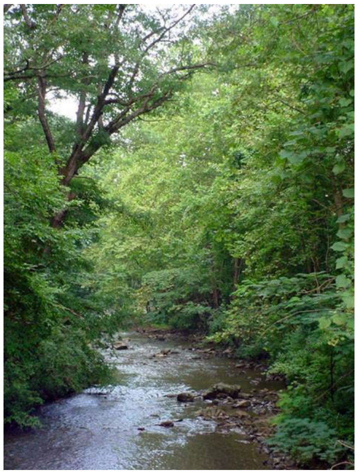
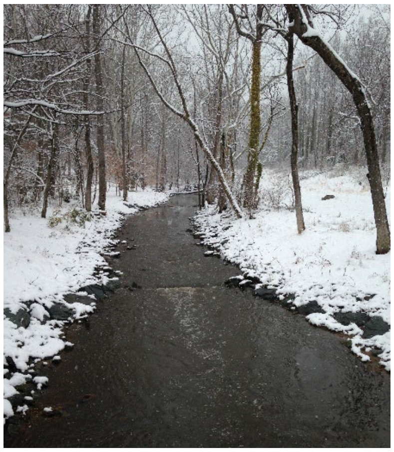
City of Charlottesville, Virginia

Sediment Total Maximum Daily Load (TMDL) Action Plan for Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch

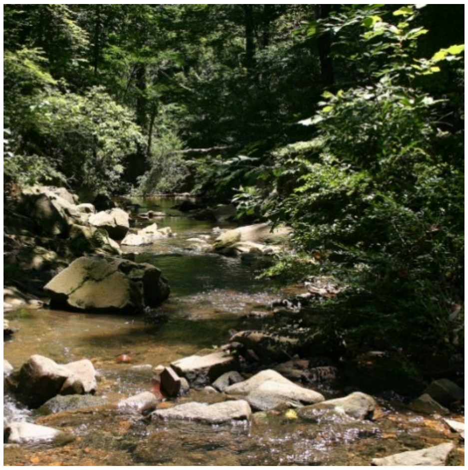


Moores Creek

Lodge Creek



Meadow Creek



Schenks Branch

MS4 General Permit Registration Number VAR040051
April 2025

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Background

The City of Charlottesville, Virginia's corporate limits and population of just over 48,000 people are located within the 750 square mile Rivanna River watershed. The Rivanna River watershed is part of the larger James River watershed, the largest watershed in Virginia; the James River is a major tributary of the Chesapeake Bay. Originating from springs in the foothills of the Blue Ridge Mountains, the Rivanna River flows along the eastern portion of Charlottesville and forms a boundary with neighboring Albemarle County. The Rivanna River and its urban tributaries provide important ecological, recreational, and cultural value to the city.

The city's 10.2 square miles contain approximately thirty-five miles of open waterways, with approximately thirteen additional miles of waterways that flow inside of the stormwater infrastructure system. Charlottesville consists of three main drainage areas. Along the eastern portions of the city, approximately 1.3 square miles of land drain through minor tributaries of or directly into the Rivanna River. The Meadow Creek and Moores Creek watersheds are the two largest drainage areas within the city and both drain into the Rivanna River. The Meadow Creek watershed spans the northern portion of the city and has a highly urbanized drainage area of approximately nine square miles, about 70 percent of which is located within the city limits. Schenks Branch is a tributary of Meadow Creek, and its approximately 2 square mile watershed encompasses much of downtown Charlottesville. Moores Creek, which has its headwaters in Albemarle County, forms the southern boundary of the city; approximately 3.8 square miles of the city drain into the creek. The thirty-five square mile Moores Creek watershed encompasses diverse land uses including highly urbanized areas, suburban and rural, agricultural, as well as open space within Charlottesville and Albemarle County. Lodge Creek is a tributary of Moores Creek, has an approximately .5 square mile watershed, and its headwaters are on the grounds of the University of Virginia.

The City has a municipal separate storm sewer system (MS4), meaning there are two separate conveyance systems for stormwater and sewage, with wastewater from residents and businesses flowing to the wastewater treatment plant, and stormwater draining untreated directly into local surface waters. As a result of stormwater runoff's impacts to water quality, stormwater discharges from MS4s are regulated by the United States Environmental Protection Agency (EPA) under the Clean Water Act and by the Commonwealth of Virginia under the Virginia Stormwater Management Act. The regulations governing MS4s were developed and implemented in two phases. The first phase began in the early 1990s, requiring operators of MS4s serving populations of greater than 100,000 people to apply for and obtain a permit to discharge stormwater collected by their systems into waterways. The second phase of MS4 regulations became effective March 23, 2003, and requires that operators of small MS4s (less than 100,000 people) in "urbanized areas" obtain permit coverage for stormwater discharges. Small MS4s include stormwater systems operated by cities such as Charlottesville, as well as counties, towns, community colleges, and public universities.

In Virginia, discharges from small MS4s are regulated by the Department of Environmental Quality (DEQ), under the *General Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems* (MS4 General Permit). Under that permit, small MS4s must develop, implement, and enforce a stormwater management program that addresses six “minimum control measures (MCMs)" to control the discharge of pollutants from the MS4 to “the maximum extent practicable” through the development and implementation of best management practices (BMP).

As required by the EPA and Commonwealth of Virginia, the City of Charlottesville operates and enforces a stormwater management program. The City was originally issued a stormwater discharge permit from DEQ on March 4, 2003 (Permit No. VAR040051). Subsequently, regulatory authority and program oversight was transferred to the Virginia Department of Conservation and Recreation (DCR) in January 2005, and the permit expired on December 9, 2007. This permit was administratively extended while new permit requirements were being finalized. The City’s second MS4 General Permit was issued by DCR on July 9, 2008 and remained in effect until July 1, 2013. Regulatory authority and program oversight was transferred back to DEQ in 2013, and the City’s third MS4 General Permit was issued on July 1, 2013 and the permit expired on October 31, 2018. This permit was administratively extended while new permit requirements were being finalized. The City’s fourth MS4 General Permit was issued by DEQ on November 1, 2018 and remained in effect until it expired on October 31, 2023. The City’s fifth, and current, MS4 General Permit was issued on November 1, 2023 and will remain in effect until it expires on October 31, 2028. The City posted this Action Plan for public comment in accordance with Part II.B.9 of the MS4 General Permit. No public comments were received.

The City has prepared this Local TMDL Action Plan to address Part II.B of the City’s MS4 General Permit, *Local TMDL Special Condition*. This included an evaluation of the results achieved by the previous version of the Action Plan. While the benthic and bacteria impairments remain in place for the Rivanna River, the actions documented in the Action Plan were completed in accordance with the MS4 General Permit and have contributed to the reduction of sediment and bacteria inputs to the Rivanna River. The City coordinated with the County of Albemarle (the County) and the University of Virginia (UVA) in the development of this Action Plan.

The requirements of this Action Plan, as presented in Part II.B of the MS4 General Permit, are below:

B. Local TMDL special condition.

> 2. Permittees previously covered under the General VPDES Permit for Discharges of Stormwater from MS4 effective November 1, 2018, shall develop and maintain a local TMDL action plan designed to reduce loadings for pollutants of concern if the permittee discharges the pollutants of concern to an impaired water for which a TMDL has been approved by the U.S. Environmental Protection Agency (EPA) as described in Part II B 2 a and 2 b:
>
> > a. For TMDLs approved by EPA prior to July 1, 2018, and in which an individual or aggregate wasteload has been allocated to the permittee, the permittee shall develop and initiate or update as applicable the local TMDL action plans to meet the conditions of Part II B 4, B 6, B 7, and B 8, as applicable, no later than 18 months after the permit effective date and continue implementation of the action plan. Updated action plans shall include:

    (1) An evaluation of the results achieved by the previous action plan; and
    (2) Any adaptive management strategies incorporated into updated action plans based on action plan evaluation.

  b. For TMDLs approved by EPA on or after July 1, 2018, and prior to October 31, 2023, and in which an individual or aggregate wasteload has been allocated to the permittee, the permittee shall develop and initiate implementation of action plans to meet the conditions of Part II B 4, B 5, B 6, B 7, and B 8, as applicable no later than 30 months after the permit effective date.

3. The permittee shall complete implementation of the TMDL action plans as determined by the schedule. TMDL action plans may be implemented in multiple phases over more than one permit cycle using the adaptive iterative approach 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 applicable TMDL.

4. Each local TMDL action plan developed by the permittee shall include the following:

  a. The TMDL project name;
  b. The EPA approval date of the TMDL;
  c. The wasteload allocated to the permittee (individually or in aggregate), and the corresponding percent reduction, if applicable;
  d. Identification of the significant sources of the pollutants of concern discharging to the permittee's MS4 that are not covered under a separate VPDES permit. For the purposes of this requirement, 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;
  e. The BMPs designed to reduce the pollutants of concern in accordance with Parts II B 5, B 6, B 7, and B 8;
  f. Any calculations required in accordance with Part II B 5, B 6, B 7, and B 8;
  g. For action plans developed in accordance with Part II B 5, B 6, and B 8, an outreach strategy to enhance the public's education (including employees) on methods to eliminate and reduce discharges of the pollutants; and
  h. A schedule of anticipated actions planned for implementation during this permit term.

The City intends to implement this Action Plan through multiple MS4 General Permit cycles using an adaptive iterative approach, making progress to reduce pollutant discharge in a manner consistent with the assumptions and requirements of the applicable TMDL WLAs. While this Action Plan presents current and future practices intended to mitigate the sediment impairments described in this report, the City reserves the right to make modifications to the Action Plan as new opportunities become available or proposed projects and strategies are deemed infeasible or ineffective.

TMDL Action Plan

1. The TMDL project name; (General Permit Part II.B.4.a)

Sediment TMDLs for Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch
Albemarle County and City of Charlottesville, Virginia (dated January 20, 2016)

The Sediment TMDL Report noted above identified four separate stream segments that were included in Virginia's 2012 303(d) Report on Impaired Waters due to violations of the general aquatic life (benthic) standard. These impaired segments include 6.37 miles of Moores Creek (VAV-H28R_MSC01A00), 1.37 miles of Lodge Creek (VAV-H28R_XRC01A04), 4.0 miles of Meadow Creek (VAV-H28R_MWC01A00), and 1.13 miles of Schenks Branch (VAV-H28R_SNK01A02).

Moores Creek and its tributary, Lodge Creek, were originally listed as impaired on Virginia's 2008 and 2006 305(b)/303(d) Water Quality Assessment Integrated Reports, respectively, due to water quality violations of the general aquatic life (benthic) standard. Meadow Creek and its tributary, Schenks Branch, were originally listed as impaired in the same reports in 2006 and 2008, respectively, also due to water quality violations of the general aquatic life (benthic) standard.

The following are excerpts from the Sediment TMDL Report (Page ii):

TMDLs must be developed for a specific pollutant. Since a benthic impairment is based on a biological inventory, rather than on a physical or chemical water quality parameter, the pollutant is not explicitly identified in the assessment, as it is with physical and chemical parameters. The process outlined in USEPA's Stressor Identification Guidance Document (USEPA, 2000) was used to identify the critical stressors for each of the impaired watersheds in this study. As a result of the stressor analysis, the most probable stressor contributing to the impairment of the benthic community in Moores Creek was identified as sediment due to poor habitat metrics related to active erosion, poor vegetative cover and bank stability. In contrast, the most probable stressors for Lodge Creek were identified as hydrologic modification and sediment because of the large amount of impervious surfaces in the watershed, poor riparian vegetation scores in the habitat metric, and erosion from unstable stream banks. For Meadow Creek, the most probable stressors were also identified as hydrologic modification and sediment due to the high percentage of urbanization in the watershed and the poor bank stability scores in the habitat metric. The same most probable stressors - hydrologic modification and sediment – were identified for Schenks Branch attributable to the high percentage of impervious surface area and headwater reaches being enclosed in culverts. This TMDL was written for the common stressor in all four streams, sediment, and will address all four benthic impairments.

Below is Figure 2-1 from the Sediment TMDL Report, Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch Watersheds.

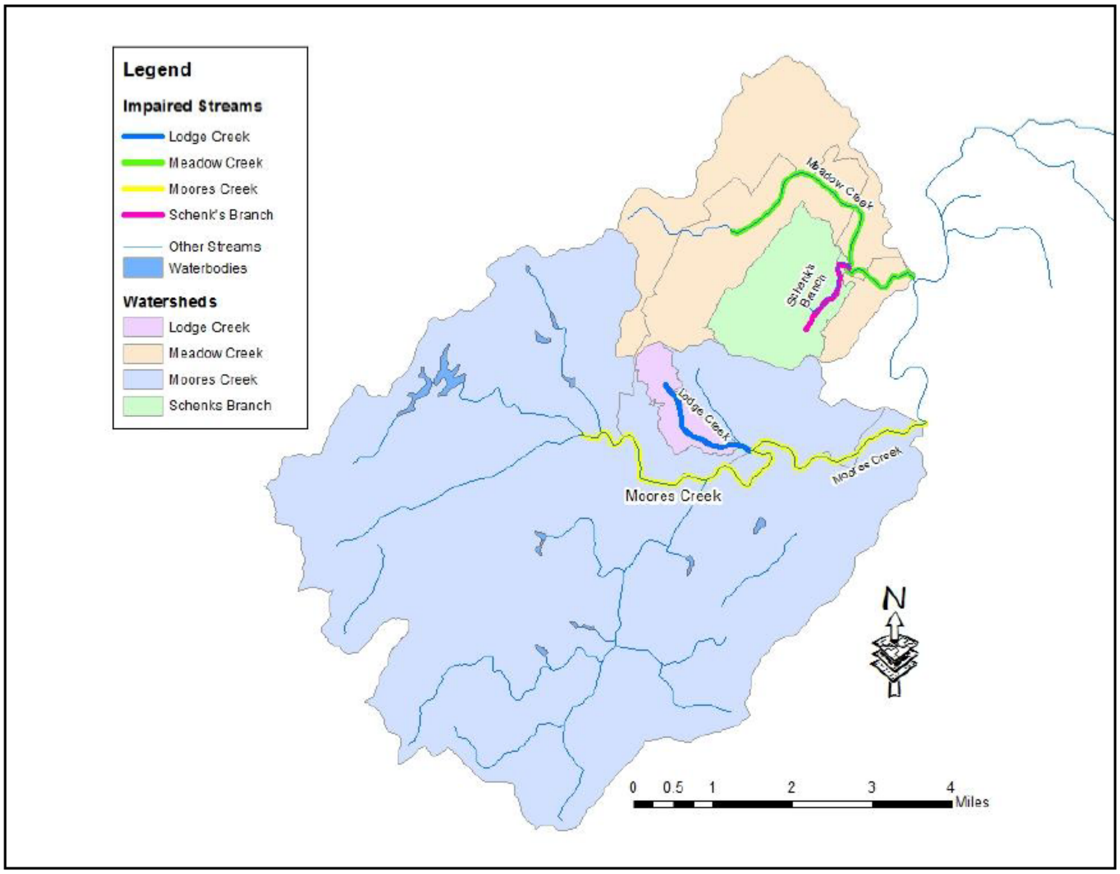


Figure 2-1. Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch Watersheds

2. The EPA approval date of the TMDL; (General Permit Part II.B.4.b)

The Sediment TMDL was approved by EPA on July 26, 2016.

3. The wasteload allocated to the permittee (individually or in aggregate), and the corresponding percent reduction, if applicable; (General Permit Part II.B.4.c)

Aggregated wasteload allocations (WLA) and corresponding percent reductions were assigned to the MS4 permit holders in the impaired watersheds. The MS4 permit holders include the City, as well as the County, UVA, the Virginia Department of Transportation, and Piedmont Virginia Community College. The figure below from the Sediment TMDL Report, Figure 5-2 shows the regulated MS4 areas in the impaired watersheds.

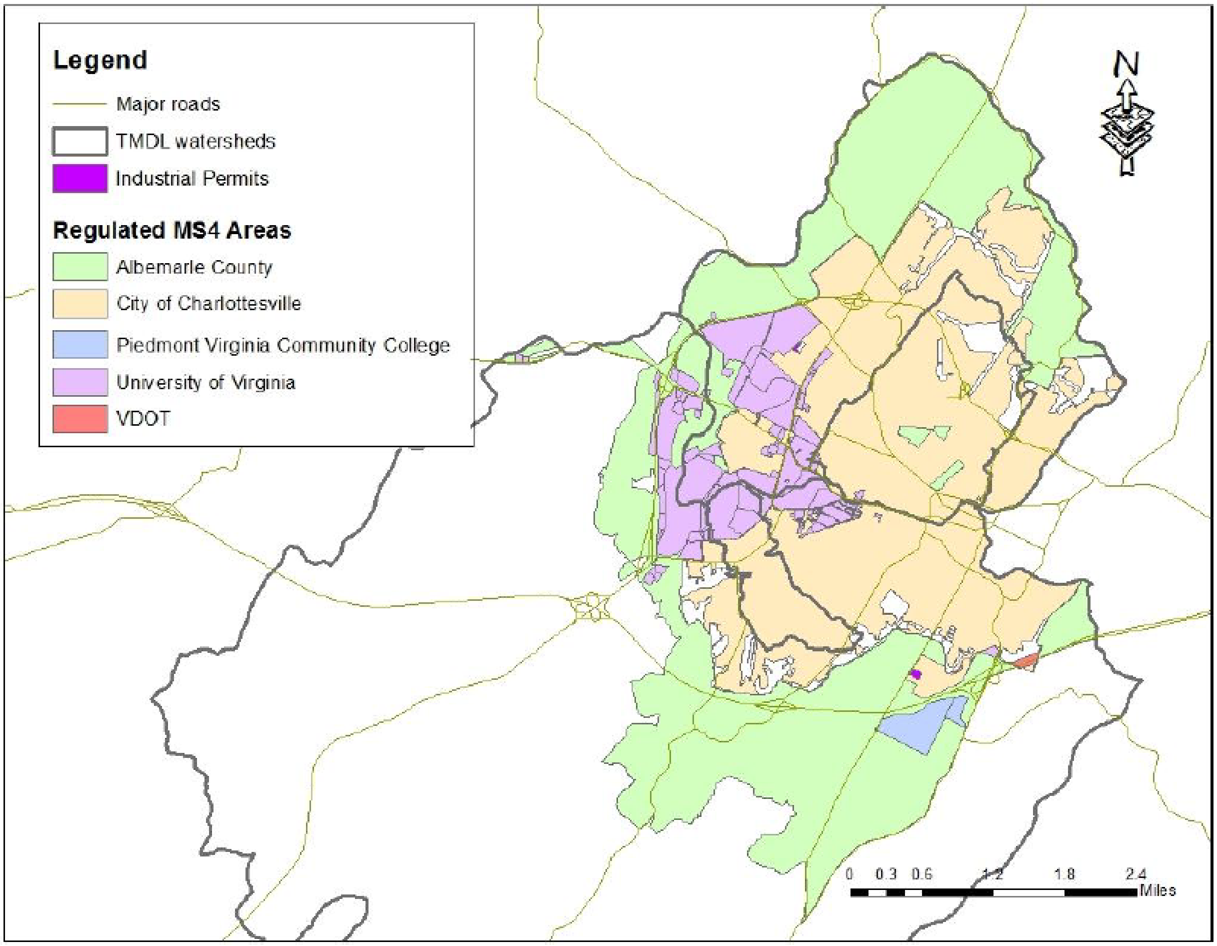


Figure 5-2. Regulated MS4 Areas within the Impaired Watersheds

The allocated MS4 wasteload allocations (WLA) and corresponding percent reductions for Lodge Creek, Moores Creek, Meadow Creek, and Schenks Branch are presented on the ensuing pages, in Tables 6-4 through 6-7 from the Sediment TMDL Report.

Table 6-4. Lodge Creek: Sediment TMDL Load Allocation Scenario

Land Use/ Source Group	Area (acres)	Existing Sediment Load (tons/yr)	Allocation Scenario		
			% Reduction	Load Reduction Needed (tons/yr)	Allocated Load (tons/yr)
Non-Regulated Areas					
Forest	2.64	0.056			0.056
Harvested Forest	0.03	0.0043	42.9%	0.0018	0.0024
Impervious developed	0.88	0.273	52.2%	0.142	0.131
Pervious developed	4.62	0.663	52.2%	0.346	0.317
Transitional***	0.06	0.238	25.0%	0.059	0.178
Channel Erosion		0.011	52.2%	0.006	0.005
Non-MS4 Permitted WLA**					0.000
SSOs		0.0014	100.0%	0.001	0.000
Non-Regulated Sub-Totals		***1.25***	***44.7%***	***0.56***	***0.69***
Regulated-MS4 Areas					
Forest	50.04	1.06			1.06
Impervious developed	156.81	48.60	52.2%	25.35	23.25
Pervious developed	252.66	36.24	52.2%	18.91	17.34
Transitional***	1.12	4.80	25.0%	1.20	3.60
Channel Erosion		0.64	52.2%	0.34	0.31
Regulated-MS4 Sub-Totals		***91.3***	***50.1%***	***45.8***	***45.6***
Future Growth				-0.5	0.5
Total Loads		**92.6**	***49.5%***	**45.8**	**46.8**

** Non-MS4 Permitted WLA includes individual VPDES, ISWGP, and other general permited loads.

*** The Allocation Scenario Load for Transitional Land Use equals the construction WLA.

🟩	LA components =	0.5
🟥	WLA components =	46.2
	TMDL - MOS =	**46.8**

Table 6-5. Moores Creek: Sediment TMDL Load Allocation Scenario

Land Use/ Source Group	Area (acres)	Existing Sediment Load (tons/yr)	Allocation Scenario			Load Reduction from §319 Implementation
			% Reduction	Load Reduction Needed (tons/yr)	Allocated Load (tons/yr)	
Non-Regulated Areas						
Row Crops	86.1	74.1	14.2%	10.5	63.6	***65.9***
Pasture	200.0	128.4	14.2%	18.2	110.2	
Hay	710.9	193.2	14.2%	27.4	165.8	
Forest	11,933.6	373.9			373.9	
Harvested Forest	120.5	30.5	42.9%	13.1	17.41	
Impervious developed	440.2	140.5	14.2%	19.9	120.6	
Pervious developed	2,704.7	286.8	14.2%	40.6	246.2	
Transitional***	31.8	93.0	25.0%	23.3	69.77	
Channel Erosion		163.0	14.2%	23.1	139.9	
Non-MS4 Permitted WLA**				-4.1	4.1	
SSOs		0.0057	100.0%	0.0057	0.0	
Non-Regulated Sub-Totals		***1,483.4***	***11.6%***	***171.9***	***1,311.6***	
Regulated-MS4 Areas						
Pasture	16.01	10.3	14.2%	1.5	8.8	
Hay	93.86	25.5	14.2%	3.6	21.9	
Forest	1,189.06	36.9			36.9	
Impervious developed	1,180.17	376.7	14.2%	57.4	319.3	
Pervious developed	2,759.24	292.6	14.2%	41.5	251.1	
Transitional***	13.91	40.7	25.0%	10.2	30.53	
Channel Erosion		52.8	14.2%	7.5	45.3	
Regulated-MS4 Sub-Totals		***835.5***	***14.6%***	***121.7***	***713.8***	
Future Growth				-21.9	21.9	
Total Loads		**2,318.9**	***11.7%***	**271.7**	**2,047.2**	

** Non-MS4 Permitted WLA includes individual VPDES, ISWGP, and other general permited loads.

*** The Allocation Scenario Load for Transitional Land Use equals the construction WLA.

🟩	LA components =	1,237.6
🟥	WLA components =	809.6
	TMDL - MOS =	**2,047.2**

Table 6-6. Meadow Creek: Sediment TMDL Load Allocation Scenario

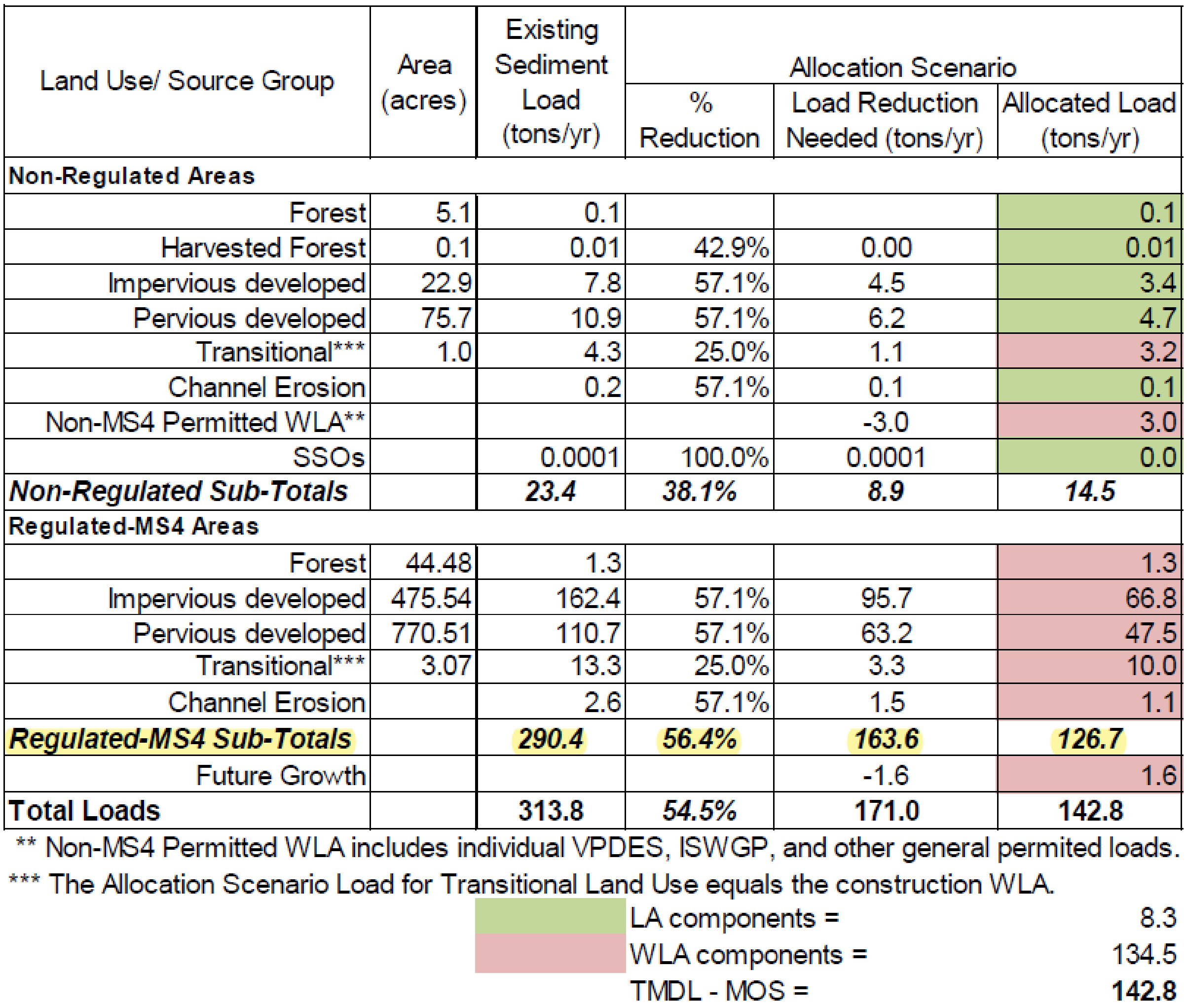
Land Use/ Source Group	Area (acres)	Existing Sediment Load (tons/yr)	Allocation Scenario		
			% Reduction	Load Reduction Needed (tons/yr)	Allocated Load (tons/yr)
Non-Regulated Areas					
Forest	74.0	2.2			2.2
Harvested Forest	0.7	0.17	42.9%	0.07	0.10
Impervious developed	27.5	9.8	52.7%	5.2	4.7
Pervious developed	84.6	11.5	52.7%	6.0	5.4
Transitional***	1.2	4.0	25.0%	1.0	2.99
Channel Erosion		2.2	52.7%	1.1	1.0
Non-MS4 Permitted WLA**				-1.6	1.6
SSOs		0.0002	100.0%	0.0002	0.0
Non-Regulated Sub-Totals		***29.8***	***39.8%***	***11.9***	***18.0***
Regulated-MS4 Areas					
Hay	35.81	14.4	52.7%	7.6	6.8
Forest	598.09	17.7			17.7
Impervious developed	1,337.67	478.4	52.7%	253.5	225.0
Pervious developed	2,249.84	304.7	52.7%	160.5	144.2
Transitional***	9.96	34.3	25.0%	8.6	25.7
Channel Erosion		49.0	52.7%	25.8	23.2
Regulated-MS4 Sub-Totals		***898.5***	***50.7%***	***455.9***	***442.6***
Future Growth				-5.1	5.1
Total Loads		**928.4**	***49.8%***	**462.6**	**465.7**

** Non-MS4 Permitted WLA includes individual VPDES, ISWGP, and other general permited loads.

*** The Allocation Scenario Load for Transitional Land Use equals the construction WLA.

🟩 LA components = 13.4
🟥 WLA components = 452.3
TMDL - MOS = **465.7**

Table 6-7. Schenks Branch: Sediment TMDL Load Allocation Scenario



Land Use/ Source Group	Area (acres)	Existing Sediment Load (tons/yr)	Allocation Scenario		
			% Reduction	Load Reduction Needed (tons/yr)	Allocated Load (tons/yr)
Non-Regulated Areas					
Forest	5.1	0.1			0.1
Harvested Forest	0.1	0.01	42.9%	0.00	0.01
Impervious developed	22.9	7.8	57.1%	4.5	3.4
Pervious developed	75.7	10.9	57.1%	6.2	4.7
Transitional***	1.0	4.3	25.0%	1.1	3.2
Channel Erosion		0.2	57.1%	0.1	0.1
Non-MS4 Permitted WLA**				-3.0	3.0
SSOs		0.0001	100.0%	0.0001	0.0
Non-Regulated Sub-Totals		***23.4***	***38.1%***	***8.9***	***14.5***
Regulated-MS4 Areas					
Forest	44.48	1.3			1.3
Impervious developed	475.54	162.4	57.1%	95.7	66.8
Pervious developed	770.51	110.7	57.1%	63.2	47.5
Transitional***	3.07	13.3	25.0%	3.3	10.0
Channel Erosion		2.6	57.1%	1.5	1.1
Regulated-MS4 Sub-Totals		***290.4***	***56.4%***	***163.6***	***126.7***
Future Growth				-1.6	1.6
Total Loads		**313.8**	***54.5%***	**171.0**	**142.8**

** Non-MS4 Permitted WLA includes individual VPDES, ISWGP, and other general permited loads.

*** The Allocation Scenario Load for Transitional Land Use equals the construction WLA.

🟩	LA components =	8.3
🟥	WLA components =	134.5
	TMDL - MOS =	**142.8**

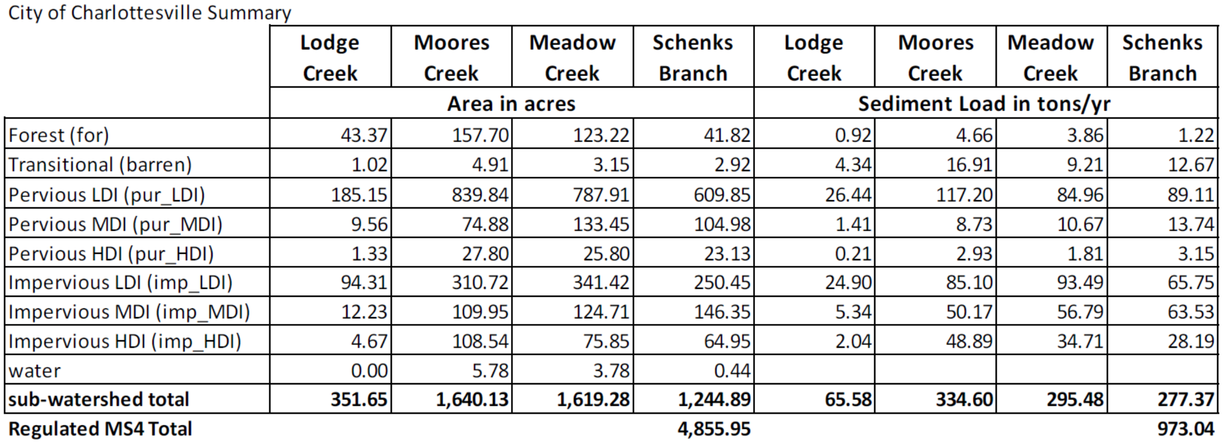
The City, County, and UVA have agreed to take responsibility for the sediment loads generated within their MS4 regulated area boundary regardless of sheet flow draining to or from another jurisdiction. Sediment reduction credit for BMPs installed on any lands with inter-jurisdictional sheet flow will be received by the permittee that installs and maintains the BMP. However, each entity reserves the right to enter into agreements in which TMDL credit is shared with adjacent permittees for any projects which treat drainage from their own and/or multiple permittees' lands.

4. **Identification of the significant sources of the pollutants of concern discharging to the permittee's MS4 that are not covered under a separate VPDES permit. For the purposes of this requirement, 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; (General Permit Part II.B.4.d)**

The Sediment TMDL Report states, "Sediment is generated in the Moores Creek and Meadow Creek watersheds through the processes of surface runoff, in-channel disturbances, and streambank and channel erosion, as well as from natural background contributions and permitted sources. Sediment generation is accelerated through human-induced land-disturbing activities related to a variety of agricultural, forestry, mining, transportation, and residential land uses" (Page 93).

The City notes that average pollutant loading rates as a function of land use are not explicitly provided in the TMDL, although they can be inferred from the Sediment TMDL Report's Table F-5, which is below.

Table F-5. City of Charlottesville Regulated MS4 Land Use Areas and Sediment Loads



City of Charlottesville Summary

	Lodge Creek	Moores Creek	Meadow Creek	Schenks Branch	Lodge Creek	Moores Creek	Meadow Creek	Schenks Branch
	Area in acres				Sediment Load in tons/yr			
Forest (for)	43.37	157.70	123.22	41.82	0.92	4.66	3.86	1.22
Transitional (barren)	1.02	4.91	3.15	2.92	4.34	16.91	9.21	12.67
Pervious LDI (pur_LDI)	185.15	839.84	787.91	609.85	26.44	117.20	84.96	89.11
Pervious MDI (pur_MDI)	9.56	74.88	133.45	104.98	1.41	8.73	10.67	13.74
Pervious HDI (pur_HDI)	1.33	27.80	25.80	23.13	0.21	2.93	1.81	3.15
Impervious LDI (imp_LDI)	94.31	310.72	341.42	250.45	24.90	85.10	93.49	65.75
Impervious MDI (imp_MDI)	12.23	109.95	124.71	146.35	5.34	50.17	56.79	63.53
Impervious HDI (imp_HDI)	4.67	108.54	75.85	64.95	2.04	48.89	34.71	28.19
water	0.00	5.78	3.78	0.44				
sub-watershed total	**351.65**	**1,640.13**	**1,619.28**	**1,244.89**	**65.58**	**334.60**	**295.48**	**277.37**
Regulated MS4 Total				**4,855.95**				**973.04**

The Sediment TMDL Report also states, "Streambank erosion was modeled within the GWLF model using a modification of the routine included in the AVGWLF version of the GWLF model (Evans et al., 2001). This routine calculates average annual streambank erosion as a function of percent developed land, average area-weighted curve number (CN) and K-factors, watershed animal density, average slope, streamflow volume, mean channel depth, and total perennial stream length in the watershed". (Page 91)

Chapter 3 of the Sediment TMDL Report discusses the most probable stressors of the benthic macroinvertebrate communities in the impaired streams, as well as potential sources of these stressors. Sediment is listed as the most probable stressor for all four impaired streams, as well as hydrologic modifications for all the streams except Moores Creek. The potential sources of sediment identified in the Report include residential runoff, forest harvesting operations, construction sites, in-stream disturbances, channel erosion from unstable banks, and washoff from impervious areas. Areas of the impaired streams with insufficient riparian buffers are noted as being more prone to erosion. The Report also notes that hydrologic modifications driven by large amounts of impervious surfaces are likely to increase channel erosion and sediment loads downstream. Based on this information, the City assumes that the following are significant sources of sediment discharging to the City's MS4: residential runoff, washoff from impervious areas, and construction sites. Additionally, the City assumes that in-stream disturbances and channel erosion from unstable stream banks (due in part to insufficient riparian buffers) in stream segments that drain to the City's MS4 are significant sources of sediment to the City's MS4.

5. The BMPs designed to reduce the pollutants of concern in accordance with Parts II B 5, B 6, B 7, and B 8; (General Permit Part II.B.4.e)

Part II.B.6 of the MS4 General Permit states:

5. Local sediment, phosphorus, and nitrogen TMDLs.

a. The permittee 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 BMPs from the Virginia Stormwater BMP Clearinghouse listed in 9VAC25-870-65 or other approved BMPs found on the Virginia Stormwater BMP Clearinghouse website;

(2) One or more BMPs approved by the Chesapeake Bay Program. 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; or

(3) Land disturbance thresholds lower than Virginia's regulatory requirements for erosion and sediment control and post development stormwater management.

b. The permittee 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.

c. The permittee shall calculate the anticipated load reduction achieved from each BMP and include the calculations in the action plan required in Part II B 4 f.

d. No later than 36 months after the effective date of this permit, the permittee shall submit to the department an update on the progress made toward achieving local TMDL action plan goals and the anticipated end dates by which the permittee will meet each wasteload allocation for sediment, phosphorus, or nitrogen. The proposed end date may be developed in accordance with Part II B 3.

The Sediment TMDL Report included a summary of BMPs implemented in MS4 areas between 2009 and 2014 to illustrate progress being made to reduce sediment in the impaired watersheds (Appendix E, page 147). However, it is the City's understanding that the Sediment TMDL Report did not incorporate sediment reductions from these BMPs, and that sediment reductions from these BMPs may be eligible towards meeting the WLAs (Sediment TMDL Report, pages 124 and 147). Similarly, sediment reductions from BMPs implemented after 2014 may also be eligible towards meeting the WLAs. The City intends to determine which of these BMPs are eligible, and to account for their sediment reductions using the latest version of DEQ's Guidance Memo No. 20-2003 - Chesapeake Bay TMDL Special Condition Guidance (dated February 6, 2021). This Action Plan will be updated with the pertinent calculations when that effort is complete.

The following BMPs have been employed by the City to reduce sediment discharges to Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch:

Stream Restoration

Project Name	Year Completed	Linear Feet Restored	Sediment Reduction (pounds/year)*	Lat/Long
Meadow Creek	2013	7,372	320,496.9	38.06384/-78.47599
Rock Creek – Phase I and II	2017	264.5	11,870.8	38.02317/-78.50182
Schenks Branch Tributary	2024	880	234,600	38.04906/-78.47322

Street Sweeping

For local TMDL accounting purposes, the City commits to sweeping 2,000 lane miles annually. This results in a reduction of 5,773 pounds of sediment annually*.

* See Appendix B for full calculations of sediment reductions.

Programmatic BMPs

The City's MS4 Program Plan includes a variety of programmatic BMPs that aim to reduce pollutants of concern, including sediment. The following section provides an explanation of how the identified BMPs are applicable to reducing the sediment impairments.

MCM 1 – Public Education and Outreach on Stormwater Impacts

The City's public education and outreach program is an effective way of making citizens and businesses aware of ways to reduce the stormwater impact of their everyday activities, as well as raising public awareness about what they see others doing on a day-to-day basis. Efforts to educate the community and promote low impact development practices such as rain gardens and rainwater harvesting, and to identify and report illicit discharges through a diverse array of media has the effect of reducing the discharge of sediment into impaired waters.

MCM 2 – Public Involvement / Participation

Involving the public in activities such as stream clean-ups, tree plantings, workshops, and community events not only educates the public on things they can do to reduce their stormwater impacts, but also promotes a connection to local waters and watershed issues while fostering a sense of shared responsibility for stewardship of these community resources. This ultimately leads to a reduction in the amount of pollutants entering local impaired waters through behavior change. Additionally, projects such as tree planting in riparian areas increases their pollution reduction capacity through greater filtration and absorption of stormwater. Continuing to foster community partnerships, such as the ones the City has cultivated with the University of Virginia, the County of Albemarle, the Rivanna Conservation Alliance, and the Thomas Jefferson Soil and Water Conservation District advances the state of stormwater management in the City, ultimately resulting in reduced pollutant discharge.

MCM 3 – Illicit Discharge Detection and Elimination

The City's illicit discharge detection and elimination (IDDE) program provides the mechanism to identify and directly eliminate pollutants entering impaired waters through dry weather screening of stormwater outfalls and response to water pollution reports. IDDE education of residents and businesses also raises awareness of the stormwater drainage system's direct connection to local waterways and illicit discharges, while providing avenues for reporting of illegal activities so that the City can take the appropriate actions. GIS mapping of the stormwater drainage system, including portions of the system that convey streams, allows for faster and targeted responses to incidents, reducing the impacts to waterways. Training of City staff also puts more “eyes on the street” to identify potential and actual situations that lead to stormwater pollution, while reducing impacts from City operations.

MCM 4 – Construction Site Stormwater Runoff Control

The City’s Erosion and Sediment Control Program aims to minimize sediment leaving active construction sites in the city. The City has voluntarily reduced the land disturbance threshold which triggers the requirement for an E&S control plan and permit to 6,000 square feet, making this program even more effective at preventing sediment from leaving construction sites. Properly trained and certified staff ensures that program administration, plan review, and site inspection most effectively and efficiently reduce sedimentation from the development process.

MCM 5 – Post Construction Stormwater Management in New Development and Redevelopment

The City’s post-construction stormwater management program aims to ensure appropriate measures are employed such that post-development water quantity does not increase and water quality does not decrease when compared to the pre-development conditions of land in the City. The City has voluntarily reduced the land disturbance threshold which triggers post-construction stormwater management requirements to 6,000 square feet, making this program even more effective at reducing stormwater volumes and protecting water quality. The City encourages green stormwater infrastructure in new development and redevelopment that reduces stormwater volume and improves stormwater quality, thereby reducing high flows that cause in-stream erosion and sedimentation. The City also implements green stormwater infrastructure on public lands in new development, redevelopment, and retrofit situations that reduce stormwater volume, thereby reducing high flows that cause in-stream erosion and sedimentation. The structural stormwater management facility (SMF) inspection program ensures that existing public and private SMFs are being maintained properly, thereby maximizing their effectiveness in addressing sediment pollution. Protecting and improving the City’s urban forest, particularly in riparian areas, allows these areas to serve as natural pollution filtration devices, keeping sediment in surface runoff from ever entering impaired waters.

MCM 6 – Pollution Prevention / Good Housekeeping for Municipal Operations

The City’s street sweeping and stormwater infrastructure flushing and cleaning programs are effective at capturing sediment pollution that would otherwise be conveyed into impaired waters. Pollution prevention training also raises public employee awareness of how they can reduce the stormwater impact of their everyday work activities. The green public lands management strategies employed by the City reduce sediment pollution by acquiring and preserving green space. Development and implementation of stormwater pollution prevention plans and nutrient management plans for certain City facilities and lands will decrease the amount of pollutants leaving these sites.

6. Any calculations required in accordance with Part II B 5, B 6, B 7, or B8; (General Permit Part II.B.4.f)

All calculations of sediment reductions presented in Section 5 above for stream restoration projects and street sweeping were completed in accordance with DEQ Guidance Memos No. 15-2002, *Chesapeake Bay TMDL Special Condition* (dated May 18, 2015) and No. 20-2003, *Chesapeake Bay TMDL Special Condition Guidance* (dated February 6, 2021).

The guidance memos state, "This document may also be used as a reference to meet the Chesapeake Bay TMDL load allocation for unregulated urban entities as well as local TMDL waste load allocations for nutrients and sediment."

See Appendix B for the detailed calculations.

As the City determines the eligibility of other existing BMPs and accounts for their sediment reductions, the pertinent calculations will be included in this Action Plan. As new BMPs are implemented, their sediment reductions and the pertinent calculations will also be included in this Action Plan.

7. For action plans developed in accordance with Part II B 4 and B 5, an outreach strategy to enhance the public's education (including employees) on methods to eliminate and reduce discharges of the pollutants; (General Permit Part II.B.3.g)

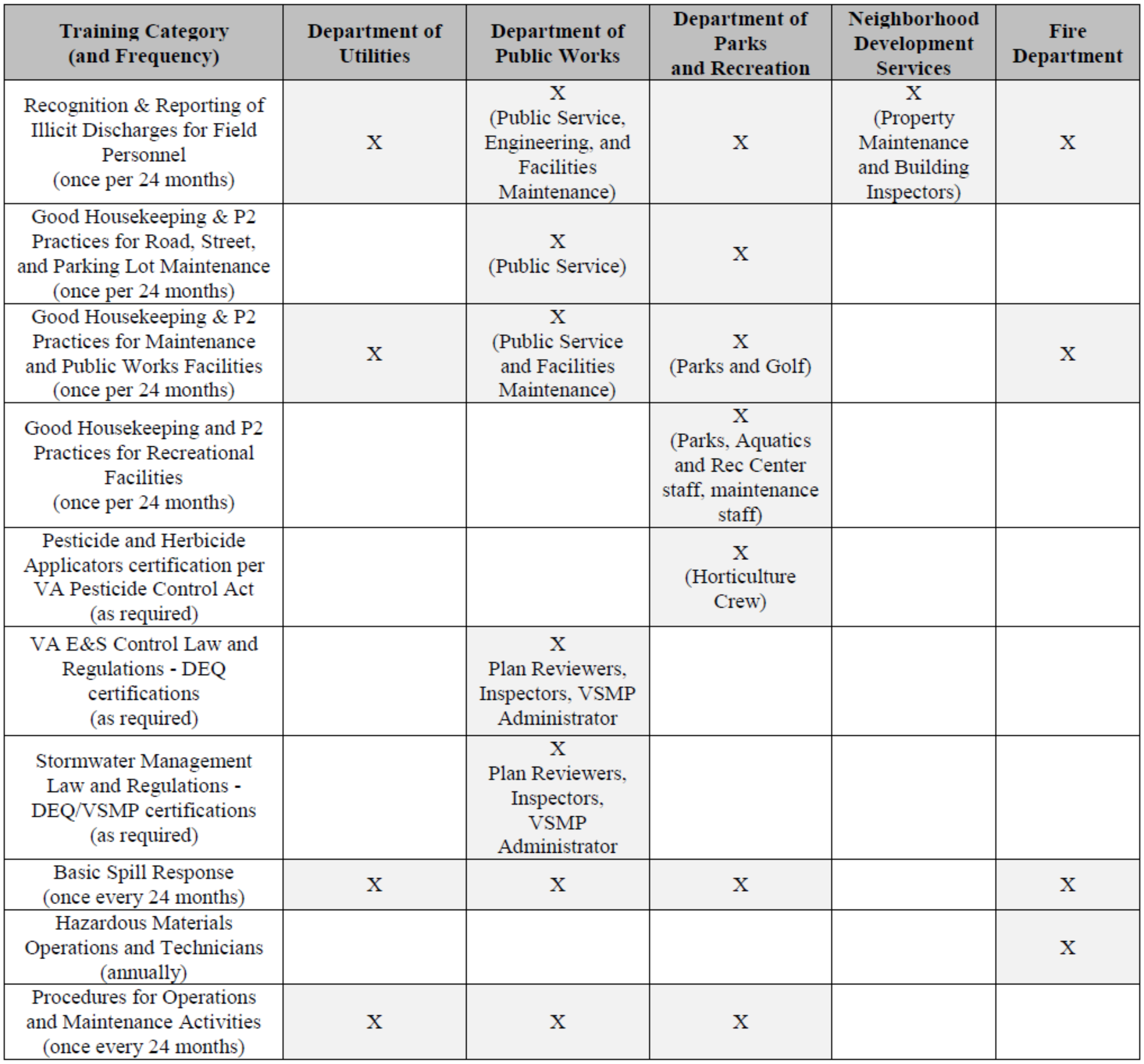
Public Education and Outreach Program

The City's public education and outreach programs have been enhanced to promote methods to eliminate and reduce discharges of sediment. See Appendix A, the City's Public Education and Outreach Plan, developed in conjunction with the Rivanna Stormwater Education Partnership (RSEP), for details on these enhancements. In addition to the education program described in Appendix A, City staff worked to enhance education and outreach through designing and conducting a stormwater management facility maintenance workshop, which educated BMP owners and maintenance staff on their responsibilities for maintenance and how best to fulfill them. The workshop was conducted in June 2016 and addressed sediment pollution. Also in collaboration with RSEP, the City completed a GIS-based Story Map website in 2020, which provides interactive information on the Rivanna River and its watershed, local stream health, community water quality monitoring programs, projects and programs the MS4 permit holders are undertaking, and things residents can do at home and work to improve stream health and water quality. The Story Map can be found here: tinyurl.com/RivannaStoryMap. The RSEP has also launched and sustained the Love Your Watershed campaign, which is a social media and online campaign designed to motivate residents of the greater Charlottesville area to reduce their impact on waterways and ultimately improve local water quality.

Training Program

The City conducts training for applicable employees in accordance with the MS4 General Permit. The goal of the training program is to reduce the impact of municipal operations on stormwater runoff. This program builds on stormwater general awareness and pollution prevention (P2) training that is routinely provided to City operations and maintenance employees from the Departments of Public Works, Utilities, and Parks and Recreation. Training materials include stormwater pollution prevention plans, standard operating procedures, illicit discharge detection and elimination procedures, training videos and other presentations.

The following table provides an overview of the training plan and its basic elements:



Training Category (and Frequency)	Department of Utilities	Department of Public Works	Department of Parks and Recreation	Neighborhood Development Services	Fire Department
Recognition & Reporting of Illicit Discharges for Field Personnel (once per 24 months)	X	X (Public Service, Engineering, and Facilities Maintenance)	X	X (Property Maintenance and Building Inspectors)	X
Good Housekeeping & P2 Practices for Road, Street, and Parking Lot Maintenance (once per 24 months)		X (Public Service)	X		
Good Housekeeping & P2 Practices for Maintenance and Public Works Facilities (once per 24 months)	X	X (Public Service and Facilities Maintenance)	X (Parks and Golf)		X
Good Housekeeping and P2 Practices for Recreational Facilities (once per 24 months)			X (Parks, Aquatics and Rec Center staff, maintenance staff)		
Pesticide and Herbicide Applicators certification per VA Pesticide Control Act (as required)			X (Horticulture Crew)		
VA E&S Control Law and Regulations - DEQ certifications (as required)		X Plan Reviewers, Inspectors, VSMP Administrator			
Stormwater Management Law and Regulations - DEQ/VSMP certifications (as required)		X Plan Reviewers, Inspectors, VSMP Administrator			
Basic Spill Response (once every 24 months)	X	X	X		X
Hazardous Materials Operations and Technicians (annually)					X
Procedures for Operations and Maintenance Activities (once every 24 months)	X	X	X		

8. A schedule of anticipated actions planned for implementation during this permit term. (General Permit Part II.B.4.h)

As permitted in Part II.B.3 of the MS4 General Permit, the City is proposing to implement this Action Plan in multiple phases over more than one permit cycle using an adaptive iterative approach to ensure that adequate progress continues to be made toward reducing the discharge of sediment to Moores Creek, Lodge Creek, Meadow Creek, and Schenks Branch.

The following schedule is proposed for implementation of the Programmatic BMPs included in this Action Plan for the current permit cycle ending on October 31, 2028:

BMP	Description	Schedule
BMP 1.1	Rivanna Stormwater Education Partnership (RSEP)	Ongoing/Annual
BMP 1.2	City Environmental Webpages	Ongoing/Annual
BMP 1.3	Youth Stormwater Education	Ongoing/Annual
BMP 1.4	Illicit Discharge and Pollution Prevention Education Program	Ongoing/Annual
BMP 1.5	Public Education and Outreach Plan	Ongoing/Annual
BMP 2.1	Volunteer Stream Clean-Ups	Ongoing/Annual
BMP 2.2	Adopt-A-Stream Program	Ongoing/Annual
BMP 2.3	Tree Planting Program	Ongoing/Annual
BMP 2.4	Watershed and Water Quality Activities	Ongoing/Annual
BMP 2.5	Public Involvement	Ongoing/Annual
BMP 3.1	IDDE Program	Ongoing/Annual
BMP 3.2	Maintenance of GIS Data, MS4 Map, and Information Table	Ongoing/Annual
BMP 3.4	Online Reporting of Environmental Concerns and Illicit Discharges	Ongoing/Annual
BMP 4.1	Erosion and Sediment Control Program	Ongoing/Annual
BMP 4.2	General Permit for Discharges from Construction Activities	Ongoing/Annual
BMP 5.1	Stormwater Management Materials	Ongoing/Annual
BMP 5.2	Development Plan Review	Ongoing/Annual
BMP 5.3	Structural Stormwater Management Facility and Best Management Practice Reporting	Ongoing/Annual
BMP 5.4 Program	Structural Stormwater Management Facility Inspection and Maintenance Program	Ongoing/Annual
BMP 5.5	Urban Forest Management	Ongoing/Annual
BMP 5.6	Investigate Green Stormwater Infrastructure Retrofit Opportunities	Ongoing/Annual
BMP 6.1	Street Sweeping Program	Ongoing/Annual
BMP 6.2	Stormwater Infrastructure Flushing and Cleaning	Ongoing/Annual
BMP 6.3	Training for Appropriate Personnel	Ongoing/Annual
BMP 6.4	Written Procedures for Operations and Maintenance Activities	Ongoing/Annual
BMP 6.5	Stormwater Pollution Prevention Plans for Municipal Facilities	Ongoing/Annual
BMP 6.6	Turf and Landscape Nutrient Management Plans	Ongoing/Annual
BMP 6.7	Green Public Lands Management Strategies	Ongoing/Annual

Additionally, the City anticipates completing the following projects during the current permit cycle ending on October 31, 2028:

Project Name	Type of BMP	Location (Lat, Long)	% POC Removal Efficiency	POC Reductions (lbs/year)	Preliminary Implementation Schedule
Street Sweeping Program	Street Sweeping (SCP-1 and SCP-2)	Across the city	TN: 3-4% TP: 8-10% TSS: 16-21%	TN: 15.1 TP: 7.28 TSS: 5,772	Annually
Biscuit Run Stream Restoration*	Stream Restoration	37.999529, -78.515791	N/A	TN: 1288 TP: 0 TSS: 0	Winter 2025

* Albemarle County and the City of Charlottesville have entered into a Memorandum of Understanding to share Chesapeake Bay TMDL pollutants of concern reductions generated by the Phase I Biscuit Run stream restoration project, a County-led project to restore approximately 6,200 linear feet of Biscuit Run

and tributaries. This project lies entirely in the County but discharges into Moores Creek, an impaired stream which lies along the City/County border. As documented in the *Biscuit Run Stream Restoration Phase 1 Pollutant Reduction Report* (dated 9/9/2022) this project is estimated to reduce 1,717 lbs/yr of total nitrogen (TN), 987 lbs/yr of total phosphorus (TP), and 1,483,346 lbs/yr of total suspended sediment (TSS). As part of this agreement, the City will claim 75% of the final total nitrogen reductions (estimated 1,288 lbs/yr) generated by the project, and the County will claim the remainder of the pollutant reductions that are applicable to the Chesapeake Bay TMDL (estimated 429 lbs/yr TN, 987 lbs/yr TP and 1,483,346 lbs/yr TSS). Final pollutant reduction values will be calculated based on an as-built survey when the project is complete. All pollutant reductions generated by the Phase I Biscuit Run stream restoration project will be claimed and reported by the two permittees in a manner that ensures pollutant reduction totals are not double counted.

The City intends to demonstrate its progress on implementation of this Action Plan by tracking and reporting on BMP implementation in its MS4 Annual Report that is submitted to DEQ on or before October 1 of each permit year. In accordance with the adaptive iterative approach adopted by the City and referenced in this Action Plan, the City may modify and/or replace BMPs, as necessary, to achieve the most effective plan for reducing the discharge of sediment from the City’s MS4 and meeting the assigned TMDL WLAs.

Appendix A

Public Education and Outreach Plan

Public Education and Outreach Plan
and
Public Involvement and Participation Program

Small MS4 MCM1 and MCM2

November 28, 2023

LOVE
your watershed
RIVANNA-STORMWATER.ORG

Prepared By:

Rivanna Stormwater Education Partnership

Albemarle County
Albemarle County Public Schools
Albemarle County Service Authority
City of Charlottesville
Rivanna Conservation Alliance
Rivanna Water and Sewer Authority
Thomas Jefferson Planning District Commission
Thomas Jefferson Soil and Water Conservation District
University of Virginia

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FIGURES

1.0 Rivanna Stormwater Education Partnership (RSEP)

Founded in March 2003, the Rivanna Stormwater Education Partnership (RSEP) meets a minimum of six times a year to plan and implement stormwater education initiatives and share information about each partner's stormwater programs. Education initiatives are undertaken by RSEP to help make citizens aware of stormwater issues, while also equipping them with practical knowledge and actions to help improve local water quality. RSEP utilizes a multi-faceted approach to educate and provide outreach across targeted urban areas (Figure 1). Past campaign materials, including print ads, movie theater ads, posters on public transit buses, magnets, radio spots, and utility bill inserts are written in simple, easy to understand language and often utilize simple pictures or drawings to help the message come across to all generations and all education levels. RSEP also provides some campaigns in Spanish. Education and outreach materials are available at www.rivanna-stormwater.org. Each partner pays an annual membership fee to help fund RSEP projects. In addition, the RSEP has successfully applied for and partnered on grants to supplement education efforts.

1.1 Members

RSEP was initially created as a collaborative effort among local public entities in the City of Charlottesville and the surrounding County of Albemarle that hold small Municipal Separate Storm Sewer (MS4) permits under the National Pollutant Discharge Elimination System program. RSEP has since expanded to also include non-MS4 members in the region who have interests related to education, outreach, and public participation in stormwater management. While the core premise of RSEP still remains focused on helping MS4 members achieve permit compliance with Minimum Control Measures (MCM) 1 and 2, the inclusion of non-MS4 members allows RSEP to look beyond compliance andreach a broader audience.

The MS4 permit holders that comprise RSEP are Albemarle County, the City of Charlottesville, and the University of Virginia. Other members of RSEP are Albemarle County Public Schools, the Albemarle County Service Authority, the Rivanna Water and Sewer Authority, the Rivanna Conservation Alliance, the Thomas Jefferson Planning District Commission, and the Thomas Jefferson Soil and Water Conservation District. The Thomas Jefferson Soil and Water Conservation District (TJSWCD) provides support to RSEP and serves as its coordinating body.

1.2 Collaboration Benefits

This program plan has been developed with the intent to increase public's knowledge on how to reduce stormwater pollution, increase the public's knowledge of hazards associated with illegal discharges and improper disposal of waste, and has been developed as a diverse program with strategies that are targeted toward individuals or groups likely to have significant stormwater impacts. RSEP has produced effective and far-reaching education programs that have benefited from the variety of expertise and resources each partner offers. Planning and implementing education initiatives through RSEP has resulted in Rivanna River watershed-focused projects and has avoided the over-exposure and redundancy that might result if each partner were carrying out projects on their own.

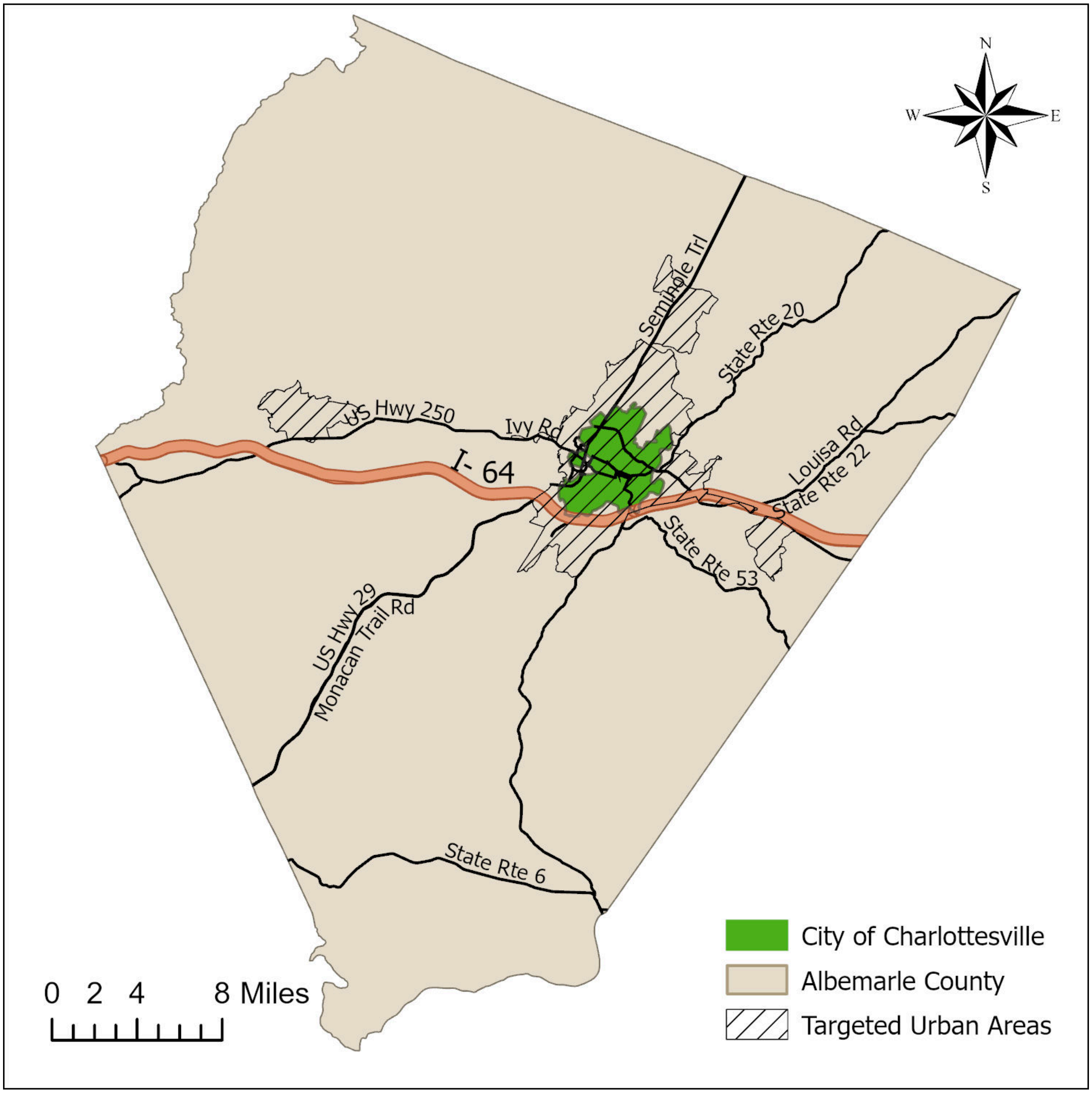

Figure 1. Urban areas targeted by RSEP Education and Outreach (US Census-designated urban areas, 2020)

2.0 High Priority Water Quality Issues

RSEP members collaborated to determine the high priority water quality issues for the region, which will be the focus of the education and outreach campaigns for the current MS4 permit cycle. During the 2013-2018 permit cycle, RSEP chose local and regional water quality impairments, bacteria, sediment, and nutrients (nitrogen and phosphorus), as their high priority issues. Campaigns conducted during this time frame were considered successful. However, RSEP found the chosen issues somewhat limited the extent of outreach efforts that the group could undertake. For the 2018-2023 permit cycle, RSEP members chose to address broader categories of water quality issues, namely runoff volume reduction, potential runoff pollutants, and TMDL impairments as the high priority issues. By grouping regional water quality impairments as one high priority issue, RSEP was able to address this highly important topic, while allowing the group to also address other issues that also have the potential to impact water quality in the region. Due to the success of this approach, RSEP has decided to continue with these same high priority water quality issues for the 2023-2028 permit cycle.

2.1 Runoff Volume Reductions

One of the biggest challenges facing urban waterways is the sheer volume of runoff being transported from impervious surfaces to the streams. In developed areas, rainwater falls on impervious surfaces, such as buildings, parking lots, and driveways which prevent water from infiltrating into the ground and recharging local aquifers. This rainwater flows rapidly across impervious surfaces and into storm sewers, which direct the water to local streams. As a result of this rapid transport to local streams, stream flow volumes and velocities are significantly higher than would be observed under natural conditions. These high, rapid flows can cause stream bank erosion and changes in stream ecosystem habitats. In addition, flooding has become an increasing issue due to the severity and intensity of rainstorms in recent years, combined with concerns about other climate change impacts. Best management practices (BMPs) can be installed to mitigate the impacts of development by slowing down the transport of water from impervious surfaces to local streams.

While localities and developers are required to install BMPs for certain construction projects, maintenance of these BMPs is not always taken into account during their installation. In addition, there are many BMPs homeowners can implement or install to reduce the runoff volume and velocity from their properties and contribute to healthier streams. RSEP intends to provide education and outreach to both homeowners as well as new and existing BMP owners during the permit period. The goal of this education program will be to educate recipients on the negative impacts of increased stormwater volume and velocity and also provide ideas for ways they can reduce, mitigate, or treat runoff from their property. Example messaging may include information about rain barrel installations, downspout disconnections, or information about local flood resilience planning.

2.2 Potential Runoff Pollutants

As stormwater flows across roadways, parking lots, and driveways, it picks up pollutants such as sediment, oil, nutrients, bacteria, and trash that are lying on the surface. Sources of these pollutants can be as varied as the pollutants themselves, ranging from pet waste left by a local resident to a diesel fuel spill on a local industrial site to cigarette butts tossed on the ground by passing smokers. Additionally, emerging contaminants that do not yet fall under TMDLs, such as chlorides and PCBs, could be covered in this category if local conditions warrant such coverage.

There are two primary ways to handle potential runoff pollutants. The first is to prevent the potential pollutant from becoming a water quality issue. Educational messaging for this approach may range from reminding restaurants how to properly handle their used cooking oil to information on excess salt usage during the winter to reminding residents to obtain a soil test before applying fertilizer on their lawns. The second way to handle potential runoff pollutants is to try to capture them after they are out in the environment. While this approach is not ideal, it is a necessary component of a comprehensive outreach program. In addition to reducing runoff as previously discussed, certain BMPs can also help trap or absorb these pollutants in the environment and prevent them from reaching local waterways. In addition, the illicit discharge and elimination (IDDE) programs run by the various MS4 permit holders will help to identify and eliminate possible illicit discharges resulting from human activity in the watershed. IDDE outreach and education efforts provided by RSEP have and will continue to warn against storm drain dumping and encourage use of the RSEP Water Pollution Hot Line to report suspected illegal discharges.

2.3 TMDL Impairments – Bacteria, Sediment, Nitrogen, Phosphorus

The Chesapeake Bay TMDL requires pollution reductions in sources of phosphorus, nitrogen, and sediment loads across the Bay watershed and sets pollution limits need to achieve desired water quality standards. These TMDL impairments have significant impacts in the local area. Sediment source reductions are also required locally by the Rivanna River Benthic TMDL. TMDLs for many local streams also touch on sediment as a pollutant source, with bacteria as an added pollutant of concern in many of these local streams.

TMDL impairments are logical topics for MS4 outreach and education programs, as most of the streams with TMDLs in the local areas are urban streams and MS4s are concentrated in the urban areas. Of the stream miles assessed within the targeted urban areas, almost 30% have an impaired benthic macro-invertebrate community, as a result of too much sediment in our waterways[1]. The *Final Report of the Benthic TMDL Development for the Rivanna River Watershed* submitted to VA DEQ (2008) identifies an existing sediment load from land-based and in-stream erosion from the MS4 point source. Over a quarter (26%) of streams assessed within the targeted urban areas are considered impaired by excessive amounts of bacteria[2]. Bacteria impairments in these streams can be caused by a variety of sources in urban stormwater including pet waste, leaking sewer pipes, wildlife excrement, and agricultural uses. As for nitrogen and phosphorus, the MS4 general permit requires permittees to utilize turf and landscape management plans to minimize nutrient usages, while also prohibiting the usage of deicers containing urea, nitrogen, or phosphorus. Similar messaging is also relevant to local residents and business owners.

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[1] *Final 2012 305(b)/303(d) Water Quality Assessment Integrated Report*, VA DEQ, 2014

[2] *Final 2012 305(b)/303(d) Water Quality Assessment Integrated Report*, VA DEQ, 2014

The goal of outreach and education campaigns focusing on TMDL impairments will include a variety of approaches, strategies, and target audiences. Licensed dog owners in the City and County could be targeted to pick up pet waste to reduce bacteria. Strategies utilized to address reductions in runoff volume could be used to target sediment. While homeowners, gardeners, and landscape maintenance professionals could be targeted to address fertilizer usage.

3.0 Public Education and Outreach Opportunities

The public education and outreach opportunities that RSEP plans to provide during the 2023-2028 permit cycle are included in Table 1. These strategies will be used to communicate the high priority water quality issues to the target audiences. At minimum, two strategies will be used per year to communicate to the target audience regarding the high priority stormwater issues.

4.0 Public Involvement and Participation Opportunities

This Outreach and Education Plan will be posted on the RSEP website, the City of Charlottesville's website, Albemarle County's website, and UVA's website and will remain available for the duration of the 2023-2028 MS4 Permit Cycle. At any time during the permit cycle, the public can visit any of these websites to report potential illicit discharges, improper disposal or spills to the MS4, complaints regarding land disturbing activities, or other potential stormwater pollution concerns. In addition, the public can also utilize these websites to provide input on any of the RSEP partners MS4 program plans, including this Outreach and Education Plan.

The public involvement and participation opportunities that RSEP plans to provide during the 2023-2028 permit cycle are included in Table 1. No fewer than four activities per year from a minimum of two or more of the activity categories will be conducted to provide an opportunity for public involvement to improve water quality and support local restoration and clean-up projects.

5.0 Adjusting Target Audiences and Messaging

As necessary, RSEP will adjust target audiences and messages to address any observed weaknesses or shortcomings in the public education and outreach programEducational materials may be developed, modified, or improved to address changing needs. In addition, the messaging or activities described in Table 1 may be altered to appeal to different target audiences or to address different high priority issues than the ones listed. Other methods beyond those currently described in Table 1 are likely to be employed as well.

Table 1. Planned Public Education and Outreach and Public Involvement and Participation Opportunities

Time Frame - Frequency	Strategy or Activity Description	High Priority Water Quality Issue Addressed			Target Audience / Metric to Determine if Activity is Beneficial to Water Quality	MCM 1	MCM 2
		Runoff Volume	Runoff Pollutants	TMDL Pollutants			
Spring - *once during permit cycle*	Written Materials - *Utility Bill Inserts*	✓	✓	✓	Homeowners and residents – number of inserts delivered	✓	
Spring - *once during permit cycle*	Written Materials – *Electronic Utility Bill Inserts*	✓	✓	✓	Homeowners and residents – number of electronic recipients	✓	
Fall - once *during permit cycle* –	Written Materials - *Charlottesville Area Transit Bus Ad*		✓	✓	Homeowners and residents – number of bus riders during ad period	✓	
Winter *Once during permit cycle*	Media Materials - *Charlottesville Public Access Station PSAs*	✓	✓	✓	Homeowners and residents – there is no metric to determine viewership or number of times the ad is shown, however it is still a worthwhile effort that may catch viewers not reached via other methods	✓	
Fall or Spring - *2-3x during permit cycle*	Media Materials - *Cville Weekly Ads*		✓	✓	Homeowners and residents – estimated distribution	✓	
Winter and Summer - *Annually*	Media Materials - *Social Media Promotion*	✓	✓	✓	Homeowners and residents – estimated number of followers	✓	
Ongoing	Media Materials – *GIS StoryMap*	✓	✓	✓	Homeowners and residents – no tracking available, but information is linked from RSEP	✓	

					website and is available to the public		
Spring - *Annually*	Alternative Materials - *Magnets*		✓	✓	Homeowners and residents – number of magnets distributed	✓	
Spring - *Annually*	Alternative Materials - *Stickers*		✓	✓	Homeowners and residents – number of stickers distributed	✓	
Spring - *Annually*	Public Education Activities – *booth at community event*	✓	✓	✓	Homeowners and residents - Number of event attendees	✓	✓
Spring - *Annually*	Public Education Activities – *SOL activities with 4th grade students*	✓	✓	✓	Local students – number of student participants	✓	✓
2-3 Events in Spring or Fall *Annually*	Public Education Activities - *Tabling at Riverfest, Ecofairs, Kidvention, or other events*	✓	✓	✓	Homeowners and residents - Number of event attendees	✓	✓
Spring or Fall *Annually*	Restoration – *Stream Clean Up Day*		✓	✓	Homeowners and residents - Number of participants or number of bags of trash collected		✓
Spring *Once per permit cycle*	Pollution Prevention - *Participant Workshop*	✓	✓	✓	Homeowners and residents - Number of workshop attendees		✓

Appendix B

Detailed Calculations

Name:	Meadow Creek
Linear Feet of Restoration:	7372

POC Reductions

TN	TP	TSS
552.9	501.296	330855.36

Acres Draining Stream Restoration Project

	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated Land*	1280.53	1400.61	2681.14	998.28	
Unregulated Land	21.40	57.16	78.56	19.57	Total
		Total	2759.7	1017.85	3777.55

*Based on Regulated_Landcover2, Albemarle County and UVA landcover

Total Reductions for Regulated and Unregulated Urban Lands

	Ratios	TN Credit	TP Credit	TSS Credit
Regulated Acres	0.7098	392.42	355.80	234826.68
Unregulated Acres	0.0208	11.50	10.43	6880.65
Forested Acres	0.2694	148.98	135.07	89148.03

Total Baseline Unregulated Land Reductions Adjustment

		Loading rate (Table 3a)	x 20	x Unregulated Acres	Total Reduction	Subtract from Credit
Regulated Urban Impervious	TN	0.042255	0.8451	18.08514	42.058044	0.00
Regulated Urban Pervious		0.02097	0.4194	23.972904		
Regulated Urban Impervious	TP	0.01408	0.2816	6.02624	8.09829	2.33
Regulated Urban Pervious		0.0018125	0.03625	2.07205		
Regulated Urban Impervious	TSS	6.7694	135.388	2897.3032	3402.85482	3477.79
Regulated Urban Pervious		0.442225	8.8445	505.55162		

TN Credit	**541.40**
TP Credit	**488.54**
TSS Credit	**320496.92**

Name:	Rock Creek			
Linear Feet of Restoration:	264.5	529	184	Added to total for Phase II

POC Reductions		
TN	TP	TSS
19.8375	17.986	11870.76

Acres Draining Stream Restoration Project					
	Urban Impervious Acres	Urban Pervious Acres	Total Urban Acres	Forested Acres	
Regulated Land*	71.29	131.18	202.47	26.74	
Unregulated Land	0	0	0	1.69	Total
		Total	202.47	28.43	230.9

*Based on Regulated_Landcover2 - Includes UVA MS4 areas within watershed

Total Reductions for Regulated and Unregulated Urban Lands				
	Ratios	TN Credit	TP Credit	TSS Credit
Regulated Acres	0.8769	17.39	15.77	10409.15
Unregulated Acres	0.0000	0.00	0.00	0.00
Forested Acres	0.1231	2.44	2.21	1461.61

Total Baseline Unregulated Land Reductions Adjustment						
		Loading rate (Table 3a)	x 20	x Unregulated Acres	Total Reduction	Subtract from Credit
Regulated Urban Impervious	TN	0.042255	0.8451	0	0	0.00
Regulated Urban Pervious		0.02097	0.4194	0		
Regulated Urban Impervious	TP	0.01408	0.2816	0	0	0.00
Regulated Urban Pervious		0.0018125	0.03625	0		
Regulated Urban Impervious	TSS	6.7694	135.388	0	0	0.00
Regulated Urban Pervious		0.442225	8.8445	0		

TN Credit	**19.84**
TP Credit	**17.99**
TSS Credit	**11870.76**

Hazen
Hazen and Sawyer
110 Avon Street, Suite 3
Charlottesville, VA 22902

July 25, 2024

Dan Frisbee
Water Resources Specialist
City of Charlottesville, Department of Public Utilities
305 4th Street NW
Charlottesville, VA 22903

Re: Post-Construction Nutrient Credits for Schenks Branch Tributary Stream Restoration Project

via email: frisbee@charlottesville.gov

Dear Mr. Frisbee:

This letter serves as documentation to support the increase of nutrient credits following the construction of the Schenks Branch Tributary Stream Restoration project in Charlottesville, Virginia. This increase in credits is a result of Field Modification 1 and 2 (Dated 12/12/2023 and 12/13/2023, respectively) which entailed:

- expanding the bankfull bench at Riffle Grade Control 6 / Cross Vane 3 and Riffle Grade Control 7 / J-Hook 4 to account for instream bedrock while
- extending the proposed left bank grading approximately 65 linear feet, tying into the edge of the limits of disturbance where the streambank slope flattens.

Refer to Attachment 1 which documents the redlines for Field Modification 1. For Field Modification 2 the Contractor used the same left bank grading scheme as dictated in the construction drawings, as shown in XS 200+12.77 on drawing C13. The representative cross-section information to compare existing conditions to the proposed grading scheme is shown in **Figure 1** and **Figure 2**. Pre-construction conditions were representative of BEHI ID 18L (BEHI: Extreme, NBS: Low; **Attachment 2**), and therefore 65 linear feet were added to the original 70 linear feet for a total of 135 feet of restoration.

Job no: 32571-004

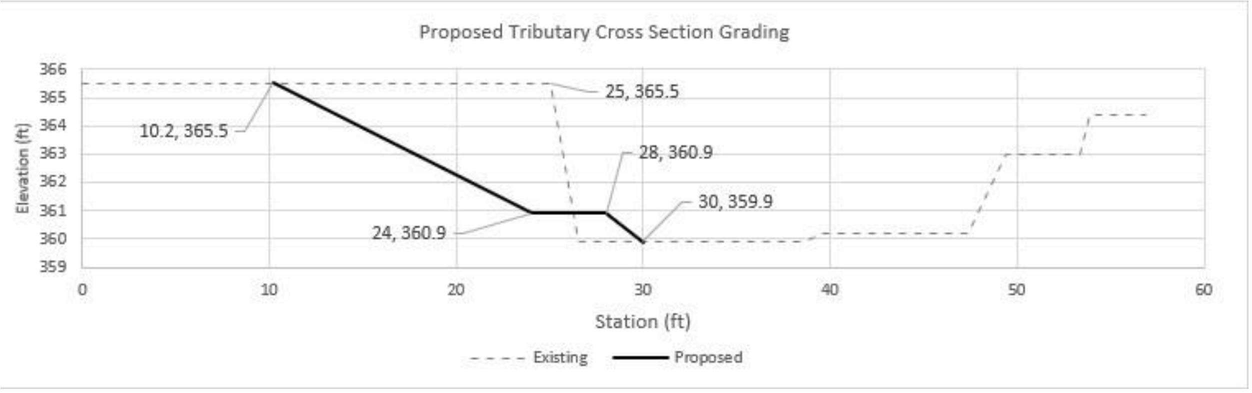


Figure 1: Representative Cross-Sections for Field Modification 2

Figure 2: Photo documentation of Existing Conditions to support Field Modification 2

Table 1, **Table 2**, **Figure 3**, and **Figure 4** document this post-construction change. **Attachments 3** and **4** provide the updated nutrient credits calculations associated with Protocols 1 and 2, respectively. The original SLAF grant application estimated an annual Total Phosphorous removal of 70 lbs/r. As seen in the **Table 2** below, the restoration exceeds the preliminary estimate by 12.1 lbs/yr.

Table 1: Updated Schenks Branch Tributary BANCS Assessment and Pollutant Loading Summary

Criteria	Unit	Left Bank	Right Bank	Total
BANCS Assessment Length	ft	679	323	1002
Streambank Erosion	tons/yr	148.5	86.0	234.5
Total Phosphorous Loading	lbs/yr	103.9	60.2	164.2
Total Nitrogen Loading	lbs/yr	89.1	51.6	140.7

Table 2: Updated Schenks Branch Tributary Pollutant Loading Credit Summary

Pollutant of Concern	Unit	Protocol 1	Protocol 2	Total
Sediment Loading	tons/yr	117.3	--	117.3
Total Phosphorous Loading	lbs/yr	82.1	--	82.1
Total Nitrogen Loading	lbs/yr	70.4	42.8	113.2

Figure 3:Photo documentation of Post-Construction Conditions to support Field Modification 1

Figure 4: Photo documentation of Post-Construction Conditions to support Field Modification 2

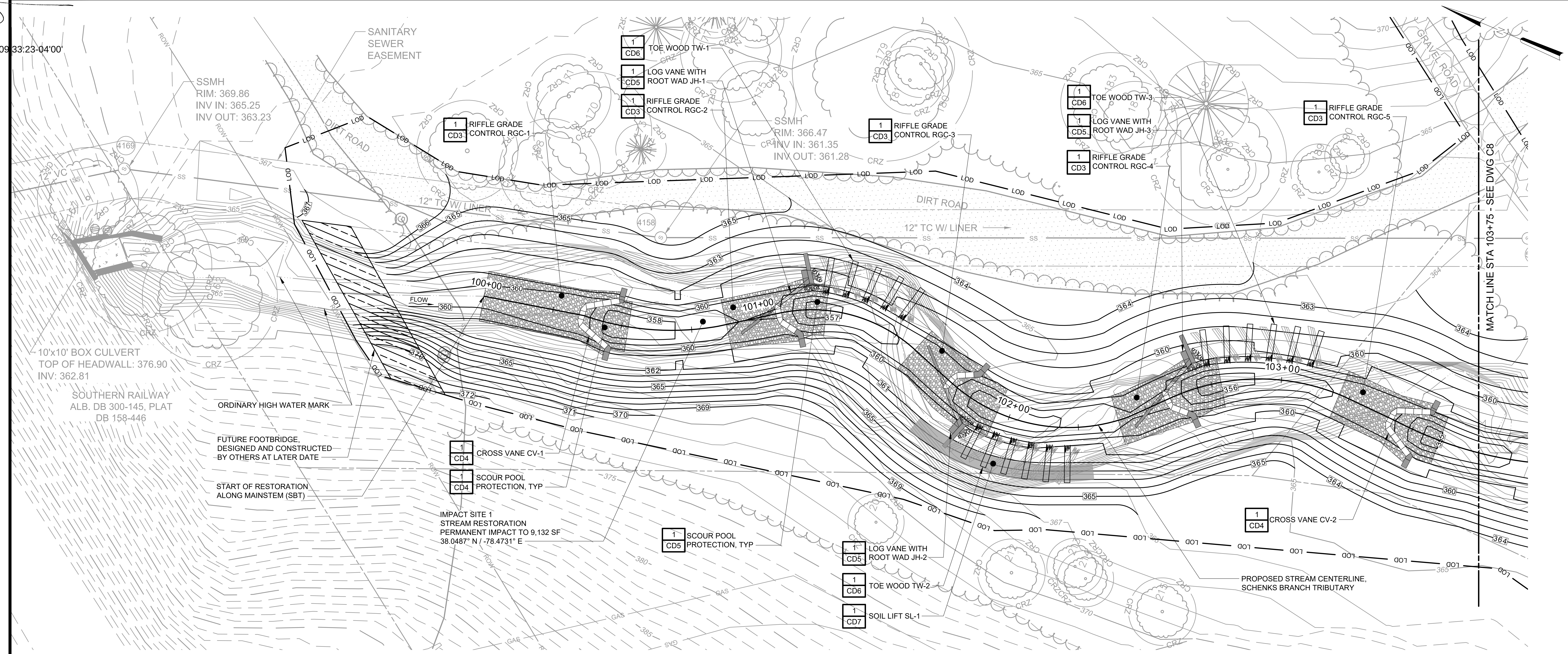
Be well,

Ty Smith, PE
Associate

Attachments:	1	Field Modification 1 Documentation
	2	Updated Existing Conditions BANCS Assessment
	3	Updated CBP Protocol 1 Calculations
	4	Updated CBP Protocol 2 Calculations

cc: Chris Tabor, Matt Wimmer, Brandon Kwa, Ben Felton

2022.05.02 09:33:23-04'00'

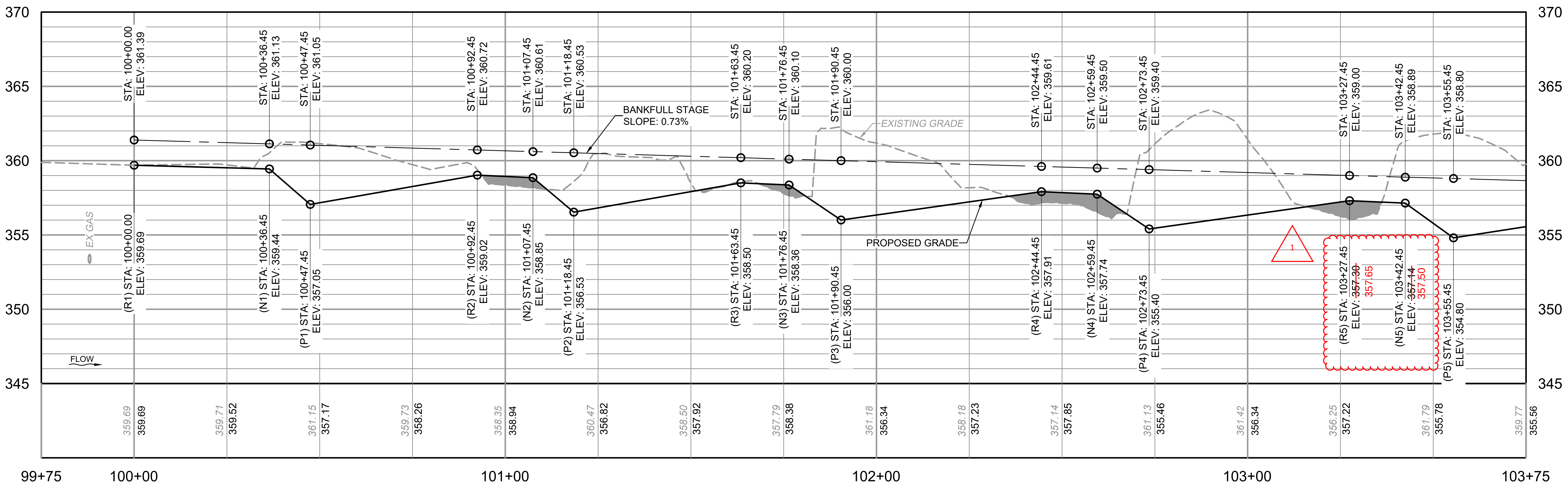


PLAN VIEW FOR SCHENKS BRANCH TRIBUTARY (SBT)

SCALE: 1" = 20'

NOTES:

1. SEE STREAM PROFILE AND STRUCTURES TABLE ON C10 FOR PROPOSED STREAM STRUCTURES, ALIGNMENT, AND PROFILE.
2. R = RIFFLE STATION, N = RUN STATION, P = POOL STATION.
3. SIZE STRUCTURES AS SPECIFIED IN CD SERIES.
4. CHANNEL GRADING DEFINED PER TYPICAL STREAM CHANNEL CROSS SECTIONS IN CD SERIES.
5. BOULDER DIMENSIONS SHOWN ARE APPROXIMATE. REFER TO CD SERIES FOR MINIMUM BOULDER DIMENSIONS.
6. SEE CD SERIES FOR IN-STREAM STRUCTURE FOOT EXCAVATION ELEVATIONS.
7. FIELD RUN TOPOGRAPHIC SURVEY WAS SUPPLEMENTED WITH CITY-PROVIDED GIS CONTOURS. MINOR GRADING MODIFICATIONS DURING CONSTRUCTION CAN BE EXPECTED.
8. SCHENKS BRANCH TRIBUTARY WIDTH:
   EXISTING = 12-15 FEET; PROPOSED = 18-22 FEET.



PROFILE

H: 1" = 20' - V: 1" = 5'

HORIZONTAL SCALE: 1" = 20
20 10 0 20'
5 0 5'
VERTICAL SCALE: 1" = 5'

File: O:\32571-000\32571-001\CAD_BIM\CIVIL\C7 Saved by SKANE Save date: 4/8/2022 8:52 AM
PLOT DATE: 4/29/2022 2:03 PM BY: SKANE

REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

PROJECT ENGINEER: C. TABOR
DESIGNED BY: T. SMITH
DRAWN BY: S. KANE
CHECKED BY: T. SCHUELER
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE
0 1/2" 1"

100% DESIGN -
ISSUED
FOR CONSTRUCTION

TYLER W. SMITH
Lic. No. 63968
2022.05.02 09:36:57-04'00'

Hazen

HAZEN AND SAWYER
1555 ROSENEATH ROAD
RICHMOND, VA, 23230

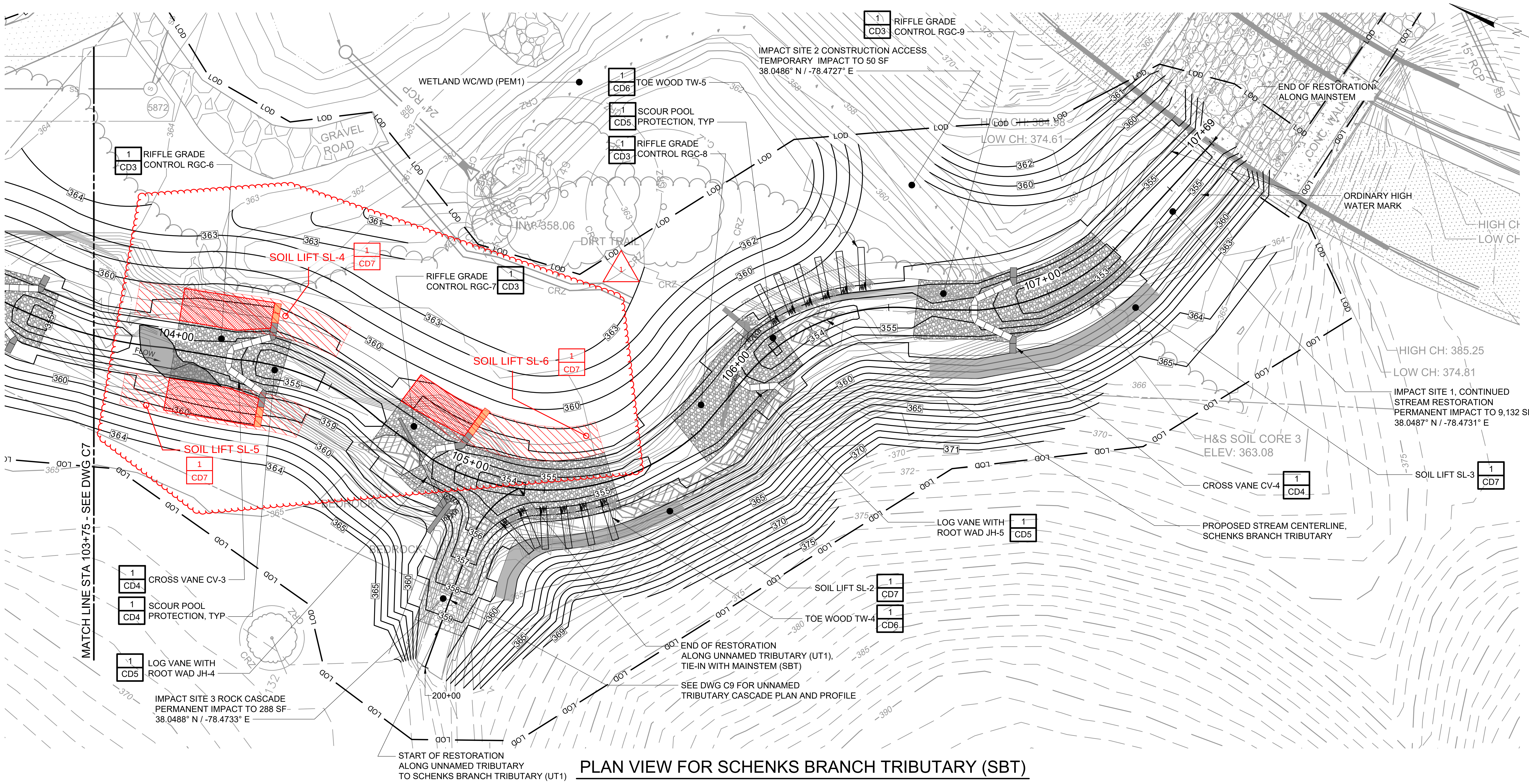
CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

CIVIL
SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PLAN AND PROFILE - 1 OF 2

DATE: APRIL 2022
HAZEN NO.: 32571-003
HAZEN CONTRACT NO.: 202827
DRAWING NUMBER: C7

2022.05.02 09:33:23-04'00'

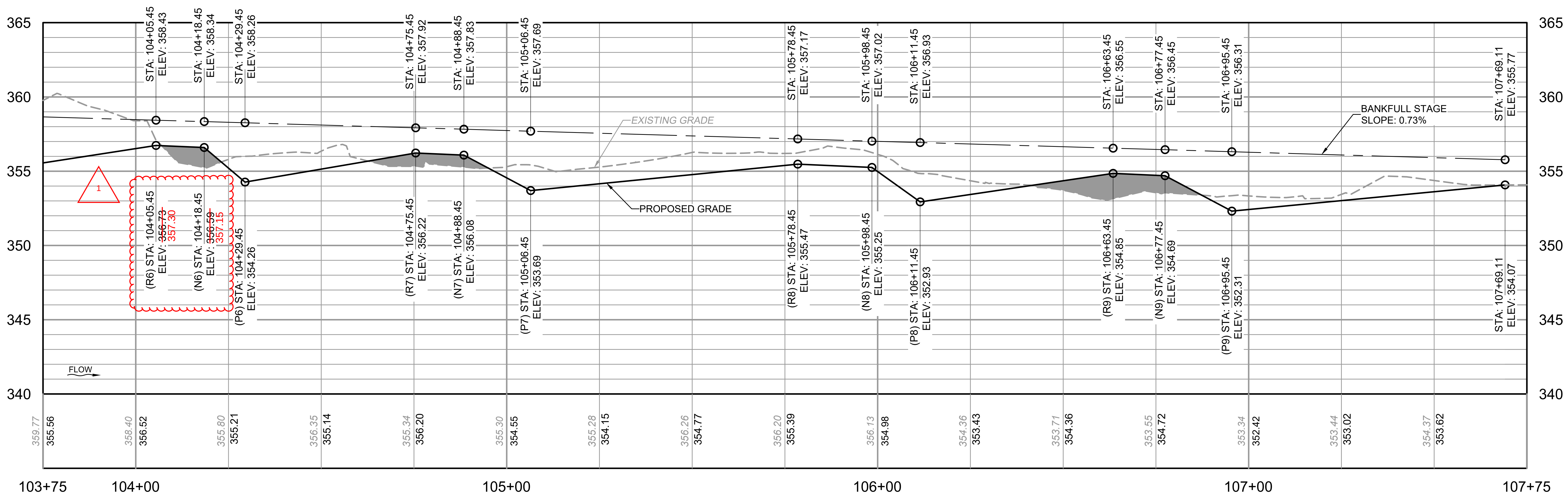


PLAN VIEW FOR SCHENKS BRANCH TRIBUTARY (SBT)

SCALE: 1" = 20'

NOTES:

1. SEE STREAM PROFILE AND STRUCTURES TABLE ON C10 FOR PROPOSED STREAM STRUCTURES, ALIGNMENT, AND PROFILE.
2. R = RIFFLE STATION, N = RUN STATION, P = POOL STATION.
3. SIZE STRUCTURES AS SPECIFIED IN CD SERIES.
4. CHANNEL GRADING DEFINED PER TYPICAL STREAM CHANNEL CROSS SECTIONS IN CD SERIES.
5. BOULDER DIMENSIONS SHOWN ARE APPROXIMATE. REFER TO CD SERIES FOR MINIMUM BOULDER DIMENSIONS.
6. SEE CD SERIES FOR IN-STREAM STRUCTURE FOOT EXCAVATION ELEVATIONS.
7. FIELD RUN TOPOGRAPHIC SURVEY WAS SUPPLEMENTED WITH CITY-PROVIDED GIS CONTOURS. MINOR GRADING MODIFICATIONS DURING CONSTRUCTION CAN BE EXPECTED.
8. SCHENKS BRANCH TRIBUTARY WIDTH:
   EXISTING = 12-15 FEET; PROPOSED = 18-22 FEET.
9. UNNAMED TRIBUTARY TO SCHENKS BRANCH TRIBUTARY (UT1) WIDTH:
   EXISTING = 15 FEET; PROPOSED = 16-20 FEET.



PROFILE

H: 1" = 20' - V: 1" = 5'

HORIZONTAL SCALE: 1" = 20'

20 10 0 20'

5 0 5'

VERTICAL SCALE: 1" = 5'

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PLOT DATE: 4/29/2022 2:03 PM BY: SKANE

REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

PROJECT ENGINEER: C. TABOR

DESIGNED BY: T. SMITH

DRAWN BY: S. KANE

CHECKED BY: T. SCHUELER

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

100% DESIGN -
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FOR CONSTRUCTION

TYLER W. SMITH
Lic. No. 63968
2022.05.02
09:37:11-04'00'

Hazen

HAZEN AND SAWYER
1555 ROSENEATH ROAD
RICHMOND, VA, 23230

CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

CIVIL
SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PLAN AND PROFILE - 2 OF 2

DATE: APRIL 2022

HAZEN NO.: 32571-003

HAZEN CONTRACT NO.: 202827

DRAWING NUMBER: C8

2022.05.02 09:33:28-04'00'

SCHENKS BRANCH TRIBUTARY PROFILE & STRUCTURE TABLE

REACH	STATION	PROFILE FEATURE	THALWEG ELEVATION	BANKFULL ELEVATION	CROSS SECTION TYPE	STRUCTURE NAME	STRUCTURE TYPE	STRUCTURE DETAIL DRAWING	THALWEG ELEVATION MODIFICATION
SCHENKS BRANCH TRIBUTARY	100+00.00	R1	359.69	361.39	RIFFLE	RGC-1	RIFFLE GRADE CONTROL	CD3	
	100+36.45	N1	359.44	361.13	RUN	CV-1	CROSS VANE	CD4	
	100+47.45	P1	357.05	361.05	CENTER POOL				
	100+92.45	R2	359.02	360.72	RIFFLE	RGC-2	RIFFLE GRADE CONTROL	CD3	
	101+07.45	N2	358.85	360.61	RUN	JH-1	J-HOOK VANE	CD5	
	101+18.45	P2	356.53	360.53	LEFT SKEWED POOL				
	101+63.45	R3	358.50	360.20	RIFFLE	RGC-3	RIFFLE GRADE CONTROL	CD3	
	101+76.45	N3	358.36	360.10	RUN	JH-2	J-HOOK VANE	CD5	
	101+90.45	P3	356.00	360.00	RIGHT SKEWED POOL				
	102+44.45	R4	357.91	359.61	RIFFLE	RGC-4	RIFFLE GRADE CONTROL	CD3	
	102+59.45	N4	357.74	359.50	RUN	JH-3	J-HOOK VANE	CD5	
	102+73.45	P4	355.40	359.40	LEFT SKEWED POOL				
	103+27.45	R5	~~357.30~~	359.00	RIFFLE	RGC-5	RIFFLE GRADE CONTROL	CD3	357.65
	103+42.45	N5	~~357.14~~	358.89	RUN	CV-2	CROSS VANE	CD4	357.50
	103+55.45	P5	354.80	358.80	CENTER POOL				
	104+05.45	R6	~~356.73~~	358.43	RIFFLE	RGC-6	RIFFLE GRADE CONTROL	CD3	357.30
	104+18.45	N6	~~356.59~~	358.34	RUN	CV-3	CROSS VANE	CD4	357.15
	104+29.45	P6	354.26	358.26	CENTER POOL				
	104+75.45	R7	356.22	357.92	RIFFLE	RGC-7	RIFFLE GRADE CONTROL	CD3	
	104+88.45	N7	356.08	357.83	RUN	JH-4	J-HOOK VANE	CD5	
	105+06.45	P7	353.69	357.69	RIGHT SKEWED POOL				
	105+78.45	R8	355.47	357.17	RIFFLE	RGC-8	RIFFLE GRADE CONTROL	CD3	
	105+98.45	N8	355.25	357.02	RUN	JH-5	J-HOOK VANE	CD5	
	106+11.45	P8	352.93	356.93	LEFT SKEWED POOL				
	106+63.45	R9	354.85	356.55	RIFFLE	RGC-9	RIFFLE GRADE CONTROL	CD3	
	106+77.45	N9	354.69	356.45	RUN	CV-4	CROSS VANE	CD4	
	106+95.45	P9	352.31	356.31	CENTER POOL				
	107+69.11	R10	354.07	355.77	RIFFLE				

1 SCHENKS BRANCH TRIBUTARY (SBT) PROFILE AND STRUCTURE TABLE

UNNAMED TRIBUTARY PROFILE & STRUCTURE TABLE

REACH	STATION	PROFILE FEATURE	THALWEG ELEVATION	BANKFULL ELEVATION	CROSS SECTION TYPE	STRUCTURE NAME	STRUCTURE TYPE	STRUCTURE DETAIL DRAWING
UNNAMED TRIBUTARY	200+12.77	C1	359.41	360.41	RUN	C-1	ROCK CASCADE	CD8
	200+62.00	P10	354.03	357.63	CENTER POOL			

2 UNNAMED TRIBUTARY (UT1) PROFILE AND STRUCTURE TABLE

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PLOT DATE: 4/29/2022 2:03 PM BY: SKANE

REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

PROJECT ENGINEER: C. TABOR
DESIGNED BY: T. SMITH
DRAWN BY: S. KANE
CHECKED BY: T. SCHUELER

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE
0 1/2" 1"

100% DESIGN -
ISSUED
FOR CONSTRUCTION

TYLER W. SMITH
Lic. No. 63968
2022.05.02
09:38:05-04'00'

Hazen
HAZEN AND SAWYER
1555 ROSENEATH ROAD
RICHMOND, VA, 23230

CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

CIVIL
STREAM PROFILE AND STRUCTURE TABLE

DATE: APRIL 2022
HAZEN NO.: 32571-003
HAZEN CONTRACT NO.: 202827
DRAWING NUMBER: C10

2022.05.02 09:33:35-04'00'

NOTES:

1. CROSS SECTION VIEWS ARE ORIENTED AS IF LOOKING DOWNSTREAM.

CROSS SECTION

H: 1" = 20' - V: 1" = 1'

HORIZONTAL SCALE: 1" = 20'
20 10 0 20'
1 0 1'
VERTICAL SCALE: 1" = 1'

REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

PROJECT ENGINEER: C. TABOR
DESIGNED BY: T. SMITH
DRAWN BY: S. KANE
CHECKED BY: T. SCHUELER

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0 1/2" 1"

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2022.05.02
09:38:36-04'00'

Hazen

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RICHMOND, VA, 23230

CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

CIVIL
SCHENKS BRANCH TRIBUTARY STREAM RESTORATION
CROSS SECTIONS

DATE: APRIL 2022
HAZEN NO.: 32571-003
HAZEN CONTRACT NO.: 202827
DRAWING NUMBER: C12

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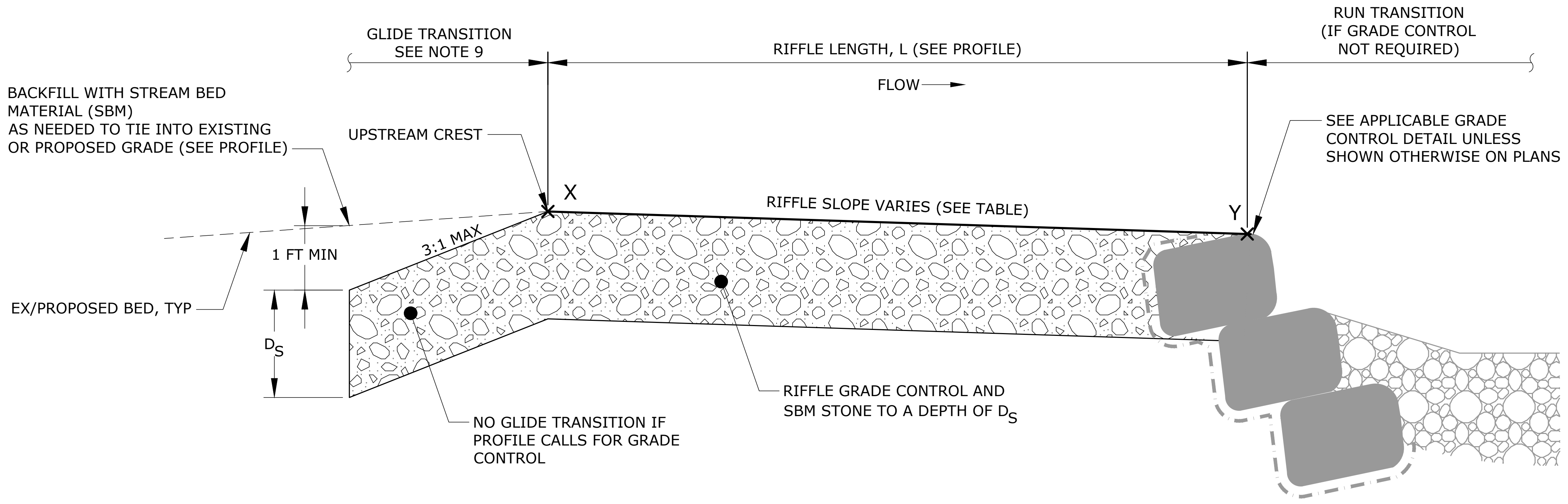
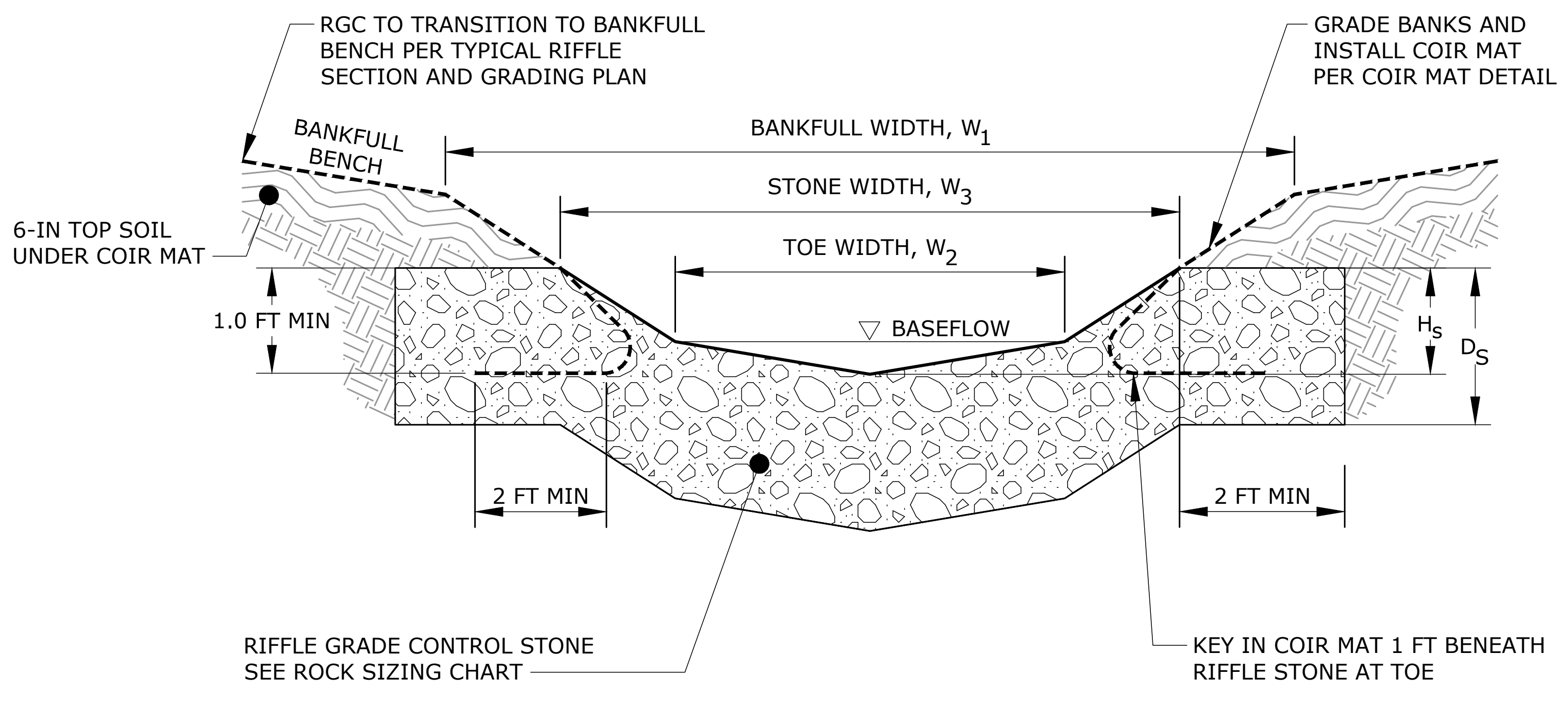


A PROFILE VIEW

NOTES:

1. IF EXISTING OR PROPOSED UTILITY OCCURS WITHIN THE RGC, COMPLETE PIPE INSTALLATION, REHABILITATION, OR REPLACEMENT WORK AND INSTALL PIPE PROTECTION (IF REQUIRED) PER SEPARATE UTILITY AND PIPE PROTECTION DETAILS PRIOR TO COMPLETING RGC WORK.
2. CONSTRUCT UPSTREAM AND DOWNSTREAM GRADE CONTROLS (IF REQUIRED) PER SEPARATE DETAILS PRIOR TO INSTALLING THE RGC.
3. CROSS-SECTIONAL DIMENSIONS AND LONGITUDINAL SPACING OF FEATURES VARY. SEE STRUCTURE TABLES, TYPICAL SECTIONS, DETAILED CROSS SECTIONS, AND PROFILES FOR DIMENSIONS OF EACH INDIVIDUAL STRUCTURE.
4. RIFFLE GRADE CONTROL STONE SHALL BE PLACED SO THAT IT SHINGLES IN A DOWNSTREAM DIRECTION. SMALL AND LARGE STONES SHALL BE MIXED PRIOR TO IN-STREAM PLACEMENT TO MINIMIZE VOID SPACES. STONES MUST BE PLACED IN A MANNER TO PROMOTE INTERLOCKING. DUMPING OF RIPRAP SHALL NOT BE PERMITTED.
5. CHINK ALL RGC VOIDS WITH SBM PER ROCK SIZING TABLE.
6. THERE MAY BE NO GLIDE OR RUN TRANSITION WHERE THE UPSTREAM OR DOWNSTREAM RIFFLE LIMITS ARE SET BY GRADE CONTROLS.
7. THALWEG MAY BE MODIFIED IN FIELD PER THE ENGINEER.
8. SEE TYPICAL RIFFLE FOR RIFFLE CROSS SECTION DIMENSIONS, DWG CD1.
9. CONTRACTOR, TO PROVIDE 5' OF GLIDE TRANSITION, UPSTREAM OF UPSTREAM CREST.



B SECTION VIEW

1 RIFFLE GRADE CONTROL (RGC) DETAIL

NTS

1

STRUCTURE #	UPSTREAM STA	DOWNSTREAM STA	STREAMBED ELEV X (MSL)	STREAMBED ELEV Y (MSL)	LENGTH L (FT)	RIFFLE SLOPE (%)	BANKFULL WIDTH W1 (FT)	TOE WIDTH W2 (FT)	STONE WIDTH W3 (FT)	STONE HEIGHT HS (FT)	RGC STONE DEPTH DS (FT)
RGC-1	100+00.00	100+36.45	359.69	359.44	36.45	0.7%	18	13.2	17	1.1	2
RGC-2	100+92.45	101+07.45	359.02	358.85	15	1.1%	18	13.2	17	1.1	2
RGC-3	101+63.45	101+76.45	358.5	358.36	13	1.1%	18	13.2	17	1.1	2
RGC-4	102+44.45	102+59.45	357.91	357.74	15	1.1%	18	13.2	17	1.1	2
RGC-5	103+27.45	103+42.45	~~357.3~~ 357.65	~~357.14~~ 357.50	15	~~1.1%~~ 1.0%	18	13.2	17	1.1	2
RGC-6	104+05.45	104+18.45	~~356.73~~ 357.30	~~356.59~~ 357.15	13	~~1.1%~~ 1.2%	18	13.2	17	1.1	2
RGC-7	104+75.45	104+88.45	356.22	356.08	13	1.1%	18	13.2	17	1.1	2
RGC-8	105+78.45	105+98.45	355.47	355.25	20	1.1%	18	13.2	17	1.1	2
RGC-9	106+63.45	106+77.45	354.85	354.69	14	1.1%	18	13.2	17	1.1	2

2 SCHENKS BRANCH TRIBUTARY PROJECT, RIFFLE GRADE CONTROL (RGC) SCHEDULE

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PLOT DATE: 4/29/2022 2:05 PM BY: SKANE

REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

PROJECT ENGINEER: C. TABOR
DESIGNED BY: T. SMITH
DRAWN BY: S. KANE
CHECKED BY: T. SCHUELER
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FOR CONSTRUCTION

TYLER W. SMITH
Lic. No. 63968
2022.05.02
09:40:32-04'00'

Hazen
HAZEN AND SAWYER
1555 ROSENEATH ROAD
RICHMOND, VA, 23230

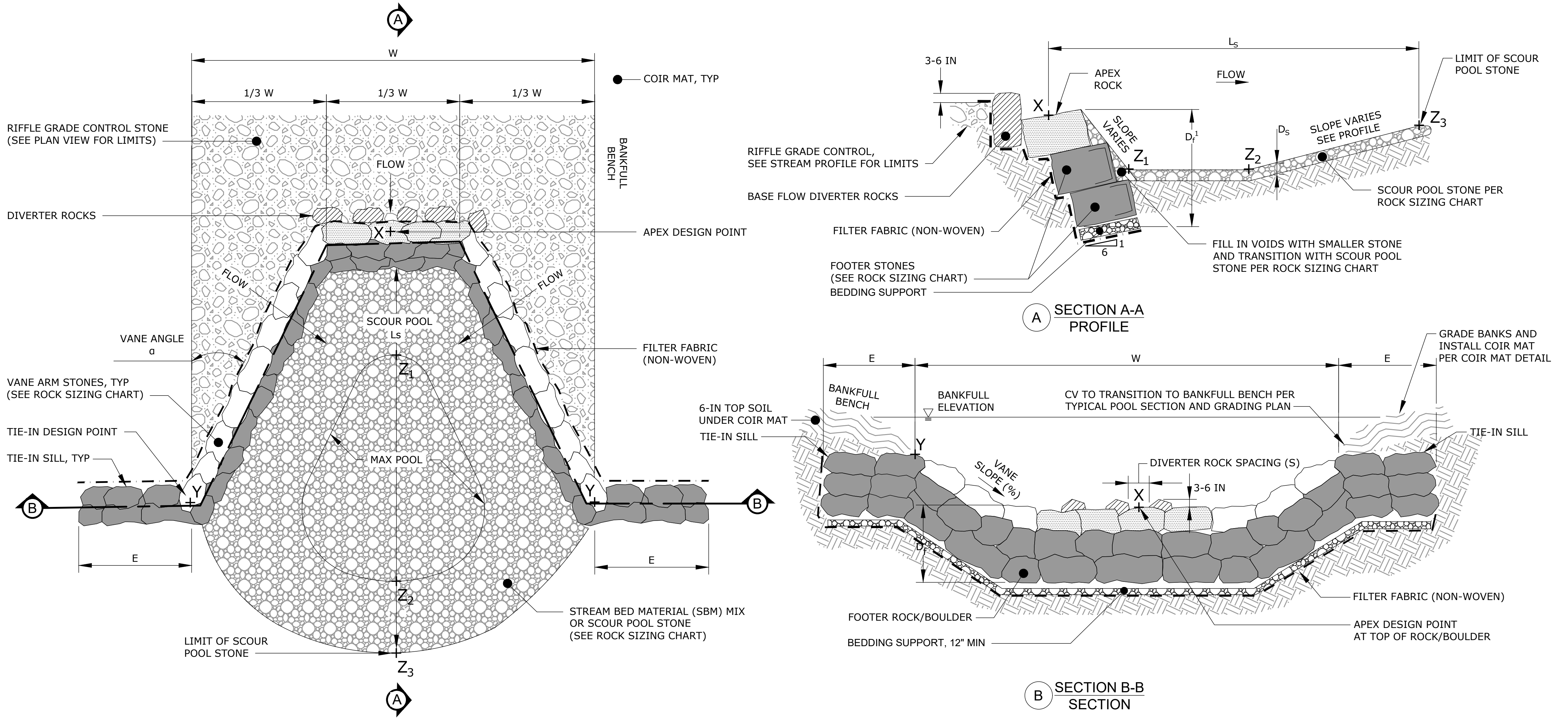
CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

DETAILS
RIFFLE GRADE CONTROL STRUCTURE

DATE: APRIL 2022
HAZEN NO.: 32571-003
HAZEN CONTRACT NO.: 202827
DRAWING NUMBER: CD3

2022.05.02 09:33:53-04'00'



PLAN VIEW

A SECTION A-A PROFILE

B SECTION B-B SECTION

1 CROSS VANE (CV) DETAIL

NTS

NOTES:

1. NUMBER OF STACKED FOOTER ROCKS REQUIRED TO ACCOMPLISH DESIGN FOOTER DEPTH MAY VARY. SEE DETAIL TABLE AND ROCK SIZING CHART FOR STONE DIMENSIONS AND MIN FOOTER DEPTHS (D_f).
2. ALL DIMENSIONS/ELEVATIONS TO BE FIELD ADJUSTED TO ENSURE STABLE INSTALLATION, FISH PASSAGE, AND TIE-IN TO BANKS.
3. VANE STONES SHALL BE BOULDERS WITH RECTANGULAR BLOCK SHAPE AND MINIMUM D50 DIMENSION OF 18 INCHES IN ANY DIRECTION UNLESS NOTED OTHERWISE (SEE ROCK SIZING CHART).
4. ROCKS/BOULDERS SHALL BE TIGHT FITTING WITH NO VOIDS/GAPS LARGER THAN 1 INCH. VOIDS ALONG APEX AND VANE ARMS SHALL BE CHINKED-IN WITH SMALLER NON-WEATHERING STONE TO ESTABLISH SURFACE FLOW AND INTERCONNECTION OF ROCKS.
5. ROCKS/BOULDERS ALONG APEX AND VANE ARMS SHALL BE FLUSH WITH THE TOP SURFACES OF ADJACENT STONES.
6. TOP ROCKS SHALL BE SUPPORTED BY A FOOTER ROCK AND SHINGLED UPSTREAM.
7. STONE PLACEMENT SHALL BE FIELD ADJUSTED TO ENSURE STONE WILL REMAIN IN PLACE OVER FULL RANGE OF FLOW CONDITIONS.
8. REPLACEMENT OF ROCKS/BOULDERS MAY BE REQUIRED BASED UPON INSPECTION OF COMPLETED INSTALLATION TO MEET DESIGN INTENT AND PERMIT REQUIREMENTS.
9. SPACING BETWEEN DIVERTER ROCKS SHALL BE 1/3 TO 1/2 THE LENGTH OF THE APEX STONE LENGTH UNLESS NOTED OTHERWISE (SEE DETAIL TABLE). DIVERTER STONES SHALL BE PLACED SO THAT THE TOP SURFACE IS 3 TO 6 INCHES ABOVE THE APEX ROCK ELEVATION.
10. TIE-IN SILLS SHALL BE EMBEDDED 4 FT (MIN) INTO STABLE CHANNEL BANK UNLESS NOTED OTHERWISE (SEE DETAIL TABLE).
11. ANGLE OF VANE ARM SHALL BE BETWEEN 20 (MIN) AND 30 (MAX) DEGREES UNLESS NOTED OTHERWISE (SEE DETAIL TABLE).
12. SLOPE OF VANE ARM SHALL BE BETWEEN 2% (MIN) AND 7% (MAX) UNLESS NOTED OTHERWISE (SEE DETAIL TABLE). ARM SLOPE IS MEASURED FROM APEX POINT X TO BANK TIE-IN POINT Y.
13. PLACE FILTER FABRIC (NON-WOVEN) ON UPSTREAM FACE OF ROCKS FOR THE ENTIRE STRUCTURE INCLUDING APEX, VANE AND TIE-IN SILLS. FABRIC SHALL EXTEND BENEATH THE FOOTER ROCKS.
14. WHERE EXISTING BED MATERIAL IN SCOUR POOLS MATCHES SIZE AND MATERIAL OF STREAM BED MATERIAL (SBM) MIX, SCOUR POOL STONE LINING IS NOT REQUIRED UNLESS NOTED OTHERWISE. WHERE SCOUR POOL LIES IN CLAY OR OTHER SUBSTRATE FINER THAN THE SBM MIX, THE CONTRACTOR SHALL OVER EXCAVATE BY 6 INCHES (MIN.) UNLESS NOTED OTHERWISE (SEE DETAIL TABLE) AND PLACE SBM MIX TO PROPOSED GRADE OR AS DIRECTED BY THE ENGINEER.
15. STREAM BED MATERIAL SHALL COME FROM SALVAGED SOURCE FIRST AND THEN FURNISHED AS NECESSARY. OFFSITE STREAMBED MATERIAL SHALL BE USED TO CHOKE BOTTOM LAYERS OF ROCK WITH SALVAGED MATERIAL SAVED FOR TOP.
16. ROCKS (APEX, ARM, AND FOOTERS) ARE PLACED AT 6:1 CAMBER WITH HORIZONTAL.
17. SEE ROCK SIZING CHART FOR STONE SIZES.

1

STRUCTURE #		APEX X	STONE TIE-IN AT BANK Y		MAX POOL Z1	MAX POOL Z2	SCOUR POOL STONE Z3	VANE SLOPE (%)	VANE ANGLE a (DEGREES)	SILL EMBEDMENT LENGTH E (FT)	SCOUR POOL STONE LENGTH LS (FT)	BANKFULL WIDTH W (FT)	ROCK DIVERTER SPACING S (FT)	FOOTER DEPTH DF (FT)	SCOUR POOL STONE DEPTH DS (FT)
			LEFT	RIGHT											
CV-1	STA	100+36.45	100+48.45	100+48.45	100+47.45	-	100+52.45	(L) 3.7% (R) 3.7%	(L) 25% (R) 25%	(L) 5 (R) 5	16	18	0.2	4.4	1.3
	OFFSET	-	12	12	11	-	-								
	ELEV	359.44	359.884	359.884	357.05	-	357.27								
CV-2	STA	103+42.45	103+54.45	103+54.45	103+55.45	-	103+60.45	(L) 3.0% (R) 3.0%	(L) 25% (R) 25%	(L) 5 (R) 5	18	18	0.2	4.4	1.3
	OFFSET	-	12	12	13	-	-								
	ELEV	357.50	357.86	357.86	354.8	-	354.99								
CV-3	STA	104+18.45	104+30.45	104+30.45	104+29.45	-	104+34.45	(L) 3.0% (R) 3.0%	(L) 25% (R) 25%	(L) ~~5~~ 10 (R) ~~5~~ 10	16	18	0.2	4.4	1.3
	OFFSET	-	12	12	11	-	-								
	ELEV	357.15	357.51	357.51	354.26	-	354.47								
CV-4	STA	106+77.45	106+89.45	106+89.45	106+95.45	-	107+24.45	(L) 3.7% (R) 3.7%	(L) 25% (R) 25%	(L) 5 (R) 5	47	18	0.2	4.4	1.3
	OFFSET	-	12	12	18	-	-								
	ELEV	354.69	355.134	355.134	352.31	-	352.43								

2 CROSS VANE (CV) SCHEDULE

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PLOT DATE: 4/29/2022 2:05 PM BY: SKANE

REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

PROJECT ENGINEER: C. TABOR
DESIGNED BY: T. SMITH
DRAWN BY: S. KANE
CHECKED BY: T. SCHUELER
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE
0 1/2" 1"

100% DESIGN -
ISSUED
FOR CONSTRUCTION

TYLER W. SMITH
Lic. No. 63968
2022.05.02 09:40:44-04'00'

Hazen
HAZEN AND SAWYER
1555 ROSENEATH ROAD
RICHMOND, VA, 23230

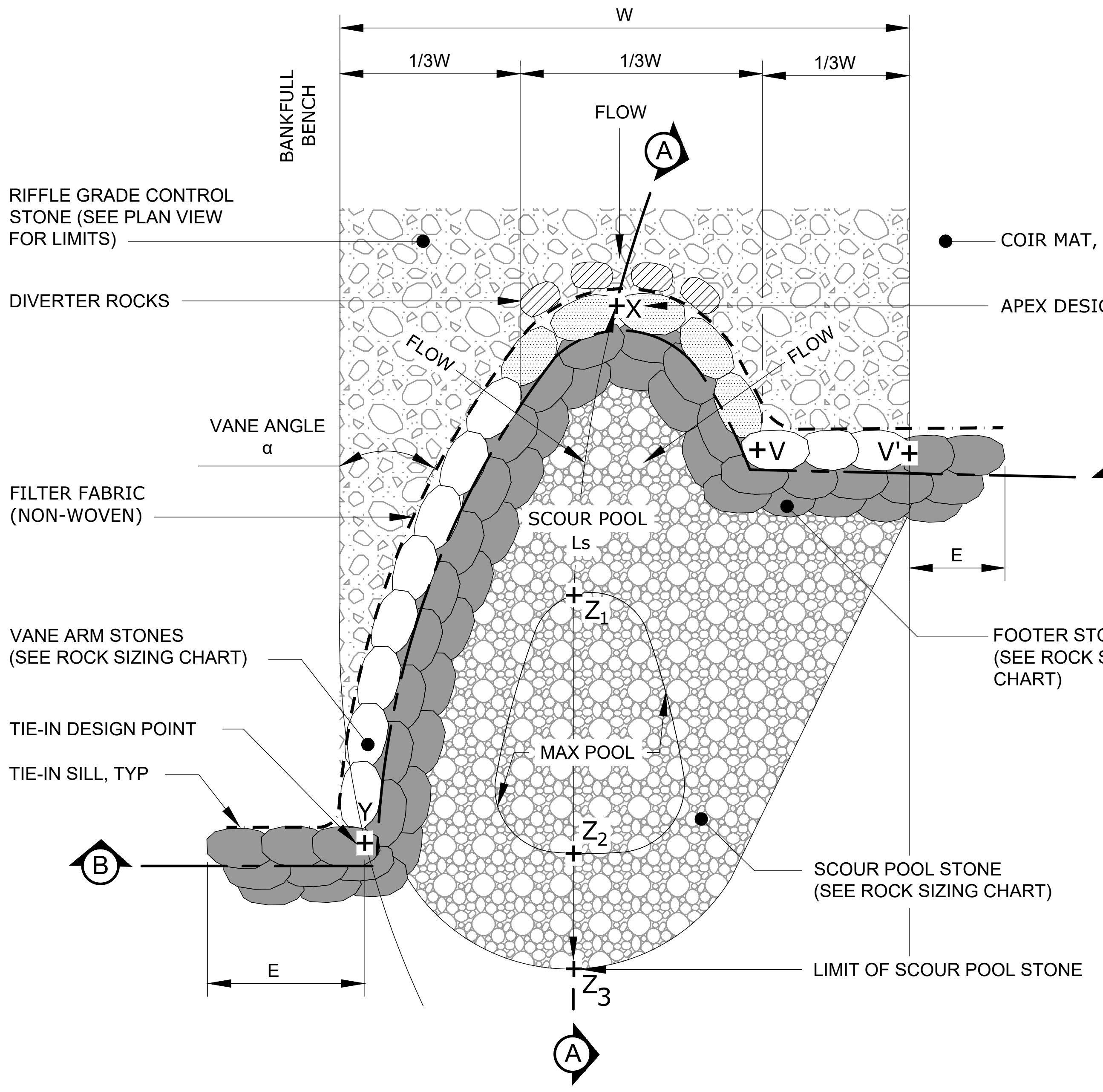
CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

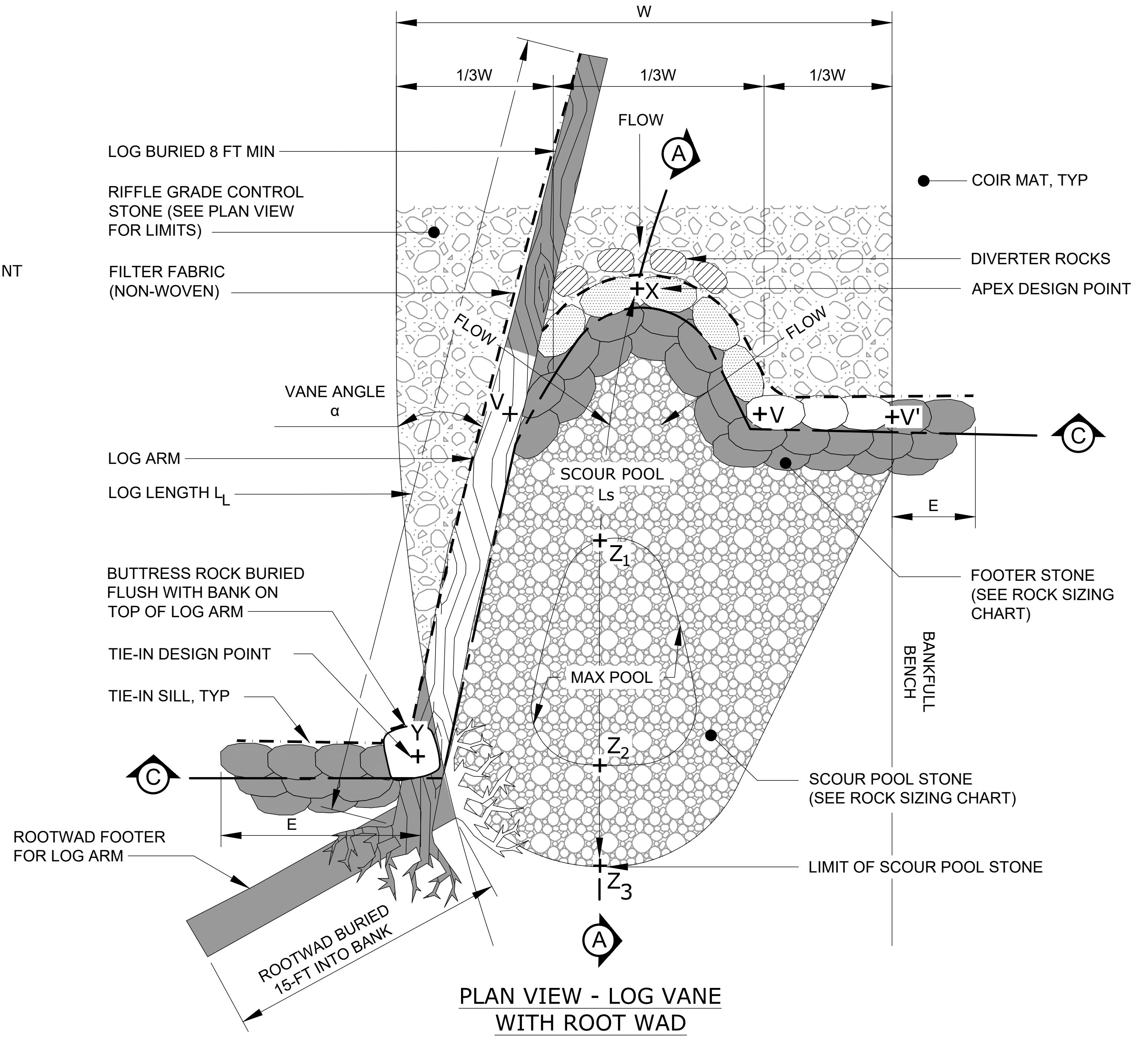
DETAILS
CROSS VANE

DATE: APRIL 2022
HAZEN NO.: 32571-003
HAZEN CONTRACT NO.: 202827
DRAWING NUMBER: CD4

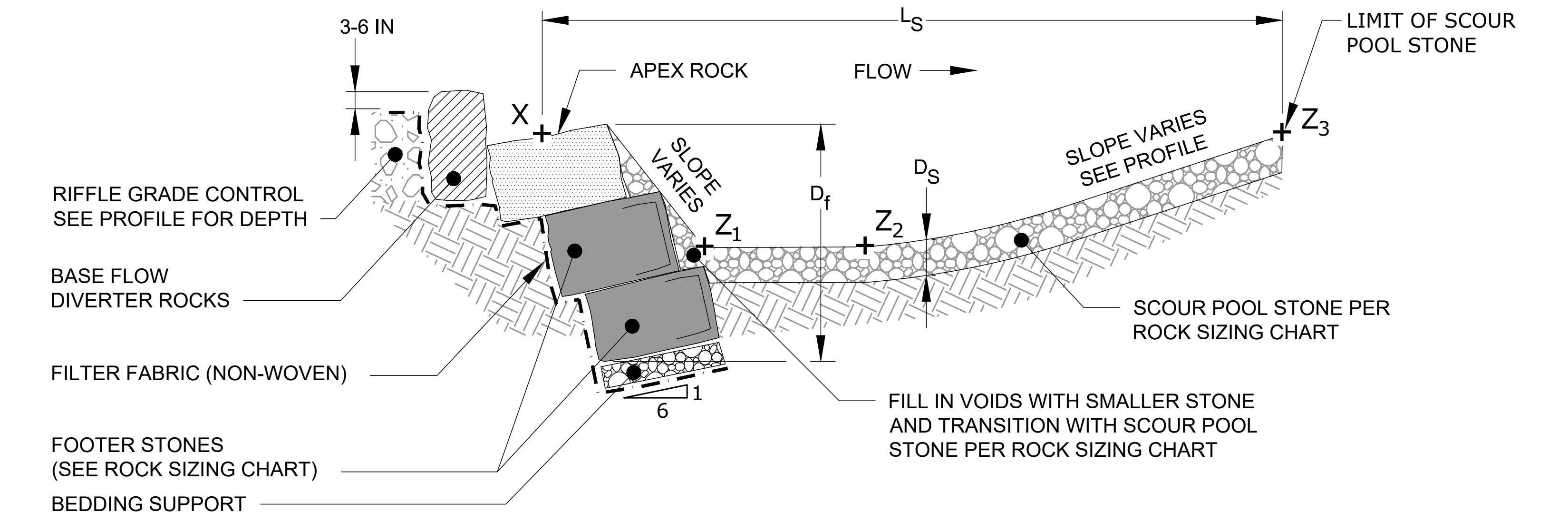
2022.05.02 09:33:56-04'00'



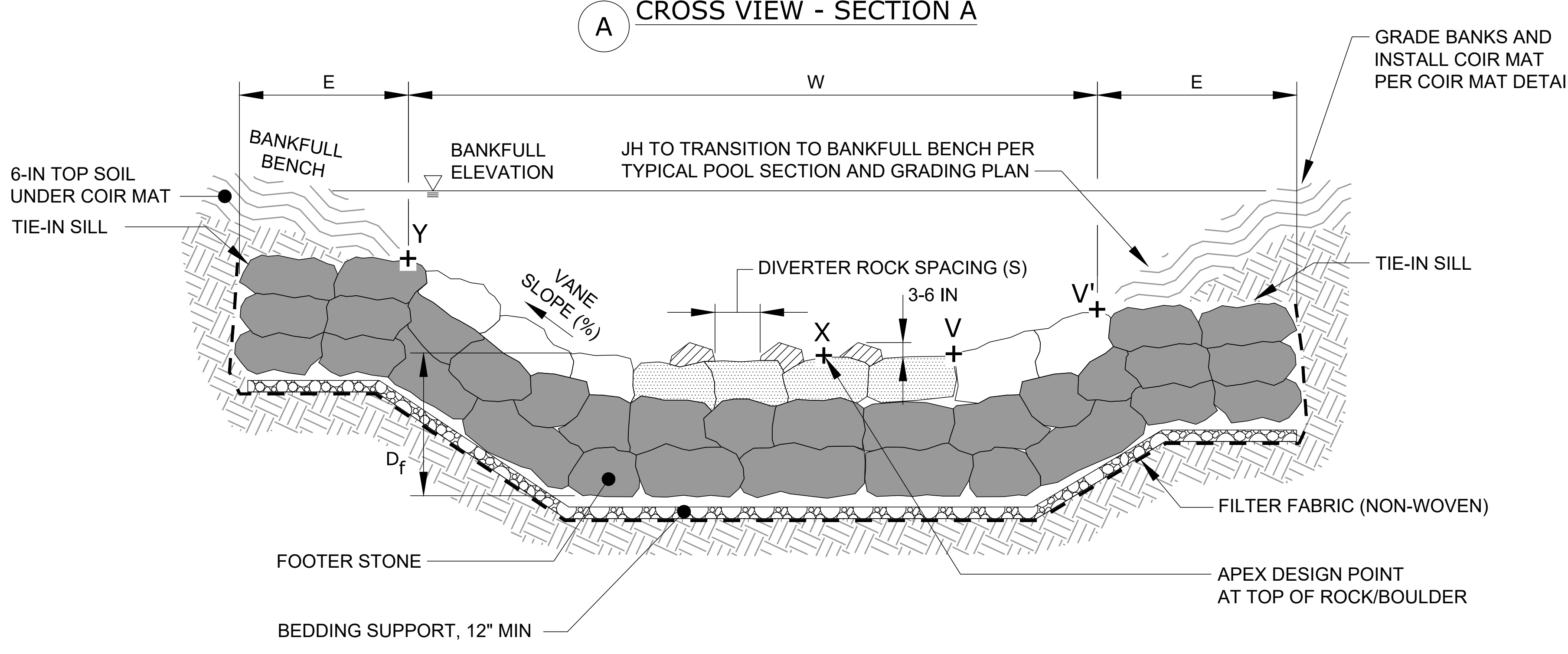
PLAN VIEW - ROCK VANE



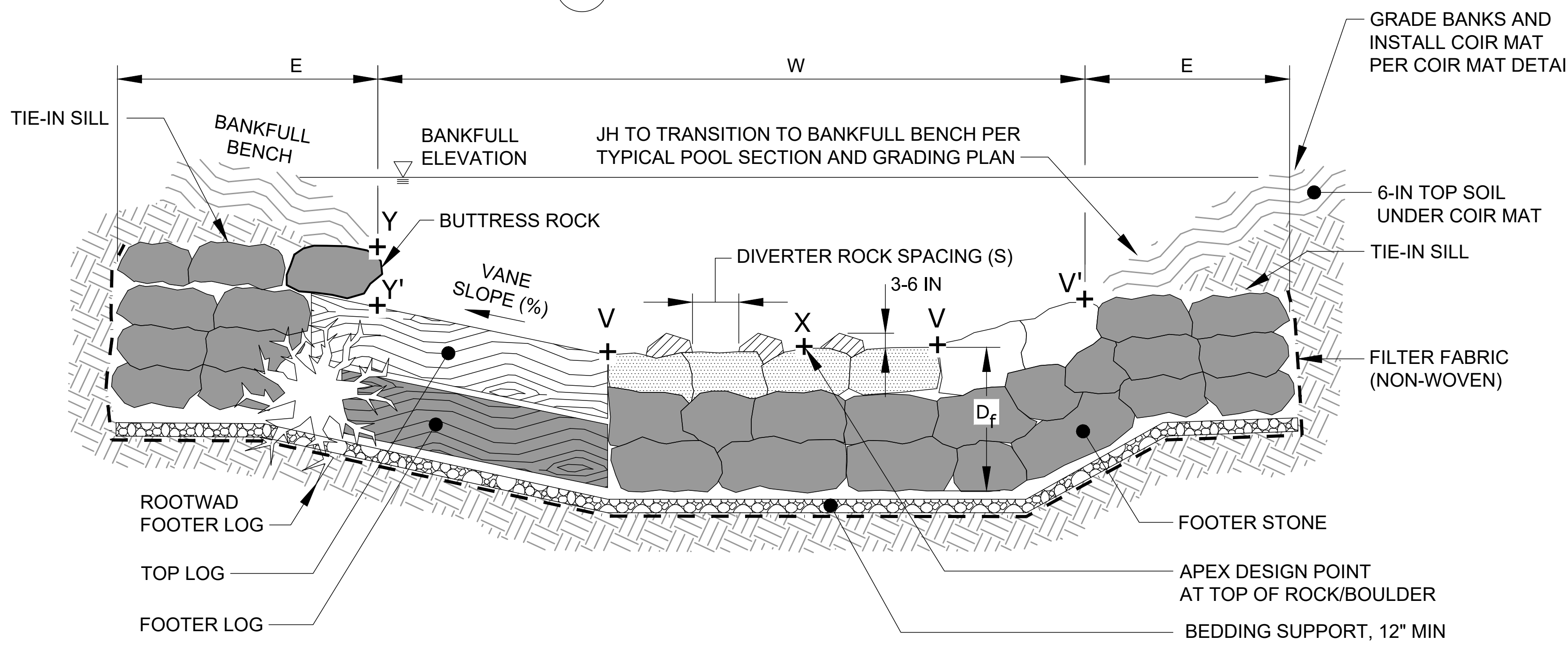
PLAN VIEW - LOG VANE
WITH ROOT WAD



A CROSS VIEW - SECTION A



B CROSS VIEW - SECTION B



C CROSS VIEW - SECTION C

J-HOOK VANE NOTES:

1. NUMBER OF STACKED FOOTER ROCKS REQUIRED TO ACCOMPLISH DESIGN FOOTER DEPTH MAY VARY. SEE DETAIL TABLE AND ROCK SIZING CHART FOR STONE DIMENSIONS AND MIN FOOTER DEPTHS (D_f).
2. ALL DIMENSIONS/ELEVATIONS MAY BE FIELD ADJUSTED BY DESIGN ENGINEER TO ENSURE STABLE INSTALLATION, FISH PASSAGE, AND TIE-IN TO BANKS.
3. VANE STONES SHALL BE BLOCK-LIKE BOULDERS WITH TWO ROUGHLY PARALLEL OPPOSITE SIDES SUITABLE FOR STACKING AND MINIMUM DIMENSION AS SPECIFIED IN THE ROCK SIZING TABLE, UNLESS NOTED OTHERWISE.
4. ROCKS/BOULDERS SHALL BE TIGHT FITTING WITH NO VOIDS/GAPS LARGER THAN 1 INCH. VOIDS ALONG APEX AND VANE ARMS SHALL BE CHINKED-IN WITH SMALLER NON-WEATHERING STONE TO ESTABLISH SURFACE FLOW AND INTERCONNECTION OF ROCKS.
5. ROCKS/BOULDERS ALONG APEX AND VANE ARMS SHALL BE FLUSH WITH THE TOP SURFACES OF ADJACENT STONES.
6. TOP ROCKS SHALL BE SUPPORTED BY A FOOTER ROCK AND SHINGLED UPSTREAM.
7. STONE PLACEMENT SHALL BE FIELD ADJUSTED TO ENSURE STONE WILL REMAIN IN PLACE OVER FULL RANGE OF FLOW CONDITIONS.
8. SPACING BETWEEN DIVERTER ROCKS SHALL BE 1/3 TO 1/2 THE LENGTH OF THE APEX STONE LENGTH UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE). DIVERTER STONES SHALL BE PLACED SO THAT THE TOP SURFACE IS 3 TO 6 INCHES ABOVE THE APEX ROCK ELEVATION.
9. TIE-IN SILLS SHALL EXTEND 4 FT (MIN) INTO STABLE CHANNEL BANK UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE).
10. ANGLE OF VANE ARM SHALL BE BETWEEN 20 (MIN) AND 30 (MAX) DEGREES UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE).
11. SLOPE OF VANE ARM SHALL BE BETWEEN 2% (MIN) AND 7% (MAX) UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE). ARM SLOPE IS MEASURED FROM APEX POINT X TO BANK TIE-IN POINT Y FOR ROCK VANES. FOR LOG VANES, ARM VANES MEASURED FROM APEX POINT X TO TO BANK TIE-IN POINT Y'.
12. LOG VANES SHALL TIE INTO BANK AT A LOWER ELEV THAN ROCK VANES IN ORDER TO BURY THE ROOTBALL IN THE BANK (SEE DETAIL SCHEDULE).
13. PLACE FILTER FABRIC (NON-WOVEN) ON UPSTREAM FACE OF ENTIRE STRUCTURE, INCLUDING APEX, VANE ROCKS, LOG VANES AND TIE-IN SILLS. FABRIC SHALL EXTEND BENEATH THE FOOTER ROCKS AND FOOTER LOGS.
14. WHERE EXISTING BED MATERIAL IN SCOUR POOLS MATCHES SIZE AND MATERIAL OF SPECIFIED SCOUR POOL STONE, SCOUR POOL STONE LINING IS NOT REQUIRED UNLESS NOTED OTHERWISE. WHERE SCOUR POOL LIES IN CLAY OR OTHER SUBSTRATE FINER THAN THE SPECIFIED SCOUR POOL STONE, THE CONTRACTOR SHALL OVER EXCAVATE BY 6 INCHES (MIN.) UNLESS NOTED OTHERWISE (SEE DETAIL SCHEDULE) AND PLACE STONE TO PROPOSED GRADE OR AS DIRECTED BY THE ENGINEER.
15. SCOUR POOL STONE SHALL COME FROM SALVAGED SOURCE FIRST AND THEN FURNISHED AS NECESSARY. OFFSITE SCOUR POOL STONE SHALL BE USED TO CONSTRUCT BOTTOM LAYERS OF POOL WITH SALVAGED MATERIAL SAVED FOR TOP.
16. ALL ROCKS ARE TO BE PLACED AT 6:1 CAMBER WITH HORIZONTAL.
17. SEE ROCK SIZING CHART FOR STONE SIZES.
18. DUCKBILL ANCHORS SHALL NOT BE INSTALLED.

1 J-HOOK (JH) VANE DETAILS

NTS

STRUCTURE #		TYPE	APEX X	HOOK SILL/LOG V	SILL AT BANK V'	STONE AT BANK Y	LOG AT BANK Y'	MAX POOL Z1	MAX POOL Z2	SCOUR POOL STONE Z3	VANE SLOPE (%)	VANE ANGLE a (DEGREES)	LOG LENGTH LL (FT)	SCOUR POOL STONE LENGTH LS (FT)	BANKFULL WIDTH W (FT)	ROCK DIVERTER SPACING S (FT)	FOOTER DEPTH DF (FT)	SCOUR POOL STONE DEPTH DS (FT)	SILL EMBEDMENT LENGTH E (FT)
JH-1	STA	LOG VANE	101+07.45	101+13.45	101+13.45	101+19.45	101+19.45	101+18.45	-	101+23.45	3.7	25	20	16	18	0.2	4.4	1.3	5
	OFFSET		-	6	6	12	12	11	-	-									
	ELEV		358.85	358.97	358.97	359.29	359.29	356.53	-	356.75									
JH-2	STA	LOG VANE	101+76.45	101+82.45	101+82.45	101+88.45	101+88.45	101+90.45	-	101+95.45	3.7	25	20	19	18	0.2	4.4	1.3	5
	OFFSET		-	6	6	12	12	14	-	-									
	ELEV		358.36	358.48	358.48	358.80	358.80	356.00	-	356.18									
JH-3	STA	LOG VANE	102+59.45	102+65.45	102+65.45	102+71.45	102+71.45	102+73.45	-	102+78.45	3.7	25	20	19	18	0.2	4.4	1.3	5
	OFFSET		-	6	6	12	12	14	-	-									
	ELEV		357.74	357.86	357.86	358.18	358.18	355.40	-	355.58									
JH-4	STA	LOG VANE	104+88.45	104+94.45	104+94.45	105+00.45	105+00.45	105+06.45	-	105+46.45	3.7	25	20	58	18	0.2	4.4	1.3	~~5~~ 10
	OFFSET		-	6	6	12	12	18	-	-									
	ELEV		356.08	356.20	356.20	356.52	356.52	353.69	-	354.68									
JH-5	STA	LOG VANE	105+98.45	106+04.45	106+04.45	106+10.45	106+10.45	106+11.45	-	106+16.45	3.7	25	20	18	18	0.2	4.4	1.3	5
	OFFSET		-	6	6	12	12	13	-	-									
	ELEV		355.25	355.37	355.37	355.69	355.69	352.93	-	353.11									

1

2 J-HOOK (JH) SCHEDULE

REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

PROJECT ENGINEER: C. TABOR
DESIGNED BY: T. SMITH
DRAWN BY: S. KANE
CHECKED BY: T. SCHUELER
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

100% DESIGN -
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FOR CONSTRUCTION

TYLER W. SMITH
Lic. No. 63968
2022.05.02

Hazen
HAZEN AND SAWYER
1555 ROSENEATH ROAD
RICHMOND, VA, 23230

CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

DETAILS
J-HOOK VANE

DATE: APRIL 2022
HAZEN NO.: 32571-003
HAZEN CONTRACT NO.: 202827
DRAWING NUMBER: CD5

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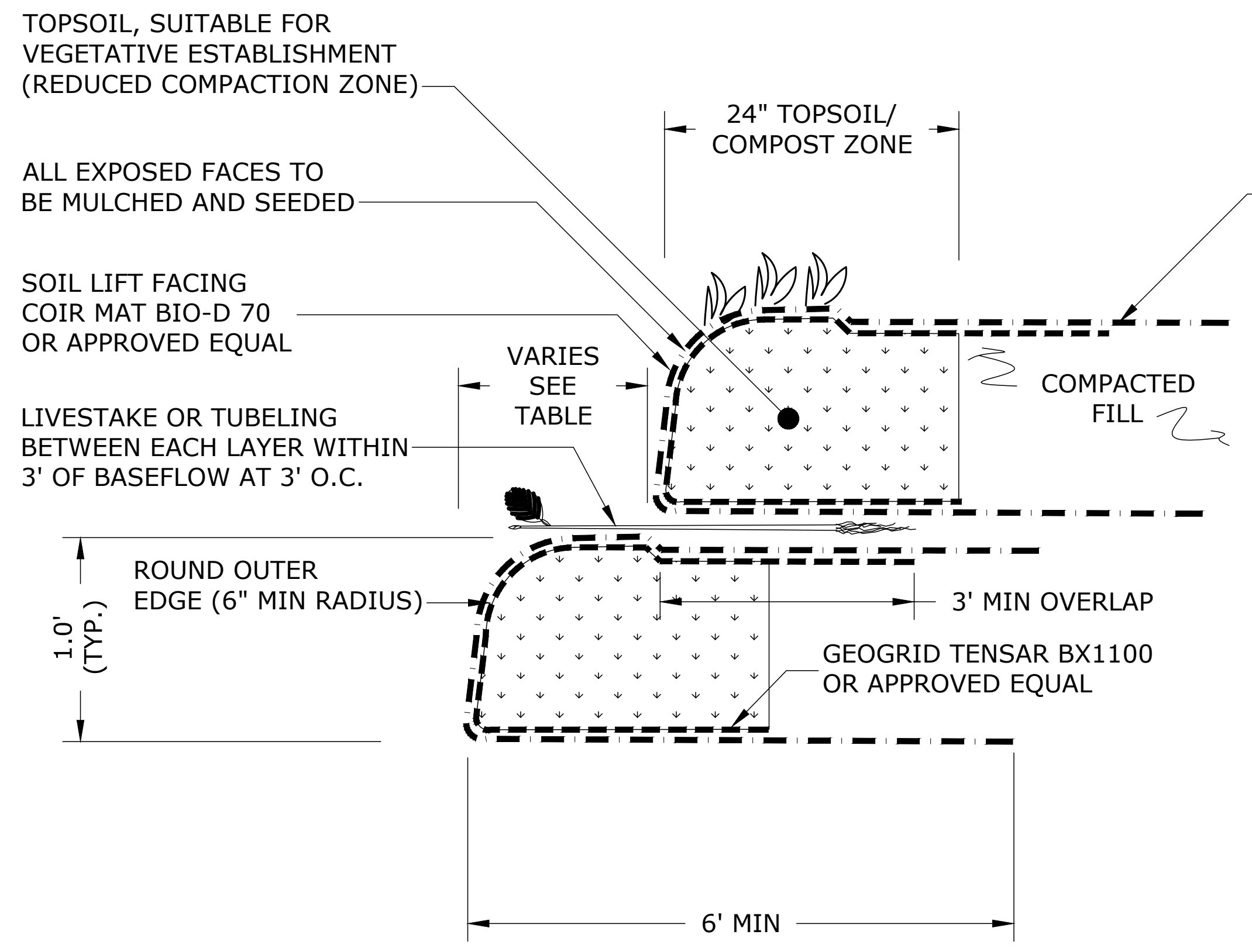
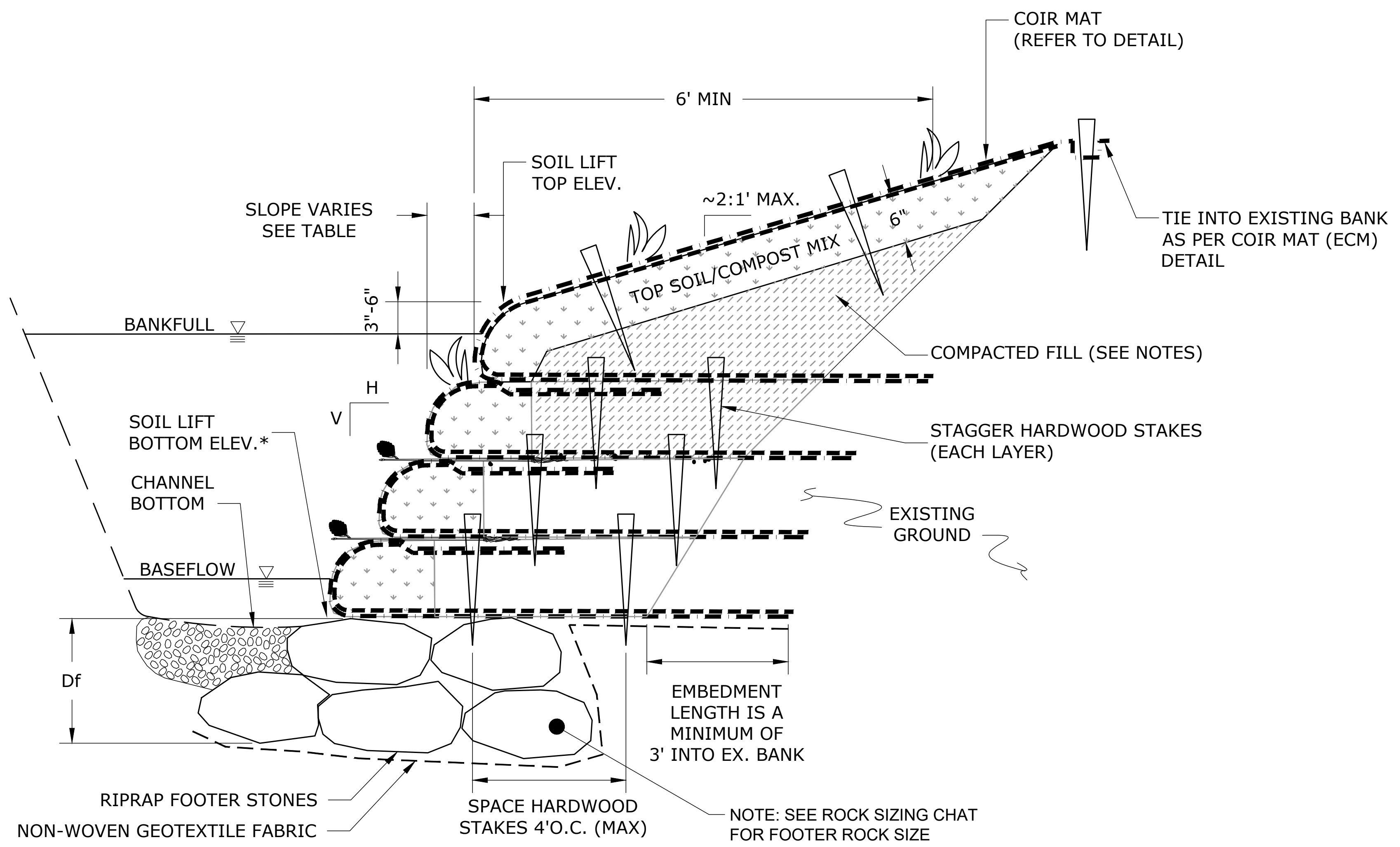


DETAILED VIEW

LEGEND

▬ ▬ ▬	INNER LAYER BIAXIAL GEOGRID
▬ · ▬ · ▬	OUTER LAYER COIR FIBER MAT
- - - - -	GEOTEXTILE FABRIC
▨	TOP SOIL/COMPOST MIX
▨	COMPACTED FILL
	PLANTS
	LIVESTAKES/ TUBLELINGS



DOUBLE LAYER SOIL LIFT CROSS SECTION

NOTES:

1. DOUBLE SOIL LIFT SHALL CONSIST OF TWO LAYERS OF MATTING OF DIFFERENT MATERIALS. THE INNER MAT LAYER IS TO CONSIST OF A BIAXIAL GEOGRID (TENSAR BX1100 OR APPROVED EQUAL). THE OUTER MAT IS TO CONSIST OF A COCONUT FIBER COIR MAT (ROLANKA BIO-D 70 OR APPROVED EQUAL. ROLANKA BIO-D BLOCK 12-300 IS AN ACCEPTABLE SUBSTITUTE.
2. THE SOIL LIFTS ARE TO BE FILLED WITH TOPSOIL AND SEED MIX.
3. THE SOIL LIFTS ARE TO BE 12-INCHES HIGH, PER LIFT.
4. MATTING TO BE STRETCHED TIGHT AND WRINKLE FREE AROUND LIFT.
5. 6" TOPSOIL/COMPOST MIX SURFACE TO BE FREE OF STICKS, DEBRIS, AND TWIGS TO PREVENT CAVITATION.
6. SATISFACTORY SOIL TYPES INCLUDE ASTM D 2487 SOIL CLASSIFICATION GROUPS GW, GP, GM, SW, SP AND SM OR A COMBINATION OF THESE SOIL GROUPS. SOIL SHALL BE FREE OF ROCK OR GRAVEL LARGER THAN 2 INCHES IN ANY DIMENSION DEBRIS, WASTE, FROZEN MATERIALS, VEGETATION AND OTHER DELETERIOUS MATTER.
7. SOIL LIFTS TO BE SEEDED AND PLANTED AS DESCRIBED ON PLANTING DETAIL PLANS.
8. PLAIN WOODEN STAKES SHALL CONSIST OF ROUGH SAWN HARDWOOD, TRIANGULAR IN SHAPE, 2-INCH BY 4-INCHES IN CROSS SECTION AND 24-INCHES IN LENGTH.
9. ONCE PLACED, SOIL LIFTS SHALL NOT BE DRIVEN OVER WITH HEAVY EQUIPMENT.

1 DOUBLE LAYER SOIL LIFT
NTS

BANK	UPSTREAM STATION	DOWNSTREAM STATION	TYPE	LENGTH	WALL SLOPE	NUMBER OF LIFTS	TOP ELEVATION TIE IN	NOTES
RIGHT	101+63.45	102+23.45	WITH COIR BLOCK	60	3H:1V	2	363	NO TOE ROCK REQUIRED
RIGHT	200+28.00	105+45.45	WITH COIR BLOCK	41	2H:1V	2	361	NO TOE ROCK REQUIRED
~~RIGHT~~	~~106+63.45~~	~~107+25.45~~	~~WITH COIR BLOCK~~	~~62~~	~~2H:1V~~	~~3~~	~~360~~	~~NO TOE ROCK REQUIRED~~
LEFT	103+86.45	104+48.45	WITH COIR BLOCK	62	-----	2	SEE DWG C12	NO TOE ROCK REQUIRED
RIGHT	103+86.45	104+48.45	WITH COIR BLOCK	62	-----	2	SEE DWG C12	NO TOE ROCK REQUIRED
LEFT	104+70.45	105+46.45	WITH COIR BLOCK	76	-----	2	SEE DWG C12	NO TOE ROCK REQUIRED

1

2 SOIL LIFT SCHEDULE

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REV	ISSUED FOR	DATE	BY
1	BEDROCK MODIFICATIONS	12/11/2023	TWS

PROJECT ENGINEER: C. TABOR
DESIGNED BY: T. SMITH
DRAWN BY: S. KANE
CHECKED BY: T. SCHUELER

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE
0 1/2" 1"

100% DESIGN -
ISSUED
FOR CONSTRUCTION

TYLER W. SMITH
Lic. No. 63968
2022.05.02 09:41:21-04'00'

Hazen

HAZEN AND SAWYER
1555 ROSENEATH ROAD
RICHMOND, VA, 23230

CITY OF CHARLOTTESVILLE
CHARLOTTESVILLE, VIRGINIA

SCHENKS BRANCH TRIBUTARY STREAM
RESTORATION PROJECT

DETAILS
SOIL LIFT

DATE: APRIL 2022
HAZEN NO.: 32571-003
HAZEN CONTRACT NO.: 202827
DRAWING NUMBER: CD7

Stream: **Schenks Branch Tributary** Location: **Mainstem**

Graph: **USFWS Hickey Run Bank Erosion Rate Curve** Total Stream Length (ft): **1100** Date:

Observers: **TS/PL**

(1)	(2)		(3)		(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
BEHI ID	**BEHI Score**	**BEHI rating**	**NBS Score**	**NBS rating**	**Bank Erosion Rate (ft/yr)**	**Length of bank (ft)**	**Study bank height (ft)**	**Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)**	**Soil Bulk Density (g/cm3)**	**Total Annual Load (TSS tons/yr)**	**Sediment Delivery Ratio**	**Erosion subtotal (tons/yr)**	**Phophorous Concentration(lb per ton of sediment)**	**Phosphorous Loading (lbs/yr)**	**Nitrogen Concentration(lb per ton of sediment)**	**Nitrogen Loading (lbs/yr)**
2L	32.50	high	1.08	low	0.40	106	6.40	271.36	1.23	10.42	1	10.42	0.70	7.29	0.60	6.25
3L	36.20	high	2.00	high	1.00	88	7.10	624.80	1.23	23.99	1	23.99	0.70	16.79	0.60	14.39
5L	41.40	very high	2.00	high	1.00	80	8.30	664.00	1.23	25.49	1	25.49	0.70	17.85	0.60	15.30
7L	35.20	high	1.11	low	0.40	39	7.10	110.76	1.23	4.25	1	4.25	0.70	2.98	0.60	2.55
9L	34.60	high	1.08	low	0.40	14	7.50	42.00	1.23	1.61	1	1.61	0.70	1.13	0.60	0.97
10L	47.50	extreme	1.25	low	1.25	60	8.20	615.00	1.23	23.61	1	23.61	0.70	16.53	0.60	14.17
12L	37.90	high	1.29	low	0.40	60	7.90	189.60	1.23	7.28	1	7.28	0.70	5.10	0.60	4.37
13L	43.70	very high	1.19	low	0.40	32	8.60	110.08	1.23	4.23	1	4.23	0.70	2.96	0.60	2.54
15L	44.00	very high	1.15	low	0.40	65	8.10	210.60	1.23	8.09	1	8.09	0.70	5.66	0.60	4.85
18L	50.20	extreme	1.14	low	1.25	135	6.10	1029.38	1.23	39.52	1	39.52	0.70	27.66	0.60	23.71
LEFT BANK TOTALS						679		3867.58				148.5		103.9		89.1
1R	33.50	high	1.12	low	0.40	57	8.40	191.52	1.23	7.35	1	7.35	0.70	5.15	0.60	4.41
4R	27.40	moderate	2.00	high	0.80	15	3.70	44.40	1.23	1.70	1	1.70	0.70	1.19	0.60	1.02
6R	40.10	very high	2.00	high	1.00	75	10.00	750.00	1.23	28.79	1	28.79	0.70	20.16	0.60	17.28
8R	40.30	very high	1.14	low	0.40	35	7.60	106.40	1.23	4.09	1	4.09	0.70	2.86	0.60	2.45
11R	45.00	extreme	1.35	low	1.25	55	8.00	550.00	1.23	21.12	1	21.12	0.70	14.78	0.60	12.67
14R	40.00	very high	1.08	low	0.40	60	12.20	292.80	1.23	11.24	1	11.24	0.70	7.87	0.60	6.74
16R	46.20	extreme	1.13	low	1.25	26	9.40	305.50	1.23	11.73	1	11.73	0.70	8.21	0.60	7.04
RIGHT BANK TOTALS						323		2240.62				86.0		60.2		51.6
GRAND TOTALS						1002		6108.20				234.5		164.2		140.7

Project: *Schenks Branch Tributary Stream Restoration*
Location: *Charlottesville, VA*
Client: *City of Charlottesville*
Hazen Project No. *32571-004*
Subject: **Nutrient Removal Protocol for Stream Restoration Work [PROTOCOL 1]**
Design Phase: *Post-Construction*
Design Date: *7/25/2024*
Designer: *BK* Version: 1.0 (5/17/2021)
Reviewer: *BF* Date: *7/25/2024*
Review Date:
Source: Reference file locations or pertinent design spreadsheets that the entered values are based on.
Template Version:

Subject: Estimate of Stream Sediment and Nutrient Loading and Removal

Methodology: Calculate mass reduction credit for prevented sediment using **Protocol 1** per guidelines set by the *Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* (dated 09/08/14) and *Consensus Recommendations for Improving the Application of the Prevented Sediment Protocol for Urban Stream Restoration Projects for Pollutant Removal Credit* (revised 2/27/20). Blue cells require user input. Green cells are result cells.

Step 1. Estimate stream sediment erosion rate and sediment load

Bulk density of soil [1], c =	1.23	gm/cc	[1] **Site specific bulk density values are now required for Protocol 1 use**; NRCS
	77.01	lb/cf	General guide for Est. Moist Bulk Density can be used as an initial guide.
			Document source of bulk density values: For this example, average silty clay
Method Used:	2	(Enter 1 or 2)	values were used from soil boring data to the right
Method #1:			
Eroding bank area, A =		sf	Document source of method #1 data, if used, in this cell.
Bank erosion rate, R =		ft/yr	
Sediment load [2], S =		tn/yr	[2] $S = \frac{\sum(c * A * R)}{2{,}000\ lb/tn}$
		lb/yr	
Method #2:			
Predicted Erosion [3] =	235	cy/yr	[3] From RiverMorph field work BEHI data below:
			Document specific location/date of collected data, if used, in this cell.
Sediment load [2], S =	234.5	tn/yr	
	469,000	lb/yr	

Step 2. Convert stream bank erosion to nutrient loading

Phosphorous concentration [4] =	0.7	lb P/tn sediment	[4] Expert panel recommended value for Phosphorous unless field measured
Nitrogen concentration [5] =	0.6	lb N/tn sediment	[5] Expert panel recommended values for Nitrogen unless field measured
			Document specific field measurement data, if used, in this cell.

Therefore, the nutrient loading for this site prior to restoration is:

Phosphorous Loading =	164.2	lb P/yr	Nutrient Loading = Sediment Load * Concentration
Nitrogen Loading =	140.7	lb N/yr	

Step 3. Estimate stream restoration efficiency

Amount of sediment, Phosphorous, Nitrogen loading reduced through restoration:

Sediment Removed [6]=	**234,500**	**lb sediment/yr**	[6] For stream restoration practices, the Expert panel recommends
Phosphorous Removed [6]=	**82.1**	**lb P/yr**	a 50% efficiency in reducing sediment and nutrients from the stream reach.
Nitrogen Removed [6]=	**70.4**	**lb N/yr**	

Project:	*Schenks Branch Tributary Stream Restoration*		
Location:	*Charlottesville, VA*		
Client:	*City of Charlottesville*		
Hazen Project No.	*32571-004*		
Subject:	**Nutrient Removal Protocol for Stream Restoration Work [PROTOCOL 2]**		
Design Phase:	*Post-Construction*		
Design Date:	*7/25/2024*		
Designer:	*BK*	Version:	1.0 (5/17/2021)
Reviewer:	*BF*	Date:	*7/25/2024*
Review Date:			
Source:	Reference file locations or pertinent design spreadsheets that the entered values are based on.		
Template Version:			

Subject: Estimate of Stream Sediment and Nutrient Loading and Removal

Methodology: Calculate mass reduction credit for prevented sediment using **Protocol 2** per guidelines set by the *Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* (dated 09/08/14) and *Consensus Recommendations to Improve Protocols 2 and 3 for Defining Stream Restoration Pollutant Removal Credits* (revised 10/26/20). Blue cells require user input. Green cells are result cells.

Step 1. Establish limits of effective hyporheic zone (EHZ), as follows:

The lateral limits of the EHZ are defined by locations where the *restored* floodplain elevation are less than 18 inches above the low flow water elevations and confirmed through on-site soil/groundwater investigation. See Figure 1 for representation of EHZ; see Ref 2-EHZ and FTZ information for more information on onsite investigation.

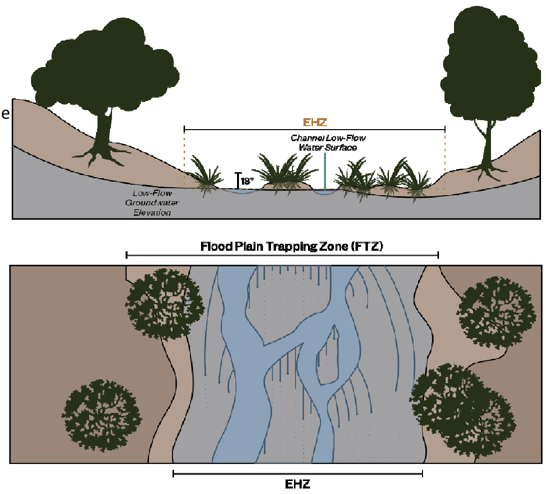

Figure 1: Representation of EHZ and FTZ boundaries

Est. *total width* EHZ:	26.50	*ft*
Est. *channel width* :	18	*ft*
Est. *length* EHZ:	883	*ft*

Est. floodplain area:	7505.5	*ft2*
Est. Channel Area:	15894	*ft2*

Step 2. Apply the denitrification rate to the EHZ:

The denitrification rate has been standardized to 0.00269 lbs/sf/year.

Est. floodplain dentification:	20.2	lbs NO_3/yr
Est. Channel denitrification:	42.8	lbs NO_3/yr

Step 3. Apply site specific discount factors:

Determine discount factors for baseflow (Bf), floodplain height factor (Hf) and aquifer conductivity reduction factor (Af) per Table 10 of the *Consensus Recommendations* .

Floodplain only:

Baseflow reduction factor (Bf):	1
Floodplain height red. factor (Hf):	0
Aquifer cond. red. Factor (Af):	1

Channel only:

Baseflow reduction factor (Bf):	1
Floodplain height red. factor (Hf):	1
Aquifer cond. red. Factor (Af):	1

Denitrification rate established in Step 2 affected by factors:
Final rate = base rate *Bf*Hf*Af

Est. floodplain dentification:	0.0	lbs NO_3/yr
Est. Channel denitrification:	42.8	lbs NO_3/yr
Total denitrification:	42.8	lbs NO_3/yr

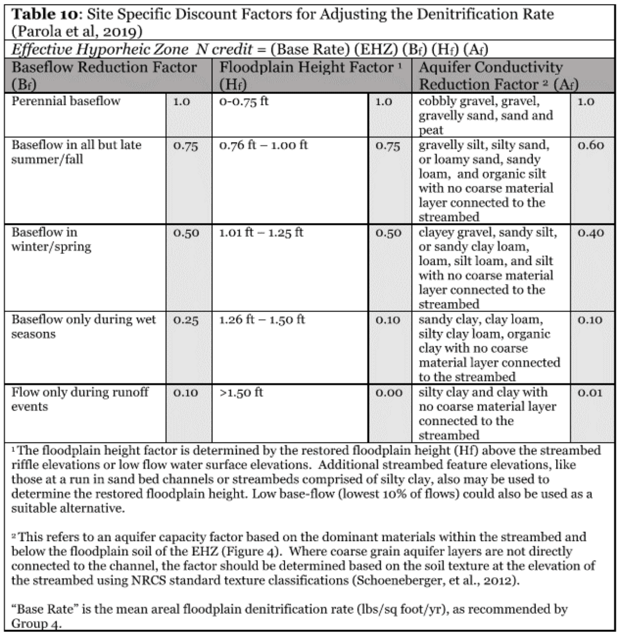

Table 10: Site Specific Discount Factors for Adjusting the Denitrification Rate (Parola et al, 2019)

Effective Hyporheic Zone N credit = (Base Rate) (EHZ) (B_f) (H_f) (A_f)

Baseflow Reduction Factor (B_f)		Floodplain Height Factor [1] (H_f)		Aquifer Conductivity Reduction Factor [2] (A_f)	
Perennial baseflow	1.0	0-0.75 ft	1.0	cobbly gravel, gravel, gravelly sand, sand and peat	1.0
Baseflow in all but late summer/fall	0.75	0.76 ft – 1.00 ft	0.75	gravelly silt, silty sand, or loamy sand, sandy loam, and organic silt with no coarse material layer connected to the streambed	0.60
Baseflow in winter/spring	0.50	1.01 ft – 1.25 ft	0.50	clayey gravel, sandy silt, or sandy clay loam, loam, silt loam, and silt with no coarse material layer connected to the streambed	0.40
Baseflow only during wet seasons	0.25	1.26 ft – 1.50 ft	0.10	sandy clay, clay loam, silty clay loam, organic clay with no coarse material layer connected to the streambed	0.10
Flow only during runoff events	0.10	>1.50 ft	0.00	silty clay and clay with no coarse material layer connected to the streambed	0.01

[1] The floodplain height factor is determined by the restored floodplain height (Hf) above the streambed riffle elevations or low flow water surface elevations. Additional streambed feature elevations, like those at a run in sand bed channels or streambeds comprised of silty clay, also may be used to determine the restored floodplain height. Low base-flow (lowest 10% of flows) could also be used as a suitable alternative.

[2] This refers to an aquifer capacity factor based on the dominant materials within the streambed and below the floodplain soil of the EHZ (Figure 4). Where coarse grain aquifer layers are not directly connected to the channel, the factor should be determined based on the soil texture at the elevation of the streambed using NRCS standard texture classifications (Schoeneberger, et al., 2012).

"Base Rate" is the mean areal floodplain denitrification rate (lbs/sq foot/yr), as recommended by Group 4.

Street Sweeping Calculations
SCP-1 and SC- 2

James River Basin SCP - 1

Subsource	Pollutant	Curb Lane Miles Swept (1 curb lane mile swept = 1 acre)	2009 EOS Loading rate (lbs/acre/yr) James River Basin	Estimated Total POC Load Based on 2009 Progress Run (lbs/yr)
Regulated Urban Impervious	Nitrogen	14.40	9.39	135.22
Regulated Urban Impervious	Phosphorus	14.40	1.76	25.34
Regulated Urban Impervious	Total Suspended Solids	14.40	676.94	9,747.94

Subsource	Pollutant	Curb Lane Miles Swept (1 curb lane mile swept = 1 acre)	Removal Rate	Total Reduction Credit (lbs/yr)
Regulated Urban Impervious	Nitrogen	135.22	0.04	5.41
Regulated Urban Impervious	Phosphorus	25.34	0.10	2.53
Regulated Urban Impervious	Total Suspended Solids	9,747.94	0.21	2,047.07

James River Basin SCP - 2

Subsource	Pollutant	Curb Lane Miles Swept (1 curb lane mile swept = 1 acre)	2009 EOS Loading rate (lbs/acre/yr) James River Basin	Estimated Total POC Load Based on 2009 Progress Run (lbs/yr)
Regulated Urban Impervious	Nitrogen	34.40	9.39	323.02
Regulated Urban Impervious	Phosphorus	34.40	1.76	60.54
Regulated Urban Impervious	Total Suspended Solids	34.40	676.94	23,286.74

Subsource	Pollutant	Estimated Total POC Load Based on 2009 Progress Run (lbs/yr)	Removal Rate	Total Reduction Credit (lbs/yr)
Regulated Urban Impervious	Nitrogen	323.02	0.03	9.69
Regulated Urban Impervious	Phosphorus	60.54	0.08	4.84
Regulated Urban Impervious	Total Suspended Solids	23,286.74	0.16	3,725.88