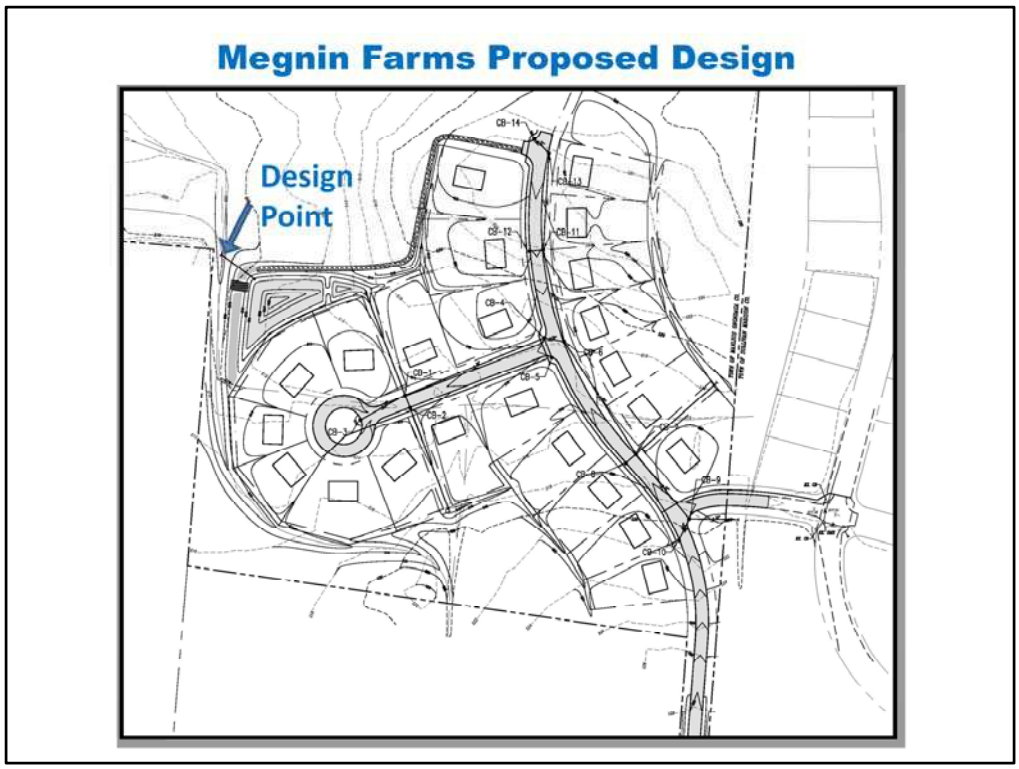
In August 2010, the Department finalized changes to the New York State Stormwater Management Design Manual (Design Manual) to include green infrastructure techniques. The updates added Runoff Reduction Volume (RRv) to the sizing criteria that projects must achieve to be eligible for coverage under the *SPDES General Permit for Stormwater Associated with Construction Activity (GP-0-10-001).* As a companion to the updated manual, the Department has developed a series of worksheets to assist with the accounting of Runoff Reduction techniques and complete the new questions being added to the NOI for coverage under GP-0-10-001. This document presents a design example with instructions on how to use the Runoff Reduction Worksheets for projects with one design point. Projects with multiple design points should complete a set of worksheets for each design point and then manually combine the totals for all design points for reporting information on the NOI. Worksheets presented in this instruction manual are available for download at http://www.dec.ny.gov/chemical/8694.html. **Designers who would like to receive e-mail notifications of updates and corrections to the worksheets should email stormh2o@gw.dec.state.ny.us with subject line NYS Stormwater Design Manual Worksheets and request to be added to the email notification list.**

Note: Designers using the worksheets are responsible to ensure that designs are in conformance with the Design Manual criteria and the accuracy of all calculations presented in a SWPPP. If there are discrepancies between information in the worksheets and the design manual, the design manual shall be used.



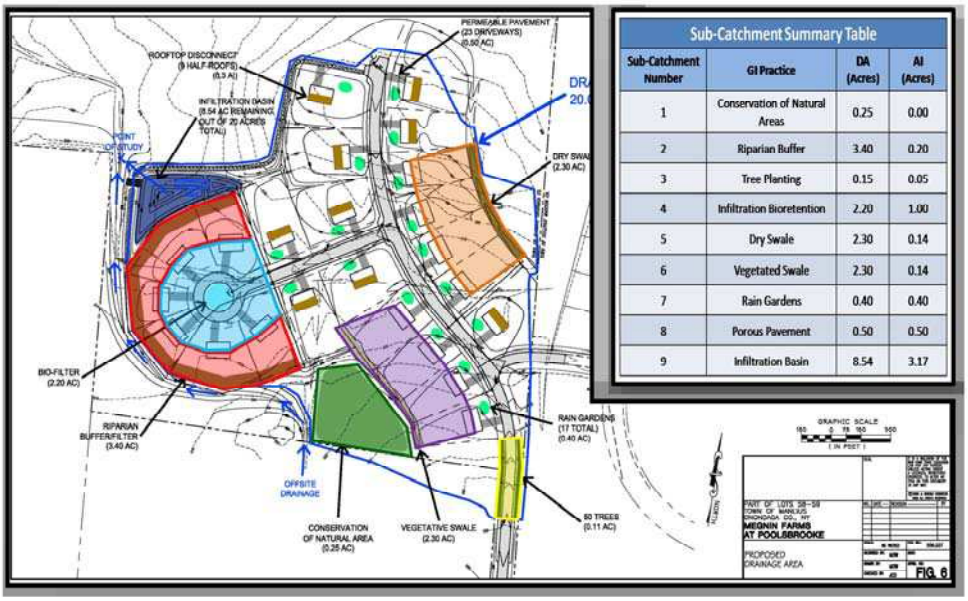
Megnin Farms is a proposed 23 lot residential subdivision with supporting infrastructure. Each house has a 3,000 sf building footprint and a 1,000 sf driveway. Stormwater runoff from the proposed houses and roadways will be captured and conveyed by a series of swales and closed drainage system to an infiltration basin, located north of the cul-de-sac (near design point). The proposed drainage area is 20 acres, with 5.6 acres of impervious cover and 14.4 acres of pervious cover. The soils present on the site are HSG B soils.

The Design Manual sets forth a required planning process that must be followed when addressing stormwater management (See Chapter 3). Once the planning is exhausted and the project is laid out to fit the site, then the designer has a goal for what needs to be managed. The goal of green infrastructure techniques is to break up the watershed into smaller drainage areas and distribute the flow rather than collecting it and sending it to an end of pipe treatment.

Once the final site plan/layout has been prepared, the designer should follow the following steps:

1. Divide the site into sub-catchments or contributing drainage areas,
2. Calculate the total WQv required for each area.
3. Determine the RR techniques (Area/Volume Reduction) and *Standard SMPs with RRv Capacity* to be used to reduce the total WQv required.

Delineation of Sub-catchments



Sub-Catchment Summary Table

Sub-Catchment Number	GI Practice	DA (Acres)	AI (Acres)
1	Conservation of Natural Areas	0.25	0.00
2	Riparian Buffer	3.40	0.20
3	Tree Planting	0.15	0.05
4	Infiltration Bioretention	2.20	1.00
5	Dry Swale	2.30	0.14
6	Vegetated Swale	2.30	0.14
7	Rain Gardens	0.40	0.40
8	Porous Pavement	0.50	0.50
9	Infiltration Basin	8.54	3.17

For this example, the site has been broken up into 9 sub-catchment areas. Below, is a summary of the 9 sub-catchments and the practice chosen for runoff reduction.

- Sub-catchment 1 (dark green shaded) is proposed to be conserved as a natural area.
- Sub-catchment 2 (red shaded) proposes to use a riparian buffer to reduce the runoff from the back half of the roof top areas of six houses located in the cul-de-sac.
- Sub-catchment 3 (yellow shaded) proposes to use tree plantings to reduce runoff from 0.05 acres of roadway.
- Sub-catchment 4 (cyan shaded) proposes to use a bioretention area to manage the runoff from the front half of the homes, front yards and cul-de-sac.
- Sub-catchment 5 (orange shaded) proposes a dry swale to manage the runoff from the back half of four homes and their backyards. Stormwater runoff that is not reduced in the dry swale is directed to the infiltration basin.
- Sub-catchment 6 (purple shaded) proposes to convey the runoff from half of the roof top area of four houses and their backyards using a vegetated swale. Stormwater runoff that is not reduced in the vegetated swale is directed to the infiltration basin for further treatment/reduction.
- Sub-catchment 7 (bright green shaded) proposes to reduce the runoff from half of the roof top area of 17 houses using 17 individual rain gardens.
- Sub-catchment 8 (dark grey shaded) proposes permeable pavement to infiltrate the runoff from 23 driveways (0.50 acres)
- Sub-catchment 9 (blue shaded) proposes an infiltration basin to treat the remaining areas (8.54 acre area with 3.17 acres IA) and flows not reduced with other practices (Sub-catchment 5 – Dry Swale & Sub-catchment 6 - Vegetated Swale)

Total Water Quality Volume Calculation

Version 1.0 — Total Water Quality Volume Calculation
Last Updated: 7/2/2013 — WQv(acre-feet) = [(P)(Rv)(A)] /12

Is this project subject to Chapter 10 of the NYS Design Manual (i.e. WQv is equal to post-development 1 year runoff volume)?..... No

Design Point: 1

P= 0.90 inch — *Manually enter P, Total Area and Impervious Cover*

Breakdown of Subcatchments

Catchment	Total Area (Acres)	Impervious Cover (Acres)	Percent Impervious %	Runoff Coefficient Rv	WQv (ft^3)	Description
1	0.25	0.00	0%	0.05	41	Conservation of Natural Areas
2	3.40	0.20	6%	0.10	1,143	Riparian Buffer
3	0.15	0.05	33%	0.35	172	Tree Planting/Tree Pit
4	2.20	1.00	45%	0.46	3,300	Infiltration Bioretention
5	2.30	0.14	6%	0.10	787	Dry Swale
6	2.30	0.14	6%	0.10	787	Vegetated Swale
7	0.40	0.40	100%	0.95	1,241	Rain Garden
8	0.50	0.50	100%	0.95	1,552	Porous Pavement
9	8.54	3.17	37%	0.38	10,716	Infiltration Basin
10						
Subtotal (1-10)	20.04	5.60	28%	0.30	19,739	**Subtotal 1**
Subtotal (11-30)	0.00	0.00			0	**Subtotal 2**
Total	20.04	5.60	28%	0.30	19,739	**Initial WQv**

The 'Total WQv Calculation' worksheet allows the calculation of the WQv for each sub-catchment and the overall WQv for the site. The WQv is calculated using the following formula from Chapter 4 of the NYS Design Manual:

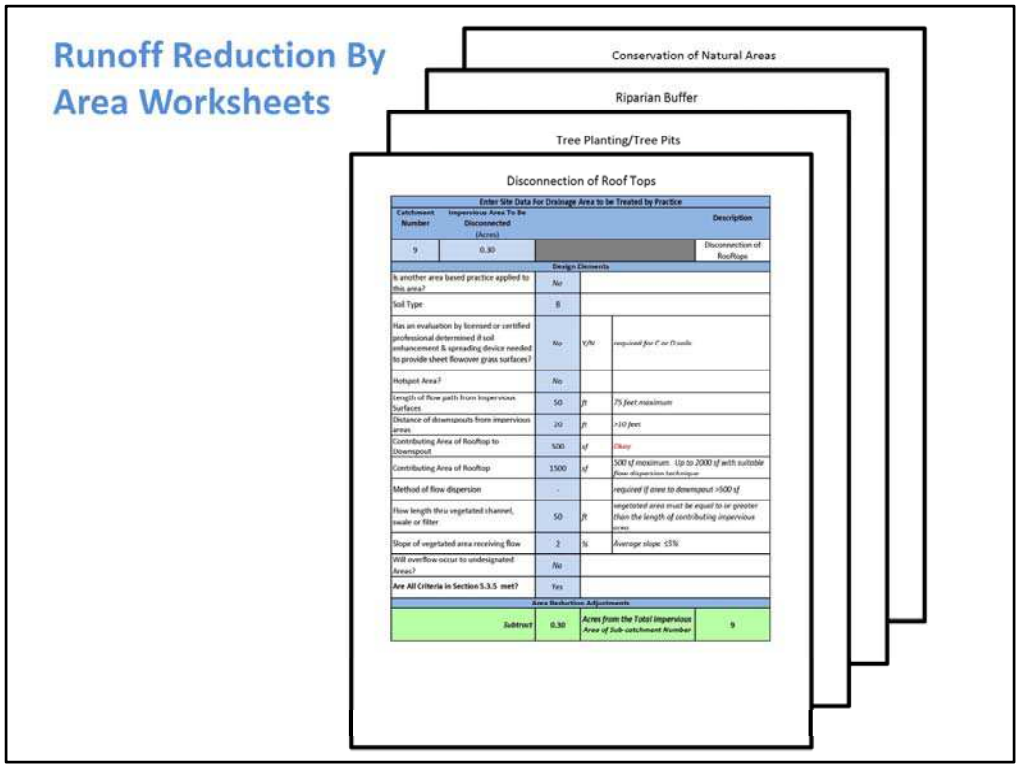
$$WQv = (P)(Rv)(A)/12$$

Where:
P = the 90th percentile storm (Figure 4.1, page 4-2 of Design Manual)
Rv = 0.05 + 0.009(I), where I is percent impervious cover**
A = site area in acres (sub-catchment area)

Cells that are shaded blue require the designer to manually input information or select an option from a drop down menu that will appear when the cell is selected.

This workbook and associated worksheets are only applicable for new development projects that are <u>not</u> subject to the requirements of Chapter 10 of the NYS Design Manual. For projects located in the watersheds identified in Appendix C of the *SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-10-001)* that must use Chapter 10 in the design, the WQv for each sub-catchment is the runoff from the 1 year, 24 hour storm event, the worksheet will display an error message stating "This workbook is not applicable and can not be used."

<u> Note: If soil restoration is not applied according to Table 5.3 of the Design manual, the designer must include those areas as impervious area when calculating the WQv</u>**



The calculation of Runoff Reduction (RRv) falls within three general methods. The first group of practices (RRv by area) includes site design techniques that a designer could factor in by subtracting conserved areas and areas draining to them from the total site area, resulting in reduced WQv. The standards set limitations on the size, slope, and characteristics of the contributing drainage area such that runoff enters the practice as sheet flow and the volume of runoff generated does not overwhelm the area where reduction/infiltration is expected to occur. Worksheets for these area reduction practices (Conservation of Natural Areas, Riparian Buffers, Filter Strips, Tree Planting and Disconnection of rooftops) provide a series of questions. If all of the criteria are met, the areas are removed from the overall area and the initial WQv is adjusted. The 'Total WQv calculation' worksheet includes a section (rows 17 thru 32) where the WQv is adjusted to account for these area reduction techniques. (see page 9).

In the second group of green infrastructure practices, RRv by volume, the runoff reduction is determined based on the storage volume provided within the practices. These practices provide storage capacity within the practice where runoff is temporarily stored until it can be infiltrated, evapotranspirated or reused.

Some of the standard SMPs (infiltration, bioretention and dry swales) provide runoff reduction and are referred to as *Standard SMPs with RRv Capacity.* These make up the third group of practices that provide runoff reduction.

Sub-catchment 1 – Conservation of Natural Areas

Conservation of Natural Areas

Design Point:	1						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	Total Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (ft^3)	Precipitation (in)	Description
1	0.25	0.00	0.00	0.05	40.84	0.90	Conservation of Natural Areas

Design Elements	
Is Contiguous Area ≥ 10,000 ft2?	Yes
Will limits of disturbance be clearly shown on all construction drawings and marked in field/project development site with structural barriers?	Yes
Is the Conservation area located in an acceptable conservation easement instrument that ensures perpetual protection of proposed area?	Yes
Does the easement specify how the natural area vegetation will be managed and boundaries will be marked?	Yes
Does the conservation area receive runoff from other contributing areas?	No
Does Conservation Area drain to a Design Point?	Yes
Is Sheet Flow to Riparian Buffer or another area based practice already being Used for this area?	No
Are All Criteria in Section 5.3.1 Met?	Yes

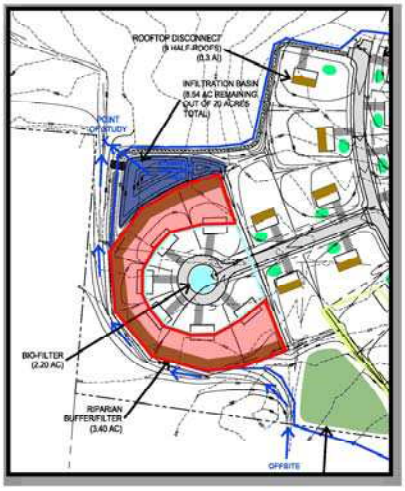
Area Reduction Adjustments		
Subtract	0.25	Acres from Total Area
Subtract	0.00	Acres from Total Impervious Area

Conservation of Natural Areas was the selected practice in sub-catchment 1 (green shaded area). The 'Conservation of Natural Areas' worksheet is used to determine the area reduction credit for this sub-catchment. The designer should start by selecting sub-catchment 1 in the drop down menu in the blue cell under catchment number. The worksheet will import the Total Area, Impervious Area, Percent Impervious, Rv, WQv, Precipitation, and Description for this sub-catchment from the 'Total WQv Calculation' worksheet.

The worksheet contains a series of questions selected to match the criteria listed in *Section 5.3.1 Conservation of Natural Areas* of the Design Manual. If an answer provided does not meet the criteria in the Design Manual, an error message will occur. The designer needs to derive why the error message occurred and either change their design to meet the criteria of the Design Manual or select a different practice for the sub-catchment.

The last question of this work sheet asks if all criteria of Section 5.3.1 of Design Manual were met. If the designer believes that all criteria have been met after completing this worksheet and reviewing Section 5.3.1, yes should be selected. If yes is selected, the impervious area and total area for this sub-catchment are imported to the 'Total WQv Calculation' worksheet where they are subtracted from the initial WQv. If no is selected, no reduction in WQv will be applied.

Sub-catchment 2 – Riparian Buffer



Riparian Buffer

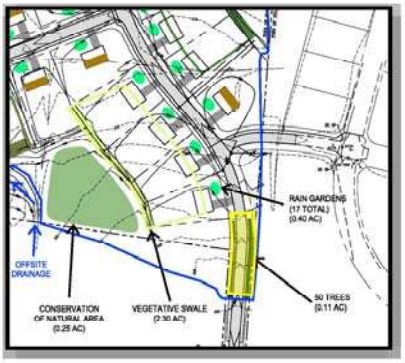
Design Point:	1						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	Total Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (ft^3)	Precipitation (in)	Description
2	3.40	0.20	0.06	0.10	1143.45	0.90	Riparian Buffer
Design Elements							
Is another area based practice applied to this area?			No				
Undisturbed Soil and Natural Vegetation? (Y/N)			Yes				
Outside the limits of disturbance?			Yes				
Protected by ESC during Construction?			Yes				
Adjacent to Stream Buffer or Forest Conservation Area?			Yes				
Boundary Spreader?			No		GD at top of buffer		
Boundary Zone?			Yes		10 feet of level grass		
Specify how sheet flow will be ensured			Level Spreader		level spreader shall be used for buffer slopes ranging from 3-15%		
Slope of first 10 feet of buffer			2	%	4% maximum		
Overall Slope			2	%	6% maximum		
Contributing Length of Pervious Areas (PC)			100	ft	150 ft maximum		
Contributing Length of Impervious areas (IC)			50	ft	75 ft maximum		
Maximum PC Contributing Length for combination of PC & IC			100	ft	Okay		
Soil Group (HSG)			B				
Buffer Width			50	ft	50 ft minimum for slopes 0-8% 75 ft minimum for slopes 8-12%		
Are All Criteria for Riparian Buffers in Section 5.3.2 met?			Yes				
Area Reduction Adjustments							
		Subtract	3.40		from total Area		
		Subtract	0.20		from total Impervious Area		

Riparian Buffer is the selected practice for sub-catchment 2 (red shaded area). The 'Riparian Buffer' worksheet is used to determine the area reduction credit for this sub-catchment. Select sub-catchment 2 in the drop down menu in the blue cell under catchment number to import the sub-catchment design information.

The worksheet contains a series of questions that were selected to match the criteria listed *Section 5.3.2 Sheetflow to Riparian Buffers or Filter Strips* of the Design Manual. If an answer provided does not meet the criteria in the Design Manual, an error message will occur. The designer needs to derive why the error message occurred and either change their design to meet the criteria of the Design Manual or select a different practice for the sub-catchment.

The last question of this work sheet asks if all criteria of Section 5.3.2 of Design Manual were met. If the designer believes that all criteria have been met after completing this worksheet and reviewing Section 5.3.2 of the Design Manual, yes should be selected. If yes is selected, the impervious area and total area for this sub-catchment are imported to the 'Total WQv Calculation' worksheet where they are subtracted out of the WQv calculation. If no is selected, no reduction in WQv will be applied.

Sub-catchment 3 – Tree Planting/Tree Pits



Tree Planting/Tree Pits

Design Point:	1						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	Total Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (ft^3)	Precipitation (in)	Description
3	0.15	0.05	0.33	0.35	171.52	0.90	Tree Planting/Tree Pit
Do you intend to use this practice for area reduction or volume reduction?			Area	Design practice using criteria below			
Design Elements							
Is another area based practice applied to this area?			No				
Diameter of Mature Canopy			30	ft			
Area Reduced per Tree			100	sf			For up to a 16-foot diameter canopy of a mature tree, the area considered for reduction shall be ½ the area of the tree
Number of Trees			50				
Total Area Reduced			5000	sf			
			0.11	af	Okay		
Area Ratio: Total to Impervious area			3.0		Okay		
Are All Criteria in Section 5.3.4 met?			Yes				
Area Reduction Adjustments							
		Subtract	0.15	Acres from total Area			
		Subtract	0.05	Acres from total Impervious Area			

Tree Planting is the selected practice for sub-catchment 3 (yellow shaded area). Tree plantings can be designed using the 'Tree planting/Tree Pits' worksheet, 'Riparian Buffer' worksheet or in an urban setting using the 'Bioretention' or 'Stormwater Planter' worksheet (see page 5-66 of Design Manual). In this example, tree plantings will be used as an area reduction practice to reduce the total WQv. Therefore, the 'Tree Planting-Tree Pits' worksheet is used to determine the reduction credit for this sub-catchment. Select sub-catchment 3 in the drop down menu in the blue cell under catchment number to import the sub-catchment design information.

The worksheet contains a series of questions that were selected to match the criteria listed in *Section 5.3.4 Tree Planting/Tree Pit* of the Design Manual. If an answer provided does not meet the criteria in the Design Manual, an error message will occur. The designer needs to derive why the error message occurred and either change their design to meet the criteria of the Design Manual or select a different practice for the sub-catchment.

Although not stated in the Design manual, a question is included related to the loading ratio. In order to assure adequate area for infiltration and prevent damage or flooding, the Department recommends a minimum 3:1 ratio of total area to impervious area.

The last question of this work sheet asks if all criteria of *Section 5.3.4* of the Design Manual were met. If the designer believes that all criteria have been met after completing this worksheet and reviewing *Section 5.3.4* of the Design Manual, "yes" should be selected. If "yes" is selected, the impervious area and total area for this sub-catchment are imported to the 'Total WQv Calculation' worksheet where they are subtracted out of the WQv calculation. If no is selected, no reduction in WQv will be applied.

Total WQv Worksheet – Area Reduction Summary & Adjusted WQv

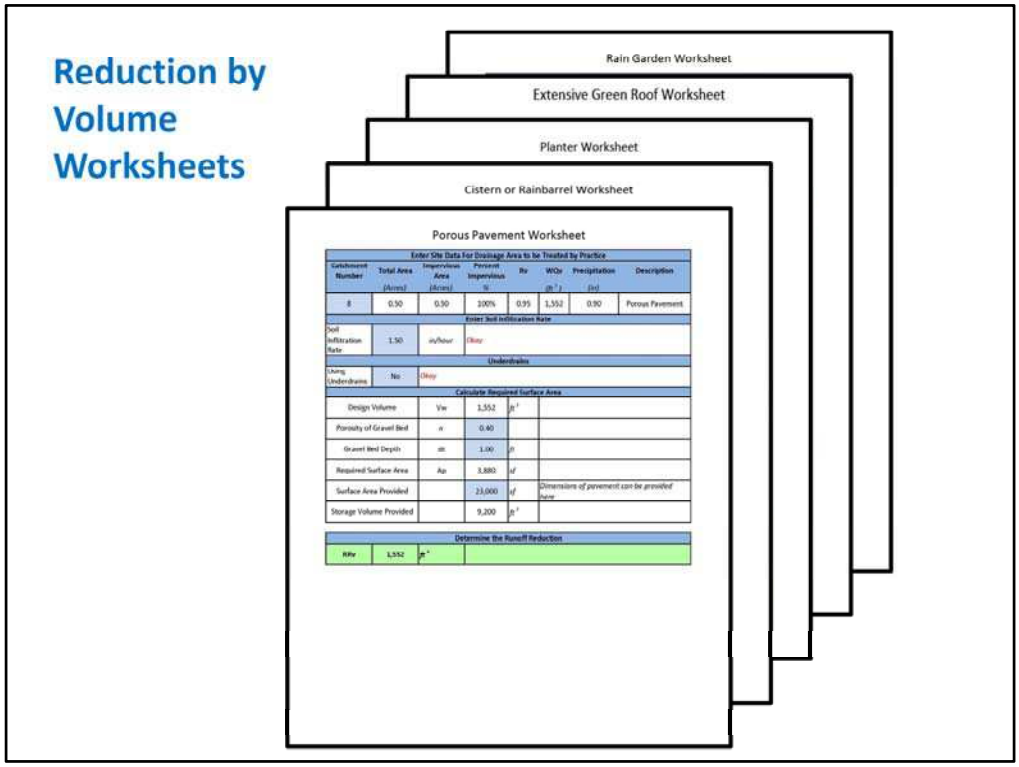
Version 1.0
Last Updated: 7/2/2013

Total Water Quality Volume Calculation
WQv(acre-feet) = [(P)(Rv)(A)] /12

Identify Runoff Reduction Techniques By Area			
Technique	Total Contributing Area (Acre)	Contributing Impervious Area (Acre)	Notes
Conservation of Natural Areas	0.25	0.00	*minimum 10,000 sf*
Riparian Buffers	3.40	0.20	*maximum contributing length 75 feet to 150 feet*
Filter Strips	0.00	0.00	
Tree Planting	0.15	0.05	*Up to 100 sf directly connected impervious area may be subtracted per*
Total	**3.8**	**0.25**	

Recalculate WQv after application of Area Reduction Techniques					
	Total Area (Acres)	Impervious Cover (Acres)	Percent Impervious %	Runoff Coefficient Rv	WQv (ft^3)
"<<Initial WQv"	20.04	5.60	28%	0.30	19,739
Subtract Area	-3.80	-0.25			
WQv adjusted after Area Reductions	**16.24**	**5.35**	33%	0.35	18,383
Disconnection of Rooftops		0.30			
Adjusted WQv after Area Reduction and Rooftop Disconnect	16.24	5.05	31%	0.33	**17,501**
WQv reduced by Area Reduction techniques					2,238

The 'Total WQv calculation' worksheet includes a section (rows 17 thru 32) where the WQv is adjusted to account for area reduction techniques. The WQv is further adjusted to remove the impervious cover associated with rooftops that are disconnected (see page 18 for further discussion on Disconnection of Rooftops) . For this example, the original WQv was 19,739 ft^3 (0.45 af). After applying the area reduction credits associated with conservation of natural areas, riparian buffers, tree plantings, and disconnection of rooftops, the WQv is recalculated to be 17,501 ft^3 (0.40 af) resulting in a reduction in WQv of 2,238 ft^3.



For the volume reduction techniques, the runoff reduction is determined based on the storage volume provided within the practice. These practices provide storage capacity within the practice where runoff is temporarily stored until it can be infiltrated, evapo-transpirated or reused. Worksheets for these volume reduction practices (Rain Garden, Green Roofs, Planters, Cisterns, Vegetated Swales and Porous Pavement) calculate the required storage and determines the RRv based on the actual storage provided in the proposed practices. These practices must provide adequate storage capacity that is greater than or equal to the WQv.

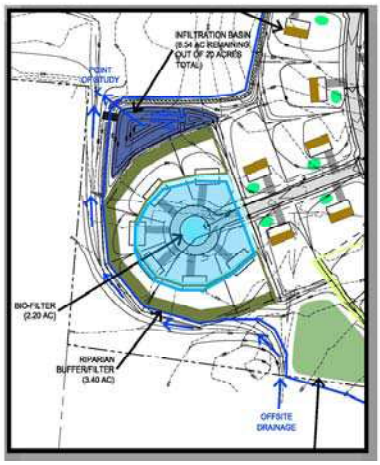
Table 3.5
Standard SMPs with RRv Capacity

- Infiltration practices
  - 90% of WQv
- Bioretention
  - 80% of WQv (HSG A and B, no underdrain)
  - 40% of WQv (HSG C and D, with underdrain)
- Dry swale (open channel)
  - 40% of WQv (HSG A and B)
  - 20% of WQv (HSG C and D)

Standard Stormwater Management Practices (Standard SMPs) are structural practices that are acceptable for water quality treatment and meet the performance standards defined in Chapter 6 of the New York State Stormwater Management Design Manual. These practices are designed to capture and treat the water quality volume (the portion infeasible to retain onsite using runoff reduction techniques) through one or more pollutant removal pathway(s) and their performances are documented by removal efficiency of specific pollutants. Some of these SMPs (infiltration, bioretention and dry swales) also provide runoff reduction and are referred to as *Standard SMPs with RRv Capacity*.

For the *standard SMPs with RRv capacity*, the RRv provided by a practice will be equal to a percentage of the WQv provided by the practice. The percentages are intended to account for the documented long term performance of these practices and are listed in Table 3.5 of the Design Manual (and reproduced above). Designers may elect to increase the size of the practice to improved the long term reduction achieved. However, designers are not required to oversize a standard SMP with RRv capacity provided that the minimum RRv for the design point is achieved. If a designer elects to oversize the practice, the maximum RRv that can be applied is the WQv. If a designer does not elect to oversize the practice and it is sized in accordance with Chapter 6, the volume that is not reduced is considered to be effectively treated and does not need to be routed to another practice. This volume is accounted for as “Volume Treated” in the summary worksheet (see page 20)

Standard SMPs with RRv Capacity
Infiltrating Bioretention Worksheet



Infiltrating Bioretention Worksheet

Design Point:	1						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	Total Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (ft^3)	Precipitation (in)	Description
4	2.20	1.00	0.45	0.46	3299.67	0.90	Infiltration Bioretention
Enter Impervious Area Reduced by Disconnection of		0.00	45%	0.46	3,300	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	ft^3	
Infiltrating Bioretention Parameters							
Treatment Volume		WQv	3,300	ft^3			
Enter depth of soil Media		DSM	4.00	ft	2.5 - 4 ft		
Enter depth of drainage		DDL	0.50	ft	≥ 0.5 ft		
Enter ponding depth above surface		DP	0.25	ft	≤ 0.5		
Enter porosity of Soil Media		nSM	0.20		≥20%		
Enter porosity of Drainage		nDL	0.40		≥ 40%		
Required Bioretention Area		ARG	2640	sf			
Bioretention Area Provided			3150	ft2			
Native Soil Infiltration Rate			1.50	in/hr	Okay		
Are you using underdrains?			No				
Total Volume Provided			3,938	ft^3	Sum of storage Volume Provided in each layer		
Determine Runoff Reduction							
Runoff Reduction			3,150	ft^3	This is 80% of storage volume provided or WQv whichever is less		
Volume Treated			150	ft^3	This is the portion of the WQv that is not reduced in the practice		
Sizing v			OK		Check to be sure Area provided ≥ Af		

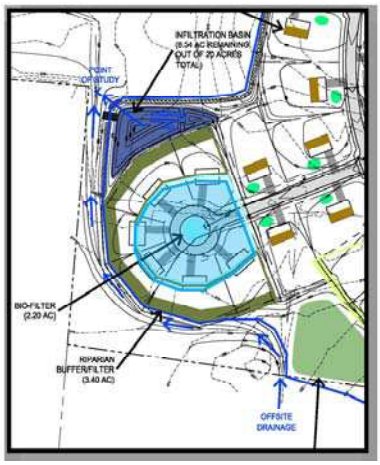
Note: An Infiltrating Bioretention is a form of bioretention without underdrains. It can only be used in areas where the soil infiltration rate is 0.50 in/hr or greater. If the soil infiltration rate is less that 0.50 in/hr or if underdrains are proposed, the 'Infiltrating Bioretention' worksheet is not appropriate and the designer should use the 'Bioretention' worksheet.

Some worksheets include provisions to account for the reduction in impervious area associated with the disconnection of rooftops (see page 18 for further discussion of disconnected areas). If impervious areas are adequately disconnected, they can be deducted from the sub-catchment's impervious area total when computing WQv. For the 'Infiltrating Bioretention' worksheet, these areas should be entered in Cell C10.

The worksheets for standard SMPs with RRv capacity (bioretention, infiltrating bioretention, infiltration trenches, dry wells and infiltration basins) have provisions to account for non-reduced WQv from other practices that may be routed to them for further treatment and/or reduction. This information is entered in cell F11 on the 'Infiltrating Bioretention' worksheet.

For the *standard SMPs with RRv capacity*, the RRv provided by a practice will be equal to a percentage of the WQv provided by the practice. The percentages are intended to account for the documented decline in performance of these practices and are listed in Table 3.5 of the Design Manual (80% for Bioretention practices without underdrains). Designers may elect to increase the size of the practice to offset this decline. (**Note: Designers are not required to oversize a *standard SMP with RRv capacity* provided the minimum RRv has been achieved for each design point.)**. If a designer elects to oversize the practice, the maximum RRv that can be applied is the WQv.

Sub-catchment 4 – Infiltrating Bioretention



Infiltrating Bioretention Worksheet

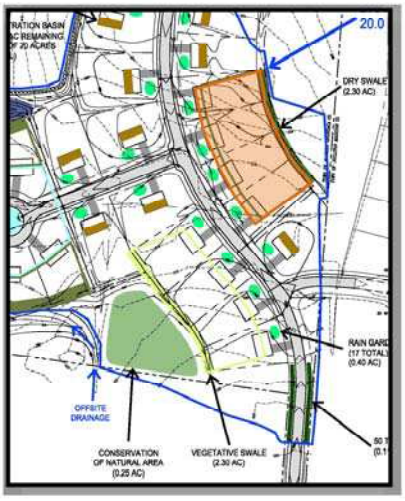
Design Point:	1						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	Total Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (ft^3)	Precipitation (in)	Description
4	2.20	1.00	0.45	0.46	3299.67	0.90	Infiltration Bioretention
Enter Impervious Area Reduced by Disconnection of		0.00	45%	0.46	3,300	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					0	ft^3	
Infiltrating Bioretention Parameters							
Treatment Volume		WQv	3,300	ft^3			
Enter depth of soil Media		DSM	4.00	ft	2.5 - 4 ft		
Enter depth of drainage		DDL	0.50	ft	≥ 0.5 ft		
Enter ponding depth above surface		DP	0.25	ft	≤ 0.5		
Enter porosity of Soil Media		nSM	0.20		≥20%		
Enter porosity of Drainage		nDL	0.40		≥ 40%		
Required Bioretention Area		ARG	2640	sf			
Bioretention Area Provided			3150	ft2			
Native Soil Infiltration Rate			1.50	in/hr	Okay		
Are you using underdrains?			No				
Total Volume Provided			3,938	ft^3	Sum of storage Volume Provided in each layer		
Determine Runoff Reduction							
Runoff Reduction			3,150	ft^3	This is 80% of storage volume provided or WQv whichever is less		
Volume Treated			150	ft^3	This is the portion of the WQv that is not reduced in the practice		
Sizing v			OK		Check to be sure Area provided ≥ Af		

Infiltrating Bioretention is the selected practice for sub-catchment 4 (cyan shaded area). The 'Infiltration Bioretention' worksheet is used to determine the reduction credit for this sub-catchment. Select sub-catchment 4 in the Catchment Number drop down menu to import the sub-catchment design information. In this example, there was insufficient space to adequately disconnect the roof tops in this sub-catchment, so zero is entered in cell C10. No additional flow is being directed to this practice, so zero is entered in cell F11.

Design information for the proposed practice (depth of soil media, depth of drainage layer, ponding depth, soil media porosity, and drainage layer porosity) must be entered. The worksheet will use this information to calculate the required bioretention area using the static storage volume provided within the soil layer, drainage layer and ponding area. Information on the actual area of the bioretention area provided, soil infiltration rate, and if under drains are being used must also be entered to allow the worksheet to calculate the total volume provided and the runoff reduction volume.

In this example, the designer elected to oversize the practice, however 80% of the actual storage volume provided (3,150 ft^3) is less than the WQv (3,300 ft^3). Therefore 3,150 ft^3 is applied as RRv. This value is imported into the 'Summary Table' worksheet in the "Volume Reduced (RRv)" column in the "Bioretention & Infiltration Bioretention" row. Since this practice is considered to be a *standard SMP with RRv capacity* which has been sized to temporarily store the WQv, the remaining volume that is not reduced (150 ft^3) is considered to be effectively treated and does not need to be routed to another practice. This value is imported into the 'Summary Table' worksheet in the "Volume Treated" column in the "Bioretention & Infiltration Bioretention" row.

Sub-catchment 5 – Dry Swale



Dry Swale Worksheet

Design Point:	1						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	Total Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (ft^3)	Precipitation (in)	Description
5	2.30	0.14	0.06	0.10	787.35	0.90	Dry Swale
Enter Impervious Area Reduced by Disconnection of Rooftops		0.00	6%	0.10	787	<<WQv after adjusting for Disconnected Rooftops	
Pretreatment Provided					Pretreatment Technique		
Pretreatment (10% of WQv)			79	ft^3	Filter Strip		
Calculate Available Storage Capacity							
Bottom Width	2	ft	Design with a bottom width no greater than eight feet to avoid potential gullying and channel braiding, but no less than two feet				
Side Slope (X:1)	3	Okay	Channels shall be designed with moderate side slopes (flatter than 3:1) for most conditions. 2:1 is the absolute maximum side slope				
Longitudinal Slope	1%	Okay	*Maximum longitudinal slope shall be 4%*				
Flow Depth	0.58	ft	*Maximum ponding depth of one foot at the mid-point of the channel, and a maximum depth of 18" at the end point of the channel (for storage of the WQv)*				
Top Width	5.48	ft					
Area	2.17	sf					
Minimum Length	327	ft					
Actual Length	600	ft					
End Point Depth check	1.00	Okay	*A maximum depth of 18" at the end point of the channel (for storage of the WQv)*				
Storage Capacity	1,380	ft^3					
Soil Group (HSG)			B				
Runoff Reduction							
Is the Dry Swale contributing flow to another practice?			Yes	Select Practice	Infiltration Basin		
RRv	552	ft^3	Runnoff Reduction equals 40% in HSG A and B and 20% in HSG C and D up to the WQv				
Volume Treated	0	ft^3	This is the difference between the WQv calculated and the runoff reduction achieved in the swale				
Volume Directed	235	ft^3	This volume is directed another practice				
Volume √	Okay		Check to be sure that channel is long enough to store WQv				

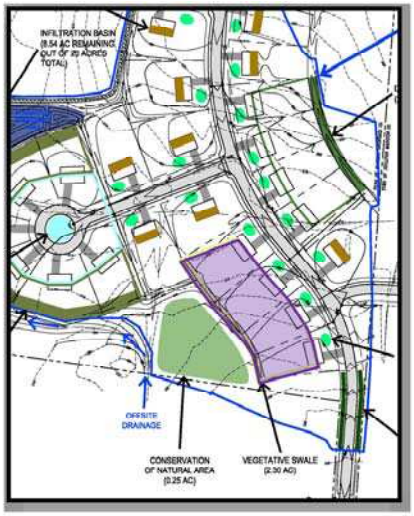
Dry Swale is the selected practice for sub-catchment 5 (orange shaded area). The 'Dry Swale' worksheet is used to determine the reduction credit for this sub-catchment. Select sub-catchment 5 in the Catchment drop down menu to import the design information for this sub-catchment.

The worksheet will calculate the pretreatment volume (10% of WQv). The designer must enter how the pretreatment requirement is satisfied. Information on the dimensional characteristics which include the bottom width, side slope, longitudinal slope, flow depth, length, and end point depth dimensions of the swale must be provided to allow the worksheet to calculate the minimum length of the swale. Information on the actual length and hydrologic soil type must be provided to determine the Volume Reduced and Volume Treated.

A dry swale is considered to be a *standard SMP with RRv capacity*, the RRv provided by this practice will be equal to a percentage of the WQv provided by the practice. The percentages are intended to account for the documented decline in performance of these practices and are listed in Table 3.5 of the Design Manual. Per Table 3.5, if the hydrologic soil group is A or B, the runoff reduction volume is 40% of the actual volume provided. If the hydrologic soil group is C or D, it would be 20%.

For this example, the hydrologic soil group is B so the RRv would be 40% of the storage capacity of the swale, or 552 ft^3 . This value is imported into the 'Summary Table' worksheet in the "Volume Reduced (RRv)" column for dry swale. Since the dry swale is sized using Chapter 6 of the Design Manual, the remaining WQv that is not reduced is considered to be effectively treated and does not need to be routed to another treatment practice. However, in this design example the dry swale contributes flow to the infiltration basin. Therefore, the volume that is not reduced (235 cf) must be considered in the sizing of the infiltration basin. If this volume was not directed to another practice, it would be credited in the 'Summary Table' in the "WQv treated" column.

Sub-catchment 6 – Vegetated Swale



Vegetated Swale Worksheet

Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	Total Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (ft^3)	Precipitation (in)	Description
6	2.30	0.14	6%	0.10	787	0.90	Vegetated Swale
Enter Soil Infiltration Rate							
Soil Infiltration Rate		1.50	in/hour	Okay			
Calculate Peak WQv							
Modified CN	83	Note: Value is modified curve number using Appendix B.2 - Water Quality Peak Flow Calculation of the New York State Stormwater Management Design Manual					
Ia	0.410						
Ia/P	0.456						
Tc (hours)	0.70	Note: Tc is a direct entry using the flow path for the catchment draining to the practice					
qu	700	Note: qu value is taken from TR-55 (either Exhibit 4-II (Type II Rainfall Distribution) or Exhibit 4-III (Type III Rainfall Distribution) depending on the location in the State					
Qp	0.24	cfs					
Q10	8	cfs	From TR-55				
Enter Swale Dimensions							
Bottom Width	4	ft	Minimum of 2 ft but no greater than 6 ft				
Side Slopes	3	:1	Okay				
Channel Height	1.5	ft					
Flow Depth	0.33	ft	Okay				
Longitudinal Slope	2.0%		Between .5% and 4% (1.5-2.5% Preferred)				
Swale Length	600.00	ft					
Mannings Coef.	0.15		Use variable n values corresponding to flow depths (from .15 down to .03) (APPENDIX I)				
Calculated Swale Dimensions							
Top Width	5.98		Q		1.0		
Area	1.65	ft^2	Velocity		0.59	fps	
Wetted Perimeter	6.09	ft	Detention Time		17.02	minutes	
Determine Required Length Of Channel							
Required Length	600.00	ft					
Length Provided	600.00	ft	Okay				
Q10 Velocity	1.85	fps	Okay				
Q10 flow depth	8.52	inches					
Q10 freeboard	9.48	inches	Okay				
Determine Runoff Reduction							
Soil Group	B	Percent Reduction		0.20			
Is the Vegetated Swale contributing flow to another practice?			Yes	Select Practice	Infiltration Basin		
Runoff Reduction			157	$ft3$			
Portion of WQv not reduced that must be directed to a standard SMP			630	$ft3$			

Vegetated Swale is the selected practice for sub-catchment 6 (purple shaded area). The 'Vegetated Swale' worksheet is used to determine the reduction credit for this sub-catchment. Select "6" in the Catchment # drop down to import the design information for this sub-catchment.

If the infiltration rate is 0.50 in/hr or less, RRv will not be credited for this practice and sizing of the treatment practice receiving the flow conveyed by the vegetated swale cannot be adjusted.

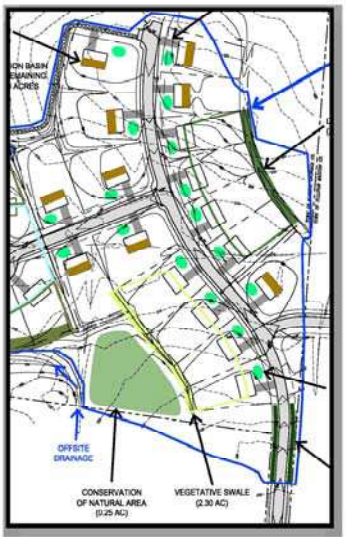
The peak WQv (Qp) used to size the channel must be calculated using the modified curve number method presented in Appendix B of the New York State Stormwater Management Design Manual. Notes are provided for information that must be entered to allow determination of Qp. For this example, Qp = 0.24 ft^3.

Information related to the channel design must also be entered to allow the worksheet to calculate a flow rate (Q), Velocity, Qp Detention Time and required length of channel. The designer should enter the channel length provided. *Section 5.3.3 - Vegetated Swale* of the Design Manual sets limitations on the allowable Qp, velocities, the detention time and flow depths. If any of these criteria are not met, an error message will occur. The designer needs to derive why the error message occurred and modify the design of the vegetated swale to meet these requirements.

The percent reduction for vegetated swales is based on the soil type (See Vegetated Swale sizing criteria, page 5-59). Since HSG B soils are present, 20% of the WQv (157 cf) draining through the swale is reduced. This value is imported into the 'Summary Table' worksheet in the "Volume Reduced (RRv)" column for vegetated swale.

The worksheet will also calculate the portion of WQv not reduced by the vegetated swale. For this example it is 630 ft^3. Since a vegetated swale is not considered to be a *standard SMP with RRv capacity*, flows not reduced must be directed to a standard SMP for treatment prior to discharge. In this example, this flow will be directed to the infiltration basin (see page 19 sub-catchment 9 – Infiltration Basin).

Sub-catchment 7 – Rain Gardens



Rain Garden Worksheet

Design Point:	1						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	Total Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (ft^3)	Precipitation (in)	Description
7	0.40	0.40	1.00	0.95	1241.46	0.90	Rain Garden
Enter Impervious Area Reduced by Disconnection of		0.00	100%	0.95	1,241	<<WQv after adjusting for Disconnected Rooftops	
Soil Information							
Soil Group		B					
Using Underdrains		No	Okay				
Infiltration Rate		1.50	in/hour	Okay			
Rain Garden Parameters							
Enter number of Rain Gardens			17				
Enter area of each Rain Garden			1,000				
Enter Rain Garden Surface area		ARG	17,000	sf			
Enter depth of Soil Media		DSM	1.00	ft	1 to 1.50		
Enter depth of drainage layer		DDL	1.00	ft	≥ 0.50 ft		
Enter ponding depth above surface		DP	0.50	ft	≤ 0.50		
Enter porosity of Soil Media		nSM	0.40		≥20%, enter as a decimal		
Enter porosity of Drainage Layer		nDL	0.50		≥ 40%, enter as a decimal		
Volume Provided In Soil Media		VSM	6,800	ft^3			
Volume Provided in Drainage Layer		VDL	8,500	ft^3			
Volume Provided In Ponding Area			8,500	ft^3			
Total Volume Provided			23,800	ft^3			
Determine Runoff Reduction							
Percent Reduction			100%				
Runoff Reduction			1,241	ft^3			
WQv ≤ VSM + VDL + (DP x ARG) √			OK				

Rain Garden is the selected practice for sub-catchment 7 (bright green shaded area). The 'Rain Garden' worksheet is used to determine the reduction credit for this sub-catchment. Select "7" in the Catchment # drop down menu to import the design information.

Rain Gardens can only be used for runoff reduction in areas where the soil infiltration rate is 0.50 in/hr or greater and the practice will not have under drains. The 'Bioretention' worksheet may be used in these conditions.

The worksheet includes a series of questions that were selected to match the criteria listed *Section 5.3.7 Rain Gardens* of the Design Manual. For projects with multiple rain gardens that are the same size (square footage), have identical design characteristics (depth or soil media, depth of drainage layer, etc.), and have the same soil classification, the worksheet allows them to be treated as an aggregate. If you are designing rain gardens that vary in size, soil type, etc., a separate worksheet for each rain garden should be completed. Each worksheet allows up to four separate practices (scroll down to access additional pages). The sum of the area, impervious area, Volume Reduced and Volume Treated by each practice is calculated and imported to the 'Summary Table' worksheet.

In this example, all 17 rain gardens are the same size and have the same design characteristics, therefore they are treated as an aggregate for design purposes. Information on the number of rain gardens, area of each rain garden, depth of soil media, depth of drainage layer, ponding depth, porosity of soil media, and porosity of drainage layer must be entered to allow the worksheet to calculate the total volume provided in the soil media, drainage layers, and ponding areas. The worksheet will then calculate the total volume provided and the runoff reduction volume. From page 5-79 of the Design Manual, runoff reduction credit equal to the 100% of the WQv is applied for HSG A or B soils. A 40% credit is applied for HSG C or D soils.

In this example, the rain gardens are located in HSG B soils, so the RRv is equal to 100% of the WQv, which is 1,241 ft^3. This value is imported into the 'Summary Table' worksheet in the Volume Reduced (RRv) column for Rain Gardens.

Sub-catchment 8 – Porous Pavement

Porous Pavement Worksheet

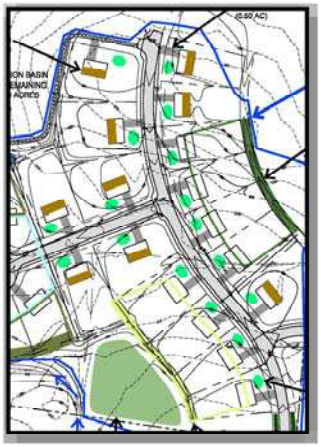
Design Point:	1						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	Total Area (Acres)	Impervious Area (Acres)	Percent Impervious %	Rv	WQv (ft^3)	Precipitation (in)	Description
8	0.50	0.50	1.00	0.95	1551.83	0.90	Porous Pavement
Enter Soil Infiltration Rate							
Soil Infiltration Rate		1.50	in/hour				
Calculate Required Surface Area							
Design Volume		Vw	1,552	ft^3			
Porosity of Gravel Bed		n	0.40				
Gravel Bed Depth		dt	1.00	ft			
Required Surface Area		Ap	3,880	sf			
Surface Area Provided			23,000	sf	Dimensions of pavement can be provided here		
Storage Volume Provided			9,200	ft^3			
Determine the Runoff Reduction							
RRv	1,552	ft^3					

Porous Pavement is the selected practice for the driveways/sub-catchment 8 (dark grey shaded area). The 'Porous Pavement' worksheet is used to determine the reduction credit for this sub-catchment. Select 8 in the Catchment # drop down menu to import the design criteria and enter the infiltration rate. If the soil infiltration rate is less that 0.50 in/hr, porous pavement is not an appropriate practice for runoff reduction in this area and the designer should select a different practice. If underdrains are proposed, it is important to note that only storage volume under the invert elevation of the under drain pipe can be used for RRv credit.

Information regarding the porosity and depth of the gravel bed must be entered to allow the worksheet to calculate the required surface area to accommodate the WQv. The designer then needs to input the surface area of the porous pavement they are intending to use. In this example, there are 23 driveways that are 1,000 ft^2 each, so the surface area provided is 23,000 ft^2. The worksheet will then use the surface area provided to calculate the storage volume being provided, which is 9,200 ft^3.

The worksheet will then calculate runoff reduction volume, which in this example is 1,552 ft^3 (RRv cannot exceed the WQv of the sub-catchment). This value is imported into the 'Summary Table' worksheet in the "Volume Reduced (RRv)" column for Porous Pavement.

Disconnection of Roof Tops



Disconnection of Roof Tops

Design Point:	1			
Enter Site Data For Drainage Area to be Treated by Practice				
Catchment Number	Impervious Area To Be Disconnected (Acres)			Description
9	0.30			Disconnection of Rooftops
Design Elements				
Is another area based practice applied to this area?	No			
Soil Type	B			
Has an evaluation by licensed or certified professional determined if soil enhancement & spreading device needed to provide sheet flowover grass surfaces?	No	Y/N	required for C or D soils.	
Hotspot Area?	No			
Length of flow path from Impervious Surfaces	50	ft	75 feet maximum	
Distance of downspouts from impervious areas	20	ft	>10 feet	
Contributing Area of Rooftop to Downspout	500	sf	Okay	
Contributing Area of Rooftop	1500	sf	500 sf maximum. Up to 2000 sf with suitable flow dispersion technique	
Method of flow dispersion	-		required if area to downspout >500 sf	
Flow length thru vegetated channel, swale or filter	50	ft	vegetated area must be equal to or greater than the length of contributing impervious	
Slope of vegetated area receiving flow	2	%	Average slope ≤5%	
Will overflow occur to undesignated Areas?	No			
Are All Criteria in Section 5.3.5 met?	Yes			
Area Reduction Adjustments				
Subtract	0.30	Acres from the Total Impervious Area of Sub-catchment Number		9

Disconnection of rooftops is not considered to be a stand-alone practice. The runoff from these areas needs to be directed to another practice for further reduction or treatment. However, the sizing of those practices may be reduced. If impervious areas are adequately disconnected, they can be deducted from the sub-catchments impervious total (Rv calculation) when computing WQv for sizing the associated practice receiving flow from the disconnected areas. Some worksheets were designed to account for the reduction in impervious area associated with the disconnection of rooftops. For this example, to reduce the runoff entering the infiltration basin (sub-catchment 9), nine rooftops have been disconnected (see brown shaded rooftops in picture above). The 'Disconnection of Rooftops' worksheet is used to ensure that this credit can be taken prior to completing the worksheet for the infiltration basin.

Sub-catchment 9 is selected to identify the sub-catchment where the practice is to be applied. The disconnected impervious area must be manually entered. For this example, 9 rooftops each with 1500 sf of impervious area are disconnected so 0.30 acres is entered.

The worksheet includes a series of questions that were selected to match the criteria listed *Section 5.3.5 Disconnection of Rooftop Runoff* of the Design Manual. If an answer provided does not meet the criteria in the Design Manual, an error message will occur. The designer needs to derive why the error message occurred and either change their design to meet the criteria of the Design Manual or select a different practice for the sub-catchment.

The last question of this work sheet asks if all criteria of Section 5.3.5 of Design Manual were met. If the designer believes that all criteria have been met after completing this worksheet and reviewing Section 5.3.5 of the Design Manual, yes should be selected. If yes is selected, the impervious area for this sub-catchment that is to be removed by the disconnection of rooftops is calculated. The impervious area is imported to the 'Total WQv Calculation' worksheet where it is subtracted out of the WQv calculation. This total must also be manually inputted on the worksheet for the infiltration basin (page 19). If no is selected, disconnection of rooftops is not an acceptable practice for the sub-catchment.

Sub-catchment 9 – Infiltration Basin

Infiltration Basin Worksheet

Design Point:	1						
Enter Site Data For Drainage Area to be Treated by Practice							
Catchment Number	**Total Area** *(Acres)*	**Impervious Area** *(Acres)*	**Percent Impervious** *%*	**Rv**	**WQv** *(ft^3)*	**Precipitation** *(in)*	**Description**
9	8.54	3.17	0.37	0.38	10715.76	0.90	Infiltration Basin
Enter Impervious Area Reduced by Disconnection of:		0.30	34%	0.35	9,834	<<WQv after adjusting for Disconnected Rooftops	
Enter the portion of the WQv that is not reduced for all practices routed to this practice.					865	ft^3	
Pretreatment Techniques to Prevent Clogging							
Infiltration Rate			1.50	in/hour	Okay		
Pretreatment Sizing			25	% WQv	*25% minimum; 50% if >2 in/hr 100% if >5in/hour*		
Pretreatment Required Volume			2,675	ft^3			
Pretreatment Provided			2,800	ft^3			
Pretreatment Techniques utilized			*Plunge Pool*				
Size An Infiltration Basin							
Design Volume	10,699	ft^3	WQv				
Basal Area Required	2,675	ft^2	*Infiltration practices shall be designed to exfiltrate the entire WQv through the floor of each practice.*				
Basal Area Provided	2,800	ft^2					
Design Depth	4.00	ft					
Volume Provided	11,200	ft^3	*Storage Volume provided in infiltration basin area (not including pretreatment.*				
Determine Runoff Reduction							
RRv	10,080	ft^3	***90% of the storage provided in the basin or WQv whichever is smaller***				
Volume Treated	619	ft^3	*This is the portion of the WQv that is not reduced/infiltrated*				
Sizing √	OK		*The infiltration basin must provide storage equal to or greater than the WQv of the contributing area.*				

An Infiltration Basin is the selected practice to manage the runoff from the remaining areas and flows that are not fully reduced in other practices (sub-catchment 9 (blue shaded area)). The 'Infiltration Basin' worksheet is used to determine the reduction credit for this sub-catchment. Select 9 in the Catchment # drop down menu to import the sub-watershed design information.

This worksheet allows for the reduction in impervious area associated with the disconnection of rooftops. By disconnecting the rooftops of nine houses, the impervious area of sub-catchment 9 will be reduced by 0.30 acres resulting in a reduction of WQv for the infiltration basin from 10,716 ft^3 to 9,834 ft^3. The disconnected impervious area (0.3 acres) must be manually entered to allow the worksheet to calculate the updated percent impervious, Rv, and WQv. The impervious area reduced by the disconnection of rooftops is imported to the 'Total WQv Calculation' worksheet (see page 8) where it will be subtracted out along with other area reduction techniques to develop an adjusted WQv.

Any runoff that is not reduced in other practices that are directed to the infiltration basin must be manually entered to ensure that the infiltration basin is adequately sized for all flows that it will receive. For this example, the infiltration basin is receiving 630 ft^3 of volume from the vegetated swale and 235 ft^3 from the dry swale, for a total of 865 ft^3. The infiltration basin needs to account for these volumes in addition to the WQv associated with the 8.54 acre sub-catchment that drains to it.

Information on the soil infiltration rate, pretreatment sizing, pretreatment provided, and pretreatment techniques utilized is required to allow the work sheet to calculate pretreatment required volume, which must be equal or less than the pretreatment provided. The worksheet will then calculate the design volume and basal area required. Information related to the proposed basal area and design depth must be entered to allow the worksheet to calculate the volume provided which must be greater than or equal to the design volume. Error messages will appear if the proposed basal area is less than the basal area required or if the volume provided in the practice is less than the design volume.

An infiltration basin is considered to be a *standard SMP with RRv Capacity*. For the *standard SMPs with RRv Capacity*, the RRv will be equal to a percentage of the WQv provided by the practice. The percentages are intended to account for the documented decline in performance of these practices and are listed in Table 3.5 of the Design Manual. From Table 3.5, the RRv for infiltration basins is 90% of the storage provided in the basin or the WQv, whichever is smaller. In this example, the designer elected to oversize the basin and 90% of the storage provided in the basin (10,080), is less than the WQv, therefore a RRv volume of 10,080 ft^3 is applied. This value is imported into the 'Summary Table' worksheet in the Volume Reduced (RRv) column for Infiltration Basin. Since the basin was sized in accordance with Chapter 6, the remaining volume that is not reduced is considered to be treated. This volume (WQv – RRv), 619 ft^3, is credited in the 'Summary Table' in the "WQv treated" column.

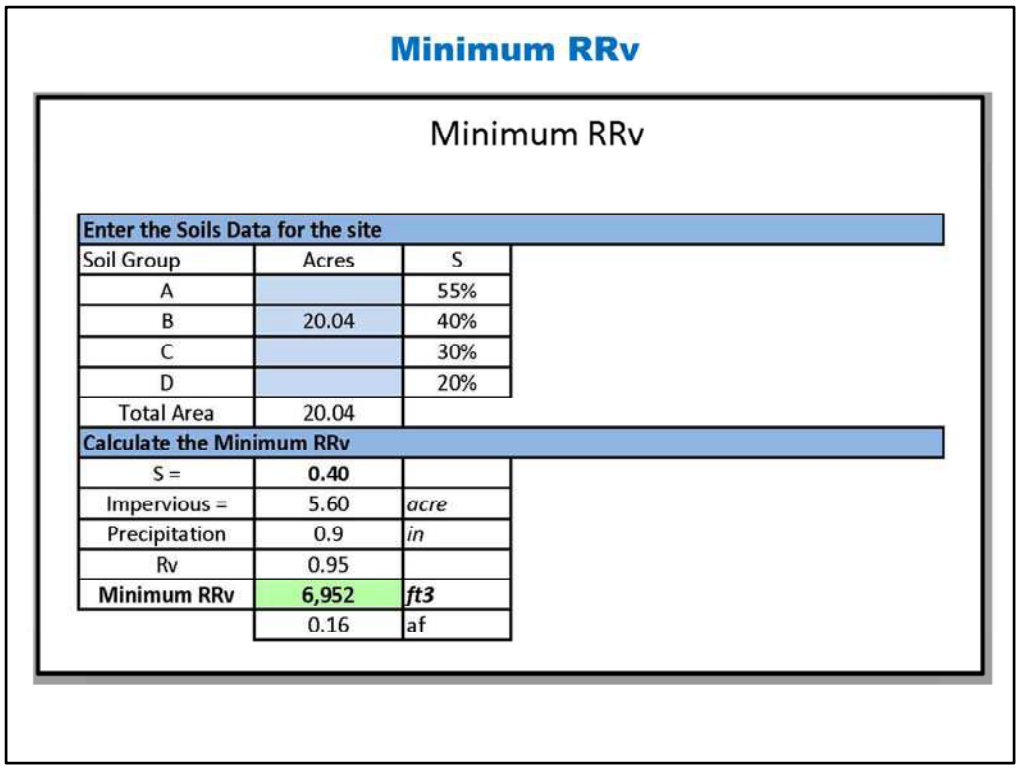
Summary Table

Runoff Reduction Volume and Treated volumes						
Runoff Reduction Techiques/Standard SMPs			Total Contributing Area (acres)	Total Contributing Impervious Area (acres)	WQv Reduced (RRv) cf	WQv Treated cf
Area/Volume Reduction	Conservation of Natural Areas	RR-1	0.25	0.00		
	SheetFlow to Riparian Buffers/Filter Strips	RR-2	3.40	0.20		
	Tree Planting/Tree Pit	RR-3	0.15	0.05		
	Disconnection of Rooftop Runoff	RR-4		0.30		
	Vegetated Swale	RR-5	2.30	0.14	157	
	Rain Garden	RR-6	0.40	0.40	1241	
	Stormwater Planter	RR-7	0.00	0.00	0	
	Rain Barrel/Cistern	RR-8	0.00	0.00	0	
	Porous Pavement	RR-9	0.50	0.50	1552	
	Green Roof (Intensive & Extensive)	RR-10	0.00	0.00	0	
Standard SMPs w/RRv Capacity	Infiltration Trench	I-1	0.00	0.00	0	0
	Infiltration Basin	I-2	8.54	2.87	10080	619
	Dry Well	I-3	0.00	0.00	0	0
	Underground Infiltration System	I-4	0.00			
	Bioretention & Infiltration Bioretention	F-5	2.20	1.00	3150	150
	Dry swale	O-1	2.30	0.14	552	0
Standard SMPs	Micropool Extended Detention (P-1)	P-1				
	Wet Pond (P-2)	P-2				
	Wet Extended Detention (P-3)	P-3				
	Multiple Pond system (P-4)	P-4				
	Pocket Pond (p-5)	P-5				
	Surface Sand filter (F-1)	F-1				
	Underground Sand filter (F-2)	F-2				
	Perimeter Sand Filter (F-3)	F-3				
	Organic Filter (F-4	F-4				
	Shallow Wetland (W-1)	W-1				
	Extended Detention Wetland (W-2	W-2				
	Pond/Wetland System (W-3)	W-3				
	Pocket Wetland (W-4)	W-4				
	Wet Swale (O-2)	O-2				
Totals by Area Reduction →			3.80	0.55	2238	
Totals by Volume Reduction →			3.20	1.04	2951	
Totals by Standard SMP w/RRV →			13.04	4.01	13782	768
Totals by Standard SMP →			0.00	0.00		0
Totals (Area + Volume + all SMPs) →			20.04	5.60	18,971	768

The 'Summary Table' worksheet is provided as an accounting tool for all of the practices. The 'Summary Table' tracks the total contributing area and total contributing impervious area for each practice type. This information will be reported on the NOI for question 29. The 'Summary Table' will also track the WQv Reduced (RRv) for volume reduction techniques as well as the WQv Reduced and WQv Treated for standard SMPs with RRv capacity.

Currently there are no worksheets for the standard practices that do not have reduction capacity. However, the total contributing area, total contributing impervious area, and WQv treated can be manually entered for these practices.

The 'Summary Table' will calculate the total contributing area, total impervious area, Total WQv Reduced (RRv) and Total WQv Treated, which are used to answer pertinent questions on the NOI for one design point. If the project consists of multiple design points, separate sets of worksheets should be completed for each design point. The results reported on the Summary Table for each design point will need to be manually combined and reported on the NOI.



The Design Manual specifies a minimum RRv that must be achieved for a project to be eligible for coverage under the General Permit. The minimum RRv is based on the soil type and is considered to be part of the sizing criteria. Projects that deviate from the sizing criteria are not eligible for coverage. In order to demonstrate that the project is eligible for coverage, the Designer must show that the RRv achieved for the project exceeds the minimum RRv at each design point.

The 'minimum RRv' worksheet calculates the minimum RRv required. The designer needs to input the area in acres for each soil type found in the drainage area being studied. For this example, the entire 20 acre drainage area has HSG B soil. Therefore, the designer should enter 20 in the box adjacent to Soil Group B. The worksheet will then calculate the minimum RRv, which for this example is 6,952 ft^3 or 0.16 af.

NOI Questions Worksheet

NOI QUESTIONS

#	NOI Question	Reported Value	
		cf	af
28	Total Water Quality Volume (WQv) Required	19739	*0.453*
30	Total RRV Provided	18971	*0.436*
31	Is RRv Provided ≥WQv Required?	No	
32	Minimum RRv	6952	*0.160*
32a	Is RRv Provided ≥ Minimum RRv Required?	Yes	
33a	Total WQv Treated	768	*0.018*
34	Sum of Volume Reduced & Treated	19739	*0.453*
34	Sum of Volume Reduced and Treated	19739	*0.453*
35	Is Sum RRv Provided and WQv Provided ≥WQv Required?	Yes	

Apply Peak Flow Attenuation			
36	Channel Protection	*Cpv*	
37	Overbank	*Qp*	
37	Extreme Flood Control	*Qf*	
	Are Quantity Control requirements met?	*Yes*	Plan Completed

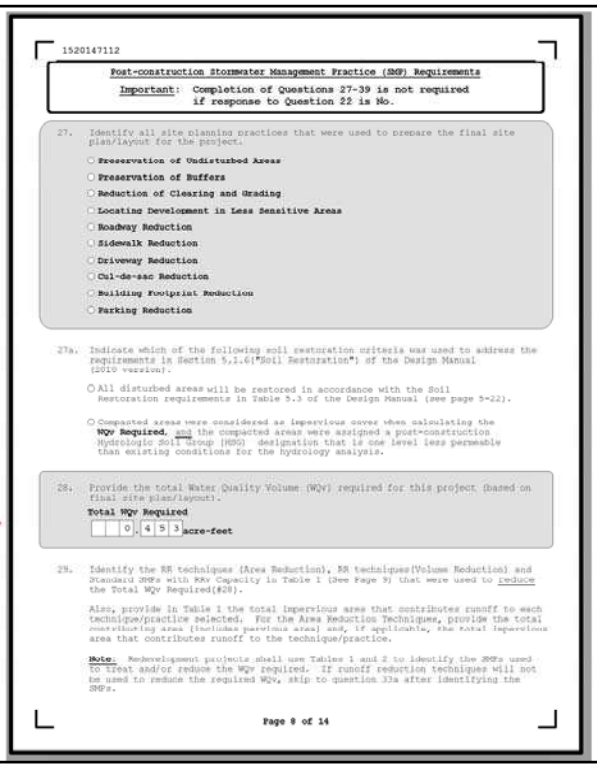
The 'NOI Worksheet' summary imports the information needed to answer the pertinent questions on the NOI. The green highlighted cells contain the information that is to be reported for the respective NOI Question #.

The 'NOI Worksheet' imports the Total Volume Reduced (RRv) and Total Volume Treated from the 'Summary Table' worksheet and calculates the Sum of Volume Reduced & Treated, which are needed to answer questions 30, 33a, and 34, respectively, of the NOI

The worksheet will also provide the answers to questions 31, 32, 32a, 34, and 35 of the NOI. Ultimately, the spreadsheet checks to see if the sum of RRv and WQv provided is greater than or equal to the WQv required. For this example, the sum of RRv provided and WQv treated (19,733 ft^3) is equal to the total WQv required (19,733 ft^3) and the RRv provided is greater than the minimum required. Therefore, the proposed design is acceptable. If the sum of RRv provided and WQv treated was less than the total WQv required, an error message will occur and the designer would need to incorporate additional treatment and/or reduction techniques.

The designer would then need to manually enter the information on peak flow attenuation and answer whether the quantity controls requirements were met.

Example: Completed NOI Questions 28-29



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Post-construction Stormwater Management Practice (SMP) Requirements

Important: Completion of Questions 27-39 is not required if response to Question 22 is No.

27. Identify all site planning practices that were used to prepare the final site plan/layout for the project.

- ○ Preservation of Undisturbed Areas
- ○ Preservation of Buffers
- ○ Reduction of Clearing and Grading
- ○ Locating Development in Less Sensitive Areas
- ○ Roadway Reduction
- ○ Sidewalk Reduction
- ○ Driveway Reduction
- ○ Cul-de-sac Reduction
- ○ Building Footprint Reduction
- ○ Parking Reduction

27a. Indicate which of the following soil restoration criteria was used to address the requirements in Section 5.1.6("Soil Restoration") of the Design Manual (2010 version).

- ○ All disturbed areas will be restored in accordance with the Soil Restoration requirements in Table 5.3 of the Design Manual (see page 5-22).
- ○ Compacted areas were considered as impervious cover when calculating the **WQv Required**, and the compacted areas were assigned a post-construction Hydrologic Soil Group (HSG) designation that is one level less permeable than existing conditions for the hydrology analysis.

28. Provide the total Water Quality Volume (WQv) required for this project (based on final site plan/layout).

Total WQv Required

0.453 **acre-feet**

29. Identify the SR techniques (Area Reduction), SR techniques(Volume Reduction) and Standard SMFs with RRv Capacity in Table 1 (See Page 9) that were used to reduce the Total WQv Required(#28).

Also, provide in Table 1 the total impervious area that contributes runoff to each technique/practice selected. For the Area Reduction Techniques, provide the total contributing area (includes pervious area) and, if applicable, the total impervious area that contributes runoff to the technique/practice.

Note: Redevelopment projects shall use Tables 1 and 2 to identify the SMFs used to treat and/or reduce the WQv required. If runoff reduction techniques will not be used to reduce the required WQv, skip to question 33a after identifying the SMFs.

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The information is then applied to the NOI.

Example: Completed NOI Question 29

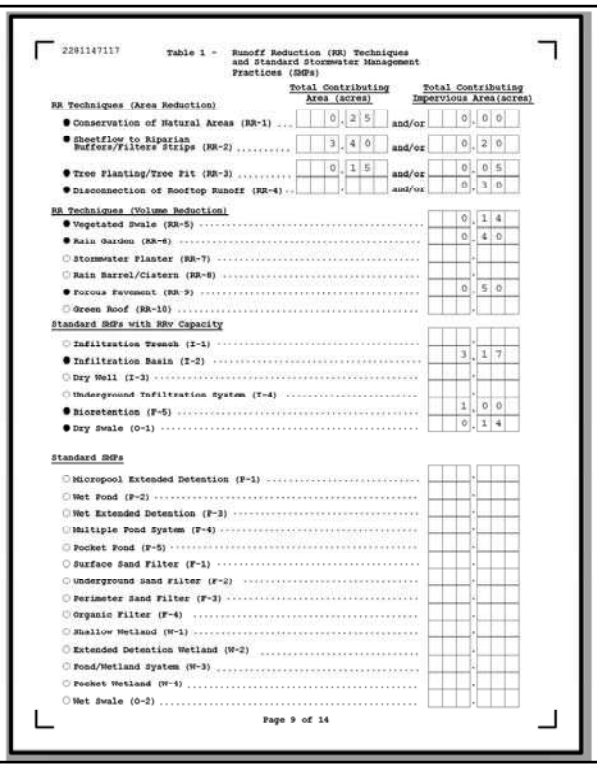

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Table 1 - Runoff Reduction (RR) Techniques and Standard Stormwater Management Practices (SMPs)

	Total Contributing Area (acres)		Total Contributing Impervious Area (acres)
RR Techniques (Area Reduction)			
● Conservation of Natural Areas (RR-1)	0.25	and/or	0.00
● Sheetflow to Riparian Buffers/Filters Strips (RR-2)	3.40	and/or	0.20
● Tree Planting/Tree Pit (RR-3)	0.15	and/or	0.05
● Disconnection of Rooftop Runoff (RR-4)	.	and/or	0.30
RR Techniques (Volume Reduction)			
● Vegetated Swale (RR-5)			0.14
● Rain Garden (RR-6)			0.40
○ Stormwater Planter (RR-7)			.
○ Rain Barrel/Cistern (RR-8)			.
● Porous Pavement (RR-9)			0.50
○ Green Roof (RR-10)			.
Standard SMPs with RRv Capacity			
○ Infiltration Trench (I-1)			.
● Infiltration Basin (I-2)			3.17
○ Dry Well (I-3)			.
○ Underground Infiltration System (I-4)			.
● Bioretention (F-5)			1.00
● Dry Swale (O-1)			0.14
Standard SMPs			
○ Micropool Extended Detention (P-1)			.
○ Wet Pond (P-2)			.
○ Wet Extended Detention (P-3)			.
○ Multiple Pond System (P-4)			.
○ Pocket Pond (P-5)			.
○ Surface Sand Filter (F-1)			.
○ Underground Sand Filter (F-2)			.
○ Perimeter Sand Filter (F-3)			.
○ Organic Filter (F-4)			.
○ Shallow Wetland (W-1)			.
○ Extended Detention Wetland (W-2)			.
○ Pond/Wetland System (W-3)			.
○ Pocket Wetland (W-4)			.
○ Wet Swale (O-2)			.

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Example: Completed NOI Questions 30-32a

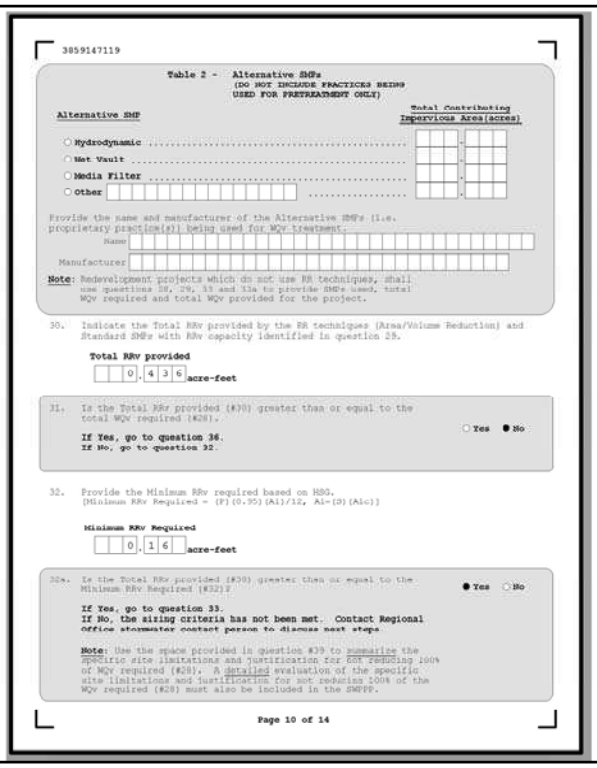

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Table 2 - Alternative SMPs
(DO NOT INCLUDE PRACTICES BEING USED FOR PRETREATMENT ONLY)

Alternative SMP	Total Contributing Impervious Area(acres)
○ Hydrodynamic	
○ Wet Vault	
○ Media Filter	
○ Other	

Provide the name and manufacturer of the Alternative SMPs (i.e. proprietary practice(s)) being used for WQv treatment.

Name

Manufacturer

Note: Redevelopment projects which do not use RR techniques, shall use questions 28, 29, 33 and 33a to provide SMPs used, total WQv required and total WQv provided for the project.

30. Indicate the Total RRv provided by the RR techniques (Area/Volume Reduction) and Standard SMPs with RRv capacity identified in question 29.

Total RRv provided

0.436 **acre-feet**

31. Is the Total RRv provided (#30) greater than or equal to the total WQv required (#28).

○ Yes ● No

If Yes, go to question 36.
If No, go to question 32.

32. Provide the Minimum RRv required based on HSG.
[Minimum RRv Required = (P)(0.95)(Ai)/12, Ai=(S)(Aic)]

Minimum RRv Required

0.16 **acre-feet**

32a. Is the Total RRv provided (#30) greater than or equal to the Minimum RRv Required (#32)?

● Yes ○ No

If Yes, go to question 33.
If No, the sizing criteria has not been met. Contact Regional Office stormwater contact person to discuss next steps.

Note: Use the space provided in question #39 to summarize the specific site limitations and justification for NOT reducing 100% of WQv required (#28). A detailed evaluation of the specific site limitations and justification for not reducing 100% of the WQv required (#28) must also be included in the SWPPP.

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Example: Completed NOI Questions 33-35

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33. Identify the Standard SMPs in Table 1 and, if applicable, the Alternative SMPs in Table 2 that were used to treat the remaining total WQv(=Total WQv Required in 28 - Total RRv Provided in 30).

Also, provide in Table 1 and 2 the total impervious area that contributes runoff to each practice selected.

Note: Use Tables 1 and 2 to identify the SMPs used on Redevelopment projects.

33a. Indicate the Total WQv provided (i.e. WQv treated) by the SMPs identified in question #33 and Standard SMPs with RRv Capacity identified in question 29.

WQv Provided

0.018 **acre-feet**

Note: For the standard SMPs with RRv capacity, the WQv provided by each practice = the WQv calculated using the contributing drainage area to the practice + RRv provided by the practice. (See Table 3.5 in Design Manual)

34. Provide the sum of the Total RRv provided (#30) and the WQv provided (#33a). 0.453

35. Is the sum of the RRv provided (#30) and the WQv provided (#33a) greater than or equal to the total WQv required (#28)? ● **Yes** ○ **No**

If Yes, go to question 36.
If No, the sizing criteria has not been met. Contact Regional Office stormwater contact person to discuss next steps.

36. Provide the total Channel Protection Storage Volume (CPv) required and provided or select waiver (36a), if applicable.

CPv Required ____ **acre-feet** **CPv Provided** ____ **acre-feet**

36a. The need to provide channel protection has been waived because:
○ Site discharges directly to tidal waters or a fifth order or larger stream.
○ Reduction of the total CPv is achieved on site through runoff reduction techniques or infiltration systems.

37. Provide the Overbank Flood (Qp) and Extreme Flood (Qf) control criteria or select waiver (37a), if applicable.

Total Overbank Flood Control Criteria (Qp)

Pre-Development ____ **CFS** **Post-development** ____ **CFS**

Total Extreme Flood Control Criteria (Qf)

Pre-Development ____ **CFS** **Post-development** ____ **CFS**

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