

YORK COUNTY COMMUNITY CLEAN WATER TOOLBOX

A County-Based Action Plan for Clean Water

June 2018



YORK 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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YORK COUNTY TOOLBOX

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 York 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).

York County's Clean Water Goal

Countywide Goal for York County

Year	Nitrogen (lbs/year)	Phosphorus (lbs/year)
	Delivered to Local York County Waterways	Delivered to Local York County Waterways
1985(Actual)	12,665,518	612,429
1985 (Actual) Federal Load*	16,840	8,419
2017 (Actual)	11,975,341	445,696
2017 (Actual) Federal Load*	17,754	1,299
2025 (Final TMDL Planning Target)	7,988,907	452,432
Remaining Load to be Achieved Through Local Planning Goals *	4,004,188	-5,437

*Federal load is referring to the load attributing from Defense Depot Susquehanna Pennsylvania (DDSP). This load is separate, due to the federal facility is responsible for reducing their own load.

The nitrogen and phosphorus planning targets for Pennsylvania in Figure 1 (above) are broken down into federal and non-federal land within York County. The 2025 planning target is a summation of both federal and non-federal loads. Added together across all counties, these goals will help Pennsylvania reach its assigned nutrient reduction planning targets.

Depiction of York County's Goal

Hypothetical Journey to York County's Goal

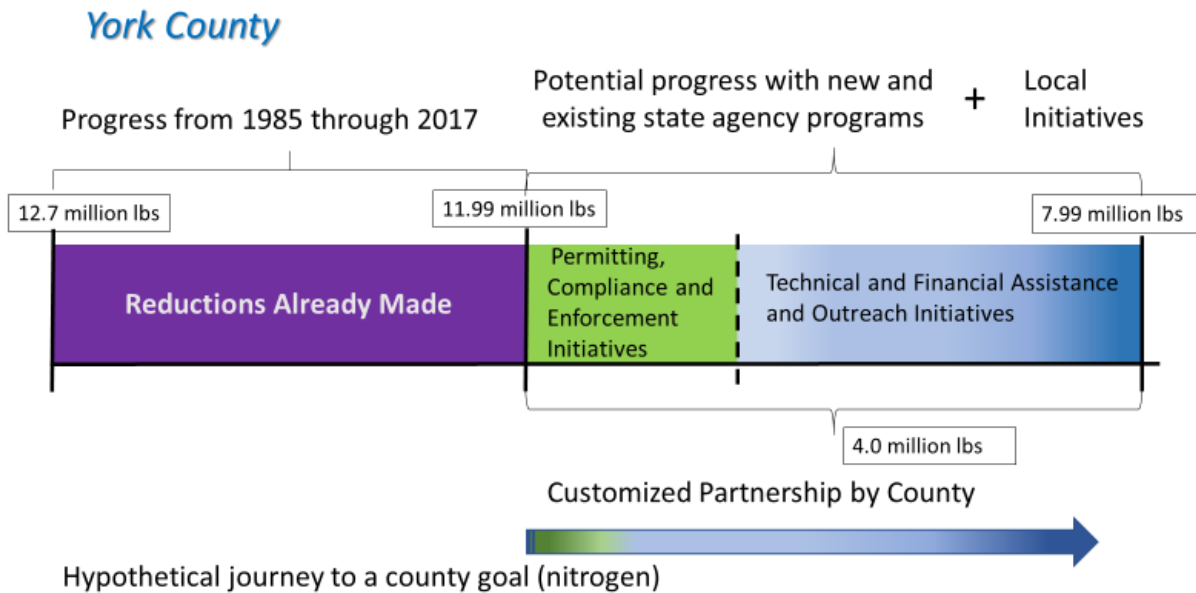


Figure 3 represents York County's hypothetical journey to countywide goals and overall water quality targets. Moreover, it represents York County's journey to clean water:

- The purple section represents the progress York 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 York 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 York County's Water Quality Story

Current Conditions of York County Streams

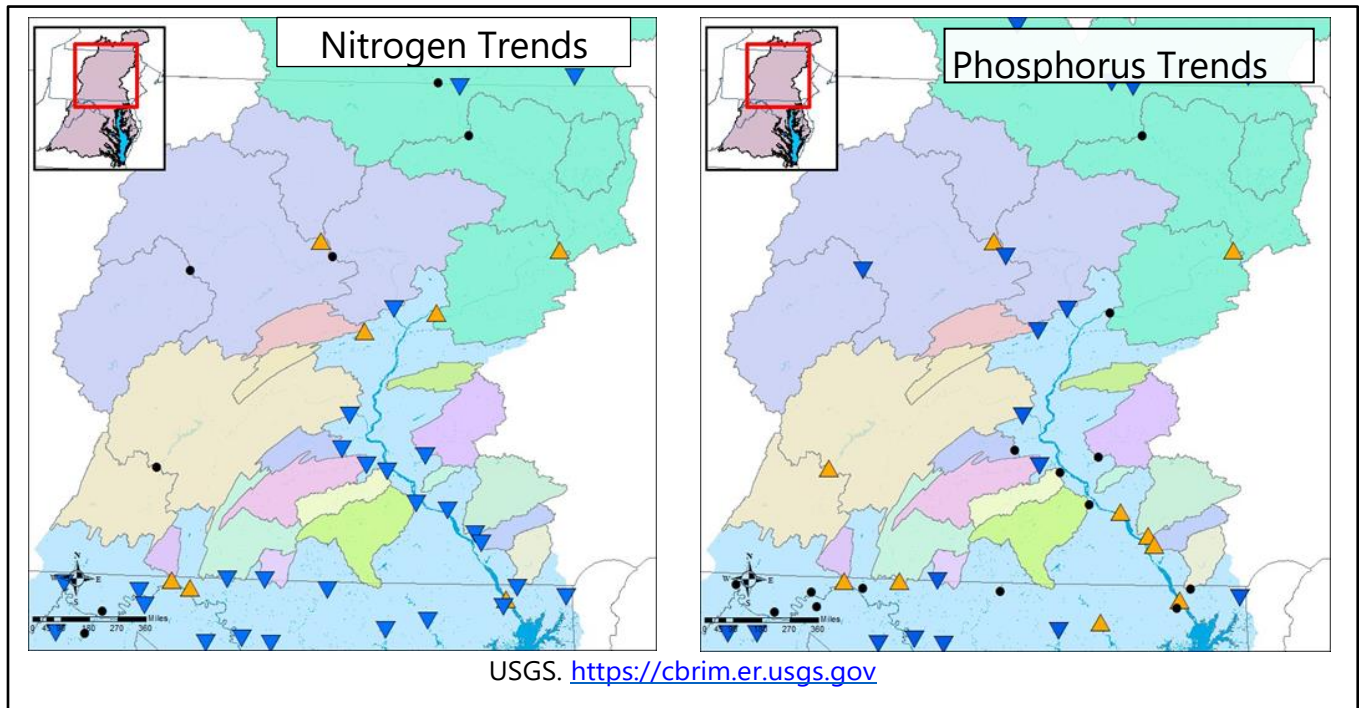
- Water quality in York County's streams is changing over time. Substantial nutrient reductions have already occurred in York County, largely due to wastewater treatment plant upgrades. Since stream monitoring began in 1985, York County has achieved nearly half its pollution-reduction target for nitrogen and more than 99% of its target for phosphorus.
- Of York County's 1,670 total stream miles, 23% (~385 miles) have degraded aquatic life communities due to causes such as siltation (excess sediment), nutrient pollution, and others.
- Most impairments occur in West Conewago Creek and Codorus Creek watersheds along the York – Hanover metro corridor.
- Long-term nutrient loading trends for two prominent York County watersheds (West Branch Conewago and Yellow Breeches) show that nitrogen has steadily declined (sign of improvement) since 2005 for both watersheds.

Sources of Nutrients & Sediment in York County

- The dominant source of nutrients in York County is from agricultural activities (more than 60% of nitrogen total), followed by developed lands (~20% of nitrogen).
- On agricultural lands, the majority of nutrients are applied as fertilizer (80% of nitrogen) as opposed to manure (15% of nitrogen).
- On developed lands, the nitrogen load comes primarily from turf grass, which represents lawns, parks and other grassy lands in residential or urban areas.
- Wastewater upgrades have reduced wastewater loads significantly; wastewater and septic sources make up a small portion of total loads, but can be important locally.
- In both agricultural and developed areas, erosion of stream banks is an important source of sediment to streams.

Opportunities for Implementation in York County

- The primary causes of stream impairment in York County are excess sediment and disturbance; therefore, stormwater management coupled with stream corridor restoration are practices that might be considered to restore water health.
- Agriculture accounts for the majority of nutrient pollution in York County. The southern half of the county's watersheds (e.g. Muddy Creek, South Branch Codorus) are dominated by farms. Because the main share of agricultural nutrients is fertilizer, implementation of nutrient management plans and use of precision fertilizer application approaches, especially in combination, are effective practices to consider in order to reduce nutrient pollutants.



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 York County, in perspective.

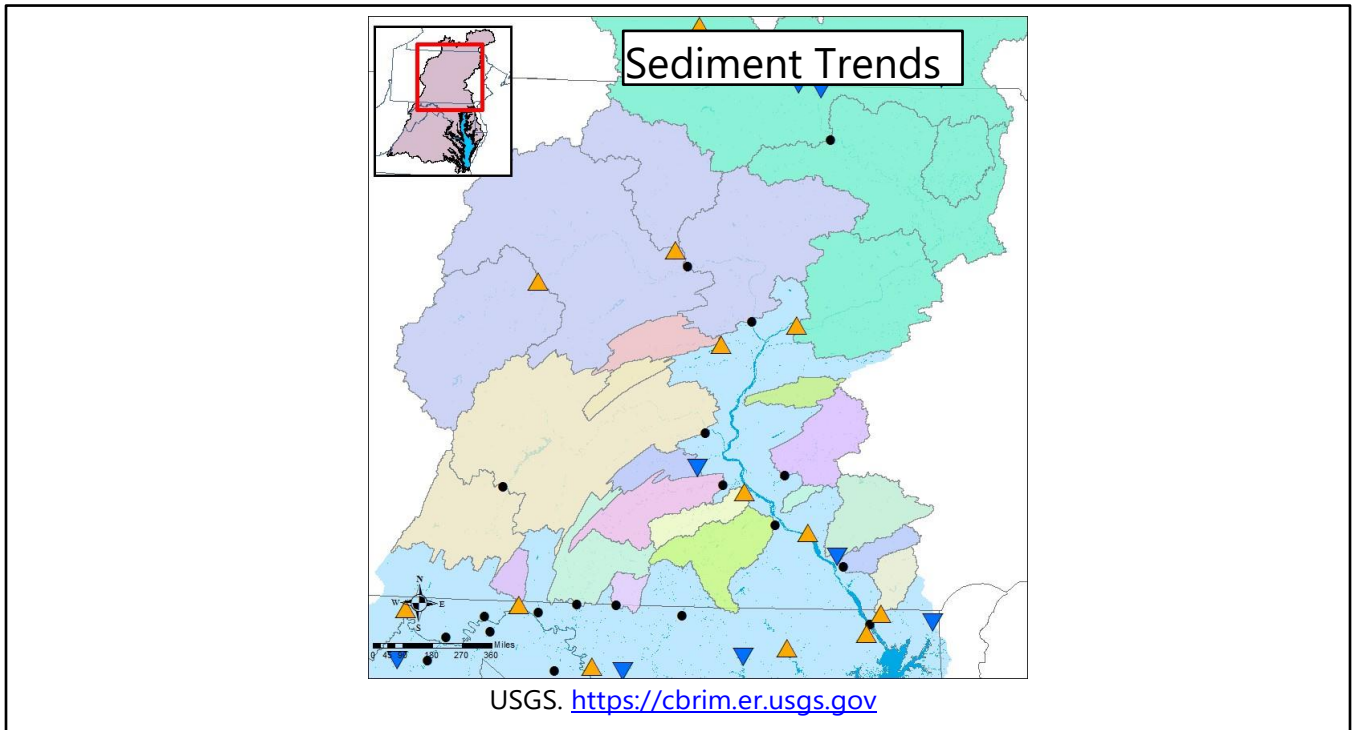
In addition to providing real-time water quality data, the USGS/SRBC monitoring stations help to identify changes in water quality over time. These maps demonstrate nitrogen and phosphorus trends from 2007-2017.

- 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 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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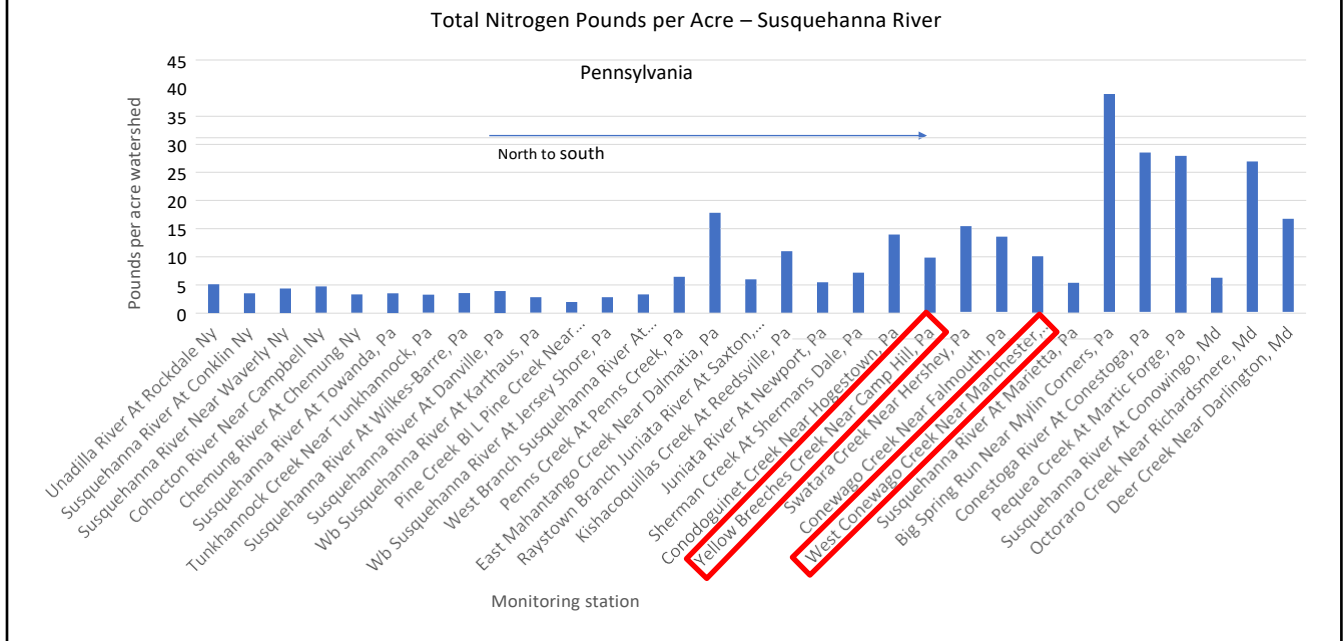
These results tell us that:

- 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>.

USGS Monitoring Data Show Excess Nitrogen Levels in the Lower Susquehanna River Watershed



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.

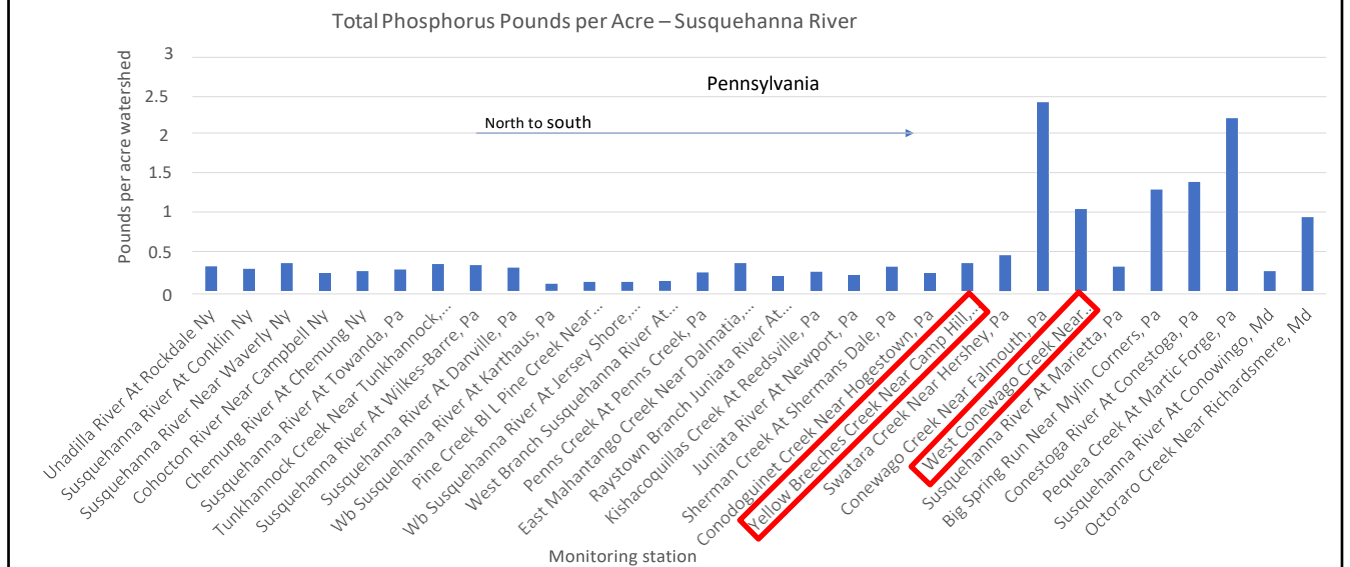
In the graph above, the bars show the annual pounds of nitrogen measured at monitoring stations divided by the acres of watershed draining into that station. The larger the bar, the more nitrogen there is in the watershed's streams relative to its size, and the greater the impact on streams.

Small watersheds in the Lower Susquehanna, including those in York 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.

York County's small watersheds have relatively high amounts of both nitrogen and phosphorus (next page), making them effective places to manage both simultaneously.

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

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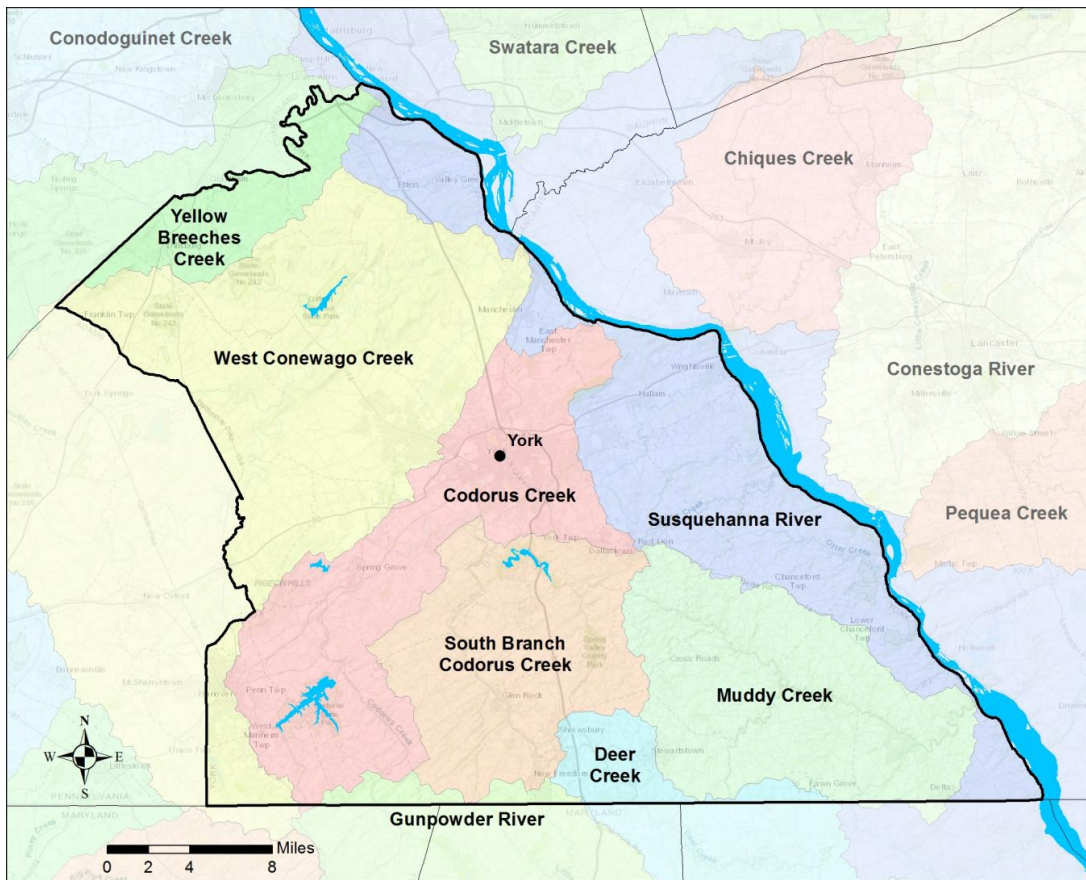
In the graph above, the bars show the annual pounds of phosphorus measured at monitoring stations divided by the acres of watershed draining into that station. The larger the bar, the more phosphorus there is in the watershed's streams relative to its size and the greater the impact on streams.

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

York County small watersheds have relatively high amounts of both nitrogen (previous page) and phosphorus, making them effective places to manage both simultaneously.

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

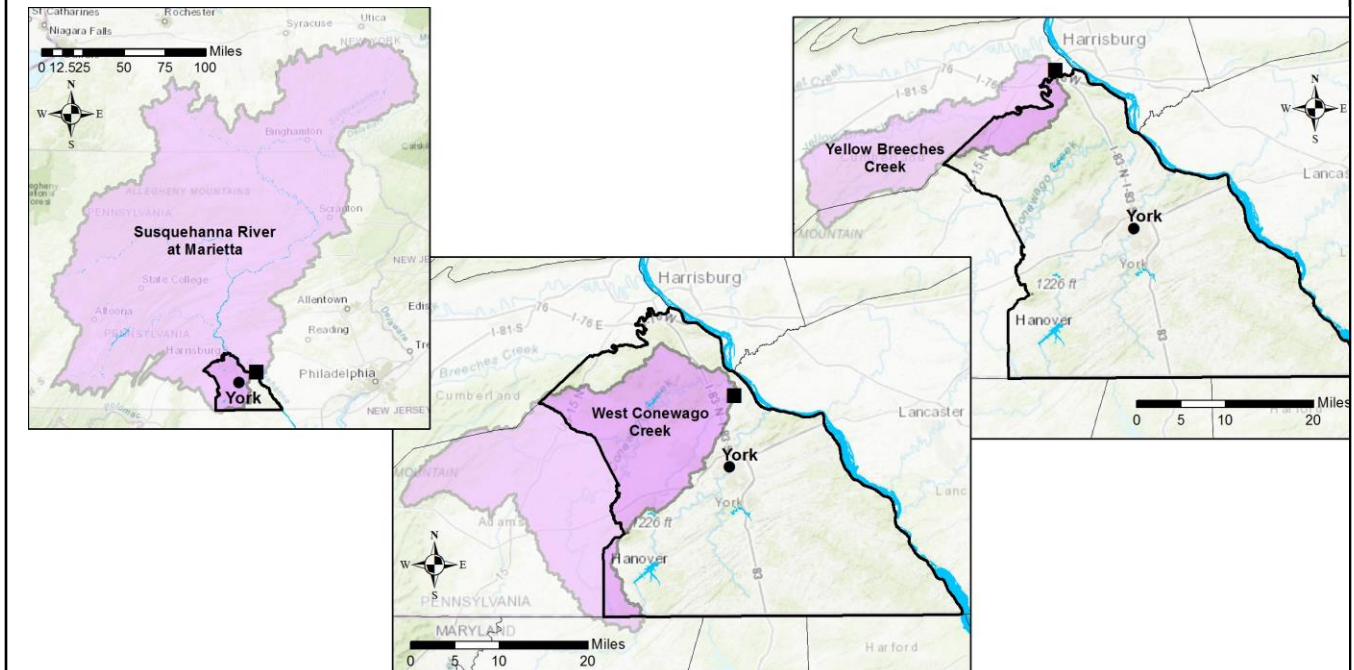
York County's Local Watersheds



<https://cbrim.er.usgs.gov>

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

Water quality monitoring stations for York County's watersheds

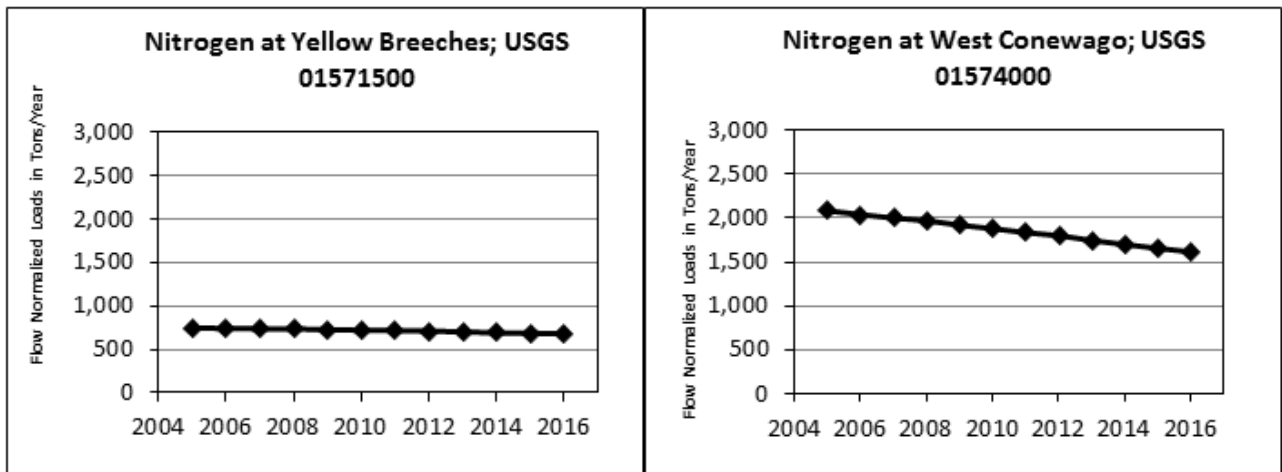


Three USGS monitoring stations (small squares) measure water quality in York County's watersheds. These maps depict the areas that drain into each of those monitoring stations.

- The Susquehanna River at Marietta measures water quality in the Susquehanna River, and therefore captures the regional picture of the entire Susquehanna River watershed above the monitoring station. This is the last monitoring station on the Susquehanna River before the Conowingo Dam.
- The Yellow Breeches Creek monitoring station is located on the border of York and Cumberland County, and drains the upper portion of York County.
- The West Conewago monitoring station covers half of the northern part of the county.

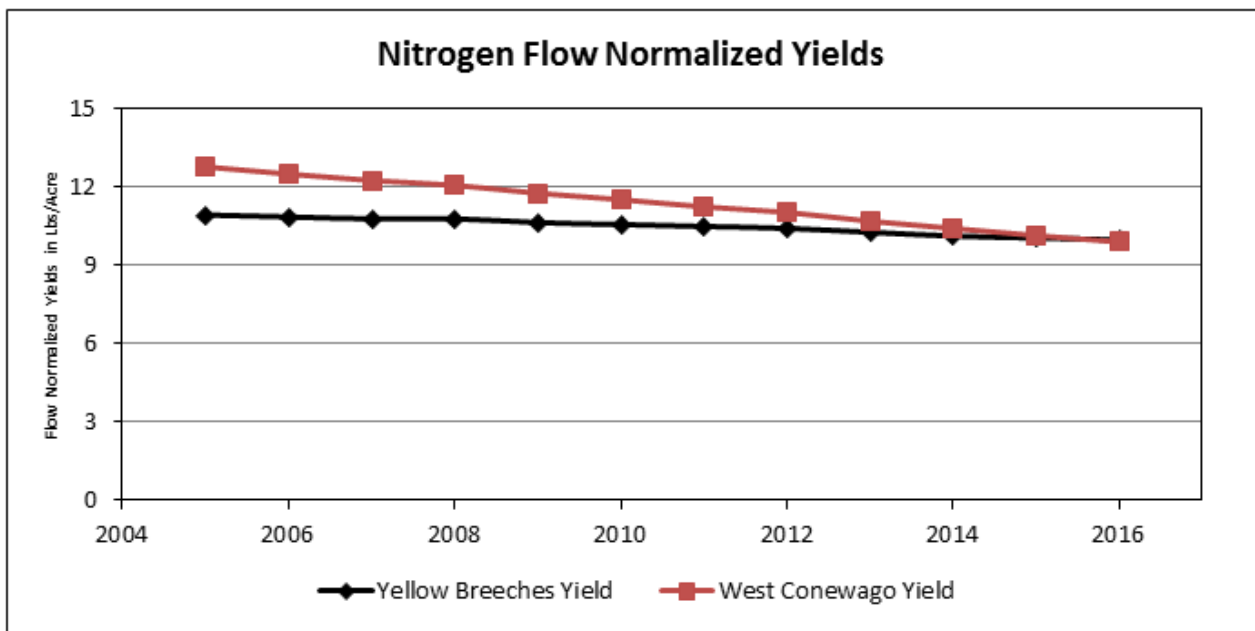
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10 year trend: Improving

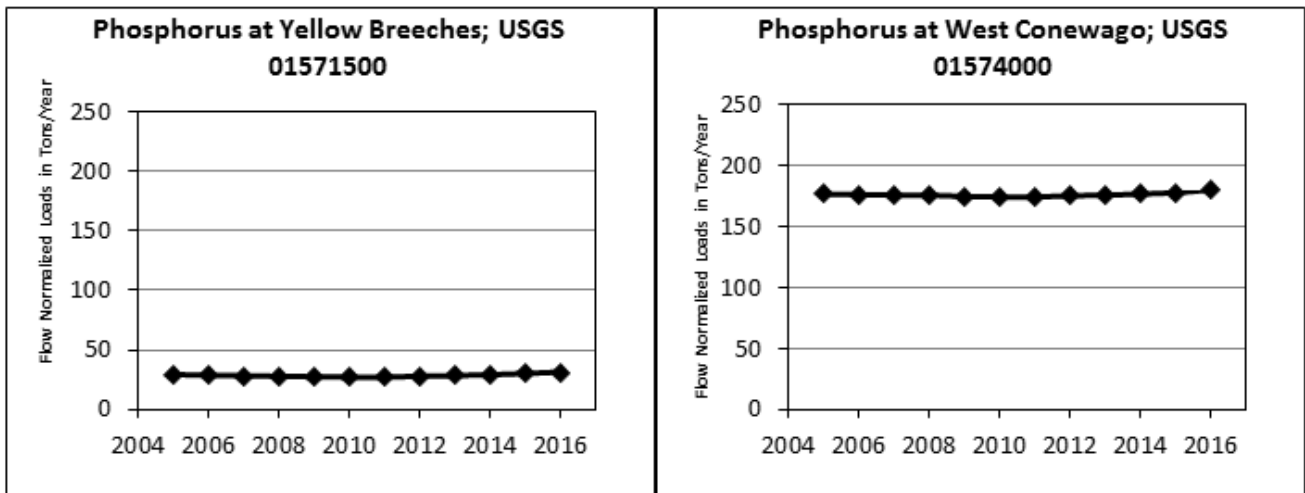
10 year trend: Improving



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

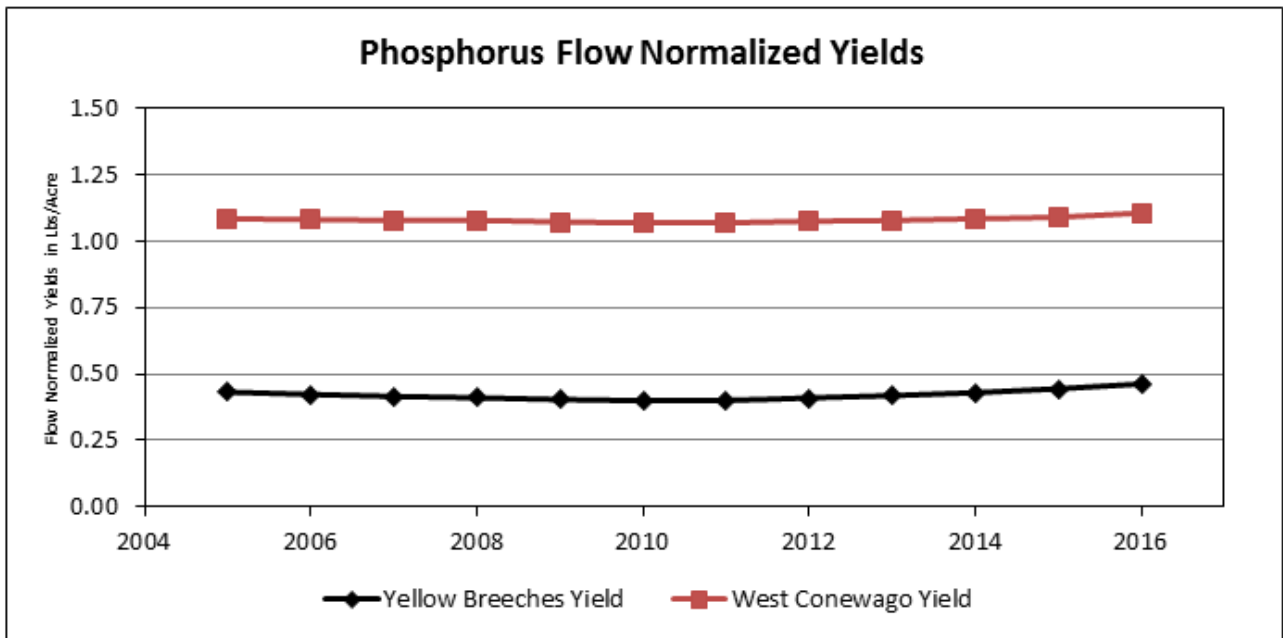
- Of York County's two local monitored watersheds (Yellow Breeches and West Conewago), West Conewago has much higher nitrogen loads than Yellow Breeches. This is partially due to its larger size.
- The previous graphs show that when size is taken into account, the nitrogen load per acre of watershed is similar between these two watersheds.
- 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 graphs above take into account variability between years in river flow. For more information, visit: <https://cbrim.er.usgs.gov/summary.html>.



10 year trend: No Trend

10 year trend: No Trend

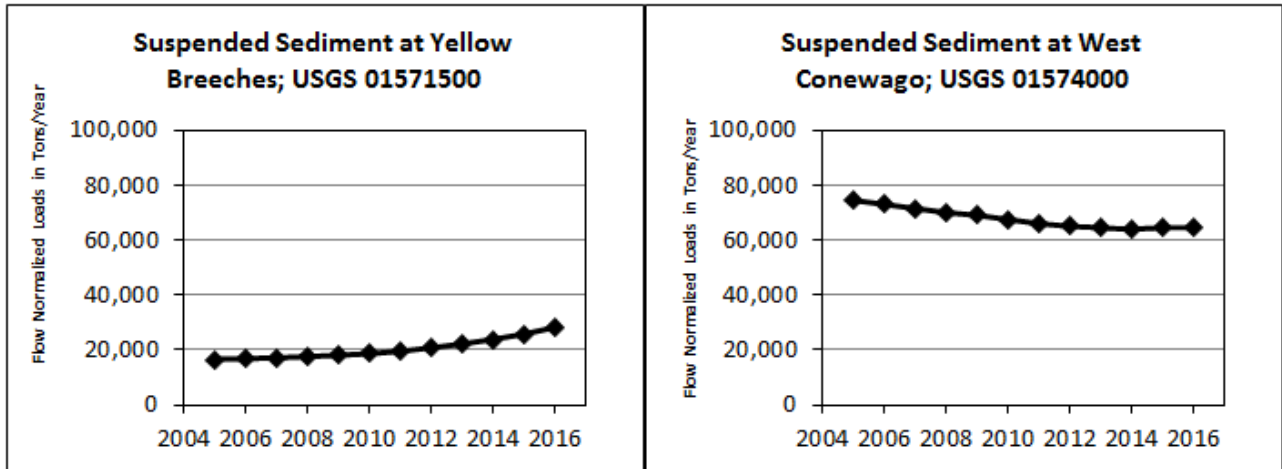


The monitored watersheds within York County show slightly degrading phosphorus trends.

- Of York County’s two local monitored watersheds (Yellow Breeches and West Conewago), West Conewago has much higher phosphorus loads than Yellow Breeches. This is partially due to its larger size.
- The previous graphs show that when size is taken into account, the phosphorus load per acre of watershed is still higher in West Conewago.
- The high yields and degrading trends in West Conewago make it an effective area to focus efforts.

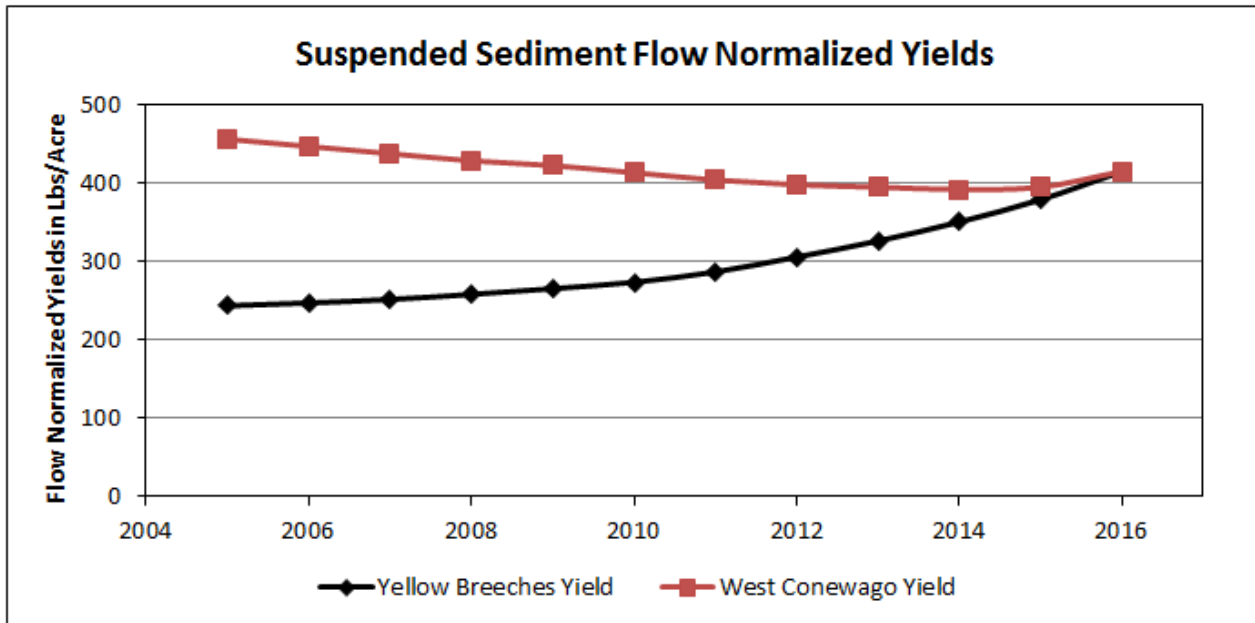
The graphs above take into account variability between years in river flow.

For more information, visit: <https://cbrim.er.usgs.gov/summary.html>.



10 year trend: Degrading

10 year trend: No Trend

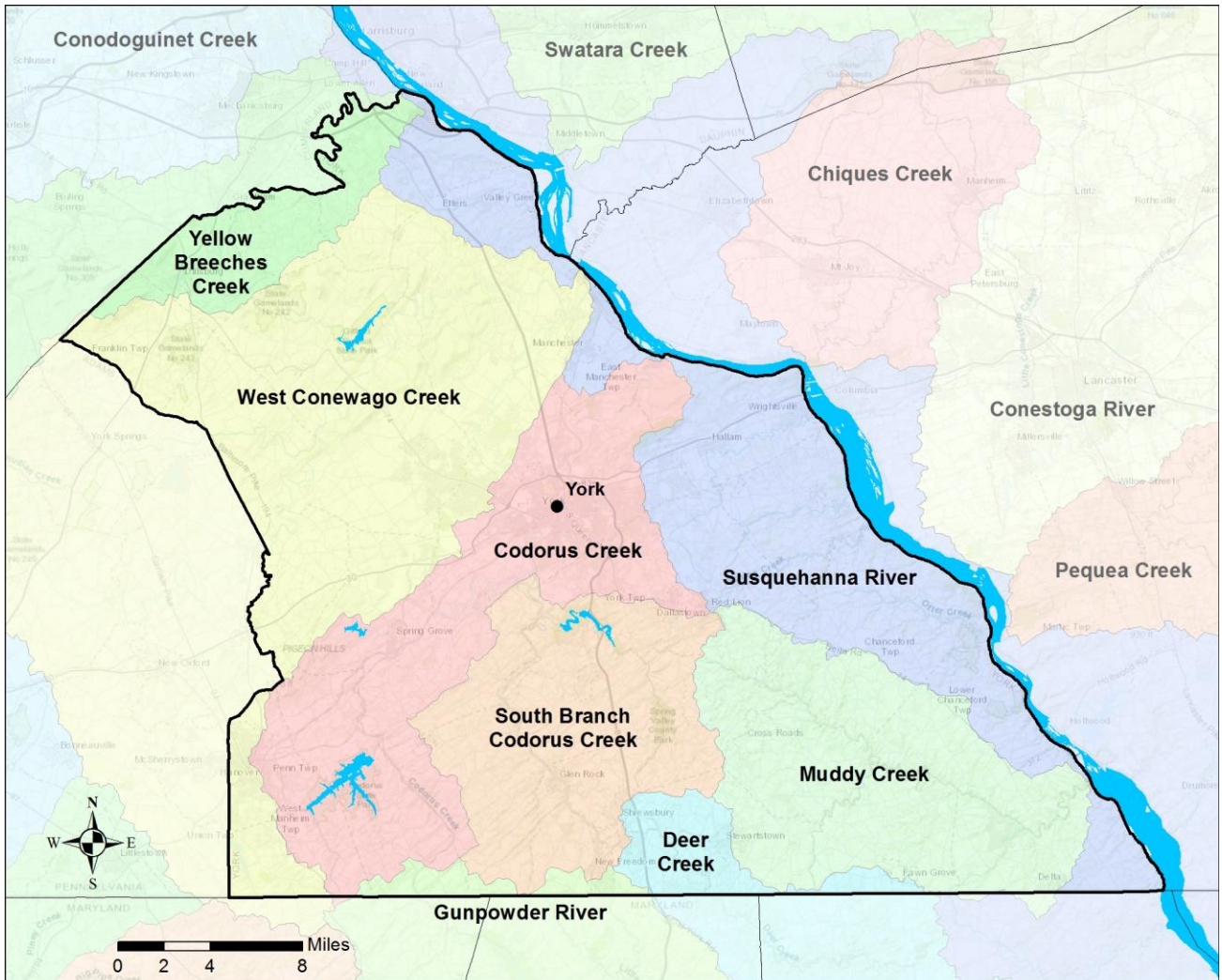


The monitored watersheds within York County show varying sediment trends (some are degrading while others are leveling off).

- Of York County's two local monitored watersheds (Yellow Breeches and West Conewago), West Conewago has more sediment loads than Yellow Breeches. This is partially due to its larger size.
- The previous graphs show that when size is taken into account, the sediment load per acre of watershed is very similar.
- The high yields and degrading trends in the Yellow Breeches and West Conewago watershed makes both effective area to focus efforts.

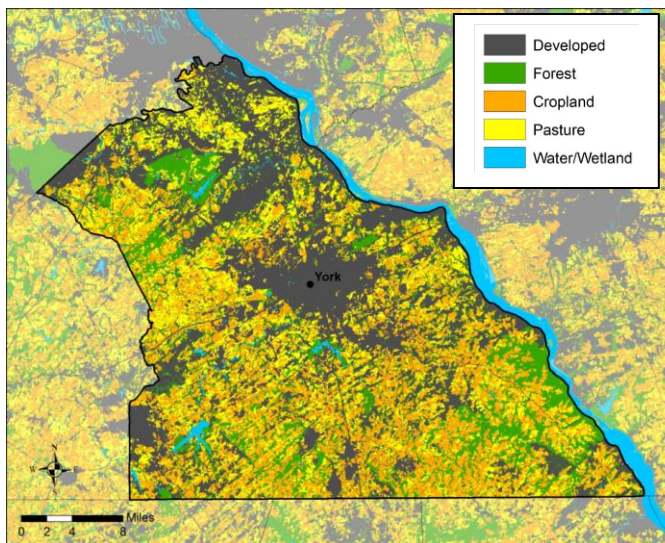
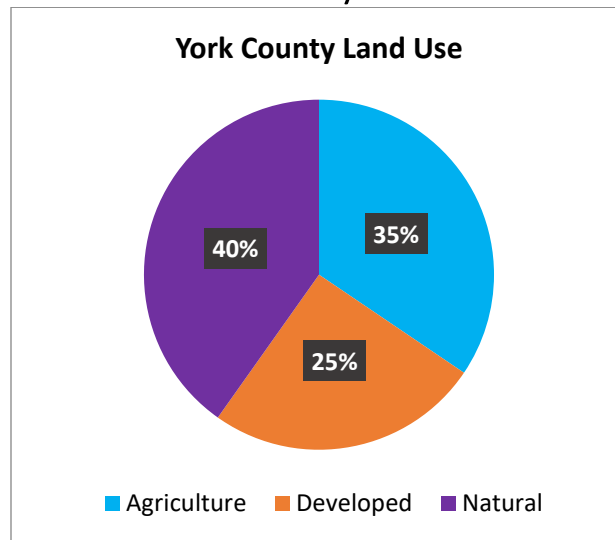
The graphs above take into account variability between years in river flow.

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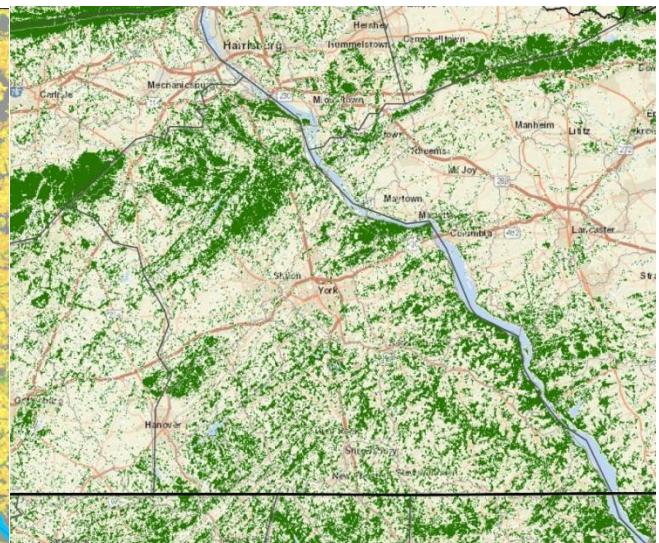


Sources of Nutrients and Sediment in York County

York County has less forested land than most other Pennsylvania counties



York County Land Use Map



York County Forest Map

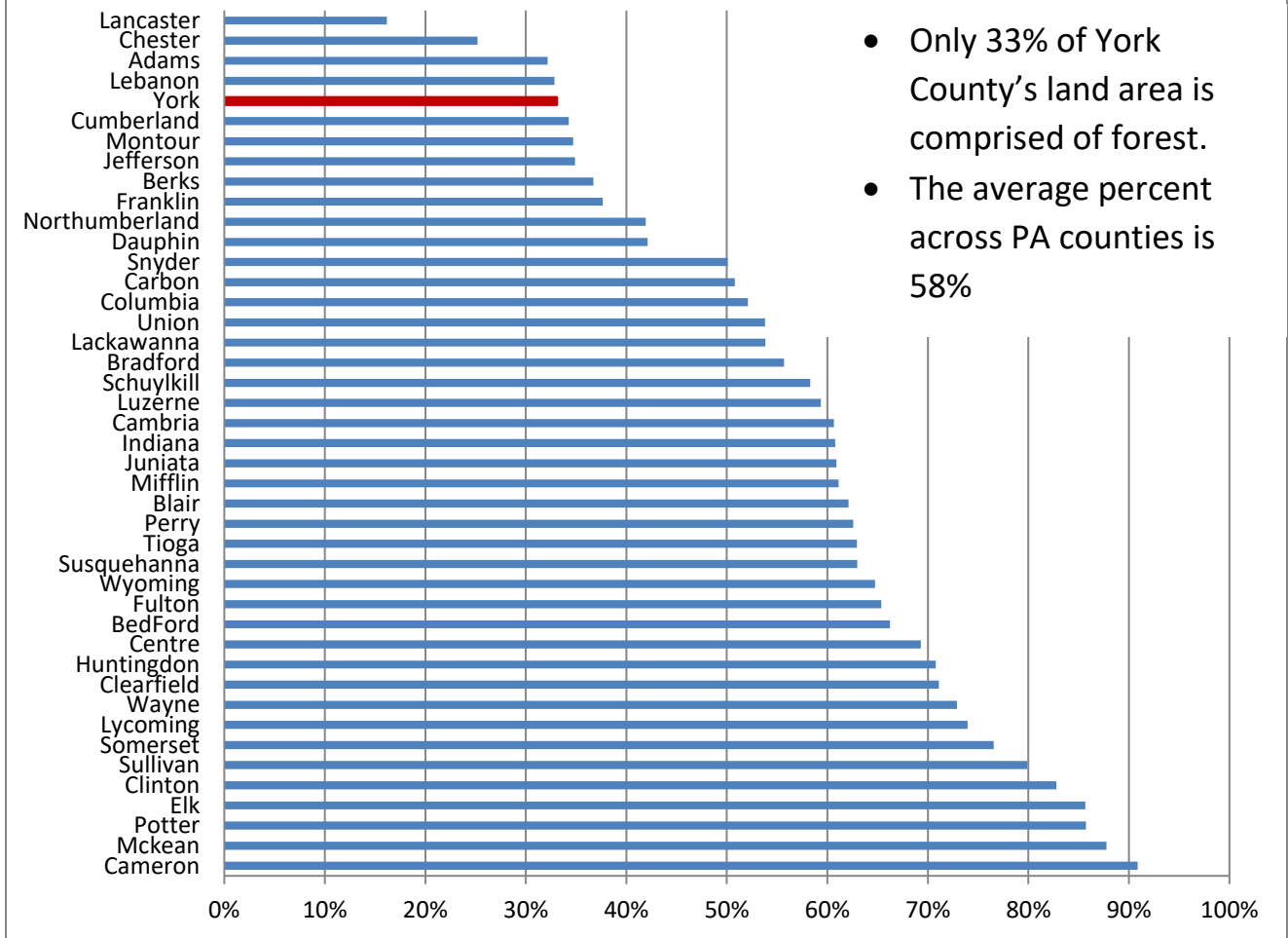
York County has unique challenges in restoring water quality.

- The pie chart above shows the breakdown of land uses in York County. 60 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).
- Agricultural and developed land generates more nutrients and sediment than forested land. York County has unique local water quality challenges in part due to its high acreage of these land uses.

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 (left) and Google Earth (right). The breakdown of land use by county can be found on CAST at: <http://cast.chesapeakebay.net/>.

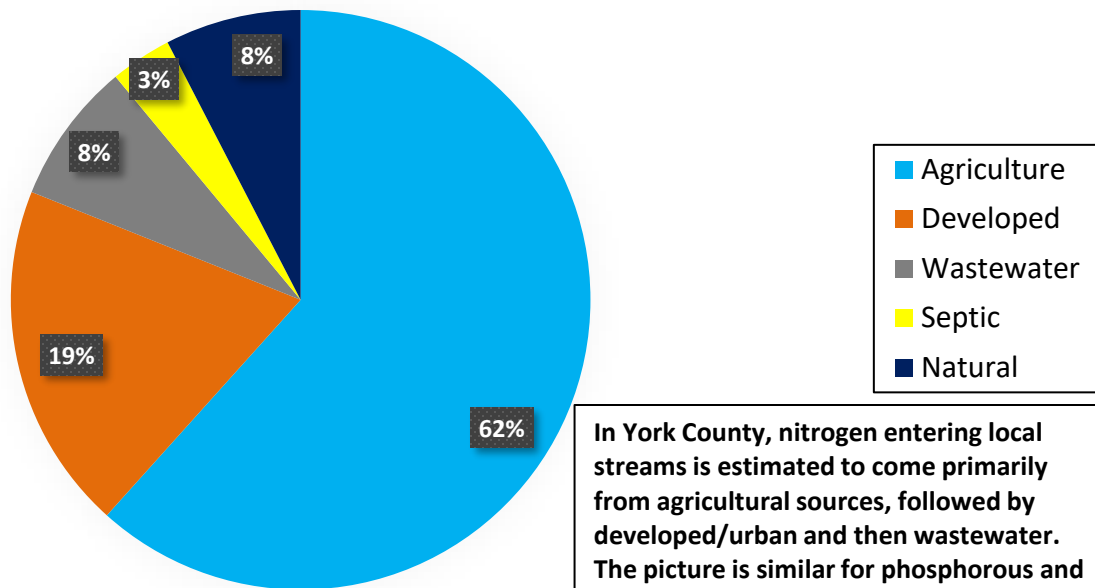
Percent of Land Area within Chesapeake Bay Watershed Covered By Forest



York County's land is only 33 percent forested. This is the fifth least forested county of all counties in Pennsylvania's Chesapeake Bay watershed, representing a unique challenge for York 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/>.

York County - Nitrogen Delivered to Streams by Sector (2017)



In York County, nitrogen entering local streams is estimated to come primarily from agricultural sources, followed by developed/urban and then wastewater. The picture is similar for phosphorous and sediment.

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 York County comes from agricultural sources including cropland, pastures and barnyards.

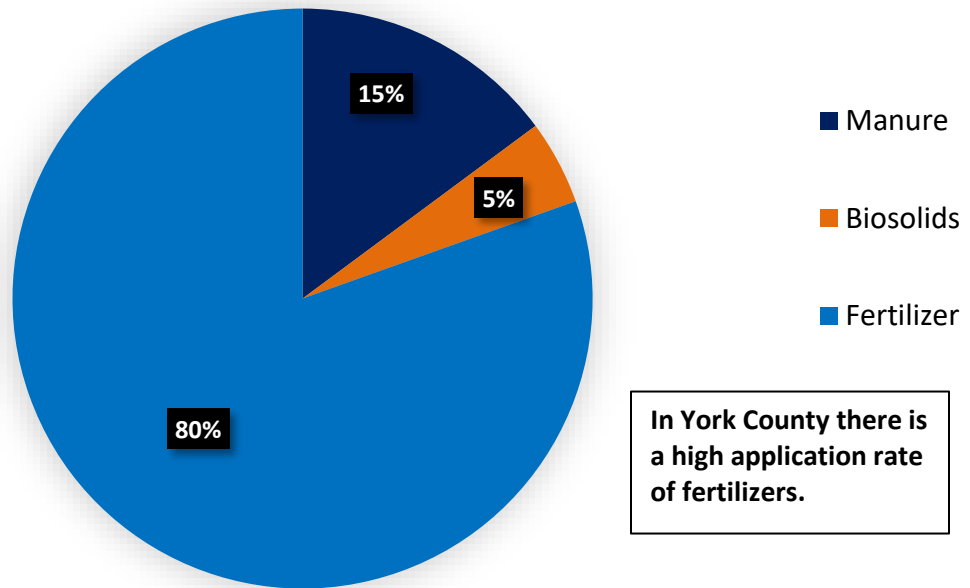
The developed/urban sector also contributes a fair amount of the load from stormwater.

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

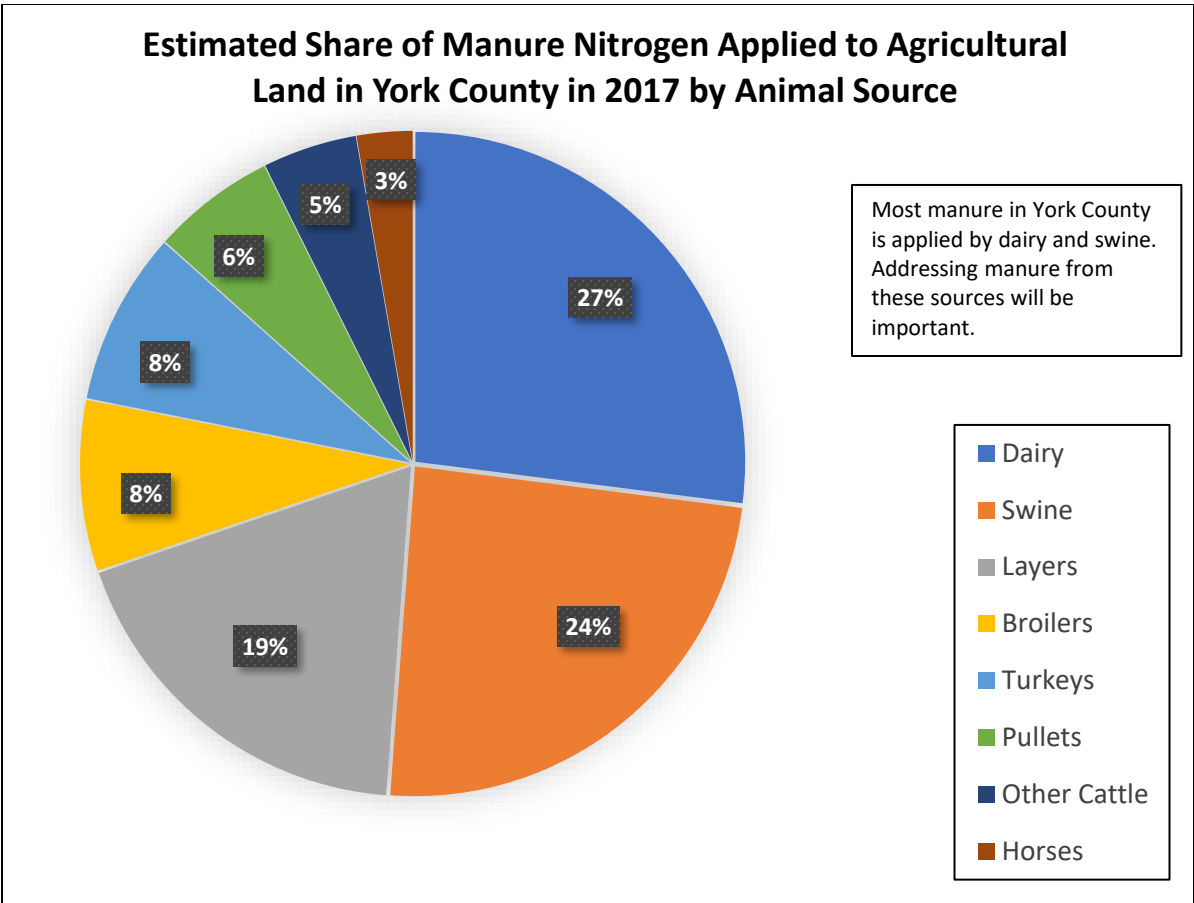
Estimated Share of Nitrogen Applied to Agricultural Land in York County in 2017 by Main Source



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 York 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 pollutants.

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

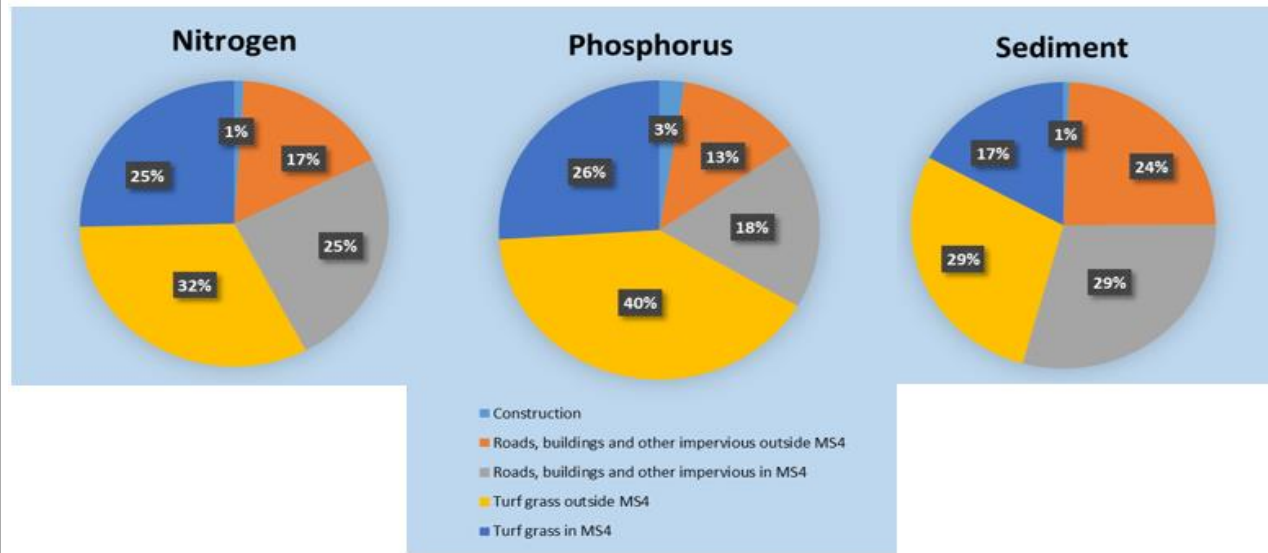


Some nutrients in York County area also applied as manure, and understanding where manure is coming from within the county will help identify opportunities to manage it.

More than half of manure in York County is from dairy and swine operations. Focusing efforts on implementing practices at these sorts of operations can address a large portion of York County's manure management needs.

Estimated share of manure nutrient animal sources can be found on CAST at <http://cast.chesapeakebay.net/>.

York County - Loads Delivered to Streams from Developed/Stormwater Sector



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

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

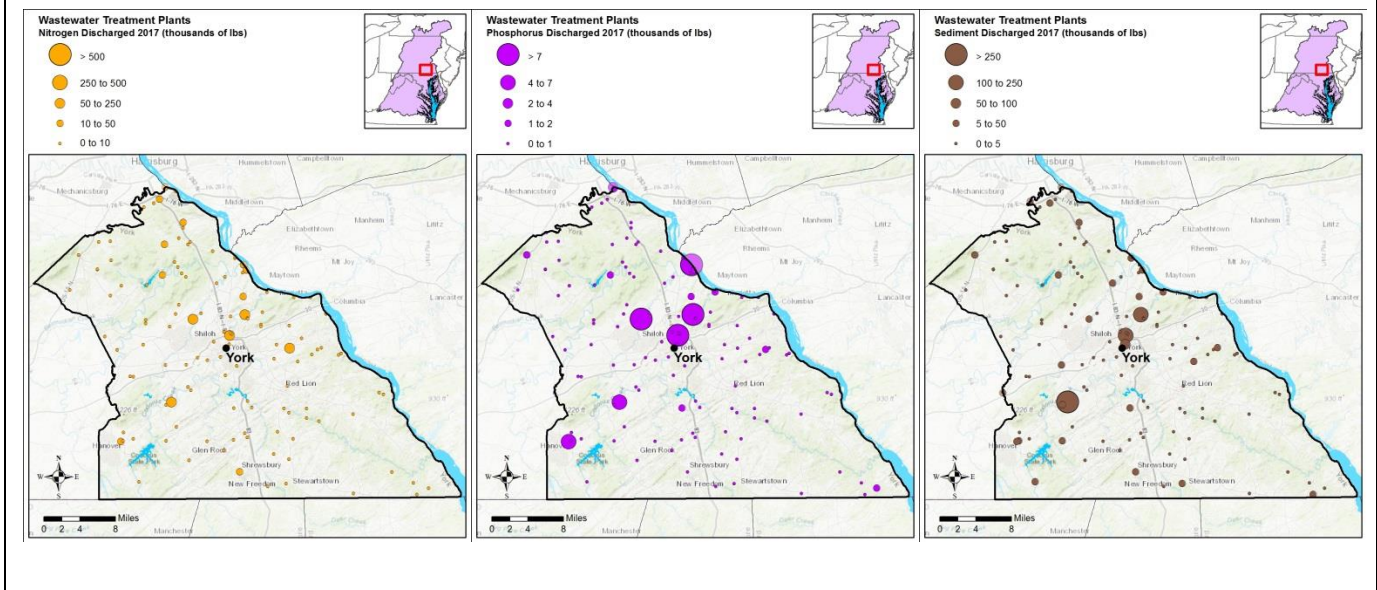
- MS4 (municipal separate storm sewer systems) areas are regulated by DEP.
- Land outside of MS4 areas is not regulated.
- Turf grass represents grassy and barren lands that have been altered through compaction, removal of organic material, and/or fertilization. These include all lawns and grassy areas 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 York County, both impervious and turf grass areas are important sources to manage stormwater.
- Managing stormwater outside of regulated MS4 areas will also be important in York County.
- 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 York County and their annual discharges of nitrogen, phosphorus and sediment in 2017.

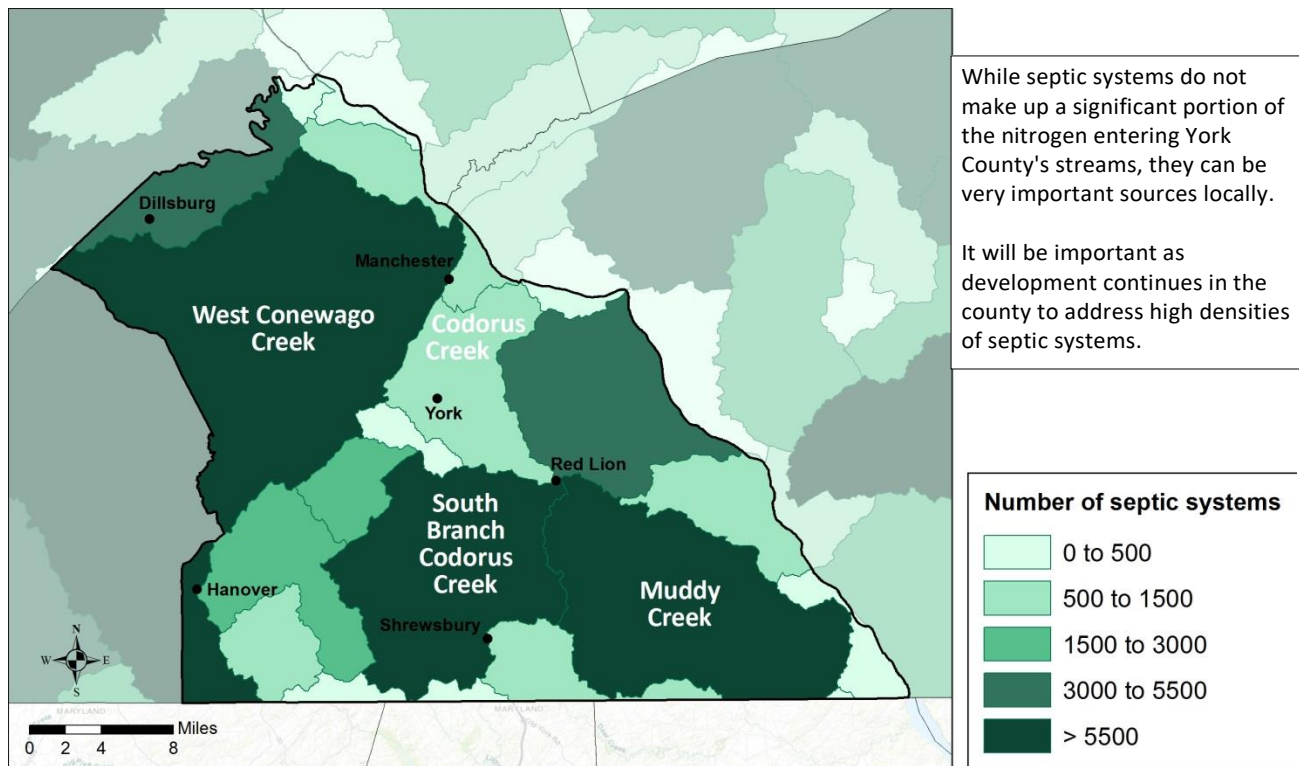
Although wastewater makes up a smaller portion of nutrient loads to streams than agricultural or developed land and has already been significantly reduced, it is still an important source to control as the discharges enter streams directly.

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 York County



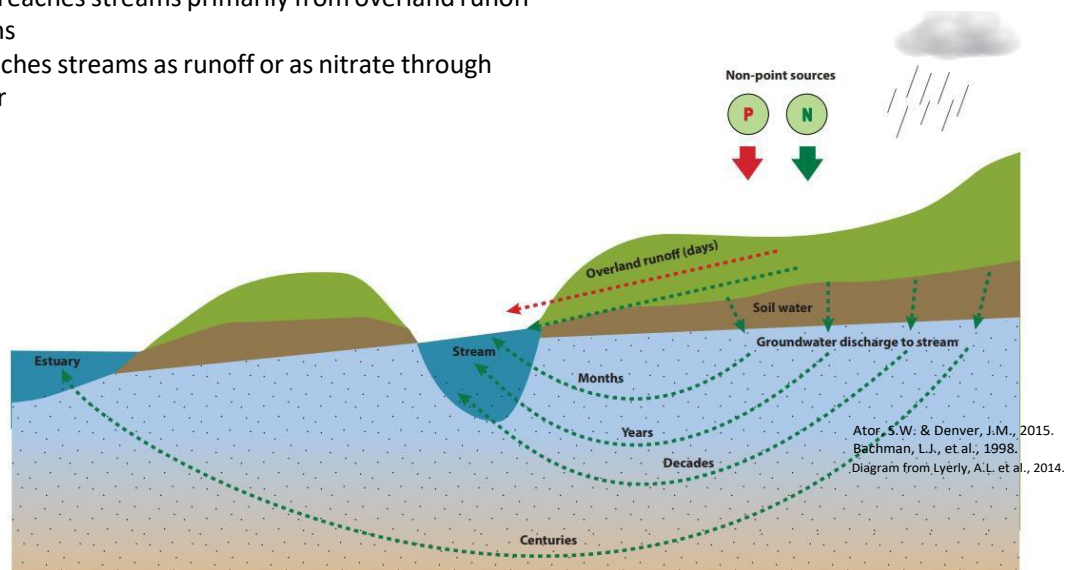
Although on-lot septic systems do not make up a large portion of the load in York County, they can be very important local sources of nitrogen, especially when leaking into groundwater.

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



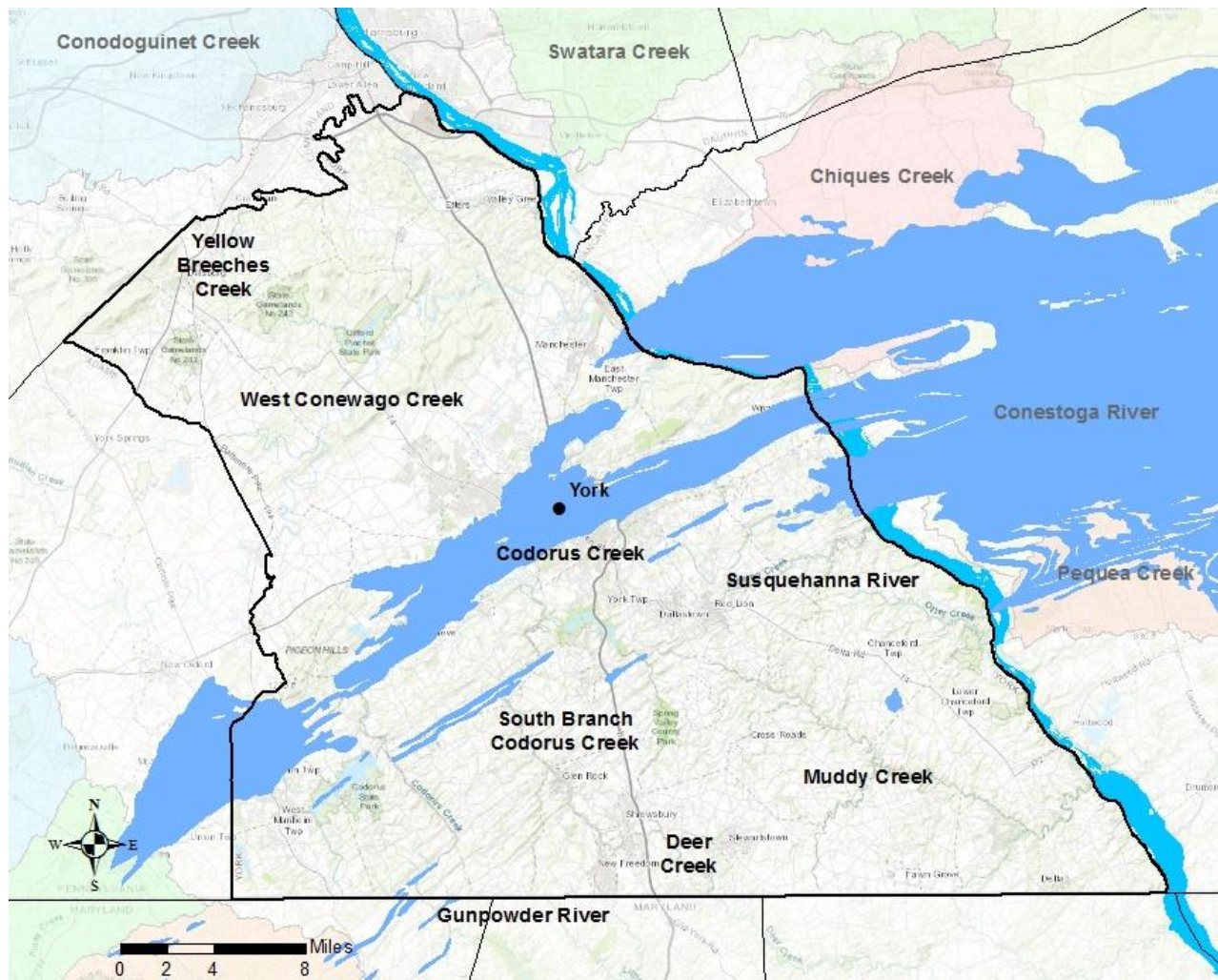
The way in which nutrients and sediment reach our streams impacts which practices will be effective at controlling them.

Phosphorus and sediment travel over the top of the land during high runoff events such as storms and rainfall.

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

- In Yellow Breeches, 81% of the nitrate in streams is from groundwater. In West Conewago, 57% of the nitrate in streams is 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.

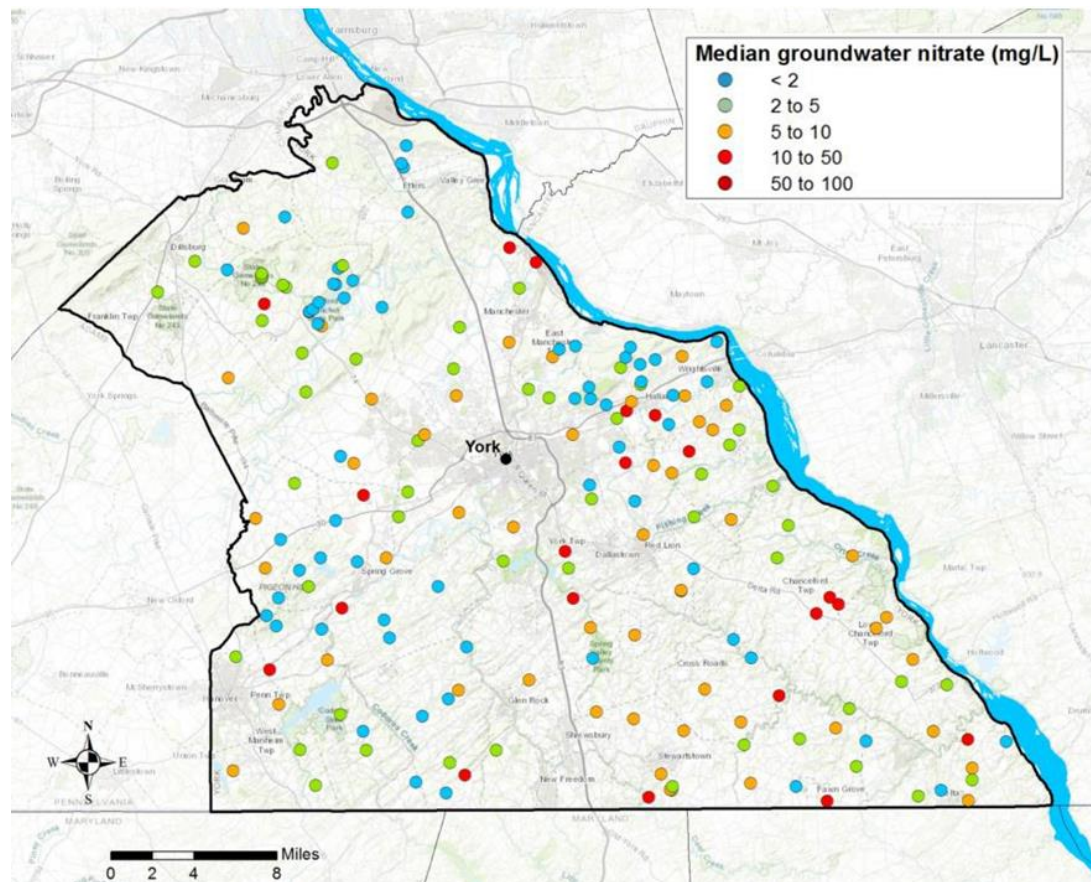
York County contains a small area vulnerable to groundwater contamination (Karst highlighted in blue)



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 York County



Groundwater in York County has some elevated nitrate levels.

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

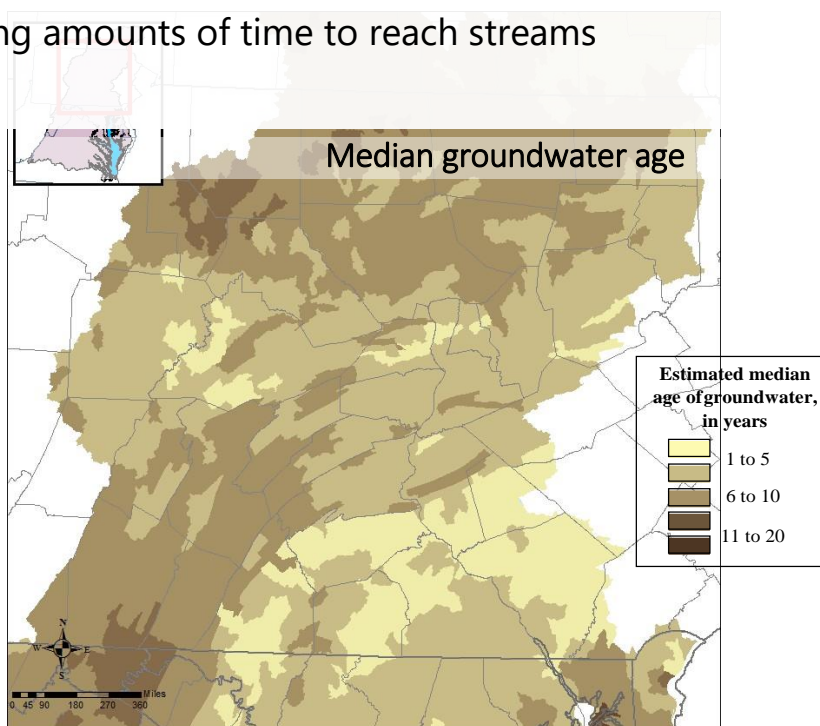
Groundwater quality data over multiple years can be found from USGS:

<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 York 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.

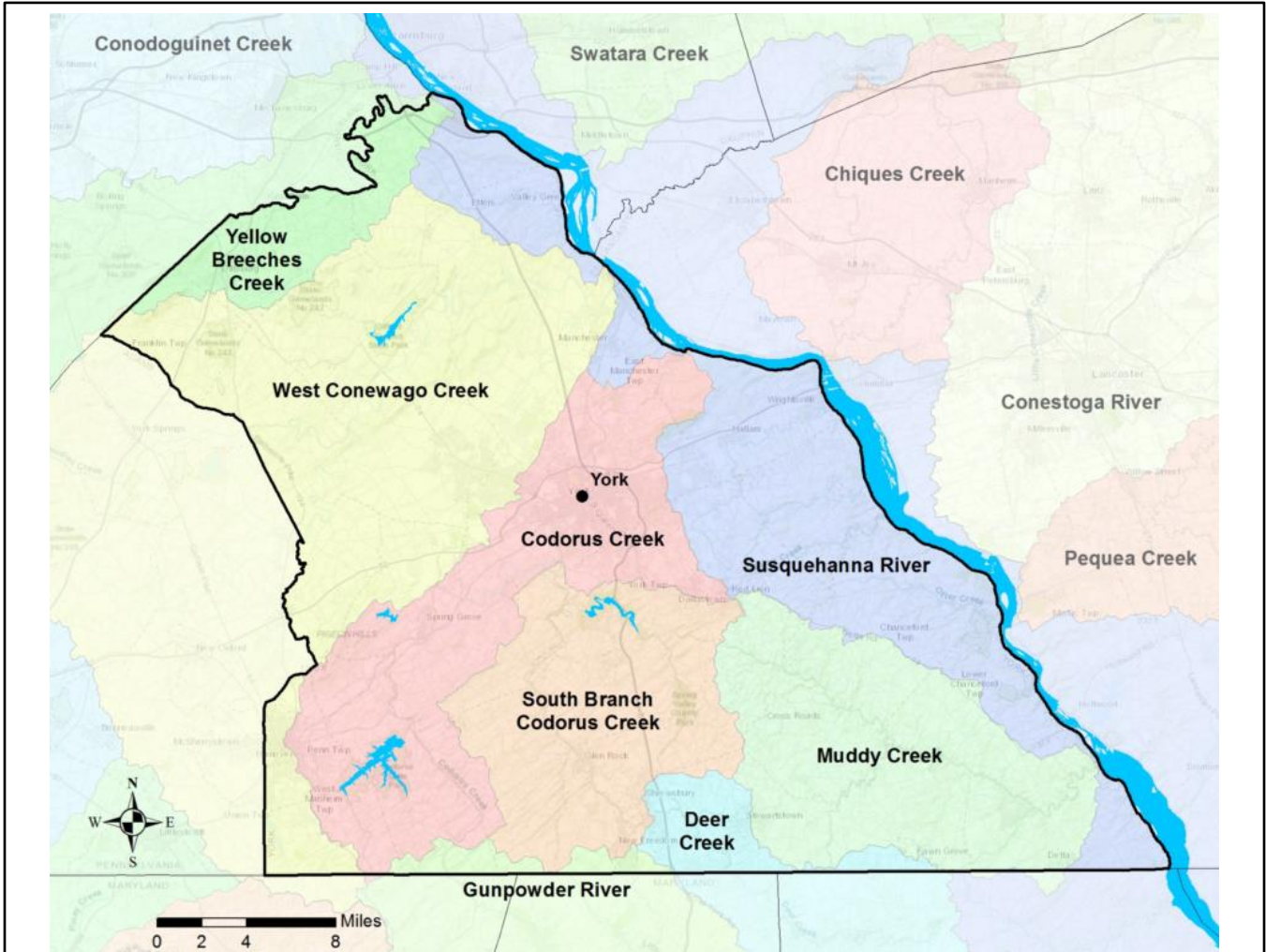


Groundwater takes anywhere from days to years to reach nearby streams.

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

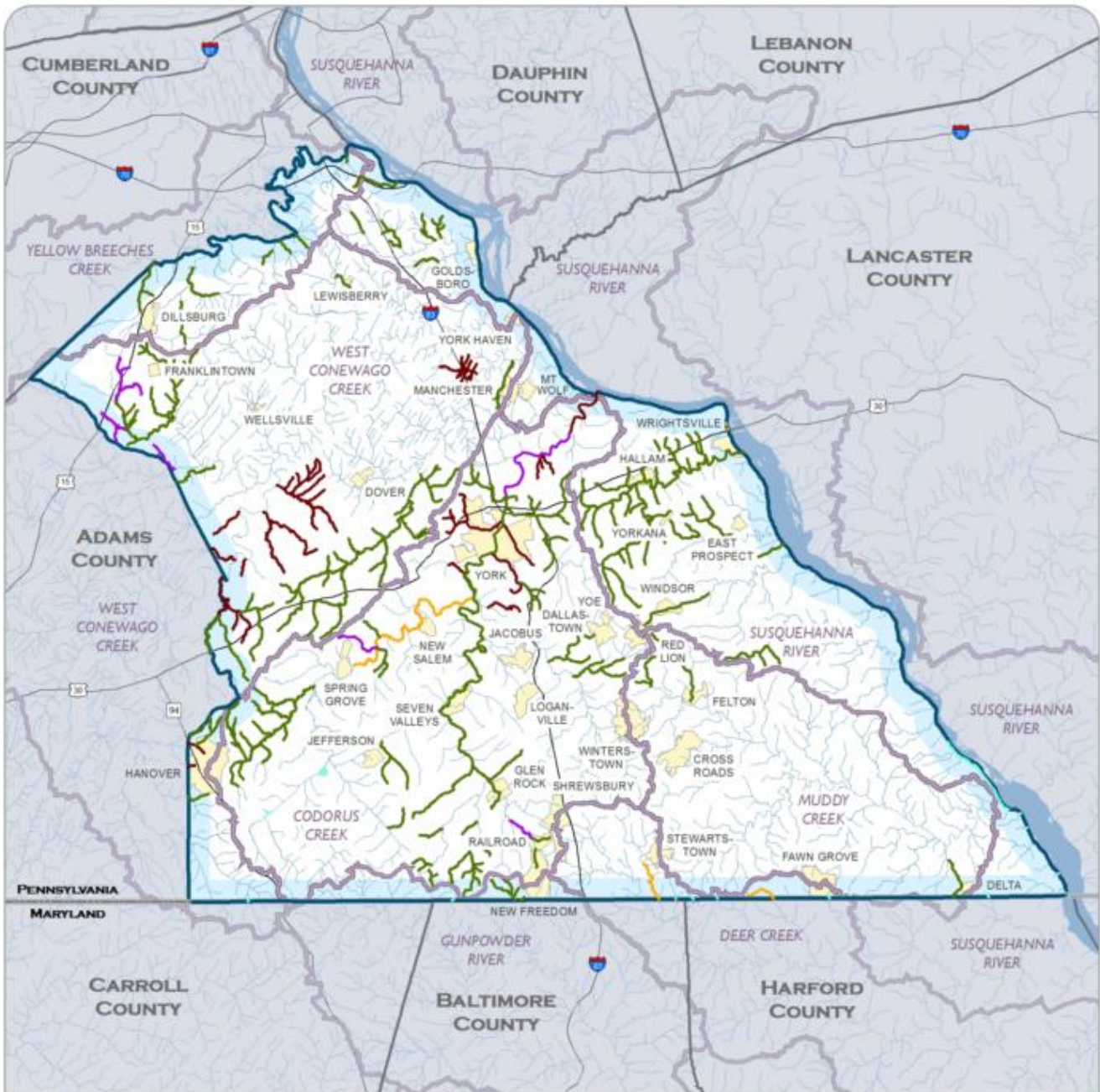
This means that we should see decreased nutrient benefits in groundwater from local stream restoration and conservation efforts relatively faster than anywhere else in the Chesapeake Bay watershed.

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



Information to Help Geographically Focus York County's Efforts

Impaired Waterways in York County, PA, 2018



Impaired Waterway Miles by Cause*

- Siltation - 294 mi.
- Disturbance - 238 mi.
- Nutrients - 80 mi.
- Other - 31 mi.

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

- Unassessed Stream 7 mi.
- River/Stream 1,670 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 (1243hh) 06-18-2018

2 0 2 Miles

York County has many streams that are impaired for different reasons.

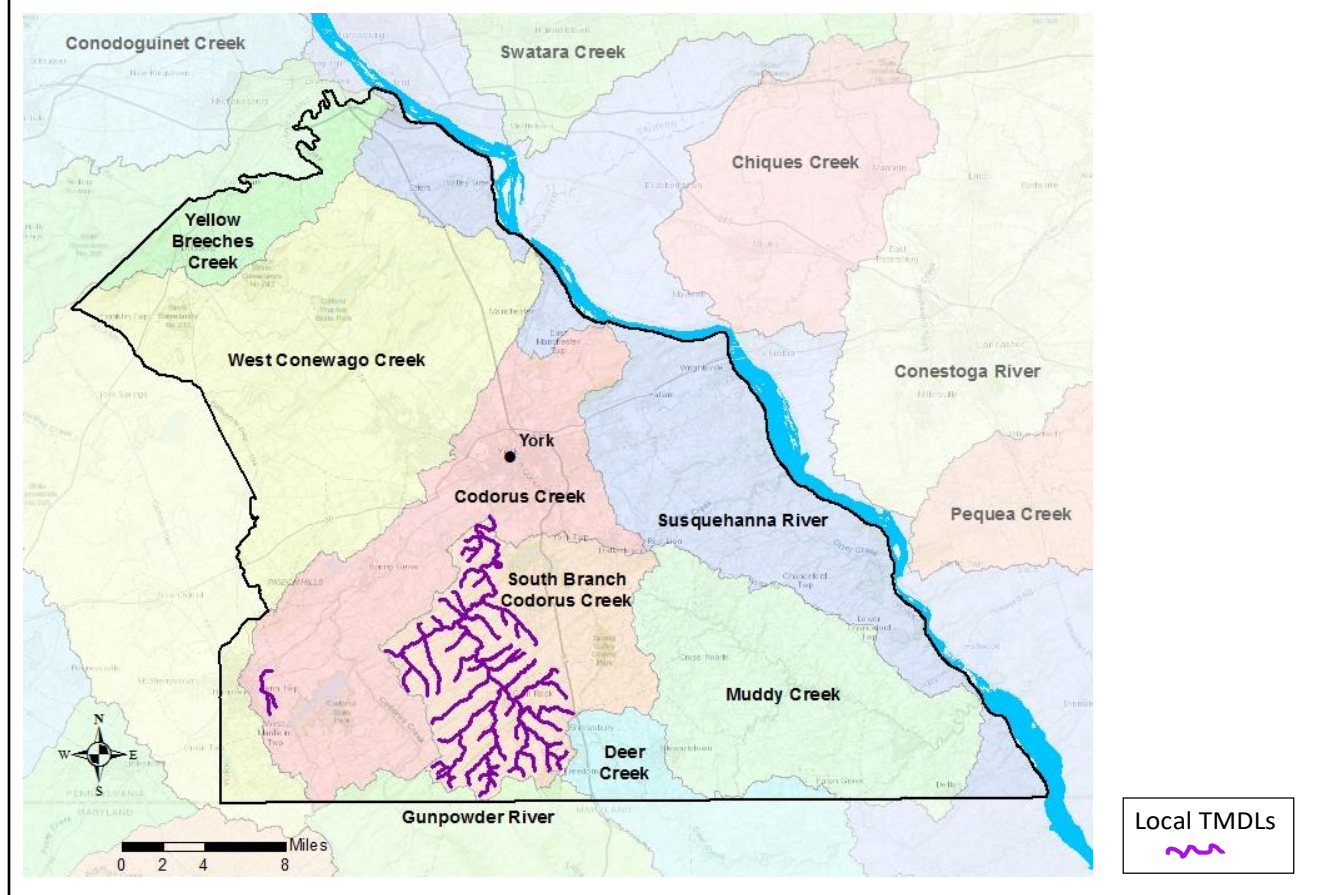
Knowing the sources of these impairments help to prioritize or coordinate efforts.

- 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.

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 York County's water quality.

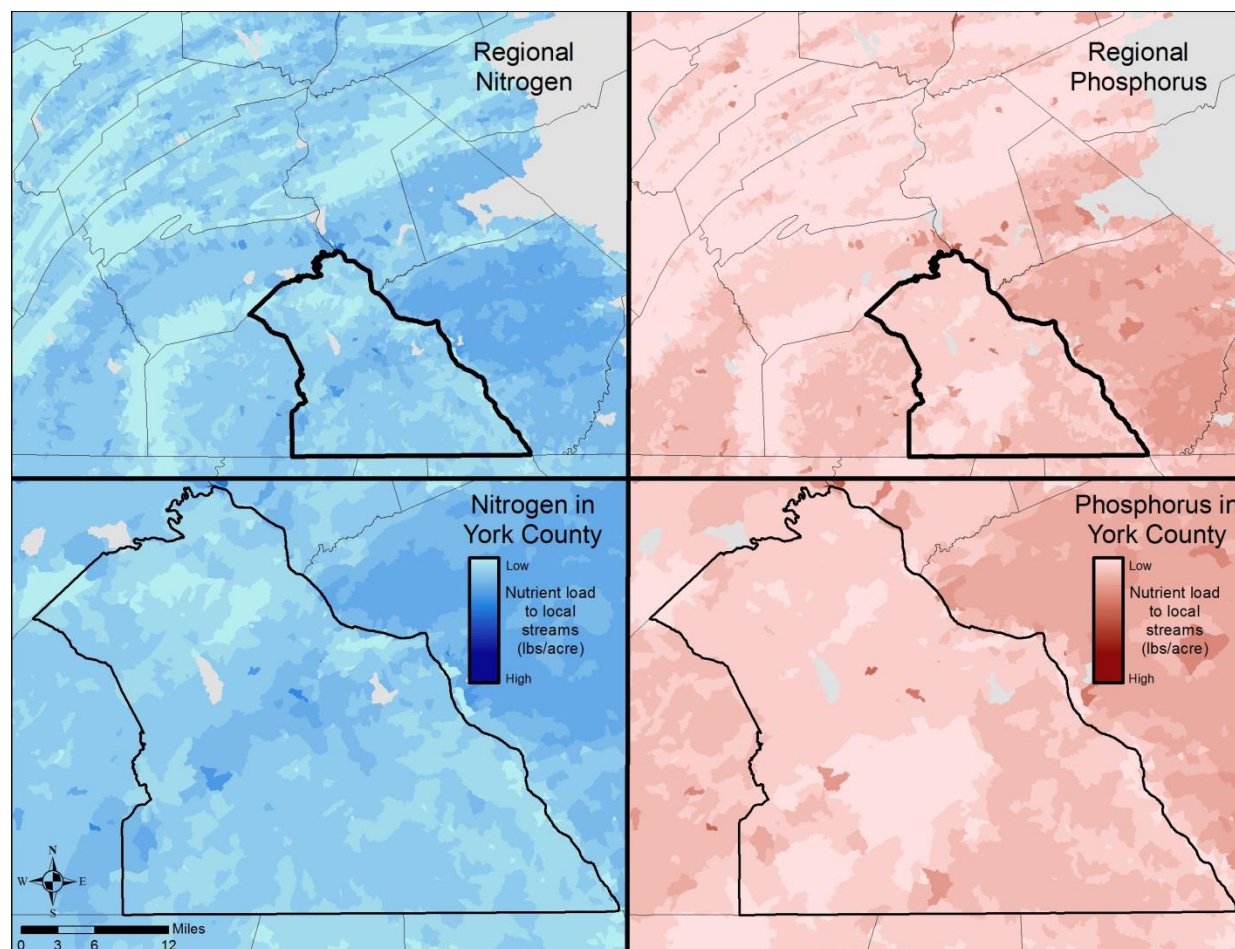


While many waters are listed as impaired, only some of these impairments are being addressed through regulatory Total Maximum Daily Loads (TMDLs).

Local groups may want to coordinate restoration efforts to focus on the watersheds that already have these local TMDLs (Oil Creek and South Branch Codorus Creek).

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 York County can result in the greatest water quality benefits

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

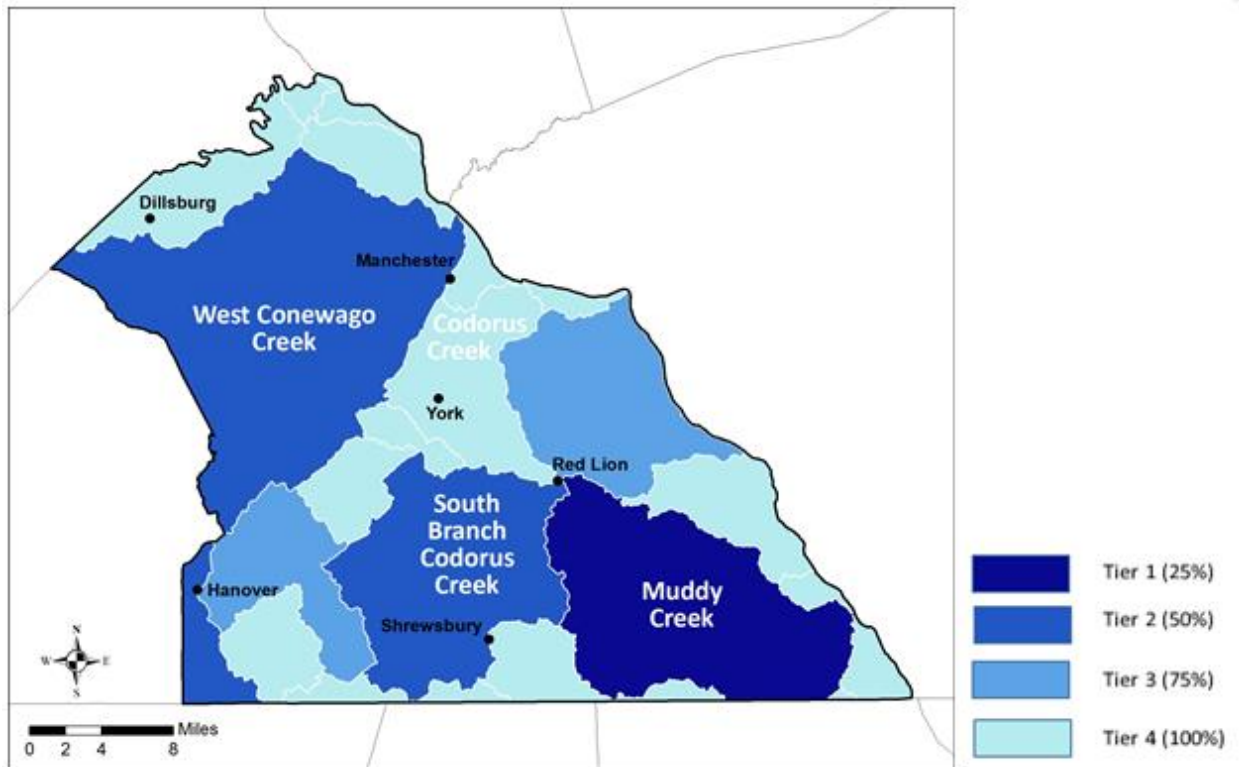
The maps above show these higher loading areas within York County and compared to the regional scale.

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.

The maps above are generated from the USGS SPARROW model for the Chesapeake Bay watershed:

<https://pubs.usgs.gov/sir/2011/5167/>.

Remaining agricultural nitrogen loads that could be controlled

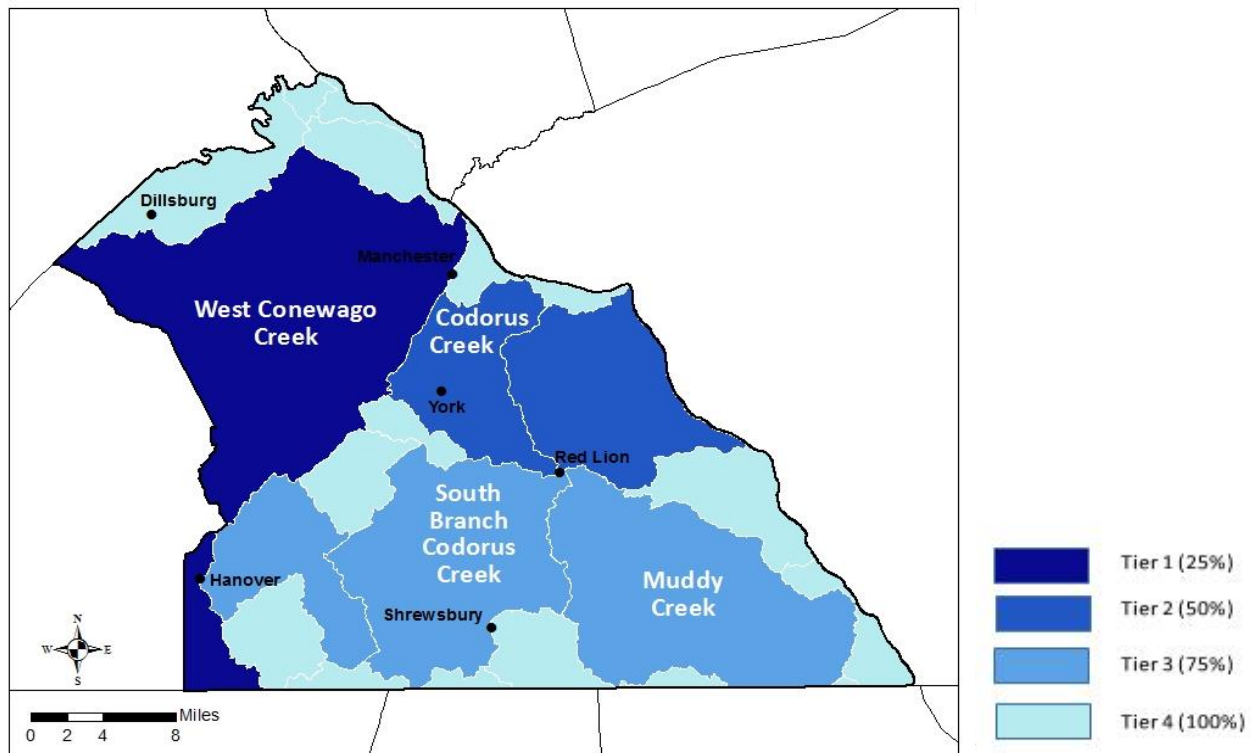


For each watershed within York County, we can estimate the remaining nitrogen and phosphorus reductions that are feasibly possible from the agricultural sector.

- 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 York County broken into 25 percent tiers.
- For example, if we were to reduce nitrogen loads in the three darkest watersheds as low as feasibly possible, that would address 50 percent of the entire remaining nitrogen load.
- West Conewago Creek is in the top two tiers across nitrogen and phosphorus 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

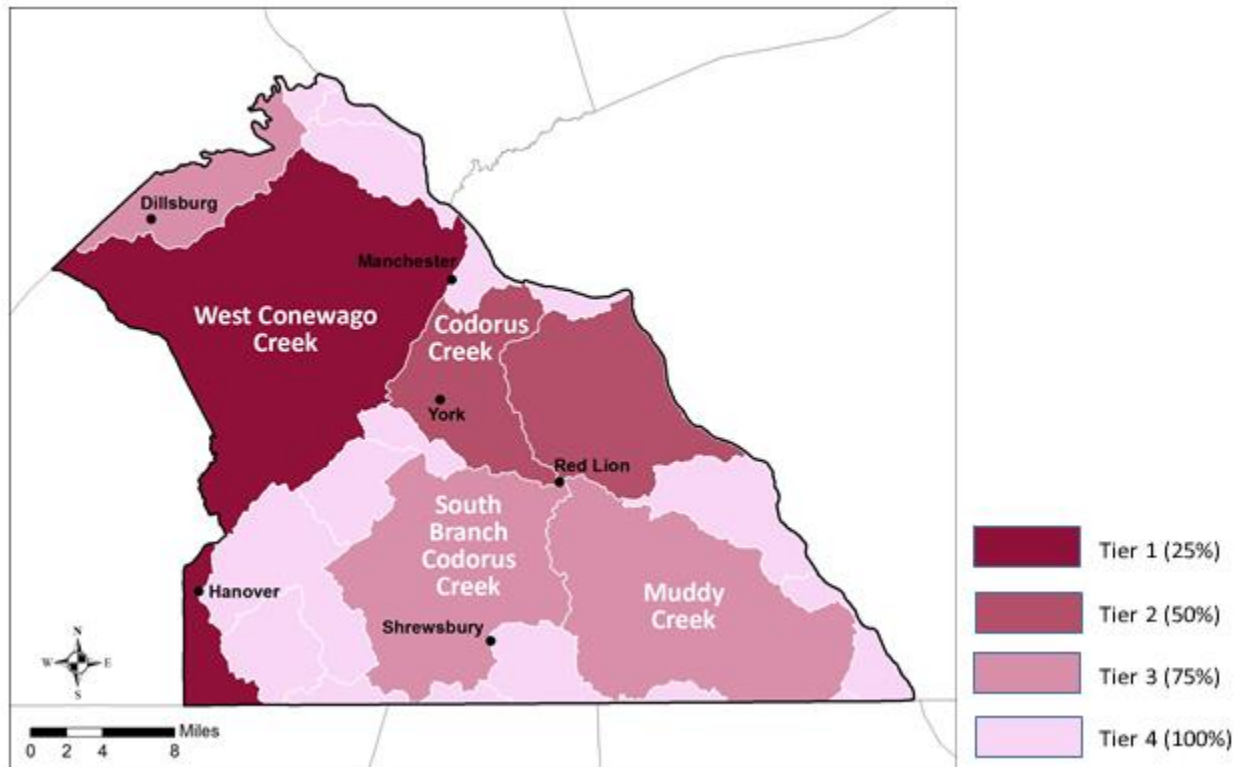


For each watershed within York County, we can estimate the remaining nitrogen and phosphorus reductions that are feasibly possible from the developed/urban sector.

- 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 nitrogen reductions possible in York 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 is in the top two tiers across nitrogen and phosphorus for both agricultural and developed sectors.

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

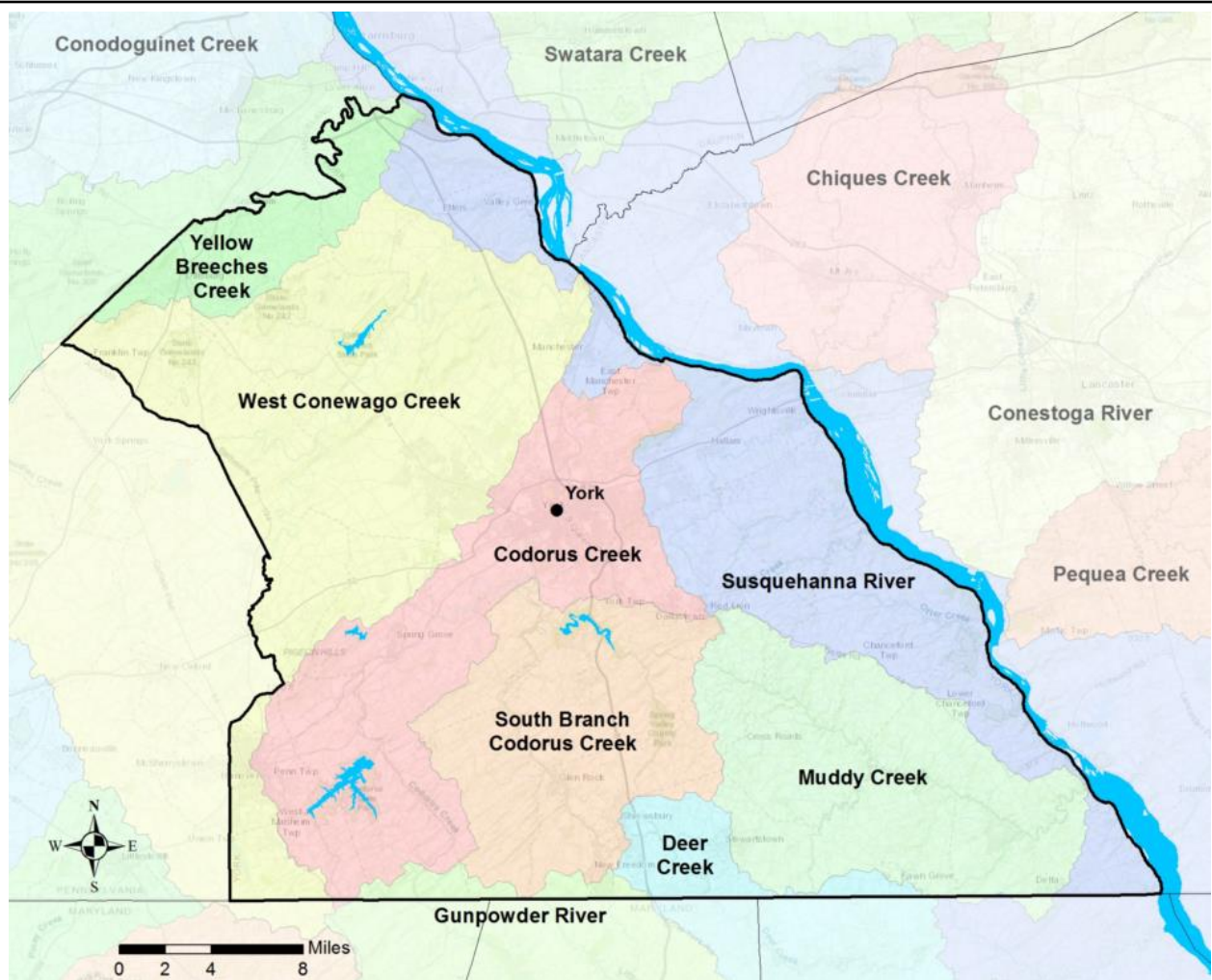
Remaining developed land phosphorus loads that could be controlled



For each watershed within York County, we can estimate the remaining nitrogen 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 nitrogen reductions possible in York County broken into 25 percent tiers.
- For example, if we were to reduce phosphorus loads in the two darkest watersheds as low as feasibly possible, that would address 50 percent of the entire remaining phosphorus load.
- West Conewago Creek is frequently in the top two tiers across nitrogen and phosphorus 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 York 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	2.65	-3.75
Agriculture	Conservation Tillage	0	3.14	0
Agriculture	Alternative Crops	18.26	30.31	0.60
Agriculture	Grass Buffer	56.95	62.23	0.92
Agriculture	Soil Conservation and Water Quality Plans	1.94	1.68	1.16
Agriculture	Grass Buffer – Streamside with Exclusion Fence	277.30	180.78	1.53
Agriculture	Wetland Restoration - Floodplain	96.58	57.38	1.68
Agriculture	Forest Buffer	157.35	79.93	1.97
Agriculture	Grass Buffer - Narrow	56.95	25.17	2.26
Agriculture	Water Control Structures	17.74	7.41	2.40
Agriculture	Barnyard Runoff Control	567.46	160.55	3.53
Agriculture	Forest Buffer – Streamside with Exclusion Fence	709.73	188.96	3.76
Agriculture	Cropland Irrigation Management	4.57	1.06	4.33
Agriculture	Tree Planting	115.18	25.00	4.61
Agriculture	Agricultural Storm water Management	1,584.68	279.91	5.67

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

Sector	BMP	Cost per unit BMP	Nitrogen Lbs Reduced per unit BMP	Nitrogen \$/lb reduced/year
Developed	Forest Planting	92.23	8.04	11.46
Developed	Forest Buffer	153.28	10.59	14.47
Developed	Bioswale	865.95	7.92	109.39
Developed	Tree Planting – Canopy	107.78	0.89	120.49
Developed	Infiltration Practices w/o sand, veg. – A/B soils, no underdrain	1,093.35	9.05	120.85
Developed	Wet Ponds and Wetlands	330.44	2.26	146.09
Developed	Dry Extended Detention Ponds	342.62	2.26	151.48
Developed	Vegetated Open Channels a/b Soils, no underdrain	819.32	5.09	161.01
Developed	Storm Drain Cleaning	0.62	0.00	346.97
Developed	Bioretention/raingardens – C/D soils, underdrain	1,059.40	2.83	374.71

The lists above reflect the top 15 agricultural practices and top 10 developed practices that are most cost-effective at reducing nitrogen in York County.

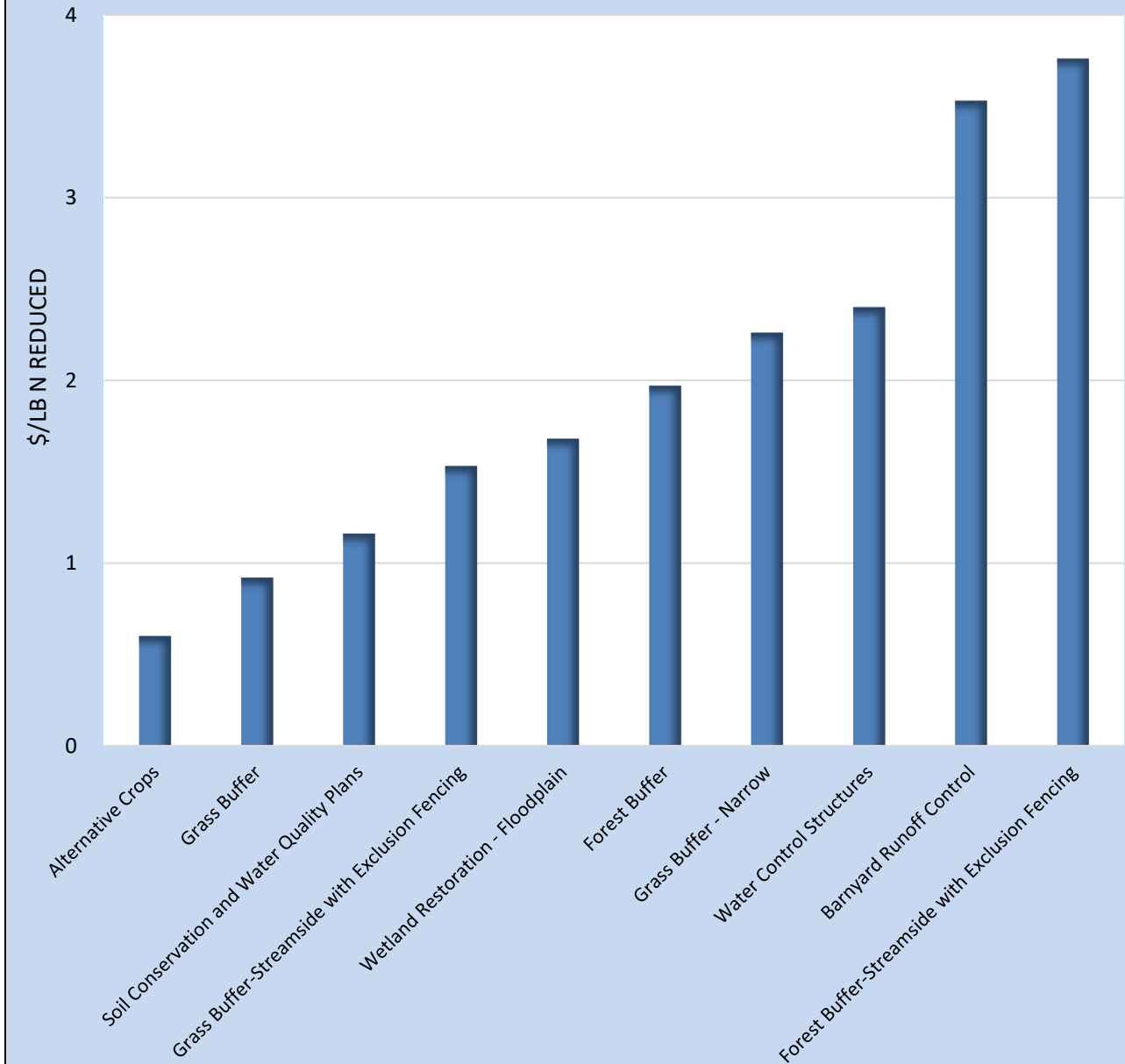
This list can serve as a starting point to assess feasibility of practice implementation.

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>.

Most Effective Practices to Reduce N to the Stream



The chart above displays some of the most common best management practices ranked by the cost per pound of nitrogen reduced.

Remaining Opportunities in York County for Agricultural Practices

Practice	Current Reported Implementation	Acres Remaining
Basic Nutrient Management	6%	185,000
Conservation Tillage	55%	67,000
Cover Crop	7%	136,000
Prescribed Grazing	6%	18,000
Barnyard Runoff Control	69%	70
Soil & Water Conservation Plans	10%	180,000
Forest Buffers	1%	13,200

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This chart shows the current implementation in York County of some effective agricultural practices, and the 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 6 percent of pasture land in York County is currently reported to have prescribed grazing implemented. 18,000 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 is available in CAST. Reported implementation is available on CAST at <http://cast.chesapeakebay.net>.

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

Practice	Current Reported Implementation	Acres Remaining
Erosion & Sediment Control	100%	0
Stormwater Management	2.8%	145,000

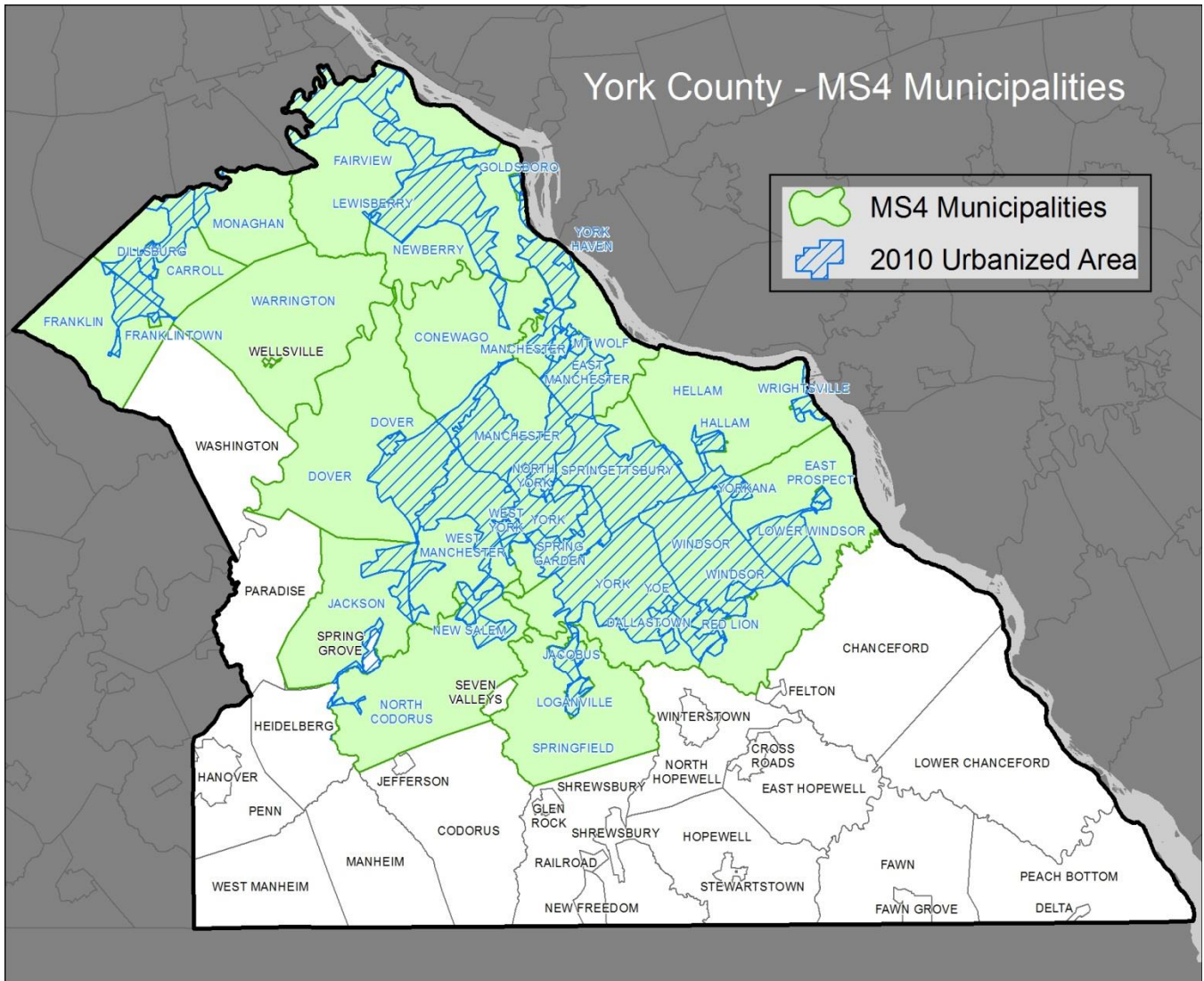
38

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

Erosion and sediment control address 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 York 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 York County.

York County is at the forefront of MS4 permit compliance with a regional coordinated effort. This ongoing effort can assist to achieve water quality goals for the county. More information can be found here-

<http://www.dep.pa.gov/Business/Water/CleanWater/StormwaterMgmt/Stormwater/Pages/default.aspx>