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

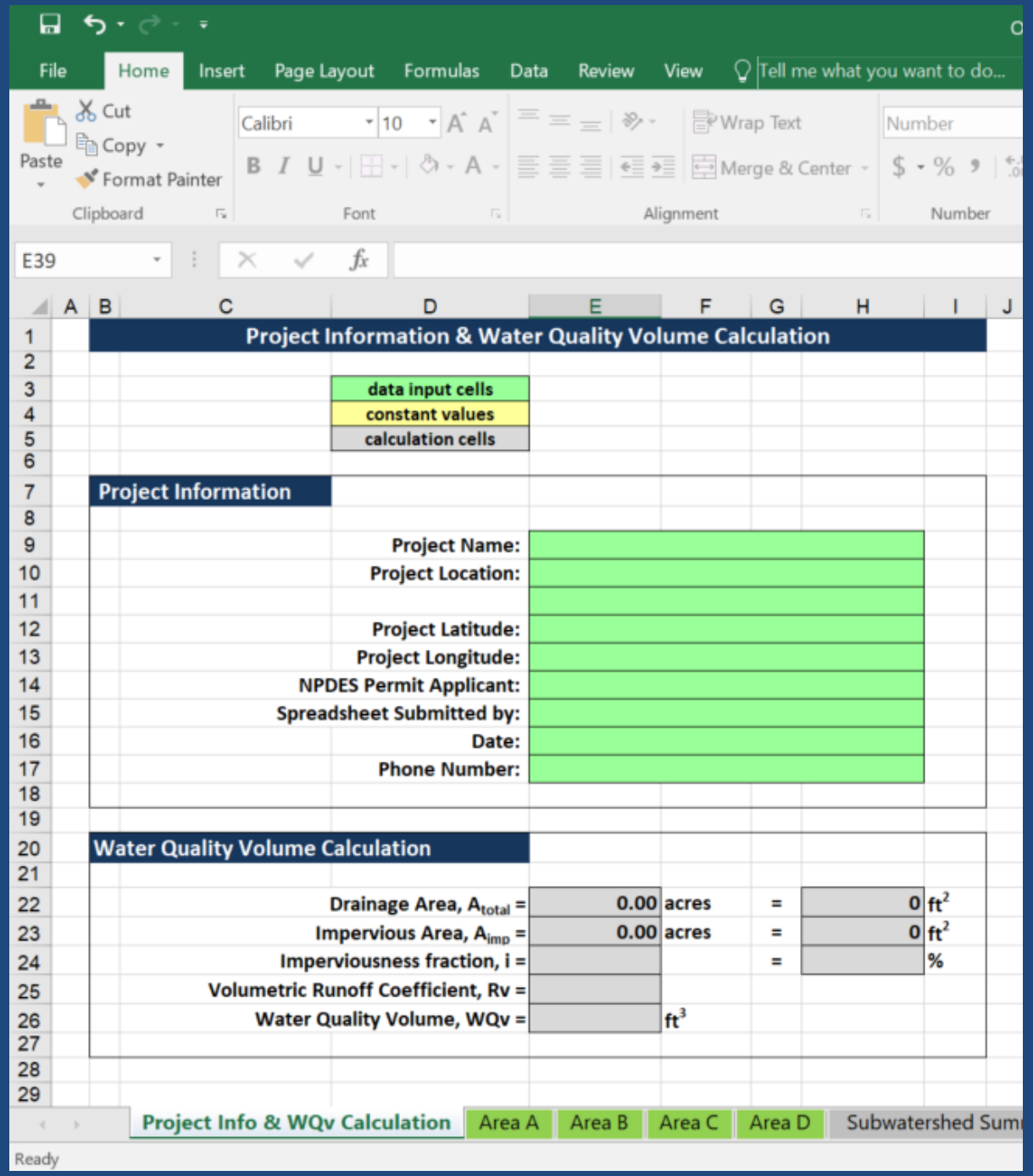
- The runoff reduction volume (RRv) must be calculated using the Ohio Runoff Reduction Method spreadsheet
- The WQv and RRM must be determined by subwatershed area – i.e., cannot take credit for over-retention of the WQv in one subwatershed to reduce the WQv in another subwatershed that drains to a different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

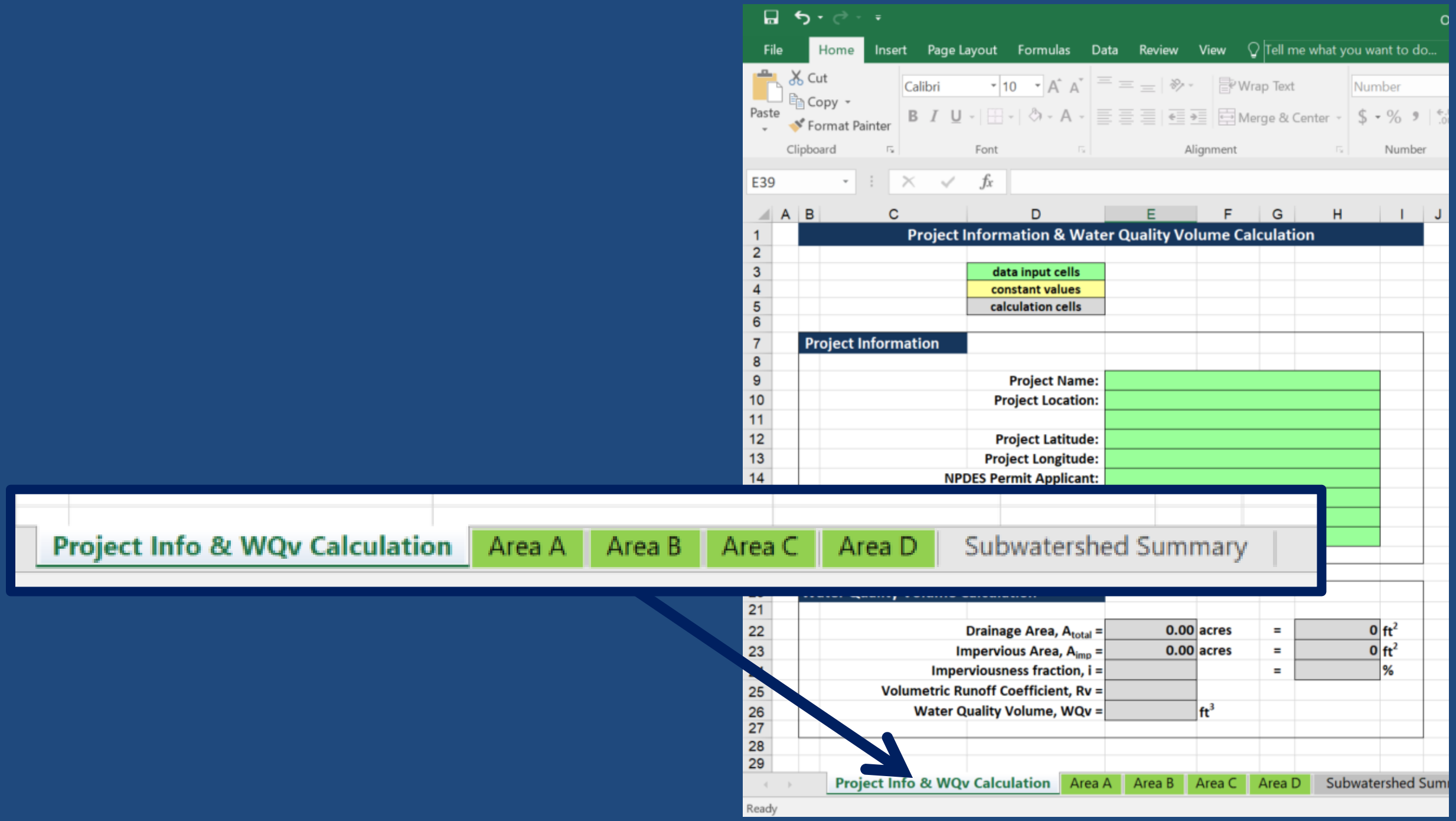
Runoff Reduction Documentation

- 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

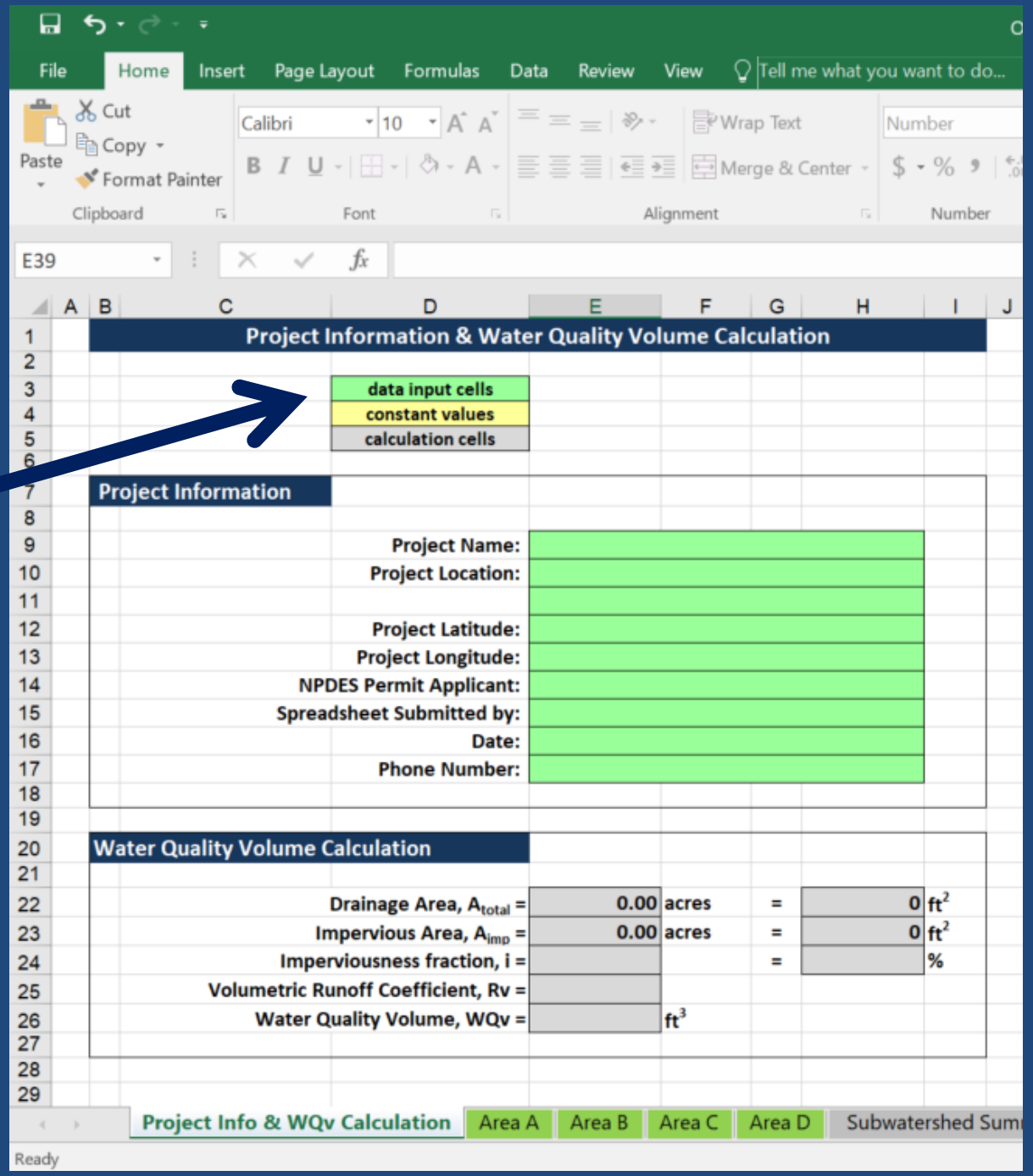
Runoff Reduction Spreadsheet

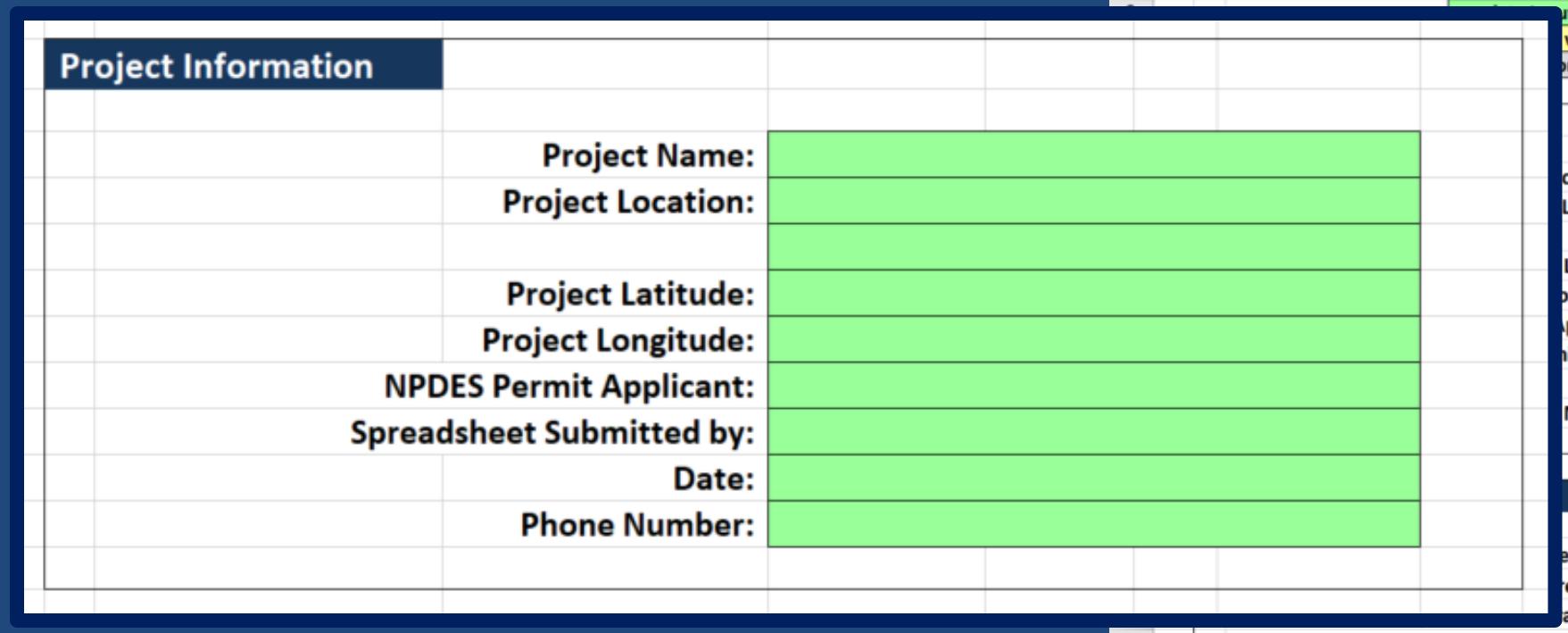
Cover Page

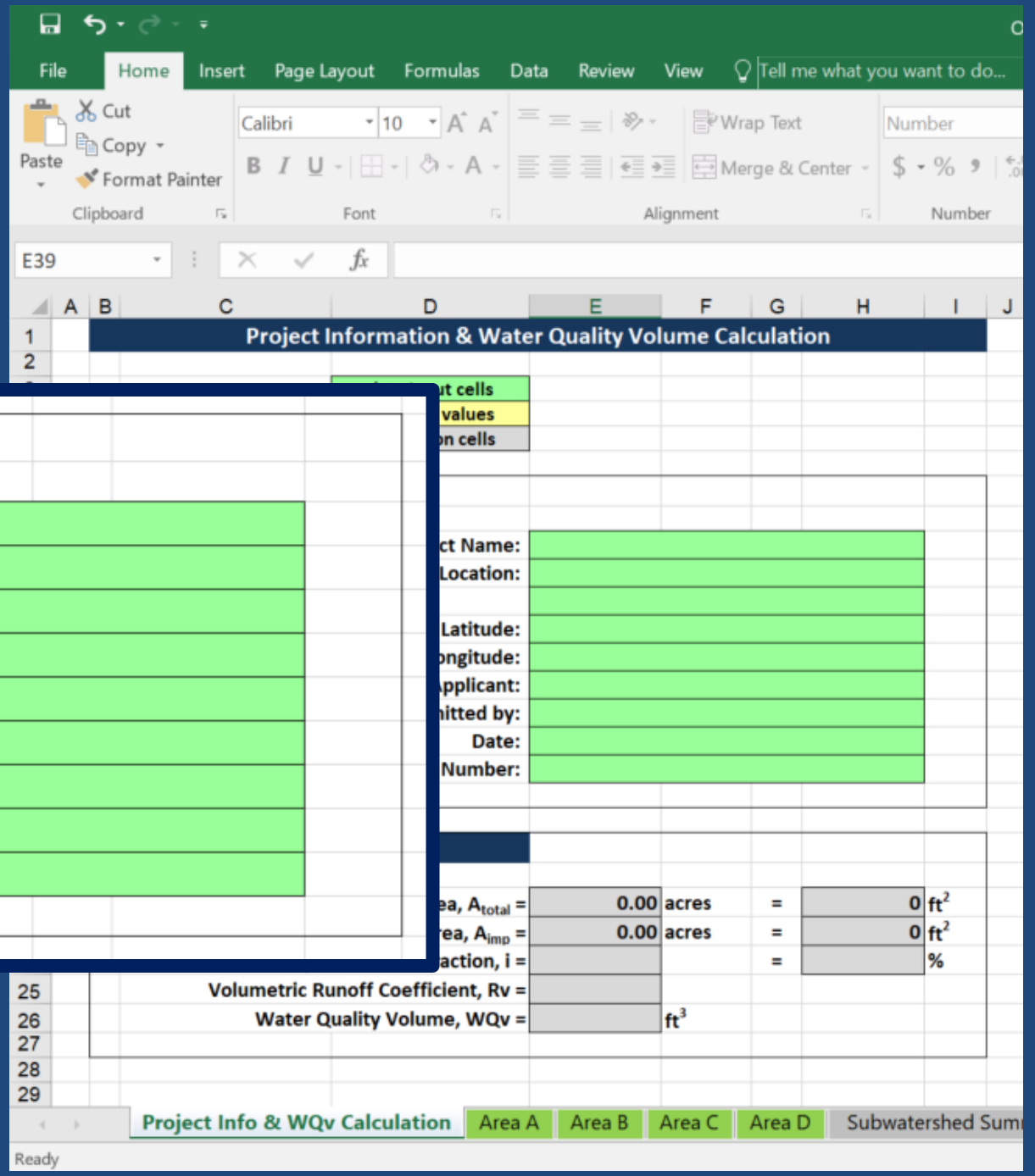



File
Home
Insert
Page Layout
Formulas
Data
Review
View
Tell me what you want to do...
Cut
Copy
Format Painter
Paste
Calibri
10
Wrap Text
Merge & Center
Number
Clipboard
Font
Alignment
Number
E39
Project Information & Water Quality Volume Calculation
data input cells
constant values
calculation cells
Project Information
Project Name:
Project Location:
Project Latitude:
Project Longitude:
NPDES Permit Applicant:
Drainage Area, A_total = 0.00 acres = 0 ft²
Impervious Area, A_imp = 0.00 acres = 0 ft²
Imperviousness fraction, i = = %
Volumetric Runoff Coefficient, Rv =
Water Quality Volume, WQv = ft³
Project Info & WQv Calculation
Area A
Area B
Area C
Area D
Subwatershed Summary
Ready

data input cells
constant values
calculation cells

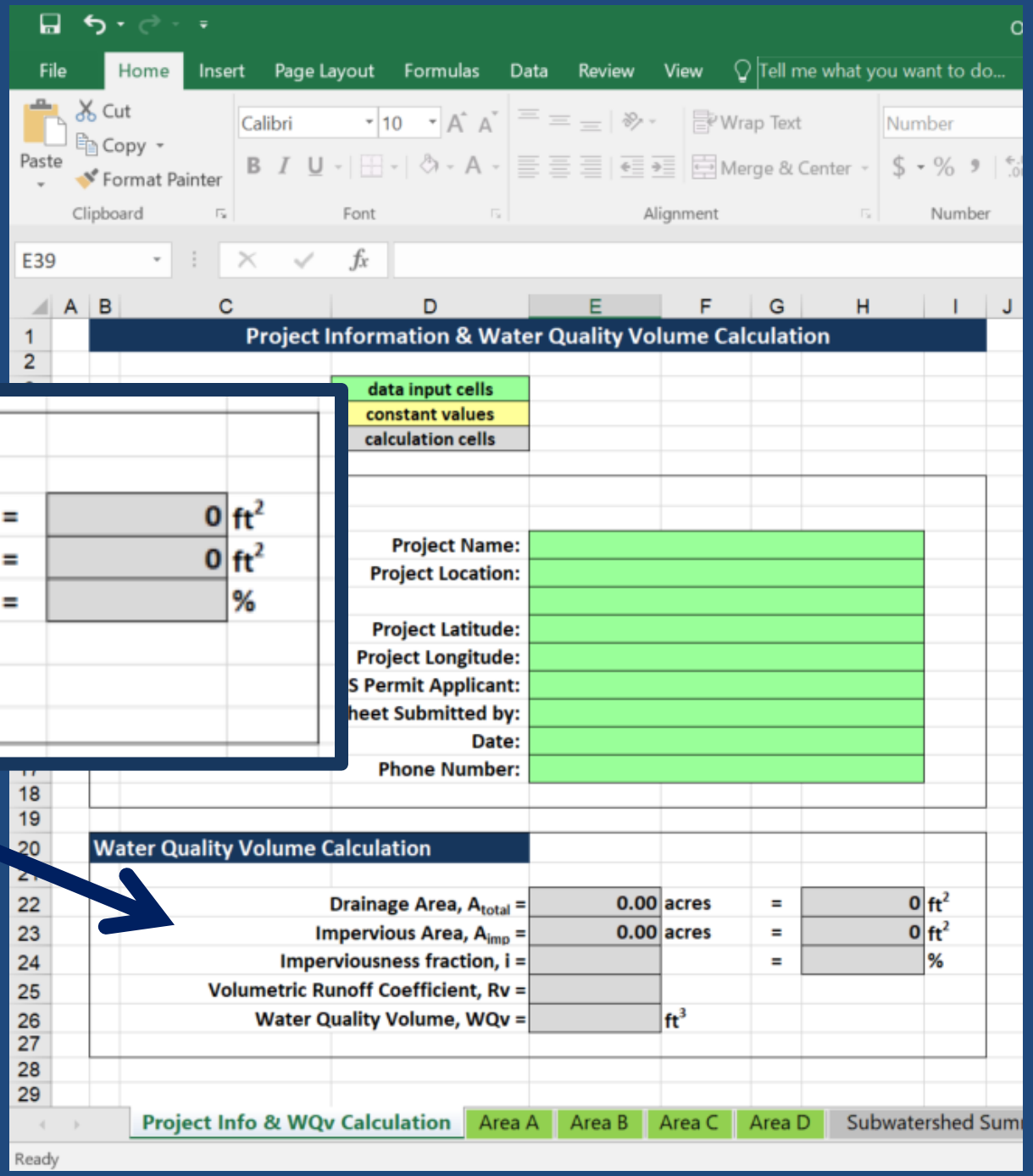



Project Information
Project Name:
Project Location:
Project Latitude:
Project Longitude:
NPDES Permit Applicant:
Spreadsheet Submitted by:
Date:
Phone Number:


File
Home
Insert
Page Layout
Formulas
Data
Review
View
Tell me what you want to do...
Cut
Copy
Format Painter
Paste
Calibri
10
Wrap Text
Merge & Center
Number
Clipboard
Font
Alignment
Number
E39
Project Information & Water Quality Volume Calculation
Project Name:
Location:
Latitude:
Longitude:
Applicant:
Submitted by:
Date:
Number:
Area, A_total = 0.00 acres = 0 ft²
Area, A_imp = 0.00 acres = 0 ft²
Fraction, i = = %
Volumetric Runoff Coefficient, Rv =
Water Quality Volume, WQv = ft³
Project Info & WQv Calculation
Area A
Area B
Area C
Area D
Subwatershed Sum
Ready

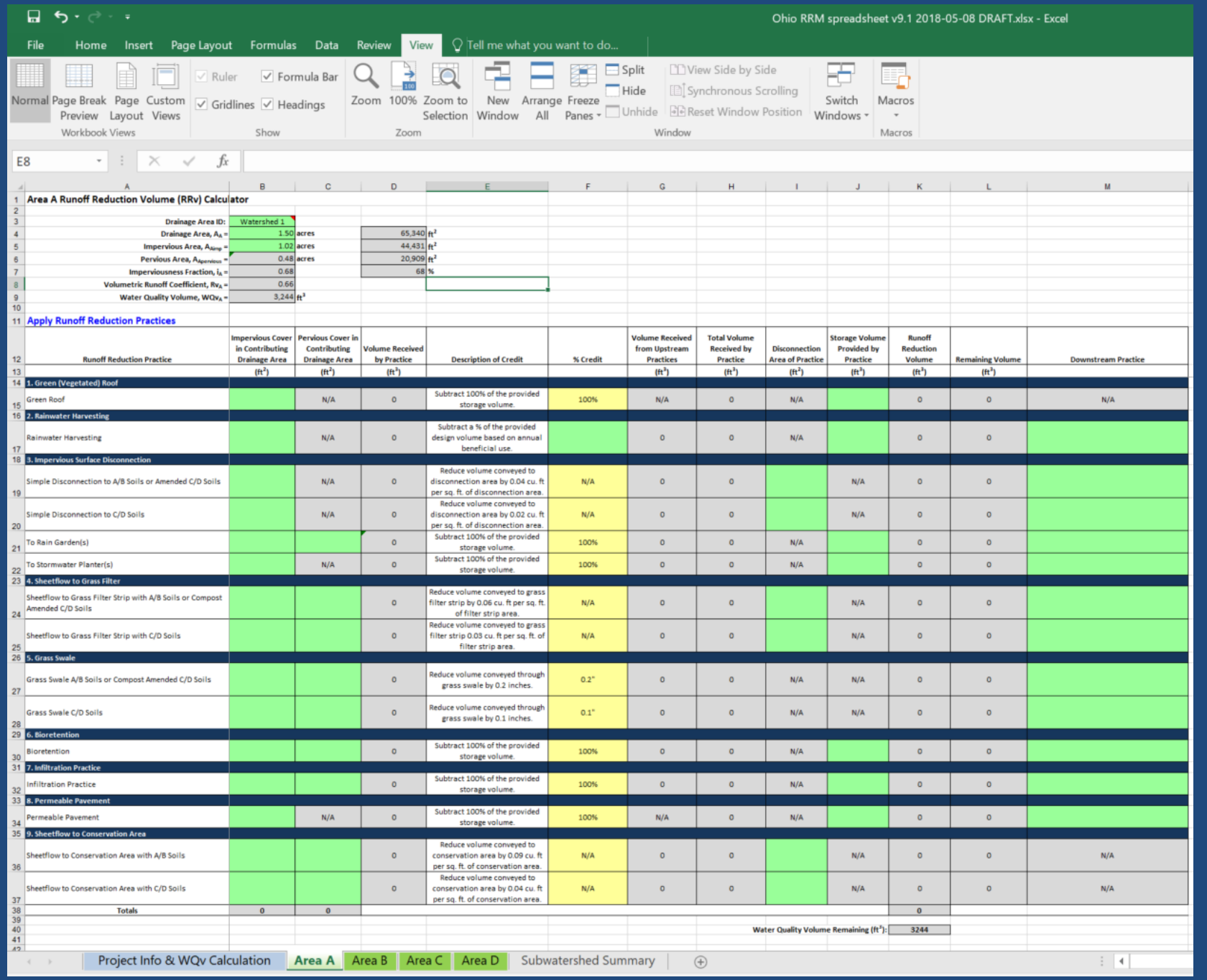
Water Quality Volume Calculation

Drainage Area, A_{total} =	0.00	acres	=	0	ft^2
Impervious Area, A_{imp} =	0.00	acres	=	0	ft^2
Imperviousness fraction, i =			=		%
Volumetric Runoff Coefficient, Rv =					
Water Quality Volume, WQv =		ft^3			



Runoff Reduction Spreadsheet

Sub-Area RRv Calculation Worksheet



Ohio RRM spreadsheet v9.1 2018-05-08 DRAFT.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View Tell me what you want to do...

Normal Page Break Preview Page Layout Custom Views | Ruler Gridlines Formula Bar Headings | Zoom 100% Zoom to Selection | New Window Arrange All Freeze Panes Split Hide Unhide View Side by Side Synchronous Scrolling Reset Window Position | Switch Windows | Macros

Workbook Views | Show | Zoom | Window | Macros

E8

Area A Runoff Reduction Volume (RRv) Calculator

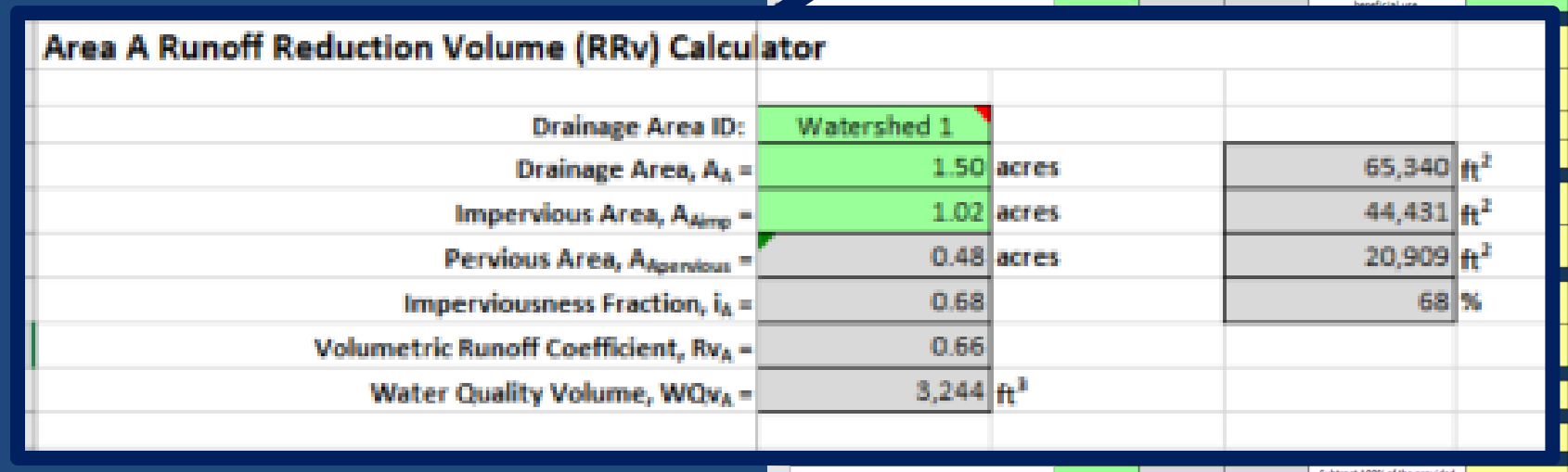
Drainage Area ID:	Watershed 1			
Drainage Area, A_A =	1.50	acres	65,340	ft²
Impervious Area, A_{Aimp} =	1.02	acres	44,431	ft²
Pervious Area, A_{Aperv} =	0.48	acres	20,909	ft²
Imperviousness Fraction, i_A =	0.68		68	%
Volumetric Runoff Coefficient, Rv_A =	0.66			
Water Quality Volume, WQv_A =	3,244	ft³		

Apply Runoff Reduction Practices

Runoff Reduction Practice	Impervious Cover in Contributing Drainage Area (ft²)	Pervious Cover in Contributing Drainage Area (ft²)	Volume Received by Practice (ft³)	Description of Credit	% Credit	Volume Received from Upstream Practices (ft³)	Total Volume Received by Practice (ft³)	Disconnection Area of Practice (ft²)	Storage Volume Provided by Practice (ft³)	Runoff Reduction Volume (ft³)	Remaining Volume (ft³)	Downstream Practice
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												
Rainwater Harvesting		N/A	0	Subtract a % of the provided design volume based on annual beneficial use.		0	0	N/A		0	0	
3. Impervious Surface Disconnection												
Simple Disconnection to A/B Soils 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	
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	0	
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	0	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.	N/A	0	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"	0	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												
Infiltration 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												
Sheetflow to Conservation Area with A/B Soils			0	Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
Sheetflow to Conservation Area with C/D Soils			0	Reduce volume conveyed to conservation area by 0.04 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
Totals	0	0								0		

Water Quality Volume Remaining (ft³): 3244

Project Info & WQv Calculation | Area A | Area B | Area C | Area D | Subwatershed Summary



Ohio RRM spreadsheet v9.1 2018-05-08 DRAFT.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View Tell me what you want to do...

Normal Page Break Preview Page Layout Custom Views | Ruler Formula Bar Gridlines Headings | Zoom 100% Zoom to Selection | New Window Arrange All Freeze Panes Split Hide Unhide | View Side by Side Synchronous Scrolling Reset Window Position | Switch Windows | Macros

Workbook Views Show Zoom Window Macros

E8

Area A Runoff Reduction Volume (RRv) Calculator

Drainage Area ID:	Watershed 1			
Drainage Area, A_A =	1.50	acres	65,340	ft^2
Impervious Area, A_{Aimp} =	1.02	acres	44,431	ft^2
Pervious Area, A_{Aperv} =	0.48	acres	20,909	ft^2
Imperviousness Fraction, i_A =	0.68		68	%
Volumetric Runoff Coefficient, Rv_A =	0.66			
Water Quality Volume, WQv_A =	3,244	ft^3		

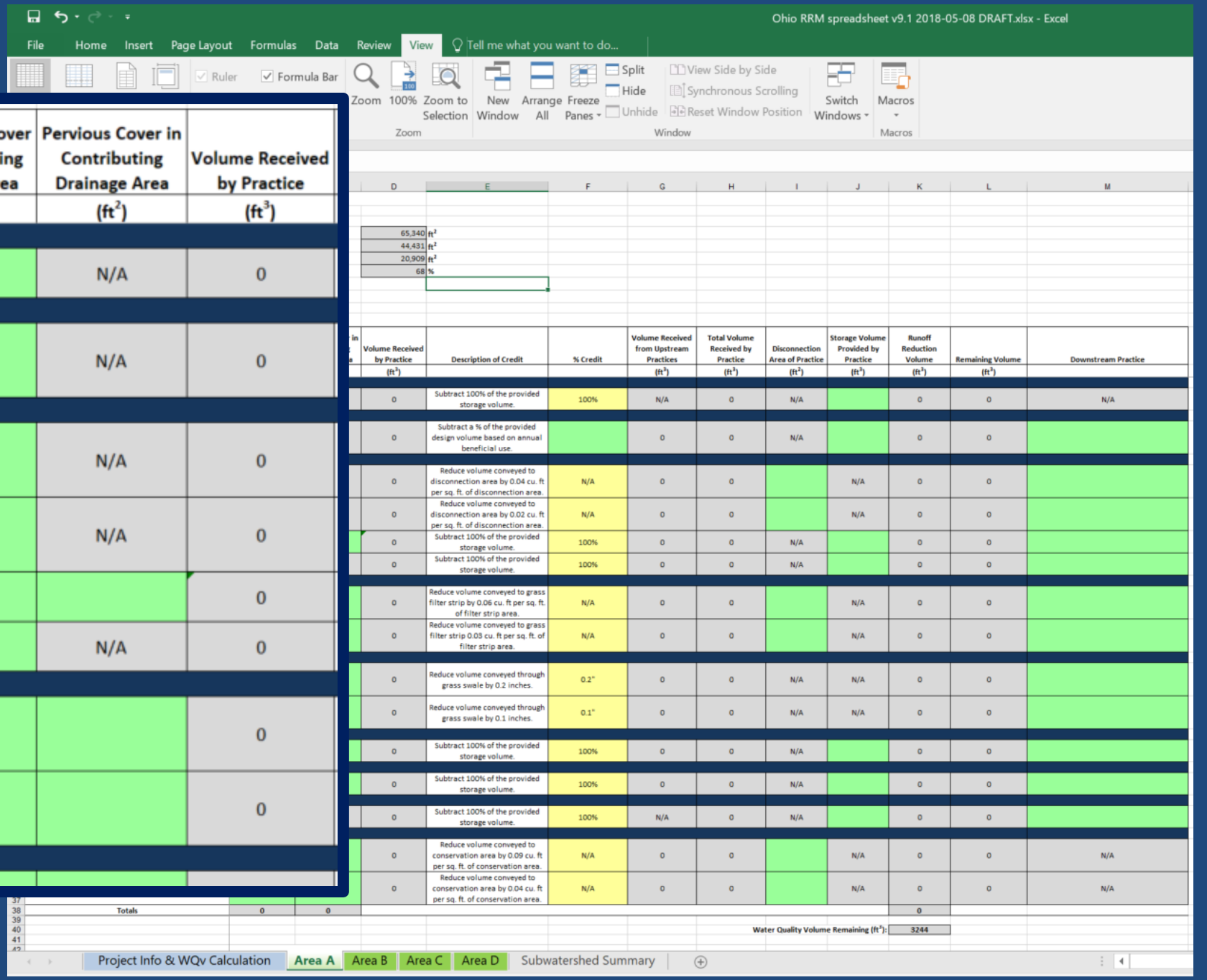
Apply Runoff Reduction Practices

Runoff Reduction Practice	Impervious Cover in Contributing Drainage Area (ft^2)	Pervious Cover in Contributing Drainage Area (ft^2)	Volume Received by Practice (ft^3)	Description of Credit	% Credit	Volume Received from Upstream Practices (ft^3)	Total Volume Received by Practice (ft^3)	Disconnection Area of Practice (ft^2)	Storage Volume Provided by Practice (ft^3)	Runoff Reduction Volume (ft^3)	Remaining Volume (ft^3)	Downstream Practice
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												
Rainwater Harvesting		N/A	0	Subtract a % of the provided design volume based on annual beneficial use		0	0	N/A		0	0	
3. Impervious Disconnection												
Impervious Disconnection			0	Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area.		0	0		N/A	0	0	
4. Soil Amendments												
Soil Amendments			0	Reduce volume conveyed to conservation area by 0.04 cu. ft per sq. ft. of conservation area.		0	0		N/A	0	0	
5. Bioretention												
Bioretention			0	Subtract 100% of the provided storage volume.		0	0	N/A		0	0	
6. Infiltration Practices												
Infiltration Practices			0	Subtract 100% of the provided storage volume.		0	0	N/A		0	0	
7. Dry Swale												
Dry Swale			0	Subtract 100% of the provided storage volume.		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												
Sheetflow to Conservation Area with A/B Soils			0	Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
Sheetflow to Conservation Area with C/D Soils			0	Reduce volume conveyed to conservation area by 0.04 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
Totals	0	0								0		

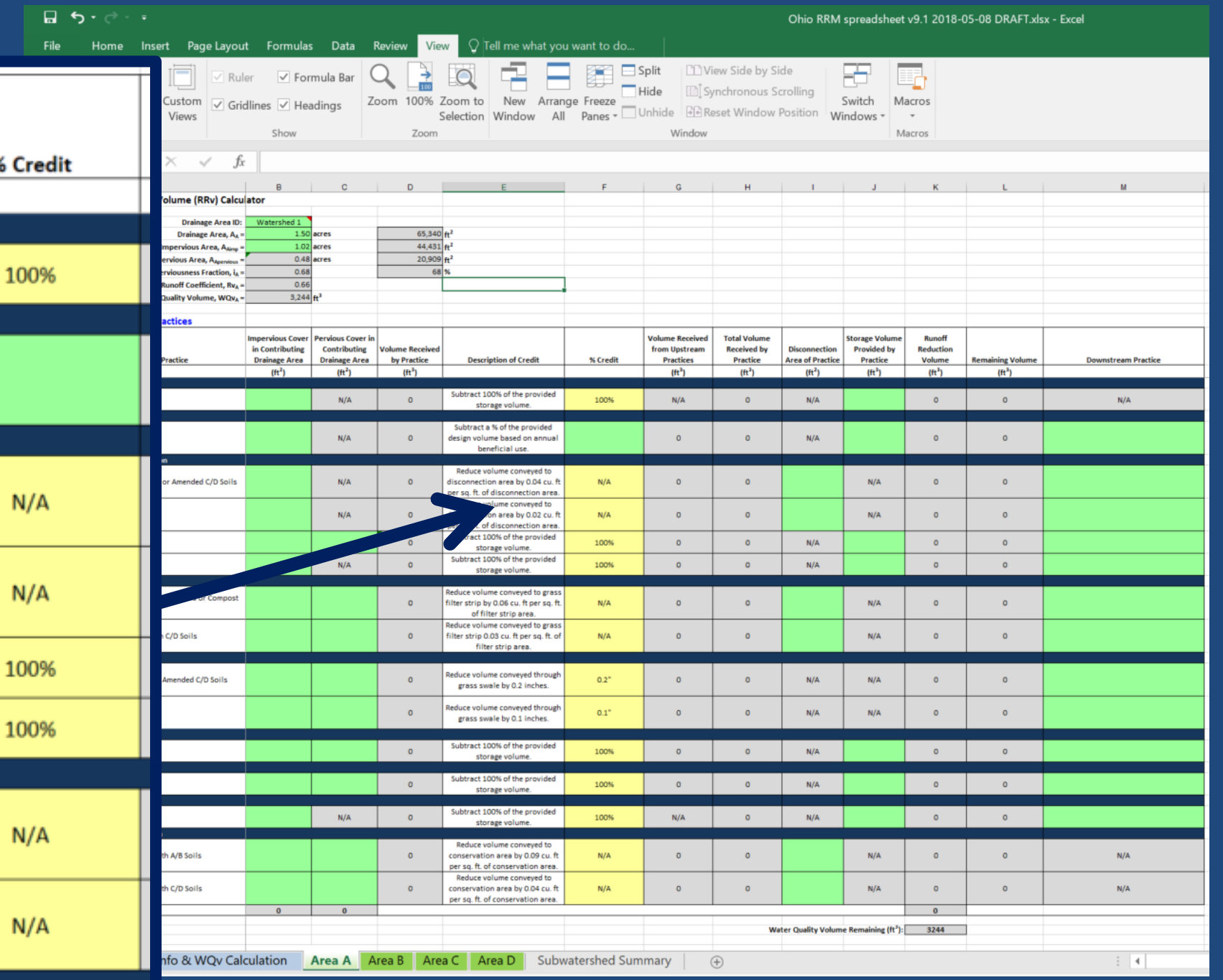
Water Quality Volume Remaining (ft^3): 3244

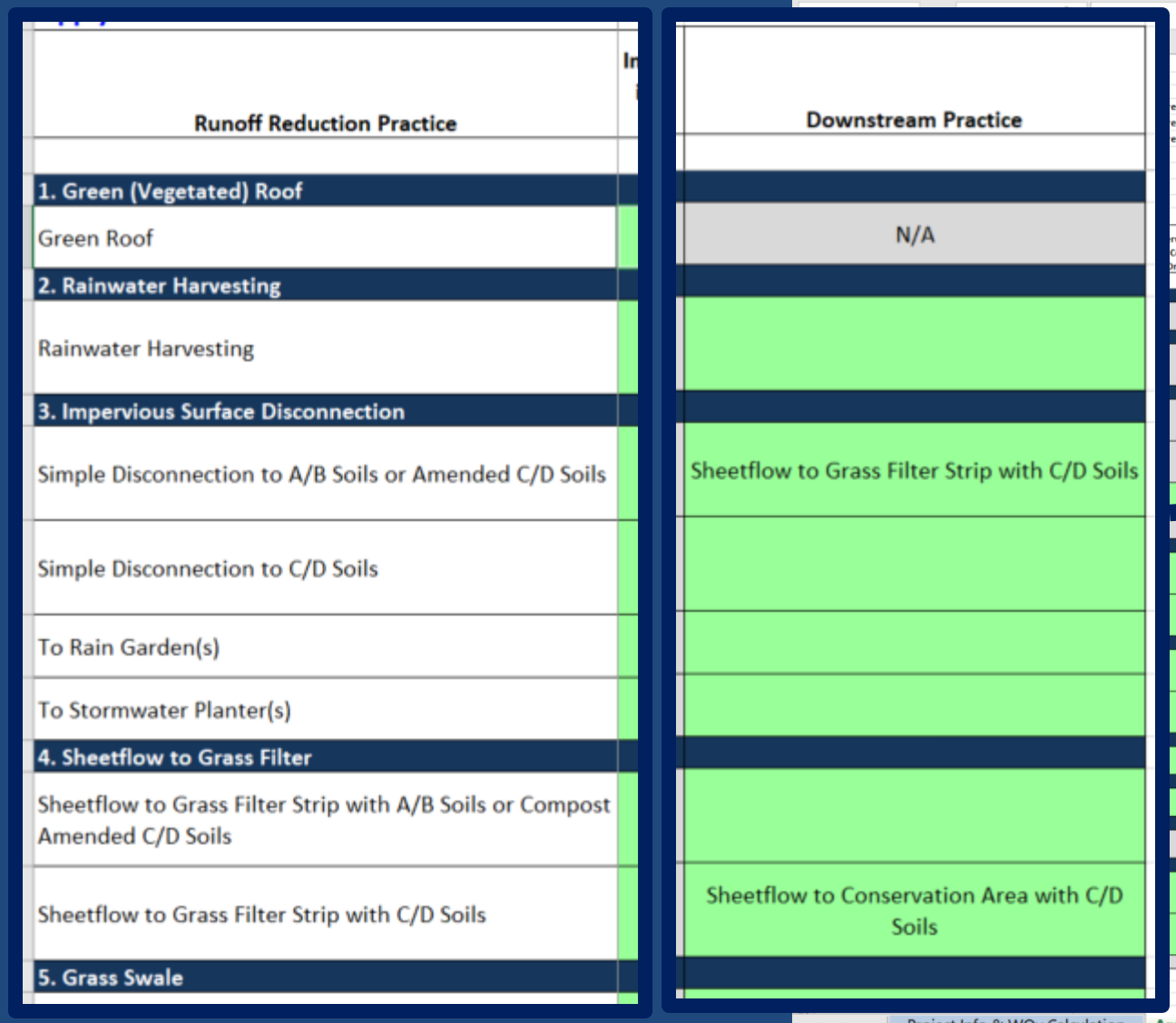
Project Info & WQv Calculation | Area A | Area B | Area C | Area D | Subwatershed Summary

Runoff Reduction Practice	Impervious Cover in Contributing Drainage Area (ft^2)	Pervious Cover in Contributing Drainage Area (ft^2)	Volume Received by Practice (ft^3)
1. Green (Vegetated) Roof			
Green Roof		N/A	0
2. Rainwater Harvesting			
Rainwater Harvesting		N/A	0
3. Impervious Surface Disconnection			
Simple Disconnection to A/B Soils or Amended C/D Soils		N/A	0
Simple Disconnection to C/D Soils		N/A	0
To Rain Garden(s)			0
To Stormwater Planter(s)		N/A	0
4. Sheetflow to Grass Filter			
Sheetflow to Grass Filter Strip with A/B Soils or Compost Amended C/D Soils			0
Sheetflow to Grass Filter Strip with C/D Soils			0
5. Grass Swale			



Description of Credit	% Credit
Subtract 100% of the provided storage volume.	100%
Subtract a % of the provided design volume based on annual beneficial use.	
Reduce volume conveyed to disconnection area by 0.04 cu. ft per sq. ft. of disconnection area.	N/A
Reduce volume conveyed to disconnection area by 0.02 cu. ft per sq. ft. of disconnection area.	N/A
Subtract 100% of the provided storage volume.	100%
Subtract 100% of the provided storage volume.	100%
Reduce volume conveyed to grass filter strip by 0.06 cu. ft per sq. ft. of filter strip area.	N/A
Reduce volume conveyed to grass filter strip 0.03 cu. ft per sq. ft. of filter strip area.	N/A





Runoff Reduction Practice	Downstream Practice
1. Green (Vegetated) Roof	
Green Roof	N/A
2. Rainwater Harvesting	
Rainwater Harvesting	
3. Impervious Surface Disconnection	
Simple Disconnection to A/B Soils or Amended C/D Soils	Sheetflow to Grass Filter Strip with C/D Soils
Simple Disconnection to C/D Soils	
To Rain Garden(s)	
To Stormwater Planter(s)	
4. Sheetflow to Grass Filter	
Sheetflow to Grass Filter Strip with A/B Soils or Compost Amended C/D Soils	
Sheetflow to Grass Filter Strip with C/D Soils	Sheetflow to Conservation Area with C/D Soils
5. Grass Swale	

Ohio RRM spreadsheet v9.1 2018-05-08 DRAFT.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View Tell me what you want to do...

Normal Page Break Preview Page Layout Custom Views | Ruler Formula Bar Gridlines Headings | Zoom 100% Zoom to Selection | New Window Arrange All Freeze Panes Split Hide Unhide View Side by Side Synchronous Scrolling Reset Window Position | Switch Windows | Macros

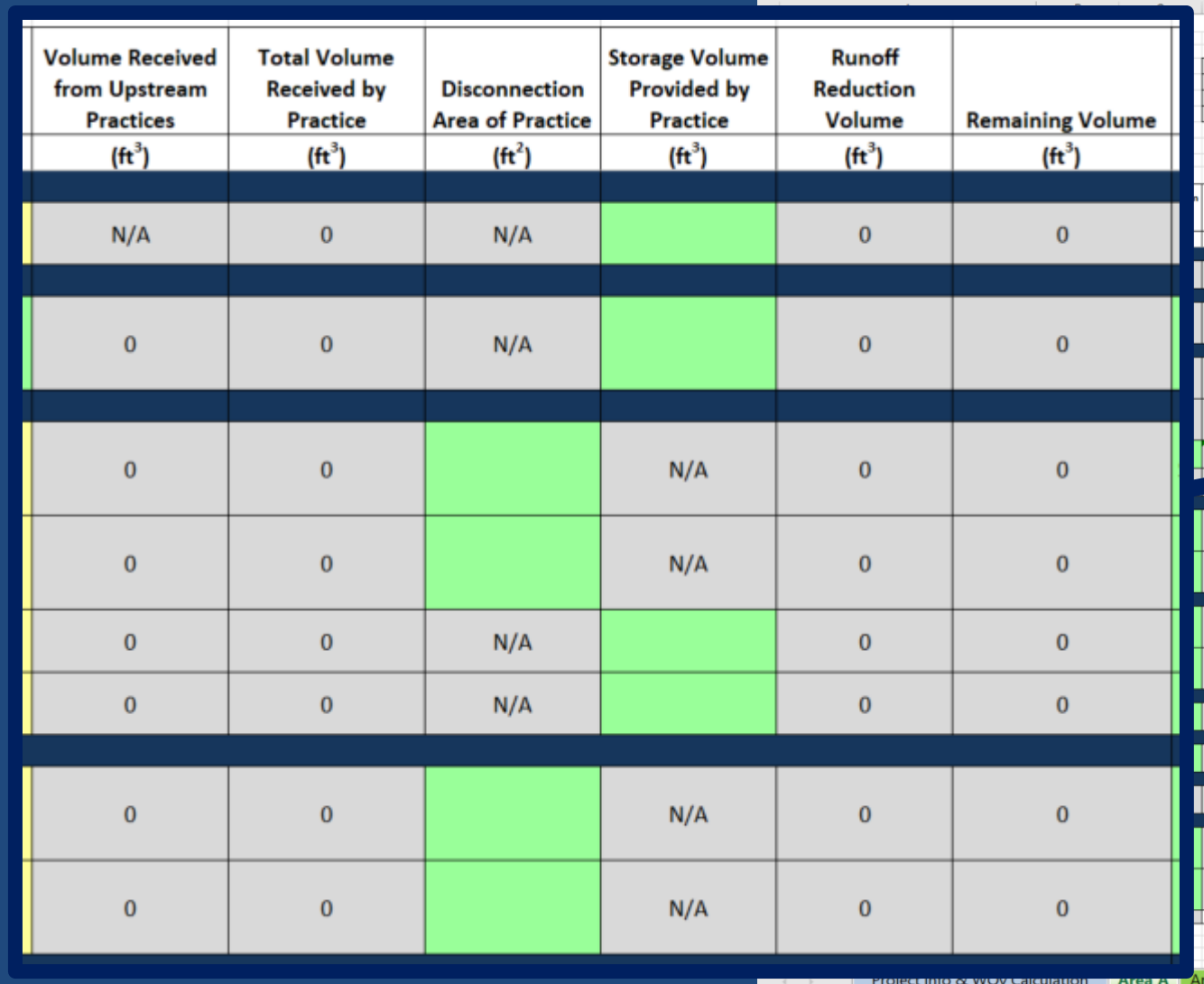
Workbook Views | Show | Zoom | Window | Macros

	65,340 ft²										
	44,431 ft²										
	20,909 ft²										
	68 %										

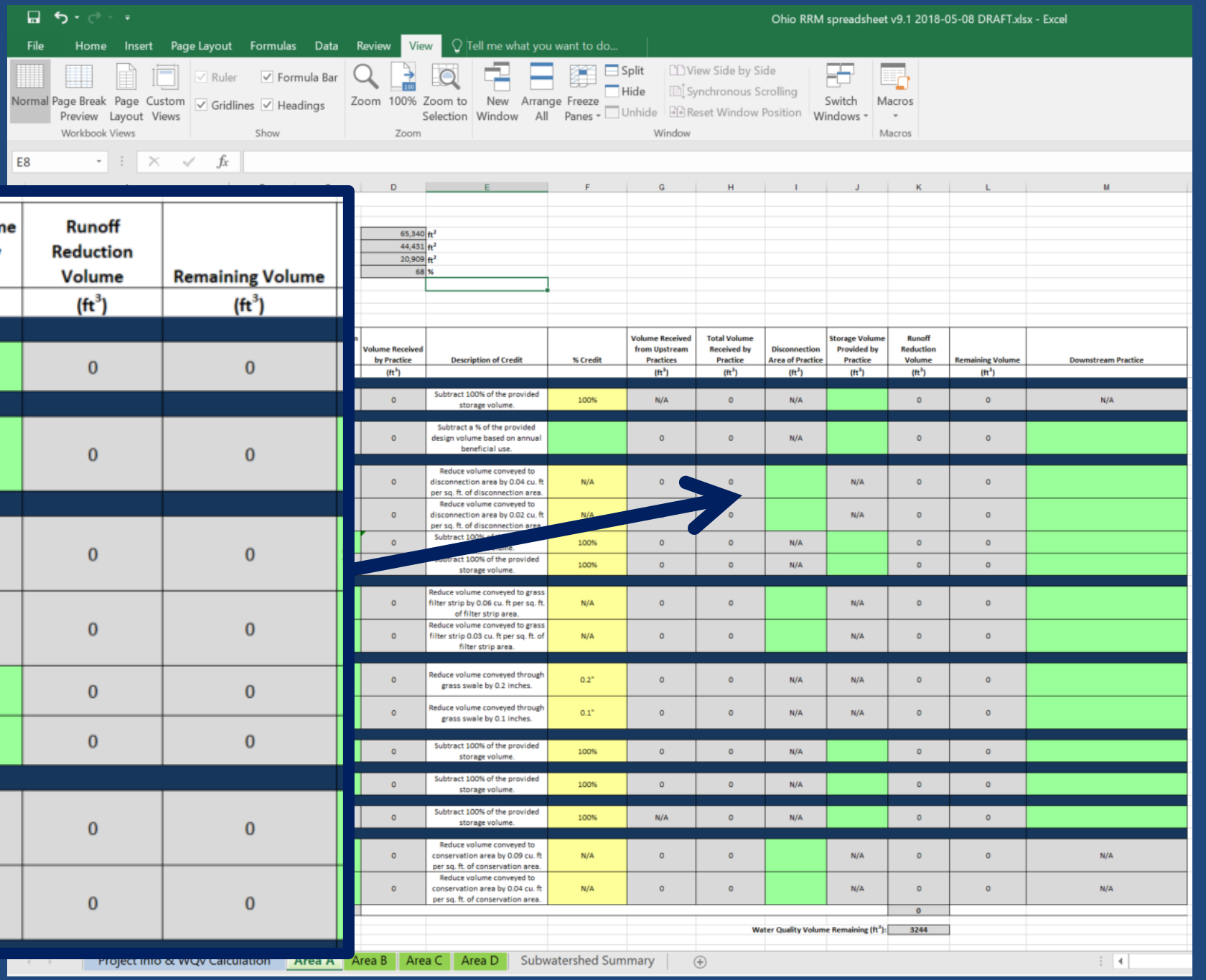
C	D	E	F	G	H	I	J	K	L	M
rvious Cover in Contributing Drainage Area (ft²)	Volume Received by Practice (ft³)	Description of Credit	% Credit	Volume Received from Upstream Practices (ft³)	Total Volume Received by Practice (ft³)	Disconnection Area of Practice (ft²)	Storage Volume Provided by Practice (ft³)	Runoff Reduction Volume (ft³)	Remaining Volume (ft³)	Downstream Practice
N/A	0	Subtract 100% of the provided storage volume.	100%	N/A	0	N/A		0	0	N/A
N/A	0	Subtract a % of the provided design volume based on annual beneficial use.		0	0	N/A		0	0	
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		
N/A	0	Reduce volume conveyed to disconnection area by 0.02 cu. ft per sq. ft. of disconnection area.	N/A	0	0					
				0	0	N/A		0	0	
N/A	0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
	0	Reduce volume conveyed to grass filter strip by 0.06 cu. ft per sq. ft. of filter strip area.	N/A	0	0		N/A	0	0	
	0	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	
	0	Reduce volume conveyed through grass swale by 0.2 inches.	0.2"	0	0	N/A	N/A	0	0	
	0	Reduce volume conveyed through grass swale by 0.1 inches.	0.1"	0	0	N/A	N/A	0	0	
	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	
N/A	0	Subtract 100% of the provided storage volume.	100%	N/A	0	N/A		0	0	
	0	Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
	0	Reduce volume conveyed to conservation area by 0.04 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
0								0		

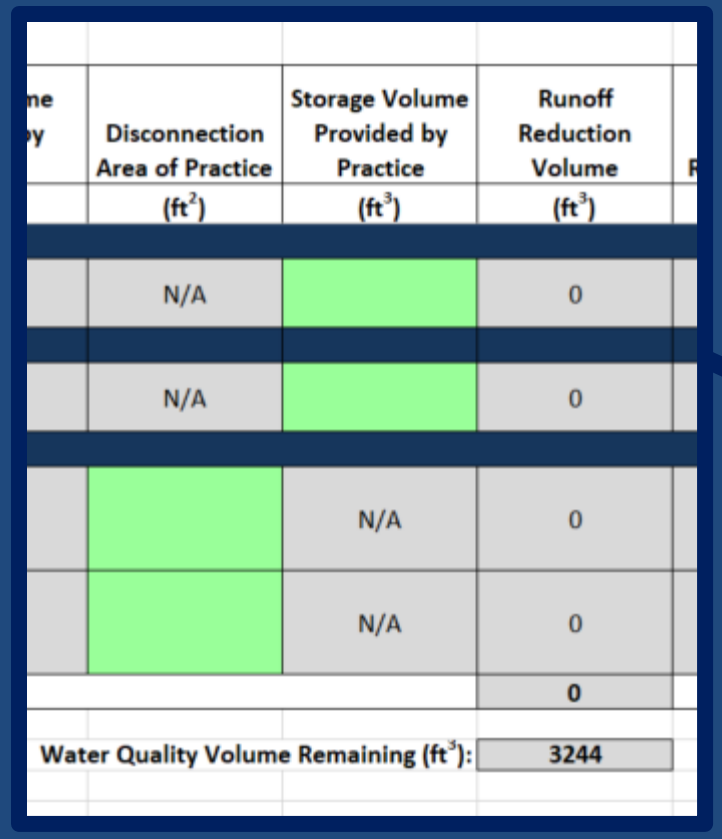
Water Quality Volume Remaining (ft³): 3244

Project Info & WQv Calculation | Area A | Area B | Area C | Area D | Subwatershed Summary



Volume Received from Upstream Practices (ft³)	Total Volume Received by Practice (ft³)	Disconnection Area of Practice (ft²)	Storage Volume Provided by Practice (ft³)	Runoff Reduction Volume (ft³)	Remaining Volume (ft³)
N/A	0	N/A		0	0
0	0	N/A		0	0
0	0		N/A	0	0
0	0		N/A	0	0
0	0	N/A		0	0
0	0	N/A		0	0
0	0		N/A	0	0
0	0		N/A	0	0





ne y	Disconnection Area of Practice (ft^2)	Storage Volume Provided by Practice (ft^3)	Runoff Reduction Volume (ft^3)	R
	N/A		0	
	N/A		0	
		N/A	0	
		N/A	0	
			0	
Water Quality Volume Remaining (ft^3):			3244	

Ohio RRM spreadsheet v9.1 2018-05-08 DRAFT.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View Tell me what you want to do...

Normal Page Break Preview Page Layout Custom Views | Ruler Formula Bar Gridlines Headings | Zoom 100% Zoom to Selection | New Window Arrange All Freeze Panes Split Hide Unhide View Side by Side Synchronous Scrolling Reset Window Position | Switch Windows | Macros

Workbook Views | Show | Zoom | Window | Macros

E8

Area A Runoff Reduction Volume (RRv) Calculator

Drainage Area ID:	Watershed 1			
Drainage Area, A_A =	1.50	acres	65,340	ft^2
Impervious Area, A_{Aimp} =	1.02	acres	44,431	ft^2
Pervious Area, A_{Aperv} =	0.48	acres	20,909	ft^2
Imperviousness Fraction, i_A =	0.68		68	%
Volumetric Runoff Coefficient, Rv_A =	0.66			
Water Quality Volume, WQv_A =	3,244	ft^3		

Apply Runoff Reduction Practices

Runoff Reduction Practice	Impervious Cover in Contributing Drainage Area (ft^2)	Pervious Cover in Contributing Drainage Area (ft^2)	Volume Received by Practice (ft^3)	Description of Credit	% Credit	Volume Received from Upstream Practices (ft^3)	Total Volume Received by Practice (ft^3)	Disconnection Area of Practice (ft^2)	Storage Volume Provided by Practice (ft^3)	Runoff Reduction Volume (ft^3)	Remaining Volume (ft^3)	Downstream Practice
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												
Rainwater Harvesting		N/A	0	Subtract a % of the provided design volume based on annual beneficial use.		0	0	N/A		0	0	
3. Impervious Surface Disconnection												
Simple Disconnection to A/B Soils 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	
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	0	
To [illegible]en(s)			0	Subtract 100% of the provided storage volume.	100%	0	0	N/A		0	0	
To Stormwater Pra		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 [illegible] 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	0	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.	N/A	0	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	[illegible]duce volume conveyed through [illegible] swale by 0.1 inches.	0.1"	0	0	N/A	N/A	0	0	
6. Bioretention												
Bioretention			0	Subtract 100% [illegible] provided storage volu[illegible]	100%	0	0	N/A		0	0	
7. Infiltration Practice												
Infiltration Practice			0	Subtract 100% of the provided storage volume.		0	0	N/A		0	0	
8. Permeable Pavement												
Permeable Pavement		N/A	0	Subtract 100% of the provided storage volume.	100%		0	N/A		0	0	
9. Sheetflow to Conservation Area												
Sheetflow to Conservation Area with A/B Soils			0	Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area.	N/A	0			N/A	0	0	N/A
Sheetflow to Conservation Area with C/D Soils			0	Reduce volume conveyed to conservation area by 0.04 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
Totals	0	0								0		

Water Quality Volume Remaining (ft^3): 3244

Project Info & WQv Calculation | Area A | Area B | Area C | Area D | Subwatershed Summary

Sub-Area Worksheet

Print Layout

Area A Runoff Reduction Volume (RRv) Calculator

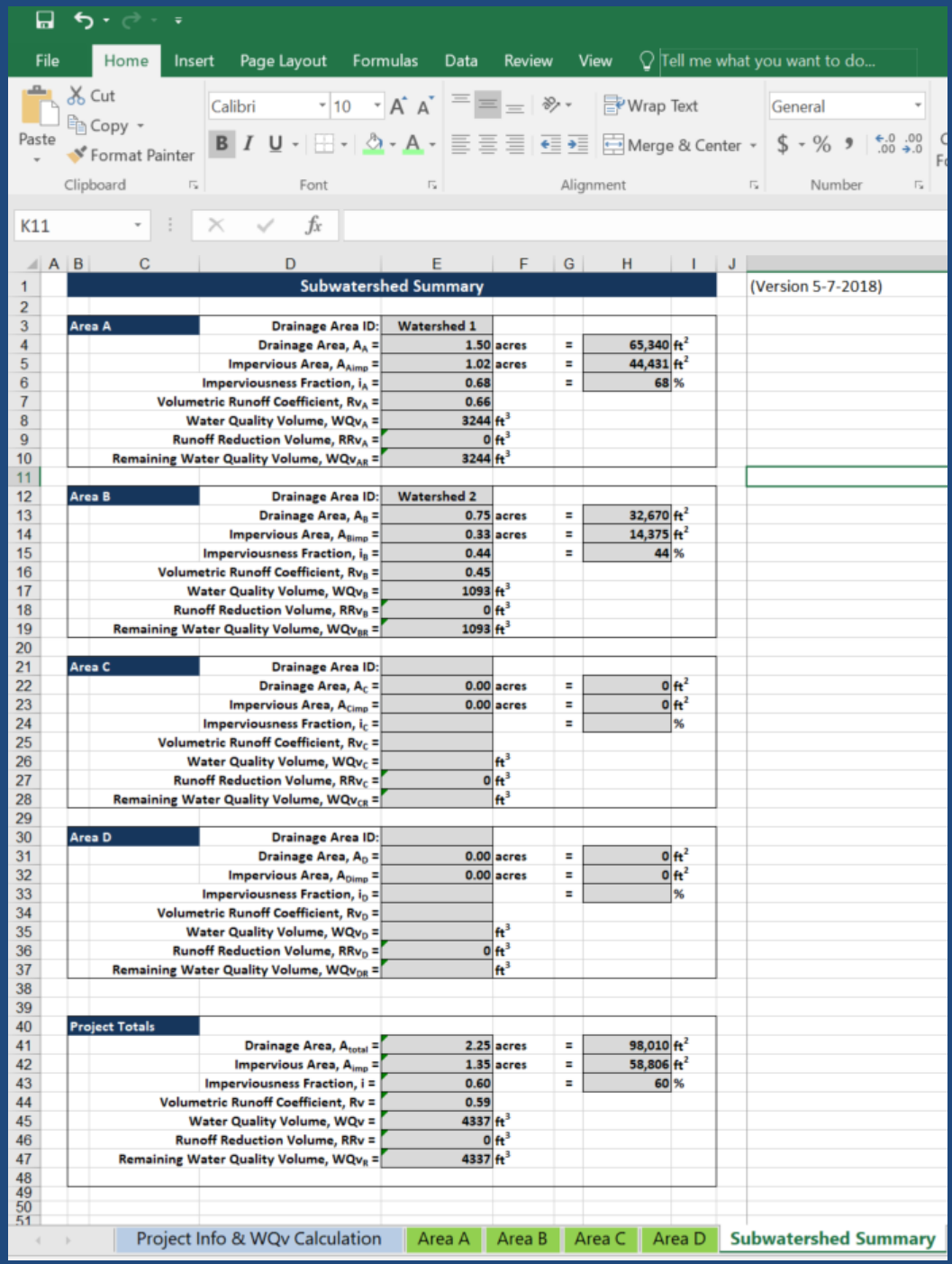
Drainage Area ID:	Watershed 1			
Drainage Area, A_A =	1.50	acres	65,340	ft^2
Impervious Area, A_{Aimp} =	1.02	acres	44,431	ft^2
Pervious Area, $A_{Apervious}$ =	0.48	acres	20,909	ft^2
Imperviousness Fraction, i_A =	0.68		68	%
Volumetric Runoff Coefficient, Rv_A =	0.66			
Water Quality Volume, WQv_A =	3,244	ft^3		

Apply Runoff Reduction Practices

Runoff Reduction Practice	Impervious Cover in Contributing Drainage Area (ft^2)	Pervious Cover in Contributing Drainage Area (ft^2)	Volume Received by Practice (ft^3)	Description of Credit	% Credit	Volume Received from Upstream Practices (ft^3)	Total Volume Received by Practice (ft^3)	Disconnection Area of Practice (ft^2)	Storage Volume Provided by Practice (ft^3)	Runoff Reduction Volume (ft^3)	Remaining Volume (ft^3)	Downstream Practice
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												
Rainwater Harvesting		N/A	0	Subtract a % of the provided design volume based on annual beneficial use.		0	0	N/A		0	0	
3. Impervious Surface Disconnection												
Simple Disconnection to A/B Soils 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	
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	0	
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	0	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.	N/A	0	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"	0	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												
Infiltration 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												
Sheetflow to Conservation Area with A/B Soils			0	Reduce volume conveyed to conservation area by 0.09 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
Sheetflow to Conservation Area with C/D Soils			0	Reduce volume conveyed to conservation area by 0.04 cu. ft per sq. ft. of conservation area.	N/A	0	0		N/A	0	0	N/A
Totals	0	0								0		
									Water Quality Volume Remaining (ft^3):	3244		

Runoff Reduction Spreadsheet

Subwatershed Summary



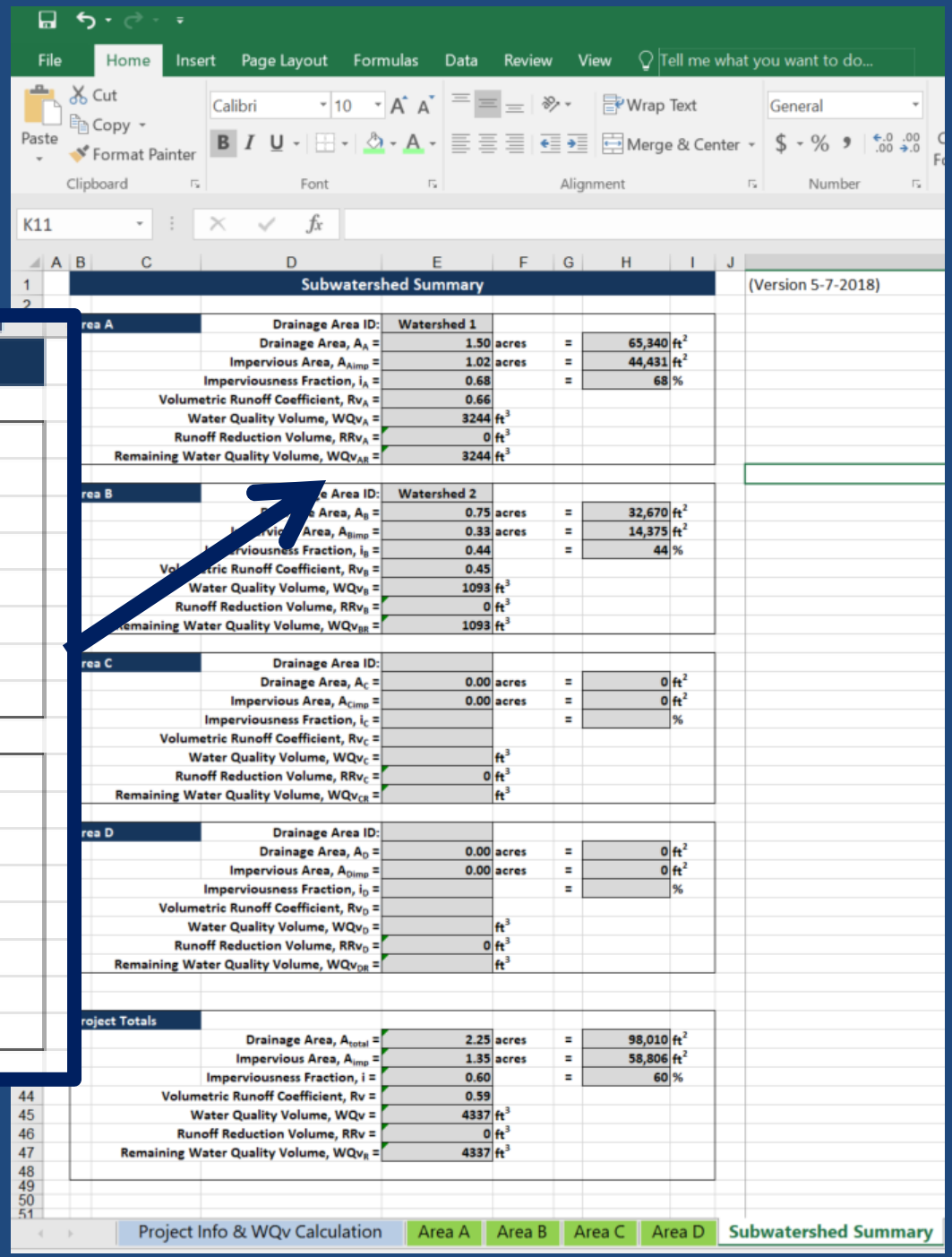
Subwatershed Summary

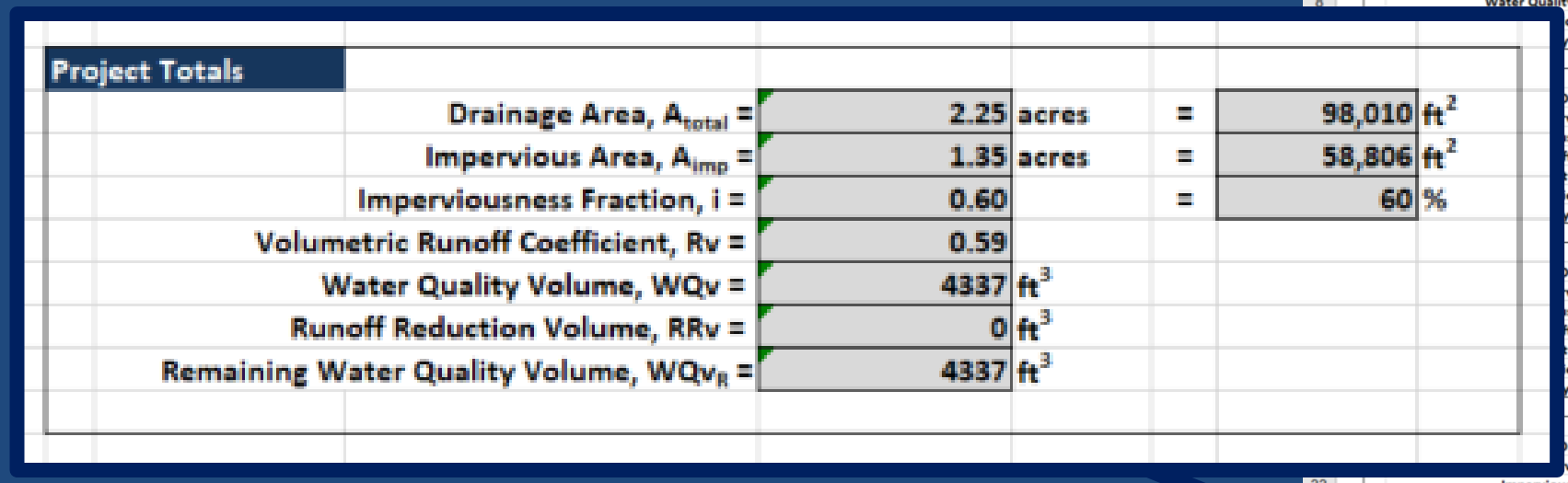
(Version 5-7-2018)

Area A	Drainage Area ID:	Watershed 1				
	Drainage Area, A_A =	1.50	acres	=	65,340	ft^2
	Impervious Area, A_{Aimp} =	1.02	acres	=	44,431	ft^2
	Imperviousness Fraction, i_A =	0.68		=	68	%
	Volumetric Runoff Coefficient, Rv_A =	0.66				
	Water Quality Volume, WQv_A =	3244	ft^3			
	Runoff Reduction Volume, RRv_A =	0	ft^3			
	Remaining Water Quality Volume, WQv_{AR} =	3244	ft^3			
Area B	Drainage Area ID:	Watershed 2				
	Drainage Area, A_B =	0.75	acres	=	32,670	ft^2
	Impervious Area, A_{Bimp} =	0.33	acres	=	14,375	ft^2
	Imperviousness Fraction, i_B =	0.44		=	44	%
	Volumetric Runoff Coefficient, Rv_B =	0.45				
	Water Quality Volume, WQv_B =	1093	ft^3			
	Runoff Reduction Volume, RRv_B =	0	ft^3			
	Remaining Water Quality Volume, WQv_{BR} =	1093	ft^3			
Area C	Drainage Area ID:					
	Drainage Area, A_C =	0.00	acres	=	0	ft^2
	Impervious Area, A_{Cimp} =	0.00	acres	=	0	ft^2
	Imperviousness Fraction, i_C =			=		%
	Volumetric Runoff Coefficient, Rv_C =					
	Water Quality Volume, WQv_C =		ft^3			
	Runoff Reduction Volume, RRv_C =	0	ft^3			
	Remaining Water Quality Volume, WQv_{CR} =		ft^3			
Area D	Drainage Area ID:					
	Drainage Area, A_D =	0.00	acres	=	0	ft^2
	Impervious Area, A_{Dimp} =	0.00	acres	=	0	ft^2
	Imperviousness Fraction, i_D =			=		%
	Volumetric Runoff Coefficient, Rv_D =					
	Water Quality Volume, WQv_D =		ft^3			
	Runoff Reduction Volume, RRv_D =	0	ft^3			
	Remaining Water Quality Volume, WQv_{DR} =		ft^3			
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	%
	Volumetric Runoff Coefficient, Rv =	0.59				
	Water Quality Volume, WQv =	4337	ft^3			
	Runoff Reduction Volume, RRv =	0	ft^3			
	Remaining Water Quality Volume, WQv_R =	4337	ft^3			

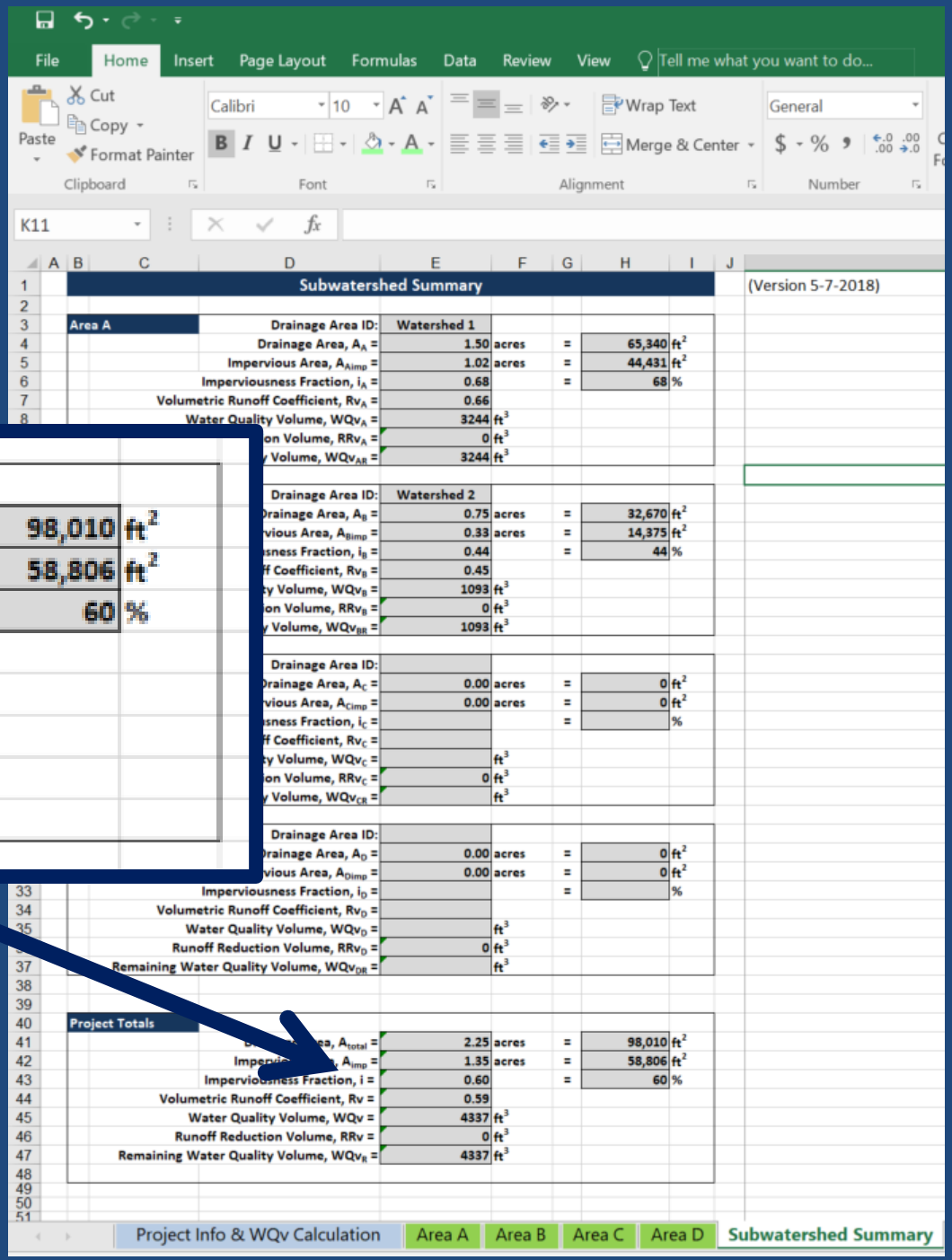
Subwatershed Summary

Area A	Drainage Area ID:	Watershed 1				
	Drainage Area, A_A =	1.50	acres	=	65,340	ft^2
	Impervious Area, A_{Aimp} =	1.02	acres	=	44,431	ft^2
	Imperviousness Fraction, i_A =	0.68		=	68	%
	Volumetric Runoff Coefficient, Rv_A =	0.66				
	Water Quality Volume, WQv_A =	3244	ft^3			
	Runoff Reduction Volume, RRv_A =	0	ft^3			
	Remaining Water Quality Volume, WQv_{AR} =	3244	ft^3			
Area B	Drainage Area ID:	Watershed 2				
	Drainage Area, A_B =	0.75	acres	=	32,670	ft^2
	Impervious Area, A_{Bimp} =	0.33	acres	=	14,375	ft^2
	Imperviousness Fraction, i_B =	0.44		=	44	%
	Volumetric Runoff Coefficient, Rv_B =	0.45				
	Water Quality Volume, WQv_B =	1093	ft^3			
	Runoff Reduction Volume, RRv_B =	0	ft^3			
	Remaining Water Quality Volume, WQv_{BR} =	1093	ft^3			





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	%
Volumetric Runoff Coefficient, Rv =	0.59				
Water Quality Volume, WQv =	4337	ft^3			
Runoff Reduction Volume, RRv =	0	ft^3			
Remaining Water Quality Volume, WQv_R =	4337	ft^3			



File Home Insert Page Layout Formulas Data Review View Tell me what you want to do...

Cut Copy Format Painter Paste Clipboard

Calibri 10 Font

Wrap Text Merge & Center Alignment

General Number

K11

Subwatershed Summary (Version 5-7-2018)

Area A						
Drainage Area ID:	Watershed 1					
Drainage Area, A_A =	1.50	acres	=	65,340	ft^2	
Impervious Area, A_{Aimp} =	1.02	acres	=	44,431	ft^2	
Imperviousness Fraction, i_A =	0.68		=	68	%	
Volumetric Runoff Coefficient, Rv_A =	0.66					
Water Quality Volume, WQv_A =	3244	ft^3				
on Volume, RRv_A =	0	ft^3				
Volume, WQv_{AR} =	3244	ft^3				

Drainage Area ID:	Watershed 2					
rainage Area, A_B =	0.75	acres	=	32,670	ft^2	
vious Area, A_{Bimp} =	0.33	acres	=	14,375	ft^2	
sness Fraction, i_B =	0.44		=	44	%	
f Coefficient, Rv_B =	0.45					
y Volume, WQv_B =	1093	ft^3				
on Volume, RRv_B =	0	ft^3				
Volume, WQv_{BR} =	1093	ft^3				

Drainage Area ID:						
rainage Area, A_C =	0.00	acres	=	0	ft^2	
vious Area, A_{Cimp} =	0.00	acres	=	0	ft^2	
sness Fraction, i_C =			=		%	
f Coefficient, Rv_C =						
y Volume, WQv_C =		ft^3				
on Volume, RRv_C =	0	ft^3				
Volume, WQv_{CR} =		ft^3				

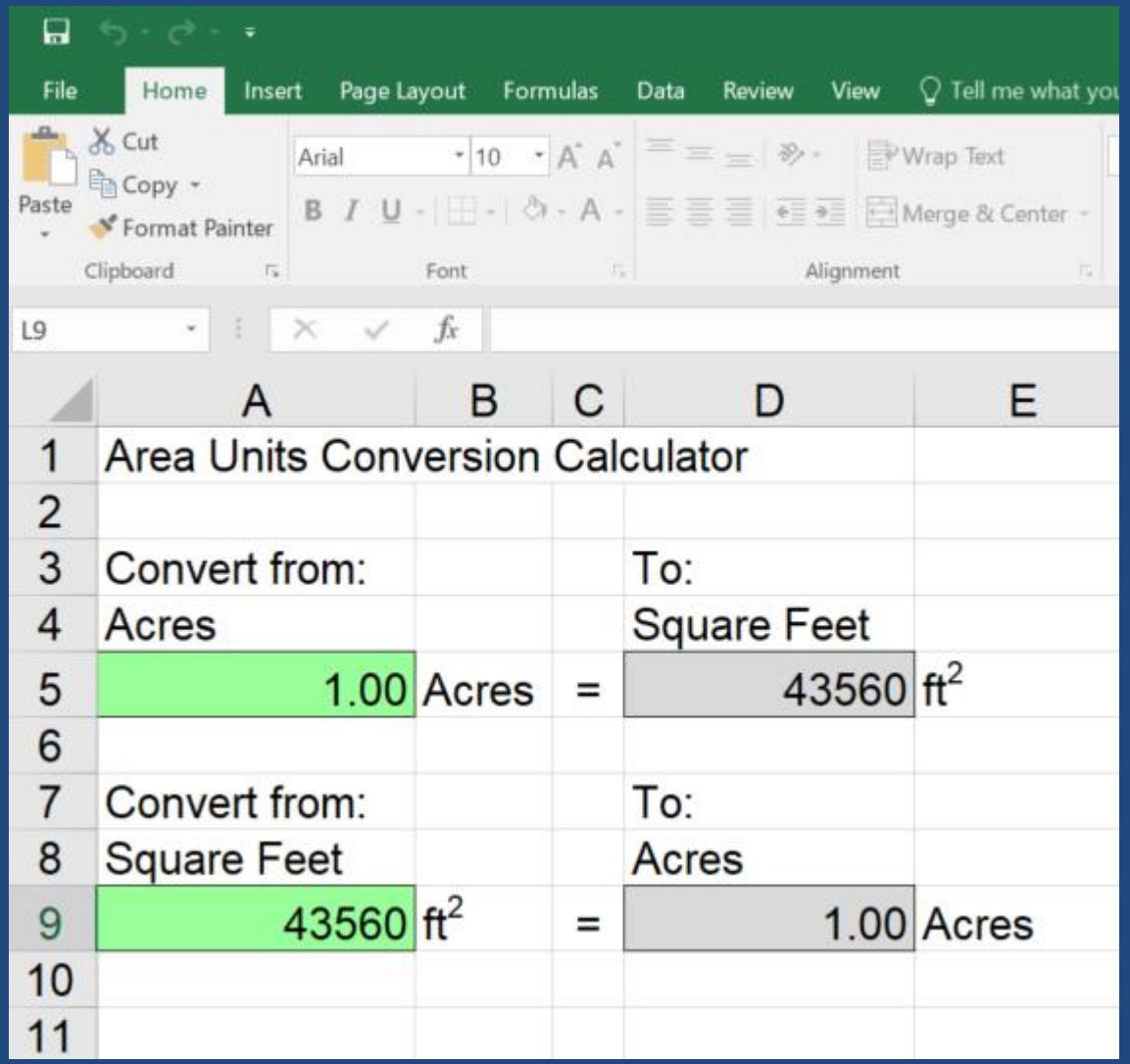
Drainage Area ID:						
rainage Area, A_D =	0.00	acres	=	0	ft^2	
vious Area, A_{Dimp} =	0.00	acres	=	0	ft^2	
Imperviousness Fraction, i_D =			=		%	
Volumetric Runoff Coefficient, Rv_D =						
Water Quality Volume, WQv_D =		ft^3				
Runoff Reduction Volume, RRv_D =	0	ft^3				
Remaining Water Quality Volume, WQv_{DR} =		ft^3				

Project Totals					
ea, A_{total} =	2.25	acres	=	98,010	ft^2
Impe A_{imp} =	1.35	acres	=	58,806	ft^2
Imperviousness Fraction, i =	0.60		=	60	%
Volumetric Runoff Coefficient, Rv =	0.59				
Water Quality Volume, WQv =	4337	ft^3			
Runoff Reduction Volume, RRv =	0	ft^3			
Remaining Water Quality Volume, WQv_R =	4337	ft^3			

Project Info & WQv Calculation | Area A | Area B | Area C | Area D | Subwatershed Summary

Runoff Reduction Spreadsheet

Area Units Conversion Calculator

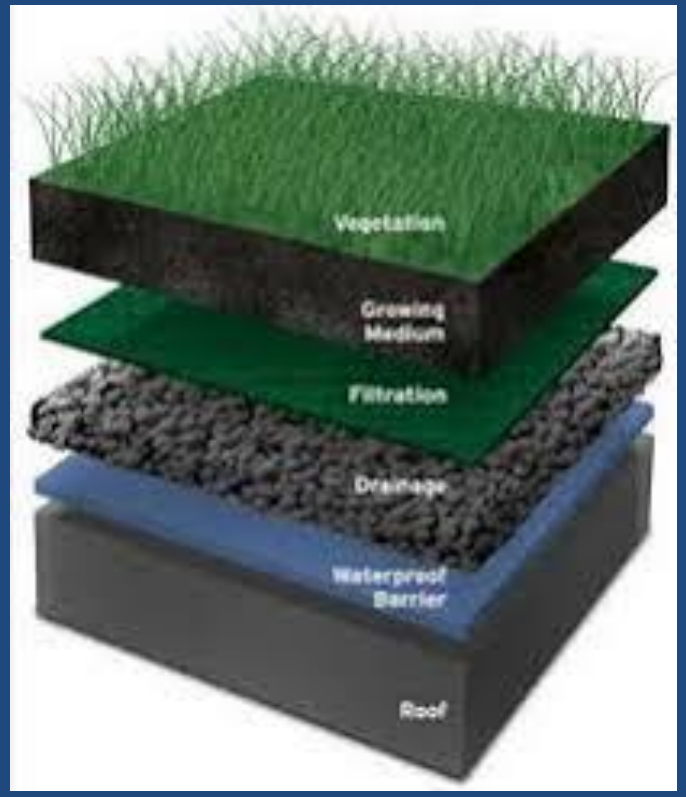


	A	B	C	D	E
1	Area Units Conversion Calculator				
2					
3	Convert from:			To:	
4	Acres			Square Feet	
5	1.00	Acres	=	43560	ft^2
6					
7	Convert from:			To:	
8	Square Feet			Acres	
9	43560	ft^2	=	1.00	Acres
10					
11					

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

Green Roof



Source: Greensulate

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

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

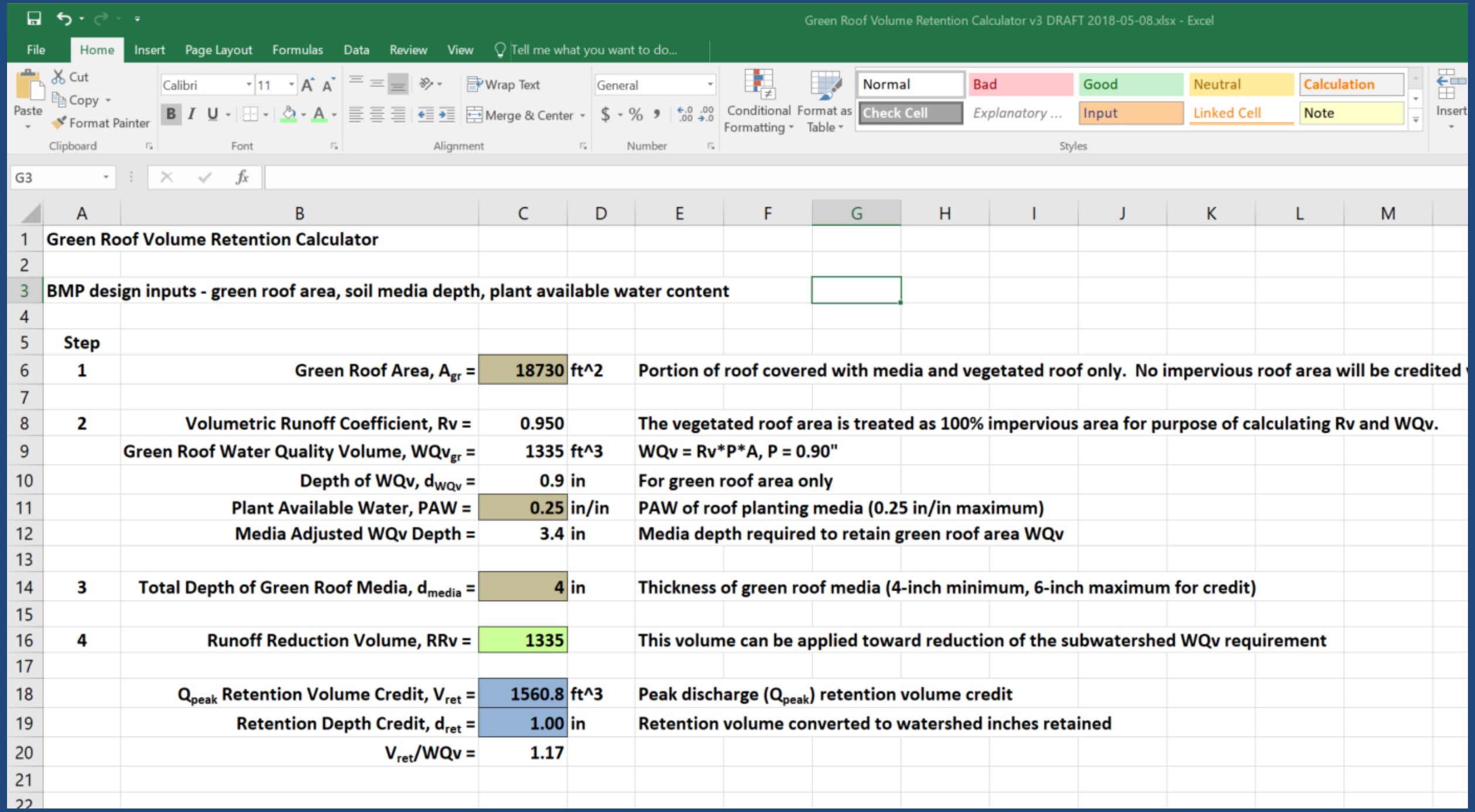
Subject to the following criteria:

$d_{WQv} \leq d_{media} * PAW$

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

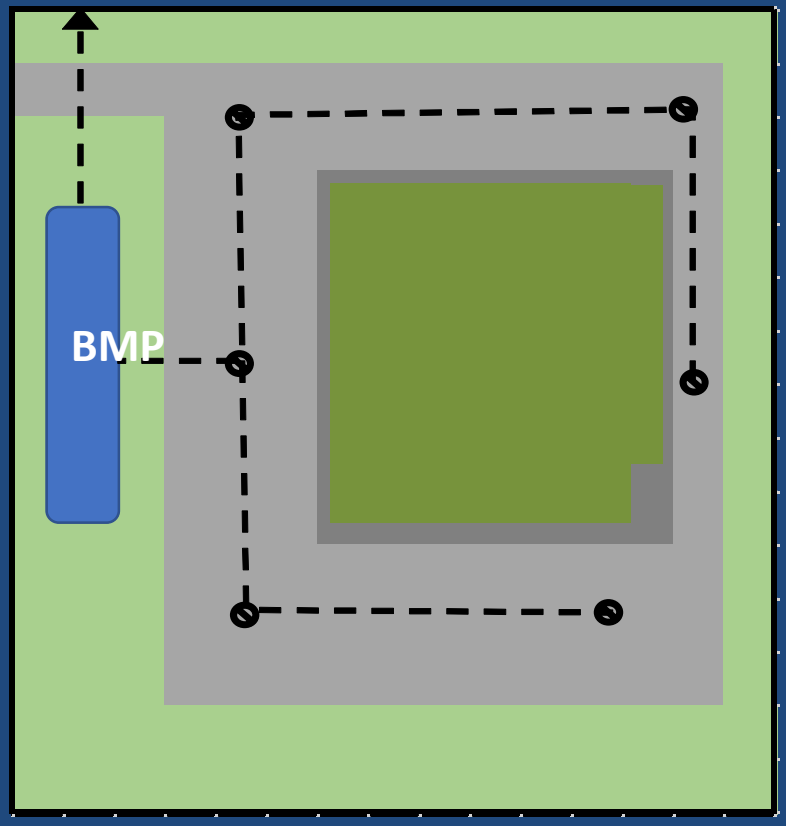


	A	B	C	D	E
1	**Green Roof Volume Retention Calculator**				
2					
3	**BMP design inputs - green roof area, soil media depth, plant available water content**				
4					
5	**Step**				
6	**1**	**Green Roof Area, A_{gr} =**	**18730**	**ft^2**	**Portion of roof covered with media and vegetated roof only. No impervious roof area will be credited**
7					
8	**2**	**Volumetric Runoff Coefficient, Rv =**	**0.950**		**The vegetated roof area is treated as 100% impervious area for purpose of calculating Rv and WQv.**
9		**Green Roof Water Quality Volume, WQv_{gr} =**	**1335**	**ft^3**	**WQv = Rv*P*A, P = 0.90"**
10		**Depth of WQv, d_{WQv} =**	**0.9**	**in**	**For green roof area only**
11		**Plant Available Water, PAW =**	**0.25**	**in/in**	**PAW of roof planting media (0.25 in/in maximum)**
12		**Media Adjusted WQv Depth =**	**3.4**	**in**	**Media depth required to retain green roof area WQv**
13					
14	**3**	**Total Depth of Green Roof Media, d_{media} =**	**4**	**in**	**Thickness of green roof media (4-inch minimum, 6-inch maximum for credit)**
15					
16	**4**	**Runoff Reduction Volume, RRv =**	**1335**		**This volume can be applied toward reduction of the subwatershed WQv requirement**
17					
18		**Q_{peak} Retention Volume Credit, V_{ret} =**	**1560.8**	**ft^3**	**Peak discharge (Q_{peak}) retention volume credit**
19		**Retention Depth Credit, d_{ret} =**	**1.00**	**in**	**Retention volume converted to watershed inches retained**
20		**V_{ret}/WQv =**	**1.17**		
21					

Example Site

Total site area:	2.25 acres
Planned impervious area:	1.35 acres
Roof area:	0.48 acres
Green roof area:	0.43 acres

$WQv = 4337\ ft^3$



Green Roof Volume Retention Calculator

BMP design inputs - green roof area, soil media depth, plant available w

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) Calculator

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

Runoff Reduction Practice	Impervious Cover in Contributing Drainage Area (ft^2)	Pervious Cover in Contributing Drainage Area (ft^2)	Volume Received by Practice (ft^3)	Description of Credit	% Credit	Volume Received from Upstream Practices (ft^3)	Total Volume Received by Practice (ft^3)	Disconnection Area of Practice (ft^2)	Storage Volume Provided by Practice (ft^3)	Runoff Reduction Volume (ft^3)	Remaining Volume (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	%
Volumetric Runoff Coefficient, Rv =	0.59				
Water Quality Volume, WQv =	4337	ft^3			
Runoff Reduction Volume, RRv =	1335	ft^3			
Remaining Water Quality Volume, WQv_R =	3002	ft^3			

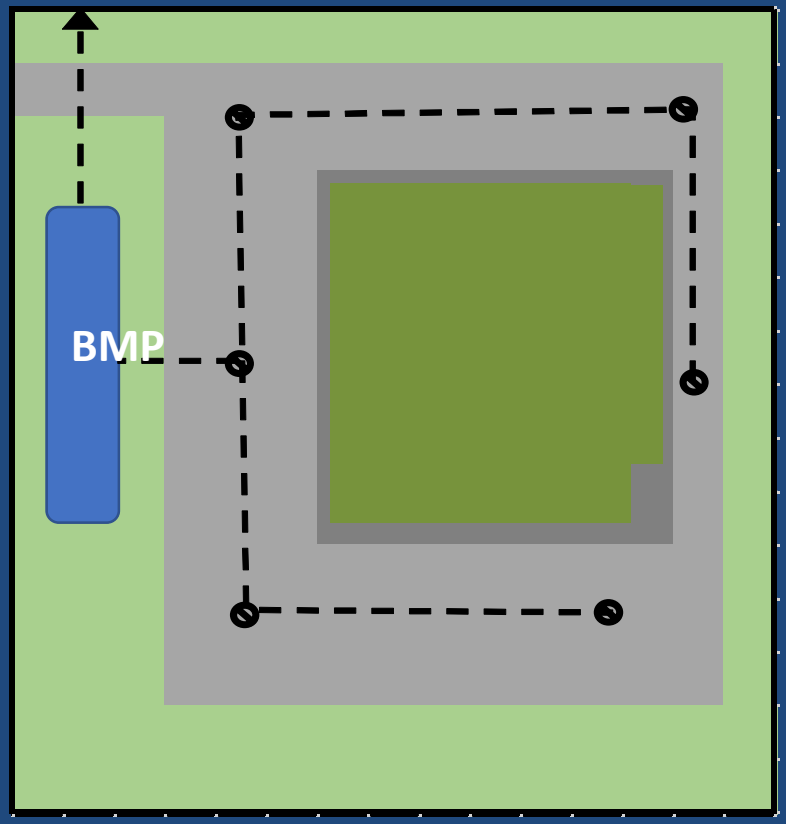
Example Site

Total site area:	2.25 acres
Planned impervious area:	1.35 acres
Roof area:	0.48 acres
Green roof area:	0.43 acres

$WQv = 4337\ ft^3$

$RRv = 1335\ ft^3$

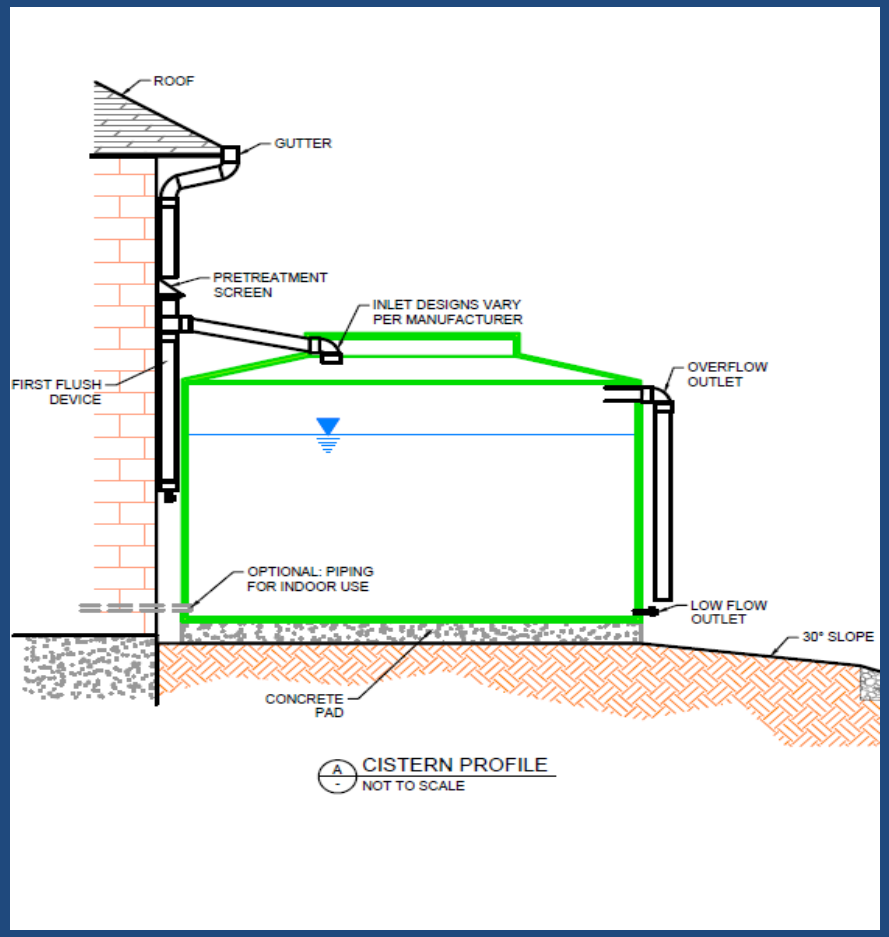
$WQv_{adjusted} = 3002\ ft^3$



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



Graphic Source: Tetra Tech

Photo 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
- ***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

Impervious Area Disconnection

Simple Disconnection

Source: WVDEP

Stormwater Planter

Source: Blue Water Baltimore

Rain Garden

Simple Disconnection Credit and Criteria

Runoff Reduction Volume (RRv) Credit	• HSG-A/B soils: 0.04 ft^3/ft^2 of filter strip • Amended HSG-C/D soils: 0.04 ft^3/ft^2 of filter strip • HSG-C/D soils: 0.02 ft^3/ft^2 of filter strip
Runoff Reduction Volume (RRv) Design Criteria	• Maximum impervious area treated: 1,000 ft^2 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

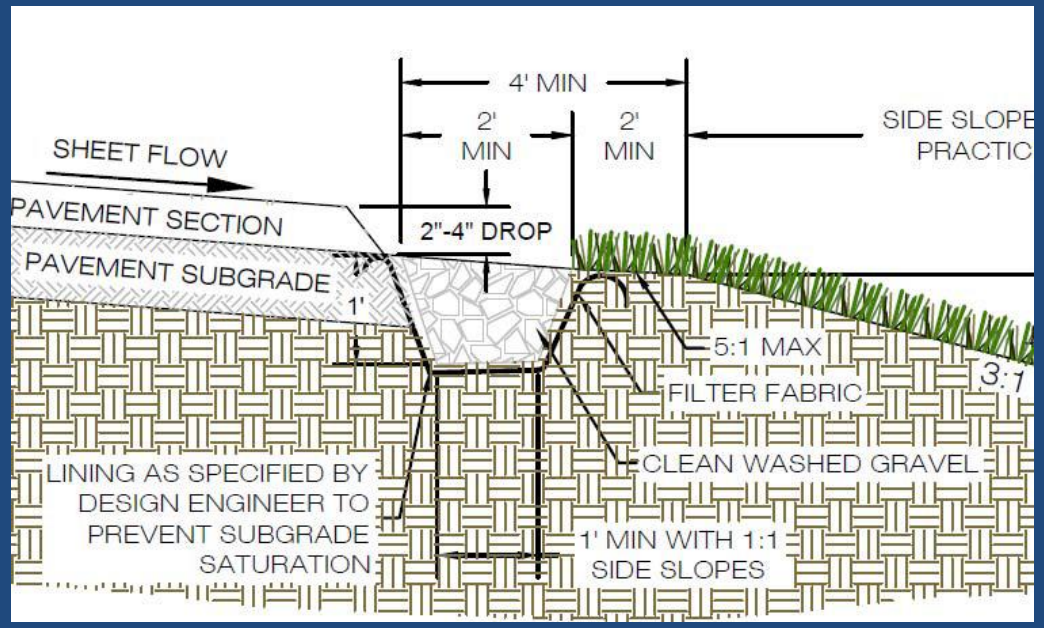
Rain Garden Credit and Criteria

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

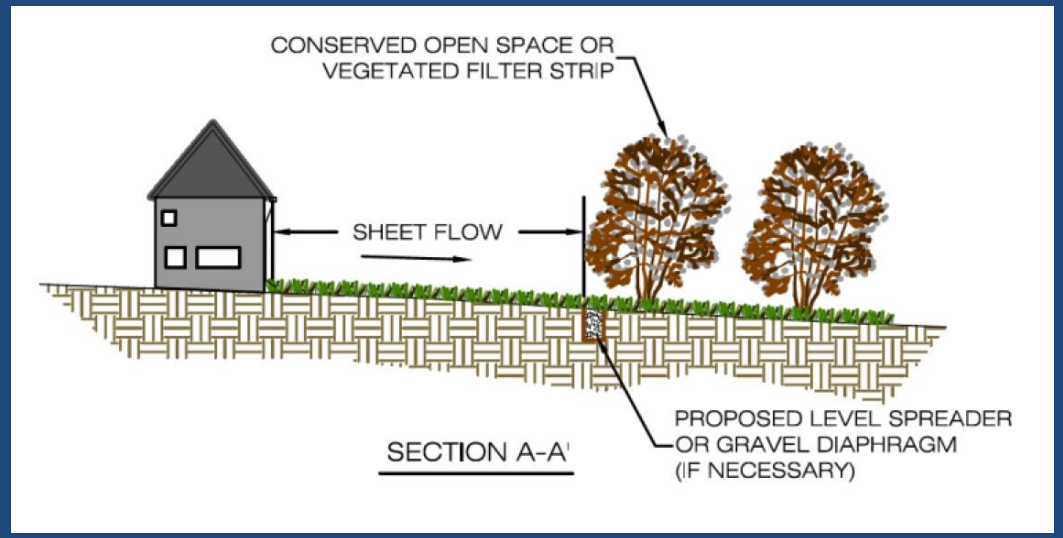
Photo Source: John Mathews

Sheet Flow to Grass Filter Strip

Runoff Reduction Volume (RRv) Credit	• HSG-A/B soils: 0.06 ft^3/ft^2 of filter strip • Amended HSG-C/D soils: 0.06 ft^3/ft^2 of filter strip • HSG-C/D soils: 0.03 ft^3/ft^2 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: VA DEQ

Sheet Flow to Conservation Area

Runoff Reduction Volume (RRv) Credit	• HSG-A/B soils: 0.09 ft^3/ft^2 of conservation area • Amended HSG-C/D soils: 0.09 ft^3/ft^2 of conservation area • HSG-C/D soils: 0.04 ft^3/ft^2 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

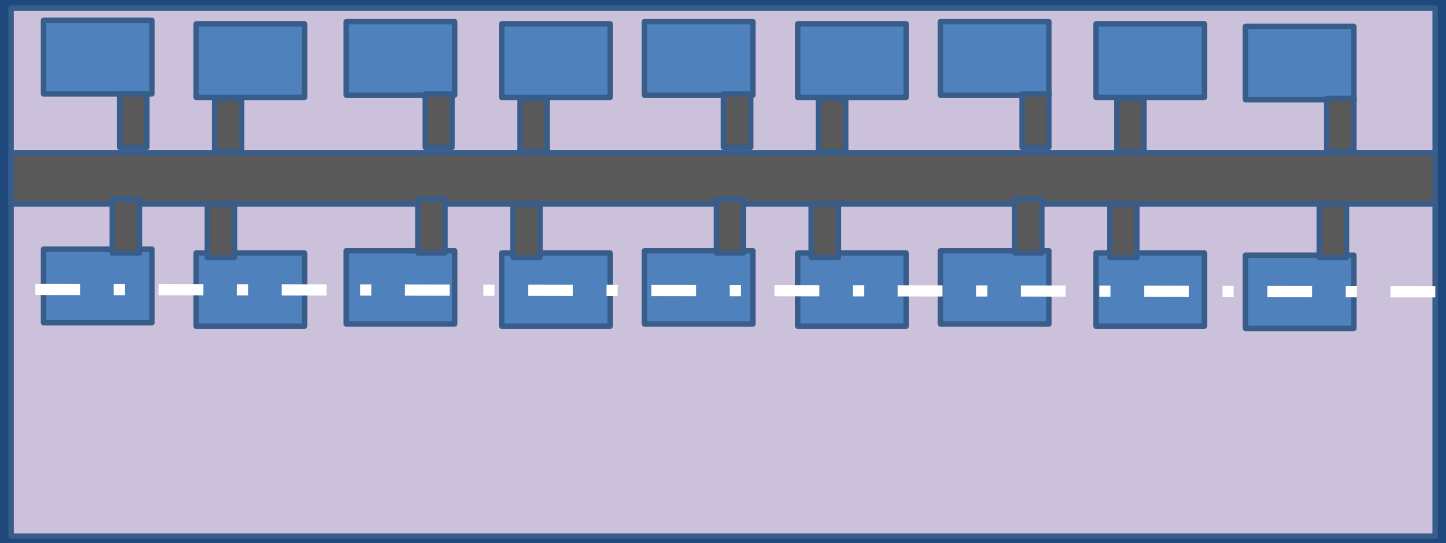
Total area: 0.90 ac

Impervious: 13%

Rv = 0.05 + 0.9(0.13) = 0.17

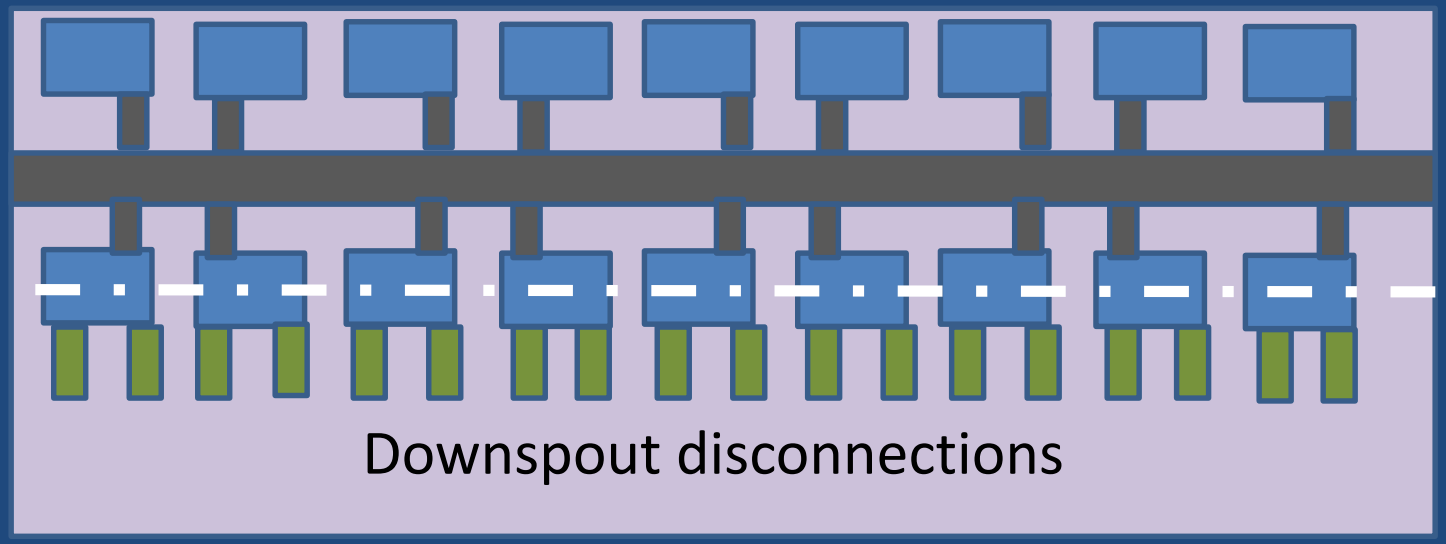
WQv = 0.90”*0.17*0.90 ac/12

WQv = 500 ft^3



Total area: 0.90 ac
Impervious: 13%
Rv = 0.05 + 0.9(0.13) = 0.17
WQv = 0.90”*0.17*0.90 ac/12
WQv = 500 ft^3

$A_{impervious}$ = 5400 ft^2
$A_{disconnection}$ = 5400 ft^2
RRv (disconnection) = 108 ft^3

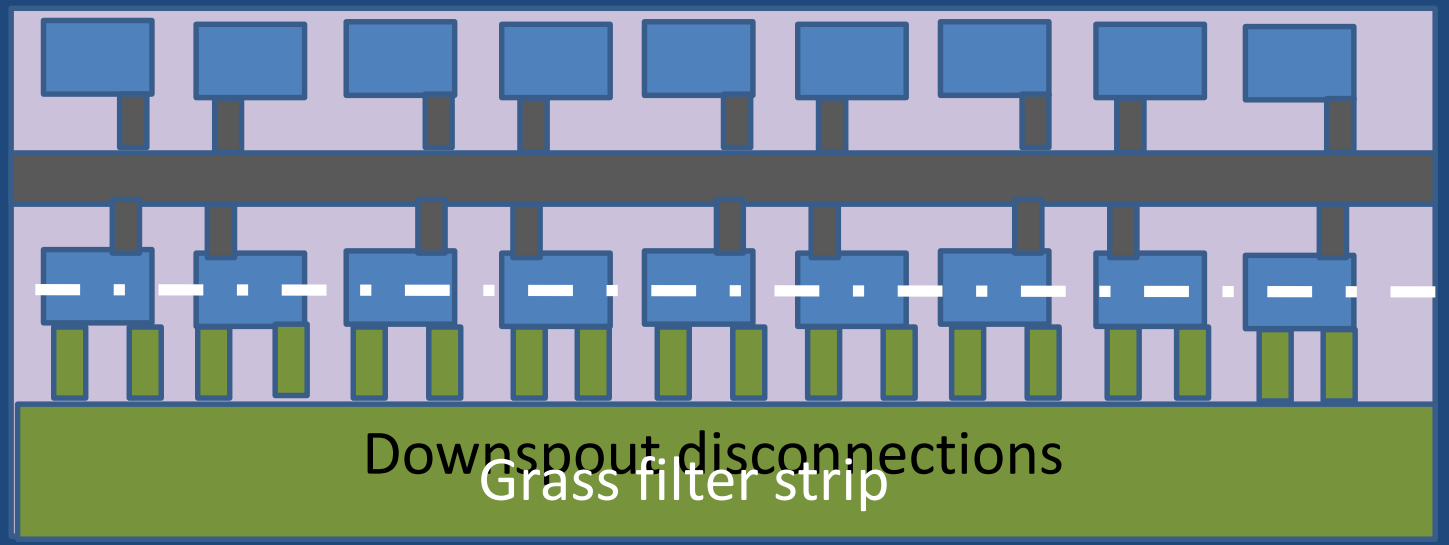


Total area: 0.90 ac
Impervious: 13%
Rv = 0.05 + 0.9(0.13) = 0.17
WQv = 0.90”*0.17*0.90 ac/12
WQv = 500 ft^3

$A_{impervious}$ = 5400 ft^2
$A_{disconnection}$ = 5400 ft^2
RRv (disconnection) = 108 ft^3

A_{filter} = 13100 ft^2
RRv = 392 ft^3

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

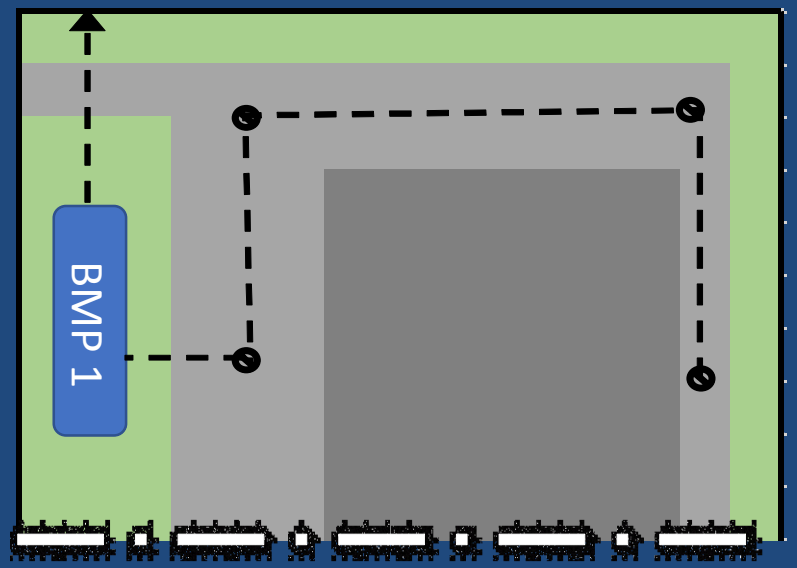
Total area: 1.50 ac

Impervious: 68%

Rv = 0.05 + 0.9(0.68) = 0.662

WQv = 0.90 in x 0.662 x 1.50 ac ÷ 12

WQv = 3,244 ft^3



Drainage Area #2

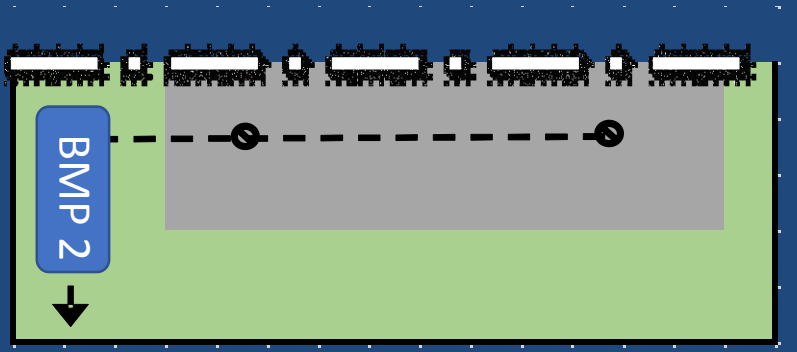
Total area: 0.75 ac

Impervious: 44%

Rv = 0.05 + 0.9(0.44) = 0.446

WQv = 0.90 in x 0.446 x 0.75 ac ÷ 12

WQv = 1,093 ft^3



WQv = 3,244 + 1,093 = 4337 ft^3

Example Site – 2 Drainage Areas

Drainage Area #2

Total area: 0.75 ac

Impervious: 44%

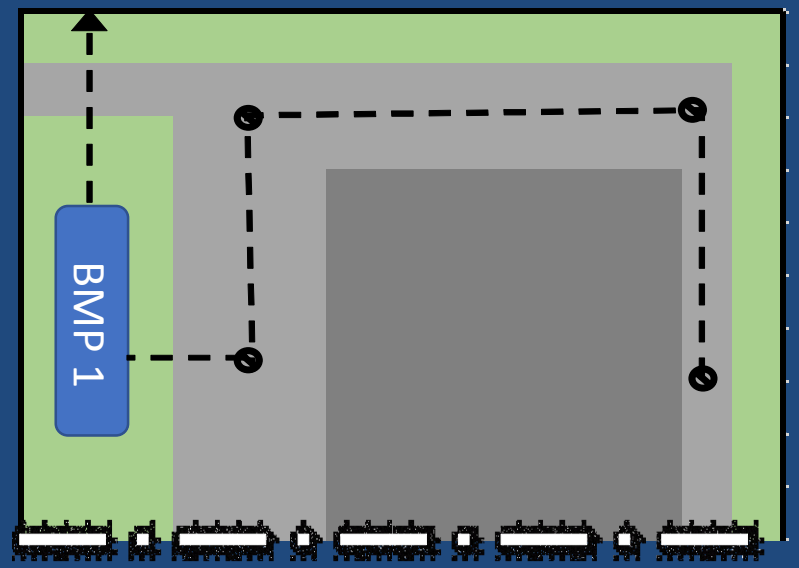
WQv = 1,093 ft^3

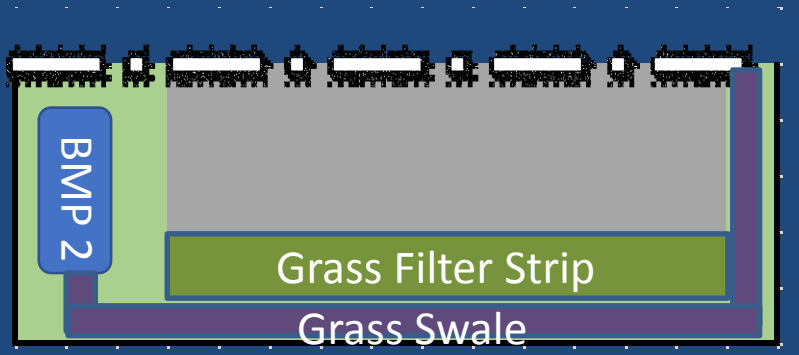
RRv (filter strip) = 504 ft^3

RRv (grass swle) = 243 ft^3

RRv (total) = 747 ft^3

$WQv_{adjusted}$ = 1093 – 747 = 346 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 ac

Impervious: 44%

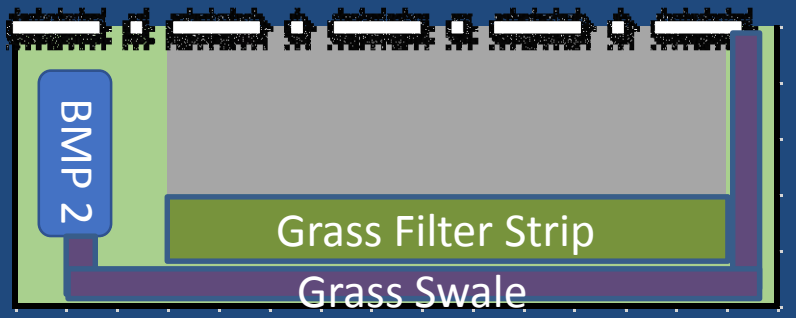
WQv = 1,093 ft^3

RRv (filter strip) = 504 ft^3

RRv (grass swle) = 243 ft^3

RRv (total) = 747 ft^3

$WQv_{adjusted}$ = 1093 – 747 = 346 ft^3



Resizing BMP after Runoff Reduction

(1) $WQv_{adjusted} = WQv - RRv$

(2) Calculate the Equivalent Contributing Impervious Area:

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

Where:

$A_{imp}(eq)$ = equivalent contributing impervious area

Rv_{imp} = volumetric runoff coefficient for impervious area = 0.95

P_{WQv} = precipitation depth for the water quality event = 0.90

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:

$$A_{infiltration} \geq 0.05 * A_{imp}(eq)$$

BMP Resizing Calculator

	A	B	C	D
1	BMP Minimum Infiltration Area Resizing Calculator			
3	Runoff Reduction Volume, RRv =	747 ft^3		
	Adjusted Water Quality Volume, WQv(adj) =	346 ft^3	A_{total} =	32670 ft^2
	Equivalent Contributing Impervious Area, A_{impeq} =	4854 ft^3	A_{imp} =	14375 ft^2
	Minimum Infiltration Area, $A_{...}$ =	243 ft^2	ss, I =	44.0 %
	Infiltration Area, A_{inf} =	250 ft^2	Rv =	0.446
	Equivalent Hydrologic Loading Ratio (A_{impeq}/A_{inf}) =	19.41	VQv =	1093 ft^3
	Depth of Adjusted Water Quality Volume, $d_{WQv(adj)}$ =	16.6 in		
11			Infiltration Area, A_{inf} =	720 ft^2
12			Hydrologic Loading Ratio (A_{imp}/A_{inf}) =	19.97
13			Depth of Water Quality Volume, d_{WQv} =	18.2 in

Example Site

Drainage Area #2

Total area: 0.75 ac

Impervious: 44%

$WQv = 1{,}093\ ft^3$

$RRv\ (filter\ strip) = 504\ ft^3$

$RRv\ (grass\ swle) = 243\ ft^3$

$RRv\ (total) = 747\ ft^3$

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

Before Runoff Reduction:

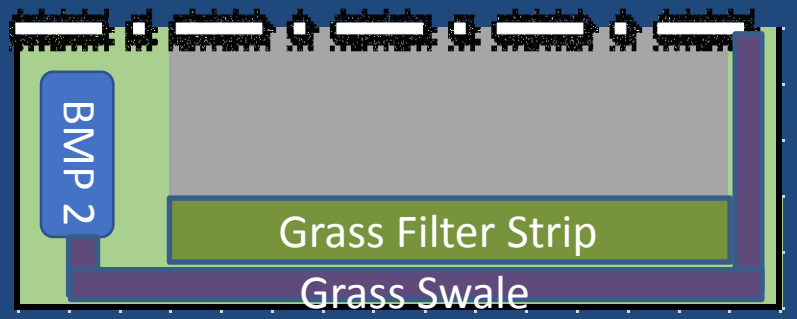
$WQv = 1{,}093\ ft^3$

$A_{infiltration} = 720\ ft^2$

After Runoff Reduction:

$WQv_{adjusted} = 346\ ft^3$

$A_{infiltration} = 250\ ft^2$



Runoff Reduction Cost Savings?

Reduction in $A_{bioretention}$ = 470 ft^2

Unit cost for bioretention = \$20 to \$25/ft^2

Savings ~ 470 ft^2 * \$20/ft^2 = \$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

Ohio Environmental Protection Agency

The Ohio State University
Stormwater Management Program