# Module 5e: Wet Detention Basins in WinSLAMM

#### Problem Description

You are the stormwater engineer for a commercial site that must reduce its pollution load by 40 percent. The site is fully developed with silty soils. Determine the site's pollution load if a wet detention basin is installed. Instructions for modifying the file begin on page 2. A schematic of the inputs for the detention basin is shown at the end of the example (page 12).

How much runoff and pollution does the site generate (Answers to be filled in throughout example)?

- i. Runoff (cu ft):
- ii. TSS (mg/L):
- iii. TSS (lbs):
- iv. Total Copper (lbs):
- v. Particulate Lead (lbs):

What is the percent reduction of TSS (lbs)?

Steps:

- 1) Review the data regarding the detention basin
- 2) Save the file as another name and update the site description
- 3) Enter the detention basin data
- 4) Run the model
- 5) View the output
- 6) Save the output

### Problem

1) Review the data regarding the detention basin

Put a detention basin at the site's outfall. Start with Example 1a. Follow the steps starting on page 3 to enter the data.

Particle Size Distribution:	<u>Nurp</u>
Initial Stage Elevation (ft):	5
Peak to Average Flow Ratio:	3.8 - default

Stage	Area	1		
(ft)	(ac)			
0	0	1		
0.01	0.001			
2	0.006			
4	0.024			
6	0.053			
8	0.067			
Outlet		-		
Orifice				
Orifice Diameter (ft)	): <u>0.5</u>			
Invert elevation abo	ove datum (ft): <u>5</u>			
Broad Crested Weir				
Weir Crest Length (ft): <u>15</u>				
Weir Crest Width (ft	t): <u>1</u>			
Discharge Coefficie	nt (ft): <u>default</u>			
Height of Weir Oper	ning (ft) 1			

Height from Datum to Bottom of Weir Opening (ft): \_\_\_\_\_6

2) Save the file as another name and update the site description

Save Example 1a as "Example 1g"

Change the description of the file to reflect the detention basin

Contraction Contraction	Site Description	1			×	1
Edit Ske Descript.	Enter the Site De	escription (23)	0 characters m	ovimum)t	OK Cancel	est Management
Edit Seed	-					
Edit   Rain File:	Re. Directly Conn	nected Drains	age, Silly Sols,	Detention Po	nd at Outfall	
		1				
dit Start Date:	01/01/81	Winter S	Season Range			
ant cho Date:	12/31/81	Start of Win	eer (nm/läd)		End of W	(inter (mm/dd)
dit Pollutant Probat	12/31/81 illy Distribution File:	Stat of We	der Imm/ddl	VSLAMM\\V/	End of W	/inter (mm/dd)
dit   Pollutant Probat	12/31/81 ility Distribution File: nt File:	Start of Wei C:VPROGR	or Inni/Iddl    Am Filestwir Am Filestwir	VSLAMM\WI	End of W _GEO01.PPD _SL01.RSV	/inter.imm/ddl
ant Pollutant Probat ant Pollutant Probat ant Punot Coefficie ant Particulate Solid	12/31/81 ility Distribution File: nt File: s Concentration File:	Start of We C-VPROGR C-VPROGR C-VPROGR	Ger Inno/Gdl   AM FILESSWAR AM FILESSWAR AM FILESSWAR	VSLAMM\WI VSLAMM\WI	End of W _GEO01 PPD _SL01 RSV _AVG01 PSC	′inter (men/dd)
cant construction cant Pollutant Probat cant Particulate Solid cant Particulate Resi	12/31/81 ility Distribution File: nt File: a Concentration File: due Delivery File:	CVPROGR CVPROGR CVPROGR CVPROGR	AM FILESSWIR AM FILESSWIR AM FILESSWIR AM FILESSWIR	VSLAMM/WI VSLAMM/WI VSLAMM/WI	End of W _GEOOI PPD _SLOI.RSV _AVGOI.PSC _DLVOI PRR	finter (men/dd)
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dit Poluteri Probet dit Poluteri Probet dit Pariculate Sold dit Pariculate Sold dit Pariculate Resi dit Street Delivery 1 © Residentia LU © Instances	12/31/81 Ally Distribution File: a Concentration File: tue Delivery File: Tie (Select LU) C Industrial LU	CVPROGR CVPROGR CVPROGR CVPROGR CVPROGR CVPROGR	AM FILES WIT AM FILES WIT AM FILES WIT AM FILES WIT Files WinSLAT	VSLAMMIWI VSLAMMIWI VSLAMMIWI VSLAMMIWI VSLAMMIWI VSLAMMIWI_STR	End of W _GEO01 PPD _SL01.RSV _AVG01.PSC _DLV01.PRR _OLV01.PRR	finite (mov/dd)

3) Enter the detention basin data

To enter the detention basin data at the outfall, click Land Use then Outfall then Wet Detention

WinSLAMM Data File: [	C:\85086 UW	WinSLAMM\Eng\W	inSLAMM Files\Example1g.dat]	_101 ×
Pre Conduction     Presented     Instantional     Instantial     Instantial     Instantial     Instantial     Instantial     Coher Uban     Treeways     Current File Sta     Current File Sta	n nuneff Quartities age Control tus intered as 0.00 Acres 0.00 Acres 0.00 Acres 0.00 Acres 0.00 Acres 0.00 Acres 0.00 Acres 0.00 Acres	BicFitration     WrETextension     Other Control	e area data, select senu item, and select rd Use.	

Select the particle size distribution – Click **Select** next to "Particle Size Distribution File" – go to the directory where the distributions are stored and select **Nurp.cpz** – Click **OK** 

Outlet Options C. 1. Sharp Crested Weir C. 2. V - Notch Weir
C 4. Seepage Basin
clouier
C:\  Program Files  WinSLAMM  Control Demo Files  Rain Files  Standard Land Use Files
e:
c: 💌

The basin's permanent pool is 5 feet deep. Set the "Initial Stage Elevation" at "5" - Press Enter - Leave the "Peak to Average Flow Ratio" at the default of "3.8" – Press Enter

Wet Detention Control Device	
Outfall Control	Add Outlet
Total Area: 7.39 acres	e Dutlet Dobons
Pond Number 1	C 1. Sharp Crested Weir C 2. V - Notch Weir
Select Particle Size Distribution File:	C 3. Unlice C 4. Seepage Basin
C-VPROGRAM	C 5. Natural Seepage
	C 7. Other Outflow
	C S. Water Withdrawl
Initial Stage Elevation (It) 5	C 10. Vertical Stand Pipe
Peak to Average Flow Ratio 3.8	
Edit Stage Area Data	Edit Existing Outlet
	Selected Outlets (Max. 5)
Save this Pond as a WinDETPOND File	Double Llick to East or Delete
<u>Continue</u> <u>D</u> elete Pond	
Δ	
Flow Average Flow	
Time (1.2 * Rainfal	Duration)

Enter the Stage-Area data by selecting Edit Stage Area Data

	Stage (ft)	Area (acres)	Cumulative Volume
0	0.00	0.000	(ac-n) 0.000
	0	Stage (ft) 0 0.00	Stage (it)         Alea (acres)           0         0.00         0.000           1

To enter the Stage-Area data, enter the data in the box next to the table.

The basin has a 1600 square foot permanent pool surface area. The permanent pool is 5 feet deep. The basin has 4:1 side slopes and 1 foot of freeboard.

The Row number will appear to the left of the box. The Column heading will appear just above the box. You can place your curser on a particular box and it will change the Row and Column. Place your curser in the box for Row 1, Stage (ft), enter the corresponding Stage, press **Enter**, (the Column heading will change), enter the Area, press **Enter**. Follow the sequence until all the Stage-Area data is entered.

🖷, Stage Area Values				X
Pond Number 1				
Outfall		Stage (ft)	Area (acres)	Cumulative Volume (ac-ft)
Stage	0	0.00	0.000	0.000
Row 6	1	0.01	0.001	0.000
	2	2.00	0.006	0.007
	3	4.00	0.024	0.037
Insert a row before	4	6.00	0.053	0.114
row number:	5	8.00	0.067	0.234
Delete row number: Delete Row				
Recalculate Cumulative Volume				
<u>Cancel</u> Co <u>n</u> tinue	U	se Shift plus move thr	the arrow k ough the gri	eys to d

If you need to insert or delete a row, put the row number in the box next to "Insert Row" or "Delete Row".

Click Recalculate Cumulative Volume and the program will calculate the volumes.

### Press Continue

Enter the outlet structure. The basin has an orifice at the top of the permanent pool, then an overflow spillway 1 foot above the permanent pool.

First, enter the Orifice. Click Add Outlet

Outfall Control	Add Outlet
fotal Area: 7.39 acres Pond Number 1 Select Particle Size Distributi CYPROGRAM FILESWINSLAMMWURP.CPZ	on File: C 3. Orifice C 4. Seepage Basin C 5. Natural Seepage C 6. Evaporation C 7. Orifice
Initial Stage Elevation (R) [ Peak to Average Flow Ratio [	C 2. Unter Outlow     C 8. Water Withdrawl     C 9. Broad Created Weir     C 10. Vertical Stand Pipe 3.80
Edit Stage Area Data	
Save this Pond as a WinDETPOND File	Double Click to Edit or Delet
<u>C</u> ontinue <u>D</u> elete Pon	a
Flow	

Select **3. Orifice** – The Orifice Outlet input screen will appear. Enter the "Orifice diameter" and "Invert elevation above datum" – Click Continue

Orifice Ou	tlet		
Outfall			
Pond Nu	umber 1	Outlet Numb	er 1
1. Orifi	ice diameter	(ft)	0.5
2. Inve	ert elevation	above datum (ft)	5
	Cancel	<u>C</u> ontinue	Delete

"Orifice" will appear in the Selected Outlets in the lower right side of the screen.

Dutfall Control	Add Outlet
fotal Area: 7.39 acres	- Rutlet Retions
Pond Number 1	C 1. Sharp Crested Weir
	C 2. V - Notch Weir
Select Particle Size Distribution File	C 4. Seepage Basin
CVPROGRAM	C 5. Natural Seepage
FILES/WINSLAMM/NURP.CPZ	C 6 Evaporation
	C 9. Water Withdrawd
	C 9. Broad Crested Weir
Initial Stage Elevation (It) 5	C 10. Vertical Stand Pipe
Peak to Average Flow Ratio 3.80	
Edit Stage Area Data	Edit Existing Outlet
Course Maine Dermed and a	Selected Outlets (Max. 5) Double Click to Edit or Delet
WinDETPOND File	1 - Orifice
Continue Delete Pond	
	1
Flow Austran Flow	<b>N</b>
Average Flow	

Enter the Overflow Spillway. Click Add Outlet – Select 9. Broad Crested Weir – Enter the data describing the Spillway – Click Continue

Broa	Broad Crested Weir				
Out	Outfall				
Por	Pond Number 1 Outlet Number 2				
1.	Weir Crest Length (ft)	15			
2.	Weir Crest Width (ft)	1			
3.	Discharge Coefficient (English Units)	0			
	Oefault Discharge Coefficients				
4.	Height of Weir Opening (ft)	2			
5.	Height from Datum to Bottom of Weir Opening (ft)	6			
	Ca <u>n</u> cel <u>C</u> ontinue	<u>D</u> elete			

"Broad Crested Weir" will appear in the Selected Outlets in the lower right side of the screen.

Dutrali Control	Add Outlet
Total Area: 7.39 acres Pond Number 1 Select   Particle Size Distribution File:	C 1 Sharp Crested Wei C 2 V Notch Wei C 3 Online
C:VPROGRAM PILESWINSLAMMWURP.CPZ Initial Stage Elevation (It) 5	C 4 Seepage Basin C 5 Natural Seepage C 6 Evaporation C 7 Other Dutflow C 8 Water Withdrawl C 9 Broad Crested Weie C 10 Vertical Stored Prior
Peak to Average Flow Ratio 3.80	Edit Existing Outlet
	Selected Outlets (Max. 5) Double Click to Edit or Delet
Save this Pond as a WinDETPOND File	1 - Orifice 2 - Broad Crested Weir

If you need to edit an outlet structure or delete an outlet structure – Click Edit Existing Outlet, then double click on the outlet structure to be edited.

Now all the data describing the detention basin is entered. Click Continue

Save your changes

WinSLAMM Data File	: [C:\85086 UW \	WinSLA	MPS\Eng\WinSLAMP1Files\Exar	ngle1e,dat]	_10
He Land Use Pollutant	s Options Run	Utilities	Help		
New					
Open					
Seve					
Save Ac.					
Saus Inc. d Data					
Save input baca					
Output Options					
C:\85086 LW Wr/SLAM	MiEnglWinSLAMM F	FileslEva	mole1a.dat		
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Liberty will be a feature	CANAL AND AND AND	DETRON	Ci Standard Land Line Electric Cont	role //R 0 amb/011 field	n Commercial Class dat
r:/dronb/waterResourc	sertmenterwawa"way	LEIPON	Upcandard Land Use Plesi(No Cont	rois, up kain(stu sen	p commercial Clay, dat
L:/work/projects/82042	(EnglisLAMM Analy)	sis)Propo	ised BMPs(STR Clay site.dat		
Exit					
1 1.1 A 1997	1	11	Prayground 1		
Current File 5	tatus	72	Playground 2		1 Contraction
		73	Driveways 1	2.35	Entered
Lurrent File Data	Entered	74	Driveways 2		
Land Han A		75	Driveways 3		
Long Old Pa		76	Sidewalks/Walks 1	0.06	Entered
lesidential Area:	8.00 Acres	77	Sidewalks/Walks 2		
nstitutional Area:	0.00 Acres	78	Street Area 1	0.31	Entered
Commercial Area:	7.39 Acres	79	Street Area 2		
ndustrial Area:	0.00 Acres	80	Street Area 3		
Ither Urban Area	0.00 Acres	81	Large Landscaped Area 1		
Looman Asna	0.00 Acres	82	Large Landscaped Area 2		
Total Area:	7 39 Acres	83	Undeveloped Area		
Tura Area.	r.33 Acres	84	Small Landscaped Area 1	0.63	Entered
		85	Small Landscaped Area 2		
		86	Small Landscaped Area 3		
Exit Progra	m	87	Isolated Area		
		88	Other Pervious Area		
Press F1 for	Help	89	Other Dir Cnctd Imp Area		
		90	Other Part Cnctd Imp		

4) Run the model

File Land Use Polistan	ts Options	Run Utilities	Help	STATISTICS (CR	semple ( e.c	at j					=100
		Calculation	Module				_	_	_	_	
SI AMM Data Eila		Run Batch I	Editor	ce Area	Area	1 .	p	0	s	B	Source Area
Survivi Data Fille		No.	-		forment	_			_		Parameter
E Komple ( E.DA )		61	61 Roofs 1		1.48						Entered
		62	Roofs 2				-				
Current Land Use: Commercial		63	Roofs 3								
		64	Roofs 4								
Current Source Area		65	Roofs 5								
		66	Paved Park	2.56						Entered	
		67	Paved Park	ing/Storage 2							
Current File Data		68	Paved Park								
		69	Unpaved P								
-		70	Unpaved P	rkng/Storage							
1		71	71 Playground 1								
Current File Status		72	Playground	2		-					
		73	Driveways	1	2.35						Entered
Current File Dat	a Entered	74	Driveways								
I and Han d		- 75	75 Driveways 3								
Cano Ose y	uuus	76	Sidewalks/Walks 1		0.06						Entered
Residential Area:	0.00 Ac	les 77	Sidewalks/	Walks 2							
Institutional Area:	0.00 Act	res 78	Street Area	1	0.31						Entered
Commercial Area:	7.39 Ac	res 79	Street Area	2							
Industrial Area:	8.00 Act	80	Street Area	3							
Other Urban Area	0.00 40	er 81	Large Land	scaped Area 1							
Freeman Area	0.00 40	82	Large Land	scaped Area 2							
Total Area:	7 39 4	83	Undevelop	ed Area							
FOUR PAREN.	1.55 Pic	84	Small Land	scaped Area 1	0.63						Entered
		85	Small Land	scaped Area 2							
		86	Small Land	scaped Area 3							
Exit Progr	-	87	Isolated An	1ð							
		88	Other Pervi	ous Area							
Press F1 fo	e Helo	89	Other Dir C	nctd Imp Area							
		90	Other Part	Cnotd Imp							

Save File and Execut	e
Save File with a Different Na	me and
Execute	
Cancel Program Executi	on

# 5) View the output

How much runoff and pollution does the site generate (fill in the table on page 1)?

WinSLAMM Model Output			<u>_</u>
e View			
Runolf Volume	Particulate Solids	Pollutants	Output Summary
File Name: C:\85086 UW WinS	LAMM\Minn Course\Example 1	Example 1f.dat	
Total Before Drainage System Total After Drainage System Total After Outla Controls	Runoff         Percent           Volume         Runoff           (cu.lt.)         Reduction           551494         Base           551495         0.00 %           551503         000	Particulate Solid: Conc. (mg/L) 125.3 125.3 7959 Total	Particulate Solids Yield (Bt) 4390 Base 4390 0.00% 2507 42.83% Area Modeled (ac)
Total Control Practic	ce Costs		
Capital Cost	N/A		Print Output Summary to
Land Cost	N/A		File
Annual Maintenance Cost	N/A		-
Present Value of All Costs	N/A		Print Output Summary to Text File
Annualized Value of All Costs	E 11/4		. 64 1 86

- i. Runoff (cu ft): **561,503** *cu. ft.* ii. TSS (mg/L): **71.59** *mg/L* iii. TSS (lbs): **2,507** *lbs*

Runoff	Volume	Part	iculate Solids		Pollutan	ts	Outpu	t Summary
1	Concentration	3	Yield (lbs)		r	Percent SA Con	tribution	
Data File: E:	ample 1f.DAT	9						-
Rain File: M	SN1981.RAN						14	1
Date: 09-05-	05 Time: 2:58	47 PM						
Site Descript	ion: Example 1	1						
Total Area. v	ith Drainage a	nd Outfall Con	trols - Yield of	TOTAL COPP	ER (lbs)			
Summary of I	Runoll Produce	ng Events						
	Rain Total (inches)	Total Before Drainage System	Total Alter Drainage System	Total After Outfall Controls				
Minimum	0.01	6.691E-06	6.691E-06	5.279E-06				
Maximum	2.59	0.06604	0.06604	0.05686				
FI WI Ave:	-	83359.0	0.02668	0.02190				
Totał	32.10	0.6765	0.6765	0.5285				
Total Area, v	eth Drainage a	nd Outfall Con	trols - Yield of	PARTICULAT	E LEAD (bs)			
Summary of I	Runoll Ptoduce	ng Events		22220			1	
	Hain Total (inches)	Total Before Drainage Sustem	After Drainage Sustem	Total After Outfall				

iv. Total Copper (lbs): 0.5285 lbs

Runoff	Volume	Part	iculate Solids	j i	Pollutants	Output Summa	ary	
(	Concentration	Ĩ	3	Yield (lbs)	T	Percent SA Contribution	í.,	
Data File: Ex	ample 1f.DAT	3						
Minimum	0.01	6.691E-06	6.691E-06	5.279E-06			1	
Maximum	2.59	0.06604	0.06604	0.05686				
FI WI Ave:		0.02668	0.02668	0.02190				
Total	32.10	0.6765	0.6765	0.5285				
Total Area, w Summary of F	ath Drainage a Runoff Produci	nd Outfall Con ng Events	trols - Yield of	PARTICULATE LI	EAD (bs)			
	Rain Total (inches)	Total Before Drainage System	Total After Drainage System	Total After Outfall Controls				
Minimum:	0.01	5.156E-06	5.156E-06	7.524E-08				
Maximum	2.59	0.1098	0.1098	0.07795			-	
FI WI Ave:		0.01114	0.04444	0.02813				
Total	32.10	1.128	1.128	0.6479				

- v. Particulate Lead (lbs): 0.6479 lbs
- 6) Save the output

	WinSLAMS File View Bunoff	1 Model Outp	νε [ γ]	Printing Options	× _			
I		Concentration		C Printer		Percent SA Contribution		
t	Data File: Example1e.DAT		_					
1	Maximum: FI V/L Ave: Total Total Area, v Summary of Minimum: Maximum: FI V/L Ave: Total	2 59 32 10 with Disinage a Runoff Produci Rein Total (inches) 0.01 2 59 32 10	0.06 0.02 0.6 nd Outial ng Event Total Before Drainas Syster 5.156 0.1 0.04 1.	Select Item(s) to Print Runoff Volume F Runoff Volume (cu It) SA Runoff Vol. Contribution Particulate Solids Concentration SA Yield SA Yield Contribution Pollutants Concentration Yield (lbs) Percent SA Contribution				
	4			<u>Cancel</u>		,*		
l	Press	F1 for Help		89 Other Dir Crictd Imp Area 90 Other Part Crictd Imp	-			
d The	file Exam	ple1g.csv i	nas bee	n created in the directory "C:	\85086	UW WinSLAMM\Eng\WinSl		

d. What is the percent reduction from the basin of TSS(%)? 42.89 %

Alternative Scenarios (if available time)

b. Question: Instead of 40 percent, you would like to control the pollution from the site by 80%. How do you modify the detention basin to achieve that goal?

Answer: Increase the volume and permanent pool surface area and/or further restrict the flow leaving the basin.

	Top of Basin		
7	▲ <u> </u>		
6—	Height of Weir		
5—	Opening (ft)		
4 —	<b>*</b>		<b>^</b>
3	Height from Datum	Storage above Scour Depth	Dead Storage
2	Opening (ft)		Volume
1		Scour Depth	
0	Datum - Basin Bottom _		¥

Wet Detention Basin Geometry