Revisions to the Delaware Sediment & Stormwater Regulations

Training Session 5:

DURMM v2

Compliance Tool

Why DURMM v.2????

DURMM REL 1.1 vs. DURMM v.2

DURMM REL 1.1

- Event-based only
- Pre- vs. Post-developed comparison
- Impervious runoff & pervious runoff calculated separately
- BMP designer
- No ability to link BMPs
- Compliance based on 80% reduction of TSS

DURMM v.2

- Capable of estimating event & annual runoff
- Post-dev. condition only
- Single regression curve used to calculate runoff using composite RCN
- Compliance tool only
- "Treatment train"
- Compliance based on:
  - **0% Effective Imp.**

What is Meant By 0% Effective Imperviousness?

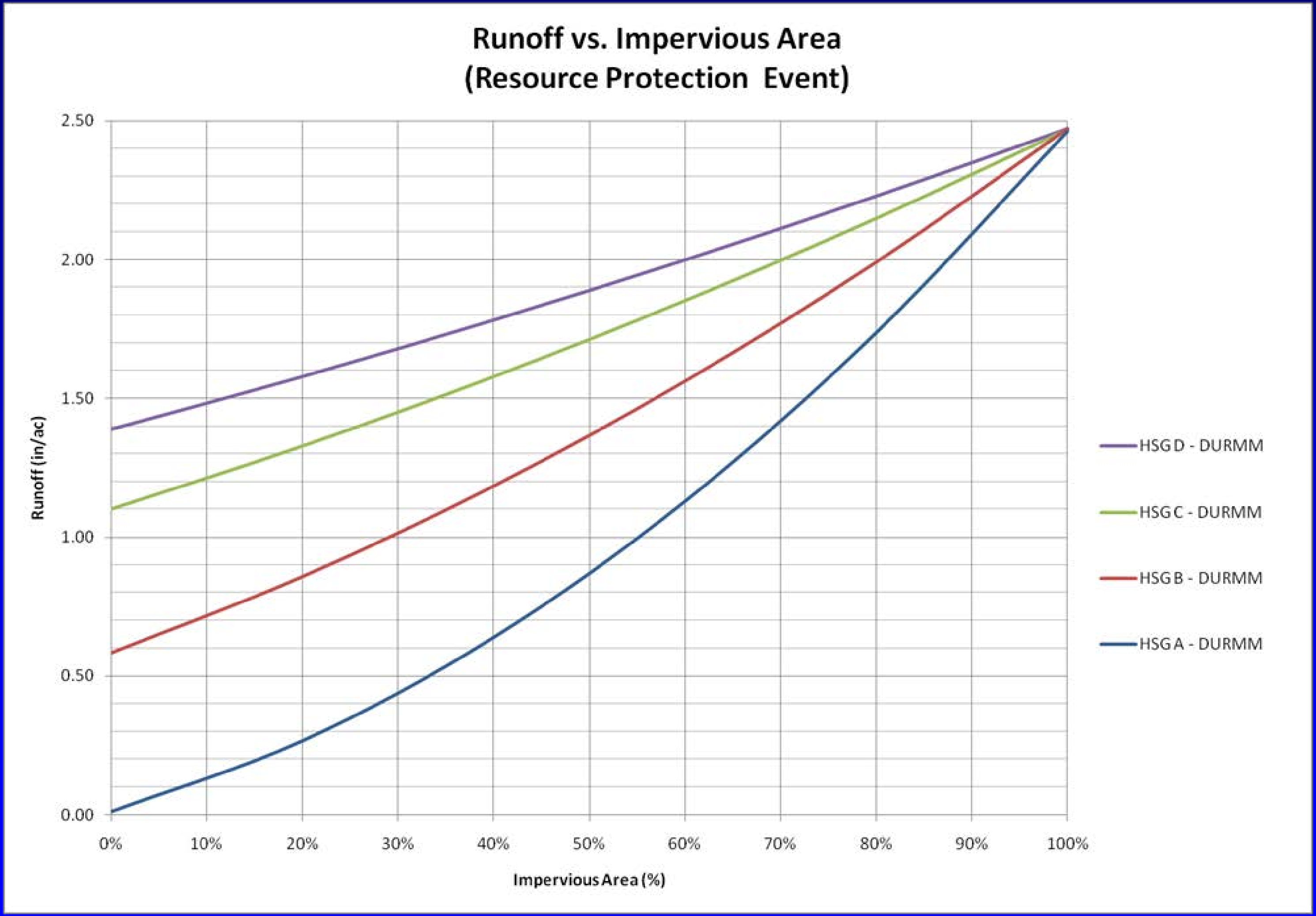
Runoff for Various Combinations of Open Space & Imperviousness

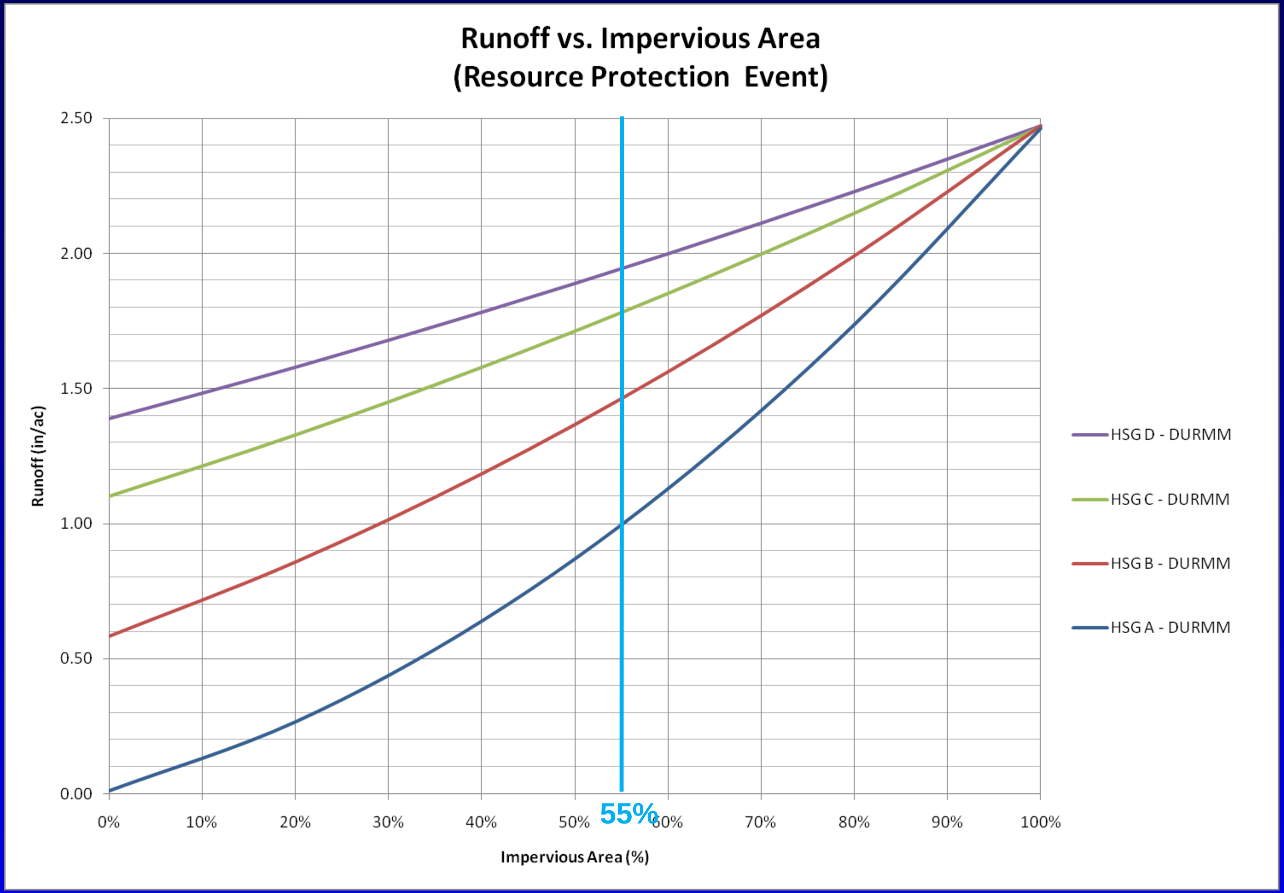
	DURMM v.2 RO (in.) @ 2.7" Rainfall			
% Imp	HSG A	HSG B	HSG C	HSG D
0%	0.01	0.58	1.10	1.39
20%	0.27	0.86	1.33	1.58
40%	0.64	1.18	1.58	1.78
60%	1.13	1.56	1.85	2.00
80%	1.74	1.99	2.15	2.23
100%	2.46	2.47	2.47	2.47

What is Meant By 0% Effective Imperviousness?

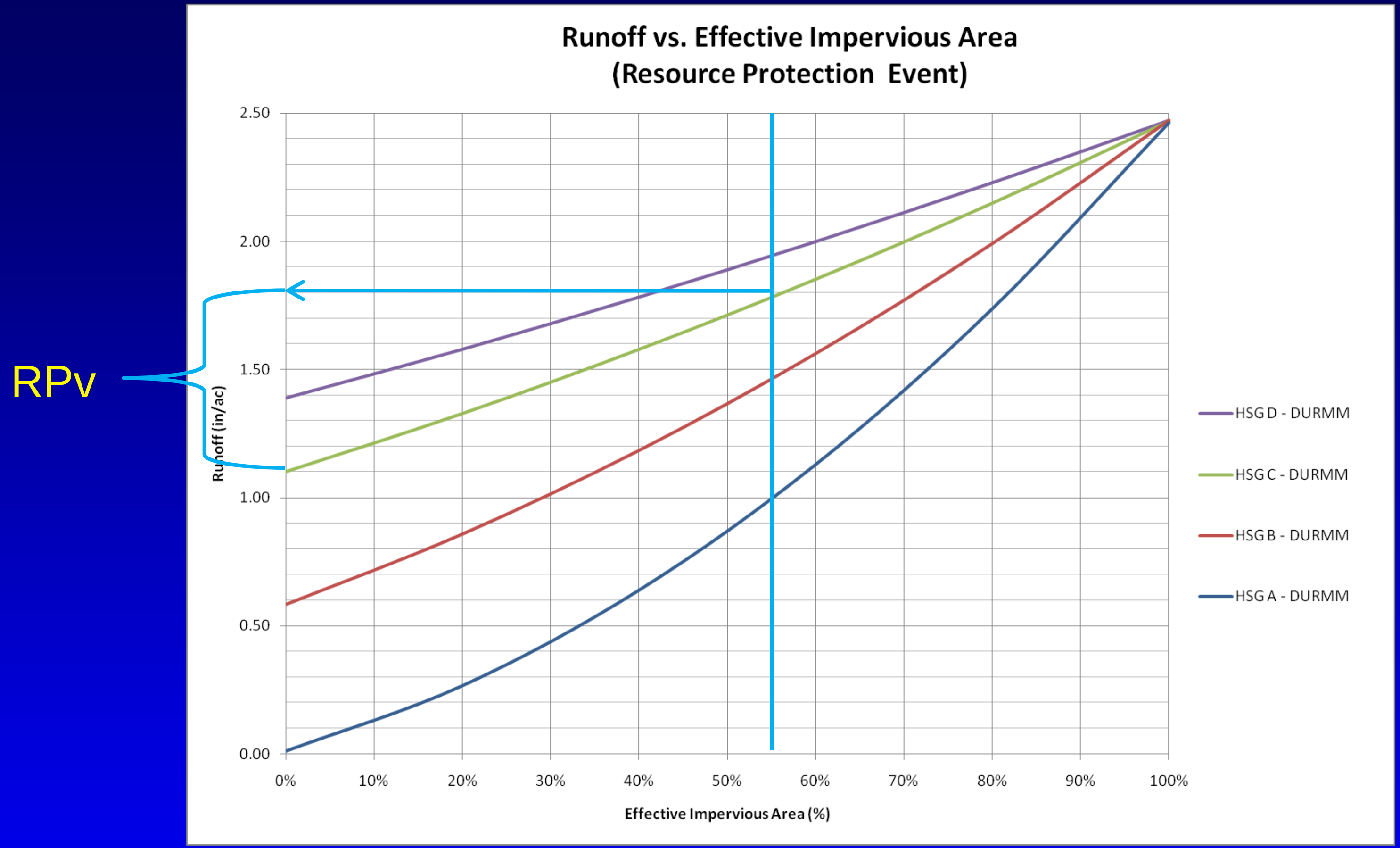
= 100% Open Space Condition

Runoff vs. Imperviousness by HSG





Example: 55% Impervious, HSG C Soil



Example: 55% Impervious, HSG C Soil

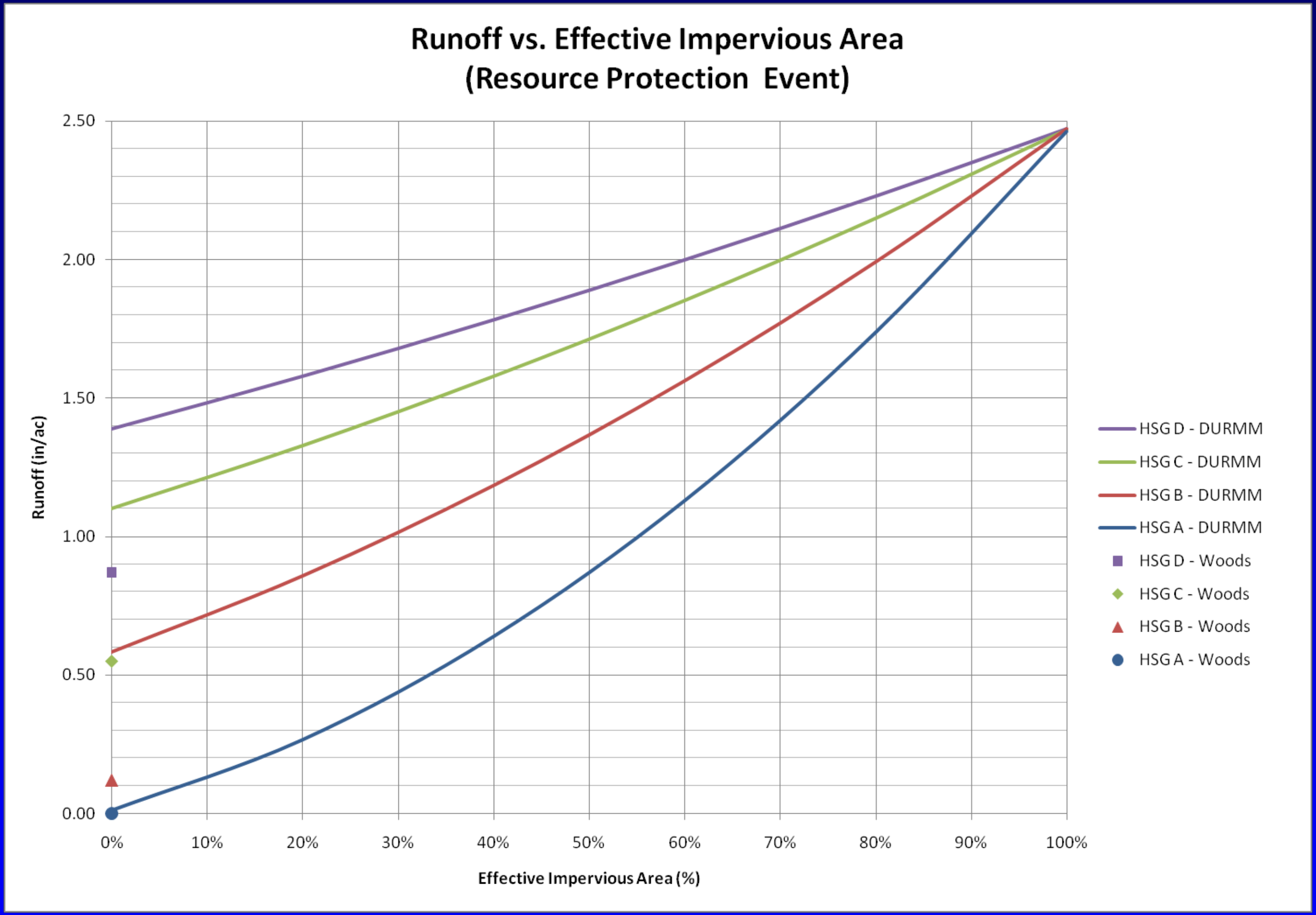
Runoff 1.8”

Minimum RR = 1.8” – 1.1” = 0.7” (38% Reduction)

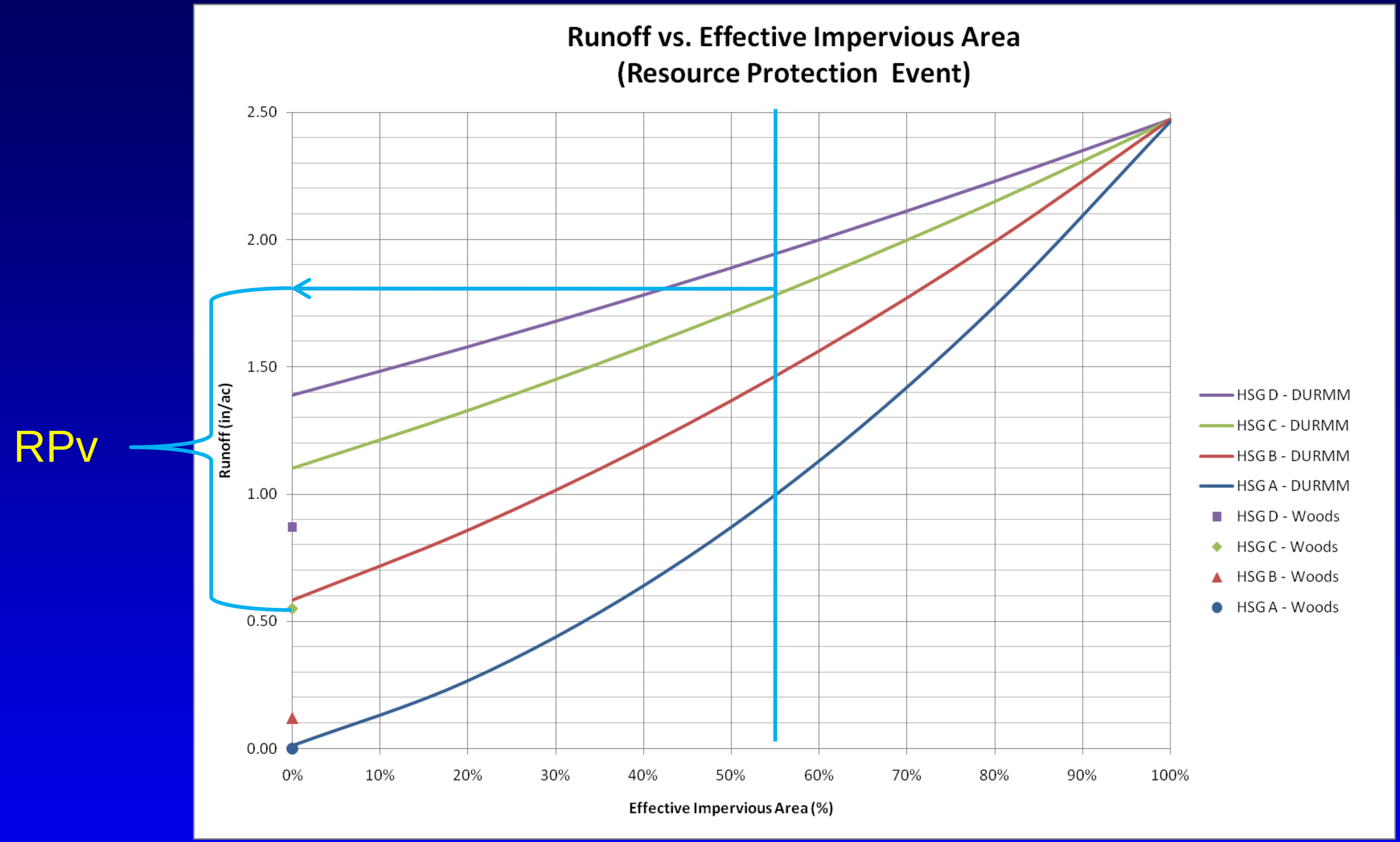
0% Effective Imperviousness

% Imp	Req. Runoff Reduction for 0% Effective Imp.(in)			
	HSG A	HSG B	HSG C	HSG D
10%	0.15	0.13	0.11	0.09
20%	0.27	0.27	0.23	0.19
30%	0.43	0.43	0.35	0.29
40%	0.62	0.60	0.48	0.39
50%	0.85	0.78	0.61	0.50
60%	1.10	0.97	0.75	0.61
70%	1.39	1.18	0.90	0.72
80%	1.71	1.40	1.05	0.83
90%	2.06	1.63	1.20	0.95
100%	2.45	1.88	1.36	1.07

Existing Woods/Meadow*?



*Only applies to woods/meadow within the LOD



Example: 55% Impervious, HSG C Soil, **Existing Woods**

Runoff 1.8”

Minimum RR = 1.8” – 0.55” = 1.25” (69% Reduction)

How is Runoff Reduction Determined for SW BMPs?

Quantifying Runoff Reduction


GREEN TECHNOLOGY

Biofiltration Swales

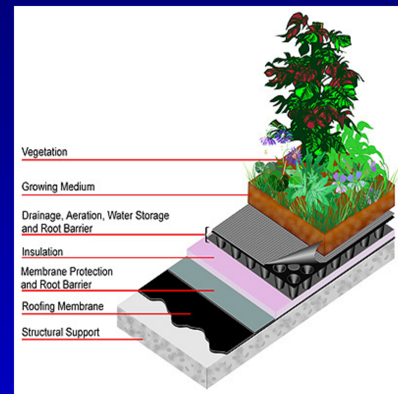
Biofiltration swales convey runoff at shallow flow depths through wide, flat-bottomed swales. They can be very effective in removing Total Suspended Solids (TSS) and adsorbed metals, although less effective in terms of decreasing the amount of nutrients contained in water.

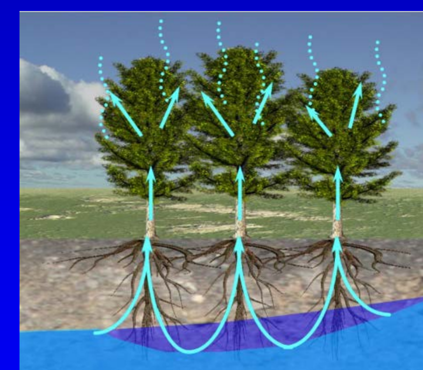
Infiltration Trenches

Most Green Technology BMPs incorporate infiltration as part of the treatment process. Specific infiltration facilities include infiltration trenches. Infiltration trenches located in swales provide additional wetted surface area and storage volume, and often they can be designed to penetrate shallow impermeable soil profiles to recharge deeper soil horizons.

FOR MORE INFORMATION

For more information, please contact the Delaware Department of Natural Resources and Environmental Control, Sediment and Stormwater Program at (302) 739-9921.

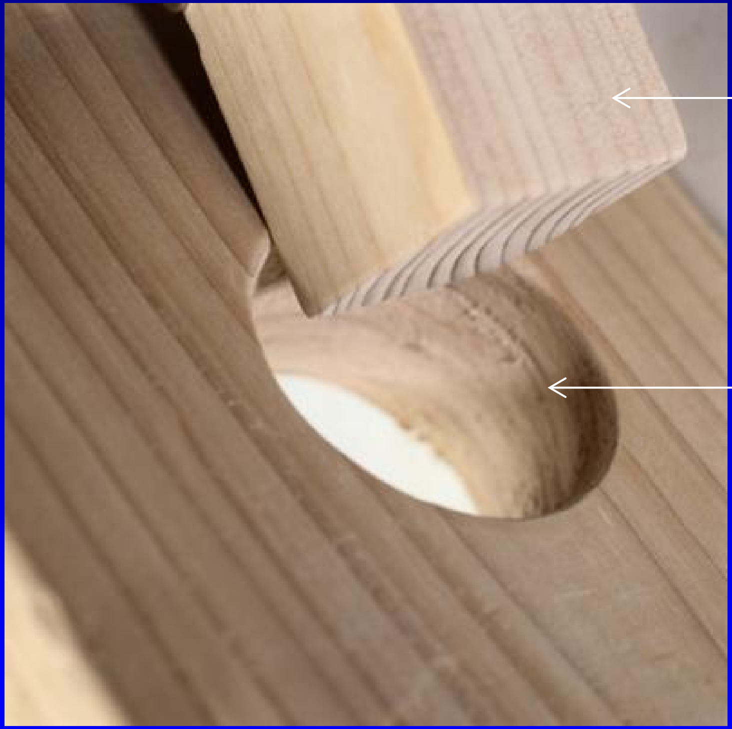




- Retention Practices (i.e., storage)
- Annual Reduction Practices (i.e., surface recharge)

The Problem:

Event-Based Methodology

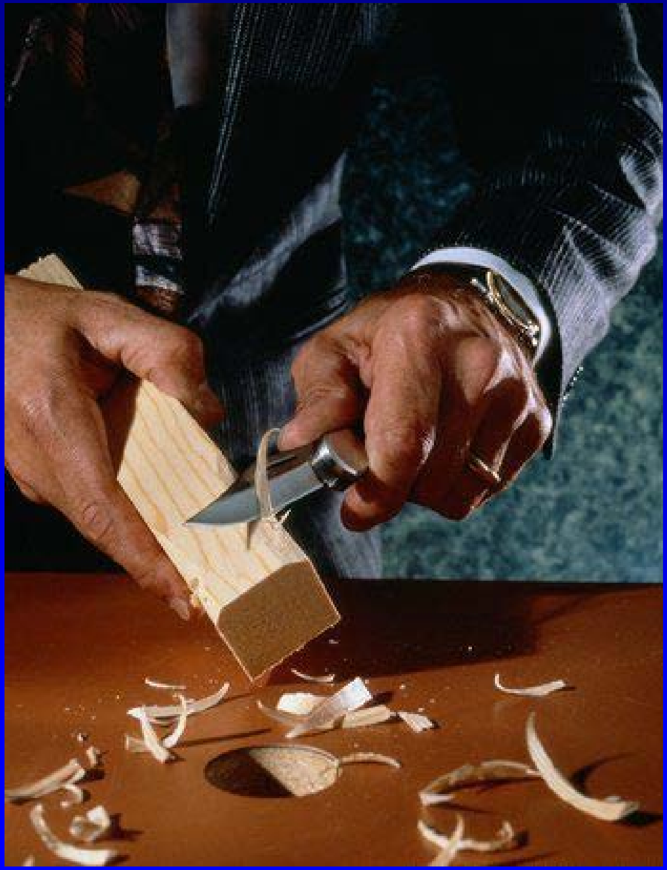


Predicting Annual Runoff

Limitations of Event-Based Methodology to Estimate Annual RR

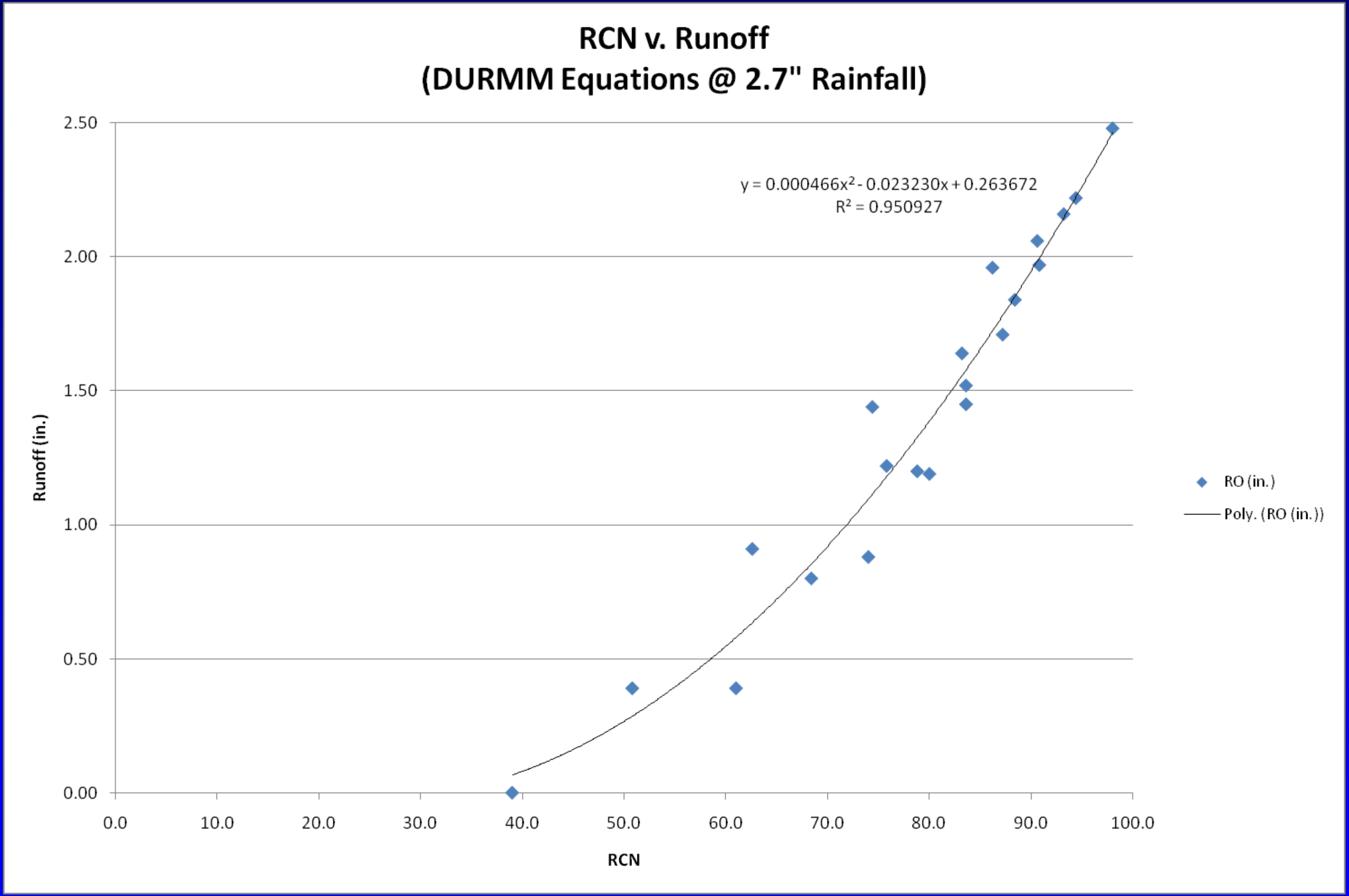
	Hi-CN	Lo-CN
Hi-Rain	✓	✓
Lo-Rain	✓	✗

The Solution:



- Find the link between:
  - Event-based methodologies for modeling retention practices
  - Annual rainfall/runoff relationships for modeling runoff reduction practices

DURMM v.2 – Event RR Equation



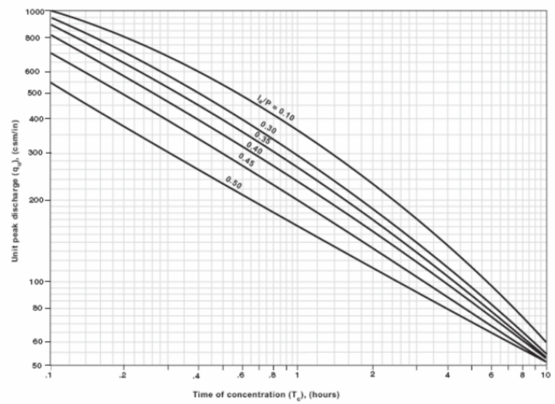
➢ **1-YR Event Runoff = 0.000466(RCN)^2 – 0.023230(RCN) + 0.263672**

Modeling Runoff Reduction Practices

- Storage Practices
  - Ex.: infiltration trench, bioretention, etc.
  - Runoff reduction a function of storage volume (constant)
  - Typically modeled using event-based methodology
  - Recommendation: MDE’s CN* method

Adjusted Curve Number (CN*) Method

Exhibit 4-II Unit peal discharge (q_u) for NRCS (SCS) type II rainfall distribution



Method 1 - Change in Curve Number Method

Step 1: Compute the increased upland runoff depth for the 2-year storm.

$Q = Q_a - (q_{ub} / q_{ua})Q_b$

$Q = 1.16 - (375 / 590)(0.69) = 0.72$ inches

The infiltration basin is sized to store 0.72 inches (65,340 ft3)of runoff.

Step 2 : Compute the adjusted curve number (CN*) associated with the revised after development runoff depth (Q).

$Q = 1.16 - 0.72 = 0.44$ inches

$CN^* = 200 / [(P+2Q+2) - \sqrt{(5PQ + 4Q^2)}$

$CN^* = 200 / [(3.3+2(.44)+2) - \sqrt{(5(3.3)(.44) + 4(.44)^2)}$

$CN^* = 59.78$

Step 3 - Compute the revised peak discharge and outflow hydrograph from the TR-20 Program.

Input:

D.A.	=	0.0390 square miles
CN*	=	59. 78
t_c	=	0.37 hrs
P	=	3.3 inches

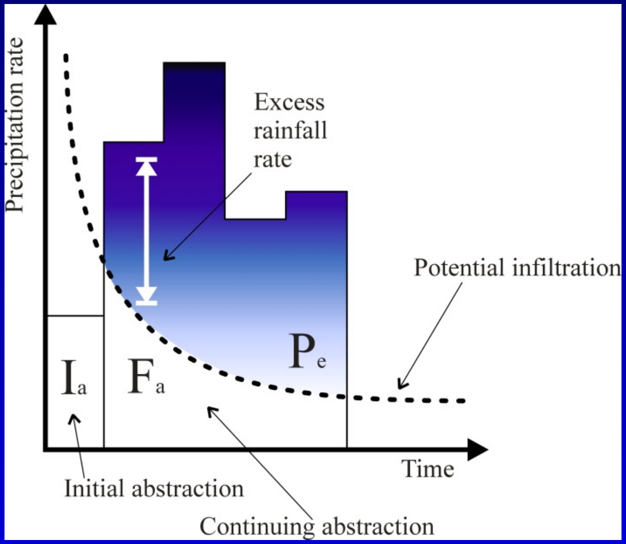
Output: q_a (with infiltration basin) = 6.1 cfs

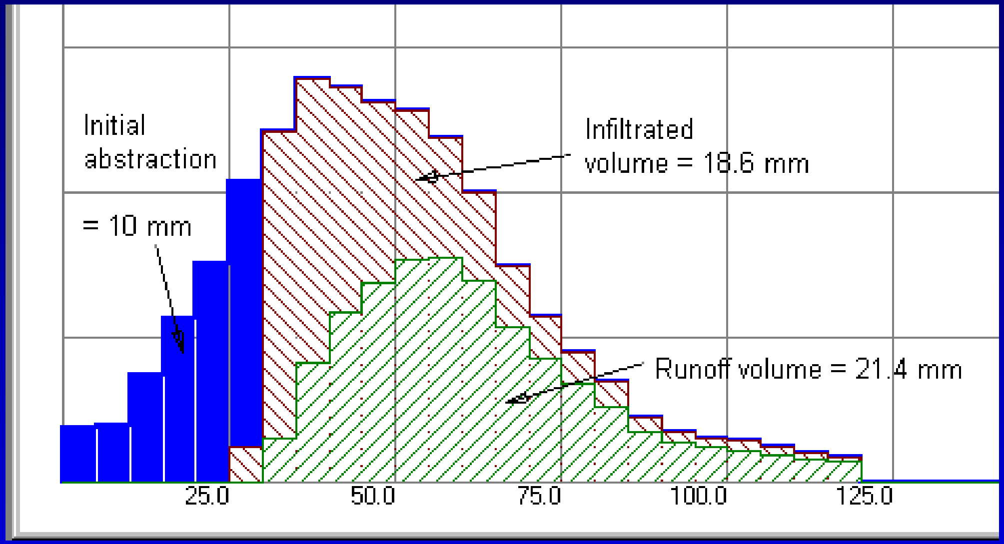
See Figure 1 for the resultant outflow hydrograph.

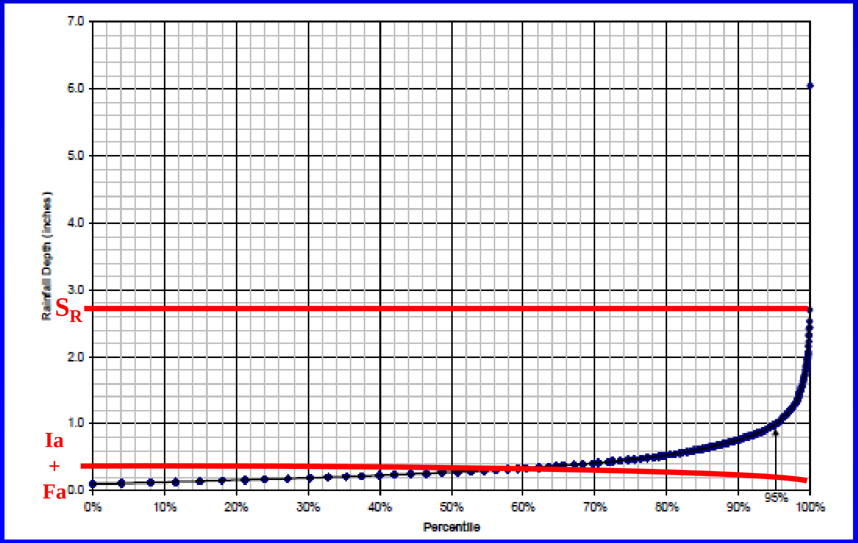
Modeling Runoff Reduction Practices

- Storage Practices
  - Ex.: infiltration trench, bioretention, etc.
  - Runoff reduction a function of storage volume (constant)
  - Typically modeled using event-based methodology
  - Recommendation: MDE’s CN* method
- Non-Storage Practices
  - Ex: filter strip, bioswale, soil amendment, etc.
  - Runoff reduction a function of rainfall (variable)

RPv BMP Hydrology







Modeling Runoff Reduction Practices

- Storage Practices
  - Ex.: infiltration trench, bioretention, etc.
  - Runoff reduction a function of storage volume (constant)
  - Typically modeled using event-based methodology
  - Recommendation: MDE's CN* method
- Non-Storage Practices
  - Ex: filter strip, bioswale, soil amendment, etc.
  - Runoff reduction a function of rainfall (variable)
  - Typically modeled using deterministic methods (ex., SWMM) or empirical methods based on regression equations (ex., Simple Method) using annual precipitation
  - Needed: simple computational method based on RCN

Annual RR Modeling: Correlation Approach

		% Pervious	% Impervious (directly connected)	% Impervious (disconnected)	Clay RV	Silt RV	Sand RV
Residential	Ultra low density	90.4	5.6	4.0	0.11	0.09	0.05
	Low density						
	typical	79.6	14.9	5.5	0.16	0.14	0.11
	connected	79.6	20.4	0	0.22	0.20	0.17
	disconnected	79.6	7.0	13.4	0.12	0.10	0.07
	Medium density						
	typical	62.3	24.2	13.5	0.26	0.23	0.19
	connected	62.3	37.7	0	0.35	0.34	0.32
	disconnected	62.3	12.8	24.9	0.19	0.14	0.11
	High density						
	typical	47.0	39.9	13.1	0.37	0.34	0.32
	connected	47.0	53.0	0	0.46	0.45	0.43
	disconnected	47.0	13.5	39.5	0.29	0.24	0.21
Commercial (shopping center)		8.28	91.72	0	0.72	0.72	0.72
Industrial		16.7	62.8	20.5	0.52	0.52	0.52

Source: Pitt & Voorhees (2004)

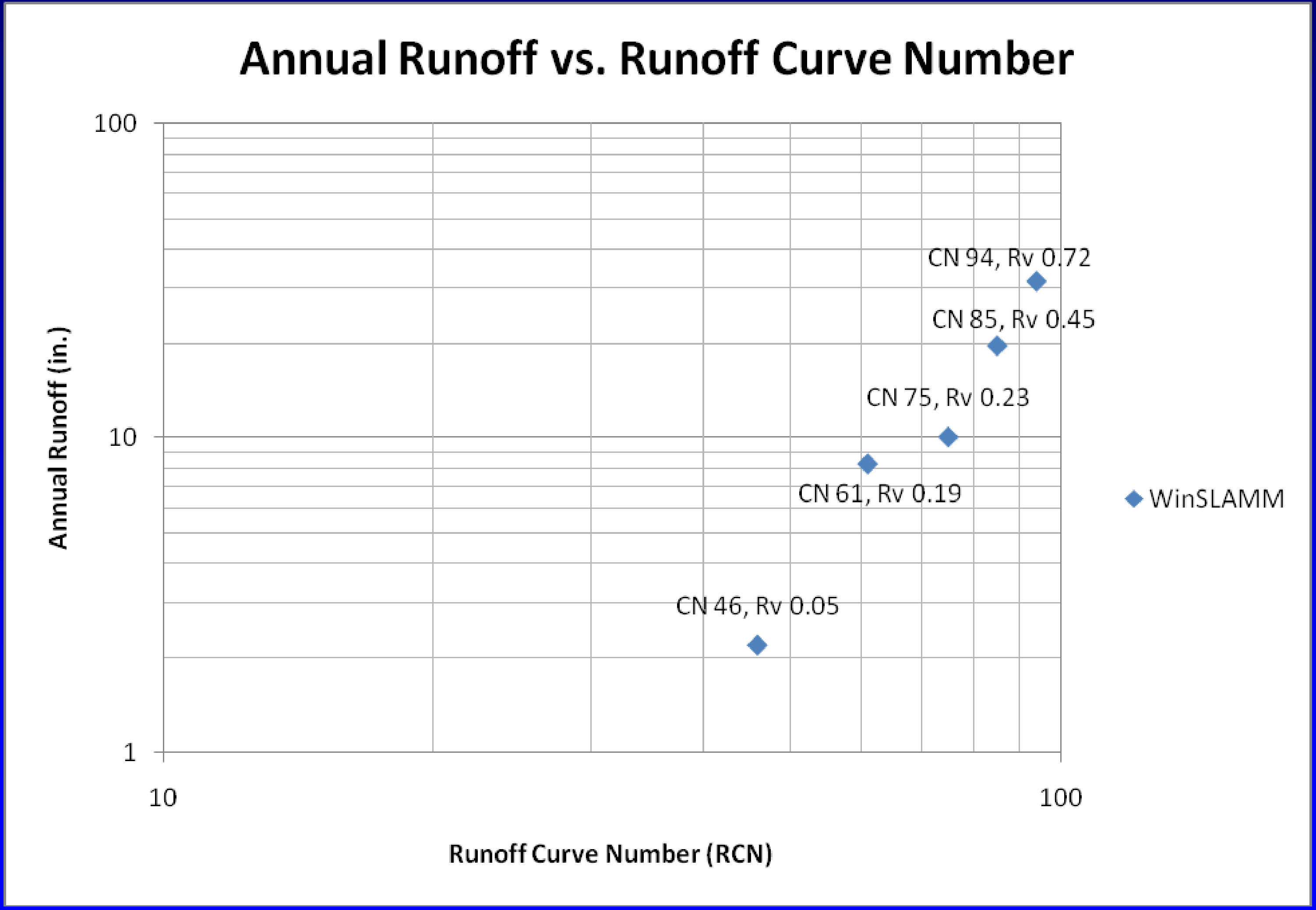
Annual RR Modeling: Correlation Approach

Table 2-2a Runoff curve numbers for urban areas [1]

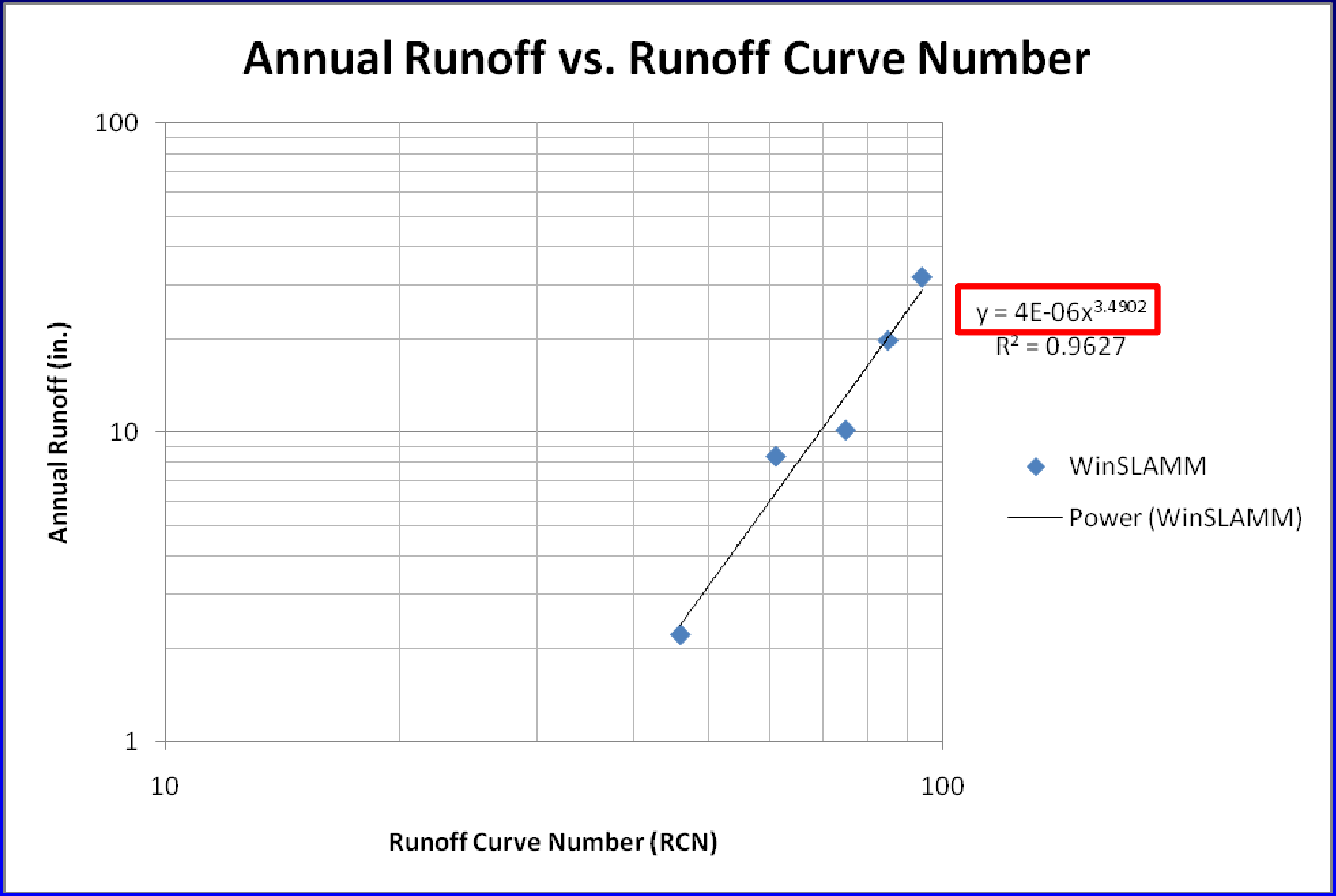
Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82

Source: Table 2-2a, USDA-NRCS TR-55

Annual RR Modeling



DURMM v.2 – Annual RR Equation



- **Annual Runoff = 0.000004(RCN)$^{3.5}$**

DURMM v.2 BMP Modeling for RPv

- Retention (Storage) Practices
  - 1-YR Storm (2.7”)
  - Event runoff calculated using RCN with WinSLAMM algorithms
  - Runoff reduction based on BMP storage using CN* methodology

DURMM v.2 BMP Modeling for RPv

- Annual Reduction Practices
  - All events up to 1-YR Storm (≤ 2.7")
  - Annual runoff calculated using correlation between RCN & Rv values
  - Runoff reduction based on literature values for % annual runoff reduction

DURMM v.2

Runoff Reduction Methodology Caveats

- The methodology was developed as an empirical compliance tool. It should <u>not</u> be considered as a replacement for physically-based hydrologic modeling tools.
- Under actual rainfall conditions, low magnitude events would be expected to be fully captured by the runoff reduction practices. However, as magnitude increases, the percentage of runoff volume captured decreases. Therefore, the runoff reduction calculated for GTBMPs using this methodology should be viewed as an <u>average value based on the annual rainfall distribution</u>.

DURMM v.2
Limitations of the Model

- The current version of DURMM v.2 does not included a BMP design component
- DURMM v.2 is used to quickly assess various runoff reduction practices to determine the optimum solution for compliance, but the user must then use the Post-Construction Stormwater BMP Stds & Specs for final design of the selected practices

DURMM v.2

Important Modeling Assumptions

- The runoff reduction requirement is dependent on an accurate estimate of the impervious footprint on the appropriate HSG
- **If the impervious area is not allocated properly by HSG, the calculated RPv will not be valid**

RR Methodology: Documentation

Delaware DNREC Runoff Reduction Guidance Document

Introduction

The benefits of controlling stormwater runoff volume that results from land development activities have been well documented and are generally accepted by contemporary stormwater management practitioners. Although infiltration practices have been used for many years to mitigate the impacts associated with increased stormwater runoff, the benefits of more passive and non-structural approaches have only recently been recognized. Unfortunately, methods to quantify and assess those benefits have been limited, ranging from relatively simple empirical methods based on percentage of impervious cover to highly complex deterministic models which are beyond the needs of site-level analysis. In addition, the benefits from these so-called "green infrastructure" practices are generally associated with reductions in the annual runoff volume. Traditional stormwater management has relied on event-based methods to evaluate stormwater impacts and verify regulatory compliance. The Delaware Sediment & Stormwater Program has developed a methodology based on the Natural Resource Conservation Service's Runoff Curve Number (RCN) methodology to estimate the annual runoff from developing lands and runoff reduction benefits associated with Green Technology Best Management Practices (GTBMPs). This guidance document presents the scientific background behind, derivation of, and application of the methodology for compliance with the Delaware Sediment & Stormwater Regulations.

Background

It has been shown that the majority of the annual stormwater runoff is generated by small storm events accumulating over time. Dr. Robert Pitt of the University of Alabama is recognized in the scientific community as a national leader on the subject of small storm hydrology. Figure 1 illustrates his findings that rain events between 0.35" and 3" are responsible for about 80% of the total annual runoff volume based on data collected from BWI airport and modeled in his WinSLAMM model. Although rainfall events less than 0.1" can account for up to 20% of the annual precipitation, as Figure 1 shows, they produce little if any runoff, which tends to skew the annual rainfall-runoff relationship. Based on Pitt's data, it was determined that the median runoff event was about 1.25 inches, which is approximately the 90th percentile rainfall event for the Delmarva region. That is, the 90th percentile rainfall event only accounts for about 50% of the annual runoff. This has important implications for stormwater management, particularly from a water quality and resource protection perspective. In order to manage the 90th percentile annual runoff volume, one would need to capture the runoff generated by the 99th percentile rainfall event.

Technical Document, Article 3.04.2

McCUEN'S CHANGE IN CURVE NUMBER METHOD*

(* Adapted from MDE 1983)

There are three different methods that can be used with the TR-20 program for modeling infiltration systems. The TR-20 methods include: 1) the change in curve number method, 2) the truncated hydrograph method, or 3) the hydrograph routing method. Method 1, the change in curve number method is described below.

Background

The method described below describes a volume based approach to control increases in discharge rates by storing the increased runoff depth due to changes in land use. This method was developed by Dr. Richard McCuen as part of the development of the Maryland Standards and Specifications for Stormwater Management Infiltration Practices (MDE 1984) and described by MDE in the publication titled, "Modelling Infiltration Practices Using TR-20) (MDE, 1983). The materials presented below have been adapted from these two publications.

Most stormwater management policies require the peak discharge for a selected return period(s). The before development peak discharge (qb) can be determined using the SCS graphical method:

$$q_b = (q_{ub})(A)(Q_b) \qquad \text{Equation 1}$$

In which q_{ub} is the unit peak discharge, in cubic feet per second per square mile per inch of runoff (csm/in.), from Exhibit 4-II, page 4-5 of the NRCS TR-55 (NRCS, 1986) based on the before development time of concentration (t_{cb}) in hours, and Q_b is the before development depth of runoff in inches, and A is the drainage area in square miles. Using a subscript "a" to indicate "after development", the after development peak discharge (q_a) is given by:

$$q_a = (q_{ua})(A)(Q_a) \qquad \text{Equation 2}$$

While the total drainage area (A) will remain constant, both the unit peak discharge (q_u) and the runoff depth (Q) will typically be greater for the after development conditions. If the development causes a decrease in the time of concentration, then the unit peak discharge will increase. Similarly, an increase in the percent of imperviousness will cause an increase in the volume of runoff. If the stormwater management policy requires qa to be equal to q_b, then the policy could be met if a difference in depths of runoff ΔQ was controlled; this is determined as follows:

$$Q_{ua}(A)(Q_a\text{-}Q_b) = q_{ub}(A)Q_b \qquad \text{Equation 3}$$

Therefore solving for ΔQ yields:

$$\Delta Q = Q_a - (q_{ub} / q_{ua})(Q_b) \qquad \text{Equation 4}$$

Technical Document, Article 3.04.3

DURMM v.2 Layout

DURMM_v2_2010-06-15.xls [Compatibility Mode] - Microsoft Excel

PROJECT:	
DRAINAGE SUBAREA ID:	
LOCATION (County):	
UNIT HYDROGRAPH:	

Cover Type	Treatment	Hydrologic Condition	A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
			Curve Numbers for Hydrologic Soil Type							
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39		61		74		80
Impervious Areas										
	Paved parking lots, roofs, driveways			98		98		98		98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
	User defined urban			**		**		**		**
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
			0		0		0		0	
			Total Acres				**0**			
	Weighted Runoff Curve Number (RCN)						**0**			

CLEAR TABLE

User input

Pre-set or output

Result

Workflow →

C.A. RCN | LOD | OLOD | RPv | TMDL | Cv | Fv | DURMM Report

DURMM v.2: Contributing Area RCN Sheet

	PROJECT:										
	DRAINAGE SUBAREA ID:										
	LOCATION (County):										
	UNIT HYDROGRAPH:										
CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET			Curve Numbers for Hydrologic Soil Type								
Cover Type	Treatment	Hydrologic Condition	A		B		C		D		
			Acres	*RCN*	*Acres*	*RCN*	*Acres*	*RCN*	*Acres*	*RCN*	
FULLY DEVELOPED URBAN AREAS (Veg Established)											
Open space (Lawns,parks etc.)											
	Poor condition; grass cover < 50%			68		79		86		89	
	Fair condition; grass cover 50% to 75 %			49		69		79		84	
	Good condition; grass cover > 75%			39		61		74		80	
Impervious Areas											
	Paved parking lots, roofs, driveways			98		98		98		98	
	Streets and roads										
	Paved; curbs and storm sewers			98		98		98		98	
	Paved; open ditches (w/right-of-way)			83		89		92		93	
	Gravel (w/ right-of-way)			76		85		89		91	
	Dirt (w/ right-of-way)			72		82		87		89	
Urban Districts		Avg % impervious									
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	Industrial	72		81		88		91		93	
Residential districts by average lot size		Avg % impervious									
	1/8 acre (town houses)	65		77		85		90		92	
	1/4 acre	38		61		75		83		87	
	1/3 acre	30		57		72		81		86	
	1/2 acre	25		54		70		80		85	
	1 acre	20		51		68		79		84	
	2 acre	12		46		65		77		82	
DEVELOPING URBAN AREA (No Vegetation)											
	Newly graded area (pervious only)			77		86		91		94	
USER DEFINED											
	Subarea Contributing Area per Soil Type (ac)		0		0		0		0		CLEAR TABLE
UPSTREAM CONTRIBUTING AREAS		*Subarea ID*	*Acres*	*RCN*							
	Upstream Contributing Area 1										
	Upstream Contributing Area 2										
	Upstream Contributing Area 3										
	Upstream Contributing Area 4										
		Total Contributing Area (ac)						0			
		Weighted Runoff Curve Number (RCN)						0			

C.A. RCN / LOD / OLOD / RPv / TMDL / Cv / Fv / DURMM Report / Data & Documentation / Summary Common POI

DURMM v.2: LOD Sheet

	A	B	C	D	E	F	G
1	**PROJECT:**	0					
2	**DRAINAGE SUBAREA ID:**	0					
3	**LOCATION (County):**	0					
4	**UNIT HYDROGRAPH:**	0					
5	**LIMIT OF DISTURBANCE (LOD) WORKSHEET**						
6	**Step 1 - Subarea LOD Data**	**HSG A**	**HSG B**	**HSG C**	**HSG D**		**RESET**
7	1.1 HSG Area Within LOD (ac)						
8	1.2 Pre-Developed Woods/Meadow Within LOD (ac)						
9	1.3 Pre-Developed Impervious Within LOD (ac)						
10	1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***						
11	1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	0%	0%	0%	0%		
12							
13	**Step 2 - Subarea LOD Runoff Calculations**						
14	2.1 RCN per HSG	0.00	0.00	0.00	0.00		
15	2.2 RPv per HSG (in.)	0.00	0.00	0.00	0.00		
16	2.3 Target Runoff per HSG (in.)	0.00	0.00	0.00	0.00		
17	2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.00	0.00	0.00		
18	2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	0.00	0.00	0.00	0.00		
19							
20	2.6 Subarea LOD (ac)	0.00					
21	2.7 Subarea Weighted RCN	#DIV/0!					
22	2.8 Subarea Weighted RPv (in.)	#DIV/0!					
23	2.9 Subarea Weighted Target Runoff (in.)	#DIV/0!					
24							
25	**Step 3 - Upstream LOD Areas** ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**		
26	3.1 Upstream Sub-Area ID						
27	3.2 Upstream LOD Area (ac)						
28	3.3 Target Runoff for Upstream Area (in.)						
29	3.4 Adjusted CN after all reductions						
30	3.5 Adjusted RPv (in.)						
31	3.6 Adjusted Cv (in.)						
32	3.7 Adjusted Fv (in.)						
33							
34	**Step 4 - RPv Calculations for Combined LOD**						
35	4.1 Combined LOD (ac)	0.00					
36	4.2 Weighted RCN	#DIV/0!					
37	4.3 Weighted RPv (in.)	#DIV/0!					
38	4.4 Weighted Target Runoff (in.)	#DIV/0!					
39	4.5 Estimated Annual Runoff (in.)	#DIV/0!					
40	4.6 Req'd Runoff Reduction within LOD (in.)	#DIV/0!					
41	4.7 Req'd Runoff Reduction within LOD (%)	#DIV/0!					
42							
43	**Step 5 - Cv Unit Discharge**						
44	5. LOD Allowable Unit Discharge (cfs/ac)	#DIV/0!					
45							
46	**Step 6 - Fv Unit Discharge**						
47	6. LOD Allowable Unit Discharge (cfs/ac)	#DIV/0!					

C.A. RCN | **LOD** | OLOD | RPv | TMDL | Cv | Fv | DURMM Report | Data & Documentation | Summary Common POI

DURMM v.2: OLOD Sheet

PROJECT:	0
DRAINAGE SUBAREA ID:	0
LOCATION (County):	0
UNIT HYDROGRAPH:	0

OUTSIDE LIMIT OF DISTURBANCE (OLOD) WORKSHEET

Step 1 - Site Data

1.1 Total Contributing Area (ac)	N/A
1.2 C.A. RCN	N/A
1.3 LOD Area (ac)	N/A
1.4 LOD RCN	N/A
1.5 Outside LOD Area (ac)	N/A
1.6 Outside LOD RCN	N/A

Step 2 - Time of Concentration

FLOW TYPE	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
Sheet				----------	N/A	0.00
				----------	N/A	0.00
				----------	N/A	0.00
Shallow Concentrated				N/A	----------	0.00
				N/A	----------	0.00
				N/A	----------	0.00
Open Channel			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00

CLEAR Tc

2.7 Time of Concentration (Tc) 0.10

Sheet Flow Surface Codes

- a smooth surface
- b fallow (no residue)
- c cultivated < 20% Res.
- d cultivated > 20% Res.
- e grass - range, short
- f grass, dense
- g grass, bermuda
- h woods, light
- i woods, dense
- j range, natural

Shallow Concentrated Surface Codes

- u unpaved surface
- p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	0	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	#N/A	#N/A
3.4 Initial Abstraction, Ia (in.)	#N/A	#N/A
3.5 Ia/P ratio	#N/A	#N/A
3.6 Unit Peak Discharge, qu (csm/in)	#N/A	#N/A
3.7 Runoff (in.)	#N/A	#N/A
3.8 Peak Discharge, qp (cfs)	#VALUE!	#VALUE!
3.9 Equiv. unit peak discharge (cfs/ac)	0.00	0.00

C.A. RCN | LOD | OLOD | RPv | TMDL | Cv | Fv | DURMM Report

DURMM v.2: RPv Sheet

	A	B	C	D	E	F	G	H	I	J	K
1	PROJECT:	0									
2	DRAINAGE SUBAREA ID:	0									
3	LOCATION (County):	0									
4	RESOURCE PROTECTION EVENT (RPv) WORKSHEET										
5	RESET	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
6		Type	--	Type	--	Type	--	Type	--	Type	--
7	*Step 1 - Calculate Initial RPv*	Data		Data		Data		Data		Data	
8	1.1 Total contributing area to BMP (ac)	0.00		0.00		0.00		0.00		0.00	
9	1.2 *Reserved*										
10	1.3 Initial RCN	#DIV/0!									
11	1.4 RPv for Contributing Area (in.)	#DIV/0!									
12	1.5 Req'd RPv Reduction for Contributing Area (in.)	#DIV/0!									
13	1.6 Req'd RPv Reduction for Contributing Area (%)	#DIV/0!									
14	1.7 RPv allowable discharge rate (cfs)	#DIV/0!									
15											
16	*Step 2 - Adjust for Retention Reduction*										
17	2.1 Storage volume (cu. ft.)										
18	2.2 Retention reduction allowance (%)	N/A		N/A		N/A		N/A		N/A	
19	2.3 Retention reduction volume (ac-ft)	N/A		N/A		N/A		N/A		N/A	
20	2.4 Retention reduction volume (in.)	N/A		N/A		N/A		N/A		N/A	
21	2.5 Runoff volume after retention reduction (in.)	N/A		N/A		N/A		N/A		N/A	
22	2.6 Adjusted CN*	N/A		N/A		N/A		N/A		N/A	
23											
24	*Step 3 - Adjust for Annual Runoff Reduction*										
25	3.1 Annual CN (ACN)	#DIV/0!		N/A		N/A		N/A		N/A	
26	3.2 Annual runoff (in.)	#DIV/0!		N/A		N/A		N/A		N/A	
27	3.3 Proportion A/B soils in BMP footprint (%)										
28	3.4 Annual runoff reduction allowance (%)	N/A		N/A		N/A		N/A		N/A	
29	3.5 Annual runoff after reduction (in.)	N/A		N/A		N/A		N/A		N/A	
30	3.6 Adjusted ACN	N/A		N/A		N/A		N/A		N/A	
31	3.7 Annual Runoff Reduction Allowance for RPv (in.)	N/A		N/A		N/A		N/A		N/A	
32											
33	*Step 4 - Calculate RPv with BMP Reductions*										
34	4.1 RPv runoff volume after all reductions (in.)	N/A		N/A		N/A		N/A		N/A	
35	4.2 Total RPv runoff reduction (in.)	N/A		N/A		N/A		N/A		N/A	
36	4.3 Total RPv runoff reduction (%)	N/A		N/A		N/A		N/A		N/A	
37	4.4 Adjusted CN after all reductions	N/A		N/A		N/A		N/A		N/A	
38	4.5 Adjusted equivalent annual runoff (in.)	N/A		N/A		N/A		N/A		N/A	
39	4.6 Equivalent TR-55 RCN for H&H modeling	N/A		N/A		N/A		N/A		N/A	
40	4.7 Required reduction met?	N/A		N/A		N/A		N/A		N/A	
41	4.8 If required reduction met, reduction credit (cu.ft)	N/A		N/A		N/A		N/A		N/A	
42											
43	*Step 5 - Determine Runoff Reduction Shortfall*										
44	5.1 Runoff Reduction Shortfall (in.)	N/A		N/A		N/A		N/A		N/A	
45	5.2 Runoff Reduction Shortfall (cu.ft./ac)	N/A		N/A		N/A		N/A		N/A	
46	5.3 Total Shortfall Volume (cu.ft.)	N/A		N/A		N/A		N/A		N/A	
47											
48											
49											
50											
51											

C.A. RCN | LOD | OLOD | **RPv** | TMDL | Cv | Fv | DURMM Report | Data & Documentation | Summa

DURMM v.2: TMDL Sheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	**PROJECT:**	0																			
2	**DRAINAGE SUBAREA ID:**	0																			
3	**LANDUSE TYPE:**																				
4	**TMDL WATERSHED:**																				
5	**TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET**																				
6		**BMP 1**				**BMP 2**				**BMP 3**				**BMP 4**				**BMP 5**			
7		**Type:**	--			**Type:**	--			**Type:**	--			**Type:**	--			**Type:**	--		
8	***Step 1 - Calculate Annual Runoff Volume***	**Data**	**TN**	**TP**	**TSS**	**Data**	**TN**	**TP**	**TSS**	**Data**	**TN**	**TP**	**TSS**	**Data**	**TN**	**TP**	**TSS**	**Data**	**TN**	**TP**	**TSS**
9	1.1 Total contributing area to BMP (ac)	0.00																			
10	1.2 Initial RCN	#DIV/0!																			
11	1.3 Annual runoff volume (in.)	#DIV/0!																			
12	1.4 Annual runoff volume (liters)	#DIV/0!																			
13																					
14	***Step 2 - Calculate Annual Pollutant Load***																				
15	2.1 EMC (mg/L)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
16	2.2 Load (mg/yr)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
17	2.3 Stormwater Load (lb/ac/yr)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
18																					
19	***Step 3 - Adjust for Pollutant Reduction***																				
20	3.1 BMP annual runoff reduction (%)	N/A				N/A				N/A				N/A				N/A			
21	3.2 Adjusted annual runoff volume (in)	N/A				N/A				N/A				N/A				N/A			
22	3.3 Adjusted annual runoff volume (liters)	N/A				N/A				N/A				N/A				N/A			
23	3.4 Adjusted load from annual reductions (lb/ac/yr)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
24	3.5 BMP removal efficiency (%)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
25	3.6 Treatment train removal efficiency (%)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
26	3.7 BMP effluent concentration (mg/L)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
27	3.8 Final Adjusted load (lb/ac/yr)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
28	3.9 Final Adjusted load (lb/yr)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
29																					
30	***Step 4 - Pollutant Reduction Met?*** *(For Informational Purposes)*																				
31	4.1 TMDL (lb/ac/yr)		#N/A	#N/A	#N/A																
32	4.2 Reduction met?		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
33	4.3 Removed Load (lb/yr)		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
34																					

DURMM v.2: Cv Sheet

A	B	C	D	E	F	G	H	I	J	K
PROJECT:	0									
DRAINAGE SUBAREA ID:	0									
LOCATION (County):	0									
CONVEYANCE EVENT (Cv) WORKSHEET										
	BMP 1		**BMP 2**		**BMP 3**		**BMP 4**		**BMP 5**	
	Type:	--	**Type:**	--	**Type:**	--	**Type:**	--	**Type:**	--
Step 1 - Calculate Initial Cv	**Data**		**Data**		**Data**		**Data**		**Data**	
1.1 Total contributing area to BMP (ac)	0.00		0.00		0.00		0.00		0.00	
1.2 Initial RCN	#DIV/0!									
1.3 10-Year Rainfall (in.)	#N/A									
1.4 Cv runoff volume (in.)	#N/A									
1.5 LOD allowable unit discharge (cfs/ac)	#DIV/0!									
1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
1.7 Cv allowable discharge rate (cfs)	#DIV/0!									
Step 2 - Adjust for Retention Reduction										
2.1 Storage volume (cu. ft.)	N/A		N/A		N/A		N/A		N/A	
2.2 Storage volume (ac-ft)	N/A		N/A		N/A		N/A		N/A	
2.3 Storage volume (in.)	N/A		N/A		N/A		N/A		N/A	
2.4 Runoff volume after reduction (in.)	N/A		N/A		N/A		N/A		N/A	
2.5 CN*	N/A		N/A		N/A		N/A		N/A	
Step 3 - Adjust for Annual Runoff Reduction										
3.1 Runoff reduction allowance (%)	N/A		N/A		N/A		N/A		N/A	
3.2 Annual runoff after reduction (in.)	N/A		N/A		N/A		N/A		N/A	
3.3 Adjusted ACN	N/A		N/A		N/A		N/A		N/A	
3.4 Event-based runoff reduction (in.)	N/A		N/A		N/A		N/A		N/A	
Step 4 - Calculate Cv with BMP Reductions										
4.1 Cv runoff volume after all reductions (in.)	N/A		N/A		N/A		N/A		N/A	
4.2 Total Cv runoff reduction (%)	N/A		N/A		N/A		N/A		N/A	
4.3 Adjusted RCN for H&H modeling	N/A		N/A		N/A		N/A		N/A	

DURMM v.2: Fv Sheet

	A	B	C	D	E	F	G	H	I	J	K
1	**PROJECT:**	0									
2	**DRAINAGE SUBAREA ID:**	0									
3	**LOCATION (County):**	0									
4	**FLOODING EVENT (Fv) WORKSHEET**										
5		**BMP 1**		**BMP 2**		**BMP 3**		**BMP 4**		**BMP 5**	
6		**Type:**	--	**Type:**	--	**Type:**	--	**Type:**	--	**Type:**	--
7	***Step 1 - Calculate Initial Fv***	**Data**		**Data**		**Data**		**Data**		**Data**	
8	1.1 Total contributing area to BMP (ac)	0.00		0.00		0.00		0.00		0.00	
9	1.2 Initial RCN	#DIV/0!									
10	1.3 100-Year Rainfall (in.)	#N/A									
11	1.4 Fv runoff volume (in.)	#N/A									
12	1.5 LOD allowable unit discharge (cfs/ac)	#DIV/0!									
13	1.6 Equiv. unit discharge outside LOD (cfs/ac)	0.00									
14	1.7 Fv allowable discharge rate (cfs)	#DIV/0!									
15											
16	***Step 2 - Adjust for Retention Reduction***										
17	2.1 Storage volume (cu. ft.)	N/A		N/A		N/A		N/A		N/A	
18	2.2 Storage volume (ac-ft)	N/A		N/A		N/A		N/A		N/A	
19	2.3 Storage volume (in.)	N/A		N/A		N/A		N/A		N/A	
20	2.4 Runoff volume after reduction (in.)	N/A		N/A		N/A		N/A		N/A	
21	2.5 CN*	N/A		N/A		N/A		N/A		N/A	
22											
23	***Step 3 - Adjust for Annual Runoff Reduction***										
24	3.1 Runoff reduction allowance (%)	N/A		N/A		N/A		N/A		N/A	
25	3.2 Annual runoff after reduction (in.)	N/A		N/A		N/A		N/A		N/A	
26	3.3 Adjusted ACN	N/A		N/A		N/A		N/A		N/A	
27	3.4 Event-based runoff reduction (in.)	N/A		N/A		N/A		N/A		N/A	
28											
29	***Step 4 - Calculate Fv with BMP Reductions***										
30	4.1 Fv runoff volume after all reductions (in.)	N/A		N/A		N/A		N/A		N/A	
31	4.2 Total Fv runoff reduction (%)	N/A		N/A		N/A		N/A		N/A	
32	4.3 Adjusted RCN for H&H modeling	N/A		N/A		N/A		N/A		N/A	

DURMM v.2: DURMM Report

	A	B	C	D	E	F
1	PROJECT:	0				
2	DRAINAGE SUBAREA ID:	0				
3	COUNTY:	0		UNIT HYDROGRAPH:		0
4	TMDL Watershed:	0		LANDUSE:	0	
5	DURMM OUTPUT WORKSHEET				DURMM v2.00.130226	
6	*Site Data*					
7	Contributing Area to BMPs (ac.)	0.00				
8	C.A. RCN	0.00				
9	Subarea LOD (ac.)	0.00				
10	Subarea RCN	#DIV/0!				
11	Upstream Subarea ID					
12	Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
13	Combined LOD with Upstream Areas (ac.)	0.00				
14	Combined RCN with Upstream Areas (ac.)	#DIV/0!				
15	Watershed TMDL-TN (lb/ac/yr)	#N/A				
16	Watershed TMDL-TP (lb/ac/yr)	#N/A				
17	Watershed TMDL-TSS (lb/ac/yr)	#N/A				
18						
19	*BMP Data*	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
20						
21		--	--	--	--	--
22						
23	RPv runoff volume after all reductions (in.)	N/A	N/A	N/A	N/A	N/A
24	Total RPv runoff reduction (in.)	N/A	N/A	N/A	N/A	N/A
25	Total RPv runoff reduction (%)	N/A	N/A	N/A	N/A	N/A
26	Req'd runoff reduction met?	N/A	N/A	N/A	N/A	N/A
27	RPv Offset Volume (cu. ft.)	N/A	N/A	N/A	N/A	N/A
28	Adjusted pollutant load, TN (lb/ac/yr)	N/A	N/A	N/A	N/A	N/A
29	Adjusted pollutant load, TP (lb/ac/yr)	N/A	N/A	N/A	N/A	N/A
30	Adjusted pollutant load, TSS (lb/ac/yr)	N/A	N/A	N/A	N/A	N/A
31	Cv runoff volume after all reductions (in.)	N/A	N/A	N/A	N/A	N/A
32	Fv runoff volume after all reductions (in.)	N/A	N/A	N/A	N/A	N/A
33						
34	*Resource Protection Event (RPV)*					
35	RPv for Contributing Area (in.)	#DIV/0!				
36	Annual Runoff for Contributing Area (in.)	#DIV/0!				
37	Req'd RPv Reduction for Contributing Area (in.)	#DIV/0!				
38	Req'd RPv Reduction for Contributing Area (%)	#DIV/0!				
39	RPv Runoff Reduction Shortfall or Credit (cu.ft.)	0.00	CREDIT			
40	C.A. allowable discharge rate (cfs)	#DIV/0!				
41	Adjusted CN after all reductions	0.00				
42	Equivalent RCN for H&H Modeling	0.00				
43						
44	*Conveyance Event (Cv)*					
45	Cv runoff volume (in.)	#N/A				
46	Stds-based allowable discharge (cfs)	#DIV/0!				
47	Equivalent RCN for H&H Modeling	0.00				

C.A. RCN / LOD / OLOD / RPv / TMDL / Cv / Fv / DURMM

Ready 82%

	A	B	C	D	E	F
1	PROJECT:	0				
2	DRAINAGE SUBAREA ID:	0				
3	COUNTY:	0		UNIT HYDROGRAPH:		0
4	TMDL Watershed:	0		LANDUSE:	0	
5	DURMM OUTPUT WORKSHEET				DURMM v2.00.130226	
48						
49	*Flooding Event (Fv)*					
50	Fv runoff volume (in.)	#N/A				
51	Stds-based allowable discharge (cfs)	#DIV/0!				
52	Equivalent RCN for H&H Modeling	0.00				
53						
54	*Adjusted Subarea Data for Downstream DURMM Modeling*					
55	Subarea ID	0.00				
56	Contributing Area (ac.)	0.00				
57	C.A. RCN	0.00				
58	LOD Area (ac.)	0.00				
59	Weighted Target Runoff (in.)	#DIV/0!				
60	Adjusted CN after all reductions	0.00				
61	Adjusted RPv (in.)	0.00				
62	Adjusted Cv (in.)	0.00				
63	Adjusted Fv (in.)	0.00				
64						
65	*Adjusted Subarea Data for Nutrient Protocol Modeling*					
66	Contributing Area (ac.)	0.00				
67	LOD Area (ac.)	0.00				
68	TN Pollutant Load (lb/yr)	0.00				
69	TP Pollutant Load (lb/yr)	0.00				
70	TSS Pollutant Load (lb/yr)	0.00				
71	Percent Impervious Cover	#DIV/0!				
72						
73	*Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest*					
74	Subarea ID	0.00				
75	Contributing Area (ac.)	0.00				
76	Runoff Reduction Shortfall or Credit (cu.ft.)	0.00	CREDIT			
77	Adjusted CN after all reductions	0.00				
78	Cv RCN for H&H Modeling	0.00				
79	Fv RCN for H&H Modeling	0.00				
80	TN Pollutant Load (lb/yr)	0.00				
81	TP Pollutant Load (lb/yr)	0.00				
82	TSS Pollutant Load (lb/yr)	0.00				
83						
84						
85						
86						
87						
88						
89						

C.A. RCN / LOD / OLOD / RPv / TMDL / Cv / Fv / DURMM

DURMM v.2: Data & Documentation

	Class	BMP Category	DURMM Variant	TN Reduction		TP Reduction		TSS Reduction		Retention Allowable	Annual Runoff Reduction, RPv, A/B Soil		Annual Runoff Reduction, RPv, C/D Soil		Runoff Reduction, Cv		Runoff Reduction, Fv	
3	Retention Practice	1.0 Infiltration	1-A Infiltration Trench	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
4	Retention Practice	1.0 Infiltration	1-B Infiltration Basin	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
5	Retention Practice	1.0 Infiltration	1-C Underground Infiltration	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
7	Retention Practice	2.0 Bioretention	2-A Traditional Bioretention - Underdrain	30%	of Load Reduction	40%	of Load Reduction	80%	of Load Reduction	50%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
8	Retention Practice	2.0 Bioretention	2-A Traditional Bioretention - Infiltration	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
9	Retention Practice	2.0 Bioretention	2-B In-Situ Bioretention - Underdrain	30%	of Load Reduction	40%	of Load Reduction	80%	of Load Reduction	50%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
10	Retention Practice	2.0 Bioretention	2-B In-Situ Bioretention - Infiltration	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
11	Retention Practice	2.0 Bioretention	2-C Streetscape Bioretention - Underdrain	30%	of Load Reduction	40%	of Load Reduction	80%	of Load Reduction	50%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
12	Retention Practice	2.0 Bioretention	2-C Streetscape Bioretention - Infiltration	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
13	Retention Practice	2.0 Bioretention	2-D Engineered Tree Pits - Underdrain	30%	of Load Reduction	40%	of Load Reduction	80%	of Load Reduction	50%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
14	Retention Practice	2.0 Bioretention	2-D Engineered Tree Pits - Infiltration	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
15	Retention Practice	2.0 Bioretention	2-E Stormwater Planters - Underdrain	30%	of Load Reduction	40%	of Load Reduction	80%	of Load Reduction	50%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
16	Retention Practice	2.0 Bioretention	2-E Stormwater Planters - Infiltration	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
17	Retention Practice	2.0 Bioretention	2-F Advanced Bioretention - Underdrain	30%	of Load Reduction	40%	of Load Reduction	80%	of Load Reduction	50%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
18	Retention Practice	2.0 Bioretention	2-F Advanced Bioretention - Infiltration	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
20	Retention Practice	3.0 Permeable Pavement	3-A Porous Asphalt (PA)	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
21	Retention Practice	3.0 Permeable Pavement	3-B Pervious Concrete (PC)	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
22	Retention Practice	3.0 Permeable Pavement	3-C Permeable Concrete Pavers (PP) & (CP)	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
23	Retention Practice	3.0 Permeable Pavement	3-D Plastic & Composite Grid Pavers (GP)	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	100%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
25	Annual Runoff Reduction Practice	4.0 Vegetated Roofs	4-A Extensive Vegetated Roofs	100%	of Load Reduction	100%	of Load Reduction	0%	of Load Reduction	0%	50%	Annual RR	0%	Annual RR	5%	Runoff Reduction	1%	Runoff Reduction
26	Annual Runoff Reduction Practice	4.0 Vegetated Roofs	4-B Intensive Vegetated Roofs	100%	of Load Reduction	100%	of Load Reduction	0%	of Load Reduction	0%	75%	Annual RR	0%	Annual RR	8%	Runoff Reduction	2%	Runoff Reduction
28	Retention Practice	5.0 Rainwater Harvesting	5-A Seasonal Rainwater Harvesting	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	50%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
29	Retention Practice	5.0 Rainwater Harvesting	5-B Continuous Rainwater Harvesting	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	75%	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage	0%	of Retention Storage
31	Annual Runoff Reduction Practice	6.0 Restoration Practices	6-A Step Pool RSCS	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
32	Annual Runoff Reduction Practice	6.0 Restoration Practices	6-B Seepage Wetland RSCS	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
33	Annual Runoff Reduction Practice	6.0 Restoration Practices	6-C Streambank Stabilization	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
35	Annual Runoff Reduction Practice	7.0 Rooftop Disconnection	7-A Rooftop Disconnection	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	25%	Annual RR	10%	Annual RR	1%	Runoff Reduction	0%	Runoff Reduction
37	Annual Runoff Reduction Practice	8.0 Vegetated Channels	8-A Bioswale	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	50%	Annual RR	20%	Annual RR	2%	Runoff Reduction	0%	Runoff Reduction
38	Annual Runoff Reduction Practice	8.0 Vegetated Channels	8-B Grassed Channel	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	25%	Annual RR	10%	Annual RR	1%	Runoff Reduction	0%	Runoff Reduction
40	Annual Runoff Reduction Practice	9.0 Sheet Flow	9-A Sheet Flow to Turf Filter Strip	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	25%	Annual RR	10%	Annual RR	10%	of RPv Allowance	1%	of RPv Allowance
41	Annual Runoff Reduction Practice	9.0 Sheet Flow	9-A Sheet Flow to Forested Filter Strip	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	40%	Annual RR	20%	Annual RR	10%	of RPv Allowance	1%	of RPv Allowance
42	Annual Runoff Reduction Practice	9.0 Sheet Flow	9-B Sheet Flow to Turf Open Space	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	50%	Annual RR	20%	Annual RR	10%	of RPv Allowance	1%	of RPv Allowance
43	Annual Runoff Reduction Practice	9.0 Sheet Flow	9-B Sheet Flow to Forested Open Space	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	65%	Annual RR	40%	Annual RR	10%	of RPv Allowance	1%	of RPv Allowance
45	Stormwater Treatment Practice	10.0 Detention Practices	10-A Dry Detention Pond	5%	Removal Efficiency	10%	Removal Efficiency	10%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
46	Stormwater Treatment Practice	10.0 Detention Practices	10-B Dry Extended Detention (ED) Pond	20%	Removal Efficiency	20%	Removal Efficiency	60%	Removal Efficiency	0%	10%	Annual RR	10%	Annual RR	1%	Runoff Reduction	0%	Runoff Reduction
47	Stormwater Treatment Practice	10.0 Detention Practices	10-C Underground Detention Facilities	5%	Removal Efficiency	10%	Removal Efficiency	10%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
49	Stormwater Treatment Practice	11.0 Stormwater Filtering Systems	11-A Non-Structural Sand Filter	40%	Removal Efficiency	60%	Removal Efficiency	80%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
50	Stormwater Treatment Practice	11.0 Stormwater Filtering Systems	11-B Surface Sand Filter	40%	Removal Efficiency	60%	Removal Efficiency	80%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
51	Stormwater Treatment Practice	11.0 Stormwater Filtering Systems	11-C 3-Chamber Underground Sand Filter	40%	Removal Efficiency	60%	Removal Efficiency	80%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
52	Stormwater Treatment Practice	11.0 Stormwater Filtering Systems	11-D Perimeter Sand Filter (DE Sand Filter)	40%	Removal Efficiency	60%	Removal Efficiency	80%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
54	Stormwater Treatment Practice	12.0 Wetlands	12-A Traditional Constructed Wetlands	30%	Removal Efficiency	40%	Removal Efficiency	80%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
55	Stormwater Treatment Practice	12.0 Wetlands	12-B Wetland Swales	20%	Removal Efficiency	30%	Removal Efficiency	60%	Removal Efficiency	0%	15%	Annual RR	10%	Annual RR	1%	Runoff Reduction	0%	Runoff Reduction
56	Stormwater Treatment Practice	12.0 Wetlands	12-C Ephemeral Constructed Wetlands	20%	Removal Efficiency	30%	Removal Efficiency	60%	Removal Efficiency	0%	40%	Annual RR	10%	Annual RR	1%	Runoff Reduction	0%	Runoff Reduction
57	Stormwater Treatment Practice	12.0 Wetlands	12-D Submerged Gravel Wetlands	0%	Removal Efficiency	0%	Removal Efficiency	0%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
59	Stormwater Treatment Practice	13.0 Wet Pond	13-A Wet Pond	20%	Removal Efficiency	45%	Removal Efficiency	60%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
60	Stormwater Treatment Practice	13.0 Wet Pond	13-B Wet Extended Detention (ED) Pond	20%	Removal Efficiency	45%	Removal Efficiency	60%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
62	Annual Runoff Reduction Practice	14.0 Soil Amendments	14-A Compost Amended Soil - HSG A	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	38%	Annual RR	0%	Annual RR	4%	Runoff Reduction	0%	Runoff Reduction
63	Annual Runoff Reduction Practice	14.0 Soil Amendments	14-B Compost Amended Soil - HSG B	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	50%	Annual RR	0%	Annual RR	5%	Runoff Reduction	1%	Runoff Reduction
64	Annual Runoff Reduction Practice	14.0 Soil Amendments	14-C Compost Amended Soil - HSG C	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	0%	Annual RR	29%	Annual RR	3%	Runoff Reduction	0%	Runoff Reduction
65	Annual Runoff Reduction Practice	14.0 Soil Amendments	14-D Compost Amended Soil - HSG D	100%	of Load Reduction	100%	of Load Reduction	100%	of Load Reduction	0%	0%	Annual RR	13%	Annual RR	1%	Runoff Reduction	0%	Runoff Reduction
67	Stormwater Treatment Practice	15.0 Proprietary Practices	15-A Hydrodynamic Structures	5%	Removal Efficiency	10%	Removal Efficiency	10%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
69	Stormwater Treatment Practice	16.0 Source Controls	16-A Nutrient Management	17%	Removal Efficiency	22%	Removal Efficiency	0%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction
70	Stormwater Treatment Practice	16.0 Source Controls	16-B Street Sweeping	3%	Removal Efficiency	3%	Removal Efficiency	9%	Removal Efficiency	0%	0%	Annual RR	0%	Annual RR	0%	Runoff Reduction	0%	Runoff Reduction

C.A. RCN | LOD | OLOD | RPv | TMDL | Cv | Fv | DURMM Report | **Data & Documentation** | Summary Common POI

DURMM v.2: Summary Common POI

Summary Table for Sub-Areas Draining to a Common Point of Interest (POI)[1]

POI: ____

Ref. #	Sub-Area ID[2]	Contributing Area (ac)	RPv Runoff Reduction Shortfall(+) or Credit(-) (in.)[3]	Adjusted RPv CN after all reductions[4]	Cv RCN for H&H Modeling[4]	Fv RCN for H&H Modeling[4]	TN Pollutant Load (lb/yr)	TP Pollutant Load (lb/yr)	TSS Pollutant Load (lb/yr)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
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26									
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28									
29									
30									
Totals to Common POI		**0.00 ac**	**0.00 in.**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**0.00 lb/yr**	**0.00 lb/yr**	**0.00 lb/yr**
RPv Runoff Reduction Goal Met?			**YES**						
If Not, Total Offset Volume Required			**N/A**						

Notes:

1. As long as the site lies within the same watershed, all sub-areas within the site can be tallied to reflect global site conditions; or, the summary table can be used to show conditions to a specific POI.
2. Only the most downstream sub-area information should be entered for a series of sub-areas that drain directly into each other, as the upstream areas will already be accounted for in the DURMM computations.
3. A RPv runoff reduction shortfall should be entered as a positive number, as it is the runoff volume still needed to be reduced. A RPv credit should be entered as a negative number, as it indicates the additional volume that was reduced past the requirement.
4. To portray an accurate total weighted CN value for the RPv, Cv and Fv events, an entry must be made for every defined sub-area. If a sub-area's contributing drainage acreage is entered, but not its corresponding CN value, then the total weighted CN will be skewed.

C.A. RCN | LOD | OLOD | RPv | TMDL | Cv | Fv | DURMM Report | Data & Documentation | **Summary Common POI**

5.3: Runoff Reduction Allowances & BMP Removal Efficiencies

DURMM v.2:
BMP Performance Standards

Class	BMP Category	DURMM Variant	TN Reduction	TP Reduction	TSS Reduction
Retention Practice	1.0 Infiltration	1-A Infiltration Trench	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	1.0 Infiltration	1-B Infiltration Basin	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	1.0 Infiltration	1-C Underground Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-A Traditional Bioretention - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-A Traditional Bioretention - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-B In-Situ Bioretention - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-B In-Situ Bioretention - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-C Streetscape Bioretention - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-C Streetscape Bioretention - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-D Engineered Tree Pits - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-D Engineered Tree Pits - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-E Stormwater Planters - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-E Stormwater Planters - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-F Advanced Bioretention - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-F Advanced Bioretention - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	3.0 Permeable Pavement	3-A Porous Asphalt (PA)	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	3.0 Permeable Pavement	3-B Pervious Concrete (PC)	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	3.0 Permeable Pavement	3-C Permeable Concrete Pavers (PP) & (CP)	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	3.0 Permeable Pavement	3-D Plastic & Composite Grid Pavers (GP)	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	4.0 Vegetated Roofs	4-A Extensive Vegetated Roofs	100% of Load Reduction	100% of Load Reduction	0% of Load Reduction
Annual Runoff Reduction Practice	4.0 Vegetated Roofs	4-B Intensive Vegetated Roofs	100% of Load Reduction	100% of Load Reduction	0% of Load Reduction
Retention Practice	5.0 Rainwater Harvesting	5-A Seasonal Rainwater Harvesting	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	5.0 Rainwater Harvesting	5-B Continuous Rainwater Harvesting	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	6.0 Restoration Practices	6-A Step Pool RSCS	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	6.0 Restoration Practices	6-B Seepage Wetland RSCS	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	6.0 Restoration Practices	6-C Streambank Stabilization	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	7.0 Rooftop Disconnection	7-A Rooftop Disconnection	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	8.0 Vegetated Channels	8-A Bioswale	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	8.0 Vegetated Channels	8-B Grassed Channel	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction

DURMM v.2: BMP Class

- Volume Management Practices
  - Reduce pollutant load
    - Retention Practices
      - Design criteria based on storage capacity for 1-YR event
      - *ex*.; infiltration trench
    - Annual Runoff Reduction Practices
      - Design criteria based on reduction of annual runoff
      - *ex*.; filter strip
- Stormwater Treatment Practices
  - Reduce pollutant concentration
  - Design criteria based on empirical removal efficiency data
  - ex.; wet pond

DURMM v.2: BMP Performance Standards

Class	BMP Category	DURMM Variant	TN Reduction	TP Reduction	TSS Reduction
Retention Practice	1.0 Infiltration	1-A Infiltration Trench	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	1.0 Infiltration	1-B Infiltration Basin	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	1.0 Infiltration	1-C Underground Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-A Traditional Bioretention - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-A Traditional Bioretention - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-B In-Situ Bioretention - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-B In-Situ Bioretention - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-C Streetscape Bioretention - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-C Streetscape Bioretention - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-D Engineered Tree Pits - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-D Engineered Tree Pits - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-E Stormwater Planters - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-E Stormwater Planters - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	2.0 Bioretention	2-F Advanced Bioretention - Underdrain	30% of Load Reduction	40% of Load Reduction	80% of Load Reduction
Retention Practice	2.0 Bioretention	2-F Advanced Bioretention - Infiltration	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	3.0 Permeable Pavement	3-A Porous Asphalt (PA)	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	3.0 Permeable Pavement	3-B Pervious Concrete (PC)	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	3.0 Permeable Pavement	3-C Permeable Concrete Pavers (PP) & (CP)	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	3.0 Permeable Pavement	3-D Plastic & Composite Grid Pavers (GP)	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	4.0 Vegetated Roofs	4-A Extensive Vegetated Roofs	100% of Load Reduction	100% of Load Reduction	0% of Load Reduction
Annual Runoff Reduction Practice	4.0 Vegetated Roofs	4-B Intensive Vegetated Roofs	100% of Load Reduction	100% of Load Reduction	0% of Load Reduction
Retention Practice	5.0 Rainwater Harvesting	5-A Seasonal Rainwater Harvesting	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Retention Practice	5.0 Rainwater Harvesting	5-B Continuous Rainwater Harvesting	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	6.0 Restoration Practices	6-A Step Pool RSCS	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	6.0 Restoration Practices	6-B Seepage Wetland RSCS	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	6.0 Restoration Practices	6-C Streambank Stabilization	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	7.0 Rooftop Disconnection	7-A Rooftop Disconnection	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	8.0 Vegetated Channels	8-A Bioswale	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction
Annual Runoff Reduction Practice	8.0 Vegetated Channels	8-B Grassed Channel	100% of Load Reduction	100% of Load Reduction	100% of Load Reduction

DURMM v.2: RPv Sheet

Retention Practices →

Annual RR Practices →

	A	B	C
1	PROJECT:	0	
2	DRAINAGE SUBAREA ID:	0	
3	LOCATION (County):	0	
4	RESOURCE PROTECTION EVENT (RPv) WORKSHEET		
5	RESET	BMP 1	
6		Type	--
7	***Step 1 - Calculate Initial RPv***	**Data**	
8	1.1 Total contributing area to BMP (ac)	0.00	
9	1.2 *Reserved*		
10	1.3 Initial RCN	#DIV/0!	
11	1.4 RPv for Contributing Area (in.)	#DIV/0!	
12	1.5 Req'd RPv Reduction for Contributing Area (in.)	#DIV/0!	
13	1.6 Req'd RPv Reduction for Contributing Area (%)	#DIV/0!	
14	1.7 RPv allowable discharge rate (cfs)	#DIV/0!	
15			
16	***Step 2 - Adjust for Retention Reduction***		
17	2.1 Storage volume (cu. ft.)		
18	2.2 Retention reduction allowance (%)	N/A	
19	2.3 Retention reduction volume (ac-ft)	N/A	
20	2.4 Retention reduction volume (in.)	N/A	
21	2.5 Runoff volume after retention reduction (in.)	N/A	
22	2.6 Adjusted CN*	N/A	
23			
24	***Step 3 - Adjust for Annual Runoff Reduction***		
25	3.1 Annual CN (ACN)	#DIV/0!	
26	3.2 Annual runoff (in.)	#DIV/0!	
27	3.3 Proportion A/B soils in BMP footprint (%)	0%	
28	3.4 Annual runoff reduction allowance (%)	N/A	
29	3.5 Annual runoff after reduction (in.)	N/A	
30	3.6 Adjusted ACN	N/A	
31	3.7 Annual Runoff Reduction Allowance for RPv (in.)	N/A	
32			
33	***Step 4 - Calculate RPv with BMP Reductions***		
34	4.1 RPv runoff volume after all reductions (in.)	N/A	
35	4.2 Total RPv runoff reduction (in.)	N/A	
36	4.3 Total RPv runoff reduction (%)	N/A	

DURMM v.2: TMDL Sheet

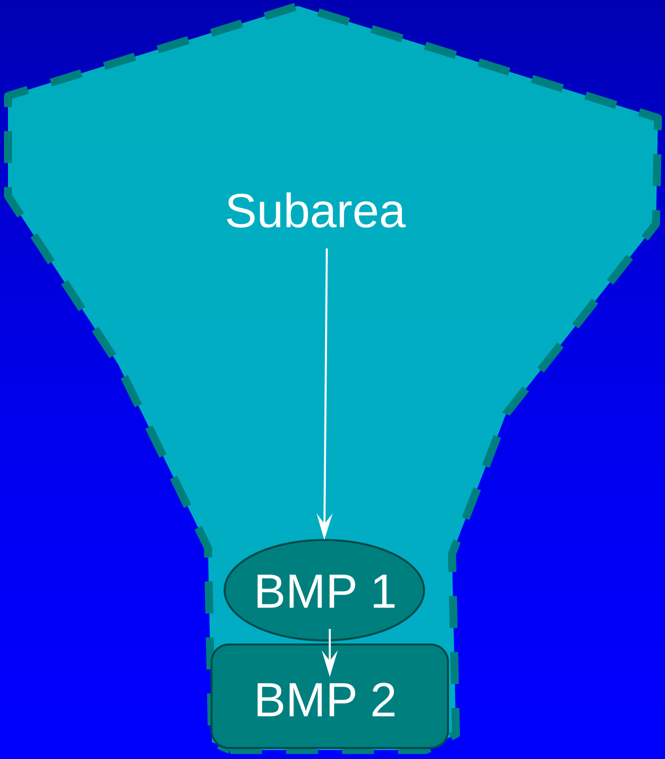
Load Reduction →

Concentration Reduction →

	A	B	C	D	E	
1	**PROJECT:**	0				
2	**DRAINAGE SUBAREA ID:**	0				
3	**LANDUSE TYPE:**					
4	**TMDL WATERSHED:**					
5	**TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET**					
6		**BMP 1**				
7		**Type:**	--			**Ty**
8	***Step 1 - Calculate Annual Runoff Volume***	**Data**	**TN**	**TP**	**TSS**	**D**
9	1.1 Total contributing area to BMP (ac)	0.00				
10	1.2 Initial RCN	#DIV/0!				
11	1.3 Annual runoff volume (in.)	#DIV/0!				
12	1.4 Annual runoff volume (liters)	#DIV/0!				
13						
14	***Step 2 - Calculate Annual Pollutant Load***					
15	2.1 EMC (mg/L)		N/A	N/A	N/A	
16	2.2 Load (mg/yr)		N/A	N/A	N/A	
17	2.3 Stormwater Load (lb/ac/yr)		N/A	N/A	N/A	
18						
19	***Step 3 - Adjust for Pollutant Reduction***					
20	3.1 BMP annual runoff reduction (%)	N/A				N
21	3.2 Adjusted annual runoff volume (in)	N/A				N
22	3.3 Adjusted annual runoff volume (liters)	N/A				N
23	3.4 Adjusted load from annual reductions (lb/ac/yr)		N/A	N/A	N/A	
24	3.5 BMP removal efficiency (%)		N/A	N/A	N/A	
25	3.6 Treatment train removal efficiency (%)		N/A	N/A	N/A	
26	3.7 BMP effluent concentration (mg/L)		N/A	N/A	N/A	
27	3.8 Final Adjusted load (lb/ac/yr)		N/A	N/A	N/A	
28	3.9 Final Adjusted load (lb/yr)		N/A	N/A	N/A	
29						
30	***Step 4 - Pollutant Reduction Met?*** *(For Informational Purposes)*					

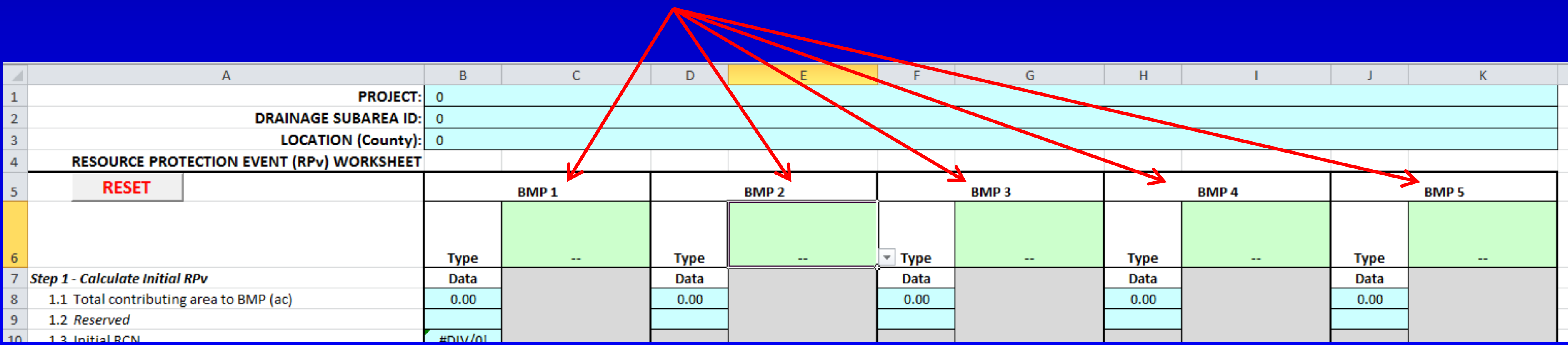
Accounting for BMPs in a Treatment Train
Equal Drainage Area

- More often than not, a BMP will be a part of a “treatment train”
- IF the drainage area is EQUAL for ALL of the BMPs:



Accounting for BMPs in a Treatment Train
Equal Drainage Area

- Then the same DURMM v.2 workbook can be used and the BMPs entered consecutively in the RPv sheet.



Upstream Areas
Accounting for BMPs in a Treatment Train

- More often than not, a BMP will be a part of a “treatment train”
- IF the drainage area is EQUAL for ALL of the BMPs then the same DURMM v.2 workbook can be used and all the BMPs entered in the RPv sheet.

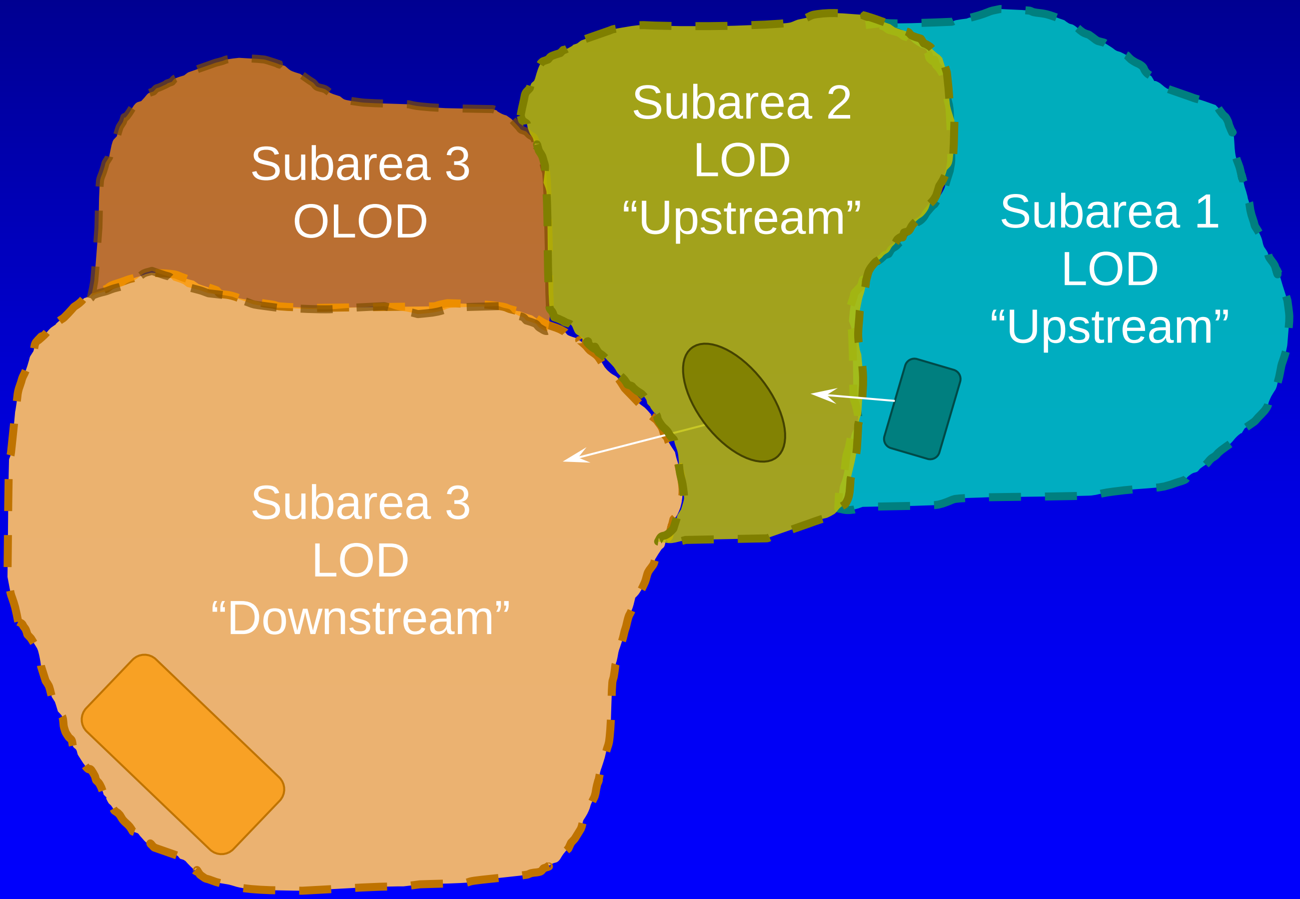
	A	B	C	D	E	F	G	H	I	J	K
1	PROJECT:	0									
2	DRAINAGE SUBAREA ID:	0									
3	LOCATION (County):	0									
4	RESOURCE PROTECTION EVENT (RPv) WORKSHEET										
5	RESET	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
6		Type	--	Type	--	Type	--	Type	--	Type	--
7	*Step 1 - Calculate Initial RPv*	Data		Data		Data		Data		Data	
8	1.1 Total contributing area to BMP (ac)	0.00		0.00		0.00		0.00		0.00	
9	*1.2 Reserved*										
10	1.3 Initial RCN	#DIV/0!									

- (If the total area is not the same to each BMP, Step 1.2 “Reserved”, might allow for a % of the drainage area treated to be entered ***in the future***, but for now the old fashioned way...)

Upstream Areas

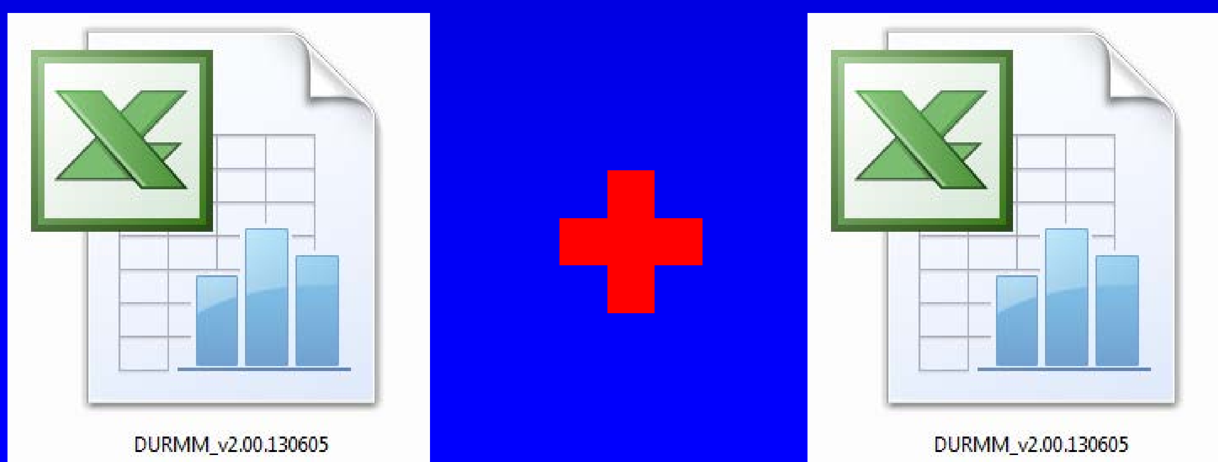
Accounting for BMPs in a Treatment Train

- IF the drainage area is NOT EQUAL for ALL of the BMPs…



Upstream Areas
Accounting for BMPs in a Treatment Train

- … then separate DURMM v.2 workbooks must be used for each different subarea.
- Start with the most upstream subarea and fill out a DURMM v.2 workbook with the BMPs that apply to that specific subarea.
- Then start a new DURMM v.2 workbook for the next downstream subarea, using the results from the upstream subarea.



Upstream Areas
Subarea 1: Most Upstream Area

- Fill out a DURMM v.2 workbook using just the area that goes to the most upstream BMP
- In the “DURMM Report” worksheet, the data needed for the next downstream subarea is reported in the “Adjusted Subarea Data for Downstream DURMM Modeling” section

	A	B	C	D	E	F
1	PROJECT:	Upstream Area Example				
2	DRAINAGE SUBAREA ID:	Rooftop				
3	COUNTY:	Sussex		UNIT HYDROGRAPH:		DMV
4	TMDL Watershed:	Rehoboth Bay		LANDUSE:	Residential	
5	DURMM OUTPUT WORKSHEET				DURMM v2.00.130226	
54	*Adjusted Subarea Data for Downstream DURMM Modeling*					
55	Subarea ID	Rooftop				
56	Contributing Area (ac.)	0.10				
57	C.A. RCN	98.00				
58	LOD Area (ac.)	0.10				
59	Weighted Target Runoff (in.)	0.01				
60	Adjusted CN after all reductions	90.27				
61	Adjusted RPv (in.)	1.96				
62	Adjusted Cv (in.)	5.01				
63	Adjusted Fv (in.)	8.96				
64						
65	*Adjusted Subarea Data for Nutrient Protocol Modeling*					
66	Contributing Area (ac.)	0.10				
67	LOD Area (ac.)	0.10				
68	TN Pollutant Load (lb/yr)	1.27				
69	TP Pollutant Load (lb/yr)	0.17				
70	TSS Pollutant Load (lb/yr)	38.01				
71	Percent Impervious Cover	100%				
72						
73	*Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a*					
74	Subarea ID	Rooftop				
75	Subarea Contributing Area (ac.)	0.10				
76	Runoff Reduction Shortfall or Credit (cu.ft.)	708.32	SHORT			
77	Adjusted CN after all reductions	90.27				
78	Cv RCN for H&H Modeling	97.57				
79	Fv RCN for H&H Modeling	98.00				
80	TN Pollutant Load (lb/yr)	1.27				
81	TP Pollutant Load (lb/yr)	0.17				
82	TSS Pollutant Load (lb/yr)	38.01				

C.A. RCN | LOD | OLOD | RPv | TMDL | Cv | Fv | **DURMM Report** | Dat

Use Data from DURMM Report as upstream entry in downstream areas

Upstream Areas
Subarea 2: Next Downstream Area

- Fill out a NEW DURMM v.2 workbook
- On the "C.A. RCN" sheet – enter the contributing area info for the next downstream area. The area from the upstream area is entered in the "Upstream Contributing Areas" section at the bottom.
- On the "LOD" sheet – enter the limit of disturbance info for the next downstream area. The area from the upstream area is entered in the "Upstream LOD Areas" section.
- Remember to use the upstream numbers as tabulated in the DURMM Report!
- The rest of the workbook is filled out using just the info for the current downstream area.

C.A. RCN Worksheet

	PROJECT:	Upstream Area Example
	DRAINAGE SUBAREA ID:	Bioretention
	LOCATION (County):	Sussex
	UNIT HYDROGRAPH:	DMV

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	A Acres	A RCN	B Acres	B RCN	C Acres	C RCN	D Acres	D RCN
		good		32		58		72		79
	Woods	poor		45		66		77		83
		fair		36		60		73		79
		good		30		55		70		77
	Farmsteads	----		59		74		82		86
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%		0.15	39		61		74		80
Impervious Areas										
	Paved parking lots, roofs, driveways		0.15	98		98		98		98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
	Subarea Contributing Area per Soil Type (ac)		0.3		0		0		0	
	Subarea Contributing Area (ac)	0.3								

UPSTREAM CONTRIBUTING AREAS	Subarea ID	Acres	RCN
Upstream Contributing Area 1	Rooftop	0.1	98
Upstream Contributing Area 2			
Upstream Contributing Area 3			
Upstream Contributing Area 4			

Total Contributing Area w. Upstream Areas (ac) 0.4

Weighted Runoff Curve Number (RCN) 76

New drainage area info not already calculated in upstream area is entered.

Upstream Area info is entered from the DURMM Report for that subarea.

Adjusted Subarea Data for Downstream DURMM Modeling

Subarea ID	Rooftop
Contributing Area (ac.)	0.10
C.A. RCN	98.00
LOD Area (ac.)	0.10
Weighted Target Runoff (in.)	0.01
Adjusted CN after all reductions	90.27
Adjusted RPv (in.)	1.96
Adjusted Cv (in.)	5.01
Adjusted Fv (in.)	8.96

PROJECT:	Upstream Area Example
DRAINAGE SUBAREA ID:	Bioretention
LOCATION (County):	Sussex
UNIT HYDROGRAPH:	DMV

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data	**HSG A**	**HSG B**	**HSG C**	**HSG D**
1.1 HSG Area Within LOD (ac)	0.3			
1.2 Pre-Developed Woods/Meadow Within LOD (ac)				
1.3 Pre-Developed Impervious Within LOD (ac)				
1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); ***OR***	0.15			
1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)	50%	0%	0%	0%

RESET

Step 2 - Subarea LOD Runoff Calculations

2.1 RCN per HSG	68.50	0.00	0.00	0.00
2.2 RPv per HSG (in.)	0.86	0.00	0.00	0.00
2.3 Target Runoff per HSG (in.)	0.01	0.00	0.00	0.00
2.4 Cv Weighted Unit Discharge per HSG (cfs/ac)	0.75	0.00	0.00	0.00
2.5 Fv Weighted Unit Discharge per HSG (cfs/ac)	2.25	0.00	0.00	0.00

2.6 Subarea LOD (ac)	0.30
2.7 Subarea Weighted RCN	68.50
2.8 Subarea Weighted RPv (in.)	0.86
2.9 Subarea Weighted Target Runoff (in.)	0.01

Step 3 - Upstream LOD Areas ***(from previous DURMM Report as applicable)***	**Area 1**	**Area 2**	**Area 3**	**Area 4**
3.1 Upstream Sub-Area ID	**Rooftop**			
3.2 Upstream LOD Area (ac)	0.10			
3.3 Target Runoff for Upstream Area (in.)	0.01			
3.4 Adjusted CN after all reductions	90.27			
3.5 Adjusted RPv (in.)	1.96			
3.6 Adjusted Cv (in.)	5.01			
3.7 Adjusted Fv (in.)	8.96			

Step 4 - RPv Calculations for Combined LOD

4.1 Combined LOD (ac)	0.40
4.2 Weighted RCN	73.94
4.3 Weighted RPv (in.)	1.13
4.4 Weighted Target Runoff (in.)	0.01
4.5 Estimated Annual Runoff (in.)	13.91
4.6 Req'd Runoff Reduction within LOD (in.)	1.12
4.7 Req'd Runoff Reduction within LOD (%)	99%

Step 5 - Cv Unit Discharge

5. LOD Allowable Unit Discharge (cfs/ac)	1.82

Step 6 - Fv Unit Discharge

6. LOD Allowable Unit Discharge (cfs/ac)	3.93

LOD Worksheet

LOD info for just the current drainage area is entered

Upstream Area info is entered from the DURMM Report for that subarea.

Adjusted Subarea Data for Downstream DURMM Modeling

Subarea ID	Rooftop
Contributing Area (ac.)	0.10
C.A. RCN	98.00
LOD Area (ac.)	0.10
Weighted Target Runoff (in.)	0.01
Adjusted CN after all reductions	90.27
Adjusted RPv (in.)	1.96
Adjusted Cv (in.)	5.01
Adjusted Fv (in.)	8.96

Upstream Areas
Subarea 3: Next Downstream Area?

- If the Bioretention area next discharged into a Wet Pond the results from the Bioretention DURMM Report would then be entered into the Wet Pond workbook.
- No Double Counting! Just the results from the Bioretention DURMM report would be entered, NOT the Rooftop DURMM report as well (since the Rooftop values area summed into the Bioretention DURMM report).

Adjusted Subarea Data for Downstream DURMM Modeling

Subarea ID	Bioretention
Contributing Area (ac.)	0.40
C.A. RCN	75.88
LOD Area (ac.)	0.40
Weighted Target Runoff (in.)	0.01
Adjusted CN after all reductions	61.08
Adjusted RPv (in.)	0.54
Adjusted Cv (in.)	2.05
Adjusted Fv (in.)	5.45

0.1 Rooftop Ac + 0.3 Bioretention Ac = 0.40 Ac Total

Upstream Areas

Subarea 3: Next Downstream Area?

- The multiple upstream area entries allow for several independent treatment trains to converge into one BMP, ie, two different bioretention systems and a bioswale discharging into a Wet Pond.
- Each respective system would be entered as an Upstream Contributing Area

UPSTREAM CONTRIBUTING AREAS		*Subarea ID*	*Acres*	*RCN*
	Upstream Contributing Area 1	Bioretention 1	0.4	75.9
	Upstream Contributing Area 2	Bioretention 2	0.3	78
	Upstream Contributing Area 3	Bioswale	0.5	79.2
	Upstream Contributing Area 4			

Three separate systems that merge at a common BMP

Common POI Summary Table

- When multiple systems discharge to the same POI, or to summarize the entire site (if its all within the same watershed), the "Summary Table for Sub-Areas Draining to a Common Point of Interest" table can be used.
- Balances the RPv Runoff Reductions and Shortfalls to see if global compliance is met (as well as TMDLs).
- Adjusted CN values area tallied for H&H modeling.
- Only the most downstream subarea for each independent system should be entered (since the upstream areas are reflected in the downstream subareas).

Common POI Summary Table

- Use the data from the "DURMM Report" in the "Adjusted Subarea Data for the Summary Table to Common POI" section for each independent system.

Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest		
Subarea ID	Bioretention	
Contributing Area (ac.)	0.40	
Runoff Reduction Shortfall or Credit (cu.ft.)	771.01	SHORTFALL
Adjusted CN after all reductions	61.08	
Cv RCN for H&H Modeling	67.43	
Fv RCN for H&H Modeling	69.54	
TN Pollutant Load (lb/yr)	1.29	
TP Pollutant Load (lb/yr)	0.17	
TSS Pollutant Load (lb/yr)	38.75	

Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest		
Subarea ID	Bioretention 2	
Contributing Area (ac.)	0.60	
Runoff Reduction Shortfall or Credit (cu.ft.)	-27.23	CREDIT
Adjusted CN after all reductions	32.37	
Cv RCN for H&H Modeling	39.65	
Fv RCN for H&H Modeling	45.06	
TN Pollutant Load (lb/yr)	0.21	
TP Pollutant Load (lb/yr)	0.03	
TSS Pollutant Load (lb/yr)	6.30	

Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest		
Subarea ID	Bioswale	
Contributing Area (ac.)	1.00	
Runoff Reduction Shortfall or Credit (cu.ft.)	1514.71	SHORTFALL
Adjusted CN after all reductions	56.19	
Cv RCN for H&H Modeling	67.98	
Fv RCN for H&H Modeling	68.50	
TN Pollutant Load (lb/yr)	2.41	
TP Pollutant Load (lb/yr)	0.33	
TSS Pollutant Load (lb/yr)	72.35	

Results from three separate systems used in Summary Table to Common POI

Summary Table for Sub-Areas Draining to a Common Point of Interest (POI)[1]

POI: ______________________________

Ref. #	Sub-Area ID[2]	Subarea Contributing Area (ac)	RPv Runoff Reduction Shortfall(+) or Credit(-) (cu.ft.)[3]	Adjusted RPv CN after all reductions[4]	Cv RCN for H&H Modeling[4]	Fv RCN for H&H Modeling[4]	TN Pollutant Load (lb/yr)	TP Pollutant Load (lb/yr)	TSS Pollutant Load (lb/yr)
1	Bioretention 1	0.40	771	61.08	67.43	69.54	1.29	0.17	38.75
2	Bioretention 2	0.60	-27	32.37	39.65	45.06	0.21	0.03	6.30
3	Bioswale	1.00	1515	56.19	67.98	68.50	2.41	0.33	72.35
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
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28									
29									
30									
Totals to Common POI		**2.00 ac**	**2258 cu.ft.**	**50.02**	**59.37**	**61.68**	**3.91 lb/yr**	**0.53 lb/yr**	**117.40 lb/yr**
RPv Runoff Reduction Goal Met?			**NO**						
If Not, Total Offset Volume Required			**2258 cu.ft.**						

Notes:

1. As long as the site lies within the same watershed, all sub-areas within the site can be tallied to reflect global site conditions; or, the summary table can be used to show conditions to a specific POI.
2. Only the most downstream sub-area information should be entered for a series of sub-areas that drain directly into each other, as the upstream areas will already be accounted for in the DURMM computations.
3. A RPv runoff reduction shortfall should be entered as a positive number, as it is the runoff volume still needed to be reduced. A RPv credit should be entered as a negative number, as it indicates the additional volume that was reduced past the requirement.
4. To portray an accurate total weighted CN value for the RPv, Cv and Fv events, an entry must be made for every defined sub-area. If a sub-area's contributing drainage acreage is entered, but not its corresponding CN value, then the total weighted CN will be skewed.

Results from three separate systems entered in table

Note: Shortfall entered as "+", Credits entered as "-"

RPv Runoff Reduction summarized with Offset Volume stated, if applicable.

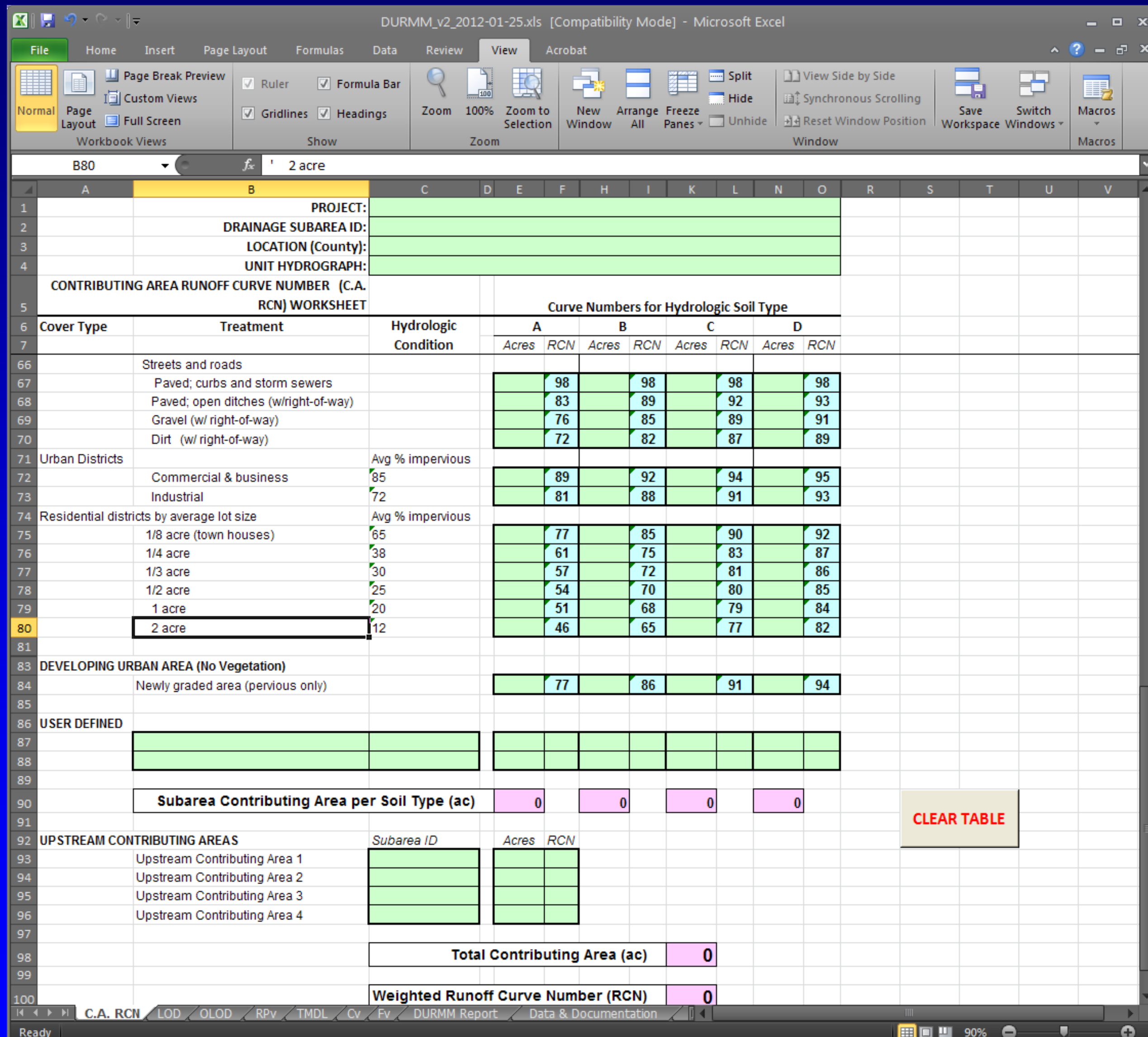
Here, an additional BMP(s) would need to be added, or an offset provided.

Nutrient Protocol

- The DURMM Report also contains a section that summarizes the inputs needed for the DNREC Nutrient Protocol.
- The Nutrient Protocol is an Excel workbook that takes into account the nutrient load from all aspects of a project, including ag, septic, stormwater, landuse, etc and compares the project's totals with the watershed's TMDLs.
- The DURMM Report values are entered to represent the project's stormwater nutrient loadings.

Adjusted Subarea Data for Nutrient Protocol Modeling	
Contributing Area (ac.)	1.00
LOD Area (ac.)	1.00
TN Pollutant Load (lb/yr)	2.41
TP Pollutant Load (lb/yr)	0.33
TSS Pollutant Load (lb/yr)	72.35
Percent Impervious Cover	50%

Questions?



DURMM_v2_2012-01-25.xls [Compatibility Mode] - Microsoft Excel

B80 ' 2 acre

	PROJECT:									
	DRAINAGE SUBAREA ID:									
	LOCATION (County):									
	UNIT HYDROGRAPH:									
CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET			Curve Numbers for Hydrologic Soil Type							
Cover Type	Treatment	Hydrologic Condition	A		B		C		D	
			Acres	RCN	Acres	RCN	Acres	RCN	Acres	RCN
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts		Avg % impervious								
	Commercial & business	85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size		Avg % impervious								
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94
USER DEFINED										
	Subarea Contributing Area per Soil Type (ac)		0		0		0		0	
UPSTREAM CONTRIBUTING AREAS		Subarea ID	Acres	RCN						
	Upstream Contributing Area 1									
	Upstream Contributing Area 2									
	Upstream Contributing Area 3									
	Upstream Contributing Area 4									
		Total Contributing Area (ac)					0			
		Weighted Runoff Curve Number (RCN)					0			

CLEAR TABLE

C.A. RCN | LOD | OLOD | RPv | TMDL | Cv | Fv | DURMM Report | Data & Documentation

Ready