Bayside Creeks Watershed Assessment and Action Plan

February 1, 2022

Photo credit: UMCES

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1.0 Introduction

The purpose of this plan is to provide guidance on the restoration of the Bayside Creeks. The Bayside Creeks Watershed Assessment and Action Plan outlines a series of recommendations for watershed restoration, describes management strategies, and identifies priority projects for implementation. Planning level cost estimates are provided, where feasible, and a preliminary schedule for implementation is outlined. Financial and technical partners for plan implementation are suggested for various recommendations and projects. The watershed plan is intended to assist ShoreRivers, Kent County Government, Kent County Soil Conservation District, and people living within the watershed in reaching local clean water goals and supporting the larger Chesapeake Bay restoration effort.

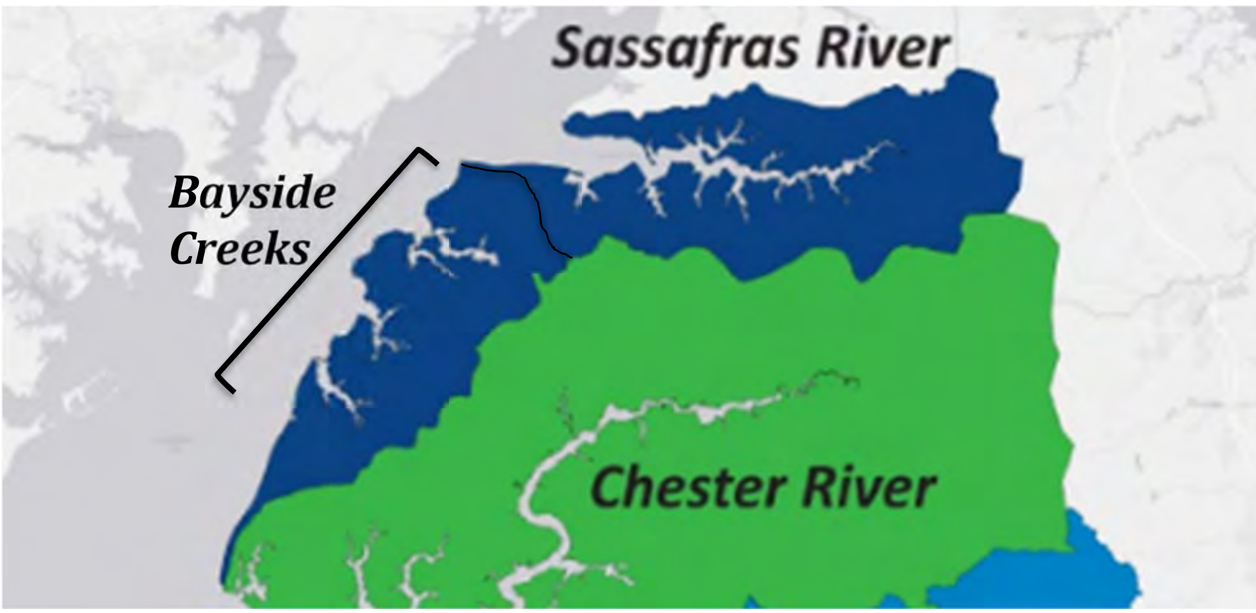

Figure 1: The Bayside Creeks watershed, located between the Chester River and Sassafras River

1.1 U.S. EPA Watershed Planning "A-I Criteria"

In 2003, the U.S. Environmental Protection Agency (EPA) required that all watershed restoration projects funded under Section 319 of the federal Clean Water Act be supported by a watershed plan.[1] EPA identified nine key elements that are critical for improving water quality and should be included in watershed plans that intend to address water quality impairments. These nine elements have come to be known as the "A-I criteria":[2]

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[1] For more information on 319 grant funding opportunities, visit MDE's Nonpoint Source Program (319) Management and Financial Assistance website at http://www.mde.state.md.us/programs/Water/319NonPointSource/Pages/index.aspx

[2] For a more detailed description on the nine key elements review Chapter 2 of the EPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*

EPA A-I Criteria

A. Identification of Causes and Sources of Impairments
B. Expected Load Reductions
C. Proposed Management Measures
D. Technical and Financial Assistance Needs
E. Information, Education, and Public Participation Component
F/G. Schedule and Milestones
H. Load Reduction Evaluation Criteria
I. Monitoring Component

This watershed plan meets the A-I criteria and Table 1 shows where these criteria are addressed throughout this watershed plan.

Table 1: Location of A-I Criteria Within this Report

Section of the Report	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Section 1	X								
Section 2					X				
Section 3			X						
Section 4		X							
Section 5				X		X	X		
Section 6								X	X

https://www.epa.gov/sites/production/files/2015-09/documents/2008_04_18_nps_watershed_handbook_handbook-2.pdf

1.2 Background

The Bayside Creeks watershed is located in western Kent County on the Eastern Shore of Maryland, and is made up of four creeks: Still Pond, Churn, Worton, and Fairlee. This area falls between the Sassafras River and Chester River watersheds, and has previously been left out of many restoration efforts and water quality monitoring because it was not represented by a watershed organization. ShoreRivers incorporated the Bayside Creeks region into its territory in 2019, and has been working to increase restoration, education, and water quality monitoring efforts in these four creeks since then. A specific watershed-based plan is necessary for these creeks due to their historic underrepresentation in water quality improvement efforts and to establish a baseline for future restoration and outreach work.

In 2010 the Environmental Protection Agency (EPA) established a cleanup plan known as the Chesapeake Bay Total Maximum Daily Load (TMDL). The plan sets federally regulated limits on nitrogen, phosphorus, and sediment loads entering the bay. Each state in the bay's watershed was allocated a specific reduction of these pollutants from the different sectors including agriculture, wastewater, and urban stormwater. To achieve these reductions, Maryland developed a Watershed Implementation Plan (WIP) that took the state's allocation and further divided it into the responsibility of each county to reduce its contribution of the overall load. Unlike the majority of the counties, Kent County failed to develop a Phase III Watershed Implementation Plan (WIP), leaving them without a modern plan to address the excess nutrient and sediment loads entering these waterways. Furthermore, because of the rural nature of Kent County, the county is not mandated by the State of Maryland to comply with municipal separate stormwater sewer system (MS4) requirements.

Absent the state and federal requirements, this watershed plan will serve as a guidance document for ways that ShoreRivers and other watershed partners can strategically chip away at pollution loads coming from agricultural and residential stormwater runoff. This plan was created following the EPA's A-I criteria, which is explained in more detail in section 1.1 of this document.

Identification of Causes and Sources of Impairment

Location and Description: The Bayside Creeks watershed is made up of four creeks: Still Pond, Churn, Worton, and Fairlee. This watershed is roughly 37,803 acres and the land use is similar to the nearby Sassafras and Chester watersheds. Land use is approximately:

- 56% agriculture
- 28% forest
- 7% developed
- 9% wetlands

These creeks suffer from the same problems that affect the Sassafras, Chester, and most Eastern Shore waterbodies, including:

- High phosphorus loading
- Wetland loss

- Soil erosion
- Algal blooms
- Low tidal flushing

The Maryland water quality standards Surface Water Use Designation (Code of Maryland Regulations [COMAR] 26.08.02.07) for Still Pond Creek is Use I – *water contact recreation, fishing, and protection of aquatic life and wildlife*. Nitrogen and phosphorus loadings from non-point sources have resulted in higher than acceptable chlorophyll-a concentrations that classify the creek as being impaired for not meeting the designated use water quality standards. Because of the impairment of the Still Pond Creek, a Total Maximum Daily Load (TMDL) for nitrogen and phosphorus was established in 2001. However, while the Maryland Department of the Environment monitored several sites on the creek in the 1990s, there is no longer a state-operated monitoring program. The other three creeks in this watershed do not have a TMDL and have not been consistently monitored on any regular basis.

Table 2: Bayside Creeks Land Use/Cover

Land Cover	Area (Acres)
Impervious	1,031
Forest	9,677
Turf/Open	1,261
Agriculture	19,208
Wetlands	3,171
Total	34,348

Still Pond Creek is approximately 3.97 miles long from the headwaters to where it meets Churn Creek and the Chesapeake Bay. Still Pond Creek is relatively shallow, but is still a popular boating and fishing spot due to its sheltered nature. There are three small offshoots from the main stem, but otherwise the creek is relatively straight.

Churn Creek is approximately 3.53 miles long from the headwaters to where it meets Still Pond Creek. Most of the creek is very shallow, which limits boating traffic to kayaks and smaller vessels. There are two "prongs" of the creek, with one branch being just under a mile long and the other branch being navigable for about 1.93 miles.

Worton Creek is approximately 5.79 miles long from the head of Mill Creek to where the Worton Creek meets the Chesapeake Bay. It is fed by Mill Creek, Tim's Creek, and an unnamed tributary. There are also two marinas on Worton Creek, Green Point Landing Marina and Worton Creek Marina, which are popular boating spots.

Fairlee Creek is approximately 4.95 miles long from its headwaters near the town of Fairlee to where it meets the Chesapeake Bay at its mouth. It is fed by three tributaries: Orchard's Branch, Fairlee Lake, and an unnamed tributary that flows around the town of Fairlee. Mears Great Oak Landing Marina is a popular marina located at the mouth of the creek. There is a public landing, Fairlee Landing, that is frequently used by kayakers and watermen.

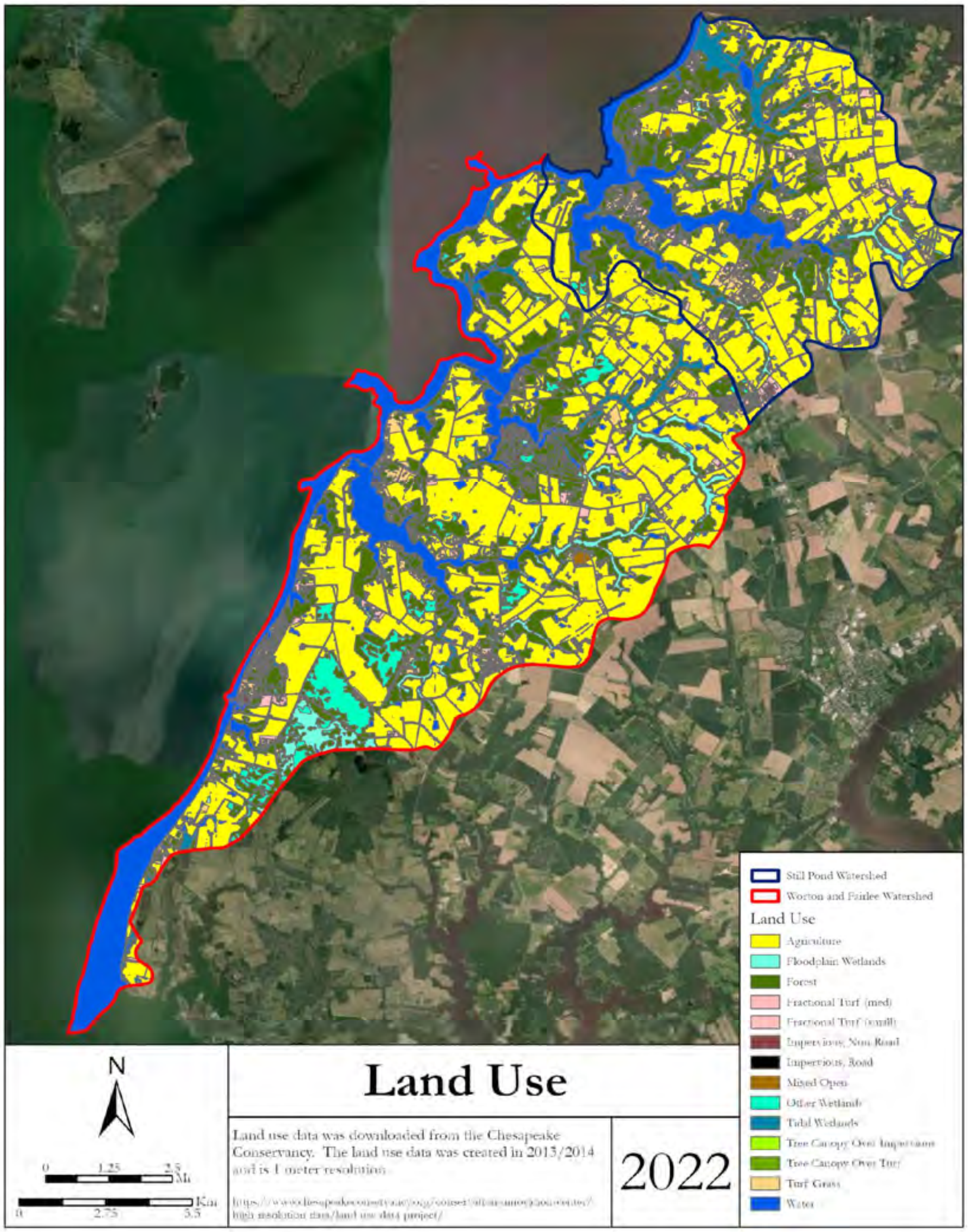

Figure 2: Land use in the Bayside Creeks

Ambient Conditions

Water quality data for the Bayside Creeks is extremely limited or non-existent. The most recent prior data collection and analysis was published in 2001 by the Maryland Department of the Environment; *Total Maximum Daily Loads of Nitrogen and Phosphorus in Still Pond Creek, Kent County, Maryland.* This document only focuses on one of the four Bayside Creeks, so its scope is limited. Since then, any water quality data has not been readily available or accessible.

ShoreRivers began incorporating this area into its monitoring range in 2019, with the first season of data collection taking place in 2020. Due to the global pandemic, there was some issues with data processing and collection, but this represents the most complete data set collected for the four creeks. 2021 marked the second full season of water quality monitoring for this watershed, but that data set is incomplete at the time of publishing this assessment due to delays in laboratory processing of several samples. That data will be complete in the spring of 2022.

Overall, this limited set of data shows water quality conditions that are comparable to other Eastern Shore rivers, and especially the two nearest rivers to the Bayside Creeks; the Chester River and the Sassafras River. Namely, excess levels of nutrients are entering the creeks, contributing to algal blooms, reduced water clarity, and low oxygen levels. This trend is particularly significant in the summer when water temperatures increase. The salinity regime changes quickly between the Bayside Creeks. While the Sassafras is mainly fresh, to slightly oligohaline in the lower river, the Bayside Creeks are entirely oligohaline. Table 3 shows the average water quality parameters for each of the creeks. Currently ShoreRivers monitors one sampling station on each creek, close to the mouth of the river. More sites will be added as funding and resources become available. The data showing the full range of each parameter is included in the appendices.

Table 3: Average Water Quality Parameters of the Bayside Creeks

Site Name	Salinity (ppt)	Dissolved Oxygen (mg/l)	Secchi (Meters)	Total N (mg/l)	Total P (mg/l)	Chl -a (ug/L)
SP02	2.50	9.37	0.60	1.23	0.05	10.53
CC02	2.62	8.74	0.74	0.71	0.04	11.23
WC02	3.67	10.07	0.54	1.09	0.12	20.69
FC02	3.17	9.46	0.62	0.87	0.05	16.32

In 2020, ShoreRivers also expanded its bacteria monitoring program to the Bayside Creeks, with one sample site on each of the four creeks. This program samples popular water contact locations throughout the summer when there is the highest number of people having contact with the water. For the summer of 2020 these samples were collected every other week from Memorial Day to Labor Day. Due to the global pandemic, and the potential of COVID-19 spreading through human waste, the monitoring began two weeks earlier than expected. Samples are collected and analyzed for *Enterococcus* bacteria, which is frequently used as an indicator for fecal coliforms in waterways. Overall, the Bayside Creeks sites showed similar levels of bacteria to the Sassafras River, with three of the four creeks only receiving failing results for one sample date throughout the season. The pass/fail rates for each site are below in Table 4.

Table 4: Bacteria Results for the Bayside Creeks in 2020

Site Name	Pass	Fail
SP02	87.50%	12.50%
CC02	100%	0%
WC02	87.50%	12.50%
FC02	87.5	12.5

Figure 3: Water quality and bacteria sampling locations in 2020

Causes and Sources of Pollution

Nonpoint Source Pollution and Sources: Since the Bayside Creeks watershed is predominantly agricultural, the majority of pollution originates from nonpoint sources. In general, the nonpoint source pollution stems from either residential or agricultural land practices, including, but not limited to, lawn fertilizer application, agricultural operations, road salt application, herbicide and pesticide application, hydrocarbons from road surfaces, detergents, and atmospheric deposition.

Point Source Pollution and Sources: In 1972 a component of the Clean Water Act was established to control point source water pollution through a permitting system. Point sources are defined as any conveyance such as a pipe or a manmade ditch that eventually discharges directly into surface water. Municipal, industrial, and other facilities must obtain a National Pollution Discharge Elimination (NPDES) permit if their discharges go directly to surface waters. Maryland Department of the Environment (MDE) issues NPDES permits in Maryland as a means of limiting the amount of pollution entering surface waters from industrial and municipal facilities. The Bayside Creeks watershed has six NPDES-permitted facilities, which are shown in Table 5 below.

Table 5: NPDES Permitted Facilities

Facility Name	**Address**	**Permit Type**	**Permit No.**
Tolchester Marina, Inc	21085 Tolchester Beach Road, Chestertown, MD 21620	Minor: General Permit Covered Facility	MDG999241
Fairfield Farm	22840 Bayshore Road, Chestertown, MD 21620	Minor: General Permit Covered Facility	MDG010041
Zachary Loller/William Loller Farm, LLC	8966 Bakers Lane, Chestertown, MD 21620	Minor: General Permit Covered Facility	MDG010399
Tolchester Wastewater Treatment Plant	22010 Bay Shore Road, Chestertown, MD21620	Minor: NPDES Individual Permit	MD0067202

Mears Great Oak Landing Wastewater Treatment Plant	22170 Great Oak Landing Road, Chestertown, MD 21620	Minor: NPDES Individual Permit Minor: General Permit Covered Facility	MD0024945 MDG999221
Worton Creek Marina	23145 Buck Neck Road, Chestertown, MD 21620	Minor: General Permit Covered Facility	MDG999158

The discharge, or effluent, from these facilities includes toxic organic and inorganic materials that can have a devastating impact on the water quality in the Bayside Creeks if permit limits are exceeded. Of the six permitted facilities in the watershed, three have been inspected in the past five years: Tolchester Wastewater Treatment Plant; Tolchester Marina; and Mears Great Oak Landing Wastewater Treatment Plant. Only two of those inspections resulted in finding a violation or a formal enforcement action by the state, at Worton Creek Marina and Tolchester Marina. A full analysis of the permitted facilities and the pollutants they discharge can be found in Appendix A.

Maryland's NPDES program offers key avenues for public participation in the permit-issuing process. By being involved, citizen and watershed groups can advocate for permit limits that protect local water quality and enforceable conditions that provide accountability when permit limits are violated. Figure 2 illustrates opportunities and advice for public involvement at each step of MDE's permitting process. For a full description of this process, basic information, and tools and tips to assist in analyzing and commenting on NPDES permits in Maryland, reference the Citizens Guide to Public Participation in Maryland's NPDES Permitting Program.[5]

In terms of protecting the Bayside Creeks from point sources of pollution, citizen advocacy and enforcement groups should monitor the permitted facilities mentioned in Table 5 and reference the Citizen Guide to effectively navigate the process and advocate for strong, enforceable permits.

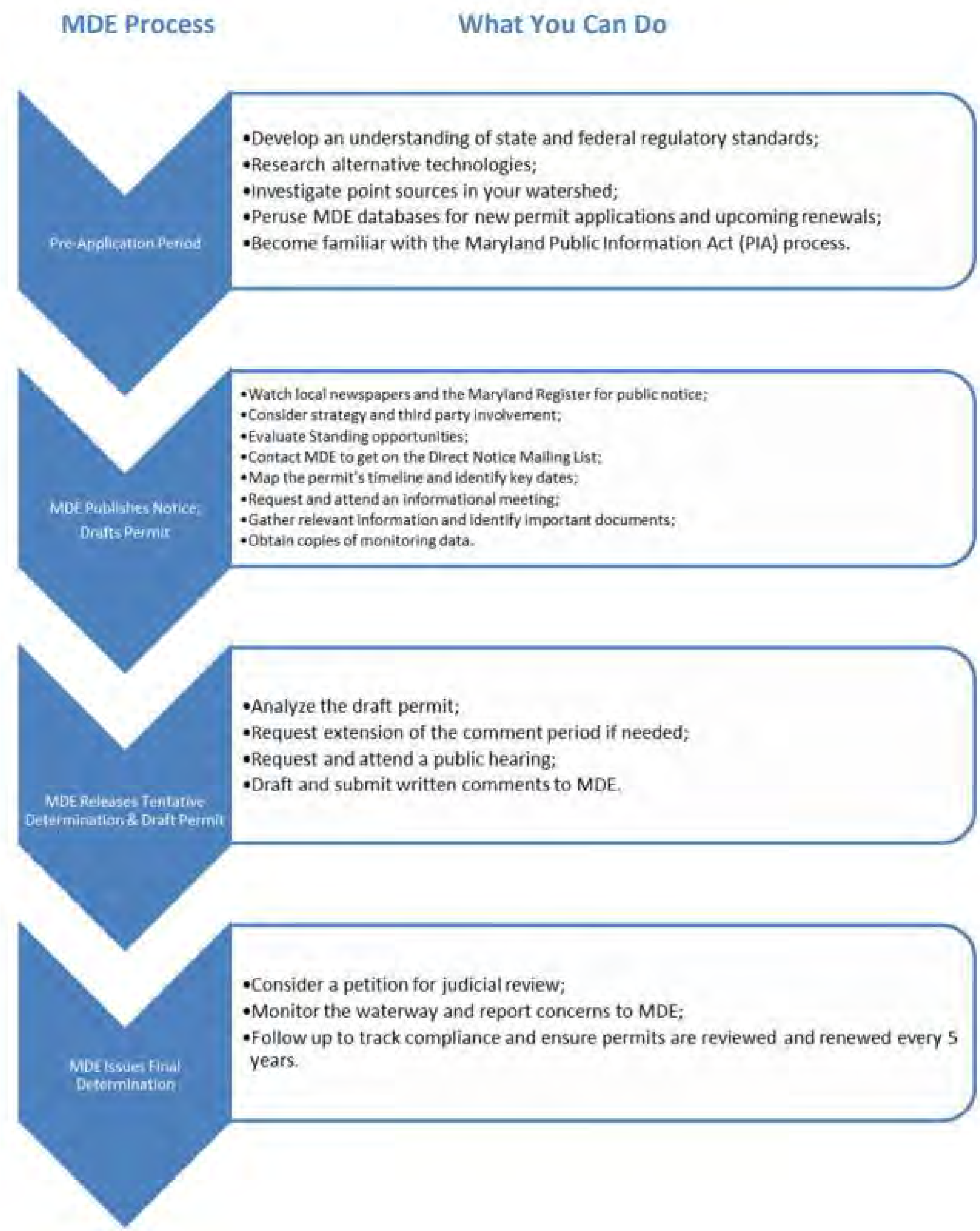

Figure 4: Opportunities for Public Involvement in MD's NPDES Permitting Process

2.0 Watershed Goal, Strategies and Recommendations

2.1 Watershed Goal

Healthy and clean Bayside Creeks that are safe for swimming and fishing, and are free from all water quality impairments.

2.2 Strategies

1. **Quantify the problem in terms of nutrient loads.** Identify flow-paths and nutrient sources.
2. **Public-private partnerships.** Leverage the County's resources in collaboration with skills and expertise from a diverse group of watershed partners.
3. **Increase the knowledge of homeowners, faith communities, and students**. Education is essential for creating behavior change.
4. **Implement stormwater retrofit practices wherever space and site conditions permit**. Agriculture and uirban/suburban runoff is best treated when stormwater practices are designed to absorb into the ground.
5. **Increase public access to and awareness of the Bayside Creeks.** Build a greater appreciation for the creeks and all of their potential.
6. **Incorporate climate change adaptation strategies into project planning and implementation.** Impacts of climate change will affect how restoration practices perform into the future.

2.3 Recommendations

The Bayside Creeks provide a stark contrast to many agriculturally dominated watersheds. Conservation has been implemented at a scale that is not often seen, addressing nutrient and sediment both at the source and through transport. Grassed waterways are the norm rather than the exception and most stream segments are well buffered with mature forest or have grass buffers. Farm ponds and wetlands are numerous and in most instances work in tandem with grassed waterways to provide a "treatment train" to slow down erosion, provide storage for stormwater, and treat nutrients. The recommendations in this plan reflect this conservation-minded landscape and provide guidance on how to maintain what is there and also pinpoint areas that might have continued nutrient and sediment loss. The recommendations also reflect working with the broader community consisting of many small towns and developments.

1. **Make sure all grassed waterways are being maintained and re-enrolled in cost share programs if available**. Try to get the remaining high-priority waterways established as grassed waterways. The Agricultural Conservation Planning Framework (ACPF) model identified 711 grassed waterway opportunities, which, after quality control based on satellite images, only 285 opportunities were not already existing grassed waterways. Of the remaining 285 opportunities, only 10 (3.5%) have very high risk for runoff, and only 43 (18%) have high risk for runoff. [4]

2. **Examine the outfalls and downstream of grassed waterways to identify if there is erosion occurring**. Grassed waterways help stabilize field erosion, but in some cases once the water enters a forest buffer area, it is no longer in a stabilized channel. This can lead to erosion that goes unnoticed, especially in older grassed waterways. There are several instances where this was documented in both Bayside Creek watersheds.
3. **Check farm ponds and wetlands to identify whether they are still operating at design specifications and also examine outfalls for erosion.** Most farm ponds and wetlands in the Bayside Creeks were established at least 25 years ago, and many are over 40 years old, making maintenance an issue. During field visits, there were a few sites identified that have erosion from the outlet or spillway from the pond or wetland that need to be addressed.
4. **Complete stream restorations on Tim's Creek, Mill Creek, and Fairlee Creek.** These three creeks were identified to have unstable channels, eroding banks, incision, or opportunities to reconnect the floodplain. The Bayside Creeks have a unique geography, where elevations quickly go from 80' - 100' elevation to sea level. The history of first deforestation followed by intensive tillage agriculture has caused excessive sediment transport and streams becoming disconnected from their floodplain. This has made them very efficient conduits to move water and inefficient at providing stormwater storage or nutrient treatment. Restoring the streams to provide better connection to the floodplain and stabilize the channels has the potential to have major positive impacts on tidal waters. These three creeks represent the most apparent stream restoration opportunity, but other streams in the Bayside Creek watersheds could also benefit from restoration.
5. **Implement water-quality-centric cover cropping practices and advanced nutrient management on as many farms as possible, especially those identified as critical source areas.** Core nutrient management is completed on most farms in Maryland. The next step is addressing timing, rate, and placement of nutrients to maximize crop uptake and reduce losses to the groundwater and surface waters. Cover cropping is also a common practice, but it is critical that cover crops are planted early enough to mine nutrients before they leach below the root zone. Cover crops should be planted between July and early September and, if possible, planting green is encouraged to maintain a continuous green landscape throughout the year.
6. **Outreach and education of residents on lawn care practices**. Administer a fertilizer outreach campaign with property owners and lawn care professionals. Educate them on the impacts of fertilizers and the alternative practices that are available. Our River-Friendly Yards program works with residents to maintain their properties in a way that reduces nutrient runoff into local waterways and improves ecosystem health for our native species of plants and animals.
7. **Outreach and Education to Marinas and Boaters.** These creeks are popular raft-up and boating locations with local residents and visitors. Marinas on Fairlee and Worton Creeks are great opportunities to add pumpout stations and educate boaters about properly disposing of their waste. These marinas also have their own wastewater treatment plants, which are another restoration opportunity. The Sassafras Riverkeeper regularly speaks with the local marinas and yacht clubs about ways they can help clean up the river. These marinas are starting to become involved in several of our outreach initiatives, including Don’t Paddle Past it, Let Healthy Grasses Stay, and Pump Don’t Dump.
8. **Outreach and education of residents on septic maintenance practices.** Most of these residential communities are 40-60 years old and have outdated or poorly maintained septic systems. Several homes in this watershed have outfall pipes that dispose waste directly into the rivers. As such, there is a great opportunity to work with Kent County

health department to connect residents with resources to upgrade their septic systems and maintain their systems in better ways to prevent this nutrient loading to the creeks.

9. **Faith-based outreach and engagement.** The Bayside Creeks watershed includes many churches and places of worship. Watershed partners should engage with these faith communities and provide education on creation care and stewardship of our land and water. Watershed partners should work with congregations to implement restoration projects on their church properties, as well as provide the members with homeowner education and the tools and resources to implement projects on their home properties.
10. **Point-source monitoring and engagement.** There are six facilities that have permits to discharge their waste within the Bayside Creeks watershed. Using the Citizens Guide to Public Participation in Maryland's NPDES Permitting Program, monitor and engage in permit compliance and reissuing processes. Advocate that each permit includes strong permit limits and enforceable permit conditions, and provide accountability when a permit is violated.
11. **Construct treatment wetlands where possible.** Treatment wetlands are one of the most effective ways to absorb stormwater runoff and the nutrients and pollutants that it carries.
12. **Increase participation in the Marylanders Grow Oysters (MGO) program.** The MGO program is an opportunity for citizens to engage in oyster restoration. Through the program, citizens who have access to docks or piers are given the equipment and spat-on-shell oysters needed to participate in oyster gardening. The growers help to maintain and protect the young oysters during their vulnerable first year of the life, so they can be planted on local sanctuaries, where the oysters can enrich the local ecosystem and the oyster population.[3] While the Sassafras River has salinity that is too low to support oyster growth, the Bayside Creeks have high enough salinity levels to be included in this program.
13. **Education and outreach to school-aged children.** Educate school children on environmental issues, including land development, non-point source pollution, water quality degradation and habitat destruction. Teach students about the solutions to these problems and engage them in restoration efforts, tree plantings, trash cleanups, and educational signage projects.
14. **Participate in local code and ordinance review**s. Focusing on erosion controls, right-of-ways, and site designs, help to update local ordinances so they are conducive to implementing clean water projects. Encourage more street tree plantings in the right-of-way. Provide stricter regulations for construction sites with bare soils and erosion possibilities.
15. **Implement restoration on public land whenever applicable.** By implementing projects on public land, the government is demonstrating to watershed residents the new way of conducting business and managing stormwater runoff. Lead by example.
16. **Plan for increased rainfall amounts and intensity, and regional plant species migration due to changing climate patterns.** By planning for these expected changes, we will be able to implement projects that are more resilient to the effects of climate change. Rainfall is becoming more intense and more frequent, while we are also experiencing longer periods of drought-like conditions. These changes will have an effect

[3] For information on the Marylanders Grow Oyster program please visit http://dnr.maryland.gov/fisheries/Pages/MGO/index.aspx

on the size of our stormwater practices, as well as the plants that are used in green infrastructure projects.

17. **Monitor the health of the Bayside Creeks as a means of tracking progress.** Monitor the pulse on the health of the Bayside Creeks by conducting an ongoing water quality monitoring program. Test the water for physical degradations, as well as chemical impairments. Test dissolved oxygen levels at the surface and the bottom of the water column. Test nutrient and bacteria levels from different areas throughout the creeks and the surrounding watershed. Identify emerging hot-spots of pollution.

3.0 Watershed Restoration Practices

This section provides an overview of the key recommended practices for restoring the Bayside Creeks. Successful restoration requires collaboration among local, county and state government, watershed partners, businesses, farmers, and residents. Local and state governments are able to implement capital projects such as large-scale roadway stormwater retrofits, and change ordinances and municipal operations to encourage continued restoration. Watershed partners, businesses, and residents are encouraged to implement smaller-scale projects and programs, such as rain gardens, lawn care education, community outreach, and restoration of streams and wetlands. The variety of practices recommended in this plan are primarily urban stormwater retrofits, and are described in more detail below.

Residential Best Management Practices:

1. **Septic Maintenance** – Old or improperly maintained septic systems can leach nutrients and bacteria into groundwater and waterways. There are many resources available to homeowners to upgrade outdated systems to Best Available Technology (BAT) systems that significantly reduce the amount of nutrients coming from their septic systems. Homeowners are also encouraged to have their septic tanks pumped out and inspected on a regular basis to quickly catch cracks or damage and not overburden the leach field.
2. **River-Friendly Yards Practices** – Lawn fertilizers and associated chemicals for maintaining non-native landscaping plants are a major contributor of nutrients to our local waterways. Our River-Friendly Yards program works with local community members to reduce the amount of turf grass on their properties, eliminate fertilizer use, replace non-native and invasive plants with native options, and other actions on their properties to reduce the amount of sediment and nutrients flowing off their properties.
3. **Utilizing Pumpout Stations** – Many local marinas are equipped with pumpout stations for boaters to properly dispose of onboard waste. Currently, boaters are allowed to discharge treated effluent from their marine heads into tidal waterways, but this does not mitigate the nutrient load entering the waterway. The Chester River was recently designated as a No Discharge Zone, which includes even treated effluent. Outreach to local boaters about the impacts of their waste, as well as the available pumpout locations is necessary.
4. **Rain Garden** – A rain garden is a constructed shallow depression adjacent to structures that collects rainwater from roofs, driveways, parking lots, or streets, and allows water to soak into the ground. Planted with native species, rain gardens can be a cost effective and aesthetically pleasing way to reduce runoff from residential properties or businesses. Rain

gardens also help filter out pollutants in runoff and provide food and shelter for butterflies, song birds, and other wildlife.[1]

Figure 5. Rain garden example in Easton, Maryland.

5. **Downspout Disconnection** – Downspouts that discharge directly into a driveway or road contribute to stormwater issues downstream. Disconnecting or redirecting the downspout away from impervious surfaces and allowing water to fill a rain barrel or soak into adjacent grass reduces stormwater volume and is a simple way for local residents to do their part in helping resolve stormwater issues.

Figure 6. Example of a downspout disconnected from the driveway and redirected to a rain barrel. Downspout disconnections can also be redirected to lawn or other vegetated spaces rather than into a barrel.

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[1]Soak Up the Rain: Rain Gardens, EPA, https://www.epa.gov/soakuptherain/soak-rain-rain-gardens

Agricultural Best Management Practices:

1. **Cover Crops NRCS Standard 340** – Growing a crop of grass, small grain, or legumes primarily for seasonal protection and soil improvement. Cover crops reduce erosion from wind and water while also utilizing excessive soil nutrients and increasing soil health by adding organic matter. It is critical to plant these crops by late summer or early fall and to either plant green or terminate just before planting the next crop. Mixed cover crops also provide the added benefit of diversity and help develop better soil structure.

Figure 7. Cover crop example showing vegetation covering the soil. (photo: Farmfuture.com)

2. **Grassed Waterway, NRCS Standard 412 –** A graded or shaped channel established with vegetation suitable to convey water at a non-erosive velocity using a broad and shallow cross section. Grassed waterways protect and improve water quality by filtering runoff and maintaining vegetative cover on water conveyance channels.

Figure 8. Grassed Waterways example showing the vegetative cover over the drainage channel. (Photo: NRCS)

3. **Nutrient Management [Plans], NRCS Standard 590 –** The certified plan and subsequent actions to manage the amount, source, placement, form and timing of the application of nutrients. Obtaining and following a nutrient management plan helps minimize agricultural nonpoint source pollution and properly utilize manure and other organic fertilizers.

4. **Phosphorus Sorbing Materials in Agricultural Ditch[1]** – The application of "Phosphorus sorbing" materials to absorb available dissolved phosphorus in cropland drainage systems for removal and reuse as an agricultural fertilizer. These in-channel engineered systems can capture significant amounts of dissolved phosphorus in agricultural drainage water by passing them through phosphorus sorbing materials, such as gypsum, drinking water treatment residuals, or acid mine drainage residuals.

5. **Riparian Forest Buffer, NRCS Standard 391** – A corridor of trees and/or shrubs planted adjacent to a river, stream, wetland, or water body. The planting is of sufficient width, up-gradient, and proximity to the water body to ensure adequate functioning. The primary purposes for installing a riparian forest buffer include protecting near-stream soils from over-bank flows, trapping harmful chemicals or sediment transported by surface and subsurface flows from adjacent land uses, or providing shade, detritus and large woody debris for the in-stream ecosystem.

6. **Streambank and Shoreline Protection, NRCS Standard 580 –** The use of plants and other natural elements to stabilize and protect the banks of streams and drainage ditches. The benefit of streambank and shoreline stabilization is the ability to maintain the flow capacity of a stream, reduce sediment erosion impacting downstream habitats, and improve the stream corridor for fish and wildlife habitat.

Figure 9. Structure for water control installed in a ditch to help control water level and increase nutrient removal within the ditch.

[1]For more on Phosphorus Sorbing Materials visit the Maryland Department of Agriculture's website. https://mda.maryland.gov/resource_conservation/WIPCountyDocs/bmpdef_pg.pdf

7. **Structure for Water Control, NRCS Standard 587 –-** A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation, or measures water. This structure allows a farmer to control the stage, discharge, distribution, delivery, and direction of water flow.
8. **Two-Stage Ditch (Open Channel), NRCS Standard 582 –** A design conversion that modifies the geometry of a ditch to establish benches within the ditch. The ditch provides a low-flow channel and then a vegetated bench that is flooded during higher flows. The vegetation provides some slowing of water flow where sediments and other heavier material in the water might settle. A two-stage ditch is an in-channel practice.

Figure 10. Two-stage ditch example showing the extended benches within the ditch. This two-stage ditch is located in Talbot County, MD

Figure 11. Wetland creation adjacent to a farm field in Cecil County, Sassafras River watershed

9. **Wetland Restoration, NRSC Standard 657, Created Wetland, NRCS Standard 656 –** The return of a wetland to an area with hydric (very wet) soils. This involves managing the drainage volume, water table volume and vegetation at a site suitable for wetland restoration. The benefits of this practice are to filter nutrients from runoff while providing fish and wildlife habitat.
10. **Water and Sediment Control Basin (WASCOB), NRCS Standard 638 –** A WASCOB is an earthen embankment that crosses the slope of a drainageway (concentrated flow path) to trap stormwater and sediment and release the water in a less erosive manner using a pipe to a stabilized outlet. This practice helps reduce gully erosion, trap sediment, and reduce and manage stormwater runoff.

Figure 12. This photo depicts a WASCOB with a berm running across a grassed drainage area and two orange risers that help convey stormwater in a less erosive manner. Photo from Essex Soil and Crop Improvement Association, http://escia.ca/2019-conservation-farm-award/wascob/

4.0 Project Selection and Prioritization Methods

4.1 Project Selection

The creation of a watershed plan that covers an expansive area presents the challenge of identifying projects throughout the watershed, but also providing enough project detail to adequately describe and justify the installation of the conservation practices at the field scale. Many watershed plans provide either general project suggestions that can be applied throughout the watershed without pinpointing exact locations, or, in other instances, pinpoint in great detail a few projects, neglecting the remainder of the watershed. To overcome this challenge, a targeting method developed by the United States Department of Agriculture (USDA) titled Agricultural Conservation Planning Framework (ACPF), was employed that takes advantage of the latest geospatial data to evaluate the entire watershed for various different nutrient reduction practices, providing a broad range of conservation options that are precisely located at the field scale. Data used to execute the targeting method were the most recent light detection and ranging (LIDAR) derived digital elevation model (DEM), soils survey data (gSSURGO), crop data from the USDA National Agricultural Statistics Service, in addition to data layers derived through analyses performed on the aforementioned data sets. The execution of the targeting method was completed through the use of the ACPF ArcPro toolbox that analyzed the previously described data sets to identify field-level project opportunities. Additional information on the ACPF targeting method can be obtained on the ACPF website, https://acpf4watersheds.org/.

The output from the ACPF targeting method produced a tremendous amount of suggested conservation measures (Appendix B.1 and B.2). The ACPF outputs are parcel-based plans, using a unique field boundary (FB) identification to distinguish each parcel. Conservation practice locations are identified by the field boundary identification number to easily categorize on what parcel the practice is located. Parcel-based categorization of conservation practices allows for the practices to be suggested at the property scale and provides tailored plans for each landowner within the watershed. All practices suggested in this plan are approved Natural Resources Conservation Service (NRCS) best management practices that have national standards.

4.2 Calculating Load Reductions

Once projects were identified and recorded in each section, the FieldDoc calculator was used to estimate nutrient and sediment load reductions.[4] FieldDoc is a standardized method for project reporting and calculating nutrient and sediment reductions in accordance with the latest version of the Chesapeake Bay Watershed Model. Reductions were determined based on the type of best management practice being proposed and the size of the drainage area that the project is treating.

For critical source areas. nitrogen (N) reduction amounts were estimated based on four different best management practices: cover crop (traditional rye early aerial); nutrient management N Rate; N Placement; and N Timing. Three sites selected from different areas within the

[4] To review the FieldDoc user guide please visit: http://www.nfwf.org/chesapeake/Documents/FieldDoc-User-Guide.pdf

watersheds were modeled for each practice with similar results. Average reduction estimations for each practice were summed to estimate reductions across all critical source area fields. Residual nitrogen in the soil was estimated using Hirsch and Weil, 2019, and reductions are reflected from this baseline.

4.3 Estimating Costs

Estimating costs for projects that are not yet designed presents a challenge. To provide general guidance on costs for some of the projects, estimates were made using Chesapeake Assessment Scenario Tool (CAST) documentation of best management practice cost effectiveness. This information can be accessed on the CAST website[5]. For drainage water management projects, estimated costs were based on the average cost of two drainage water management projects installed in December 2021 in Delaware.

4.4 Project Prioritization

Based on field visits and the spatial analysis, the projects with the highest priority are the stream restorations and controlling nutrients at the source through advanced nutrient management and cover cropping. Appendix C provides concept-level descriptions of the stream restoration projects, as well as estimation of nutrient and sediment reductions. Figure 13 highlights the fields that have the greatest need for cover cropping and advanced nutrient management due to sandy soil allowing for greater opportunities for dissolved nutrient losses. Appendix D details nutrient reductions and costs for projects.

Some fields have drainage water management (DWM) potential, but it is estimated that this region does not lose as many lbs. per acre of nitrogen when compared to other regions in the Chesapeake Bay, making DWM less cost effective[6,7].

From the recommendations it is pointed out that there remains 10 high priority grassed waterways that have not been implemented based on modeling. Although important to stop nutrient and sediment transport, when taking all the grassed waterways into consideration that have been installed the final 10 installations are not as high a project priority as the stream restorations and controlling nutrients at the source.

[5] https://cast.chesapeakebay.net/Documentation/wipbmpcharts

[6] https://chesbay.maps.arcgis.com/apps/webappviewer/index.html?id=e90eb4f9edf244ae920768f39c70b450

[7] Field Doc estimates roughly 6 lbs per acre of nitrogen reduced using DWM, whereas other watersheds can be in excess of 10 lbs per acre reduced.

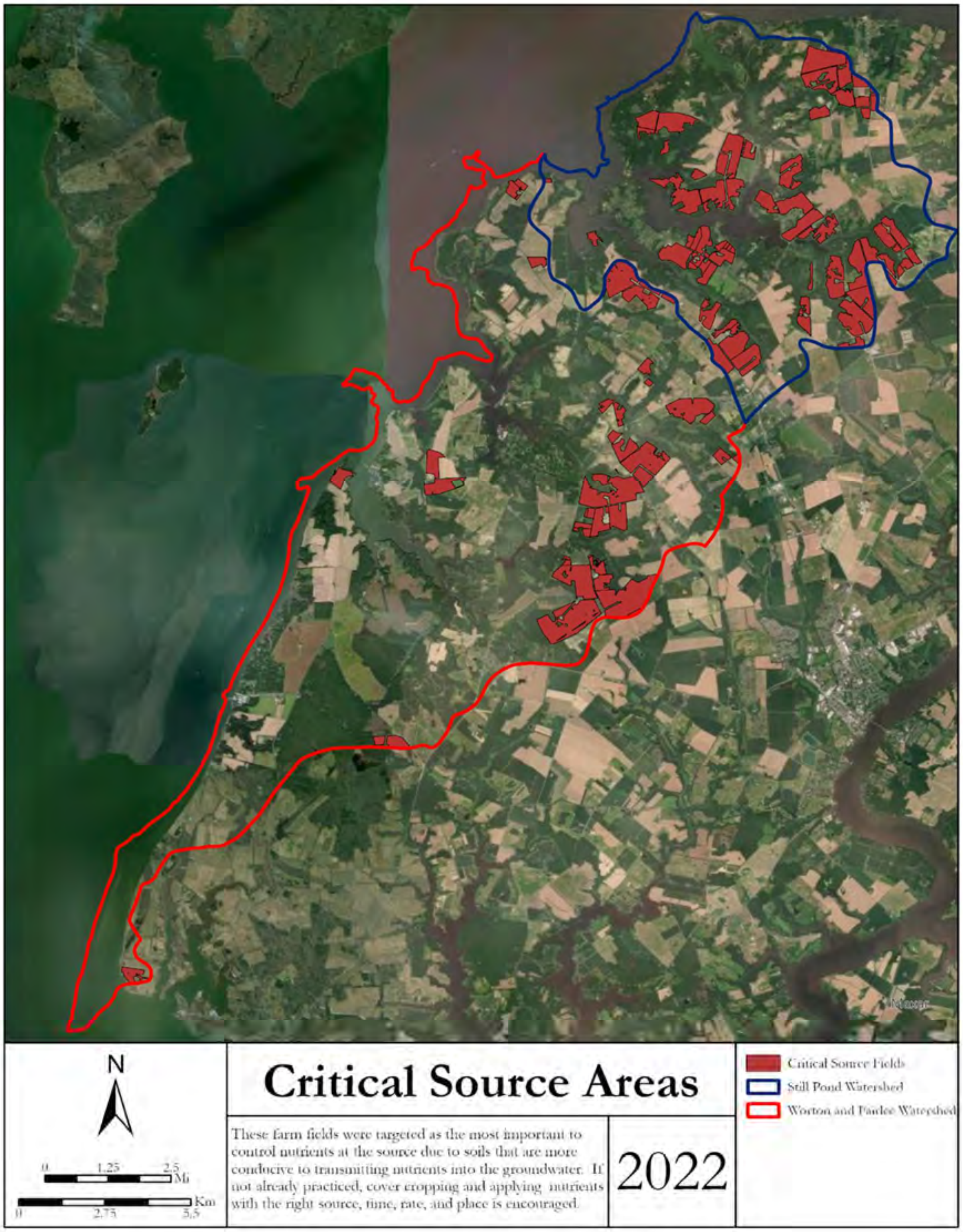

Figure 13. Critical source areas in the Bayside Creeks region.

4.5 Implementation Schedule

Table 7: Implementation Timeline – Percentage of Goals Achieved By Year

Goal	2022	2023	2024	2025	2026	2027	2028	2029
Design and install three highest priority restoration projects**	10%		25%		50%		75%	100%
Have 50 watershed residents volunteer for the SwimTesters Bacteria Monitoring program	25%	50%	75%	100%				
Conduct outreach and education events with all of the marinas and boating groups in the watershed	25%	50%	75%	100%				
Install 25 River-Friendly Yards practices on public/residential properties*		25%		50%	75%		100%	
Enroll 20 high risk/very high risk grass waterways in cost share programs	10%		25%	50%	75%		100%	
Implement at least 2 restoration projects on public land (parks, marinas, etc)**	10%		25%		50%		75%	100%

*Partners are encouraged to conduct community outreach to residents on an on-going basis as a catalyst to gaining support for the actions in this plan and encouraging future best management practice implementation. Rain barrel giveaways have proven to be a successful tool in gaining participation at community outreach events and should be considered whenever possible.
**The goals that are specific to constructing best management practices will require a significant amount of time in the pre-construction phase for planning, design and permitting. Partners are encouraged to start on this phase early so ensure that there's time for implementation before 2029.

5.0 Funding Strategy

To best prepare for implementing the projects and strategies identified in this plan, Appendix E provides a list of funding sources that have historically supported similar efforts. By identifying the funder, the purpose, the funding limit, and the date of the last Request for Proposal for each grant program, partners can plan accordingly.

The grant programs identified in the table below are made available state- and nation-wide, depending on the program; therefore it is a very competitive process. To prepare more competitive applications to fund this Action Plan, watershed partners are encouraged to reference the partner details in Appendix C to form strategically unique and supportive partnerships. Watershed partners are encouraged to engage businesses, local governments, churches, and community associations to create public-private-nonprofit partnerships to help achieve the goals of this plan.

As previously mentioned, this plan includes all of the elements of the EPA's A-I criteria, which makes these projects eligible for funding under EPA's 319 Nonpoint Source Pollution Program. In Maryland, the 319 Nonpoint Source Program is administered by MDE.

6.0 Monitoring and Reporting Progress

Watershed partners and funders will have a vested interest in determining whether or not the projects that are being implemented are successful. Success can be measured in many ways including direct improvements to water quality indicators, such as water clarity, reduced nitrogen and phosphorus levels, increased habitat, and fish abundance. Success can also be measured indirectly through metrics associated with the projects, including gallons of stormwater filtered, total pounds of nitrogen and phosphorus removed, number of rain gardens installed, etc.

The monitoring plan includes the monitoring of the four creeks as it relates to aquatic and water quality indicators, as well as monitoring the progress toward achieving the six 8-year goals identified in Table 7. Since ShoreRivers has the experience and the capabilities to monitor water quality they should continue to test the water as they have done for the past two years and expand that monitoring program where it's necessary. Identifying long-term trends in data will help us understand if the work being performed on the land is generating a sustainable change in water quality. On-going water quality monitoring in the Bayside Creeks will also help to identify any additional hot spots of pollution that might be forming, as well as provide a snapshot of what the water quality is throughout the different seasons.

In order to monitor the progress towards the 8-year goals, ShoreRivers and watershed partners will continue to collect information and create a clearing house of projects that have been implemented and plan to be implemented. These groups should assess progress towards the 8-year goals twice each year, if not more frequent. Measuring progress is a way to motivate watershed partners and encourage more implementation. The more frequent the organizations assess the progress, the more conversations and strategizing will occur among them.

To help monitor the progress made in terms of project implementation, and therefore nutrient load reduction, the FieldDoc calculator should be used as a monitoring tool. All of the projects presented in this plan have been entered and saved in the FieldDoc database. Once a project is implemented, ShoreRivers can enter that information into the database. ShoreRivers should also prepare a yearly summary of progress that can be submitted to MDE and other interested officials to ensure that the projects that are being implemented are accounted for and contributing to the load reductions identified in the Chesapeake Bay Cleanup Plan.

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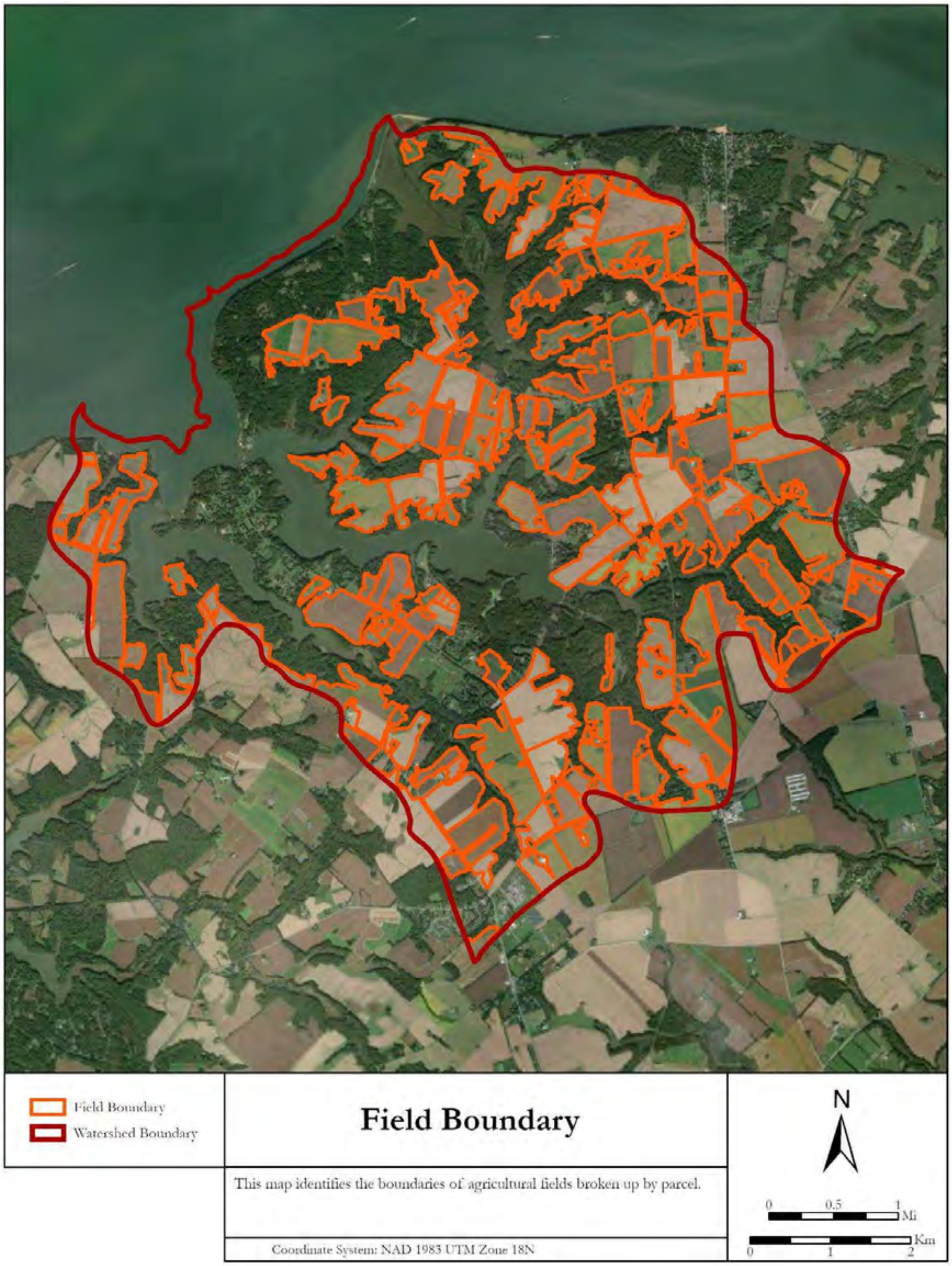
NFWF (National Fish and Wildlife Foundation), 2016. FieldDoc.io User Guide. http://www.nfwf.org/chesapeake/Documents/FieldDoc-User-Guide.pdf

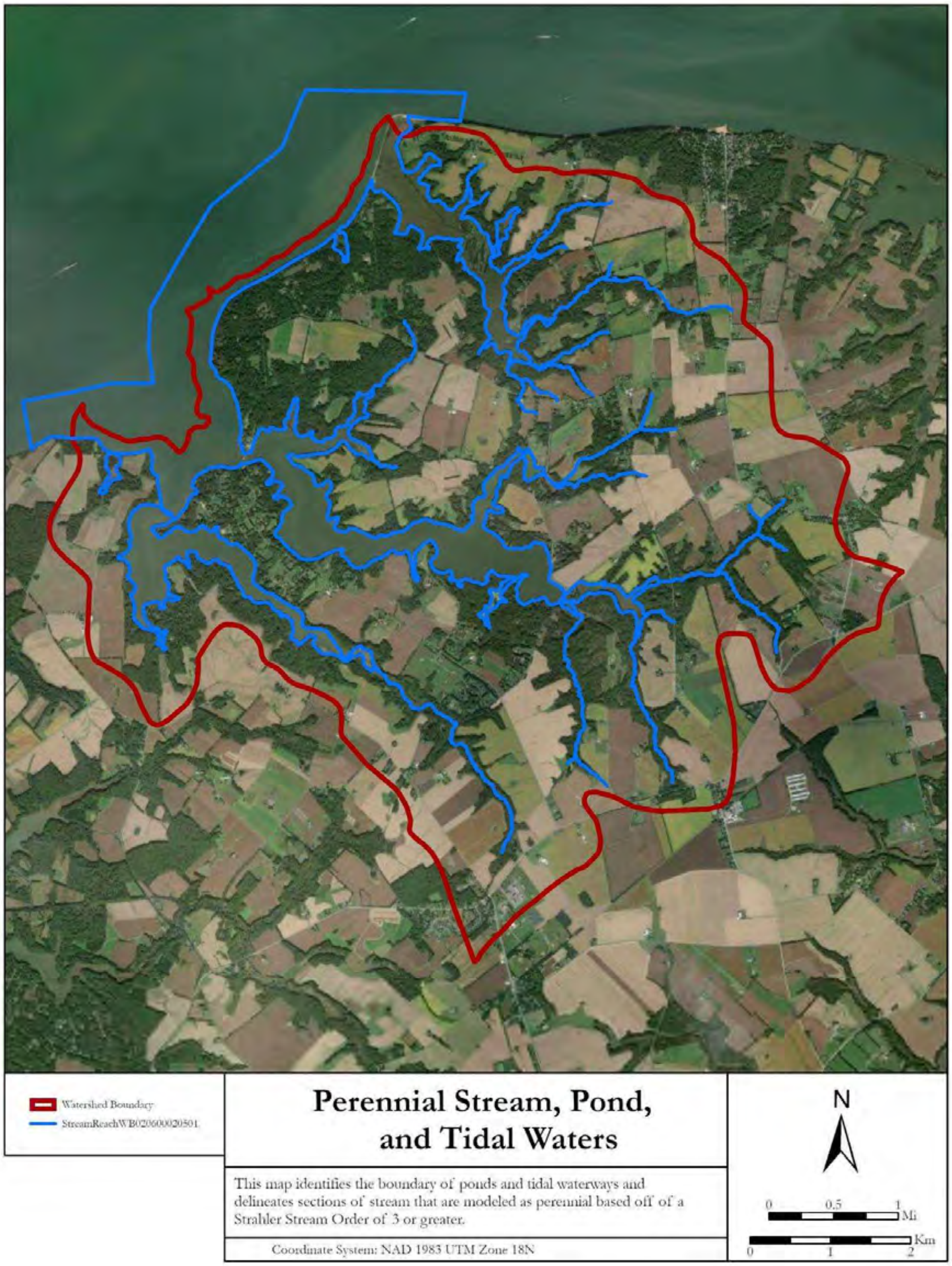
Appendices

Appendix A
NPDES

Facility Name	Permit Number	Discharge Characteristic	Permit Limit
Tolchester Marina, Inc	MDG999241	Copper, total (as Cu) Flow Lead, total (as Pb) Oil & grease Solids, total suspended Zinc, total (as Zn)	.06 mg/L Mon gal/d .08 mg/L 15 mg/L 50 mg/L .81 mg/L
Fairfield Farm	MDG010041	N/A	Permit Expired
Zachary Loller/William Loller Farm, LLC	MDG010399	N/A	Permit Expired
Tolchester Wastewater Treatment Plant	MD0067202	BOD, 5-day, 20 deg. C Chlorine, total residual Coliform, fecal general Flow Nitrogen, total (as N) Oxygen, dissolved (DO) Phosphorus, total (as P) Solids, total suspended pH	99 lb/d MX WK AV .1 mg/L DAILY MX 14 MPN/100mL MO MED Mon MGD Mon lb/mo 6 mg/L MN WK AV Mon lb/mo 99 lb/d MX WK AV 8.5 SU MAXIMUM
Mears Great Oak Landing Wastewater Treatment Plant	MD0024945 MDG999221	Copper, total (as Cu) Flow Lead, total (as Pb) Oil & grease Solids, total suspended Zinc, total (as Zn)	.06 mg/L Monitored gal/d .08 mg/L 15 mg/L 50 mg/L .81 mg/L
Worton Creek Marina	MDG999158	N/A	Permit Expired

Appendix B.1
ACPF Outputs for Still Pond and Churn Creek

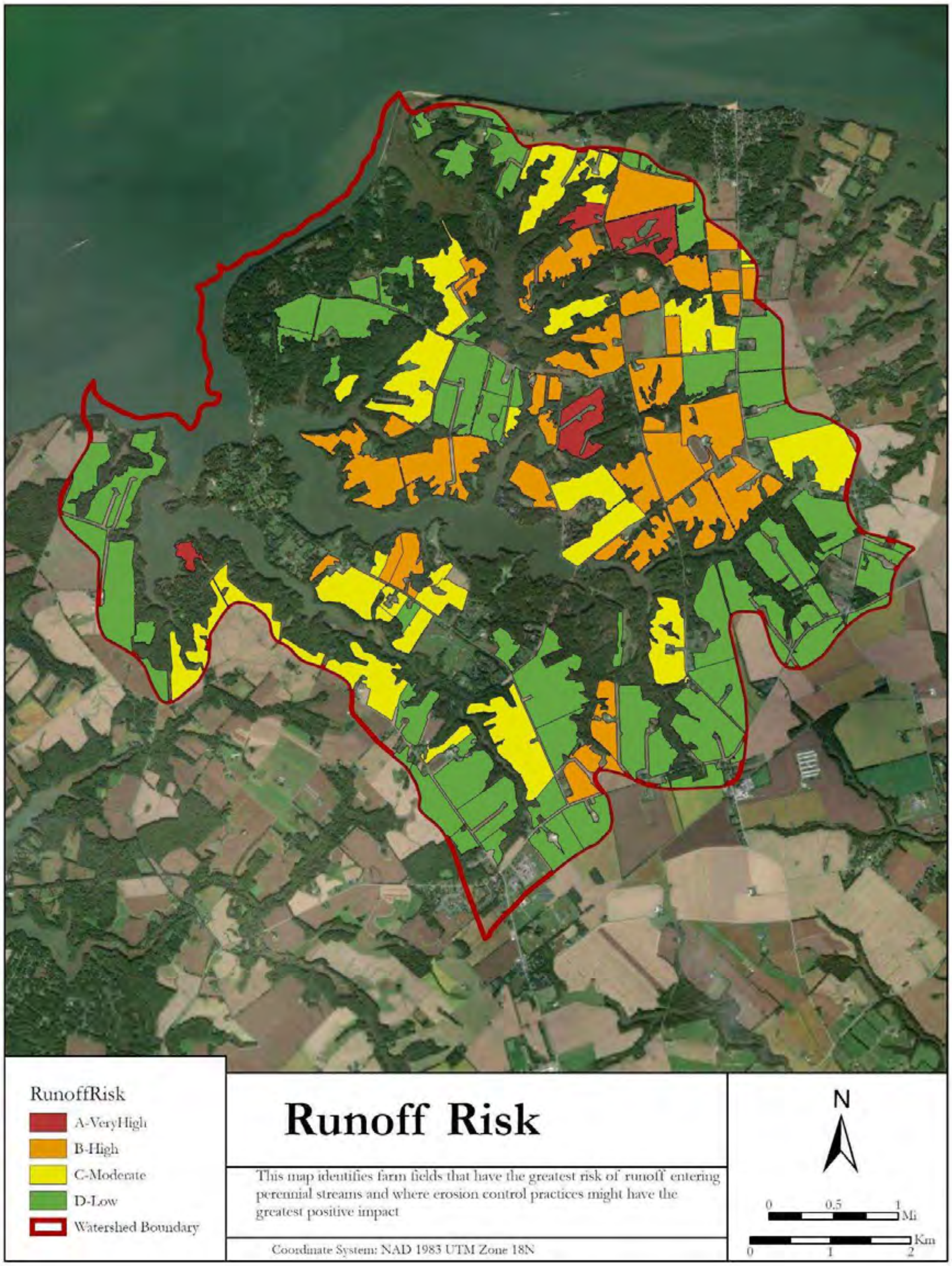


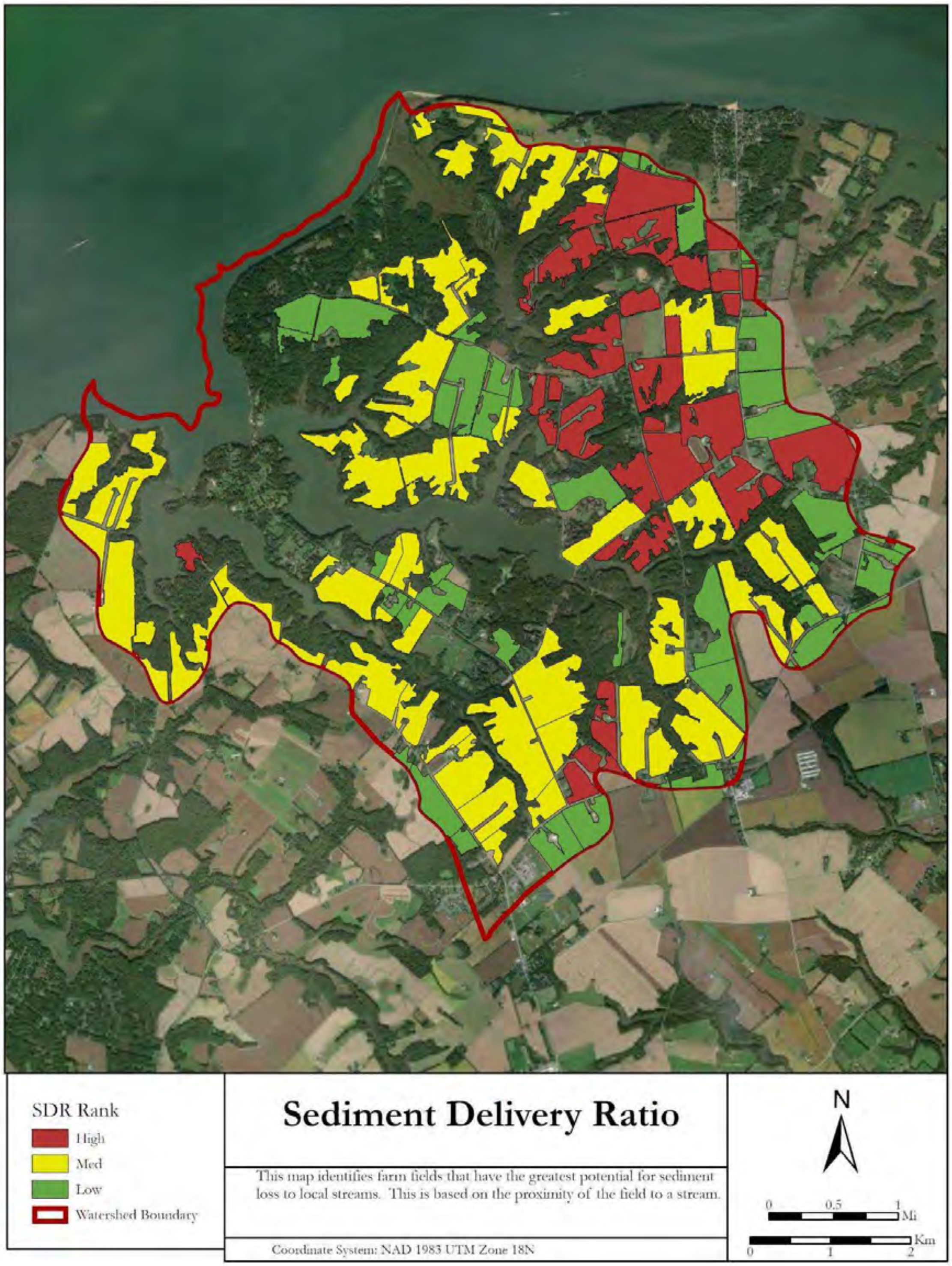


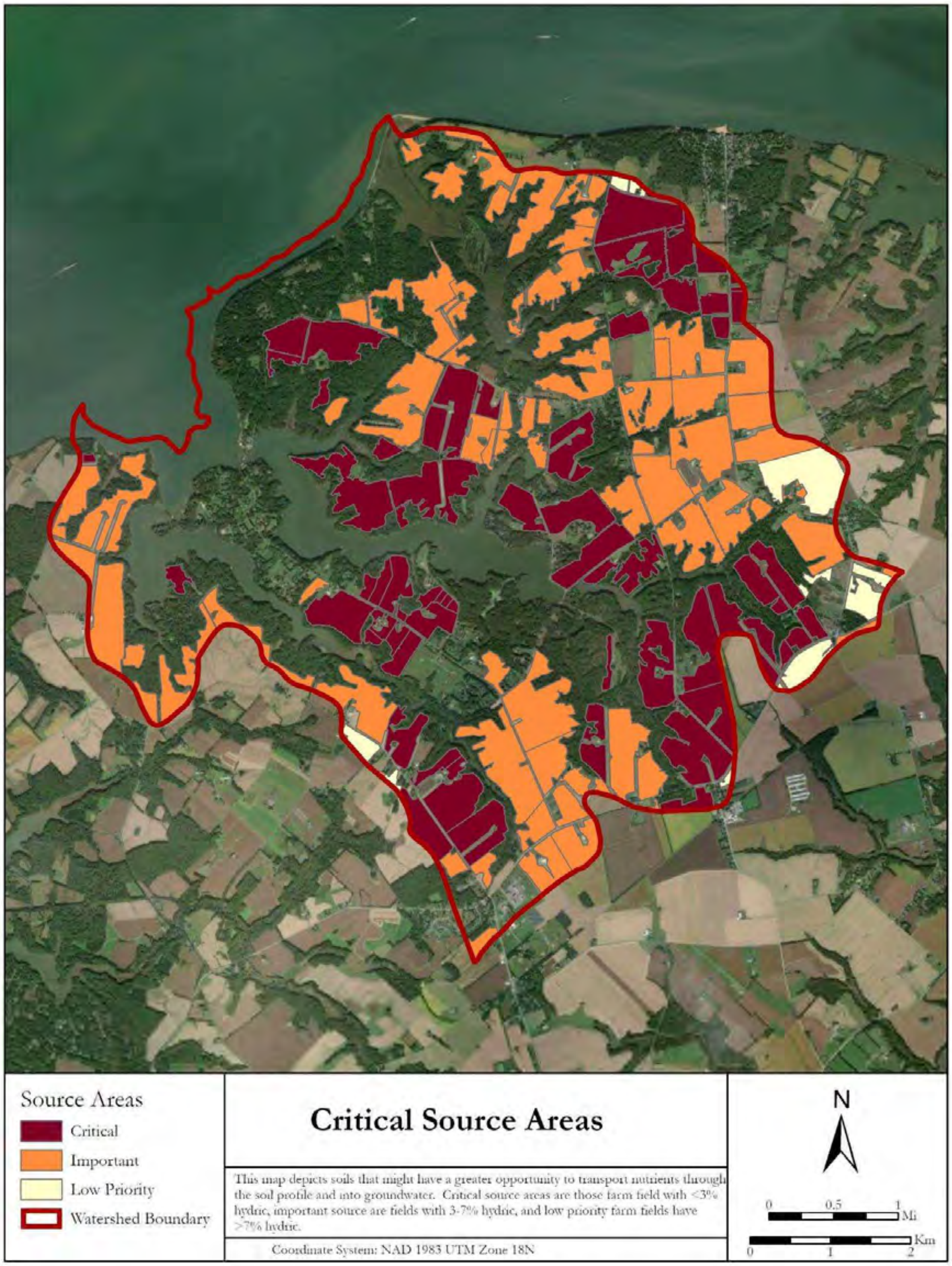
Perennial Stream, Pond, and Tidal Waters

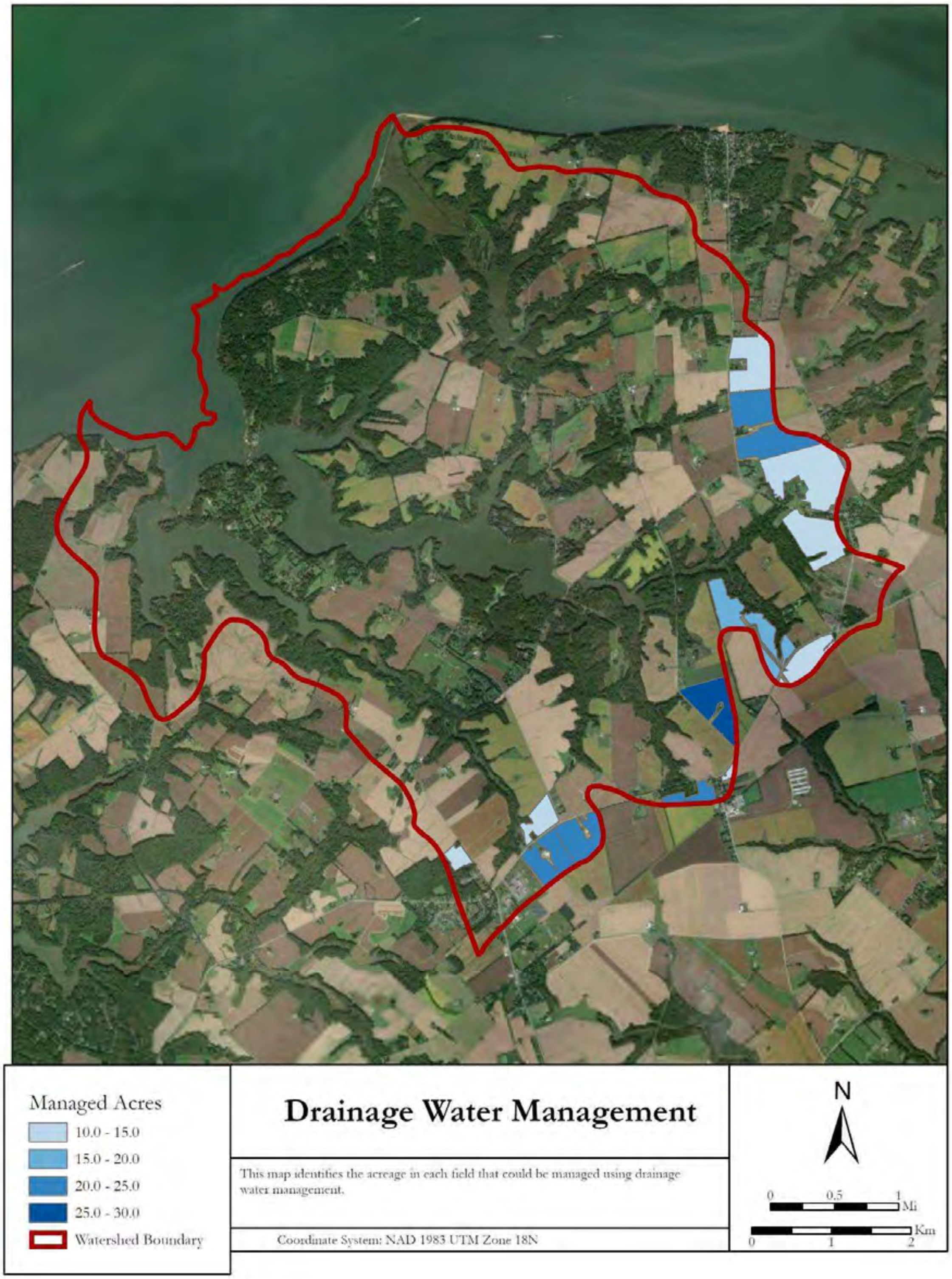
This map identifies the boundary of ponds and tidal waterways and delineates sections of stream that are modeled as perennial based off of a Strahler Stream Order of 3 or greater.

Coordinate System: NAD 1983 UTM Zone 18N


RunoffRisk
A-VeryHigh
B-High
C-Moderate
D-Low
Watershed Boundary
Runoff Risk
This map identifies farm fields that have the greatest risk of runoff entering perennial streams and where erosion control practices might have the greatest positive impact
Coordinate System: NAD 1983 UTM Zone 18N
N
0 0.5 1 Mi
0 1 2 Km


SDR Rank
High
Med
Low
Watershed Boundary
Sediment Delivery Ratio
This map identifies farm fields that have the greatest potential for sediment loss to local streams. This is based on the proximity of the field to a stream.
Coordinate System: NAD 1983 UTM Zone 18N
N
0 0.5 1 Mi
0 1 2 Km

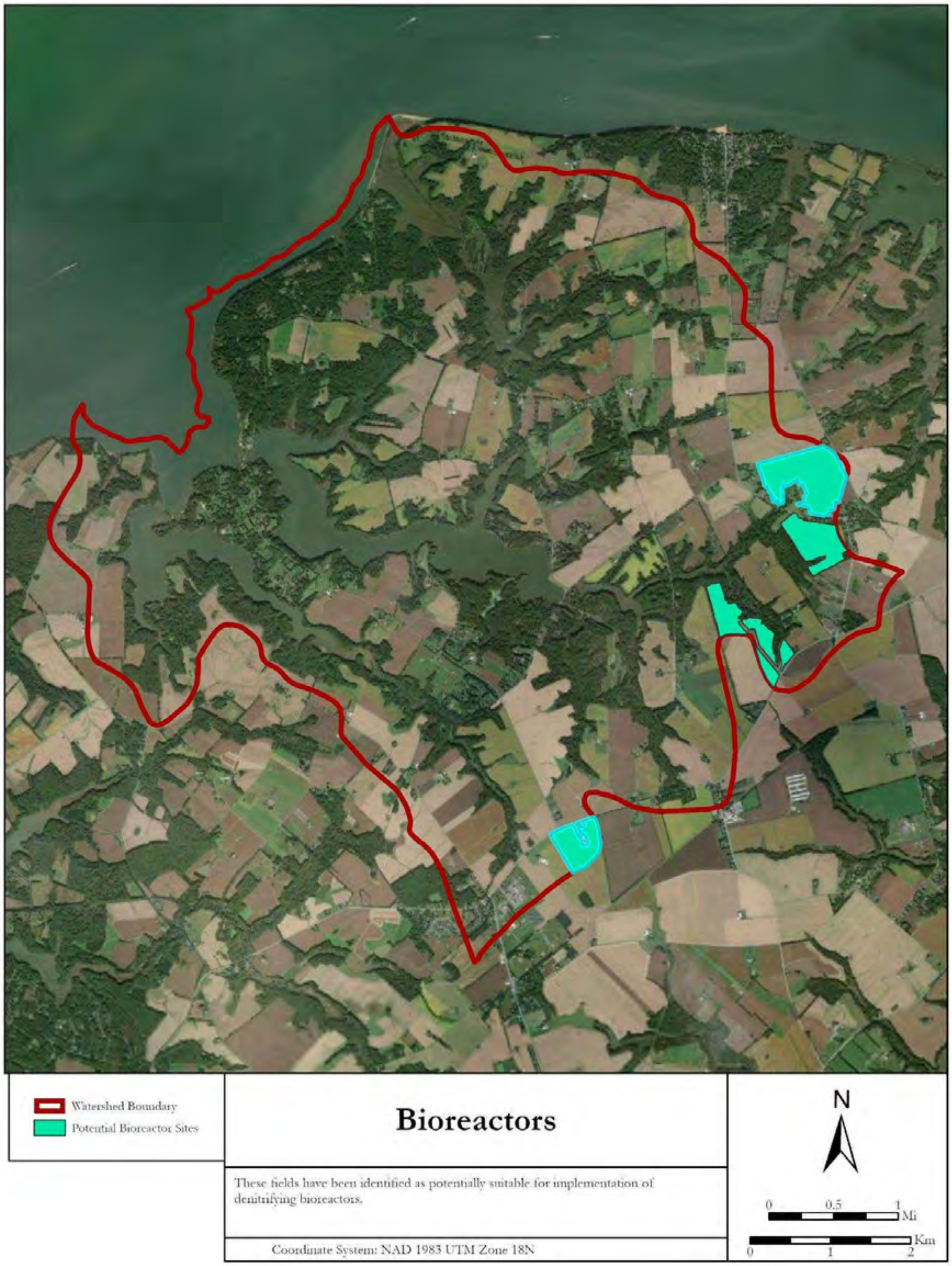

Source Areas
Critical
Important
Low Priority
Watershed Boundary
Critical Source Areas
This map depicts soils that might have a greater opportunity to transport nutrients through the soil profile and into groundwater. Critical source areas are those farm field with <3% hydric, important source are fields with 3-7% hydric, and low priority farm fields have >7% hydric.
Coordinate System: NAD 1983 UTM Zone 18N
N
0
0.5
1
Mi
0
1
2
Km

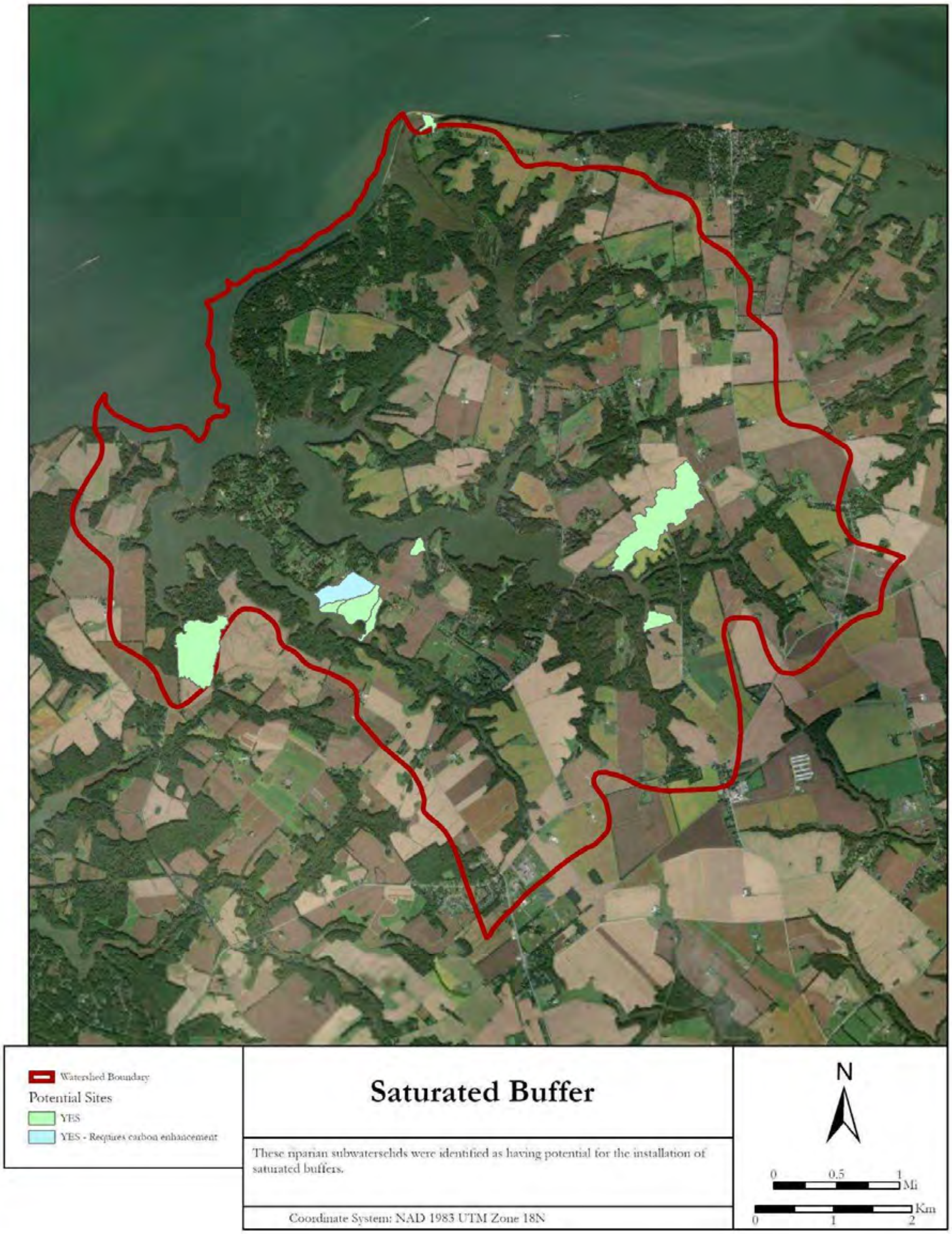


Drainage Water Management

This map identifies the acreage in each field that could be managed using drainage water management.

Coordinate System: NAD 1983 UTM Zone 18N


Watershed Boundary
Potential Bioreactor Sites
Bioreactors
These fields have been identified as potentially suitable for implementation of denitrifying bioreactors.
Coordinate System: NAD 1983 UTM Zone 18N
N
0 0.5 1 Mi
0 1 2 Km


Watershed Boundary
Potential Sites
YES
YES - Requires carbon enhancement
Saturated Buffer
These riparian subwatersehds were identified as having potential for the installation of saturated buffers.
Coordinate System: NAD 1983 UTM Zone 18N
N
0 0.5 1 Mi
0 1 2 Km

Watershed Boundary
Grassed Waterway

Grassed Waterways

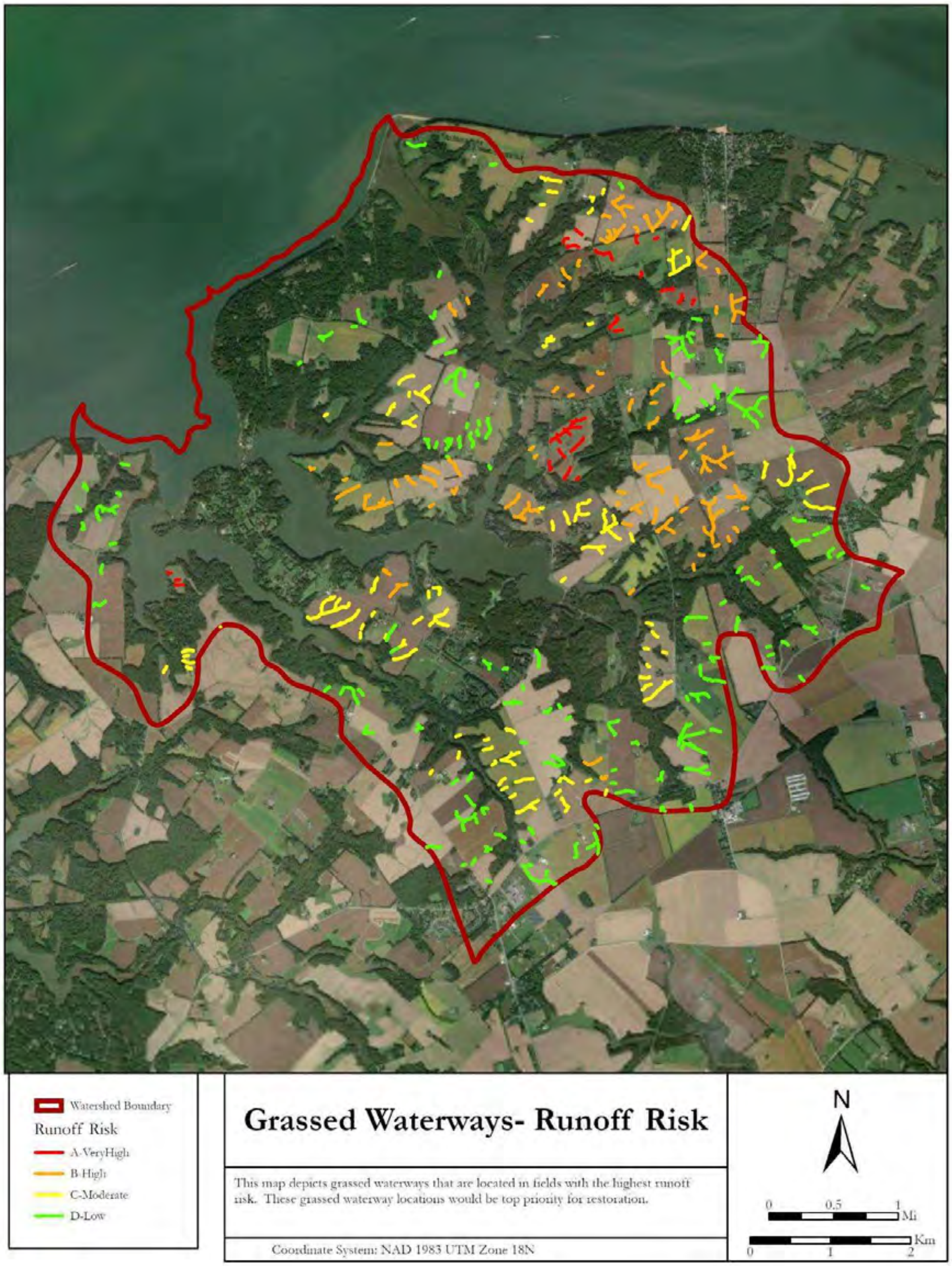
This map depicts potential locations of grassed waterways. Grassed waterways help reduce nutrient and sediment transport by stabilizing preferential overland flowpaths using grass buffers.

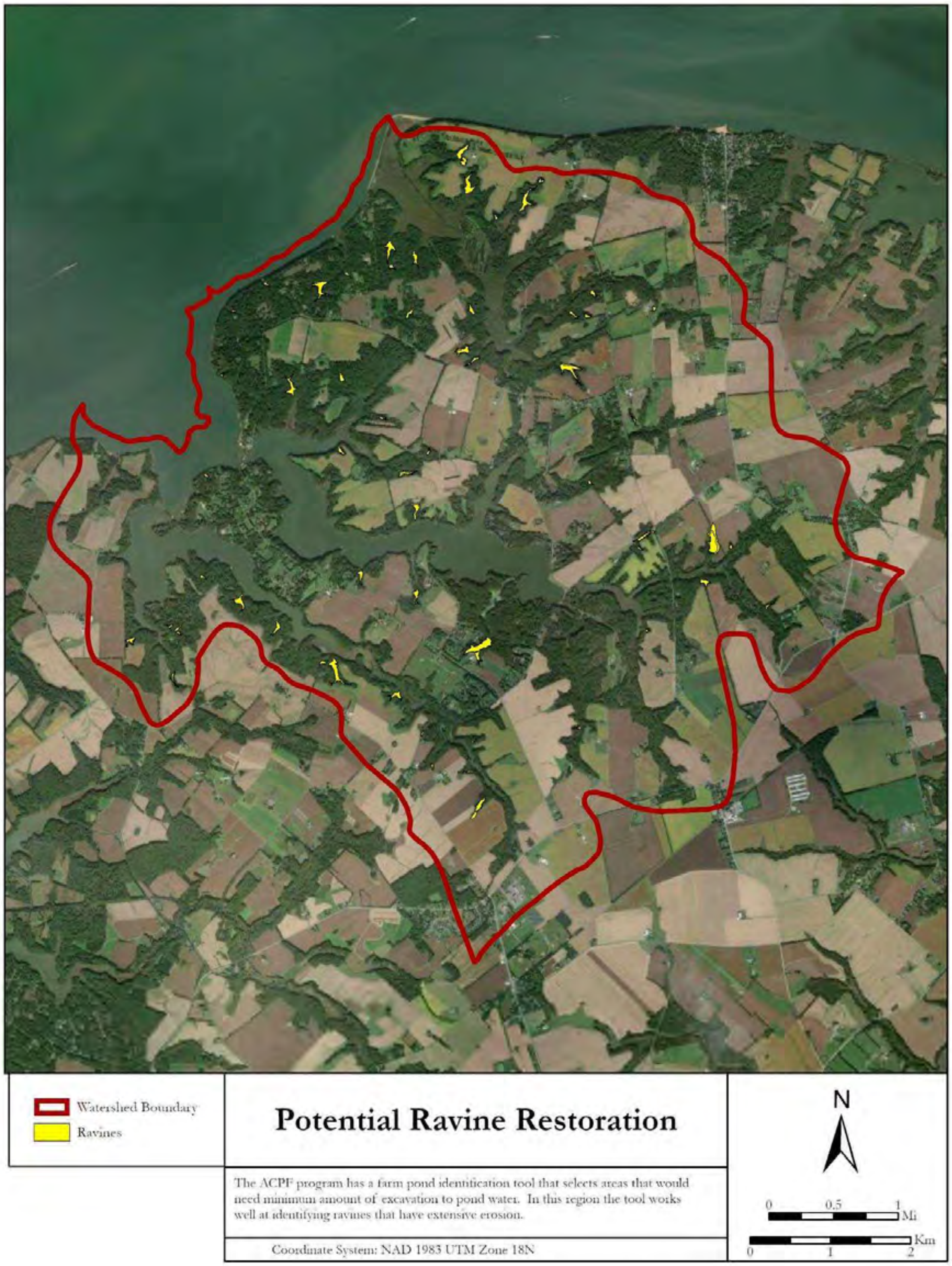
Coordinate System: NAD 1983 UTM Zone 18N

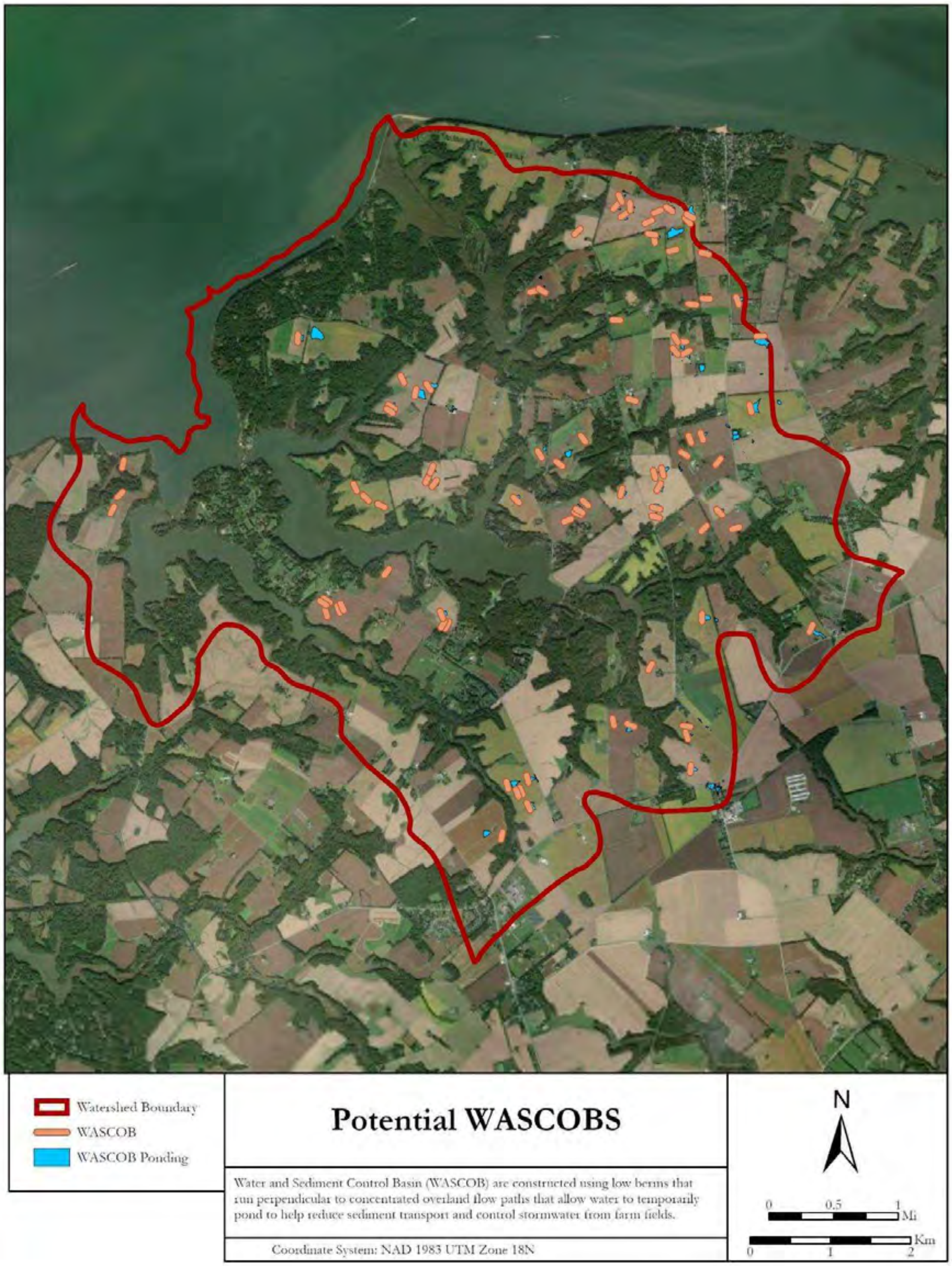
N

0 0.5 1 Mi

0 1 2 Km

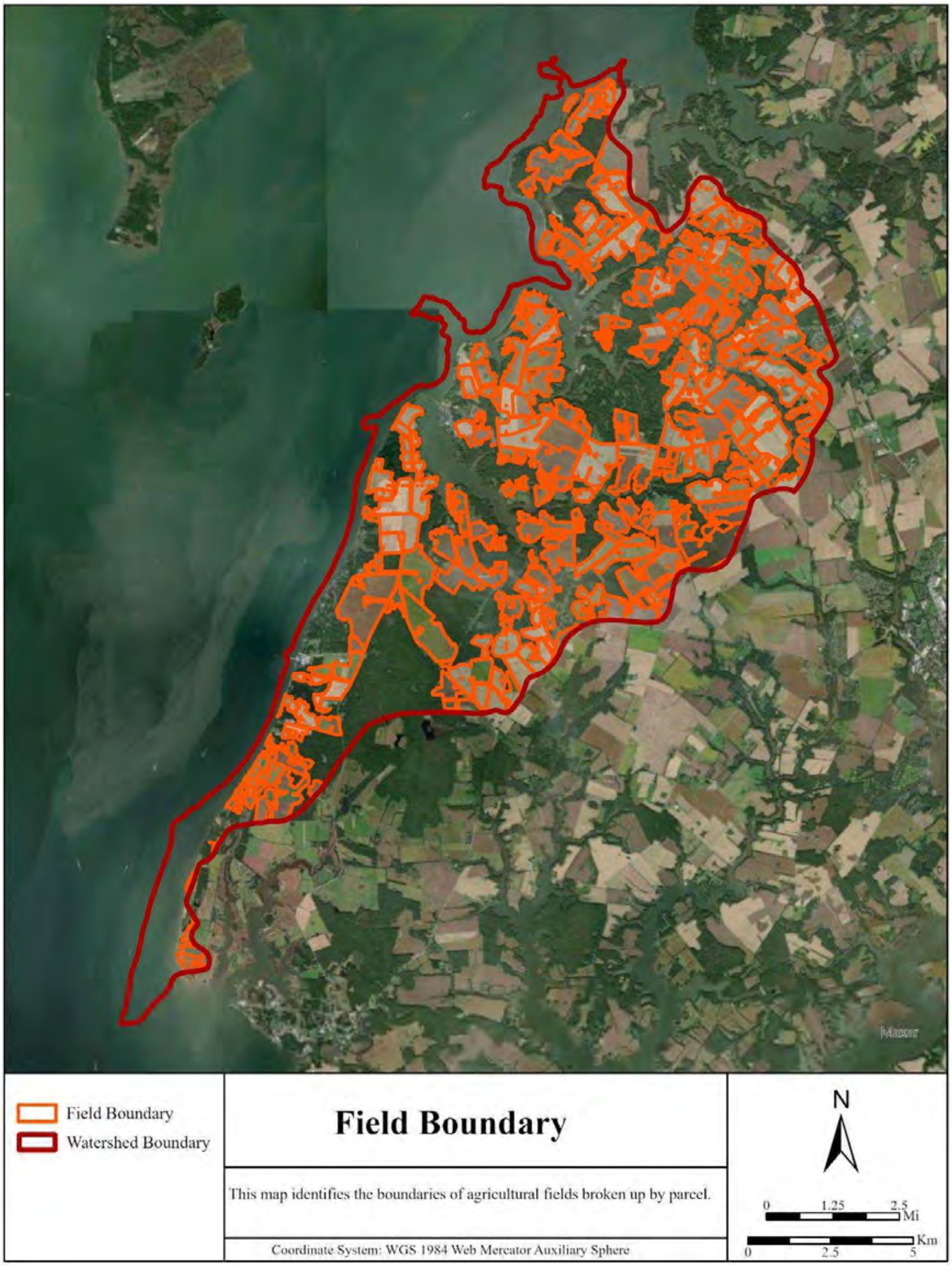

Watershed Boundary
Runoff Risk
A-VeryHigh
B-High
C-Moderate
D-Low
Grassed Waterways- Runoff Risk
This map depicts grassed waterways that are located in fields with the highest runoff risk. These grassed waterway locations would be top priority for restoration.
Coordinate System: NAD 1983 UTM Zone 18N
N
0 0.5 1 Mi
0 1 2 Km

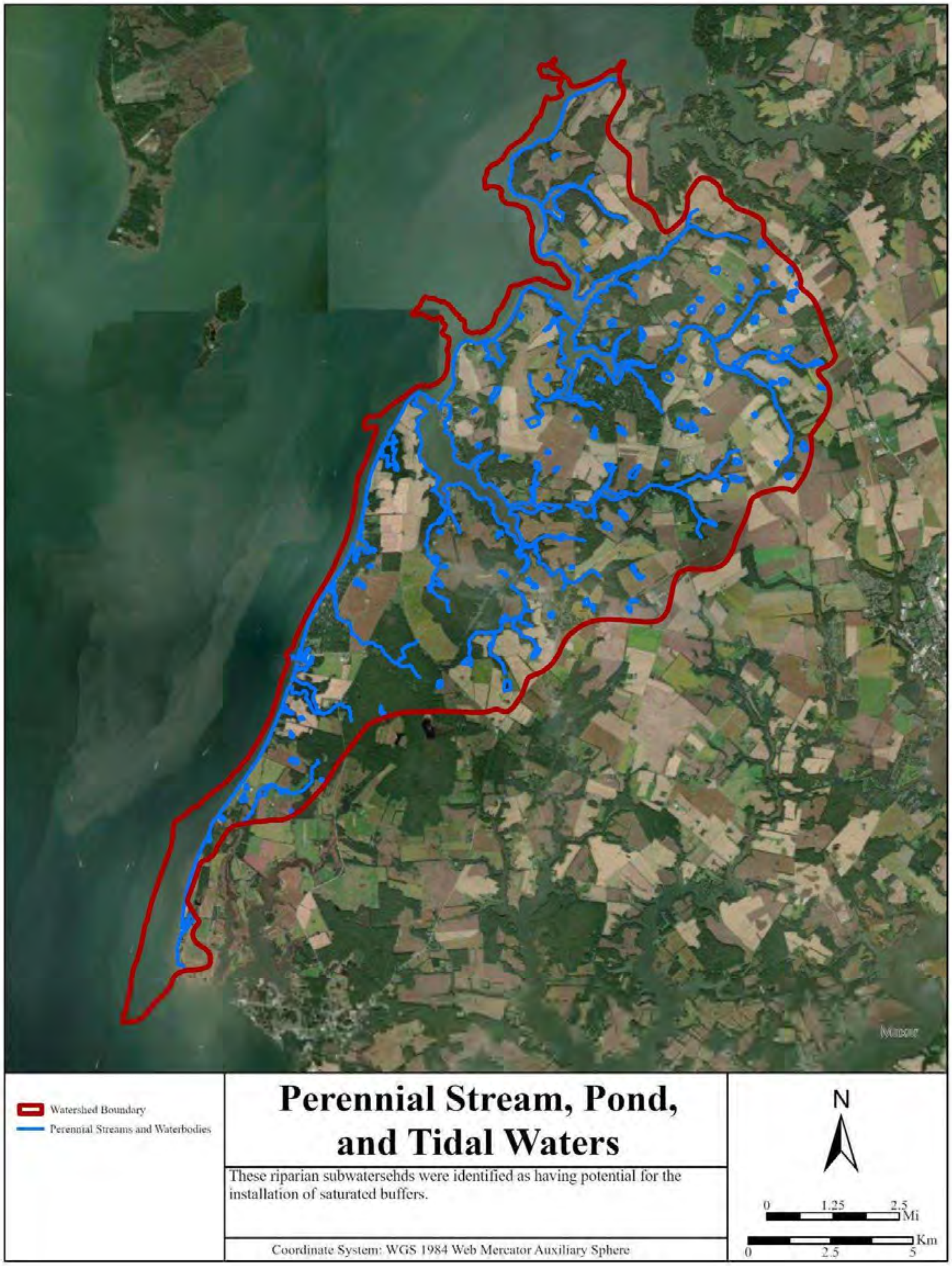

Watershed Boundary
Ravines
Potential Ravine Restoration
The ACPF program has a farm pond identification tool that selects areas that would need minimum amount of excavation to pond water. In this region the tool works well at identifying ravines that have extensive erosion.
Coordinate System: NAD 1983 UTM Zone 18N
N
0 0.5 1 Mi
0 1 2 Km

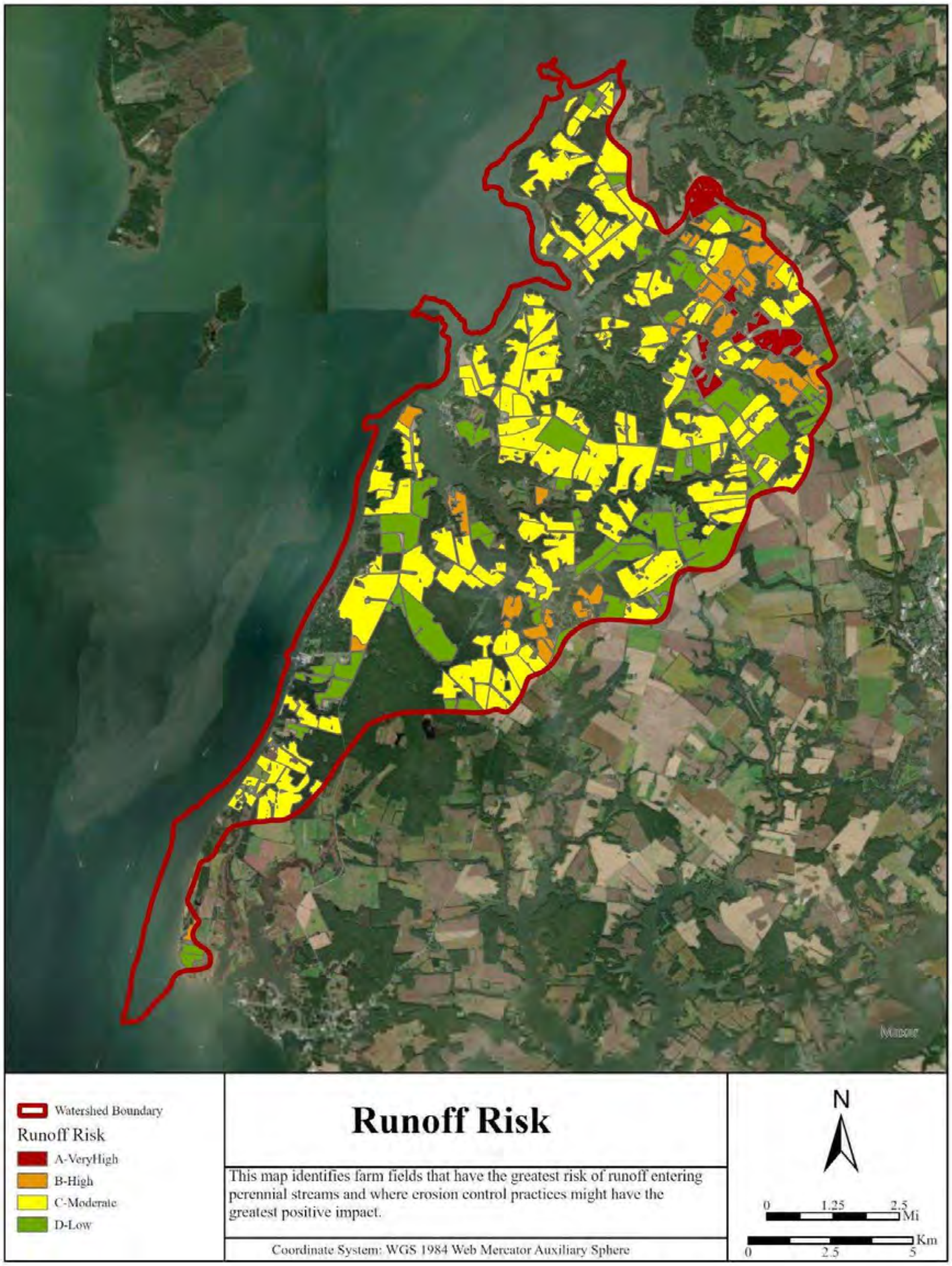

Watershed Boundary
WASCOB
WASCOB Ponding
Potential WASCOBS
Water and Sediment Control Basin (WASCOB) are constructed using low berms that run perpendicular to concentrated overland flow paths that allow water to temporarily pond to help reduce sediment transport and control stormwater from farm fields.
Coordinate System: NAD 1983 UTM Zone 18N
N
0 0.5 1 Mi
0 1 2 Km

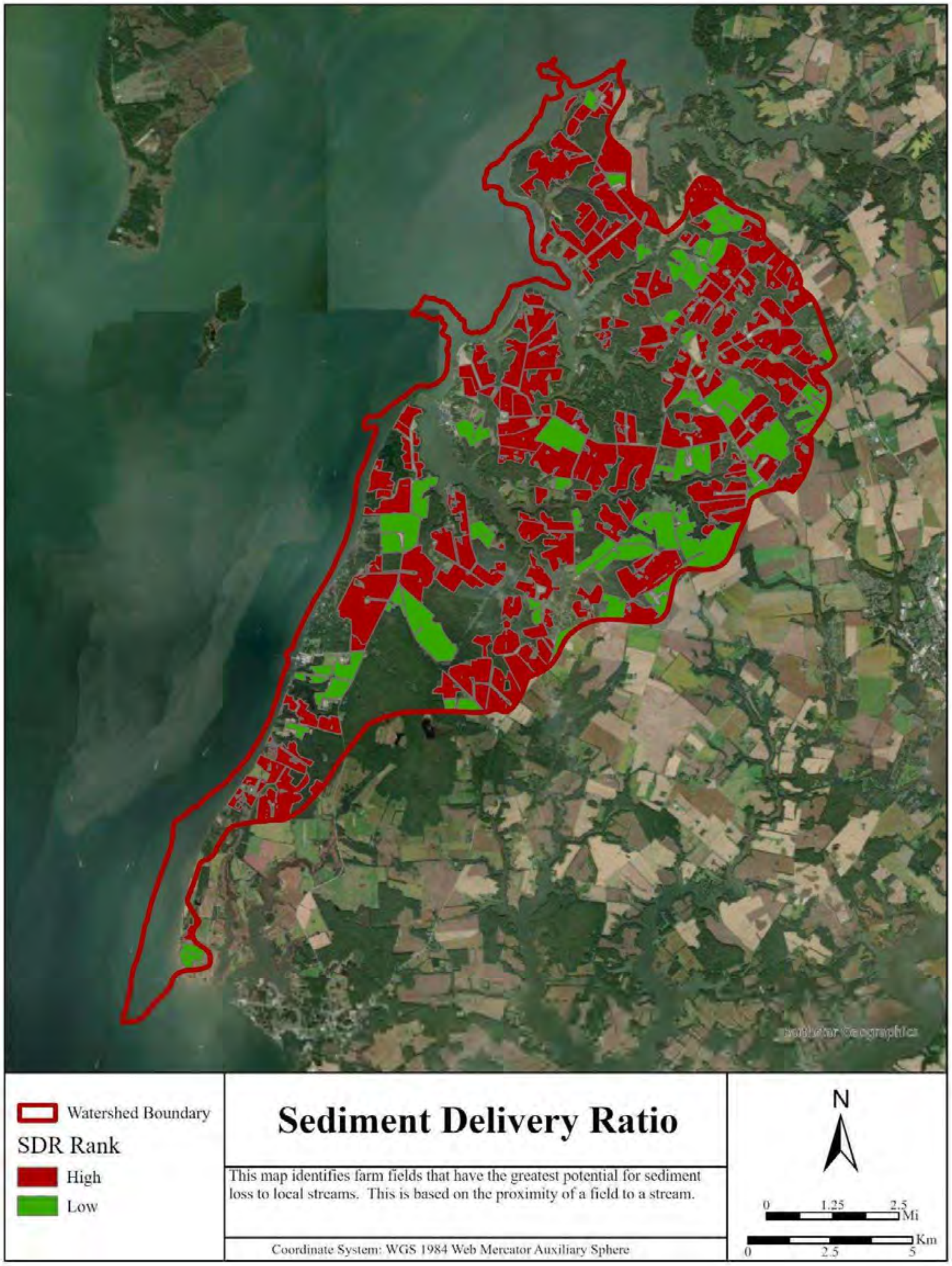
Appendix B.1

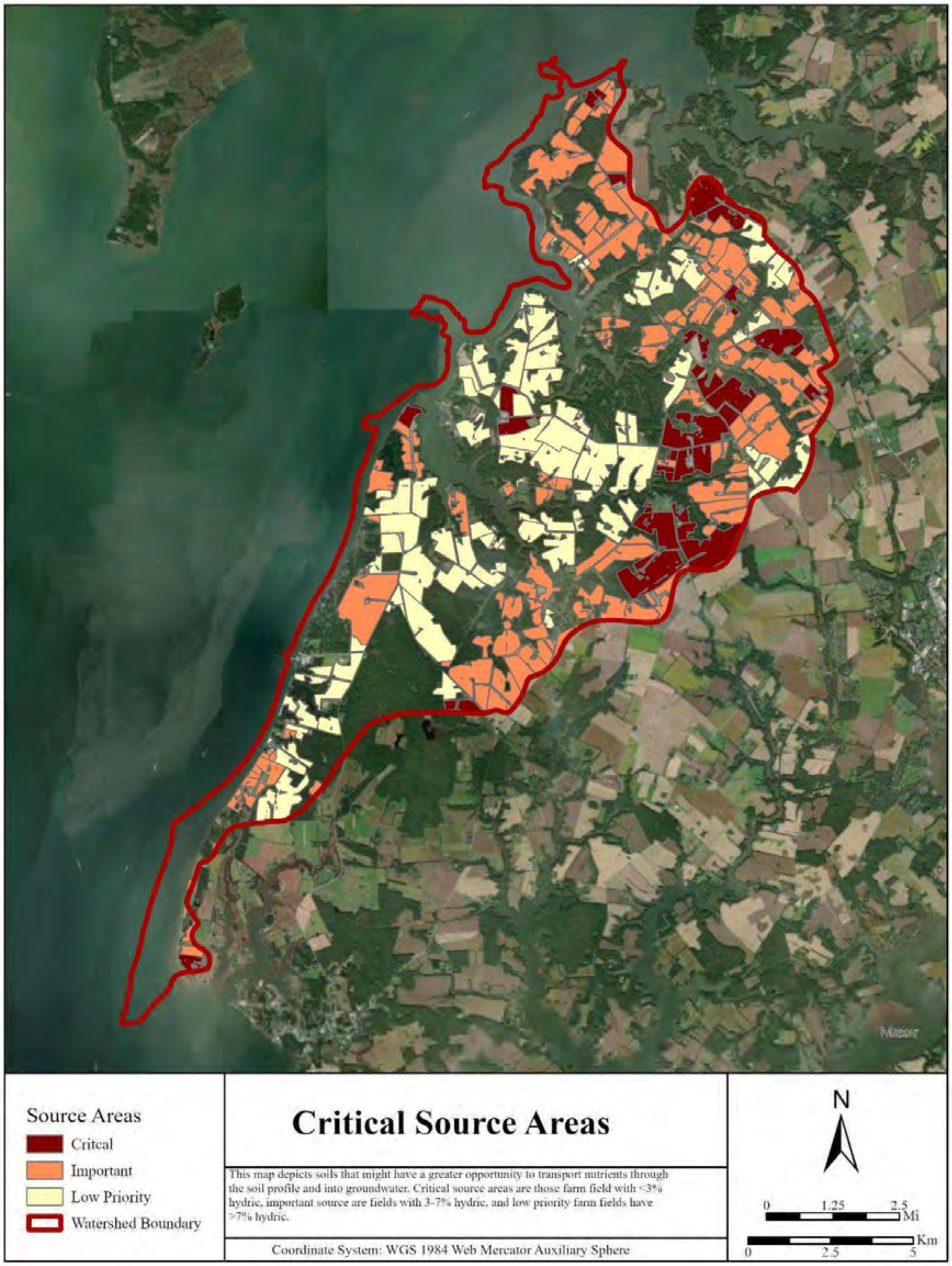
Appendix B.2
ACPF Outputs for Worton Creek and Fairlee Creek

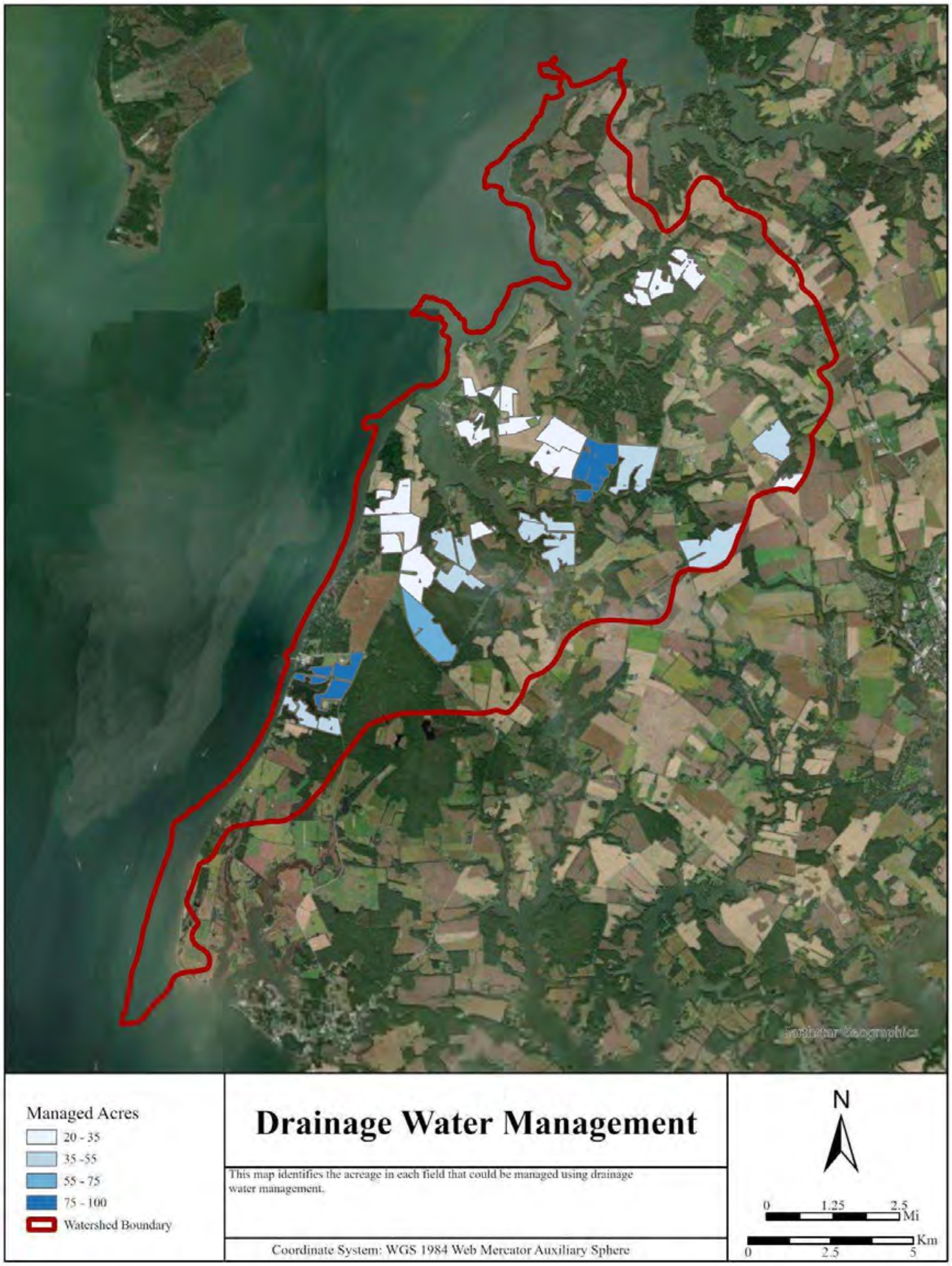


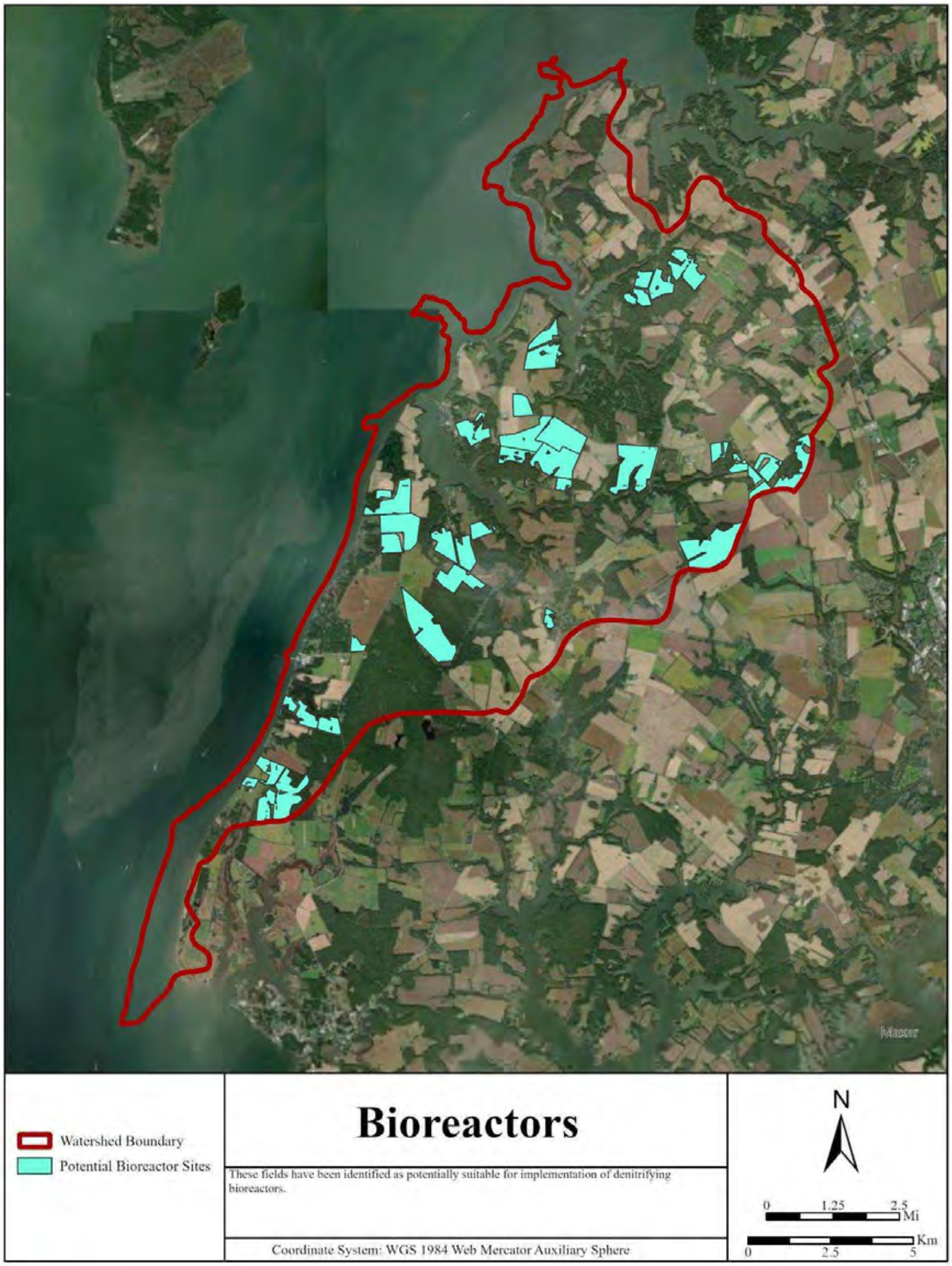

Watershed Boundary
Perennial Streams and Waterbodies
Perennial Stream, Pond, and Tidal Waters
These riparian subwatersehds were identified as having potential for the installation of saturated buffers.
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
N
0 1.25 2.5 Mi
0 2.5 5 Km

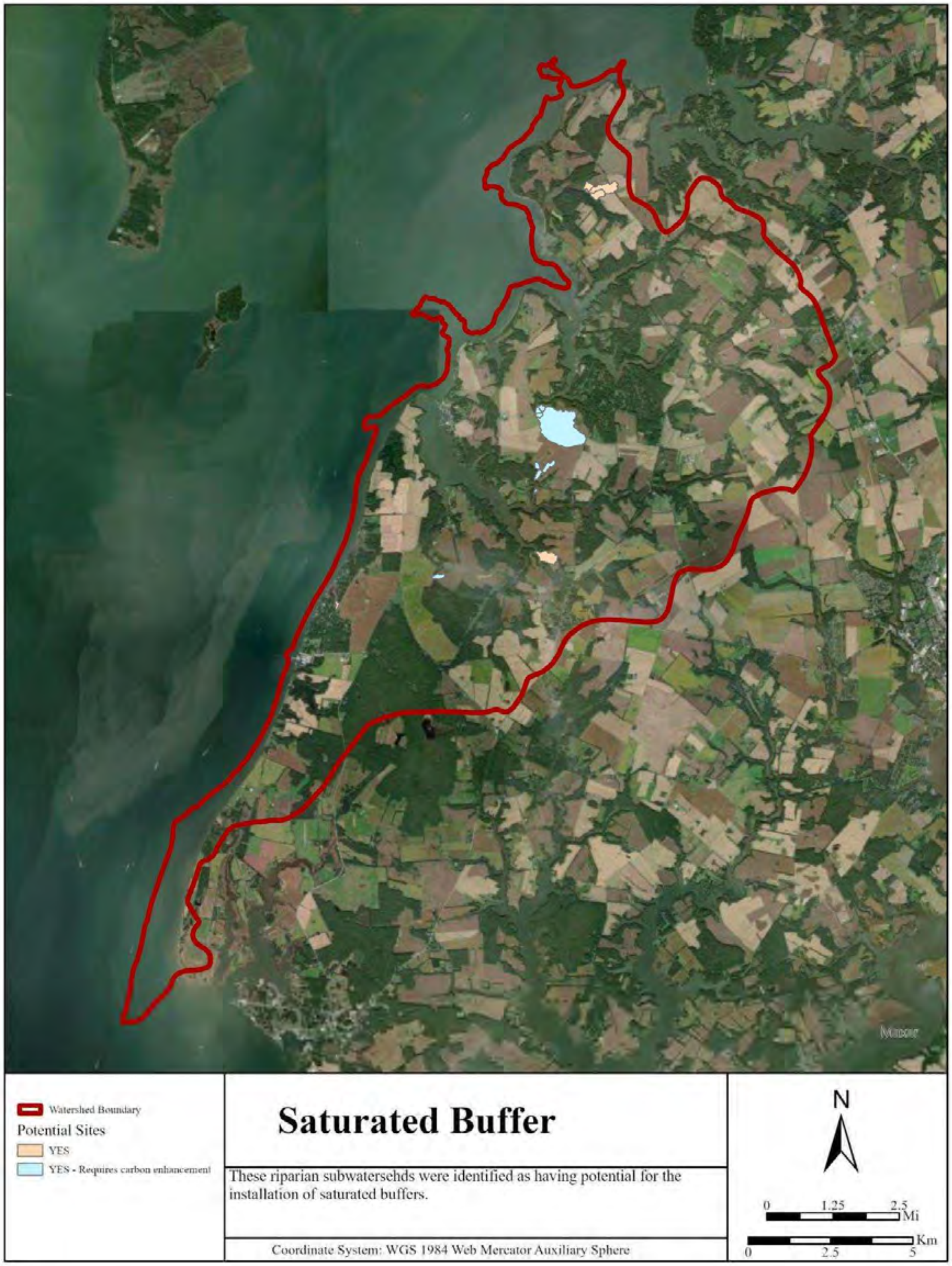

Watershed Boundary
Runoff Risk
A-VeryHigh
B-High
C-Moderate
D-Low
Runoff Risk
This map identifies farm fields that have the greatest risk of runoff entering perennial streams and where erosion control practices might have the greatest positive impact.
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
N
0 1.25 2.5 Mi
0 2.5 5 Km

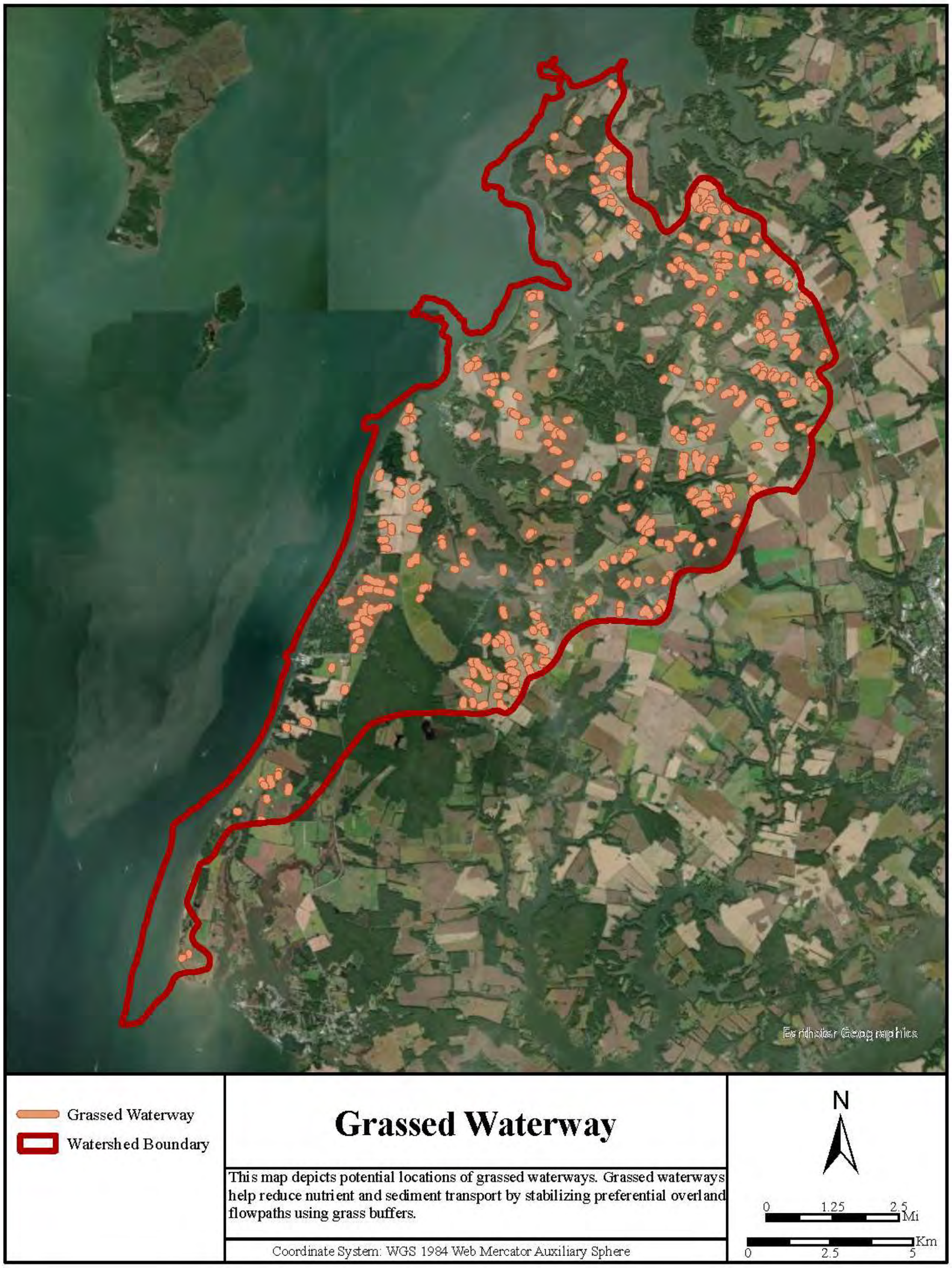

Watershed Boundary
SDR Rank
High
Low
Sediment Delivery Ratio
This map identifies farm fields that have the greatest potential for sediment loss to local streams. This is based on the proximity of a field to a stream.
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
N
0 1.25 2.5 Mi
0 2.5 5 Km

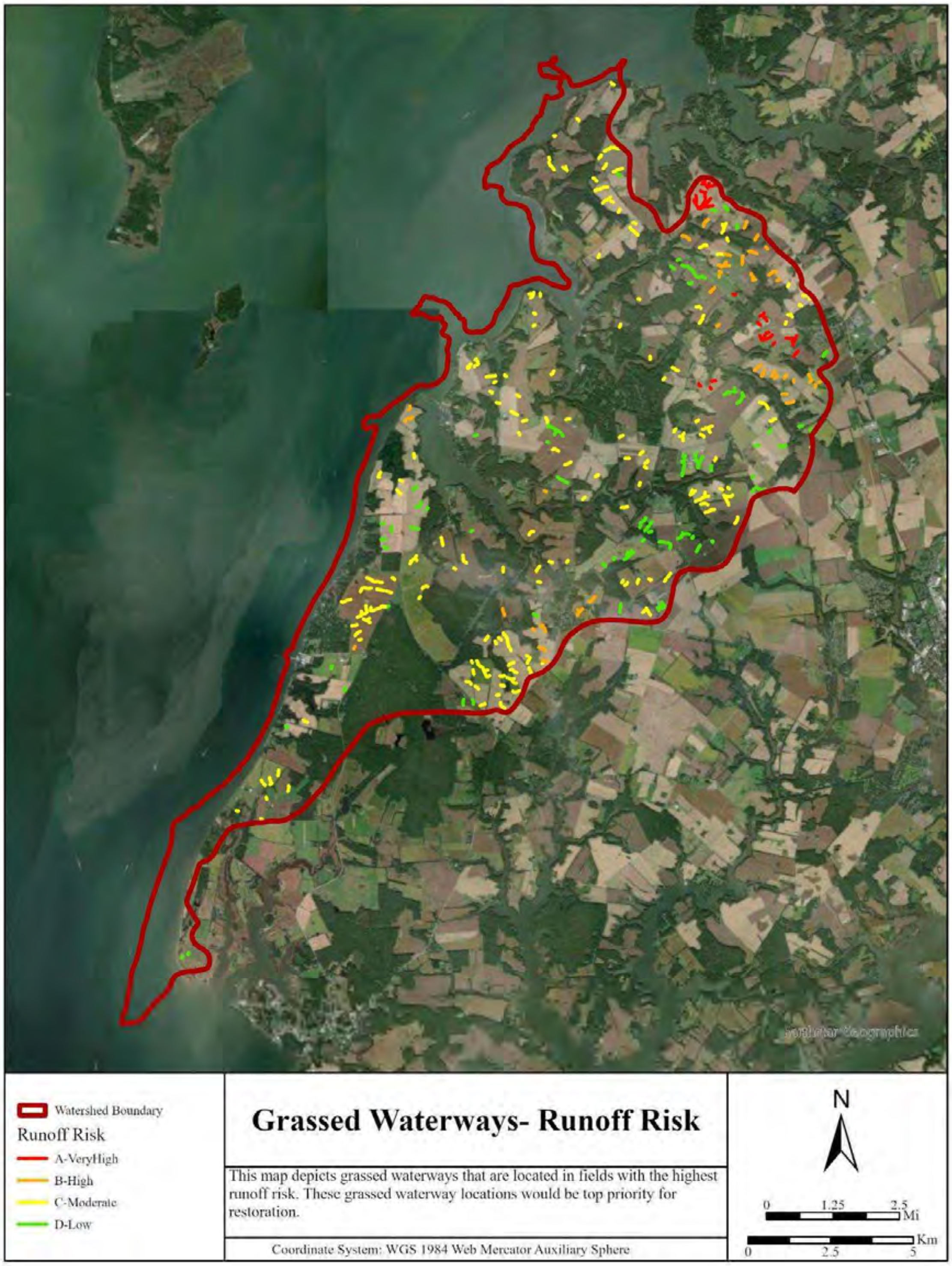

Source Areas
Critcal
Important
Low Priority
Watershed Boundary
Critical Source Areas
This map depicts soils that might have a greater opportunity to transport nutrients through the soil profile and into groundwater. Critical source areas are those farm field with <3% hydric, important source are fields with 3-7% hydric, and low priority farm fields have >7% hydric.
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
N
0 1.25 2.5 Mi
0 2.5 5 Km


Managed Acres
20 - 35
35 -55
55 - 75
75 - 100
Watershed Boundary
Drainage Water Management
This map identifies the acreage in each field that could be managed using drainage water management.
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
N
0
1.25
2.5
Mi
0
2.5
5
Km


Maxar
Watershed Boundary
Potential Bioreactor Sites
Bioreactors
These fields have been identified as potentially suitable for implementation of denitrifying bioreactors.
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
N
0 1.25 2.5 Mi
0 2.5 5 Km


Watershed Boundary
Potential Sites
YES
YES - Requires carbon enhancement
Saturated Buffer
These riparian subwatersehds were identified as having potential for the installation of saturated buffers.
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
N
0 1.25 2.5 Mi
0 2.5 5 Km
Maxar


Earthstar Geographics
Grassed Waterway
Watershed Boundary
Grassed Waterway
This map depicts potential locations of grassed waterways. Grassed waterways help reduce nutrient and sediment transport by stabilizing preferential overland flowpaths using grass buffers.
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
N
0 1.25 2.5 Mi
0 2.5 5 Km



Grassed Waterways- Runoff Risk

This map depicts grassed waterways that are located in fields with the highest runoff risk. These grassed waterway locations would be top priority for restoration.

Potential Ravine Restoration

The ACPF program has a farm pond identification tool that selects areas that would need minimum amount of excavation to pond water. In this region the tool works well at identifying ravines that have extensive erosion.


Watershed Boundary
WASCOB
WASCOB Ponding
Potential WASCOBS
Water and Sediment Control Basin (WASCOB) are constructed using low berms that run perpendicular to concentrated overland flow paths that allow water to temporarily pond to help reduce sediment transport and control stormwater from farm fields.
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
N
0 1.25 2.5 Mi
0 2.5 5 Km

Appendix C
Stream Restoration Concept Designs

See separate document for Concept Designs

Appendix D

Nutrient and Sediment Reductions and estimated costs

FAIRLEE CREEK STREAM RESTORATION 1			<90% DESIGN REDUCTION ESTIMATES			$1,951 $/lb N
PROJECT	**LENGTH (FT)**	**PROTOCOL***	**TN (LB)**	**TP (LB)**	**TSS (TONS)**	**Cost Estimate**
BANK STABILIZATION	416	1, 5				
FLOODPLAIN RECONNECTION AND CHANNEL REALIGNMENT OR STABILIZATION	974 (3 AC)	1,2,3	713	647	1,179	**$1,391,063**
FLOODPLAIN RECONNECTION	3,366 (8.8 AC)	2,3				
TOTAL	4,756					
*FIELD DOC STREAM RESTORATION PROTOCOLS. FINAL PROTOCOLS DETERMINED DURING DESIGN PHASE						

FAIRLEE CREEK STREAM RESTORATION 2			<90% DESIGN REDUCTION ESTIMATES			$1,951 $/lb N
PROJECT	**LENGTH (FT)**	**PROTOCOL***	**TN (LB)**	**TP (LB)**	**TSS (TONS)**	**Cost Estimate**
BANK STABILIZATION	2,930	1, 5				
FLOODPLAIN RECONNECTION AND CHANNEL REALIGNMENT OR STABILIZATION	587 (2.8 AC)	1,2,3	645	585	1,067	**$1,258,395**
FLOODPLAIN RECONNECTION	785 (2.6 AC)	2,3				
TOTAL	4,302					
*FIELD DOC STREAM RESTORATION PROTOCOLS. FINAL PROTOCOLS DETERMINED DURING DESIGN PHASE						

FAIRLEE CREEK STREAM RESTORATION 3			<90% DESIGN REDUCTION ESTIMATES			$1,951 $/lb N
PROJECT	**LENGTH (FT)**	**PROTOCOL***	**TN (LB)**	**TP (LB)**	**TSS (TONS)**	**Cost Estimate**
BANK STABILIZATION	1,013	1, 5				
CHANNEL REALIGNMENT OR STABILIZATION AND POTENTIAL FLOODPLAIN RECONNECTION	1,452 (0.86 AC)	1,2,3	453	410	749	**$883,803**
FLOODPLAIN RECONNECTION	555 (1.82 AC)	2,3				
TOTAL	3,020					
*FIELD DOC STREAM RESTORATION PROTOCOLS. FINAL PROTOCOLS DETERMINED DURING DESIGN PHASE						

FAIRLEE CREEK STREAM RESTORATION 4			<90% DESIGN REDUCTION ESTIMATES			$1,951 $/lb N
PROJECT	**LENGTH (FT)**	**PROTOCOL***	**TN (LB)**	**TP (LB)**	**TSS (TONS)**	**Cost Estimate**
BANK STABILIZATION	1,209	1, 5				
FLOODPLAIN RECONNECTION AND CHANNEL REALIGNMENT OR STABILIZATION	1,858	1,2,3	685	621	1,132	**$1,336,435**
FLOODPLAIN RECONNECTION	1,500	2,3				
TOTAL	4,567					
*FIELD DOC STREAM RESTORATION PROTOCOLS. FINAL PROTOCOLS DETERMINED DURING DESIGN PHASE						

					Annual Nitrogen Reduction Best Management Practices (Reduction Rate x Field Acres)											
Field ID	Field Acres	N Application (lbs/acre)	N Amount Applied (lbs)	N Residual (lbs/acre)	Cover Crop N Reduction (lbs)	N Rate Reduction (lbs)	N Placement Reduction (lbs)	N Timing Reduction (lbs)	N Remaining (lbs)	N Remaining After BMPs	N Total Reduced (lbs)	Cover Crop N Cost ($14.48/lb N)	N Rate Cost ($8.26/lb N)	N Placement Cost ($21.68/lb N)	N Timing Cost ($8.92/lb N)
F0600020501_1_7	119	200	23,728	78	657	142	64	149	9,254	8,241	1,013	$9,517	$1,176	$1,389	$1,333
F0600020501_1_8	91	200	18,164	78	503	109	49	114	7,084	6,308	776	$7,286	$900	$1,063	$1,021
F0600020501_1_9	80	200	16,011	78	443	96	43	101	6,244	5,561	684	$6,422	$793	$937	$900
F0600020501_1_10	73	200	14,663	78	406	88	40	92	5,718	5,092	626	$5,881	$727	$858	$824
F0600020501_1_11	140	200	28,052	78	777	168	76	177	10,940	9,743	1,198	$11,252	$1,390	$1,642	$1,576
F0600020501_1_12	14	200	2,785	78	77	17	8	18	1,086	967	119	$1,117	$138	$163	$157
F0600020501_1_13	117	200	23,451	78	650	141	63	148	9,146	8,145	1,001	$9,406	$1,162	$1,373	$1,318
F0600020501_1_15	11	200	2,152	78	60	13	6	14	839	747	92	$863	$107	$126	$121
F0600020501_1_16	19	200	3,834	78	106	23	10	24	1,495	1,331	164	$1,538	$190	$224	$215
F0600020501_1_17	63	200	12,622	78	350	76	34	80	4,923	4,384	539	$5,063	$626	$739	$709
F0600020501_1_19	126	200	25,148	78	697	151	68	158	9,808	8,734	1,074	$10,087	$1,246	$1,472	$1,413
F0600020501_1_23	30	200	6,051	78	168	36	16	38	2,360	2,102	258	$2,427	$300	$354	$340
F0600020501_1_24	14	200	2,836	78	79	17	8	18	1,106	985	121	$1,138	$141	$166	$159
F0600020501_1_28	41	200	8,223	78	228	49	22	52	3,207	2,856	351	$3,298	$408	$481	$462
F0600020501_1_31	68	200	13,527	78	375	81	37	85	5,275	4,698	578	$5,426	$670	$792	$760
F0600020501_1_32	75	200	14,998	78	415	90	40	94	5,849	5,209	640	$6,016	$743	$878	$843
F0600020501_1_33	60	200	12,060	78	334	72	33	76	4,703	4,188	515	$4,837	$598	$706	$678
F0600020501_1_41	11	200	2,183	78	60	13	6	14	851	758	93	$875	$108	$128	$123
F0600020501_1_42	103	200	20,596	78	570	124	56	130	8,032	7,153	879	$8,261	$1,021	$1,206	$1,157
F0600020501_1_43	98	200	19,655	78	544	118	53	124	7,665	6,826	839	$7,883	$974	$1,151	$1,105
F0600020501_1_53	17	200	3,310	78	92	20	9	21	1,291	1,150	141	$1,328	$164	$194	$186
F0600020501_1_56	12	200	2,338	78	65	14	6	15	912	812	100	$938	$116	$137	$131
F0600020501_1_58	92	200	18,319	78	507	110	49	115	7,144	6,362	782	$7,348	$908	$1,072	$1,029
F0600020501_1_63	72	200	14,483	78	401	87	39	91	5,648	5,030	618	$5,809	$718	$848	$814
F0600020501_1_64	136	200	27,136	78	752	163	73	171	10,583	9,424	1,159	$10,884	$1,345	$1,588	$1,525
F0600020501_1_65	118	200	23,617	78	654	142	64	149	9,211	8,202	1,008	$9,473	$1,170	$1,382	$1,327
F0600020501_1_66	74	200	14,891	78	412	89	40	94	5,808	5,172	636	$5,973	$738	$872	$837
F0600020501_1_67	26	200	5,190	78	144	31	14	33	2,024	1,802	222	$2,082	$257	$304	$292
F0600020501_1_73	114	200	22,826	78	632	137	62	144	8,902	7,928	975	$9,156	$1,131	$1,336	$1,283
F0600020501_1_75	48	200	9,503	78	263	57	26	60	3,706	3,300	406	$3,812	$471	$556	$534
F0600020501_1_77	115	200	22,952	78	636	138	62	145	8,951	7,971	980	$9,206	$1,138	$1,344	$1,290
F0600020501_1_82	27	200	5,461	78	151	33	15	34	2,130	1,896	233	$2,190	$271	$320	$307
F0600020501_1_85	46	200	9,104	78	252	55	25	57	3,551	3,162	389	$3,652	$451	$533	$512
F0600020501_1_86	49	200	9,775	78	271	59	26	62	3,812	3,395	417	$3,921	$484	$572	$549
F0600020501_1_88	85	200	16,915	78	469	101	46	107	6,597	5,875	722	$6,785	$838	$990	$951
F0600020501_1_92	43	200	8,687	78	241	52	23	55	3,388	3,017	371	$3,484	$431	$508	$488
F0600020501_1_93	15	200	2,980	78	83	18	8	19	1,162	1,035	127	$1,195	$148	$174	$167
F0600020501_1_94	118	200	23,554	78	652	141	64	148	9,186	8,180	1,006	$9,447	$1,167	$1,379	$1,324
F0600020501_1_95	177	200	35,440	78	982	213	96	223	13,821	12,308	1,513	$14,215	$1,756	$2,074	$1,992
F0600020501_1_103	20	200	4,013	78	111	24	11	25	1,565	1,394	171	$1,610	$199	$235	$226
F0600020501_1_104	51	200	10,214	78	283	61	28	64	3,983	3,547	436	$4,097	$506	$598	$574
F0600020501_1_106	74	200	14,716	78	408	88	40	93	5,739	5,111	628	$5,903	$729	$861	$827
F0600020501_1_107	15	200	3,010	78	83	18	8	19	1,174	1,045	129	$1,207	$149	$176	$169
F0600020501_1_25	9	200	1,878	78	52	11	5	12	732	652	80	$753	$93	$110	$106
F0600020501_1_49	4	200	815	78	23	5	2	5	318	283	35	$327	$40	$48	$46
F0600020501_1_62	6	200	1,228	78	34	7	3	8	479	426	52	$493	$61	$72	$69
F0600020501_1_90	4	200	724	78	20	4	2	5	282	251	31	$290	$36	$42	$41
F0600020501_1_91	3	200	687	78	19	4	2	4	268	238	29	$275	$34	$40	$39
F0600020501_1_97	4	200	768	78	21	5	2	5	300	267	33	$308	$38	$45	$43
F0600020502_1_25	3	200	525	78	15	3	1	3	205	182	22	$210	$26	$31	$29
F0600020502_1_30	10	200	2,084	78	58	13	6	13	813	724	89	$836	$103	$122	$117
F0600020502_1_31	16	200	3,129	78	87	19	8	20	1,220	1,087	134	$1,255	$155	$183	$176
F0600020502_1_33	62	200	12,325	78	341	74	33	78	4,807	4,281	526	$4,944	$611	$721	$693
F0600020502_1_37	40	200	8,062	78	223	48	22	51	3,144	2,800	344	$3,234	$400	$472	$453
F0600020502_1_38	23	200	4,612	78	128	28	12	29	1,799	1,602	197	$1,850	$229	$270	$259
F0600020502_1_39	7	200	1,421	78	39	9	4	9	554	494	61	$570	$70	$83	$80
F0600020502_1_44	133	200	26,682	78	739	160	72	168	10,406	9,267	1,139	$10,702	$1,322	$1,562	$1,499
F0600020502_1_46	17	200	3,334	78	92	20	9	21	1,300	1,158	142	$1,337	$165	$195	$187
F0600020502_1_51	68	200	13,502	78	374	81	36	85	5,266	4,689	577	$5,416	$669	$790	$759
F0600020502_1_60	204	200	40,895	78	1,133	245	110	258	15,949	14,203	1,746	$16,403	$2,027	$2,394	$2,298
F0600020502_1_63	12	200	2,395	78	66	14	6	15	934	832	102	$961	$119	$140	$135
F0600020502_1_65	24	200	4,747	78	131	28	13	30	1,851	1,649	203	$1,904	$235	$278	$267
F0600020502_1_67	35	200	6,938	78	192	42	19	44	2,706	2,409	296	$2,783	$344	$406	$390
F0600020502_1_82	51	200	10,129	78	281	61	27	64	3,950	3,518	432	$4,063	$502	$593	$569
F0600020502_1_86	225	200	44,903	78	1,244	269	121	283	17,512	15,595	1,917	$18,010	$2,225	$2,628	$2,523
F0600020502_1_88	8	200	1,608	78	45	10	4	10	627	558	69	$645	$80	$94	$90
F0600020502_1_89	218	200	43,634	78	1,209	262	118	275	17,017	15,154	1,863	$17,501	$2,162	$2,554	$2,452
F0600020502_1_90	197	200	39,327	78	1,089	236	106	248	15,338	13,658	1,679	$15,774	$1,949	$2,302	$2,210
F0600020502_1_94	10	200	2,023	78	56	12	5	13	789	703	86	$812	$100	$118	$114
F0600020502_1_97	53	200	10,537	78	292	63	28	66	4,109	3,660	450	$4,226	$522	$617	$592
F0600020502_1_99	11	200	2,165	78	60	13	6	14	844	752	92	$868	$107	$127	$122
F0600020502_1_105	163	200	32,598	78	903	196	88	205	12,713	11,321	1,392	$13,075	$1,616	$1,908	$1,832
F0600020502_1_106	69	200	13,840	78	383	83	37	87	5,398	4,807	591	$5,551	$686	$810	$778
F0600020502_1_129	112	200	22,337	78	619	134	60	141	8,711	7,758	954	$8,959	$1,107	$1,307	$1,255
F0600020502_1_134	23	200	4,671	78	129	28	13	29	1,822	1,622	199	$1,873	$231	$273	$262
F0600020502_1_136	28	200	5,616	78	156	34	15	35	2,190	1,951	240	$2,253	$278	$329	$316
F0600020502_1_148	143	200	28,594	78	792	172	77	180	11,152	9,931	1,221	$11,469	$1,417	$1,674	$1,607
F0600020502_1_149	13	200	2,502	78	69	15	7	16	976	869	107	$1,004	$124	$146	$141
F0600020502_1_152	25	200	4,935	78	137	30	13	31	1,925	1,714	211	$1,979	$245	$289	$277
Total	4,927	15,800	985,338	6,162	27,294	5,912	2,660	6,208	384,282	342,208	42,074	$395,215	$48,833	$57,678	$55,372

Drainage Water Management Potential and Costs					
Field ID	**Field Acres**	**Controlled Acres**	**% of Field**	**N lbs Reduced/yr**	**Cost Estimate**
F0600020502_1_10	107	43	40	259	$77,517
F0600020502_1_24	37	25	67	148	$44,369
F0600020502_1_26	46	22	47	131	$39,313
F0600020502_1_35	142	25	17	148	$44,333
F0600020502_1_36	131	27	21	164	$49,236
F0600020502_1_36	131	36	28	216	$64,732
F0600020502_1_58	199	34	17	202	$60,624
F0600020502_1_58	199	50	25	300	$89,862
F0600020502_1_75	226	23	10	136	$40,809
F0600020502_1_75	226	62	27	372	$111,399
F0600020502_1_79	170	88	52	528	$158,346
F0600020502_1_83	172	37	21	219	$65,775
F0600020502_1_83	172	26	15	159	$47,596
F0600020502_1_89	218	37	17	221	$66,207
F0600020502_1_89	218	41	19	244	$73,067
F0600020502_1_108	214	89	42	537	$160,979
F0600020502_1_109	235	51	22	308	$92,483
F0600020502_1_111	146	22	15	133	$39,924
F0600020502_1_111	146	24	16	143	$43,016
F0600020502_1_113	137	50	36	297	$89,102
F0600020502_1_114	179	24	14	145	$43,522
F0600020502_1_114	179	24	14	145	$43,460
F0600020502_1_114	179	23	13	136	$40,810
F0600020502_1_117	93	40	43	241	$72,133
F0600020502_1_119	127	25	19	149	$44,553
F0600020502_1_128	77	25	32	148	$44,430
F0600020502_1_129	112	20	18	121	$36,177
F0600020502_1_130	56	21	37	125	$37,562
F0600020502_1_145	139	31	23	188	$56,318
F0600020502_1_151	106	27	25	159	$47,790
F0600020501_1_4	16	11	68	65	$19,499
F0600020501_1_10	73	21	28	124	$37,218
F0600020501_1_20	60	18	29	105	$31,522
F0600020501_1_35	108	21	20	127	$38,179
F0600020501_1_36	144	29	20	175	$52,441
F0600020501_1_37	117	22	18	129	$38,726
F0600020501_1_40	186	25	13	149	$44,700
F0600020501_1_42	103	28	28	170	$51,118
F0600020501_1_52	325	12	4	71	$21,256
F0600020501_1_60	87	11	12	64	$19,237
F0600020501_1_84	127	13	10	79	$23,689
F0600020501_1_87	34	12	35	73	$21,871
F0600020501_1_89	147	11	8	68	$20,281
F0600020501_1_95	177	20	11	119	$35,798
F0600020501_1_99	216	31	14	184	$55,068
Total	6,437	1,354		8,125	$2,436,047

Appendix E
Major Funding Sources and Dates

Funder	Grant Program	Grant Purpose	Last RFP Due Date	Grant Limit or Range	Notes
Chesapeake Bay Trust & Maryland Dept. of Natural Resources	Watershed Assistance Grant Program	Supports design assistance, watershed planning and programmatic development associated with protection and restoration program and project that lead to improved water quality in the Maryland portion of the Chesapeake Bay watershed.	Dec 2021	$5,001 - $150,000	Leverage resulting designs, plans, or projects to craft future proposals for implementation funding to the Maryland Chesapeake and Atlantic Coastal Bays Trust Fund, grant programs at the Chesapeake Bay Trust, or other sources of support;

National Fish and Wildlife Foundation	Chesapeake Bay Stewardship Fund – Small Watershed Grant (SWG)	Projects that promote community-based efforts to protect and restore the diverse natural resources of the Chesapeake Bay and its tributary rivers and streams. SWG Implementation grants are awarded for projects that result in direct, on-the-ground actions to protect and restore water quality, species, and habitats in the Bay watershed; SWG Planning and Technical Assistance grants are awarded for projects that enhance local capacity to more efficiently and effectively implement future on-the-ground actions through assessment, planning, design, and other technical assistance-oriented activities.	May 2020	$50,000-$500,000 depending on the program**	SWG Implementation program will range from $50,000-$500,000 for two year projects and requires a one-third non-federal match. SWG Planning and Technical Assistance grants will not exceed $50,000 for a one-year project.

National Fish and Wildlife Foundation	Chesapeake Bay Stewardship Fund – Innovative Nutrient & Sediment Reduction Grant (INSR)	A program designed to accelerate the implementation of water quality improvements specifically through the collaborative and coordinated efforts of sustainable, regional-scale partnerships and networks of practitioners with a shared focus on water quality restoration and protection.	Nov 2021	$750,000 - $1 million	These grants encourage non-federal matching contributions equal to the grant request. All grants must be completed within three years of grant award.
Maryland Dept of Natural Resources	Chesapeake & Atlantic Coastal Bays Trust Fund	Fund the most cost-effective, efficient nonpoint nutrient and sediment reduction project proposals in geographic targeted areas of the State. The Trust Fund encourages projects that will achieve the greatest reduction per dollar invested	Dec 2021	Typically $100,000-$1,000,000	

Appendix F
Water Quality Mean-Min-Max 2020

	Surface Salinity (ppt)	Bottom Salinity (ppt)	Surface DO (mg/l)	Bottom DO (mg/l)	Secchi (M)	Total Nitrogen (uM)	Total N (mg/l)	Total Phosphorus (uM)	Total P (mg/l)	Fya (ug/l)	Chl -a (ug/l)
SP02											
Mean	**2.50**	**2.58**	**9.37**	**9.33**	**0.60**	**87.93**	**1.23**	**1.60**	**0.05**	**4.53**	**10.53**
Min	0.83	0.83	7.62	7.10	0.40	51.65	0.72	0.88	0.03	1.13	1.52
Max	4.25	4.46	13.02	13.02	1.30	254.38	3.56	2.53	0.08	8.51	20.36
CC02											
Mean	**2.62**	**2.76**	**8.74**	**7.66**	**0.74**	**61.73**	**0.71**	**1.67**	**0.04**	**6.27**	**11.23**
Min	0.99	0.99	7.36	5.98	0.30	49.90	0.00	0.93	0.00	0.81	1.50
Max	4.39	4.90	10.24	10.36	1.50	91.11	1.28	2.59	0.08	22.25	22.37
WC02											
Mean	**3.67**	**3.82**	**10.07**	**8.42**	**0.54**	**77.72**	**1.09**	**3.87**	**0.12**	**7.98**	**20.69**
Min	1.65	1.65	7.12	5.48	0.30	39.00	0.55	1.21	0.04	2.28	3.39
Max	5.49	5.60	14.01	11.97	0.80	207.01	2.90	13.99	0.43	13.95	41.06
FC02											
Mean	**3.12**	**3.31**	**9.38**	**8.09**	**0.65**	**69.10**	**0.86**	**1.91**	**0.05**	**8.15**	**15.80**
Min	1.21	1.61	8.31	5.93	0.40	39.00	0.55	1.42	0.04	0.82	0.87
Max	6.07	6.07	12.25	10.65	0.70	310.51	4.35	3.20	0.10	21.67	39.73