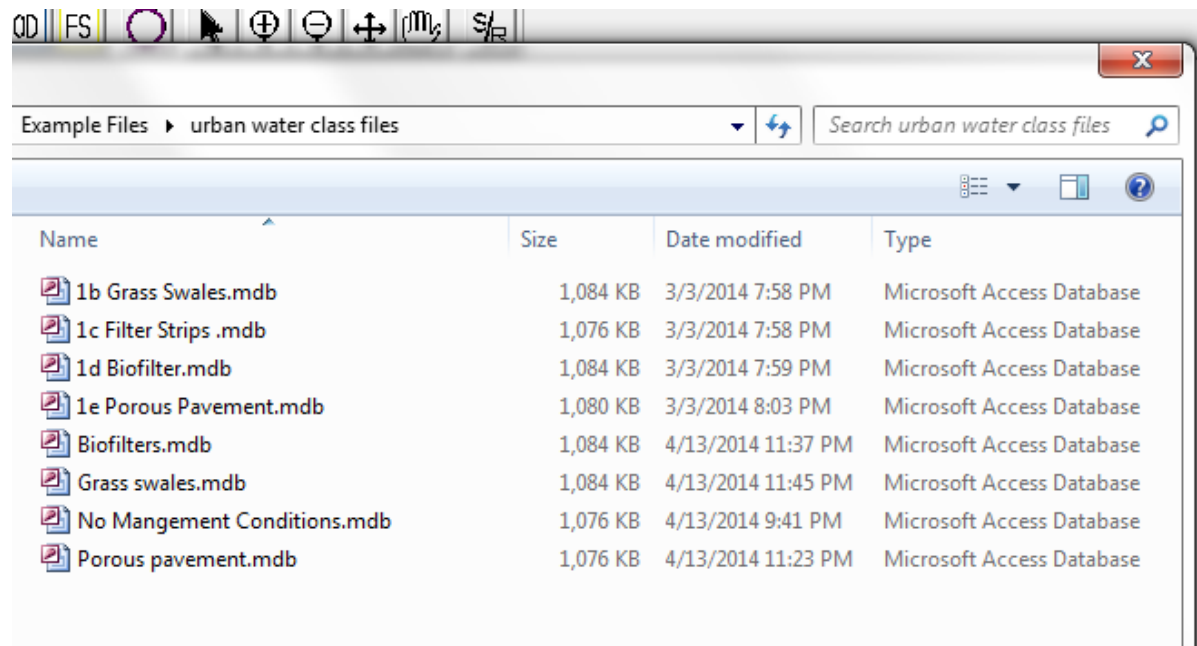


Water Tank/Cistern Example

Cistern/Water Tank Example

For this example, we will start with the model file we created for No Controls and add water tanks/cisterns. Only the roof runoff will be routed to the water tanks and the water will be used to irrigate the large landscaped area.

Open the No Controls model file and Save the File with a new name.



Change the Site Description in the Current File Data to reflect the tanks.

Water Tank/Cistern Example

Current File Data

SLAMM Data File Name:
C:\WinSLAMM Files\Example Files\urban water class files\No Mangement Conditions.mdb

Site Descript.: Water tanks for roof runoff, commercial development

Edit Seed: -42

Edit Rain File: C:\WinSLAMM Files\Rain Files\AL Birmingham 8799.RAN

Edit Start Date: 01/01/94 ☐ Winter Season Range
Edit End Date: 12/31/98 Start of Winter (mm/dd) End of Winter (mm/dd)

Edit Pollutant Probability Distribution File: C:\WinSLAMM Files\SouthEast April 05 2014.ppd

Edit Runoff Coefficient File: C:\WinSLAMM Files\SouthEast April 05 2014.rsv

Edit Particulate Solids Concentration File: C:\WinSLAMM Files\SouthEast April 05 2014.psc

Edit Street Delivery File (Select LU)
☒ Residential LU ☐ Other Urban LU
☐ Institutional LU ☐ Freeways
☐ Commercial LU
☐ Industrial LU
Change all Street Delivery Files to Match the Current File

Edit Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\PSD source area SSC.csv

☒ Use Cost Estimation Option **Select Cost Data File** C:\WinSLAMM Files\Birmingham Cost Data.csv

Replace Default Values with these Current File Data Values Use Default Values Replace all Particle Size Distribution Files with the Program Default file(s) Cancel Continue

Select the CI (cistern option) as the first control device for roofs 1/

Water Tank/Cistern Example

The screenshot displays the SWMM2D software interface. The left pane shows the 'Land Use' table for 'Commercial 1'. The right pane shows a network diagram with a 'Commercial 1' node connected to 'Junction 1', which is then connected to an 'Outfall' node.

Source Area #	Source Area	Area (acres)	Source Area Parameters	First Control Practice	Second Control Practice
Roofs					
1	Roofs 1	0.680	Entered	CI	--
2	Roofs 2				
3	Roofs 3				
4	Roofs 4				
5	Roofs 5				
6	Roofs 6				
7	Roofs 7				
8	Roofs 8				
9	Roofs 9				
10	Roofs 10				
11	Roofs 11				
12	Roofs 12				
Parking					
13	Paved Parking 1	2.850	Entered	--	--
14	Paved Parking 2				
15	Paved Parking 3				
16	Paved Parking 4				
17	Paved Parking 5				
18	Paved Parking 6				
19	Unpaved Parking 1				
20	Unpaved Parking 2				
21	Unpaved Parking 3				
22	Unpaved Parking 4				
23	Unpaved Parking 5				
24	Unpaved Parking 6				
Driveways/Sidewalks					
25	Driveways 1	0.170	Entered	--	--
26	Driveways 2				
27	Driveways 3				
28	Driveways 4				

Land Use #	Land Use Type	Land Use Label	Land Use Area (acres)
1	Commercial	Commercial 1	7.290

CP #	Control Practice Type	Control Practice Name or Location
1	Cistern	SA Device, LU# 1, SA# 1

Current File Data Entered Total Area = 7.290 acres No Upstream Source Areas LU# = 1 Index Number = 1 Remaining Icons = 253 Start Date: 01/01/94

The water use will be based on maximum applications to the large landscaped area (turf grass). This area is 2.14 acres and the monthly water use (source area gallons/day for each month) was calculated to be (almost all of the water use would occur from May through October at all three of these locations, requiring relatively large tanks to hold the winter runoff for this other period):

Water Tank/Cistern Example

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual
Average Birmingham monthly rain (in/mo)	5.46	4.51	5.26	3.95	3.89	3.92	4.06	3.56	4.55	3.64	4.77	3.65	51.22
Lawn moisture needs (in/mo)	2	2	4	4	8	8	10	10	10	8	4	2	72
Deficit irrigation need (in/mo)	0	0	0	0.05	4.11	4.08	5.94	6.44	5.45	4.36	0	0	30.42
Deficit irrigation needed (gallons/day) for 2.14 acres	0	0	0	94	7,865	7,790	11,352	12,301	10,417	8,335	0	0	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual
Average Tuscaloosa monthly rainfall	4.25	3.29	4.60	4.87	4.00	3.00	4.52	3.22	3.37	4.04	3.07	5.75	47.98
Lawn moisture needs (in/mo)	2	2	4	4	8	8	10	10	10	8	4	2	72
Deficit irrigation need (in/mo)	0	0	0	0	4.00	5.00	5.48	6.78	6.63	3.96	0.93	0	32.78
Deficit irrigation needed (gallons/day) for 2.14 acres	0	0	0	0	7,646	9,547	10,479	12,959	12,668	7,574	1,778	0	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual
Average Huntsville monthly rainfall	5.26	4.77	6.65	4.68	5.03	4.25	4.55	3.43	4.08	3.43	4.73	5.49	56.34
Lawn moisture needs (in/mo)	2	2	4	4	8	8	10	10	10	8	4	2	72
Deficit irrigation need (in/mo)	0	0	0	0	2.97	3.75	5.45	6.57	5.92	4.57	0	0	29.24
Deficit irrigation needed (gallons/day) for 2.14 acres	0	0	0	0	5,681	7,166	10,418	12,559	11,324	8,736	0	0	

Water Tank/Cistern Example

With the CI form open, enter the data shown below. It can be re-opened by clicking on the CI label at the source area.

Note: when moving through the Cistern form, press the "Enter" key to move to the next cell, not the "Tab" key.

The water tank is described with the CI device, using the above water usage values:

Cistern Control Device

First Source Area Control Practice
Land Use: Commercial 1
Source Area: Roof 1

Total Area: 0.680 acres
Cistern No. 1

Device Properties

Top Surface Area (sf)	80.0
Bottom Surface Area (sf)	80.0
Height to Overflow (ft)	10.00
Rock Filled Depth (ft)	0.00
Rock Fill Porosity (0-1)	0.00
Inflow Hydrograph Peak to Average Flow Ratio	3.80
Number of Devices in Source Area or Land Use	1
Runoff Fraction Entering Devices (0-1)	1.00

Source Area Water Use Rate Multiplier =

Apply Rate Multiplier

Copy Cistern Data

Paste Cistern Data

Water Use Rate

Month	Water Use Rate per Cistern (gal/day)	Source Area Water Use Rate (gal/day)
January	0.00	0.00
February	0.00	0.00
March	0.00	0.00
April	93.75	93.75
May	7865.25	7865.25
June	7790.25	7790.25
July	11352.00	11352.00
August	12300.75	12300.75
September	10416.75	10416.75
October	8334.75	8334.75
November	0.00	0.00
December	0.00	0.00

Delete

Cancel

Continue

Control Practice #: 1 Land Use #: 1 Source Area #: 1

Run the model.

Results

Years in model run:	4.98 (5 years)
Runoff Volume without controls:	3,181,000 ft ³ for 5 years
Outfall Total with controls:	3,047,000 ft ³ for 5 years (612,501 ft ³ per year)
Runoff Volume Percent Reduction:	4.2%
Particulate Solids Concentration (with controls):	70 mg/L (an increase compared to no controls as better quality roof runoff is being diverted from the stormwater flows for the total area)
Particulate Solids Yield (with controls):	2,691 lbs/yr
Particulate Solids Percent Reduction:	0.4% (very little particulate solids in roof runoff)
Rv (with controls):	0.41
Approx. Urban Stream Classification:	Poor
Total Phosphorus Concentration (with controls):	1.34
Total Phosphorus Yield (with controls):	255 lbs/5 yrs
Total Phosphorus Yield Percent Reduction:	0.7%
Annualized Value of all costs:	not available

Water Tank/Cistern Example

Land Uses	Junctions	Control Practices	Outfall	Output Summary
File Name: C:\WinSLAMM Files\Example Files\urban water class files\No Mangement Conditions.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	3.181E+06		0.43	67.67 13439
Outfall Total with Controls	3.047E+06	4.21 %	0.41	70.38 13389 0.37 %
Current File Output: Annualized Total After Outfall Controls 612501 Years in Model Run: 4.98 2691				
Pollutant	Concen- tration - No Controls	Concen- tration - With Controls	Concen- tration Units	Pollutant Yield - No Controls Pollutant Yield - With Controls Pollutant Yield Units Percent Yield Reduction
Particulate Solids	67.67	70.38	mg/L	13439 13389 lbs 0.37 %
Total Phosphorus	1.294	1.342	mg/L	257.0 255.3 lbs 0.66 %
Print Output Summary to Text File		Print Output Summary to .csv File		Total Area Modeled (ac) 7.290
Total Control Practice Costs Capital Cost \$ 0 Land Cost \$ 0 Annual Maintenance Cost \$ 0 Present Value of All Costs \$ 0 Annualized Value of All Costs \$ 0			Receiving Water Impacts Due To Stormwater Runoff (CWP Impervious Cover Model) Calculated Rv Approximate Urban Stream Classification Without Controls 0.43 Poor With Controls 0.41 Poor	
Perform Outfall Flow Duration Curve Calculations				

The pollution reduction reported at the outfall is the overall pollution reduction for the entire site. To see the pollution reduction from just the roof runoff due to the water tanks, select the "Control Practices" tab.

Land Uses	Junctions	Control Practices	Part.
Runoff Volume	Part. Solids Yield (lbs)		Part.
Data File: C:\WinSLAMM Files\Example Files\urban water class files\No Mangement Conditions.mdb			
Rain File: AL Birmingham 8799.RAN			
Date: 04-14-14 Time: 12:46:04 AM			
Site Description: Water tanks for roof runoff, commercial development			
Control Practice No.	Control Practice Type	Control Practice Name or Location	Total Inflow Volume (cf) Total Outflow Volume (cf) Percent Volume Reduction Total Influent Load (lbs) Total Effluent Load (lbs) Percent Load Reduction
1	Cistern	SA Device, LU# 1 ,SA# 1	555191 421301 24.12 208.0 157.8 24.13

Water Tank/Cistern Example

Outfall				Output Summary			
Solids Conc. (mg/L)		Summary Table					
Flow Weighted Influent Conc (mg/L)	Flow Weighted Effluent Conc (mg/L)	Percent Conc. Reduction	Influent Median Part. Size (microns)	Effluent Median Part. Size (microns)	Notes	Days Dry (days)	Runoff Producing Events/ Ttl. Rains
6.000	6.000	0.000	110.72	110.71		789	336/511

The water tank and associated irrigation of the large landscaped area is reducing the roof runoff and particulate discharges by 24%. However, the outfall runoff reductions are much less as the roof runoff is only about 16% of the total site runoff (the paved parking area produces about 73% of the total site runoff in contrast).

The following table shows the effects of additional storage on roof runoff reductions that better utilize this water for on-site irrigation. The single tank only provides about 0.3 inches of storage over the roof area. About 1 ft of storage would be needed to provide about 75% roof runoff control, while about 2 ft of storage would result in about 100% removal of the roof runoff.

Number of tanks (10ft D; 10 ft H)	Total storage volume (ft ³)	Storage (ft ³ storage/ft ² roof area)	Percent reduction of annual roof runoff	Percent reduction of total annual area runoff
1	800	0.027	24.1	4.2
3	2,400	0.081	36.3	6.3
5	4,000	0.14	41.7	7.3
10	8,000	0.27	47.8	8.3
25	20,000	0.68	62.2	10.9
50	40,000	1.35	78.2	13.6
75	60,000	2.03	100	16.0

Since the annual roof runoff is only a small portion of the total area annual runoff, complete removal of the roof runoff is therefore limited to a maximum of about 16%, even with the largest tanks. Therefore, it will also be necessary to reduce the flows from the paved parking areas with the use of biofilters, porous pavement (in overflow parking areas) or additional water tanks.

Water Tank/Cistern Example

