Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch Sediment Total Maximum Daily Load (TMDL) Action Plan
Permit Cycle: 2023-2028

General Permit No.: VAR040073

May 2025

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UNIVERSITY of VIRGINIA

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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 Moores Creek, Lodge Creek, Meadow Creek and Schenks Branch watersheds. These watersheds drain to the Rivanna River on the eastern boundary with the City of Charlottesville, then flow to the James River, and ultimately discharge 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 non-traditional 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 Management Act and the MS4 General Permit granted by the Department of Environmental Quality (DEQ).

In compliance with Part II.B of the November 1, 2023 General Permit for Discharges of Stormwater from Small MS4s (Permit No.: VAR040073), the University of Virginia has developed a Sediment Total Maximum Daily Load (TMDL) Action Plan for Moores Creek, Lodge Creek, Meadow Creek and Schenks Branch. Additionally, the University has coordinated with Albemarle County and the City of Charlottesville in the preparation of this Action Plan. The TMDL for these watersheds sets limits on the amount of the pollutant of concern (POC), which in this case is total suspended solids (TSS) or sediment, that can be discharged to the local streams without detrimentally impacting water quality. The MS4 Permit Special Condition for local TMDLs requires all MS4 operators to reduce existing levels of this POC 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 Name and EPA Approval Date

Wasteload allocations (WLAs) for sediment were assigned to the University for the Moores Creek, Lodge Creek, Meadow Creek and Schenks Branch Watersheds in the approved Final TMDL report as follows:

- *Sediment TMDLs for Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch Albemarle County and Charlottesville City, Virginia (Revised: January 20, 2016)*
- EPA approval date was 7/26/2016.

2. Pollutants Causing the Impairments

The TMDL report noted in Section 1 identified four separate tributaries to the Rivanna River or stream segments which receive runoff from UVA with benthic impairments as listed in Virginia's 2012 Section 303(d) Report on Impaired Waters: Moores Creek (VAV-H28R_MSC01A00), Lodge Creek (VAV-H28R_XRC01A04), Meadow Creek (VAV-H28R_MWC01A00), and Schenks Branch (VAV-H28R_SNK01A02) (Appendix A).

The Lodge Creek and Meadow Creek tributaries were originally listed as impaired on Virginia's 2006 305(b)/303(d) Water Quality Assessment Integrated Report whereas the Moores Creek and Schenks Branch segments were first indicated as impaired in the 2008 report.

The TMDL Report (page 45) states:

"Since a benthic impairment is based on a biological inventory, rather than on a physical or chemical water quality parameter, the pollutant is not explicitly identified in the assessment, as it is with physical and chemical parameters. The process outlined in USEPA's Stressor Identification Guidance Document (USEPA, 2000) was used to identify the critical stressors for each of the impaired watersheds in this study."

The resulting stressor analysis identified sediment as the most probable stressor for all four of the watersheds listed in the TMDL. Additionally, hydrologic modification was recognized as a stressor for all of the applicable streams except Moores Creek.

3. WLAs Assigned to the Permittee

The affected area MS4s, including UVA, have been assigned aggregated waste load allocations and percent reduction requirements for each of the four watersheds in the TMDL Report as is shown in Table 1.

Table 1

Regulated MS4 Aggregated Sediment Wasteload Allocation Within the Impaired Watersheds: Moores Creek, Lodge Creek, Meadow Creek and Schenks Branch (excerpt from Tables 6-4 to 6-7 of the Sediment TMDL Development Report)				
Watershed	**Existing Total Load* (tons/yr)**	**Percent Reduction (%)**	**Allocated Load (tons/yr)**	**Required Load Reduction (tons/yr)**
Moores Creek	835.5	14.6	713.8	121.7
Lodge Creek	91.3	50.1	45.6	45.8
Meadow Creek	898.5	50.7	442.6	455.9
Schenks Branch	290.4	56.4	126.7	163.6

(*) The existing total load accounts for all land sources including forested areas.

4. Significant Sources of Pollutants of Concern

The TMDL Report identified several factors that attributed to the sediment impairment ranging from active erosion, poor vegetative cover, large amounts of impervious surfaces, urban land uses, poor riparian vegetation, forest harvesting operations and unstable stream banks.

This section identifies significant sources of sediment within the UVA MS4 service area 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 MS4 permit states: "a significant source of pollutants of concern 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. Through desktop and site inspection analysis, it was determined that the University does not contain any sites that are significant sources of sediment. However, the areas identified in the analysis will continue to be monitored.

Potential Sources at UVA

Potential significant sources of sediment discharging and applicable to UVA's MS4 include construction sites, litter and street dust. In addition, there are several sites with municipal operations 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 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.

Instream erosion is identified as the largest contributor of land based non-point sediment load. Specifically the Louis Berger TMDL Development Report (March 2008) states: "there is a higher level of sedimentation related to stream bank instability". Large volumes of water entering streams at high velocities, can cause erosion of stream banks and scour-related degradation. If the urban runoff from large parking lots and other sizeable impervious surfaces is not treated by a downstream BMP, it may be a significant source of sediment.

5. BMPs Designed to Reduce the POCs

The University of Virginia has taken a proactive stance and made an aggressive effort to reduce POCs within its watersheds. The University's MS4 Program Plan and Annual MS4 Reports include a wide array of best management practices (BMPs) that aim to reduce pollutants including sediment and bacteria and correlate with the minimum control measures:

BMPs

1. **Websites and Social Media**– Information on erosion and sediment control (E&SC) and stormwater management (SWM) can be found on the Environmental Resources website (https://pollutionprevention.virginia.edu). Additionally, a Facebook page and an Instagram account have been created in conjunction with the "UVA Clean Water" student group to promote good water quality practices and behaviors.

2. **Public Awareness Events** - 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**– Through RSEP, advertisements are displayed in a local newspaper (Cville Weekly), and buses addressing methods to reduce sediment with car washing tips and other reminders to prevent anything except stormwater from entering storm drains, etc.

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

6. **Educational Lectures**– 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**– UVA students, faculty and staff are encouraged to participate in stream enhancement and education projects and programs where possible.

8. **Illicit Discharge Program**– 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.

9. **MS4 Outfall Inspections/Dry Weather Discharge Inspections**– 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 BMP 8 are followed if any suspicious discharges are noted.

10. **Storm Drain Stenciling Program** - 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. **Erosion and Sediment Control Program** – UVA follows DEQ-approved Standards and Specifications (S&S) for E&SC in compliance with the Virginia Erosion and Stormwater Management 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; the City's threshold is lower than Virginia's regulatory requirements. Plan approval is required prior to commencement of any regulated land disturbing activity. UVA also requires E&SC controls to be installed on all land disturbing projects, even if a formal E&SC plan is not required.

12. **Construction General Permit Compliance** - 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.

13. **Construction Site Inspections** - 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.

14. **Stormwater Management Master Plan -** 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.

15. **Stormwater Management Project Review** – UVA follows S&S for SWM in compliance with the Virginia Erosion and Stormwater Management Regulation as related to MS4s and construction activities. SWM Plans are required for all land disturbances over 10,000 sf in Albemarle County and 6,000 sf in the City of Charlottesville; these thresholds are lower than Virginia's regulatory requirements. Plan approval is required prior to commencement of any regulated land disturbing activity.

16. **Structural BMP Implementation**– 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 Stormwater Management Handbook.

17. **Structural BMP Inspections** - UVA inspects and maintains all structural BMPs on its property, unless subject to a long-term lease to another entity. In these cases, the entity leasing the property is responsible for the maintenance. Inspectors conduct routine inspections and complete maintenance as needed.

18. **Storm Drain Inspection and Cleaning –** 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 17. UVA's computerized maintenance 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 across the entire MS4.

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

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

21. **Biennial Staff Training Plan**– 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. Training will occur for the appropriate personnel at the required frequencies as described in UVA's MS4 Program Plan.

There are no established load reduction calculation methods for most of these BMPs. Progress toward TMDL achievement will ultimately be demonstrated by DEQ's water quality monitoring program. All of the BMPs UVA installed to meet the requirements of this TMDL are in the Chesapeake Bay watershed and will be utilized to meet local TMDL requirements. Anticipated sediment load reductions from these BMPs are detailed in UVA's Chesapeake Bay TMDL Action Plan; a summary of these reductions are provided in Appendix C. These load reduction calculations may be underestimated since pollutant loading rates directly to the local watersheds may be higher than for those delivered to the Chesapeake Bay.

6. Outreach Strategies to Enhance Public Education

One of the most important and effective BMPs in controlling and reducing sediment 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 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 PSAs, print ads, flyers on buses, mailings, etc.) to increase public awareness about stormwater pollution prevention.

UVA Environmental Resources maintains a webpage (https://pollutionprevention.virginia.edu/) 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
- Stormwater Runoff Management Brochure
- Vehicle Washing Brochure
- RSEP Stormwater PSA Video
- After the Storm (EPA) Video
- Prevent Storm Drain Pollution 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 sediment 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.

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. Schedule of Anticipated Implementation Actions

The University is committed to using a variety of management practices and control techniques for the purposes of reducing sediment pollution. The University intends to use an adaptive, iterative approach for the implementation of BMPs over multiple permit cycles as referenced in the MS4 General Permit Part II.B.3. Table 4 presents a schedule of anticipated actions planned for implementation during this permit term. The schedule may need to be modified in order to achieve the POC reductions necessary to restore the water quality of Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch, and ultimately remove the impairment listing. Current projections estimate an end date to meet the WLA for this TMDL in 2071.

Table 2

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 2 annually
BMP 3	Rivanna Stormwater Education Partnership Member	Ongoing
BMP 4	Advertising	Once every two or three years
BMP 5	Utility Bill Mailings	Once every permit cycle
BMP 6	Educational Lectures	At least 1 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	Erosion and Sediment Control Program	Ongoing
BMP 12	Construction General Permit Compliance	Ongoing (project based)
BMP 13	Construction Site Inspections	As needed / biweekly
BMP 14	Stormwater Management Master Plan	Ongoing
BMP 15	Stormwater Management Project Review	As needed (project based)
BMP 16	Structural BMP Implementation	As needed / ongoing
BMP 17	Structural BMP Inspections	At least annually
BMP 18	Storm Drain Inspection and Cleaning	Quarterly
BMP 19	Street Sweeping and Vacuuming	At least 1 annually
BMP 20	Municipal Facility Pollution Prevention and Good Housekeeping	Ongoing
BMP 21	Biennial Staff Training	Biennially (See MS4 Prog Plan)

Potential Projects

In an effort to make additional 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 Stream Corridor Assessment for the University of Virginia on an Unnamed Tributary to Meadow Creek and UVA Morey Creek Stream Assessment and Concept Design – Appendix D):

Table 3

Potential Stream Restoration Segments on University Grounds				
Stream Location	**Adjacent Redevelopment Zone**	**Watershed**	**Estimated Restoration Length (ft)**	**TSS Reductions (lbs/yr)**
Meadow Creek North Grounds	Darden	Meadow Creek	5,000	368,400
Fontaine Park – West	Fontaine Park	Moores Creek	1,000	12,000
Schenks Branch Nutrient Credit Purchase (From City of Charlottesville)^	NA	Schenks Branch	820	4,000

^See Appendix E

The Meadow Creek Concept report also highlighted two outfall stabilization projects that could be completed following Protocol 5 to significantly reduce total suspended solids:

Table 4

Potential Outfall Stabilization Opportunities		
Outfall Location	**Watershed**	**TSS Reductions (lbs/yr)**
Meadow Creek North Grounds	Meadow Creek	74,200

UVA also identified several potential BMP retrofits in the 2015 SWM Master Plan. The list below 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**	**Watershed**
The Park Basin	Dry Detention	Wet Pond	Meadow Creek
FM Basin	Dry Detention	Wet Pond	Meadow Creek

* UVA will model sediment load reductions pursuant to the Chesapeake Bay TMDL Action Plan Guidance Document published by DEQ (latest edition) as well as any additional guidance received from DEQ to track both the effectiveness and progress toward the TMDL requirement.

Inter-Jurisdictional Agreement

The University, Albemarle County and the City of Charlottesville have agreed to take responsibility for the sediment loads generated within their regulated area boundary regardless of sheet flow draining to or from another jurisdiction. Sediment 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 their own and/or multiple permittees' lands and could target the specific watersheds.

8. Action Plan Evaluation and Adaptive Management Strategies

Since the last action plan update, the University has made notable progress toward reduction requirements. The first project involved the retrofit of a detention basin near Gilmer Hall (formerly listed as a potential project) that reduced TSS (5,176 lbs/yr) in the Lodge Creek watershed.

Additionally, the City of Charlottesville completed a stream restoration project in Schenks Branch since the last action plan update. UVA entered into an agreement with the City of Charlottesville to purchase 4000 lbs /yr sediment reduction credits that were generated from that project due to the limited area UVA owns in the watershed. This agreement fully satisfies UVA's reduction requirement for that drainage basin. (See Appendix E)

With the progress that was achieved with these projects, the action plan and the BMPs in place have been effective and shown measurable progress. The University has not adopted any new adaptive management strategies with respect to this action plan but will continue to evaluate the potential projects that have been identified and will explore any new opportunities as they arise.

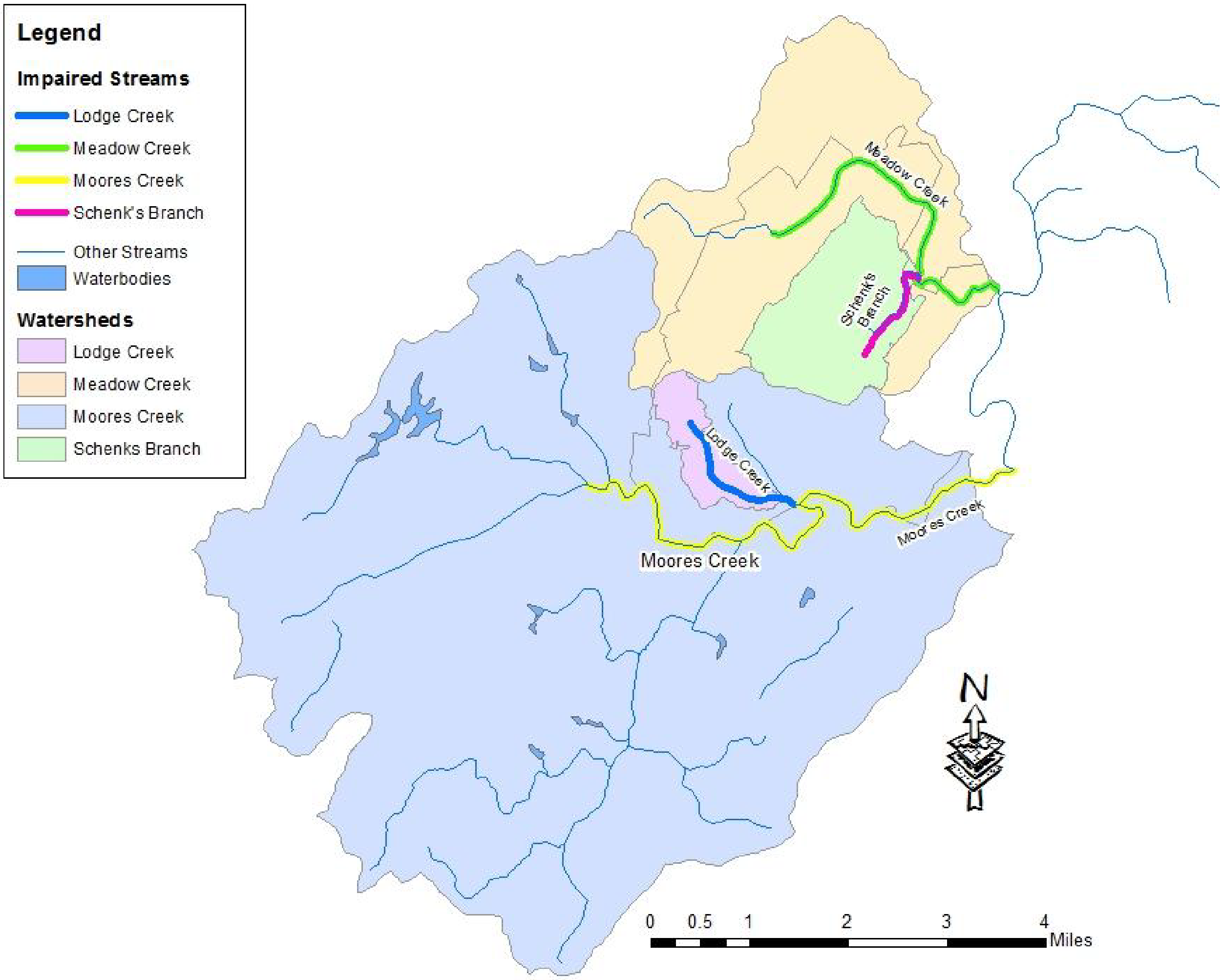
As described above, UVA will continue to reduce the loads associated with sediment through implementation of BMPs from the Virginia Stormwater BMP Clearinghouse and/or approved by the Chesapeake Bay Program, and also by requiring erosion and sediment controls and post development stormwater management for land disturbing project sizes lower than Virginia's regulatory requirements.

9. Public Comment on Action Plan

This Action Plan is posted on the TMDL section of the UVA Environmental Resources website. Prior to finalizing the documents in accordance with the 2023 MS4 Permit, this Action plan was posted on the website for 15 days to provide the opportunity for public comment and suggested revisions. No comments were received.

Appendix A

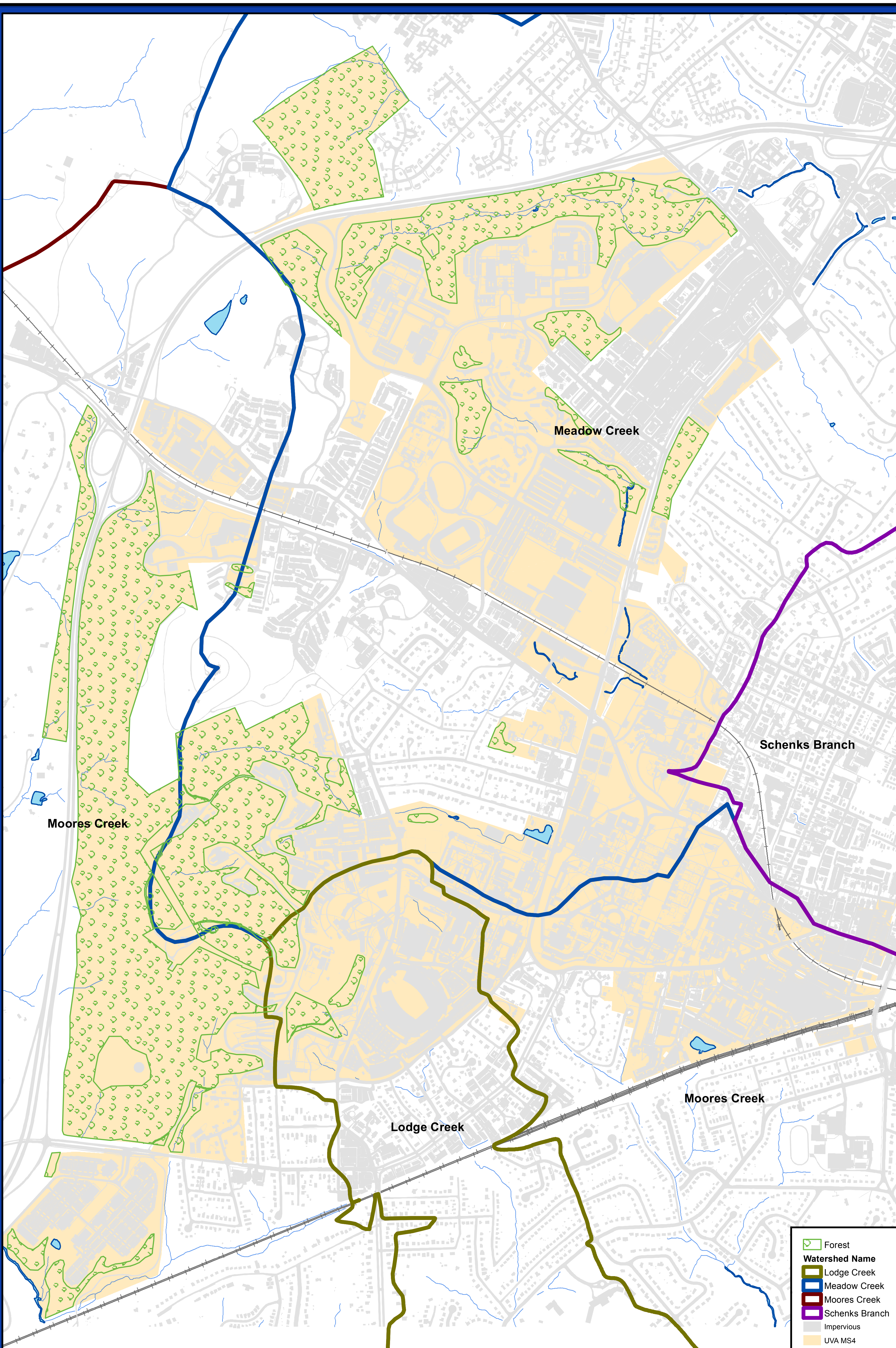
Impaired Stream Segments in the Moores Creek, Lodge Creek, Meadow Creek and Schenks Branch Watersheds



Source: TMDL Report Figure 5-1: Sediment TMDLs for Moores Creek, Lodge Creek, and Schenks Branch (Revised January 20, 2016)

Appendix B

Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch Watersheds and Land Cover within UVA's Regulated MS4



Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch Watersheds and Land Cover within UVA's Regulated MS4

Date: 4/30/2021

Appendix C

Structural BMPs Implemented to Reduce Sediment

Structual BMPs Implemented as of May 1, 2025

Site Name	Watershed	Year Installed	BMP Type	Maximum Reductions (lbs/yr) Suspended Solids
Moores Creek Watershed				
MR-6	Moores Creek	2009	Vegetated Roof	164
PSC Addition, ITC Basin	Moores Creek	2009	Dry Extended Detention	1,086
Sieg Warehouse	Moores Creek	2009	Bioretention & Rain Garden	751
Amphitheater	Moores Creek	2010	Permeable Pavement	51
PCC Annex	Moores Creek	2010	Filterra®	35
South Lawn	Moores Creek	2010	Bioretention	224
South Lawn	Moores Creek	2010	Bioretention	550
South Lawn	Moores Creek	2010	Bioretention	572
South Lawn	Moores Creek	2010	Bioretention	275
Garrett Hall	Moores Creek	2011	Vegetated Roof	113
New Cabell	Moores Creek	2013	Bioretention	54
New Cabell	Moores Creek	2013	Bioretention	44
Hospital	Moores Creek	2014	Vegetated Roof	325
Thornton Hall Entry	Moores Creek	2016	Permeable Pavement	16
Clark Hall (Nook)	Moores Creek	2017	Bioretention	11
Clinical Wing	Moores Creek	2017	Green Roof	60
Education Resource Center	Moores Creek	2017	Infiltration	344
Hereford Rain Garden	Moores Creek	2017	Bioretention	29
MSE Bioretention	Moores Creek	2017	Bioretention	33
Bond House	Moores Creek	2019	Bioretention	1,223
Brandon Avenue	Moores Creek	2020	Bioretention (4)	1,145
			Subtotal	**7,105**
Lodge Creek Watershed				
Alderman Building 6 (Gibbons)	Lodge Creek	2015	Infiltration Chamber	299
Gilmer Basin	Lodge Creek	2024	Extended Detention	5,176
			Subtotal	**5,475**
Meadow Creek Watershed				
Bavaro Hall	Meadow Creek	2010	Hydrodynamic Structure	14
Newcomb Hall	Meadow Creek	2010	Vegetated Roof	28
Arlington Blvd	Meadow Creek	2011	Dry Detention	59
Lambeth – Phase 1	Meadow Creek	2011	Stream Restoration	5,835
Lambeth – Phase 2	Meadow Creek	2012	Stream Restoration	3,793
Carr's Hill Field Park	Meadow Creek	2013	Stream Restoration	10,323
Thrust Theatre	Meadow Creek	2013	Vegetated Roof	17
Ridley Hall	Meadow Creek	2014	Bioretention	313
North Grounds Mechanical Plant	Meadow Creek	2015	Filtering Practice	93
Rugby Administration Building (O'Neil)	Meadow Creek	2015	Bioretention	92
Leake II (Skipwith)	Meadow Creek	2016	Vegetated Roof	22
Leake II (Skipwith)	Meadow Creek	2016	Bioretention	16
Leake II (Skipwith)	Meadow Creek	2016	Permeable Concrete	104
Remembrance Garden	Meadow Creek	2017	Permeable Pavement	12
FM Yard Redevelopment Pavement	Meadow Creek	2019	Porous Asphalt	69
FM Yard Redevelopment Pavement	Meadow Creek	2019	Pervious Concrete	130
Lambeth Commons Permeable Pavers	Meadow Creek	2022	Permeable Pavers	76
			Subtotal	**20,996**
Schenks Branch Watershed				
None	Schenks Branch	NA	NA	0
			Subtotal	**0**
			Grand Total (lbs/yr)	**33,576**

*See UVA Chesapeake Bay TMDL Action Plan for detailed calculations

Appendix D

Meadow Creek and Morey Creek Stream Assessment Reports

Biohabitats

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

MEMORANDUM

Date: May 15, 2023

To: Dawson Garrod, University of Virginia, Facilities Management

From: Biohabitats, Inc.

Subject: Stream Corridor Assessment for the University of Virginia on an Unnamed Tributary to Meadow Creek

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Executive Summary

Biohabitats, Inc. performed a stream corridor assessment for the University of Virginia on an unnamed tributary to Meadow Creek located in Albemarle County and the city of Charlottesville in November 2022. This more detailed assessment of potential restoration opportunities was conducted as a follow-up to the UVA Campus-Wide Stream Assessment, Phase I: Near-Term Projects, conducted in 2019.

The stream reach for this study is approximately 5,000 feet long. The purpose of the assessment was to further refine restoration opportunities, restoration approach, costs, and pollutant reductions for this subwatershed to Meadow Creek. This assessment is the first step in the planning and design process. Subsequent activities will include preparation of grant applications, preparation of design development and construction documents for proposed restoration activities, regulatory permitting, and construction of the restoration design, which may occur in phases.

The Rivanna Trails system traverses the site and crosses the stream in numerous locations. It is recommended that UVA and Biohabitats seek stakeholder input with regards to locating an alternate trail routing during construction activities.

Site Description

Surrounding environs

The site is located on property owned by the University of Virginia and is bounded by the right-of-way of US Route 250/29 Bypass to the north, Barracks Road to the east, Leonard Sandridge Road to the west and the Darden School of Business, the Law School, the Judge Advocate General School, and the Park Sports Complex to the south.

Topography

The landform can be characterized as riparian floodplain bounded by gently to steeply sloping upland areas. Elevations range between elevation 622 in the northwest corner of the site to elevation 450 where the tributary stream leaves the site at Barracks Road.

Slope conditions in the floodplain range from less than one percent to greater than four percent. Slope conditions in uplands found north of the stream range between five percent and greater than twenty five percent. Slope conditions in uplands found south of the stream range between twenty and thirty percent.

Vegetation

Vegetative conditions on the site are varied. Vegetation in the upper one third of the riparian floodplain and adjacent upland slopes is predominately hardwood trees and shrubs with little herbaceous cover and few invasive species. The lower two thirds of the floodplain and adjacent slopes have fewer large trees, dense stands of smaller trees and shrubs and vines with limited herbaceous cover. There is a significant presence of invasive species in the lower or downstream portion of the site. Invasive species include: Autumn olive (*Elaeagnus umbellata)*, Porcelain-berry (*Ampelopsis brevipedunculata*), Japanese stilt-grass (*Microstegium vimineum*), Oriental bittersweet, (*Celastrus orbiculatus*) and others.

Existing Stormwater Management Features

The study catchment contains stormwater management features such as dry ponds on the south side in association with UVA graduate schools. The north side, dominated by runoff from US Route 250/29, does not contain any stormwater management features. Historic aerial photographs from the 1960s show an impoundment of the stream near the center of the study reach. Aerial photos from the 1980s show the impoundment dewatered. The assumed dam embankment for this impoundment is still present and the stream is culverted through the dam.

Streams

The unnamed tributary to Meadow Creek flows from west to east through the site and is approximately 5,000 feet long. The different reach conditions starting at Barracks Road (station 0+00) and ending at Leonard Sandridge Road (station 50+00) are characterized below (see Attachment A for overall reach length and stationing). Proposed restoration reaches that were considered during this assessment are labeled with Reach numbers behind their station designation.

- 0+00 to 2+00 (Reach 9) - This section of stream is stable with little incision and little active erosion occurring. Less than 10% of stream banks are eroded.
- 2+00 to 12+00 (Reach 8) – This section of stream is incised with severe active bank erosion occurring on 80-90% of the banks. Adjacent riparian vegetation is in poor condition with widespread coverage of invasive species.
- 12+00 to 21+00 (Reach 6) – This section of stream is incised with moderate to active bank erosion occurring on 50-60% of the banks. Adjacent riparian vegetation is in poor condition with widespread coverage of invasive species. An intermittent stream conveying flows from the north enters the main tributary at 13+85 (Reach 7).
- 22+00 to 30+00 (Reach 4) – This section of stream is found within the footprint of a former impoundment. The stream is incised within legacy sediments with severe active erosion occurring. This section of stream has near vertical banks and significant erosion of 80-90% of the banks. There is very high potential for TMDL credit associated with restoration of this reach. There is a significant presence of invasive species adjacent to this section of stream. Intermittent streams conveying flows from the north enter the main tributary at 23+20 (Reach 5) and 28+20 (Reach 3).
- 30+00 to 50+00 - This section of stream is stable with some bedrock, vegetated banks and little erosion. Less than 10% of stream banks are eroded and therefore, there is little potential for TMDL credit associated with restoration of this reach. Ephemeral

channels conveying flow from the north enter the main tributary at 36+50 (Reach 2) and 41+50 (Reach 1).

Wetlands

The approximate location of wetlands on the site was determined during the 2019 assessment. A detailed wetland delineation will be performed if required during the design and permitting phases of the planning process. There are several springs/seeps which discharge at the base of the slopes on both sides of the of the floodplain. These wetland areas are defined by the steep topography and are generally narrow. There are three larger wetland areas within the low gradient portion of the floodplain.

Stream Assessment

Two Biohabitats staff visited the site on November 16th and 17th, 2022 to conduct field assessment activities. The assessment crew walked all onsite stream reaches and observed channel degradation, wetland presence, potential opportunities and constraints, vegetation conditions, and potential construction access. During field assessment activities potential restoration alternatives were considered for each reach with considerations for optimizing potential credit and reducing project costs with considerations such as ease of access, balancing cut/fill, using onsite materials etc. A description of existing reach conditions and potential restoration approach for each prioritized reach is described in more detail below.

Restoration Reach Description/Condition

- Reach 1

  This 125-foot long reach is located in the northwest quadrant of the site. The channel receives flows from a 36-inch diameter pipe which conveys flows from the Route 250/29 bypass. There is a significant headcut approximately 50 feet downstream of the pipe outlet (at the end of the rock apron protection, Photo 1) and another headcut approximately 150 feet downstream of the pipe outlet.

Photo 1: Headcut at Reach 1 outfall.

- Reach 2
  This 200-foot reach is found approximately 500-feet east of Reach 1. This small intermittent stream channel receives flows from a 24-inch diameter pipe which conveys flows from the Route 250/29 bypass. There is a significant headcut approximately 10 feet downstream of the pipe outlet in the rock apron outlet protection (Photo 2) and another headcut approximately 50 feet downstream of the pipe outlet.

Photo 2: Headcut at Reach 2 outfall.

- Reach 3
  This 412--foot reach is found approximately 830 feet east of Reach 2. This reach receives stream flow from a five foot by 12-foot box culvert. The channel parallels the main tributary, creating a peninsula between the two channels (Photo 3). The reach is deeply incised with near vertical banks.

Photo 3: Confluence of Reaches 3 and 4 – showing severely entrenched channels within legacy sediments and eroded banks on each reach.

- Reach 4
  This 800--foot reach is on the main tributary which traverses the site. It is characterized by an incised channel with near vertical, eroding banks (Photo 4).

Photo 4: Headcut at the upstream end of Reach 4 where channel conditions begin to significantly degrade

- Reach 5 -
  This 100-foot tributary stream channel receives flows from a 40-inch diameter pipe which conveys flows from the Route 250/29 bypass. This steep reach is deeply incised and widened with near vertical eroding banks (Photo 5).

Photo 5: Vertical and highly erodible banks present throughout Reach 5

Reach 6 - This 900-foot reach is on the main tributary which traverses the site. It is generally bound by the dam embankment at the upstream end and a Rivanna Trail walking bridge at the downstream end of the reach. It is characterized by a moderately incised channel with near vertical, eroding banks. Riparian vegetation is in poor condition with widespread invasive species throughout the adjacent riparian area (Photo 6).

Photo 6: Moderately eroded banks and invasive vegetation present throughout Reach 6.

- Reach 7 - This 350-foot reach receives flows from a 30-inch diameter pipe which conveys flows from the Route 250/29 bypass. The reach is in relatively stable condition with vegetated banks, stable plan geometry and vertical profile (Photo 7).

Photo 7: Relatively stable channel conditions present in Reach 7 compared to other outfall tributaries.

- Reach 8
  This 1,000-foot reach is on the main tributary which traverses the site. It is generally bound by two Rivanna Trail walking bridges which cross the stream. It is characterized by an incised channel with near vertical, eroding banks (Photo 8). This reach may also be impacted by legacy sediments from the breached stone dam found about 100 feet downstream from the Trail walking bridge nearest Barracks Road. Riparian vegetation is in poor condition with widespread invasive species throughout the adjacent riparian area.

Photo 8: Vertical and highly erodible banks present throughout Reach 8

- Reach 9
  This 200-foot reach is in stable condition with vegetated banks and bedrock grade control (Photo 9). The reach is between the easternmost Rivanna Trails walking bridge and the culvert under Barracks Road

Photo 9: Relatively stable channel conditions present in Reach 9 compared to other main tributary reaches.

Proposed Intervention (see Attachment B for reach level concepts)

- Reach 1 – This outfall channel could be stabilized with boulder cascade grade controls in the existing channel to prevent further headcutting erosion (see example Photo 10 below). This would likely require the installation of 2-4 boulder cascades in or around the existing headcut locations. These grade controls would prevent significant vertical downcutting and associated channel erosion. It is anticipated that the Chesapeake Bay Program Protocol 5 – Crediting Outfall and Gully Stabilization Projects would apply to work on this tributary. This reach is the furthest from the anticipated access location from Barracks Road and would be accessed via the Rivanna Trail segment, which may influence the cost-benefit analysis of including this outfall in the proposed work. Access would be relatively simple if VDOT allowed access from the Route 29/250 Bypass.

Photo 10: Example of boulder cascade channel stabilization.

- Reach 2 - This outfall channel could be stabilized with boulder cascade grade controls in the existing channel to prevent further erosion due to headcutting (see example Photo 11 below). This would likely require the installation of 2-4 boulder cascades in or around the existing headcut locations. These grade controls would prevent significant vertical downcutting and associated channel erosion. It is anticipated that the Chesapeake Bay Program Protocol 5 – Crediting Outfall and Gully Stabilization Projects would apply to work on this tributary. This reach is the second furthest from the anticipated access location near via the Rivanna Trail segment, which may influence the cost-benefit analysis of including outfall in the proposed work. Access would be relatively simple if VDOT allowed access from the Route 29/250 Bypass.

Photo 11: Example of boulder cascade channel stabilization.

- Reach 3 – This perennial tributary channel could be restored with a series of riffles or cascade structures constructed within the existing channel (see example Photo 12 below). The channel bed could be raised to lessen channel entrenchment and bank slopes could be graded to a stable slope for vegetation establishment. The installation of the grade control structures and increase in bank stability will result in significantly less channel erosion potential. Raising the channel bed will increase hyporheic flow and increase nutrient capture. This was the type of intervention installed at the John Paul Jones Arena stream reach in 2021. This restoration approach will require some short-term impacts to aquatic habitat, but these impacts will be outweighed by the long-term benefits of re-establishing a more stable channel with improved aquatic habitat and reconnection with the adjacent floodplain. It is anticipated that the Chesapeake Bay Program Protocol 1 –Credit for Prevented Sediment during Storm Flow and Protocol 2 – Credit for Instream and Riparian Nutrient Processing during Baseflow would apply to work on this tributary. It is assumed that construction access to this reach would need to be accomplished from the adjacent Rivanna Trail segment.

Photo 12: Example of riffle pool restoration with raise in channel bed and bank grading.

- Reach 4 – This portion of the main channel in the former pond impoundment area could be restored with a series rock and large woody debris grade control structures in the existing channel (see example Photo 13 below). The channel bed could be raised to provide low banks and enhanced connection with the adjacent floodplain. The installation of the grade control structures and increase in bank stability will result in significantly less channel erosion potential. Raising the channel bed will increase hyporheic flow and increase nutrient capture as well as providing a more frequent connection with the adjacent floodplain to reduce erosive forces on the channel and deposit nutrients on the floodplain. This restoration approach will require some short-term impacts to aquatic habitat, but these impacts will be outweighed by the long-term benefits of re-establishing a more stable channel with improved aquatic habitat and reconnection with the adjacent floodplain. It is anticipated that the Chesapeake Bay Program Protocol 1 –Credit for Prevented Sediment during Storm Flow and Protocol 2 – Credit for Instream and Riparian Nutrient Processing during Baseflow would apply to work on this reach of the main channel. Protocol 3 – Credit for Floodplain Reconnection Volume may apply to work on this reach of the main channel, but it is not included in preliminary load reduction computations due required modeling to be completed in detailed design phases. It is assumed that construction access to this reach would need to be accomplished from the adjacent Rivanna Trail segment.

Photo 13: Example of riffle pool restoration with incorporated large woody debris with raise in channel bed and bank grading.

- Reach 5 – This perennial tributary channel could be restored with a series cascade structures due to its steepness (see example Photo 14 below). The channel bed could be raised to lessen channel entrenchment and bank slopes could be graded to a stable slope for vegetation establishment. The installation of the grade control structures and increase in bank stability will result in significantly less channel erosion potential. Raising the channel bed will increase hyporheic flow and increase nutrient capture. This restoration approach will require some short-term impacts to aquatic habitat, but these impacts will be outweighed by the long-term benefits of re-establishing a more stable channel with improved aquatic habitat and reconnection with the adjacent floodplain. It is anticipated that the Chesapeake Bay Program Protocol 1 –Credit for Prevented Sediment during Storm Flow and Protocol 2 – Credit for Instream and Riparian Nutrient Processing during Baseflow would apply to work on this tributary. It is assumed that construction access to this reach would need to be accomplished from the adjacent Rivanna Trail segment.

Photo 14: Example of cascade pool restoration with raise in channel bed and bank grading.

- Reach 6 - This portion of the main channel below the pond embankment to the first Rivanna Trail walking bridge could be restored in a similar manner to Reach 4 with a series rock and large woody debris grade control structures in the existing channel (see example Photo 15 below). The channel bed could be raised to provide low banks and enhanced connection with the adjacent floodplain. This reach also has low quality riparian vegetation with widespread presence of invasive species. The restoration in this area should include invasive treatments and maintained establishment of native riparian vegetation. The installation of the grade control structures and increase in bank stability will result in significantly less channel erosion potential. Raising the channel bed will increase hyporheic flow and increase nutrient capture as well as providing a more frequent connection with the adjacent floodplain to reduce erosive forces on the channel and deposit nutrients on the floodplain. This restoration approach will require some short-term impacts to aquatic habitat, but these impacts will be outweighed by the long-term benefits of re-establishing a more stable channel with improved aquatic habitat and reconnection with the adjacent floodplain. It is anticipated that the Chesapeake Bay Program Protocol 1 –Credit for Prevented Sediment during Storm Flow and Protocol 2 – Credit for Instream and Riparian Nutrient Processing during Baseflow would apply to work on this reach of the main channel. Protocol 3 – Credit for Floodplain Reconnection Volume may apply to work on this reach of the main channel, but it is not included in preliminary load reduction computations due required modeling to be completed in detailed design phases. It is assumed that construction access to this reach would need to be accomplished from the adjacent Rivanna Trail segment.

Photo 15: Example of riffle pool restoration with floodplain reconnection and large woody debris installations.

- Reach 7 - Due its relatively stable condition, no restoration work is currently recommended for this tributary.

- Reach 8 – Alt 1 - This portion of the main channel between the two Rivanna Trail walking bridges could be restored in a similar manner to Reach 4 & 6 with a series rock and large woody debris grade control structures in the existing channel. The channel bed could be raised to provide low banks and enhanced connection with the adjacent floodplain. This reach also has low quality riparian vegetation with widespread presence of invasive species. The restoration in this area should include invasive treatments and maintained establishment of native riparian vegetation. The installation of the grade control structures and increase in bank stability will result in significantly less channel erosion potential. Raising the channel bed will increase hyporheic flow and increase nutrient capture as well as providing a more frequent connection with the adjacent floodplain to reduce erosive forces on the channel and deposit nutrients on the floodplain. This restoration approach will require some short-term impacts to aquatic habitat, but these impacts will be outweighed by the long-term benefits of re-establishing a more stable channel with improved aquatic habitat and reconnection with the adjacent floodplain. It is anticipated that the Chesapeake Bay Program Protocol 1 –Credit for Prevented Sediment during Storm Flow and Protocol 2 – Credit for Instream and Riparian Nutrient Processing during Baseflow would apply to work on this reach of the main channel. Protocol 3 – Credit for Floodplain Reconnection Volume may apply to work on this reach of the main channel, but it is not included in preliminary load reduction computations due required modeling to be completed in detailed design phases.

- Reach 8 – Alt 2 - This portion of the main channel could be restored by creating a new stable channel alignment using Natural Channel Design techniques (see example Photo 16 below). Available floodplain area and poor-quality riparian vegetation in this area make it the best candidate of all the reaches for channel relocation. The relocated channel will be designed for more frequent connection with the adjacent floodplain, stable planform geometry, and stable grade controls at transitions between meander bends. This reach also has low quality riparian vegetation with widespread presence of invasive species. The restoration in this area should include invasive treatments and maintained establishment of native riparian vegetation. The new stable channel design will increase bank stability and will result in significantly less channel erosion potential. Raising the channel bed will increase hyporheic flow and increase nutrient capture as well as providing a more frequent connection with the adjacent floodplain to reduce erosive forces on the channel and deposit nutrients on the floodplain. This restoration approach will require some short-term impacts to aquatic habitat, but these impacts will be outweighed by the long-term benefits of re-establishing a more stable channel with improved aquatic habitat and reconnection with the adjacent floodplain. It is anticipated that the Chesapeake Bay Program Protocol 1 –Credit for Prevented Sediment during Storm Flow and Protocol 2 – Credit for Instream and Riparian Nutrient Processing during Baseflow would apply to work on this reach of the main channel. Protocol 3 – Credit for Floodplain Reconnection Volume may apply to work on this reach of the main channel, but it is not included in preliminary load reduction computations due required modeling to be completed in detailed design phases. It is assumed that construction access to this reach would result in temporary relocation of the Rivanna trail during removal of invasive species and construction activities.

Photo 15: Example of natural channel design channel with enhanced floodplain connection and large woody debris installations.

- Reach 9 - Due its relatively stable condition, no restoration work is currently recommended for this reach of the main channel.

Water Quality Credits – Chesapeake Bay TMDL Waste Load Reduction

Ongoing and recent research demonstrates differences in nutrient and sediment delivery rates between healthy, degraded and restored urban streams. Urban streams experience high rates of channel erosion that deliver large volume of sediment to the channel network. The stream restoration community has taken recent action to better quantify the benefits provided by constructed stream restoration projects that reduce nutrient and sediment loads. In 2010, an expert panel reviewed available science on the nutrient and sediment removal performance associated with qualifying urban stream restoration projects in relation to those generated by degraded urban stream channels. Since that time, various groups have reviewed and "test driven" the recommendations to refine them. The latest revised and approved recommendations were released in February 2020 and provide a procedure to quantify estimates of removal rates in smaller zero- to third-order stream reaches not simulated in the Chesapeake Bay Watershed Model (Wood, 2019).

A preliminary Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) were conducted on each reach to be restored. These are the two factors used in the Bank Assessment for Non-Point Source Consequences of Sediment (BANCS) (Rosgen, 2006). The BANCS method estimates the rate of erosion and the volume of bank material delivered to the stream via bank erosion. It is a field-based visual assessment tool that, when combined with empirical studies, can be used to predict estimates of erosion rates. There are several empirical curves that have been developed for the prediction of bank erosion using the BEHI/NBS methodology. The most regionally similar method for each delineated Project Area is the North Carolina Piedmont Regional Curve.

Table 1 summarizes the predicted annual load reductions in total nitrogen, total phosphorus, and total suspended solids using Protocol 1: Prevented Sediment, Protocol 2: Instream Denitrification, and Protocol 5 Outfall Stabilization. For Protocol 1 the load reduction was calculated based on the BANCS analysis and associated erosion rate along with the nutrient concentration and bulk density from the sediment sampling performed. The load reduction values were calculated using guidelines outlined in the 2020 Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects with the assumption of a 50% removal efficiencies and delivery ratios of 0.64 for Total Suspended Sediment (TSS) and 0.77 for Total Nitrogen (TN) and 0.71 for Total Phosphorus (TP) based on the Piedmont Physiographic Region. Protocol 2 reductions were calculated by comparing the existing and designed hyporheic zones and incorporating the floodplain height and soil type in accordance to the Consensus Recommendations to Improve Protocols 2 Protocol 5 reductions were calculated using the existing stream slope compared to the equilibrium slope and the prevented sediment from continued gully erosion based on drainage area in accordance with the Recommendations for Crediting Outfall and Gully Stabilization Projects in the Chesapeake Bay Watershed updated in 2019.

Table 1 Pollutant Load Reduction Values

	TSS Reduction ton/yr				TN Reduction lbs/yr				TP Reduction lbs/yr			
Reach	P1	P2	P5	Total	P1	P2	P5	Total	P1	P2	P5	Total
Reach 1	NA	NA	18.7	18.7	NA	NA	30.4	30.4	NA	NA	415.1	415.1
Reach 2	NA	NA	18.4	18.4	NA	NA	29.8	29.8	NA	NA	408.0	408.0
Reach 3	35.7	NA	NA	35.7	155.2	18.5	NA	173.6	15.8	NA	NA	15.8
Reach 4	86.5	NA	NA	86.5	375.9	107.5	NA	483.4	38.3	NA	NA	38.3
Reach 5	13.9	NA	NA	13.9	60.3	11.0	NA	71.3	6.1	NA	NA	6.1
Reach 6	19.0	NA	NA	19.0	82.4	148.2	NA	230.6	8.4	NA	NA	8.4
Reach 8	29.1	NA	NA	29.1	126.4	147.7	NA	274.1	12.9	NA	NA	12.9
Total	221.2				1293.1				904.7			

Project Implementation Cost

Determining the project implementation cost was done in a series of steps. Starting off with identifying which reaches are in need of restoration, then determining what approach would be needed for a restoration to be successful. Reaches one (1) and two (2) are ephemeral outfall channels and will require all rock structures during construction, the remaining reaches have consistent baseflow and will benefit from a hybrid approach of utilizing both rock and wood. This reduces the assumed cost in terms of cost of materials and labor of installation. Once the restoration approach was determined a standard cost per linear foot was applied to determine the construction cost range. This is inclusive of erosion and sediment control measures, mobilization and demobilization, plantings, and a contingency. Construction oversight and design were then calculated as a percent of the total construction cost. Table 2 below contains the summary of estimated costs.

Table 2 Cost Estimate

Reach	Design Cost		Construction Cost		Oversight Cost		Reach Total Cost	
	Low End	High End	Low End	High End	Low End	High End	Low End	High End
Reach 1	$26,563	$31,250	$97,591	$114,813	$4,703	$5,533	$128,856	$151,596
Reach 2	$42,500	$50,000	$156,145	$183,700	$7,253	$8,533	$205,898	$242,233
Reach 3	$70,040	$82,400	$240,763	$283,250	$15,404	$18,123	$326,207	$383,773
Reach 4	$136,000	$160,000	$467,500	$550,000	$29,013	$34,133	$632,513	$744,133
Reach 5	$17,000	$20,000	$58,438	$68,750	$3,627	$4,267	$79,064	$93,017
Reach 6	$153,000	$180,000	$525,938	$618,750	$32,640	$38,400	$711,578	$837,150
Reach 8	$170,000	$200,000	$584,375	$687,500	$36,267	$42,667	$790,642	$930,167
Project Total Cost	$615,103	$723,650	$2,130,748	$2,506,763	$128,908	$151,656	$2,874,758	$3,382,069

Since TN is the priority pollutant for UVA and TSS is a secondary priority, the total cost per pounds of TN and TSS removed is included for use in project reach prioritization. Table 3 below contains the summary of average unit cost of TN and TSS removal in pounds per year and tons per year, respectively, by reach and prioritization based on unit costs.

Table 3. TN and TSS Reduction Unit Cost by Reach and Restoration Prioritization

Reach	TN Reduction lbs/yr	Total Cost	Total Cost TN lbs/yr	Reach Priority	TSS Reduction ton/yr	Total Cost	Total Cost TSS tons/yr	Reach Priority
Reach 1	30.4	$ 151,596	$ 4,992	6	18.7	$151,596	$8,091	5
Reach 2	29.8	$ 242,233	$ 5,080	7	18.4	$242,233	$8,233	6
Reach 3	173.6	$ 383,773	$ 873	4	35.7	$383,773	$4,245	2
Reach 4	483.4	$ 744,133	$ 314	1	86.5	$744,133	$1,753	1
Reach 5	71.3	$ 93,017	$ 2,127	5	13.9	$93,017	$10,931	7
Reach 6	230.6	$ 837,150	$ 657	3	19.0	$837,150	$7,995	4
Reach 8	274.1	$ 930,167	$ 553	2	29.1	$930,167	$5,214	3

References

Rosgen, D.L. (2006). Watershed Assessment of River Stability and Sediment Supply (WARSSS). Fort Collins, CO: Wildland Hydrology.

Wood, David, 2019 (Revised 2020). Consensus Recommendations of Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects Built for Pollutant Removal Credit. Chesapeake Stormwater Network

ATTACHMENT A
OVERALL PROJECT REACH MAP

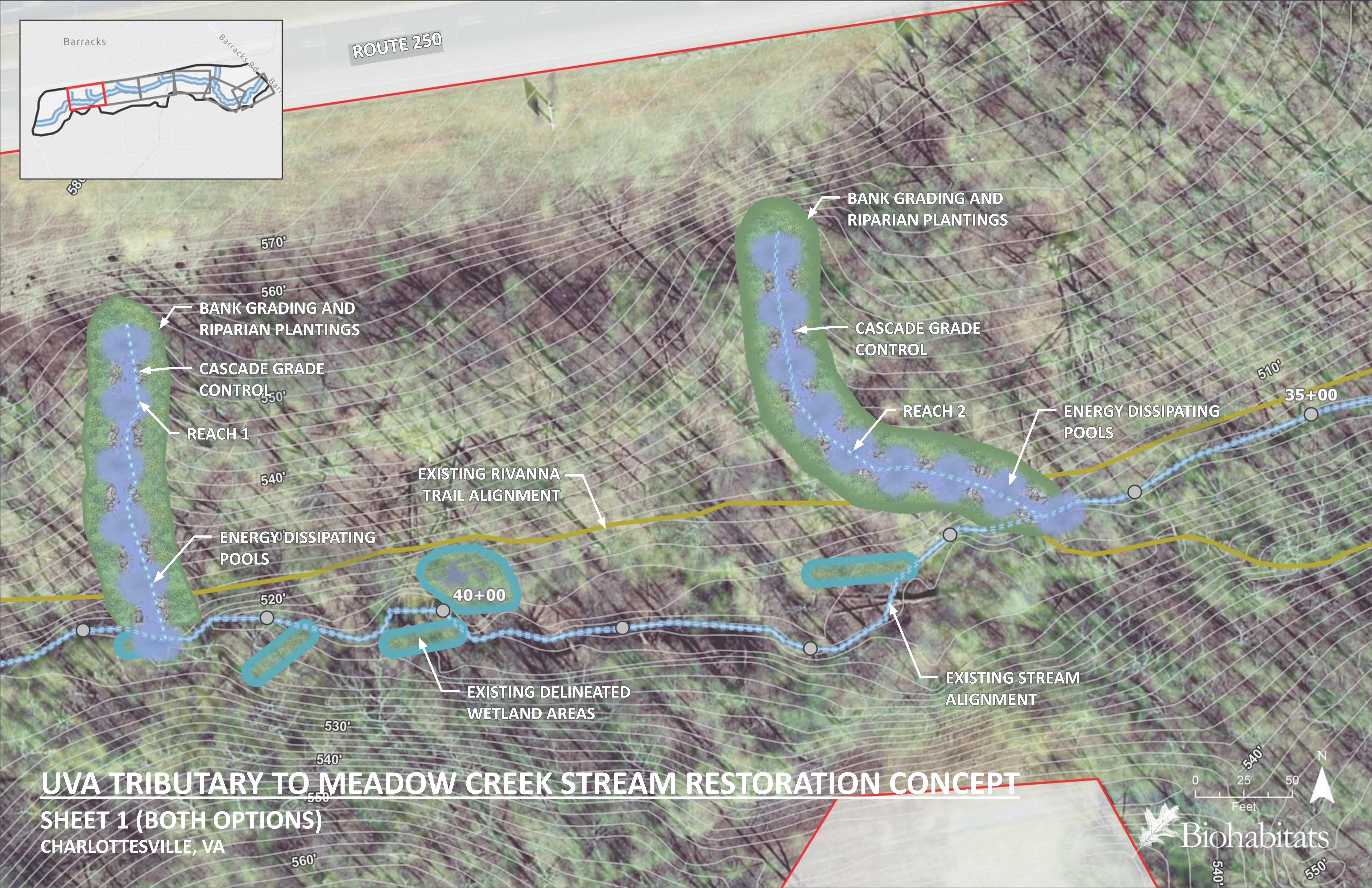
Barracks
Meadow Creek
Woodthorne Rd
Westminster
Chaucer Rd
Surrey Rd
Bennington Rd
Barracks Rd
Middlesex
250
PAGE 1
PAGE 2
PAGE 3
PAGE 4
PAGE 5
PAGE 6
Reach 1
Reach 2
Reach 3
Reach 4
Reach 5
Reach 6
Reach 7
Reach 8
Reach 9
Meadow Creek
Leonard Sandridge Rd
Darden Blvd
Duffy Blvd
Nash Dr
Massie Rd
Buckler Dr
Arlington Blvd
Wise St
0
150
300
Feet
N
Biohabitats

ATTACHMENT B
REACH LEVEL CONCEPT MAPS

UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT

OVERVIEW (OPTION 1)

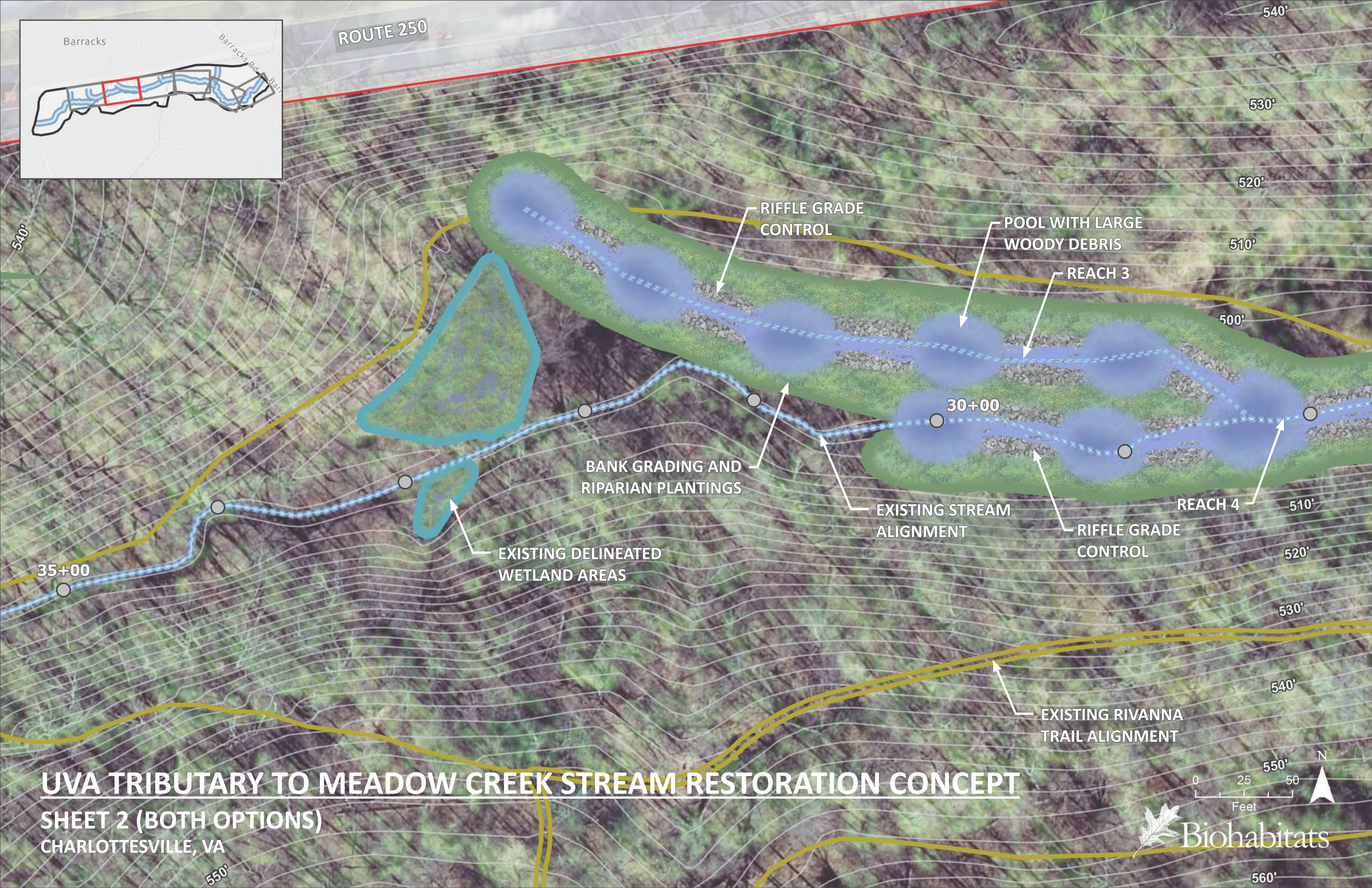
CHARLOTTESVILLE, VA



UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT

SHEET 1 (BOTH OPTIONS)

CHARLOTTESVILLE, VA



UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT

SHEET 2 (BOTH OPTIONS)

CHARLOTTESVILLE, VA

Barracks
Barracks Rd
ROUTE 250
CASCADE GRADE
CONTROL
ENERGY
DISSIPATING POOLS
REACH 5
REACH 4
25+00
POOL WITH LARGE
WOODY DEBRIS
RIFFLE GRADE
CONTROL
EXISTING DELINEATED
WETLAND AREAS
EXISTING STREAM
ALIGNMENT
BANK GRADING AND
RIPARIAN PLANTINGS
EXISTING RIVANNA
TRAIL ALIGNMENT
540'
530'
520'
510'
500'
550'
0 25 50
Feet
N
Biohabitats
UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT
SHEET 3 (BOTH OPTIONS)
CHARLOTTESVILLE, VA

UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT

SHEET 4 (BOTH OPTIONS)

CHARLOTTESVILLE, VA

UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT

SHEET 5 (OPTION 1)

CHARLOTTESVILLE, VA

UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT

SHEET 6 (OPTION 1)

CHARLOTTESVILLE, VA

UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT

OVERVIEW (OPTION 2)

CHARLOTTESVILLE, VA

0 150 300
Feet
N

Biohabitats


UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT
SHEET 5 (OPTION 2)
CHARLOTTESVILLE, VA
Barracks
Barracks Rd
REACH 7
EXISTING DELINEATED WETLAND AREAS
EXISTING RIVANNA TRAIL ALIGNMENT
NEW CHANNEL ALIGNMENT
EXISTING STREAM ALIGNMENT
BANK GRADING AND RIPARIAN PLANTINGS
RIFFLE GRADE CONTROL & POOL DEVELOPMENT
REACH 8
10+00
5+00
490'
480'
470'
500'
510'
520'
530'
0 25 50
Feet
N
Biohabitats

Barracks
Barracks Rd
490'
460'
0+00
EXISTING STREAM ALIGNMENT
EXISTING RIVANNA TRAIL ALIGNMENT
BARRACKS ROAD
NEW CHANNEL ALIGNMENT
470'
480'
REACH 9
BANK GRADING AND RIPARIAN PLANTINGS
RIFFLE GRADE CONTROL & POOL DEVELOPMENT
470'
5+00
UVA TRIBUTARY TO MEADOW CREEK STREAM RESTORATION CONCEPT
SHEET 6 (OPTION 2)
CHARLOTTESVILLE, VA
480'
490'
0 25 50
Feet
N
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MEMORANDUM

Date	**July 19, 2024**
To	Ms. Kristin Carter, University of Virginia Mr. Dawson Garrod, University of Virginia
From	Biohabitats, Inc.
RE	UVA Morey Creek
Subject	Stream Assessment and Concept Design

On March 7, 2024 a two person team conducted field work and recorded observations of stream and floodplain conditions on a 1,000-ft long reach of Morey Creek located immediately south of the Fontaine Research Park. The purpose of the field work was to determine current stream conditions regarding erosion and stability and to generate alternatives for stream restoration.

On June 25, 2004, another field crew conducted sediment sampling for the purpose of determining soil physical characteristics and nutrient concentrations to be used in pollutant load reduction calculations.

Stream Erosion/Stability

This reach of Morey Creek labeled as FPW-001 was evaluated in 2019 (see Figure 1) as part of a campus-wide assessment of stream conditions (University of Virginia Campus-Wide Stream Assessment, Phase I: Near-Term Projects). However, it should be noted that this reach included an additional 300-ft of stream channel between the 29 Bypass Expressway and Natural Resources Dr, which is not included in the current conceptual restoration plans. The drainage area of Morey Creek through the site is approximately 3.16 square miles (See attached Attachment A – USGS Streamstats Report).

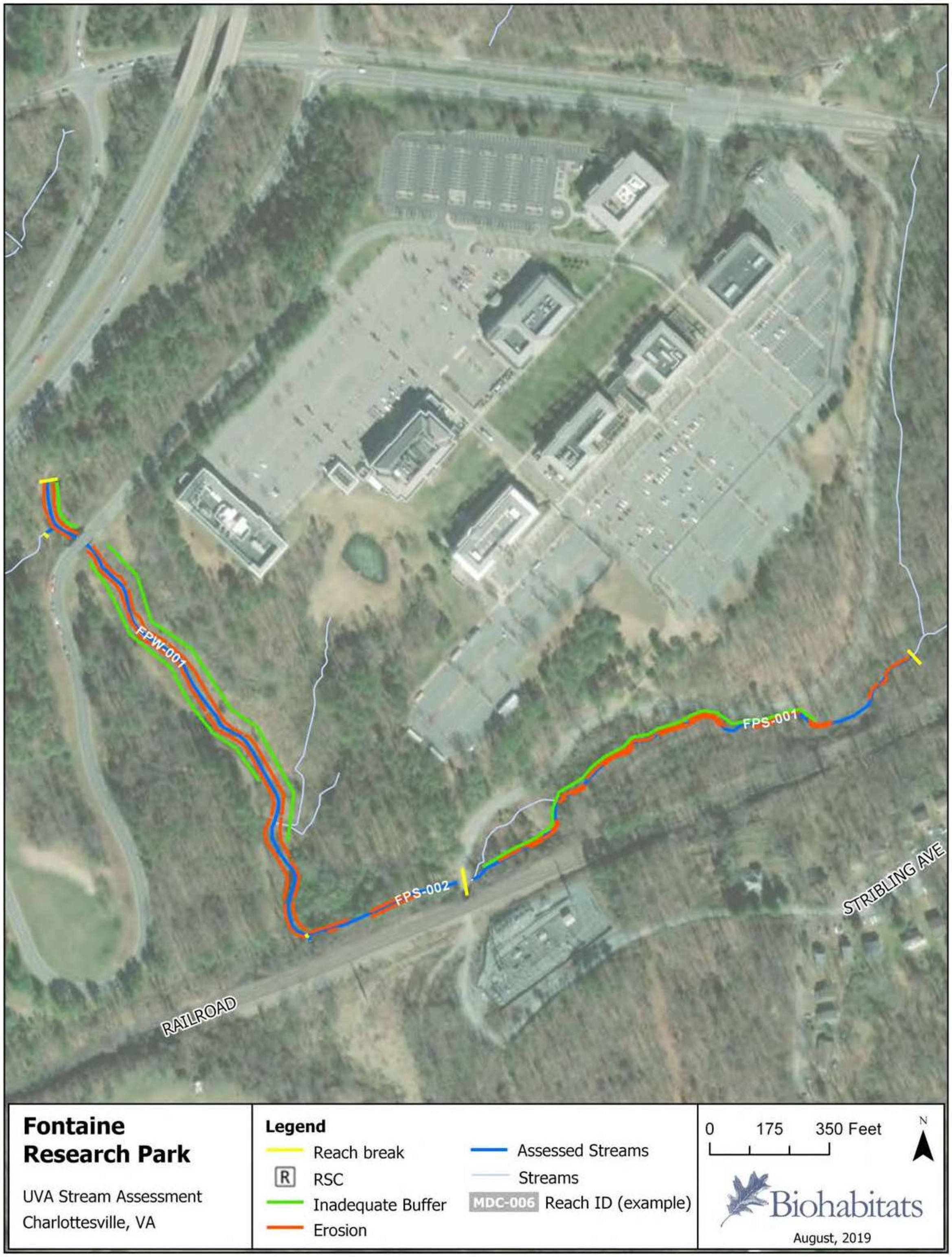


Figure 1 — Study reaches from the 2019 campus wide assessment

The purpose of the 2019 assessment was to determine the condition of on-site streams with regard to erosion and stability and to determine the potential for receiving MS4 credits for stream restoration. Guidance on calculation methodologies for determining stream restoration pollutant reduction credits using Protocol 1 have been modified since the calculation methods used in the 2019 study. The primary change was using specific delivery factors for sediment, phosphorus, and nitrogen for this river segment's delivery of pollutants to the Chesapeake Bay. Based on the 2019 assessment and updated calculation methods, it was estimated that 1,800 lbs/yr TSS, 1 lbs/yr TP, and 7 lbs/yr TN load reduction (Ches Bay TMDL) would be achieved by restoration of this reach in the 2019 study. Average eroded bank heights were 4.25-ft in 2019. The bank erosion hazard index (BEHI) rating for this reach was "Moderate" and the near bank stress (NBS) was "Low" in 2019, but these ratings may have been influenced by an observed beaver dam that was backwatering some of the stream reach at that time.

During the 2024 field work it was evident that significant degradation of stream conditions had occurred since the 2019 assessment (See Figure 2). Field measurements were taken at several locations and eroded bank heights had increased by 1-ft on average and the BEHI rating increased to "High" and NBS rating increased to "Moderate". Collected sediment samples had an average bulk density of 74.2 lb/ft^3, an average nitrogen concentration of 0.1%, and an average phosphorus concentration of 0.059%. Based on the new assessment and Protocol 1 calculation methods, it was estimated that stream restoration of this reach would result in 12,000 lbs/yr TSS, 23 lbs/yr TP, and 28 lbs/yr TN load reduction (Ches Bay TMDL).

Additional total nitrogen pollution load reduction is also available for stream restoration per the Chesapeake Program's Protocol 2 guidance for hyporheic denitrification. The width and length of the restored hyporheic zone were estimated as well as baseflow, floodplain, and aquifer conductivity reduction factors. A total nitrate removal of 97 lbs/yr was estimated using Protocol 2 guidance.

Using the Chesapeake Bay Program guidance for Protocols 1 and 2, a total load reduction of 12,000 lbs/yr TSS, 23 lbs/yr TP, and 125 lbs/yr TN is estimated for this proposed stream restoration project. Attachment D provides additional detail on credit calculations and sediment testing results.

Figure 2 — Typical channel conditions in the Morey Creek study reach

Stream Restoration Concepts

Two restoration concepts were developed for further consideration. The current stream is deeply incised with limited access to its floodplain. There is significant and ongoing erosion due to exposed near vertical banks and unstable plan geometry. The channel has down cut to a point where little vegetative, or root protection is provided in the streambanks, so bank soil rapidly erodes during high flow events. Figure 3 exemplifies the large-scale sedimentation due to bank failure within the channel.

Figure 3 – Eroded bank sediments observed in the Morey Creek study reach

The first concept focuses on maintaining the current stream alignment to the greatest extent practicable. Minor changes in stream alignment and raising the channel invert elevation in concert with providing floodplain bench and stable banks slopes will restore the stream. Construction of an appropriately sized bankfull channel and adequately sized and well vegetated floodplain bench will reduce erosion potential and greatly improve stream functions. See Attachment B – Morey Creek Restoration Alternatives for the conceptual restoration plans.

The second concept proposes a more significant realignment of the stream. Beginning immediately downstream of the bridge at the upper end of the reach, the stream alignment would be relocated to the north. An appropriately sized bankfull channel and floodplain bench would be constructed through the upland floodplain. The new stream alignment would be located near the current stream to minimize impact to an existing emergent wetland. See attached Attachment B – Morey Creek Restoration Alternatives for the conceptual restoration plans.

Findings and Design Issues

Based on the most recent stream assessment, it was estimated that stream restoration of this reach would result in 12,000 lbs/yr TSS, 23 lbs/yr TP, and 125 lbs/yr TN load reduction (Ches Bay TMDL) towards meeting the university's MS4 goals.

The property boundary between the university-owned property and the Virginia Department of Forestry (VDF) land to the south generally follows the stream alignment. A brief discussion with VDF staff indicated a willingness to work with the University to facilitate stream restoration work. It will be important to reach a more formal agreement prior to proceeding further with cost estimating and design.

Planning is currently underway for additional development within the Fontaine Research Park. Utility infrastructure will be constructed to meet the stormwater requirements for this new development. BMP construction will extend into the stream valley of Morey Creek. The outfall from the BMP should be incorporated into the stream restoration design to ensure a stable channel through the emergent wetland.

A new sanitary sewer line is also under design. The line will flow north to south and cross Morey Creek, connecting to the existing Rivanna Water and Sewer Authority line located south of and roughly parallel to the stream. Note that the existing sewer lines are not shown on the conceptual plans and these will picked up by surveyors in the detailed design phase.

The current design for the sewer proposes an aerial crossing of approximately 50 feet of stream valley from the base of the hillside to the north, then crossing Morey Creek at an elevation approximately two feet above the existing stream banks and connecting to a manhole with a rim elevation approximately four feet above existing grade. These infrastructure designs will need to be assessed with regard to the proposed stream restoration. Figure 4 shows the approximate location of the proposed sanitary line and BMP expansion.

Figure 4 – Looking upslope toward the proposed sanitary sewer alignment and BMP expansion

Both design concepts shall consider the impact of alteration to the 100-year floodplain. It is anticipated that if net export of excavated floodplain soil or balance of excavation and fill can be achieved by the restoration, no rise in floodplain elevations will be achievable. However, this will need to be confirmed during the detailed design phase.

The topographic information generated for the recent field work was from 2015 LiDAR from VGIN and was then converted to contours. Based on the information obtained when collecting data for the BEHI calculations it was determined that the topographic information did not accurately represent existing conditions. Due to the observed lack of necessary topographic detail for design, channel dimensions and excavation quantities were estimated based on field observations. A detailed topographic survey will be required prior to initiation of modeling for the project and detailed design, ensuring more accurate cost estimating during the construction document phase of design.

Opinion of Probable Cost

A detailed cost estimate was developed for the two restoration alternatives in coordination with Meadville Land Services (MLS). MLS has constructed several previous stream restoration projects on the UVA campus and would be considered a highly qualified contractor for this type of restoration work. Note that this estimate assumes that the project will be completed as design-bid-build process rather than design-build, which would allow for some cost efficiencies.

Biohabitats estimated material quantities for each restoration alternative and MLS provided unit prices. We recommend that UVA also hold a 10-20% contingency on the cost estimate due to the conceptual level of the restoration plans. Also, the estimates assume that the entire project reach would be constructed in a single mobilization and not divided into separate phases requiring multiple mobilizations. The total estimated construction cost for Alternative 1 is $671,638. The total estimated construction cost for Alternative 2 is $621,068. Based on the 1000-LF of restoration of the existing channel, Alternative 1 has unit cost of $672 per LF and Alternative 2 has a unit cost of $621 per LF. Note that these costs are only for the construction contractor estimate and don’t include any design or independent construction administration services by the designer. Additional cost estimate detail is attached in Attachment C – Cost Estimate Detail.

Three options were considered for site construction access including different mulch and restoration options. Option 1 is the mid-range cost and assumes the entire access will have a 20-ft wide mulch access road, with the mulch incorporated into existing site soils following construction and seeded. Option 2 is the most expensive and includes the same 20-ft wide mulch access but assumes complete removal and trucking offsite of the mulch access road following construction. Option 3, the most cost-effective approach, assumes no mulch access road and site soils will be decompacted and planted post-construction. A 5-ft wide mulch trail will remain under all options. The above total costs for Stream Design Alternatives 1 and 2 assume that Option 1 is implemented. Option 2 could be implemented for an additional cost of $19,772 compared to Option 1. Option 3 could be implemented for a price reduction of $8,474 compared to Option 1.

Estimates for two planting approaches: a conservative approach using large potted plants and a cost-effective approach with bare-root plantings was included for the University’s consideration. The cost estimate for Stream Restoration Alternatives 1 and 2 assume the cost-effective planting approach was selected. For an additional cost of $379,117 (Alternative 1) or $370,822 (Alternative 2) the site could be planted with more mature vegetation.

Biohabitats developed a detailed cost estimate for the design, permitting, and construction documents development phases of the project. Table 1 below summarizes the costs associated with these phases of the project.

Table 1 – Project Design, Permitting, and CD

Task	Cost Estimate
1. Site Assessment & Survey	$40,667
2. Restoration SD and DD	$92,735
3. Restoration CDs	$31,600
4. Permitting	$19,840
Total	**$184,842**

Biohabitats also developed a detailed cost estimate for construction administration and post-construction monitoring phases of the project. The estimated cost of construction administration activities including milestone meetings, bi-weekly construction inspections, submittal reviews, and responding to requests for information total to $62,223. The estimated cost of 3-years of post-construction monitoring as required by the USACE is $23,640.

All design, construction, construction administration, and monitoring costs are summarized by Alternative in Table 2 below.

Table 2 – Total Project Costs by Alternative

Project Phase	Alternative 1*	Alternative 2*
Design, CD, Permitting	$184,842	$184,842
Construction	$671,638	$621,068
Construction Admin	$62,223	$62,223
Monitoring	$23,640	$23,640
Total	**$942,343**	**$891,773**

*Assumes Option 1 for access road and the cost-effective planting approach

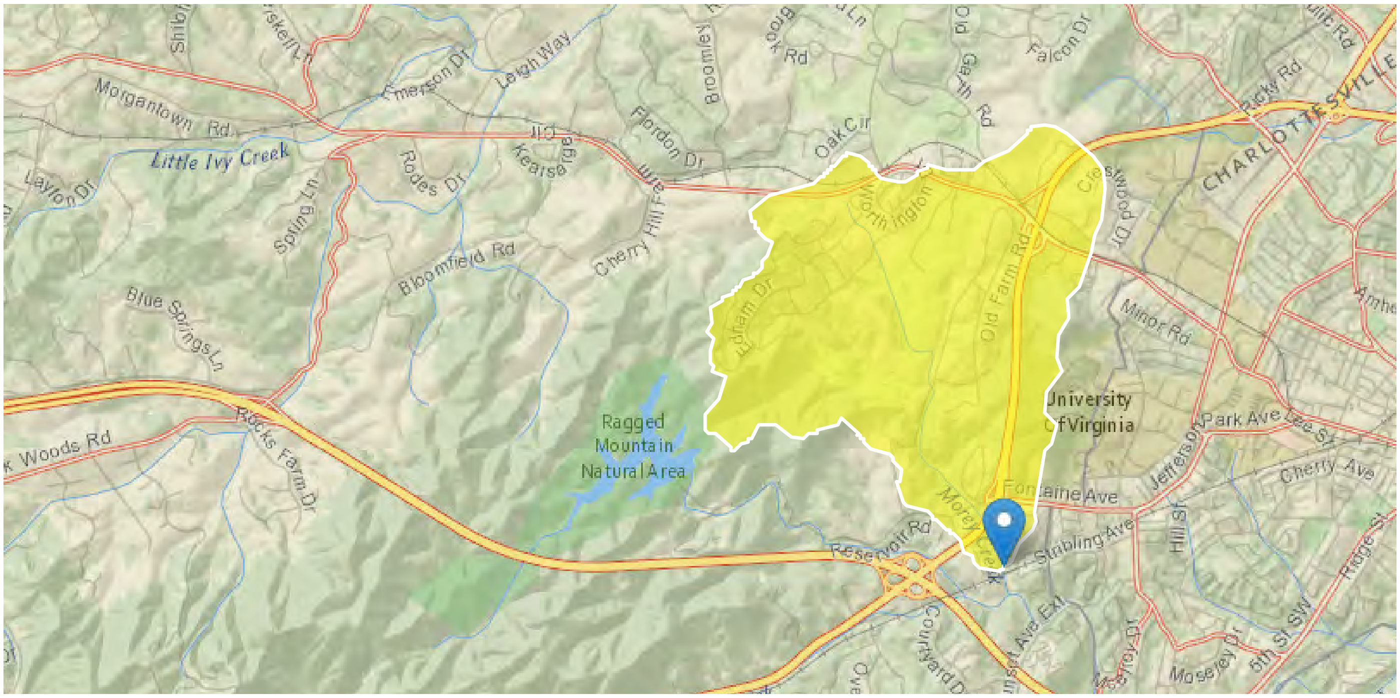
Attachments

Attachment A – USGS Streamstats Report
Attachment B – Morey Creek Restoration Alternatives
Attachment C – Cost Estimate Detail
Attachment D – Pollutant Load Reduction Calculations and Sediment Test Results

Attachment A – USGS Streamstats Report

StreamStats Report

Region ID: VA
Workspace ID: VA20240306145623667000
Clicked Point (Latitude, Longitude): 38.02147, -78.52802
Time: 2024-03-06 09:56:50 -0500



➕ Collapse All

› Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	3.16	square miles
LC01DEV	Percentage of land-use from NLCD 2001 classes 21-24	36.05	percent
LC06DEV	Percentage of land-use from NLCD 2006 classes 21-24	39.22	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	39.6	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Blue Ridge 2011 5144]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.16	square miles	0.06	7866

Peak-Flow Statistics Flow Report [Blue Ridge 2011 5144]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
50-percent AEP flood	303	ft^3/s	17
42.9-percent AEP flood	358	ft^3/s	18
20-percent AEP flood	666	ft^3/s	20
10-percent AEP flood	1030	ft^3/s	24
4-percent AEP flood	1610	ft^3/s	29
2-percent AEP flood	2180	ft^3/s	32
1-percent AEP flood	3020	ft^3/s	30
0.5-percent AEP flood	3810	ft^3/s	33

Peak-Flow Statistics Citations

Austin, S.H., Krstolic, J.L., and Wiegand, Ute,2011, Peak-flow characteristics of Virginia streams: U.S. Geological Survey Scientific Investigations Report 2011–5144, 106 p. + 3 tables and 2 appendixes on CD. (http://pubs.usgs.gov/sir/2011/5144/)

Low-Flow Statistics

Low-Flow Statistics Parameters [Blue Ridge 2011 5143]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.16	square miles	0.09	7393

Low-Flow Statistics Flow Report [Blue Ridge 2011 5143]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
1 Day 1.11 Year Low Flow	0.705	ft^3/s	44
1 Day 1.25 Year Low Flow	0.487	ft^3/s	54.2
1 Day 1.43 Year Low Flow	0.359	ft^3/s	63.1

Statistic	Value	Unit	ASEp
1 Day 1.67 Year Low Flow	0.27	ft^3/s	71.7
1 Day 2 Year Low Flow	0.201	ft^3/s	81.1
1 Day 2.5 Year Low Flow	0.145	ft^3/s	91.9
1 Day 3.33 Year Low Flow	0.0981	ft^3/s	106
1 Day 5 Year Low Flow	0.0598	ft^3/s	126
1 Day 10 Year Low Flow	0.0264	ft^3/s	167
4 Day 1.11 Year Low Flow	0.741	ft^3/s	44.7
4 Day 1.25 Year Low Flow	0.52	ft^3/s	54.7
4 Day 1.43 Year Low Flow	0.388	ft^3/s	63.8
4 Day 1.67 Year Low Flow	0.292	ft^3/s	73
4 Day 2 Year Low Flow	0.219	ft^3/s	82.8
4 Day 2.5 Year Low Flow	0.159	ft^3/s	93.9
4 Day 3.33 Year Low Flow	0.109	ft^3/s	108
4 Day 5 Year Low Flow	0.0664	ft^3/s	129
4 Day 10 Year Low Flow	0.0297	ft^3/s	169
4 Day 20 Year Low Flow	0.0124	ft^3/s	228
7 Day 1.11 Year Low Flow	0.798	ft^3/s	44.1
7 Day 1.25 Year Low Flow	0.555	ft^3/s	54.2
7 Day 1.43 Year Low Flow	0.414	ft^3/s	63.3
7 Day 1.67 Year Low Flow	0.312	ft^3/s	72.5
7 Day 2 Year Low Flow	0.234	ft^3/s	82.2
7 Day 2.5 Year Low Flow	0.17	ft^3/s	93.3
7 Day 3.33 Year Low Flow	0.117	ft^3/s	107
7 Day 5 Year Low Flow	0.072	ft^3/s	127
7 Day 10 Year Low Flow	0.0332	ft^3/s	165
7 Day 20 Year Low Flow	0.0151	ft^3/s	217
30 Day 1.11 Year Low Flow	1.14	ft^3/s	34.8
30 Day 1.25 Year Low Flow	0.797	ft^3/s	43.3
30 Day 1.43 Year Low Flow	0.599	ft^3/s	50.9
30 Day 1.67 Year Low Flow	0.46	ft^3/s	58.2
30 Day 2 Year Low Flow	0.355	ft^3/s	65.9
30 Day 2.5 Year Low Flow	0.268	ft^3/s	74.6
30 Day 3.33 Year Low Flow	0.194	ft^3/s	85.3
30 Day 5 Year Low Flow	0.13	ft^3/s	99.8
30 Day 10 Year Low Flow	0.071	ft^3/s	126

Statistic	Value	Unit	ASEp
30 Day 20 Year Low Flow	0.0399	ft^3/s	156
30 Day 50 Year Low Flow	0.0196	ft^3/s	206
30 Day 100 Year Low Flow	0.012	ft^3/s	252
30 Day 200 Year Low Flow	0.00869	ft^3/s	295

Low-Flow Statistics Citations

Austin, S.H., Krstolic, J.L., and Wiegand, Ute,2011, Low-flow characteristics of Virginia streams: U.S. Geological Survey Scientific Investigations Report 2011–5143, 122 p. + 9 tables on CD. (http://pubs.usgs.gov/sir/2011/5143/)

Bankfull Statistics

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.16	square miles	0.07722	940.1535

Bankfull Statistics Parameters [Piedmont P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.16	square miles	0.289575	939.99906

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.16	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	24.5	ft
Bieger_D_channel_depth	1.56	ft
Bieger_D_channel_cross_sectional_area	38.8	ft^2

Bankfull Statistics Flow Report [Piedmont P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	22.1	ft
Bieger_P_channel_depth	1.64	ft
Bieger_P_channel_cross_sectional_area	37	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	18.6	ft
Bieger_USA_channel_depth	1.54	ft
Bieger_USA_channel_cross_sectional_area	31.8	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
Bieger_D_channel_width	24.5	ft
Bieger_D_channel_depth	1.56	ft
Bieger_D_channel_cross_sectional_area	38.8	ft^2
Bieger_P_channel_width	22.1	ft
Bieger_P_channel_depth	1.64	ft
Bieger_P_channel_cross_sectional_area	37	ft^2
Bieger_USA_channel_width	18.6	ft
Bieger_USA_channel_depth	1.54	ft
Bieger_USA_channel_cross_sectional_area	31.8	ft^2

Bankfull Statistics Citations

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFC

Urban Peak-Flow Statistics

Urban Peak-Flow Statistics Parameters [Peak Urban01 2014 5090]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.16	square miles	0.07	2404
LC01DEV	Percent_Developed_from_NLCD2001	36.05	percent	10	96

Urban Peak-Flow Statistics Parameters [Peak Urban06 2014 5090]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.16	square miles	0.07	2404
LC06DEV	Percent Developed from NLCD2006	39.22	percent	10	96

Urban Peak-Flow Statistics Parameters [Peak Urban11 2014 5090]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.16	square miles	0.07	2404
LC11DEV	Percent Developed from NLCD2011	39.6	percent	10	96

Urban Peak-Flow Statistics Flow Report [Peak Urban01 2014 5090]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Urban 99.5-percent AEP flood	102	ft^3/s	70.4
Urban 99-percent AEP flood	112	ft^3/s	67.8
Urban 95-percent AEP flood	141	ft^3/s	60.5
Urban 90-percent AEP flood	172	ft^3/s	59.3
Urban 80-percent AEP flood	217	ft^3/s	57.5
Urban 66.7-percent AEP flood	258	ft^3/s	57.3
Urban 50-percent AEP flood	316	ft^3/s	57.3
Urban 42.9-percent AEP flood	352	ft^3/s	57.1
Urban 20-Percent AEP flood	535	ft^3/s	60.6
Urban 10-percent AEP flood	742	ft^3/s	64.1
Urban 4-percent AEP flood	1100	ft^3/s	74.4
Urban 2-percent AEP flood	1450	ft^3/s	84.8
Urban 1-percent AEP flood	1810	ft^3/s	97.9
Urban 0.5-percent AEP flood	2300	ft^3/s	102
Urban 0.2-percent AEP flood	3400	ft^3/s	134

Urban Peak-Flow Statistics Flow Report [Peak Urban06 2014 5090]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Urban 99.5-percent AEP flood	110	ft^3/s	70.4
Urban 99-percent AEP flood	119	ft^3/s	67.8
Urban 95-percent AEP flood	150	ft^3/s	60.5
Urban 90-percent AEP flood	181	ft^3/s	59.3
Urban 80-percent AEP flood	229	ft^3/s	57.5
Urban 66.7-percent AEP flood	273	ft^3/s	57.3
Urban 50-percent AEP flood	334	ft^3/s	57.3
Urban 42.9-percent AEP flood	372	ft^3/s	57.1

Statistic	Value	Unit	ASEp
Urban 20-Percent AEP flood	563	ft^3/s	60.6
Urban 10-percent AEP flood	778	ft^3/s	64.1
Urban 4-percent AEP flood	1150	ft^3/s	74.4
Urban 2-percent AEP flood	1510	ft^3/s	84.8
Urban 1-percent AEP flood	1890	ft^3/s	97.9
Urban 0.5-percent AEP flood	2400	ft^3/s	102
Urban 0.2-percent AEP flood	3560	ft^3/s	134

Urban Peak-Flow Statistics Flow Report [Peak Urban11 2014 5090]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Urban 99.5-percent AEP flood	110	ft^3/s	70.4
Urban 99-percent AEP flood	120	ft^3/s	67.8
Urban 95-percent AEP flood	151	ft^3/s	60.5
Urban 90-percent AEP flood	183	ft^3/s	59.3
Urban 80-percent AEP flood	230	ft^3/s	57.5
Urban 66.7-percent AEP flood	275	ft^3/s	57.3
Urban 50-percent AEP flood	337	ft^3/s	57.3
Urban 42.9-percent AEP flood	374	ft^3/s	57.1
Urban 20-Percent AEP flood	566	ft^3/s	60.6
Urban 10-percent AEP flood	783	ft^3/s	64.1
Urban 4-percent AEP flood	1160	ft^3/s	74.4
Urban 2-percent AEP flood	1510	ft^3/s	84.8
Urban 1-percent AEP flood	1900	ft^3/s	97.9
Urban 0.5-percent AEP flood	2420	ft^3/s	102
Urban 0.2-percent AEP flood	3580	ft^3/s	134

Urban Peak-Flow Statistics Citations

Austin, S.H.,2014, Methods and equations for estimating peak streamflow per square mile in Virginia’s urban basins: U.S. Geological Survey Scientific Investigations Report 2014–5090, 25 p. (http://pubs.usgs.gov/sir/2014/5090)

Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [Crippen Bue Region 5]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.16	square miles	0.1	10000

Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 5]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	23800	ft^3/s

Maximum Probable Flood Statistics Citations

Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (https://pubs.usgs.gov/wsp/1887/report.pdf)

Application Version: 4.19.4
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

Attachment B – Morey Creek Restoration Alternatives

Concept Map

UVA Stream Assessment
Charlottesville, VA

Morey Creek Alternative 1

Proposed SS
Contours (1ft)
Proposed Pond Embankment Extents
Proposed SS LOD
Parcels
Boulder Cascade
Riffle
Existing Channel
Channel
Floodplain Bench
NNI Treatment Area
Proposed Construction Access (20' wide)
LOD
Stormwater Outfall Channel

April 2024

0 50 100 150 Feet

Biohabitats

Concept Map

UVA Stream Assessment
Charlottesville, VA

Morey Creek Alternative 2

- Proposed SS
- Contours (1ft)
- Proposed Pond Embankment Extents
- Proposed SS LOD
- Parcels
- Boulder Cascade
- Riffle
- Channel
- Floodplain Bench
- Clay Channel Plug
- Fill Existing Channel
- Stormwater Outfall Channel
- Proposed Construction Access (20' wide)
- LOD

April 2024

0 50 100 150 Feet

Biohabitats

Attachment C – Cost Estimate Detail

ESTIMATE OF CONSTRUCTION COST
Morey Creek-Alternative 1

Biohabitats

5/2/2024

Item No.	Approximate Quantity		Item Description	UNIT PRICE	UNIT PRICE TOTAL
1	1	LS	MOBILIZATION & DEMOBILIZATION	$26,250.00	$26,250.00
2	1	LS	TRAFFIC CONTROL	$1,050.00	$1,050.00
3	1	EA	STABILIZED CONSTRUCTION ENTRANCE	$4,200.00	$4,200.00
4	500	LF	BLAZE ORANGE FENCE (CONSTRUCTION FENCE)	$5.78	$2,887.50
5	230	LF	FILTER LOG	$12.60	$2,898.00
6	2690	SY	MULCH ACCESS (20' wide x .5' thick)-OPTION 1	$13.65	$36,718.50
7	15	EA	HARDWOOD MATS	$1,050.00	$15,750.00
8	1	LS	DEWATERING	$26,250.00	$26,250.00
9	2	EA	TEMPORARY STREAM CROSSING	$3,150.00	$6,300.00
10	2.70	AC	CLEARING AND GRUBBING	$15,750.00	$42,525.00
11	1020	CY	EXCAVATION WITH HAULOFF	$52.50	$53,550.00
12	1700	CY	EXCAVATION TO REMAIN ONSITE	$23.10	$39,270.00
13	5	EA	RIFFLE STRUCTURE (50% Class 2 and 50% Class 1 with Gravel choke in)	$22,575.00	$112,875.00
14	1	EA	BOULDER CASCADE (Class 3)	$51,975.00	$51,975.00
15	6000	SY	SOIL STABILIZATION MATTING	$6.30	$37,800.00
16	1	LS	INVASIVE SPECIES MANAGEMENT	$21,000.00	$21,000.00
					$481,299.00
			PLANT MATERIALS		
17	2430	EA	TREES - COST EFFECTIVE APPROACH - Bare root	$26.25	$63,787.50
18	2430	EA	SHRUBS - COST EFFECTIVE APPROACH - Bare root	$26.25	$63,787.50
19	70	LBS	SEEDING- ERNMX-154	$367.50	$25,725.00
20	110	LBS	SEEDING- TEMPORARY SEED - Cereale Rye	$2.63	$288.75
			PLANTING TOTAL		**$153,589.00**
21	1	LS	CONSTRUCTION STAKEOUT	$10,500.00	$10,500.00
22	1	LS	AS-BUILT SURVEY	$15,750.00	$15,750.00
23	1	LS	PERFORMANCE AND PAYMENT BOND	$10,500.00	$10,500.00
			TOTAL		**$671,638.00**

ESTIMATE OF CONSTRUCTION COST
Morey Creek-Alternative 2

5/2/2024

Item No.	Approximate Quantity		Item Description	UNIT PRICE	UNIT PRICE TOTAL
1	1	LS	MOBILIZATION & DEMOBILIZATION	$26,250.00	$26,250.00
2	1	LS	TRAFFIC CONTROL	$1,050.00	$1,050.00
3	1	EA	STABILIZED CONSTRUCTION ENTRANCE	$4,200.00	$4,200.00
4	500	LF	BLAZE ORANGE FENCE (CONSTRUCTION FENCE)	$5.78	$2,887.50
5	230	LF	FILTER LOG	$12.60	$2,898.00
6	2690	SY	MULCH ACCESS (20' wide x .5' thick)-OPTION 1	$13.65	$36,718.50
7	15	EA	HARDWOOD MATS	$1,050.00	$15,750.00
8	1	LS	DEWATERING	$31,500.00	$31,500.00
9	1	EA	TEMPORARY STREAM CROSSING	$3,150.00	$3,150.00
10	3.00	AC	CLEARING AND GRUBBING	$15,750.00	$47,250.00
11	0	CY	EXCAVATION WITH HAULOFF	$0.00	$0.00
12	3700	CY	EXCAVATION TO REMAIN ONSITE	$21.00	$77,700.00
13	50	CY	CLAY CHANNEL BLOCK	$210.00	$10,500.00
14	8	EA	RIFFLE STRUCTURE (Class 1 with Gravel choke in)	$10,500.00	$84,000.00
15	1	EA	BOULDER CASCADE (Class 3)	$35,437.50	$35,437.50
16	5000	SY	SOIL STABILIZATION MATTING	$6.30	$31,500.00
17	1	LS	INVASIVE SPECIES MANAGEMENT	$21,000.00	$21,000.00
					$431,791.50
			PLANT MATERIALS		
18	2430	EA	TREES - COST EFFECTIVE APPROACH - Bare root	$26.25	$63,787.50
19	2430	EA	SHRUBS - COST EFFECTIVE APPROACH - Bare root	$26.25	$63,787.50
20	70.00	LBS	SEEDING- ERNMX-154	$367.50	$25,725.00
21	105.00	LBS	SEEDING- TEMPORARY SEED - Cereale Rye	$2.63	$275.63
			PLANTING TOTAL		**$153,576.00**
22	1	LS	CONSTRUCTION STAKEOUT	$10,500.00	$10,500.00
23	1	LS	AS-BUILT SURVEY	$15,750.00	$15,750.00
24	1	LS	PERFORMANCE AND PAYMENT BOND	$9,450.00	$9,450.00
			TOTAL		**$621,067.50**

Attachment D – Pollutant Load Reduction Calculations and Sediment Test Results

Protocol 1 Calculations

Morey Creek

							By Reach (North/South)					Nutrient % Stream Reach Averages			
Reach	Reach Name	Bank ID	Bank Side	Bank Height (ft)	BEHI Category	NBS Category	Bulk Density of Soil (lb/cf)	Erosion Rate (ft/yr)	Bank Length (ft)	Bank Area (sf)	Sediment Load (ton/yr)	TN%	TP%	TN Load (lb/yr)	TP Load (lb/yr)
FPW-001	Morey Creek	All	Both	5.25	High	Moderate	74.2	0.1	2000	10500	57.8	0.100	0.059	115.55	68.18

Sediment Load (ton/yr)	
Restoration Efficiency	**Sediment Delivery Ratio**
50%	0.220
TOTAL	**58**
w/ Restoration Efficiency	**29**
w/ Sediment Delivery Ratio	**6**

Total Nitrogen Load (lb/yr)	
Restoration Efficiency	**Sediment Delivery Ratio**
50%	0.490
TOTAL	**116**
w/ Restoration Efficiency	**58**
w/ Sediment Delivery Ratio	**28**

Total Phosphorus Load (lb/yr)	
Restoration Efficiency	**Sediment Delivery Ratio**
50%	0.680
TOTAL	**68**
w/ Restoration Efficiency	**34**
w/ Sediment Delivery Ratio	**23**

Erosion Rate Calculation Data for Reference only

		BEHI					
		Very Low	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
NBS	**Very Low**	0.000	0.000	0.006	0.078	0.470	0.962
	Low	0.000	0.000	0.016	0.107	0.587	1.528
	Moderate	0.000	0.000	0.041	0.148	0.732	2.426
	High	0.000	0.000	0.106	0.205	0.913	3.853
	Very High	0.000	0.000	0.277	0.282	1.139	6.117
	Extreme	0.000	0.000	0.721	0.390	1.421	9.714

From Appendix A. "TMDL Credit Reduction Workbook using BANCS and Protocol 1 of the Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects"

Developed by the USFWS CBP Office with modifications to compute the TMDL adde

Morey Creek Protocol 2 Credit

Area	Width (ft)	Length (ft)	Area (sq ft)	Denitrification Rate (lbs/sq ft/year)	lbs NO3/year	Baseflow Type Factor	Floodplain Height Factor	Soil Type Factor	Nitrate Removal (lb/yr)
Left Bank	30	1000	30000	0.00269	80.7	1	0.75	0.6	36.315
Right Bank	25	1000	25000	0.00269	67.25	1	0.75	0.6	30.2625
Channel	25	1000	25000	0.00269	67.25	1	0.75	0.6	30.2625
Total									96.84

Report Number: 24-178-0770

Account Number: 27355

Send To: Biohabitats Inc
2081 Clipper Park Road
Baltimore MD 21211

Waypoint ANALYTICAL

"Every acre...Every year."™

7621 Whitepine Road, Richmond, VA 23237
Main 804-743-9401 ° Fax 804-271-6446
www.waypointanalytical.com

Grower: Biohabitats Inc. c/o Tanaira Cullen

SOIL ANALYSIS REPORT

Analytical Method(s):

MD = Maryland Fertility Index Value

Date Received: 06/26/2024 **Date Of Analysis:** 06/27/2024 **Date Of Report:** 07/01/2024

Sample ID Field ID	Lab Number	OM	W/V	ENR	Phosphorus			Potassium	Magnesium	Calcium	Sodium	pH		Acidity	C.E.C
		% Rate	Soil Class	lbs/A	ppm Rate	ppm Rate	ppm Rate	K ppm Rate	Mg ppm Rate	Ca ppm Rate	Na ppm Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
UVA4B	13404														
UVA4A	13405														
UVA3A	13406														
UVA3B	13407														
UVA3C	13408														

Sample ID Field ID	Percent Base Saturation					Nitrate	Sulfur	Zinc	Manganese	Iron	Copper	Boron	Soluble Salts	Bulk Density (Undisturbed)	
	K %	Mg %	Ca %	Na %	H %	NO_3 N ppm Rate	S ppm Rate	Zn ppm Rate	Mn ppm Rate	Fe ppm Rate	Cu ppm Rate	B ppm Rate	SS ms/cm Rate	g/cm3	
UVA4B														1.2	
UVA4A														1.4	
UVA3A														1.4	
UVA3B														1.2	
UVA3C														1.3	

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

by: Brandi Watson

Brandi Watson

Waypoint ANALYTICAL

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7/5/2024

Biohabitats Inc
2081 Clipper Park Road
Baltimore, MD, 21211

Ref: Analytical Testing
Report Number: 24-179-0001
Project Description: Biohabitats Inc. c/o Tanaira Cullens
Waypoint Analytical Virginia, Inc. received sample(s) on 6/27/2024 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method. Sub-contracted testing is noted on the Sample Summary Table if applicable.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA (including 40 CFR 136 Method Update Rule May 2012) and NELAC unless otherwise indicated.

Certain parameters (chlorine, pH, dissolved oxygen, sulfite...) are required to be analyzed within 15 minutes of sampling. Usually, but not always, any field parameter analyzed at the laboratory is outside of this holding time. Refer to sample analysis time for confirmation of holding time compliance.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Brandi Watson

Brandi Watson

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Waypoint ANALYTICAL
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Sample Summary Table

Report Number: **24-179-0001**

Client Project Description: **Biohabitats Inc. c/o Tanaira Cullens**

Lab No	Client Sample ID	Matrix	Date Collected	Date Received	Method	Lab ID
66071	UVA2A	Solids		06/27/2024	6010D	WP MTN
66072	UVA2B	Solids		06/27/2024	6010D	WP MTN
66073	UVA2C	Solids		06/27/2024	6010D	WP MTN
66074	UVA1A	Solids		06/27/2024	6010D	WP MTN
66075	UVA1B	Solids		06/27/2024	6010D	WP MTN
66076	UVA1C	Solids		06/27/2024	6010D	WP MTN

WP MTN - Memphis, TN: Waypoint Analytical - TN, Memphis, TN

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27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0001**

REPORT OF ANALYSIS

Lab No : **66071**
Sample ID : **UVA2A**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**570**	mg/Kg	25.0	5	07/02/24 00:23	BKN	6010D

Qualifiers/ Definitions

DF Dilution Factor

MQL Method Quantitation Limit

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27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0001**

REPORT OF ANALYSIS

Lab No : **66072**
Sample ID : **UVA2B**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**377**	mg/Kg	25.0	5	07/02/24 00:29	BKN	6010D

Qualifiers/ Definitions DF Dilution Factor MQL Method Quantitation Limit

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27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Biohabitats Inc. c/o Tanaira Cullens

Information :

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0001**

REPORT OF ANALYSIS

Lab No : **66073**
Sample ID : **UVA2C**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**496**	mg/Kg	50.0	10	07/02/24 13:34	BKN	6010D

Qualifiers/ Definitions DF Dilution Factor MQL Method Quantitation Limit

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27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0001**

REPORT OF ANALYSIS

Lab No : **66074**
Sample ID : **UVA1A**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**539**	mg/Kg	25.0	5	07/02/24 00:49	BKN	6010D

Qualifiers/ Definitions

DF	Dilution Factor	MQL	Method Quantitation Limit

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27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0001**

REPORT OF ANALYSIS

Lab No : **66075**
Sample ID : **UVA1B**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**578**	mg/Kg	50.0	10	07/02/24 13:39	BKN	6010D

Qualifiers/ Definitions

DF Dilution Factor

MQL Method Quantitation Limit

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27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0001**

REPORT OF ANALYSIS

Lab No : **66076**
Sample ID : **UVA1C**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**589**	mg/Kg	50.0	10	07/02/24 13:44	BKN	6010D

Qualifiers/ Definitions DF Dilution Factor MQL Method Quantitation Limit

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Client: Biohabitats Inc
Project: Biohabitats Inc. c/o Tanaira Cullens
Lab Report Number: 24-179-0001
Date: 7/3/2024

CASE NARRATIVE

Metals Analysis Method 6010D
Sample 66073 (UVA2C)
QC Batch No: L759307/L759047
One or more Internal Standards are outside method acceptance criteria. Re-analysis and/or sample dilutions are required.

Sample 66075 (UVA1B)
QC Batch No: L759307/L759047
One or more Internal Standards are outside method acceptance criteria. Re-analysis and/or sample dilutions are required.

Sample 66076 (UVA1C)
QC Batch No: L759307/L759047
One or more Internal Standards are outside method acceptance criteria. Re-analysis and/or sample dilutions are required.

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Shipment Receipt Form

Customer Number: **27355**
Customer Name: **Biohabitats Inc**
Report Number: **24-179-0001**

Shipping Method

○ Fed Ex	○ US Postal	○ Lab	○ Other :	
● UPS	○ Client	○ Courier	Thermometer ID:	

Shipping container/cooler uncompromised?	● Yes	○ No	
Number of coolers/boxes received	1		
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Present
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Present
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	○ Yes	● No	○ Not Present
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	○ Yes	● No	
Water - Sample containers properly preserved	○ Yes	○ No	● N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments:

Signature: David Lennon Date & Time: 06/27/2024 07:26:24

6

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Richmond, VA 23237
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SOIL SAMPLE INFORMATION SHEET

CUSTOMER INFORMATION		GROWER INFORMATION	
Biohabitats Inc. c/o Tanaira Cullens			
2081 Clipper Park Road			
Baltimore, MD 21211		Send Report to e-mail address	tcullens@biohabitats.com
Account # 27355	Grower ID	Farm ID	Field ID

Please check samples in column provided if Herbicide or Nematode analysis requested. If Herbicide, please indicate name of Herbicide in Add'l Info box below.

Lab Number (Lab Use Only)	Sample ID (6 chars. max)	S1M	S2M - Specify Add'l Tests: B	Cu	Fe	Mn	Na	S	Zn	S3M	Soluble Salts	Texture	NO3-N	Additional Tests	Intended Crop Code	Intended Crop Yield	Alternate Crop Code	Alternate Crop Yield	Previous Crop	Herbicide	Nematode
66071	UVA2A											X		X ✓							
72	UVA2B											X		X ✓							
73	UVA2C											X		X ✓							
74	UVA1A											X		X ✓							
75	UVA1B											X		X ✓							
76	UVA1C											X		X ✓							

S1M - Organic Matter, Phosphorous, Potassium, Calcium, Magnesium, pH, Buffer pH
S2M - S1M plus any two of the following: Sodium, Sulfate-Sulfur, Boron, Zinc, Manganese, Iron, Copper. Each additional test (above two) cost
S3M - S1M plus all of the following: Sodium, Sulfate-Sulfur, Boron, Zinc, Manganese, Iron, Copper.

Biohabitats Inc
Biohabitats Inc. c/o Tanaira Cullens
24-179-0001
27355
06-27-2024
07:25:04

CROP CODES TO BE USED IF FERTILIZER RECOMMENDATIONS ARE REQUESTEI

If the crop for which you would like recommendations is not listed, write the crop name in the crop code

FIELD CROPS

1. Barley
5. Canola
10. Corn
11. Corn/Soybeans Rotation
12. Corn - No Till
13. Corn Silage
20. Cotton
21. Cotton - No Till
25. Grain Sorghum
30. Oats
32. Peanuts
34. Popcorn
35. Rapeseed
36. Rice
39. Rye
45. Soybeans
46. Soybeans - No Till
51. Sugarcane - Plant
52. Sugarcane - Stubble
62. Tobacco - Burley
63. Tobacco - Dark
64. Tobacco - Flue Cured
75. Wheat
78. Wheat Silage/Corn Silage
92. Wheat/Beans Double Crop

FORAGE CROPS

101. Alfalfa Hay
103. Alfalfa/Cool Season Grass Hay
106. Alfalfa/Warm Season Grass Hay
116. Bahiagrass Hay
117. Bahiagrass Pasture
121. Common Bermuda Hay
122. Common Bermuda Pasture
123. Common Bermuda/Legume Hay
124. Common Bermuda/Legume Pasture
161. Coastal Bermuda Hay
162. Coastal Bermuda Pasture
172. Cool Season Grass Pasture
173. Cool Season Grass Hay
181. Fescue Hay
182. Fescue Pasture
183. Fescue/Legume Hay
184. Fescue/Legume Pasture
237. Ryegrass

INDICATE TYPE OF GRASS AND/OR LEGUME

297. OTHER HAY
298. OTHER PASTURE
299. CRP

VEGETABLE CROPS

307. Beans - Lima
309. Beans - Snap
320. Cabbage
322. Cantaloupe
330. Cucumbers
340. Garden
369. Peppers
381. Spinach
382. Squash
383. Sweet Corn
384. Sweet Potato(ton)
391. Sweet Potato(bu)
385. Tomatoes
398. Watermelons

FRUIT & NUT CROPS

400. Apples
410. Blueberries
420. Citrus
430. Grapes
470. Peaches
475. Pecans
490. Strawberries

TURFGRA:

512. Bahiagrass Lawn
513. Bahiagrass Sod Prc
517. Bentgrass Green
521. Bermudagrass Athle
522. Bermudagrass Fairw
523. Bermudagrass Gree
524. Bermudagrass Lawn
525. Bermudagrass Sod F
526. Bermudagrass Tee
533. Bluegrass Lawn
534. Bluegrass Sod Produ
546. Centipede Lawn
547. Centipede Sod Produ
561. Fescue Athletic Field
563. Fescue Lawn
564. Fescue Sod Productio
576. St. Augustine Lawn
577. St. Augustine Sod Proc
583. Zoysiagrass Lawn
584. Zoysiagrass Sod Produ

Additional Tests or Other Information

TP (EPA method 3051 + 6010)
TN (combustion method)
~~Bulk Density (disturbed soils) 2" x 4" liner = 12.57 in²~~ Undisturbed
Soil Texture (particle size analysis)

Note: No bulk density for UVA2A or UVA2B.

1 of 2

No Bulk

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Main 804-743-9401 ° Fax 804-271-6446
www.waypointanalytical.com

7/5/2024

Biohabitats Inc
2081 Clipper Park Road
Baltimore, MD, 21211

Ref: Analytical Testing
Report Number: 24-179-0002
Project Description: Biohabitats Inc. c/o Tanaira Cullens

Waypoint Analytical Virginia, Inc. received sample(s) on 6/27/2024 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method. Sub-contracted testing is noted on the Sample Summary Table if applicable.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA (including 40 CFR 136 Method Update Rule May 2012) and NELAC unless otherwise indicated.

Certain parameters (chlorine, pH, dissolved oxygen, sulfite...) are required to be analyzed within 15 minutes of sampling. Usually, but not always, any field parameter analyzed at the laboratory is outside of this holding time. Refer to sample analysis time for confirmation of holding time compliance.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Brandi Watson

Brandi Watson

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

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www.waypointanalytical.com

Sample Summary Table

Report Number: **24-179-0002**

Client Project Description: **Biohabitats Inc. c/o Tanaira Cullens**

Lab No	Client Sample ID	Matrix	Date Collected	Date Received	Method	Lab ID
66077	UVA4B	Solids		06/27/2024	6010D	WP MTN
66078	UVA4A	Solids		06/27/2024	6010D	WP MTN
66079	UVA3A	Solids		06/27/2024	6010D	WP MTN
66080	UVA3B	Solids		06/27/2024	6010D	WP MTN
66081	UVA3C	Solids		06/27/2024	6010D	WP MTN

WP MTN - Memphis, TN: Waypoint Analytical - TN, Memphis, TN

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www.waypointanalytical.com

27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0002**

REPORT OF ANALYSIS

Lab No : **66077**
Sample ID : **UVA4B**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**628**	mg/Kg	50.0	10	07/02/24 13:49	BKN	6010D

Qualifiers/ Definitions			
DF	Dilution Factor	MQL	Method Quantitation Limit

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27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0002**

REPORT OF ANALYSIS

Lab No : **66078**
Sample ID : **UVA4A**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**480**	mg/Kg	50.0	10	07/02/24 14:04	BKN	6010D

Qualifiers/ Definitions

DF Dilution Factor

MQL Method Quantitation Limit

7621 Whitepine Road, Richmond, VA 23237
Main 804-743-9401 ° Fax 804-271-6446
www.waypointanalytical.com

27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0002**

REPORT OF ANALYSIS

Lab No : **66079**
Sample ID : **UVA3A**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**572**	mg/Kg	25.0	5	07/02/24 01:16	BKN	6010D

Qualifiers/ Definitions			
DF	Dilution Factor	MQL	Method Quantitation Limit

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www.waypointanalytical.com

27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0002**

REPORT OF ANALYSIS

Lab No : **66080**
Sample ID : **UVA3B**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**1380**	mg/Kg	25.0	5	07/01/24 21:28	BKN	6010D

Qualifiers/ Definitions

DF Dilution Factor

MQL Method Quantitation Limit

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27355
Biohabitats Inc
2081 Clipper Park Road

Baltimore , MD 21211

Project Information : Biohabitats Inc. c/o Tanaira Cullens

Report Date : 07/05/2024
Received : 06/27/2024

Brandi Watson

Report Number : **24-179-0002**

REPORT OF ANALYSIS

Lab No : **66081**
Sample ID : **UVA3C**

Matrix: **Solids**
Sampled:

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Phosphorus	**436**	mg/Kg	25.0	5	07/01/24 21:44	BKN	6010D

Qualifiers/ Definitions

DF Dilution Factor

MQL Method Quantitation Limit

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Client: Biohabitats Inc

CASE NARRATIVE

Project: Biohabitats Inc. c/o Tanaira Cullens
Lab Report Number: 24-179-0002
Date: 7/3/2024

Metals Analysis Method 6010D
Sample 66077 (UVA4B)
QC Batch No: L759307/L759047
One or more Internal Standards are outside method acceptance criteria. Re-analysis and/or sample dilutions are required.

Sample 66078 (UVA4A)
QC Batch No: L759307/L759047
One or more Internal Standards are outside method acceptance criteria. Re-analysis and/or sample dilutions are required.

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Shipment Receipt Form

Customer Number: **27355**
Customer Name: **Biohabitats Inc**
Report Number: **24-179-0002**

Shipping Method

○ Fed Ex	○ US Postal	○ Lab	○ Other :	
● UPS	○ Client	○ Courier	Thermometer ID:	

Shipping container/cooler uncompromised?	● Yes	○ No	
Number of coolers/boxes received	1		
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Present
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Present
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	○ Yes	● No	○ Not Present
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	○ Yes	● No	
Water - Sample containers properly preserved	○ Yes	○ No	● N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments:

Signature: David Lennon Date & Time: 06/27/2024 07:29:23

5

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SOIL SAMPLE INFORMATION SHEET

CUSTOMER INFORMATION	GROWER INFORMATION
Biohabitats Inc. c/o Tanaira Cullens	
2081 Clipper Park Rd.	
Baltimore, MD 21211	Send Report to e-mail address: tcullens@biohabitats.com
Account # 27355 / Grower ID	Farm ID / Field ID

Please check samples in column provided if Herbicide or Nematode analysis requested. If Herbicide, please indicate name of Herbicide in Add'l info box below.

Lab Number (Lab Use Only)	Sample ID (6 chars. max)	S1M	B	Cu	Fe	Mn	Na	S	Zn	S3M	Soluble Salts	Texture	NO3-N	Additional Tests	Intended Crop Code	Intended Crop Yield	Alternate Crop Code	Alternate Crop Yield	Previous Crop	Herbicide	Nematode
66077	UVA4B											X		X							
78	UVA4A											X		X							
79	UVA3A											X		X							
80	UVA3B											X		X							
81	UVA3C											X		X							

(B through Zn: S2M - Specify Add'l Tests)

S1M - Organic Matter, Phosphorous, Potassium, Calcium, Magnesium, pH, Buffer pH
S2M - S1M plus any two of the following: Sodium, Sulfate-Sulfur, Boron, Zinc, Manganese, Iron, Copper. Each additional test (above two) cost
S3M - S1M plus all of the following: Sodium, Sulfate-Sulfur, Boron, Zinc, Manganese, Iron, Copper.

Biohabitats inc
Biohabitats Inc. c/o Tanaira Cullens
24-179-0002
27355
06-27-2024
07:29:08

CROP CODES TO BE USED IF FERTILIZER RECOMMENDATIONS ARE REQUESTED

If the crop for which you would like recommendations is not listed, write the crop name in the crop code

FIELD CROPS

1. Barley
5. Canola
10. Corn
11. Corn/Soybeans Rotation
12. Corn - No Till
13. Corn Silage
20. Cotton
21. Cotton - No Till
25. Grain Sorghum
30. Oats
32. Peanuts
34. Popcorn
35. Rapeseed
36. Rice
39. Rye
45. Soybeans
46. Soybeans - No Till
51. Sugarcane - Plant
52. Sugarcane - Stubble
62. Tobacco - Burley
63. Tobacco - Dark
64. Tobacco - Flue Cured
75. Wheat
78. Wheat Silage/Corn Silage
92. Wheat/Beans Double Crop

FORAGE CROPS

101. Alfalfa Hay
103. Alfalfa/Cool Season Grass Hay
106. Alfalfa/Warm Season Grass Hay
116. Bahiagrass Hay
117. Bahiagrass Pasture
121. Common Bermuda Hay
122. Common Bermuda Pasture
123. Common Bermuda/Legume Hay
124. Common Bermuda/Legume Pasture
161. Coastal Bermuda Hay
162. Coastal Bermuda Pasture
172. Cool Season Grass Pasture
173. Cool Season Grass Hay
181. Fescue Hay
182. Fescue Pasture
183. Fescue/Legume Hay
184. Fescue/Legume Pasture
237. Ryegrass

INDICATE TYPE OF GRASS AND/OR LEGUME

297. OTHER HAY
298. OTHER PASTURE
299. CRP

VEGETABLE CROPS

307. Beans - Lima
309. Beans - Snap
320. Cabbage
322. Cantaloupe
330. Cucumbers
340. Garden
369. Peppers
381. Spinach
382. Squash
383. Sweet Corn
384. Sweet Potato(ton)
391. Sweet Potato(bu)
385. Tomatoes
398. Watermelons

FRUIT & NUT CROPS

400. Apples
410. Blueberries
420. Citrus
430. Grapes
470. Peaches
475. Pecans
490. Strawberries

TURFGRA

512. Bahiagrass Lawn
513. Bahiagrass Sod P
517. Bentgrass Green
521. Bermudagrass Atl
522. Bermudagrass Fa
523. Bermudagrass Gr
524. Bermudagrass La
525. Bermudagrass So
526. Bermudagrass Te
533. Bluegrass Lawn
534. Bluegrass Sod Pr
546. Centipede Lawn
547. Centipede Sod Pr
561. Fescue Athletic Fi
563. Fescue Lawn
564. Fescue Sod Prod
576. St. Augustine Law
577. St. Augustine Soc
583. Zoysiagrass Lawr
584. Zoysiagrass Sod

Additional Tests or Other Information

TP (EPA method 3051 + 6010)
TN (Combustion method)
~~Bulk Density (disturbed soils)~~ 2"x4" liner = 12.57 in^2 Undisturbed
Soil texture (particle size analysis)

Total: 9 bulk density
11 TP + TN + texture

2 of 2

Report Number: 24-178-0769
Account Number: 27355

Send To: Biohabitats Inc
2081 Clipper Park Road
Baltimore MD 21211

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7621 Whitepine Road, Richmond, VA 23237
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Grower: Biohabitats Inc. c/o Tanaira Cullen

SOIL ANALYSIS REPORT

Analytical Method(s):
MD = Maryland Fertility Index Value

Date Received: 06/26/2024 **Date Of Analysis:** 06/27/2024 **Date Of Report:** 07/01/2024

Sample ID Field ID	Lab Number	OM	W/V	ENR	Phosphorus						Potassium		Magnesium		Calcium		Sodium		pH		Acidity	C.E.C
		% Rate	Soil Class	lbs/A	ppm	Rate	ppm	Rate	ppm	Rate	K ppm	Rate	Mg ppm	Rate	Ca ppm	Rate	Na ppm	Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
UVA2C	13399																					
UVA1A	13400																					
UVA1B	13401																					
UVA1C	13402																					

Sample ID Field ID	Percent Base Saturation					Nitrate		Sulfur		Zinc		Manganese		Iron		Copper		Boron		Soluble Salts		Bulk Density (Undisturbed)	
	K %	Mg %	Ca %	Na %	H %	NO_3 N ppm	Rate	S ppm	Rate	Zn ppm	Rate	Mn ppm	Rate	Fe ppm	Rate	Cu ppm	Rate	B ppm	Rate	SS ms/cm	Rate	g/cm3	
UVA2C																						1.1	
UVA1A																						0.9	
UVA1B																						1.2	
UVA1C																						1.0	

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

by: Brandi Watson

Brandi Watson

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Sample Summary Table

Report Number: **24-178-0768**

Client Project Description: **Biohabitats Inc c/o Tanaira Cullens**

Lab No	Client Sample ID	Matrix	Date Collected	Date Received	Method	Lab ID
13394	UVA4B	Solids		06/26/2024		
13394	UVA4B	Solids		06/26/2024	AOAC 2.4.02	WP MTN
13395	UVA4A	Solids		06/26/2024		
13395	UVA4A	Solids		06/26/2024	AOAC 2.4.02	WP MTN
13396	UVA3A	Solids		06/26/2024		
13396	UVA3A	Solids		06/26/2024	AOAC 2.4.02	WP MTN
13397	UVA3B	Solids		06/26/2024		
13397	UVA3B	Solids		06/26/2024	AOAC 2.4.02	WP MTN
13398	UVA3C	Solids		06/26/2024		
13398	UVA3C	Solids		06/26/2024	AOAC 2.4.02	WP MTN

WP MTN - Memphis, TN: Waypoint Analytical - TN, Memphis, TN

Report Number: 24-178-0768
Account Number: 27355

Send To: Biohabitats Inc
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Baltimore MD 21211

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Grower: Biohabitats Inc c/o Tanaira Cullens

SOIL ANALYSIS REPORT

Analytical Method(s): Texture

Date Received: 06/26/2024 **Date Of Analysis:** 06/27/2024 **Date Of Report:** 07/11/2024 MD = Maryland Fertility Index Value

Sample ID Field ID	Lab Number	OM	W/V	ENR	Phosphorus						Potassium		Magnesium		Calcium		Sodium		pH		Acidity	C.E.C
		% Rate	Soil Class	lbs/A	ppm	Rate	ppm	Rate	ppm	Rate	K ppm	Rate	Mg ppm	Rate	Ca ppm	Rate	Na ppm	Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
UVA4B	13394																					
UVA4A	13395																					
UVA3A	13396																					
UVA3B	13397																					
UVA3C	13398																					

Sample ID Field ID	Percent Base Saturation					Nitrate		Sulfur		Zinc		Manganese		Iron		Copper		Boron		Soluble Salts		Total Nitrogen	
	K %	Mg %	Ca %	Na %	H %	NO_3 N ppm	Rate	S ppm	Rate	Zn ppm	Rate	Mn ppm	Rate	Fe ppm	Rate	Cu ppm	Rate	B ppm	Rate	SS ms/cm	Rate	%	
UVA4B																						0.00	
UVA4A																						0.00	
UVA3A																						0.00	
UVA3B																						0.00	
UVA3C																						0.00	

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

by: Brandi Watson

Brandi Watson

Report Number: 24-178-0768
Account Number: 27355

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Grower: Biohabitats Inc c/o Tanaira Cullens

Comments:

Total Nitrogen detection limit is 0.10

"The recommendations are based on research data and experience, but NO GUARANTEE or WARRANTY expressed or implied, concerning crop performance is made."

Brandi Watson

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TEXTURE ANALYSIS

Client :	Grower :	Report No : 24-178-0768
Biohabitats Inc 2081 Clipper Park Road Baltimore , MD 21211	Biohabitats Inc c/o Tanaira Cullens	Cust No : 27355 Date Printed : 07/11/2024
	Farm :	Date Received : 06/26/2024

Lab No	Field ID	Sample Identification	Percent Sand	Percent Silt	Percent Clay	Textural Classification
13394		UVA4B	22.3	47.9	29.7	Clay Loam
13395		UVA4A	46.3	35.9	17.7	Loam
13396		UVA3A	64.3	23.9	11.7	Sandy Loam
13397		UVA3B	66.3	23.9	9.7	Sandy Loam
13398		UVA3C	52.3	29.9	17.7	Sandy Loam

Analysis prepared by: Waypoint Analytical Virginia, Inc.

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Sample Summary Table

Report Number: **24-178-0767**

Client Project Description: **Biohabitats Inc. c/o Tanaira Cullens**

Lab No	Client Sample ID	Matrix	Date Collected	Date Received	Method	Lab ID
13387	UVA2A	Solids		06/26/2024		
13387	UVA2A	Solids		06/26/2024	AOAC 2.4.02	WP MTN
13388	UVA2B	Solids		06/26/2024		
13388	UVA2B	Solids		06/26/2024	AOAC 2.4.02	WP MTN
13389	UVA2C	Solids		06/26/2024		
13389	UVA2C	Solids		06/26/2024	AOAC 2.4.02	WP MTN
13390	UVA1A	Solids		06/26/2024		
13390	UVA1A	Solids		06/26/2024	AOAC 2.4.02	WP MTN
13391	UVA1B	Solids		06/26/2024		
13391	UVA1B	Solids		06/26/2024	AOAC 2.4.02	WP MTN
13393	UVA1C	Solids		06/26/2024		
13393	UVA1C	Solids		06/26/2024	AOAC 2.4.02	WP MTN

WP MTN - Memphis, TN: Waypoint Analytical - TN, Memphis, TN

Report Number: 24-178-0767
Account Number: 27355

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Grower: Biohabitats Inc. c/o Tanaira Cullen

SOIL ANALYSIS REPORT

Analytical Method(s): Texture

Date Received: 06/26/2024 **Date Of Analysis:** 06/27/2024 **Date Of Report:** 07/11/2024 MD = Maryland Fertility Index Value

Sample ID Field ID	Lab Number	OM % Rate	W/V Soil Class	ENR lbs/A	Phosphorus ppm Rate	Phosphorus ppm Rate	Phosphorus ppm Rate	Potassium K ppm Rate	Magnesium Mg ppm Rate	Calcium Ca ppm Rate	Sodium Na ppm Rate	pH Soil pH	pH Buffer Index	Acidity H meq/100g	C.E.C meq/100g
UVA2A	13387														
UVA2B	13388														
UVA2C	13389														
UVA1A	13390														
UVA1B	13391														

Sample ID Field ID	Percent Base Saturation K %	Mg %	Ca %	Na %	H %	Nitrate NO_3 N ppm Rate	Sulfur S ppm Rate	Zinc Zn ppm Rate	Manganese Mn ppm Rate	Iron Fe ppm Rate	Copper Cu ppm Rate	Boron B ppm Rate	Soluble Salts SS ms/cm Rate	Total Nitrogen %	
UVA2A														0.00	
UVA2B														0.00	
UVA2C														0.00	
UVA1A														0.14	
UVA1B														0.00	

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

by: Brandi Watson

Brandi Watson

Report Number: 24-178-0767
Account Number: 27355

Send To: Biohabitats Inc
2081 Clipper Park Road
Baltimore MD 21211

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Grower: Biohabitats Inc. c/o Tanaira Cullen

Comments:

Total Nitrogen detection limit is 0.10

"The recommendations are based on research data and experience, but NO GUARANTEE or WARRANTY expressed or implied, concerning crop performance is made."

Brandi Watson

Report Number: 24-178-0767
Account Number: 27355

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Grower: Biohabitats Inc. c/o Tanaira Cullen

SOIL ANALYSIS REPORT

Analytical Method(s): Texture

Date Received: 06/26/2024 **Date Of Analysis:** 06/27/2024 **Date Of Report:** 07/11/2024 MD = Maryland Fertility Index Value

Sample ID Field ID	Lab Number	OM	W/V	ENR	Phosphorus			Potassium	Magnesium	Calcium	Sodium	pH		Acidity	C.E.C
		% Rate	Soil Class	lbs/A	ppm Rate	ppm Rate	ppm Rate	K ppm Rate	Mg ppm Rate	Ca ppm Rate	Na ppm Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
UVA1C	13393														

Sample ID Field ID	Percent Base Saturation					Nitrate	Sulfur	Zinc	Manganese	Iron	Copper	Boron	Soluble Salts	Total Nitrogen	
	K %	Mg %	Ca %	Na %	H %	NO_3 N ppm Rate	S ppm Rate	Zn ppm Rate	Mn ppm Rate	Fe ppm Rate	Cu ppm Rate	B ppm Rate	SS ms/cm Rate	%	
UVA1C														0.00	

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

by:

Brandi Watson

Waypoint ANALYTICAL
7621 Whitepine Road, Richmond, VA 23237
Main 804-743-9401 ° Fax 804-271-6446
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TEXTURE ANALYSIS

Client :	Grower :	Report No : 24-178-0767
Biohabitats Inc 2081 Clipper Park Road Baltimore , MD 21211	Biohabitats Inc. c/o Tanaira Cullens	Cust No : 27355 Date Printed : 07/11/2024
	Farm :	Date Received : 06/26/2024

Lab No	Field ID	Sample Identification	Percent Sand	Percent Silt	Percent Clay	Textural Classification
13387		UVA2A	46.3	39.9	13.7	Loam
13388		UVA2B	70.3	17.9	11.7	Sandy Loam
13389		UVA2C	38.3	41.9	19.7	Loam
13390		UVA1A	70.3	23.9	5.7	Sandy Loam
13391		UVA1B	64.3	27.9	7.7	Sandy Loam
13393		UVA1C	56.3	31.9	11.7	Sandy Loam

Analysis prepared by: Waypoint Analytical Virginia, Inc.

Appendix E

Memorandum of Understanding – Schenks Branch Tributary Stream Restoration Project (Sediment Reduction Sharing)

MEMORANDUM OF UNDERSTANDING

THIS MEMORANDUM OF UNDERSTANDING is entered into this __8__ day of __July__, 2024, by and between the **UNIVERSITY OF VIRGINIA**, an educational institution of the Commonwealth of Virginia (hereinafter "the University") and the **CITY OF CHARLOTTESVILLE, VIRGINIA**, a municipal corporation and political subdivision of the Commonwealth of Virginia (hereinafter "the City").

PURPOSE: The purpose of the Memorandum of Understanding is to detail the agreement between the City and the University to share entitlement to the reductions of sediment pollution generated by the City's Schenks Branch Tributary stream restoration project (hereinafter "the Project").

PROJECT DESCRIPTION AND LOCATION: The City is restoring approximately eight hundred and twenty (820) linear feet of degraded urban stream within the City's jurisdictional boundary. The Project will result in reductions of pollutants of concern, including nitrogen, phosphorus, and sediment. The Project is located on City of Charlottesville Tax Map Parcel Numbers 450001000, 460002000, and 460001200.

CITY RESPONSIBILITIES: The City shall perform the following tasks in furtherance of this Memorandum of Understanding:

1. The City shall manage the design and construction of the Project.

2. The City shall pay all costs for design and construction of the Project.

4. The City shall maintain the Project following completion of the Project's construction. Maintenance shall be in general accord with the Post-Construction Monitoring Plan Schenks Branch Tributary Stream Restoration prepared by Hazen and Sawyer dated April 6, 2022. The City shall pay all costs associated with maintenance of the Project.

UNIVERSITY RESPONSIBILITIES: The University shall perform the following task in furtherance of this Memorandum of Understanding:

1. The University shall make a one-time payment of six thousand one hundred and fifty-six dollars ($6,156.00) to the City to purchase two (2) tons/year of sediment pollution reduction. The University's payment shall occur in one installment, after the Project is fully constructed.

CITY REVIEW OPPORTUNITIES/INFORMATION REQUESTS: While the City shall maintain full responsibility for design and construction of the Project, the City will provide any request for information about the Project within five (5) business days of the University's request.

SPLITTING OF POLLUTANTS OF CONCERN REDUCTIONS: Upon completion of the Project, the City will claim all nitrogen and phosphorus reductions generated by the

Project. The City will claim all sediment reductions minus the two (2) tons/year sold to the University.

IN WITNESS WHEREOF, the City and University do hereby execute this Memorandum of Understanding:

UNIVERSITY OF VIRGINIA

DocuSigned by:

By: Donald E. Sundgren

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Donald E. Sundgren
Associate Vice President and
Chief Facilities Officer

Date: 7/8/2024

CITY OF CHARLOTTESVILLE, Virginia

By: [signature]

Lauren Hildebrand
Director of Utilities

Date: 7/16/2024