

# Appendix E

## WinSLAMM Analyses of Hidden Meadow Development

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### Summary

WinSLAMM (version 10.3) was used to estimate the total phosphorus load in post-development stormwater at a multifamily town house development project in the New York City Watershed. The site selected for this analysis, Hidden Meadow, is located in the Town of Somers and drains into the Amawalk Reservoir in Westchester County, New York. The pre-developed site was forested with a centrally located, town-regulated wetland. Fifteen and a half acres of the site was developed and modeled. The remaining undeveloped 20.1 acres were assumed to have the same stormwater characteristics as the pre-development woods conditions. Table 1 lists each subarea used in the WinSLAMM analysis (measured directly from site plans).

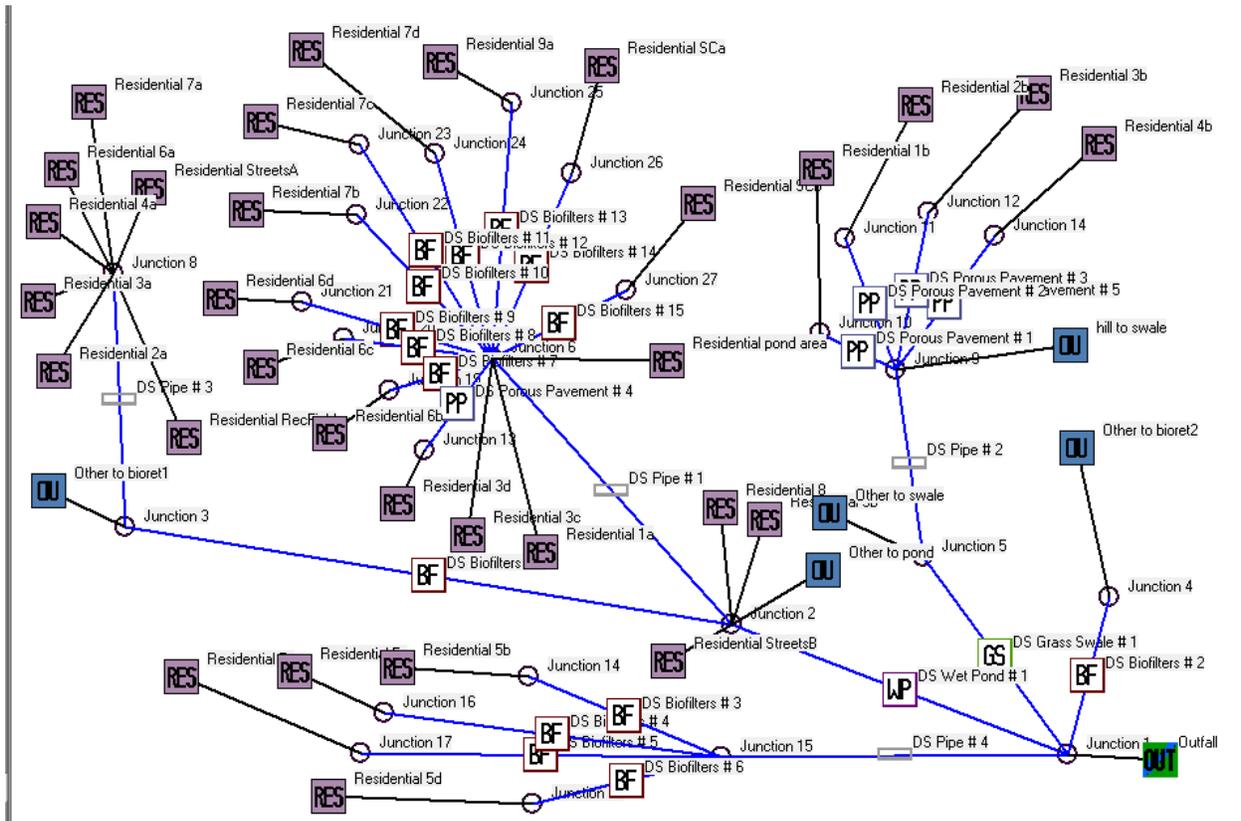
**Table 1: Modeled Subareas**

sub area	developed area (acres)	undeveloped area contribution (acres)
Area 1	0.29	
Area 2	0.24	
Area 3	0.24	
Area 4	0.17	
Area 5	0.43	
Area 6	0.31	
Area 7	0.36	
Area 8	0.21	
Area 9	0.20	
Sport Court	0.034	
Streets	0.95	
Recreation Field	0.62	
BioRet2	1.57	1.63
Pond Area	1.26	
Swale	0.83	3.30
other to pond	1.45	
other to swale	0.72	
other to bioretention	0.72	
total modeled:	10.11	4.89
grand total modeled:	15.50	

Stormwater at the subareas listed above is treated to remove total phosphorus and include: the 10-acre developed area; and the 5.5-acre undeveloped areas, that drain onto the developed area. WinSLAMM primarily models developed areas but can also include small areas of undeveloped land within developed urban areas.

The Hidden Meadow site is comprised of many small elements representing portions of the buildings (roofs and driveways for example) directed towards different stormwater controls and drainage components. The following modeling schematic in Figure 1 is quite complex, especially considering the small area of the developed site. Simplified modeling analyses were not possible due to the use of distributed controls that are placed in many locations throughout the area, usually splitting source areas (such as roofs and landscaped areas) for different treatment. Appendix E-1 in this document shows the detailed development characteristics for each of these subareas.

**Figure 1: Winslamm Site Layout Showing Subarea and Treatment Area Connections for Developed Portions of Hidden Meadow.**



There are many stormwater controls used at the site. Porous pavement driveways and backyard decks (which also receive portions of roof runoff) and rain gardens are used throughout the site. A large swale drains an upgradient area (as shown on the site maps) along with backyard areas for some of the units. A large bioretention area is located along the road which also receives some site drainage. A large bioretention area at the recreation field receives runoff from several buildings and adjacent areas, and a large pond receives runoff from much of the area (most having received prior treatment). The stormwater controls modeled are discussed in Appendix E-2 in this document, with assumed vertical profiles and underground features if they were not described in the site reports. The dimensions of the areas treated by the stormwater controls were measured on the site plans.

WinSLAMM was previously calibrated for East Coast conditions using data from the National Stormwater Quality Database ([http://rpitt.eng.ua.edu/Publications/4\\_Stormwater\\_Characteristics\\_Pollutant\\_Sources\\_and\\_Land\\_Development\\_Characteristics/Land\\_development\\_characteristics/Standard%20Land%20Use%20file%20descriptions%20final%20April%2018%202011%20for%20EPA%20Cadmus.pdf](http://rpitt.eng.ua.edu/Publications/4_Stormwater_Characteristics_Pollutant_Sources_and_Land_Development_Characteristics/Land_development_characteristics/Standard%20Land%20Use%20file%20descriptions%20final%20April%2018%202011%20for%20EPA%20Cadmus.pdf)). Site soils are reported as fine sandy loam, loam, and silt/sand. Normally compacted silt soils were assumed, with infiltration rates of about 0.5 inch/hour for the infiltrating stormwater controls.

Ten years (1995 through 2005) of rainfall records for Yorktown Heights, NY, were used for WinSLAMM long-term continuous modeling calculations. (Yorktown Heights is approximately 4 miles from Somers, the Hidden Meadow location).

Appendix E-3 in this document provides WinSLAMM modeling summary results for post-development conditions at the Hidden Meadow site. The level of stormwater treatment was quite high, especially for particulate forms of phosphorus.

Table 2 presents the annual runoff discharge loads for the rainy period.

**Table 2: Rainy Season Annual Runoff Discharge Loads**

The post-development WinSLAMM analysis was only for the non-winter season (excluding rains from December 2 to March 12, based on typical temperatures and snowfall). The following are the annual runoff discharge loads for the rainy period:	Value for rainy period only
Rain depth	32.80 inches per year (in/yr)
Runoff volume	150,100 cubic feet per year (ft <sup>3</sup> /yr) (about 57% reductions)
Total particulate solids yield	254 pounds per year (lbs/yr) (about 93% reductions)
Total particulate solids concentration	27.1 milligrams per liter (mg/L)
Total phosphorus yield	1.86 lb/yr (about 76% reductions)
Total phosphorus concentrations	0.33 mg/L
Particulate phosphorus yield	0.27 lb/yr (about 94% reductions)
Particulate phosphorus concentration	0.18 mg/L
Filterable phosphorus yield	1.59 lb/yr (about 57% reductions)
Filterable phosphorus concentration	0.15 mg/L

These yield values require that the stormwater controls are designed, built, and maintained correctly.

Since WinSLAMM does not calculate snowmelt runoff, the following estimate was used to predict the discharge of total phosphorus in snowmelt at the site. The estimated amount of runoff from this developed area during snowmelt events (when infiltration practices are not likely to be functioning) is estimated to be about 55,900 ft<sup>3</sup>/yr (based on the 10-year average rainfall amount measured during the winter season. A reasonable value for snowmelt total phosphorus concentrations is 0.23 mg/L, as measured during extensive snowmelt water quality monitoring in Toronto residential and commercial areas (Pitt and McLean 1986). This estimated snowmelt total phosphorus yield (snowmelt runoff volume multiplied by the concentration) is therefore estimated to be about 0.80 lb/yr.

Therefore, the 15.5 acre modeled area is calculated to have the following annual total phosphorus discharges after development:

Winter season yield:	0.80 lb/yr
Rain season yield:	1.86 lb/yr
Total:	2.66 lb/yr

Based on Don Lake's analyses applying the Simple Method for this site and Yorktown Heights area rains, the pre-development total phosphorus load at the Hidden Meadow site was calculated to be 1.57 lb/yr. The total phosphorus load is therefore expected to increase by about 1.09 lb/yr (about 70% compared to the pre-developed conditions), even with the extensive stormwater controls proposed at the site.

In addition to this 15.5 acre modeled area, an additional 20.1 acres of undeveloped area is also included on the site that do not drain to the site stormwater controls. This area was not modeled using WinSLAMM, as the model only considers developed urban land. However, the total phosphorus load at this undeveloped area is expected to remain at pre-developed levels. When the total phosphorus load from this undeveloped area is added to the modeled urban developed land (again using Don Lake's pre-development/undeveloped land analyses applying the Simple Method for this area), the total 35.6 areas would produce an expected annual discharge of 7.87 lb/acre, compared to the pre-developed total phosphorus annual load of 6.78 lb/acre. The difference between pre- and post-development is the same at 1.09 lb/yr. However, the percentage difference decreases from approximately 70% to about 16%, due to the larger area. Nonetheless, 1.09 lb/yr of additional total phosphorus is estimated to leave the site in the post-developed condition.

Table 3 summarizes the pre- and post-development total phosphorus discharges for the Hidden Meadow development. This table shows the calculated total phosphorus mass discharges for pre-development and post-development conditions. Estimates for snowmelt total phosphorus discharges are also shown, based on simple calculations. These snowmelt discharges account for about 30% of the annual total phosphorus discharges for this site.

**Table 3: Summary of Calculated Total Phosphorus Discharges at Hidden Meadow Site (total phosphorus runoff discharges, lb/yr)**

	Hidden Meadow (15.5 ac developed area)
A. Site undeveloped (all seasons)	1.57
B. Site developed (non-winter seasons) (not including off site area)	1.86
C. Site developed snowmelt (estimate)	0.80
D. Total site developed all seasons (B plus C) (not including off site area)	2.66
E. Site change with development (D minus A)	1.09
F. Off-site change due to treatment onsite (3.2 acres draining to bioretention area 2)	0.87 reduction
G. Net change (E minus F)	0.22

The off-site treatment is provided at bioretention 2 which receives runoff from the adjacent road (0.5 acres) plus runoff from about 2.7 acres of large landscaped and undeveloped areas. This large bioretention area (about 0.3 acre in size) completely eliminated all runoff from this off-site area.

The Hidden Meadow development uses a wide variety and extensive use of stormwater management practices. However, it is still expected to result in increased total phosphorus discharges compared to pre-developed conditions. This site also includes additional treatment of off-site stormwater that drains to site controls, providing additional total phosphorus reductions compared to pre-developed conditions. Therefore, one method to further reduce the total phosphorus discharges would be to increase the treatment of off-site stormwater.

This example illustrates how WinSLAMM can be used to calculate complex development sites having many types of stormwater controls. WinSLAMM accurately routes flows, particulates, particle sizes, and pollutants through multiple controls, using the effluent characteristics from upland controls, adding new flow additions, and then routing the combined flows to downstream controls. This example was overly complex due to the numerous small components and the many distributed stormwater controls. Also, these analyses are estimates based on calculated results and reasonable assumptions concerning source areas and stormwater control details. More precise analyses are possible with actual measurements and specific design information.

## Appendix E-1: Subarea Development Characteristics

### Area 1

	area (square feet - ft <sup>2</sup> )	area (acre - ac)	fraction to subarea	1a to pond	1a to pond total	1b to back yard deck (deck) porous pavement (PP) & swale	1b to PP & swale total
area 1 roofs	5,148	0.118					
1a roof to pond			0.5	0.059			
1b roof to deck PP and outfall			0.5			0.059	
area 1 PP driveways to pond	1,652	0.038	1	0.038			
area 1 PP decks to outfall	816	0.019	1			0.019	
area 1 front yards to pond	1,588	0.036	1	0.036			
area 1 rear yards to pond	3,456	0.079	1	0.079			
totals		0.291			0.213		0.078

## Area 2

	area (ft <sup>2</sup> )	area (ac)	fraction to subarea	2a to bioret	2a to bioret total	2b to deck PP & swale	2b to PP & swale total
area 2 roofs	4,158	0.095					
2a roof to bioret			0.5	0.048			
2b roof to deck PP and outfall			0.5			0.048	
area 2 PP driveways to bioret	1,377	0.032	1	0.032			
area 2 PP decks to outfall	680	0.016	1			0.016	
area 2 front yards to bioret	1,323	0.030	1	0.030			
area 2 rear yards to bioret	2,880	0.066	1	0.066			
totals		0.239			0.176		0.063

Bioret = bioretention facility

### Area 3

	area (ft2)	area (ac)	fraction to subarea	3a to bioret	3a to bioret total	3b to deck PP and swale	3b to deck PP and swale total	3c to pond	3c to pond total	3d to deck PP and pond	3d to deck PP and pond total
area 3 roofs	4,158	0.095									
3a roof to bioret			0.3	0.029							
3b roof to deck PP and outfall			0.2			0.019					
3c to pond			0.3					0.029			
3d roof to deck pp and pond			0.2							0.019	
area 3 PP driveways	1,377	0.032									
3a PP driveway			0.4	0.013							
3c PP driveway			0.6					0.019			
area 3 PP decks	680	0.016									
3b PP decks			0.4			0.006					
3d PP decks			0.6							0.009	
area 3 front yards	1,323	0.030									
3a front yards			0.4	0.012							
3c front yards			0.6					0.018			
area 3a rear yards to bioret	2,880	0.066	1	0.066							
totals		0.239			0.120		0.025		0.066		0.028

**Area 4**

	area (ft2)	area (ac)	fraction to subarea	4a to bioret	4a to bioret total	4b to deck PP and swale	4b to PP and swale total
area 4 roofs	4,158	0.095					
4a roof to bioret			0.5	0.048			
4b roof to deck PP and outfall			0.5			0.048	
area 4a PP driveways to bioret	1,377	0.032	1	0.032			
area 4b PP decks to outfall	680	0.016	1			0.016	
area 4a front yards to bioret	1,323	0.030	1	0.030			
totals		0.173			0.110		0.063

**Area 5**

	area (ft <sup>2</sup> )	area (ac)	fraction to sub-area	5a to bioret	5a to bioret total	5b to rain garden (RG) 1 to out-fall	5b to rain garden 1 to out-fall total	5c to rain garden 2 to out-fall	5c to rain garden 2 to out-fall total	5d to rain garden 3 to out-fall	5d to rain garden 3 to out-fall total
area 5 roofs	5,427	0.125									
5a roof to bioret			0.65	0.081							
5b roof to RG1 and outfall			0.12			0.015					
5c roof to RG2 and outfall			0.12					0.015			
5d roof to RG3 and outfall			0.11							0.014	
area 5a driveways to bioret	1,377	0.032	1	0.032							
area 5a front yards to bioret	1,323	0.030	1	0.030							
area 5 rear yards	10,714	0.246									
5b rear yard to RG1			0.4			0.098					
5c rear yard to RG2			0.2					0.049			
5d rear yard to RG3			0.4							0.098	
totals		0.433			0.143		0.113		0.064		0.112

**Area 6**

	area (ft <sup>2</sup> )	area (ac)	fraction to subarea	6a to bioret	6a to bioret total	6b to rain garden 4 to pond	6b to rain garden 4 to pond total	6c to rain garden 5 to pond	6c to rain garden 5 to pond total	6d to rain garden 6 to pond	6d to rain garden 6 to pond total
area 6 roofs	5,379	0.123									
6a roof to bioret			0.6	0.074							
6b roof to RG4 and pond			0.14			0.017					
6c roof to RG5 and pond			0.13					0.016			
6d roof to RG6 and pond			0.13							0.016	
area 6a driveways to bioret	1,163	0.027	1	0.027							
area 6a front yards to bioret	1,440	0.033	1	0.033							
area 6 rear yards	5,454	0.125									
6b rear yard to RG4 and pond			0.7			0.088					
6c rear yard to RG5 and pond			0.2					0.025			
6d rear yard to RG6 and pond			0.1							0.013	
totals		0.308			0.134		0.105		0.041		0.029

**Area 7**

	area (ft <sup>2</sup> )	area (ac)	fraction to subarea	7a to bioret	7a to bioret total	7b to rain garden 7 to pond	7b to rain garden 7 to pond total	7c to rain garden to pond	7c to rain garden to pond total	7d to rain garden 8 to pond	7d to rain garden 8 to pond total
area 7 roofs	6,804	0.156									
7a roof to bioret			0.5	0.078							
7b roof to RG7 and pond			0.17			0.027					
7c roof to pond			0.16					0.025			
7d roof to RG8 and pond			0.17							0.027	
area 7a driveways to bioret	1,395	0.032	1	0.032							
area 7a front yards to bioret	2,430	0.056	1	0.056							
area 7 rear yards	5,040	0.116									
7b rear yard to RG7 and pond			0.4			0.046					
7c rear yard to pond			0.3					0.035			
7d rear yard to RG8 and pond			0.3							0.035	
totals		0.360			0.166		0.073		0.060		0.061

**Area 8**

	area (ft2)	area (ac)	fraction to subarea	8 to pond	8 to pond total
area 8 roofs to pond	3,029	0.070	1	0.070	
area 8 driveways to pond	734	0.017	1	0.017	
area 8 front yards to pond	985	0.023	1	0.023	
area 8 sidewalks to pond	428	0.010	1	0.010	
area 8 sideyards to pond	3,125	0.072	1	0.072	
area 8 rear yards to pond	900	0.021	1	0.021	
totals		0.211			0.211

**Area 9**

	area (ft <sup>2</sup> )	area (ac)	fraction to subarea	9a to rain garden 11	9a to rain garden 11 total	9b to pond	9b to pond total
area 9 roofs	3,029	0.070					
area 9a roofs to RG 11			0.13	0.009			
area 9b roofs to pond			0.87			0.061	
area 9b driveways to pond	490	0.011	1			0.011	
area 9b front yards to pond	985	0.023	1			0.023	
area 9b sidewalks to pond	428	0.010	1			0.010	
area 9 sideyards	2,871	0.066					
area 9a sideyards to RG11			0.25	0.016			
area 9b sideyards to pond			0.75			0.049	
area 9 rear yards	900	0.021					
area 9a rear yards to RG11			0.05	0.001			
area 9b rear yards to pond			0.95			0.020	
totals		0.200			0.027		0.173

**Sport Court (SC)**

	area (ft2)	area (ac)	fraction to subarea	SCa to RG9 to pond	SCa to RG9 to pond total	SCb to RG10 to pond	SCb to RG10 to pond total
sport court	1,494	0.034					
SCa sport court to RG9 to pond			0.5	0.017			
SCb sport court to RG10 to pond			0.5			0.017	
totals		0.034			0.017		0.017

**Streets (ST)**

	area (ft2)	area (ac)	fraction to subarea	STa to Bioret	STa to Bioret total	STb to pond	STb to pond total
streets	41,400	0.950					
STa to Bioret			0.5	0.475			
STb to pond			0.5			0.475	
totals		0.950			0.475		0.475

**Recreation Field**

	area (ft2)	area (ac)	fraction to subarea	RecField to bioret to pond	RecField to bioret to pond total
RecField large landscape to bioret to pond	23,220	0.533	1	0.533	
RecField sidewalks to bioret to pond	3,744	0.086	1	0.086	
totals		0.619			0.619

**Bioretention Area Near Street (Bioret2)**

	area (ft2)	area (ac)	fraction to subarea		Bioret 2 to outfall	Bioret 2 to outfall total
BioRet2 large landscape to bioret2 to outfall	46,800	1.074	1		1.074	
BioRet2 street to bioret2 to outfall	2,640	0.500	1		0.500	
BioRet2 un-dev large landscape to bioret2 to outfall	69,264	1.626	1		1.590	
<b>totals</b>		<b>3.200</b>				<b>3.200</b>

**Large Pond Area**

	area (ft2)	area (ac)	fraction to subarea	pond to outfall	pond to outfall total
pond large landscape to pond to outfall	54,720	1.120	1	1.120	
pond water surface to pond to outfall	5,940	0.136	1	0.136	
<b>Totals</b>		<b>1.256</b>			<b>1.256</b>

Other to Pond (1.45 acres, all large landscaped area)

Other to Swale (0.724 acres, all large landscaped area)

Other to Bioretention (0.724 acres, all large landscaped area)

Swale (0.83 acres, all vegetated area within the swale)

## Appendix E-2: Hidden Meadow Stormwater Controls Modeled by WinSLAMM

### Wet Pond:

Wet Detention Control Device

**Pond Number 1**  
**Drainage System Control Practice**

Initial Stage Elevation (ft):

Maximum Inflow into Pond (cfs)   
 Enter 0 or leave blank for no limit:

Enter fraction (greater than 0) that you want to modify all pond areas by and then select 'Modify Pond Areas' button

Stage (ft)	Area (acres)	Cumulative Volume (ac-ft)
0	0.00	0.0000
1	0.01	0.1500
2	3.00	0.3000
3	5.00	0.3800
4	10.00	0.5800
5	12.00	0.6500
6	14.00	0.7500
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		

**Add Sharp Crested Weir**

Weir Length (ft)   
 Height from datum to bottom of weir opening (ft)

**Add V-Notch Weir**

Weir Angle (<180 degrees)   
 Height from datum to bottom of weir opening (ft)   
 Number of V-Notch weirs

**Remove Orifice Set 1**

Orifice Diameter (ft)   
 Invert elevation above datum (ft)   
 Number of orifices in set

**Add Orifice Set 2**

Orifice Diameter (ft)   
 Invert elevation above datum (ft)   
 Number of orifices in set

**Add Orifice Set 3**

Orifice Diameter (ft)   
 Invert elevation above datum (ft)   
 Number of orifices in set

**Add Stone Weeper**

Width at bottom of weeper (ft)   
 Weeper side slope [ H:1V]   
 Upstream side slope [ H:1V]   
 Downstream side slope [ H:1V]   
 Horizontal flow path length at top of weeper (ft)   
 Average rock diameter (ft)   
 Distance from bottom to top of weeper (ft)   
 Height from datum to bottom of weeper (ft)

**Add Vertical Stand Pipe**

Pipe diameter (ft)   
 Height above datum (ft)

Month	Evaporation (in/day)	Water Withdraw Rate (ac-ft/day)
Jan	0.00	0.000
Feb	0.00	0.000
Mar	0.00	0.000
Apr	0.00	0.000
May	0.00	0.000
Jun	0.00	0.000
Jul	0.00	0.000
Aug	0.00	0.000
Sep	0.00	0.000
Oct	0.00	0.000
Nov	0.00	0.000
Dec	0.00	0.000

Stage (ft)	Natural Seepage Rate (in/hr)	Other Outflow Rate (cfs)
0.00	0.00	0.000
0.01	0.00	0.000
3.00	0.00	0.000
5.00	0.00	0.000
10.00	0.00	0.000
12.00	0.00	0.000
14.00	0.00	0.000

**Remove Broad Crested Weir (Required)**

Weir crest length (ft)   
 Weir crest width (ft)   
 Height from datum to bottom of weir opening (ft)

**Add Seepage Basin**

Infiltration rate (in/hr)   
 Width of device (ft)   
 Length of device (ft)   
 Invert elevation of seepage basin inlet above datum (ft)

**Add Pump**

# Recreation Field Bioretention:

**Biofiltration Control Device**

**Drainage System Control Practice**

**Device Properties** **Biofilter Number 1**

Top Area (sf)	9500
Bottom Area (sf)	5200
Total Depth (ft)	7.00
Typical Width (ft) (Cost est. only)	65.00
Native Soil Infiltration Rate (in/hr)	0.500
Native Soil Infiltration Rate CDV	N/A
Infil. Rate Fraction-Bottom (0.001-1)	1.000
Infil. Rate Fraction-Sides (0.001-1)	1.000
Rock Filled Depth (ft)	0.00
Rock Fill Porosity (0-1)	0.00
Engineered Media Type	Media Data
Engineered Media Infiltration Rate	1.00
Engineered Media Infiltration Rate CDV	N/A
Engineered Media Depth (ft)	2.00
Engineered Media Porosity (0-1)	0.40
Percent solids reduction due to Engineered Media (0-100)	N/A
Inflow Hydrograph Peak to Average Flow Ratio	3.80
Number of Devices in Source Area or Upstream Drainage System	1

Activate Pipe or Box Storage  Pipe  Box

Diameter (ft) \_\_\_\_\_  
 Length (ft) \_\_\_\_\_  
 Within Biofilter (check if Yes)   
 Perforated (check if Yes)   
 Bottom Elevation (ft above datum) \_\_\_\_\_  
 Discharge Orifice Diameter (ft) \_\_\_\_\_

**Select Native Soil Infiltration Rate**

<input type="radio"/> Sand - 8 in/hr	<input type="radio"/> Clay loam - 0.1 in/hr
<input type="radio"/> Loamy sand - 2.5 in/hr	<input type="radio"/> Silty clay loam - 0.05 in/hr
<input type="radio"/> Sandy loam - 1.0 in/hr	<input type="radio"/> Sandy clay - 0.05 in/hr
<input type="radio"/> Loam - 0.5 in/hr	<input type="radio"/> Silty clay - 0.04 in/hr
<input type="radio"/> Silt loam - 0.3 in/hr	<input type="radio"/> Clay - 0.02 in/hr
<input type="radio"/> Sandy silt loam - 0.2 in/hr	<input type="radio"/> Rain Barrel/Cistern - 0.00 in/hr

Use Random Number Generation to Account for Infiltration Rate Uncertainty

Estimated Surface Drain Time = 57.6 hrs.

**Add Sharp Crested Weir**

Weir Length (ft) \_\_\_\_\_  
 Height from datum to bottom of weir opening (ft) \_\_\_\_\_

**Remove Broad Crested Weir-Req'd**

Weir crest length (ft) 25.00  
 Weir crest width (ft) 3.00  
 Height from datum to bottom of weir opening (ft) 6.00

**Add Other Outlet**

Stage Number	Stage (ft)	Other Outflow Rate (cfs)
1		
2		
3		
4		
5		

**Add Evapotranspiration**

Month	Evapotranspiration (in/day)	Evaporation (in/day)
Jan		
Feb		
Mar		
Apr		
May		
Jun		
Jul		
Aug		
Sep		
Oct		
Nov		
Dec		

Soil porosity (saturation moisture content, 0-1) \_\_\_\_\_  
 Soil field moisture capacity (0-1) \_\_\_\_\_  
 Permanent wilting point (0-1) \_\_\_\_\_  
 Supplemental irrigation used?   
 Fraction of available capacity when irrigation starts (0-1) \_\_\_\_\_  
 Fraction of available capacity when irrigation stops (0-1) \_\_\_\_\_  
 Fraction of biofilter that is vegetated \_\_\_\_\_  
 Plant type \_\_\_\_\_  
 Root depth (ft) \_\_\_\_\_  
 ET Crop Adjustment Factor \_\_\_\_\_

**Add Vertical Stand Pipe**

Pipe diameter (ft) \_\_\_\_\_  
 Height above datum (ft) \_\_\_\_\_

**Add Surface Discharge Pipe**

Pipe Diameter (ft) \_\_\_\_\_  
 Invert elevation above datum (ft) \_\_\_\_\_  
 Number of pipes at invert elev. \_\_\_\_\_

**Remove Drain Tile/Underdrain**

Pipe Diameter (ft) 0.25  
 Invert elevation above datum (ft) 1.50  
 Number of pipes at invert elev. 5

**Biofilter Geometry Schematic**

Initial Water Surface Elevation (ft) 0.00

Use Random Number Generation to Account for Infiltration Rate Uncertainty

Estimated Surface Drain Time = 57.6 hrs.

Press 'F1' for Help

**Detailed Media Characteristics**

Soil Type Texture	Saturation Water Content % (Porosity)	Field Capacity (Percent)	Permanent Wilting Point (Percent)	Infiltration Rate (in/hr)	Fraction of Soil Type Texture in Engineered Soil (0-1)
<input type="checkbox"/> User-Defined Soil Type	0.0	0.0	0.0	0.000	0.000
Gravel	32	4	0	40	0.000
Sands	38	8	2.5	13	0.000
Loamy Sands	39	13.5	4.5	2.5	0.000
Sandy Loams	40	19.5	6.5	1	1.000
Fine Sandy Loams	42	26.5	10.5	0.5	0.000
Loams & Silt Loams	43	34	14	0.15	0.000
Clay Loams/Silty Clay Loams	50	34.5	17	0.1	0.000
Silty Clays & Clays	55	33.5	18	0.015	0.000
Peat as Amendment	78	59	5	3	0.000
Compost as Amendment	61	55	5	3	0.000
Composite Soil Mixture Properties	40.0	19.5	6.5	1.000	1.000

Apply Soil Mixture Values as a User Defined Soil Mixture

Apply Porosity  Apply Field Capacity  Apply Wilting Point  Apply Infiltration Rate  Apply All Values

# Roadside Bioretention:

Biofiltration Control Device
✕

**Drainage System Control Practice**

**Device Properties**      **Biofilter Number 2**

Top Area (sf)	13200
Bottom Area (sf)	3375
Total Depth (ft)	11.00
Typical Width (ft) (Cost est. only)	50.00
Native Soil Infiltration Rate (in/hr)	0.500
Native Soil Infiltration Rate COV	N/A
Infil. Rate Fraction-Bottom (0.001-1)	1.000
Infil. Rate Fraction-Sides (0.001-1)	1.000
Rock Filled Depth (ft)	0.00
Rock Fill Porosity (0-1)	0.00
Engineered Media Type	Media Data
Engineered Media Infiltration Rate	1.00
Engineered Media Infiltration Rate COV	N/A
Engineered Media Depth (ft)	2.00
Engineered Media Porosity (0-1)	0.40
Percent solids reduction due to Engineered Media (0-100)	N/A
Inflow Hydrograph Peak to Average Flow Ratio	3.80
Number of Devices in Source Area or Upstream Drainage System	1

Activate Pipe or Box Storage     Pipe     Box

Diameter (ft) \_\_\_\_\_  
 Length (ft) \_\_\_\_\_  
 Within Biofilter (check if Yes)   
 Perforated (check if Yes)   
 Bottom Elevation (ft above datum) \_\_\_\_\_  
 Discharge Orifice Diameter (ft) \_\_\_\_\_

**Select Native Soil Infiltration Rate**

<input type="radio"/> Sand - 8 in/hr	<input type="radio"/> Clay loam - 0.1 in/hr
<input type="radio"/> Loamy sand - 2.5 in/hr	<input type="radio"/> Silty clay loam - 0.05 in/hr
<input type="radio"/> Sandy loam - 1.0 in/hr	<input type="radio"/> Sandy clay - 0.05 in/hr
<input type="radio"/> Loam - 0.5 in/hr	<input type="radio"/> Silty clay - 0.04 in/hr
<input type="radio"/> Silt loam - 0.3 in/hr	<input type="radio"/> Clay - 0.02 in/hr
<input type="radio"/> Sandy silt loam - 0.2 in/hr	<input type="radio"/> Rain Barrel/Cistern - 0.00 in/hr

Estimated Surface Drain Time = 93.6 hrs.

**Add Sharp Crested Weir**

Weir Length (ft) \_\_\_\_\_  
 Height from datum to bottom of weir opening (ft) \_\_\_\_\_

**Remove Broad Crested Weir-Regd**

Weir crest length (ft) 25.00  
 Weir crest width (ft) 3.00  
 Height from datum to bottom of weir opening (ft) 9.00

**Add Vertical Stand Pipe**

Pipe diameter (ft) \_\_\_\_\_  
 Height above datum (ft) \_\_\_\_\_

**Add Surface Discharge Pipe**

Pipe Diameter (ft) \_\_\_\_\_  
 Invert elevation above datum (ft) \_\_\_\_\_  
 Number of pipes at invert elev. \_\_\_\_\_

**Remove Drain Tile/Underdrain**

Pipe Diameter (ft) 0.25  
 Invert elevation above datum (ft) 1.50  
 Number of pipes at invert elev. 10

**Add Other Outlet**

Stage Number	Stage (ft)	Other Outflow Rate (cfs)
1		
2		
3		
4		
5		

**Add Evapotranspiration**

Month	Evapotranspiration (in/day)	Evaporation (in/day)
Jan		
Feb		
Mar		
Apr		
May		
Jun		
Jul		
Aug		
Sep		
Oct		
Nov		
Dec		

**Plant Types**

1	2	3	4
▼	▼	▼	▼

Fraction of biofilter that is vegetated \_\_\_\_\_  
 Plant type \_\_\_\_\_  
 Root depth (ft) \_\_\_\_\_  
 ET Crop Adjustment Factor \_\_\_\_\_

**Biofilter Geometry Schematic**      Refresh Schematic

Press 'F1' for Help      Delete      Cancel      Continue

**Hillside Swale:**

Grass Swales
×

**Drainage System Control Practice**
**Grass Swale Number 1**
Press 'F1' for Help

Grass Swale Data	
Total Drainage Area (ac)	5.079
Fraction of Drainage Area Served by Swales (0-1)	1.00
Swale Density (ft/ac)	883.98
Total Swale Length (ft)	640
Average Swale Length to Outlet (ft)	313
Typical Bottom Width (ft)	10.0
Typical Swale Side Slope ( ___ ft H : 1 ft V)	2.5
Typical Longitudinal Slope (ft/ft, V/H)	0.025
Swale Retardance Factor	D ▾
Typical Grass Height (in)	6.0
Swale Dynamic Infiltration Rate (in/hr)	0.250
Typical Swale Depth (ft) for Cost Analysis (Optional)	10.0

Use Total Swale Length Instead of Swale Density for Infiltration Calculations

Total area served by swales (acres): 5.079  
Total area (acres): 5.079

Select Particle Size Distribution File

**Particle Size Distribution File Name**

View Retardance Table

Not needed - calculated by program

**Select Swale Density by Land Use**

<input type="radio"/> Low density residential - 240 ft/ac	<input type="radio"/> Shopping center - 90 ft/ac
<input type="radio"/> Medium density residential - 350 ft/ac	<input type="radio"/> Industrial - 260 ft/ac
<input type="radio"/> High density residential - 375 ft/ac	<input type="radio"/> Freeways (shoulder only) - 480 ft/ac
<input type="radio"/> Strip commercial - 410 ft/ac	<input type="radio"/> Freeways (center and shoulder) - 540 ft/ac

Copy Swale Data

Paste Swale Data

Delete

Cancel

Continue

**Backyard Porous Pavement Example (same cross-section as porous pavement driveways):**

Porous Pavement Control Device

**Drainage System Control Practice**

Total Porous and Upstream Drainage Area: 0.028 ac.

Porous pavement area (acres):

Inflow Hydrograph Peak to Average Flow Ratio

**Pavement Geometry and Properties**

1 - Pavement Thickness (in)	2.0
Pavement Porosity (>0 and <1)	0.33
2 - Aggregate Bedding Thickness (in)	3.0
Aggregate Bedding Porosity (>0 and <1)	0.33
3 - Aggregate Base Reservoir Thickness (in)	6.0
Aggregate Base Reservoir Porosity (>0 and <1)	0.33
Porous Pavement Area to Agg Base Area Ratio	1.00

**Outlet/Discharge Options**

Perforated Pipe Underdrain Diameter, if used (inches)	2.00
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above Datum)	4.0
Number of Perforated Pipe Underdrains (<250)	1
Subgrade Seepage Rate (in/hr) - select below or enter	0.500
Use Random Number Generation to Account for Uncertainty in Seepage Rate	<input type="checkbox"/>
Subgrade Seepage Rate CDV	
Underdrain Discharge Percent TSS Reduction (0-100) or leave blank for program to calculate	0

**Select Subgrade Seepage Rate**

<input type="radio"/> Sand - 8 in/hr	<input type="radio"/> Clay loam - 0.1 in/hr
<input type="radio"/> Loamy sand - 2.5 in/hr	<input type="radio"/> Silty clay loam - 0.05 in/hr
<input type="radio"/> Sandy loam - 1.0 in/hr	<input type="radio"/> Sandy clay - 0.05 in/hr
<input type="radio"/> Loam - 0.5 in/hr	<input type="radio"/> Silty clay - 0.04 in/hr
<input type="radio"/> Silt loam - 0.3 in/hr	<input type="radio"/> Clay - 0.02 in/hr
<input type="radio"/> Sandy silt loam - 0.2 in/hr	

**Surface Pavement Layer Infiltration Rate Data**

Initial Infiltration Rate (in/hr)	30.00
Surface Pavement Percent Solids Removal Upon Cleaning (0-100)	75.0

Enter either these three values:

Percent of Infiltration Rate After 3 Years (0-100)	
Percent of Infiltration Rate After 5 Years (0-100)	
Time Period Until Complete Clogging Occurs (yrs)	

Or this value:

Surface Clogging Load (lb/sf)	0.06
-------------------------------	------

**Restorative Cleaning Frequency**

Never Cleaned  
 Three Times per Year  
 Semi-Annually  
 Annually  
 Every Two Years  
 Every Three Years  
 Every Four Years  
 Every Five Years  
 Every Seven Years  
 Every Ten Years

**Select Particle Size Distribution File**

**Percent of Total Area that is Porous Pavement**

32.1 %

**Porous Pavement Geometry Schematic**

**Press 'F1' for Help**



### Appendix E-3: Modeling Summary Results

Current File Data

**SLAMM Data File Name:**  
 C:\WinSLAMM Files\Example Files\NY P load WinSLAMM files\Hidden Meadows\Hidden Meadows with controlsC Yorktown add road with winter restrict.mdb

Site Descript:

**Edit** Seed:

**Edit** Rain File:

**Edit** Start Date:   Winter Season Range  
**Edit** End Date:  Start of Winter (mm/dd)  End of Winter (mm/dd)

**Edit** Pollutant Probability Distribution File:

**Edit** Runoff Coefficient File:

**Edit** Particulate Solids Concentration File:

**Edit** Street Delivery File (Select LU)  
 Residential LU  Other Urban LU  
 Institutional LU  Freeways  
 Commercial LU  
 Industrial LU

**Edit** Source Area PSD and Peak to Average Flow Ratio File:

Use Cost Estimation Option

age Area = 0.000 acres Icon Number Index Number = Icons Left = Start Date: 01/01/96 End Date: 12/31/05

File Name:

C:\WinSLAMM Files\Example Files\NY P load\WinSLAMM files\Hidden Meadows\Hidden Meadows with controls\C Yorktown add road with winter restrict.mdb

### Outfall Output Summary

	Runoff Volume (cu. ft.)	Percent Runoff Reduction	Runoff Coefficient (Rv)	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Total of All Land Uses without Controls	3.999E+06		0.17	139.1	34731	
Outfall Total with Controls	1.501E+06	62.47 %	0.06	27.12	2541	92.68 %
Current File Output: Annualized Total After Outfall Controls						
	150061		Years in Model Run: 10.00		254.0	

Pollutant	Concentration - No Controls	Concentration - With Controls	Concentration Units	Pollutant Yield - No Controls	Pollutant Yield - With Controls	Pollutant Yield Units	Percent Yield Reduction
Particulate Phosphorus	0.1847	0.02921	mg/L	46.11	2.738	lbs	94.06 %
Filterable Phosphorus	0.1466	0.1693	mg/L	36.60	15.86	lbs	56.66 %
Total Phosphorus	0.3313	0.1985	mg/L	82.71	18.60	lbs	77.51 %

Print Output Summary to Text File

Print Output Summary to .csv File

Total Area Modeled (ac)  
15.499

#### Total Control Practice Costs

Capital Cost	N/A
Land Cost	N/A
Annual Maintenance Cost	N/A
Present Value of All Costs	N/A
Annualized Value of All Costs	N/A

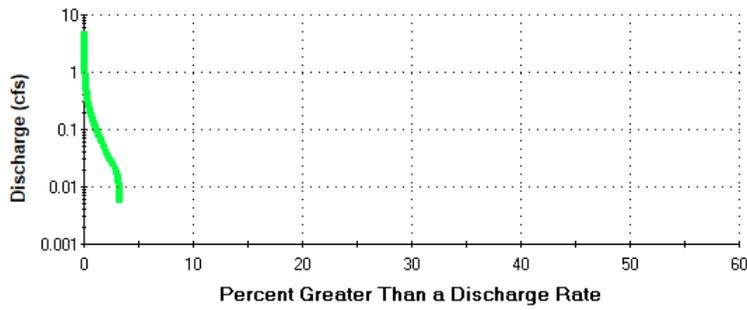
Perform Outfall Flow Duration Curve Calculations

#### Receiving Water Impacts Due To Stormwater Runoff (CWP Impervious Cover Model)

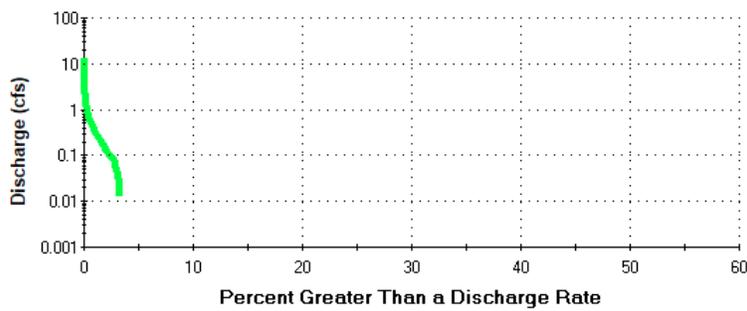
	Calculated Rv	Approximate Urban Stream Classification
Without Controls	0.17	Fair
With Controls	0.06	Good

Flow Duration Curves

Flow Duration Curve for Current Model Run



Flow Duration Curve for Current Model Run Without Controls



Flow Duration Data

Discharge Greater Than Percent	Flow Rate (cfs) for Current Model Run	Flow Rate (cfs) Without Controls
0	4.967	12.71
0.1	0.6953	1.729
1	0.1142	0.3306
3	0.01490	0.05086
5	0	0
10	0	0
20	0	0
30	0	0
40	0	0
50	0	0
60	0	0
70	0	0
80	0	0
90	0	0
100	0	0

Print

Close