Chester River Watershed Assessment & Priority Restoration Plan

Chester River Association
March, 2016

Funding Provided by Chesapeake Bay Trust
GIS Analysis Provided by Chesapeake Conservancy
Stream Data Provided by CRA Chester Testers

Table of Contents

1.0 Executive Summary 3
2.0 Introduction 4
3.0 Methods 5
3.1 Conducting the Watershed Assessment 5
Table 1: Stream Stations Ranked by 3-Yr Water Quality Index 7
3.2 Developing the Priority Restoration Plan 9
4.0 Watershed Assessment and Priority Restoration Plan 10
Table 2: Stream Station Priority Restoration Tiers 11
Figure 1: Stream Station Priority Restoration Tiers 13
4.1 Subwatershed Characteristics 14
4.2 Water Quality and Stream Characteristics: Clues to Pollution Sources 21
4.3 Watershed-Wide Community Outreach 22
4.4 Priority Restoration Plans for Top Three Tier Stream Basins 23
Tier 1 Stream Basins 23
Tier 2 Stream Basins 29
Tier 3 Stream Basins 36
5.0 Appendices 41
Appendix A: Stream Basin Characterizations 41

1.0 Executive Summary

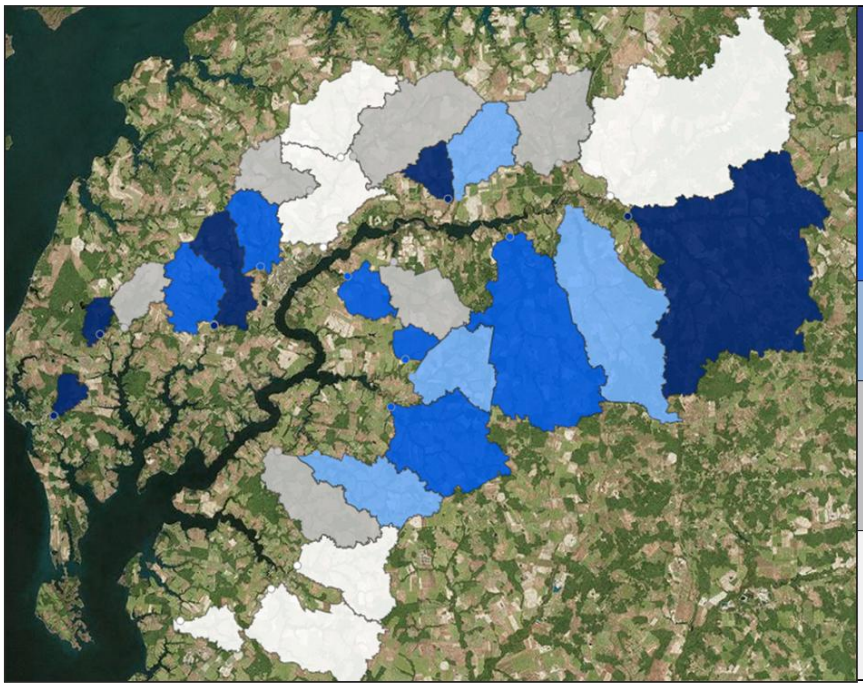
Through science-based advocacy, restoration, and outreach, the Chester River Association (CRA) works to protect and restore the Chester. Our vision is of a vibrant, healthy Chester River for our community and for future generations.

The Chester River and its tributaries are impaired with too many nutrients and sediments. CRA conducted an analysis to better understand exactly where in our watershed pollution is coming from and what we can do about it. The Watershed Assessment evaluates the health of the Chester and its tributaries using historical water quality monitoring data and GIS land use and water flow analysis. The Priority Restoration Plan presents a list of stream basins in which to target restoration and outreach efforts to most effectively accelerate reduction of nutrients and sediments to the Chester River.

The Priority Restoration Plan places 27 stream basins into five priority groups: Tier 1, 2, 3, 4, and 5, with Tier 1 being the most impaired and highest priority. Placement was determined using water quality data, GIS land use and water flow analysis, potential for restoration or outreach projects, potential for public involvement, and opportunities for partnership. We developed a one-page Priority Restoration Plan for each station in the top three priority tiers. Each plan describes the stream basin's land use, water quality impairments, and potential pollution sources. The plan also lists potential restoration and outreach actions that could be taken to improve water quality; actions are tailored to the landowners and water quality impairments specific to that stream basin.

CRA will use this analysis to systematically and strategically address pollution issues in the Chester, with an end goal of efficiently and effectively achieving a healthier watershed.

Stream Station Priority Restoration Tiers



Tier 1	Grays Inn Creek Shipyard Creek Harmony Woods Creek Airy Hill Creek Andover Branch
Tier 2	Church Hill Branch Red Lion Branch Radcliffe Creek Brices Mill Pond Creek Johnny Powell Branch Rosin Creek
Tier 3	Granny Finley Branch Unicorn Branch Browns Branch Chesterville Branch
Tier 4	Sandy Bottom Creek Rileys Mill Branch Island Creek Branch Mills Branch Perkins Hill Branch Foreman Branch
Tier 5	Morgan Creek Cypress Branch Old Mill Stream Branch Reed Creek Urieville Lake Branch Three Bridges Branch

2.0 Introduction

The Chester River and its tributaries are impaired with too many nutrients and sediments. Through science-based advocacy, restoration, and outreach, the Chester River Association works to protect and restore the Chester. Our vision is of a vibrant, healthy Chester River for our community and for future generations.

Chester River Watershed

Our extensive water quality monitoring shows higher levels of nutrients and sediments in the upper reaches of the Chester's tributaries – clear evidence the Chester is polluted from our own actions. We also know from research conducted at Washington College that Chester river water does not mix well with Chesapeake Bay water; meaning, we cannot blame our pollution issues on Baltimore, the Conowingo Dam, or Pennsylvania. Our pollution is home-grown; therefore, the solution must be as well.

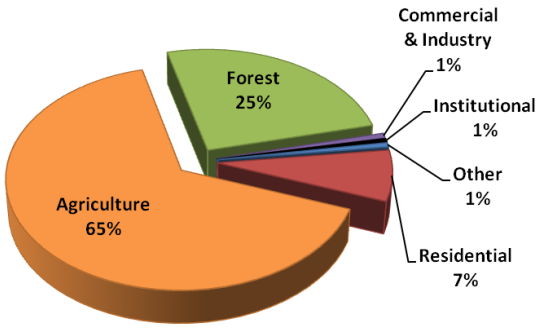
CRA conducted an analysis to better understand exactly where in our watershed excess nutrients and sediments are coming from and what we can do about it. The Watershed Assessment evaluates the health of the Chester and its tributaries using years of water quality monitoring data. The Priority Restoration Plan presents a priority list of stream basins in which to target restoration and outreach efforts to most effectively accelerate reduction of nutrients and sediments to the Chester River. The resulting Watershed Assessment and Priority Restoration Plan is based on the best available technology and data and will be used to guide future restoration and outreach efforts to maximize conservation dollars and restoration impact.

CRA will use this analysis to systematically and strategically address pollution issues in the Chester, with an end goal of efficiently and effectively achieving a healthier watershed.

About the Chester River

The Chester River is a major tributary of the Chesapeake Bay. The watershed encompasses about 250,000 acres of land in both Kent and Queen Anne's counties, the majority of which is agricultural. The river is listed under the Environmental Protection Agency as an impaired waterway for nitrogen, phosphorus, and sediment. The majority of these pollutants stem from farming practices, but pollution also comes from septic systems, wastewater treatment plants, stormwater runoff, shoreline degradation, legacy nutrients in groundwater, and legacy sediments in the riverbed.

Chester River Watershed
Kent & Queen Anne's County
Land Use & Cover



Data from MD Department of Planning

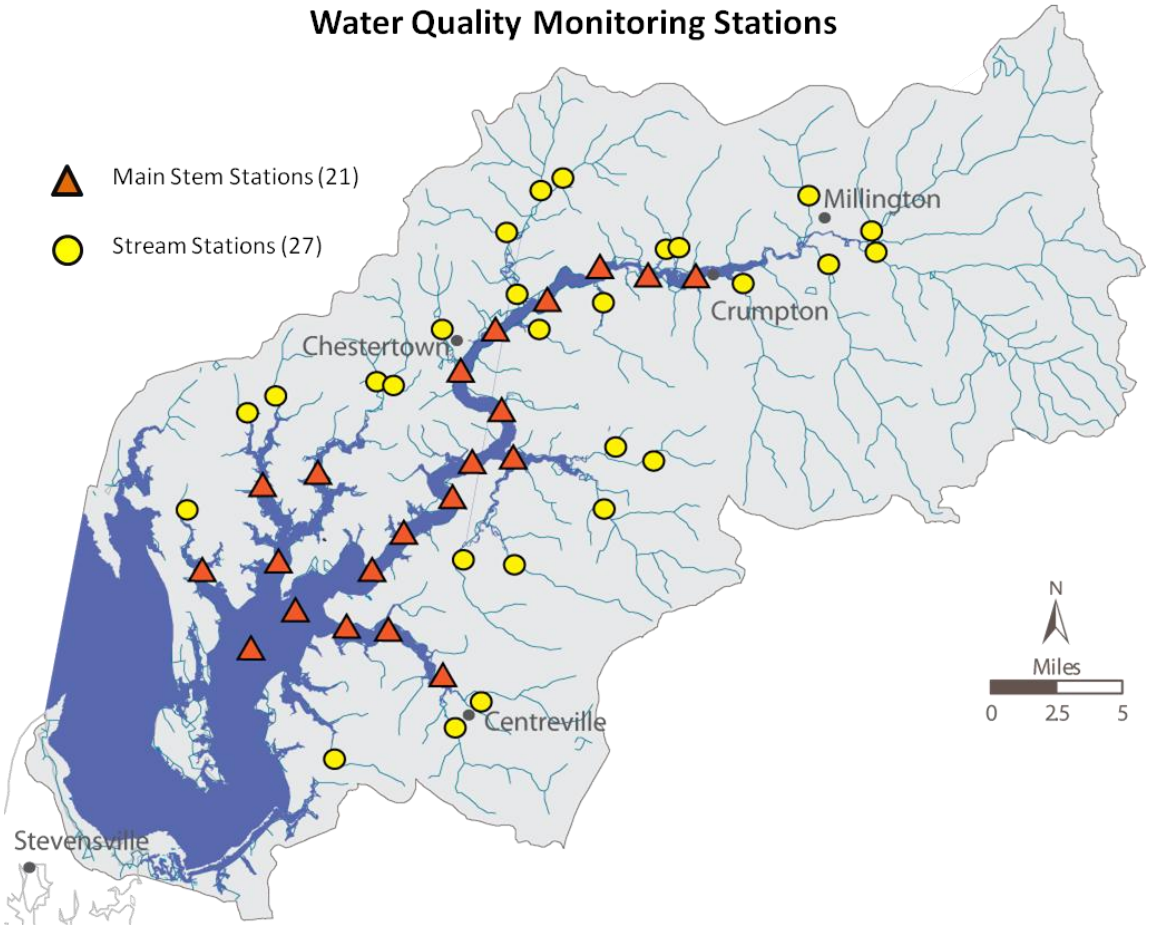
3.0 Methods

3.1 Conducting the Watershed Assessment

The Watershed Assessment evaluates the health of the Chester and its tributaries using five years of water quality data from 27 sites in the watershed as well as watershed-wide GIS land use and water flow analysis performed by Chesapeake Conservancy.

CRA Water Quality Data

The Chester River Association has a robust water quality monitoring program comprised of main stem testing at 21 sites conducted by the staff from April through October and stream testing at 27 tributary sites conducted by our team of trained volunteer Chester Testers. For this assessment we focused on data collected at the 27 stream stations.



Every year, we assign scores to our testing sites using a scoring methodology based on guidance provided by the Mid-Atlantic Tributary Assessment Coalition. We test for five parameters, twice a month, year-round at each of 27 stream stations: dissolved oxygen, nitrate, ammonia, phosphate, and turbidity. The Mid-Atlantic Tributary Assessment Coalition has defined thresholds for stream health for each of these parameters; parameters either pass or fail according to their threshold. We average scores through the year to get the annual score for dissolved oxygen, nitrate, ammonia, phosphate, and

turbidity for each station. The annual scores for these five parameters are then averaged together to obtain the station's overall Water Quality Index (WQI) for that year.

Water Quality Index Scores	
80-100%	Excellent
60-79%	Good
40-59%	At Risk
20-39%	Degraded
0-19%	Severely Degraded

Water Quality Index scores range from 0-100%; for example, a score of 50% means the station passed for water quality health half of the times it was tested. A score from 0-19% is considered Severely Degraded; a 20-39% is Degraded; a 40-59% is At Risk; a 60-79% is Good; and an 80-100% is Excellent.

To get an understanding of the current health of our stream stations based on our water quality data, we averaged each site's Water Quality Index over a three year period (2012-2014) to eliminate outliers from any given year based on uncommon weather patterns or other unusual occurrences. The result is a table that quantitatively ranks the 27 stream stations by their three-year Water Quality Index, from worst water quality to best (Table 1).

Table 1: Stream Stations Ranked by 3-Yr Water Quality Index

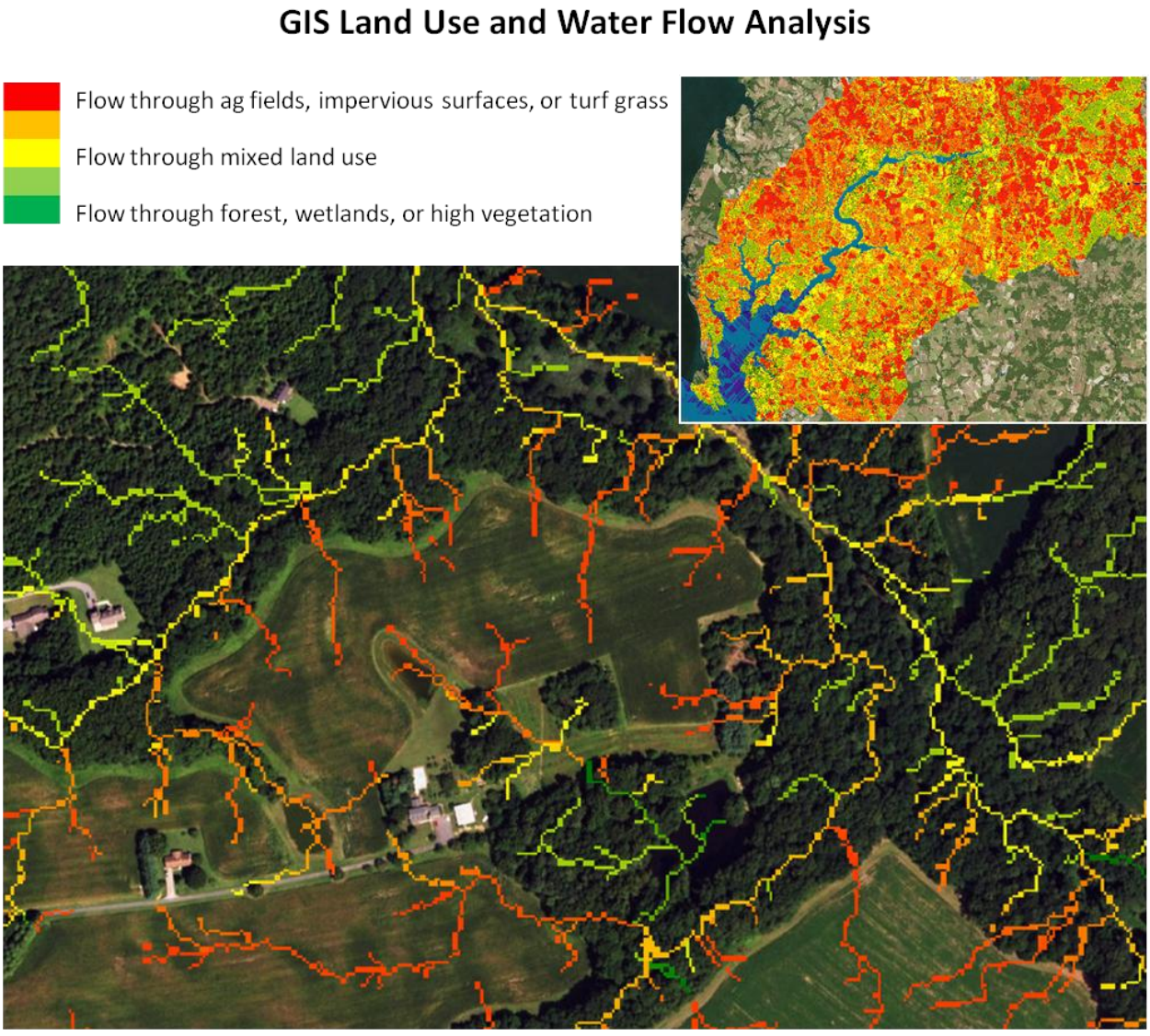
(Data averaged from 2012-2014)

Station	Sub-watershed	Size (acres)	3-yr WQI (%)	Breakdown of 3-yr WQI Parameters (Average Scores) (%)				
				DO Score (Jun- Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
Grays Inn Creek	Lower	828	29	9	97	12	20	8
Shipyard Creek	Langford	933	31	24	98	26	2	6
Harmony Woods Creek	Upper	1,629	35	17	35	41	31	52
Morgan Creek	Middle	5,804	40	17	81	31	37	33
Airy Hill Creek	Langford	3,524	40	38	69	54	12	26
Andover Branch	Upper	26,372	40	29	91	38	34	10
Sandy Bottom Creek	Langford	2,382	41	50	99	43	9	3
Church Hill Branch	Southeast	7,966	42	100	13	12	14	72
Red Lion Branch	Upper	14,536	44	4	3	91	57	64
Radcliffe Creek	Middle	2,967	48	67	29	45	55	43
Rileys Mill Branch	Middle	2,972	50	92	22	34	22	79
Brices Mill Pond Creek	Langford	3,571	51	96	14	80	2	62
Johnny Powell Branch	Southeast	1,089	52	100	0	29	57	72
Granny Finley Branch	Southeast	5,195	53	76	38	68	8	74
Unicorn Branch	Upper	13,005	54	43	13	52	85	75
Browns Branch	Southeast	4,603	54	96	32	43	28	73
Island Creek Branch	Southeast	5,367	57	79	98	53	13	41
Mills Branch	Upper	5,712	57	90	95	65	10	27
Perkins Hill Branch	Middle	7,829	59	92	41	46	28	90
Foreman Branch	Upper	3,942	60	65	15	63	86	73
Cypress Branch	Upper	23,530	63	70	73	51	77	46
Old Mill Stream Branch	Corsica	7,580	65	100	17	78	42	88
Reed Creek	Lower	1,734	66	100	100	52	10	67
Urieville Lake Branch	Middle	5,429	69	100	49	45	87	63
Chesterville Branch	Upper	3,930	70	94	6	87	71	90
Rosin Creek	Middle	1,930	70	87	24	68	85	85
Three Bridges Branch	Corsica	5,202	70	100	54	79	30	88

GIS Land Use and Water Flow Analysis

Chesapeake Conservancy analyzed land use and water flow in the Chester watershed to predict the potential for pollution loading from any given area. They utilized high-resolution satellite imagery to map land use, the degree and type of vegetative cover within the watershed, and water flow paths across land, resulting in an analysis of the potential for water to be carrying pollutants. For example, a flow path across row crops is labeled with a high potential to be carrying pollutants, while a flow path through a grassland buffer is labeled with low potential.

While this mapping and data analysis is a predictor of the potential for a flow path to be carrying pollutants, the amount of actual pollution loading must be confirmed on the ground by reviewing land practices or conducting water quality testing. This GIS analysis enables us to strategically place restoration projects so they intercept water flow with high levels of pollutants in order to maximize project dollars and water quality impact.



Combining Water Quality Data with the GIS Analysis

We then conducted an in-depth study of each of the stream stations using the Water Quality Index, historic water quality data, aerial imagery, and GIS land use and water flow analysis (Appendix A).

For each site, the recent trend value was determined by looking at five years of water quality data (2010-2014). The impairments listed for each site were those with a Water Quality Index value of 39% or below. The narrative section includes information on the surrounding land use and potential pollution sources, derived from aerial imagery, GIS land use and water flow analysis provided by Chesapeake Conservancy, and discussions with CRA Agricultural Specialists and US Geological Survey scientists.

The result is a table that characterizes each stream station by three-year Water Quality Index, five-year water quality trend, watershed size, pollution complaints, pollutant impairments, and surrounding land use and potential pollution sources (Appendix A).

3.2 Developing the Priority Restoration Plan

The first step of creating the Priority Restoration Plan was to use the Watershed Assessment along with our local knowledge of the watershed to place the 27 streams into five priority groups. The additional criteria we used to refine our prioritization included local WIP goals, potential for restoration or outreach projects, potential for public involvement, level of visibility of a project, and opportunities for partnership.

The resulting table categorizes 27 streams into five priority groups: Priority Tier 1, 2, 3, 4, and 5 (Table 2). Table 2 includes information on location within the Chester watershed, stream basin size, three-year Water Quality Index, five-year water quality trend, pollution complaints, pollutant impairments, and our justification for that stream's priority placement.

For each stream basin in the top three priority tiers we developed potential restoration and outreach actions to improve water quality. Actions are tailored to the landowners and water quality impairments specific to that stream basin.

The result of these efforts is a one-page Priority Restoration Plan for each stream basin in the top three priority tiers. Each one-page plan states the stream basin's land use and known best management practices, describes the water quality impairments and potential pollution sources, and lists potential restoration and outreach actions that could be taken to improve water quality.

4.0 Watershed Assessment and Priority Restoration Plan

The Watershed Assessment and Priority Restoration Plan presents the current health of the Chester watershed and CRA's proposed restoration and outreach projects to improve water quality in the Chester River and its tributaries. The Assessment and Plan includes:

- 27 stream basins placed in five priority tiers (Table 2 and Figure 1). Stream basins are not prioritized *within* each tier; they are listed by their three-year Water Quality Index from lowest to highest score;
- A description of each of the six subwatersheds in the Chester as well as five-year water quality trend graphs for the stream basins in each subwatershed: Upper Chester River, Middle Chester River, Lower Chester River, Southeast Creeks, Corsica River, and Langford Bay;
- A description of the water quality parameters and physical characteristics of a stream basin that give us clues to potential pollution sources;
- A list of outreach activities to conduct across the entire Chester watershed, based on water quality issues observed throughout the watershed; and
- For each stream basin in the top three priority tiers, a one-page plan that identifies that basin's water quality pollutant issues, potential pollution sources, and potential restoration and outreach actions.

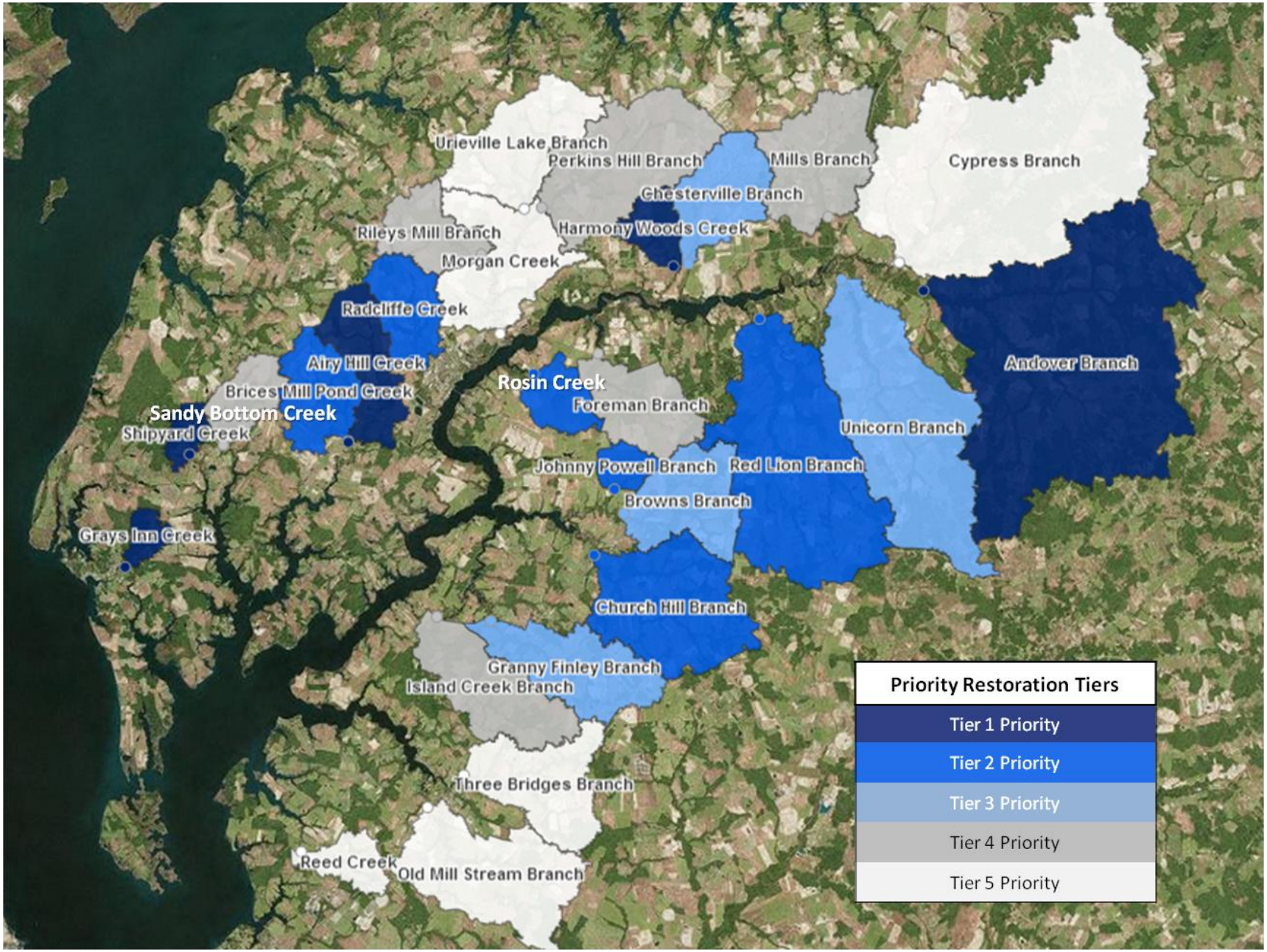
Table 2: Stream Station Priority Restoration Tiers

(Stations within each tier hold the same priority level; they are listed by their 3-yr WQI from lowest to highest score)

Tier	Station	Sub-watershed	Size (acres)	Tidal	3-yr WQI (%)	5-yr Trend	Pollution/ Complaints	Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
								DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
1	Grays Inn Creek	Lower	828	Partial	29	↔	Yes	9	97	12	20	8
1	Shipyard Creek	Langford	933	Partial	31	↔	No	24	98	26	2	6
1	Harmony Woods Creek	Upper	1,629	No	35	↓	No	17	35	41	31	52
1	Airy Hill Creek	Langford	3,524	Partial	40	↓	Yes	38	69	54	12	26
1	Andover Branch	Upper	26,372	No	40	↓	No	29	91	38	34	10
2	Church Hill Branch	Southeast	7,966	No	42	↔	No	100	13	12	14	72
2	Red Lion Branch	Upper	14,536	Yes	44	↓	No	4	3	91	57	64
2	Radcliffe Creek	Middle	2,967	No	48	↓	No	67	29	45	55	43
2	Brices Mill Pond Creek	Langford	3,571	Partial	51	↓	Yes	96	14	80	2	62
2	Johnny Powell Branch	Southeast	1,089	No	52	↓	Yes	100	0	29	57	72
2	Rosin Creek*	Middle	1,930	No	70	↓	Yes	87	24	68	85	85
3	Granny Finley Branch	Southeast	5,195	No	53	↓	No	76	38	68	8	74
3	Unicorn Branch	Upper	13,005	No	54	↔	No	43	13	52	85	75
3	Browns Branch	Southeast	4,603	No	54	↓	No	96	32	43	28	73
3	Chesterville Branch*	Upper	3,930	No	70	↓	No	94	6	87	71	90
4	Sandy Bottom Creek*	Langford	2,382	Partial	41	↔	No	50	99	43	9	3
4	Rileys Mill Branch*	Middle	2,972	No	50	↑	No	92	22	34	22	79
4	Island Creek Branch	Southeast	5,367	No	57	↑	No	79	98	53	13	41
4	Mills Branch	Upper	5,712	No	57	↑	No	90	95	65	10	27
4	Perkins Hill Branch	Middle	7,829	No	59	↔	No	92	41	46	28	90
4	Foreman Branch	Upper	3,942	No	60	↑	No	65	15	63	86	73
5	Morgan Creek*	Middle	5,804	Yes	40	↔	No	17	81	31	37	33
5	Cypress Branch	Upper	23,530	No	63	↔	No	70	73	51	77	46
5	Old Mill Stream Branch	Corsica	7,580	Partial	65	↑	No	100	17	78	42	88
5	Reed Creek	Lower	1,734	No	66	↑	No	100	100	52	10	67
5	Urieville Lake Branch	Middle	5,429	No	69	↑	No	100	49	45	87	63
5	Three Bridges Branch	Corsica	5,202	No	70	↑	No	100	54	79	30	88

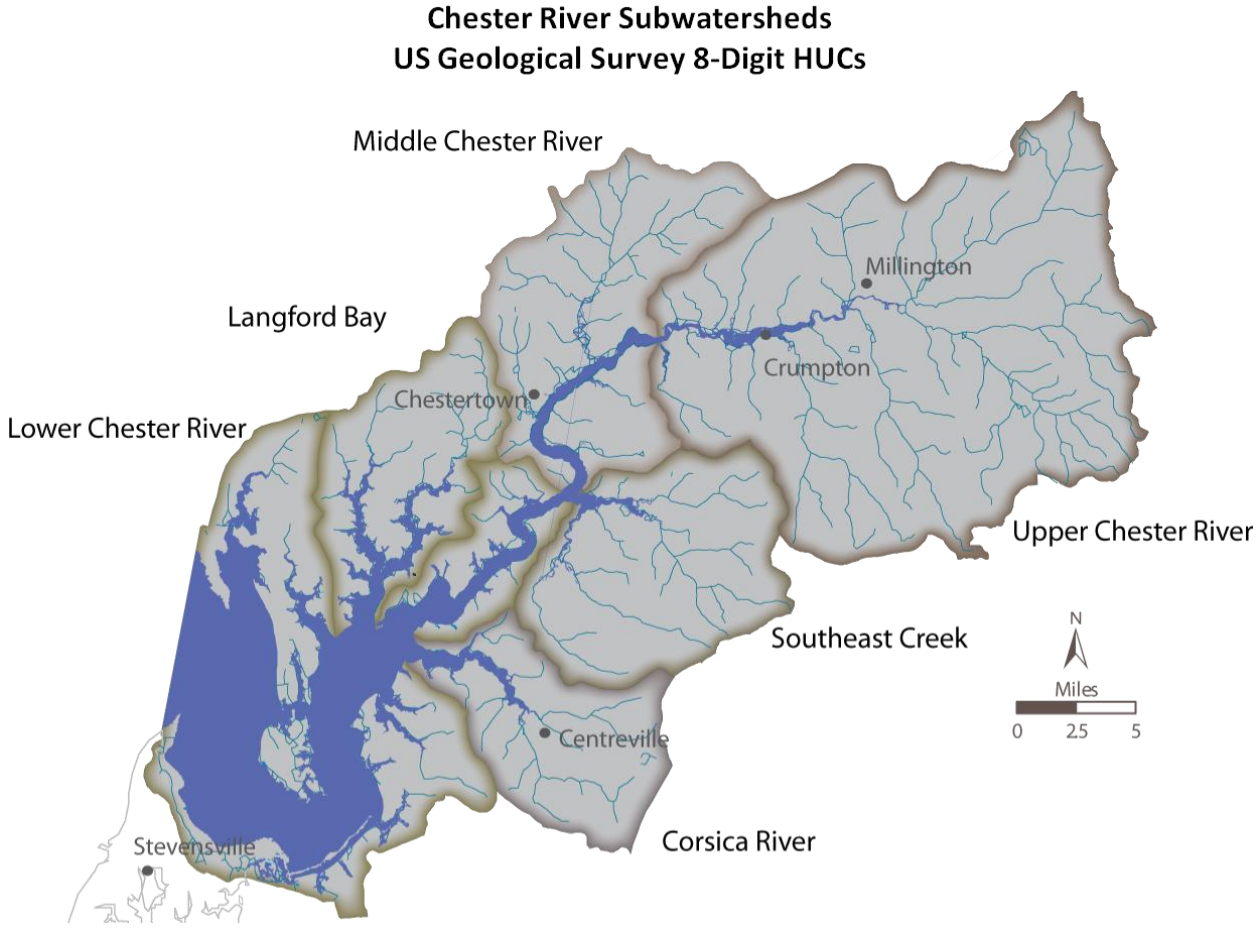
* Tier	Station	Justification for Priority Placement
2	Rosin Creek	Moved up to Tier 2; site has a negative trend and has experienced significant and increasing algae blooms in the past five years.
3	Chesterville Branch	Moved up to Tier 3; site has a significant negative trend with a very poor nitrate score. The site's small basin and few landowners could lead to increased potential for restoration projects.
4	Sandy Bottom Creek	Moved down to Tier 4; the site's location just downstream of a waterfall and mill pond could be the source of the poor phosphate and turbidity scores as the waterfall stirs up the legacy sediment in the stream.
4	Riley's Mill Branch	Moved down to Tier 4; the site has a positive trend, we've completed 2 projects in the watershed and are installing a third, and none of the water quality parameters are Severely Degraded.
5	Morgan Creek	Moved down to Tier 5; stream basin is very large and contains three other stations. We will focus on those stream basins.

Figure 1: Stream Station Priority Restoration Tiers



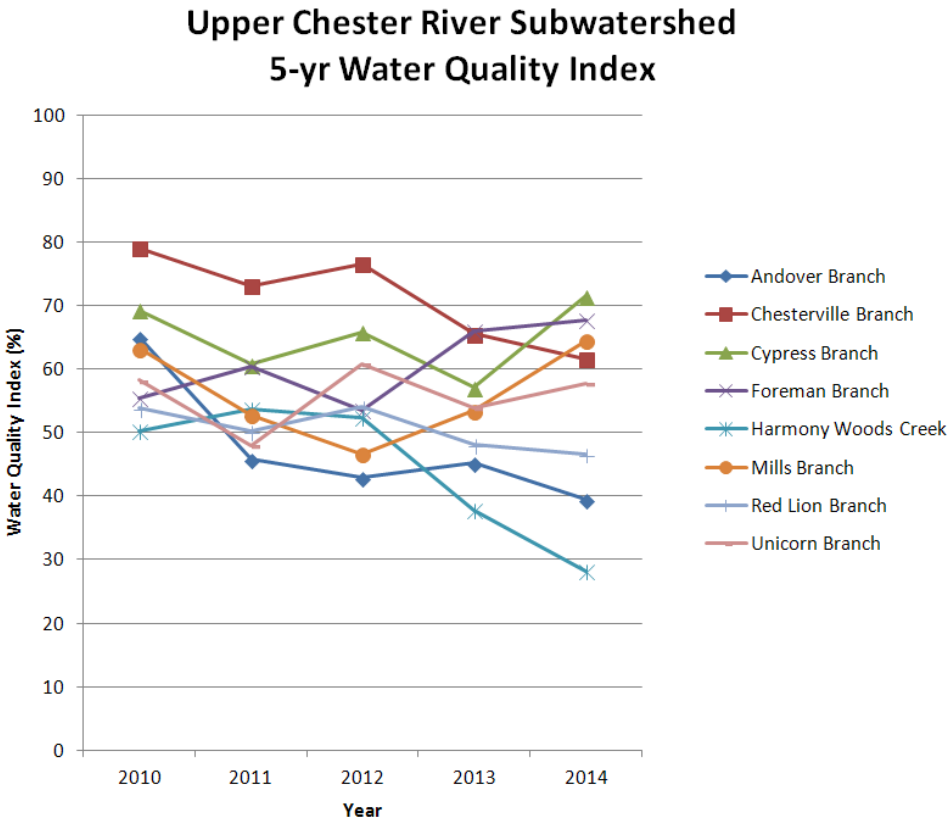
4.1 Subwatershed Characteristics

The Chester River is divided into six subwatersheds based on the US Geological Survey's hydrologic unit classification. The six subwatersheds are in the fourth level of classification and are identified by unique eight-digit hydrological unit codes (HUC). The six subwatersheds are: Upper Chester River (HUC 02130510), Middle Chester River (HUC 02130509), Southeast Creek (HUC 02130508), Corsica River (HUC 02130507), Langford Bay (HUC 02130506), and Lower Chester River (HUC 02130505).



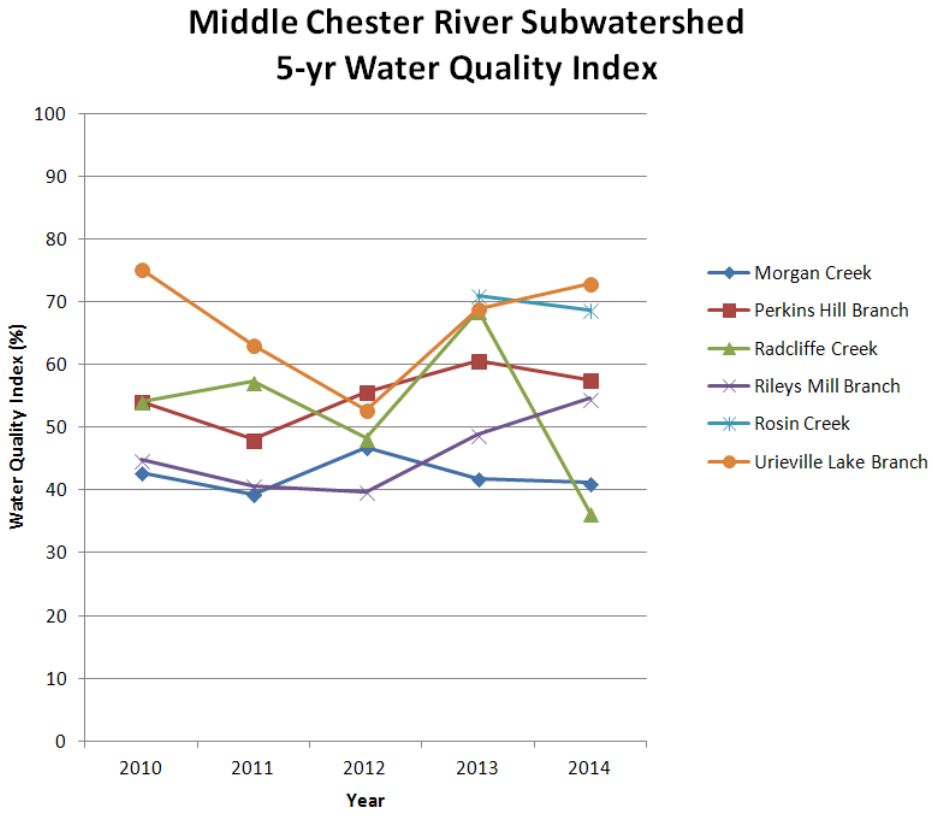
Upper Chester River Subwatershed

The Upper Chester River is our largest subwatershed and drains land in both Delaware and Maryland. Several of the stream basins in this subwatershed are large; we recommend conducting stream testing at additional sites within these basins in order to narrow potential pollution sources.



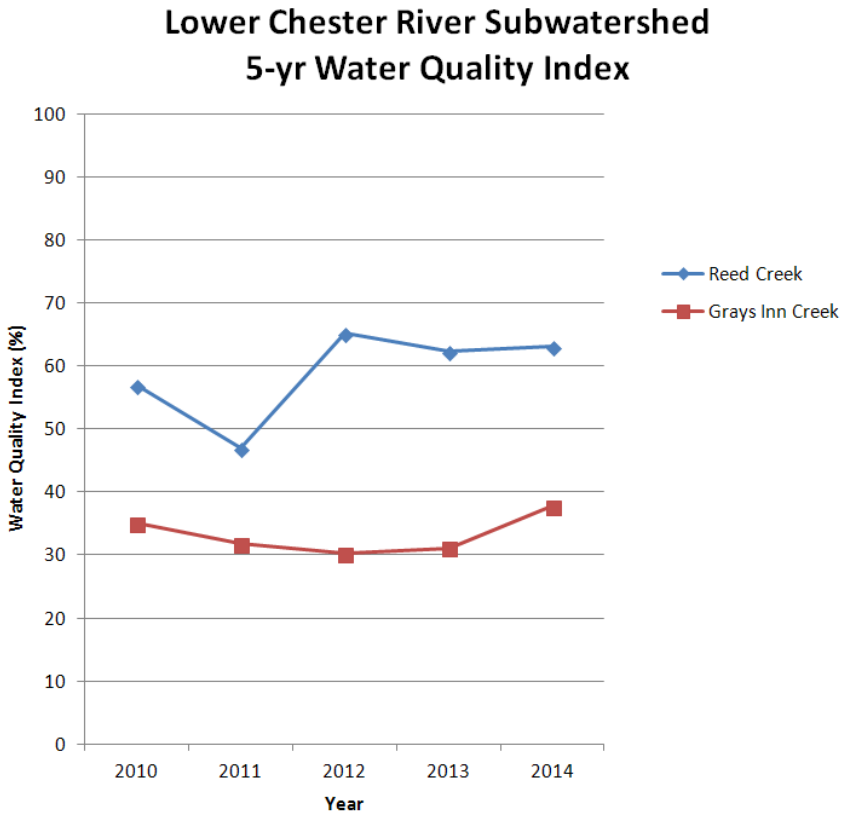
Middle Chester River Subwatershed

The Middle Chester River subwatershed is dominated by Morgan Creek; the station is fully tidal with a large upstream drainage that includes three other stations. We moved the Morgan Creek station to the lowest priority tier in order to focus on the three smaller stream basins.



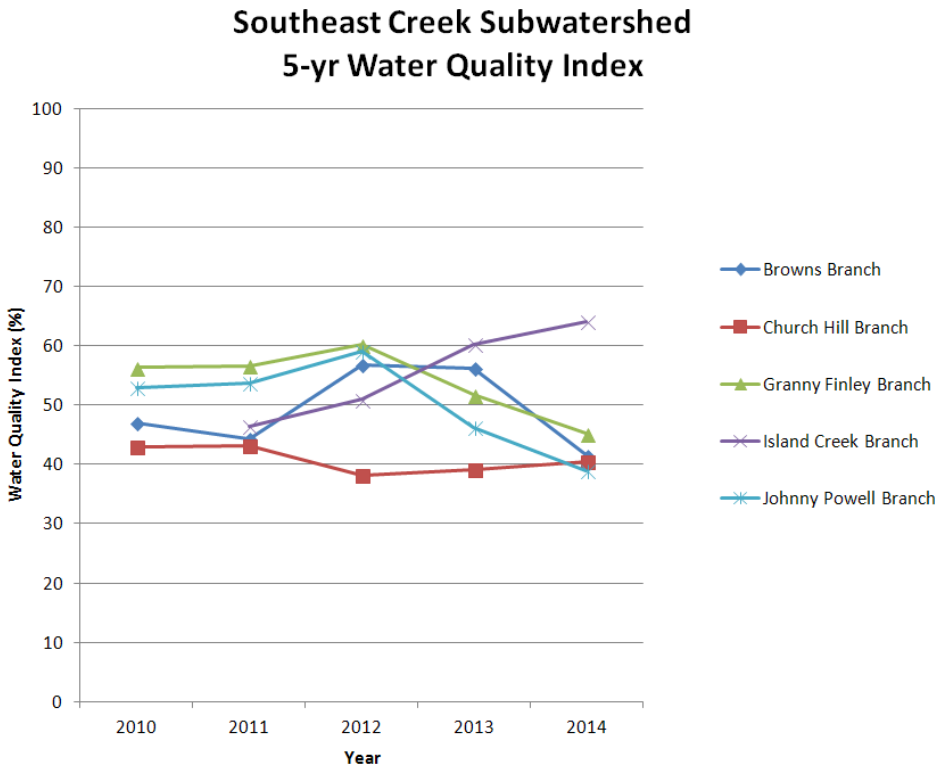
Lower Chester River Subwatershed

The Lower Chester River subwatershed contains two stream stations located on either side of the Chester: Gray's Inn Creek in Kent County, which has very poor water quality and is in Priority Tier 1, and Reed Creek in Queen Anne's County, which has good water quality and is in Priority Tier 5.



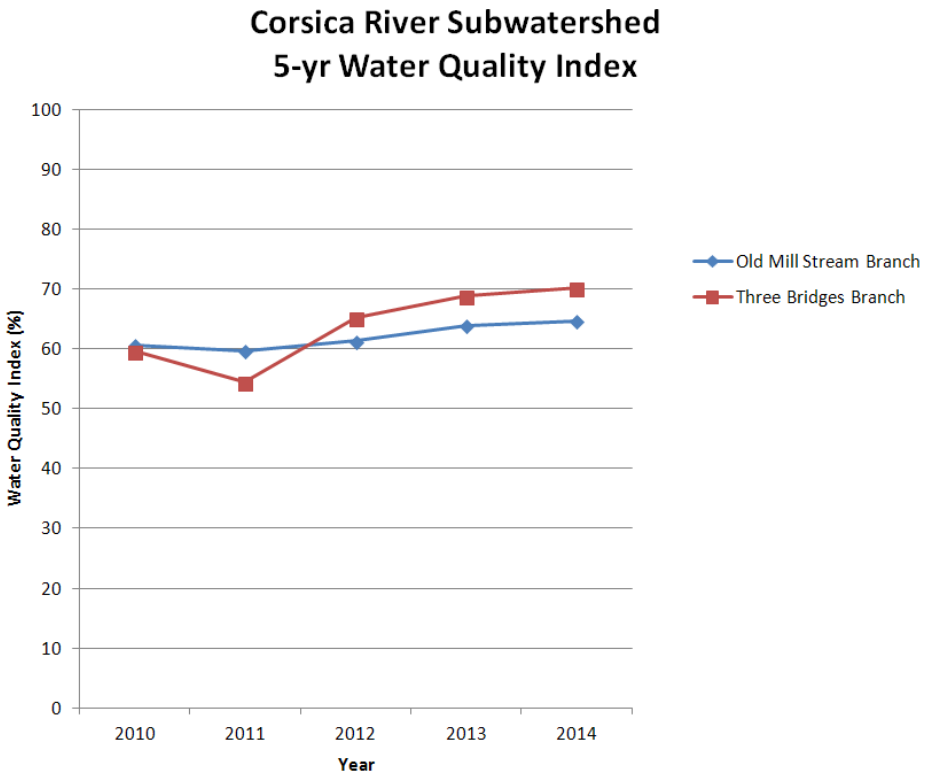
Southeast Creek Subwatershed

The Southeast Creek subwatershed has very sandy soils; we know from US Geological Survey studies that groundwater in this region carries high levels of legacy nitrates. This is reflected in our stream testing; all sites exhibit high nitrate levels. The exception is Island Creek Branch, which has a stream basin that is very wet and wooded and has not experienced the same agricultural pressure as the other creeks have. Island Creek Branch is in Priority Tier 4, while the other four branches are in Priority Tier 2 or Tier 3.



Corsica River Subwatershed

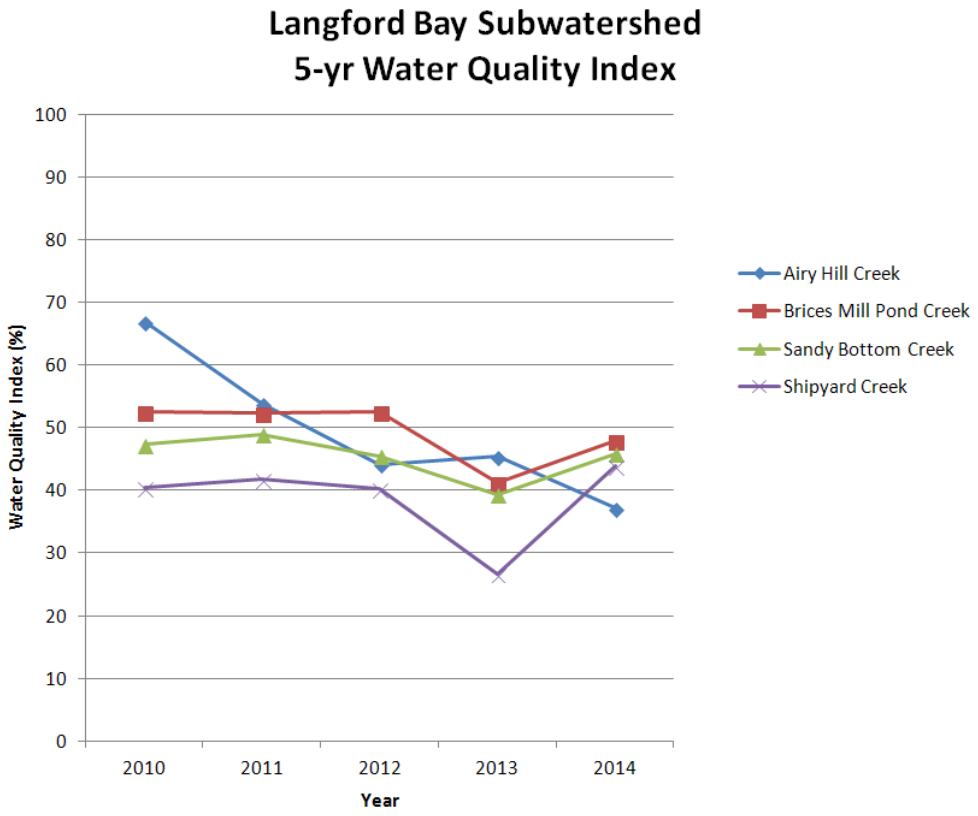
The Corsica Creeks subwatershed has some of the healthiest streams in the Chester, which could be partly due to the high number of restoration projects completed in Centreville. Both Old Mill Stream Branch and Three Bridges Branch are in Priority Tier 5.



Langford Bay Subwatershed

The four stream stations in the Langford Bay subwatershed all exhibit poor water quality and neutral or declining five-year trends. Airy Hill and Shipyard Creek are in Priority Tier 1 and Brices Mill Pond Creek is in Priority Tier 2. Sandy Bottom Creek exhibits very poor water quality but we moved it to Priority Tier 4 for a number of reasons:

- The station lies just downstream of a waterfall; the waterfall could be stirring up legacy sediments in the stream and causing the very poor phosphate and turbidity scores;
- The station lies just downstream of a large mill pond which could be storing legacy sediments and also contributing to the very poor phosphate and turbidity scores;
- The stream basin drains agricultural and wooded land, but with the stream itself being highly wooded with thick buffers we see fewer opportunities for restoration projects.



4.2 Water Quality and Stream Characteristics: Clues to Pollution Sources

The levels of the parameters we test for – dissolved oxygen, nitrate, ammonia, phosphate, and turbidity – and the physical characteristics of each stream site are related, and certain combinations can give us clues as to where pollution could be coming from.

Nutrients

Nitrate + Phosphate: High levels of nitrate and phosphate at a stream station are indicative of fertilizer pollution from row crop agriculture.

Phosphate + Turbidity: High levels of phosphate and turbidity are indicative of sediment runoff. Phosphate is not as water-soluble as nitrate; instead, it binds to soil particles and travels with sediment runoff into streams. Many of our sites do not show current, extensive erosion issues and we hypothesize legacy sediments to be the cause of the pollution.

Ammonia: High ammonia levels are indicative of an animal operation. Ammonia applied to farm fields converts quickly to nitrate and therefore our water quality testing catches this type of pollution in its nitrate form. However, animal waste tends to occur in higher concentrations, inhibiting nitrification of ammonia and resulting in higher levels of ammonia in nearby streams. If there isn't an animal operation in the stream basin, the ammonia is probably coming from a non-agricultural source.

Soils

Soils in Queen Anne's County are mostly sandy and porous; nitrogen applied to fields moves quickly through the soil into the groundwater. US Geological Survey research has shown high levels of legacy nitrogen in groundwater and interflow in areas of Queen Anne's County, especially in the Southeast Creeks subwatershed. Therefore, some sites with high levels of nitrates might be experiencing this introduction of legacy nitrogen.

Areas that are very wet, with wetlands and clay soils dominating, create the anaerobic conditions needed for denitrification. Sites with high levels of nitrates but normal levels of the other parameters may need more wetland areas in order for the nitrate in the water and soil to be converted. Alternatively, some sites with terrible water quality overall have very low levels of nitrates, indicating the presence of wet areas that are getting rid of the excess nitrogen in runoff.

Tides

Some of the stream stations are tidally influenced; the water quality at these sites could be influenced by the downstream watershed as well as the upstream watershed, making it more difficult to hone in on potential pollution sources. In addition, the flowing water found at non-tidal stations tends to produce high dissolved oxygen scores. Alternatively, tidally-influenced stations tend to have more stagnant water, leading to lower dissolved oxygen scores. For tidally-influenced stations, it would be beneficial to locate a test site farther upstream where the stream is no longer tidal.

4.3 Watershed-Wide Community Outreach

Based on water quality issues observed throughout the watershed, we identified several outreach activities to conduct across the entire Chester watershed. The efforts described below seek to engage everyone who enjoys the Chester in the effort to achieve a healthier river.

Farmer Forums

With 65% of the Chester watershed's land use in row crop agriculture, conducting outreach to the farming community will be essential to improving water quality. CRA will continue to engage farmers, landowners, agricultural industries, Soil Conservation District staff, and Natural Resources Conservation Service staff to encourage implementation of ag BMPs. Through events like our annual Farmers Breakfast and annual Food and Clean Water Panel, we will advocate for increased efficiency in nitrogen application, uniform use of cover crops, increased buffer widths, and wetland restorations.

River-Friendly Yard Campaign

The Watershed Analysis identifies several stream stations potentially impacted by the large residential developments in their drainage basins. In addition, the Chester waterfront along many portions of the river and its tributaries are lined with residential homes. Therefore, there is high potential across the watershed for public engagement focused around developing river-friendly yards. For this reason, one of the watershed-wide outreach actions we have identified in our Priority Restoration Plan is a River-Friendly Yard Campaign that will encourage homeowners to reduce their lawn fertilizer use, replace turf grass with native plants, and increase buffers.

State of the Chester Annual Event

The State of the Chester will be an annual, spring event where we release the Chester River Report Card, discuss the health of the Chester and its tributaries, and discuss ongoing restoration and outreach projects. The goal is to bring together CRA members, volunteers, and the general public to increase awareness of water quality issues and projects in our watershed.

Chester River Report Card

The Report Card is an annual, spring publication that documents the health of the river and its tributaries from our water quality monitoring efforts. Through this publication, constituents learn about the water quality in the stream near them as well as the overall health of the Chester River.

River Watch Website

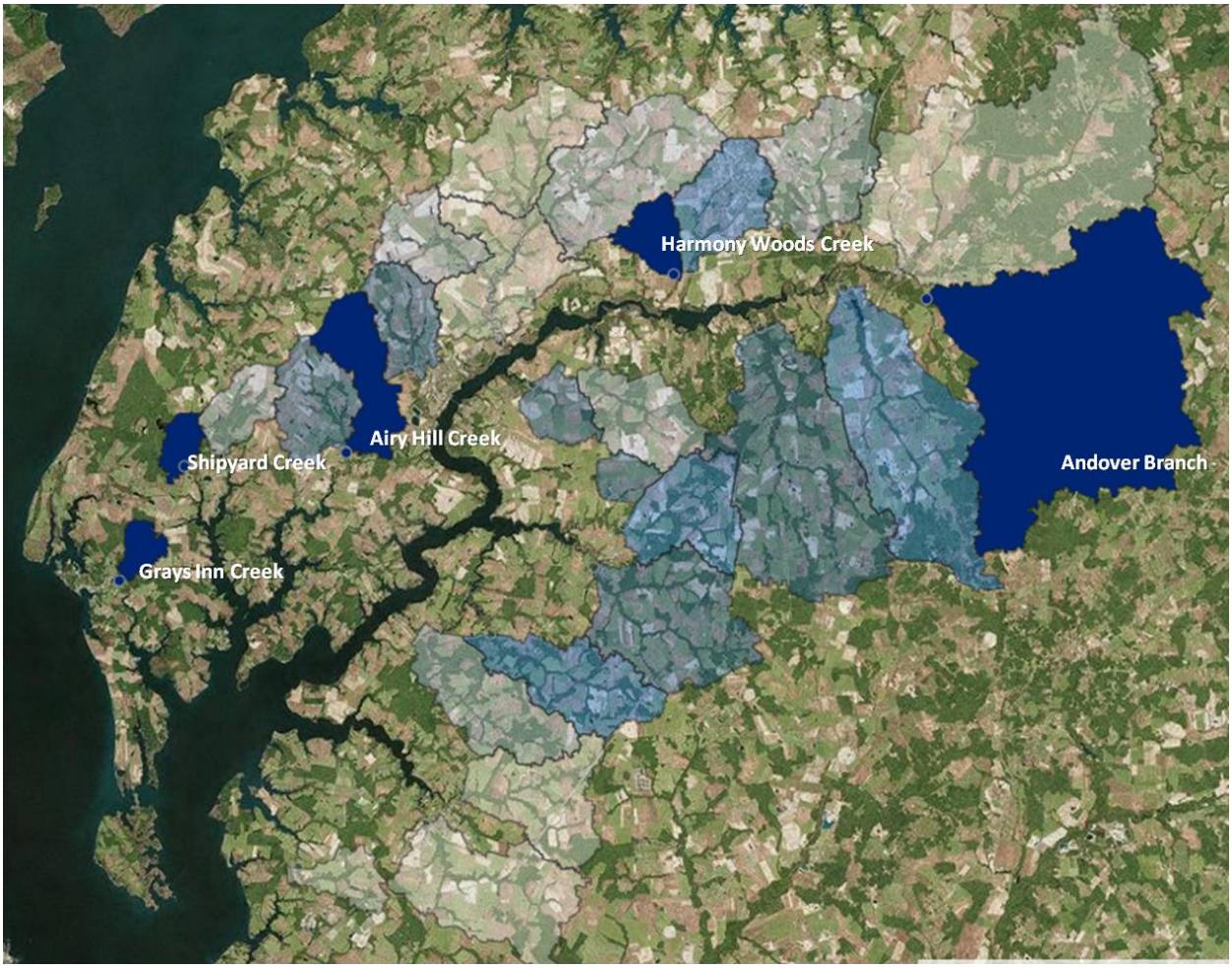
The River Watch website will be an interactive, map-based site that houses our water quality monitoring information and increases the public's access to our extensive data. The site will display updated and historical data from our 21 main stem stations, 27 stream stations, and 13 bacteria stations.

Development of this website was partially in response to our Chester Testers and others in the community wishing to be able to look up, in real-time, the health of their stretch of the river or tributary. We will also use this tool when reaching out to specific landowners to encourage practices identified in our Priority Restoration Plan. Increasing the public's awareness of the water quality problems in their own backyards is critical to inspiring lasting behavior changes; River Watch will be a tool in this endeavor.

4.4 Priority Restoration Plans for Top Three Tier Stream Basins

Tier 1 Stream Basins

Tier	Station	Sub-watershed	Size (acres)	Tidal	3-yr WQI (%)	5-yr Trend	Pollution/ Complaints	Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
								DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
1	Grays Inn Creek	Lower	828	Partial	29	↔	Yes	9	97	12	20	8
1	Shipyard Creek	Langford	933	Partial	31	↔	No	24	98	26	2	6
1	Harmony Woods Creek	Upper	1,629	No	35	↓	No	17	35	41	31	52
1	Airy Hill Creek	Langford	3,524	Partial	40	↓	Yes	38	69	54	12	26
1	Andover Branch	Upper	26,372	No	40	↓	No	29	91	38	34	10



Grays Inn Creek

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
1	Grays Inn Creek	Lower	828	Partial		29	↔	Yes		9	97	12	20	8

The Grays Inn Creek stream station consistently exhibited very poor water quality from 2010-2014. The station is tidally-influenced – water at the site is occasionally influenced by high tides. This is the smallest Chester Tester stream basin in the Chester Watershed, draining a portion of the Town of Rock Hall as well as woodlands, some low density residential areas, and some agricultural land.

Hypothesis

Poor dissolved oxygen scores are consistent with a tidally-influenced station. Very poor phosphate and turbidity scores could indicate a legacy sediment issue at the site and/or polluted runoff from the town.

Action

Due to this stream's location in Rock Hall, there is high potential for project visibility and public engagement in restoration efforts. Our first action will be to approach the Town Manager, Mayor, and Council to share the results of our water quality analysis and obtain their first-hand local knowledge of the town and potential sources of pollution. This information gathered will determine whether we approach individual homeowners and businesses or host a public town meeting to gather more input.

The results of this on-the-ground information gathering will lead to a combination of restoration and outreach projects: site-specific restoration projects, outreach to specific home or business-owners, and/or a general awareness campaign to the Town of Rock Hall.

Shipyard Creek

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
1	Shipyard Creek	Langford	933	Partial		31	↔	No		24	98	26	2	6

The Shipyard Creek stream station has very poor water quality with a neutral five-year trend. The station is tidally-influenced – water at the site is occasionally influenced by high tides. This stream basin is one of our smallest and drains land owned almost exclusively by one sporting farm. The land is largely wooded, with some agricultural fields and product test plots. All the agricultural fields are planted with cover crops. Land downstream of the station exhibits extensive grassed and treed buffers and grassed waterways.

Hypothesis

Very poor turbidity and phosphate scores are indicative of a sediment issue; the fact that the stream station is tidally-influenced suggests that these poor scores could be a result of legacy sediments washing back and forth in the stream. Poor ammonia scores are indicative of an animal operation nearby but there don't appear to be any in the stream basin except birds raised by the sporting farm. Poor dissolved oxygen scores are consistent with a tidally-influenced station. Due to the stream basin's largely wooded land use, it is possible the poor water quality at this site is primarily due to legacy sediment and groundwater pollution.

Action

Our first action will be to approach the owners and managers of the sporting farm to share the results of our water quality analysis and offer to collaborate to identify potential sources of pollution and potential restoration projects.

Harmony Woods Creek

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
1	Harmony Woods Creek	Upper	1,629	No		35	↓	No		17	35	41	31	52

The Harmony Woods Creek stream station has very poor water quality with a significant, negative five-year trend. The stream station experienced a significant drop in water quality occurring from 2012-2014. This is one of our smallest stream basins and is comprised of agricultural land, one dairy farm, and one poultry farm. Farms in the basin exhibit best management practices such as grassed waterways, significant CREP buffers, and cover crops. One farm in the stream basin uses manure as a fertilizer. Some of the lands are steep and therefore erodible. The majority of the water tested at the stream station passes through a pond.

Hypothesis

Extensive buffers and grassed waterways usually result in improved nitrate scores, while this site has poor nitrate scores. Poor nitrate, ammonia, and phosphate scores could indicate an animal operation nearby or the spreading of manure for fertilizer.

Action

Since nitrate, phosphate, and ammonia scores are all poor at this station, our first step will be to review practices on the dairy, poultry, and other farms in the basin.

Taking samples at an additional site could help narrow potential pollution sources. A potential site for additional testing is where Harmony Woods Creek passes under Morgnec Road, between Kennedyville Road to the west and Route 298 to the east. We will also approach the owners of the pond through which the majority of the stream flows to ask permission to test water quality in the pond. Results from these additional sampling will help determine where to focus restoration and outreach efforts.

Airy Hill Creek

Tier	Station	Sub-watershed	Size (acres)	Tidal		WQI (%)	Trend	Complaints		DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
1	Airy Hill Creek	Langford	3,524	Partial		40	↓	Yes		38	69	54	12	26

The Airy Hill Creek stream station has very poor water quality with a significant, negative trend that dropped consistently from 2010-2014. The station site is tidally-influenced. The stream basin lies on the outskirts of Chestertown and is one of the few Chester Tester stream basins with multiple large-lot developments. Farms in the basin exhibit best management practices such as grassed waterways and cover crops.

Hypothesis

Good nitrate scores are indicative of functioning grassed waterways and cover crops. Poor turbidity and phosphate scores indicate a sediment issue. Poor dissolved oxygen scores are consistent with a tidally-influenced station. We hypothesize the water quality at this site could be partially influenced by water quality downstream and by sediment pollution, either from erosion or legacy sediment in the stream.

Action

Our first action will be to take samples at additional sites to narrow potential pollution sources. A potential site for additional testing is where Airy Hill Creek passes under Route 20 and Brices Mill Road; this site would cut the original stream basin in half. Results from additional sampling will determine where to focus restoration and outreach efforts.

Additionally, we will conduct targeted outreach in the two large-lot developments in this stream basin, Orchard Hill and Fannell's Meadow. Outreach will focus on lawn fertilizer and Bay-friendly yard practices and will include an introductory flyer in mailboxes, searching our database for members who live in those developments, getting in touch with homeowner's associations if they have them, and targeting these neighborhoods for our lawn fertilizer workshops.

Andover Branch

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
1	Andover Branch	Upper	26,372	No		40	↓	No		29	91	38	34	10

The Andover Branch stream station has very poor water quality with a significant, negative five-year trend. This is the largest Chester Tester stream basin and is comprised of agricultural land, woods, some mid-density residential areas, some poultry farms, and one nursery. Most of the suburban developments and poultry farms are in Delaware.

Hypothesis

Andover Branch has very poor turbidity and poor ammonia, phosphate, and dissolved oxygen. In order to hypothesize potential pollution sources we will need to test at additional sites.

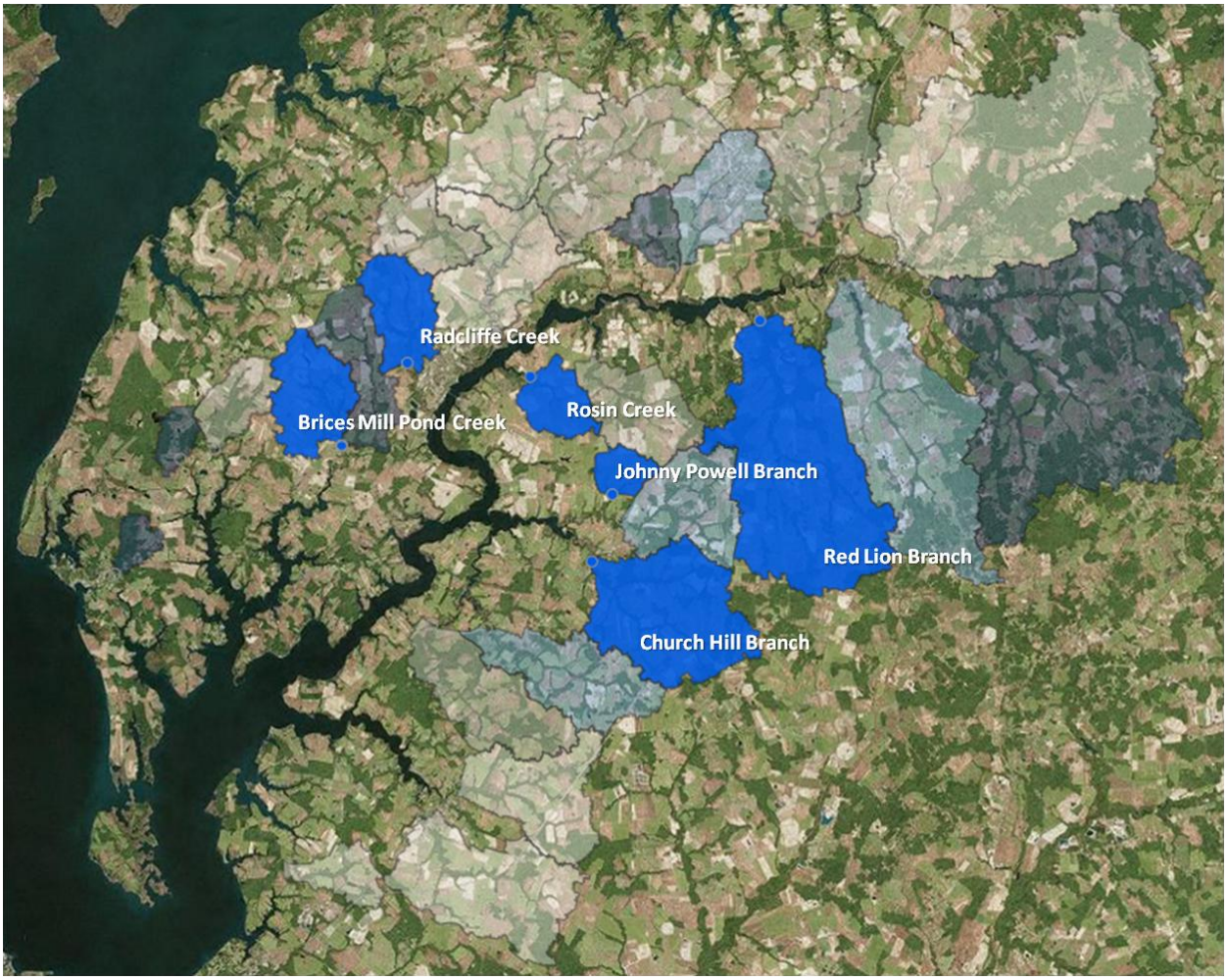
Action

Since this stream basin is so large, our first action will be to take samples at additional sites to narrow potential pollution sources. A potential site for additional testing is where Andover Branch passes under Route 300, between Everett Road to the west and Busic Church Road to the east; testing at this site would capture water quality from a smaller stream basin that also includes the one nursery.

Another potential site is where Andover Branch passes under Sewell Branch Road, between Millington Road to the north and Downs Chapel Road to the south. A third potential site for additional testing is where Andover Branch passes under Stultown Road, between Felton School Road to the east and Puddle Duck Lane to the north (there are two branches that pass under the road here; we would test the branch to the east). Results from additional sampling will determine where to focus restoration and outreach efforts.

Tier 2 Stream Basins

Tier	Station	Sub-watershed	Size (acres)	Tidal	3-yr WQI (%)	5-yr Trend	Pollution/ Complaints	Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
								DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
2	Church Hill Branch	Southeast	7,966	No	42	↔	No	100	13	12	14	72
2	Red Lion Branch	Upper	14,536	Yes	44	↓	No	4	3	91	57	64
2	Radcliffe Creek	Middle	2,967	No	48	↓	No	67	29	45	55	43
2	Brices Mill Pond Creek	Langford	3,571	Partial	51	↓	Yes	96	14	80	2	62
2	Johnny Powell Branch	Southeast	1,089	No	52	↓	Yes	100	0	29	57	72
2	Rosin Creek*	Middle	1,930	No	70	↓	Yes	87	24	68	85	85



Church Hill Branch

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
2	Church Hill Branch	Southeast	7,966	No		42	↔	No		100	13	12	14	72

The Church Hill Branch stream station is among our worst streams, with a three-year Water Quality Index of 42%. The five-year trend is neutral, but water quality monitoring consistently shows high levels of all nutrients – nitrates, ammonia, and phosphates. The relatively large watershed includes approximately half of downtown Church Hill (a small town), a few subdivisions, several horse farms, a nursery, a landfill, and significant row crop agriculture. In general, the streams are well forested.

Hypothesis

The high nitrate levels in Church Hill Branch are common in this area of Queen Anne's County with sandy soils. Elevated nitrates are likely due to agricultural activity and legacy nitrates entering the stream through groundwater. Ammonia could be associated with fertilizer inputs or horse farms. High levels of phosphates are indicative of a sediment problem, although our sampling does not indicate a turbidity issue.

Action

Church Hill Branch's large watershed is accessible in many areas via public roadways. Due to the varied land use, additional sampling throughout the watershed will allow potential sources of pollution to be isolated and identified. Any direct source of pollution identified will be addressed in an appropriate manner. Additionally, we will continue outreach to farmers to enhance buffer areas and plant cover crops, and we will conduct outreach to homeowners regarding river-friendly yard practices.

Red Lion Branch

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
2	Red Lion Branch	Upper	14,536	Yes		44	↓	No		4	3	91	57	64

The Red Lion Branch stream station has poor water quality and a moderate, negative five-year trend. The station is tidally-influenced. This is one of the largest stream basins in the Chester watershed and is comprised primarily of agricultural land with some poultry houses, woodlands, low-density residential areas, and one nursery. The stream basin also includes the Sudlersville/Barclay wastewater treatment plant, which was upgraded in 2015. Participation in the cover crop program in this basin is not as high as in other basins.

Hypothesis

Poor dissolved oxygen scores are consistent with a tidally-influenced station. Poor nitrate scores could be influenced by the tide, a result of legacy nitrates in groundwater seeping through the sandy soils of the area, a result of fertilizers applied at the nursery, or stem from effluent from the wastewater treatment plant before it was updated.

Action

Taking samples at additional sites will be a necessary action in order to narrow potential pollution sources in this large stream basin. A potential site for additional testing is where Red Lion Branch passes under Sudlersville Road and Benton Corners Road; this site would cut the original stream basin in half. Another potential site for additional testing is where a branch passes under Coleman Road by Route 301; this site would capture water coming from the one nursery in the stream basin. Results from additional sampling will determine where to focus restoration and outreach efforts.

Additionally, increased cover crop participation would help reduce nitrate pollution to surface and shallow groundwater. Therefore, we will increase outreach to farmers in this stream basin to encourage participation in this program.

Radcliffe Creek

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
2	Radcliffe Creek	Middle	2,967	No		48	↓	No		67	29	45	55	43

The Radcliffe Creek stream station has poor water quality with a moderate, negative five-year trend. Water quality improved from 2012 to 2013 and then declined significantly from 2013 to 2014. The stream basin drains a large portion of Chestertown and includes two large shopping centers, several suburban developments, and part of Washington College. A series of step pools were completed in mid-2014 to filter stormwater from the two shopping centers; the step pools are located upstream of the Radcliffe Creek stream station. The developed area covers approximately 1/3 of the land area, with the remaining area being primarily agricultural land and a few scattered industrial sites.

Hypothesis

Radcliffe Creek's water quality is poor across the board. This is likely due to the development density and large swaths of impervious area. Other than the step-pools constructed in 2014, there is little to no stormwater management. The upstream agricultural area also likely contributes to the poor water quality.

Action

Due to this stream's location in Chestertown, there is high potential for project visibility and public engagement in restoration efforts. Targeted outreach will include increasing lawn fertilizer awareness in neighborhoods, approaching Washington College to reduce lawn fertilizer and partner on filtration restoration projects, and presenting to the town councilmen on the issue and potential projects. Additionally, we will conduct outreach with farmers in the agricultural area of the watershed to enhance stream buffers and plant cover crops.

Brices Mill Pond Creek

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
2	Brices Mill Pond Creek	Langford	3,571	Partial		51	↓	Yes		96	14	80	2	62

Brices Mill Pond Creek has very poor nitrate and phosphate scores, with a significant, negative five-year trend. The sample station is influenced by high tides on a regular basis. The Brices Mill Pond Creek stream basin is primarily row crop agriculture with some low density housing. There is also dairy farm and at least one large horse farm. The historic "mill pond" is immediately upstream of the sample station. The mill pond is located on private property, but analysis of aerial imagery and conversations with local landowners indicate that the mill pond is nearly 100% filled in. In the summer of 2015, we received a citizen complaint regarding algae blooms in the headwaters of the east fork of Langford Bay, which is the receiving water body of Brices Mill Pond Creek.

Hypothesis

High nitrate levels are likely associated with current agricultural practices and potentially with legacy nitrates in the groundwater. The poor phosphate score is indicative of a sediment issue. Although there are stream buffers along the main stem of the creek, there are many large farm fields (100+ acres) with no evident forest or grass buffers.

Action

There are several publically accessible sampling sites throughout the Brices Mill Pond Creek watershed. Additional sampling at these sites could help identify pollution sources. Any identified sources will be addressed appropriately. Extensive buffers, grassed waterways, and cover crops all contribute to nitrogen uptake and reduce erosion in agricultural fields; we propose working with landowners and the Kent County Soil Conservation District to install more agricultural BMPs on the farmland.

Johnny Powell Branch

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
2	Johnny Powell Branch	Southeast	1,089	No		52	↓	Yes		100	0	29	57	72

The Johnny Powell Branch stream station exhibits poor water quality with a significant, negative five-year trend. A tributary to Southeast Creek, the stream basin is one of the smallest in the Chester watershed and drains primarily agricultural land in addition to a small nursery and some medium-density residential land. The agricultural land exhibits a small amount of woods, minimal grassed waterways, wetlands, buffers, or cover crops. There is evidence of extensive erosion in some of the fields and along the banks of the stormwater ponds. We have received citizen complaints of severe sedimentation after rain events at the stream station site.

Hypothesis

The Johnny Powell stream station is severely degraded for nitrates. The stream's location in the Southeast Creeks subwatershed indicates that some of the high nitrate levels could be a result of legacy nitrates in the groundwater moving into the stream. However, the general absence of cover crops and grassed waterways on the agricultural land could also be contributing to the high nitrate levels found at the station. In addition, we hypothesize the erosion visible on the fields and along the stormwater ponds to be causing the sedimentation downstream.

Action

Extensive buffers, grassed waterways, and cover crops all contribute to nitrogen uptake and reduce erosion in agricultural fields. We propose working with the landowner and the Queen Anne's County Soil Conservation District to install more agricultural BMPs on the farmland.

Rosin Creek

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
2	Rosin Creek*	Middle	1,930	No		70	↓	Yes		87	24	68	85	85

The Rosin Creek stream station is one of the healthiest based on its three-year Water Quality Index value of 70% (Table 1). However, the site has a negative water quality trend and the tidal portion of the creek has been experiencing five years of significant algae blooms every summer. The Chester River Association has received multiple citizen complaints about these algae blooms. The stream basin, one of our smallest, drains agricultural fields, a horse farm, and a portion of a small development. Much of the agricultural land is managed with multiple best management practices.

The creek lies on the outskirts of Chestertown on the Queen Anne's County side. The tidal portion is very small and shallow, surrounded by high density development with a neighborhood association on one side and a socioeconomically diverse residential community on the other. Initial conversations with residents show high interest in a meeting to discuss the problem and potential solutions.

For these reasons – persistent algae blooms in addition to potential community involvement – we increased the site's priority level to Tier 2.

Hypothesis

Nitrate is the only parameter at this site with poor scores. Considering the agricultural best management practices in use in the stream basin, we hypothesize that the poor nitrate scores are a result of the legacy nitrates moving through groundwater and entering the stream. This is consistent with streams in the sandy soils of the Southeast Creeks and northern Queen Anne's County geography.

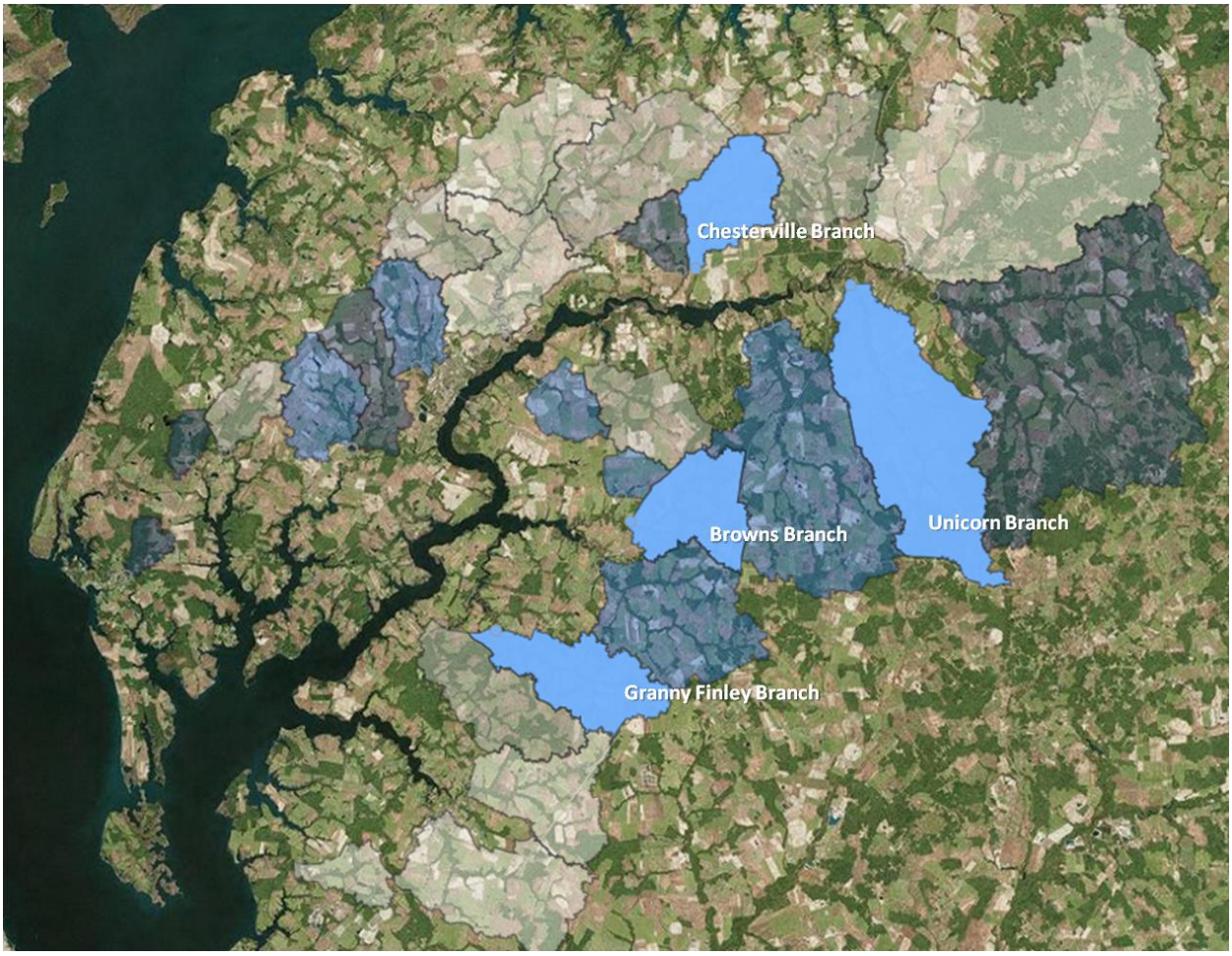
Action

Due to this stream's location, there is high potential for project visibility and public engagement in restoration efforts. Our first action is to reach out to surrounding homeowners and homeowner groups to conduct a targeted outreach campaign on lawn fertilizer use and septic system upgrades.

There is potential for a restoration project where the creek turns tidal; the land on one side of the stream is a public park owned by Queen Anne's County and the land on the other side of the stream is owned by the homeowner's association. We will reach out to these entities to assess next steps.

Tier 3 Stream Basins

Tier	Station	Sub-watershed	Size (acres)	Tidal	3-yr WQI (%)	5-yr Trend	Pollution/ Complaints	Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
								DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
3	Granny Finley Branch	Southeast	5,195	No	53	↓	No	76	38	68	8	74
3	Unicorn Branch	Upper	13,005	No	54	↔	No	43	13	52	85	75
3	Browns Branch	Southeast	4,603	No	54	↓	No	96	32	43	28	73
3	Chesterville Branch*	Upper	3,930	No	70	↓	No	94	6	87	71	90



Granny Finley Branch

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
3	Granny Finley Branch	Southeast	5,195	No		53	↓	No		76	38	68	8	74

Granny Finley Branch has a low nitrate score, a very low phosphate score, and a negative five-year trend. The watershed land use is primarily row crop agriculture with generally well-buffered streams and significant forests. There are many wet areas within this watershed and many farmed wetlands.

Hypothesis

We hypothesize that the poor nitrate scores are a result of the legacy nitrates moving through groundwater and interflow and entering the stream. This is consistent with streams in the sandy soils of the Southeast Creeks and northern Queen Anne's County geography. High phosphate levels are generally indicative of a sediment issue; however, turbidity at this site is relatively low. The low turbidity and well-forested buffers are not typical of a stream with a sediment issue.

Action

Further sampling of the watershed may help identify a specific phosphate sources. The wet geography of the Granny Finley watershed provides an excellent potential for wetland creation and restoration projects, which reduce nutrient and sediment pollution. Extensive buffers, grassed waterways, and cover crops all contribute to nitrogen uptake and reduce erosion in agricultural fields. Although Granny Finley Branch has adequate buffers, we propose working with landowners and the Queen Anne's County Soil Conservation District to install more agricultural BMPs on the farmland.

Unicorn Branch

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
3	Unicorn Branch	Upper	13,005	No		54	↔	No		43	13	52	85	75

Unicorn Branch has overall moderate water quality, with moderate dissolved oxygen and ammonia scores and a very poor nitrate score. The land use is primarily row crop agriculture. Just upstream of the sample station lies a man-made pond and fish hatchery. The pond recently had a fish ladder installed. The watershed also includes a large industrial lumber mill, a nursery, at least one horse farm, and several chicken houses. There is a mix of well-buffered streams and open fields.

Hypothesis

Poor dissolved oxygen scores could be associated with algae blooms and excess nutrients from the pond and fish hatchery. Poor nitrate scores are likely a result of legacy nitrates in groundwater seeping through the sandy soils of the area or as a result of fertilizers applied for agricultural purposes. The pond upstream of the sample station could allow sediment and phosphorus to settle out, resulting in the relatively good scores observed for those parameters.

Action

We will investigate the fish hatchery to understand its operation and what impacts it may have on water quality. Additional water quality testing upstream of the pond will help narrow potential pollution sources. A potential site for additional testing is where Unicorn Branch crosses under Hackett Corner Road, between Glanding Road to the east and Millington Road to the west; this site would allow us to assess Unicorn Branch water quality uninfluenced by the fish hatchery or pond.

Extensive buffers, grassed waterways, and cover crops all contribute to nitrogen uptake and reduce erosion in agricultural fields. We propose working with landowners and the Queen Anne's County Soil Conservation District to install more agricultural BMPs on the farmland. We will also investigate the lumber mill, chicken houses, and other livestock operations to determine their impact.

Browns Branch

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
3	Browns Branch	Southeast	4,603	No		54	↓	No		96	32	43	28	73

Browns Branch has moderate water quality with a slight, negative five-year trend. Water quality monitoring data shows a moderate ammonia score and marginal phosphate and nitrate scores. The watershed land use is a mix of forests and agriculture with a few low density residential areas. There is a livestock operation with a documented history of water pollution and poor maintenance practices. Streams are generally well buffered with forests, and the percentage of forest as a land use is among the highest in the Chester River watershed.

Hypothesis

Poor nitrate scores are likely a result of legacy nitrates in groundwater seeping through the sandy soils of the area or as a result of fertilizers applied for agricultural purposes. Ammonia could be associated with animal waste at any of the livestock or chicken operations. Phosphate is indicative of soil loss and erosion.

Action

Extensive buffers, grassed waterways, and cover crops all contribute to nitrogen uptake and reduce erosion in agricultural fields. Although Browns Branch has adequate buffers, we propose working with landowners and the Queen Anne's County Soil Conservation District to install more agricultural BMPs on the farmland. We have worked with the livestock operator in the past with poor results, but will increase efforts to enforce regulations and reduce impacts.

Chesterville Branch

Tier	Station	Sub-watershed	Size (acres)	Tidal		3-yr WQI (%)	5-yr Trend	Pollution/ Complaints		Breakdown of 3-yr WQI Parameters (Avg. Scores) (%)				
										DO Score (Jun-Sep)	Nitrate Score	Ammonia Score	Phosphate Score	Turbidity Score
3	Chesterville Branch*	Upper	3,930	No		70	↓	No		94	6	87	71	90

The Chesterville Branch stream station is one of the healthiest based on its three-year Water Quality Index value of 70% (Table 1). However, the site has a significant, negative five-year water quality trend and is severely degraded for nitrates. Additionally, US Geological Survey research in Chesterville Branch shows high levels of herbicides and insecticides commonly used on ornamental shrubs.

A tributary to the upper Chester, the stream basin is majority agricultural, with half of the basin owned by a large nursery operation. The row crop farmland in the basin exhibits best management practices such as grassed waterways, CREP buffers, and cover crops. CRA has worked with the nursery in the past to construct two sediment ponds and there could be potential to work with them again.

For these reasons – high nitrate and pesticide levels in addition to the potential for restoration projects – we increased the site's priority level to Tier 3.

Hypothesis

The high nitrate and pesticide levels paired with the presence of a large, high-density nursery operation suggest one potential source is the nursery.

Action

Our first action will be to reach out to the owners of the nursery to share the results of our water quality analysis and offer to collaborate to identify potential sources of pollution and potential restoration projects.

We can also test water quality at different sites within the stream basin to help narrow potential pollution sources. A potential site for additional testing is where Chesterville Branch crosses under Morgnec Road between Route 298 to the west and Route 444 to the east. Another potential site is just upstream where Chesterville Branch crosses under Route 444.

5.0 Appendices

Appendix A: Stream Basin Characterizations

Upper Chester River Creeks						
Stream Basin	**3-yr WQI**	**5-yr Trend**	**Impairments**	**Size (acres)**	**Complaints**	**Narrative**
Andover Branch	40	↓	DO Ammonia Nitrate Clarity	26,372	No	• Land use primarily agricultural with some woodlands and low density residential • numerous wetlands in the headwaters
Chesterville Branch	70	↓	Nitrate	3,930	No	• Watershed is primarily a large nursery, with some woodlands
Cypress Branch	63	↔	-	23,530	No	• Land use primarily agricultural with some woodlands, wetlands, and low density residential
Foreman Branch	60	↑	Nitrate	3,942	No	• Land use primarily agricultural with few woodlands and some low density residential • Sample site is located on a large pond • Watershed includes a large farm that uses extensive BMPs
Harmony Woods Creek	35	↓	DO Nitrate Phosphate	1,629	No	• Land use primarily agricultural with one dairy farm • Many farmed wetlands and streams • All water flows to a pond
Mills Branch	57	↑	Phosphate	5,712	No	• Land use primarily agricultural with few woodlands
Red Lion Branch	44	↓	DO Nitrate	14,536	No	• Land use primarily agricultural with some woodlands and low density residential • Tidally-influenced • Includes Sudlersville/Barclay WWTP; which was upgraded in 2015, and one nursery
Unicorn Branch	54	↔	Nitrate	13,005	No	• Land use primarily agricultural with very few woodlands, with some low density residential and industrial use • Sample site is downstream of Unicorn Lake, a property managed by MD DNR that includes a fish hatchery

Middle Chester River Creeks						
Stream Basin	**3-yr WQI**	**5-yr Trend**	**Impairments**	**Size (acres)**	**Complaints**	**Narrative**
Morgan Creek	40	↔	DO Ammonia Phosphate Clarity	5,804	No	• Large drainage area that is primarily agricultural • Includes several large dairy operations, two WWTPs, and a chemical plant • Samples taken at tidally-influenced location
Perkins Hill Branch	59	↔	Phosphate	7,829	No	• Primarily agricultural land use with some urban (Town of Kennedyville) and suburban development • Large organic dairy farm • Kennedyville WWTP
Radcliffe Creek	48	↓	Nitrate	2,967	No	• Landuse primarily urban and suburban (Chestertown) with some agriculture • Drains two large shopping centers with significant impervious area • Stormwater step pools were installed to treat runoff in 2014
Rileys Mill Branch	50	↑	Nitrate Ammonia Phosphate	2,972	No	• Primarily agricultural land use, with some urban/suburban (Worton) and industrial • Includes the Worton WWTP • Includes NPDES Discharge Permit for a chemical company
Rosin Creek	70	↓	Nitrate	1,930	Yes	• Drainage area is agricultural with several large suburban developments and public lands/parks • Suburban developments are on septic, many older systems • Received multiple complaints in 2014 and 2015 about large algae blooms
Urieville Lake Branch	69	↑	-	5,429	No	• Land use is almost exclusively agricultural with low density residential • Includes a small portion of Lynch and a fertilizer facility • Sample site is immediately downstream of Urieville Lake • Urieville Lake is believed to function as a stormwater pond, trapping nutrients and sediments, so the relative good water quality at the sample site may not be representative of the water quality in the drainage area

Lower Chester River Creeks						
Stream Basin	**3-yr WQI**	**5-yr Trend**	**Impairments**	**Size (acres)**	**Complaints**	**Narrative**
Grays Inn Creek	29	↔	DO Ammonia Phosphate Clarity	828	Yes	• Drains into tidal portion of Grays Inn Creek. • Land use is primarily urban in the town of Rock Hall, woods, and some agriculture
Reed Creek	66	↑	Phosphate	1,734	No	• Drains into tidal portion of Reed Creek • Land use is primarily agricultural with some woodlands

Southeast Creeks						
Stream Basin	**3-yr WQI**	**5-yr Trend**	**Impairments**	**Size (acres)**	**Complaints**	**Narrative**
Browns Branch	54	↓	Nitrate Phosphate	4,603	No	• Land use is primarily agricultural, with some woods and low density residential • Soils are very sandy and nitrate levels are believed to be significantly influenced by legacy nutrients in interflow
Church Hill Branch	42	↔	Nitrate Ammonia Phosphate	7,966	No	• Land use mixture of light urban (Town of Church Hill) and agricultural. • Soils are very sandy and nitrate levels are believed to be significantly influenced by legacy nutrients in interflow
Granny Finley Branch	53	↓	Nitrate Phosphate	5,195	No	• Land use is primarily agricultural with significant mature woodlands and some low density residential • Very wet area; lots of farmed wetlands
Island Creek Branch	53	↑	Phosphate	5,367	No	• Land use is mix of mature woodland and agriculture, with low density residential • One of the most wooded subwatersheds in the Chester River watershed
Johnny Powell Branch	52	↓	Nitrate Ammonia	1,089	No	• Land use is primarily agricultural • Soils are very sandy and nitrate levels are believed to be significantly influenced by legacy nutrients in interflow

Corsica River Creeks						
Stream Basin	**3-yr WQI**	**5-yr Trend**	**Impairments**	**Size (acres)**	**Complaints**	**Narrative**
3 Bridges Branch	70	↑	Phosphate	5,202	No	• Drains into tidal portion of Corsica River • The Corsica Watershed has undergone significant restoration on account of the Corsica River Watershed Restoration Action Strategies plan. • Land use is agricultural with some suburban developments
Old Mill Stream	65	↑	Nitrate	7,580	No	• Drains into tidal portion of Corsica River • The Corsica Watershed has undergone significant restoration on account of the Corsica River Watershed Restoration Action Strategies plan. • Land use is a mix of urban land in Centreville, agricultural and suburban developments

Langford Bay Creeks						
Stream Basin	**3-yr WQI**	**5-yr Trend**	**Impairments**	**Size (acres)**	**Complaints**	**Narrative**
Airy Hill Creek	40	↓	DO Phosphates Clarity	3,524	Yes	• Drains into the east fork of Langford Bay • Received complaints about algae in receiving waters • Land use is primarily agricultural with some low density development and minimal forests
Brices Mill Pond	51	↓	Nitrates Phosphates	3,571	Yes	• Drains into the east fork of Langford Bay • Received complaints about algae in receiving waters. • Land use is primarily agricultural with minimal forests
Sandy Bottom Creek	41	↔	Phosphate Clarity	2,382	No	• Drains into west fork of Langford Bay • Station is immediately downstream of lake and waterfall • Land use is almost exclusively agriculture and forests
Shipyard Creek	31	↔	DO Ammonia Phosphate Clarity	933	No	• Drains into west fork of Langford Bay • Land use is half agriculture and half forests • Watershed lies almost exclusively within one farm