



Blacks Run & Cooks Creek TMDL Action Plan

Permit Number: VAR040112

In compliance with the general Permit for Stormwater Discharges from Small Municipal
Separate Storm Sewer Systems (MS4)

Last Revised: August 2026

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ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice	MCM	Minimum Control Measure
DEQ	Department of Environmental Quality	MS4	Municipal Separate Storm Sewer System
EPA	Environmental Protection Agency	NPDES	National Pollution Discharge Elimination System
ESC	Erosion and Sediment Control	POC	Pollutants of Concern
FM	Facilities Management	SWCB	Soil & Water Conservation Board
HUC	Hydrologic Unit Code	SWPPP	Stormwater Pollution Prevention Plan
IDDE	Illicit Discharge Detection and Elimination	TMDL	Total Maximum Daily Load
JMU	James Madison University	WLA	Waste Load Allocation
MEP	Maximum Extent Practicable		

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BACKGROUND

James Madison University occupies approximately 785 acres and is located within the border of the City of Harrisonburg, with property also located in Rockingham County. The University is situated within the Blacks Run watershed. This watershed drains to the North River where Cooks Creek and Blacks Run meet in Rockingham County, just south of the City of Harrisonburg. The North River flows to the South Fork of the Shenandoah River and ultimately discharges via the Potomac River to the Chesapeake Bay. The Blacks Run watershed is approximately 12,430 acres and includes the majority of the City of Harrisonburg and all of the University's campus located within the City's limits. Blacks Run is 11.64 miles in length and flows into Cooks Creek south of Harrisonburg. The Cooks Creek watershed is approximately 28,216 acres, including Blacks Run. Cooks Creek is located west of Harrisonburg and flows 14.37 miles before draining into the North River.

As a predominately urbanized state agency with separate storm and sanitary sewer conveyance systems, the University is classified as a Small Municipal Separate Storm Sewer System (MS4). Therefore, JMU is mandated to follow the regulations of the Environmental Protection Agency (EPA) as outlined in the Clean Water Act, the Virginia Stormwater 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.: VAR040112) James Madison University has developed a Blacks Run & Cooks Creek Total Maximum Daily Load (TMDL) Action Plan.

The TMDL for the Blacks Run & Cooks Creek watershed sets limits on the amount of pollutants of concern (POCs), including total suspended solids (TSS) and phosphorus, that can be discharged to the river without detrimentally impacting water quality. The MS4 Permit Special Condition for local TMDLs requires all MS4 operators to reduce existing levels of these POCs to a level that will be protective of water quality. This

process typically requires that the MS4 operator install best management practices (BMPs) that will, through various means, lower the contaminant levels in stormwater discharged to local streams and other water bodies.

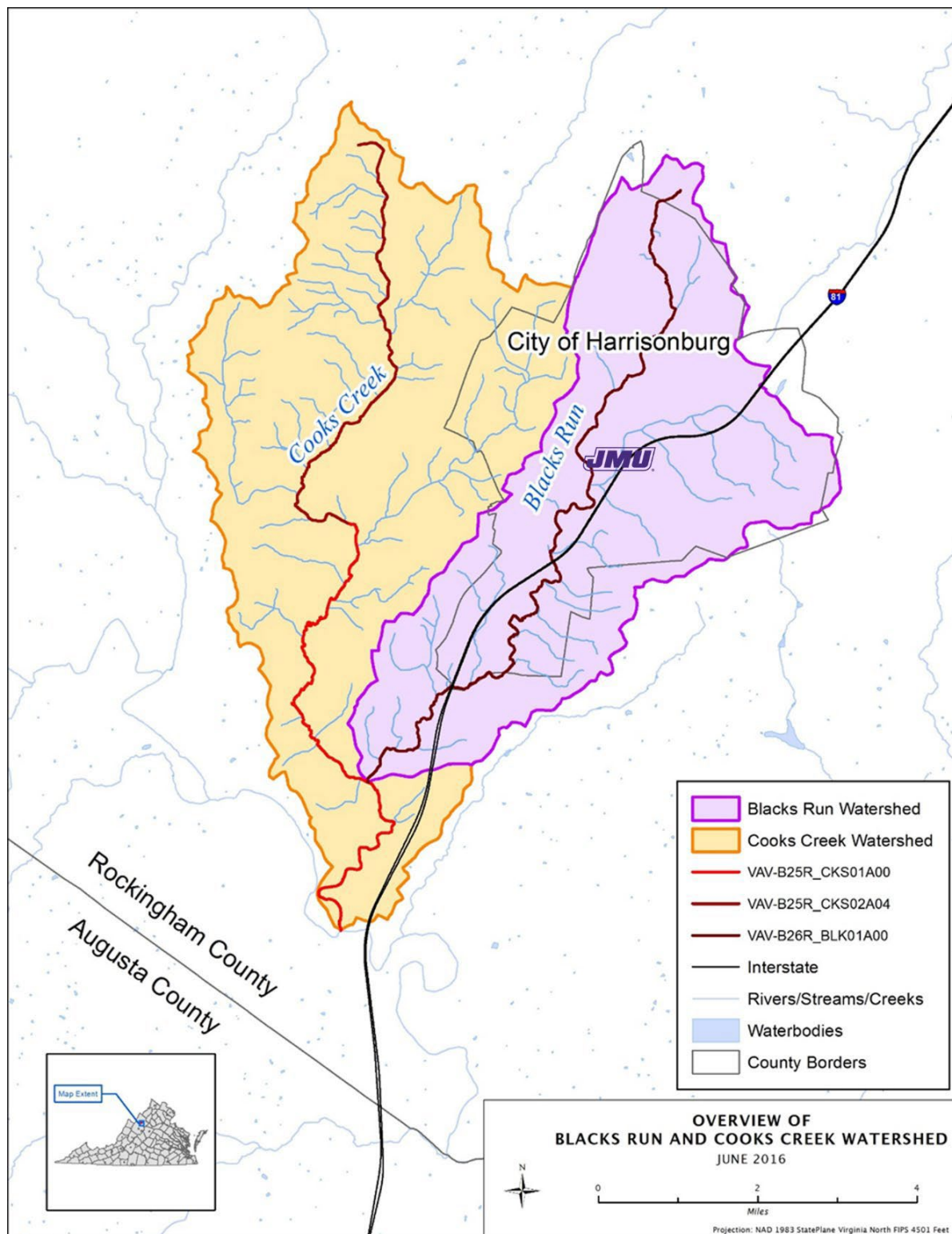


FIGURE 1. LOCATION OF BLACKS RUN AND COOKS CREEK WATERSHEDS AND ASSOCIATED STREAM IMPAIRMENTS

1. TMDL PROJECT NAMES AND EPA APPROVAL DATES

Wasteload allocations (WLAs) were assigned to the University for the Blacks Run/Cooks Creek Watershed in the approved Final TMDL report as follows:

Project Name:

Revision of the Benthic Total Maximum Daily Load (TMDL) Developed for the Blacks Run and Cooks Creek Watershed Located in the City of Harrisonburg and Rockingham County.

EPA Approval:

July 10, 2019

TMDL Watershed	305(b) Segment ID	Cause Group Code 303(d) Impairment ID	Year First Listed
Blacks Run	VAV-B26R_BLK01A00 (11.6 mi)	B26R-01-BEN	1996
Cooks Creek	VAV-B25R_CKS01A00 (7.74 mi) VAV-B25RCKS02A04 (6.63 mi)	B25R-01-BEN	1996

FIGURE 2. IMPAIRED STREAM SEGMENTS ADDRESSED IN THE ABOVE REFERENCED TMDL STUDY

The TMDL was prepared by James Madison University and EEE Consulting, Inc. and prepared for the Virginia Department of Environmental Quality (DEQ) on January 31, 2019. The Soil and Water Conservation Board (SWCB) approved the TMDL on June 27, 2019 and the Environmental Protection Agency (EPA) approved the TMDL on July 10, 2019.

A previous TMDL report contained sediment and phosphorus TMDLs for the Blacks Run and Cooks Creek watersheds. The report as referenced above and as submitted on July 1, 2019, will supersede the previous 2002 sediment and phosphorus TMDLs, which were approved by EPA on June 5, 2002.

2. WASTE LOAD ALLOCATIONS (WLAs) ASSIGNED TO THE PERMITTEE

Loading sources, including municipalities and regulated entities, within the watershed have been provided with Waste Load Allocations (WLA) for both Total Suspended Solids (TSS) or Sediment and Phosphorus (P) in the approved TMDL referenced above. The numbers below were calculated and recorded at the time the TMDL revision was being produced taking into account BMPs installed for sediment (TSS) reduction post-2009 and for phosphorus (TP) reduction post-2016 and prior to approval of the TMDL revision.

Blacks Run Watershed			
Pollutant	Wasteload Allocation (lbs/yr)	Reduction Amount Required (lbs/yr)	Reduction %
Sediment	64,600	153,400	70.4
	Pre-Allocation Load with BMPs	Reductions Achieved Post-2009	Remaining %
	218,000	172,015.61	0
Cooks Creek and Blacks Run Watersheds			
Pollutant	Wasteload Allocation (lbs/yr)	Reduction Amount Required (lbs/yr)	Reduction %
Phosphorus	28	78	73.2
	Pre-Allocation Load with BMPs	Reductions Achieved Post-2016	Remaining %
	106	0	73.2

FIGURE 3. WASTELOAD ALLOCATIONS AND PERCENT REDUCTIONS ASSIGNED TO JMU

Fortunately, implementing measures going well above the required reductions for the Chesapeake Bay TMDL has allowed for no additional WLA reductions for the University concerning sediment (TSS) as seen in Figure 3. For phosphorus (TP), the Chesapeake Bay TMDL required a reduction of 78.90 lbs/yr. JMU implemented measures to reduce 342.79 lbs/yr. These phosphorus reductions for the Chesapeake Bay TMDL were considered part of the existing conditions when the load allocations were calculated in the revised Blacks Run and Cooks Creek TMDL.

As seen in Figure 2, the Blacks Run and Cooks Creek TMDL has determined an additional 73.2% reduction of the calculated 106 lb/yr load of TP, requiring further measures to reduce the phosphorus load by approximately 78 lbs/yr. This Action Plan has been developed to meet the reduction goals still needed for phosphorus.

3. SIGNIFICANT SOURCES OF POLLUTANTS OF CONCERN (POCs)

This section identifies significant sources of pollutants of concern (POCs) to the JMU MS4 that are not covered under a separate VPDES permit. 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.”

Virginia’s 1998 303(d) list identifies urban runoff as the primary source of pollutants in the Blacks Run watershed. Cooks Creek was listed as impacted by agricultural nonpoint sources with the lower three miles also affected by urban runoff contributed by Blacks Run. Both watersheds were assessed by the 2002 TMDL as having a high potential for nonpoint source pollution based on land use, soils, and other watershed characteristics.

The surrounding City of Harrisonburg, James Madison University, and other urban areas contribute to the high percentage of urban land in the Blacks Run and Cooks Creek watersheds. Urban land uses represented in the 2002 TMDL land use coverage data include commercial, industrial, transportation, and residential areas. The primary sources of sediment and phosphorus are construction sites, impervious surfaces, and other pervious lands.

Construction sites have high erosion rates due to the removal of vegetation and topsoil. Typical erosion rates for construction sites are 35 to 45 tons per acre per year as compared to 1 to 10 tons per acre per year for cropland. The University is required to implement a construction and post-construction stormwater management program to regulate land disturbing activities on campus. While JMU has not been assigned a WLA for sediment due to meeting the reduction requirements prior to the writing of the revised TMDL by installing several stream restoration practices which went above and beyond TSS reductions, construction sites are a potential source of sediment.

Residential lawns and other green spaces contribute sediment in the same fashion as low-intensity pasture areas or other similar land uses. Fertilizer application on lawns can be a significant source of phosphorus and other pollutants. The University holds a current, unexpired Nutrient Management Plan (NMP) which is followed when applying fertilizers on campus. JMU’s NMP includes areas where no fertilizer applications are allowed due to proximity to a waterway or a stormwater management facility.

4. BEST MANAGEMENT PRACTICES DESIGNED TO REDUCE POCs

The University shall reduce the loads associated with sediment, phosphorus, or nitrogen through implementation of one or more of the following:

1. One or more of the post-construction BMPs from the latest version of the DEQ Virginia Stormwater Management Handbook.
2. One or more BMPs approved by the Chesapeake Bay Program and listed in the *Chesapeake Bay TMDL Special Condition DEQ Guidance Memo 20-2003* document. Pollutant load reductions generated by annual practices, such as street and storm drain cleaning, shall only be applied to the compliance year in which the annual practice was implemented.
3. Land disturbance thresholds lower than Virginia's regulatory requirements for erosion and sediment control and post development stormwater requirements.

JMU may meet the local TMDL requirements for sediment, phosphorus, or nitrogen through BMPs implemented or sediment, phosphorus, or nitrogen credits acquired. BMPs implemented and nutrient and sediment credits acquired to meet the requirements of the Chesapeake Bay TMDL in Part II A may also be utilized to meet local TMDL requirements as long as the BMPs are implemented or the credits are generated in the watershed for which local water quality is impaired and these BMPs were not accounted for existing conditions of the WLA for Blacks Run and Cooks Creek Watersheds.

The University has taken a proactive stance and made great efforts to reduce POCs within its watershed. In addition to the installation of new BMPs or annual practices, 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 phosphorus and correlate with the minimum control measures.

1. **Illicit Discharge Program (Sediment and Phosphorus)** – The University's program involves monitoring, detection, and elimination of illicit discharges. The University maintains a SPCC Plan and response plan for any oil type discharges, including other spills and illicit discharges. Additionally, the FM stormwater website provides an online reporting option for illicit discharges which are distributed to the stormwater team. 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 and is applicable to anyone on campus.
2. **MS4 Outfall Inspections/Dry Weather Discharge Inspections (Sediment and Phosphorus)** – 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 5 are followed if any suspicious discharges are noted.
3. **Erosion and Sediment Control Program (Sediment)** – JMU follows DEQ-approved Standards and Specifications (S&S) for E&SC in compliance with the Virginia Erosion and Stormwater Management Regulation. E&SC Plans are required for all land disturbances over 10,000 square feet (sf) on campus. Plan approval is required prior to commencement of any regulated land disturbing activity. JMU also requires E&SC controls to be installed on all land disturbing projects, even if a formal E&SC plan is not required.
4. **Construction General Permit Compliance (Sediment and Phosphorus)** - 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). JMU has provided a SWPPP template for construction activities to help guide contractors to plan for appropriate controls to prevent non-stormwater discharges.

5. **Construction Site Inspections (Sediment and Phosphorus)** - JMU 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.
6. **Stormwater Management Project Review (Sediment and Phosphorus)** – JMU 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 on campus. Plan approval is required prior to commencement of any regulated land disturbing activity.
7. **Structural BMP Implementation (Sediment and Phosphorus)** – JMU has installed various 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 or as specified in DEQ GM15-2005.
8. **Stormwater Management Facilities Inspections (Sediment and Phosphorus)** - JMU inspects and maintains all permanent stormwater BMPs on its property, unless subject to a long-term lease to another entity. In these cases, the other entity leasing the property is responsible for the maintenance. Inspectors conduct routine inspections and maintenance is completed as needed.
9. **Street Sweeping and Vacuuming (Sediment and Phosphorus)** - JMU 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.
10. **Municipal Facility Pollution Prevention (Sediment and Phosphorus)** – JMU has developed and implemented site-specific SWPPPs for all its municipal high-priority facilities. These are facilities that have an increased potential for pollution due to those facilities' operations. Part of JMU's MS4 compliance requirements were to identify "high-priority facilities" and develop Stormwater Pollution Prevention Plans (SWPPP) for those facilities. These locations are listed in JMU's MS4 Plan, and each SWPPP provides a summary description of the facility and activities associated with that facility such as a description of potential pollutants and sources, procedures for reducing and preventing pollutant discharges, and procedures for inspections and maintenance. SWPPP's will continue to be maintained and implemented, and facilities inspected on a regular basis. Newly constructed facilities or facilities with updated activities meeting the criteria for a high-priority facility will have a SWPPP developed and recorded in MS4 annual reporting to DEQ.
11. **Nutrient Management Plans or NMPs (Phosphorus)** - JMU implements Nutrient Management Plans (NMPs) to outline the rates and frequencies that nutrients may be applied, who may apply them, and covers best management practices to follow regarding the application of these nutrients. By following this Department of Conservation and Recreation (DCR) approved plan, it

can be ensured that nutrients are applied in a manner that will minimize their impact on stormwater quality. NMPs are updated every 3 years, and FM staff keep applicator certifications up to date with required continuing education classes.

5. CALCULATIONS FOR REDUCING POCs

Calculations for BMPs that have been installed, are being proposed for this permit cycle to be utilized for reduction of phosphorus and sediment, the pollutants of concern for this TMDL, are located in the Appendices listed below by BMP category. As other future BMPs and BMP strategies are added to this action plan to meet POC reductions, the calculation methodology will be added to the action plan, as applicable.

- Appendix A: Calculation of Pollutant Removal: Land Use Conversion
- Appendix B: Calculation of Pollutant Removal: Forest Buffers
- Appendix C: Newman Lake Pollution Reduction Credit Feasibility Study

6. LEGAL AUTHORITY FOR TMDL IMPLEMENTATION

James Madison University falls under the Phase II MS4 regulations as a small municipal storm sewer system operator, based on the definition found in 40 CFR 122.26(b)(8). As an operator of a small MS4, JMU must develop, implement, and enforce an MS4 Program designed to reduce the discharge of pollutants from the small MS4 to the maximum extent practicable, to protect water quality, to ensure compliance with water quality standards, and to satisfy the water quality requirements of the Clean Water Act and its attendant regulations.

As the operator of the MS4, and other campus infrastructure, University Administration has assigned the Facilities Management Department the responsibility of, and authority to administer a comprehensive and compliant Stormwater Management Program. JMU has developed and administered a compliant MS4 program since it was first permitted in 2007. The core of the program revolves around the six minimum controls measures (MCM) found in the Phase II MS4 General Permit. Best management practices implemented to comply with the minimum control measures and outcomes achieved can be found in JMU's MS4 Program Plan and annual reports, respectively. The MCMs include:

1. Public education and outreach on stormwater impacts
2. Public involvement/participation
3. Illicit discharge detection and elimination (IDDE)
4. Construction site stormwater runoff control
5. Post-construction stormwater management
6. Pollution prevention/good housekeeping for municipal operations

The Facilities Management Department maintains four stormwater policies that provide it with the authority to administer the program and comply with the MCMs. The policies describe in detail their purpose, definitions, responsibilities, and procedures. They provide guidance to faculty, staff, students and the public, which results in the efficient administration of the program, and continuity of operations within the Stormwater Division. These policies can be found in the Appendices of the MS4 Program Plan, and are reviewed annually – this plan and the policies below can be viewed at www.jmu.edu/stormwater. The existing policies and their most recent version include:

- Policy 4310 Illicit Discharge Detection and Elimination (IDDE)
- DEQ-approved JMU Standards & Specifications for ESC & SWM

- FM IV 11 Land-Disturbing Activities Policy
- FM IV 10 Stormwater Management Facilities Policy
- FM IV 12 Daily Operating Procedures for Stormwater Control Best Management Practices

MCMs 4 and 5 regulate construction and post-construction stormwater management, respectively. § 62.1-44.15:54 of the Virginia Administrative Code allows state agencies to adopt their own Virginia Erosion and Sediment Control (ESC) Program. JMU has administered its own ESC program since 2009, with the oversight of the Virginia Department of Conservation and Recreation (DCR), and now DEQ. As of July 1, 2014, the University now also administers its own Virginia Stormwater Management Program (VSMP), as allowed by § 62.1-44.15:27. JMU submits ESC and stormwater management Annual Standards & Specifications for approval by DEQ to ensure all development on the campus conforms with the intent of the Virginia Erosion and Sediment Control Law, the Virginia Stormwater Management Act, and attendant regulations.

Regarding legal authority over contractor activities, all contractors performing land disturbing activities on JMU properties are required, through contract documents, to obtain all applicable permits before construction activity commences, and to follow JMU's DEQ approved Standards and Specifications. CO-7 of the General Conditions of the Construction Contract addresses requirements related to land disturbance. The existing program provides adequate authority to address the requirements in the Cooks Creek & Blacks Run TMDL. The required deliverables will be produced with existing Facilities Management staff, and outside support available to staff.

Projects implemented to achieve pollutant reduction targets, and strategies to fund them will be developed and managed by existing staff. A robust recordkeeping system will provide long-term continuity for managing load reductions and maintenance activities. Funds to implement projects to meet the WLAs assigned may continue to be requested from the University General Fund or be supplemented by grant funding.

7. OUTREACH STRATEGIES TO REDUCE LOCAL POCs

An outreach strategy to enhance the public's education (including employees) on methods to eliminate and reduce discharges of the pollutants of concern (POCs) will be implemented using Public education, outreach, and employee training for the impairments (Phosphorus and Sediment) of this TMDL is being met through measures already implemented in JMU's MS4 Plan. These measures include:

1. **Websites and Online Media (Sediment and Phosphorus)** – Information on erosion and sediment control (E&SC) and stormwater management (SWM) can be found on the JMU Facilities Management (FM) Stormwater website (www.jmu.edu/stormwater).
2. **Public Awareness Events (Sediment and Phosphorus)** – The University tables at events such as Quad Fest, EJC Arboretum Harvest Festival, Earth Week and Blacks Run Clean Up Day for education and outreach to make the campus community aware of POCs and strategies to prevent these from entering waterways.
3. **Educational Lectures & Guest Speaking (Sediment and Phosphorus)** – Members of the Facilities Management Stormwater team routinely guest lecture in classes for Geography, GIS, Integrated Sciences and Technology (ISAT) and Environmental Science at the University to talk about the

importance of POC awareness and reductions. Staff are also occasionally requested to guest speak on these topics on campus and in the community as part of a workshop or field trip.

4. **Storm Drain Stenciling Program (Sediment and Phosphorus)** - 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.
5. **Stream Cleanups (Sediment and Phosphorus)** – JMU students, faculty, and staff are encouraged to participate in stream enhancement and cleanup programs where possible.
6. **Biennial Staff Training Plan (Sediment and Phosphorus)** – JMU 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 JMU’s MS4 Program Plan.

8. MILESTONE IMPLEMENTATION SCHEDULE

Milestones for the Blacks Run/Cooks Creek TMDL will plan to be completed via the allowable adaptive iterative approach over multiple permit cycles provided adequate progress is achieved in the implementation of BMPs designed to reduce pollutant discharges in a manner that is consistent with the assumptions and requirements of the TMDL.

BMP/Milestone Activity	Schedule	Estimated lbs P Removal Annually
Newman Lake Improvements & Aquatic Bench	2016-2023	45
2023-2028 Permit Cycle		
Triangle Meadow – Land Use Conversion	2023	0.46
East Campus Forest Buffer	2023	6.14
Oversized BMP at Village Phase 1	2026	0.75
Oversized BMP at Carrier Library	2026	1.77
University Boulevard Reforestation	2027/28	6.25
Total		60.37
2028-2033 Permit Cycle		
BMP Retrofit	TBD	TBD
Oversized BMP from capital project	TBD	TBD
Land Use Conversion	TBD	TBD
New BMP - Bioretention	TBD	TBD
New BMP – Grass Swale	TBD	TBD
Estimated Total		7.00
2034-2040 Permit Cycle		
Oversized BMP from capital project	TBD	TBD
New BMP - Bioretention	TBD	TBD
Land Use Conversion	TBD	TBD
New BMP - Stream Restoration	TBD	TBD
Street Sweeping (Annual Practice)	TBD	TBD
Storm Drain Cleaning (Annual Practice)	TBD	TBD
Estimated Total		10.63
Total Estimated Phosphorus Removal by 2040		78

TABLE 1. MILESTONE AND BMP IMPLEMENTATION SCHEDULE

The University will demonstrate its adequate progress on implementation of this Action Plan by tracking and reporting on BMP implementation in its Annual MS4 Report submitted to the DEQ on or before October 1st of each permit year. In accordance with the adaptive iterative approach referenced here, the University may modify/replace BMPs, as necessary and as new opportunities present themselves, to achieve the most effective plan for reducing the discharge of POCs from the University's MS4 and meeting assigned TMDL WLAs.

By the end of the current permit cycle (2023-2028) the University is anticipating 78% progress on meeting our total WLA of 78 lbs of P/year. BMPs installed to date and anticipated to be installed by the end of the current cycle will total an estimated 61.25 lbs/year of phosphorus removal from the TMDL watershed.

A retrofit study by Colman Engineering is in the process of wrapping up this spring (2026). This study is for the University to explore opportunities for new BMPs, opportunities for BMP retrofits, and areas where land use could be converted to forest or mixed open (meadow) to address the remaining 16.75 lbs/year of phosphorus removal required. Once completed the study will be included in the Appendices as, Appendix D: JMU BMP Retrofit Study for Blacks Run TMDL.

9. PUBLIC COMMENT PERIOD FOR TMDL ACTION PLAN

A 15-day public comment period was held April 15 – April 29, 2026. Any additional edits to the Action Plan will have a 15-day public comment period. Public comment periods will be noted in this section below as applicable. An opportunity for receipt and consideration of public comments regarding the draft Cooks Creek & Blacks Run TMDL Action Plan will be provided through the following mediums:

- JMU Stormwater Website: www.jmu.edu/stormwater
- Circulated via a JMU News Announcement to campus via email.
- Circulated via a JMU Environment-interest email listserv.

Comments will be accepted by phone call, hardcopy mediums, and/or email correspondence. Additionally, public comments may be received at any time as noted on our website linked above. Specifically, questions or comments may be emailed to stormwater@jmu.edu, mailed to the JMU Stormwater Coordinator at 181 Patterson Street, Harrisonburg, VA 22807, or directed to 540-568-3174.

The following is a summary of comments received and responses to those comments.

Public Comment Period: April 15 – April 29

No public comments were received.

Public comments will continue to be received at any time. Any public comments received outside of the previous public comment periods will be recorded and added to the action plan annually and noted in the University's MS4 annual report.

APPENDIX A: CALCULATION OF POLLUTANT REMOVAL: LAND USE CONVERSION

(Text from GM20-2003)

Permittees may receive credit for land use change conversions based on the number of acres converted. Conversion efficiencies for land use change are dependent on basin and are listed in Table V.H.1. Permittees may receive 100% credit for converting lands within their regulated MS4 area, but must deduct the L2 as the baseline within the unregulated area before taking any credit for the unregulated area. Please note that these numbers should be used for land use changes in urban areas only. If the land use change involves agricultural lands, contact DEQ and we will provide additional information on the calculation methodology.

1. *Impervious to Forest – Permittees may receive credit for converting any Impervious Surface to Forest. To receive credit for the “Forest” land use, permittees should meet the tree density per acre described in the Virginia Department of Forestry’s Land Use Tax Assessment Standards (Table V.H.2), which can be found on the Virginia Department of Forestry’s website.*
2. *Impervious to Mixed Open – Permittees may receive credit for converting any Impervious Surface to Mixed Open. “Mixed Open” would be defined as herbaceous cover that is minimally disturbed (periodically bush hogged, meadows, etc.). To qualify for this credit, the “Mixed Open” must be unmanaged (i.e. no nutrient application).*
3. *Impervious to Turf – Permittees may receive credit for converting any Impervious Surface to a Turf Surface (managed grass or lawns).*
4. *Turf to Forest – Permittees may receive credit for converting any Turf Surface (managed grass or lawns) to Forest.*
5. *Turf to Mixed Open – Permittees may receive credit for converting any Turf Surface (managed grass or lawns) to Mixed Open.*
6. *Mixed Open to Forest – Permittees may receive credit for converting any Mixed Open Surface to Forest.*

Land Use Change Conversion Efficiency Table					
Basin	Land Use From	Conversion	TN (lbs/ac/year)	TP (lbs/ac/year)	TSS (lbs/ac/year)
Potomac	Turf	Forest	5.58	1.46	557
Potomac	Turf	Mixed Open	5.28	1.15	0.00

Triangle Meadow – Land Use Conversion: The University has converted 0.40 acres of contiguous land within the MS4 service area from turf to mixed open (meadow).

Triangle Meadow Project at JMU East Campus Hillside					
Basin	Land Use from	Conversion	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
Potomac	Turf	Mixed Open	5.28	1.15	0
Regulated (MS4 Area) Converted			0.4	0.4	0.4
Total Reduction for 0.4 Acre Project			2.11	0.46	0

University Boulevard Reforestation – Land Use Conversion: The University plans to convert at total of 4.28 acres from turf to forest along a shared use path and roadway. There are seven sections of plantings proposed, with the smallest contiguous planting area 0.26 acres. The trees will be planted at a density

consistent with the size of the plantings and the stocking rate required by DEQ and GM20-2003 at 400 seedlings per acre. This project is planned to be installed in fall of 2026 and be completed by fall of 2027.

University Boulevard JMU Reforestation Project					
<i>Basin</i>	<i>Land Use from</i>	<i>Conversion</i>	<i>TN (lbs/ac/yr)</i>	<i>TP (lbs/ac/yr)</i>	<i>TSS (lbs/ac/yr)</i>
Potomac	Turf	Forest	5.58	1.46	557
<i>Regulated (MS4 Area) Acreage Converted</i>			4.28	4.28	4.28
Total Reduction for 4.28 Acre Project			23.88	6.25	2,383.96

APPENDIX B: CALCULATION OF POLLUTANT REMOVAL: FOREST BUFFERS

(Text from GM20-2003)

Forest Buffers can be credited as both a land use change and efficiency BMP. The land use change component should be credited in accordance with the applicable section of Table App B.1. Efficiency is applied at up to a 2-to-1 ratio for upland acres that drain to the buffer as sheetflow (i.e. if a one acre buffer is installed, but only 1.5 upland acres drain to the buffer as sheetflow, the permittee may only receive the efficiency credit for 1.5 acres). The following established efficiencies for TP, TN, and TSS should be used (Table App B.1):

Table App B.1 - Efficiencies for Forest Buffers Applied to Two Upland Acres per Acre of Buffer

Practice	TN	TP	TSS
Forest Buffer	25%	50%	50%

East Campus Stream – Forest Buffer: In the fall of 2022 and the spring of 2023 a tree planting was completed in partnership with the City of Harrisonburg along 1,034 linear feet of the East Campus stream, which is a tributary to Siebert Creek and Newman Lake. The new forest buffer width varies from 35 feet wide to 100 feet wide for a total of 3.03 acres of forested buffer.

EAST CAMPUS STREAM FOREST BUFFER LAND CONVERSION	
Description	Inputs
Tree buffer area (acres)	3.03
Potential Upland Treated Acres (buffer x2)	6.06
Actual Upland Drainage Area: Total	10.19
Actual Upland Drainage Area: Impervious	0.79
Actual Upland Drainage Area: Pervious	9.4
Allowable Upland Drainage Area: Impervious	0.79
Allowable Upland Drainage Area: Pervious	5.27
Allowable Upland Drainage Area: Total	6.06

Calculations for Forest Buffer Reductions	TN lbs/ac/yr	TP lbs/acre/yr	TSS lbs/acre/yr
Turf to Forest Land Use Change Reductions	5.58	1.46	577.00
Pollutant Reductions for 3.03 ac of Forest	16.91	4.42	1,748.31
Regulated MS4 Loading Rate: Pervious	10.07	0.41	175.80
Regulated MS4 Loading Rate: Impervious	16.86	1.62	1,171.32
Loading Rate: Pervious Upland Drainage (5.27 ac)	53.07	2.16	926.47
Loading Rate: Impervious Upland Drainage (0.79 ac)	13.32	1.28	925.34
Total Loading Rates (Reductions) for Upland Drainage	66.39	3.44	1,851.81
Forest Buffer Efficiencies	0.25	0.50	0.50
Total Reductions of Upland Drainage with Efficiencies	16.60	1.72	925.90
Total Project Allowable Reductions	33.50	6.14	2,674.21

APPENDIX C: NEWMAN LAKE POLLUTION REDUCTION CREDIT FEASIBILITY STUDY

To access and view the Newman Lake Dam Improvements Design referenced in the feasibility study, please reach out directly to stormwater@jmu.edu or call (540) 568-3174.

APPENDIX D: PHOSPHORUS CREDITS ACCOUNTING FOR CONSTRUCTION PROJECTS

Per the DEQ Guidance Memo 20-2003, oversized BMPs which reduce more nutrients than is needed for development may utilize the excess credits to offset pollutants of concern (POC) reductions required under a local TMDL. This accounting methodology was approved by the DEQ on 11/24/14 via email correspondence and as outlined in the DEQ Guidance Memo 20-2003.

Section of the VDEQ Guidance Memo 20-2003:

- *3.c. Oversized BMPs –*
 - *If an oversized BMP is installed and the excess capacity has not been utilized to offset additional development, permittees may use that capacity to meet the POC reductions required under the TMDL. If permittees choose to use the remaining BMP capacity to meet their TMDL requirements, that capacity cannot be used to meet other regulatory requirements for future development.*
- *Appendix V.E BMPs Installed to Meet Development and Redevelopment Requirements*
 - *For oversized BMPs permittees may receive credit for the difference between the BMP's reductions and the reductions required under VSMP regulations, TP serves as an indicator pollutant for TN and TSS and permittees must account for the associated reductions required for those POCs prior to taking credit for reductions that exceed the VSMP requirements.*

The table below details the calculations the University is using to account for credits from development and redevelopment projects to utilize for addressing TP reductions for the Blacks Run and Cooks Creek TMDL Action Plan. The University maintains a database recording of oversized BMP calculations for excess nutrients and where these are utilized. Nutrient credits from this excess credit bank are utilized on a case by case basis for TMDLs, development, and redevelopment compliance needs and approved by the Facilities Management: Engineering Department.

Phosphorus Credits from Construction Projects				
Date Functional	Project Name/Description	Required Removal for P	Total BMP Removal for P	Excess P Credits
7/24/2025	Village Housing - Potomac Hall (was Ikenberry) - (3 BRs)	1.09	1.84	0.75
12/23/2025	Carrier Library Renovation and Addition (UGD, MD/SF)	2.28	4.05	1.77
Total Excess P Credits (lbs/year)				2.52

APPENDIX E: JMU BMP RETROFIT STUDY FOR BLACKS RUN TMDL

This study was completed by Colman Engineering in June 2026. A second public comment period was posted once this study was completed and added to this action plan document. No public comments were received. Public comments will continue to be taken at any time.

JAMES MADISON UNIVERSITY BMP STUDY FOR BLACKS RUN TMDL ACTION PLAN

MAY 2026



PREPARED FOR:



James Madison University
181 Patterson St., MSC 7004
Harrisonburg, VA 22807
(540) 568-3174

PREPARED BY:



Colman Engineering
1123 South High St
Harrisonburg, VA 22801
(540) 246-3712

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EXECUTIVE SUMMARY

James Madison University (JMU) requested that Colman Engineering evaluate potential stormwater pollutant reduction opportunities on the JMU campus to support implementation of the Blacks Run & Cooks Creek TMDL Action Plan. This study focuses primarily on total phosphorus reduction because phosphorus is the remaining primary pollutant reduction need identified in the local TMDL Action Plan. Total nitrogen and total suspended solids reductions were also estimated where applicable to support broader stormwater planning and Chesapeake Bay TMDL reporting considerations.

The study identified a range of potential Best Management Practice (BMP) opportunities, including land use change projects, new structural BMPs, retrofits to existing stormwater facilities and conveyance features, constructed wetland concepts, and stream restoration projects. Each opportunity was evaluated at a planning level based on estimated pollutant reduction potential, construction cost, feasibility, campus life disruption, and anticipated reporting certainty. The purpose of the study is to help JMU compare potential implementation options and identify projects that may warrant further evaluation, design, and regulatory coordination.

The screening results indicate that land use change projects generally represent the strongest near-term implementation opportunities. These projects typically have lower construction costs, fewer design and permitting requirements, and more predictable crediting procedures than structural BMPs or stream restoration projects.

Structural BMPs and retrofits provide additional opportunities to treat runoff from developed campus areas, particularly where existing drainage patterns can be used or modified to route stormwater to treatment practices. These projects provide strategic water quality benefits but generally require more detailed design, utility coordination, construction planning, and long-term maintenance commitments and have higher construction costs. Where a retrofit modifies an existing stormwater facility or conveyance, final credit should be calculated as the incremental improvement above the documented existing condition.

Stream restoration projects show some of the highest individual pollutant reduction potential, especially for sediment and phosphorus. However, these projects have high construction costs, as well as greater uncertainty at the planning stage because final credits depend on field-measured streambank erosion, soil data, geomorphic assessment, restoration design, permitting, construction documentation, and post-construction verification.

To compare the alternatives, each opportunity was scored using a decision matrix that considered total phosphorus reduction, feasibility, cost effectiveness, and reporting certainty. The resulting scores, as shown in the following table, are intended to support planning-level prioritization.

BMP Analysis Summary by Category

#	BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption	Decision Matrix Score
1	Land Use Conversion 1: JMU DRIVER DRIVE FOREST	Turf to Forest	5.77	\$18,614.00	\$3,226.00	Limited	19
2	Land Use Conversion 2: JMU HILLSIDE FIELD SIBERT CREEK STREAM BUFFER	Turf to Forest	2.57	\$4,948.00	\$1,925.29	Substantial	17
3	Land Use Conversion 3: JMU OLD UNIVERSITY BOULEVARD	Turf to Forest	5.80	\$18,708.63	\$3,225.63	Limited	20
4	Land Use Conversion 4: JMU R2 PARKING LOT ISLANDS	Turf to Mixed Open	0.89	\$1,485.00	\$1,668.54	Substantial	15
5	Land Use Conversion 5: JMU D2 PARKING LOT ISLAND	Turf to Mixed Open	2.82	\$4,724.00	\$1,675.18	Limited	18
6	Land Use Conversion 6: JMU FIELD HOCKEY COMPLEX AREA	Turf to Mixed Open	7.19	\$12,052.00	\$1,676.22	Moderate	17
7	Land Use Conversion 7: JMU KING HALL	Turf to Mixed Open	1.69	\$2,835.00	\$1,677.51	Substantial	15
8	Land Use Conversion 8: JMU EAST CAMPUS PONDS	Turf to Mixed Open	1.58	\$2,642.00	\$1,672.15	Moderate	17
9	Land Use Conversion 9: JMU VETERANS MEMORIAL DRIVE – MEMORIAL HALL	Turf to Mixed Open	0.39	\$656.00	\$1,682.05	Substantial	12
10	Land Use Conversion 10: JMU C14 PARKING LOT – MEMORIAL HALL	Turf to Mixed Open	0.09	\$155.00	\$1,722.22	Limited	16
11	Land Use Conversion 11: JMU Y PARKING LOT – MEMORIAL HALL	Turf to Mixed Open	0.52	\$868.00	\$1,669.23	Moderate	17
12	Land Use Conversion 12: JMU R9 PARKING LOT – MEMORIAL HALL	Turf to Mixed Open	0.40	\$675.00	\$1,687.50	Moderate	17
13	Land Use Conversion 13: JMU U2 & U3 PARKING LOTS	Turf to Mixed Open	2.76	\$4,628.04	\$1,676.83	Limited	20
14	Land Use Conversion 14: JMU U4 PARKING LOT	Turf to Mixed Open	2.05	\$3,432.46	\$1,674.37	Limited	20
15	Land Use Conversion 15: JMU SALT STORAGE SHED	Turf to Mixed Open	0.15	\$250.69	\$1,671.24	Limited	15
16	Land Use Conversion 16: JMU SOUTH MAIN STREET MAINTENANCE	Turf to Mixed Open	1.31	\$2,198.32	\$1,678.11	Limited	18
17	New BMP 1: JMU R2 PARKING LOT	Bioretention	3.50	\$558,600.00	\$159,600.00	Moderate	13
18	New BMP 2: MUSIC BUILDING AND SPOTSWOOD HALL	Bioretention	0.33	\$45,570.00	\$138,090.91	Substantial	8
19	New BMP 3: SHELDON & ALUMNAE HALLS	Bioretention	0.35	\$50,890.00	\$145,400.00	Substantial	8
20	New BMP 4: SOUTH WILLOW STREET BASEBALL FIELD	Stream Restoration	7.43	\$250,000.00	\$33,647.38	Moderate	12
21	New BMP 5: JMU R12 PARKING LOT AND FACILITIES BUILDINGS	Stream Restoration	7.05	\$475,000.00	\$67,375.89	Moderate	12
22	New BMP 6: JMU TRANSPORTATION DEPARTMENT STORAGE YARD	Bioretention	3.94	\$560,000.00	\$142,131.98	Limited	15
23	Retrofit BMP 1: JMU R2 PARKING LOT CHANNEL	Grass Channel	0.71	\$24,200.00	\$34,084.51	Moderate	13
24	Retrofit BMP 2: LOCUST HILL ROAD & UNIVERSITY DRIVE CHANNEL	Dry Swale	1.67	\$72,000.00	\$43,113.77	Limited	14
25	Retrofit BMP 3: UREC TURF CHANNEL	Grass Channel	0.05	\$10,600.00	\$212,000.00	Limited	9
26	Retrofit BMP 4: JMU C4 PARKING LOT	Stream Restoration	11.14	\$750,000.00	\$67,324.96	Substantial	10
27	Retrofit BMP 5: JMU R8 PARKING LOT	Stream Restoration	2.97	\$200,000.00	\$67,340.07	Moderate	11
28	Retrofit BMP 6: MASSANUTTEN HALL	Bioretention	0.31	\$61,110.00	\$197,129.03	Moderate	14
29	Retrofit BMP 7: WAMPLER HALL	Grass Channels	0.85	\$6,680.00	\$7,858.82	Moderate	14
30	Retrofit BMP 8: ARBORETUM POND OUTFALL TO UNIVERSITY BLVD	Stream Restoration	1.68	\$170,000.00	\$101,190.48	Moderate	10
31	Retrofit BMP 9: SINCLAIR MEMORIAL GARDEN SPIRAL POND - NORTH	Bioretention	1.01	\$112,280.00	\$111,168.32	Limited	11
32	Retrofit BMP 10: SINCLAIR MEMORIAL GARDEN SPIRAL POND - EAST	Bioretention	0.81	\$178,080.00	\$219,851.85	Limited	13
33	Retrofit BMP 11: ARBORETUM WETLANDS	Constructed Wetlands	1.70	\$134,525.00	\$79,132.35	Limited	11
34	Retrofit BMP 12: JMU ALTERNATE FUEL BUILDING	Bioretention	0.23	\$49,350.00	\$214,565.22	Limited	10

BMP Analysis Summary by Prioritization (Decision Matrix Score)

#	BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption	Decision Matrix Score
14	Land Use Conversion 14: JMU U4 PARKING LOT	Turf to Mixed Open	2.05	\$3,432.46	\$1,674.37	Limited	20
13	Land Use Conversion 13: JMU U2 & U3 PARKING LOTS	Turf to Mixed Open	2.76	\$4,628.04	\$1,676.83	Limited	20
3	Land Use Conversion 3: JMU OLD UNIVERSITY BOULEVARD	Turf to Forest	5.80	\$18,708.63	\$3,225.63	Limited	20
1	Land Use Conversion 1: JMU DRIVER DRIVE FOREST	Turf to Forest	5.77	\$18,614.00	\$3,226.00	Limited	19
16	Land Use Conversion 16: JMU SOUTH MAIN STREET MAINTENANCE	Turf to Mixed Open	1.31	\$2,198.32	\$1,678.11	Limited	18
5	Land Use Conversion 5: JMU D2 PARKING LOT ISLAND	Turf to Mixed Open	2.82	\$4,724.00	\$1,675.18	Limited	18
12	Land Use Conversion 12: JMU R9 PARKING LOT – MEMORIAL HALL	Turf to Mixed Open	0.40	\$675.00	\$1,687.50	Moderate	17
11	Land Use Conversion 11: JMU Y PARKING LOT – MEMORIAL HALL	Turf to Mixed Open	0.52	\$868.00	\$1,669.23	Moderate	17
8	Land Use Conversion 8: JMU EAST CAMPUS PONDS	Turf to Mixed Open	1.58	\$2,642.00	\$1,672.15	Moderate	17
6	Land Use Conversion 6: JMU FIELD HOCKEY COMPLEX AREA	Turf to Mixed Open	7.19	\$12,052.00	\$1,676.22	Moderate	17
2	Land Use Conversion 2: JMU HILLSIDE FIELD SIBERT CREEK STREAM BUFFER	Turf to Forest	2.57	\$4,948.00	\$1,925.29	Substantial	17
10	Land Use Conversion 10: JMU C14 PARKING LOT – MEMORIAL HALL	Turf to Mixed Open	0.09	\$155.00	\$1,722.22	Limited	16
22	New BMP 6: JMU TRANSPORTATION DEPARTMENT STORAGE YARD	Bioretention	3.94	\$560,000.00	\$142,131.98	Limited	15
15	Land Use Conversion 15: JMU SALT STORAGE SHED	Turf to Mixed Open	0.15	\$250.69	\$1,671.24	Limited	15
7	Land Use Conversion 7: JMU KING HALL	Turf to Mixed Open	1.69	\$2,835.00	\$1,677.51	Substantial	15
4	Land Use Conversion 4: JMU R2 PARKING LOT ISLANDS	Turf to Mixed Open	0.89	\$1,485.00	\$1,668.54	Substantial	15
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28	Retrofit BMP 6: MASSANUTTEN HALL	Bioretention	0.31	\$61,110.00	\$197,129.03	Moderate	14
24	Retrofit BMP 2: LOCUST HILL ROAD & UNIVERSITY DRIVE CHANNEL	Dry Swale	1.67	\$72,000.00	\$43,113.77	Limited	14
32	Retrofit BMP 10: SINCLAIR MEMORIAL GARDEN SPIRAL POND - EAST	Bioretention	0.81	\$178,080.00	\$219,851.85	Limited	13
23	Retrofit BMP 1: JMU R2 PARKING LOT CHANNEL	Grass Channel	0.71	\$24,200.00	\$34,084.51	Moderate	13
17	New BMP 1: JMU R2 PARKING LOT	Bioretention	3.50	\$558,600.00	\$159,600.00	Moderate	13
21	New BMP 5: JMU R12 PARKING LOT AND FACILITIES BUILDINGS	Stream Restoration	7.05	\$475,000.00	\$67,375.89	Moderate	12
20	New BMP 4: SOUTH WILLOW STREET BASEBALL FIELD	Stream Restoration	7.43	\$250,000.00	\$33,647.38	Moderate	12
9	Land Use Conversion 9: JMU VETERANS MEMORIAL DRIVE – MEMORIAL HALL	Turf to Mixed Open	0.39	\$656.00	\$1,682.05	Substantial	12
33	Retrofit BMP 11: ARBORETUM WETLANDS	Constructed Wetlands	1.70	\$134,525.00	\$79,132.35	Limited	11
31	Retrofit BMP 9: SINCLAIR MEMORIAL GARDEN SPIRAL POND - NORTH	Bioretention	1.01	\$112,280.00	\$111,168.32	Limited	11
27	Retrofit BMP 5: JMU R8 PARKING LOT	Stream Restoration	2.97	\$200,000.00	\$67,340.07	Moderate	11
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30	Retrofit BMP 8: ARBORETUM POND OUTFALL TO UNIVERSITY BLVD	Stream Restoration	1.68	\$170,000.00	\$101,190.48	Moderate	10
26	Retrofit BMP 4: JMU C4 PARKING LOT	Stream Restoration	11.14	\$750,000.00	\$67,324.96	Substantial	10
25	Retrofit BMP 3: UREC TURF CHANNEL	Grass Channel	0.05	\$10,600.00	\$212,000.00	Limited	9
19	New BMP 3: SHELTON & ALUMNAE HALLS	Bioretention	0.35	\$50,890.00	\$145,400.00	Substantial	8
18	New BMP 2: MUSIC BUILDING AND SPOTSWOOD HALL	Bioretention	0.33	\$45,570.00	\$138,090.91	Substantial	8

OPPORTUNITIES FOR LAND USE CONVERSIONS: TURF TO FOREST

Turf-to-forest conversion can provide relatively cost-effective pollutant reduction credit by replacing maintained lawn with more stable, lower-loading vegetated cover. These projects may also reduce long-term mowing needs, improve habitat, increase canopy cover, and provide visual or educational benefits where appropriate. However, forest conversion is not suitable for every turf area; potential drawbacks include changes to campus appearance, loss of open lawn space, establishment and maintenance needs, and the time required for planted areas to meet applicable forest density and crediting requirements.

LAND USE CONVERSION 1: JMU DRIVER DRIVE FOREST

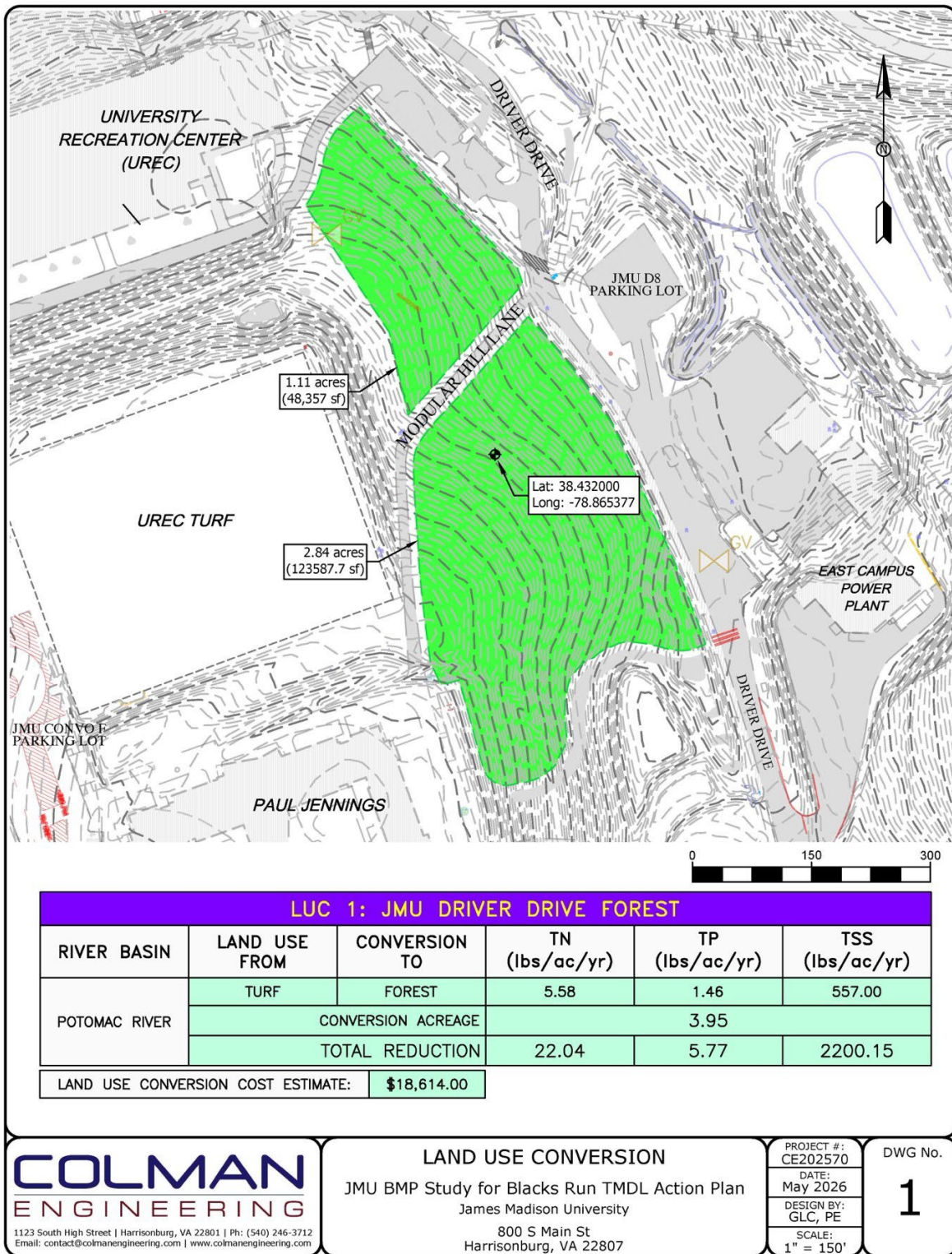


Figure 1: View facing west toward Modular Hill Lane

The 3.95-acre area between the UREC Turf Complex and Driver Drive could be converted from managed turf to forest land use. The area is moderately sloped and currently contains scattered tree cover, which may support conversion with limited site disturbance. Because the area does not appear to function as a primary gathering or programmed campus space, implementation is expected to have minimal impacts on routine campus activities.

Potential implementation considerations include temporary closure or rerouting of pedestrian access along Modular Hill Lane, the paved path that runs through the site, and limited traffic control along Driver Drive, depending on the final planting layout and construction access needs. Based on planning-level calculations, the estimated annual pollutant reduction potential for this conversion is approximately 22.04 pounds of total nitrogen and 5.77 pounds of total phosphorus. Given the anticipated level of disturbance, available planting area, and estimated pollutant reduction credit, this site appears to be a practical and cost-effective land use conversion opportunity for the University.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 1: JMU DRIVER DRIVE FOREST	Turf to Forest	5.77	\$18,614.00	\$3,226.00	Limited



LAND USE CONVERSION 2: JMU HILLSIDE FIELD SIBERT CREEK STREAM BUFFER



Figure 2: View facing northeast toward Hillside Hall

This opportunity differs from the other land use conversion sites because the proposed forest area is located along Sibert Creek and may function both as a land use conversion and as a forest buffer treatment practice. The proposed 1.05-acre buffer footprint was evaluated for turf-to-forest land use conversion credit. In addition, adjacent upland drainage areas that are assumed to discharge as sheet flow through the proposed buffer were evaluated for potential forest buffer pollutant removal credit.

Because this site is more centrally located on campus than the Driver Drive forest conversion area, implementation may have a greater temporary impact on campus circulation and nearby activities. Work in this area may need to be scheduled during periods when fewer students are on campus to reduce conflicts with pedestrian traffic, recreational use, and other routine campus operations.

Additional coordination may be needed to maintain safe access around the project area, protect the stream corridor during installation, and establish the proposed forest buffer without affecting adjacent campus uses.

Based on planning-level calculations, the estimated annual pollutant reduction potential for this conversion is approximately 12.84 pounds of total nitrogen, 2.57 pounds of total phosphorus, and 1,267.20 pounds of total suspended solids.

Overall, this site appears to offer a practical pollutant reduction opportunity with meaningful sediment and nutrient reduction potential. However, because of its central campus location, implementation would likely require more coordination than less-trafficked land use conversion areas.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 2: JMU HILLSIDE FIELD SIBERT CREEK STREAM BUFFER	Turf to Forest	2.57*	\$4,948.00	\$1,925.29	Substantial

* This estimate includes both turf-to-forest land-use conversion credit for the buffer footprint and forest buffer efficiency credit for eligible upland acres that drain to the buffer as sheet flow.



LUC 2: JMU HILLSIDE FIELD SIBERT CREEK STREAM BUFFER

RIVER BASIN	LAND USE FROM	CONVERSION TO	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
POTOMAC RIVER	TURF	FOREST	5.58	1.46	557.00
	CONVERSION ACREAGE			1.05	
	CONVERSION REDUCTION		5.86	1.53	584.85
	REGULATED UPLAND AREA SHEET FLOW			2.10	
	UPLAND AREAS IMPERVIOUS			1.00	
	UPLAND AREAS PERVIOUS			1.10	
	URBAN IMPERVIOUS LOADING		16.86	1.62	1,171.32
	URBAN PERVIOUS LOADING		10.07	0.41	175.80
	FOREST BUFFER REDUCTION RATES		25%	50%	50%
	TOTAL REDUCTION		12.84	2.57	1267.20

LAND USE CONVERSION COST ESTIMATE: **\$4,948.00**

COLMAN
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LAND USE CONVERSION

JMU BMP Study for Blacks Run TMDL Action Plan
James Madison University
800 S Main St
Harrisonburg, VA 22807

PROJECT #:
CE202570

DATE:
May 2026

DESIGN BY:
GLC, PE

SCALE:
1" = 150'

DWG No.

2

1-Land Use Conversion.dwg Plotted: 5/7/2026 By: CE-9

LAND USE CONVERSION 3: OLD UNIVERSITY BOULEVARD



Figure 3: View facing south along the previous University Blvd alignment

The portions of lawn along University Boulevard, north and west of the President’s future residence, could be converted from managed turf to forest land use. The 3.97-acre site currently consists primarily of managed turf and includes the former University Boulevard alignment.

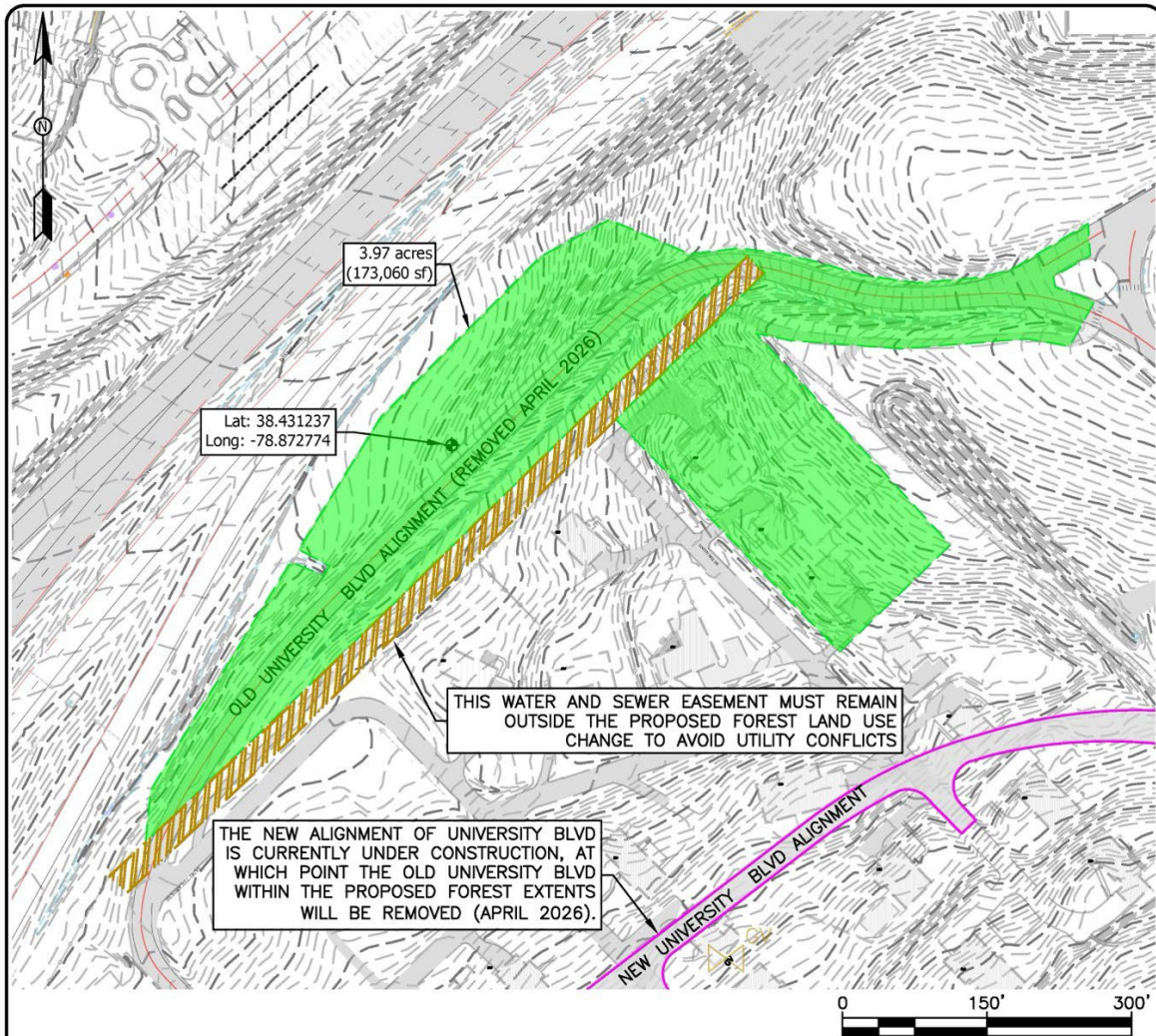
Because this area is relatively removed from primary campus facilities and high-traffic pedestrian areas, implementation is expected to have minimal impact on routine campus activities. The project could likely be installed while students are on campus, provided that construction access, staging, and any temporary path or roadway restrictions are properly coordinated.

The conversion may also provide a vegetated buffer or visual separation around the future residence, depending on the final planting design.

Based on planning-level calculations, the estimated annual pollutant reduction potential for this conversion is approximately 22.15 pounds of total nitrogen, 5.80 pounds of total phosphorus, and 2,211.29 pounds of total suspended solids.

Overall, this site appears to be a practical land use conversion opportunity with meaningful pollutant reduction potential and limited anticipated disruption to campus operations.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 3: JMU OLD UNIVERSITY BOULEVARD	Turf to Forest	5.80	\$18,708.63	\$3,225.63	Limited



LUC 3: OLD UNIVERSITY BOULEVARD					
RIVER BASIN	LAND USE FROM	CONVERSION TO	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
POTOMAC RIVER	TURF	FOREST	5.58	1.46	557.00
	CONVERSION ACREAGE		3.97		
	TOTAL REDUCTION		22.15	5.80	2211.29

LAND USE CONVERSION COST ESTIMATE: **\$18,708.63**

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LAND USE CONVERSION

JMU BMP Study for Blacks Run TMDL Action Plan
James Madison University
800 S Main St
Harrisonburg, VA 22807

PROJECT #:
CE202570

DATE:
May 2026

DESIGN BY:
GLC, PE

SCALE:
1" = 150'

DWG No.

3

1-Land Use Conversion.dwg Plotted: 5/7/2026 By: CE-9

OPPORTUNITIES FOR LAND USE CONVERSIONS: TURF TO MIXED OPEN

Turf-to-mixed-open conversion can provide pollutant reduction credit by replacing maintained lawn with minimally managed herbaceous vegetation, such as meadow cover. These projects are often less intensive than forest conversion, may preserve open views, reduce mowing needs, and provide habitat or aesthetic benefits when designed intentionally. However, mixed open areas may be perceived as less manicured than traditional turf, require careful establishment and weed control, and must remain minimally disturbed and unmanaged to maintain credit eligibility.

LAND USE CONVERSION 4: JMU R2 PARKING LOT ISLANDS



Figure 4: View facing northeast from the southwestern portion of the parking lot

The parking lot islands within Lot R2 could be candidates for mixed open use. However, since the proposed conversion area consists of primarily mulched areas—and not managed turf—it likely will not qualify for the turf-to-mixed-open land use conversion credit.

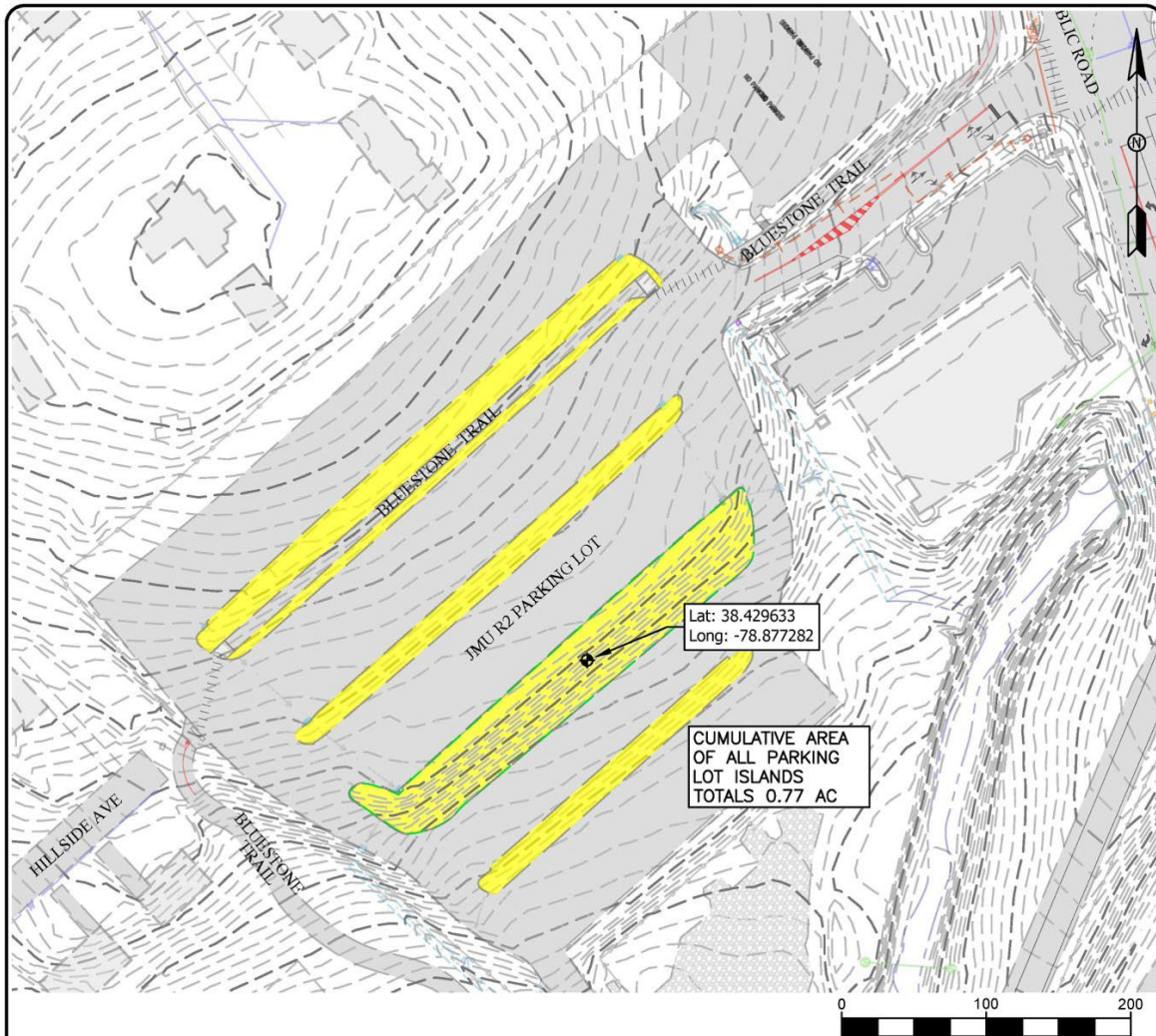
The proposed conversion area includes approximately 0.77 acres across four narrow parking lot islands that are currently mulched and contain limited tree cover. Because the work would occur within existing parking lot islands, implementation is expected to have substantial impact on campus activities. Impacts may include short-term closure of adjacent parking spaces, pedestrian routing adjustments, and coordination for installation access within the parking lot.

Additional considerations include selecting a meadow seed mix appropriate for narrow, high-visibility parking lot areas; maintaining adequate sight distance for vehicles and pedestrians; and establishing a maintenance approach consistent with mixed open crediting requirements.

Based on planning-level calculations, the estimated annual pollutant reduction potential for this conversion is approximately 4.07 pounds of total nitrogen and 0.89 pounds of total phosphorus.

Overall, this site appears to offer a modest pollutant reduction opportunity with relatively low implementation complexity. The project may also improve the visual character of Lot R2 by replacing mulched islands with meadow vegetation and increasing vegetated cover within the parking area.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 4: JMU R2 PARKING LOT ISLANDS	Turf to Mixed Open	0.89	\$1,485.00	\$1,668.54	Substantial



LUC 4: JMU R2 PARKING LOT ISLANDS

RIVER BASIN	LAND USE FROM	CONVERSION TO	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
POTOMAC RIVER	TURF	MIXED OPEN	5.28	1.15	0.00
	CONVERSION ACREAGE			0.77	
	TOTAL REDUCTION		4.07	0.89	0.00

LAND USE CONVERSION COST ESTIMATE: **\$1,485.00**

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SCALE:
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DWG No.

4

1-Land Use Conversion.dwg Plotted: 5/7/2026 By: CE-9

LAND USE CONVERSION 5: JMU D2 PARKING LOT ISLAND



Figure 5: View facing east along the D2 parking lot and I-81

The land north of the D2 parking lot could be converted from managed turf to mixed open land use. The proposed conversion area includes approximately 2.45 acres, including a portion of the landscaped area surrounding the “James Madison University” sign facing Interstate 81.

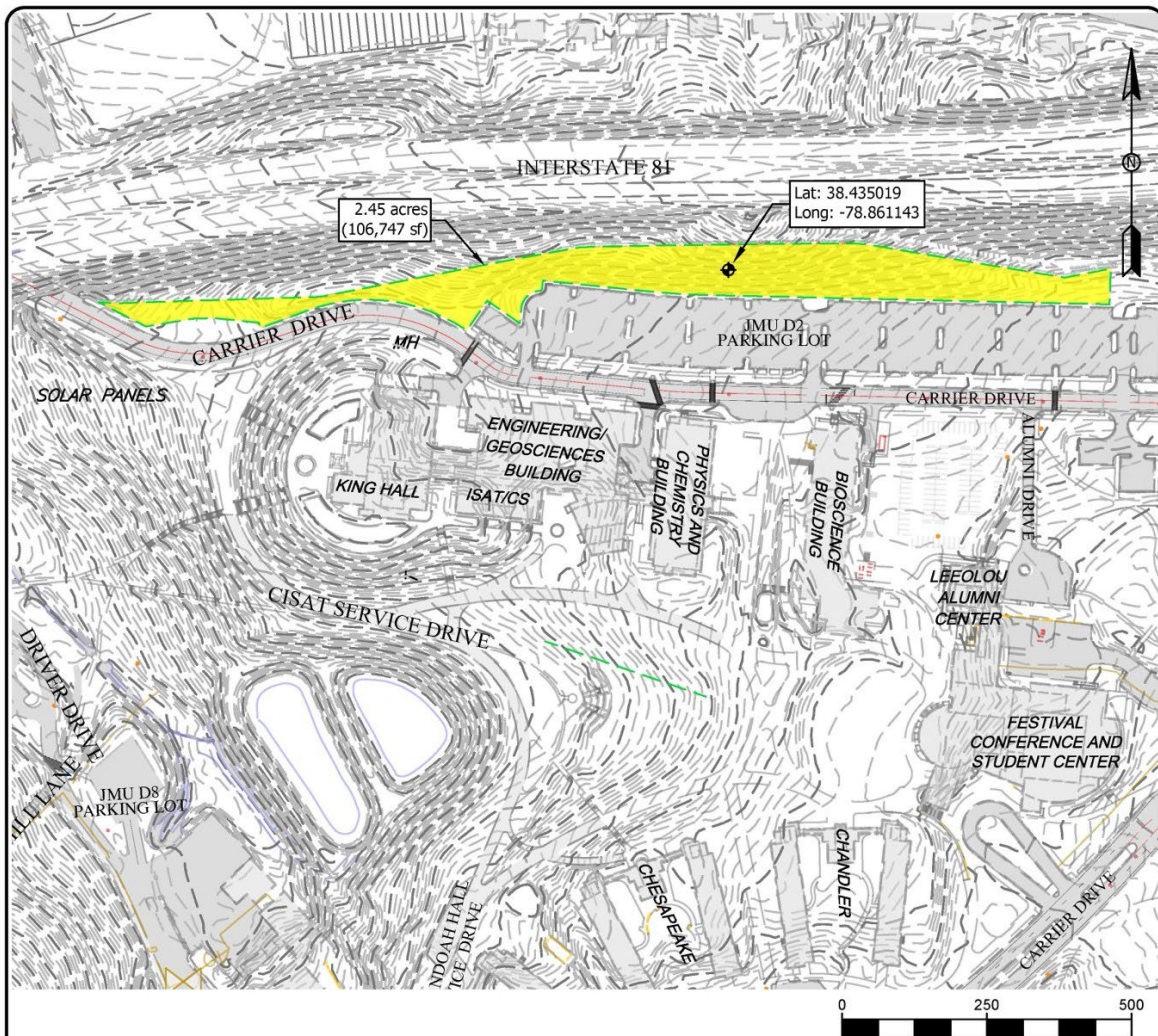
Because this area is located along the campus perimeter and away from primary pedestrian gathering areas, implementation is expected to have minimal impact on routine campus activities. Temporary impacts would likely be limited to installation access, short-term staging, and coordination with existing landscape maintenance activities.

Additional consideration should be given to the visual character of the area surrounding the University sign. The sign is currently framed by cleanly mowed turf, and conversion to meadow vegetation may be perceived by some as less formal or less maintained. To address this concern, the final design could maintain a mowed turf edge or formal landscape buffer immediately around the sign while converting the surrounding area to mixed open vegetation. A defined edge, intentional planting layout, and appropriate meadow seed mix would help distinguish the area from unmanaged or neglected vegetation.

Based on planning-level calculations, the estimated annual pollutant reduction potential for this conversion is approximately 12.94 pounds of total nitrogen and 2.82 pounds of total phosphorus.

Overall, this site offers a practical conversion opportunity with moderate nutrient reduction potential, limited campus disruption, and potential maintenance savings, provided the final design balances pollutant reduction goals with campus appearance.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 5: JMU D2 PARKING LOT ISLAND	Turf to Mixed Open	2.82	\$4,724.00	\$1,675.18	Limited



LUC 5: JMU D2 PARKING LOT ISLAND

RIVER BASIN	LAND USE FROM	CONVERSION TO	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
POTOMAC RIVER	TURF	MIXED OPEN	5.28	1.15	0.00
	CONVERSION ACREAGE			2.45	
	TOTAL REDUCTION		12.94	2.82	0.00

LAND USE CONVERSION COST ESTIMATE: **\$4,724.00**

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Harrisonburg, VA 22807

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DESIGN BY:

GLC, PE

SCALE:

1" = 250'

5

1-Land Use Conversion.dwg Plotted: 5/7/2026 By: CE-9

LAND USE CONVERSION 6: JMU FIELD HOCKEY COMPLEX AREA



Figure 6: View facing east along the C10 parking lot, beside the Small Wind Training Facility

The lawn surrounding the Field Hockey Complex could be converted from managed turf to mixed open land use. The proposed 6.25-acre conversion area includes lawn between the C10 parking lot, the field hockey facility, and the stormwater pond north of the field.

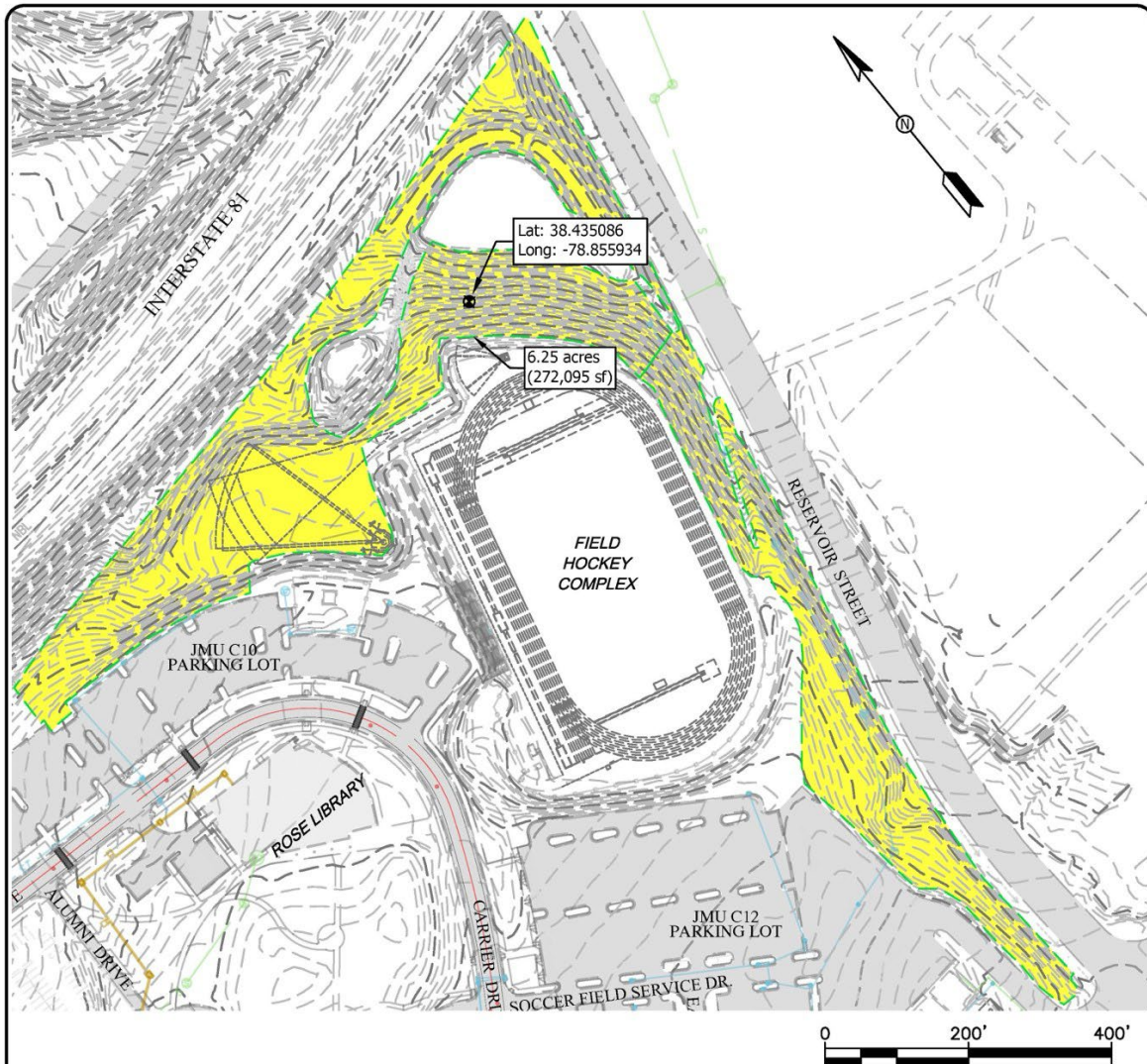
Because this area is adjacent to an active athletic facility, implementation would need to be coordinated around scheduled use of the Field Hockey Complex. The project could likely occur during the academic year, but construction access, staging, and installation activities should be scheduled to minimize conflicts with athletic events, practices, pedestrian circulation, and parking lot use.

Additional considerations include maintaining safe access to the athletic facilities, selecting a meadow seed mix suitable for a visible campus athletics area, and establishing a maintenance approach consistent with mixed open crediting requirements. The conversion may also reduce long-term mowing and maintenance needs for the University.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 33.00 pounds of total nitrogen and 7.19 pounds of total phosphorus.

Overall, this site offers a strong nutrient reduction opportunity due to its large conversion area. While implementation would require coordination with athletic facility operations, the project appears practical and may provide both pollutant reduction and maintenance benefits.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 6: JMU FIELD HOCKEY COMPLEX AREA	Turf to Mixed Open	7.19	\$12,052.00	\$1,676.22	Moderate



LUC 6: JMU FIELD HOCKEY COMPLEX AREA

RIVER BASIN	LAND USE FROM	CONVERSION TO	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
POTOMAC RIVER	TURF	MIXED OPEN	5.28	1.15	0.00
	CONVERSION ACREAGE		6.25		
	TOTAL REDUCTION		33.00	7.19	0.00

LAND USE CONVERSION COST ESTIMATE: \$12,052.00

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SCALE:
1" = 200'

DWG No.

6

1-Land Use Conversion.dwg Plotted: 5/7/2026 By: CE-9

LAND USE CONVERSION 7: JMU KING HALL



Figure 7: View facing southeast toward King Hall

The lawn wrapping around the west side of King Hall could be converted from managed turf to mixed open land use. The proposed 1.47-acre conversion area includes several steep grass slopes where reduced mowing may provide maintenance and safety benefits for maintenance staff.

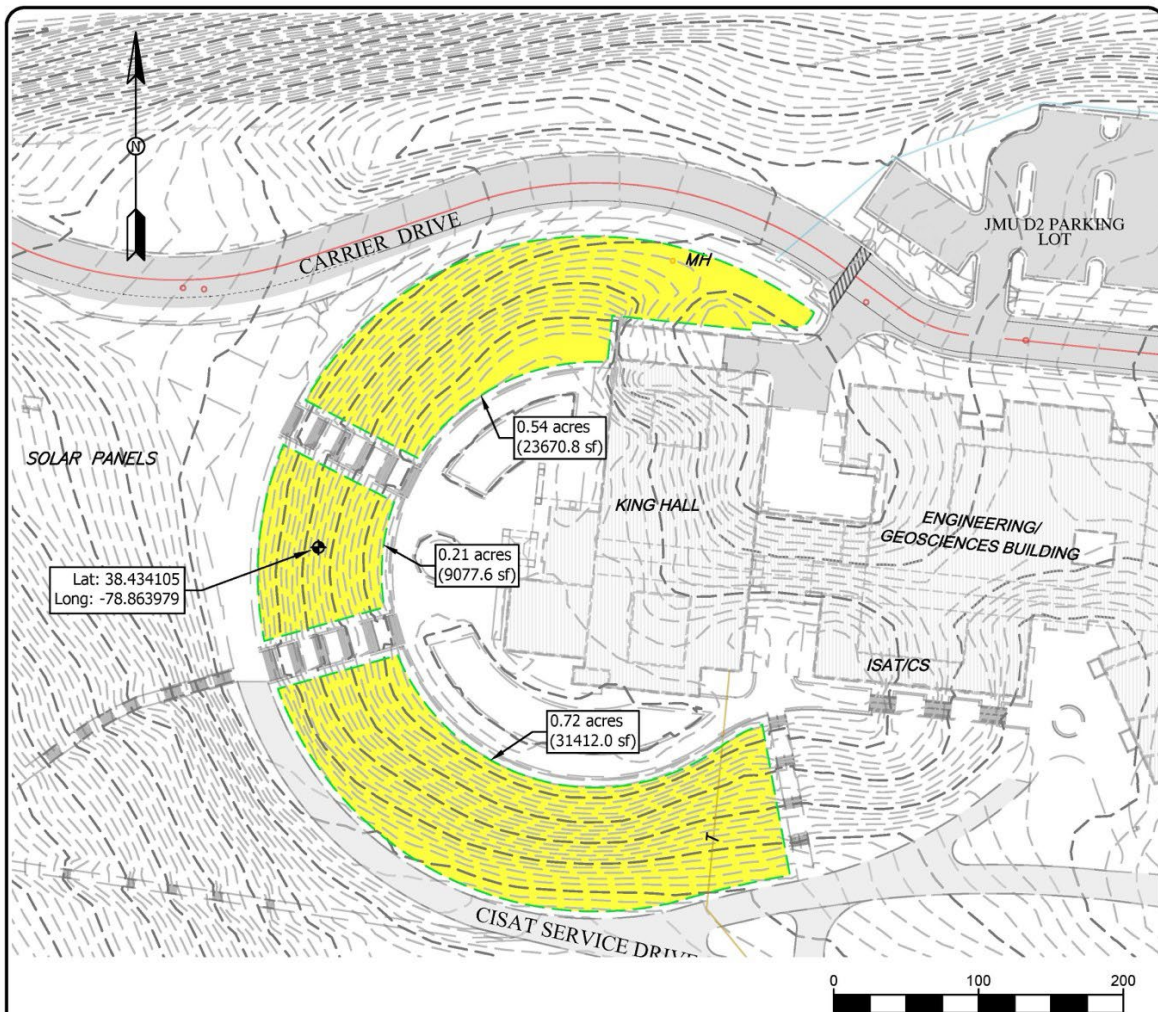
Because King Hall is an iconic and highly visible campus building, the visual character of the conversion area is an important consideration. The surrounding lawn is currently maintained as clean, formal turf, and meadow vegetation may be perceived as less manicured if not intentionally designed. A defined mowed edge, formal landscape buffer, selective planting layout, and educational signage could help the area read as a purposeful landscape.

Implementation would also require careful coordination because this is a frequently used area of campus. Construction access, temporary pedestrian routing, and installation activities should be scheduled to minimize conflicts with students, faculty, staff, and visitors.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 7.76 pounds of total nitrogen and 1.69 pounds of total phosphorus.

Overall, this site offers a modest nutrient reduction opportunity with potential maintenance and educational benefits. However, its high visibility, iconic setting, and pedestrian activity would require careful design and more coordination than less-trafficked conversion areas.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 7: JMU KING HALL	Turf to Mixed Open	1.69	\$2,835.00	\$1,677.51	Substantial



LUC 7: JMU KING HALL					
RIVER BASIN	LAND USE FROM	CONVERSION TO	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
POTOMAC RIVER	TURF	MIXED OPEN	5.28	1.15	0.00
	CONVERSION ACREAGE		1.47		
	TOTAL REDUCTION		7.76	1.69	0.00

LAND USE CONVERSION COST ESTIMATE: \$2,835.00

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SCALE:
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DWG No.

7

1-Land Use Conversion.dwg Plotted: 5/7/2026 By: CE-9

LAND USE CONVERSION 8: JMU EAST CAMPUS PONDS



Figure 8: View facing northwest

The lawn surrounding the East Campus Ponds could be converted from managed turf to mixed open land use. The proposed 1.37-acre conversion area includes moderately sloped lawn along the north, east, and south sides of the two stormwater ponds.

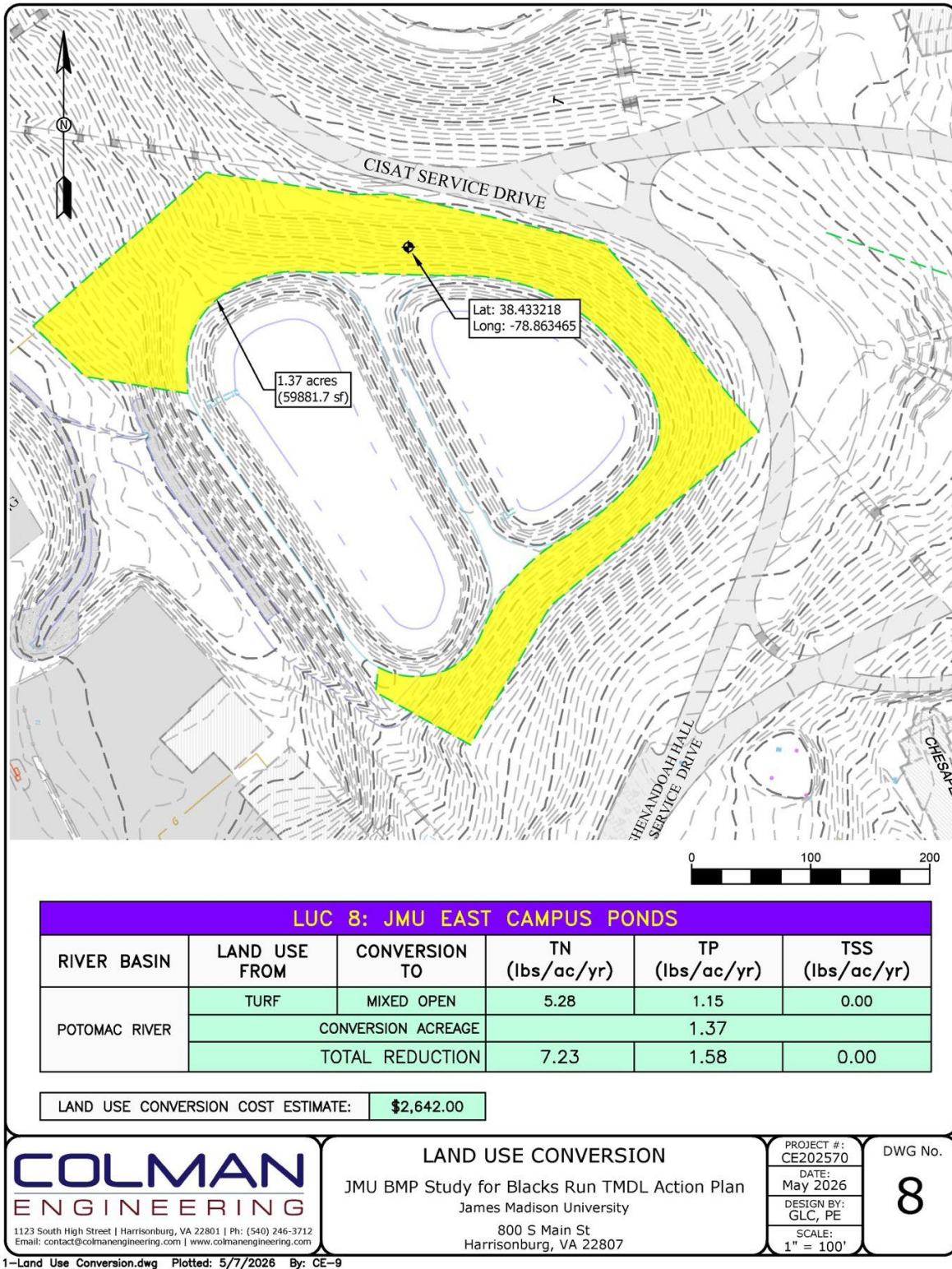
Because the site is located away from major campus streets and primary pedestrian routes, implementation is expected to have limited-to-moderate impact on students, faculty, staff, and visitors. Temporary impacts would likely be limited to installation access, staging, and coordination with existing pond maintenance activities.

Additional considerations include selecting a meadow seed mix appropriate for pond slopes, maintaining access for stormwater facility inspection and maintenance, and incorporating educational signage. Once established, this area could serve as a visible demonstration site for the University's stormwater management and pollutant reduction efforts.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 7.23 pounds of total nitrogen and 1.58 pounds of total phosphorus.

Overall, this site offers a modest nutrient reduction opportunity with moderate anticipated campus disruption and strong potential value as an educational stormwater feature.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 8: JMU EAST CAMPUS PONDS	Turf to Mixed Open	1.58	\$2,642.00	\$1,672.15	Moderate



LAND USE CONVERSION 9: JMU VETERANS MEMORIAL DRIVE – MEMORIAL HALL



Figure 9: View facing northwest, behind the fence

The lawn on the east side of Veterans Memorial Drive, opposite the Memorial Hall Arts Complex, could be converted from managed turf to mixed open land use. The proposed 0.34-acre conversion area is located behind the fence at Veterans Memorial Park near Eagle Field.

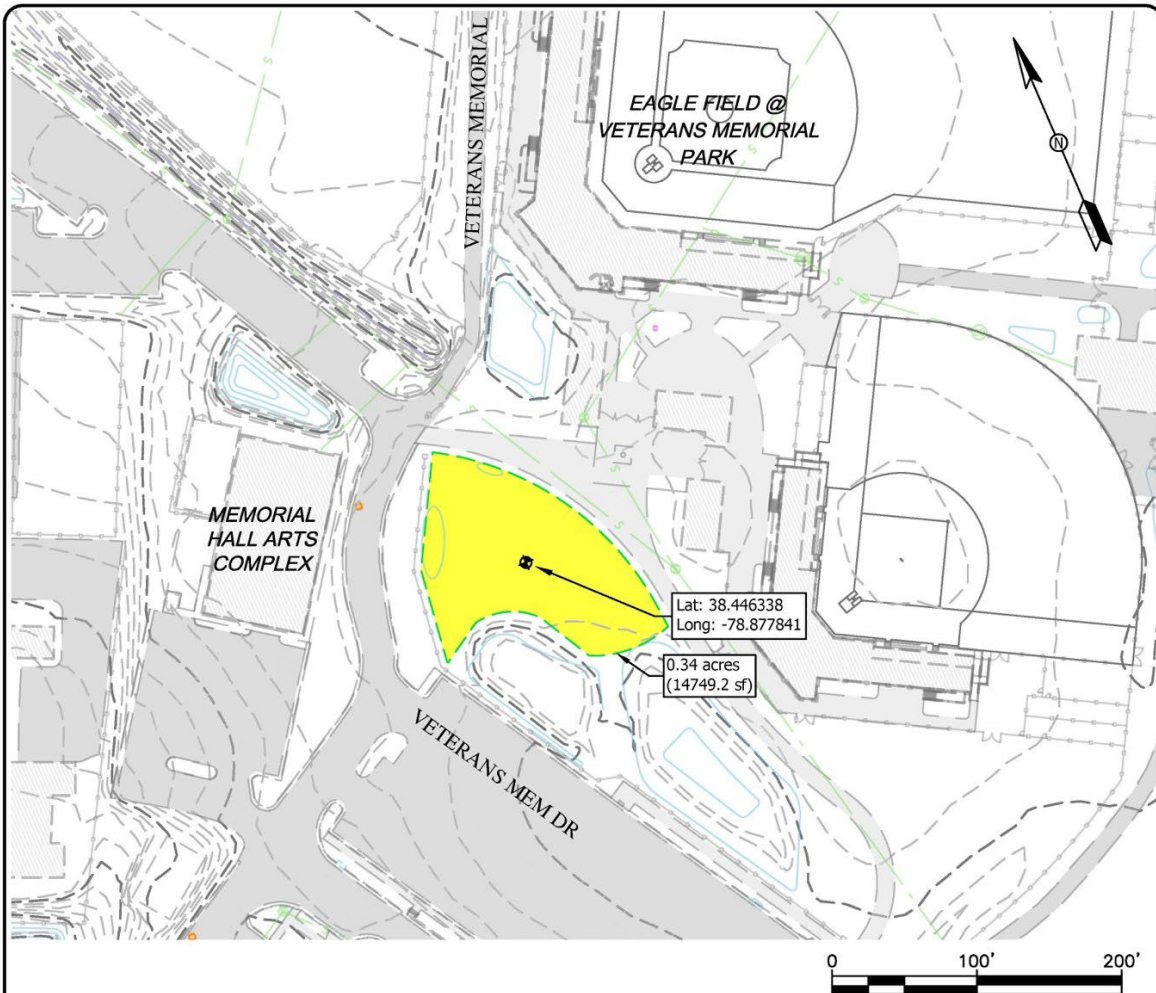
Because the site is associated with an active athletic and training facility, implementation would need to be coordinated around scheduled games, practices, and other uses of Eagle Field. Temporary impacts could be substantial in regard to athletic operations and visitor circulation.

Additional considerations include maintaining access for groundskeeping and athletic facility maintenance, selecting a meadow seed mix appropriate for a visible park setting, and ensuring the converted area does not interfere with fence lines, field operations, or spectator areas. The conversion may also reduce long-term mowing and maintenance needs within the Veterans Memorial Park Complex.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 1.80 pounds of total nitrogen and 0.39 pounds of total phosphorus.

Overall, this site offers a small nutrient reduction opportunity with potential maintenance benefits. While the pollutant reduction value is limited due to the small conversion area, the project appears relatively simple if coordinated around Eagle Field activities.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 9: JMU VETERANS MEMORIAL DRIVE – MEMORIAL HALL	Turf to Mixed Open	0.39	\$656.00	\$1,682.05	Substantial



LUC 9: JMU VETERANS MEMORIAL DR – MEMORIAL HALL

RIVER BASIN	LAND USE FROM	CONVERSION TO	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
POTOMAC RIVER	TURF	MIXED OPEN	5.28	1.15	0.00
	CONVERSION ACREAGE			0.34	
	TOTAL REDUCTION		1.80	0.39	0.00

LAND USE CONVERSION COST ESTIMATE: **\$656.00**

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GLC, PE

SCALE:

1" = 100'

9

1-Land Use Conversion.dwg Plotted: 5/7/2026 By: CE-9

LAND USE CONVERSION 10: JMU C14 PARKING LOT – MEMORIAL HALL



Figure 10: View facing south along South Willow Street

The lawn on the north side of the C14 parking lot entrance from South Willow Street could be converted from managed turf to mixed open land use. The proposed 0.08-acre conversion area is located at the corner of the parking lot near the South Willow Street entrance.

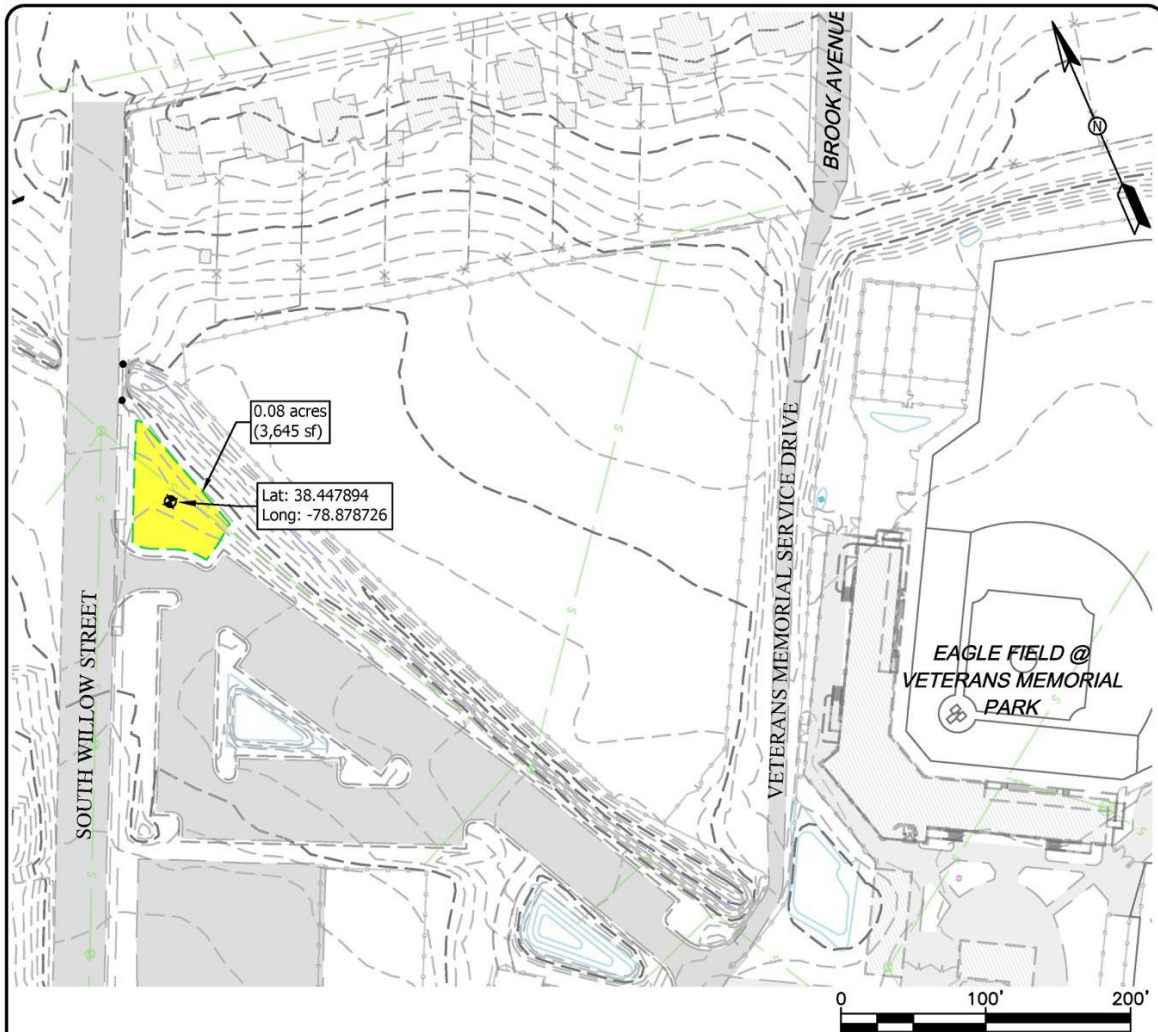
Because of its small size and location at the edge of the parking lot, implementation is expected to have minimal impact on students, faculty, staff, and visitors. Temporary impacts would likely be limited to installation access and minor traffic control along South Willow Street or at the parking lot entrance.

Additional considerations include maintaining adequate sight distance for vehicles and pedestrians, selecting a meadow seed mix suitable for a small roadside area, and coordinating work to avoid conflicts with parking lot access.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 0.36 pounds of total nitrogen and 0.09 pounds of total phosphorus.

Overall, this site offers a small nutrient reduction opportunity with low implementation complexity. While the pollutant reduction value is limited, the conversion appears straightforward and could likely be completed during the academic year with minimal disruption.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 10: JMU C14 PARKING LOT – MEMORIAL HALL	Turf to Mixed Open	0.09	\$155.00	\$1,722.22	Limited



LUC 10: JMU C14 PARKING LOT – MEMORIAL HALL					
RIVER BASIN	LAND USE FROM	CONVERSION TO	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
POTOMAC RIVER	TURF	MIXED OPEN	5.28	1.15	0.00
	CONVERSION ACREAGE			0.08	
	TOTAL REDUCTION		0.42	0.09	0.00

LAND USE CONVERSION COST ESTIMATE: \$155.00

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1" = 100'

DWG No.

10

1-Land Use Conversion.dwg Plotted: 5/7/2026 By: CE-9

LAND USE CONVERSION 11: JMU Y PARKING LOT – MEMORIAL HALL

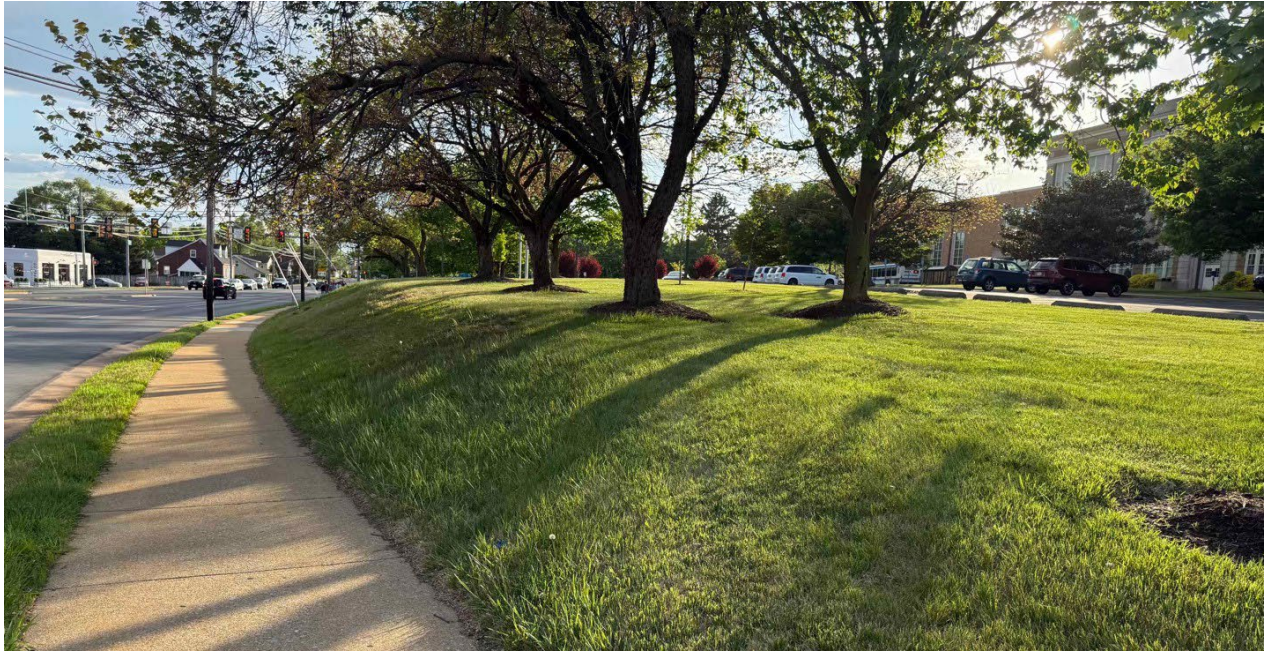


Figure 11: View facing southwest along South High Street

The lawn between the Y parking lot and South High Street could be converted from managed turf to mixed open land use. The proposed 0.45-acre conversion area is a narrow strip of lawn with limited tree cover, bordered by the parking lot and adjacent streets.

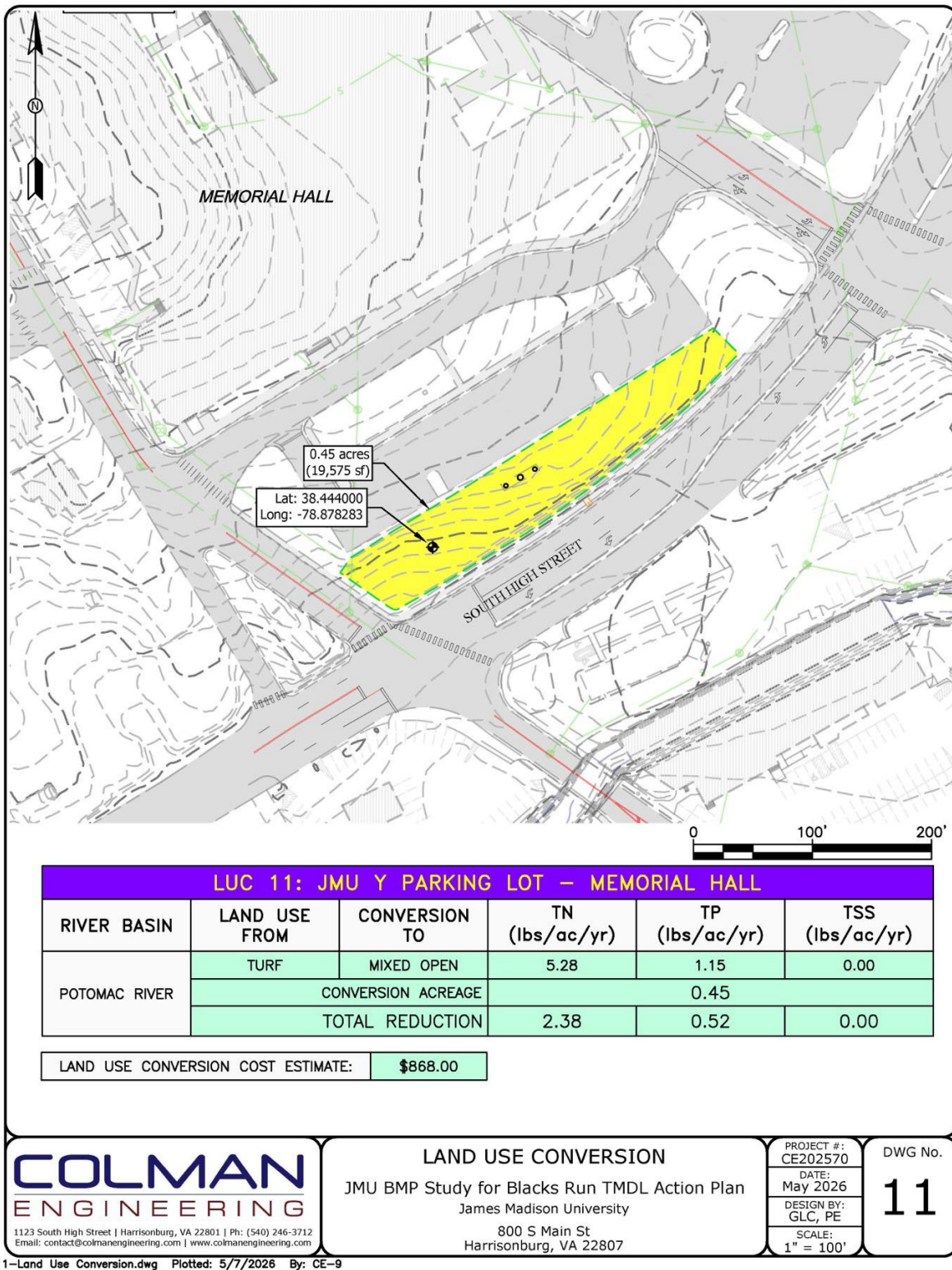
Because the site is surrounded by parking and roadway infrastructure, implementation is expected to result in moderate campus disruption. Temporary impacts may include short-term parking restrictions and pedestrian routing adjustments.

Additional considerations include maintaining sight distance for vehicles and pedestrians, coordinating with affected parking lot users, selecting a meadow seed mix suitable for a narrow roadside area, and ensuring the converted area does not interfere with existing trees, utilities, or access needs.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 2.38 pounds of total nitrogen and 0.52 pounds of total phosphorus.

Overall, this site offers a small nutrient reduction opportunity with moderate coordination needs. While the pollutant reduction value is limited, the conversion may be feasible if installation is carefully coordinated with parking, pedestrian access, and nearby traffic conditions.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 11: JMU Y PARKING LOT – MEMORIAL HALL	Turf to Mixed Open	0.52	\$868.00	\$1,669.23	Moderate



LAND USE CONVERSION 12: JMU R9 PARKING LOT – MEMORIAL HALL



Figure 12: View facing north toward South Willow Street

The lawn adjacent to the southeast side of the R9 parking lot could be converted from managed turf to mixed open land use. The proposed 0.35-acre conversion area is a steep, mowed lawn associated with the Memorial Hall area.

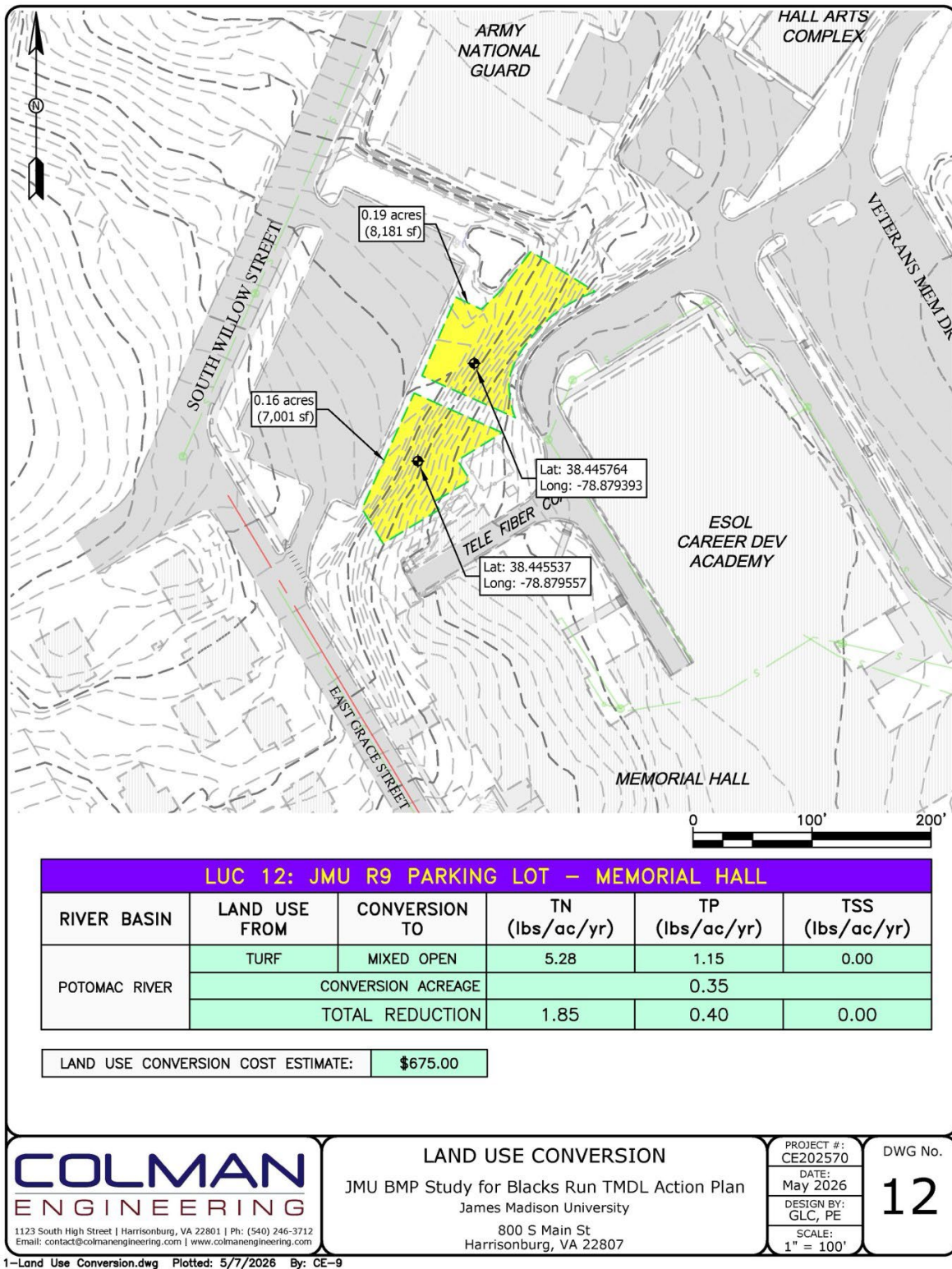
Because this site is not a high-traffic area, implementation is expected to have limited-to-moderate direct impact on routine use by students, faculty, staff, and visitors. However, because the site is located adjacent to a parking lot and on a steep slope, installation may require moderate coordination for access, staging, safety, and temporary parking or pedestrian adjustments.

Additional considerations include selecting a meadow seed mix suitable for steep slopes, maintaining safe access around the parking lot, and establishing vegetation in a way that reduces erosion risk during conversion. The project may also reduce long-term mowing and groundskeeping needs at the Memorial Hall site.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 1.85 pounds of total nitrogen and 0.40 pounds of total phosphorus.

Overall, this site offers a small nutrient reduction opportunity with potential maintenance benefits. While campus disruption is expected to be limited, the slope and parking lot adjacency create moderate coordination needs during implementation.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 12: JMU R9 PARKING LOT – MEMORIAL HALL	Turf to Mixed Open	0.4	\$675.00	\$1,687.50	Moderate



LAND USE CONVERSION 13: JMU U2 & U3 PARKING LOTS



Figure 13(a): View facing northwest from Devon Lane



Figure 13(b): View facing southeast from the cul-de-sac

The lawn east and west of the U2 and U3 parking lots could be converted from managed turf to mixed open land use. The proposed conversion area also includes turf around the Devon Lane cul-de-sac adjacent to Parking Lot U3.

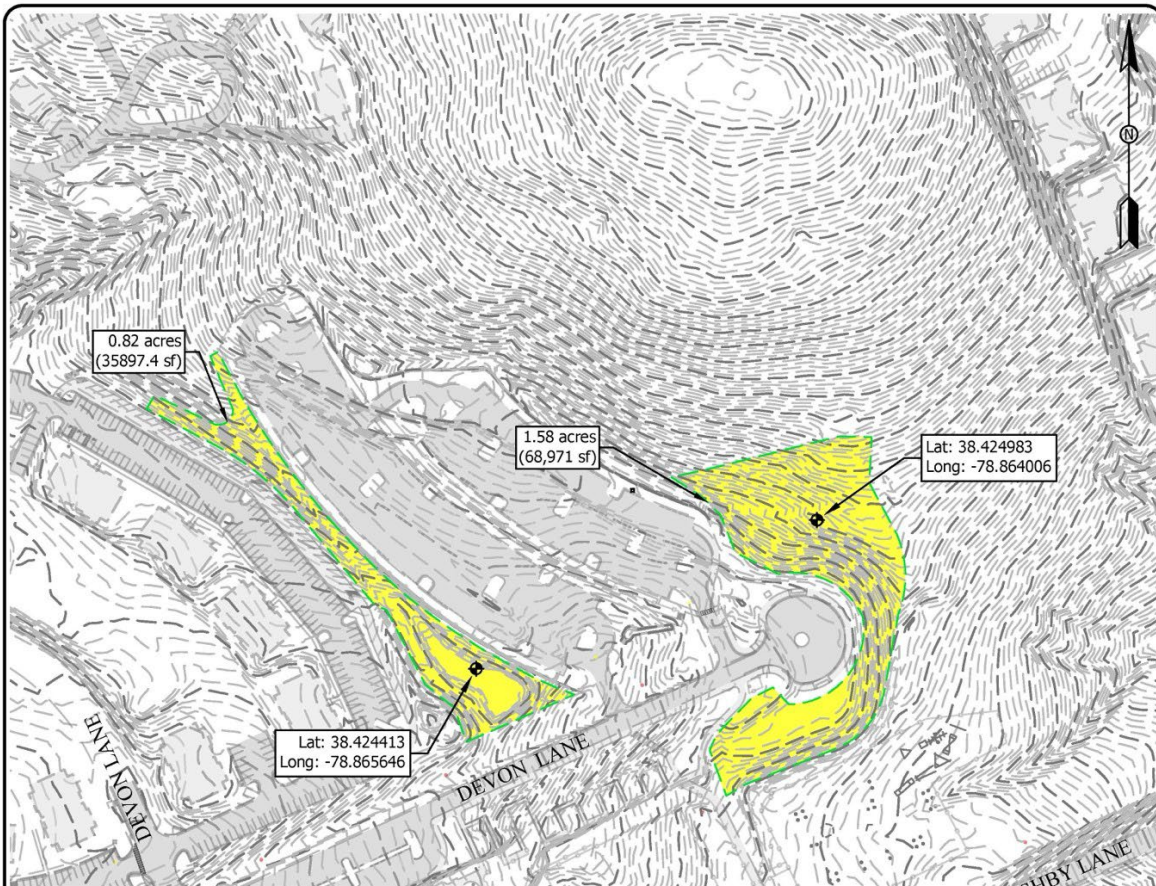
Because these areas are located away from the main campus core, implementation is expected to have limited impact on routine campus activities. Temporary impacts would likely be limited to installation access, short-term staging, and minor coordination with parking lot users and nearby roadway access.

Additional considerations include selecting a meadow seed mix suitable for roadside and parking lot-adjacent areas. The conversion may also reduce mowing and general maintenance needs in this area.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 12.67 pounds of total nitrogen and 2.76 pounds of total phosphorus.

Overall, this site offers a moderate nutrient reduction opportunity with limited anticipated campus disruption and relatively low implementation complexity. The project appears to provide practical pollutant reduction value while also reducing long-term maintenance demands.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 13: JMU U2 & U3 PARKING LOTS	Turf to Mixed Open	2.76	\$4,628.04	\$1,676.83	Limited



LUC 13: JMU U2 & U3 PARKING LOTS					
RIVER BASIN	LAND USE FROM	CONVERSION TO	TN (lbs/ac/yr)	TP (lbs/ac/yr)	TSS (lbs/ac/yr)
POTOMAC RIVER	TURF	MIXED OPEN	5.28	1.15	0.00
	CONVERSION ACREAGE			2.40	
	TOTAL REDUCTION		12.67	2.76	0.00

LAND USE CONVERSION COST ESTIMATE: **\$4,628.04**

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SCALE:
1" = 200'

DWG No.

13

1-Land Use Conversion.dwg Plotted: 5/7/2026 By: CE-9

LAND USE CONVERSION 14: JMU U4 PARKING LOT



Figure 14: View facing north from the U4 parking lot

The lawn north and northwest of the U4 parking lot could be converted from managed turf to mixed open land use. The proposed 1.78-acre conversion area consists primarily of steeply sloped lawn that appears well suited for land use conversion.

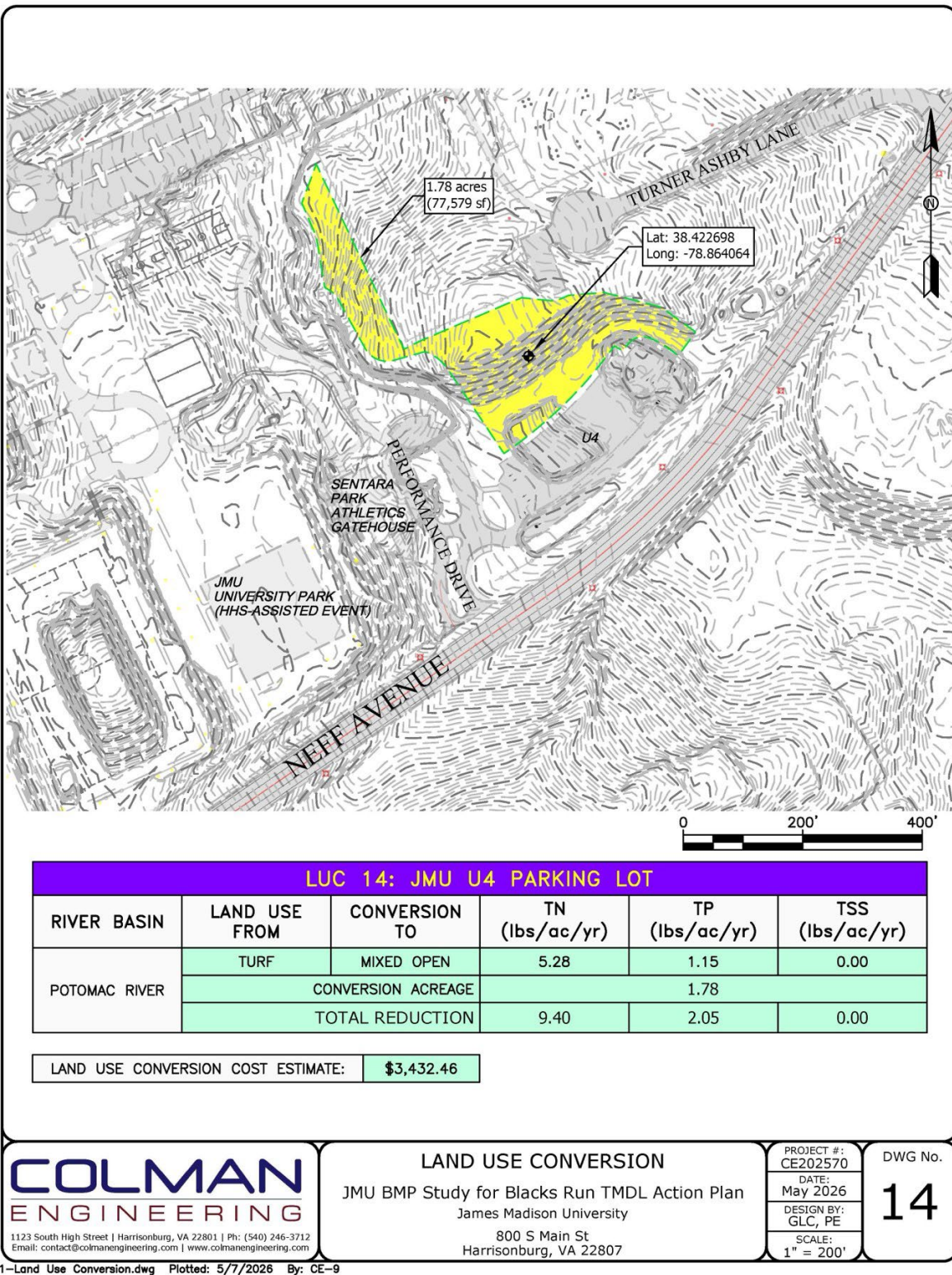
Because the site is located away from the main campus, implementation is expected to have limited impact on routine campus activities. Temporary impacts would likely be limited to installation access, short-term staging, and minor coordination with nearby parking lot users.

Additional considerations include selecting a meadow seed mix suitable for steep slopes and establishing vegetation in a way that limits erosion during conversion. Converting this area may reduce the need for mowing on steep terrain, which could provide maintenance and safety benefits for University staff.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 9.40 pounds of total nitrogen and 2.05 pounds of total phosphorus.

Overall, this site offers a substantial nutrient reduction opportunity with limited anticipated campus disruption and low implementation complexity. The steep slope and limited development potential make it a practical candidate for conversion while also reducing long-term mowing demands.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 14: JMU U4 PARKING LOT	Turf to Mixed Open	2.05	\$3,432.46	\$1,674.37	Limited



LAND USE CONVERSION 15: JMU SALT STORAGE SHED



Figure 15: Aerial image from Google Earth

The lawn area between the salt storage shed and the Alternate Fuel Building on the JMU Transportation Department property could be converted from managed turf to mixed open land use. The proposed 0.13-acre conversion area consists primarily of gently sloping lawn and is currently used for maintenance-related storage.

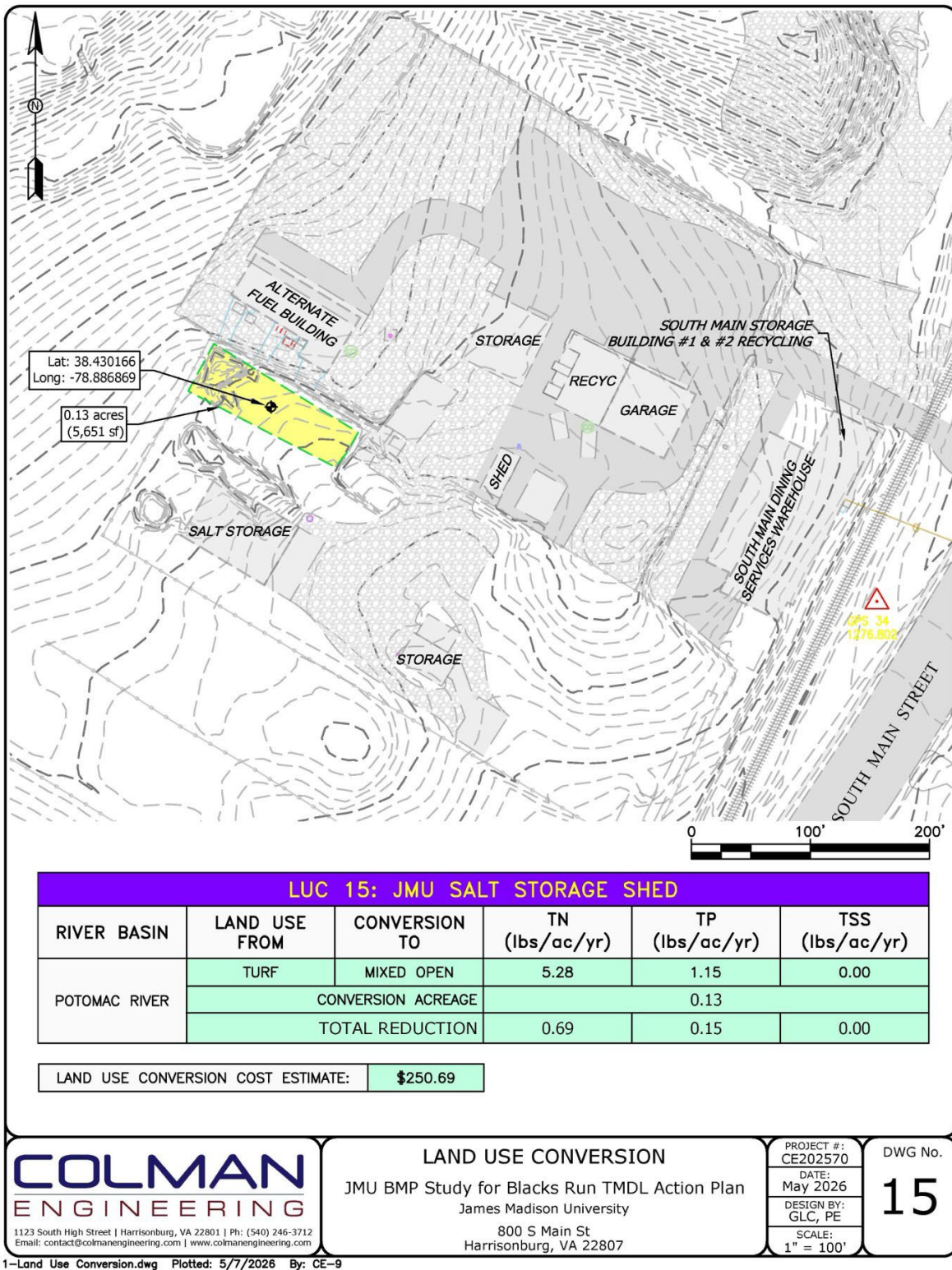
Because the University controls access around the site, implementation is expected to have limited impact on routine campus activities. Temporary impacts would likely be limited to relocating stored materials, restricting access to the immediate work area, and coordinating with Transportation Department operations.

Additional considerations include confirming that the area is no longer needed for active storage, maintaining access to adjacent maintenance facilities, and selecting a meadow seed mix appropriate for a utility and operations setting.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 0.69 pounds of total nitrogen and 0.15 pounds of total phosphorus.

Overall, this site offers a small nutrient reduction opportunity with limited anticipated campus disruption and low implementation complexity. While the pollutant reduction value is limited, the conversion appears straightforward if coordinated with existing maintenance operations.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 15: JMU SALT STORAGE SHED	Turf to Mixed Open	0.15	\$250.69	\$1,671.24	Limited



LAND USE CONVERSION 16: JMU SOUTH MAIN STREET MAINTENANCE



Figure 16: View facing southwest from the pond area

The lawn near the JMU Transportation Department parking lot could be converted from managed turf to mixed open land use. The proposed 1.14-acre conversion area is a slope adjacent to the bus parking lot, northwest of the facility entrance.

Because the site is located within an operations area and does not appear to support active storage or other routine functions, implementation is expected to have limited impact on campus activities. Temporary impacts would likely be limited to installation access, short-term staging, and coordination with Transportation Department operations.

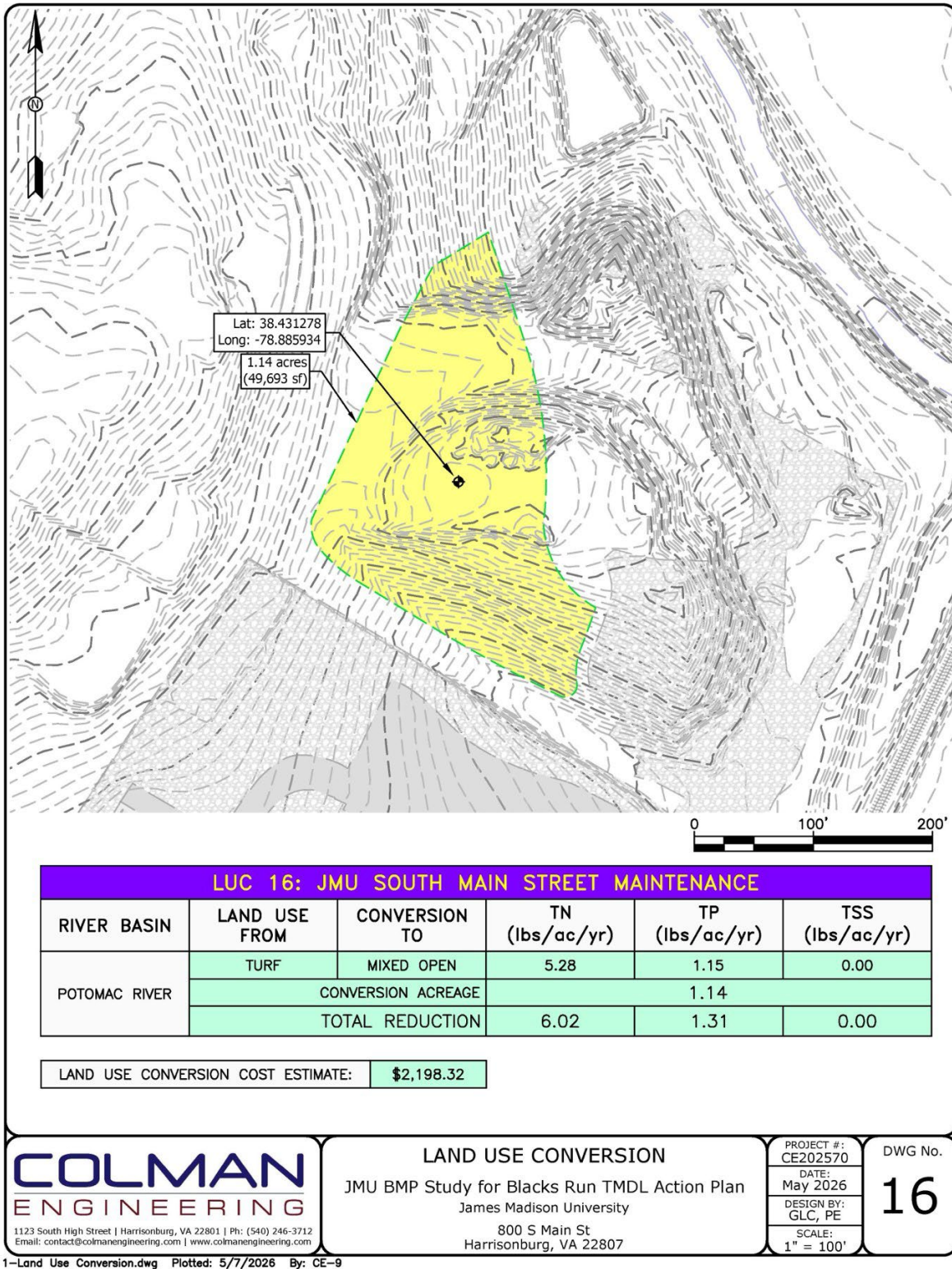
Additional considerations include selecting a meadow seed mix suitable for sloped areas and establishing vegetation in a way that limits erosion during conversion.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 6.02 pounds of total nitrogen and 1.31 pounds of total phosphorus.

Overall, this site offers a moderate nutrient reduction opportunity relative to its small size, with limited anticipated campus disruption and low implementation complexity. Its unused condition and operational setting make it a practical candidate for conversion.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
LUC 16: JMU SOUTH MAIN STREET MAINTENANCE	Turf to Mixed Open	1.31	\$2,198.32	\$1,678.11	Limited

* JMU's current Master Plan identifies the proposed BMP area for future paved parking. During future development planning, JMU should evaluate the benefit of additional parking capacity against the pollutant reduction value that would be provided by this BMP.



OPPORTUNITIES FOR NEW BMPS

New BMPs can provide targeted pollutant reduction by adding stormwater treatment where no creditable practice currently exists. These projects may offer stronger pollutant removal potential than land use conversions, especially when they intercept runoff from impervious or high-loading drainage areas, and can also provide educational or aesthetic benefits when integrated into visible campus spaces. However, new BMPs typically require more design, permitting, construction coordination, and long-term maintenance than land use conversion projects, and their feasibility depends heavily on drainage patterns, available space, utilities, access, and site constraints.

NEW BMP 1: JMU R2 PARKING LOT



Figure 17: View facing north from Sibert Creek

A Level 2 bioretention basin could be constructed to treat runoff from the Parking Lot R2 drainage area. To optimize treatment, the existing culvert that collects runoff from Parking Lot R2 and conveys it to Sibert Creek would need to be intercepted and redirected toward the southernmost portion of the proposed BMP site.

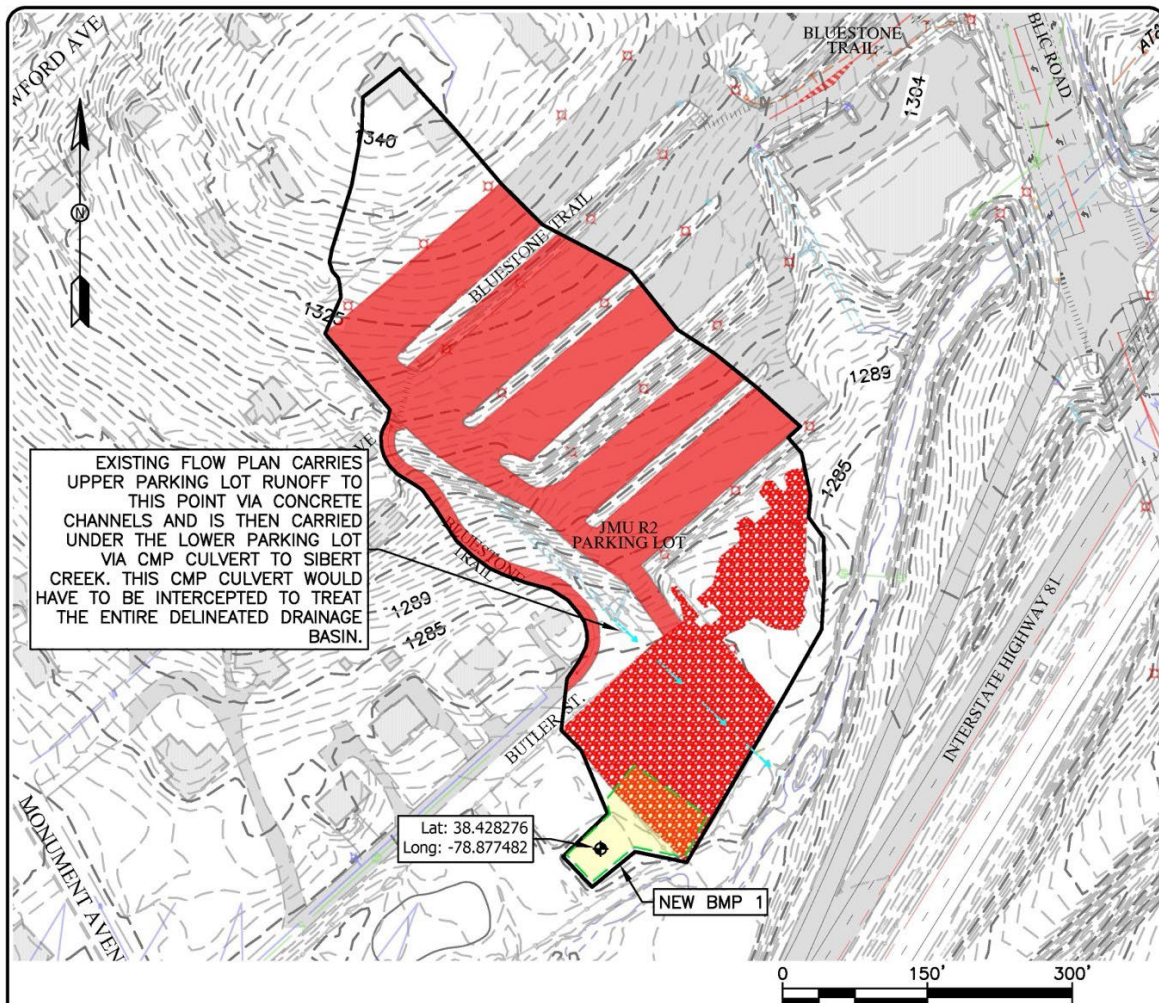
Because the site is accessible from Port Republic Road and is located away from the main campus, construction is expected to have moderate campus disruption. The Bluestone Trail segment through the parking lot and much of Parking Lot R2 could likely remain open during construction; however, temporary impacts to parking, construction access, staging, and pedestrian routing should be expected.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 46.87 pounds of total nitrogen and 3.50 pounds of total phosphorus.

Overall, this site appears to be a strong structural BMP candidate with meaningful nutrient reduction potential and manageable implementation constraints. Its location and site access make it a practical candidate for future implementation.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
NEW BMP 1: JMU R2 PARKING LOT	Bioretention	3.5	\$558,600.00	\$159,600.00	Moderate

* JMU's current Master Plan identifies the proposed BMP area as future paved parking. If this area is developed for parking, stormwater management will be required; therefore, JMU should consider this proposed basin, or an equivalent BMP, during future site layout and design.



NEW BMP 1: JMU R2 PARKING LOT							
	PROPOSED BMP:	BIORETENTION LEVEL 2				TOTAL DRAINAGE AREA (AC):	4.77
RIVER BASIN	EXISTING LAND USE (AC)				REMOVAL ESTIMATE		
POTOMAC RIVER	OPEN SPACE	MIXED OPEN	TURF	IMP. COVER	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	0	0	1.79	2.98	46.87	3.50	—
NEW BMP 1 CONSTRUCTION COST ESTIMATE:				\$558,600.00			

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2-New BMP.dwg Plotted: 5/7/2026 By: CE-9

NEW BMP

JMU BMP Study for Blacks Run TMDL Action Plan
James Madison University
800 S Main St
Harrisonburg, VA 22807

PROJECT #: CE202570

DATE: May 2026

DESIGN BY: GLC, PE

SCALE: 1" = 150'

DWG No.

17

NEW BMP 2: MUSIC BUILDING AND SPOTSWOOD HALL



Figure 18: View facing northwest toward Main Street

A Level 2 bioretention basin could treat runoff from portions of the Music Building, Spotswood Hall, and surrounding grounds. Because the site is on the Quad, implementation would require close coordination with campus activities, pedestrian circulation, utilities, building entrances, mature vegetation, and the academic calendar. Construction may need to occur during breaks or other low-traffic periods to limit disruption.

Design should preserve the Quad's historic and formal character through compatible plantings, careful basin placement, and minimal impacts to walkways and existing landscape features. The site's visibility also offers an opportunity to highlight JMU's stormwater and pollutant reduction efforts through intentional landscape design and educational signage.

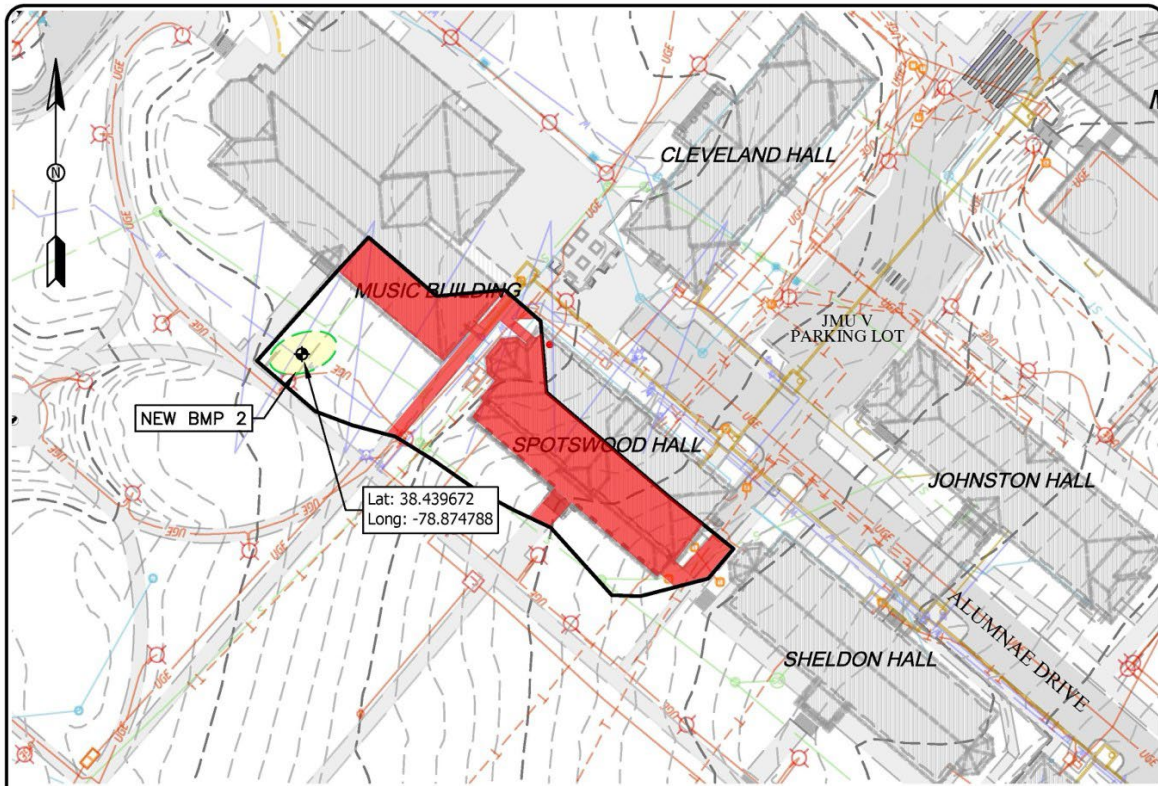
Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 4.21 pounds of total nitrogen and 0.33 pounds of total phosphorus.

Overall, this site provides modest pollutant reduction with strong educational and visibility value, but would require more careful design and coordination than less prominent BMP locations.

As an alternative, smaller Level 1 bioretention practices could be installed along the Music Building and Spotswood Hall to treat primarily roof runoff. These practices would provide less pollutant reduction than the larger Level 2 basin but could be integrated into existing planting bed areas along the building exteriors, reducing disturbance to the Quad and minimizing changes to its visual character.

Using planning-level calculations for these smaller Level 1 bioretention practices, the estimated annual pollutant reduction potential is approximately 1.58 pounds of total nitrogen and 0.09 pounds of total phosphorus.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
NEW BMP 2: MUSIC BUILDING AND SPOTSWOOD HALL	Bioretention	0.33	\$45,570.00	\$138,090.91	Substantial



NEW BMP 2: MUSIC BUILDING

	PROPOSED BMP:	BIORETENTION LEVEL 2			TOTAL DRAINAGE AREA (AC):		0.453
RIVER BASIN	EXISTING LAND USE (AC)				REMOVAL ESTIMATE		
POTOMAC RIVER	OPEN SPACE	MIXED OPEN	TURF	IMP. COVER	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	0	0	0.229	0.224	4.21	0.33	—

NEW BMP 2 CONSTRUCTION COST ESTIMATE: \$45,570.00

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NEW BMP

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Harrisonburg, VA 22807

PROJECT #: CE202570

DATE: May 2026

DESIGN BY: GLC, PE

SCALE: 1" = 80'

DWG No.

18

2-New BMP.dwg Plotted: 5/7/2026 By: CE-9

NEW BMP 3: SHELDON & ALUMNAE HALLS



Figure 19: View facing northwest in front of Alumnae Hall

A Level 2 bioretention basin could treat runoff from portions of the Sheldon Hall, Alumnae Hall, and surrounding grounds. A narrow bioretention basin across the front of Sheldon Hall could capture runoff from much of this side of the buildings while also serving as a sitting wall or similar landscape feature along the Quad.

Because the site is on the Quad, implementation would require close coordination with campus activities, pedestrian circulation, utilities, building entrances, mature vegetation, and the academic calendar. Construction may need to occur during breaks or other low-traffic periods to limit disruption.

Design should preserve the Quad's historic and formal character through compatible plantings, careful basin placement, and minimal impacts to walkways and existing landscape features. The site's visibility also offers an opportunity to highlight JMU's stormwater and pollutant reduction efforts through intentional landscape design and educational signage.

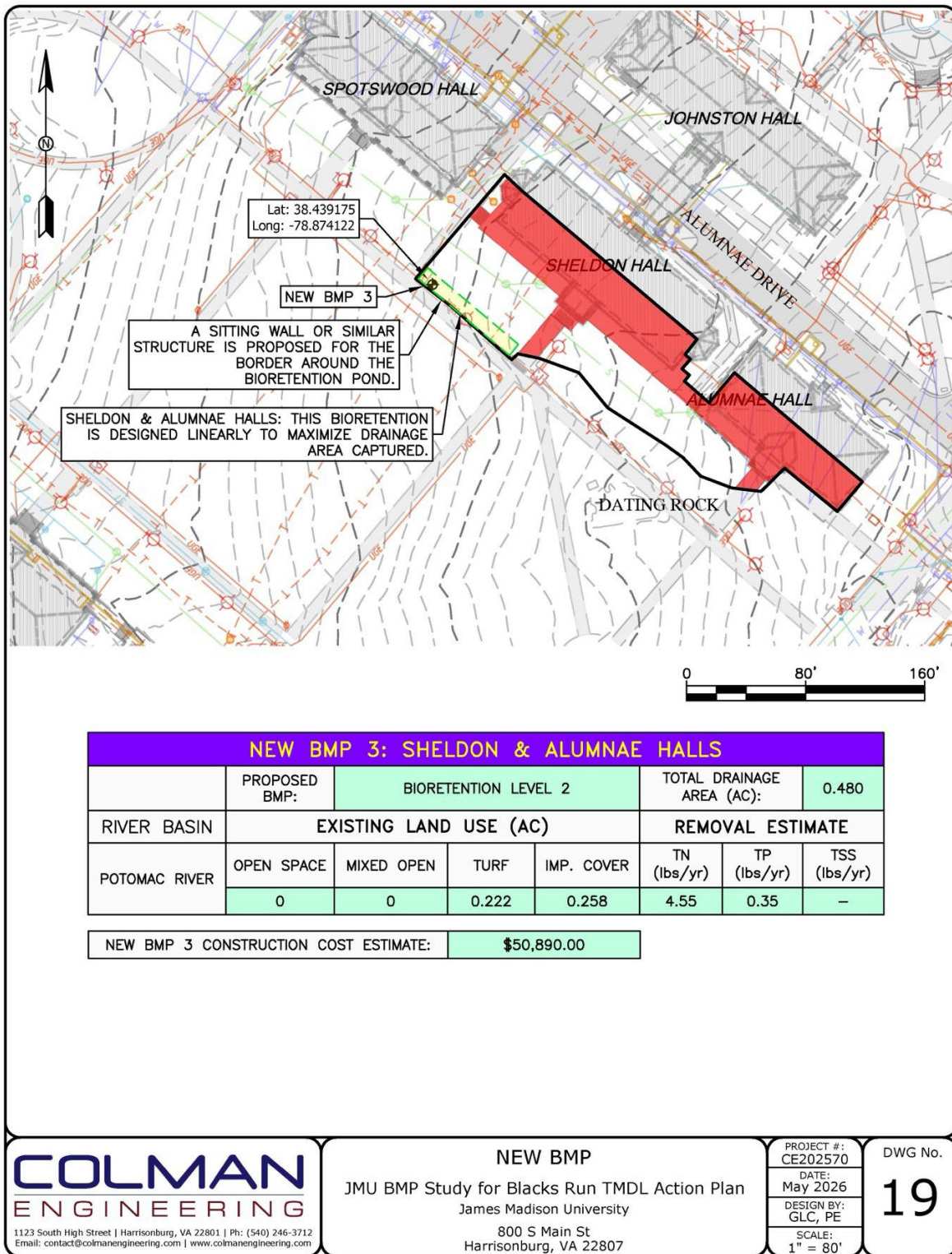
Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 4.55 pounds of total nitrogen and 0.35 pounds of total phosphorus.

Overall, this site provides modest pollutant reduction with strong educational and visibility value, but would require more careful design and coordination than less prominent BMP locations.

As an alternative, smaller Level 1 bioretention practices could be installed along Sheldon Hall and Alumnae Hall to treat primarily roof runoff. These practices would provide less pollutant reduction than the larger Level 2 basin but could be integrated into existing planting bed areas along the building exteriors, reducing disturbance to the Quad and minimizing changes to its visual character.

Using planning-level calculations for these smaller Level 1 bioretention practices, the estimated annual pollutant reduction potential is approximately 1.89 pounds of total nitrogen and 0.11 pounds of total phosphorus.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
NEW BMP 3: SHELDON & ALUMNAE HALLS	Bioretention	0.35	\$50,890.00	\$145,400.00	Substantial



NEW BMP 4: SOUTH WILLOW STREET BASEBALL FIELD

Figure 20: View facing south from South Willow Street

The banks of Blacks Run could be stabilized in accordance with Protocol 1 of the Chesapeake Bay TMDL Special Condition Guidance for urban stream restoration. Protocol 1 is focused on reducing sediment erosion and deposition within the stream channel. This project would include design and installation of stream stabilization measures along exposed streambanks between South Willow Street and Veterans Memorial Service Drive. Based on planning-level assumptions, approximately 500 linear feet of stream could be eligible for pollutant reduction credit if restoration is completed along both banks.

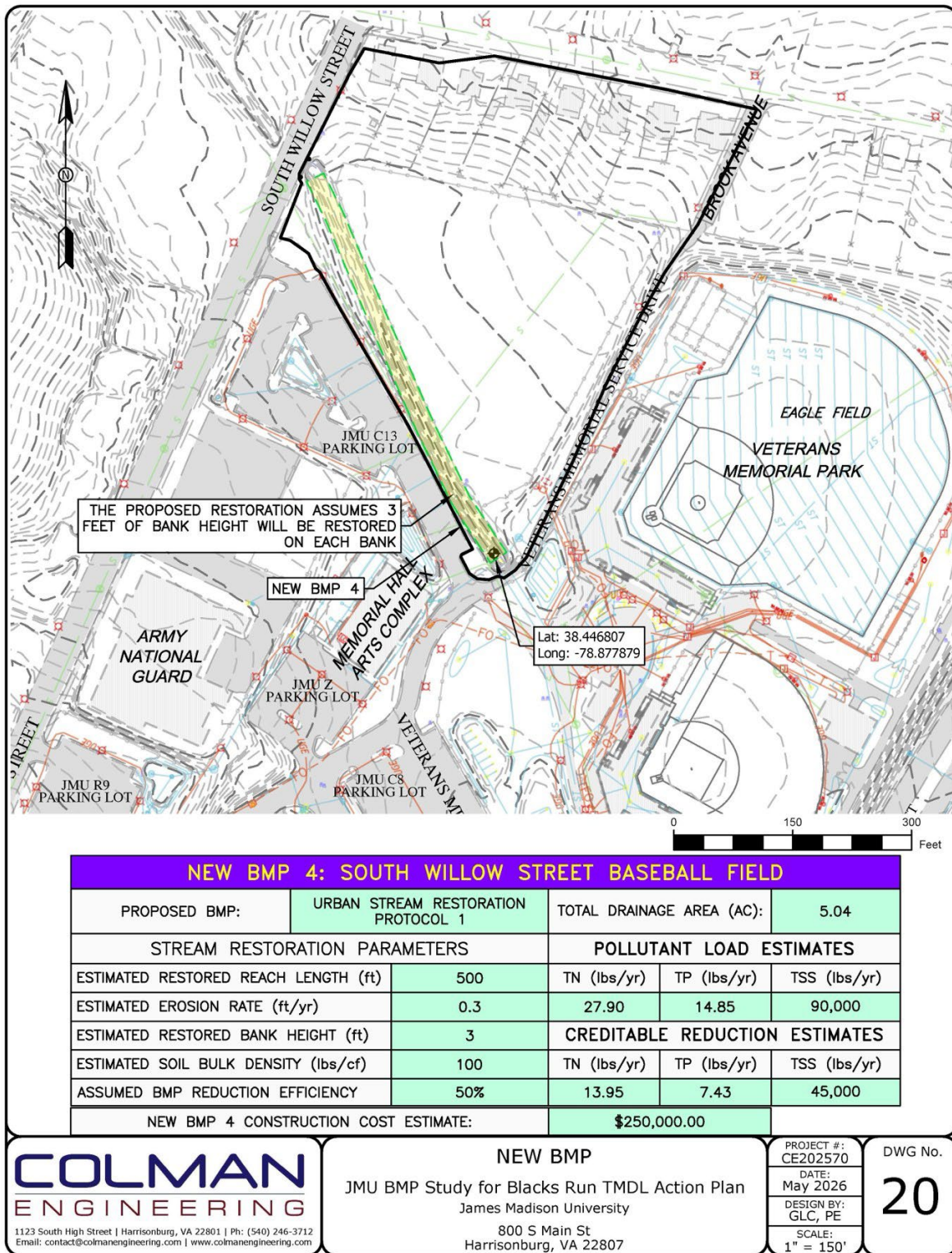
Because the site is adjacent to campus recreation and parking areas, implementation is expected to require moderate coordination. Construction access would likely require temporary closure of portions of the C13 parking lot, and scheduling should account for use of the nearby baseball field and other adjacent facilities. This project will require permitting with the U.S. Army Corps of Engineers, FEMA, and Virginia DEQ.

This report assumes the BANCS method would be used during design to quantify streambank erosion reduction in accordance with applicable Chesapeake Bay Program guidance.

Based on these planning-level assumptions, the estimated annual pollutant reduction potential is approximately 13.95 pounds of total nitrogen, 7.43 pounds of total phosphorus, and 45,000 pounds of total suspended solids.

Overall, this site appears to offer a strong pollutant reduction opportunity, particularly for sediment and phosphorus. While implementation would require more detailed analysis, permitting, and construction coordination than many other proposed projects, the potential credit value makes it a strong candidate for further evaluation.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
NEW BMP 4: SOUTH WILLOW STREET BASEBALL FIELD	Stream Restoration	7.43	\$250,000.00	\$33,647.38	Moderate



NEW BMP 5: JMU R12 PARKING LOT AND FACILITIES BUILDINGS



Figure 21: View facing southwest behind Greenberry's

The east bank of Blacks Run could be stabilized in accordance with Protocol 1 of the Chesapeake Bay TMDL Special Condition Guidance for urban stream restoration. As with New BMP 4, Protocol 1 focuses on reducing streambank erosion and sediment deposition within the channel. The proposed project would stabilize approximately 950 linear feet of stream. Because JMU owns only the east side of the stream corridor in this area, restoration would be limited to one bank.

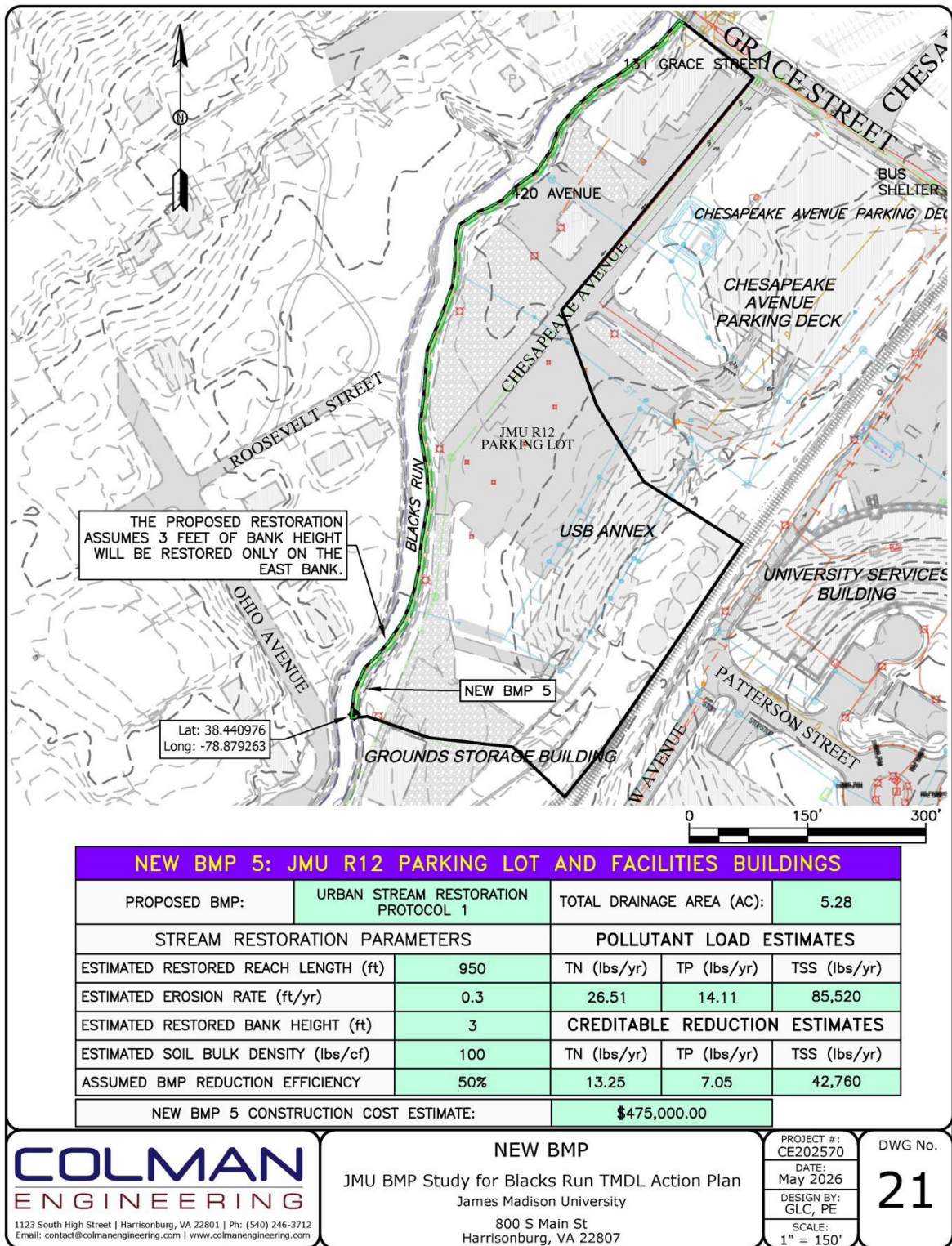
Since the site is located adjacent to developed campus areas, implementation would require coordination with nearby building occupants and staff. Construction access appears relatively straightforward from the JMU-owned side of the stream; however, work should be scheduled to minimize disruption to day-to-day activities in the surrounding area. This project will require permitting with U.S. Army Corps of Engineers, FEMA, and Virginia DEQ.

This report assumes the BANCS method would be used during design to quantify streambank erosion reduction in accordance with applicable Chesapeake Bay Program guidance.

Based on these planning-level assumptions, the estimated annual pollutant reduction potential is approximately 13.25 pounds of total nitrogen, 7.05 pounds of total phosphorus, and 42,760 pounds of total suspended solids.

Overall, this site appears to offer a strong pollutant reduction opportunity, particularly for sediment and phosphorus. Although restoration would be limited to one bank, the project appears practical due to straightforward access from JMU property and warrants further evaluation as a potential stream restoration project.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
NEW BMP 5: JMU R12 PARKING LOT AND FACILITIES BUILDINGS	Stream Restoration	7.05	\$475,000.00	\$67,375.89	Moderate



2-New BMP.dwg Plotted: 5/7/2026 By: CE-9

NEW BMP 6: JMU TRANSPORTATION DEPARTMENT STORAGE YARD

Figure 22: View facing north toward the existing stormwater pond

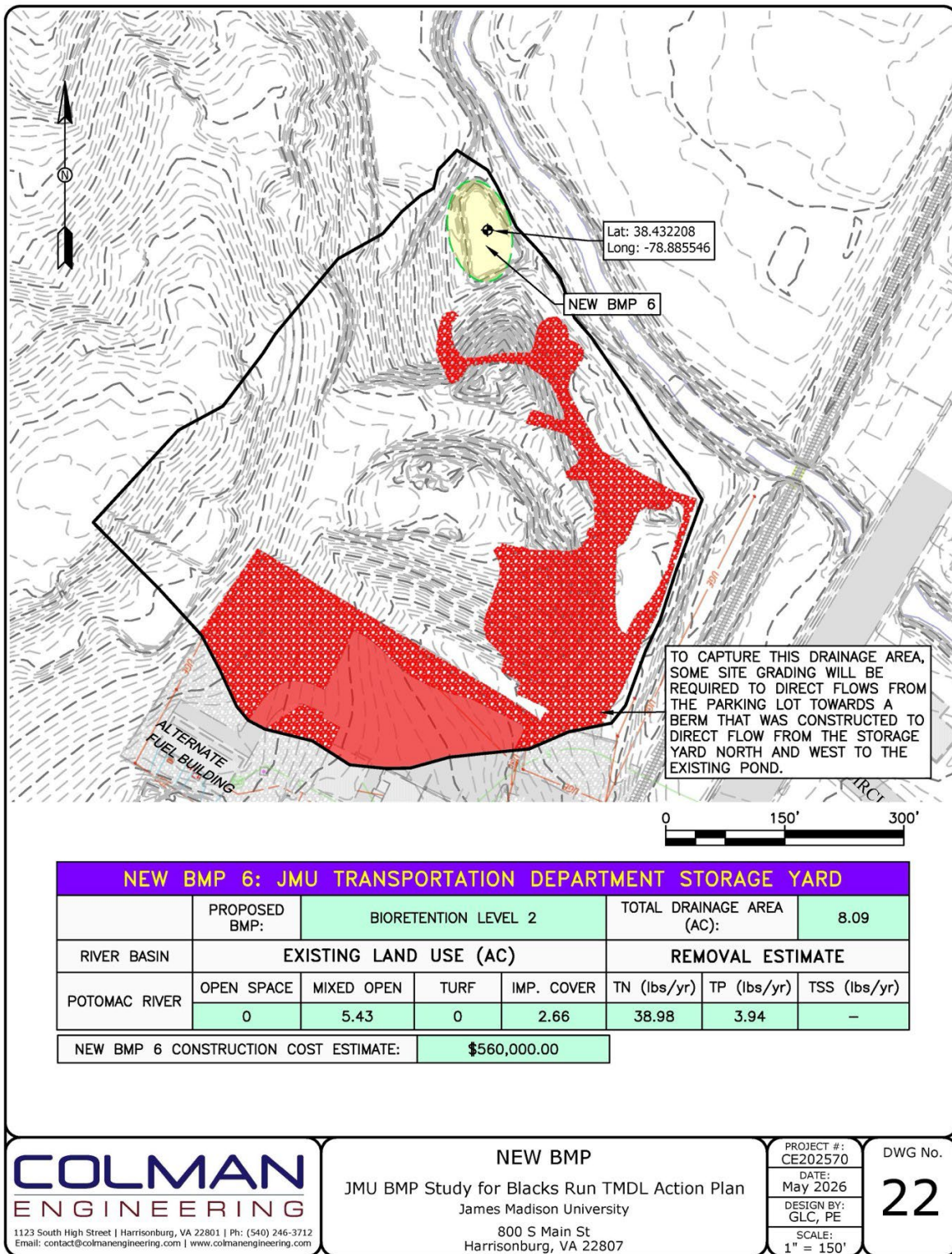
This site currently has a sediment basin at its northernmost point, with a berm/diversion dike along the north and east sides of the yard that directs runoff to the pond. By converting this sediment basin to a Level 2 bioretention basin (VSMH P-FIL-05) and regrading the site to expand the drainage area, runoff from most of the JMU Transportation Department materials storage yard and a portion of the adjacent parking lot could be captured and treated. The pollution reductions for the site increase significantly when including the impervious area (parking lot) in the proposed treatment.

Because JMU controls the entire property and the site is located away from public access and the main campus core, implementation is expected to have limited impact on students, faculty, staff, and visitors. The northeastern portion of the property currently serves as a construction yard; this use may be impacted. Coordination will also be needed to maintain operations access during construction.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 38.98 pounds of total nitrogen and 3.94 pounds of total phosphorus.

Overall, this site appears to be a strong structural BMP candidate with meaningful nutrient reduction potential and limited anticipated campus disruption. The controlled access, operational setting, and ability to capture additional impervious runoff make it a practical candidate for future implementation.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
NEW BMP 6: JMU TRANSPORTATION DEPARTMENT STORAGE YARD	Bioretention	3.94	\$560,000.00	\$142,131.98	Limited



OPPORTUNITIES TO RETROFIT EXISTING BMPS

Retrofitting existing BMPs can improve pollutant removal by enhancing stormwater facilities or conveyance features that are already in place. These projects may be more practical than constructing entirely new BMPs because they can use existing drainage patterns, available stormwater infrastructure, and established maintenance areas. However, retrofits can also be constrained by the original facility design, available hydraulic head, existing utilities, access limitations, and the need to maintain current stormwater conveyance or flood-control functions during and after construction.

RETROFIT BMP 1: JMU R2 PARKING LOT CHANNEL



Figure 23: View facing northwest alongside the R2 parking lot

A grass channel with check dams could be installed to replace the existing concrete channel south of Parking Lot R2. Currently, runoff from the western half of the R2 parking lot is conveyed through the concrete channel to a corrugated metal pipe culvert and then discharged to an outfall on Sibert Creek. While this system conveys stormwater effectively, it provides no water quality treatment. Replacing the channel with a grass channel with check dams would increase residence time, promote infiltration, and provide pollutant reduction credit for sediment, phosphorus, and nitrogen.

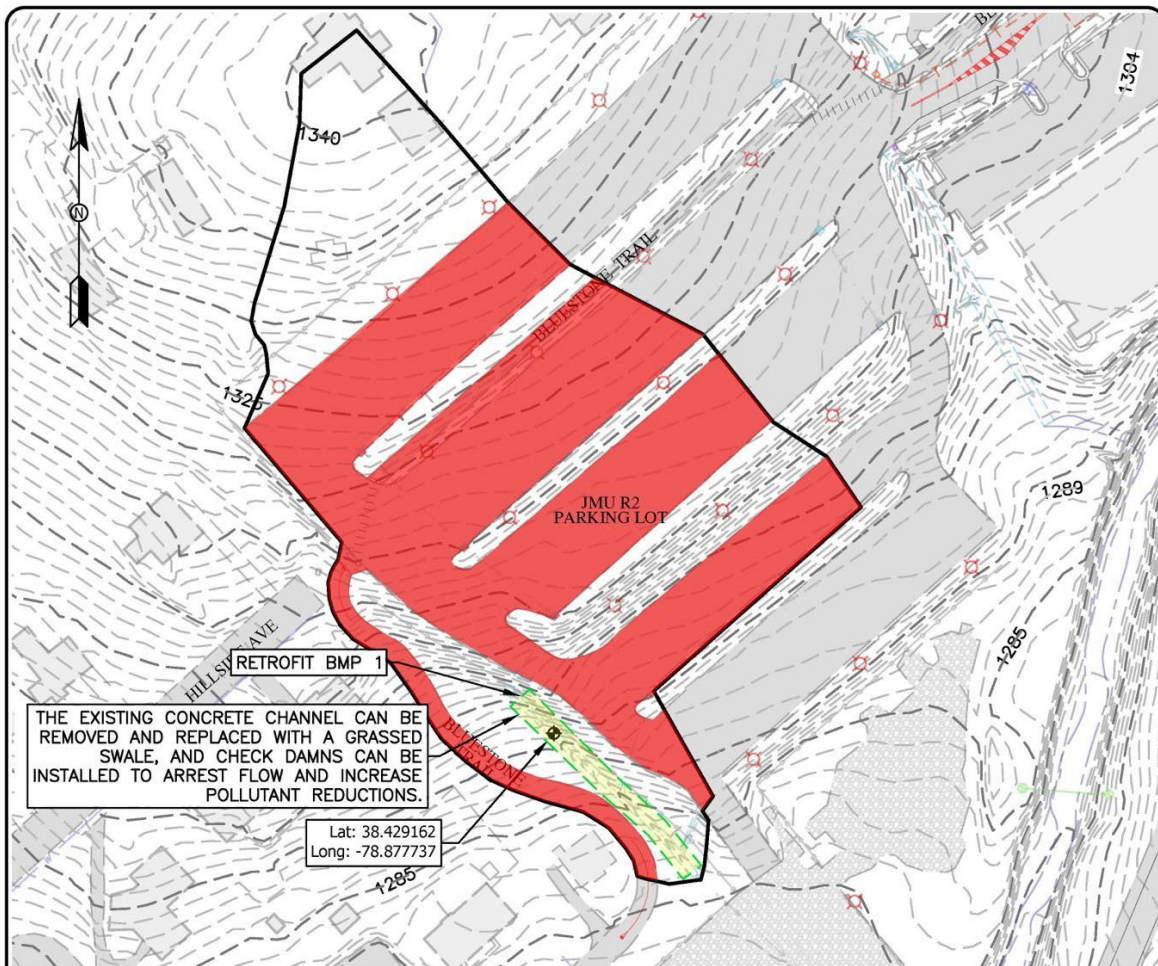
Because the proposed BMP is located near the Bluestone Trail and adjacent to the R2 parking lot, implementation would require moderate coordination. Construction activities may temporarily affect trail access and parking availability.

Additional considerations include confirming available grading and longitudinal slope, designing check dams at appropriate intervals, and maintaining stable conveyance through the channel during storm events. Coordination will also be needed to minimize impacts to the trail and parking lot during construction.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 9.95 pounds of total nitrogen, 0.71 pounds of total phosphorus, and 553 pounds of total suspended solids.

Overall, this site appears to offer a practical retrofit opportunity with moderate pollutant reduction potential and manageable implementation constraints. Although the project would require coordination with nearby trail and parking lot use, it would improve water quality treatment in an area that currently provides conveyance only.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 1: JMU R2 PARKING LOT CHANNEL	Grass Channel	0.71	\$24,200.00	\$34,084.51	Moderate



RETROFIT BMP 1: R2 PARKING LOT CHANNEL

	PROPOSED BMP:	GRASS CHANNEL W/ CHECK DAMS			TOTAL DRAINAGE AREA (AC):		2.86
RIVER BASIN	EXISTING LAND USE (AC)				CREDITABLE REDUCTION ESTIMATES		
POTOMAC RIVER	OPEN SPACE	MIXED OPEN	TURF	IMP. COVER	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	0	0	1.18	1.68	9.95	0.71	553
RETROFIT BMP 1 CONSTRUCTION COST ESTIMATE:			\$24,200.00				

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BMP RETROFIT

JMU BMP Study for Blacks Run TMDL Action Plan
James Madison University
800 S Main St
Harrisonburg, VA 22807

PROJECT #:
CE202570

DATE:
May 2026

DESIGN BY:
GLC, PE

SCALE:
1" = 100'

DWG No.

23

3-BMP Retrofit.dwg Plotted: 5/7/2026 By: CE-9

RETROFIT BMP 2: LOCUST HILL ROAD & UNIVERSITY DRIVE CHANNEL



Figure 24: View facing the existing channel, looking upstream

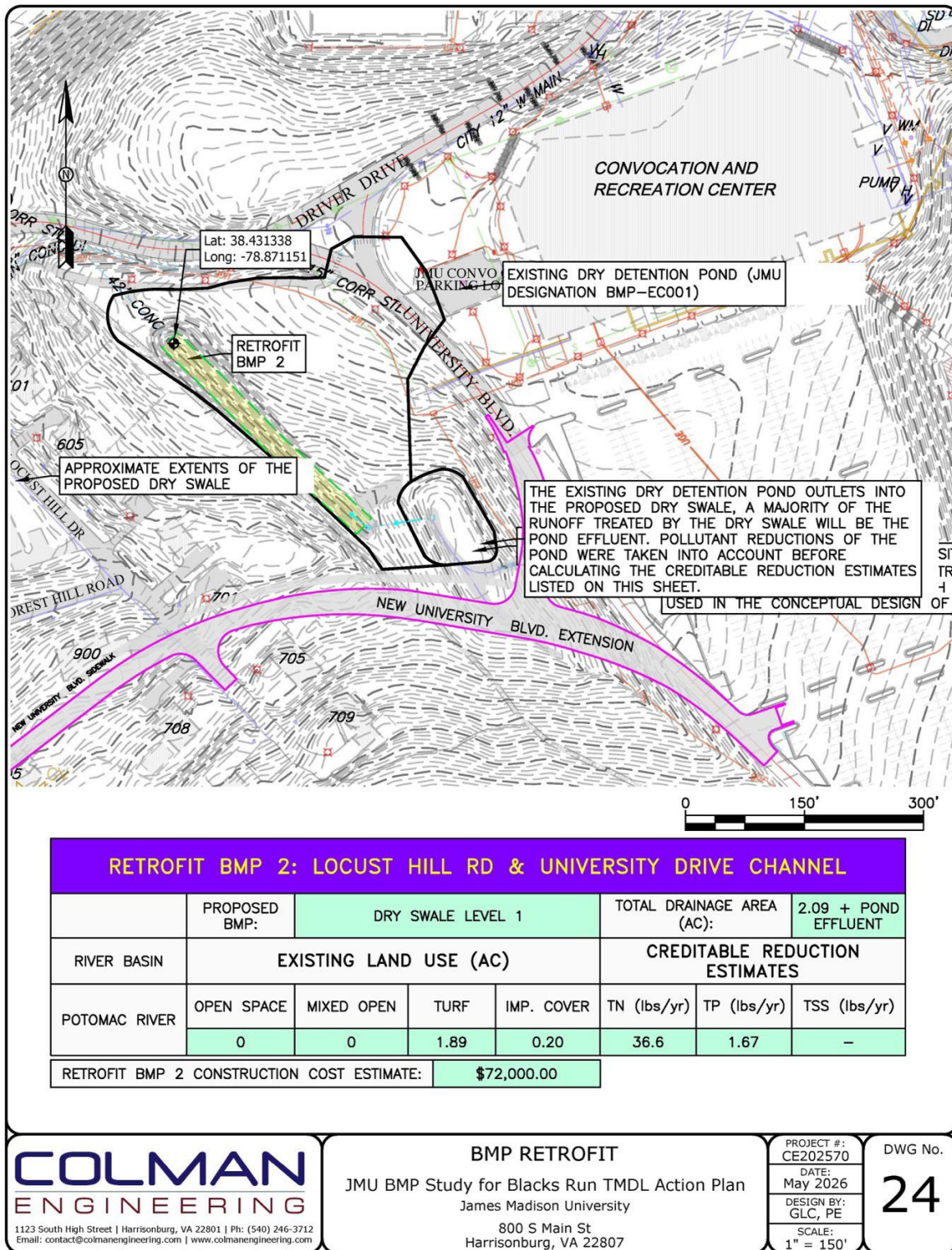
A Level 1 dry swale BMP could be constructed by retrofitting the existing earthen stormwater channel located immediately downstream of the existing dry detention pond. Under current conditions, most upstream runoff is routed through the detention pond and discharged to the earthen channel. Converting this channel to a dry swale BMP would provide greater pollutant removal than the existing configuration.

Because the site is located away from major roads and primary campus circulation routes, implementation is expected to have limited impact on routine campus activities. Temporary impacts would likely be limited to construction access and staging. Additional considerations include clearing existing vegetation within the channel and providing suitable access for construction equipment in a relatively isolated, steep-sided area.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 36.6 pounds of total nitrogen and 1.67 pounds of total phosphorus.

Overall, this site appears to be a strong retrofit opportunity with meaningful nutrient reduction potential and limited anticipated campus disruption. Although construction access may be somewhat constrained by the site's steep-sided configuration, the proposed dry swale would improve water quality treatment beyond the existing channel conditions.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 2: LOCUST HILL ROAD & UNIVERSITY DRIVE CHANNEL	Dry Swale	1.67	\$72,000.00	\$43,113.77	Limited



RETROFIT BMP 3: UREC TURF CHANNEL



Figure 25: View facing north toward UREC, showing the existing grass channel outlet

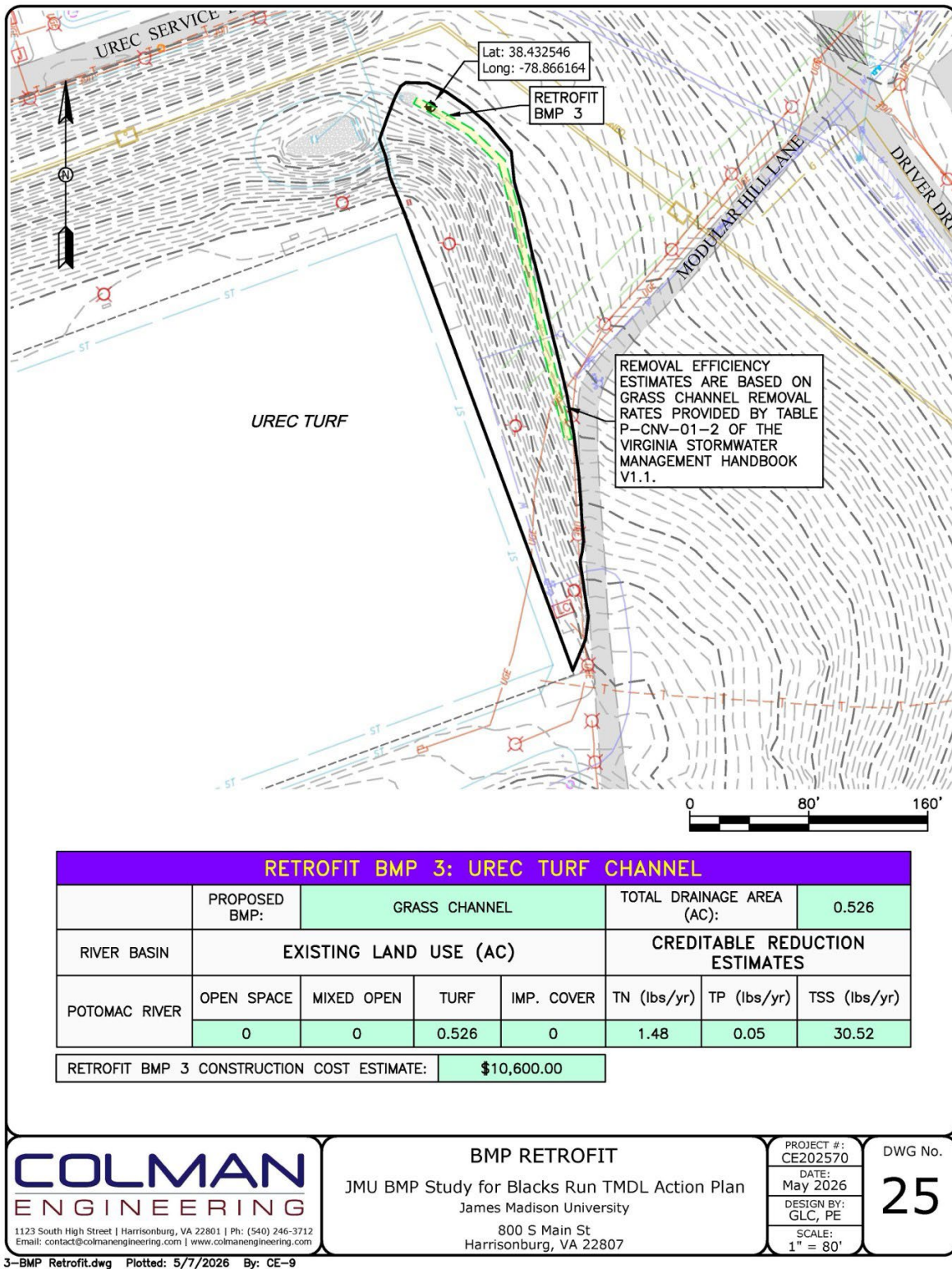
Currently, there is a small channel carrying runoff from the east slope of the UREC Turf into an RCP culvert and then to the campus stormwater system. The existing channel could be retrofitted into a vegetated grass channel (VSMH P-CNV-01) with check dams. The existing channel is technically already a grass channel, but by increasing its storage capacity with check dams it will be able to remove more pollutants than it does currently.

Because the site is located near the edge of the UREC Turf area, implementation is expected to have limited impact on routine campus activities. Temporary impacts would likely be limited to construction access, minor staging, and coordination with UREC field use and maintenance activities.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 1.48 pounds of total nitrogen, 0.05 pounds of total phosphorus, and 18.49 pounds of total suspended solids.

Overall, this site offers a small pollutant reduction opportunity with limited anticipated campus disruption and low implementation complexity. While the credit value is limited, the retrofit appears straightforward and may improve treatment within an existing conveyance feature.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 3: UREC TURF CHANNEL	Grass Channel	0.05	\$10,600.00	\$212,000.00	Limited



RETROFIT BMP 4: JMU C4 PARKING LOT



Figure 26: View facing northeast toward Hillside Hall

The banks of Blacks Run could be stabilized in this area in accordance with Protocol 1 of the Chesapeake Bay TMDL Special Condition Guidance for urban stream restoration. Protocol 1 focuses on reducing sediment erosion from streambanks during storm flow. This project would involve design and installation of approved stream stabilization measures to reduce erosion and associated sediment loading, with corresponding reductions in phosphorus and nitrogen. For planning purposes, this concept assumes restoration would be performed along both banks of the creek.

Because this segment runs through a central portion of campus, from Mr. Chips to Martin Luther King Jr. Way, implementation could result in substantial campus disruption. Construction may affect pedestrian circulation, nearby building access, and adjacent road or service access. Work would likely require careful phasing, advance coordination with affected campus users, and scheduling during lower-traffic periods where practicable. This project will also require permitting with U.S. Army Corps of Engineers, FEMA, and Virginia DEQ.

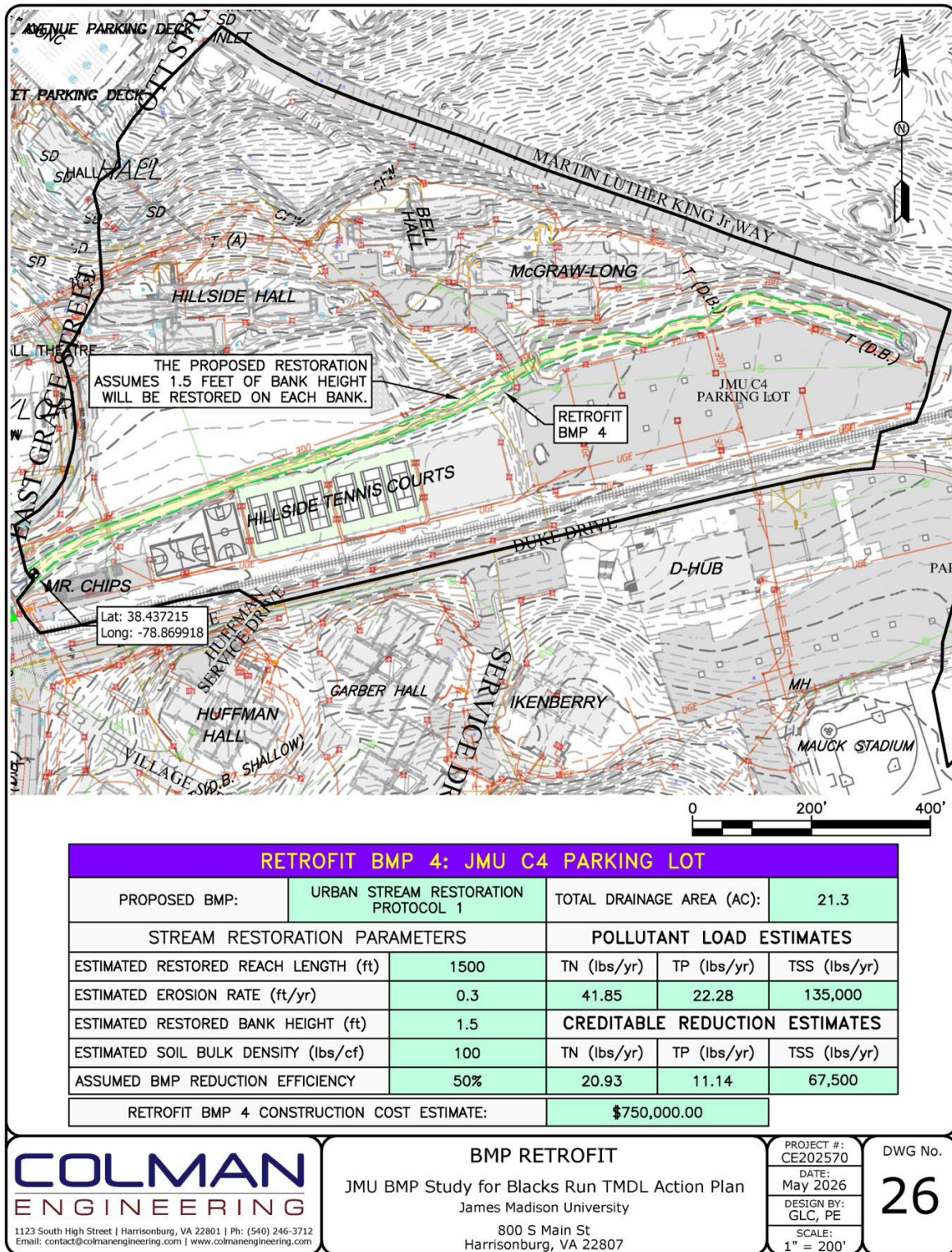
This report assumes the BANCS method, along with other approved Chesapeake Bay Program methods as applicable, would be used during design to quantify the pollutant reduction benefit of the restoration.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 20.93 pounds of total nitrogen, 11.14 pounds of total phosphorus, and 67,500 pounds of total suspended solids.

Overall, this site appears to offer a strong pollutant reduction opportunity, particularly for sediment and phosphorus. However, the project would require substantial coordination due to its location, in addition to detailed analysis, permitting, and site-specific design.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 4: JMU C4 PARKING LOT	Stream Restoration	11.14	\$750,000.00	\$67,324.96	Substantial

*This opportunity is categorized as a retrofit because stabilization measures are already present but are underperforming.



RETROFIT BMP 5: JMU R8 PARKING LOT



Figure 27: View facing west from Paul Street

The banks of Blacks Run along Parking Lot R8 could be stabilized in accordance with Protocol 1 of the Chesapeake Bay TMDL Special Condition Guidance for urban stream restoration. Protocol 1 focuses on reducing sediment erosion from streambanks during storm flow. Stabilizing this segment using approved methods would reduce sediment loading, with corresponding reductions in phosphorus and nitrogen. For planning purposes, this concept assumes restoration would be performed along both banks of the creek.

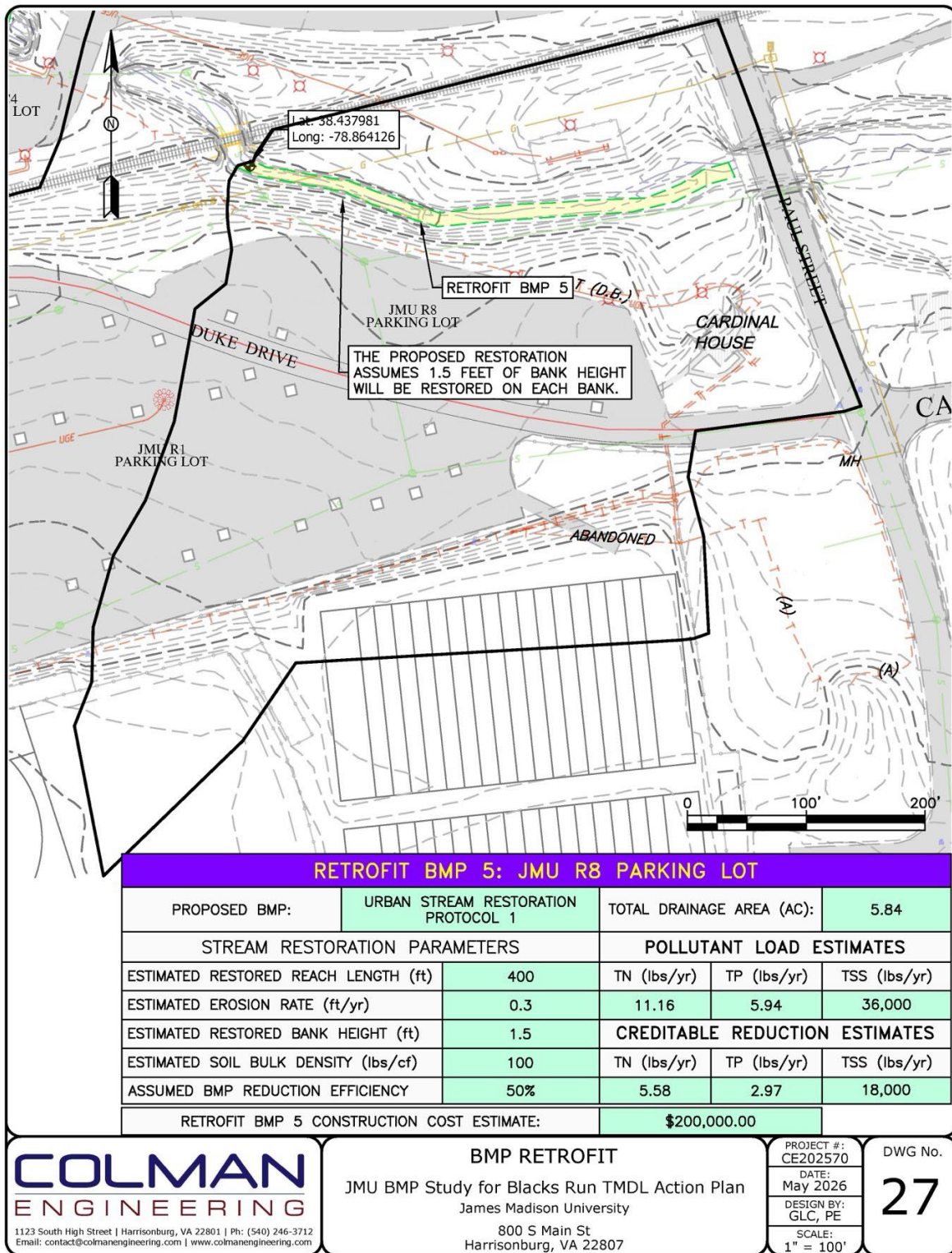
Because the project area is located along Parking Lot R8, implementation is expected to require moderate coordination. Construction may temporarily affect parking availability, access, staging, and pedestrian circulation near the lot. Work should be scheduled to minimize conflicts with parking demand and nearby campus activities. This project will also require permitting with U.S. Army Corps of Engineers, FEMA, and Virginia DEQ.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 5.58 pounds of total nitrogen, 2.97 pounds of total phosphorus, and 18,000 pounds of total suspended solids.

Overall, this site offers a meaningful pollutant reduction opportunity, particularly for sediment and phosphorus. While implementation would require permitting, design, and coordination with Parking Lot R8 operations, the project appears to be a practical candidate for further stream restoration evaluation.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 5: JMU R8 PARKING LOT	Stream Restoration	2.97	\$200,000.00	\$67,340.07	Moderate

*This opportunity is categorized as a retrofit because stabilization measures are already present but are underperforming.



RETROFIT BMP 6: MASSANUTTEN HALL



Figure 28: View facing south from Harrison Street

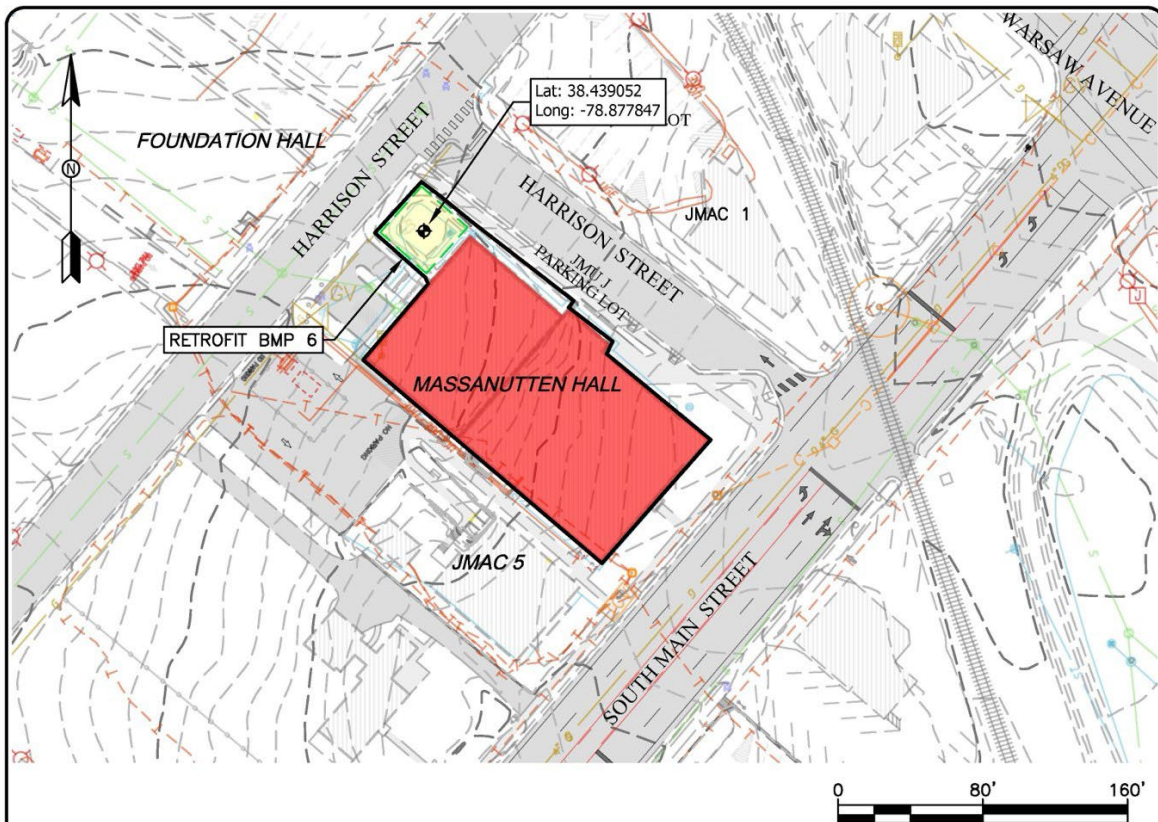
The existing dry detention basin serving Massanutten Hall could be converted into a Level 2 bioretention basin (VSMH P-FIL-05). Converting the basin would provide additional water quality treatment for stormwater runoff from the building and surrounding drainage area. Conceptual analysis indicates that an adequately sized bioretention basin could fit within the footprint of the existing pond.

Because the site is located along Harrison Street and adjacent to JMU J Parking Lot, implementation is expected to require moderate coordination. Construction may temporarily affect parking access, pedestrian circulation, roadway-adjacent work areas, and staging near Massanutten Hall. Work should be scheduled to minimize conflicts with campus operations, parking demand, and public traffic along Harrison Street.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 4.45 pounds of total nitrogen and 0.31 pounds of total phosphorus.

Overall, this site offers a modest pollutant reduction opportunity with moderate coordination needs. While the credit value is limited, the ability to retrofit an existing stormwater facility may make this a practical option for improving treatment of Massanutten Hall runoff.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 6: MASSANUTTEN HALL	Bioretention	0.31	\$61,110.00	\$197,129.03	Moderate



RETROFIT BMP 6: MASSANUTTEN HALL							
	PROPOSED BMP:	BIORETENTION LEVEL 2			TOTAL DRAINAGE AREA (AC):		0.41
RIVER BASIN	EXISTING LAND USE (AC)				CREDITABLE REDUCTION ESTIMATES		
POTOMAC RIVER	OPEN SPACE	MIXED OPEN	TURF	IMP. COVER	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	0	0	0.05	0.36	4.45	0.31	—
RETROFIT BMP 6 CONSTRUCTION COST ESTIMATE:				\$61,110.00			

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3-BMP Retrofit.dwg Plotted: 5/7/2026 By: CE-9

BMP RETROFIT
JMU BMP Study for Blacks Run TMDL Action Plan
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PROJECT #: CE202570
DATE: May 2026
DESIGN BY: GLC, PE
SCALE: 1" = 80'

DWG No.
28

RETROFIT BMP 7: WAMPLER HALL



Figure 29: View facing north toward Main Street

The existing extended detention pond across from Wampler Hall could be improved by installing grass channels between the pond inlet pipes and outlet structure. The pond currently receives runoff from two culverts entering from the east and south sides. Constructing grass channels between these inflow points and the outlet structure could increase residence time and provide additional water quality treatment for runoff moving through the pond.

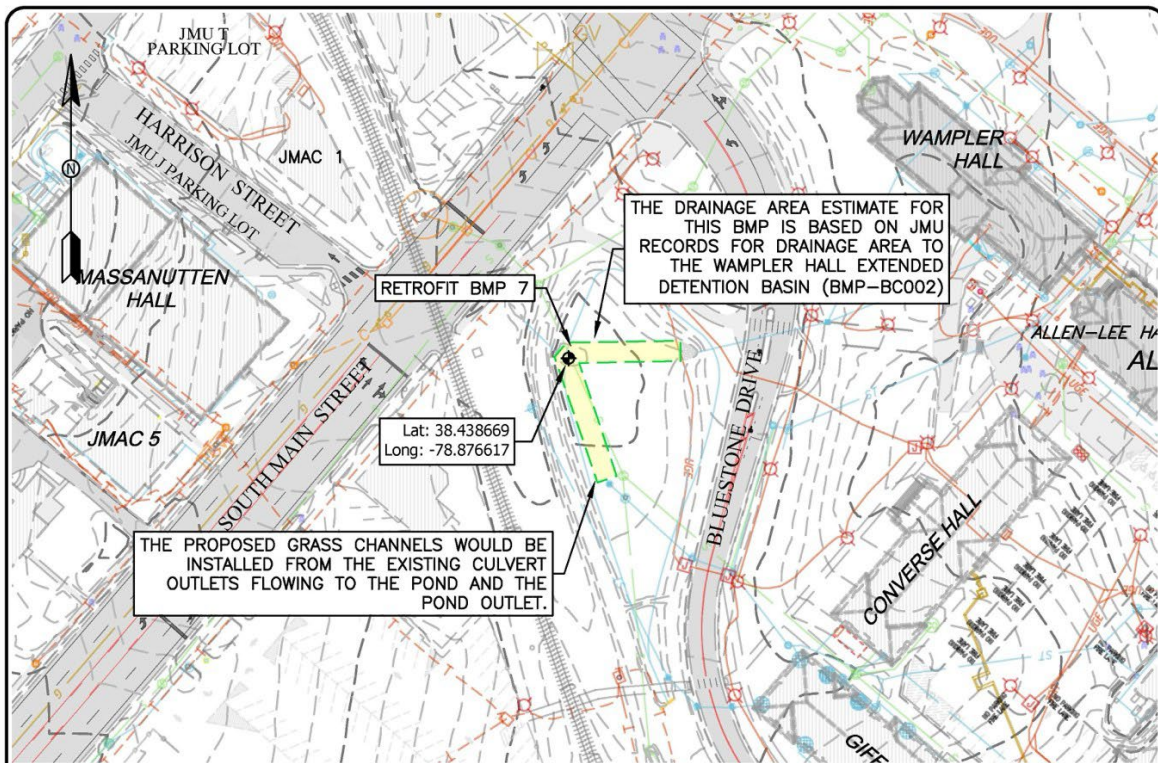
Because access to the pond is located near the intersection of South Main Street and Bluestone Drive, implementation is expected to require moderate coordination. Although this intersection can be busy during the academic year, the proposed work area is generally set back from high-traffic sidewalks and primary pedestrian routes. With appropriate scheduling, construction access, and staging, the project could likely be completed with manageable disruption to students, faculty, staff, and visitors.

JMU staff have noted prior flooding issues at this pond; therefore, a more detailed drainage analysis may indicate that a broader pond redesign—converting the pond into a Level 2 bioretention basin—would provide additional benefits for both stormwater management and pollutant reduction.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 13.6 pounds of total nitrogen, 0.85 pounds of total phosphorus, and 766 pounds of total suspended solids.

Overall, this site offers a moderate pollutant reduction opportunity with moderate coordination needs. While the proposed grass channels may improve treatment within the existing pond, further drainage analysis is recommended before design to determine whether a more comprehensive retrofit would better address flooding and water quality concerns.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 7: WAMPLER HALL	Grass Channels	0.85	\$6,680.00	\$7,858.82	Moderate



RETROFIT BMP 7: WAMPLER HALL							
	PROPOSED BMP:	GRASS CHANNELS			TOTAL DRAINAGE AREA (AC):		3.69
RIVER BASIN	EXISTING LAND USE (AC)				CREDITABLE REDUCTION ESTIMATES		
POTOMAC RIVER	OPEN SPACE	MIXED OPEN	TURF	IMP. COVER	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	0	0	2.01	1.68	13.6	0.85	766

RETROFIT BMP 7 CONSTRUCTION COST ESTIMATE: **\$6,680.00**

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BMP RETROFIT

JMU BMP Study for Blacks Run TMDL Action Plan
James Madison University
800 S Main St
Harrisonburg, VA 22807

PROJECT #:
CE202570

DATE:
May 2026

DESIGN BY:
GLC, PE

SCALE:
1" = 100'

DWG No.

29

3-BMP Retrofit.dwg Plotted: 5/7/2026 By: CE-9

RETROFIT BMP 8: ARBORETUM POND OUTFALL TO UNIVERSITY BLVD



Figure 30: View facing northwest toward the arboretum's west entrance

The streambank within the Edith J. Carrier Arboretum could be stabilized in accordance with Protocol 1 of the Chesapeake Bay TMDL Special Condition Guidance for urban stream restoration. Protocol 1 focuses on reducing sediment erosion from streambanks during storm flow. Stabilizing this segment would reduce sediment loading, with corresponding reductions in phosphorus and nitrogen. For planning purposes, this concept assumes approximately 340 linear feet of stream would be restored along both banks.

Because the project is located within the Edith J. Carrier Arboretum, implementation is expected to require moderate coordination. The Arboretum is a popular public destination and event space, with frequent use by visitors, families, students, and community members. Construction could temporarily affect trail access, event scheduling, visitor circulation, and the overall user experience within the Arboretum.

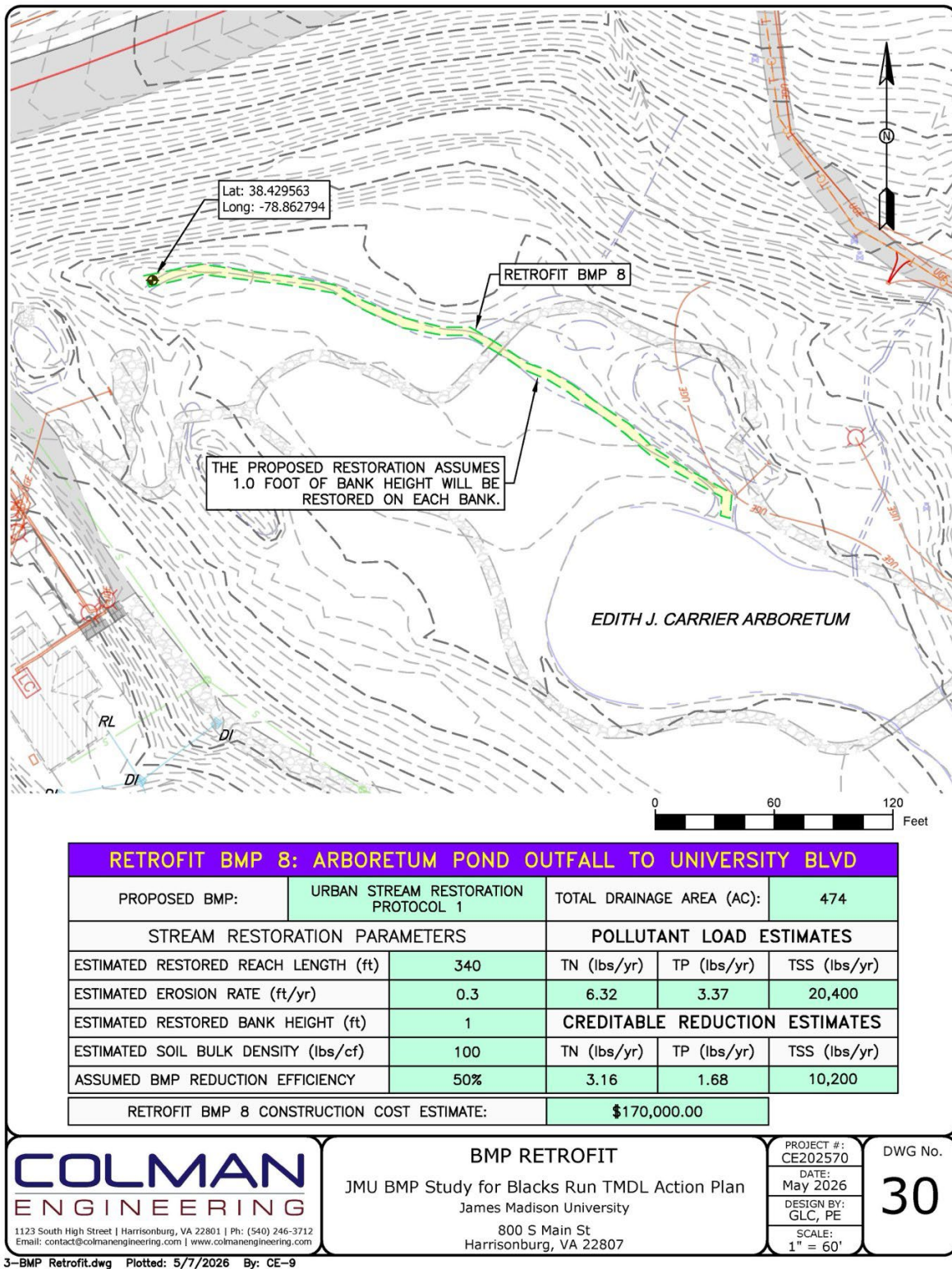
Additional considerations include protecting existing vegetation and sensitive landscape features and maintaining safe temporary access around the work area. This project will also require permitting with the Corps of Engineers, FEMA, and DEQ.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 3.16 pounds of total nitrogen, 1.68 pounds of total phosphorus, and 10,200 pounds of total suspended solids.

Overall, this site offers a meaningful sediment reduction opportunity within a highly visible natural area. However, because of the Arboretum's public use, educational value, and event schedule, implementation would require careful planning to balance stream restoration benefits with visitor access and protection of the existing landscape.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 8: ARBORETUM POND OUTFALL TO UNIVERSITY BLVD	Stream Restoration	1.68	\$170,000.00	\$101,190.48	Moderate

*This opportunity is categorized as a retrofit because stabilization measures are already present but are underperforming.



RETROFIT BMP 9: SINCLAIR MEMORIAL GARDEN SPIRAL POND - NORTH

Figure 31: View facing north toward University Boulevard

A Level 2 bioretention basin could be installed near the outfall of the culvert that conveys flow under University Boulevard to the spiral pond. Due to site constraints, the proposed basin would likely function as an offline BMP, capturing and treating a portion of the culvert flow rather than the entire drainage area.

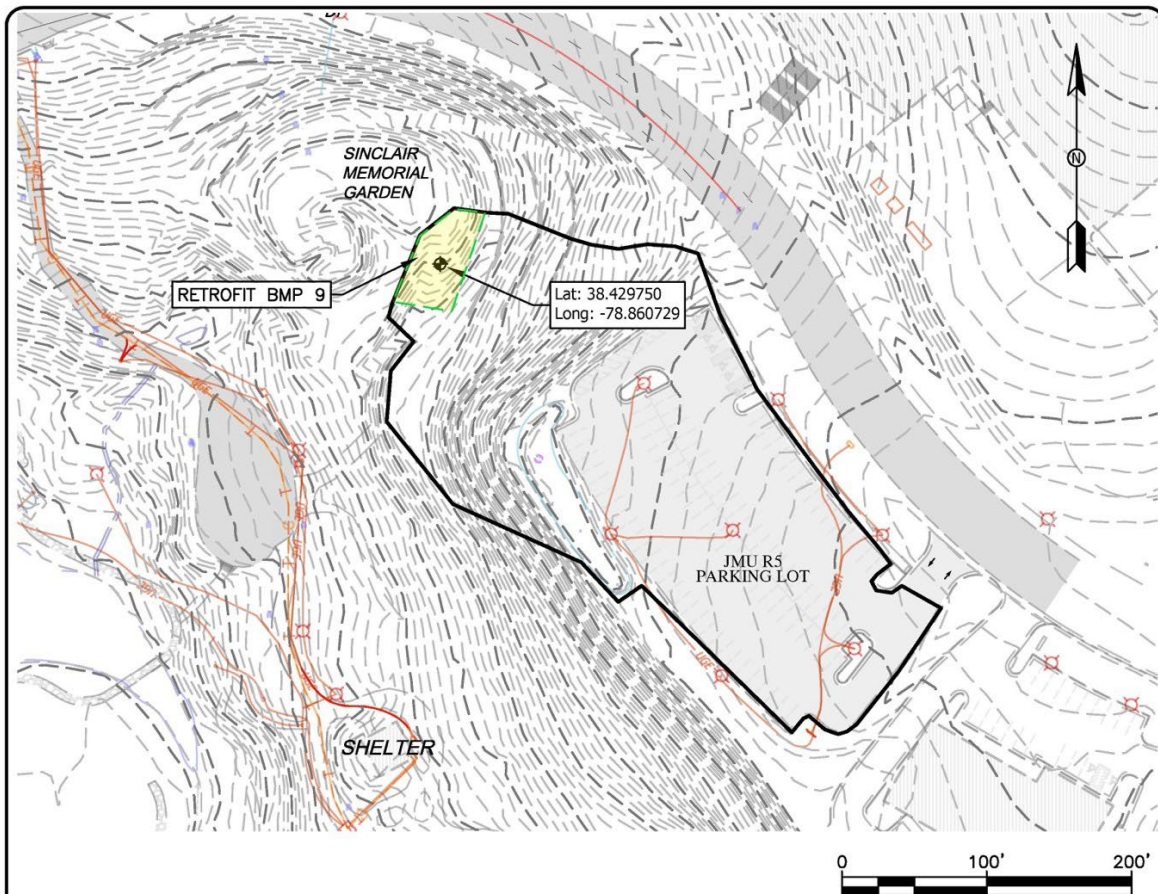
Although the site is located within the Edith J. Carrier Arboretum, it is not in a highly trafficked area. As a result, implementation is expected to have limited impact on students, faculty, staff, and visitors. Temporary impacts would likely be limited to construction access, staging, and localized disturbance near the proposed basin footprint.

Additional considerations include steep surrounding slopes, limited available footprint, and the likely need for retaining walls along the north and east sides of the basin. These constraints may make design and construction more complex than other bioretention opportunities identified in this report.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 13.93 pounds of total nitrogen and 1.01 pounds of total phosphorus.

Overall, this site offers a moderate pollutant reduction opportunity with limited anticipated campus disruption. However, the constrained footprint and steep slopes would require careful design and construction planning before implementation.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 9: SINCLAIR MEMORIAL GARDEN SPIRAL POND - NORTH	Bioretention	1.01	\$112,280.00	\$111,168.32	Limited



RETROFIT BMP 9: SINCLAIR MEMORIAL GARDEN SPIRAL POND – EAST							
	PROPOSED BMP:	BIORETENTION LEVEL 2			DRAINAGE AREA TREATED (AC):		1.39
RIVER BASIN	EXISTING LAND USE (AC)				CREDITABLE REDUCTION ESTIMATES		
POTOMAC RIVER	OPEN SPACE	MIXED OPEN	TURF	IMP. COVER	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	0	0	0.39	1.0	13.93	1.01	–
RETROFIT BMP 9 CONSTRUCTION COST ESTIMATE:				\$112,280.00			

COLMAN ENGINEERING 1123 South High Street Harrisonburg, VA 22801 Ph: (540) 246-3712 Email: contact@colmanengineering.com www.colmanengineering.com	BMP RETROFIT JMU BMP Study for Blacks Run TMDL Action Plan James Madison University 800 S Main St Harrisonburg, VA 22807	PROJECT #: CE202570 DATE: May 2026 DESIGN BY: GLC, PE SCALE: 1" = 100'	DWG No. 31
		3-BMP Retrofit.dwg Plotted: 5/7/2026 By: CE-9	

RETROFIT BMP 10: SINCLAIR MEMORIAL GARDEN SPIRAL POND - EAST



Figure 32: View facing north toward University Boulevard

A Level 2 bioretention basin could be installed near the outfall of the culvert that conveys runoff from JMU Parking Lot R5 to the spiral pond. This area has more available space than Retrofit BMP 9 and could likely be designed to treat the full flow from the culvert.

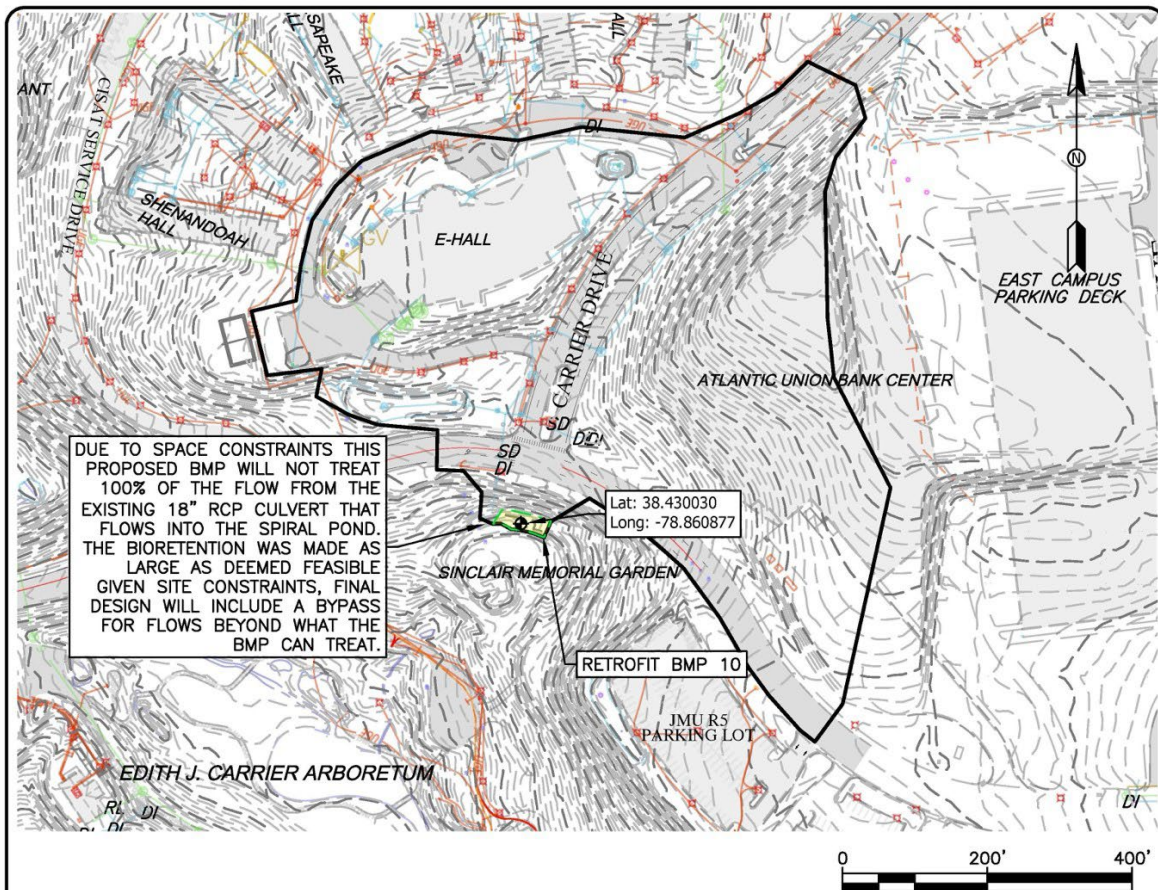
Although the site is located within the Edith J. Carrier Arboretum, it is not in a highly trafficked area. As a result, implementation is expected to have limited impact on students, faculty, staff, and visitors. Temporary impacts would likely be limited to construction access, staging, and localized disturbance near the proposed basin footprint.

Unlike Retrofit BMP 9, this site appears to have enough available space to avoid major retaining walls or other significant structural features beyond standard bioretention design requirements, which may make design and construction relatively straightforward.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 10.42 pounds of total nitrogen and 0.81 pounds of total phosphorus.

Overall, this site offers a moderate pollutant reduction opportunity with limited anticipated campus disruption. Its available footprint, proximity to existing drainage infrastructure, and lower anticipated design complexity make it a practical candidate for future bioretention implementation.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 10: SINCLAIR MEMORIAL GARDEN SPIRAL POND - EAST	Bioretention	0.81	\$178,080.00	\$219,851.85	Limited



RETROFIT BMP 10: SINCLAIR MEMORIAL GARDEN SPIRAL POND – NORTH							
	PROPOSED BMP:	BIORETENTION LEVEL 2			DRAINAGE AREA TREATED (AC):		1.18
RIVER BASIN	EXISTING LAND USE (AC)				CREDITABLE REDUCTION ESTIMATES		
POTOMAC RIVER	OPEN SPACE	MIXED OPEN	TURF	IMP. COVER	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
	0	0	0.63	0.55	10.42	0.81	—
RETROFIT BMP 10 CONSTRUCTION COST ESTIMATE:				\$178,080.00			

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BMP RETROFIT

JMU BMP Study for Blacks Run TMDL Action Plan
James Madison University
800 S Main St
Harrisonburg, VA 22807

PROJECT #: CE202570

DATE: May 2026

DESIGN BY: GLC, PE

SCALE: 1" = 200'

DWG No.

32

3-BMP Retrofit.dwg Plotted: 5/7/2026 By: CE-9

RETROFIT BMP 11: ARBORETUM WETLANDS



Figure 33: View facing north

Constructed wetlands could be installed along the existing Arboretum stream to provide additional pollutant removal while also reconnecting more of the stream to its floodplain. Some constructed wetlands have already been installed within this stream corridor; the proposed wetlands would need to be designed and located so they complement the existing features and work in combination with them to improve overall treatment.

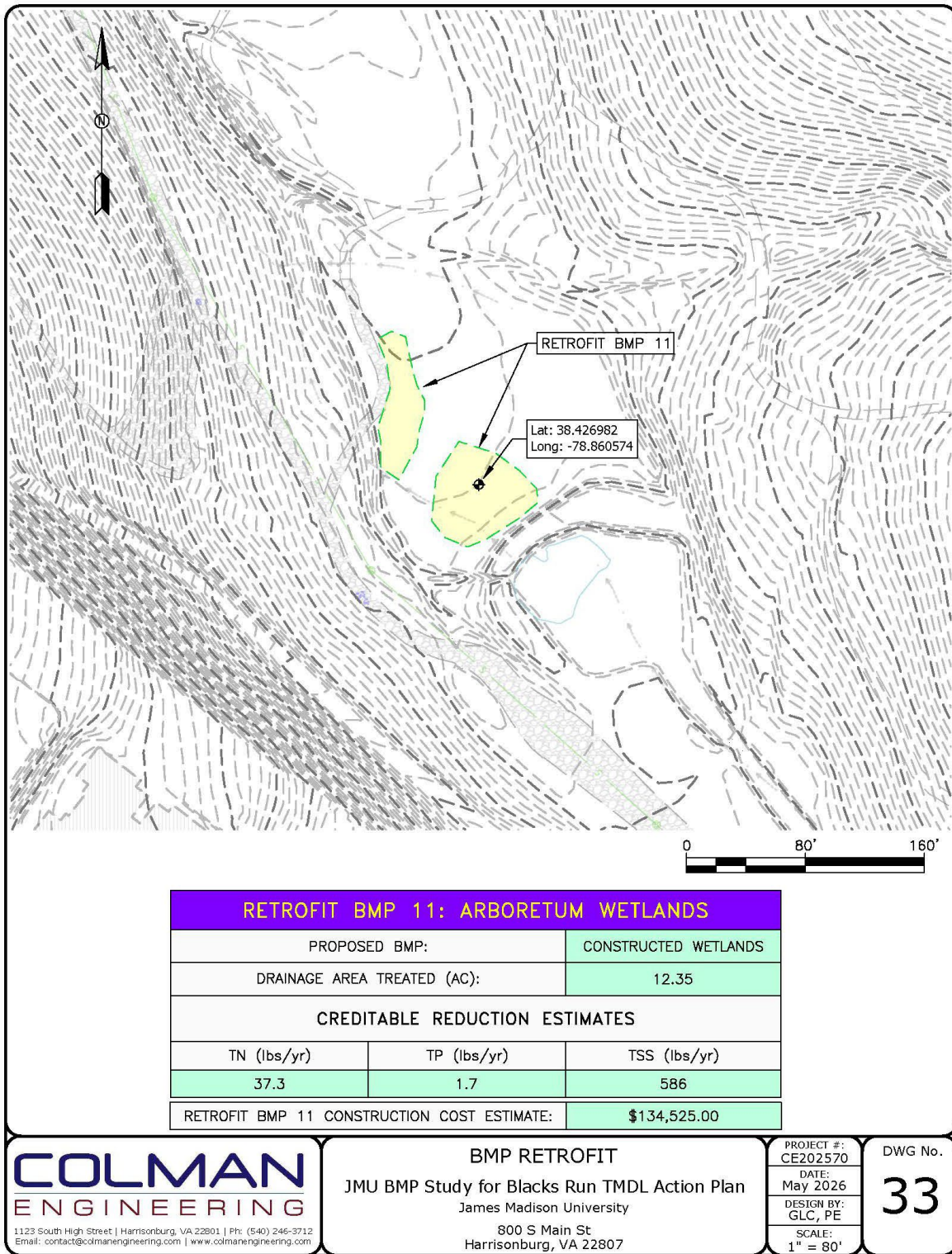
Although the project is located within the Edith J. Carrier Arboretum, this area is expected to have limited campus disruption. Temporary impacts would likely be limited to construction access, staging, and localized effects on nearby trails or Arboretum use during construction.

Because constructed wetland design is typically more detailed and extensive than many other BMP types, this project may be relatively expensive compared to its pollutant reduction benefit. Careful review would also be needed to avoid impacts to existing Arboretum features and to ensure the proposed wetlands function as intended.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 37.3 pounds of total nitrogen, 1.7 pounds of total phosphorus, and 586 pounds of total suspended solids.

Overall, this site offers a moderate pollutant reduction opportunity with limited anticipated campus disruption. However, because constructed wetland design can be complex and potentially costly, the project would require careful evaluation to determine whether its treatment benefits justify the expected design and construction effort.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 11: ARBORETUM WETLANDS	Constructed Wetlands	1.7	\$134,525.00	\$79,132.35	Limited



RETROFIT BMP 12: JMU ALTERNATE FUEL BUILDING



Figure 34: View facing north toward the Alternate Fuel Building

A Level 2 bioretention basin could be installed to treat the drainage area southwest of the Alternate Fuel Building on the JMU Transportation Department property. Although the drainage area is small, approximately 0.3 acres, it consists entirely of impervious pavement and therefore produces a relatively high pollutant load for its size.

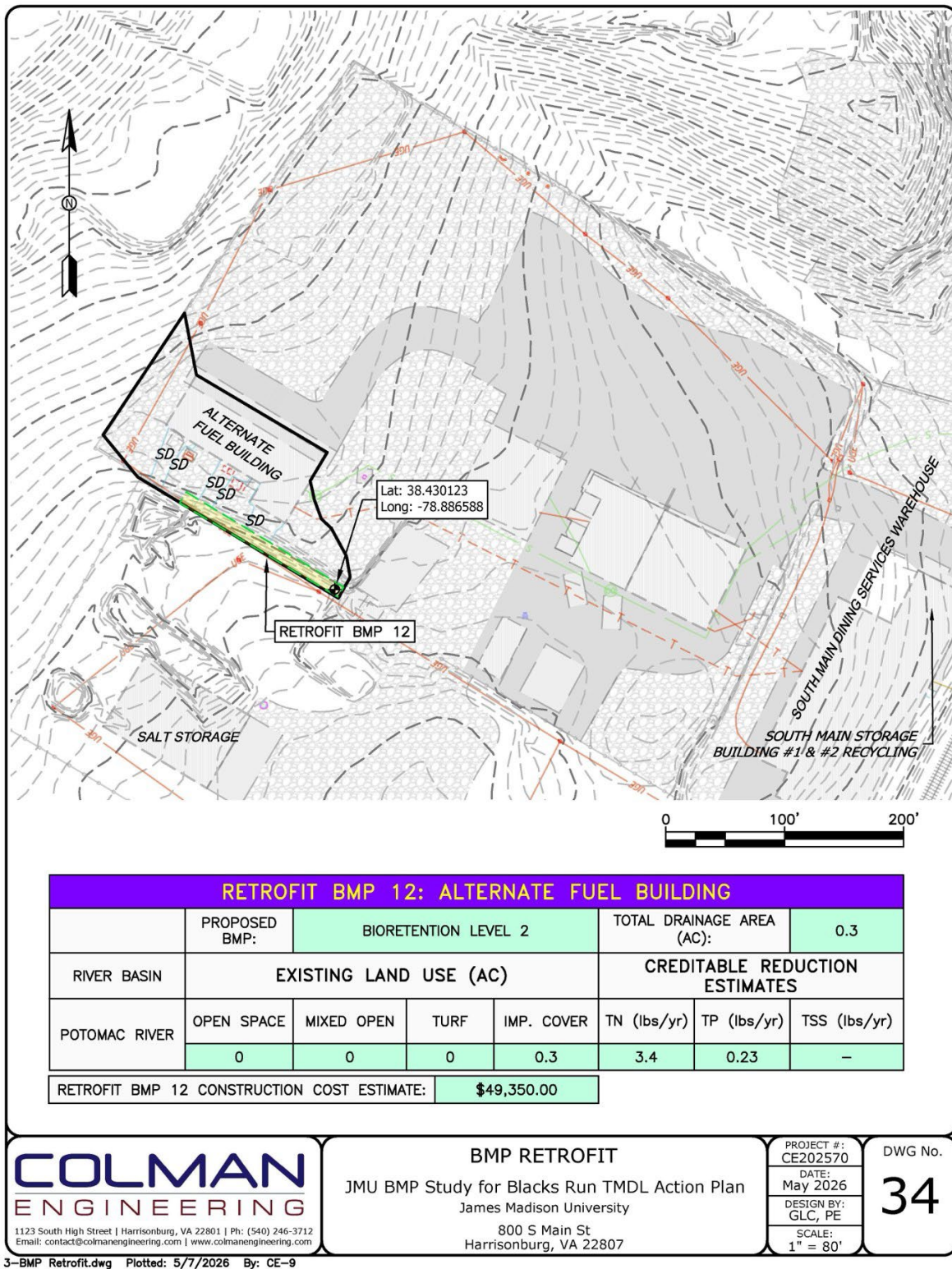
Because the site is located within the Transportation Department maintenance area and away from public access, implementation is expected to have limited impact on campus life. Temporary impacts would likely be limited to construction access, staging, and coordination with Transportation Department operations.

Additional considerations include the steep slope between the existing parking lot and the grassy area south of the lot and fuel building. The proposed basin would likely need to be constructed along the existing slope, with a retaining wall or similar structural support along the south side where the toe of the slope is currently located.

Based on planning-level calculations, the estimated annual pollutant reduction potential is approximately 3.40 pounds of total nitrogen and 0.23 pounds of total phosphorus.

Overall, this site offers a modest pollutant reduction opportunity with limited anticipated campus disruption. While the drainage area is small, the fully impervious contributing area and controlled maintenance setting make it a practical candidate for future bioretention implementation.

BMP Site	BMP Type	TP Removed (lbs/yr)	Construction Cost Estimate	Construction Cost per Annual lb TP Removed	Campus Disruption
RETROFIT BMP 12: JMU ALTERNATE FUEL BUILDING	Bioretention	0.23	\$49,350.00	\$214,565.22	Limited



APPENDIX: METHODOLOGIES

The methodologies used in this report are intended to provide planning-level estimates of potential pollutant reduction benefits, implementation costs, and relative project priority for BMP opportunities. The methods are based on applicable Virginia Department of Environmental Quality guidance, the Virginia Stormwater Management Handbook, the Chesapeake Bay TMDL Special Condition Guidance, Chesapeake Bay Program BMP guidance and expert panel recommendations, the Virginia Runoff Reduction Method, and available site information.

Because this study is intended for screening and prioritization, the calculations presented in this report should be considered conceptual. They are intended to help JMU compare opportunities and identify projects that may warrant further evaluation, design, and regulatory coordination. The pollutant reduction values should not be interpreted as final creditable reductions or approved TMDL reporting values.

Final credit eligibility will depend on the BMP type and the specific conditions of each site. In general, final credit will require confirmation of eligible existing land cover, contributing drainage area, BMP design level, existing BMP function where retrofits are proposed, field measurements where applicable, construction documentation, long-term maintenance responsibilities, and approval by the applicable reviewing authority.

For land use change projects, final creditable acreage should be limited to areas confirmed as eligible existing managed turf unless separate crediting guidance applies. For retrofit projects, final credit should be based on the incremental pollutant reduction above the documented existing condition. For stream restoration projects, final credit should be calculated using accepted Chesapeake Bay Program protocols and supported by field measurements, soil data, design documentation, permitting, and post-construction verification.

LAND USE CONVERSION METHODOLOGY

Land use conversions evaluated in this report offer a cost-effective approach for generating pollutant reduction credits. Compared with structural BMPs, land use conversions generally require less design, construction, and long-term maintenance effort. Typical implementation includes removing or suppressing managed turf grass and either reseeding the area with an appropriate meadow mix for conversion to “mixed open,” or planting trees at the required density for conversion to “forest.”

This methodology is based on Appendix V.H, Land Use Change, of the Chesapeake Bay TMDL Special Condition Guidance. The two land use conversions most applicable to this study are turf-to-forest and turf-to-mixed open. These conversion types are also consistent with the Blacks Run & Cooks Creek TMDL Action Plan, which identifies land use conversion opportunities as part of JMU’s strategy to address remaining phosphorus reduction needs.

For this report, “turf” refers to managed grass or lawn areas. Converting turf to either forest or mixed open reduces pollutant loading because the converted areas are assumed to function as lower-loading, more vegetated land covers. “Mixed open” is defined as herbaceous cover that is minimally disturbed, such as meadow areas, and must be unmanaged to qualify for credit, including no nutrient application. “Forest” conversion areas must meet the tree density requirements described in the Virginia Department of Forestry’s Land Use Tax Assessment Standards, as referenced in the Virginia DEQ guidance and Virginia Administrative Code 4VAC10-20-10.

Pollutant reductions for land use conversions were calculated by multiplying the converted acreage by the applicable Potomac River Basin edge-of-stream reduction values in Table V.H.1 of the DEQ guidance. Because JMU is located in the Blacks Run watershed, which drains to the North River, South Fork Shenandoah River, Potomac River, and ultimately the Chesapeake Bay, the Potomac Basin values were used.

All BMPs and land use conversion opportunities evaluated in this report are located within regulated MS4 areas owned or operated by JMU. The drainage areas contributing to these BMPs are also assumed to be within regulated MS4 areas. No unregulated lands are included in the pollutant reduction calculations. Therefore, no baseline reductions from unregulated lands are attributed or claimed in this study.

TURF TO FOREST CONVERSION

For turf-to-forest conversions, the following Potomac River Basin reduction rates were applied:

Basin	Land Use From	Conversion To	Total Nitrogen (lbs/ac/yr)	Total Phosphorus (lbs/ac/yr)	Total Suspended Solids (lbs/ac/yr)
Potomac	Turf	Forest	5.58	1.46	557

For example, a 3.95-acre turf-to-forest conversion would be calculated as follows:

Pollutant	Calculation	Estimated Reduction
Total Nitrogen	3.95 ac × 5.58 lbs/ac/yr	22.04 lbs/yr
Total Phosphorus	3.95 ac × 1.46 lbs/ac/yr	5.77 lbs/yr
Total Suspended Solids	3.95 ac × 557 lbs/ac/yr	2,200 lbs/yr

This approach was used for each proposed turf-to-forest conversion identified in this report.

TURF TO MIXED OPEN CONVERSION

For turf-to-mixed-open conversions, the following Potomac River Basin reduction rates were applied:

Basin	Land Use From	Conversion To	Total Nitrogen (lbs/ac/yr)	Total Phosphorus (lbs/ac/yr)	Total Suspended Solids (lbs/ac/yr)
Potomac	Turf	Mixed Open	5.28	1.15	0.0

For example, a 0.77-acre turf-to-mixed-open conversion would be calculated as follows:

Pollutant	Calculation	Estimated Reduction
Total Nitrogen	$0.77 \text{ ac} \times 5.28 \text{ lbs/ac/yr}$	4.07 lbs/yr
Total Phosphorus	$0.77 \text{ ac} \times 1.15 \text{ lbs/ac/yr}$	0.89 lbs/yr
Total Suspended Solids	$0.77 \text{ ac} \times 0.0 \text{ lbs/ac/yr}$	0.0 lbs/yr

Turf-to-mixed-open conversions receive no TSS credit under the Chesapeake Bay TMDL Special Condition Guidance because both land uses are pervious vegetated covers and the guidance does not assign an additional sediment reduction value for this conversion type.

This approach was used for each proposed turf-to-mixed-open conversion identified in this report.

STRUCTURAL BMP METHODOLOGY

Structural BMPs were evaluated as engineered stormwater treatment practices that can provide pollutant reduction by capturing, slowing, filtering, infiltrating, or otherwise treating runoff before it is discharged downstream. The structural BMP methodologies in this section apply to proposed new BMPs as well as retrofits to existing stormwater facilities and conveyance features. Pollutant reduction estimates were developed using applicable Virginia Stormwater Management Handbook specifications, DEQ calculation tools, Chesapeake Bay Program guidance, and planning-level assumptions based on available site information.

For retrofit projects involving an existing BMP, pond, channel, or vegetated conveyance feature, final pollutant reduction credit should be calculated as the incremental improvement above the documented existing condition. The planning-level estimates in this report are intended to identify potential retrofit value, but final credit should account for any treatment already provided by the existing facility or conveyance feature to avoid double-counting.

BIORETENTION

Level 2 (VSMH P-FIL-05) Bioretention opportunities were evaluated using the Virginia Stormwater Management Handbook and the Virginia Runoff Reduction Method spreadsheet, VRRM V4.1. VRRM is used to estimate pollutant removal for standard stormwater BMPs based on drainage area, land cover, hydrologic soil group, and BMP design parameters.

For each proposed bioretention area, the contributing drainage area was characterized by land cover type, including impervious cover, turf, mixed open, and forest. Hydrologic soil group assumptions were then applied to estimate runoff volume and nutrient reductions. Where a bioretention design is proposed, the reported pollutant reductions assume that the final design will meet the applicable design criteria.

Bioretention reductions presented in this report are planning-level estimates and should be confirmed during final design using surveyed drainage boundaries, verified soil conditions, and the final BMP geometry.

GRASS CHANNEL

Grass channel retrofit opportunities were evaluated using the Virginia Stormwater Management Handbook, Chapter 8.5, Standards and Specifications for Post-Construction BMPs: Grass Channels (P-CNV-01).

For each grass channel opportunity, existing pollutant loads were estimated using Potomac River Basin loading rates from the Chesapeake Bay TMDL Special Condition Guidance. The drainage area was classified as regulated urban impervious or regulated urban pervious, and pollutant loads were calculated as:

$$\text{Drainage Area} \times \text{Loading Rate} = \text{Existing Pollutant Load}$$

The resulting pollutant loads were then multiplied by the applicable grass channel removal efficiencies for TN, TP, and TSS to estimate annual creditable reductions.

For example, for Retrofit BMP 3, UREC Turf Channel, the regulated urban pervious drainage area was estimated at 0.526 acres. Using the Potomac River Basin loading rates:

Pollutant	Subsource	Loading Rate (lbs/ac/yr)	Developed Lands (ac)	Load (lbs/yr)	Estimated Creditable Reductions (lbs/yr)
Nitrogen	Regulated Urban Impervious	16.86	0	0.00	5.30 lbs/yr x 24% = 1.48 lbs/yr
	Regulated Urban Pervious	10.07	0.526	5.30	
Phosphorus	Regulated Urban Impervious	1.62	0	0.00	0.22 lbs/yr x 28% = 0.05 lbs/yr
	Regulated Urban Pervious	0.41	0.526	0.22	
TSS	Regulated Urban Impervious	1171.32	0	0.00	92.47 lbs/yr x 33% = 30.52 lbs/yr
	Regulated Urban Pervious	175.8	0.526	92.47	

This methodology was used to estimate total nitrogen, total phosphorus, and total suspended solids reductions for proposed grass channel projects. Final design should verify contributing drainage area, channel slope, check dam spacing, vegetative cover, soil conditions, stable conveyance capacity, and maintenance access.

DRY SWALE

Dry swale retrofits were evaluated using the Virginia Stormwater Management Handbook standards and specifications for Dry Swales (P-CNV-02). Dry swales provide pollutant removal through filtration, engineered soil media, vegetation, storage, and infiltration where feasible.

The dry swale proposed in the report (Retrofit BMP 2: Locust Hill Road & University Drive Channel) required more than usual assumptions be made about the runoff flowing into the swale, as the majority of the flow volume is from an existing detention pond outlet pipe. Loading and efficiency rates for the drainage through this existing pond were estimated using averages from the Chesapeake Bay Program's modeled ranges for these values. The existing pond was evaluated in a recent drainage report for the University Boulevard Extension Project. The report, written by VHB and dated January 31, 2025, reported the drainage area to the pond and the drainage area that bypasses the pond but still flows to the proposed dry swale.

VHB Report Drainage Data Used:

Pond Drainage Area (ac)	Pond Impervious Area (ac)	Bypass Drainage Area (ac)	Bypass Impervious Area (ac)
8.25	5.21	2.09	0.2

Where:

- Pond Drainage Area = total area draining to the existing pond, in acres
- Pond Impervious Area = total impervious area draining to the existing pond, in acres
- Bypass Drainage Area and Bypass Impervious Area = areas of Pond Drainage Area and Pond Impervious Area that will flow to the proposed dry swale but not through the pond

The loads associated with the pond drainage and the bypass drainage were separated to accurately estimate how much pollutant exists to be treated by the dry swale.

The existing pond's removal amount was also provided in the VHB drainage report as 5.27 lb/yr.

The assumed loading rates for each area are listed below. Estimates for loading were made using Chesapeake Bay Program's modeled loading rated for mixed urban spaces.

TP Loading Rate (Pond Area)	TP Loading Rate (Bypass Area)	TN Loading Rate (Pond Area)	TN Loading Rate (Bypass Area)
0.9 (lb/ac/yr)	0.5 (lb/ac/yr)	8 (lb/ac/yr)	5 (lb/ac/yr)

TP through Pond	Formula	Results (lb/yr)
Total TP Load (Pond Area)	$8.25 \text{ ac} \times 0.90 =$	7.43
TP Removed by Pond	Given (VHB Report)	5.27
Remaining TP After Pond	$7.43 \text{ lb/yr} - 5.27 \text{ lb/yr} =$	2.16
TP bypassing Pond	Formula	Result
TP Load (Bypass Area)	$2.09 \text{ ac} \times 0.5 =$	1.05
Total Phosphorus Load to Swale	$2.16 \text{ lb/yr} + 1.05 \text{ lb/yr}$	3.21
TP Removed by Swale	$3.21 \text{ lb/yr} \times 52\% =$	1.67 lb/yr

Pollutant removal efficiencies for the proposed dry swale were conservatively assumed at 52% for total phosphorus and 55% for total nitrogen. These values are consistent with a Level 1 design approach as described in the Virginia Stormwater Management Handbook and are lower than typical Chesapeake Bay Program BMP efficiencies to account for site constraints and upstream treatment provided by the existing dry detention pond.

The same methodology was used to estimate the nitrogen removal rate for the Dry Swale using the TN loading and efficiency rates.

Final design should verify drainage area, bypass flow, existing pond function, swale geometry, soil media, underdrain configuration, hydraulic capacity, overflow routing, and creditable pollutant reductions.

CONSTRUCTED WETLANDS

Constructed wetland opportunities were evaluated using the Virginia Stormwater Management Handbook, Chapter 8.5, Standards and Specifications for Post-Construction BMPs: Constructed Wetlands (P-BAS-01), and the Chesapeake Bay Program expert panel report for Nontidal Wetland Creation, Rehabilitation, and Enhancement, dated March 18, 2020.

The full drainage area to the arboretum stream was estimated at approximately 474 acres. Treating the full drainage area was determined to be infeasible due to available site area constraints. Therefore, the potential treatment area was estimated by identifying the acreage that could reasonably be converted to constructed

wetland and back-calculating the contributing drainage area using the assumption that the wetland surface area should equal approximately 1 percent of the treated drainage area.

The proposed constructed wetland area was estimated at 0.1235 acres. Based on the 1 percent sizing assumption, the conceptual treated drainage area was calculated as:

$$0.1235 \text{ acres} \times 100 = 12.35 \text{ acres treated}$$

The following planning-level loading rates were used:

TP Loading Rate (lb/ac/yr)	TN Loading Rate (lb/ac/yr)	TSS Loading Rate (lb/ac/yr)
0.41	10.07	175.80

For example, TP removal was estimated as follows:

	Formula	Result
TP Load to Constructed Wetlands	12.35 ac x 0.41 =	5.1 lb/yr
TP Removed by Constructed Wetlands	5.1 lb/yr x 33% =	1.7 lb/yr

Pollutant removal efficiencies for the proposed constructed wetlands are assumed at 33% for total phosphorus, 30% for total nitrogen, and 27% for total suspended solids. These values are consistent with the removal efficiencies for constructed wetlands listed in the expert panel report dated March 18, 2020. These efficiencies are for planning purposes only and should not be used for final design without verification.

The same methodology was used to estimate the loading rates and pollutant removal for TN and TSS.

STREAM RESTORATION METHODOLOGY

Urban stream restoration opportunities were evaluated using the applicable Chesapeake Bay Program and expert panel methodologies for estimating pollutant reductions from individual stream restoration projects. The primary references used for conceptual stream restoration credit estimates are:

- *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects*, September 2014
- *Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects Built for Pollutant Removal Credit*, February 27, 2020
- *Design Example for Protocol 1 - Credit for Prevented Sediment During Storm Flow*, July 27, 2021

For this study, proposed stream restoration projects were evaluated using Urban Stream Restoration Protocol 1: Prevented Sediment During Storm Flow. DEQ guidance identifies Protocol 1 as one of the established methods for calculating reductions from urban stream restoration projects.

The general stream restoration conceptual design methodology is as follows. First, the erosion rate of the bank must be estimated. For formal design this value will be measured in the field; for the purpose of this study it was estimated using Equation 1 from page 35 of *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects*.

$$S = \Sigma(c \times A \times R) \div 2,000$$

where:

- S = sediment load, in tons per year
- C = bulk density of soil, in pounds per cubic foot
- A = eroding bank area, in square feet
- R = bank erosion rate, in feet per year
- 2,000 = conversion factor from pounds to tons

Without a thorough field analysis these values had to be estimated using assumptions for the conditions found in Blacks Run and Sibert Creek.

Second, estimated streambank erosion is converted to pollutant loading using assumed nutrient and sediment concentrations in eroding bank material. For final design, soil samples should be collected and analyzed to determine site-specific pollutant concentrations. The values provided in this report are estimated from the following table, provided on page 21 of *Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects Built for Pollutant Removal Credit*.

Source	TP AVG	TP Range	TN AVG	TN Range	Location
Land Studies 2005*	1.43	0.93-1.87	4.41	2.8-6.8	PA
Baltimore DPW 2006*	0.439	0.19-0.9	--	--	MD
Walter et al. 2007*	1.05	0.68-1.92	2.28	0.83-4.32	PA
Stewart 2012*	1.78	--	5.41	--	MD
Merritts et al. 2010	1.2	0.9-1.5	2.6	1.7-3.5	PA
Stantec 2013	0.33	0.02-4.24	0.62	0.06-3.12	VA
Tetra Tech 2013	0.46	0.004-4.8	1.78	0.0066-10.6	NC
Doll et al. 2018	0.56	0.30-1.57	1.34	1.01-2.64	NC

Third, pollutant reductions for each stream restoration project are estimated by applying an assumed stream restoration efficiency of 50%. This is calculated by multiplying the loading rate for each pollutant by 50%. The assumed 50% efficiency originates from the Baltimore County DEP Spring Branch Study from the 2014 Expert Panel Report and is also used in Design Example for Protocol 1: Credit for Prevented Sediment During Storm Flow to estimate the removal efficiency for the proposed urban stream restoration project at Hickey Run in Washington, D.C. The pollutant reduction efficiency for any projects on JMU's campus will be determined during a thorough design process before reductions are deemed creditable.

COST ESTIMATING METHODOLOGY

The cost estimates and pollutant reduction values presented in this report are intended to support relative comparison of potential projects. Cost-effectiveness was generally evaluated by comparing planning-level construction cost to estimated annual total phosphorus reduction. Where presented, cost per pound of total phosphorus removed was calculated as:

$$\text{Cost per Annual Pound of TP Removed} = \text{Planning-Level Construction Cost} \div \text{Estimated Annual TP Reduction}$$

This value represents cost per annual pound of total phosphorus reduction and is intended for comparison among alternatives. It does not represent an annual project cost.

PRIORITIZATION METHODOLOGY

The opportunities identified in this report were prioritized using a planning-level decision matrix. The purpose of the matrix is to support comparison among the proposed BMPs and help identify projects that appear to be the strongest candidates for further evaluation and potential implementation.

Each opportunity was scored using four criteria:

- TP Reduction
- Feasibility
- Cost Effectiveness
- Reporting Certainty

Each criterion was assigned a score from 1 to 5, with 5 representing the most favorable condition and 1 representing the least favorable condition. The four scores were added together to calculate a total decision matrix score. The maximum possible score for each opportunity is 20 points. The scoring system is intended for planning and screening purposes only and should not be interpreted as a final recommendation for construction.

TP REDUCTION

The TP Reduction score reflects the estimated annual total phosphorus reduction for each opportunity. Because phosphorus is the primary pollutant of concern for the Blacks Run & Cooks Creek TMDL Action Plan, higher TP reductions receive higher scores.

Total nitrogen and total suspended solids reductions were reviewed as supporting information, particularly for stream restoration and other sediment-focused opportunities, but the score is based primarily on estimated TP reduction.

FEASIBILITY

The Feasibility score reflects the likelihood that an opportunity could be advanced toward implementation. It considers constructability, campus disruption, and aesthetics.

- Constructability accounts for design complexity, permitting needs, construction access, specialized methods, and post-construction monitoring. Projects with straightforward design and construction generally receive higher scores; projects requiring extensive engineering, field assessment, permitting, or monitoring generally receive lower scores.
- Campus disruption accounts for potential effects on students, faculty, staff, visitors, parking, circulation, athletic operations, public spaces, and routine campus activities. Projects in remote or operational areas generally receive higher scores than projects in highly visible or heavily used areas.
- Aesthetics accounts for whether the project can be integrated into the campus landscape in a manner consistent with JMU's campus character and beautification goals.

COST EFFECTIVENESS

The Cost Effectiveness score reflects the relative affordability of each opportunity compared with its estimated pollutant reduction benefit. This category is based primarily on the estimated construction cost per annual pound of total phosphorus removed, calculated as:

$$\text{Cost per Annual Pound of TP Removed} = \text{Planning-Level Construction Cost} \div \text{Estimated Annual TP Reduction}$$

Opportunities with a lower cost per annual pound of TP removed receive higher scores, while opportunities with a higher cost per annual pound of TP removed receive lower scores. Overall construction cost was also considered, since a project with a favorable cost-per-pound value may still require a large capital investment that could affect implementation timing or funding availability.

REPORTING CERTAINTY

The Reporting Certainty score reflects confidence that estimated pollutant reductions can be documented, approved, and credited through the applicable reporting process.

BMPs with established calculation procedures, clear regulatory guidance, and limited site-specific assumptions receive higher scores. Examples include practices that can be evaluated using DEQ guidance and the Virginia Runoff Reduction Method spreadsheet.

BMPs requiring detailed field investigation, soil sampling, geomorphic assessment, or regulatory interpretation receive lower scores. Stream restoration projects, for example, may provide substantial reduction potential but require more documentation before reductions can be deemed creditable.

Decision Matrix Criteria and Scoring

BMP Site	TP Reduction	Feasibility	Cost Effectiveness	Reporting Certainty	Total (max 20)
LUC 13: JMU U2 & U3 PARKING LOTS	5	5	5	5	20
LUC 14: JMU U4 PARKING LOT	5	5	5	5	20
LUC 3: JMU OLD UNIVERSITY BOULEVARD	5	5	5	5	20
LUC 1: JMU DRIVER DRIVE FOREST	5	5	5	4	19
LUC 16: JMU SOUTH MAIN STREET MAINTENANCE	4	4	5	5	18
LUC 5: JMU D2 PARKING LOT ISLAND	5	4	5	4	18
LUC 11: JMU Y PARKING LOT – MEMORIAL HALL	3	4	5	5	17
LUC 12: JMU R9 PARKING LOT – MEMORIAL HALL	2	5	5	5	17
LUC 2: JMU HILLSIDE FIELD SIBERT CREEK STREAM BUFFER	5	3	5	4	17
LUC 6: JMU FIELD HOCKEY COMPLEX AREA	5	3	5	4	17
LUC 8: JMU EAST CAMPUS PONDS	4	4	5	4	17
LUC 10: JMU C14 PARKING LOT – MEMORIAL HALL	1	5	5	5	16
LUC 15: JMU SALT STORAGE SHED	2	4	5	4	15
LUC 4: JMU R2 PARKING LOT ISLAND	3	3	5	4	15
LUC 7: JMU KING HALL	4	1	5	5	15
NEW BMP 6: JMU TRANSPORTATION DEPARTMENT STORAGE YARD	5	5	1	4	15
RETROFIT BMP 2: LOCUST HILL ROAD & UNIVERSITY DRIVE CHANNEL	5	4	3	3	14
RETROFIT BMP 6: MASSANUTTEN HALL	2	5	2	5	14
RETROFIT BMP 7: WAMPLER HALL	3	4	4	3	14
NEW BMP 1: JMU R2 PARKING LOT	5	3	1	4	13
RETROFIT BMP 1: JMU R2 PARKING LOT CHANNEL	3	4	3	3	13
RETROFIT BMP 10: SINCLAIR MEMORIAL GARDEN SPIRAL POND - EAST	3	5	1	4	13
LUC 9: JMU VETERANS MEMORIAL DRIVE – MEMORIAL HALL	2	1	5	4	12
NEW BMP 4: SOUTH WILLOW STREET BASEBALL FIELD	5	3	2	2	12
NEW BMP 5: JMU R12 PARKING LOT AND FACILITIES BUILDINGS	5	3	2	2	12
RETROFIT BMP 11: ARBORETUM WETLANDS	4	4	2	1	11
RETROFIT BMP 5: JMU R8 PARKING LOT	5	3	1	2	11
RETROFIT BMP 9: SINCLAIR MEMORIAL GARDEN SPIRAL POND - NORTH	4	3	1	3	11
RETROFIT BMP 12: JMU ALTERNATE FUEL BUILDING	2	3	1	4	10
RETROFIT BMP 4: JMU C4 PARKING LOT	5	2	1	2	10
RETROFIT BMP 8: ARBORETUM POND OUTFALL TO UNIVERSITY BLVD	4	3	1	2	10
RETROFIT BMP 3: UREC TURF CHANNEL	1	4	1	3	9
NEW BMP 2: MUSIC BUILDING AND SPOTSWOOD HALL	2	1	1	4	8
NEW BMP 3: SHELDON & ALUMNAE HALLS	2	1	1	4	8