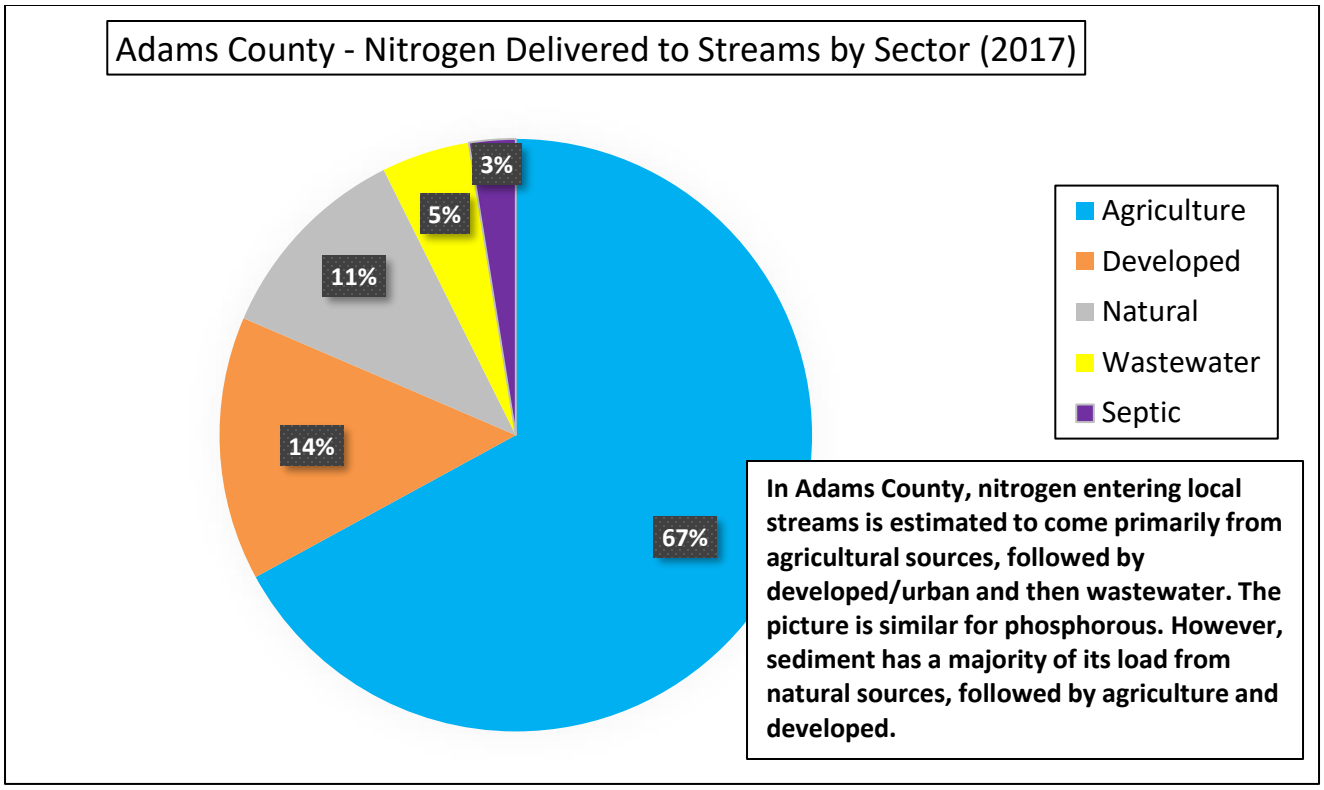
High resolution land-use for the Chesapeake Bay watershed is available from USGS and the Chesapeake Bay Program at: https://chesapeake.usgs.gov/phase6/.

The maps above are from Falcone, 2015 (middle) and Google Earth (right). The breakdown of land use by county can be found on CAST at: http://cast.chesapeakebay.net/.



Adams County's land is only 32 percent forested. This is the third least forested county of all counties in Pennsylvania's Chesapeake Bay watershed, representing a unique challenge for Adams County. The average for Pennsylvania counties is 58 percent forested land.

The breakdown of land use by county can be found on CAST at: http://cast.chesapeakebay.net/.



The pie chart above shows the percentage of nitrogen delivered to local streams based on land use or activity. Most nitrogen entering local streams in Adams County comes from agricultural sources including cropland, pastures and barnyards.

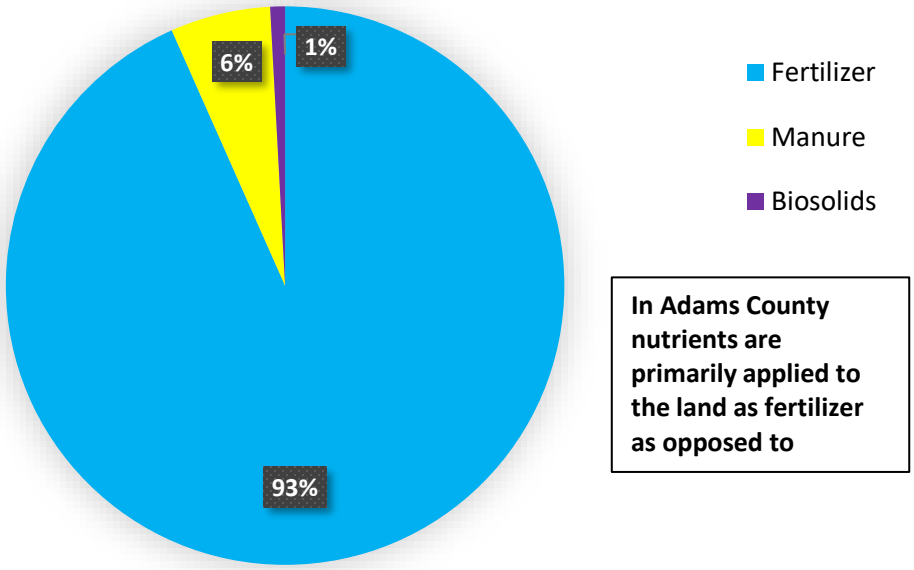
The developed/urban sector also contributes a fair amount of the load from stormwater.

Because agriculture and developed/urban sources make up the majority of the load in Adams County, these sectors will need to consider how they can supply the majority of the reductions to reach local goals. Wastewater and septic sources can also be reduced.

These estimates were generated using the Chesapeake Bay Program's Phase 6 Watershed Model. The model is generated using water quality monitoring data.

Estimated loads by sector can be found on CAST at: http://cast.chesapeakebay.net/.

Estimated Share of Nitrogen Applied to Agricultural Land in Adams County in 2017 by Main Source

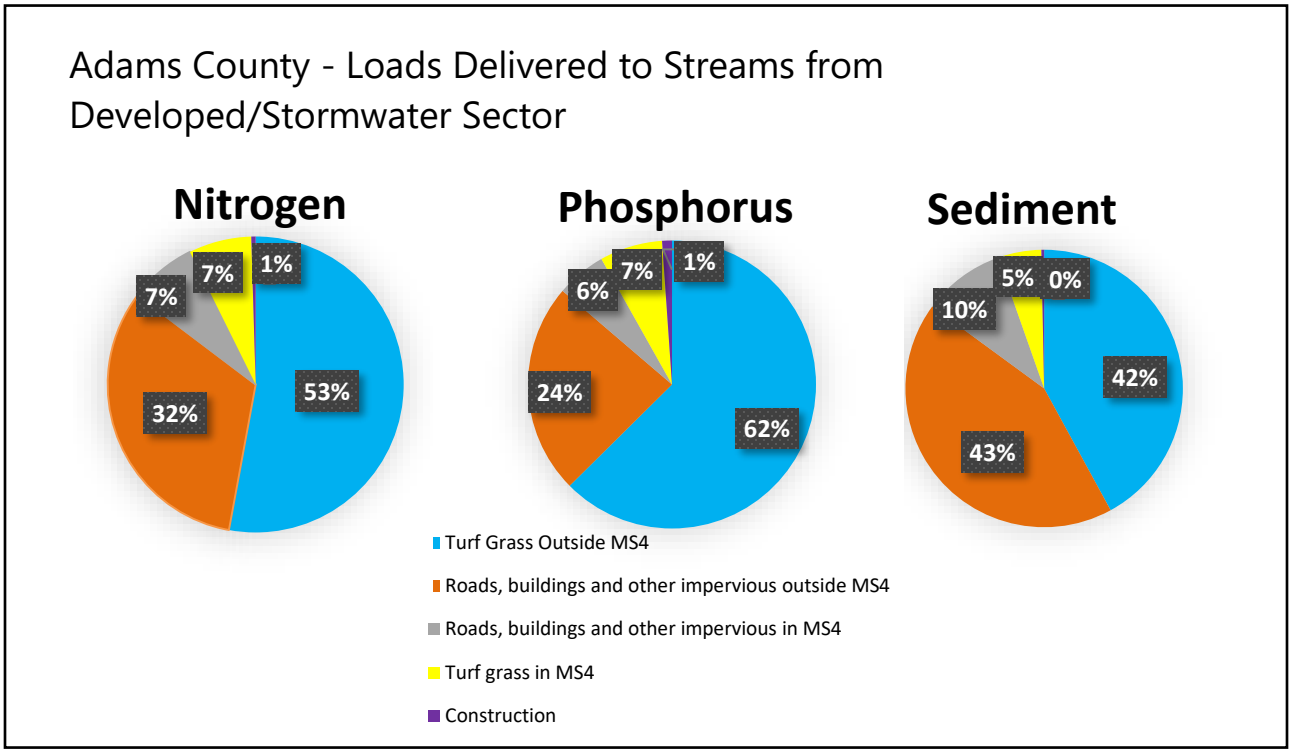


In Adams County nutrients are primarily applied to the land as fertilizer as opposed to

Understanding how nutrients are being applied to the land can lead to the sources that may need to be managed.

- Most nutrients applied to agricultural land in Adams County are in the form of fertilizer.
- Nutrients that are applied to agricultural land and not taken up by crops can negatively impact water quality.
- When identifying strategies to manage nutrient application, focusing on fertilizer will address a large portion of the issue.
- Implementation of nutrient management plans and use of precision fertilizer application approaches, especially in combination, are effective practices to consider in reducing nutrient pollution.

Estimated application of nutrients by source can be found on CAST at: http://cast.chesapeakebay.net/.



The developed/stormwater sector is also an important source of nutrients and sediment in Adams County.

The charts above show the estimated breakdown of sources of nutrients and sediment to local streams exclusively from developed/urban lands.

- MS4 (municipal separate storm sewer systems) areas are regulated by DEP, while land outside of MS4 areas is not regulated for stormwater.
- Turf grass represents grassy and barren lands that have been altered through compaction, removal of organic material, and/or fertilization. These include all

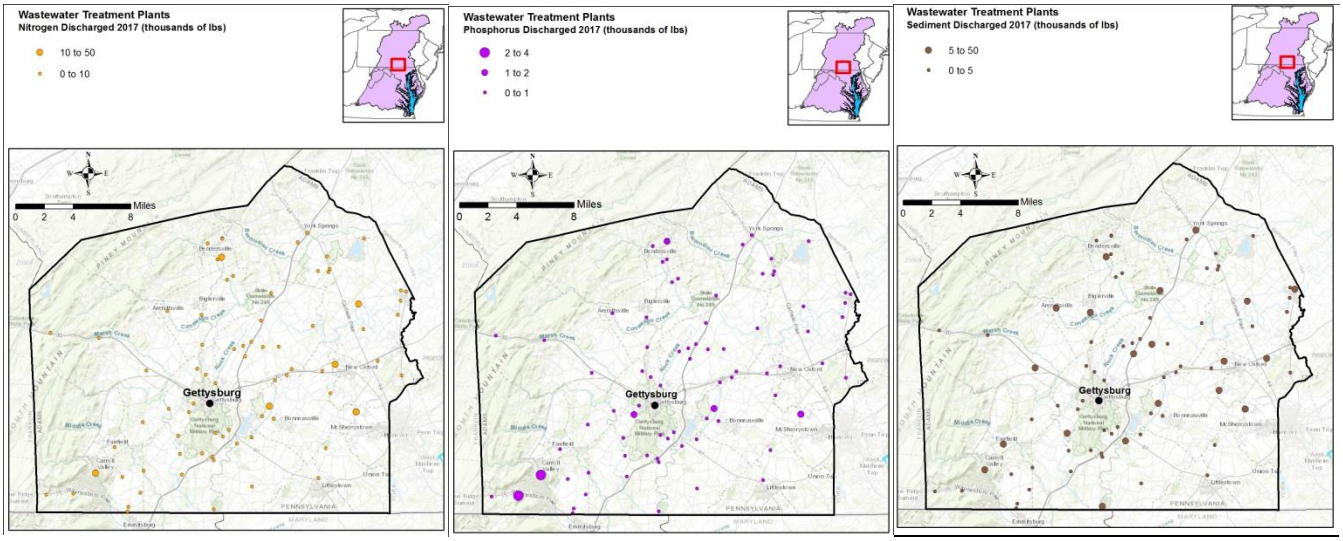
lawns and grassy areas in residential, commercial, recreational, cemeteries, shopping centers, etc.

Understanding where stormwater nutrient and sediment comes from is an important first step in addressing it.

- In Adams County, both impervious and grassy areas are important sources to manage stormwater.
- The majority of developed nutrients and sediment loads come from outside of MS4 areas, so managing lands outside these regulated areas will be especially important.
- Managing these unregulated stormwater areas may take different outreach, voluntary programs and funding programs to implement practices.

Estimated loads by sources can be found on CAST at http://cast.chesapeakebay.net/.

Wastewater Treatment Plant Location and Loads



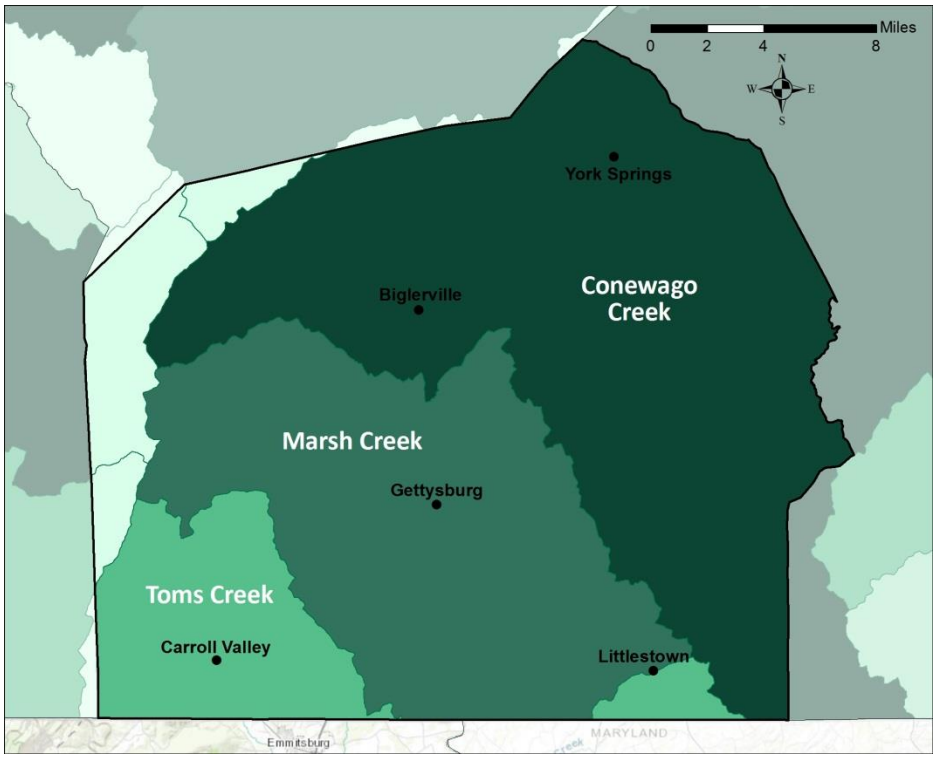
The maps above show the locations of wastewater treatment plants within Adams County and their annual discharges of nitrogen, phosphorus and sediment in 2017.

Although wastewater makes up a smaller portion of nutrient loads to streams than agricultural or developed land and has already been significantly reduced in Adams County, there is still room for reductions, particularly of nutrients. Wastewater is an important source to control as discharges directly enters the streams.

Understanding where the higher loading plants are can help identify opportunities for treatment plant upgrades in the future.

Reported wastewater treatment plant discharges and treatment plant locations are available from the Chesapeake Bay Point Source Database: https://www.chesapeakebay.net/what/downloads/bay_program_nutrient_point_source_database

Septic System Density in Adams County



While septic systems do not make up a significant portion of the nitrogen entering Adams County's streams, they can be very important sources locally.

It will be important as development continues in the county to address high densities of septic systems.

Number of septic systems

- 0 to 500
- 500 to 1500
- 1500 to 3000
- 3000 to 5500
- > 5500

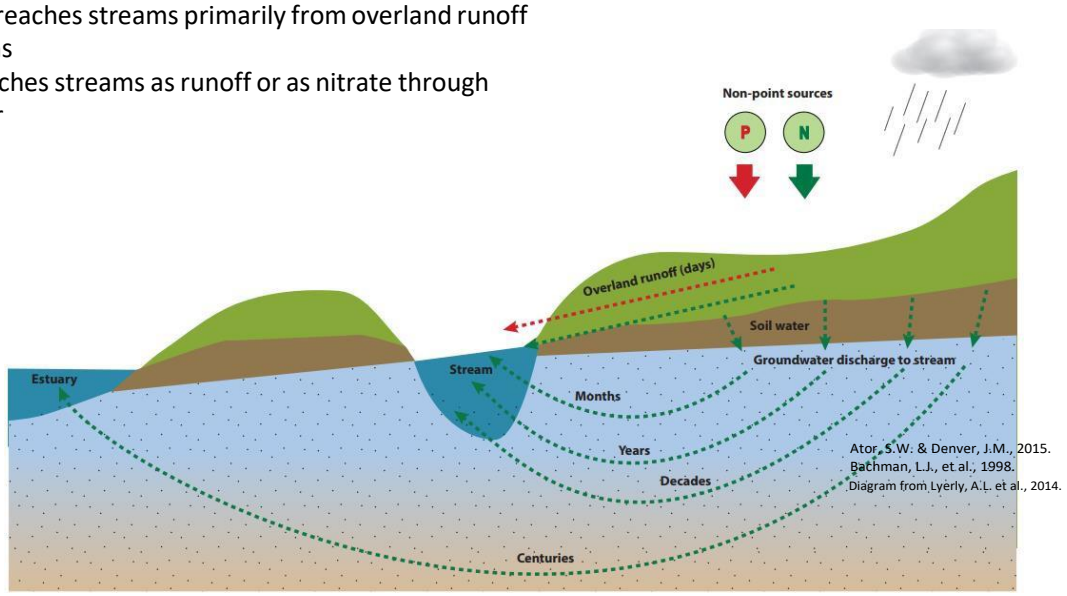
Although on-lot septic systems do not make up a large portion of the load in Adams County, they can be important local sources of nitrogen in high-density areas, especially when leaking into groundwater.

The map above shows the number of septic systems in different watersheds in the county, identifying potential areas of focus where septic system density is high.

Number of septic systems in each watershed can be found on CAST at http://cast.chesapeakebay.net/.

The transport of nutrients matters for planning implementation

- Phosphorus reaches streams primarily from overland runoff during storms
- Nitrogen reaches streams as runoff or as nitrate through groundwater



The way in which nutrients and sediment reach our streams impacts which practices will be effective at controlling them.

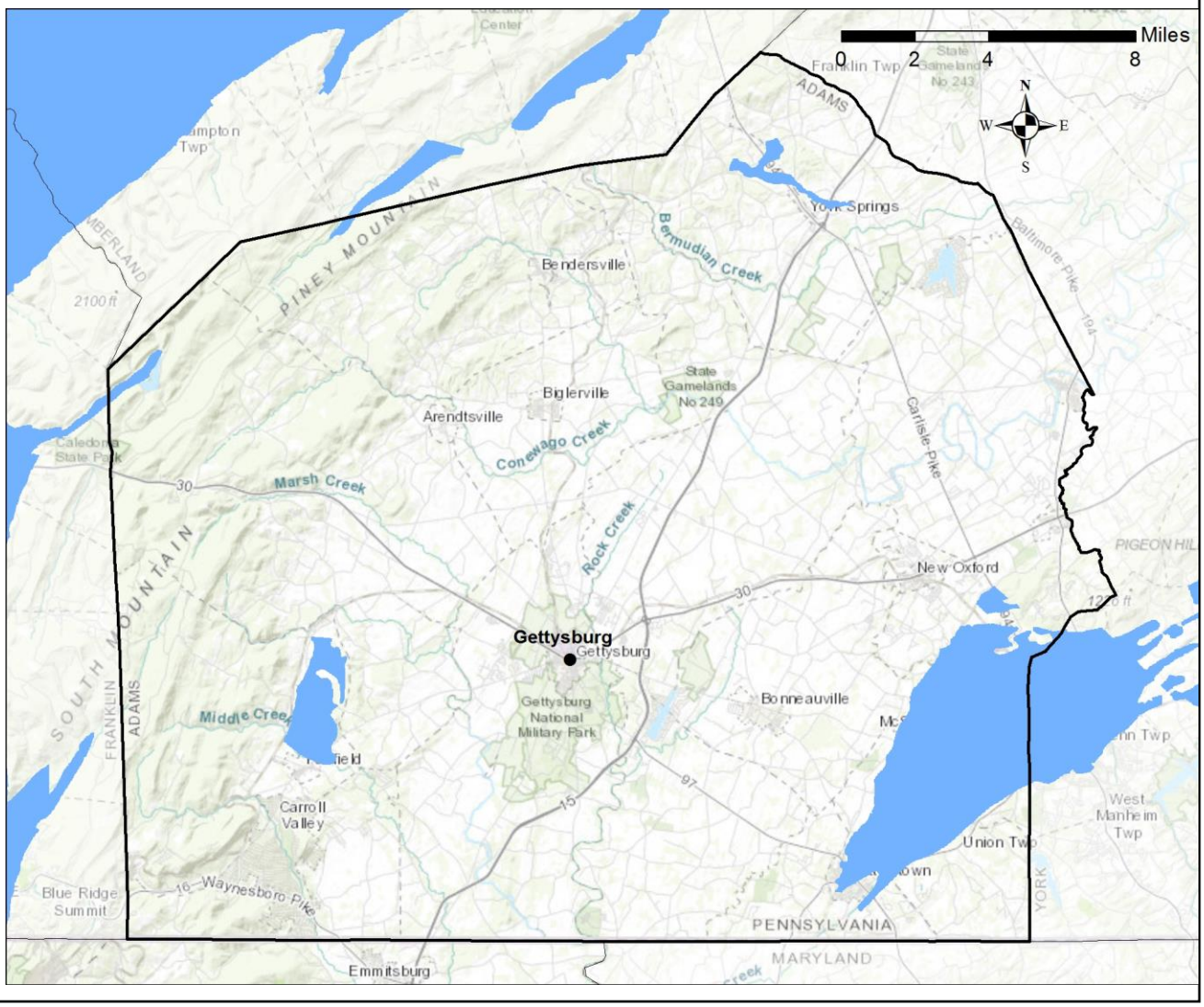
Phosphorus and sediment travel over the top of the land during high runoff events such as storms and rainfall, and also enter streams from stream bank or stream bed erosion.

Nitrogen can travel over land as well, but in many watersheds, including those in Adams County, it travels as nitrate underground in groundwater.

- For example, in the Monocacy Watershed 35.5% and in the West Conewago 44.5% of the nitrogen entering the streams in the form of nitrate from groundwater.
- If agricultural practices only focus on overland runoff, they could be missing a lot of the nitrogen that is entering streams through groundwater.
- Once nitrogen is in groundwater, it is very difficult to remove. Effective practices include those that stop nitrogen from entering groundwater in the first place, like applying less nitrogen and planting cover crops.
- Riparian buffers can remove nitrate from groundwater if placed in effective locations.

Percent of Nitrogen entering the streams as ground water nitrate can be found at https://pubs.usgs.gov/wri/wri98-4059/pdf/wri98-4059.pdf

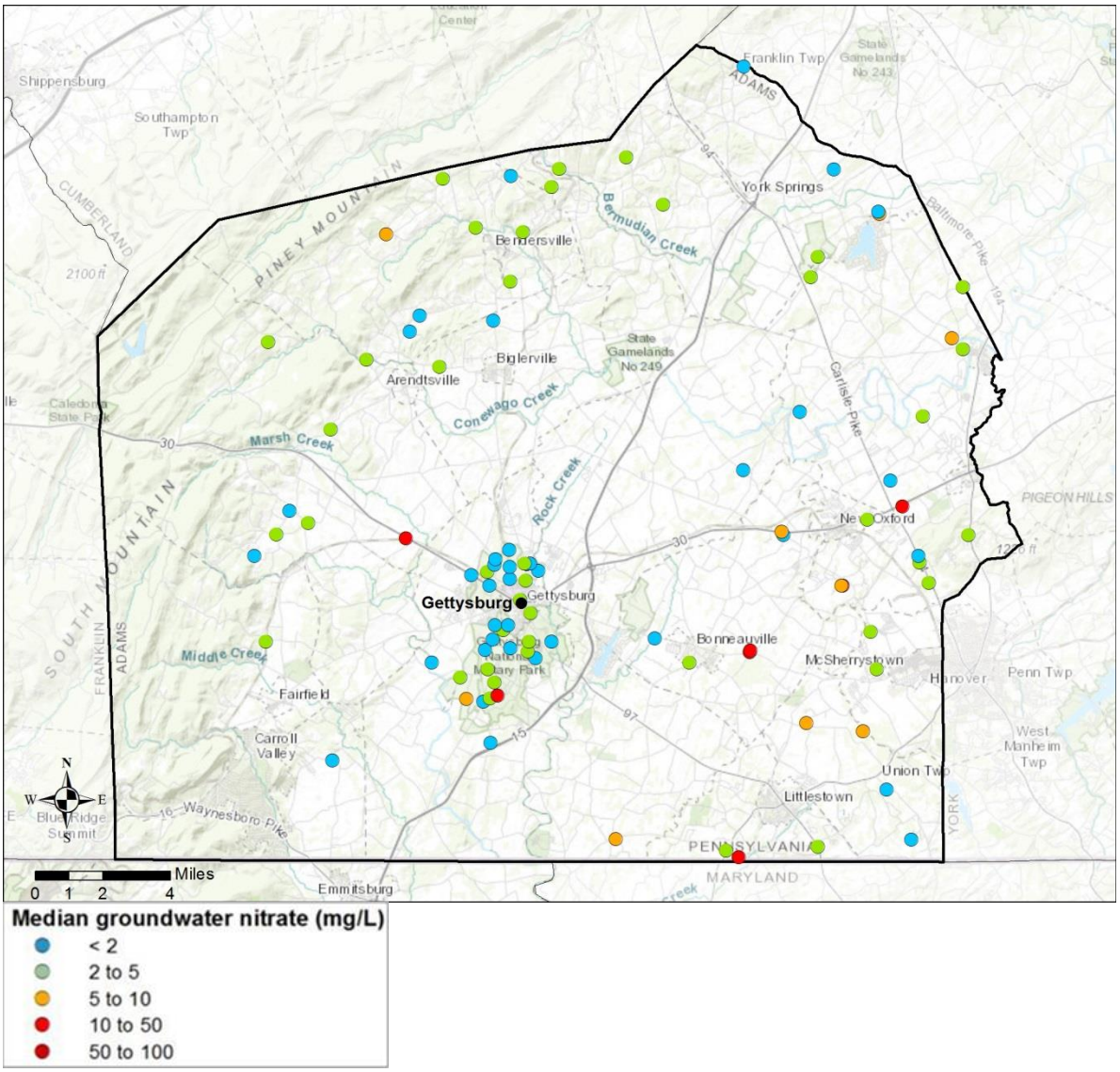
Adams County contains a small area vulnerable to groundwater contamination (Karst highlighted in blue)



Certain areas of the watershed are more vulnerable to nitrate contamination of groundwater because the geology under the soil makes it easier for nitrogen to enter groundwater and provides less opportunity for its removal to occur naturally.

- The map above shows these vulnerable areas, which have Karst or carbonate geology.
- Agricultural land on top of these areas makes the groundwater especially vulnerable due to the high inputs of nitrogen onto the landscape.
- These areas can be very effective for focusing efforts that keep nitrogen from getting into groundwater and are especially important areas to manage application of nitrogen.

Nitrate groundwater concentrations in Adams County



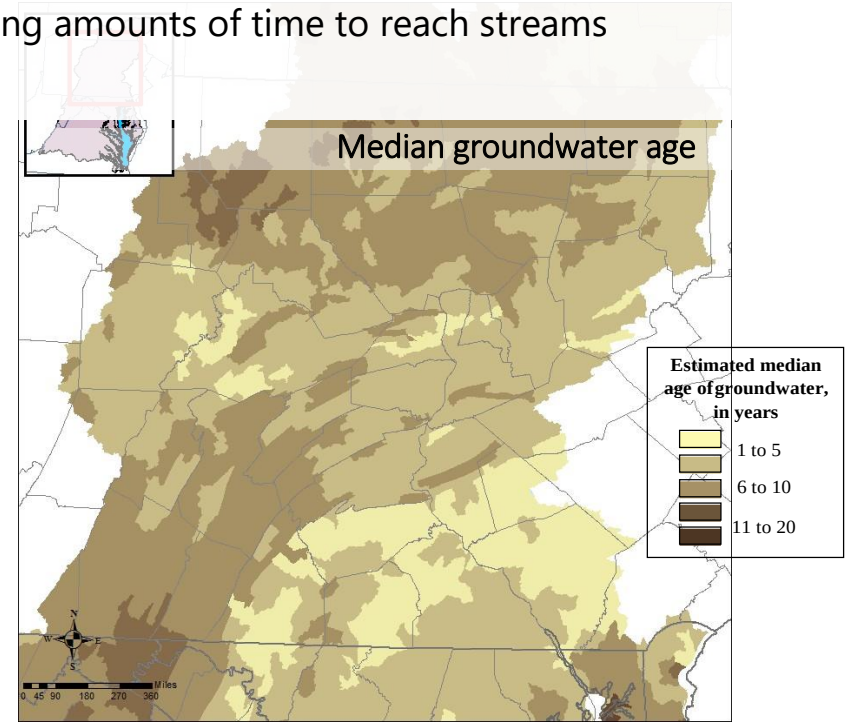
Groundwater in Adams County has some elevated nitrate levels.

- This is can be due to the vulnerable geology, and also to the over-application of nutrients over time.
- Because groundwater contributes a portion of nitrogen to streams in these watersheds, groundwater nitrate levels are indicators of what will eventually enter streams.
- In few cases throughout Adams County, groundwater nitrate levels exceed the EPA's safe drinking water threshold of 10 mg/L.

Groundwater quality data over multiple years can be found from USGS: https://water.usgs.gov/owq/data.html.

Groundwater takes varying amounts of time to reach streams depending on location

- Nitrate in groundwater represents a range of ages from recent to decades old
- Benefits from management actions will manifest immediately as well as into the future
- Chesapeake Bay Program estimates the median groundwater age across Adams County is between 1 and 10 years, with much of the groundwater being less than 5 years old.
- This means we expect very little "lag time" between when a practice is implemented and when that practice's impact can be seen in local streams. That presents a unique opportunity for quick, verifiable results that does not exist across most of the watershed.



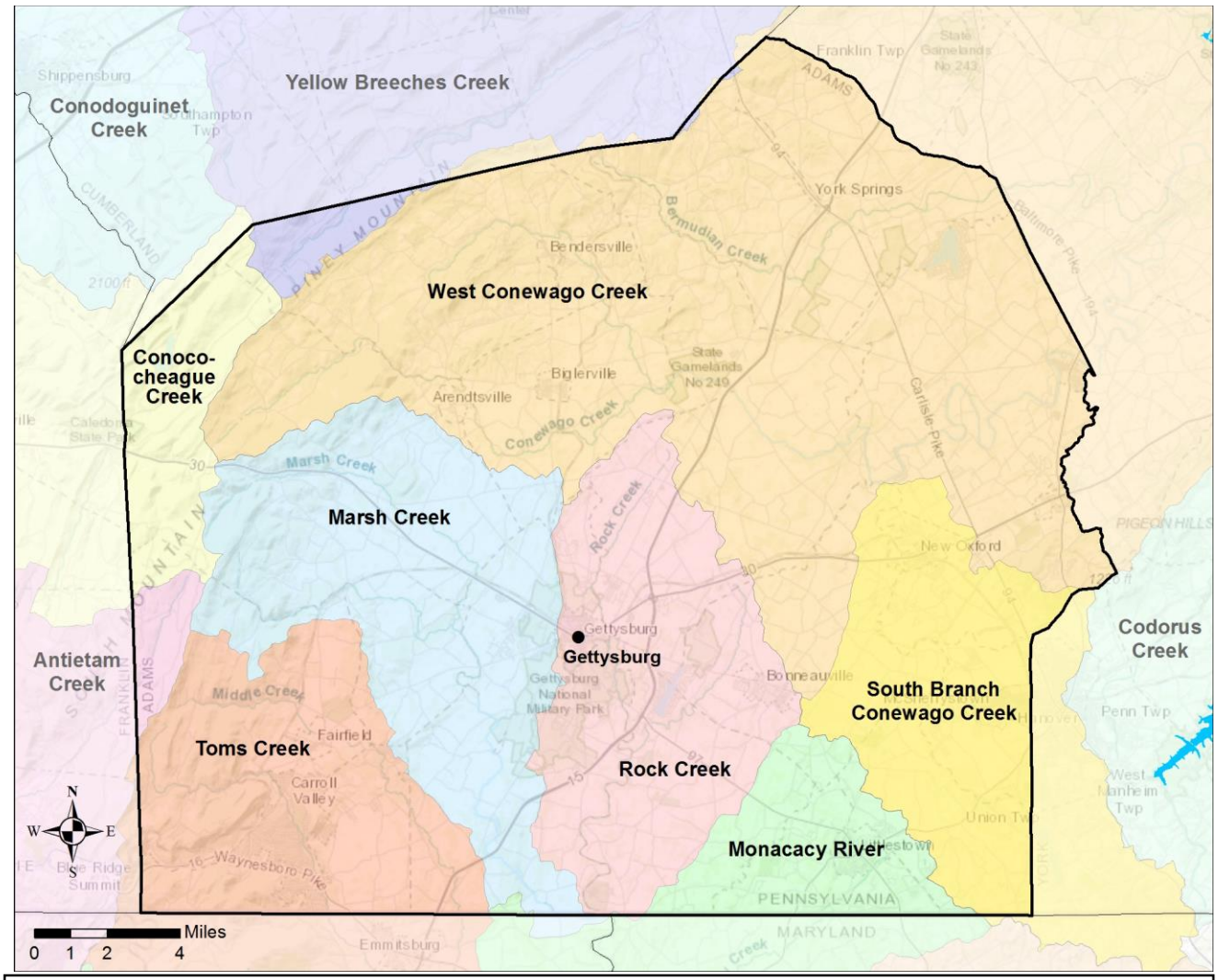
Phase 6 WSM groundwater age estimates. DRAFT from Jimmy Webber, USGS and Ghopal Batt, Chesapeake Bay Program.

Groundwater takes anywhere from days to years to reach nearby streams.

In Adams County, the groundwater is some of the youngest in the Chesapeake Bay watershed, meaning that it doesn't take long to reach streams.

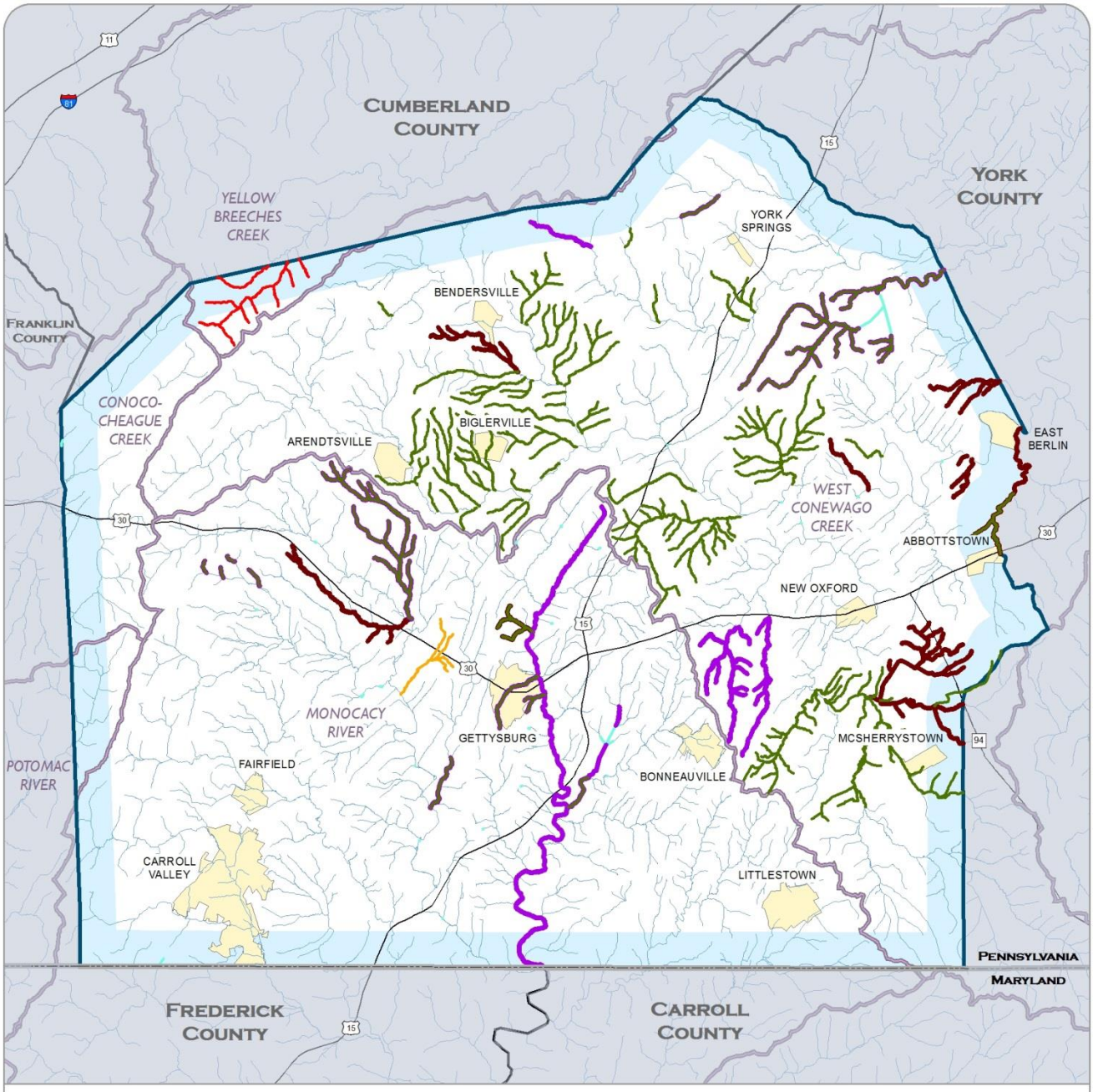
This means we would expect to see benefits from management actions related to groundwater relatively sooner compared to other areas of the watershed.

Estimated groundwater age can be obtained from the Chesapeake Bay Program at www.chesapeakebay.net.



Information to Help Geographically Focus Adams County's Efforts

Impaired Waterways in Adams County, PA, 2018



SRBC

Impaired Waterway Miles by Type*

- Siltation - 212 mi.
- Nutrients - 83 mi.
- Disturbance - 71 mi.
- Metals - 10 mi.
- Other - 9 mi.

*DISCLAIMER: Depicts aquatic life assessment category by cause of impairment. Impaired miles in legend may include duplication.

N

- Unassessed Stream 5 mi.
- River/Stream 1,270 mi.
- Major Watershed
- Water Body
- Major Road
- County Boundary
- State Boundary
- York County
- City/Town

SOURCE: Impaired Streams, 2018 Integrated List from PADEP;
DISCLAIMER: Use of Map for Any Purpose on "As Is" Basis, No Warranties Provided. SRBC (1583p) 06-26-2018

1 0 1 Miles

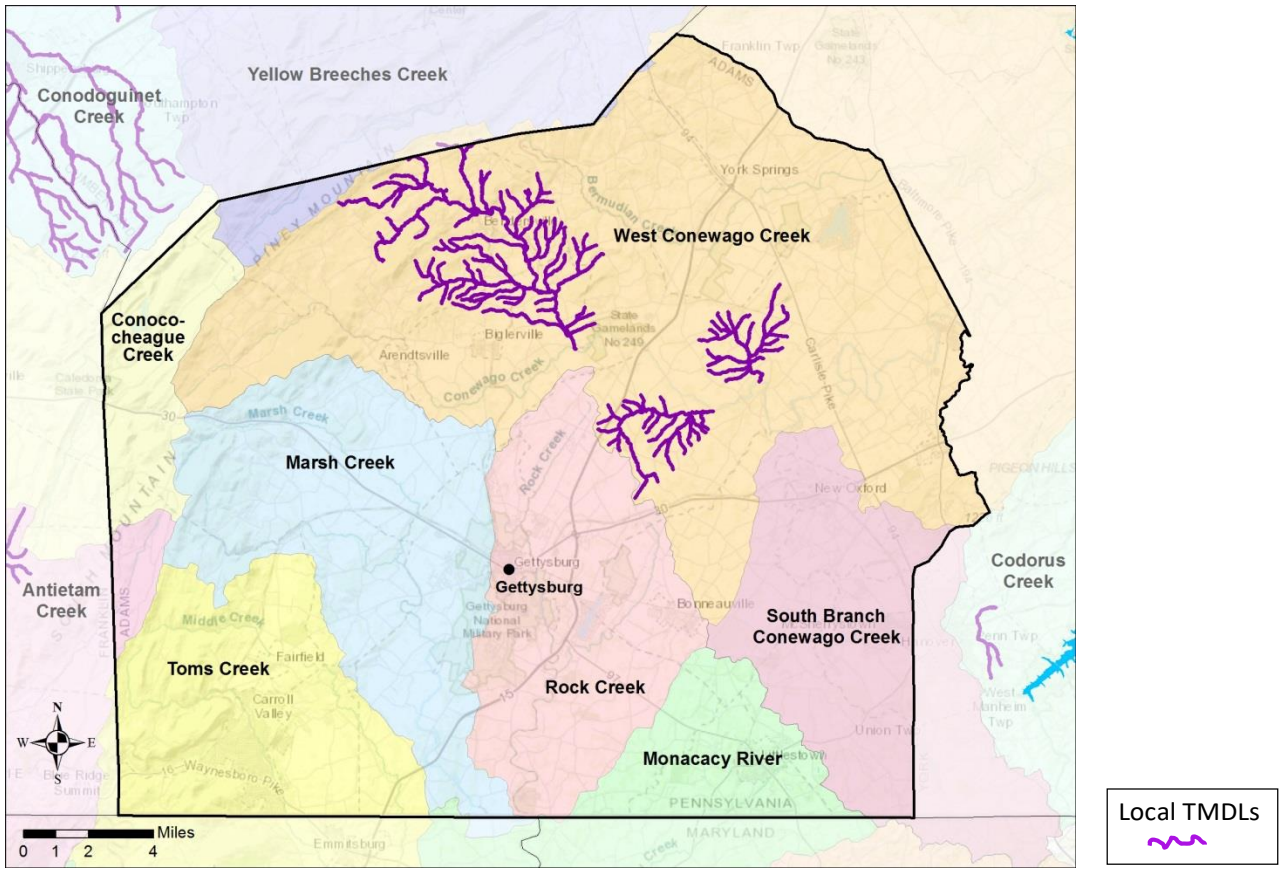
Of Adams County's 1,270 total stream miles, approximately 30% have degraded aquatic communities due to causes such as siltation (excessive sediment), nutrient pollution and others.

Knowing the sources of these impairments help to prioritize or coordinate efforts.

- For example, many agricultural practices that address nutrients can also address siltation impairments from sediment.
- Many urban/developed practices that address nutrients and sediment also address the same causes of pathogen impairments.
- Focusing efforts geographically in areas with impaired streams can help address local issues.

Local impaired waters listed on the 303(d) list can be found at PADEP: http://www.depgis.state.pa.us/integratedreport/index.html.

Local restoration efforts will help Adams County's water quality.



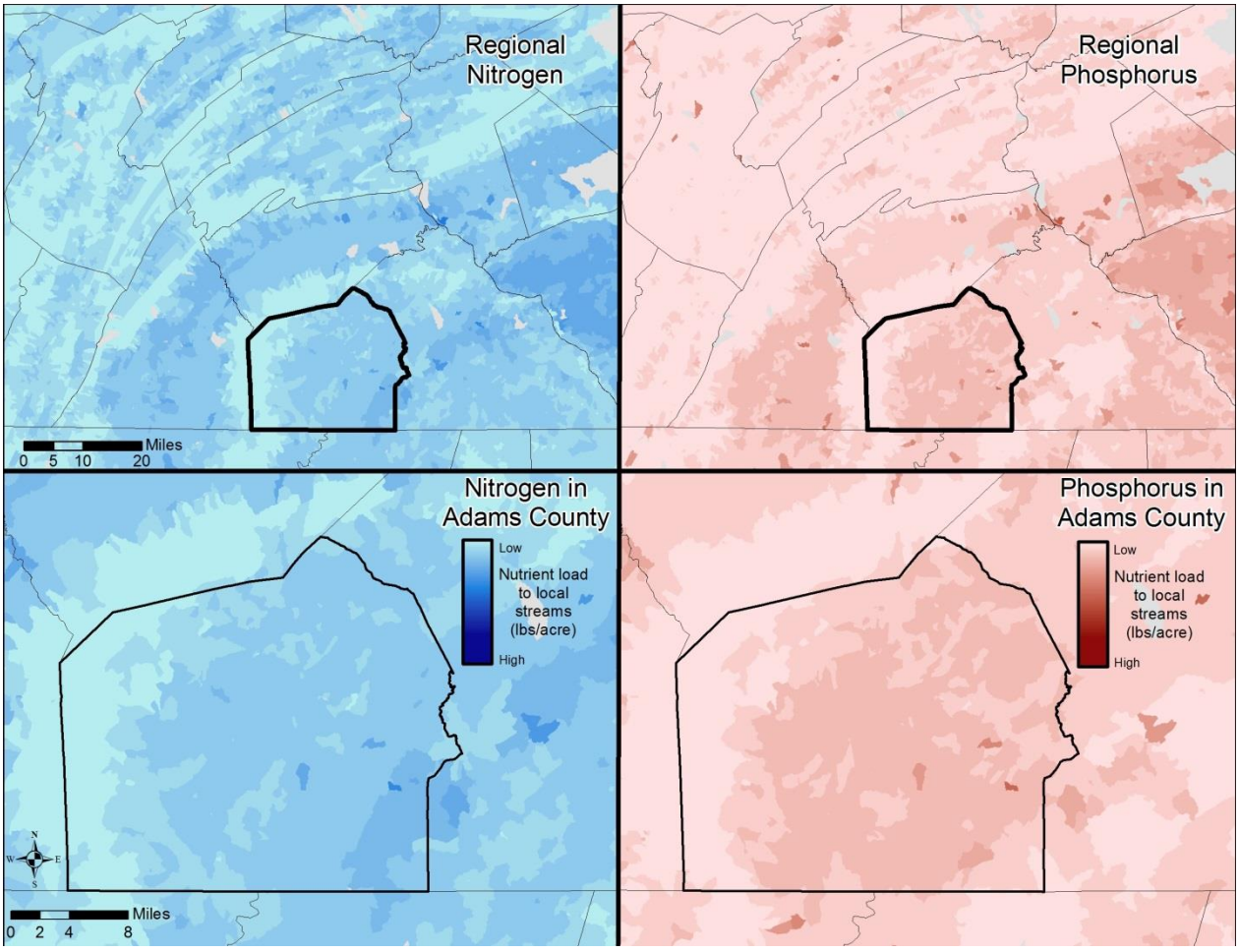
While many waters are listed as impaired, only some of these impairments are being addressed through regulatory Total Maximum Daily Loads (TMDLs).

Local groups may want to coordinate restoration efforts to focus on the watersheds that already have these local TMDLs.

- Opossum Creek
- Beaverdam Creek
- Plum Run

Local impaired waters listed on the 303(d) list that have TMDLs can be found at PADEP: http://www.depgis.state.pa.us/integratedreport/index.html.

Nutrient Load to Local Streams, using USGS SPARROW Model



Focusing efforts on the highest loading areas within Adams County can result in the greatest water quality benefits

We can estimate where the highest amounts of nitrogen and phosphorus are entering local streams.

The maps above show these higher loading areas within Adams County and compared to the regional scale.

Focusing efforts on the highest loading areas can result in the greatest water quality benefits by addressing a larger portion of the nutrients entering streams. In Adams County, the highest loading areas for both nitrogen and phosphorous tend to overlap in many areas. Focusing restoration efforts in those areas can be effective for both nitrogen and phosphorous.

The maps above are generated from the USGS SPARROW model for the Chesapeake Bay watershed: https://pubs.usgs.gov/sir/2011/5167/.

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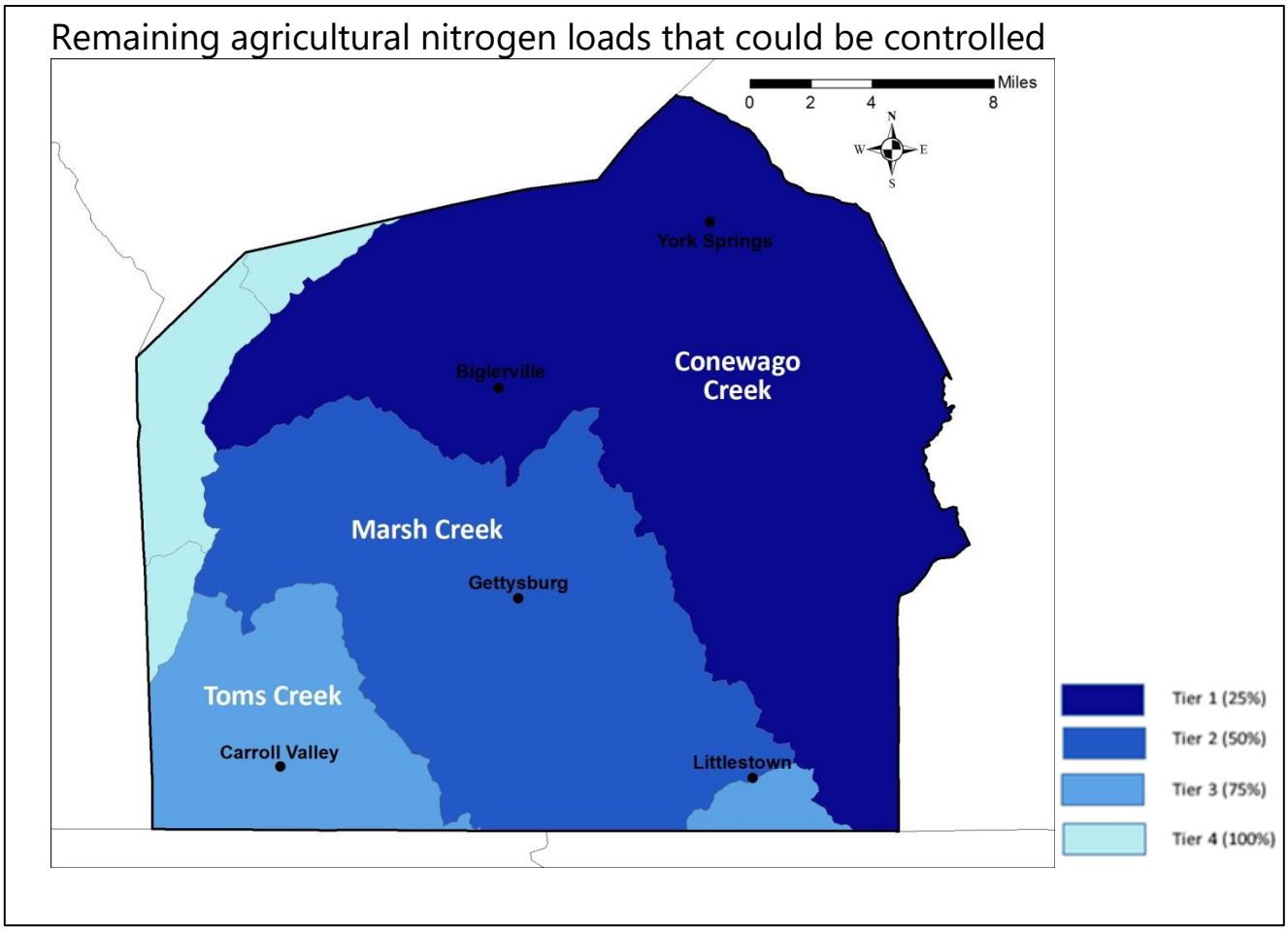
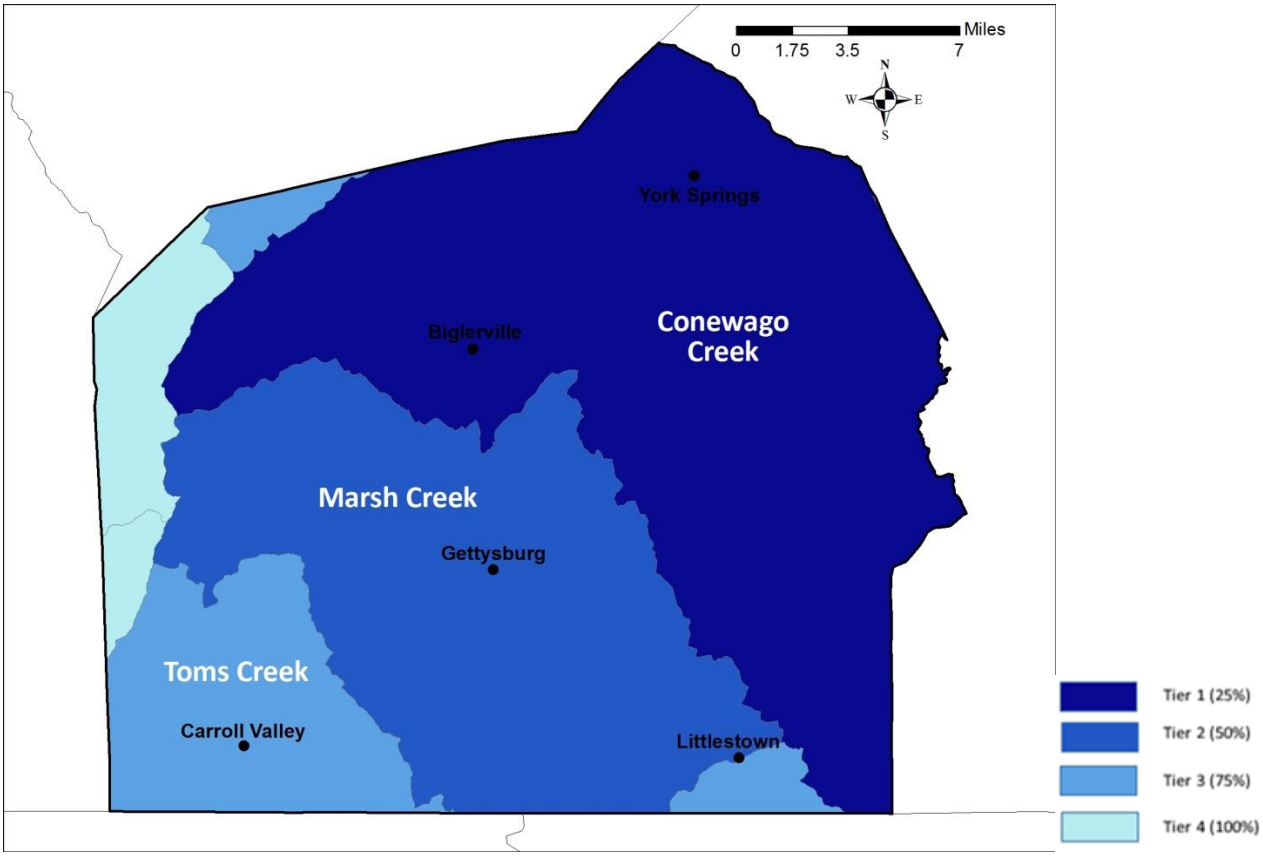


For each watershed within Adams County, we can estimate the remaining nitrogen and phosphorus reductions that are possible from the agricultural sector.

- Although we can never expect these areas to reduce all of these loads, identifying where the remaining reductions can come from can help to geographically focus efforts.
- The above map shows the total remaining nitrogen reductions possible in Adams County broken into 25 percent tiers.
- For example, if we were to reduce nitrogen loads in the two darkest watersheds as low as feasibly possible, that would address 50 percent of the entire remaining nitrogen load.
- West Conewago Creek and Marsh Creek are in the top two tiers for both nitrogen and phosphorous for both agricultural and developed sectors.

Remaining controllable agricultural loads represent the difference between 2017 Progress and the E3 scenario.

Remaining developed land nitrogen loads that could be controlled

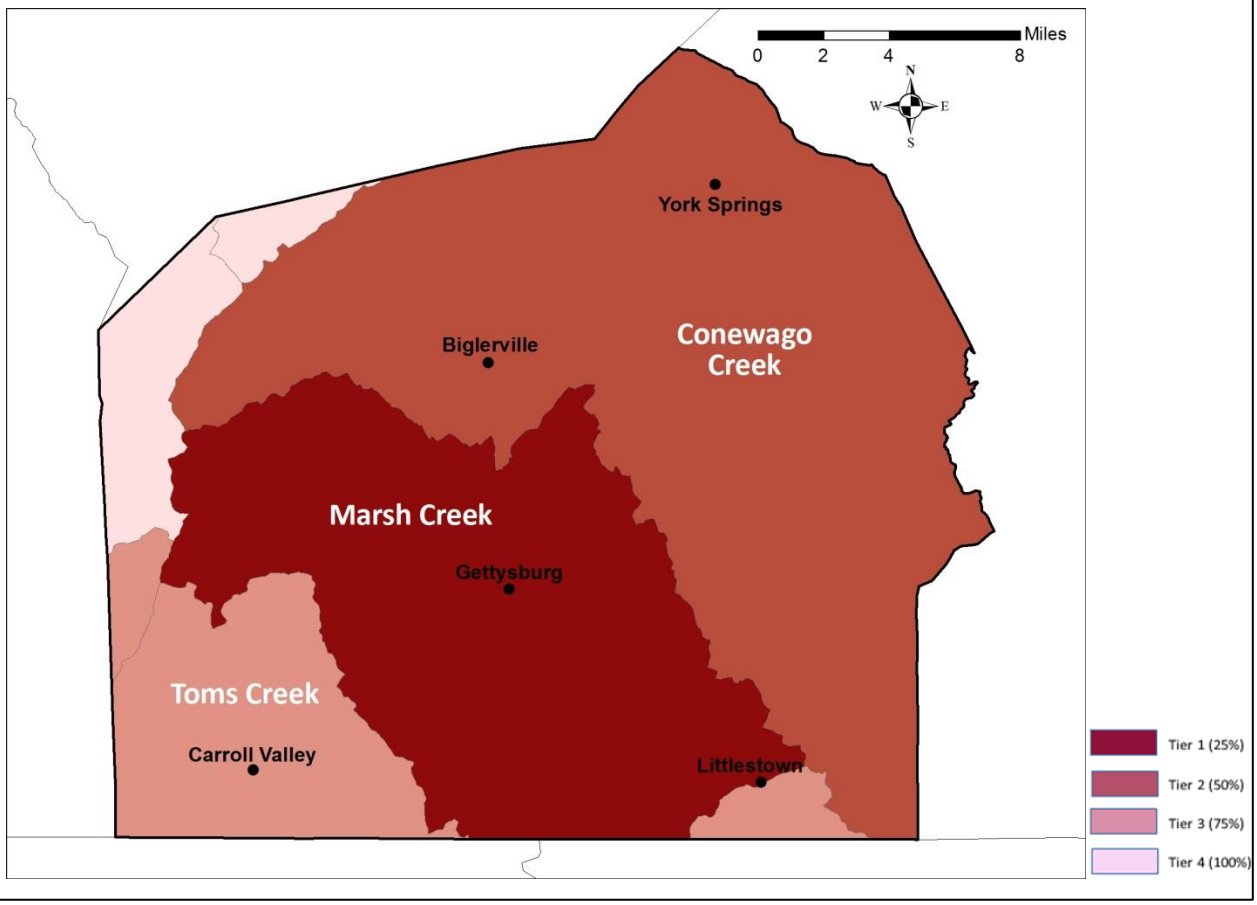


For each watershed within Adams County, we can estimate the remaining nitrogen and phosphorus reductions that are feasibly possible from the developed sector.

- Although we can never expect these areas to reduce all of these loads, identifying where the remaining reductions can come from can help to geographically focus efforts.
- The above map shows the total remaining nitrogen reductions possible in Adams County broken into 25 percent tiers.
- For example, if we were to reduce nitrogen loads in the two darkest watersheds as low as feasibly possible, that would address 50 percent of the entire remaining nitrogen load.
- West Conewago Creek and Marsh Creek are in the top two tiers for both nitrogen and phosphorous for both agricultural and developed sectors.

Remaining controllable developed land loads represent the difference between 2017 Progress and the E3 scenario.

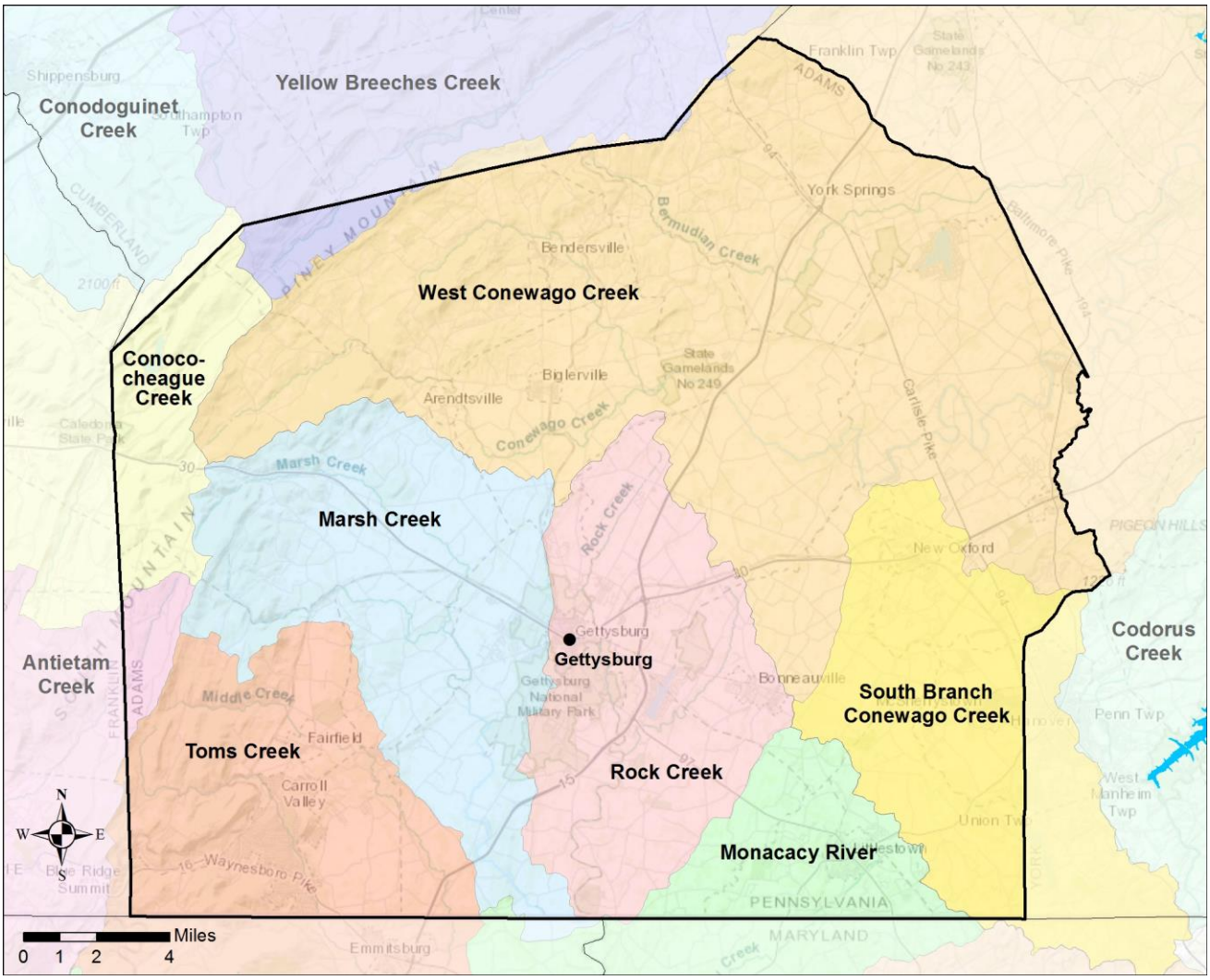
Remaining developed land phosphorus loads that could be controlled



For each watershed within Adams County, we can estimate the remaining nitrogen (previous page) and phosphorus reductions that are feasibly possible from the developed/urban sector.

- Although we can never expect these areas to reduce all of these loads, identifying where the remaining reductions can come from can help to geographically focus efforts.
- The above map shows the total remaining phosphorus reductions possible in Adams County broken into 25 percent tiers.
- For example, if we were to reduce phosphorus loads in the five darkest watersheds as low as feasibly possible, that would address 50 percent of the entire remaining phosphorus load.
- West Conewago Creek and Marsh creek are in the top two tiers for both nitrogen and phosphorous for both agricultural and developed sectors.

Remaining controllable developed land loads represent the difference between 2017 Progress and the E3 scenario.



Identifying Opportunities and Choosing Best Practices

Most Cost-effective Agricultural Practices for Nitrogen Reduction in Adams County

Sector	BMP	Cost ($) per unit BMP	Nitrogen Lbs Reduced per unit BMP	Nitrogen $/lb reduced/year
Agriculture	Dairy Precision Feeding and/or Forage Management	-10	2.25	-4.41
Agriculture	Tillage – management	0	2.02	0
Agriculture	Alternative Crops	18.26	21.40	0.85
Agriculture	Grass Buffer – Streamside with Exclusion Fence	277.30	173.96	1.59
Agriculture	Grass Buffer	56.95	28.69	1.99
Agriculture	Soil Conservation and Water Quality Plans	1.94	0.91	2.12
Agriculture	Wetland Restoration - Floodplain	96.58	33.61	2.87
Agriculture	Barnyard Runoff Control	567.46	190.17	2.98
Agriculture	Forest Buffer – Streamside with Exclusion Fence	709.73	179.09	3.96
Agriculture	Grass Buffer – Narrow	56.95	13.97	4.08
Agriculture	Water Control Structure	17.71	4.31	4.11
Agriculture	Forest Buffer	157.35	36.02	4.37
Agriculture	Agricultural Stormwater management	1584.68	331.37	4.78
Agriculture	Cropland Irrigation management	4.57	0.62	7.42
Agriculture	Tree Planting	115.18	14.33	8.04

Most Cost-effective Developed Practices for Nitrogen Reduction in Adams County

Sector	BMP	Cost ($) per unit BMP	Nitrogen Lbs Reduced per unit BMP	Nitrogen $/lb reduced/year
Developed	Forest Planting	92.23	5.83	15.81
Developed	Forest Buffer	153.28	7.70	19.90
Developed	Tree Planting – Canopy	107.78	0.78	138.46
Developed	Bioswale	865.95	5.62	153.97
Developed	Infiltration Practices w/o sand, veg. – A/B soils, no underdrain	1,093.35	6.43	170.11
Developed	Wet Ponds and Wetlands	330.44	1.61	205.58
Developed	Dry Extended Detention Ponds	342.62	1.61	2.1316
Developed	Vegetated Open Channels a/b Soils, no underdrain	819.32	3.62	226.60
Developed	Storm Drain Cleaning	0.62	0.00	393.39
Developed	Bioretention/raingardens – C/D soils, underdrain	1,059.40	2.01	527.49

The list above reflects the top 15 agriculture and top 10 developed, most cost-effective practices at reducing nitrogen in Adams County.

This list can serve as a starting point to assess feasibility of practice implementation.

For example, even though Alternative Crops are cost-effective, this practice involves replacing crops with others such as switchgrass, which may not be a feasible practice to implement.

Descriptions of the BMPS and the methods for generating cost-effectiveness can be found on the CAST website at http://cast.chesapeakebay.net.

The most effective practices were determined using CAST and isolating reductions from individual BMPs. Most effective practices list are available from CAST at http://cast.chesapeakebay.net.

Remaining Opportunities in Adams County for Agricultural Practices

Practice	Current Reported Implementation	Acres Remaining
Basic Nutrient Management	12%	114,100
Conservation Tillage	66%	28,500
Cover Crop	1%	86,000
Prescribed Grazing	10%	12,000
Barnyard Runoff Control	63%	52
Soil & Water Conservation Plans	6%	124,000
Forest Buffers	N/A	13,900

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This chart shows the current implementation in Adams County of some effective agricultural practices, and the estimated remaining acres of land in the county available to implement those practices.

The current reported implementation percent reflects how much of the land that is available for a particular practice already has that practice reported to be implemented on it.

For example, prescribed grazing's current percent implementation reflects that 10 percent of pasture land in Adams County is currently reported to have prescribed grazing implemented. 12,000 acres of pasture remain in the county without prescribed grazing, which may represent an opportunity for further implementation of that practice.

Remaining opportunity is determined as the difference between reported implemented acres and all available acres on which the practice can be implemented. Land on which BMPs can be implemented are available in CAST. Reported implementation is available on CAST at http://cast.chesapeakebay.net.

Remaining Opportunities in Adams County for Stormwater Practices on Developed/Urban Land

Practice	Current Reported Implementation	Acres Remaining
Erosion & Sediment Control	100%	0
Stormwater Management	3.8%	53,553

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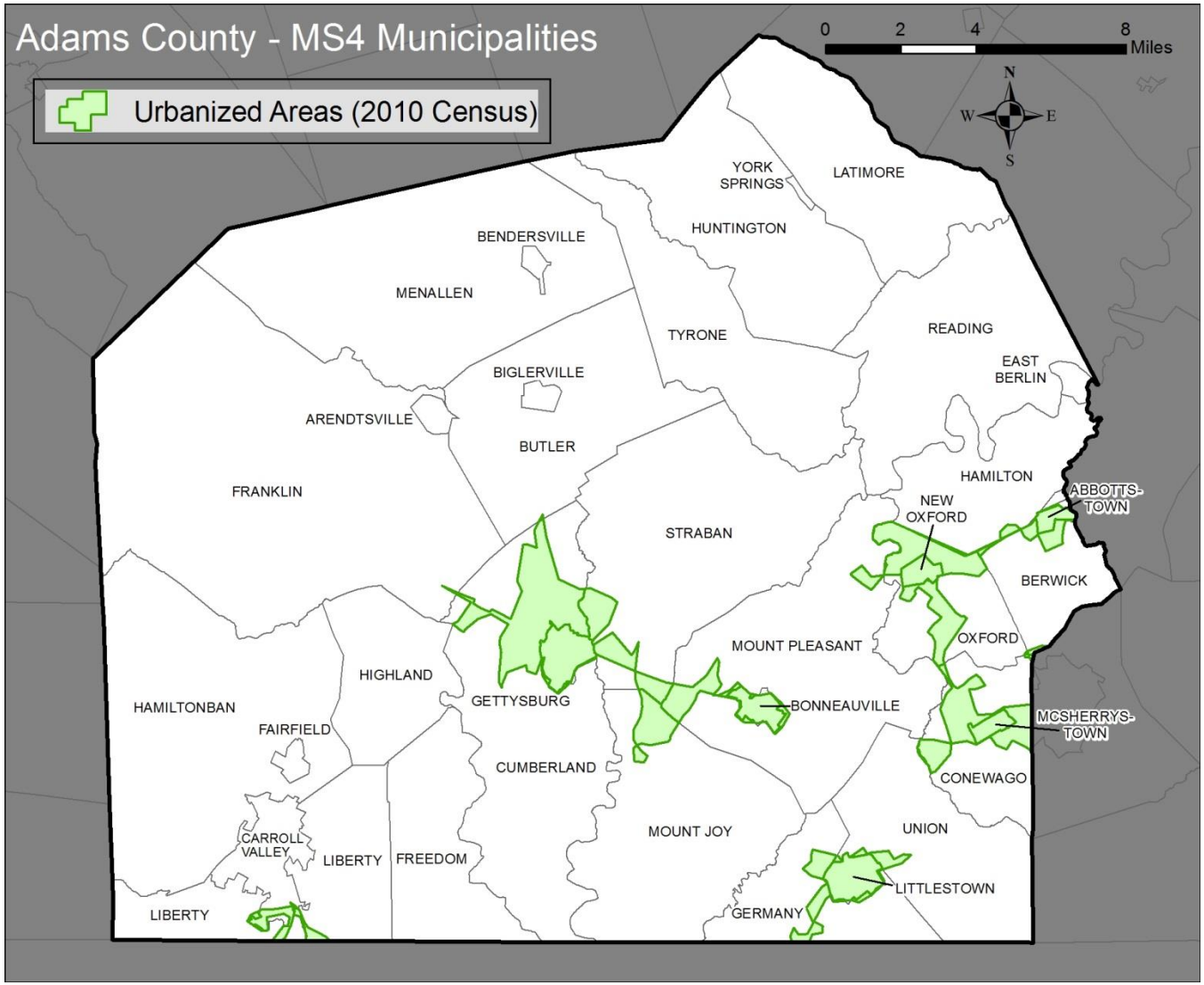
This chart shows the current implementation in Adams County of stormwater practices, and the remaining acres of land in the county available to implement those practices.

Erosion and sediment control addresses construction areas and time periods. However, sediment from developed land and from erosion of streams on developed land persists as issues long after construction is over. Therefore, stormwater management is incredibly important for managing these issues once construction ends.

Opportunities exist in Adams County to implement stormwater management practices in developed and urban areas.

Remaining opportunity is determined as the difference between reported implemented acres and all available acres on which the practice can be implemented. Land on which BMPs can be implemented are available in CAST. Reported implementation is available on CAST at http://cast.chesapeakebay.net.



Municipal separate storm sewer systems (MS4s) are identified above in Adams County.

Municipalities and other entities that meet certain standards must obtain NPDES permit coverage for discharges of stormwater from their municipal separate storm sewer systems (MS4s). MS4s must apply for NPDES permit coverage or a waiver if they are located in an urbanized area as determined by 2010 Census data.

More information can be found here:
http://www.dep.pa.gov/Business/Water/CleanWater/StormwaterMgmt/Stormwater/Pages/default.aspx