

WinSLAMM, the Source Loading and Management Model

WinSLAMM, the Source Loading and Management Model was developed starting in the mid-1970's as part of early EPA street cleaning and receiving water projects in San Jose (Pitt 1979) and Coyote Creek (CA) (Pitt and Bozeman 1983). The primary purpose of the model is to identify sources of urban stormwater pollutants and to evaluate the efficiency of control practices. During the mid 1980s, the model was expanded to include more management options beyond street cleaning, including wet detention ponds, infiltration and grass swales. The Nationwide Urban Runoff Program (NURP) projects (EPA 1983) provided a large data set for the model, especially, Alameda Co. CA (Pitt and Shawley 1983); Bellevue, WA (Pitt and Bissonnette 1983); and Milwaukee, WI (Bannerman, et al 1983). Research funded by the Ontario Ministry of the Environment (Ottawa) (Pitt 1987) and the Toronto Area Watershed Management Strategy study in the Humber River (Pitt and McLean 1986) also provided much information on bacteria sources in urban areas. During the mid-1980s, the model started to be used by the Wisconsin Department of Natural Resources (WDNR) in their Priority Watershed Program (Pitt 1986). The first Windows version of the model was developed in 1995 and the current version is 9.3.0, released in April 2008. The model is continuously being updated based on user needs and new research (recent and current support from Stormwater Management Authority of Jefferson County, AL; the TVA, Economic Development group; WDNR; the USGS; and Imbrium). The next version currently being developed will include drag and drop watershed elements and more complete routing options.

Over the years, WinSLAMM has been extensively revised and expanded and now includes a wide range of capabilities. The following lists several important model features:

- The model can evaluate a long-series of rain events. One to five years of typical rains are used, but several decades of rains can be evaluated
- The model is based on actual field data. For example, street dirt accumulation and washoff equations and direct runoff from paved surfaces are based on many thousands of measurements from actual rain events
- The effects of compacted urban soils are considered
- Uncertainties of many modeling parameters are represented by built-in Monte Carlo components
- Costs of control practices can be directly calculated and considered in model runs
- Runoff flow-duration probability distributions and associated receiving water biological conditions are calculated based on site conditions and the control measures being used
- The model can be interfaced with several other models for more detailed drainage system and receiving water evaluations.

Prior descriptions of WinSLAMM have been presented during the Engineering Foundation and in the Urban Water Modeling Conference series, and in other publications (Pitt 1986; 1997; 1999; Pitt and Voorhees 2002 for example). The model web site (<http://www.winslamm.com/>) also contains further model descriptions and references.

Applications of WinSLAMM include:

- Permit Compliance – Municipal Pollutant Loadings and Discharge Reductions
- Evaluate Alternative Stormwater Controls
 - City-wide

- Watershed
- Site Development
- Identify critical drainage areas
 - Identify critical land uses
 - Identify critical source areas
 - Assist with cost-sharing
 - Identify the most cost-effective stormwater control and development scenarios

WinSLAMM is an urban stormwater model (it does not directly address agricultural areas, natural areas, etc.). It is designed to be an effective multi-scale model (individual lots to whole communities), and can calculate annual or seasonal pollutant loads. It evaluates individual or multiple stormwater control scenarios (source area, land use, drainage, outfalls), as shown highlighted in the following table:

	Hydro-dynamic Device	Wet Detention	Street Cleaning	Biofiltration/ Rain Gardens	Porous Pavement	Rain Barrels/ Tanks	Grass Swales	Catch-basin Cleaning	Drainage Dis-connection
Roof									
Paved Parking/Storage									
Unpaved Parking/Storage									
Playgrounds									
Driveways									
Sidewalks/Walks									
Streets/Alleys									
Undeveloped Areas									
Small Landscaped Areas									
Other Pervious Areas									
Other Impervious Areas									
Freeway Lanes/Shoulders									
Large Turf Areas									
Large Landscaped Areas									
Land Uses									
Drainage System									
Outfall									

The effectiveness of the control practices are calculated based on the size and other attributes of the devices, the source area or outfall location characteristics, and the calculated runoff characteristics. The model does a complete mass balance and routing of water volume and particulate mass, considering the combined effects of all controls. Hydraulic and particle size routing occurs for each device individually, although serial effects of multiple devices are being expanded for these parameters in an upcoming version. The effects of the sedimentation controls are calculated using modified Puls hydraulic routing with surface overflow rate particulate routing. The performance of wet ponds have been verified by extensively monitoring several ponds (WI DNR and USGS, with documentation at:

<http://unix.eng.ua.edu/~rpitt/SLAMMDETPOND/WinDetpond/WinDETPOND%20user%20guide%20and%20documentation.pdf>). The infiltration and biofiltration devices use a combination of hydraulic routing with infiltration and evaporation losses, plus any pumped withdrawals. Evapotranspiration

losses are being added to the devices in the next model update. Underdrain filtering in biofilters is based on extensive tests of media filtration. Grass swale performance is calculated based on extensive laboratory and outdoor testing of particulate trapping of shallow flowing water and infiltration losses (Kirby 2005; Johnson, et al. 2003; Nara and Pitt 2005). Porous pavement performance is calculated based on infiltration losses and clogging effects. Street cleaning and catchbasin benefits are based on extensive EPA research, and newer updated research that has examined modern street cleaning equipment. Hydrodynamic devices are based on the basic sedimentation processes, but have been verified by tests conducted by the USGS and the DNR, plus continued tests at the University of Alabama. The following figure shows some example screen shots used to enter information for some of the controls.

Example Control Practice Input Screens for WinSLAMM

Hydrodynamic Device

Land Use: Industrial
Source Area: Paved Parking/Storage 1
Device Number: 1

Generic Hydrodynamic Control Device Information

Device Source Area Information

Total Source Area (ac)	1.15
Area Served by Device (ac)	1.15
Number of Devices	1
Device Density (units/ac)	0.9

Physical Characteristics of Device

1 - Average Sump Depth below Device Outlet Invert (ft)	4.00
Depth of Sediment in Device at Beginning of Study Period (ft)	1.00
2 - Typical Outlet Pipe Diameter (in)	1.00
Typical Outlet Pipe Slope (ft/ft)	0.015
3 - Typical Outlet Pipe Slope (ft/ft)	1.000
Typical Device Sump Surface Area (ft ²)	150
4 - Device Depth from Sump Bottom to Street Level (ft)	8.00
Inflow Hydrograph Peak to Average Flow Ratio	3.0
Maximum Flow to In-Line Sump (cfs)	190.0
5 - Diameter of Outlet that Controls Flow to In-Line Sump (ft)	
6 - Inflow Outlet Invert Elevation (ft)	
7 - Length (ft) of Overflow Structure Acting as a Sharp Crested Weir	
8 - Elevation of Overflow Structure to Top of In-Line Sump (ft above sump base)	
9 - Max. Allowable Depth of Sediment Accumulation Below Outlet Invert (ft)	3.0

Select Critical Particle Size file name:
C:\Program Files\WinSLAMM\MEDIUM.CPZ

For Device Cleaning, Select Either

Device Cleaning Dates

Device Cleaning No.	Device Cleaning Date (mm/dd/yyyy)
1	
2	
3	
4	
5	

OR

Device Cleaning Frequency

☒ Monthly
☐ Three Times per Year
☐ Semi-Annually
☐ Annually
☐ Every Two Years
☐ Every Three Years
☐ Every Four Years
☐ Every Five Years
☐ Never

☐ Use Proprietary Hydrodynamic Control Device Information

Manufacturer: _____ Model: _____

1 - Average Sump Depth below Device Outlet Invert (ft)
Depth of Sediment in Device at Beginning of Study Period (ft)
2 - Typical Outlet Pipe Diameter (in)
3 - Typical Outlet Pipe Slope (ft/ft)
Inflow Hydrograph Peak to Average Flow Ratio
9 - Maximum Allowable Depth of Sediment Accumulation Below Outlet Invert (ft)

Delete Control Cancel Continue

Hydrodynamic Device Input Screen

Wet Detention Control Device

Outfall Control

Total Area: 50.6 acres

Pond Number 1

Select Particle Size Distribution File
C:\PROGRAM FILES\WINSLAMM\MEDIUM.CPZ

Initial Stage Elevation (ft): 3

Peak to Average Flow Ratio: 3.00

Save this Pond as a WinDET POND File

Cancel Delete Pond Continue

Outlet Options

☒ 1 - Sharp Crested Weir
☐ 2 - V-Notch Weir
☐ 3 - Orifice
☐ 4 - Seepage Basin
☐ 5 - Natural Seepage
☐ 6 - Evaporation
☐ 7 - Other Outflow
☐ 8 - Weir/Wyldard
☐ 9 - Broad Crested Weir
☐ 10 - Vertical Steel Pipe
☐ 11 - Stone Weir

Edit Existing Outlet

Selected Outlets (ft/s): 5) Double Click to Edit or Delete

1 - V-Notch Weir
2 - Broad Crested Weir
3 - Evaporation

Stage (ft)	Area (acres)	Cumulative Volume (ac-ft)
0	0.00	0.000
1	1.00	0.075
2	2.00	0.125
3	3.00	0.250
4	4.00	0.375
5	5.00	0.500
6	6.00	0.750
7	7.00	1.000
8	8.00	1.250
9	9.00	1.500

Use Shift plus the arrow keys to move through the grid

Stage (ft) Row 1: 1.00

Insert row below row number: _____ Insert Row

Delete row number: _____ Delete Row

Flow Average Flow Time (1.2 * Rainfall Duration)

Enter fraction (greater than 0) that you want to modify all pond areas by: _____ Modify Pond Areas

Recalculate Cumulative Volume

Main Wet Detention Pond Input Screen

Porous Pavement Control Device

Land Use: Industrial
Source Area: Paved Parking/Storage 2
Total Area: 1.15 Porous Pavement Number: 1

Porous pavement area (acres): 1.15

Inflow Hydrograph Peak to Average Flow Ratio: 3.0

Pavement Geometry and Properties

1 - Pavement Thickness (in)	4
Pavement Void Ratio (P-1)	0.3
2 - Aggregate Bedding Thickness (in)	3
Aggregate Bedding Void Ratio (P-1)	0.3
3 - Aggregate Base Thickness (in)	24
Aggregate Base Void Ratio (P-1)	0.35

Outlet/Discharge Options

Perforated Pipe Underdrain Diameter, if used (inches)	2
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above datum)	12
Number of Perforated Pipe Underdrains	10
Subgrade Seepage Rate (in/hr): select below or enter	0.30
Use Random Number Generation to Account for Uncertainty in Seepage Rate	<input checked="" type="checkbox"/>
Subgrade Seepage Rate COV	1.30

Select Subgrade Seepage Rate

☐ Sand - 0.1 in/hr
☐ Loose sand - 25 in/hr
☐ Sandy loam - 1.0 in/hr
☐ Loam - 0.5 in/hr
☐ Silty loam - 0.3 in/hr
☐ Sandy silt loam - 0.2 in/hr

☐ Clay loam - 0.1 in/hr
☐ Silty clay loam - 0.05 in/hr
☐ Sandy clay - 0.05 in/hr
☐ Silty clay - 0.04 in/hr
☐ Clay - 0.02 in/hr

Surface Pavement Layer Infiltration Rate Data

Initial Infiltration Rate (in/hr)	Percent of Infiltration Rate After 3 Years (0-100)	Percent of Infiltration Rate After 5 Years (0-100)	Percent of Original Infiltration Rate Upon Cleaning (0-100)	Time Period Until Complete Clogging Occurs (yr)
15	10	5	75	10

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

Continue Cancel Delete Control

Porous Pavement Input Screen

Street Cleaning Control Device

Land Use: Industrial
Source Area: Street Area 1
Total Area: 3.1 acres

Select ☐ Street Cleaning Dates OR ☒ Street Cleaning Frequency

Street Cleaning Frequency

☐ 7 PASSES per Week
☐ 5 PASSES per Week
☐ 4 PASSES per Week
☐ 3 PASSES per Week
☐ 2 PASSES per Week
☐ One Pass Every Two Weeks
☐ One Pass Every Four Weeks
☐ One Pass Every Eight Weeks
☐ One Pass Every Twelve Weeks
☐ Two PASSES per Year (Spring and Fall)
☐ One Pass Each Spring

Model Run Start Date: 01/01/76 Model Run End Date: 12/31/76

Final cleaning period ending date (MM/DD/YY): 12/31/76

Continue Clear Cancel Edit Delete Control

Type of Street Cleaner

☐ Mechanical Broom Cleaner
☒ Vacuum Assisted Cleaner

Street Cleaner Productivity

☒ 1. Coefficients based on street features, parking density and parking controls
☐ 2. Other (specify equation coefficient)

Equation coefficient M (slope, M < 1) 0.67

Equation coefficient B (intercept, B > 1) 1.0

Parking Density

☐ 1. None
☐ 2. Light
☒ 3. Medium
☐ 4. Extensive (short term)
☐ 5. Extensive (long term)

Are Parking Controls Impaired?
☒ Yes ☐ No

Street Cleaning Input Screen

Biofiltration Control Device

Land Use: Commercial
Source Area: Small Landscaped Area 1
Total Area: 0.0367 acres
Biofilter Number: 3

Device Properties

Topsoil Area (ft²): 1600
Bottom Area (ft²): 250
Total Depth (ft): 2.50
Typical Width (ft) [Cost est. only]: 10.00
Native Soil Infiltration Rate (in/hr): 2.400
Infiltration Rate (in/hr): 1.00
Infiltration Rate Fraction Bottom (ft): 1.00
Infiltration Rate Fraction Sides (ft): 1.00
Rock Fill Depth (ft): 1.00
Rock Fill Volume (ft³): 0.10
Engineered Soil Type: Pear Sand
Engineered Soil Infiltration Rate (in/hr): 2.10
Engineered Soil Depth (ft): 0.75
Engineered Soil Void Ratio (ft): 0.30
Percent solids reduction due to Engineered Soil (0-100): 83.00
Inflow Hydrograph Peak to Average Flow Rate: 3.80
Number of Devices in Source Area or Land Use: 1

Source Areas from Land Use that Contribute Runoff to Biofiltration Control Device(s)

Roof 1, Roof 2, Roof 3, Roof 4, Roof 5, Paved Parking/Storage 1, Paved Parking/Storage 2, Paved Parking/Storage 3, Unpaved Parking/Storage 1, Unpaved Parking/Storage 2, Playground 1, Playground 2, Driveway 1, Driveway 2, Driveway 3, Sidewalk/Walk 1, Sidewalk/Walk 2, Street Area 1, Street Area 2, Street Area 3, Large Landscaped Area 1, Large Landscaped Area 2, Large Landscaped Area 3, Undeveloped Area, Small Landscaped Area 1, Small Landscaped Area 2, Small Landscaped Area 3, Isolated/Water Body Area, Other Pervious Area, Other Dry Creek Imp Area, Other Pail Creek Imp Area

Selected Outlets

1 - Vertical Stand Pipe
2 - Broad Canted Weir
3 - Underdrain Outlet

Change Geometry

Copy Biofilter Data, Paste Biofilter Data, Select Native Soil Infiltration Rate, Use Random Number Generator to Account for Infiltration Rate Uncertainty, Select Particle Size File, C:\Program Files\WinSLAMM\HIGH.DP2

Biofilter Geometry Schematic

Biofilter Input

Grass Swales

	Residential Land Use	Institutional Land Use	Commercial Land Use	Industrial Land Use	Other Urban Land Use	Freeway Land Use
Total Area in Land Use (ac)	0.00	0.00	0.00	96.60	0.00	0.00
Area Served by Swales (ac)	0.00	0.00	0.00	57.19	0.00	0.00
Swale Density (ft/ac)	0.00	0.00	0.00	125.00	0.00	0.00
Total Swale Length (ft)	0.00	0.00	0.00	7148.75	0.00	0.00
Typical Swale Side Slope (ft H : 1 ft V)	0.00	0.00	0.00	0.30	0.00	0.00
Typical Longitudinal Slope (ft/ft)	0.00	0.00	0.00	0.020	0.00	0.00
Swale Plant/Seeds Factor	0.00	0.00	0.00	D	0.00	0.00
Typical Grass Height (in)	0.00	0.00	0.00	3.00	0.00	0.00
Swale Infiltration Rate (in/hr)	0.00	0.00	0.00	0.50	0.00	0.00
Typical Swale Depth (ft) for Cost Analysis (Optional)	0.0	0.0	0.0	3.0	0.0	0.0
Particle Size Distribution File	MEDIUM.CP2					

Select Critical Particle Size File

Total area served by swales (acres): 57.19
Total area (acres): 96.60

Select Swale Density by Land Use

Low density residential - 160 ft/ac
Medium density residential - 350 ft/ac
High density residential - 375 ft/ac
Strip commercial - 630 ft/ac
Shopping center - 280 ft/ac
Industrial - 125 ft/ac
Freeways (shoulder only) - 270 ft/ac
Freeways (center and shoulder) - 410 ft/ac

Select infiltration rate by soil type

Sand - 4 in/hr
Loamy sand - 1.25 in/hr
Sandy loam - 0.5 in/hr
Loam - 0.25 in/hr
Silt loam - 0.15 in/hr
Sandy silt loam - 0.1 in/hr
Clay loam - 0.05 in/hr
Silt clay loam - 0.025 in/hr
Sandy clay - 0.02 in/hr
Silt clay - 0.01 in/hr
Clay - 0.01 in/hr

Continue

Grass Swale Input Screen

Each land use is described by characterizing elements for each source area within the land use, including source area and land use controls. Outfall and drainage system controls are described using the drop down menus. A new drag and drop interface is currently being developed that will allow greater efficiency and flexibility for control placement, and for using multiple land use source areas. The following figures show a screen from the most current version (v 9.40) and from the interface under development.

WinSLAMM Version 9.40 Source Area Screen and Version 10 Interface (Under Development)

WinSLAMM Data File: [C:\Files\SLAMM\WinSLAMM\Test Files\9.4.0 Test Files\Example 1f....]

File Land Use Pollutants Tools Run Utilities Help

SLAMM Data File:
Example 1f.DAT

Current Land Use: Commercial

Source Area: Paved Parking/Storage 1

Current File Data...

Current File Status:

Current File Data Entered

Land Use Areas

Residential Area: 0.00 Acres
Institutional Area: 0.00 Acres
Commercial Area: 4.84 Acres
Industrial Area: 0.00 Acres
Other Urban Area: 0.00 Acres
Freeway Area: 0.00 Acres
Total Area: 4.84 Acres

Source Area

Source Area No.	Source Area	Area (acres)	H	W	P	O	S	B	Source Area Parameters
61	Roof 1								
62	Roof 2								
63	Roof 3								
64	Roof 4	2.000							Entered
65	Roof 5								
66	Paved Parking/Storage 1	0.900			P				Entered
67	Paved Parking/Storage 2								
68	Paved Parking/Storage 3								
69	Unpaved Parking/Storage 1								
70	Unpaved Parking/Storage 2								
71	Playground 1								
72	Playground 2								
73	Driveway 1								
74	Driveway 2								
75	Driveway 3								
76	Sidewalk/Walk 1								
77	Sidewalk/Walk 2								
78	Street Area 1	1.150	H						Entered
79	Street Area 2								
80	Street Area 3								
81	Large Landscaped Area 1								
82	Large Landscaped Area 2	0.960							Entered
83	Undeveloped Area								
84	Small Landscaped Area 1								
85	Small Landscaped Area 2								
86	Small Landscaped Area 3								
87	Isolated/Water Body Area								
88	Other Pervious Area								
89	Other Dry Creek Imp Area	0.210							Entered
90	Other Pail Creek Imp Area								

WinSLAMM: [Land Use Area]

File New Pollutants Tools Utilities Help

Source Area

Source Area	Area (acres)	H	W	P	O	S	B	QAP
1	Roof 1							
2	Roof 2							
3	Roof 3							
4	Roof 4							
5	Roof 5							
6	Paved Parking/Storage 1							
7	Paved Parking/Storage 2							
8	Paved Parking/Storage 3							
9	Unpaved Parking/Storage 1							
10	Unpaved Parking/Storage 2							
11	Playground 1							
12	Playground 2							
13	Driveway 1							
14	Driveway 2							
15	Driveway 3							
16	Sidewalk/Walk 1							
17	Sidewalk/Walk 2							
18	Street Area 1							
19	Street Area 2							
20	Street Area 3							
21	Large Landscaped Area 1							
22	Large Landscaped Area 2							
23	Undeveloped Area							
24	Small Landscaped Area 1							
25	Small Landscaped Area 2							
26	Small Landscaped Area 3							
27	Isolated/Water Body Area							
28	Other Pervious Area							
29	Other Dry Creek Imp Area							
30	Other Pail Creek Imp Area							

Land Use Area

Land Use Area	Land Use Type	Land Use Label	Area
1	Residential 1	Residential 1	0.00
2	Residential 2	Residential 2	0.00
3	Freeway 1	Freeway 1	0.00
4	Industrial 1	Industrial 1	0.00
5	Industrial 2	Industrial 2	0.00
6	Industrial 3	Industrial 3	0.00
7	Industrial 4	Industrial 4	0.00
8	Industrial 5	Industrial 5	0.00
9	Industrial 6	Industrial 6	0.00
10	Industrial 7	Industrial 7	0.00
11	Industrial 8	Industrial 8	0.00
12	Industrial 9	Industrial 9	0.00
13	Industrial 10	Industrial 10	0.00
14	Industrial 11	Industrial 11	0.00
15	Industrial 12	Industrial 12	0.00
16	Industrial 13	Industrial 13	0.00
17	Industrial 14	Industrial 14	0.00
18	Industrial 15	Industrial 15	0.00
19	Industrial 16	Industrial 16	0.00
20	Industrial 17	Industrial 17	0.00
21	Industrial 18	Industrial 18	0.00
22	Industrial 19	Industrial 19	0.00
23	Industrial 20	Industrial 20	0.00
24	Industrial 21	Industrial 21	0.00
25	Industrial 22	Industrial 22	0.00
26	Industrial 23	Industrial 23	0.00
27	Industrial 24	Industrial 24	0.00
28	Industrial 25	Industrial 25	0.00
29	Industrial 26	Industrial 26	0.00
30	Industrial 27	Industrial 27	0.00
31	Industrial 28	Industrial 28	0.00
32	Industrial 29	Industrial 29	0.00
33	Industrial 30	Industrial 30	0.00
34	Industrial 31	Industrial 31	0.00
35	Industrial 32	Industrial 32	0.00
36	Industrial 33	Industrial 33	0.00
37	Industrial 34	Industrial 34	0.00
38	Industrial 35	Industrial 35	0.00
39	Industrial 36	Industrial 36	0.00
40	Industrial 37	Industrial 37	0.00
41	Industrial 38	Industrial 38	0.00
42	Industrial 39	Industrial 39	0.00
43	Industrial 40	Industrial 40	0.00
44	Industrial 41	Industrial 41	0.00
45	Industrial 42	Industrial 42	0.00
46	Industrial 43	Industrial 43	0.00
47	Industrial 44	Industrial 44	0.00
48	Industrial 45	Industrial 45	0.00
49	Industrial 46	Industrial 46	0.00
50	Industrial 47	Industrial 47	0.00
51	Industrial 48	Industrial 48	0.00
52	Industrial 49	Industrial 49	0.00
53	Industrial 50	Industrial 50	0.00
54	Industrial 51	Industrial 51	0.00
55	Industrial 52	Industrial 52	0.00
56	Industrial 53	Industrial 53	0.00
57	Industrial 54	Industrial 54	0.00
58	Industrial 55	Industrial 55	0.00
59	Industrial 56	Industrial 56	0.00
60	Industrial 57	Industrial 57	0.00
61	Industrial 58	Industrial 58	0.00
62	Industrial 59	Industrial 59	0.00
63	Industrial 60	Industrial 60	0.00
64	Industrial 61	Industrial 61	0.00
65	Industrial 62	Industrial 62	0.00
66	Industrial 63	Industrial 63	0.00
67	Industrial 64	Industrial 64	0.00
68	Industrial 65	Industrial 65	0.00
69	Industrial 66	Industrial 66	0.00
70	Industrial 67	Industrial 67	0.00
71	Industrial 68	Industrial 68	0.00
72	Industrial 69	Industrial 69	0.00
73	Industrial 70	Industrial 70	0.00
74	Industrial 71	Industrial 71	0.00
75	Industrial 72	Industrial 72	0.00
76	Industrial 73	Industrial 73	0.00
77	Industrial 74	Industrial 74	0.00
78	Industrial 75	Industrial 75	0.00
79	Industrial 76	Industrial 76	0.00
80	Industrial 77	Industrial 77	0.00
81	Industrial 78	Industrial 78	0.00
82	Industrial 79	Industrial 79	0.00
83	Industrial 80	Industrial 80	0.00
84	Industrial 81	Industrial 81	0.00
85	Industrial 82	Industrial 82	0.00
86	Industrial 83	Industrial 83	0.00
87	Industrial 84	Industrial 84	0.00
88	Industrial 85	Industrial 85	0.00
89	Industrial 86	Industrial 86	0.00
90	Industrial 87	Industrial 87	0.00
91	Industrial 88	Industrial 88	0.00
92	Industrial 89	Industrial 89	0.00
93	Industrial 90	Industrial 90	0.00
94	Industrial 91	Industrial 91	0.00
95	Industrial 92	Industrial 92	0.00
96	Industrial 93	Industrial 93	0.00
97	Industrial 94	Industrial 94	0.00
98	Industrial 95	Industrial 95	0.00
99	Industrial 96	Industrial 96	0.00
100	Industrial 97	Industrial 97	0.00
101	Industrial 98	Industrial 98	0.00
102	Industrial 99	Industrial 99	0.00
103	Industrial 100	Industrial 100	0.00

Press F1 for Help

The calculated outputs from WinSLAMM are organized in several tiers. The first output the model shows is a summary table with the results of the most commonly analyzed pollutants (runoff volume and particulate solids). The data in the summary table includes the following information:

Runoff Volume (ft^3 , percent reduction; and R_v , runoff coefficient) and Particulate Solids (lbs and mg/L) for:

- Source area total without controls
- Total before drainage system
- Total after drainage system
- Total after outfall controls

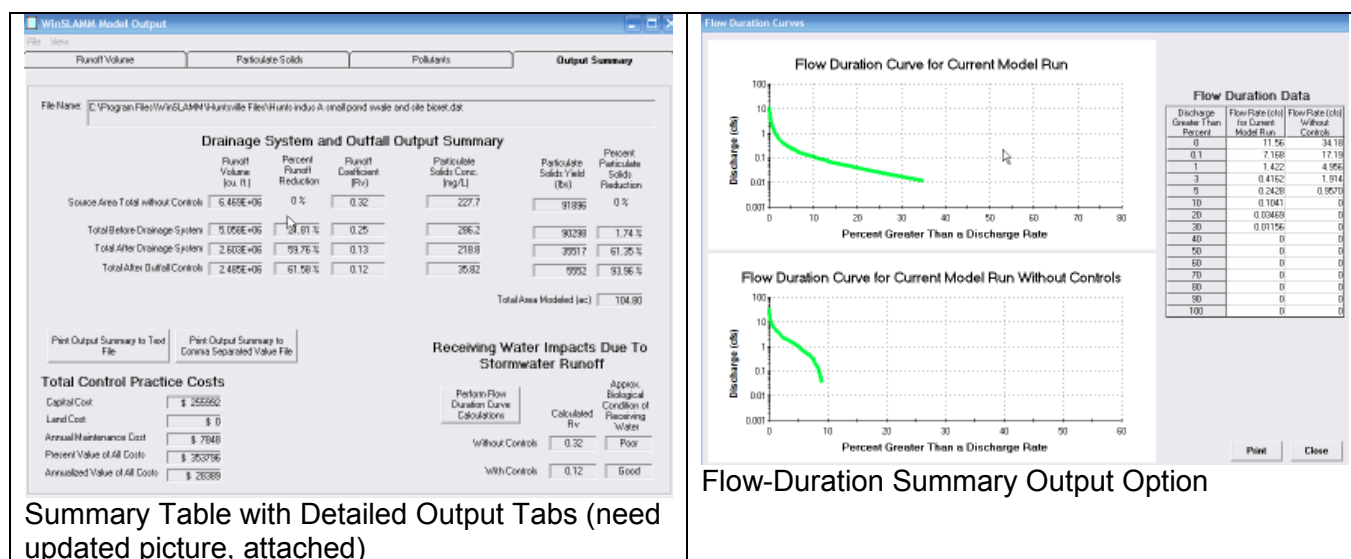
Total control practice costs:

- Capital costs
- Land cost
- Annual maintenance cost
- Present value of all costs
- Annualized value of all costs

Receiving water impacts due to stormwater runoff:

- Calculated R_v with and without controls
- Approximate biological condition of receiving water (good, fair, or poor)
- Flow duration curves (probabilities of flow rates for current model run with and without controls)

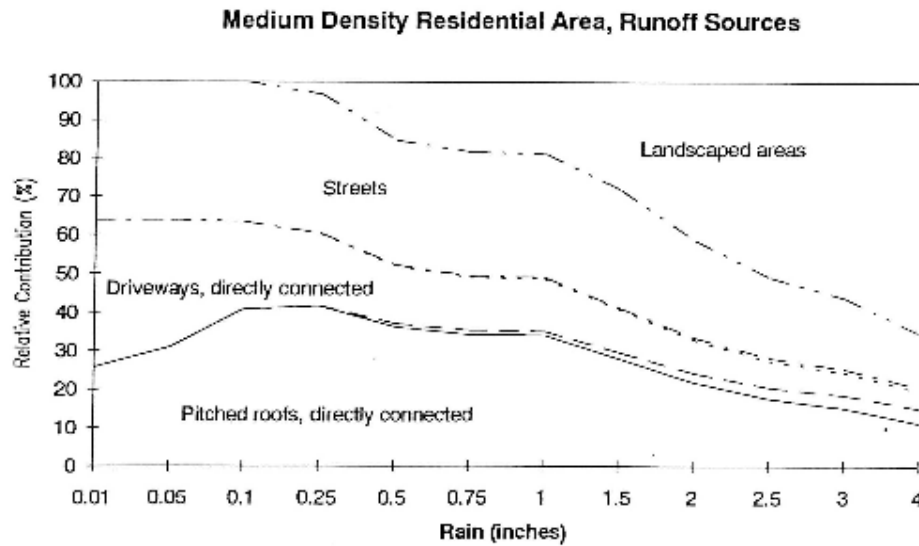
The flow duration curves are included on an optional second page, as shown on the following figure.



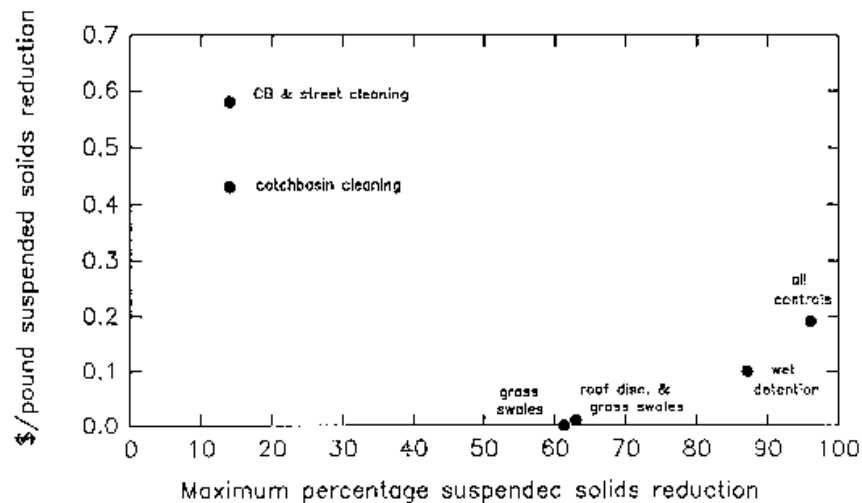
The tabs along the top of the summary table display additional results for runoff volume (ft^3), particulate solids (lbs and mg/L), and the analyzed pollutants (lbs and mg/L). Results are shown:

- By source area for each rain event
- Land use total
- Summary for all rains
- Total for land use and for each event
- Outfall summary, before and after drainage system and before and after outfall controls
- R_v (runoff volume only)
- Total losses (runoff volume only)
- Calculated CN (runoff volume only)

Hazardous Waste Asset Output																
Parent Volume		Particulate Solids					Polychlorinated					Output Summary				
Parent Volume (ft³)		Source Area/Parent Volume Contribution														
Data File: Hazards.ind - Small parcel row and the largest D Run File: H01N1930.RAW Date of 02/09/2018 Time 12:45:00 Site Description: Hazardous waste, a small parcel row and the landfill.																
Individual Areas - Parent Volume (ft³)																
Site	Parent	Plant 1	Plant 2	Parent Paving/Storage	Parent Paving/Storage	Street Area	Street Area 2	Street Area 3	Large Landscaped Area 1	Small Landscaped Area 2	Isolated Area	Land Use (ft²)	Rv	Total Losses (ft³)	Calculated CN	
01/02/06	0.75	0	0	0	3037	5607	5607	5607	17717	2543	0	61115	0.21	0.59	056	
01/03/06	0.62	0	0	16481	0	4457	4457	4457	13751	2543	0	48517	0.21	0.49	911	
01/04/06	0.01	0	0	0	0	1681	1681	1681	0	0	0	1681	0.01	0.01	N/A	
01/11/06	0.96	0	0	14571	0	2380	3954	3954	3954	11950	1970	0	42340	0.20	0.45	917
01/13/06	0.10	0	0	541	0	0	520	520	0	0	0	2502	0.07	0.09	574	
01/20/06	0.35	0	0	7949	0	1417	2219	2219	5929	552	0	22885	0.17	0.29	941	
01/26/06	0.05	0	0	0	0	186	172	172	0	0	0	7121	0.04	0.05	384	
01/28/06	0.06	0	0	237	0	236	236	236	0	0	0	9413	0.04	0.06	962	
01/29/06	0.05	0	0	0	0	186	172	172	0	0	0	7121	0.04	0.05	384	
01/30/06	0.13	0	0	382	0	4014	421	4014	11951	11951	0	138070	0.25	1.05	630	
02/04/06	0.75	0	0	3037	5607	5607	5607	5607	17717	2543	0	61115	0.21	0.59	056	
02/11/06	0.07	0	0	0	0	279	309	309	0	0	0	128	0.05	0.07	373	
02/15/06	7.79	16580	51209	2280	734	16585	16585	16585	50039	9607	0	92504	0.29	0.71	568	
02/21/06	0.75	0	0	3037	5607	5607	5607	5607	17717	2543	0	61115	0.21	0.59	056	
02/26/06	1.26	1005	36357	142	5915	10549	10549	10549	36340	6038	0	116491	0.24	0.95	050	
02/27/06	0.03	0	0	0	0	49	50	50	0	0	0	2381	0.02	0.03	405	
02/28/06	0.62	0	0	16481	0	2511	4457	4457	13751	2543	0	48517	0.21	0.49	911	
02/29/06	0.05	0	0	0	0	186	172	172	0	0	0	7121	0.04	0.05	384	
03/12/06	0.34	0	0	26299	0	3000	7067	7067	24169	4076	0	79879	0.22	0.73	074	
03/14/06	0.01	0	0	0	0	0	0	0	0	0	0	9181	0.00	0.01	N/A	
03/15/06	0.47	0	0	11227	0	1903	3285	3285	9013	1457	0	33066	0.19	0.38	507	
03/20/06	0.07	0	0	0	0	279	309	309	0	0	0	128	0.05	0.07	373	
03/28/06	1.48	14609	42623	2047	5973	12800	12800	12800	43736	7285	0	126476	0.29	1.05	045	
03/28/06	0.01	0	0	0	0	137	2043	20								



A powerful feature of WinSLAMM is the batch processor that enables many control options to be quickly compared for an area. The batch processor can analyze runoff volume and pollutants and also combine unit cost data to evaluate the cost effectiveness of control options. The following plot of the cost-performance data for one study site shows the unit costs associated with preventing particulate solids from being discharged from an area.



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