Rivanna River Combined Benthic and Bacteria Total Maximum Daily Load (TMDL) Action Plan Update
Permit Cycle: 2018-2023

General Permit No.: VAR040073

May 1, 2020

Prepared by:
University of Virginia
Facilities Management, Environmental Resources Division
1490 Leake Drive, Charlottesville, VA 22904
(434) 243-5380

Table of Contents

List of Appendices

Background

The University of Virginia (UVA) occupies approximately 1,200 acres and is located within the borders of both the City of Charlottesville and Albemarle County. The University is also situated in the headwaters of the Meadow Creek watershed and the headwaters of tributaries to the Moores Creek watershed. Both of these watersheds drain to the Rivanna River on the eastern boundary of the City of Charlottesville. The Rivanna River flows to the James River, and ultimately discharges to the lower Chesapeake Bay.

As a predominately urbanized state entity with separate storm and sanitary sewer conveyance systems, the University is classified as a Small Municipal Separate Storm Sewer System (MS4). Therefore, UVA is mandated to follow the regulations of the Environmental Protection Agency as outlined in the Clean Water Act, the Virginia Stormwater Act and the MS4 General Permit granted by the Department of Environmental Quality (DEQ). The MS4 service area currently consists of 782 acres.

In compliance with Section II.B of the General Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (Permit No.: VAR040073), and the Special Condition described therein, the University of Virginia, an MS4 Operator, has developed a Combined Benthic and Bacteria Total Maximum Daily Load (TMDL) Action Plan for the Rivanna River. This TMDL action plan has been prepared in accordance with the requirements in the November 1, 2018 DEQ General VPDES Permit for Discharges of Stormwater from Small MS4s. Additionally, the University has coordinated with Albemarle County and the City of Charlottesville in the preparation of this Action Plan. The TMDL for the Rivanna sets limits on the amount of pollutants of concern (POCs), including total suspended solids (TSS) and *E.coli* bacteria, that can be discharged to the river without detrimentally impacting water quality. The MS4 Permit Special Condition for local TMDLs requires all MS4 operators to reduce existing levels of these POCs to a level that will be protective of water quality. This process typically requires that the MS4 operator install best management practices (BMPs) that will, through various means, lower the contaminant levels in stormwater discharged to local streams and other water bodies.

1. TMDL Project Names and EPA Approval Dates

Wasteload allocations (WLAs) were assigned to the University for the Rivanna River Watershed in the approved Final TMDL reports as follows:

Benthic TMDL

- *Benthic TMDL Development for the Rivanna River Watershed (dated March 2008)*
- EPA approval date was 6/11/2008.

Bacteria TMDL

- *Bacteria TMDL Development for the Rivanna River Mainstem, North Fork Rivanna River, Preddy Creek and Tributaries, Meadow Creek, Mechums River, and Beaver Creek Watersheds (dated March 2008)*
- EPA approval date was 1/5/2009.

2. Pollutants Causing the Impairments

Benthic TMDL

The Benthic TMDL report noted in Section 1 identified two separate stream segments with benthic impairments for the mainstem Rivanna River: Segment VAV-H28R-01 and Segment VAV-H29R-01 (Appendix A). These segments, which receive runoff from UVA, are included in Virginia's 303(d) Lists of Impaired Waters as well as the Water Quality Assessment 305(b)/303(d). According to the report, as of 2004 the source of the benthic macroinvertebrate impairment for the upstream segment (VAV-H28R-01) was attributed to non-point source urban runoff. The source of the benthic macroinvertebrate impairment for segment VAV-H29R-01 was unknown at the time the TMDL was completed. However, analysis of the candidate stressors indicate that sedimentation and urban runoff are the most probable cause of the impairment and the basis of the TMDL.

Bacteria TMDL

The Bacteria TMDL report noted in Section 1 listed two stream segments with impairment listings relevant to the University and its watersheds. Those segments are the Rivanna River mainstem (VAV-H28R-RVN01A00) and Meadow Creek (VAV-H28R-MWC01A00). These segments were first identified as having impairment listings for *E. coli* and for fecal coliform bacteria on Virginia's 303(d) List of Impaired waters between 2002 (Meadow Creek) and 2006 (Rivanna River Mainstem).

The initial impairment listings for the noted stream segments were expressed as fecal coliform bacteria, as was required with the Virginia Bacteria Water Quality Standard at that time. These segments are now both listed for *E.coli* impairments under the TMDL report for the Rivanna River Watershed in accordance with current applicable water quality standards (Appendix B).

The TMDL, under the new water quality standards, limits the geometric mean concentration of *E.coli* to 126 *E. coli* counts per 100 ml of water within a calendar month and a concentration of 235 counts per 100 ml of water at any time.

3. WLAs Assigned to the Permittee

Benthic TMDL

The University has been assigned a WLA in the final Benthic TMDL report of 139 lbs/day (50,735 lbs/yr) as is shown in Table 1.

Table 1

Benthic TMDL Development Report - Table 7-2 (excerpt): Wasteload Allocation by MS4 Location# Within the Rivanna River Benthic Impaired Watershed						
Permit Number	**MS4 Permit Holder**	**Land-Based Loads (lbs/day)**	**Instream Erosion (lbs/day)**	**Existing Total Load (lbs/day)**	**Allocated Load (lbs/day)**	**Percent Reduction***
VAR040073	University of Virginia (Charlottesville)	17	49	65	27	59.3
	University of Virginia (Albemarle)	70	206	277	112	59.3
Total		**87**	**255**	**342**	**139**	**59.3**

(*) The percent load reduction for the MS4s accounts for loads from all land sources including forested areas.
(#) MS4 loads include loads from general stormwater permits issued to industrial facilities, domestic sewage facilities, mines/quarries, concrete facilities, and construction sites.

Bacteria TMDL

The University, in addition to other MS4s, has been assigned an aggregated WLA of 3.27E+10 cfu/day for *E. coli* for the Rivanna River mainstem (Table 2).

Table 2

Bacteria TMDL Development Report - Table 5-4: Rivanna River Distribution of Annual Average *E. coli* Load under Existing Conditions and TMDL Allocation				
Land Use/Source	**Average *E.coli* Loads (cfu/yr)**		**Allocation (cfu/day)**	**Percent Reduction (%)**
	Existing	**Allocation**		
Forest	5.74E+12	5.74E+12	5.74E+10	0%
Cropland	1.33E+13	6.65E+11	6.65E+09	95%
Pasture	3.86E+14	1.93E+13	1.93E+11	95%
Urban Residential	7.49E+13	3.75E+12	3.75E+10	95%
Water/Wetland	4.85E+07	4.85E+07	4.85E+05	0%
Cattle - direct deposition	1.91E+13	0.00E+00	0.00E+00	100%
Wildlife - direct deposition	4.84E+13	1.16E+13	1.16E+11	76%
Failed Septic - direct deposition	1.43E+11	0.00E+00	0.00E+00	100%
Point Source	8.29E+11	1.66E+12	4.54E+09	0%
MS4s	6.54E+13	3.27E+12	3.27E+10	95%
Total loads / Overall reduction	**6.14E+14**	**4.60E+13**	**4.48E+11**	**92%**

The University, in addition to other MS4s, has been assigned an aggregated WLA of 4.06E+10 cfu/day for *E. coli* for Meadow Creek (see Table 3).

Table 3

Bacteria TMDL Development Report - Table 5-18: Meadow Creek Distribution of Annual Average *E. coli* Load under Existing Conditions and TMDL Allocation				
Land Use/Source	**Average E.*coli* Loads (cfu/yr)**		**Allocation (cfu/day)**	**Percent Reduction (%)**
	Existing	**Allocation**		
Forest	1.15E+10	1.15E+10	1.22E+08	0%
Cropland	0.00E+00	0.00E+00	0.00E+00	0%
Pasture	2.40E+08	1.20E+07	1.27E+05	95%
Urban Residential	3.12E+13	1.56E+12	1.65E+10	95%
Water/Wetland	2.85E+06	2.85E+06	3.02E+04	0%
Cattle - direct deposition	3.35E+10	0.00E+00	0.00E+00	100%
Wildlife - direct deposition	1.27E+12	6.59E+11	6.99E+09	48%
Failed Septic - direct deposition	3.94E+09	0.00E+00	0.00E+00	100%
Point Source*	0.00E+00	6.06E+10	1.66E+08	0%
MS4s	7.66E+13	3.83E+12	4.06E+10	95%
Total loads / Overall reduction	**1.09E+14**	**6.12E+12**	**6.44E+10**	**94%**

* There are no permitted facilities; the point source allocation includes 1 percent of the total NPS allocations to account for future growth

4. Significant Sources of Pollutants of Concern

This section identifies significant sources of POCs to the UVA MS4 that are not covered under a separate VPDES permit. UVA's Parking and Transportation facility is covered under a VPDES Industrial Stormwater General Permit (VAR051372) for sediment and is excluded from this analysis. The most recent MS4 permit (2018) states: "a significant source of pollutants means a discharge where the expected pollutant loading is greater than the average pollutant loading for the land use identified in the TMDL".

Since the University owns and operates all of the facilities within the MS4 boundary, a process was established to evaluate all activities and land uses to identify any potential sites with significant sources of sediment and bacteria. Through desktop and site inspection analysis, it was determined that the University does not contain any sites that are significant sources of sediment or *E. coli*. However, the areas identified in the analysis will continue to be monitored.

Benthic TMDL

Potential significant sources of sediment discharging and applicable to UVA's MS4 include land disturbing activities, litter and street dust. In addition, there are several sites with municipal operations or that were identified as high-priority facilities under the MS4 Permit requirements that require SWPPPs. These sites have the potential to contribute to the benthic impairment as a result of urban runoff. For example, UVA's Facilities Management maintenance yards contain stockpiles of mulch and sand that could enter the storm sewer system and streams if not managed appropriately. Similarly, the Main Heat Plant has coal and ash handling operations that create an increased risk for sediment entering the storm system during runoff events.

Other areas of consideration, due to the increased risk of urban runoff, are large parking lots and impervious surfaces that discharge to the storm system and are not treated by a downstream BMP. These sizeable impermeable surfaces increase the velocity of runoff during storm events. Large volumes of water entering streams at high velocities, can cause erosion of stream banks and scour-related degradation. Instream erosion is identified as the largest contributor of land based non-point sediment load in the benthic impaired Rivanna River Watershed. As is noted in the Louis Berger TMDL Development Report (March 2008), "there is a higher level of sedimentation related to stream bank instability". Due to the University's location at the top of two tributaries to the Rivanna River, UVA is more prone to this condition.

Bacteria TMDL

Potential sources of bacteria within UVA's MS4 boundary include urban wildlife (specifically birds), domestic pets and septic systems. Canada geese can be a direct contributor of bacteria in wet stormwater management facilities (i.e., retention ponds), and domestic pets are frequently walked through campus, especially in grassy or park like settings. In addition, UVA has approximately seven (7) septic systems. If not properly managed, these can become significant sources of bacteria.

5. BMPs Designed to Reduce the POCs

Before the issuance of the most recent MS4 Permit, the University of Virginia had taken a proactive stance and made an aggressive effort to reduce POCs within its watersheds. The University's MS4 Program Plan includes a wide array of best management practices (BMPs) that aim to reduce pollutants including sediment and bacteria. The list of BMPs below outlines some of those practices and correlates with the Minimum Control Measures found in the Annual MS4 Report:

BMPs

1. **Websites and Social Media (Sediment and Bacteria**) – Information on erosion and sediment control (E&SC) and stormwater management (SWM) can be found on the Environmental Resources website (https://www.fm.virginia.edu/depts/operations/environmental/index.html). Additionally, a Facebook page, has been created in conjunction with the University-formed "Clean Water Working Group" to promote good water quality practices and behaviors.

2. **Public Awareness Events (Sediment and Bacteria)** - The University tables at events such as World Water Day and Earth Week for education and outreach.

3. **Rivanna Stormwater Education Partnership (RSEP) Member –** As a member of RSEP, the University strives to make citizens aware of stormwater issues to help reduce impacts and improve local water quality. Membership in this partnership is an effective and fundamental part of UVA's education and outreach program and is further described in Section 6.

4. **Advertising (Sediment and Bacteria**) – Through RSEP, advertisements are displayed in a local newspaper (Cville Weekly), movie theaters and buses addressing methods to reduce sediment and bacteria with car washing tips and pet waste reminders, etc.

5. **Utility Bill Mailings (Sediment and Bacteria)** – Mailings are coordinated via RSEP and are sent to all water customers in the City of Charlottesville and Albemarle County. Mailings address POC awareness and mitigation methods.

6. **Educational Lectures (Sediment and Bacteria)** – Members of the Environmental Resources team routinely guest lecture in classes for Engineering, Architecture and Environmental Science at the University to talk about the importance of POC awareness and reductions.

7. **Stream Cleanups (Sediment and Bacteria)** –UVA students, faculty and staff are encouraged to participate in stream enhancement and education projects and programs where possible.

8. **Illicit Discharge Program (Sediment and Bacteria)** – The University's program involves monitoring, detection and elimination of illicit discharges. The University maintains a 24-hour response team for reported discharges. Additionally, the RSEP website provides an online reporting tool for illicit discharges which are distributed to the appropriate MS4 operator. Utility mapping is updated regularly and illicit discharges are discouraged through public education. The University follows procedures for reporting and tracking illicit discharges and procedures for enforcing policies. An SOP has been written for illicit discharge detection and response. Procedures were revised and updated to ensure compliance with new MS4 program requirements.

9. **MS4 Outfall Inspections/Dry Weather Discharge Inspections (Sediment and Bacteria)** – An inspection program for all stormwater outfalls utilizes written procedures to detect, investigate and report illicit discharges, and document the investigation. The procedures set forth in Item 8 are followed if any suspicious discharges are noted.

10. **Storm Drain Stenciling Program (Sediment and Bacteria)** - Staff and volunteers label stormwater catch basins and inlets to raise awareness that they lead directly to local creeks in an effort to prevent illicit discharges.

11. **Septic System Inspection and Cleaning** - The University inspects and cleans all septic systems installed on the campus on a 2-year schedule. Inspections are tracked in the work order management system. This inspection frequency provides an opportunity to evaluate the effectiveness of each septic system on a regular basis. If a septic system is found to be faulty or in need of repair, a separate work order is generated during the inspection to correct the deficiency. (Consistent with Permit Part II.B.4)

12. **Inflow and Infiltration Detection (Bacteria)** – The University proactively inspects sanitary sewer lines to identify problems before they occur. The program includes sanitary sewer lining and replacement based on the inspection results.

13. **Sanitary Sewer Overflow Response Team (Bacteria)** - The University maintains an in-house 24-7 team to respond, document, and notify DEQ of sanitary sewer overflow (SSO) reports.

14. **Bird Control (Bacteria)** – Bird chasing dogs are hired to humanely herd any geese that are attempting to nest in the area of retention ponds or other stormwater BMPs. Repeated trips by these dogs eventually change the feeding habits of the geese and force them to migrate to a safer environment which eliminates the chance of bacteria from bird droppings.

15. **Water Quality Monitoring (Bacteria) -** The University uses an existing local water quality monitoring program, organized by the Rivanna Conservation Alliance (RCA) (formerly Stream Watch) to track and assess the effectiveness in bacteria reductions. The University provides financial support for this program which collects monthly samples

(February to October) at several outfall locations that discharge to the Rivanna River. Several of sampling locations were specifically chosen due to their proximity to University's MS4 boundary and are mapped on RCA's website (http://www.rivannariver.org/bacteria/). These water quality samples are monitored for *E.coli* using the Colilert® Method.

16. **Erosion and Sediment Control Program (Sediment)** – UVA follows Annual Standards and Specifications (AS&S) for E&SC in compliance with the Virginia E&SC Law and Regulations. E&SC Plans are required for all land disturbances over 10,000 square feet (sf) in Albemarle County and 6,000 sf in the City of Charlottesville. UVA requires E&SC controls to be installed on all land disturbing projects, even if a formal E&SC plan is not required. Additionally, plan approval is required prior to commencement of any regulated land disturbing activity. UVA notifies DEQ of project initiations and also reports E&SC plan approvals and annual disturbed acreage in accordance with the AS&S and MS4 Permit.

17. **Construction General Permit (Sediment and Bacteria)** - Land disturbances over 1 acre require a construction site Virginia Stormwater Management Program (VSMP) permit issued by DEQ, which requires the project to develop a Stormwater Pollution Prevention Plan (SWPPP). UVA has provided a SWPPP template for construction activities to help guide contractors to plan for appropriate controls to prevent non-stormwater discharges.

18. **Construction Site Inspections (Sediment and Bacteria)** - UVA inspectors conduct E&SC inspections for applicable land disturbing activities: 1) upon initial installation, 2) at least once within every 2 week period, 3) within 48 hours of a runoff producing storm event, and 4) upon completion of the project. Pollution-generating activities are addressed during E&SC inspections, and full SWPPP audits are conducted routinely.

19. **Stormwater Management Master Plan (Sediment and Bacteria)** The University has developed a Stormwater Management Master Plan as a proactive effort to implement a range of projects that not only provide solutions to drainage and flooding issues, but for water quality improvement needs on a watershed level. The plan strategically identifies projects that would meet pollutant load reduction targets associated with TMDLs assigned to the University.

20. **Stormwater Management Project Review (Sediment and Bacteria)** – UVA follows AS&S for SWM in compliance with the Virginia SWM Act and Virginia SWM Program (VSMP) Regulations as related to MS4s and construction activities. SWM Plans are required for all land disturbances over 1 acre in Albemarle County and 6,000 sf in the City of Charlottesville. Plan approval is required prior to commencement of any regulated land disturbing activity.

21. **Structural BMP Implementation (Sediment and Bacteria)** – UVA has installed over 100 structural BMPs that reduce the pollutant load to local streams and is actively installing more. Additionally, construction projects occurring within the MS4 are encouraged to oversize their proposed BMPs to generate additional pollutant reductions. All newly constructed or retrofitted BMPs will be built in accordance with the latest version of the Virginia BMP Clearinghouse.

22. **Structural BMP Inspections (Sediment and Bacteria)** - UVA inspects and maintains all structural BMPs on its property, unless subject to a long-term lease to another entity. In these cases, the other entity leasing the property is responsible for the maintenance. Inspectors conduct routine inspections and complete maintenance as needed. Debris is cleaned from catch basins and conveyances within the stormwater drainage system on a routine basis and after large storms.

23. **Storm Drain Inspection and Cleaning – (Sediment and Bacteria) -** UVA currently inspects and cleans all catch basins or storm drains on a quarterly basis and after large storms to compliment the Structural BMP inspections noted in BMP 22. UVA's work order management system tracks all installed storm drains and issues reminders every 3 months for inspection and cleaning. Practicing this strategy throughout the campus is a way to reduce sediment and bacteria, across the entire MS4. (Consistent with Permit Part II.B.4)

24. **Street Sweeping and Vacuuming (Sediment and Bacteria)** - UVA is responsible for the cleaning of streets (under its control), parking lots and permeable pavement which includes the removal of trash and leaves at least once per year. Parking lots are monitored and cleaned as needed.

25. **Municipal Facility Pollution Prevention and Good Housekeeping (Sediment and Bacteria)** - UVA has developed and implemented site-specific SWPPPs for all its municipal high priority facilities.

26. **Biennial Staff Training Plan (Sediment and Bacteria)** – UVA implements a training plan on IDDE, good housekeeping, pollution prevention, spill prevention, environmental awareness, and other required topics. Training is provided to appropriate staff at least every two years. See Appendix E.

The minimum control measures and the associated BMPs under the MS4 Program Plan are further detailed at:
https://www.fm.virginia.edu/docs/operations/environresources/2019/MS4_Program_Plan_2018-2023-Update_2019-09.pdf.

Benthic TMDL

In an effort to make progress toward the sediment reduction requirements under the Benthic TMDL of the Rivanna River Watershed, UVA conducted a stream assessment on UVA and UVA Foundation property that evaluated streams adjacent to near-term redevelopment projects under design. The following list identifies potential stream restoration projects currently under consideration (from University of Virginia Campus-Wide Stream Assessment, Phase I: Near-Term Projects- September 2019 – Appendix D):

Table 4

Potential Stream Restoration Segments on University Grounds			
Stream Location	**Adjacent Redevelopment Zone**	**Estimated Restoration Length (ft)**	**TSS Reductions (lbs/yr)***
Meadow Creek North Grounds (MDC-006/012)	Darden	1,041	46,720.08
Fontaine Park – West (FPW-001)	Fontaine Park	1,315	59,017.20
Ivy Mountain Area (MBW-002)	Ivy Mountain / KCRC	413	18,535.44

* TSS Reductions are calculated by multiplying the proposed length of restored stream by 44.88 lbs/ft/yr, which is the Edge-of-Stream 2011 Interim Approved Removal Rates from Table 3 of Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Reductions may increase if BANCS assessment and protocols are used.

UVA also identified several potential BMP retrofits in the 2015 SWM Master Plan. The below list identifies projects under consideration with the most potential for contributing to the sediment reduction goal:

Table 5

Potential Stormwater Basin Retrofit Opportunities			
Stormwater Facility Name	**Existing BMP Type**	**Proposed BMP Type**	**Potential TSS Reduction (lbs/yr)*^**
The Park Basin	Dry Detention	Wet Pond	854.10
FM Basin	Dry Detention	Wet Pond	2,901.75
Gilmer Basin	Dry Detention	Extended Det. & Add Forebay	372.30

*Loading rate applied = 0.3lbs/ac/day or 109.5 lbs/ac/yr. See Appendix C.

^ UVA will model sediment load reductions pursuant to the Chesapeake Bay TMDL Action Plan Guidance Document published by DEQ (Guidance Memo No. 15-2005) as well as any additional guidance received from DEQ to track both the effectiveness and progress toward the TMDL requirement.

Bacteria TMDL
The following list contains examples of potential projects, identified in the master plan, currently under consideration to reduce bacteria loading in the watershed:

Table 6

Potential Septic System Replacement Opportunities		
Building	**Design Flow (gal/day)**	**Proposed Treatment**
Duke House/ Sunnyside	1,366	Connect to Centralized Treatment
KCRC	767	Connect to Centralized Treatment

Inter-jurisdictional Agreement
The University, Albemarle County and the City of Charlottesville have agreed to take responsibility for the POC loads generated within their regulated area boundary regardless of sheet flow draining to or from another jurisdiction. POC reduction credit for BMPs installed on any lands with inter-jurisdictional sheet flow will be received by the permittee that installs and maintains the BMP. However, each entity reserves the right to enter into agreements in which TMDL credit is shared with adjacent permittees for any projects which treat drainage from multiple permittees' lands.

6. Outreach Strategies to Enhance Public Education

One of the most important and effective BMPs in controlling and reducing sediment and bacteria in local streams is the Education and Outreach program at the University. UVA has developed separate strategies to educate the general public versus employees. These strategies are described in detail below.

Education, Outreach and Public Participation Program
UVA's primary outreach and education initiatives are achieved through their role as a founding member and sponsor of the Rivanna Stormwater Education Partnership (RSEP). This partnership is a collaborative effort among local MS4 permit holders and other governmental agencies interested in stormwater protection. The mission of RSEP is to provide public education, outreach and opportunities for participation in stormwater related issues in the area to help improve local water quality.

Many students, faculty, and staff live in the areas targeted by RSEP campaigns. In this way, UVA is able to convey the same stormwater related messages at the University which are also promoted in the local community, further reinforcing their importance beyond jurisdictional or MS4 boundaries. The objective of all public education and outreach efforts, whether they are implemented by the University directly or as part of RSEP are to 1) focus public outreach campaigns to address the viewpoints and concerns of target audiences and 2) utilize diverse

media (including TV and radio PSAs, print ads, flyers on buses, mailings, etc.) to increase public awareness about stormwater pollution prevention.

The University's Environmental Resources division maintains a webpage (http://www.fm.virginia.edu/depts/operations/environmental/index.html) which provides information on stormwater, best management practices, the University's MS4 permit, TMDLs and a link to the RSEP website. RSEP's website (http://www.rivanna-stormwater.org/), provides links to public service announcements, publications, stormwater education articles as well as videos, and other useful stormwater pollution prevention related tools. Both the University's and the RSEP's webpage also provide methods for the public to report illicit discharges.

Some of the resources or publications that are available on the RSEP website include:

- Rain, Runoff and Your Backyard Pamphlet
- Raingarden Brochure
- Septic System Information Brochure
- Stormwater Runoff Management Brochure
- Vehicle Washing Brochure
- Pet Waste Education Initiative Pamphlet
- RSEP Stormwater PSA Video
- After the Storm (EPA) Video
- Prevent Storm Drain Pollution Video
- "Dog Doogity" Dog Waste PSA Video

Employee Training Programs

Another way that the University helps prevent or reduce the release of pollutants to stormwater is through employee training. All training presentations are updated regularly and incorporate specific language for both sediment and bacteria with respect to stormwater pollution. In addition, other environmentally related topics are covered in order to minimize impacts to stormwater from UVA operations. Customized presentations are made to all of the operations staff at the University and the associated auxiliary departments whose job responsibilities may have the potential to impact stormwater (Appendix E).

At a minimum, each presentation includes information about spill prevention, stormwater pollution prevention and reviews the specifics of illicit discharge detection and elimination. The training focuses on stormwater pollution prevention, recommendations for good housekeeping practices, standard operating procedures (SOPs), proper erosion and sediment control practices on construction sites, and the importance of post construction stormwater management and BMPs as applicable.

7. Interim Milestones and Implementation of BMPs and Outreach

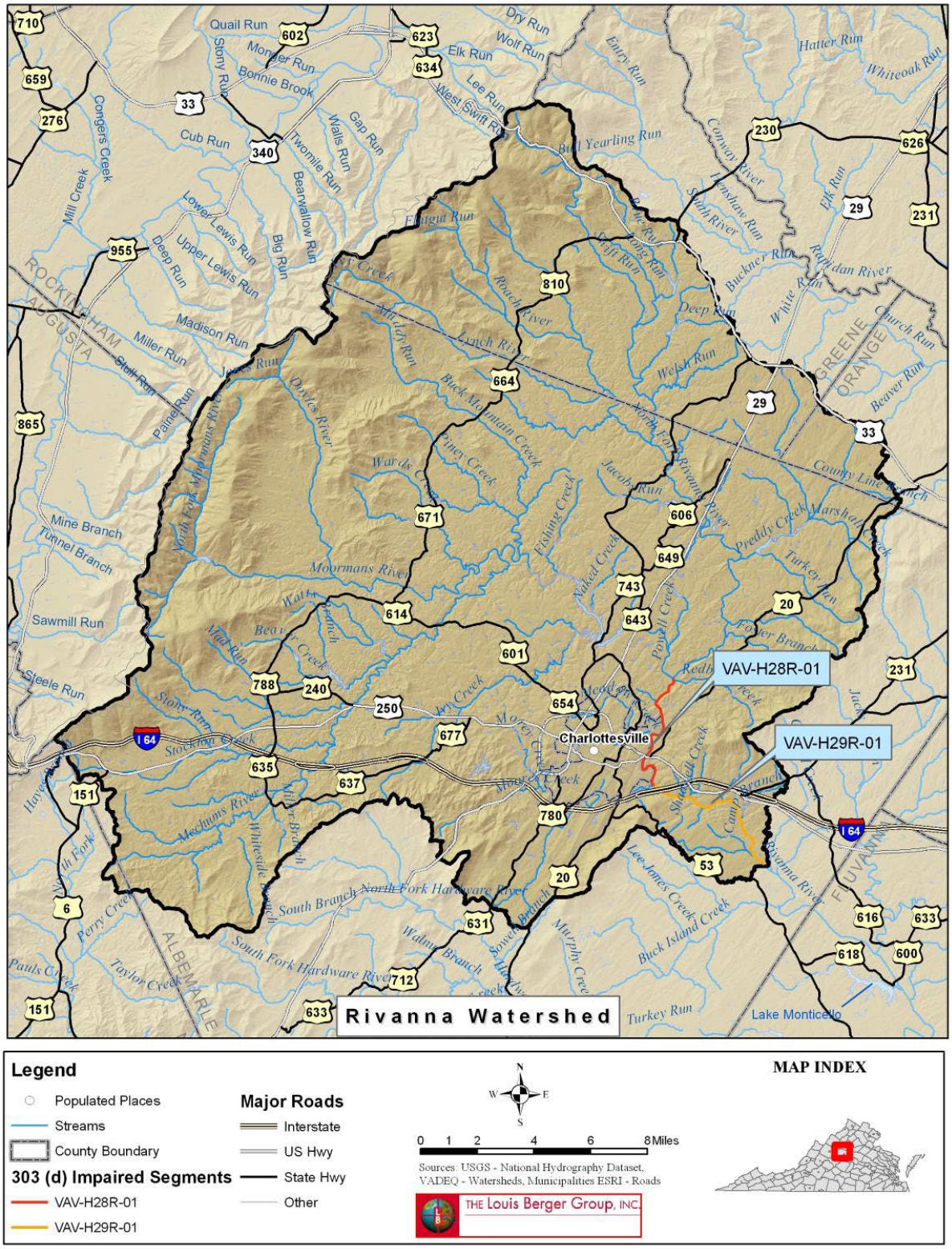
The University is committed to using a variety of management practices and control techniques for the purposes of reducing the pollutants identified in the WLAs. The University intends to use an adaptive, iterative approach for the implementation of these BMPs and milestones over multiple permit cycles, as referenced in the MS4 General Permit, Section II.B.2. These milestones or schedules may need to be modified in order to achieve the POC reductions necessary to restore the water quality of the Rivanna River, and ultimately removing the impairment listing.

Table 7

Best Management Practices and Implementation Schedule		
BMP/ Milestone	**Item Description**	**Scheduled Completion/ Frequency**
BMP 1	Websites and Social Media	Update as needed
BMP 2	Public Awareness Events	At least 4 annually
BMP 3	Rivanna Stormwater Education Partnership Member	Ongoing
BMP 4	Advertising	Annually
BMP 5	Utility Bill Mailings	Once every two or three years
BMP 6	Educational Lectures	At least 2 annually
BMP 7	Stream Cleanups	At least 1 annually
BMP 8	Illicit Discharge Program	As needed / annually
BMP 9	MS4 Outfall Inspections/Dry Weather Discharge Inspections	Annually
BMP 10	Storm Drain Stenciling Program	As needed / ongoing
BMP 11	Septic System Inspection and Cleaning	Biennial
BMP 12	Inflow and Infiltration Detection	As needed / annually
BMP 13	Sanitary Sewer Overflow Response Team	As needed
BMP 14	Bird Control	As needed / annually
BMP 15	Water Quality Monitoring	Annually (February - October)
BMP 16	Erosion and Sediment Control Program	Ongoing / annually
BMP 17	Construction General Permit	Ongoing / annually
BMP 18	Construction Site Inspections (E&SC)	As needed / annually
BMP 19	Stormwater Management Master Plan	Ongoing / annually
BMP 20	Stormwater Management Project Review	As needed / ongoing
BMP 21	Structural BMP Implementation	As needed / ongoing
BMP 22	Structural BMP Inspections	Monthly
BMP 23	Storm Drain Inspection and Cleaning	Quarterly
BMP 24	Street Sweeping and Vacuuming	At least 2 annually
BMP 25	Municipal Facility Pollution Prevention and Good Housekeeping	Ongoing/ annually
BMP 26	Biennial Staff Training	Biennially
Milestone 1	Updated Combined Benthic and Bacteria (Local) TMDL Action Plan to DEQ	May 2020
Milestone 2	Evaluate Water Quality Monitoring Program	Annually
Milestone 3	Identify Proposed BMPs for Upcoming Permit Cycle	January 2021

Appendix A

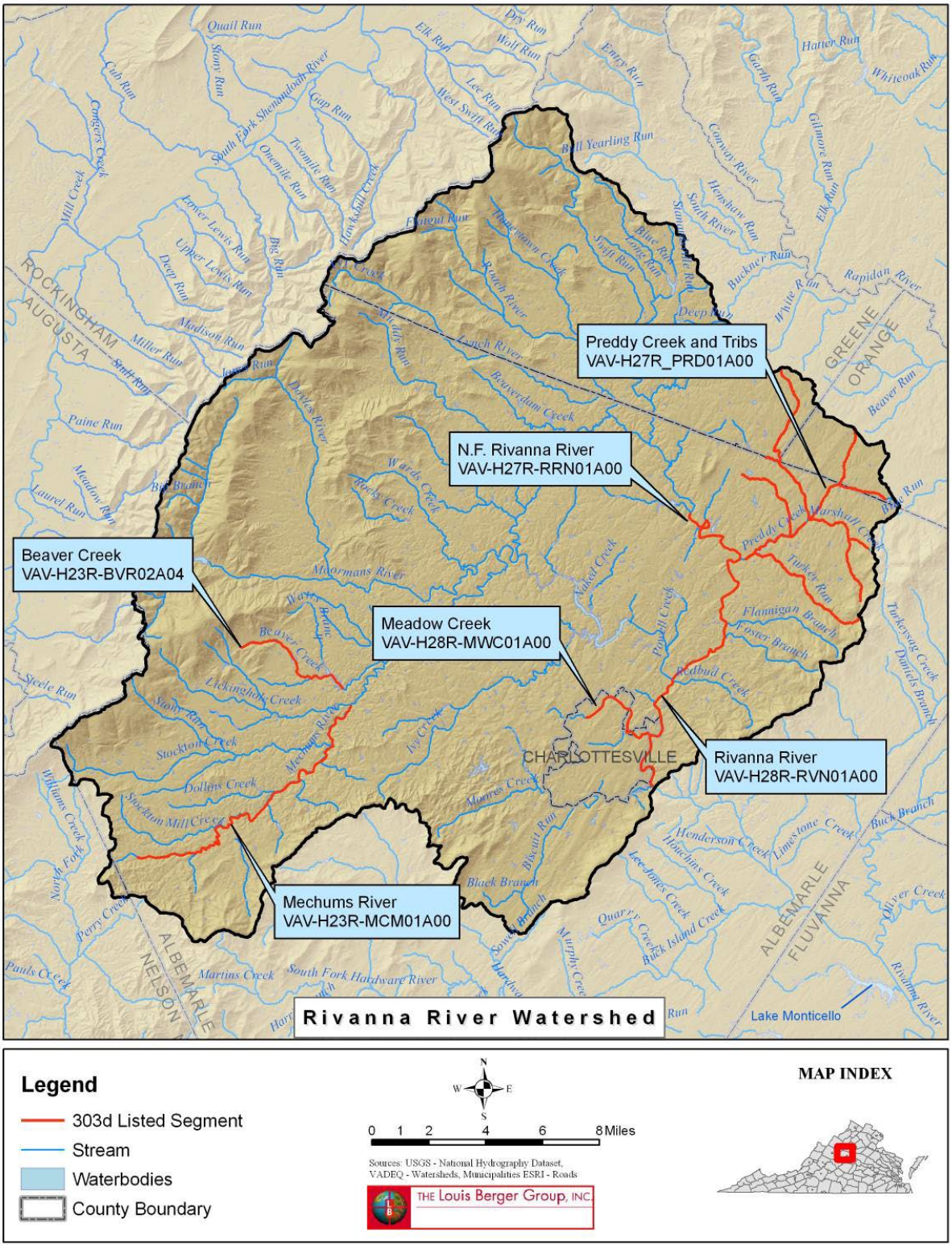
Rivanna River Benthic Impaired Segments and Delineated Watershed



Source: Figure 1-1: Benthic TMDL Development for the Rivanna River Watershed, Final Report (dated March 2008)

Appendix B

Location of Bacteria Impaired Segments of the Rivanna River Mainstem, North Fork Rivanna River, Preddy Creek and tributaries, Meadow Creek, Mechums River, and Beaver Creek Watersheds



Source: Figure 1-1: Bacteria TMDL Development for the Rivanna River Mainstem, North Fork Rivanna River, Preddy Creek and Tributaries, Meadow Creek, Mechums River, and Beaver Creek Watersheds (dated March 2008)

Appendix C

BMP Retrofit Calculations

Site Name	Gilmer Basin Retrofit	FM Basin	The Park Basin Retrofit
Existing (EX) BMP Type	Dry Detention	Dry Detention	Dry Detention
Proposed (PR) BMP Type	Extended Detention with Forebay	Wet Pond	Wet Pond
Site Area (Ac)	6.8	53	15.6
PERFORMANCE BASED CRITERIA			
Drainage Area to BMP-Impervious (Ac)	3.96	21.99	8.94
Drainage Area to BMP-Pervious (Ac)	2.84	31.01	6.66
POC LOADING RATES			
Total Suspended Solids (TSS) Loads (lbs/yr)	744.60	5803.50	1708.20
BAY PROGRAM BMP EFFICIENCY			
EX CBP BMP Type	Dry Detention	Dry Detention	Dry Detention
EX TSS Removal Efficiency	10%	10%	10%
PR CBP BMP Type	Extended Detention	Wet Pond	Wet Pond
PR TSS Removal Efficiency	60%	60%	60%
Difference of TSS Efficiency Type	50%	50%	50%
Maximum Suspended Solids Credit per Site (lbs/yr)	**372.30**	**2,901.75**	**854.10**

Notes:

1. Loading Rate = 0.3 lbs/ac/day or 109.5 lbs/ac/yr

Appendix D

University of Virginia Campus-Wide Stream Assessment, Phase I: Near-Term Projects

Biohabitats

The Stables Building
2081 Clipper Park Road
Baltimore, MD 21211
410.554.0156
www.biohabitats.com

MEMORANDUM

Date: September 4, 2019

To: Dawson Garrod, University of Virginia, Facilities Management

From: Biohabitats, Inc.

Subject: University of Virginia Campus-Wide Stream Assessment, Phase I: Near-Term Projects

---

As a Phase II Municipal Separate Storm Sewer System (MS4) permit holder, the University of Virginia (University) must achieve specific nutrient and sediment reductions to address Chesapeake Bay Total Maximum Daily Load (TMDL) requirements (DEQ, 2018). The Phase II MS4 permit requires the University to reduce its share of nutrients and sediments by 5% during the last MS4 permit cycle (2013–2018), further reduce pollutant loads by an additional 35% (40% total) during the current permit cycle (2018–2023), and a final 60% (100% total) reduction during the third permit cycle (2023–2028).

In the first permit cycle, the University met and exceeded the 5% nutrient and sediment reduction through the implementation of a variety of BMPs and restoration practices including stream restoration. The University has restored over 1,000 linear feet of stream in the following reaches (see **Figure 1**):

- Meadow Creek and Distillery Branch – JPJ Arena
- Meadow Creek – Lambeth
- Tributary to Meadow Creek – Carr's Hill Field Park

In the interest of continuing progress towards Chesapeake Bay TMDL pollutant reduction requirements, the University is evaluating streams and adjacent wetlands on University and University of Virginia Foundation (Foundation) properties. Evaluation is planned in two phases. In the first phase, approximately three miles of stream adjacent to near-term redevelopment projects were assessed in June 2019. The second phase will evaluate the remainder of the unrestored stream reaches on University and Foundation properties (approximately 14 miles of stream).

The purpose of this technical memorandum is to document the first phase of stream and wetland assessments. Methods are reviewed followed by results and recommendations.

Figure 1. UVA Stream Assessment Locator Map

Methods

The assessment and evaluation of stream reaches for restoration potential primarily consisted of two steps: field assessment and prioritization. Stream and wetland assessments were conducted for stream reaches identified by University staff as near-term priorities due to their proximity to future redevelopment projects (**Figure 1**). The stream assessment was conducted on reaches with defined channels and located on University or Foundation properties (i.e., field crews did not assess streams on private property). Stream assessment data was collected on tablets using the Collector for ArcGIS app. Field nomenclature abbreviations utilized for field data collection is provided in **Attachment A**.

Field Assessment Summary

The stream and wetland field assessment included the following:

- Bank Erosion Hazard Index/ Near Bank Stress (BEHI/NBS; modified from Rosgen, 2001)
- Habitat Assessment (DEQ, 2008)
- Modified Unified Stream Assessment (CWP, 2005)
- Wetland Assessment

BEHI/NBS

The purpose of BEHI and NBS measurements is to predict streambank erosion rates. BEHI evaluates erodibility potential of a stream reach and looks at several factors including bankfull height, root density, bank angle, and bank composition. NBS assesses the stress applied by erosion processes. There are seven methods that can be used to assess NBS. For the purposes of this assessment, Method 5 was utilized. Method 5 documents the ratio of near bank maximum depth to the bankfull mean depth to determine NBS. Together, BEHI and NBS can be used to estimate bank erosion and determine the amount of nutrient and sediment reduction credit for a potential stream restoration opportunity.

According to the Stream Restoration Expert Panel (WQGIT, 2014), nutrient and sediment reduction credit is determined based on four general protocols, which are described briefly below:

- Protocol 1: Credit for Prevented Sediment during Storm Flow - Stream restoration practices that prevent channel or bank erosion
- Protocol 2: Credit for Instream and Riparian Nutrient Processing during Base Flow – stream restoration practices that promote denitrification during baseflow through hyporheic exchange
- Protocol 3: Credit for Floodplain Reconnection Volume – stream restoration projects that reconnect stream channels to the floodplain
- Protocol 4: Credit for Dry Channel Regenerative Stormwater Conveyance (RSC) as an Upland Stormwater Retrofit – based on stormwater treatment volume.
    - RSCs were considered as a separate opportunity. Feasible RSC opportunities were identified and documented using the modified Unified Stream Assessment described below.

For the purposes of estimating nutrient and sediment reduction credit, it was assumed that the potential stream restoration projects will be able to achieve Protocol 1. This is a conservative estimate, as qualifying for credit under additional protocols is additive. Achieving additional

protocols (and therefore additional nutrient and sediment credit) may be determined at the concept stage.

As part of the nutrient and sediment reduction calculations for stream restoration projects using Protocol 1, the average BEHI and NBS ratings for each stream reach were converted to bank erosion rates using the North Carolina Piedmont Region Bank Erosion Prediction Curve (North Carolina State University Stream Restoration Program, 1989) (**Figure 2**). Due to similarities in site conditions, the North Carolina Piedmont Region Bank Erosion Prediction Curve was used over other regional curves including South Central Colorado, which has steep slopes and Hickey Run in Washington, DC, which has a high level of impervious cover.

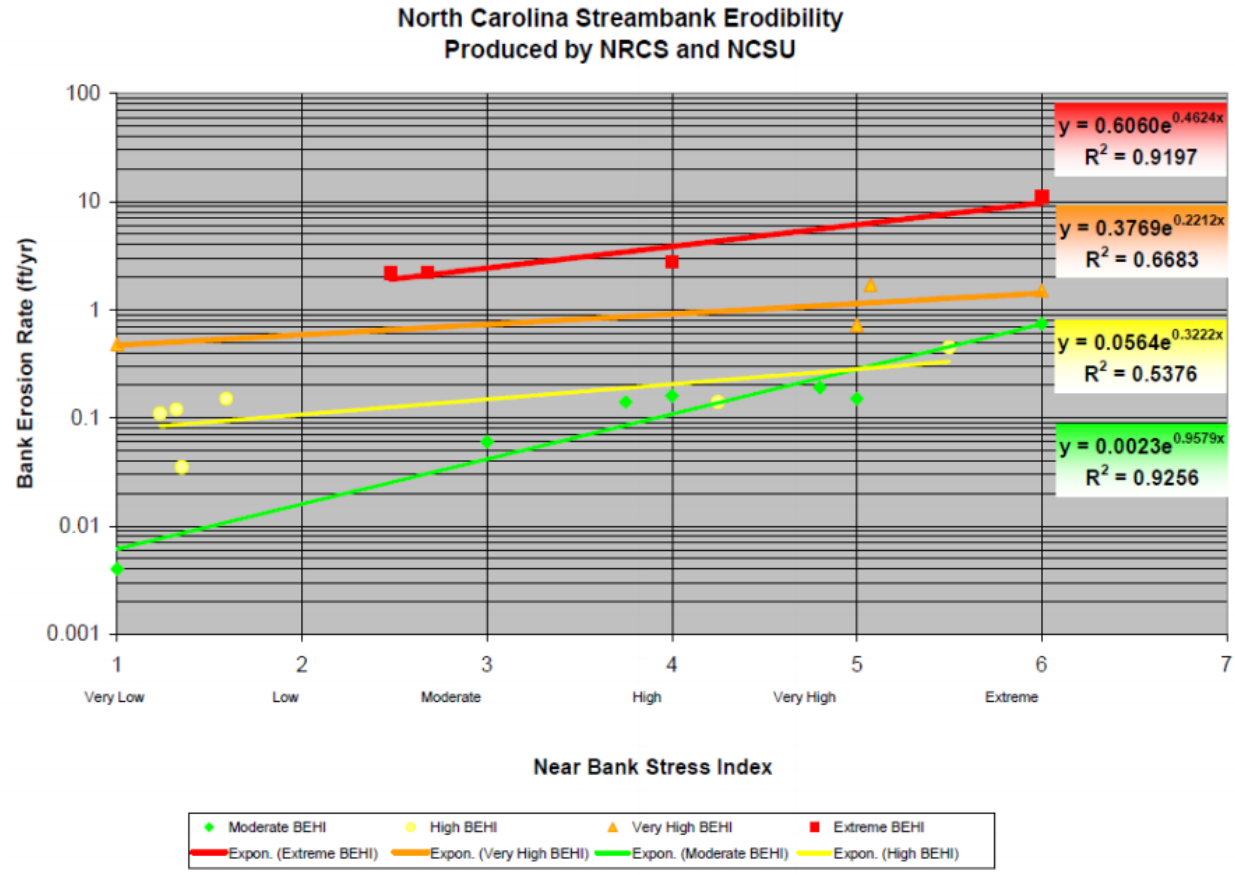


Figure 2. North Carolina Piedmont Region Bank Erosion Prediction Curve

Habitat Assessment

Each reach assessed includes a record of data that documents the overall habitat condition of the reach using Virginia Department of Environmental Quality's (DEQ) Method for Habitat Assessment for Streams (2008). Habitat assessment sites were assessed at approximately ¼ mile intervals. Additional representative sites were assessed, depending on changes in geomorphic conditions (e.g., changes in stream order, grade/profile changes, or severity of erosion). The habitat assessment documents the general conditions of the physical in-stream habitat and adjacent stream corridor using 10 habitat parameters: epifaunal substrate, embeddedness, velocity/depth regime,

sediment deposition, channel flow, channel alteration, frequency of riffles, bank stability, bank vegetation, and bank vegetation width.

Modified Unified Stream Assessment

The assessment utilized a modified version of the Center for Watershed Protection's (CWP) Unified Stream Assessment (2005) to document the following stream conditions:

- Erosion Sites: This record includes data on areas of eroding banks or channels. Severity was documented from 5 (most severe) to 1 (minor). The most severe rating is for a long section of stream (>1,000 ft) that is actively eroding and incision of several feet on both sides of the stream. A minor rating would be a short section limited to one area (e.g., a meander bend).
- Headcuts: This record includes data on headcuts in the stream channel, including the distance of the vertical drop in feet.
- Inadequate Buffer: This record includes data on the vegetative status of the area within 50 feet of either side of the stream. Inadequate buffers were generally recorded when forested areas adjacent to the stream are less than 50'. Severity was documented from 5 (most severe) to 1 (minor).
- Pipe/Outfalls: This record includes data for pipes, outfalls, and culverts discovered along or adjacent to a stream reach. This is not a comprehensive documentation of pipes/outfalls but may be useful to the University in identifying currently undocumented outfalls.
- RSC/Opportunity for Channel Stabilization: This record documented potential sites for RSC and/or channel stabilization along or adjacent to the stream reach. Documentation includes severity of the channel erosion and potential length in feet.
- Utilities: This record includes data for utilities discovered along or adjacent to a stream reach. Documentation includes utility type and whether or not repair is needed. This is not a comprehensive documentation of utilities.

Additional stream data collection included:

- Reach Breaks: This record indicates where a stream reach begins and ends; generally, a break occurs when there is a change in stream condition (e.g., gradient change; major tributary comes in; change in land use, etc.);
- Streams Not Assessed: Streams that were not assessed; field form documents reason that a given area was not assessed such as lack of defined stream channel and private property.
- Streams Assessed: Streams assessed in Phase I; streams were broken into "Reach Breaks" and given a unique ID

Wetland Assessment

Any land disturbing activity in wetlands and any alteration, fill, or back-flooding of streams is regulated by the US Corps of Engineers (US COE) and DEQ. Permits for such activities may be required by one or both agencies. Permit applications must be accompanied by survey located mapping of jurisdictional wetlands and streams and a Jurisdictional Determination letter from the COE verifying the jurisdictional limits for the subject parcel identified in the application.

For an area to be considered a jurisdictional wetland, three parameters must be present: hydrophytic vegetation, hydric soils and wetland hydrology. The US COE provides the protocol to make a determination of the presence/absence of each parameter (US COE, 2012).

Two types of wetland assessments are available based on project needs: a Preliminary Wetland Evaluation (PREWET) and a Wetland Delineation (WETDEL). The level of detail required for planning, design and construction of a project determines the type of assessment to be used for any given site. With use of either assessment, the soil survey for the subject parcel is obtained to determine those areas having soils which may have the potential to support wetlands.

The PREWET protocol was utilized for this phase of the stream and wetland assessment. Identifying the approximate location of wetlands within the Phase I study area will aid University staff in understanding potential constraints to restorability of each reach. Once a reach has been selected for restoration, the PREWET is sufficient for concept design. A WETDEL should be completed and COE confirmation obtained prior to the start of the Design Development phase of construction plans.

PREWET employs a visual assessment of the plant community as being hydrophytic or upland. If the plant community is hydrophytic, a limited number of soil samples are taken, and wetland hydrology is visually assessed to determine the presence/absence wetland hydrology. The approximate limits of potential wetland areas and streams were marked on a topographic map of the subject parcel and digitized into GIS as part of the post-field work data processing.

Prioritization Criteria

A prioritization and weighting process was used to score and rank the results of the field data. The goal is to use data from the field forms with limited amount of added computational requirements. Three potential projects can be inferred from the field data and include:

- Stream restoration
- Stream buffer reforestation
- RSCs

Prioritization parameters for the three project types are provided in **Tables 1 – 3**. Total Nitrogen (TN) was selected for the purposes of assigning a score to nutrient and sediment reductions. In future project phases (e.g., concept design), additional sediment and nutrient credit may be determined under additional protocols. In particular, additional TN credit may be available if a project qualifies for Protocol 2 (Hyporheic Zone).

Table 1. Stream Restoration Prioritization Factors

Ranking Factor	Score (Best Possible Score = 52 pts)
Habitat Assessment (12 pts)	
Velocity & Depth	
• Poor (1 – 5)	[4]
• Marginal (6 – 10)	[3]
• Suboptimal (11 – 15)	[2]
• Optimal (16 – 20)	[1]
Embeddedness	
• Poor (1 – 5)	[4]
• Marginal (6 – 10)	[3]
• Suboptimal (11 – 15)	[2]
• Optimal (16 – 20)	[1]
Bank Condition	
• Poor (0 – 2)	[4]
• Marginal (3 – 5)	[3]
• Suboptimal (6 – 8)	[2]
• Optimal (9 – 10)	[1]
Erosion Site (25 pts)	
Total Length	
• ≥ 1000 feet	[10]
• ≥ 300 feet and < 1000 feet	[5]
• < 300 feet	[1]
Average Severity	
• Most severe	[5]
• Severe / moderate	[4]
• Moderate	[3]
• Minor / moderate	[2]
• Minor	[1]
Average Correctability	
• Best	[5]
• Best / moderate	[4]
• Moderate	[3]
• Worst / moderate	[2]
• Worst	[1]
Average Access	
• Easy	[5]
• Easy/ moderate	[4]
• Moderate	[3]
• Difficult/ moderate	[2]
• Difficult	[1]
Wetland Presence (Y/N)	
• N	[3]
• Y	[1]
TN Reduction lbs/yr (from BEHI/NBS data) (12 pts)	
• >200	[12]
• >100 – 200	[8]
• >10 – 100	[4]
• <10	[1]

Table 2. RSC Prioritization Factors

Ranking Factor	Score (Best Possible Score = 31 pts)
Erosion Severity (5 pts)	
• Most severe	[5]
• Severe / moderate	[4]
• Moderate	[3]
• Minor / moderate	[2]
• Minor	[1]
Project Extent and Feasibility (18 pts)	
Correctability	
• Best	[5]
• Best / moderate	[4]
• Moderate	[3]
• Worst / moderate	[2]
• Worst	[1]
Access	
• Easy	[5]
• Easy/ moderate	[4]
• Moderate	[3]
• Difficult / moderate	[2]
• Difficult	[1]
Length	
• > 350 feet - 1000 feet	[5]
• > 150 feet - 350 feet	[4]
• > 100 feet - 150 feet	[3]
• > 50 feet - 100 feet	[2]
• 0 feet - 50 feet	[1]
Obstructions (i.e., mature trees, wetlands)	
• No	[3]
• Yes	[1]
TN Reduction lbs/yr (8 pts)	
• >2.75	[8]
• >2.35 – 2.75	[6]
• 0.95 – 2.35	[4]
• < 0.95	[1]

Table 3. Stream Buffer Reforestation Prioritization Factors

Ranking Factor	Score (Best Possible Score = 38 pts)
Inadequate Buffer Severity	
• Most severe	[5]
• Severe / moderate	[4]
• Moderate	[3]
• Minor / moderate	[2]
• Minor	[1]
Project Extent and Feasibility	
Inadequate on both sides	
• Yes	[5]
• No	[1]
Existing Width	
• ≤ 10 feet	[5]
• > 10 feet and ≤ 30 feet	[3]
• > 30 feet	[1]
Length	
• ≥ 900 feet	[5]
• ≥ 250 feet and < 900 feet	[3]
• < 250 feet	[1]
Correctability	
• Best	[5]
• Best / moderate	[4]
• Moderate	[3]
• Worst / moderate	[2]
• Worst	[1]
Access	
• Easy	[5]
• Easy / moderate	[4]
• Moderate	[3]
• Difficult / moderate	[2]
• Difficult	[1]
TN Reduction lbs/yr	
• >2.75	[8]
• >2.35 – 2.75	[6]
• 0.95 – 2.35	[4]
• < 0.95	[1]

Results

The prioritization process described in the previous section was used to score and rank potential projects. A summary of the prioritization results is provided in Tables 4 - 6. Detailed prioritization tables are provided in **Attachment B** and maps of the assessed reaches (with Reach IDs) in **Attachment C.** Additional field assessment results, including reach and assessment IDs are available via the ArcGIS online map.

Table 4. Stream Restoration Prioritization Results

Reach ID	Habitat Assessment Subtotal	Erosion Site Subtotal	Wetlands Presence	TN Reduction Score[1]	Total Score (out of 52)	Rank	Tier[2]
MDC-006	11	15	3	12	41	1	1
MDC-012	9	15	3	12	39	2	
FPW-001	9	21	1	8	39	3	
MDC-002	8	15	3	12	38	4	
FPS-002	10	13	3	12	38	5	
MBW-002	7	16	3	12	38	6	
MDC-007	11	10	3	12	36	7	2
MDC-009	6	19	1	8	34	8	
MBW-004	7	15	3	8	33	9	
FPS-001	7	21	1	4	33	10	
IRT-001	9	12	3	8	32	11	
MBE-001	7	16	1	8	32	12	
MBW-005[1]	9	18	3	1	31	13	3
LDC-001	10	17	1	1	29	14	
MBW-001	7	15	3	4	29	14	
MDC-003	9	15	3	1	28	16	
MBW-003[1]	8	16	3	1	28	17	
MDC-004	9	11	1	4	25	18	
MDC-011	7	14	3	1	25	19	4
MDC-001	7	14	3	1	25	20	
MDC-005	7	13	1	4	25	20	
MDC-010[1]	6	14	3	1	24	22	
MDC-008	6	13	1	1	21	23	
MDC-013	6	10	3	1	20	24	

1: The lowest TN reduction score (1 point) was assigned to reaches where nutrient reductions could not be calculated as a result of little to no erosion observed on these reaches

2: The tiering of stream restoration opportunities is also depicted in Figure 1

Table 5. RSC Prioritization Results

Reach ID	Assessment ID	Erosion Severity Score	Extent and Feasibility Subtotal	TN Reduction Score	Total Score (out of 31)	Rank
MDC-006	MDC-006-RC-001[1]	4	12	4	20	1
MDC-001	MDC-002-RC-001	2	10	4	16	2

1: Outfall primarily drains US Highway 250; implementation may require coordination with other stakeholders

Table 6. Stream Buffer Reforestation Results

Reach ID	Assessment ID	Severity Score	Extent and Feasibility Subtotal	TN Reduction Score	Total Score (out of 38)	Rank
FPS-001	FPS-001-IB-001	3	21	6	30	1
FPW-001	FPW-001-IB-002	3	17	8	28	2
FPW-001	FPW-001-IB-003	3	16	8	27	3
MDC-002	MDC-002-IB-001	3	12	4	19	4
MBE-001	MBE-001-IB-002	3	12	4	19	4
MBE-001	MBE-001-IB-001	3	14	1	18	6
FPW-001	FPW-001-IB-001	3	11	1	15	7

An estimate of nutrient and sediment load reductions associated with the potential projects is provided in Table 7. It is unlikely that the University would implement all the potential projects and therefore realize the total pollutant removal loads due to feasibility, budget, and other constraints.

Table 7. Estimate of Pollutant Load Reductions

Assessment ID[1]	TSS Load Reduction (lbs/yr)	TP Load Reduction (lbs/yr)	TN Load Reduction (lbs/yr)
Stream Restoration[2, 3]			
MDC-006	70,909.2	205.7	446.6
MDC-012	39,499.5	114.6	248.8
FPW-001	20,708.5	60.1	130.4
MDC-002	44,629.5	129.5	281.1
FPS-002	142,599.2	413.6	898.1
MBW-002	34,037.7	98.7	214.4
MDC-007	32,022.0	92.9	201.7
MDC-009	31,658.9	91.8	199.4
MBW-004	25,500.5	74.0	160.6
FPS-001	9,489.9	27.5	59.8
IRT-001	16,862.5	48.9	106.2
MBE-001	23,507.3	68.2	148.1
MBW-005	0.6	n/a	n/a
LDC-001	601.1	1.7	3.8
MBW-001	6,337.8	18.4	39.9
MDC-003	1,179.5	3.4	7.4
MBW-003	1.1	n/a	n/a
MDC-004	2,279.9	6.6	14.4
MDC-011	1,565.2	4.5	9.9
MDC-001	352.8	1.0	2.2
MDC-005	1,934.1	5.6	12.2
MDC-010	n/a	n/a	n/a
MDC-008	56.1	0.2	0.4
MDC-013	358.7	1.0	2.3
RSC[4]			
MDC-006-RC-001	1,082.0	0.3	1.2
MDC-002-RC-001	366.8	0.3	1.1
Stream Buffer Reforestation[5]			
FPS-001-IB-001	24.9	0.2	2.2
FPW-001-IB-002	82.0	0.7	7.1
FPW-001-IB-003	106.5	0.9	9.3
MDC-002-IB-001	10.4	0.1	0.9
MBE-001-IB-002	21.3	0.2	1.8
MBE-001-IB-001	4.1	0.0	0.4
FPW-001-IB-001	8.4	0.1	0.7

1: Projects are sorted by prioritization rank with the highest scoring projects first and lowest scoring projects last
2: Load reductions for stream restoration calculated using Protocol 1 methodology outlined in WQGIT, 2014
3: n/a indicates reaches where nutrient reductions could not be calculated as a result of little to no erosion observed on these reaches
4: Load reductions for RSCs calculated using Protocol 4 methodology outlined in WQGIT, 20
5: Forest buffers can be credited as both a land use change and efficiency BMP (DEQ, 2015). Load reductions quantified here reflect stream buffer reforestation as a land use change. Additional load reductions are available as an efficiency BMP but were not calculated as part of this initial effort.

An estimate of construction costs associated with each project type are provided in Table 8 below. Generally, project construction cost estimates, at this preliminary stage of project identification, are a function of project length or area and therefore cost was not factored into the prioritization as it

would be duplicative with project extent scoring. Construction cost estimates assume typical/average conditions, permitting, and site constraints and do not take site-specific considerations into account.

Table 8. Estimate of Project Construction Costs

Assessment ID[1]	Project Extent	Construction Unit Cost[3,4]	Estimated Construction Cost	Cost / lbs of TN Removed
Stream Restoration (linear feet)				
MDC-006	731.2	$400/lf	$ 292,460	$ 655
MDC-012	310.1		$ 124,055	$ 500
FPW-001	1,314.8		$ 525,925	$ 4,030
MDC-002	899.2		$ 359,680	$ 1,280
FPS-002	370.6		$ 148,235	$ 165
MBW-002	412.8		$ 165,115	$ 770
MDC-007	294.0		$ 117,610	$ 585
MDC-009	1233.8		$ 493,530	$ 2,475
MBW-004	419.1		$ 167,660	$ 1,045
FPS-001	1280.9		$ 512,350	$ 8,570
IRT-001	143.3		$ 57,305	$ 540
MBE-001	764.8		$ 305,930	$ 2,065
MBW-005	570.0		$ 227,985	n/a
LDC-001	514.8		$ 205,910	$ 54,390
MBW-001	355.0		$ 141,995	$ 3,555
MDC-003	307.1		$ 122,820	$ 16,535
MBW-003	321.9		$ 128,755	n/a
MDC-004	397.0		$ 158,790	$ 11,060
MDC-011	337.3		$ 134,905	$ 13,685
MDC-001	217.1		$ 86,850	$ 39,085
MDC-005	332.4		$ 132,945	$ 10,915
MDC-010	592.6		$ 237,050	n/a
MDC-008	526.5		$ 210,590	$ 596,160
MDC-013	102.1		$ 40,825	$ 18,070
RSC (linear feet)				
MDC-006-RC-001	100.0	$400/lf	$ 40,000	$ 34,865
MDC-002-RC-001	100.0		$ 40,000	$ 32,095
Stream Buffer Reforestation (acres)				
FPS-001-IB-001	0.43	$680/ac planted[2]	$ 290	$ 135
FPW-001-IB-002	1.42		$ 965	$ 135
FPW-001-IB-003	1.84		$ 1,255	$ 135
MDC-002-IB-001	0.18		$ 120	$ 135
MBE-001-IB-002	0.37		$ 250	$ 135
MBE-001-IB-001	0.07		$ 50	$ 135
FPW-001-IB-001	0.14		$ 100	$ 135

1: Projects are sorted by prioritization rank with the highest scoring projects first and lowest scoring projects last

2: Cost for stream buffer reforestation is for planting only; many of these areas may require invasive species removal first, which is not accounted for in the cost

3: Construction Costs for all three project types do not include permitting and design which will likely run approximately 30% of construction costs

4: Project construction cost estimates, at this preliminary stage of project identification, are a function of project length or area and do not take project specific constraints or efficiencies into consideration

Recommendations/ Next Steps

As the University continues to address Chesapeake Bay TMDL requirements, the University should consider moving the top six (i.e., Tier 1, top 25%) stream restoration opportunities to concept. This

will further identify potential feasibility and site constraints and potentially refine pollutant load reductions. In addition, this can assist the University in identifying potential grant opportunities, such as the Virginia Environmental Endowment, that may provide supplemental funding for design and construction costs.

In addition to moving the most cost effective and feasible Phase I stream reaches to concept, the University should continue to explore restoration opportunities by assessing the remaining stream miles (approximately 14 miles) on University and Foundation properties. This will allow the University to build a list of the most cost effective projects to meet Chesapeake Bay TMDL requirements.

Stream buffer reforestation may not yield a high level of pollutant removal credit, but it is a low cost option where stream restoration will not be pursued. Stream buffer reforestation may also be combined with a stream restoration project for potential additional load reductions. Credit may be received for reforestation occurring beyond the stream restoration project limits of disturbance and will need to be determined on a case-by-case basis. As noted in Table 8, costs do not account for invasive plant removal, which is needed at nearly all sites.

Similarly, the two potential RSCs may not appear to be particularly lucrative opportunities, but they can be combined with stream restoration projects to realize cost efficiencies and potentially increase the pollutant removal credit associated with the stream restoration project. In addition, the credits being allowed for RSCs are under review by the Chesapeake Bay Program, where preliminary indications are that the load reduction benefits will be increasing. Both RSCs are located on highlight prioritized stream reaches (MDC-002 and MDC-006).

The top stream restoration candidates are briefly summarized below and depicted in **Figure 3.** The reaches can also be located as "Tier 1" in Figure 1 and via unique ID (e.g., MDC-006) in Attachment C.

MDC-006
This portion of Meadow Creek runs between US 29 and the Law School Student Faculty Center. It has an average of four foot high banks and is more than 700 feet in length. The BEHI rating is high and active erosion was rated as severe. The surrounding riparian corridor is forested and in good condition. This project may be combined with the RSC, MDC-006-RSC-001.

MDC-012
This 300 foot tributary to Meadow Creek, originates from an outfall that drains US 29. The reach is actively eroding and includes 4.5 foot high stream banks. BEHI was rated high and active erosion was rated severe. The adjacent riparian corridor is forested and in good condition.

FPW-001
This stream reach of 1,300 feet runs to the west of Fontaine Park. It is an actively widening channel with an average of four feet high banks. The adjacent riparian corridor is sparsely forested with shrubs and invasives throughout. It is worth noting that the cost per lbs of TN removed is high due to the low-moderate level of erosion. This stream primarily consists of backwater due to a downstream beaver dam located just downstream from BEHI point, FPW-001-BH-028. A sewer line is exposed and running across the stream near the confluence with FPS. However, additional

credit may be available if Protocols 2 and/or 3 can be achieved. This may also be an attractive option if partnership opportunities are available with the City of Charlottesville.

MDC-002

This nearly 900 foot long reach is located behind University athletic fields at The Park and has an average of three foot high banks. The actively eroding channel has a BEHI rating of moderate with a riparian corridor that is forested and in good condition. Several headcuts exist on this reach along with bedrock located on the lower portion. This project may be combined with the RSC, MDC-002-RSC-001.

FPS-002

This stream channel, located to the south of Fontaine Park, is actively incising and has an average of 11 foot high stream banks. The BEHI rating is very high and erosion was rated very severe. The riparian corridor is moderate due to patches where invasives dominate. As a restoration project, this reach has the potential to reduce a relatively high load of nutrients and sediment. This also makes it one of the most cost-effective projects on cost per pounds of pollutant removed basis. The stream is located against the railroad embankment which could pose some constraints.

MBW-002

This portion of Morey Creek is located to the west of the US 250-US 29 highway bypass. This 400 foot long channel is actively widening and has an average of three foot high stream banks. BEHI was rated high and there are areas with poor riparian coverage.

MDC-006

MDC-012

FPW-001

MDC-002

FPS-002

MBW-002

Figure 3. Photos Depicting Top 6 Ranked Stream Conditions

References

Center for Watershed Protection (CWP). 2005. Unified Stream Assessment. Ellicott City, MD.

North Carolina State University Stream Restoration Program. 1989. North Carolina Piedmont Region Bank Erosion Prediction Curve. Raleigh, NC.

Rosgen, D. 2001. A practical method of computing stream bank erosion rate. Proceedings of the Seventh Federal Interagency Sedimentation Conference. Vol. 2, pp. II- 9-15, March 25-29, 2001, Reno, NV

United States Army Corps of Engineers (US COE). 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Virginia Department of Environmental Quality (DEQ). 2008. Methods for Habitat Assessment for Streams. Richmond, VA

Virginia Department of Environmental Quality (DEQ). 2015. Chesapeake Bay TMDL Action Plan Guidance Memo No. 15-2005. Richmond, VA.

Virginia Department of Environmental Quality (DEQ). 2018. General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems. General Permit No. VAR04. Richmond, VA.

Water Quality Goal Implementation Team (WQGIT). 2014. Recommendation of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Chesapeake Stormwater Network and EPA Chesapeake Bay Program.

ATTACHMENT A
UVA STREAM ASSESSMENT – Phase I
FIELD ASSESSMENT NOMENCLATURE

STREAM ASSESSMENT	[REACH ID] – [REACH SEGMENT ID] – [ASSESSMENT ID] – [UNIQUE ID]
EXAMPLES	Fourth erosion site identified in Lodge Creek: LDC-001-ER-004
	First habitat assessment on Morey Creek near Highway Bypass East: MBE-001-HB-001

ASSESSMENT [2]	ID
BEHI/NBS	BH
Habitat	HB
Erosion Site	ES
Inadequate Buffer	IB
Headcuts	HC
Pipe Outfall	OT
RSC	RC
Utility	UT
Reach Break	RB
Streams Not Assessed[1]	SN
Wetlands	WT

1: Use to indicate where stream could not be assessed for various reasons such as safety or access (i.e., snarling dogs, fencing)

2: Whenever possible, assessments were conducted facing downstream

STREAM REACH	ID
Fontaine Research Park – West	FPW
Fontaine Research Park – South	FPS
Morey Creek near Highway Bypass – East	MBE
Morey Creek near Highway Bypass – West	MBW
Ivy and Rothery Rd Trib	IRT
Lodge Creek	LDC
Meadow Creek	MDC

Attachment B
UVA Stream Assessment - Phase I
Stream Restoration Prioritization

		Habitat Assessment									Erosion						Wetlands		Pollutant Load Reduction						Cost	
Stream Reach Name	**Reach ID**	**Habitat Assessment ID**	**Velocity & Depth Rating**	**Velocity & Depth Score**	**Embededness Rating**	**Embeddedness Score**	**Bank Condition Left Rating**	**Bank Condition Right Rating**	**Bank Condition Score** (based on bank with lower score)	**Habitat Assessment Subtotal**	**Total Reach Length**	**Length Score**	**Average Severity Score**	**Average Correctability Score**	**Average Access Score**	**Erosion Subtotal**	**Wetland Presence**	**Wetland Score**	**Sediment Load Reduction (lbs/yr)**	**TP Load Reduction (lbs/yr)**	**TN Load Reduction (lbs/yr)**	**TN Load Reduction Score**	**Total Score**	**Rank**	**Total Estimated Construction Cost**	**Cost / Lbs of TN Removed**
Fontaine Research Park - South	FPS-001	FPS-001-HB-001	11	2	11	2	5	3	3	7	1280.9	10	3	5	4	21	Y	1	9,489.9	27.5	59.8	4	33	10	$ 512,350	$ 8,570
Fontaine Research Park - South	FPS-002	FPS-002-HB-001	8	3	8	3	2	2	4	10	370.6	5	5	1	2	13	N	3	20,708.5	413.6	898.1	12	38	5	$ 148,235	$ 165
Fontaine Research Park - West	FPW-001	FPW-001-HB-001	6	3	5	4	7	7	2	9	1314.8	10	3	4	4	21	Y	1	16,862.5	60.1	130.4	8	39	3	$ 525,925	$ 4,030
Ivy and Rothery Rd Trib	IRT-001	IRT-001-HB-001	12	2	3	4	5	3	3	9	143.3	1	3	3	5	12	N	3	601.1	48.9	106.2	8	32	11	$ 57,305	$ 540
Lodge Creek	LDC-001	LDC-001-HB-001	1	4	1	4	8	8	2	10	514.8	5	3	5	5	17	Y	1	23,507.3	1.7	3.8	1	29	14	$ 205,910	$ 54,390
Meadow Creek	MDC-001	MDC-001-HB-001	14	2	12	2	5	9	3	7	217.1	1	3	5	5	14	N	3	6,337.8	1.0	2.2	1	25	20	$ 86,850	$ 39,085
Meadow Creek	MDC-002	MDC-002-HB-001	11	2	6	3	4	4	3	8	899.2	5	3	4	3	15	N	3	34,037.7	129.5	281.1	12	38	4	$ 359,680	$ 1,280
Meadow Creek	MDC-003	MDC-003-HB-001	9	3	8	3	3	7	3	9	307.1	5	3	4	3	15	N	3	1.1	3.4	7.4	1	28	16	$ 122,820	$ 16,535
Meadow Creek	MDC-004	MDC-004-HB-001	9	3	9	3	4	7	3	9	397.0	5	3	3	1	11	Y	1	25,500.5	6.6	14.4	4	25	18	$ 158,790	$ 11,060
Meadow Creek	MDC-005	MDC-005-HB-001	13	2	11	2	4	7	3	7	332.4	5	3	3	2	13	Y	1	0.6	5.6	12.2	4	25	20	$ 132,945	$ 10,915
Meadow Creek	MDC-006	MDC-006-HB-001	7	3	5	4	2	2	4	11	731.2	5	4	3	3	15	N	3	352.8	205.7	446.6	12	41	1	$ 292,460	$ 655
Meadow Creek	MDC-007	MDC-007-HB-001	7	3	4	4	2	2	4	11	294.0	1	3	3	3	10	N	3	44,629.5	92.9	201.7	12	36	7	$ 117,610	$ 585
Meadow Creek	MDC-008	MDC-008-HB-001	12	2	12	2	7	8	2	6	526.5	5	2	4	2	13	Y	1	1,179.5	0.2	0.4	1	21	23	$ 210,590	$ 596,160
Meadow Creek	MDC-009	MDC-009-HB-001	12	2	12	2	7	8	2	6	1233.8	10	3	3	2	19	Y	1	2,279.9	91.8	199.4	8	34	8	$ 493,530	$ 2,475
Meadow Creek	MDC-010	MDC-010-HB-001	5	4	16	1	9	9	1	6	592.6	5	3	3	3	14	N	3	1,934.1	n/a	n/a	1	24	22	$ 237,050	n/a
Meadow Creek	MDC-011	MDC-011-HB-001	14	2	11	2	4	4	3	7	337.3	5	2	4	3	14	N	3	70,909.2	4.5	9.9	1	25	19	$ 134,905	$ 13,685
Meadow Creek	MDC-012	MDC-012-HB-001	9	3	15	2	2	2	4	9	310.1	5	4	3	3	15	N	3	32,022.0	114.6	248.8	12	39	2	$ 124,055	$ 500
Meadow Creek	MDC-013	MDC-013-HB-001	12	2	16	1	8	4	3	6	102.1	1	3	4	3	10	N	3	56.1	1.0	2.3	1	20	24	$ 40,825	$ 18,070
Morey Creek near Highway Bypass - East	MBE-001	MBE-001-HB-001	15	2	15	2	4	6	3	7	764.8	5	3	4	4	16	Y	1	31,658.9	68.2	148.1	8	32	12	$ 305,930	$ 2,065
Morey Creek near Highway Bypass - West	MBW-001	MBW-001-HB-001	6	3	17	1	8	4	3	7	355.0	5	3	4	3	15	N	3	1,565.2	18.4	39.9	4	29	14	$ 141,995	$ 3,555
Morey Creek near Highway Bypass - West	MBW-002	MBW-002-HB-001	11	2	9	3	6	6	2	7	412.8	5	4	4	3	16	N	3	39,499.5	98.7	214.4	12	38	6	$ 165,115	$ 770
Morey Creek near Highway Bypass - West	MBW-003	MBW-003-HB-001	9	3	11	2	5	6	3	8	321.9	5	3	4	4	16	N	3	358.7	0.0	0.0	1	28	17	$ 128,755	n/a
Morey Creek near Highway Bypass - West	MBW-004	MBW-004-HB-001	15	2	11	2	4	6	3	7	419.1	5	4	4	3	15	N	3	142,599.2	74.0	160.6	8	33	9	$ 167,660	$ 1,045
Morey Creek near Highway Bypass - West	MBW-005	MBW-005-HB-001	5	3	4	4	8	8	2	9	570.0	5	4	4	5	18	N	3	-	0.0	0.0	1	31	13	$ 227,985	n/a

Attachment B
UVA Stream Assessment - Phase I
RSC Prioritization

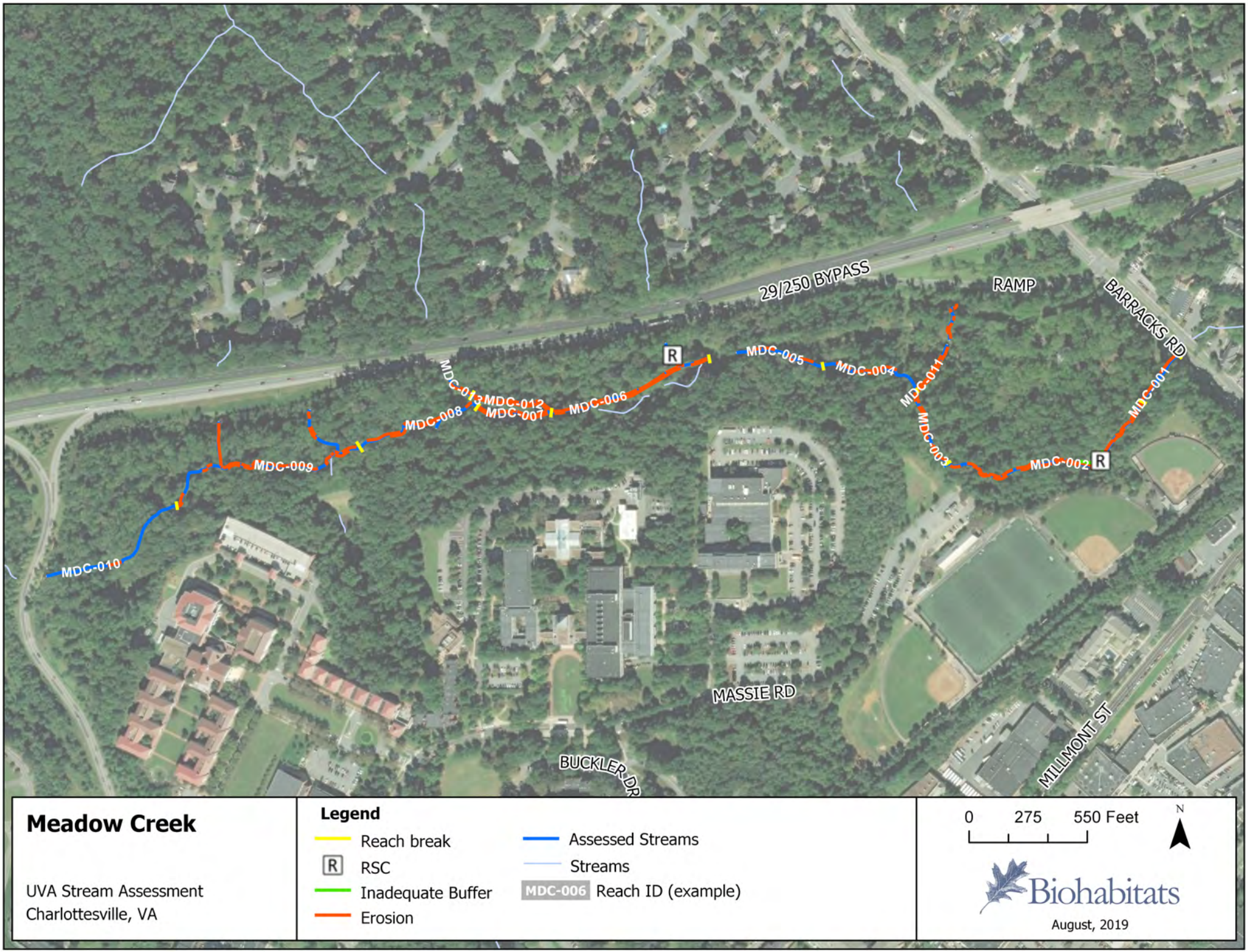
		Erosion Severity	Project Extent and Feasibility							TN Reduction Potential						Cost	
Stream Reach Name	Unique ID	Severity Score	Correctability Score	Access Score	Potential Project Length (ft)	Length Score	Obstructions	Obstruction Score	Extent and Feasibility Subtotal	TSS Load Reduction (lbs/yr)	TP Load Reduction (lbs/yr)	TN Load Reduction (lbs/yr)	TN Reduction Score	Total Score	Rank	Estimated Construction Costs	Cost/Lbs of TN Removed
Meadow Creek	MDC-006-RC-001	4	4	3	100	2	Yes	3	12	366.8	0.3	1.1	4	20	1	$ 40,000.00	$ 34,865
Meadow Creek	MDC-002-RC-001	2	2	3	100	2	Yes	3	10	1082.0	0.3	1.2	4	16	2	$ 40,000.00	$ 32,095

Attachment B
UVA Stream Assessment Phase I
Stream Buffer Reforestation Prioritization

		Severity Score	Project Extent and Feasibility									Nutrient Reduction Potential						Cost	
Stream Reach Name	Unique ID	Severity Score	Inadequate Both Sides	Inadequate Both Sides Score	Existing Forested Width	Existing Forested Width Score	Length of Gap	Length of Gap Score	Correctability Score	Access Score	Extent and Feasibility Subtotal	TSS Load Reduction (lbs/yr)	TP Load Reduction (lbs/yr)	TN Load Reduction (lbs/yr)	TN Reduction Score	Total Score	Rank	Estimated Construction Cost	Cost /Lbs of TN Removed
Fontaine Research Park – South	FPS-001-IB-001	3	Right	1	5	5	936	5	5	5	21	24.9	0.2	2.2	6	30	1	$ 290	$ 135.00
Fontaine Research Park – West	FPW-001-IB-002	3	Right	1	5	5	651	3	4	4	17	82.0	0.7	7.1	8	28	2	$ 965	$ 135.00
Fontaine Research Park – West	FPW-001-IB-001	3	Left	1	50	1	126	1	4	4	11	8.4	0.1	0.7	1	15	7	$ 100	$ 135.00
Fontaine Research Park – West	FPW-001-IB-003	3	Left	1	5	5	845	3	4	3	16	106.5	0.9	9.3	8	27	3	$ 1,255	$ 135.00
Morey Creek near Highway Bypass – East	MDC-002-IB-001	3	Right	1	25	3	105	1	4	3	12	10.4	0.1	0.9	4	19	4	$ 120	$ 135.00
Morey Creek near Highway Bypass – East	MBE-001-IB-002	3	Left	1	25	3	213	1	4	3	12	21.3	0.2	1.8	4	19	4	$ 250	$ 135.00
Morey Creek near Highway Bypass – East	MBE-001-IB-001	3	Right	1	20	3	205	1	4	5	14	4.1	0.0	0.4	1	18	6	$ 50	$ 135.00

Attachment C

Assessed Stream Reach Maps



Meadow Creek

UVA Stream Assessment
Charlottesville, VA

Legend

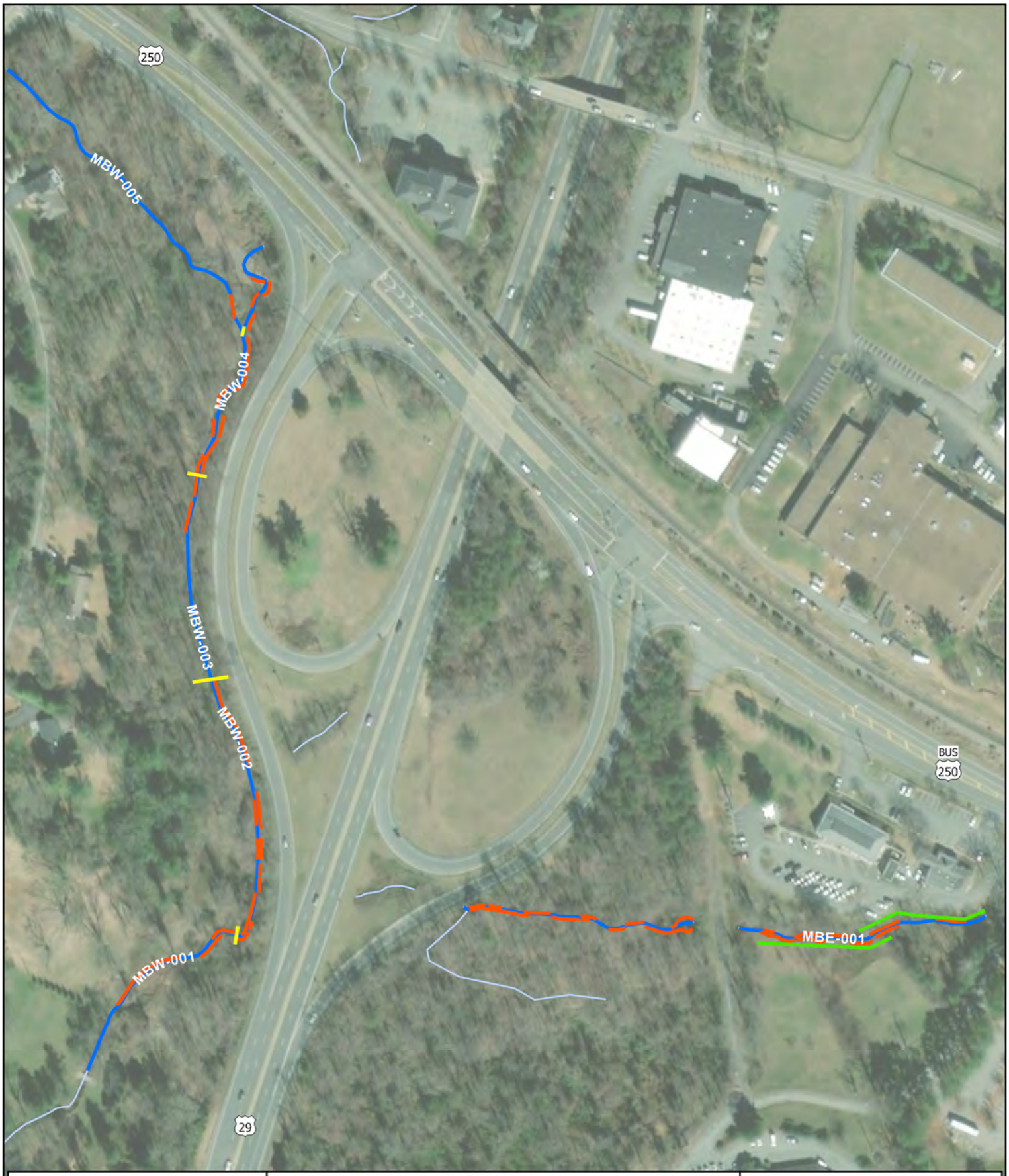
- Reach break
- R RSC
- Inadequate Buffer
- Erosion
- Assessed Streams
- Streams
- MDC-006 Reach ID (example)

0 275 550 Feet

N

Biohabitats

August, 2019



Morey Creek Bypass

UVA Stream Assessment
Charlottesville, VA

Legend

- Reach break
- R RSC
- Inadequate Buffer
- Erosion
- Assessed Streams
- Streams
- MDC-006 Reach ID (example)

0 125 250 Feet

N

Biohabitats

August, 2019

Ivy and Rothery Road Trib

UVA Stream Assessment
Charlottesville, VA

Legend

- Reach break
- R RSC
- Inadequate Buffer
- Erosion
- Assessed Streams
- Streams
- MDC-006 Reach ID (example)

0 25 50 Feet

N

Biohabitats

August, 2019

Lodge Creek

UVA Stream Assessment
Charlottesville, VA

Legend

- Reach break
- R RSC
- Inadequate Buffer
- Erosion
- Assessed Streams
- Streams
- MDC-006 Reach ID (example)

0 37.5 75 Feet

N

Biohabitats

August, 2019

Fontaine Research Park

UVA Stream Assessment
Charlottesville, VA

Legend

- Reach break
- RSC
- Inadequate Buffer
- Erosion
- Assessed Streams
- Streams
- MDC-006 Reach ID (example)

0 175 350 Feet

N

Biohabitats

August, 2019

Appendix E

UVA Training Plan and Frequency

UVA Training Plan and Frequency				
Department	**Reason Required**	**Training Type/ Objective**	**Frequency**	**Means to Achieve Training Requirement**
Athletics	6.1.(1) - Field Personnel	SPCC Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
John Paul Jones Arena	6.1.(1) - Field Personnel	Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
IM-Rec Sports	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
Heat Plant	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
Recycling	6.1.(1) - Field Personnel	Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
Utilities	6.1.(1) - Field Personnel	SPCC Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
Power and Light	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
North Grounds Zone Maintenance	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
Newcomb Zone Maintenance	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
West Grounds Zone Maintenance	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
McCormick Zone Maintenance	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
Central Grounds Zone Maintenance	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
FM HSPP Zone 1 Maintenance	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
FM HSPP Zone 2 Maintenance	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
FM HSPP Zone 3 Maintenance	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
FM HSPP Zone 4 Maintenance	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
Landscaping	6.1.(1)-(2) - Field Personnel, Street and Parking Lot Maintenance	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
Renovations	6.1.(1) - Field Personnel	Class C UST Operator, Spill Response, IDDE, SOPs	Once every 24 months	Training provided by ER or appropriate designated staff
Facilities Management Administrative Staff	6.m.(3) - Work around maintenance facility	IDDE	Once every 24 months	Training provided by ER or appropriate designated staff
FM Pesticide and Herbicide Applicators	6.m.(4) - Pesticide and herbicide applicators	VCACS Certification	As required for certification	VCACS Program Certification Requirements
Environmental Resources	6.m.(5)-(6)- E&SC and VSMP inspectors	E&SC and SWM Combined Inspector or Administrator	As required for certification	DEQ E&SC and SWM
UVA Police	6.m.(7) - Emergency response	IDDE	Once every 24 months	Officers provide training in-house on UVA emergency response procedures.
EHS	6.m.(7) - Emergency response	HAZWOPER	As required for certification	EHS to receive training by a certified trainer as appropriate.