Using Runoff Reduction Practices to Shrink the Water Quality Volume (WQv) July 12 & July 25, 2018 Jay Dorsey



The Ohio State University

Stormwater Management Program

This Presentation

Ohio EPA Post-Construction Criteria/Guidance
 Runoff Reduction Accounting
 Green Infrastructure Practice Credits & Criteria
 Runoff Reduction Examples

Post Construction Stormwater Management

 Requires capture and treatment of a water quality volume (WQv) using structural BMPs

WQv = Rv * P * A / 12

Where: Rv = volumetric runoff coefficient P = water quality event precipitation depth = 0.90 in A = area draining to the BMP (acre)

Source: Ohio EPA. 2018. General Permit for Storm Water Discharges Associated with Construction Activity

Runoff Reduction Practices (CGP p23)

"The size of structural post-construction practices used to capture and treat the WQv can be reduced by incorporating runoff reducing practices into the design of the site's drainage system."

Runoff Reduction Practices (CGP p23)

- Green roof
- Rainwater harvesting
- Impervious area disconnection
- Sheet flow to grass filter strip
- Sheet flow to conservation area
- Grass swale
- Bioretention
- Infiltration basin
- Infiltration trench
- Underground infiltration system
- Permeable pavement with infiltration

Runoff Reduction Accounting $WQv_{adjusted} = WQv - RRv$ Where: WQv = water quality volume RRv = runoff reduction volume WQv_{adjusted} = water quality volume that must be captured and treated by a Table 4 BMP

Runoff Reduction Accounting

- The runoff reduction volume (RRv) must be calculated using the Ohio Runoff Reduction Method spreadsheet
- The WQv and RRM must be determined by subwatershed area – i.e., cannot take credit for over-retention of the WQv in one subwatershed to reduce the WQv in another subwatershed that drains to a different Table 4 BMP or outlet
- Individual BMPs must meet minimum criteria outlined in the Rainwater and Land Development Manual

Runoff Reduction Documentation

- Runoff reduction volume (RRv) documentation must be submitted as part of the Storm Water Pollution Prevention Plan (SWP3) (see CGP Part III.G.1.; Ohio EPA, 2018) and include:
 - Spreadsheet cover page (project info) and subwatershed summary
 - A map showing (1) delineation of subwatershed areas used in RRM spreadsheet; and (2) delineation of all runoff reduction practices
 - Description of legal instruments (e.g., easements, deed restrictions) used to preserve grass filter areas and conservation areas
 - Description of maintenance procedures that will be utilized to ensure the continued performance of runoff reduction practices

Runoff Reduction Spreadsheet

Cover Page

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Runoff Reduction Spreadsheet

Sub-Area RRv Calculation Worksheet

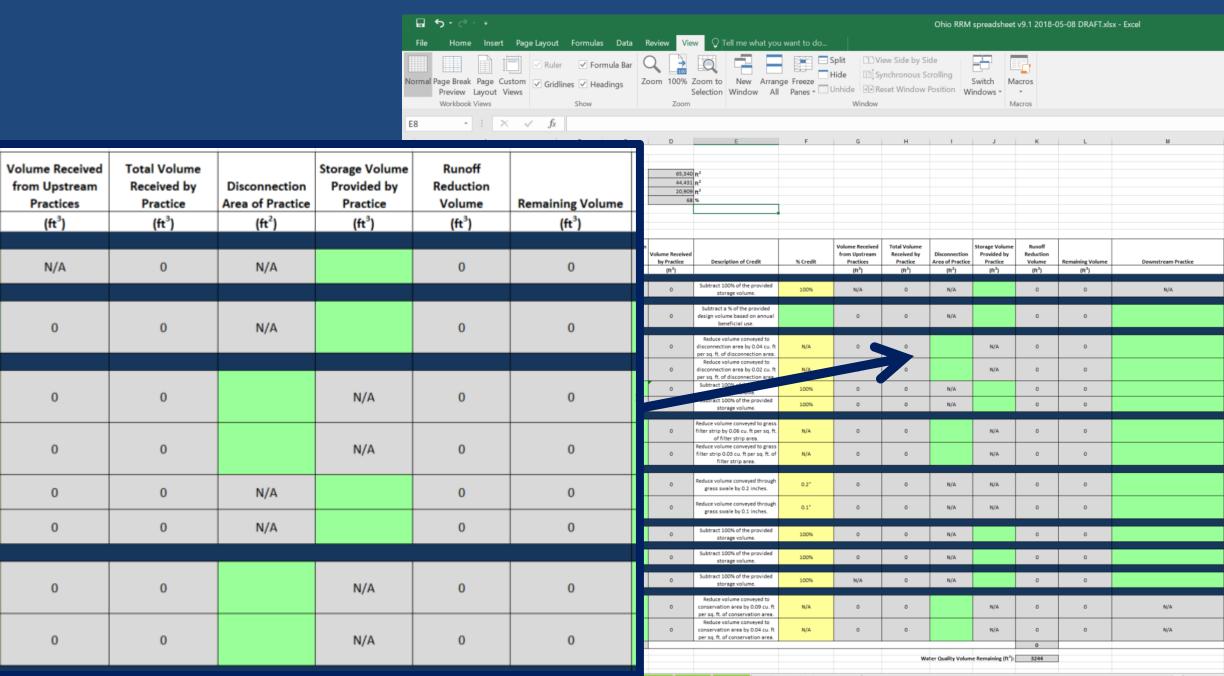
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10 11 Apply	Runoff Reduction Practices												
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12	Runoff Reduction Practice	in Contributing Drainage Area	Contributing Drainage Area	Volume Received by Practice	Description of Credit	% Credit	from Upstream Practices	Received by Practice	Disconnection Area of Practice	Provided by Practice	Reduction Volume	Remaining Volume	Downstream Practice
13	en (Vegetated) Roof	(ft ²)	(ft ²)	(ft ³)			(ft ³)	(ft ³)	(ft ²)	(ft ³)	(ft ³)	(ft ³)	
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17 18 3. Impo	ervious Surface Disconnection				beneficial use.								
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19	Disconnection to A/B soils of Ameridea C/D soils		n/A		per sq. ft. of disconnection area.	n/A	0	0		n/A			
	Disconnection to C/D Soils		N/A	o	Reduce volume conveyed to disconnection area by 0.02 cu. ft	N/A	o	o		N/A	0	0	
20	Conducto			0	per sq. ft. of disconnection area. Subtract 100% of the provided	100%	0	0	N/A		0	0	
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22	mwater Planter(s) etflow to Grass Filter		N/A	0	storage volume.	100%	0	0	N/A		0	0	
	ow to Grass Filter Strip with A/B Soils or Compost				Reduce volume conveyed to grass			0			0		
	ed C/D Soils			0	filter strip by 0.06 cu. ft per sq. ft. of filter strip area.	N/A	0	0		N/A	0	0	
Sheetfle	ow to Grass Filter Strip with C/D Soils			0	Reduce volume conveyed to grass filter strip 0.03 cu. ft per sq. ft. of	N/A	0	0		N/A	0	0	
25 26 5. Gras	s Swale				filter strip area.								
	Swale A/B Soils or Compost Amended C/D Soils			0	Reduce volume conveyed through	0.2"	0	0	N/A	N/A	0	0	
27	and a grant of composit America of D 20115				grass swale by 0.2 inches.								
	Swale C/D Soils			o	Reduce volume conveyed through grass swale by 0.1 inches.	0.1"	o	0	N/A	N/A	0	o	
28 29 6. Biore	etention				-								
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34 35 9. Shee	etflow to Conservation Area												
	ow to Conservation Area with A/B Soils			o	Reduce volume conveyed to conservation area by 0.09 cu. ft	N/A	o	o		N/A	o	o	N/A
36					per sq. ft. of conservation area. Reduce volume conveyed to								
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3. Impervious Surface Disconnection				0	Subtract 100% of the provided storage volume.	100%	N/A	0	N/A		0	0	N/A
		N/A	0	0	Subtract a % of the provided design volume based on annual beneficial use.		0	0	N/A		0	0	
Simple Disconnection to A/B Soils or Amended C/D Soils		N/A	0	0	Reduce volume conveyed to disconnection area by 0.04 cu. ft per sq. ft. of disconnection area.	N/A	0	o		N/A	0	0	
Simple Disconnection to C/D Soils		N/A	0	0	Reduce volume conveyed to disconnection area by 0.02 cu. ft per sq. ft. of disconnection area. Subtract 100% of the provided	N/A 100%	0	0	N/A	N/A	0	0	
				0	storage volume. Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
To Rain Garden(s)			0	o	Reduce volume conveyed to grass filter strip by 0.06 cu. ft per sq. ft. of filter strip area.	N/A	o	0		N/A	o	o	
To Stormwater Planter(s)		N/A	0	0	Reduce volume conveyed to grass filter strip 0.03 cu. ft per sq. ft. of filter strip area.	N/A	o	o		N/A	o	o	
4. Sheetflow to Grass Filter				o	Reduce volume conveyed through grass swale by 0.2 inches.	0.2"	o	0	N/A	N/A	0	o	
Sheetflow to Grass Filter Strip with A/B Soils or Compost			0	0	Reduce volume conveyed through grass swale by 0.1 inches.	0.1*	o	0	N/A	N/A	o	o	
Amended C/D Soils				0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	o	
Sheatflow to Grace Filter Strip with C/D Soils			0	0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
Sheetflow to Grass Filter Strip with C/D Soils			0	0	Subtract 100% of the provided storage volume.	100%	N/A	0	N/A		0	0	
5. Grass Swale				0	Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area. Reduce volume conveyed to	N/A	o	0		N/A	0	0	N/A
	37	Totals	0 0	•	conservation area by 0.04 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
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benencial use.				N/A	0	Subtract a % of the provided design volume based on annual beneficial use.		0	0	N/A		0	0	
Reduce volume conveyed to		in or Amended C/D Soils		N/A	0	Reduce volume conveyed to disconnection area by 0.04 cu. ft per sq. ft. of disconnection area.	N/A	0	0		N/A	0	0	
disconnection area by 0.04 cu. ft per sq. ft. of disconnection area.	N/A			N/A	0	volume conveyed to on area by 0.02 cu. ft of disconnection area.	N/A	o	o		N/A	o	o	
Reduce volume conveyed to				N/A	0	storage volume. Subtract 100% of the provided	100%	0	0	N/A N/A		0	0	
disconnection area by 0.02 cu. ft	N/A	or Compost			0	storage volume. Reduce volume conveyed to grass filter strip by 0.06 cu. ft per sq. ft.	N/A	0	0		N/A		0	
per sq. ft. of disconnection area.		C/D Soils			0	of filter strip area. Reduce volume conveyed to grass filter strip 0.03 cu. ft per sq. ft. of	N/A	0	0		N/A	0	0	
Subtract 100% of the provided storage volume.	100%	Amended C/D Soils			0	filter strip area. Reduce volume conveyed through grass swale by 0.2 inches.	0.2*	0	0	N/A	N/A	0	0	
Subtract 100% of the provided					0	Reduce volume conveyed through grass swale by 0.1 inches.	0.1"	0	0	N/A	N/A	0	0	
storage volume.	100%				0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
					0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
Reduce volume conveyed to				N/A	0	Subtract 100% of the provided storage volume.	100%	N/A	0	N/A		0	0	
grass filter strip by 0.06 cu. ft per sq. ft. of filter strip area.	N/A	th A/B Soils			0	Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area.	N/A	0	o		N/A	0	0	N/A
Reduce volume conveyed to		th C/D Soils			0	Reduce volume conveyed to conservation area by 0.04 cu. ft per sq. ft. of conservation area.	N/A	o	0		N/A	o	o	N/A
grass filter strip 0.03 cu. ft per sq.	N/A		0	0					We	iter Quality Volum	e Remaining (ft ³):	0 3244		
ft. of filter strip area.		nfo & WQv Cal	culation	Area A	Area B Are	a C Area D Subw	vatershed Sum	nmary (÷					: •

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In i Runoff Reduction Practice	Downstream Practice	C es es es	D 65,340 44,431 20,909	ft ² ft ²	F	G	Н	I	J	К	L	м
1. Green (Vegetated) Roof Green Roof	N/A	rvious Cover in Contributing Drainage Area	68 Volume Received by Practice	% Description of Credit	% Credit	Volume Received from Upstream Practices	Total Volume Received by Practice	Disconnection Area of Practice		Reduction Volume	Remaining Volume	Downstream Practice
2. Rainwater Harvesting		(ft²) N/A	(ft³) 0	Subtract 100% of the provided storage volume.	100%	(ft³) N/A	(ft³) 0	(ft²) N/A	(ft ³)	(ft³) 0	(ft³) 0	N/A
Rainwater Harvesting		N/A	0	Subtract a % of the provided design volume based on annual beneficial use.		o	0	N/A		0	0	
3. Impervious Surface Disconnection Simple Disconnection to A/B Soils or Amended C/D Soils	Sheetflow to Grass Filter Strip with C/D Soils	N/A N/A	0	Reduce volume conveyed to disconnection area by 0.04 cu. ft per sq. ft. of disconnection area. Reduce volume conveyed to disconnection area by 0.02 cu. ft per sq. ft. of disconnection area. Subtract 100fr. ft/	N/A N/A	0	0	N/A	N/A	0	>	
Simple Disconnection to C/D Soils		N/A	0	Subtract 100% of the provided storage volume. Reduce volume conveyed to grass filter strip by 0.06 cu. ft per sq. ft.	100% N/A	0	0	N/A	N/A	0	0	
To Rain Garden(s)			0	of filter strip area. Reduce volume conveyed to grass filter strip 0.03 cu. ft per sq. ft. of filter strip area.	N/A	0	0		N/A	0	0	
To Stormwater Planter(s)			0	Reduce volume conveyed through grass swale by 0.2 inches. Reduce volume conveyed through grass swale by 0.1 inches.	0.2"	o	0	N/A N/A	N/A N/A	0	0	
4. Sheetflow to Grass Filter			o	Subtract 100% of the provided storage volume.	100%	0	o	N/A		0	0	
Sheetflow to Grass Filter Strip with A/B Soils or Compost Amended C/D Soils		N/A	0	Subtract 100% of the provided storage volume. Subtract 100% of the provided	100%	0 N/A	0	N/A N/A		0	0	
Sheetflow to Grass Filter Strip with C/D Soils	Sheetflow to Conservation Area with C/D Soils		0	storage volume. Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area. Reduce volume conveyed to conservation area by 0.04 cu. ft	N/A	0	0		N/A N/A	0	0	N/A N/A
5. Grass Swale		0	0	per sq. ft. of conservation area.	n/ n	0		ter Quality Volume		0		n/a
	Project Info & WQv Calculation	Area A A	rea B 🛛 Are	a C Area D Subw	atershed Sum	nmary (÷					E 4



Project into & wow calculation Area A Area B Area C Area D Subwatershed Summary (+)

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- 4	A Area A Runoff Reduction Volume (RRv) Calcul		С	D	E	F	G	н	1	J	К	L	М
2	Drainage Area ID:												
4	Drainage Area ID: Drainage Area, A _A =	1.50	acres	65,340									
5 6	Impervious Area, A _{Aimp} = Pervious Area, A _{Apervious} =		acres acres	44,431 20,909									
7	Imperviousness Fraction, i _A =	0.68		68									
8	Volumetric Runoff Coefficient, Rv _A = Water Quality Volume, WQv _A =	0.66	a]										
10		0,244	n										
11	Apply Runoff Reduction Practices	Impervious Cover					Volume Received	Total Volume					
		in Contributing	Contributing	Volume Received			from Upstream	Received by	Disconnection	Storage Volume Provided by	Runoff Reduction		
12 13	Runoff Reduction Practice	Drainage Area (ft ²)	Drainage Area (ft ²)	by Practice (ft ³)	Description of Credit	% Credit	Practices (ft ³)	Practice (ft ³)	Area of Practice (ft ²)	Practice (ft ³)	Volume (ft ³)	Remaining Volume (ft ³)	Downstream Practice
	. Green (Vegetated) Roof				Subtract 100% of the provided								
15	ireen Roof . Rainwater Harvesting		N/A	0	storage volume.	100%	N/A	0	N/A		0	0	N/A
					Subtract a % of the provided								
17	ainwater Harvesting		N/A	0	design volume based on annual beneficial use.		0	0	N/A		0	0	
18	. Impervious Surface Disconnection				Reduce volume conveyed to								
	imple Disconnection to A/B Soils or Amended C/D Soils		N/A	0	disconnection area by 0.04 cu. ft	N/A	0	0		N/A	0	0	
19					per sq. ft. of disconnection area. Reduce volume conveyed to								
5	imple Disconnection to C/D Soils		N/A	0	disconnection area by 0.02 cu. ft per sq. ft. of disconnection area.	N/A	0	0		N/A	0	0	
21	on ien(s)			0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
-	o Stormwater Pra		N/A	0	Subtract 100% of the provided	100%	0	0	N/A		0	0	
22	. Sheetflow to Grass Filter				storage volume.								
	heetflow to Grass Filter Strip with A/b Compost			o	Reduce volume conveyed to grass filter strip by 0.06 cu. ft per sq. ft.	N/A	o	o		N/A	0	0	
24	mended C/D Soils			-	of filter strip area. Reduce volume conveyed to grass		-	-					
S	heetflow to Grass Filter Strip with C/D Soils			o	filter strip 0.03 cu. ft per sq. ft. of	N/A	o	0		N/A	0	o	
25 26 5	. Grass Swale				filter strip area.								
0	irass Swale A/B Soils or Compost Amended C/D Soils			0	Reduce volume conveyed through	0.2*	0	0	N/A	N/A	0	0	
27					grass swale by 0.2 inches.								
	rass Swale C/D Soils			0	Peduce volume conveyed through as swale by 0.1 inches.	0.1"	0	0	N/A	N/A	0	0	
28 29 (. Bioretention												
30	ioretention			o	Subtract 100% novided storage volume	100%	0	0	N/A		0	0	
	. Infiltration Practice				Subtract 100% of the provided								
32	nfiltration Practice			0	storage volume.		0	0	N/A		0	0	
	ermeable Pavement		N/A	0	Subtract 100% of the provided	100%		0	N/A		0	0	
34	. Sheetflow to Conservation Area				storage volume.								
36	heetflow to Conservation Area with A/B Soils			o	Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area.	N/A	0			N/A	0	o	N/A
5	heetflow to Conservation Area with C/D Soils			o	Reduce volume conveyed to conservation area by 0.04 cu. ft	N/A	o	0		N/A	o	o	N/A
37 38	Totals	0	0		per sq. ft. of conservation area.						0		
38 39 40								Wa	ter Quality Volum	e Remaining (ft ³):	3244		
41			_										
	Project Info & WOy Calc	ulation	Area A 🛛 A	rea B Are	a C Area D Subv	vatershed Sum	mary 0	+)					: 4

ne	Disconnection	Storage Volume Provided by	Runoff Reduction	
у	Area of Practice	Practice	Volume	
	(ft ²)	(ft³)	(ft³)	
	N/A		0	
	N/A		0	
		N/A	0	
		N/A	0	
			0	
Wat	er Quality Volum	e Remaining (ft ³):	3244	

Sub-Area Worksheet

Print Layout

Area A Runoff Reduction Volume (RRv) Calculator										
Drainage Area ID: Watershed 1 Drainage Area, A ₄ = 1.50 acre	145 65	340 ft ²								
Impervious Area, A _A = 1.00 acre		131 ft ²								1
Pervious Area, A _{Aperviou} = 0.48 acre		009 ft ²								
Imperviousness Fraction, i ₄ = 0.68		68 %								
Volumetric Runoff Coefficient, Rv = 0.66										
Water Quality Volume, WQv _A = 3,244 ft ³										
Apply Runoff Reduction Practices										
	Contributing Volume Receiv Drainage Area by Practice		% Credit	Volume Received from Upstream Practices	Total Volume Received by Practice	Disconnection Area of Practice		Runoff Reduction Volume	Remaining Volume	Downstream Practice
(ft ²)	(ft²) (ft²)			(ft ³)	(ft ³)	(ft ²)	(ft³)	(ft3)	(ft ³)	
1. Green (Vegetated) Roof										
Green Roof	N/A 0	Subtract 100% of the provided storage volume.	100%	N/A	0	N/A		0	0	N/A
2. Rainwater Harvesting		storage volume.								
Rainwater Harvesting	N/A O	Subtract a % of the provided design volume based on annual beneficial use.		o	0	N/A		0	0	
3. Impervious Surface Disconnection										
Simple Disconnection to A/8 Solis or Amended C/D Solis	N/A 0	Reduce volume conveyed to disconnection area by 0.04 cu. ft per sq. ft. of disconnection area.	N/A	o	0		N/A	0	0	
Simple Disconnection to C/D Soils	N/A 0	Reduce volume conveyed to disconnection area by 0.02 cu. ft per sq. ft. of disconnection area.	N/A	0	0		N/A	0	o	
To Rain Garden(s)	0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
To Stormwater Planter(s)	N/A 0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
4. Sheetflow to Grass Filter										
Sheetflow to Grass Filter Strip with A/B Soils or Compost Amended C/D Soils	0	Reduce volume conveyed to grass filter strip by 0.06 cu. ft per sq. ft. of filter strip area.	N/A	o	0		N/A	0	0	
Sheetflow to Grass Filter Strip with C/D Soils	0	Reduce volume conveyed to grass filter strip 0.03 cu. ft per sq. ft. of filter strip area.		o	0		N/A	0	0	
5. Grass Swale Grass Swale A/B Soils or Compost Amended C/D Soils	0	Reduce volume conveyed through grass swale by 0.2 inches.	0.2"	0	0	N/A	N/A	0	0	
Grass Swale C/D Soils	0	Reduce volume conveyed through grass swale by 0.1 inches.	0.1"	o	0	N/A	N/A	0	0	
6. Bioretention										
Bioretention	0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
7. Infiltration Practice		a orage volume.								
Infitration Practice	0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
8. Permeable Pavement										
Permeable Pavement	N/A 0	Subtract 100% of the provided storage volume.	100%	N/A	0	N/A		0	0	
9. Sheetflow to Conservation Area		Reduce volume conveyed to		0	0		N/A	0	0	N/A
9. Sheetflow to Conservation Area Sheetflow to Conservation Area with A/8 Soils	0	conservation area by 0.09 cu. ft per sq. ft. of conservation area.	N/A				170			
	0		N/A N/A	0	0		N/A	0	0	N/A
Sheetflow to Conservation Area with A/B Soils		per sq. ft. of conservation area. Reduce volume conveyed to conservation area by 0.04 cu. ft								N/A

Runoff Reduction Spreadsheet

Subwatershed Summary

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3	Area A		Drainage Area		shed 1		-		• 2				
4			Drainage Area, A			acres	-	65,340		_			
5 6		Ima	Impervious Area, A _{Air} erviousness Fraction,		0.68	acres	-	44,431 68		-			
7			Runoff Coefficient, R		0.66		-	00	70	-			_
8			Quality Volume, WQ		3244								_
9			eduction Volume, RR			ft ³							
10	Remaini	ing Water	Quality Volume, WQv	AR =	3244	ft ³							
11													
12	Area B		Drainage Area		shed 2		_						
13			Drainage Area,	-		acres	=	32,670		_			_
14			Impervious Area, A _{Bin}			acres	=	14,375					
15			erviousness Fraction,		0.44		=	44	%				
16	· · ·		Runoff Coefficient, R		0.45								_
17			Quality Volume, WQ										_
18 19	Bernein		eduction Volume, RR		1093	ft ³							-
20	Kemain	ing water	Quality Volume, WQv	BR -	1093	π				-			
21	Area C		Drainage Area	UD:						-			-
22			Drainage Area,		0.00	acres	=	0	ft ²	-			_
23			Impervious Area, A _{Ci}			acres	=		ft ²				_
24		Imp	erviousness Fraction,				=		%				_
25			Runoff Coefficient, R										_
26		Water	Quality Volume, WQ	v _c =		ft ³							
27		Runoff R	eduction Volume, RR	v _c =	0	ft ³							
28	Remain	ing Water	Quality Volume, WQv	CR =		ft ³							
29				_									
30	Area D		Drainage Area				_						
31			Drainage Area, A			acres	=		ft ²				
32			Impervious Area, A _{Dir}		0.00	acres	=	0	ft ² %				
33 34			erviousness Fraction, Runoff Coefficient, R				-		76				
34	\ \ \		Quality Volume, WQ	-		ft ³							
36			eduction Volume, RR		0	ft ³							
37	Remaini		Quality Volume, WQv			ft ³				-			
38													
39													_
40	Project Totals												
41			Drainage Area, A _{to}		2.25	acres	=	98,010					
42			Impervious Area, A	mp =		acres	=	58,806					
43			perviousness Fraction,		0.60		=	60	%				
44			Runoff Coefficient, R		0.59								
45			Quality Volume, WQ		4337	ft a							
46	Deres 1		Reduction Volume, RR	-	4337	ft ³				_			
47 48	Kemair	ing water	Quality Volume, WQ	v _R =	4337	n							
49	-												
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	Subwatersh	ned Summary						Impervious Area, A _{Aimp}	= 1.02 acre	s =	44,431 ft ²	
							N/	Imperviousness Fraction, i _A = Iumetric Runoff Coefficient, Rv _A =		=	68 %	
								Water Quality Volume, WQv _A				
Area A	Drainage Area ID:	Watershed 1						Runoff Reduction Volume, RRvA	= 0 ft ³		/	
					CE 340 (2	Remaining	g Water Quality Volume, WQv _{AR} :	= 3244 ft ³	_	/	
	Drainage Area, A _A =	1.50	acres	=	65,340 f		rea B	e Area ID	Watershed 2		+	
	Impervious Area, A _{Aimp} =	1.02	acres	=	44,431 f	• ²		e Area, A ₈ :	= 0.75 acre		32,670 ft ²	
								Area, A _{Bimp} =	= 0.33 acre = 0.44	s =	14,375 ft ²	
	Imperviousness Fraction, i _A =	0.68		=	68 9	6	V	cric Runoff Coefficient, Rv _B			44 %	
	Volumetric Runoff Coefficient, RvA =	0.66						Water Quality Volume, WQv ₈	= 1093 ft ³		<u>'</u>	
			- 3	+				Runoff Reduction Volume, RRv _B			/	
	Water Quality Volume, WQv _A =	3244	ft"				remainin	g Water Quality Volume, WQv _{BR} :	= 1093 ft ³	—	+	
	Runoff Reduction Volume, RRv _A =	0	ft ³				rea C	Drainage Area ID				
Remain	ning Water Quality Volume, WQv _{AR} =	3244	64 ³					Drainage Area, A _C = Impervious Area, A _{Cimp} =				
Premiero	Aing water quality volume, weavan-	9544	π	++			4 	Impervious Area, A _{Cimp} Imperviousness Fraction, ic		=	%	
							Ve	olumetric Runoff Coefficient, Rvc	-			
Area B	Drainage Area ID:	Watershed 2						Water Quality Volume, WQv _C = Runoff Reduction Volume, RRv _c =				
Area b						-		g Water Quality Volume, WQv _C =			· · · · · · · · · · · · · · · · · · ·	
	Drainage Area, A _B =	0.75	acres	=	32,670 f					_		
	Impervious Area, A _{Bimp} =	0.33	acres	=	14,375 f	+ ²	rea D	Drainage Area ID Drainage Area, A _D :		s =	0 ft ²	
								Impervious Area, A _{Dimp}	= 0.00 acre			
	Imperviousness Fraction, i _B =	0.44		=	44 9	6	¥	Imperviousness Fraction, ip		=	%	
1	Volumetric Runoff Coefficient, Rv _B =	0.45						University Volume, WQvp				
			e.3					Runoff Reduction Volume, RRv _D	= 0 ft ³		!	
	Water Quality Volume, WQv ₈ =	1093		\rightarrow			Remaining	g Water Quality Volume, WQv _{DR} :	= ft ^{>}		/	
	Runoff Reduction Volume, RRv _B =	0	ft ³								· · · · · · · · · · · · · · · · · · ·	
Pamair	ining Water Quality Volume, WQv _{BB} =	1093	e. 3				roject Totals					
Reman	Aing water quality volume, wqv _{BR} -	1033	π				4_ 4	Drainage Area, A _{total} Impervious Area, A _{imp}	= 2.25 acre = 1.35 acre		98,010 ft ² 58,806 ft ²	
								Impervious Area, A _{imp} = Imperviousness Fraction, i =		s = =		
						44	V	olumetric Runoff Coefficient, Rv =	0.59			
						45		Water Quality Volume, WQv = Runoff Reduction Volume, RRv =	4337 ft ³		/	
						46 47	Remainir	Runoff Reduction Volume, RRv = ng Water Quality Volume, WQv _R =				
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				2 3 Area A Drainage Area ID: Watershed 1
				on Volume, RRv _A = 0 ft ³ / Volume, WQv _{AR} = 3244 ft ³
Project Totals				Drainage Area ID: Watershed 2
Drainage Area, A _{total} =	2.25	acres	=	98,010 ft^2 brainage Area, A₈ = 0.75 acres = 32,670 ft ² vious Area, A _{8imp} = 0.33 acres = 14,375 ft ²
Impervious Area, A _{imp} =	1.35	acres	=	58.806 ff 56.606 ff 6 6 6 6 7 6 7 6 7 6 7 6 7 7 7 7 7 7 7 7 7 7
Imperviousness Fraction, i =	0.60		-	ty Volume, WQvg = 1093 ft ³ 60 % on Volume, RRvg = 0 ft ³
Volumetric Runoff Coefficient, Rv =	0.59			Volume, WQv _{BR} = 1093 ft ³
				Drainage Area ID: Drainage Area, A _C = 0.00 acres = 0 ft ²
Water Quality Volume, WQv =	4337			vious Area, A _{Cimp} = 0.00 acres = 0 ft ²
Runoff Reduction Volume, RRv =		ft ³		f Coefficient, Rv _c =
Remaining Water Quality Volume, WQv _R =	4337	ft ³		or Volume, $RV_c = 0$ Volume, $RV_c = 0$ t ³
				Drainage Area ID:
				Prainage Area, $A_0 = 0.00$ acres = 0 ft ²
				33 Imperviousness Fraction, i _D = = %
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				3 Runoff Reduction Volume, RRv _D = 0 ft ³ 37 Remaining Water Quality Volume, WQv _{DR} = ft ³
				38 39 40 Project Totals 41 D
				40 Project Totals 41 D. C. C. C. C. Atotal = 2.25 acres = 98,010 ft ²
				42 Impendence Aimp 1.35 acres = 58,806 ft ² 43 Impervicemess Fraction, i = 0.60 = 60 %
				44 Volumetric Runoff Coefficient, Rv = 0.59 45 Water Quality Volume, WQv = 4337 ft ³
				46 Runoff Reduction Volume, RRy = 0 (ft ³
				47 Remaining Water Quality Volume, WQvg = 4337 ft ³ 48 49 50 51
				51 Project Info & WOy Calculation Area A Area B Area C Area D Subwatershed Summa

Runoff Reduction Spreadsheet

Area Units Conversion Calculator

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Runoff Reduction Practices

- Green roof
- Rainwater harvesting
- Impervious area disconnection
- Sheet flow to grass filter strip
- Sheet flow to conservation area
- Grass swale
- Bioretention
- Infiltration basin
- Infiltration trench
- Underground infiltration system
- Permeable pavement with infiltration



Source: Greensulate

Green Roof



Source: ???

Green Roof Credit and Criteria

Runoff Reduction Volume (RRv) Credit	Up to 100% of the WQv design volume for the green roof area
Runoff Reduction Volume Design Criteria	 Rv = 0.95 for green roof area Planting media > 4 inches Vegetated roof must conform with ASTM International Green (Vegetated) Roof Standards

Green Roof WQv

 $WQv_{GR} = Rv^*P_{WQv}^*A_{GR}/12$ Rv = 0.95 for green roof area $P_{WQv} = 0.90''$ $A_{GR} =$ green roof area

Green Roof RRv

 $RRv_{GR} = A_{GR} * d_{WQv} = WQv_{GR}$

Subject to the following criteria: $d_{WQv} \leq d_{media} * PAW$

d_{WQv} = "depth" of the water quality volume
d_{media} = planting media depth (minimum 4", maximum 6")
PAW = plant available water of the planting media

	• ⇔ • €						een Roof Volur	me Retention Calculator v3	DRAFT 2018-05-08.>	dsx - Excel			
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2													
3	BMP desi	gn inputs - green roof area, soil media depth,	plant ava	ilable w	ater conten	t							
4													
5	Step												
6	1	Green Roof Area, A _{gr} =	18730	ft^2	Portion of	roof covere	d with me	dia and vegetated	roof only. No	impervious ro	of area will k	e cred	ited
7													
8	2	Volumetric Runoff Coefficient, Rv =	0.950		-			ed as 100% imperv	ious area for p	urpose of calc	ulating Rv ar	d WQv	
9		Green Roof Water Quality Volume, WQv _{gr} =	1335			*P*A, P = 0.9							
10		Depth of WQv, d _{WQv} =	0.9		-	roof area on	•						
11		Plant Available Water, PAW =		in/in			•	5 in/in maximum					_
12		Media Adjusted WQv Depth =	3.4	in	Media dep	oth required	to retain g	green roof area W	Qv				_
13	-									6 U.S			
14	3	Total Depth of Green Roof Media, d _{media} =	4	in	Inickness	of green roo	of media (4	l-inch minimum, 6	-inch maximur	n for credit)			
15 16	4	Runoff Reduction Volume, RRv =	1335		This volum	a can be an	plied town	ard reduction of th	o cubwatarch	d WOv requir	omont		
17	-	Runon Reduction volume, RRV =	1333		This volun	le can be ap	pheu towa	and reduction of th	ie subwatersne	eu woov requir	ement		
18		Q _{peak} Retention Volume Credit, V _{ret} =	1560.8	ft^3	Peak disch	arge (Q _{neak})	retention	volume credit					
19		Retention Depth Credit, d _{ret} =	1.00					watershed inches	retained				
20		V _{ret} /WQv =	1.17										
21		100 - 5											
22													

Example Site

Total site area:2.25 acresPlanned impervious area:1.35 acresRoof area:0.48 acresGreen roof area:0.43 acres

BMP 0

 $WQv = 4337 \text{ ft}^3$

Green Ro	of Volume Retention Calculator	-	
BMP des	ign inputs - green roof area, soil media depth	, plant avai	ilable v
Step			
1	Green Roof Area, A _{gr} =	18730	ft^2
2	Volumetric Runoff Coefficient, Rv =	0.950	
	Green Roof Water Quality Volume, WQv _{gr} =	1335	ft^3
	Depth of WQv, d _{WQv} =	0.9	in
	Plant Available Water, PAW =	0.25	in/in
	Media Adjusted WQv Depth =	3.4	in
3	Total Depth of Green Roof Media, d _{media} =	4	in
4	Runoff Reduction Volume, RRv =	1335	

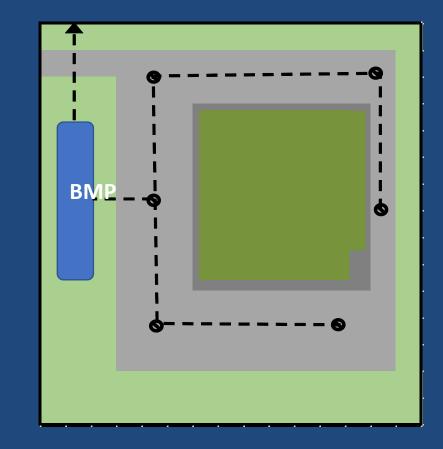
Area A Runoff Reduction Volume (RRv) Calcula	tor										
Drainage Area ID:	Watershed 1										
Drainage Area, A _A =	2.25	acres	98,010	ft ²							
Impervious Area, A _{Aimp} =	1.35	acres	58,806	ft ²							
Pervious Area, A _{Apervious} =	0.90	acres	39,204	ft ²							
Imperviousness Fraction, i _A =	0.60		60	%							
Volumetric Runoff Coefficient, Rv _A =	0.59										
Water Quality Volume, WQv _A =	4,337	ft ³									
Apply Runoff Reduction Practices											
	Impervious Cover	Pervious Cover in				Volume Received	Total Volume		Storage Volume	Runoff	
	in Contributing	Contributing	Volume Received			from Upstream	Received by	Disconnection	Provided by	Reduction	
Runoff Reduction Practice	Drainage Area	Drainage Area	by Practice	Description of Credit	% Credit	Practices	Practice	Area of Practice	Practice	Volume	Remaining Volume
	(ft ²)	(ft ²)	(ft ³)			(ft ³)	(ft ³)	(ft ²)	(ft ³)	(ft ³)	(ft ³)
1. Green (Vegetated) Roof											
Green Roof	18730	N/A	1335	Subtract 100% of the provided storage volume.	100%	N/A	1335	N/A	1335	1335	0

Project Totals							
	Drainage Area, A _{total} =	2.25	acres	=	98,010	ft ²	
	Impervious Area, A _{imp} =	1.35	acres	=	58,806	ft ²	
	Imperviousness Fraction, i =	0.60		=	60	%	
Volum	etric Runoff Coefficient, Rv =	0.59					
N N	/ater Quality Volume, WQv =	4337	ft ³				
Run	off Reduction Volume, RRv =	1335	ft ³				
Remaining W	ater Quality Volume, WQv _R =	3002	ft ³				

Example Site

Total site area:2.25 acresPlanned impervious area:1.35 acresRoof area:0.48 acresGreen roof area:0.43 acres

 $WQv = 4337 \text{ ft}^{3}$ RRv = 1335 ft³ $WQv_{adjusted} = 3002 \text{ ft}^{3}$



Runoff Reduction Practices

- Green roof
- Rainwater harvesting
- Impervious area disconnection
- Sheet flow to grass filter strip
- Sheet flow to conservation area
- Grass swale
- Bioretention
- Infiltration basin
- Infiltration trench
- Underground infiltration system
- Permeable pavement with infiltration

Rainwater Harvesting

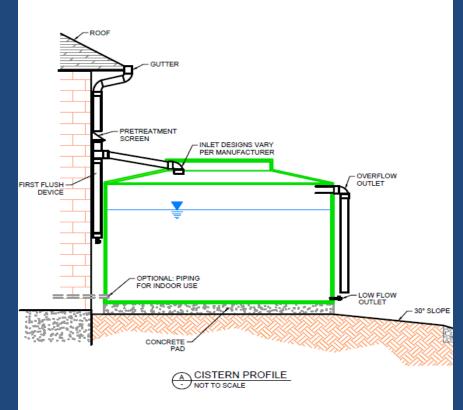




Photo Source: Tetra Tech



Graphic Source: Tetra Tech

Rainwater Harvesting Credit and Criteria

Runoff Reduction Volume (RRv) Credit	Credit is only available for dedicated year- round demand for the water and/or runoff reduction drawdown to infiltration area
Runoff Reduction Volume Design Criteria	Runoff reduction credits based on the total amount of internal water reuse, outdoor water reuse, and tank dewatering provided by the cistern system with discharge to infiltration area.

Runoff Reduction Practices

- Green roof
- Rainwater harvesting
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- Grass swale
- Bioretention
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- Infiltration trench
- Underground infiltration system
- Permeable pavement with infiltration

Impervious Area Disconnection



Simple Disconnection

Source: WVDEP



Stormwater Planter





Rain Garden

Simple Disconnection Credit and Criteria

Runoff Reduction Volume (RRv) Credit	 HSG-A/B soils: 0.04 ft³/ft² of filter strip Amended HSG-C/D soils: 0.04 ft³/ft² of filter strip HSG-C/D soils: 0.02 ft³/ft² of filter strip
Runoff Reduction Volume (RRv) Design Criteria	 Maximum impervious area treated: 1,000 ft² per disconnection Maximum disconnection area = contributing impervious drainage area Maximum contributing flow path (impervious) length: 75 ft. Maximum disconnection slope: ≤ 2%; ≤ 5% with turf reinforcement Minimum setback from buildings: >5 ft if receiving area less than 1% slope Topsoil or soil amendment to match credit

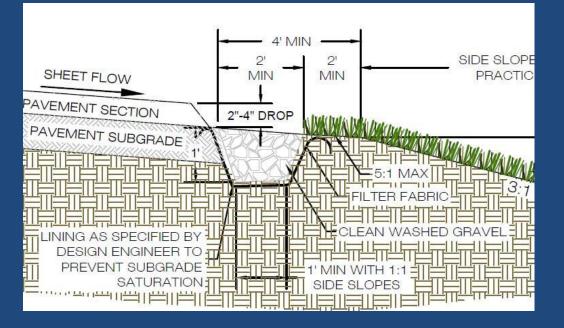
Rain Garden Credit and Criteria

Runoff Reduction Volume (RRv) Credit	Up to 100% of WQv for contributing drainage area
Runoff Reduction Volume (RRv) Design Criteria	 Maximum impervious area treated: 1,000 square feet Maximum surface ponding depth: 12 inches Minimum soil infiltration rate: 0.5 in/hr or use underdrain with 12" minimum depth gravel sump Minimum filter media depth: 18 inches

Runoff Reduction Practices

- Green roof
- Rainwater harvesting
- Impervious area disconnection
- Sheet flow to grass filter strip
- Sheet flow to conservation area
- Grass swale
- Bioretention
- Infiltration basin
- Infiltration trench
- Underground infiltration system
- Permeable pavement with infiltration

Sheet Flow to Grass Filter Strip



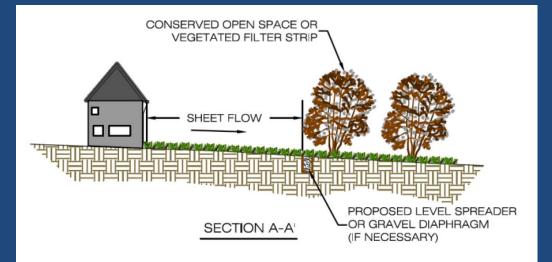


Source: VA DEQ

Sheet Flow to Grass Filter Strip

Runoff Reduction Volume (RRv) Credit	 HSG-A/B soils: 0.06 ft³/ft² of filter strip Amended HSG-C/D soils: 0.06 ft³/ft² of filter strip HSG-C/D soils: 0.03 ft³/ft² of filter strip
Runoff Reduction Volume (RRv) Design Criteria	 Runoff reduction credit applies only to areas directly contributing sheet flow Pervious areas: max contributing flow length = 150 ft Impervious areas: max contributing flow length = 75 ft Minimum filter strip width: Slope = 1-4% minimum 35 ft width Slope = 4-6% minimum 50 ft width Slope = 6-8% minimum 65 ft width Slope must be < 2% for first 10 ft for all cases Gravel diaphragm at top of filter for all filters that drain impervious areas Rock trench level spreader placed on level contour at top of slope Topsoil or soil amendment to match credit Vegetative cover/establishment – seeding, sodding, erosion control matting to achieve/maintain 90% cover

Sheet Flow to Conservation Area



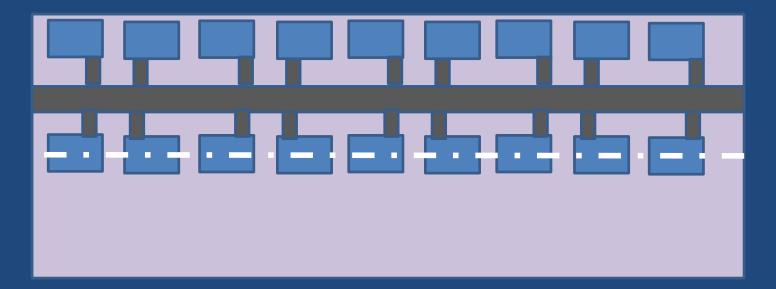
Source: WV DEP

Source: VA DEQ

Sheet Flow to Conservation Area

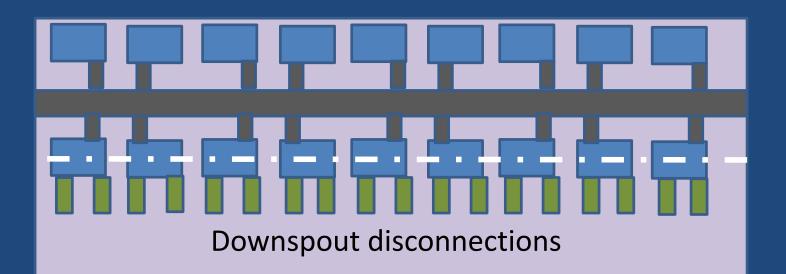
Runoff Reduction Volume (RRv) Credit	 HSG-A/B soils: 0.09 ft³/ft² of conservation area Amended HSG-C/D soils: 0.09 ft³/ft² of conservation area HSG-C/D soils: 0.04 ft³/ft² of conservation area
Runoff Reduction Volume (RRv) Design Criteria	 Pervious areas: max flow length = 150 ft Impervious areas: max flow length = 75 ft Minimum conservation buffer strip width Slope = 0.5-3% min 35 ft width Slope = 3-6% min 50 ft width Slope = 6-8% min 65 ft width Slope must be < 2% for first 10 ft for all cases Gravel diaphragm at top of filter for all filters that drain impervious areas

Total area: 0.90 ac Impervious: 13% Rv = 0.05 + 0.9(0.13) = 0.17WQv = 0.90''*0.17*0.90 ac/12 $WQv = 500 \text{ ft}^3$



Total area: 0.90 ac Impervious: 13% Rv = 0.05 + 0.9(0.13) = 0.17WQv = 0.90"*0.17*0.90 ac/12 $WQv = 500 \text{ ft}^3$

 $\begin{array}{l} \mathsf{A}_{\mathrm{impervious}} = 5400 \ \mathrm{ft}^2 \\ \mathsf{A}_{\mathrm{disconnection}} = 5400 \ \mathrm{ft}^2 \\ \mathsf{RRv} \ (\mathrm{disconnection}) = 108 \ \mathrm{ft}^3 \end{array}$

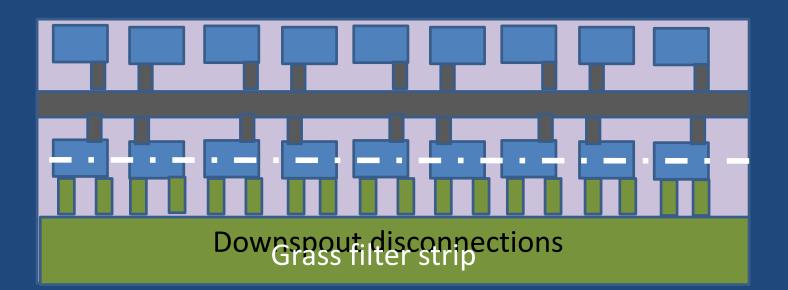


Total area: 0.90 ac Impervious: 13% Rv = 0.05 + 0.9(0.13) = 0.17WQv = 0.90"*0.17*0.90 ac/12 $WQv = 500 \text{ ft}^3$

 $\begin{array}{l} \mathsf{A}_{\mathrm{impervious}} = 5400 \ \mathrm{ft}^2 \\ \mathsf{A}_{\mathrm{disconnection}} = 5400 \ \mathrm{ft}^2 \\ \mathsf{RRv} \ (\mathrm{disconnection}) = 108 \ \mathrm{ft}^3 \end{array}$

 $A_{filter} = 13100 \text{ ft}^2$ RRv = 392 ft³

WQv = 500 - 108 - 392 = 0



Runoff Reduction Practices

- Green roof
- Rainwater harvesting
- Impervious area disconnection
- Sheet flow to grass filter strip
- Sheet flow to conservation area
- Grass swale
- Bioretention
- Infiltration basin
- Infiltration trench
- Underground infiltration system
- Permeable pavement with infiltration

Grass Swale





Source: Center for Watershed Protection

Grass Swale Credit and Criteria

Runoff Reduction Volume (RRv) Credit

HSG-A/B soils and amended C/D soils: 0.20 inches for the contributing drainage area draining to the swale RRv = A_{cda} *Rv*0.20/12

HSG-C/D soils: 0.10 inches for the contributing drainage area draining to the swale $RRv = A_{cda} * Rv*0.10/12$

Grass Swale Credit and Criteria

Runoff Reduction Volume (RRv) Design Criteria

• Trapezoidal shape

- Bottom width > 4 ft
- Sideslopes 3:1 maximum
- Stable inlets (e.g., rock aprons/level spreaders) are required to dissipate energy and slow velocity at concentrated inflow points
- Combined slope and geometry to maintain maximum design flow < 1 ft/s
- Maximum 4-inch depth for water quality flow (WQf)
- Minimum flow length set by minimum 9-minute residence time
- Topsoil or soil amendment to match credit

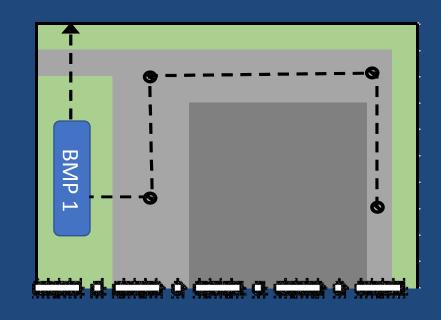
Example Site – 2 Drainage Areas

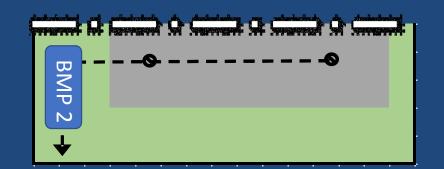
Drainage Area #1

Total area:1.50 acImpervious:68%Rv = 0.05 + 0.9(0.68) = 0.662WQv = 0.90 in x 0.662 x 1.50 ac \div 12WQv = 3,244 ft³

Drainage Area #2

Total area:0.75 acImpervious:44%Rv = 0.05 + 0.9(0.44) = 0.446 $WQv = 0.90 \text{ in } x \ 0.446 \ x \ 0.75 \ \text{ac} \div 12$ $WQv = 1,093 \ \text{ft}^3$





WQv = 3,244 + 1,093 = 4337 ft³

Example Site – 2 Drainage Areas

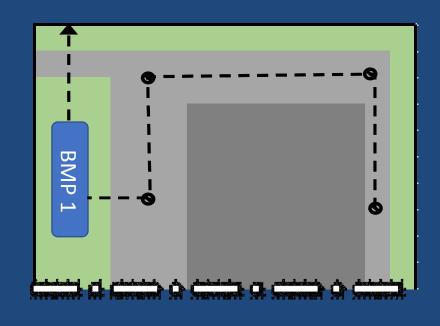
Drainage Area #2

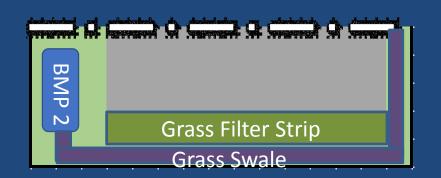
Total area:0.75 acImpervious:44%WQv = 1,093 ft³

RRv (filter strip) = 504 ft³ RRv (grass swle) = 243 ft³

RRv (total) = 747 ft^{3}

 $WQv_{adjusted} = 1093 - 747 = 346 \text{ ft}^3$





Runoff Reduction Practices

- Green roof
- Rainwater harvesting
- Impervious area disconnection
- Sheet flow to grass filter strip
- Sheet flow to conservation area
- Grass swale
- Bioretention
- Infiltration basin
- Infiltration trench
- Underground infiltration system
- Permeable pavement with infiltration

Table 4 Infiltration Practice Credit and Criteria

Runoff Reduction Volume (RRv) Credit	Up to 100% of the WQv for unlined systems
 Runoff Reduction Volume (RRv) Design Criteria Bioretention Infiltration basin Infiltration trench Underground infiltration system Permeable pavement 	 Pretreatment required Surface basins must drain RRv within 24 hours Subsurface systems must drain RRv within 48 hours Minimum 1-foot separation from seasonally high water table or bedrock, except permeable pavement (2-foot minimum)

Runoff Reduction Accounting $WQv_{adjusted} = WQv - RRv$ Where: WQv = water quality volume RRv = runoff reduction volume WQv_{adjusted} = water quality volume that must be captured and treated by a Table 4 BMP

Example Site

Drainage Area #2

Total area:0.75 acImpervious:44%WQv = 1,093 ft³

RRv (filter strip) = 504 ft³ RRv (grass swle) = 243 ft³

RRv (total) = 747 ft³

 $WQv_{adjusted} = 1093 - 747 = 346 \text{ ft}^3$



(1) WQv_{adjusted} = WQv - RRv

(2) Calculate the Equivalent Contributing Impervious Area:

$$A_{imp}(eq) = (WQv_{adjusted})/(Rv_{imp}*P_{WQv}/12)$$

Where:

 $\begin{array}{ll} \mathsf{A}_{\mathsf{imp}}(\mathsf{eq}) = \mathsf{equivalent} \ \mathsf{contributing} \ \mathsf{impervious} \ \mathsf{area} \\ \mathsf{Rv}_{\mathsf{imp}} & = \mathsf{volumetric} \ \mathsf{runoff} \ \mathsf{coefficient} \ \mathsf{for} \ \mathsf{impervious} \ \mathsf{area} = 0.95 \\ \mathsf{P}_{\mathsf{WQv}} & = \mathsf{precipitation} \ \mathsf{depth} \ \mathsf{for} \ \mathsf{the} \ \mathsf{water} \ \mathsf{quality} \ \mathsf{event} = 0.90 \end{array}$

Resizing BMP after Runoff Reduction (1) WQv_{adjusted} = WQv - RRv

(2) Calculate the Equivalent Contributing Impervious Area:

$$A_{imp}(eq) = (WQv_{adjusted})/(Rv_{imp}*P_{WQv}/12)$$

(3) Recalculate the minimum infiltration area of the BMP: $A_{infiltration} \ge 0.05*A_{imp}(eq)$

BMP Resizing Calculator

		А	В				С	D
	1	BMP Minin	num Infiltration Area Resizin	g Calculat	or	_		
3		Runoff I	Reduction Volume, RRv =	747	ft ³			
	Adjusted Water Quality Volume, WQv(adj) =			346	ft ³	total =	32670	ft ²
	Equivalent Contributing Impervious Area, Aimpeg =			4854	ft ³	A _{imp} =	14375	ft ²
		Minimum Infiltration Area, A., =			ft ²	ss, I =	44.0	%
			Infiltration Area, A _{inf} =	250	ft ²	. Rv =	0.446	
	Equivalent Hyd	Irologic Loa	aing katio (A _{impeq} /A _{inf}) =	19.41		VQv =	1093	ft ³
	Depth of Adjusted Water Quality Volume, d _{WQv(adj)} =			16.6	in	A	710	f+ ²
	11			Infiltra	ation Are	ea, A _{inf} =	720	ft ²
	12		Hydrologic L	oading Ka	atio (A _{im}	p/A _{inf}) =	19.97	
	13 Depth of Water Quality Volume, d _{WQv}			e, d _{wqv} =	18.2	in		

Example Site

Drainage Area #2Total area:0.75 acImpervious:44%WQv = 1,093 ft³

RRv (filter strip) = 504 ft³ RRv (grass swle) = 243 ft³

RRv (total) = 747 ft³

 $WQv_{adjusted} = 1093 - 747 = 346 \text{ ft}^{3}$

Before Runoff Reduction: $WQv = 1,093 \text{ ft}^3$ $A_{infiltration} = 720 \text{ ft}^2$

After Runoff Reduction: $WQv_{adjusted} = 346 \text{ ft}^3$ $A_{infiltration} = 250 \text{ ft}^2$



Runoff Reduction Cost Savings?

Reduction in $A_{bioretention} = 470 \text{ ft}^2$ Unit cost for bioretention = \$20 to \$25/ft² Savings ~ 470 ft² * \$20/ft² = \$9400

Other savings??:

- Catch basins
- Storm sewer

Take Home

- Runoff reduction credits enabled, but not required, by new CGP
- Runoff reduction practices must meet Rainwater manual criteria
- Draft spreadsheet available for runoff reduction accounting
- Green roofs offer 1:1 reduction in WQv

Take Home

- Impervious area disconnection, grass swales, and sheet flow to grass filter strips or conservation areas provide opportunity to receive credit for pretreatment practices or functional open space
- Sheet flow to grass filter strips or conservation areas can help address challenging edge of parcel areas

Runoff Reduction Submittals

We encourage designers and MS4s to share Runoff Reduction Method (RRM) submittals with **Ohio EPA Stormwater Technical Assistance staff** (Justin.Reinhart@epa.ohio.gov). In addition to checking compliance with RRM requirements, this will help Ohio EPA improve tools and guidance.

Direct Questions To:

Justin Reinhart Justin.Reinhart@epa.ohio.gov 614-705-1149

Jay Dorsey Dorsey.2@osu.edu 614-949-1465



