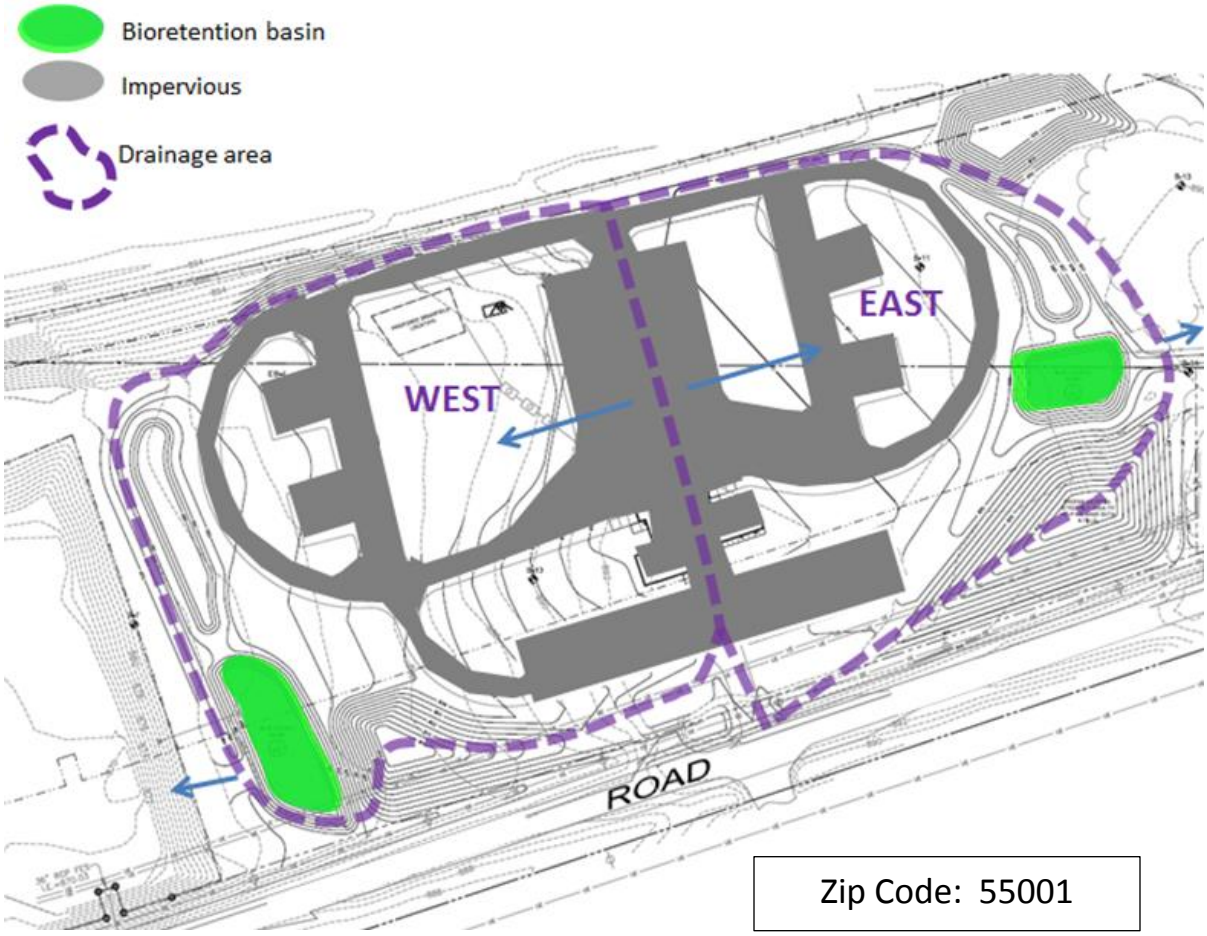
Exercise 1: Simple Bioretention—New Project on Site without Restrictions

Assignment:

- Does the site conform to the performance goal?
- What percentage of TP is removed from WEST, EAST, and Total?
- If the site doesn't conform to the performance goal, make some design changes and use the calculator until your design conforms to the performance goal. What did you do?

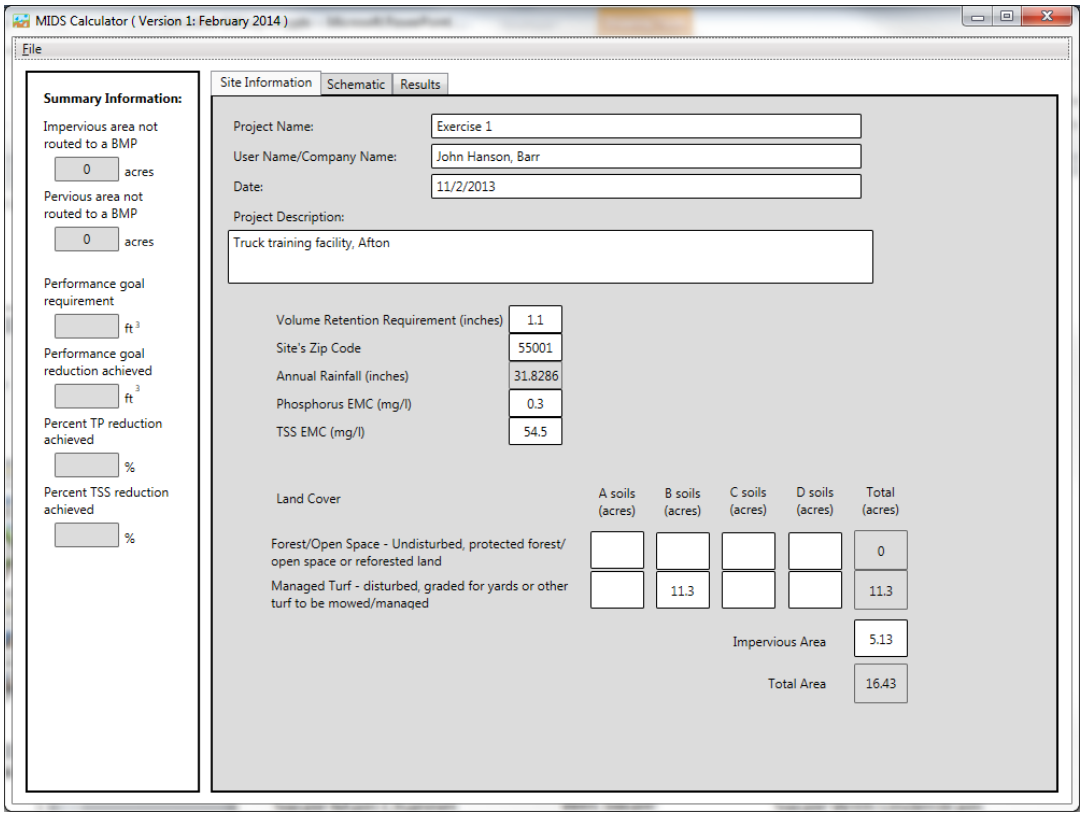


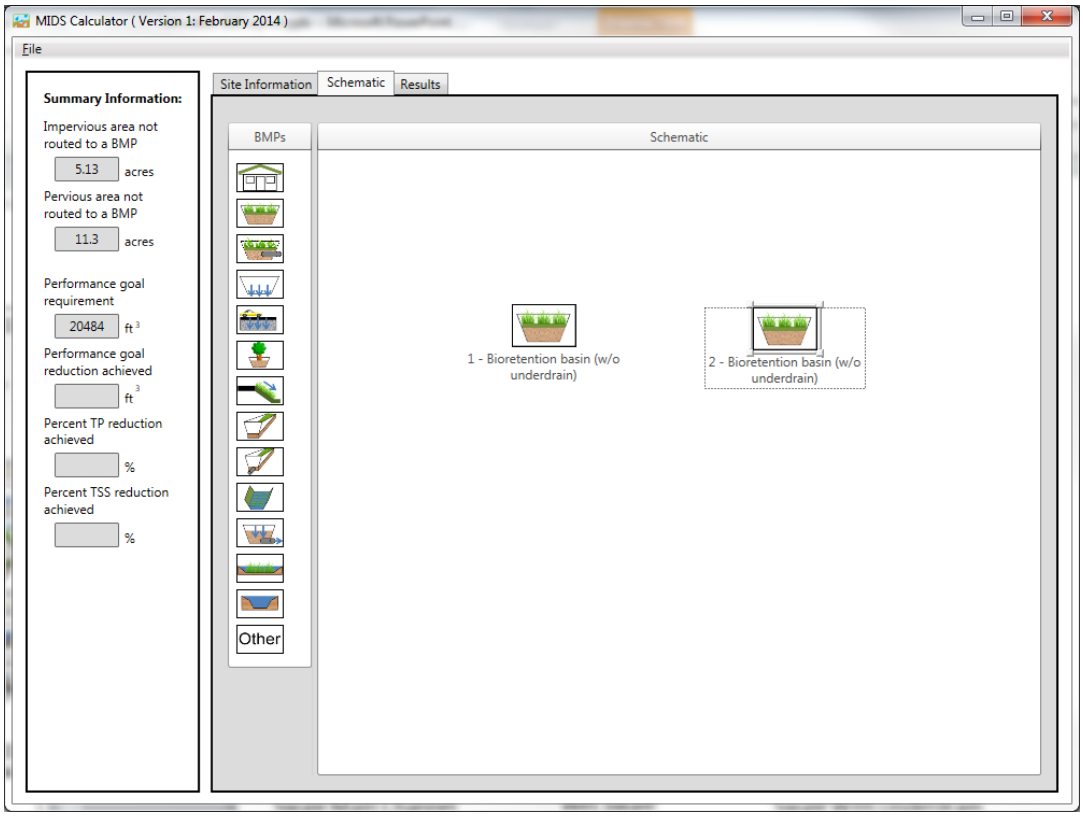
Zip Code: 55001

Drainage Area	Land Cover (acres) - assume all 'B' Soils			Total
	Turf	Forest/Open Space	Impervious	
WEST	5.95	0.00	2.53	8.48
EAST	5.35	0.00	2.60	7.95
Total:	11.3	0.00	5.13	16.43

Drainage Area	BMP Description	BMP Information		
		Overflow Surface area (ft^2)	Bottom Surface Area (ft^2)	Overflow Depth (ft)
WEST	Bioretention basin	14,000	11,000	1.2
EAST	Bioretention basin	7,500	5,000	1.2

Exercise 1: Step-by-Step Calculator Inputs





BMP Properties

BMP Properties: West Bioretention basin (w/o underdrain)

Watershed | BMP Parameters | BMP Summary

BMP Name: West Bioretention basin (w/o underdrain)

Routing/downstream BMP:

Minnesota Stormwater Manual Wiki

BMP Watershed Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed		5.95			5.95
		Impervious Cover (acres)			2.53
		Total Area (acres)			8.48

OK HELP

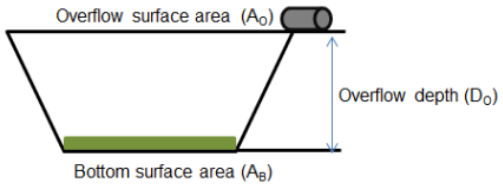
BMP Properties

BMP Properties: West Bioretention basin (w/o underdrain)

Watershed | BMP Parameters | BMP Summary

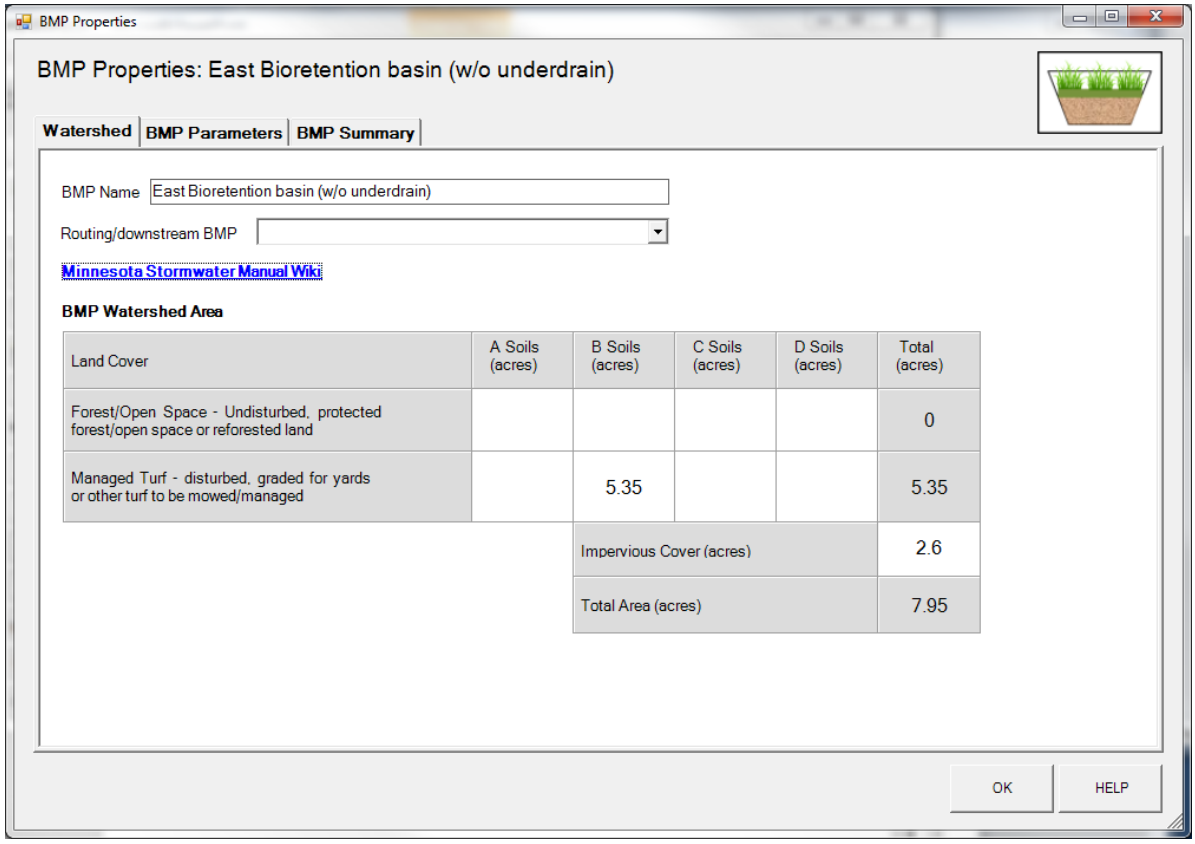
Bioretention basin (w/o underdrain)

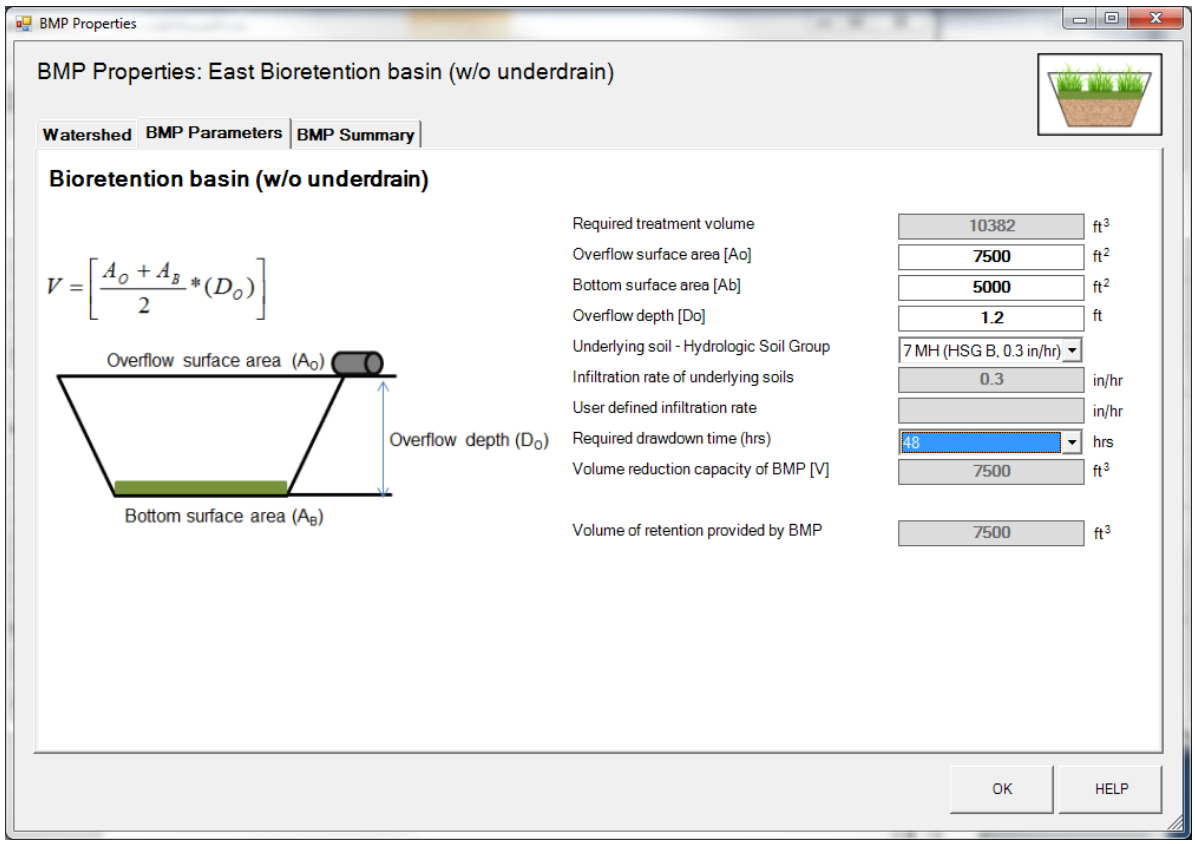
$$V = \left[\frac{A_O + A_B}{2} * (D_O)\right]$$



Required treatment volume	10102	ft^3
Overflow surface area [Ao]	14000	ft^2
Bottom surface area [Ab]	11000	ft^2
Overflow depth [Do]	1.2	ft
Underlying soil - Hydrologic Soil Group	7 MH (HSG B, 0.3 in/hr)	
Infiltration rate of underlying soils	0.3	in/hr
User defined infiltration rate		in/hr
Required drawdown time (hrs)	48	hrs
Volume reduction capacity of BMP [V]	15000	ft^3
Volume of retention provided by BMP	10102	ft^3

OK HELP

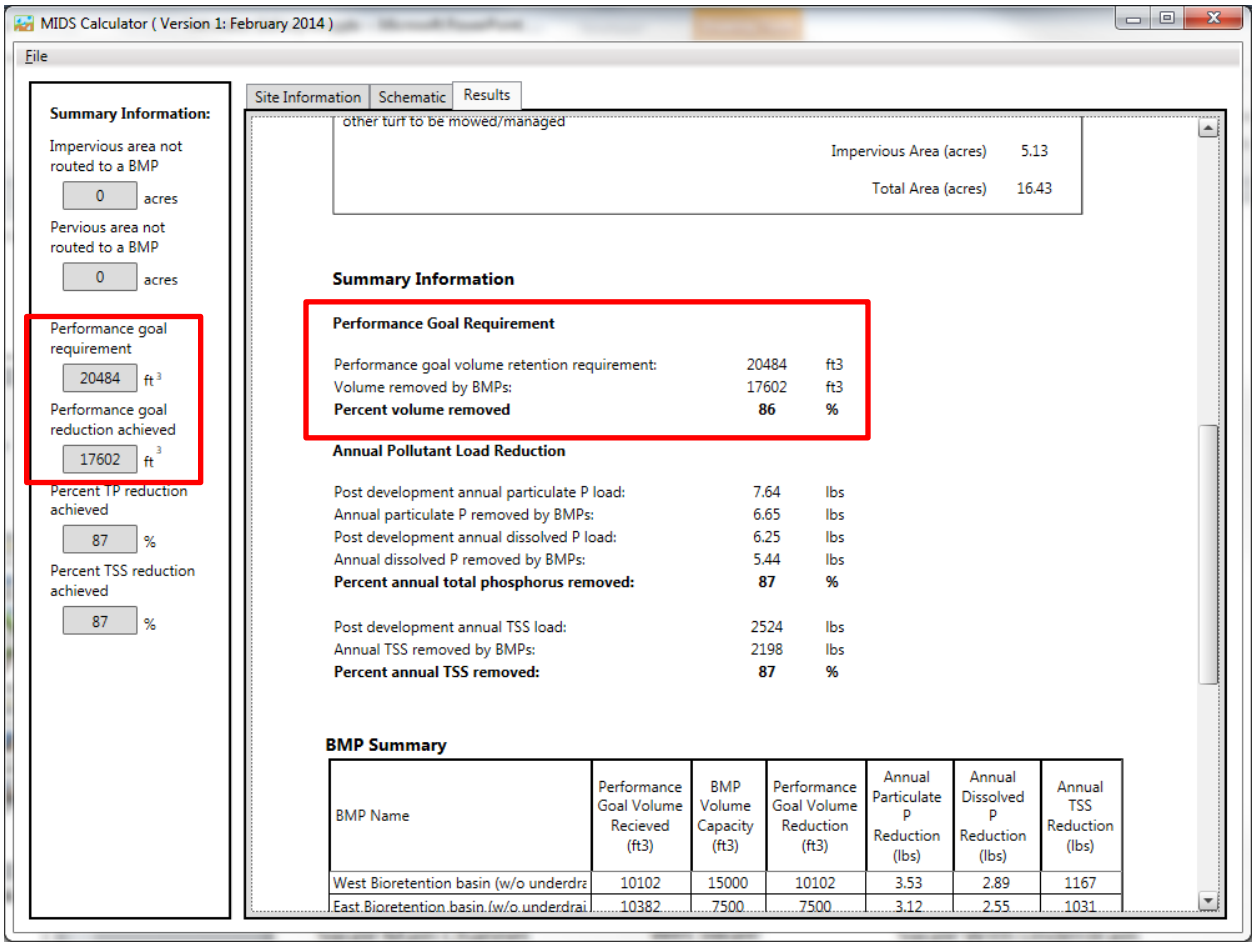

BMP Properties
BMP Properties: East Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
BMP Name
East Bioretention basin (w/o underdrain)
Routing/downstream BMP
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
5.35
5.35
Impervious Cover (acres)
2.6
Total Area (acres)
7.95
OK
HELP


BMP Properties
BMP Properties: East Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
Bioretention basin (w/o underdrain)
$V = \left[\frac{A_O + A_B}{2} * (D_O)\right]$
Overflow surface area (A_O)
Overflow depth (D_O)
Bottom surface area (A_B)
Required treatment volume
10382
ft3
Overflow surface area [Ao]
7500
ft2
Bottom surface area [Ab]
5000
ft2
Overflow depth [Do]
1.2
ft
Underlying soil - Hydrologic Soil Group
7 MH (HSG B, 0.3 in/hr)
Infiltration rate of underlying soils
0.3
in/hr
User defined infiltration rate
in/hr
Required drawdown time (hrs)
48
hrs
Volume reduction capacity of BMP [V]
7500
ft3
Volume of retention provided by BMP
7500
ft3
OK
HELP

Exercise 1: Answers

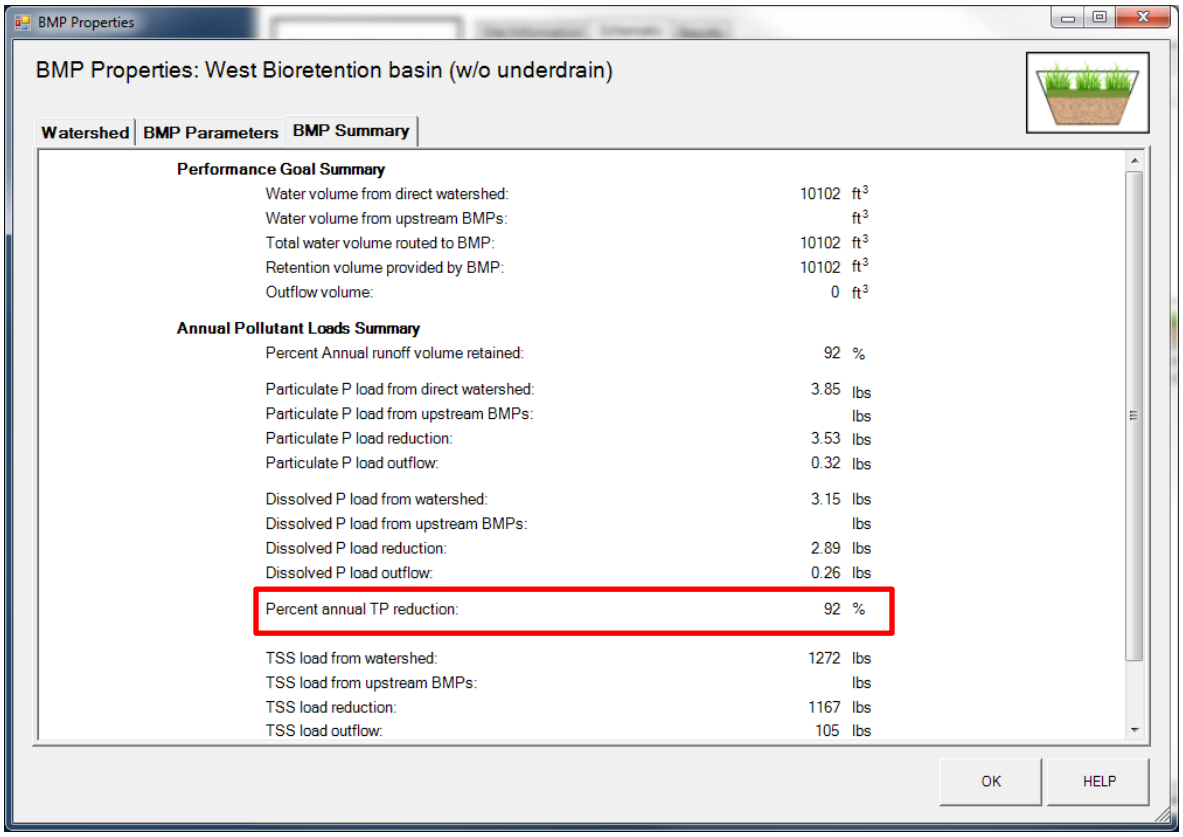
Does the site conform to the performance goal?

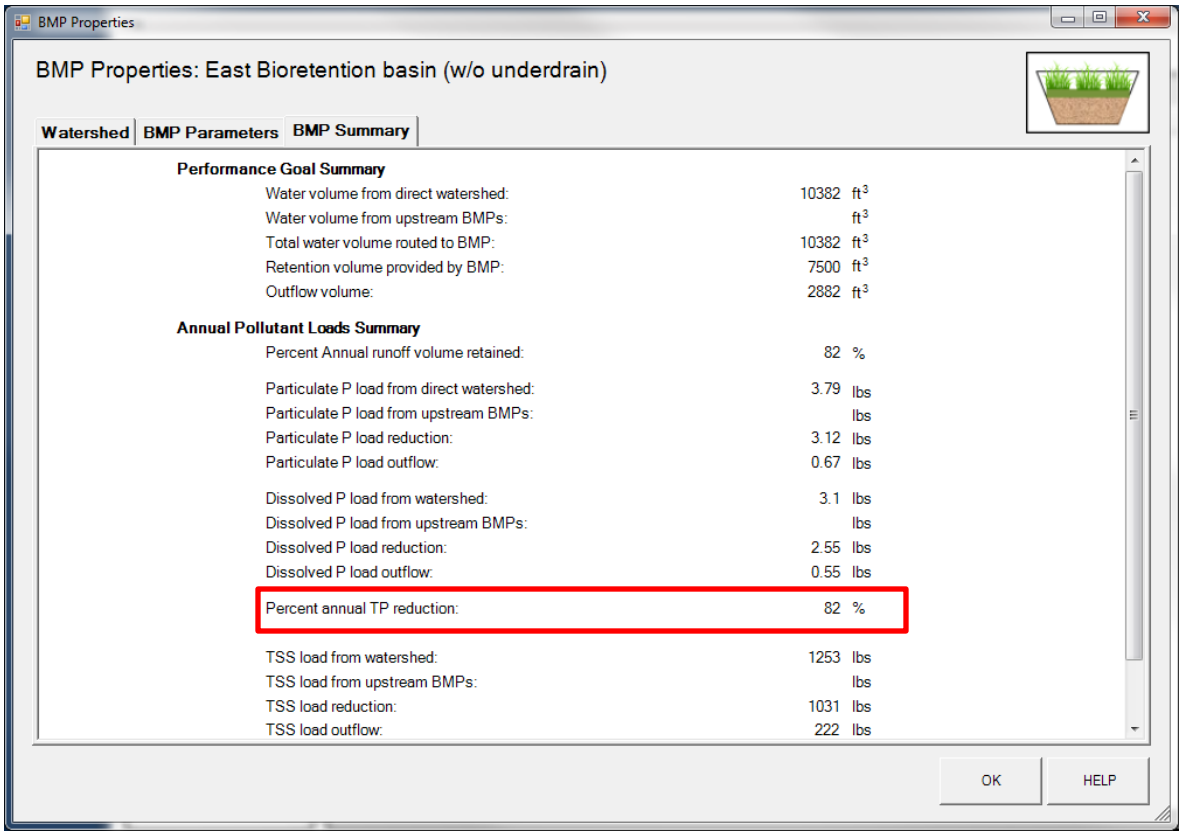
Answer: No the site does not conform to the performance goal. The site reduced 86% of the performance goal requirement volume. It needed to reduce 100% to meet the performance goal.

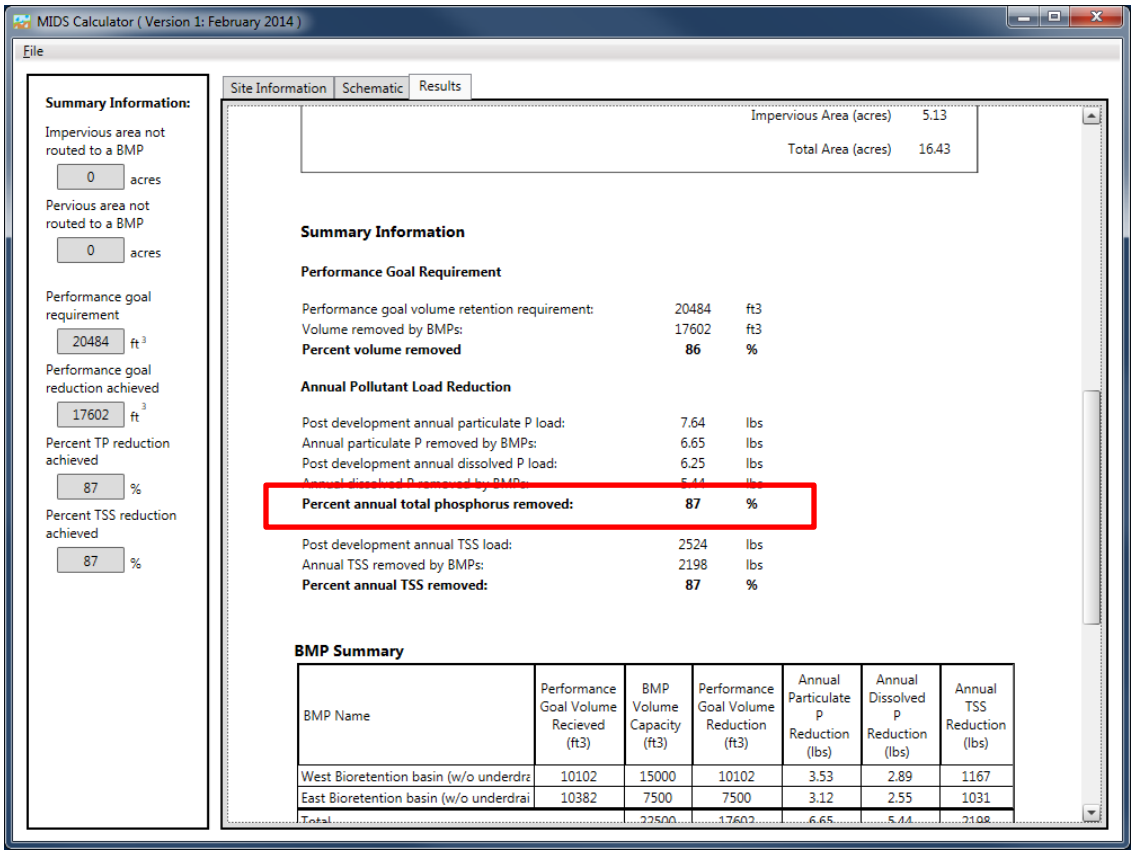


What percentage of TP is removed from WEST, EAST and Total?

Answer: West = 92%, East = 82% and Total = 87%.




BMP Properties
BMP Properties: East Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
Performance Goal Summary
Water volume from direct watershed: 10382 ft3
Water volume from upstream BMPs: ft3
Total water volume routed to BMP: 10382 ft3
Retention volume provided by BMP: 7500 ft3
Outflow volume: 2882 ft3
Annual Pollutant Loads Summary
Percent Annual runoff volume retained: 82 %
Particulate P load from direct watershed: 3.79 lbs
Particulate P load from upstream BMPs: lbs
Particulate P load reduction: 3.12 lbs
Particulate P load outflow: 0.67 lbs
Dissolved P load from watershed: 3.1 lbs
Dissolved P load from upstream BMPs: lbs
Dissolved P load reduction: 2.55 lbs
Dissolved P load outflow: 0.55 lbs
Percent annual TP reduction: 82 %
TSS load from watershed: 1253 lbs
TSS load from upstream BMPs: lbs
TSS load reduction: 1031 lbs
TSS load outflow: 222 lbs
OK
HELP


MIDS Calculator (Version 1: February 2014)
File
Summary Information:
Impervious area not routed to a BMP
0 acres
Pervious area not routed to a BMP
0 acres
Performance goal requirement
20484 ft3
Performance goal reduction achieved
17602 ft3
Percent TP reduction achieved
87 %
Percent TSS reduction achieved
87 %
Site Information
Schematic
Results
Impervious Area (acres) 5.13
Total Area (acres) 16.43
Summary Information
Performance Goal Requirement
Performance goal volume retention requirement: 20484 ft3
Volume removed by BMPs: 17602 ft3
Percent volume removed 86 %
Annual Pollutant Load Reduction
Post development annual particulate P load: 7.64 lbs
Annual particulate P removed by BMPs: 6.65 lbs
Post development annual dissolved P load: 6.25 lbs
Percent annual total phosphorus removed: 87 %
Post development annual TSS load: 2524 lbs
Annual TSS removed by BMPs: 2198 lbs
Percent annual TSS removed: 87 %
BMP Summary
BMP Name
Performance Goal Volume Recieved (ft3)
BMP Volume Capacity (ft3)
Performance Goal Volume Reduction (ft3)
Annual Particulate p Reduction (lbs)
Annual Dissolved p Reduction (lbs)
Annual TSS Reduction (lbs)
West Bioretention basin (w/o underdra 10102 15000 10102 3.53 2.89 1167
East Bioretention basin (w/o underdrai 10382 7500 7500 3.12 2.55 1031

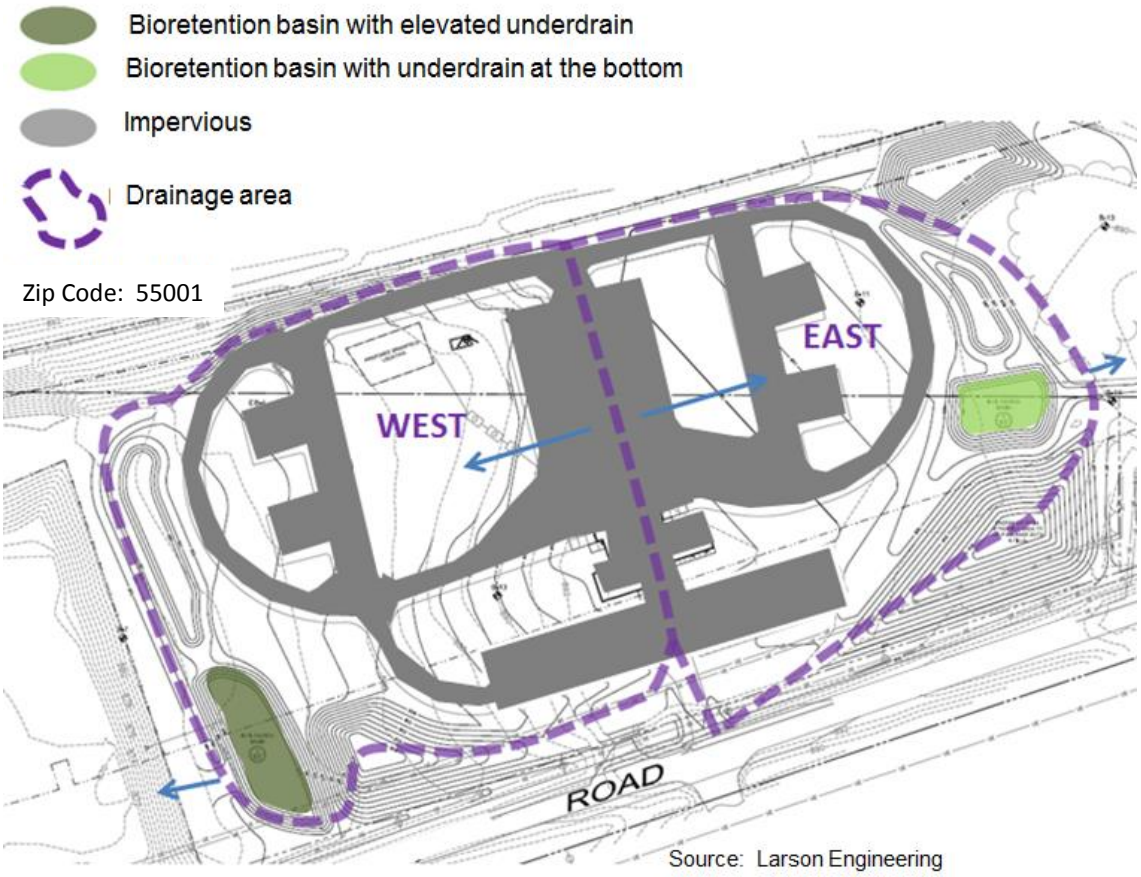
If the site doesn't conform to the performance goal, make some design in the calculator to bring it into conformance. What did you do?

Need to increase the size of the East Bioretention Basin to meet performance goal.

Exercise 2: Bioretention Basins with Underdrains

Assignment:

What is the annual TP reduction at WEST and EAST?

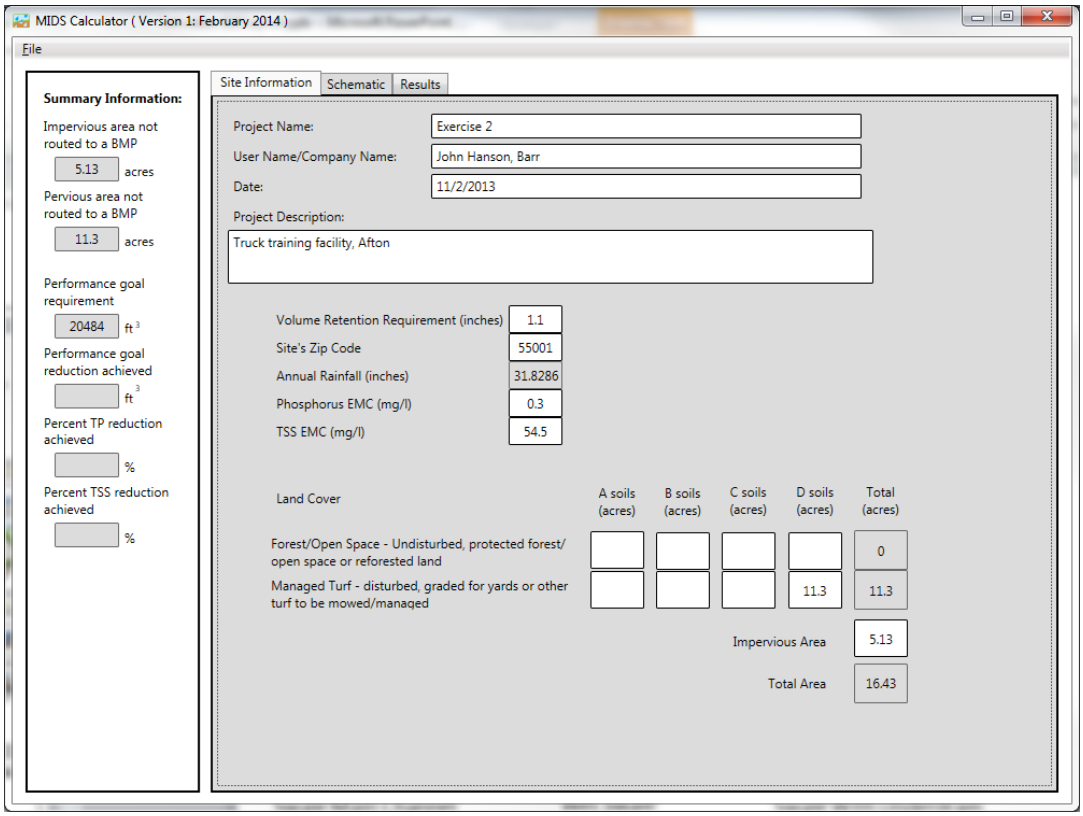


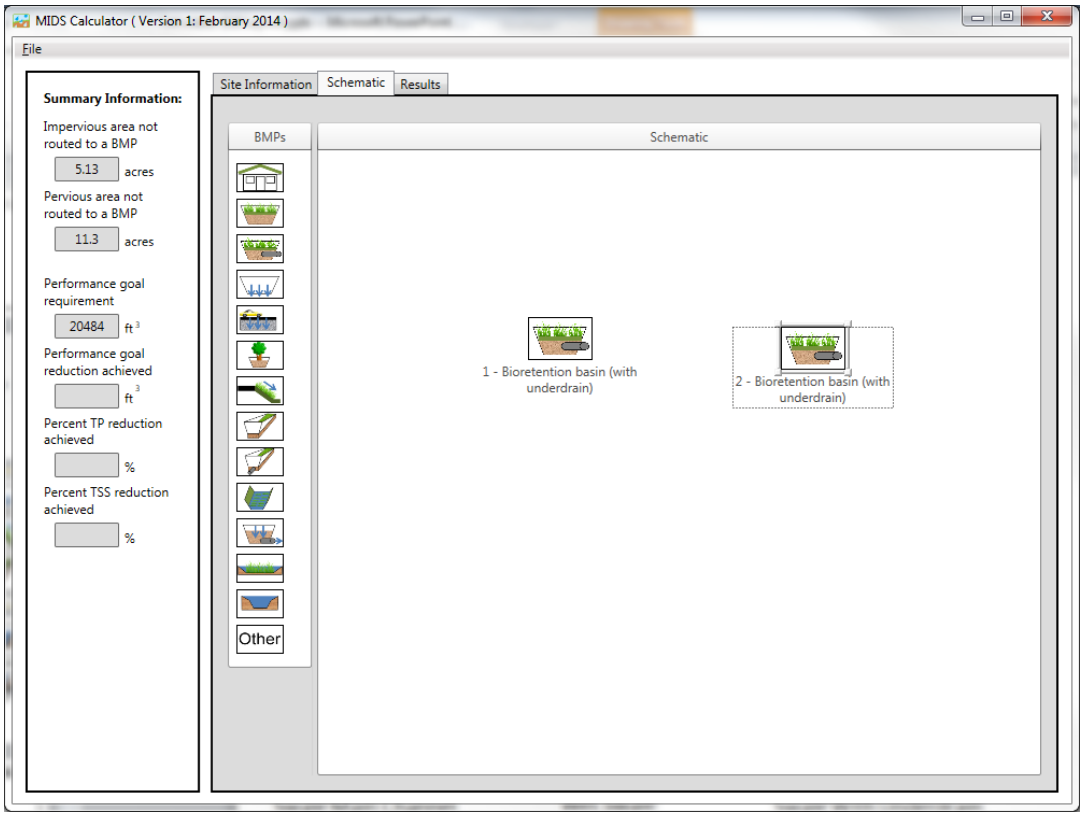
Drainage Area	Land Cover (acres) - assume all 'D' Soils			Total
	Turf	Forest/Open Space	Impervious	
WEST	5.95	0.00	2.53	8.48
EAST	5.35	0.00	2.60	7.95
Total:	11.3	0.00	5.13	16.43

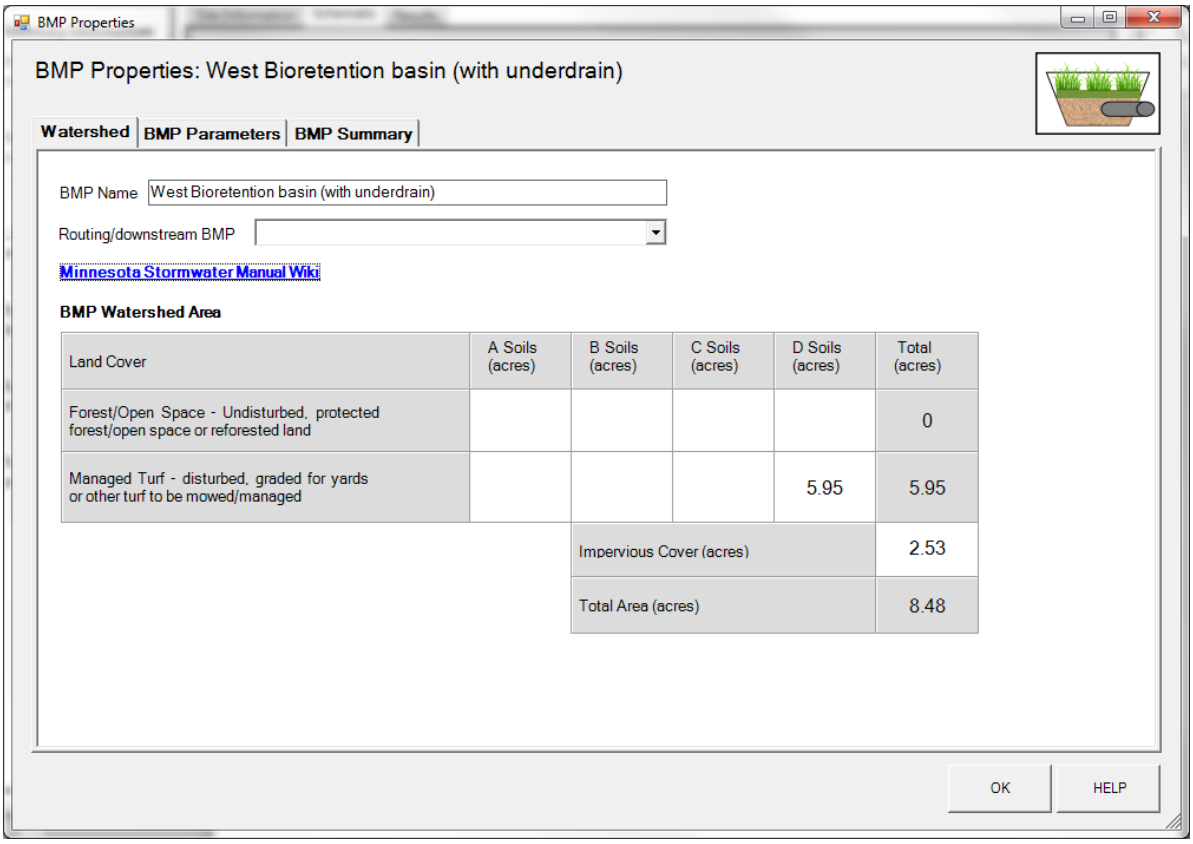
Drainage Area	BMP Description	BMP Information					
		Surface Area at Overflow (ft^2)	Surface Area at Media Surface (ft^2)	Surface Area at Underdrain (ft^2)	Bottom Surface Area (ft^2)	Total Media Depth (ft)	Depth below Underdrain (ft)
WEST	Bioretention basin with elevated underdrain	14,000	11,000	8,500	7,875	1.24	0.24
EAST	Bioretention basin with underdrain at bottom	7,500	5,000	2,400	2,400	1	NA

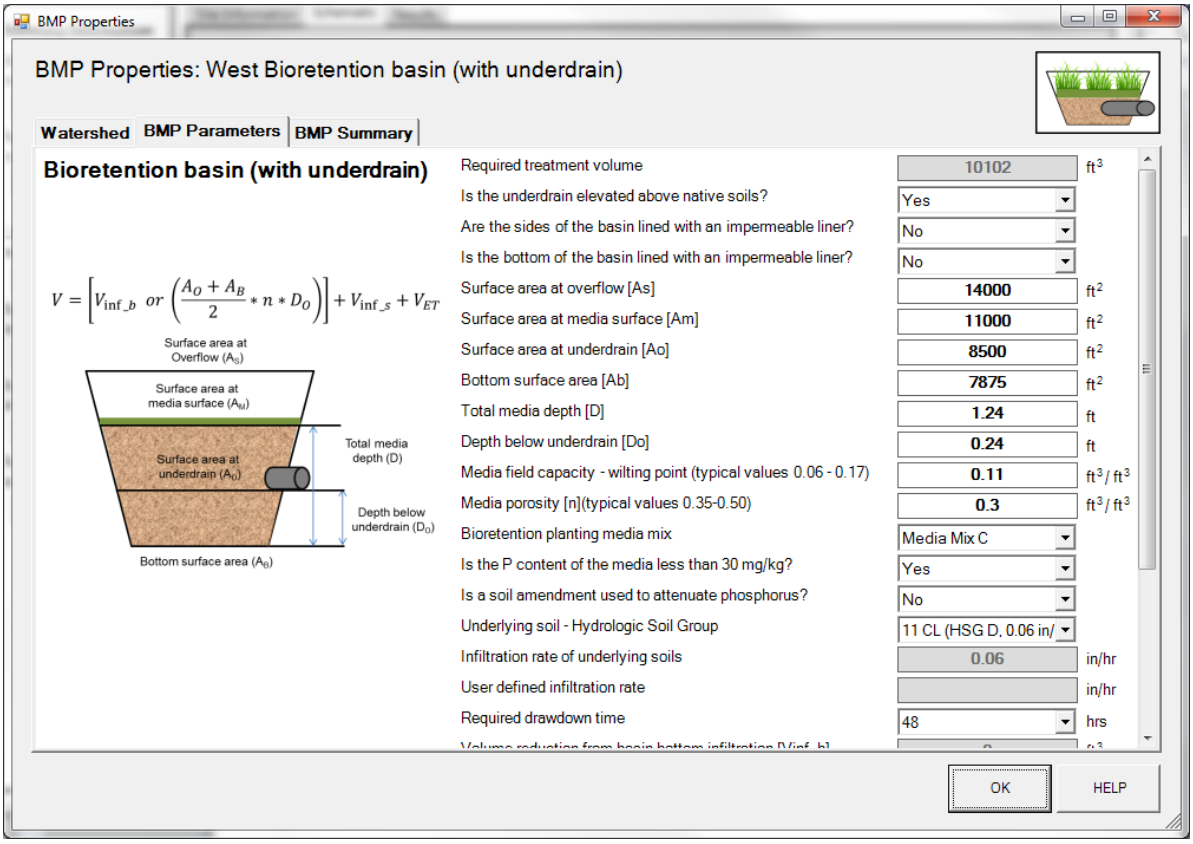
Drainage Area	BMP Information						
	Media field capacity – wilting point (ft^3/ft^3)	Media porosity (ft^3/ft^3)	Planting media mix	P content less than 30 mg/kg?	Soil amendments used?	Underlying Soil	Required drawdown time (hours)
WEST	0.11	0.3	C	Yes	No	CL	48
EAST	0.11	0.3	C	Yes	No	CL	48

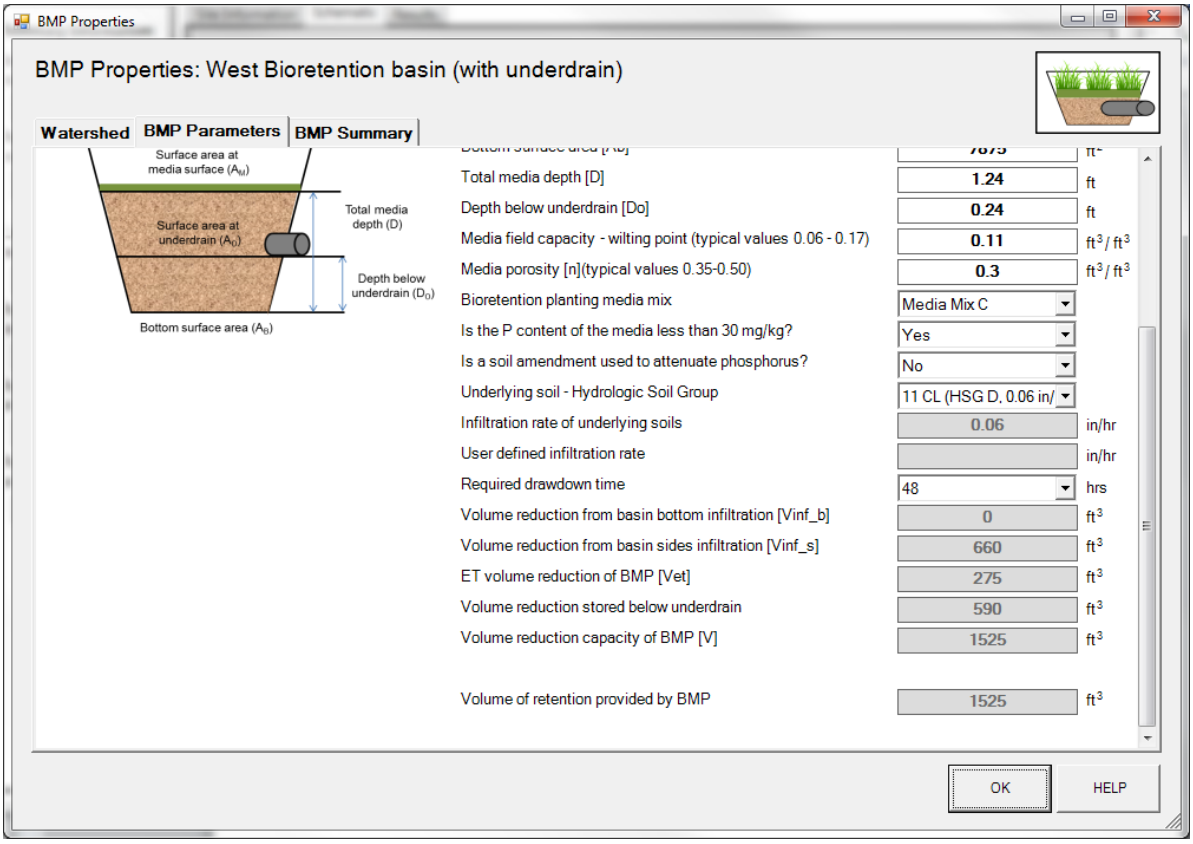
Exercise 2: Step-by-Step Calculator Inputs

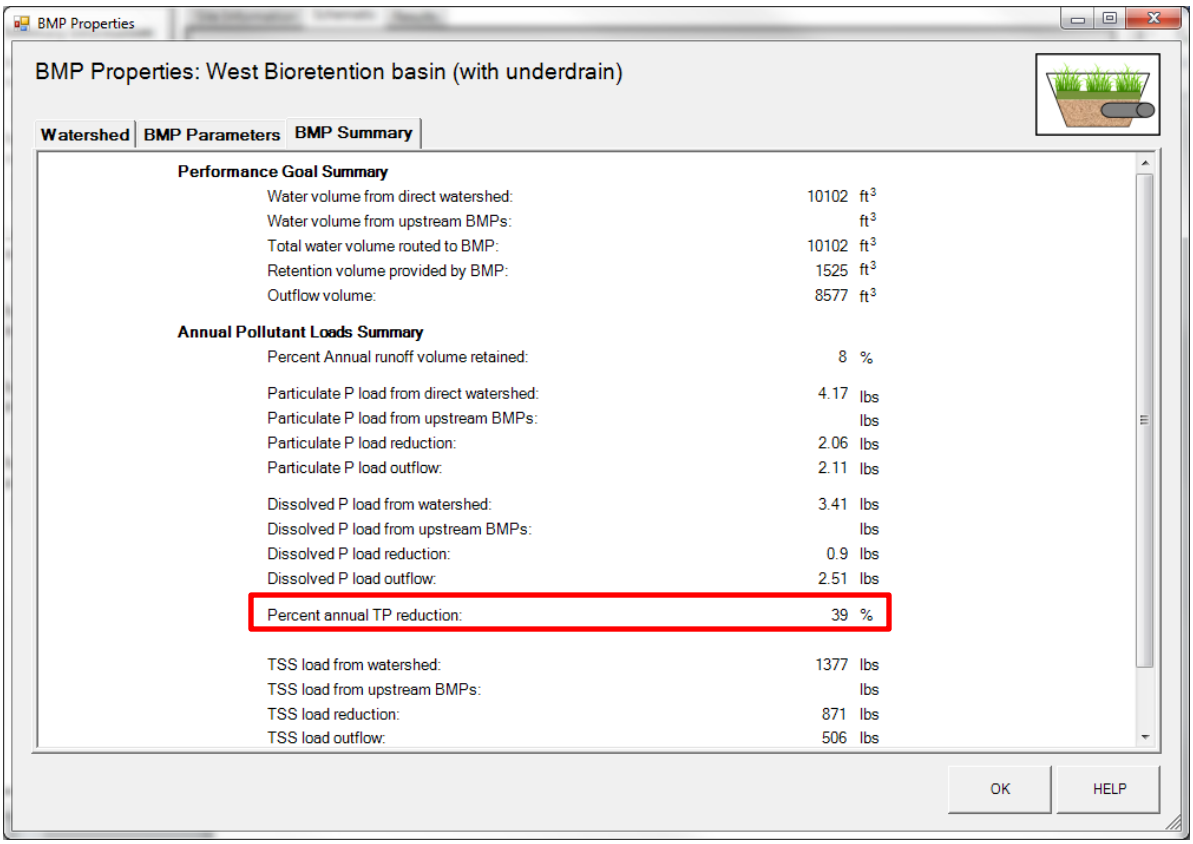


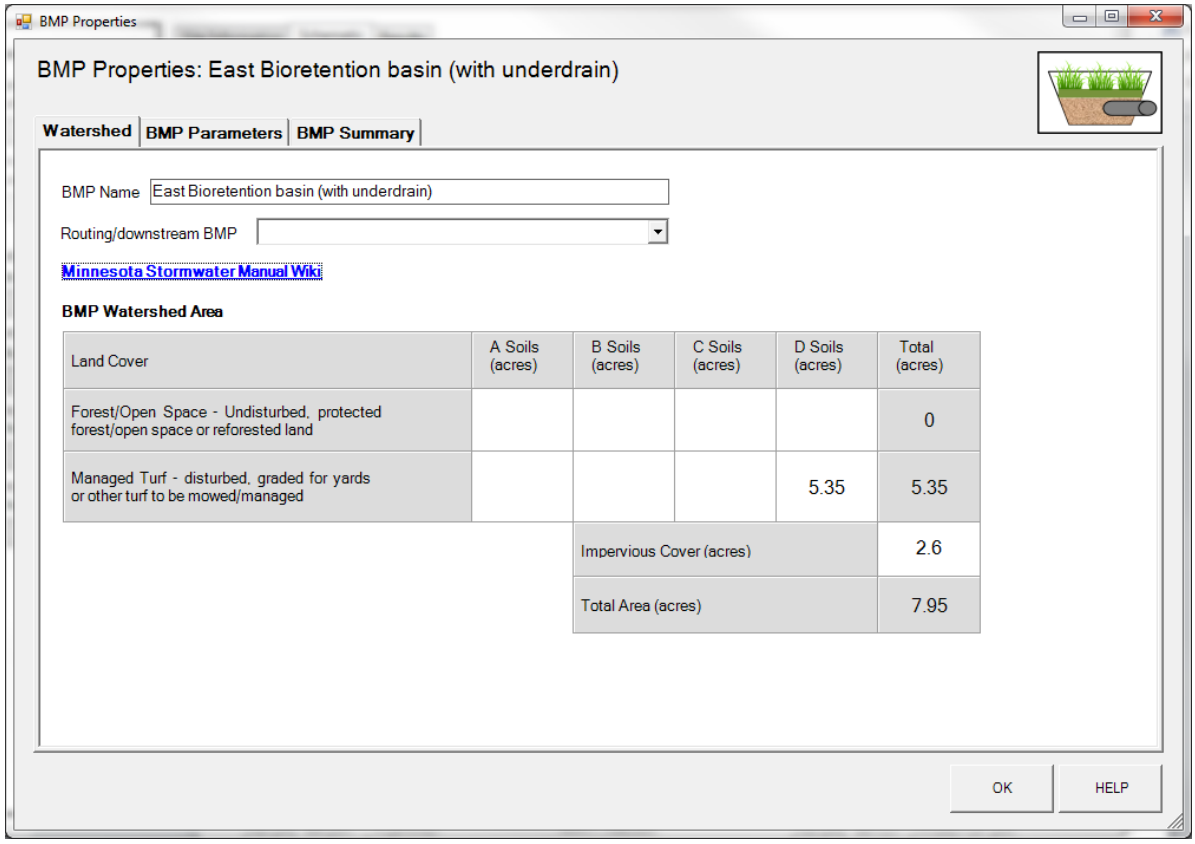



BMP Properties
BMP Properties: West Bioretention basin (with underdrain)
Watershed
BMP Parameters
BMP Summary
BMP Name
West Bioretention basin (with underdrain)
Routing/downstream BMP
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
5.95
5.95
Impervious Cover (acres)
2.53
Total Area (acres)
8.48
OK
HELP


BMP Properties
BMP Properties: West Bioretention basin (with underdrain)
Watershed
BMP Parameters
BMP Summary
Bioretention basin (with underdrain)
$V = \left[V_{\inf\_b} \; or \; \left(\frac{A_O + A_B}{2} * n * D_O\right)\right] + V_{\inf\_s} + V_{ET}$
Surface area at Overflow (A_S)
Surface area at media surface (A_M)
Surface area at underdrain (A_O)
Total media depth (D)
Depth below underdrain (D_O)
Bottom surface area (A_B)
Required treatment volume
10102
ft3
Is the underdrain elevated above native soils?
Yes
Are the sides of the basin lined with an impermeable liner?
No
Is the bottom of the basin lined with an impermeable liner?
No
Surface area at overflow [As]
14000
ft2
Surface area at media surface [Am]
11000
ft2
Surface area at underdrain [Ao]
8500
ft2
Bottom surface area [Ab]
7875
ft2
Total media depth [D]
1.24
ft
Depth below underdrain [Do]
0.24
ft
Media field capacity - wilting point (typical values 0.06 - 0.17)
0.11
ft3 / ft3
Media porosity [n](typical values 0.35-0.50)
0.3
ft3 / ft3
Bioretention planting media mix
Media Mix C
Is the P content of the media less than 30 mg/kg?
Yes
Is a soil amendment used to attenuate phosphorus?
No
Underlying soil - Hydrologic Soil Group
11 CL (HSG D, 0.06 in/
Infiltration rate of underlying soils
0.06
in/hr
User defined infiltration rate
in/hr
Required drawdown time
48
hrs
OK
HELP


BMP Properties
BMP Properties: West Bioretention basin (with underdrain)
Watershed
BMP Parameters
BMP Summary
Surface area at media surface (A_M)
Surface area at underdrain (A_D)
Bottom surface area (A_B)
Total media depth (D)
Depth below underdrain (D_O)
Total media depth [D] 1.24 ft
Depth below underdrain [Do] 0.24 ft
Media field capacity - wilting point (typical values 0.06 - 0.17) 0.11 ft³/ft³
Media porosity [n](typical values 0.35-0.50) 0.3 ft³/ft³
Bioretention planting media mix Media Mix C
Is the P content of the media less than 30 mg/kg? Yes
Is a soil amendment used to attenuate phosphorus? No
Underlying soil - Hydrologic Soil Group 11 CL (HSG D, 0.06 in/
Infiltration rate of underlying soils 0.06 in/hr
User defined infiltration rate in/hr
Required drawdown time 48 hrs
Volume reduction from basin bottom infiltration [Vinf_b] 0 ft³
Volume reduction from basin sides infiltration [Vinf_s] 660 ft³
ET volume reduction of BMP [Vet] 275 ft³
Volume reduction stored below underdrain 590 ft³
Volume reduction capacity of BMP [V] 1525 ft³
Volume of retention provided by BMP 1525 ft³
OK
HELP


BMP Properties
BMP Properties: West Bioretention basin (with underdrain)
Watershed
BMP Parameters
BMP Summary
Performance Goal Summary
Water volume from direct watershed: 10102 ft³
Water volume from upstream BMPs: ft³
Total water volume routed to BMP: 10102 ft³
Retention volume provided by BMP: 1525 ft³
Outflow volume: 8577 ft³
Annual Pollutant Loads Summary
Percent Annual runoff volume retained: 8 %
Particulate P load from direct watershed: 4.17 lbs
Particulate P load from upstream BMPs: lbs
Particulate P load reduction: 2.06 lbs
Particulate P load outflow: 2.11 lbs
Dissolved P load from watershed: 3.41 lbs
Dissolved P load from upstream BMPs: lbs
Dissolved P load reduction: 0.9 lbs
Dissolved P load outflow: 2.51 lbs
Percent annual TP reduction: 39 %
TSS load from watershed: 1377 lbs
TSS load from upstream BMPs: lbs
TSS load reduction: 871 lbs
TSS load outflow: 506 lbs
OK
HELP


BMP Properties
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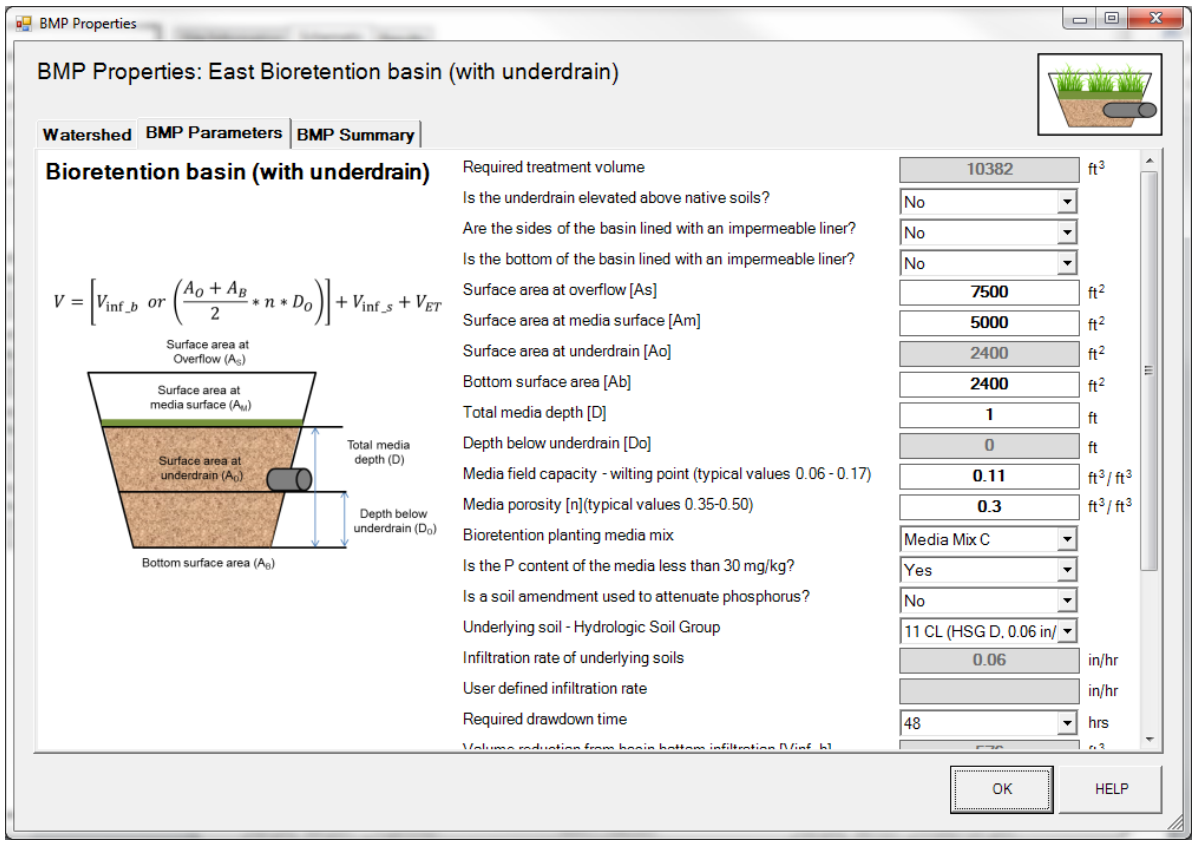
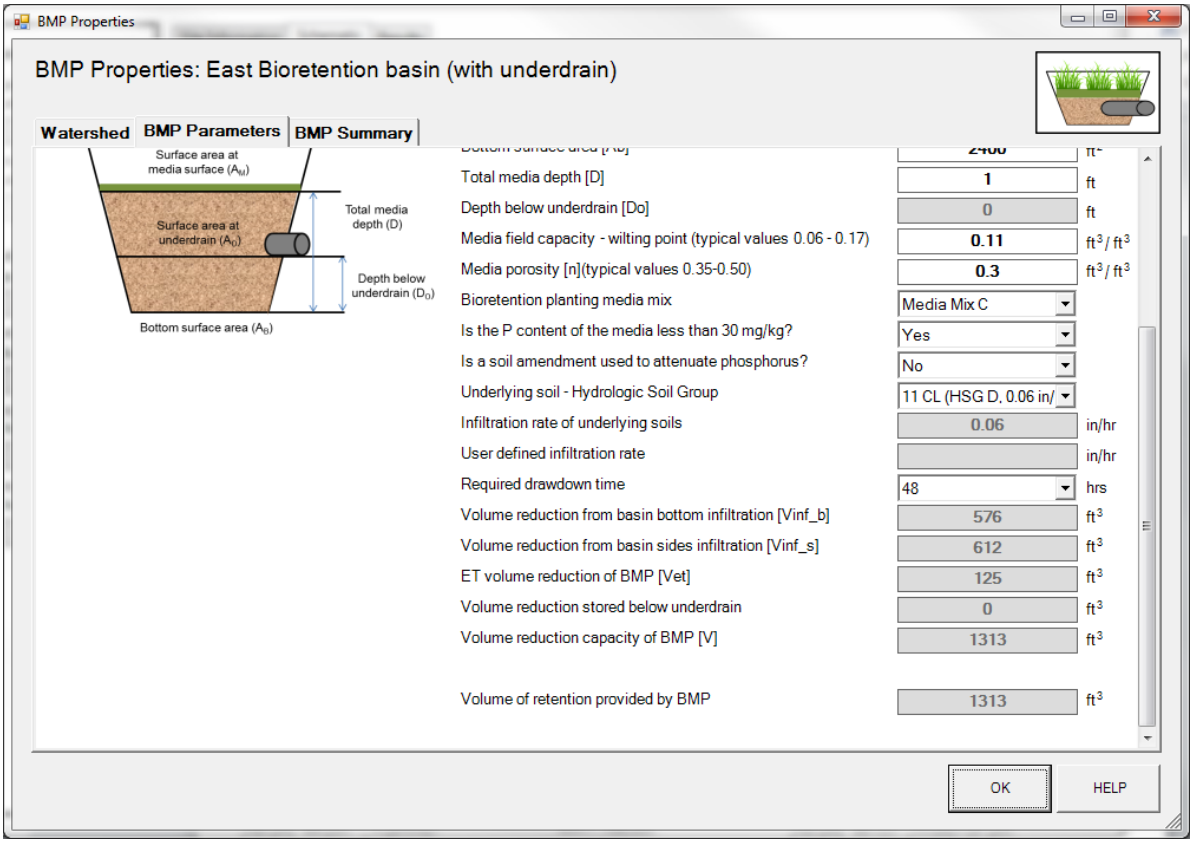
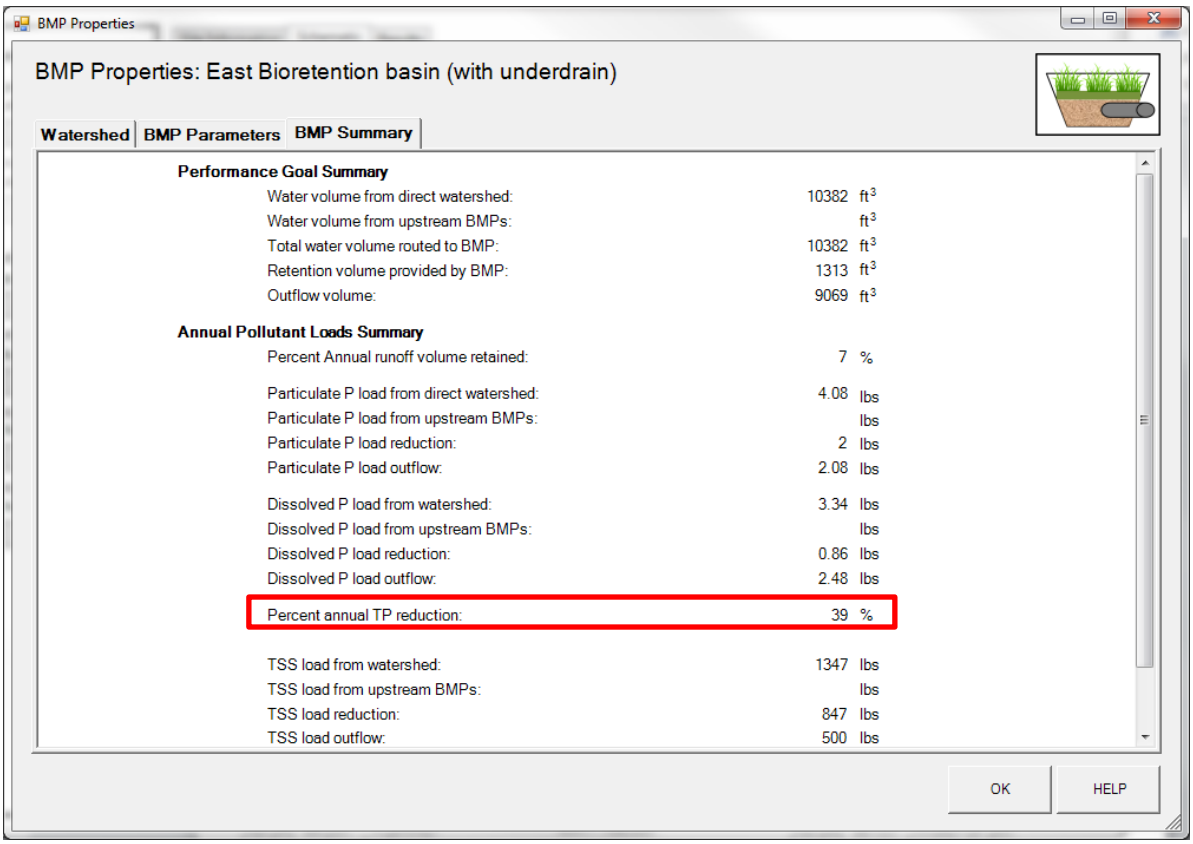
Watershed
BMP Parameters
BMP Summary
BMP Name
East Bioretention basin (with underdrain)
Routing/downstream BMP
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
5.35
5.35
Impervious Cover (acres)
2.6
Total Area (acres)
7.95
OK
HELP


BMP Properties
BMP Properties: East Bioretention basin (with underdrain)
Watershed
BMP Parameters
BMP Summary
Bioretention basin (with underdrain)
$V = \left[V_{\inf\_b} \ or \ \left(\frac{A_O + A_B}{2} * n * D_O\right)\right] + V_{\inf\_s} + V_{ET}$
Surface area at Overflow (A_S)
Surface area at media surface (A_M)
Surface area at underdrain (A_O)
Total media depth (D)
Depth below underdrain (D_O)
Bottom surface area (A_B)
Required treatment volume
10382
ft3
Is the underdrain elevated above native soils?
No
Are the sides of the basin lined with an impermeable liner?
No
Is the bottom of the basin lined with an impermeable liner?
No
Surface area at overflow [As]
7500
ft2
Surface area at media surface [Am]
5000
ft2
Surface area at underdrain [Ao]
2400
ft2
Bottom surface area [Ab]
2400
ft2
Total media depth [D]
1
ft
Depth below underdrain [Do]
0
ft
Media field capacity - wilting point (typical values 0.06 - 0.17)
0.11
ft3 / ft3
Media porosity [n](typical values 0.35-0.50)
0.3
ft3 / ft3
Bioretention planting media mix
Media Mix C
Is the P content of the media less than 30 mg/kg?
Yes
Is a soil amendment used to attenuate phosphorus?
No
Underlying soil - Hydrologic Soil Group
11 CL (HSG D, 0.06 in/
Infiltration rate of underlying soils
0.06
in/hr
User defined infiltration rate
in/hr
Required drawdown time
48
hrs
OK
HELP


BMP Properties
BMP Properties: East Bioretention basin (with underdrain)
Watershed
BMP Parameters
BMP Summary
Surface area at media surface (A_M)
Total media depth (D)
Surface area at underdrain (A_U)
Depth below underdrain (D_O)
Bottom surface area (A_B)
Total media depth [D] 1 ft
Depth below underdrain [Do] 0 ft
Media field capacity - wilting point (typical values 0.06 - 0.17) 0.11 ft³/ft³
Media porosity [n](typical values 0.35-0.50) 0.3 ft³/ft³
Bioretention planting media mix Media Mix C
Is the P content of the media less than 30 mg/kg? Yes
Is a soil amendment used to attenuate phosphorus? No
Underlying soil - Hydrologic Soil Group 11 CL (HSG D, 0.06 in/
Infiltration rate of underlying soils 0.06 in/hr
User defined infiltration rate in/hr
Required drawdown time 48 hrs
Volume reduction from basin bottom infiltration [Vinf_b] 576 ft³
Volume reduction from basin sides infiltration [Vinf_s] 612 ft³
ET volume reduction of BMP [Vet] 125 ft³
Volume reduction stored below underdrain 0 ft³
Volume reduction capacity of BMP [V] 1313 ft³
Volume of retention provided by BMP 1313 ft³
OK
HELP


BMP Properties
BMP Properties: East Bioretention basin (with underdrain)
Watershed
BMP Parameters
BMP Summary
Performance Goal Summary
Water volume from direct watershed: 10382 ft³
Water volume from upstream BMPs: ft³
Total water volume routed to BMP: 10382 ft³
Retention volume provided by BMP: 1313 ft³
Outflow volume: 9069 ft³
Annual Pollutant Loads Summary
Percent Annual runoff volume retained: 7 %
Particulate P load from direct watershed: 4.08 lbs
Particulate P load from upstream BMPs: lbs
Particulate P load reduction: 2 lbs
Particulate P load outflow: 2.08 lbs
Dissolved P load from watershed: 3.34 lbs
Dissolved P load from upstream BMPs: lbs
Dissolved P load reduction: 0.86 lbs
Dissolved P load outflow: 2.48 lbs
Percent annual TP reduction: 39 %
TSS load from watershed: 1347 lbs
TSS load from upstream BMPs: lbs
TSS load reduction: 847 lbs
TSS load outflow: 500 lbs
OK
HELP

Exercise 2 Answer:

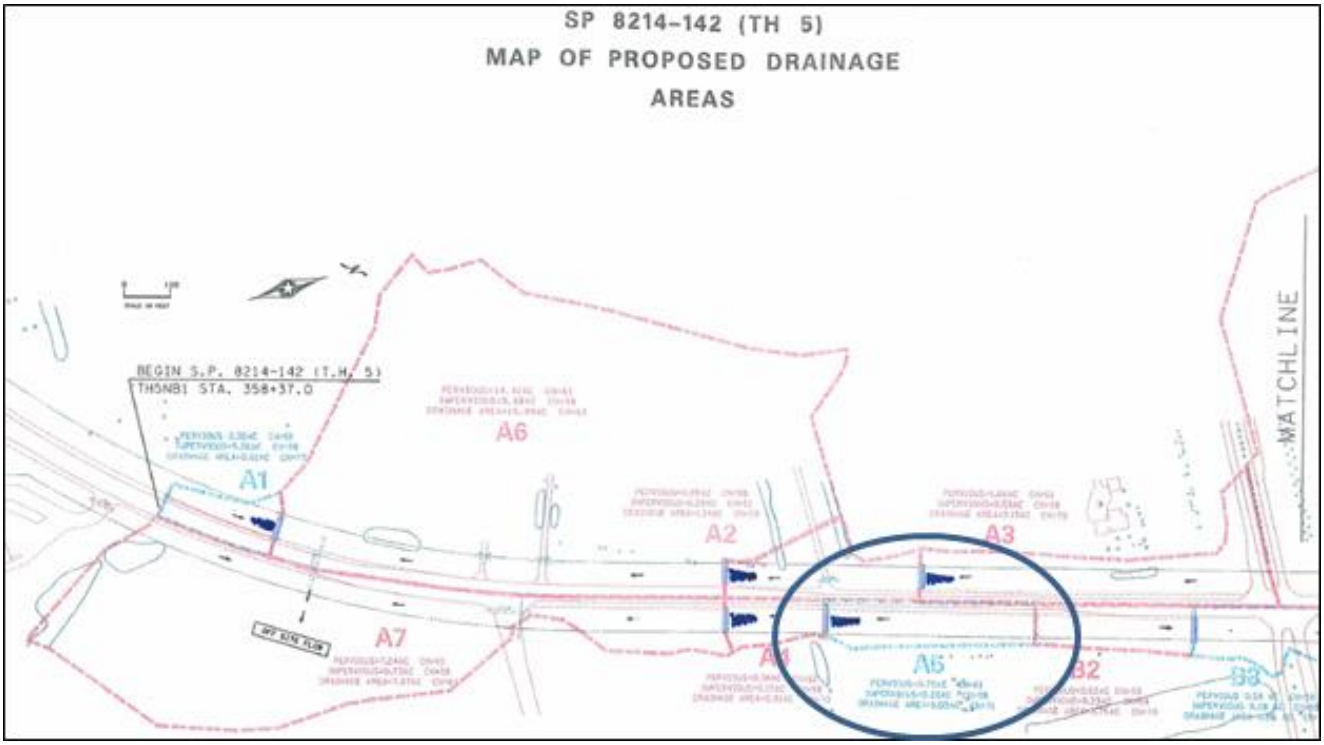
What is the annual TP reduction at WEST and EAST? 39% and 39%

Exercise 3: Swale

Assignment: Use given swale, cross-section, and no check dam or bioretention base

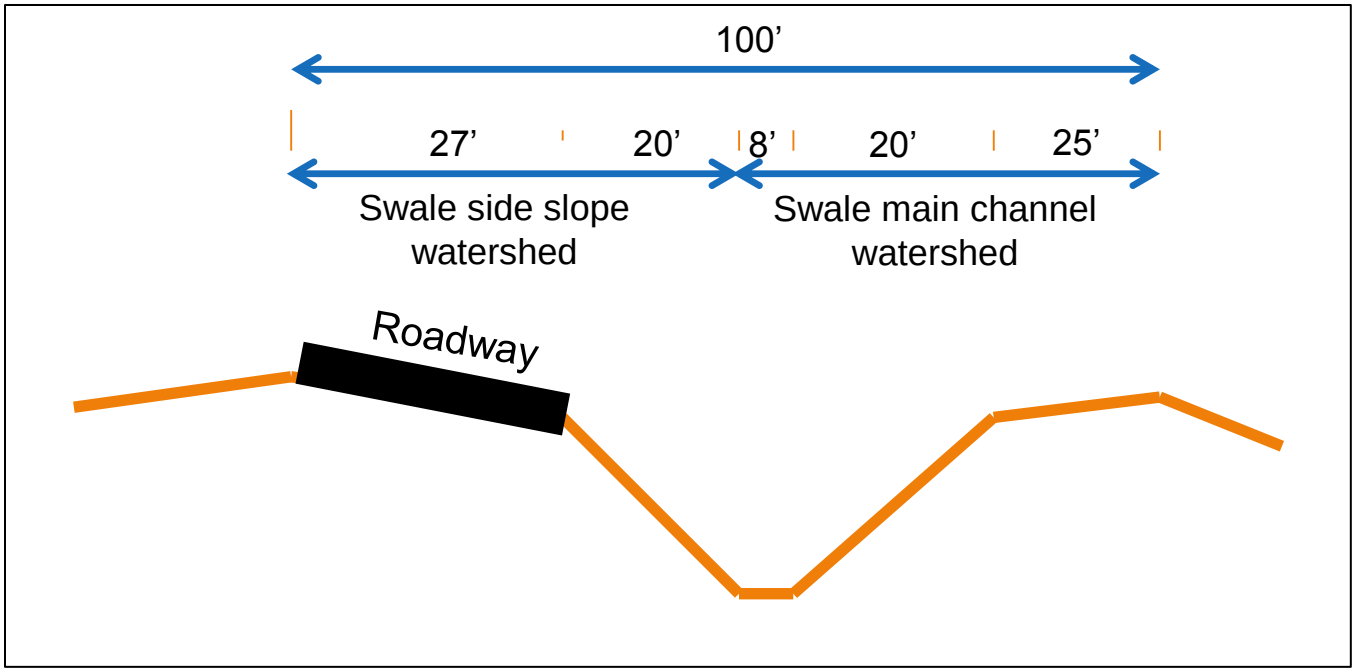
Determine: The volume of runoff lost through the entire swale with

- mowed turf
- with native (tall) grass



Rural Section of Highway 5 in Lake Elmo, MN (55042)

- Drainage Area A5:
- B soils
- Rectangular drainage area: 450’ by 100’
- Road/shoulder: 27’ wide
- Longitudinal slope is 2%
- Side slope 4:1



Calculate watershed areas

Swale Side slope watershed

- Impervious Area = 27’ * 450’ * 1 acre/ 43560’
  = 0.279 acres
- Pervious Area = 20’ * 450’ * 1 acre/ 43560’
  = 0.207 acres

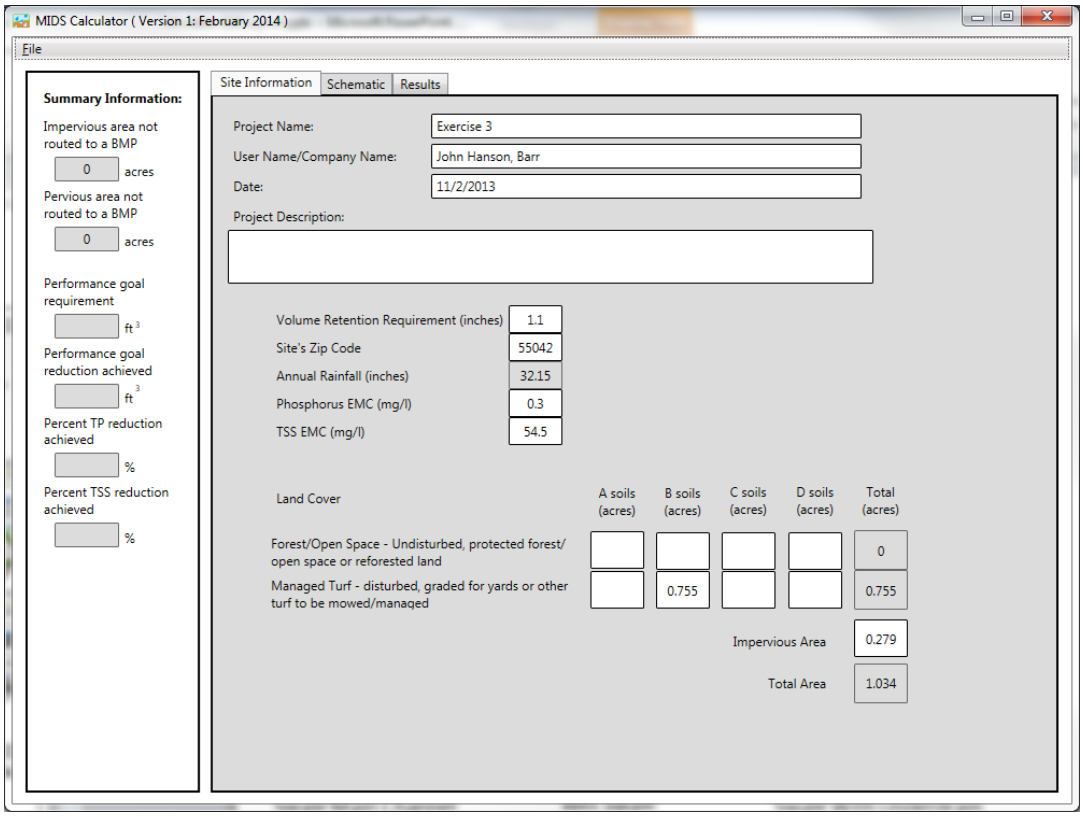
Swale main channel watershed

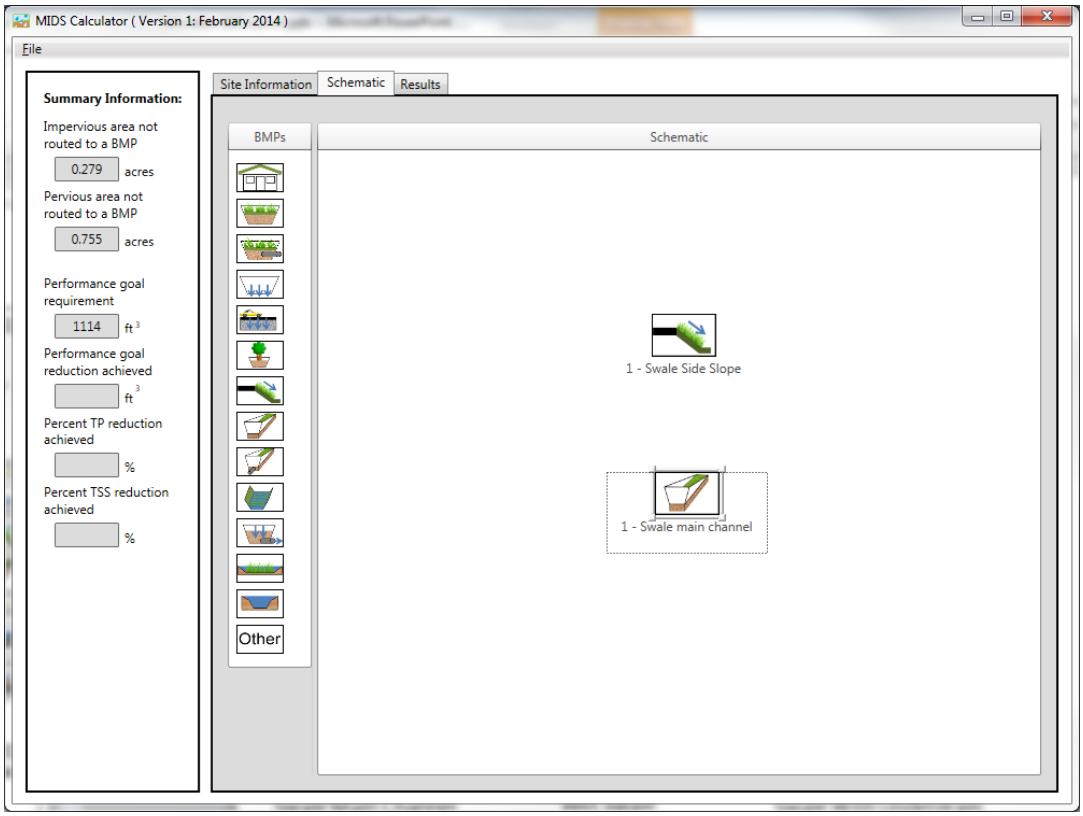
- Pervious area = 53’ * 450’ * 1 acre/43560’
  = 0.548 acres

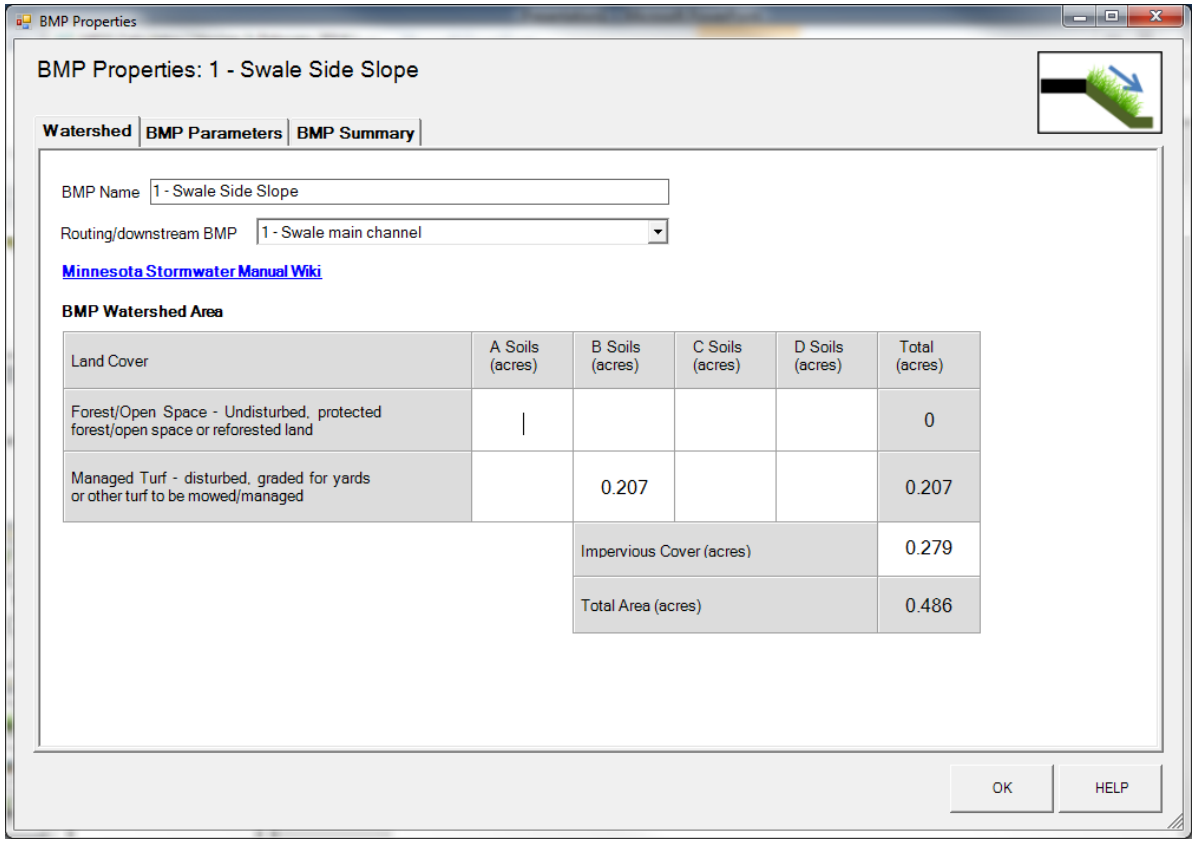
Total Site Watershed

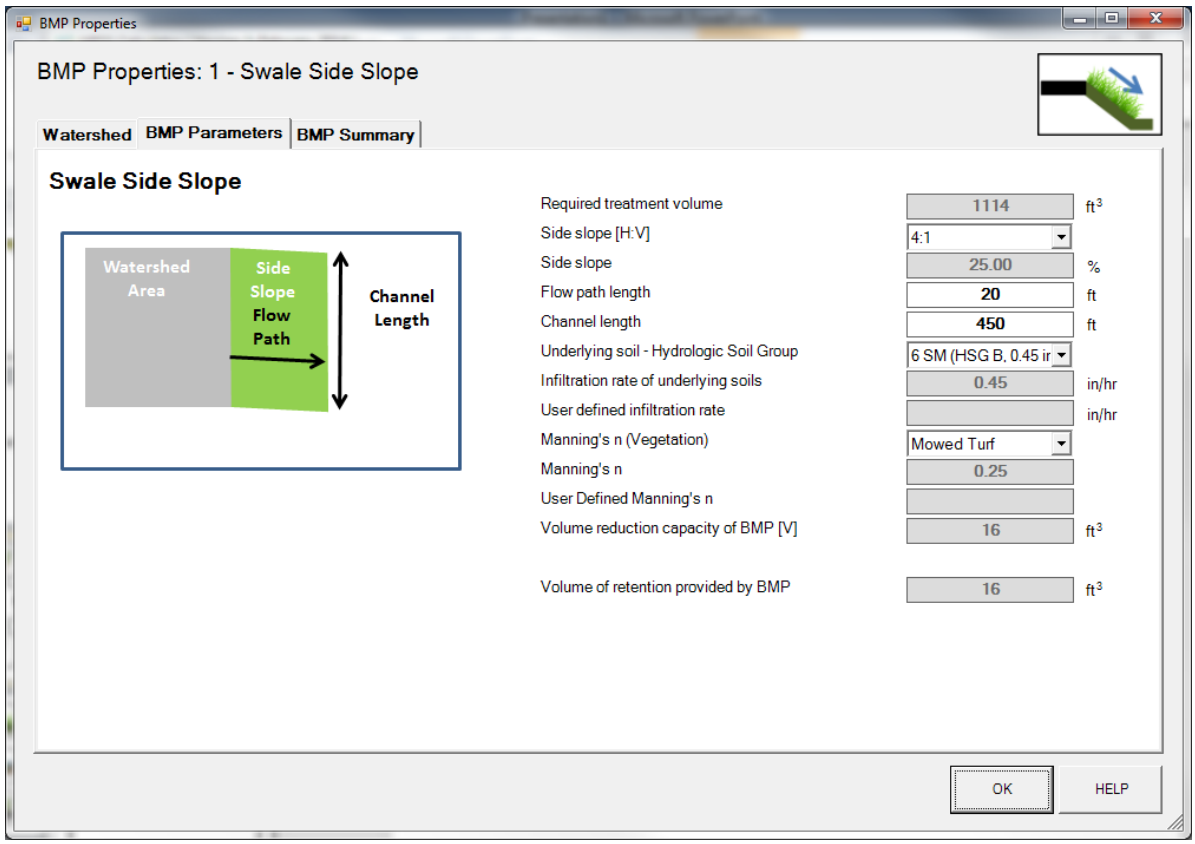
- Pervious area = 0.548 + 0.207 = 0.755 acres
- Impervious area = 0.279 acres

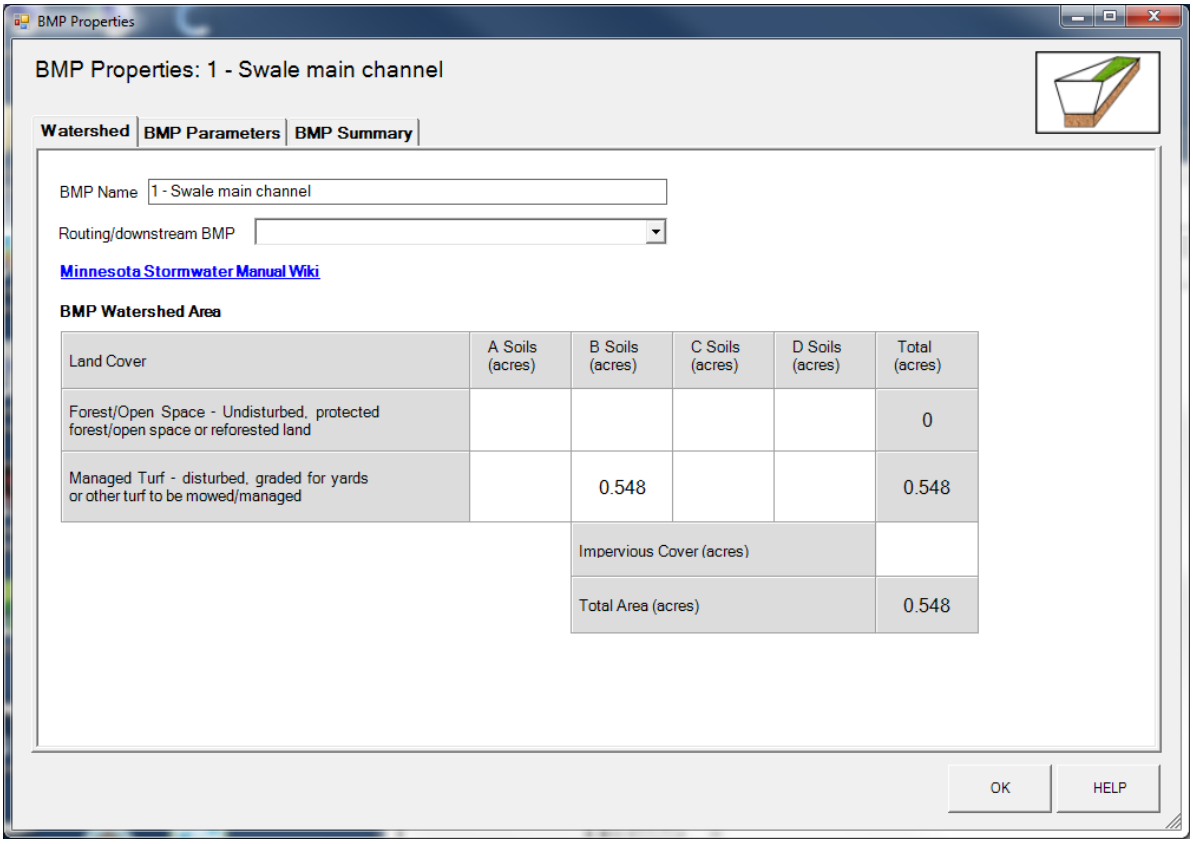
Exercise 3A: Step-by-Step Calculator Inputs

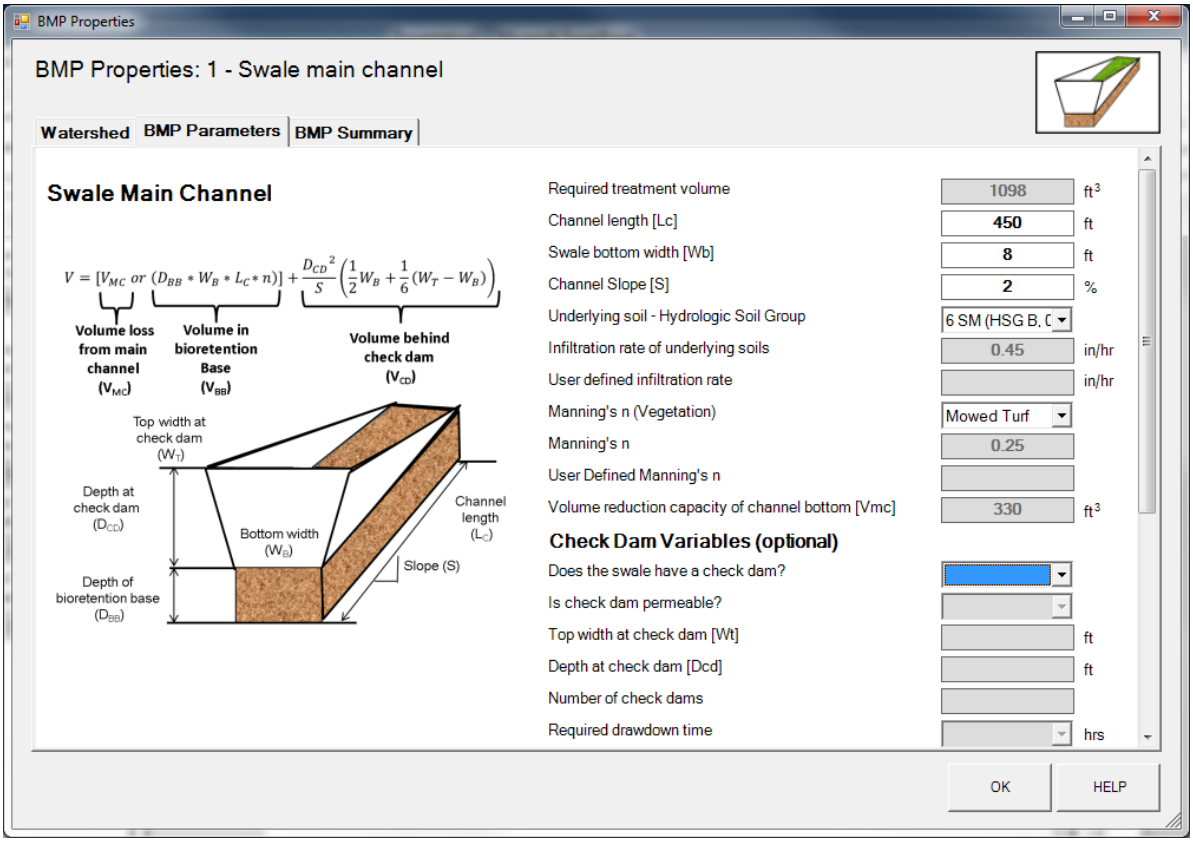





BMP Properties
BMP Properties: 1 - Swale Side Slope
Watershed
BMP Parameters
BMP Summary
BMP Name 1 - Swale Side Slope
Routing/downstream BMP 1 - Swale main channel
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
0.207
0.207
Impervious Cover (acres)
0.279
Total Area (acres)
0.486
OK
HELP


BMP Properties
BMP Properties: 1 - Swale Side Slope
Watershed
BMP Parameters
BMP Summary
Swale Side Slope
Watershed Area
Side Slope Flow Path
Channel Length
Required treatment volume 1114 ft3
Side slope [H:V] 4:1
Side slope 25.00 %
Flow path length 20 ft
Channel length 450 ft
Underlying soil - Hydrologic Soil Group 6 SM (HSG B, 0.45 ir
Infiltration rate of underlying soils 0.45 in/hr
User defined infiltration rate in/hr
Manning's n (Vegetation) Mowed Turf
Manning's n 0.25
User Defined Manning's n
Volume reduction capacity of BMP [V] 16 ft3
Volume of retention provided by BMP 16 ft3
OK
HELP

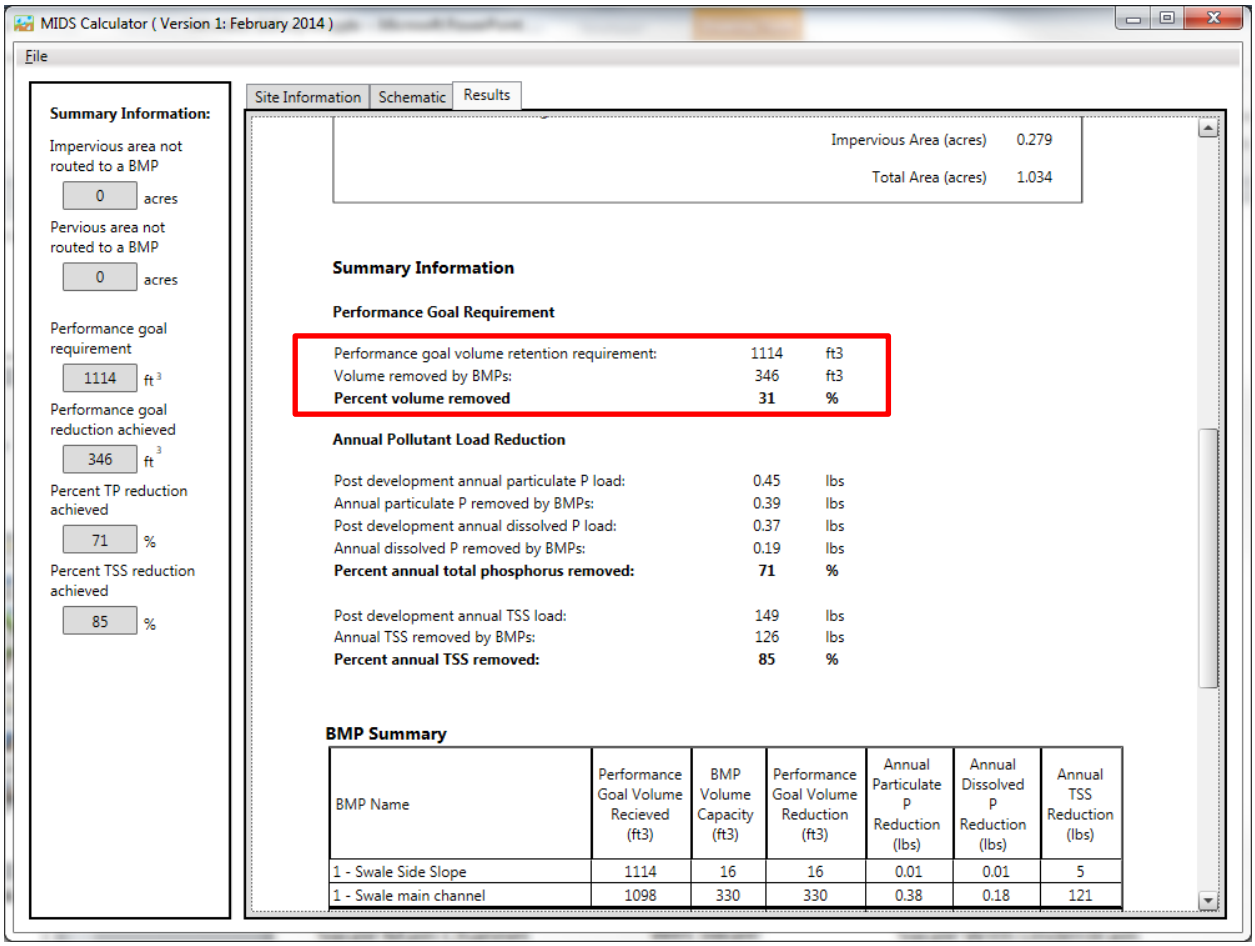

BMP Properties
BMP Properties: 1 - Swale main channel
Watershed
BMP Parameters
BMP Summary
BMP Name
1 - Swale main channel
Routing/downstream BMP
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
0.548
0.548
Impervious Cover (acres)
Total Area (acres)
0.548
OK
HELP


BMP Properties
BMP Properties: 1 - Swale main channel
Watershed
BMP Parameters
BMP Summary
Swale Main Channel
$V = [V_{MC} \text{ or } (D_{BB} * W_B * L_C * n)] + \frac{D_{CD}^2}{S}\left(\frac{1}{2}W_B + \frac{1}{6}(W_T - W_B)\right)$
Volume loss from main channel (V_{MC})
Volume in bioretention Base (V_{BB})
Volume behind check dam (V_{CD})
Top width at check dam (W_T)
Depth at check dam (D_{CD})
Bottom width (W_B)
Channel length (L_C)
Slope (S)
Depth of bioretention base (D_{BB})
Required treatment volume
1098
ft3
Channel length [Lc]
450
ft
Swale bottom width [Wb]
8
ft
Channel Slope [S]
2
%
Underlying soil - Hydrologic Soil Group
6 SM (HSG B, C
Infiltration rate of underlying soils
0.45
in/hr
User defined infiltration rate
in/hr
Manning's n (Vegetation)
Mowed Turf
Manning's n
0.25
User Defined Manning's n
Volume reduction capacity of channel bottom [Vmc]
330
ft3
Check Dam Variables (optional)
Does the swale have a check dam?
Is check dam permeable?
Top width at check dam [Wt]
ft
Depth at check dam [Dcd]
ft
Number of check dams
Required drawdown time
hrs
OK
HELP

Exercise 3A: Answer

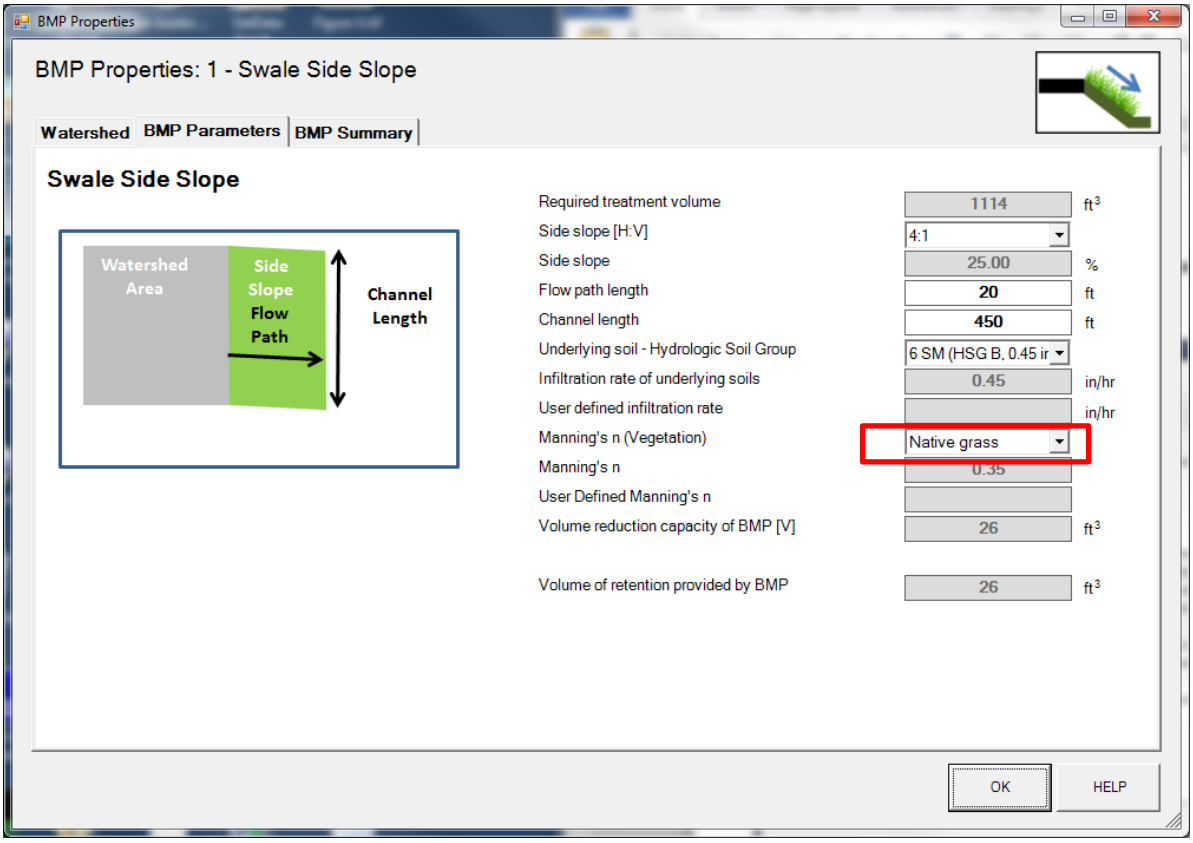
What is the volume of runoff lost through the swale with mowed turf?

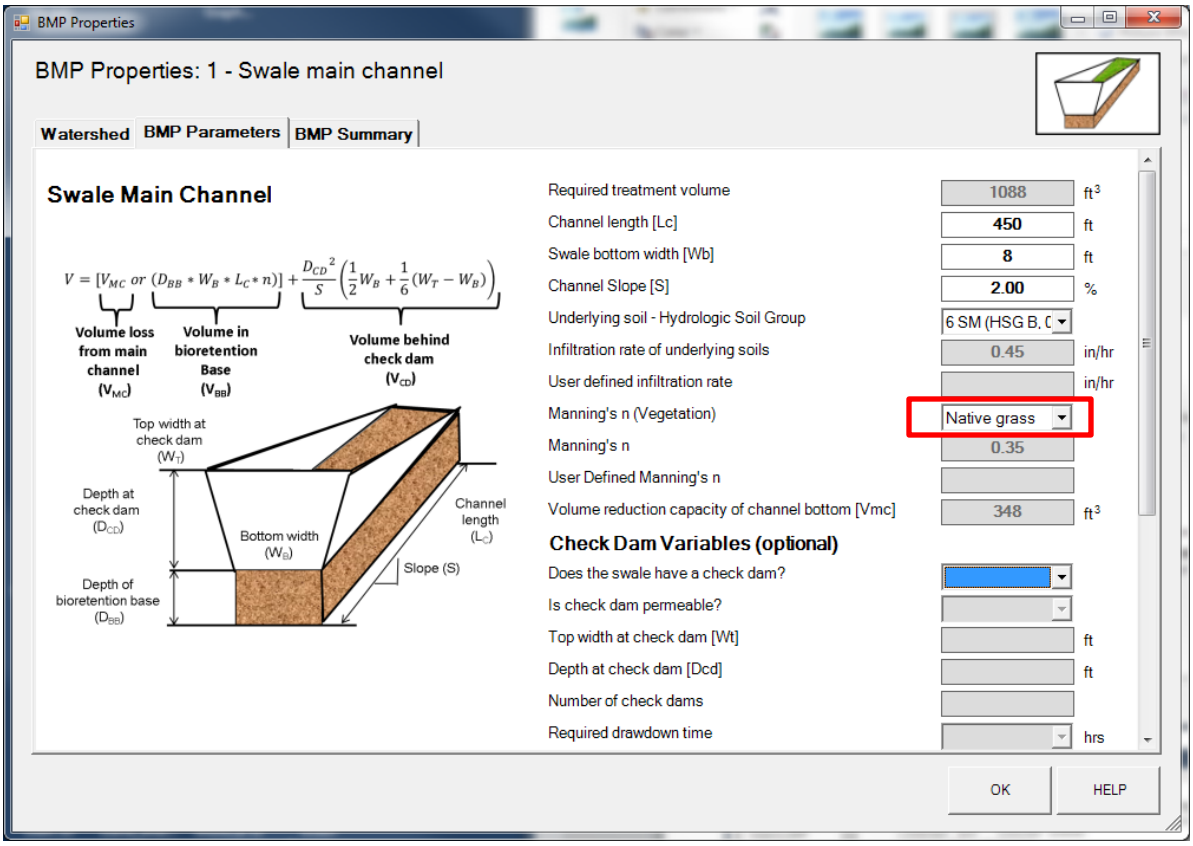
Answer: 346 ft^3

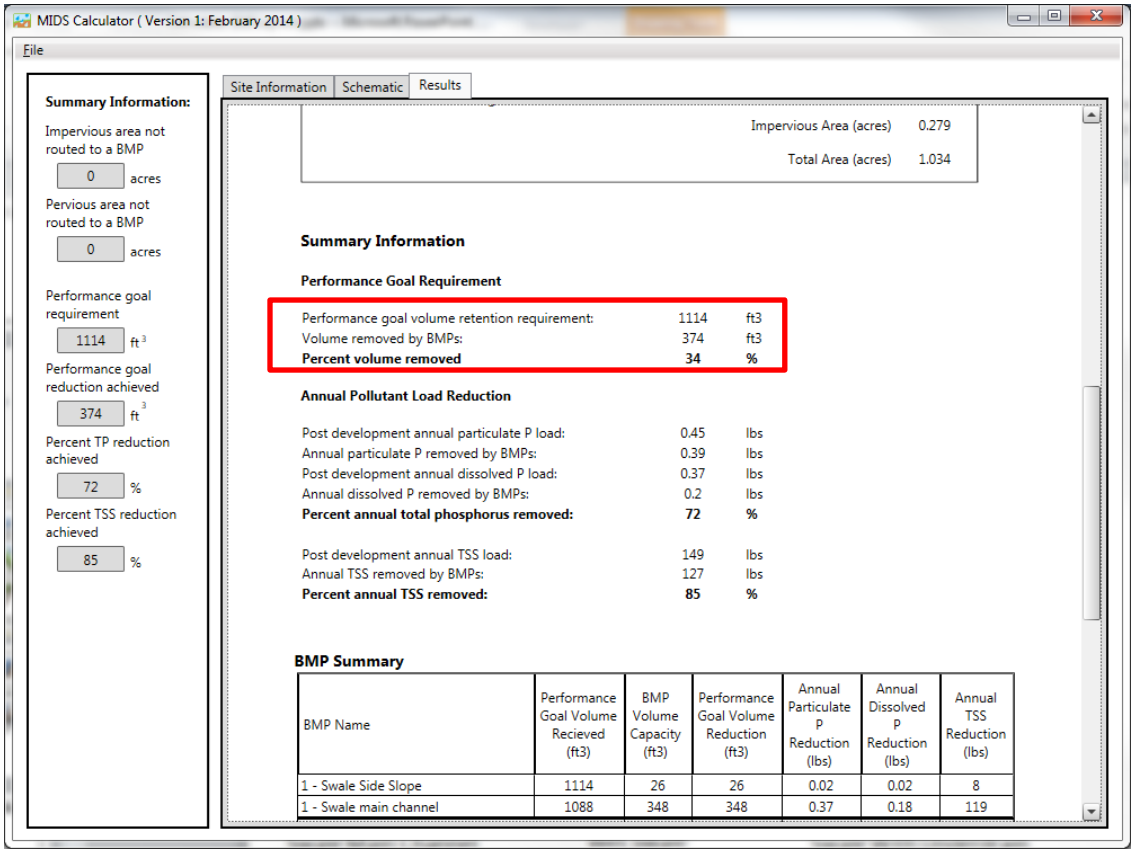


What is the volume of runoff lost through the swale with native grass?

Answer: 374 ft^3




BMP Properties
BMP Properties: 1 - Swale main channel
Watershed
BMP Parameters
BMP Summary
Swale Main Channel
$V = [V_{MC} \text{ or } (D_{BB} * W_B * L_C * n)] + \frac{D_{CD}^2}{S}\left(\frac{1}{2}W_B + \frac{1}{6}(W_T - W_B)\right)$
Volume loss from main channel (V_{MC})
Volume in bioretention Base (V_{BB})
Volume behind check dam (V_{CD})
Top width at check dam (W_T)
Depth at check dam (D_{CD})
Bottom width (W_B)
Channel length (L_C)
Slope (S)
Depth of bioretention base (D_{BB})
Required treatment volume 1088 ft3
Channel length [Lc] 450 ft
Swale bottom width [Wb] 8 ft
Channel Slope [S] 2.00 %
Underlying soil - Hydrologic Soil Group 6 SM (HSG B, C
Infiltration rate of underlying soils 0.45 in/hr
User defined infiltration rate in/hr
Manning's n (Vegetation) Native grass
Manning's n 0.35
User Defined Manning's n
Volume reduction capacity of channel bottom [Vmc] 348 ft3
Check Dam Variables (optional)
Does the swale have a check dam?
Is check dam permeable?
Top width at check dam [Wt] ft
Depth at check dam [Dcd] ft
Number of check dams
Required drawdown time hrs
OK
HELP


MIDS Calculator (Version 1: February 2014)
File
Summary Information:
Impervious area not routed to a BMP
0 acres
Pervious area not routed to a BMP
0 acres
Performance goal requirement
1114 ft3
Performance goal reduction achieved
374 ft3
Percent TP reduction achieved
72 %
Percent TSS reduction achieved
85 %
Site Information
Schematic
Results
Impervious Area (acres) 0.279
Total Area (acres) 1.034
Summary Information
Performance Goal Requirement
Performance goal volume retention requirement: 1114 ft3
Volume removed by BMPs: 374 ft3
Percent volume removed 34 %
Annual Pollutant Load Reduction
Post development annual particulate P load: 0.45 lbs
Annual particulate P removed by BMPs: 0.39 lbs
Post development annual dissolved P load: 0.37 lbs
Annual dissolved P removed by BMPs: 0.2 lbs
Percent annual total phosphorus removed: 72 %
Post development annual TSS load: 149 lbs
Annual TSS removed by BMPs: 127 lbs
Percent annual TSS removed: 85 %
BMP Summary
BMP Name | Performance Goal Volume Recieved (ft3) | BMP Volume Capacity (ft3) | Performance Goal Volume Reduction (ft3) | Annual Particulate p Reduction (lbs) | Annual Dissolved p Reduction (lbs) | Annual TSS Reduction (lbs)
1 - Swale Side Slope | 1114 | 26 | 26 | 0.02 | 0.02 | 8
1 - Swale main channel | 1088 | 348 | 348 | 0.37 | 0.18 | 119

Assignment 3B: Add Stormwater Pond

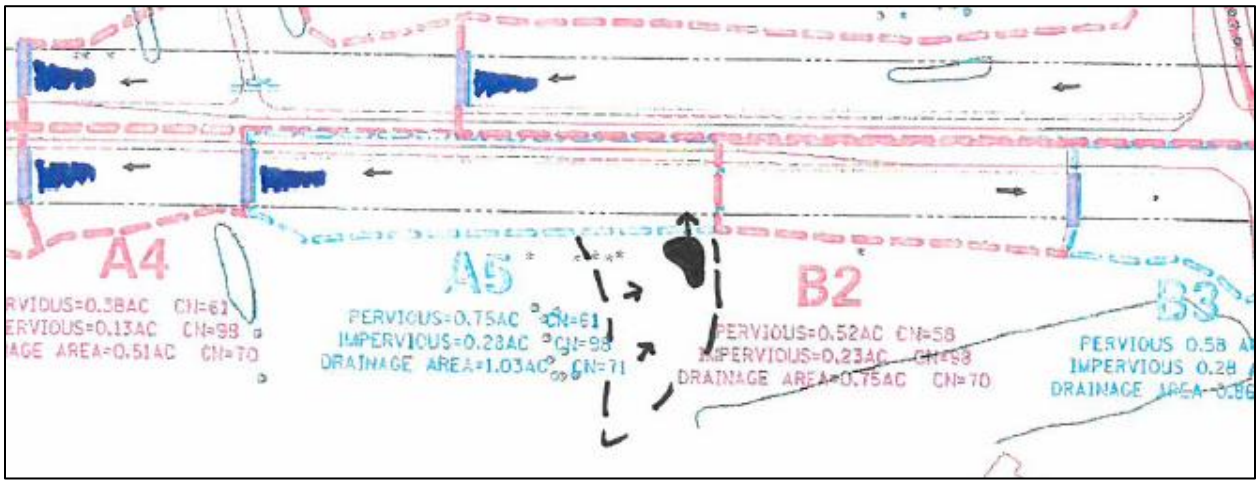
Givens: Assume an adjacent stormwater pond discharges into the bottom of the swale (with native grasses)

Stormwater Pond drainage area:

- 0.45 acres of B soils in turf
- 0.25 acres of impervious surface

Assignment: Determine if the example conforms to the performance goal?

What percent annual TSS is removed?

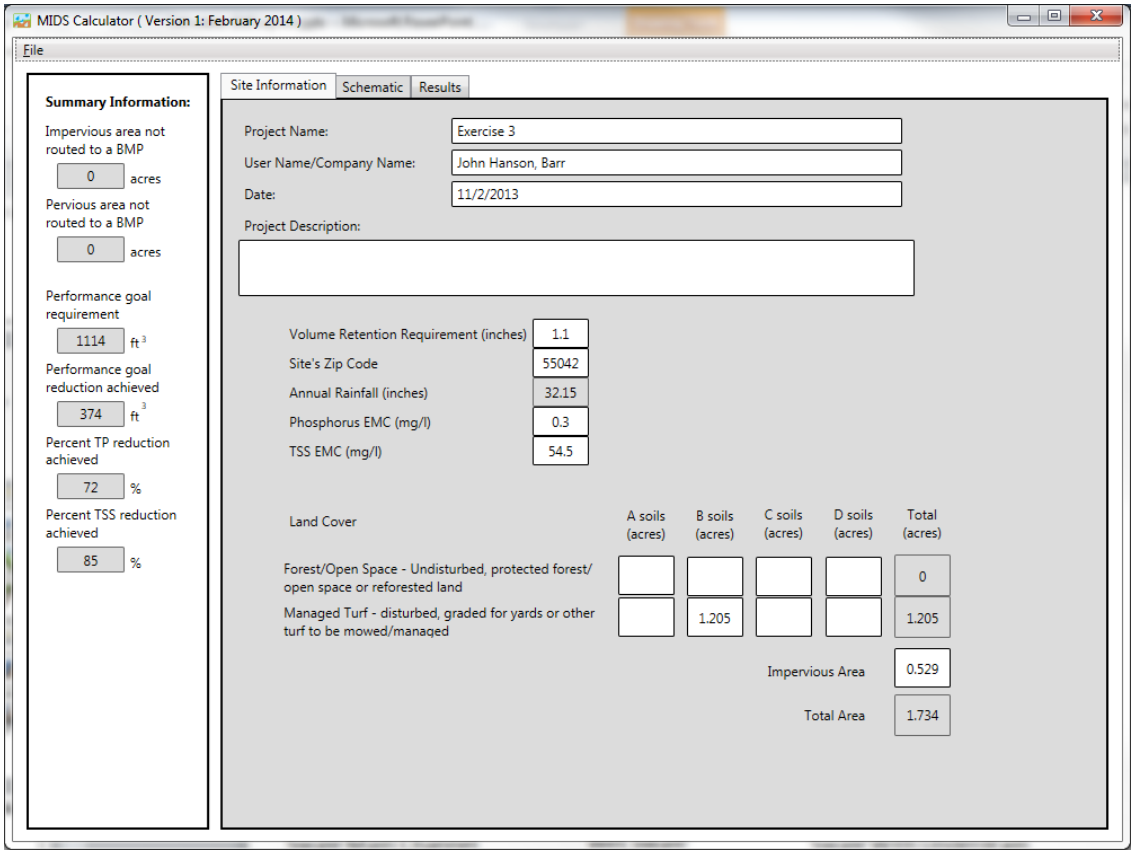


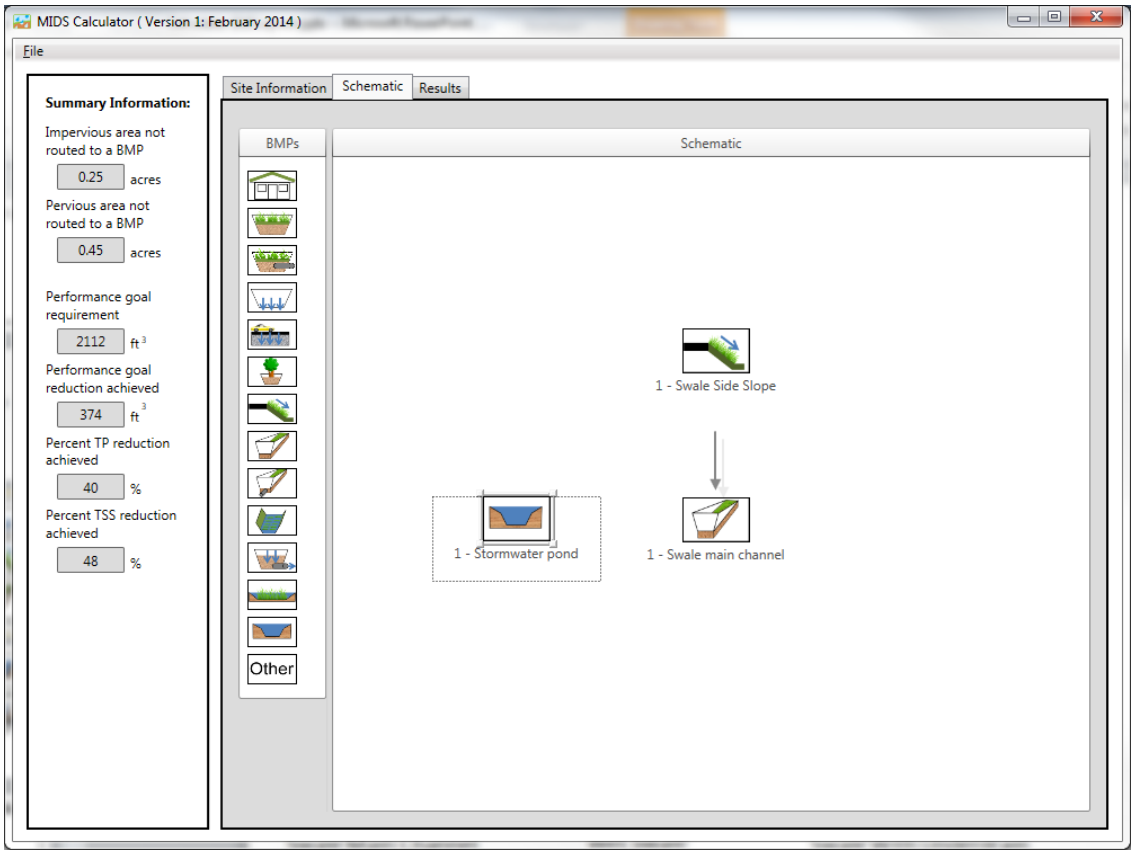
Exercise 3B: Step-by-Step Calculator Inputs

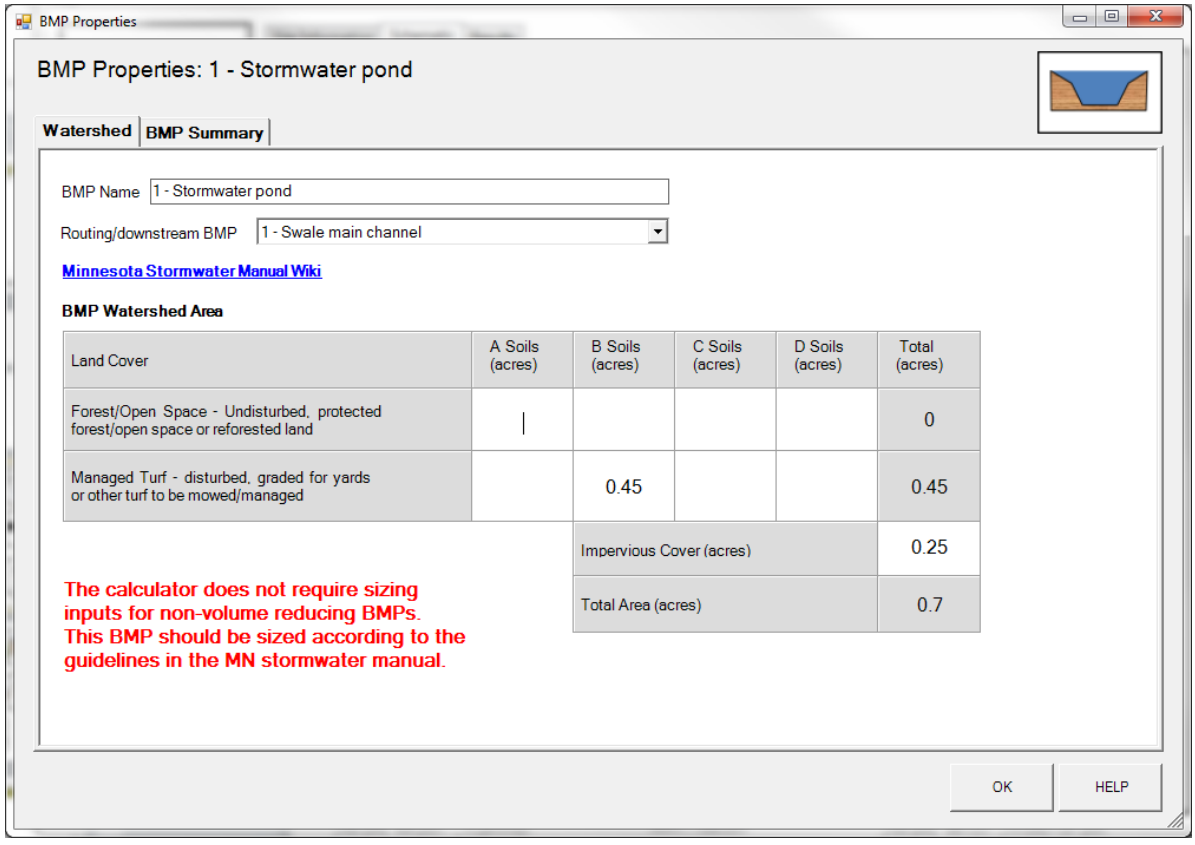
Make sure to go into the site information tab and add the new watershed areas to the already existing watershed areas.

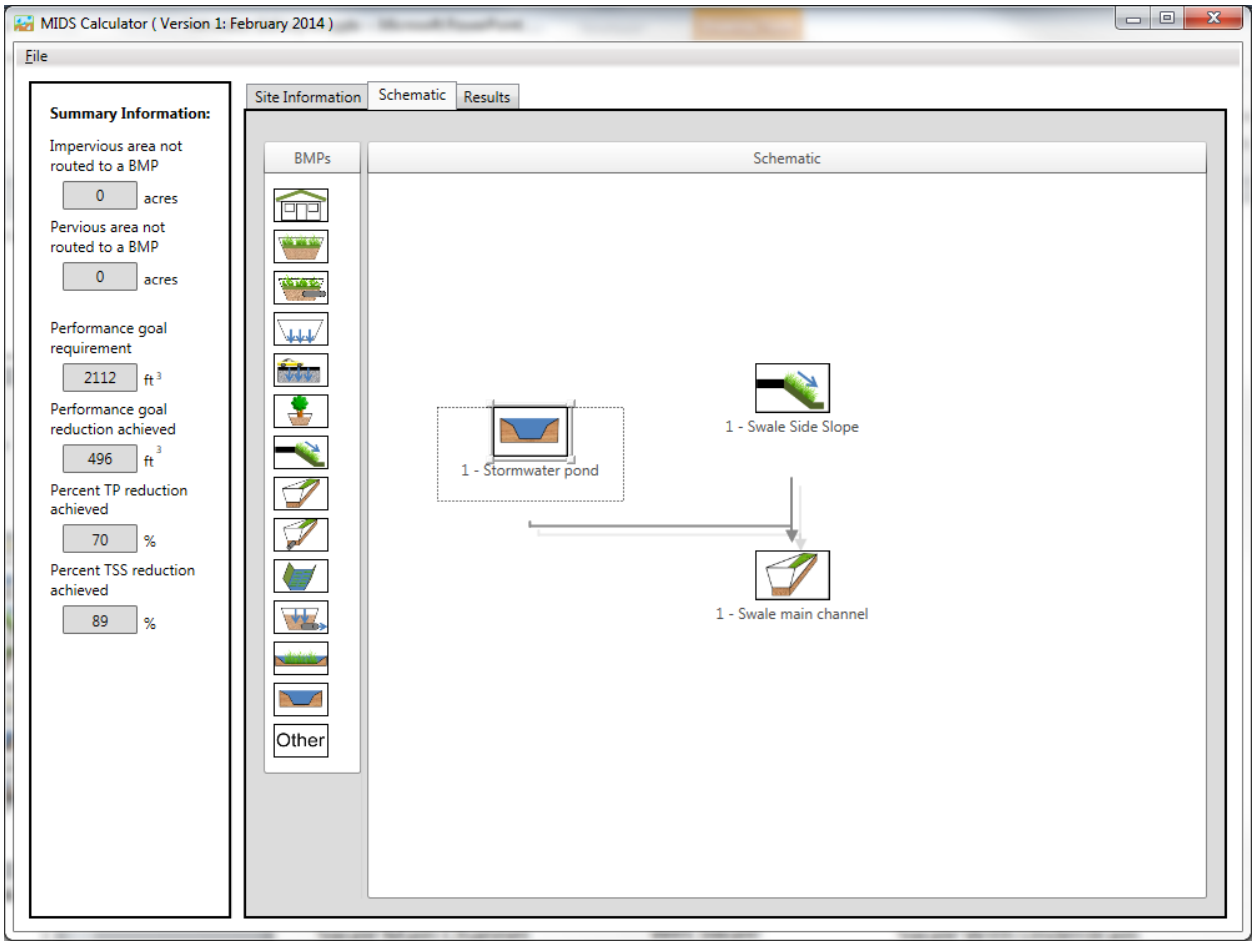
Total Site Watershed

- Pervious area = 0.755+ 0.45 = 1.205 acres
- Impervious area = 0.279 + 0.25 = 0.529 acres




MIDS Calculator (Version 1: February 2014)
File
Summary Information:
Impervious area not routed to a BMP
0.25 acres
Pervious area not routed to a BMP
0.45 acres
Performance goal requirement
2112 ft3
Performance goal reduction achieved
374 ft3
Percent TP reduction achieved
40 %
Percent TSS reduction achieved
48 %
Site Information
Schematic
Results
BMPs
Schematic
Other
1 - Swale Side Slope
1 - Stormwater pond
1 - Swale main channel


BMP Properties
BMP Properties: 1 - Stormwater pond
Watershed
BMP Summary
BMP Name 1 - Stormwater pond
Routing/downstream BMP 1 - Swale main channel
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
0.45
0.45
Impervious Cover (acres)
0.25
Total Area (acres)
0.7
The calculator does not require sizing inputs for non-volume reducing BMPs. This BMP should be sized according to the guidelines in the MN stormwater manual.
OK
HELP



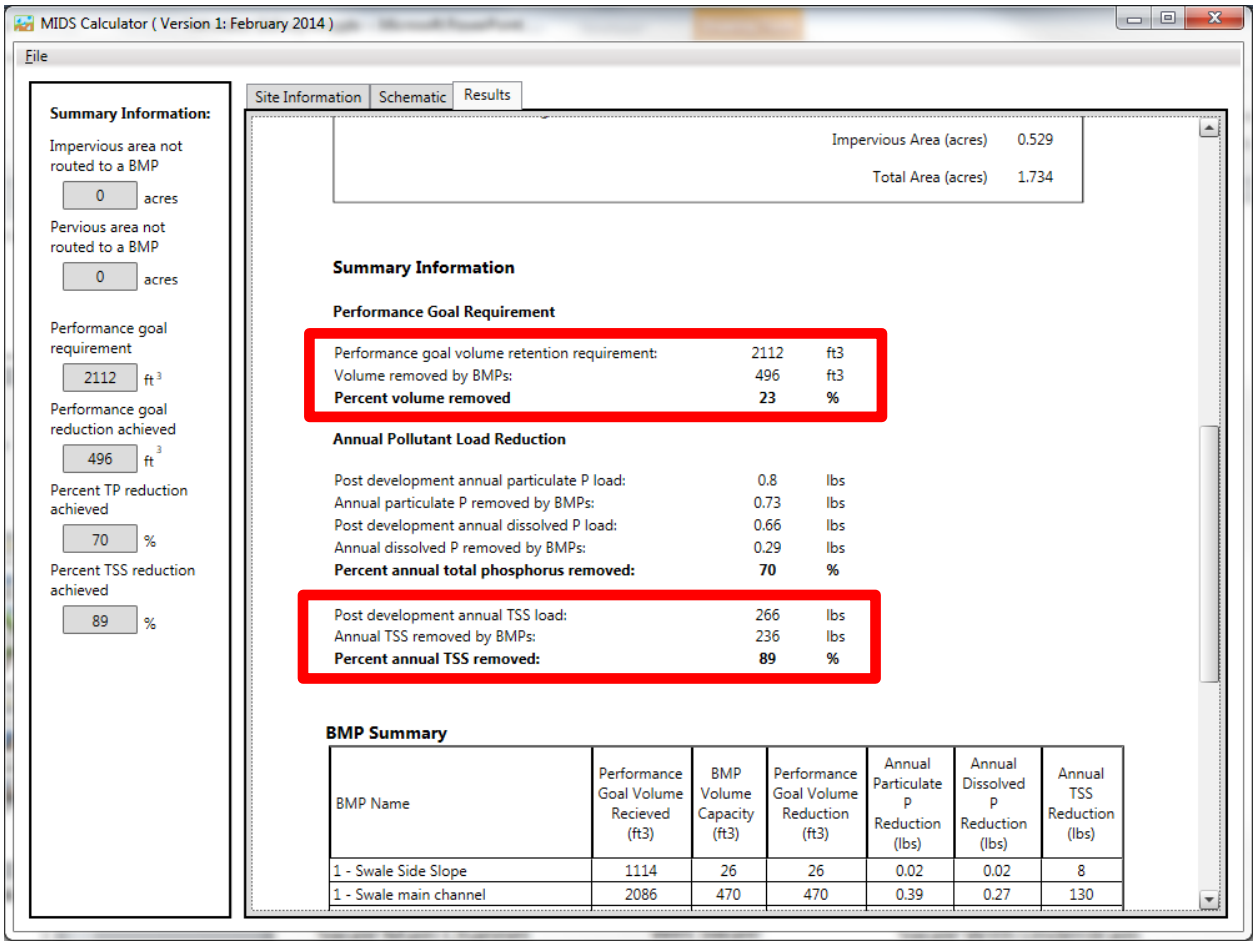
Exercise 3B: Answer

Does the example conform to the performance goal?

Answer: No

What percent annual TSS is removed?

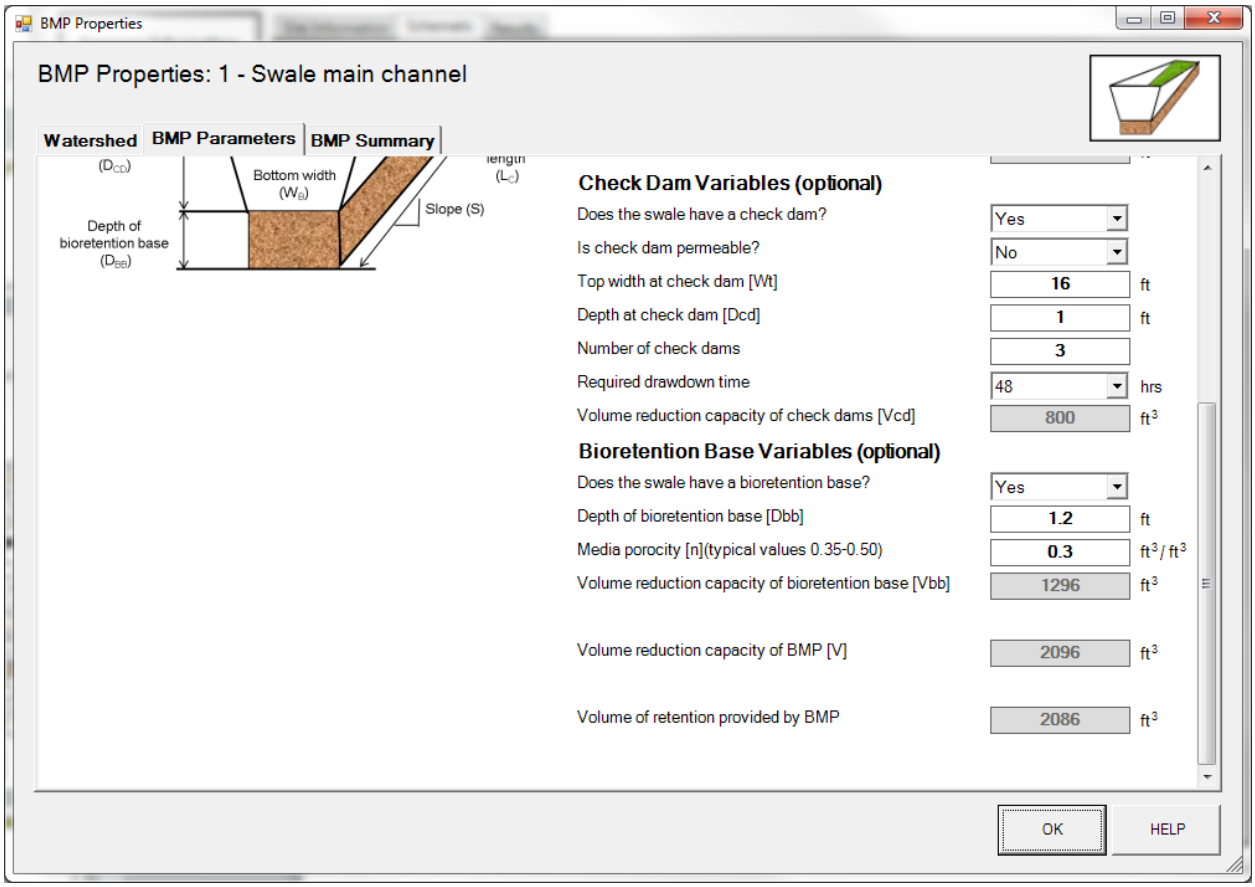
Answer: 89%


MIDS Calculator (Version 1: February 2014)
File
Summary Information:
Impervious area not routed to a BMP
0
acres
Pervious area not routed to a BMP
0
acres
Performance goal requirement
2112
ft3
Performance goal reduction achieved
496
ft3
Percent TP reduction achieved
70
%
Percent TSS reduction achieved
89
%
Site Information
Schematic
Results
Impervious Area (acres) 0.529
Total Area (acres) 1.734
Summary Information
Performance Goal Requirement
Performance goal volume retention requirement: 2112 ft3
Volume removed by BMPs: 496 ft3
Percent volume removed 23 %
Annual Pollutant Load Reduction
Post development annual particulate P load: 0.8 lbs
Annual particulate P removed by BMPs: 0.73 lbs
Post development annual dissolved P load: 0.66 lbs
Annual dissolved P removed by BMPs: 0.29 lbs
Percent annual total phosphorus removed: 70 %
Post development annual TSS load: 266 lbs
Annual TSS removed by BMPs: 236 lbs
Percent annual TSS removed: 89 %
BMP Summary
BMP Name
Performance Goal Volume Recieved (ft3)
BMP Volume Capacity (ft3)
Performance Goal Volume Reduction (ft3)
Annual Particulate p Reduction (lbs)
Annual Dissolved p Reduction (lbs)
Annual TSS Reduction (lbs)
1 - Swale Side Slope 1114 26 26 0.02 0.02 8
1 - Swale main channel 2086 470 470 0.39 0.27 130

Exercise 3C: Assignment/Question

Add check dams and a bioretention base until the example conforms to the performance goal. What did you do?

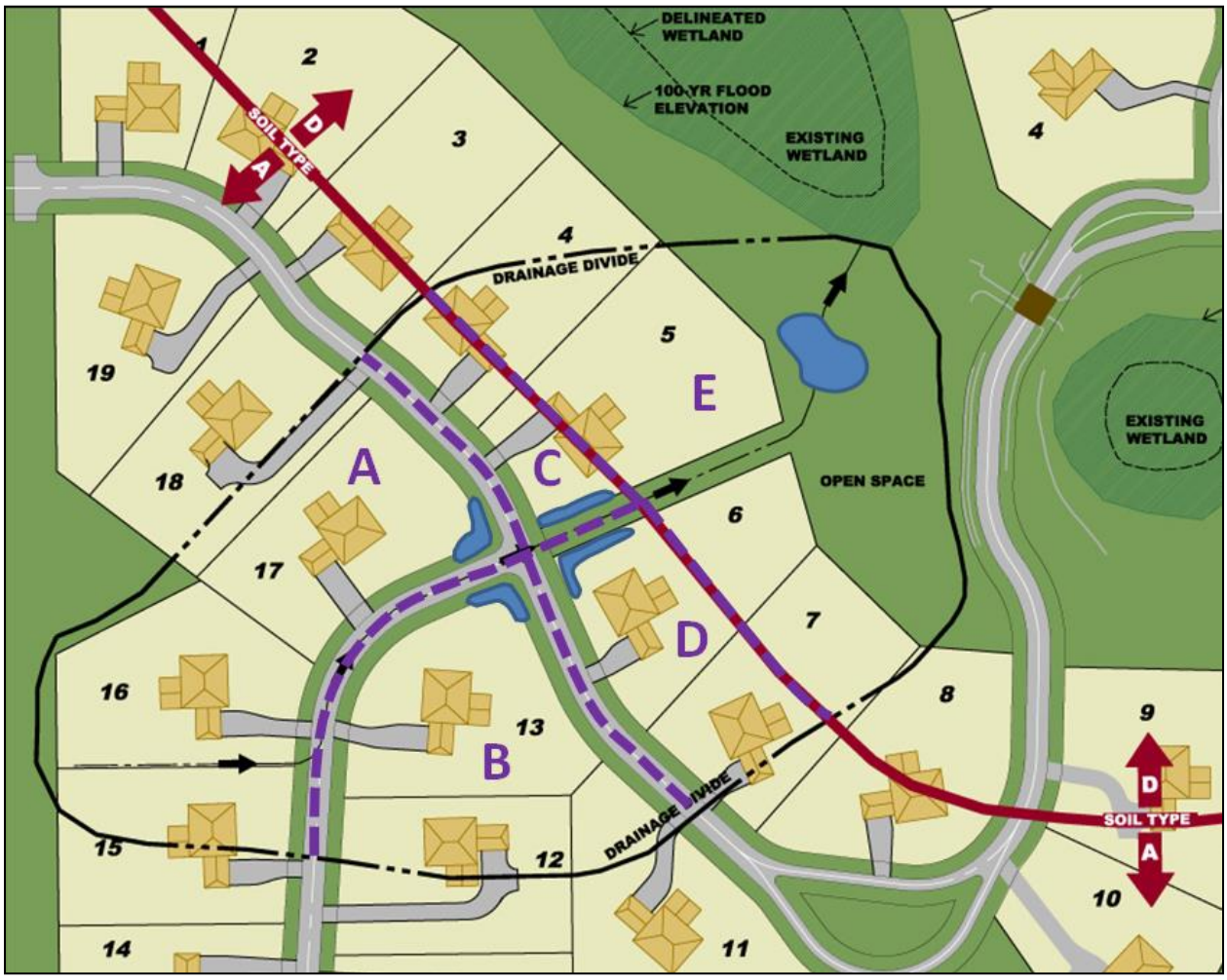
Exercise 3C: Step-by-Step Calculator Inputs



Exercise 4: Individual vs. Clumping of BMPs

Assignment: Use the givens and determine the volume retention results by calculating bioretention basins with individual drainage areas and as one clumped basin.

Are the results different? Why/why not?



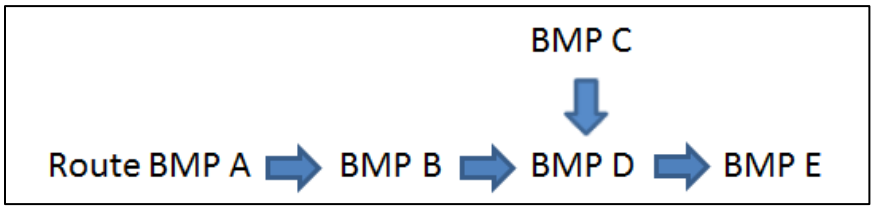
Zip code: 55042

Individual BMPs

*Note soil types for each drainage area designated by the **bold red line**

Drainage Area*	Land Cover (acres)			Total
	Turf	Forest/Open Space	Impervious	
A	1.08	0.00	0.22	1.30
B	0.72	0.00	0.18	0.90
C	0.22	0.00	0.08	0.30
D	0.39	0.00	0.16	0.55
E	0.76	0.80	0.04	1.60
Total:	3.17	0.80	0.68	4.65

Drainage Area	BMP Description	BMP Information				
		Top Area (ft^2)	Bottom Area (ft^2)	Depth (ft)	Underlying Soil Type	Drawdown Time (hrs)
A	Bioretention basin (w/o drain tile)	650	600	1.4	SP (HSG A)	48
B	Bioretention basin (w/o drain tile)	500	450	1.4	SP (HSG A)	48
C	Bioretention basin (w/o drain tile)	750	500	1.4	SP (HSG A)	48
D	Bioretention basin (w/o drain tile)	500	300	1.4	SP (HSG A)	48
E	Stormwater pond (no volume credit)					



Clumping BMPs

Drainage Area*	Land Cover (acres) Turf	Forest/Open Space	Impervious	Total
A + B + C + D	2.41	0.00	0.64	3.05
E	0.76	0.80	0.04	1.60
Total:	3.17	0.80	0.68	4.65

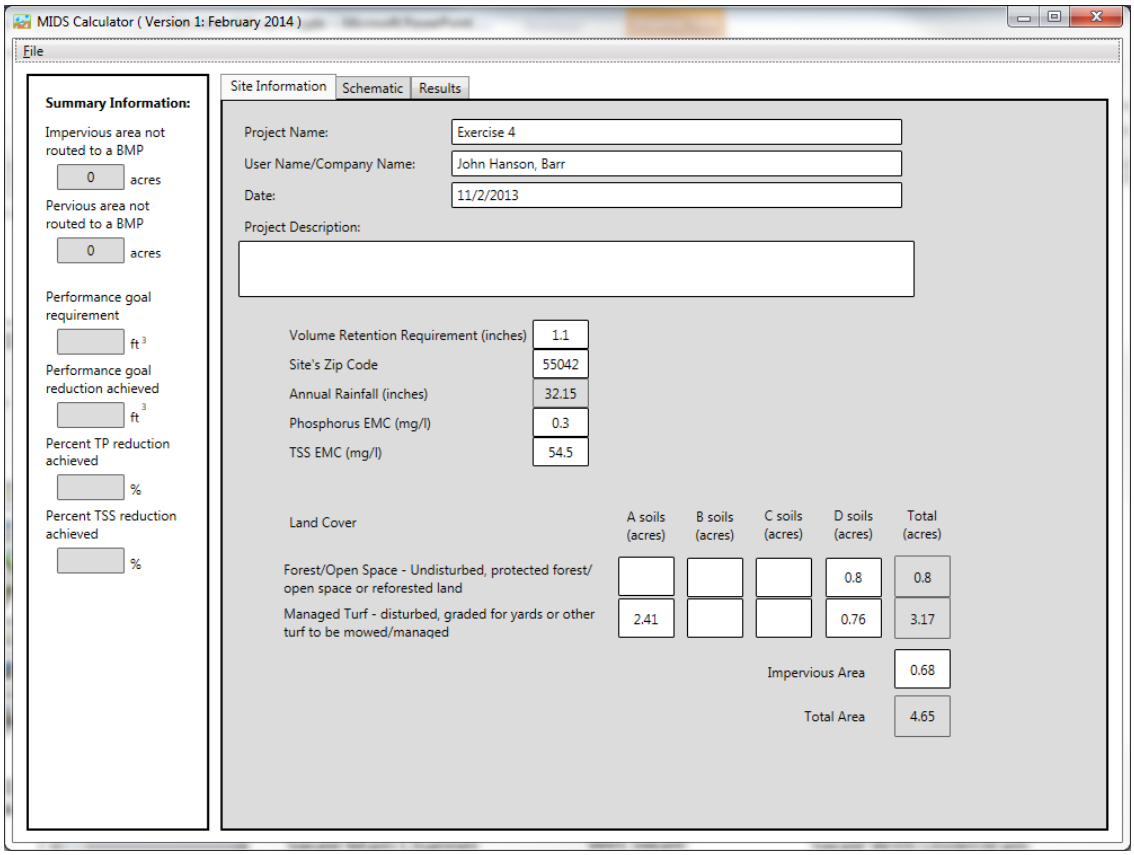
*Note soil types for each drainage area designated by the **bold red line**

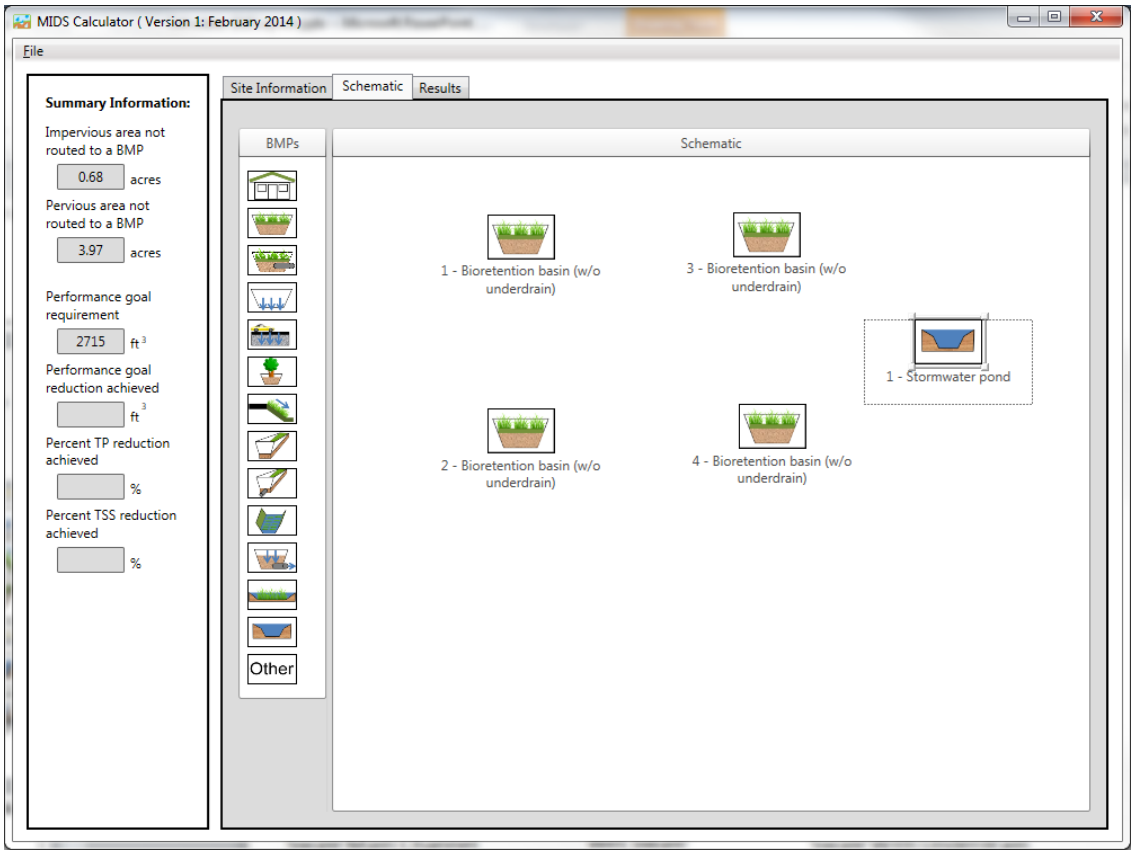
Drainage Area	BMP Description	BMP Information Top Area (ft²)	Bottom Area (ft²)	Depth (ft)	Underlying Soil Type	Drawdown Time (hrs)
A+B+C+D	Bioretention basin (w/o drain tile)	2400	1850	1.4	SP (HSG A)	48
E	Stormwater pond (no volume credit)					

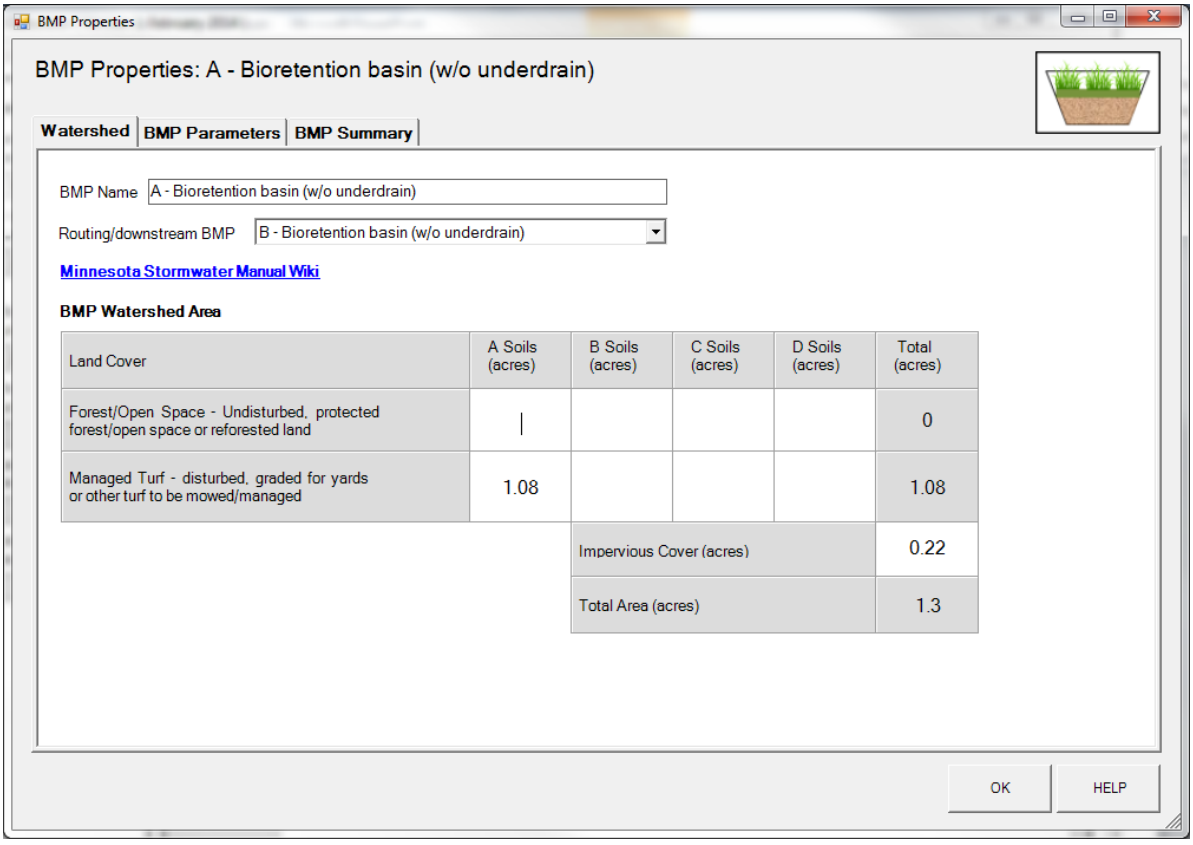
Route BMP A +B +C+D → BMP E

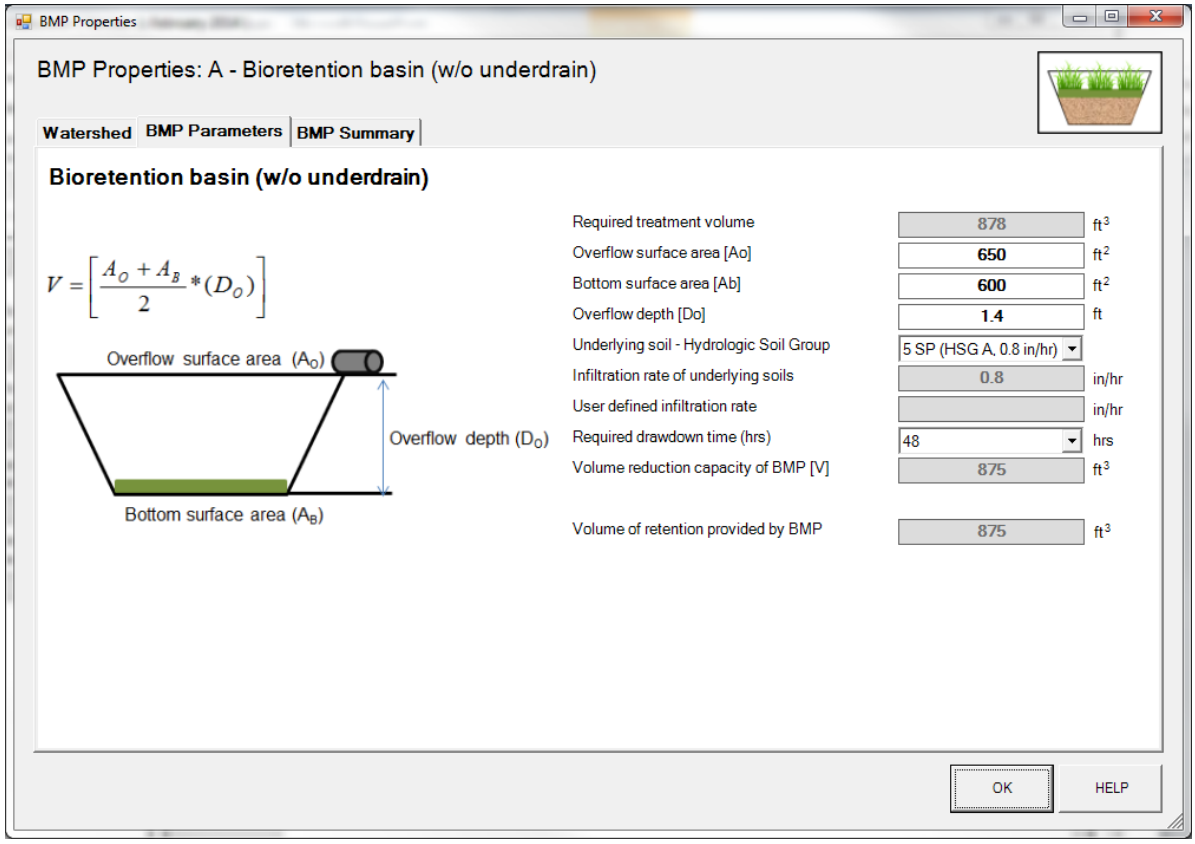
Exercise 4: Step-by-Step Calculator Inputs

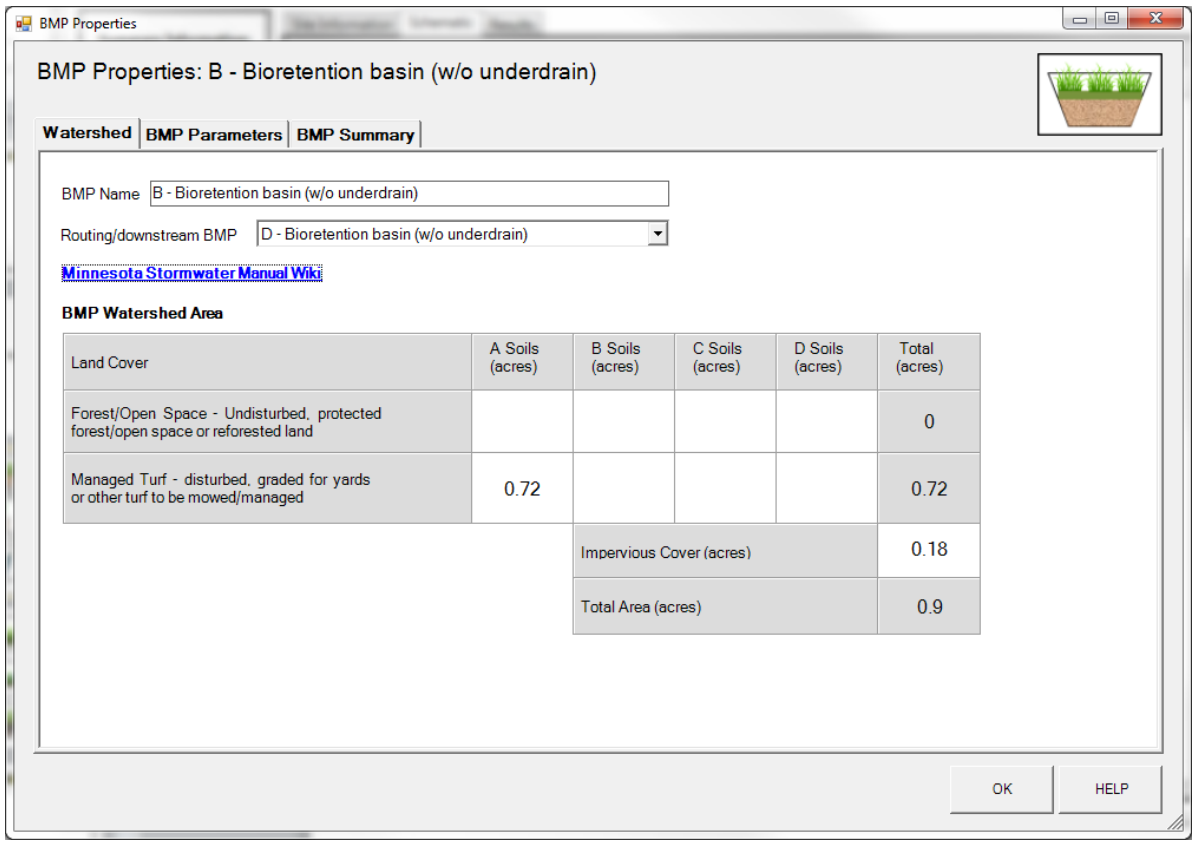
Individual Drainage Areas

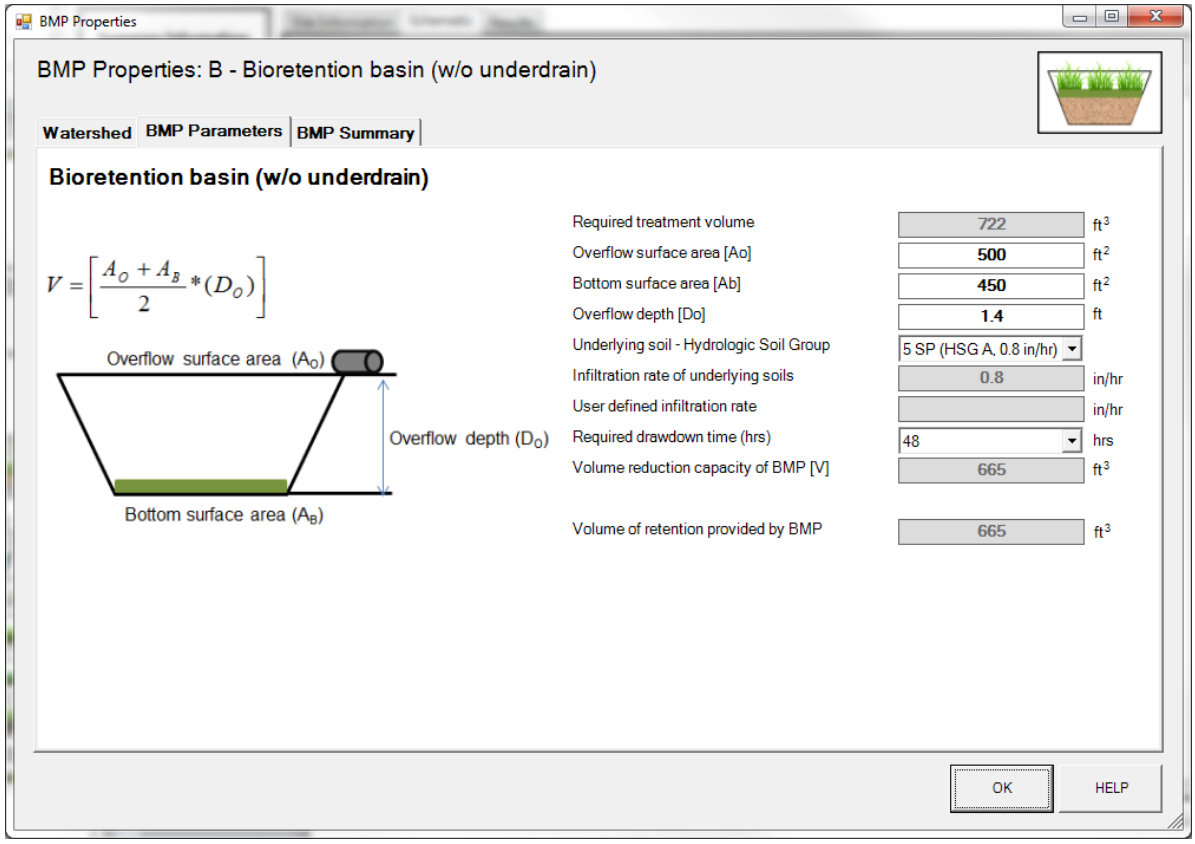


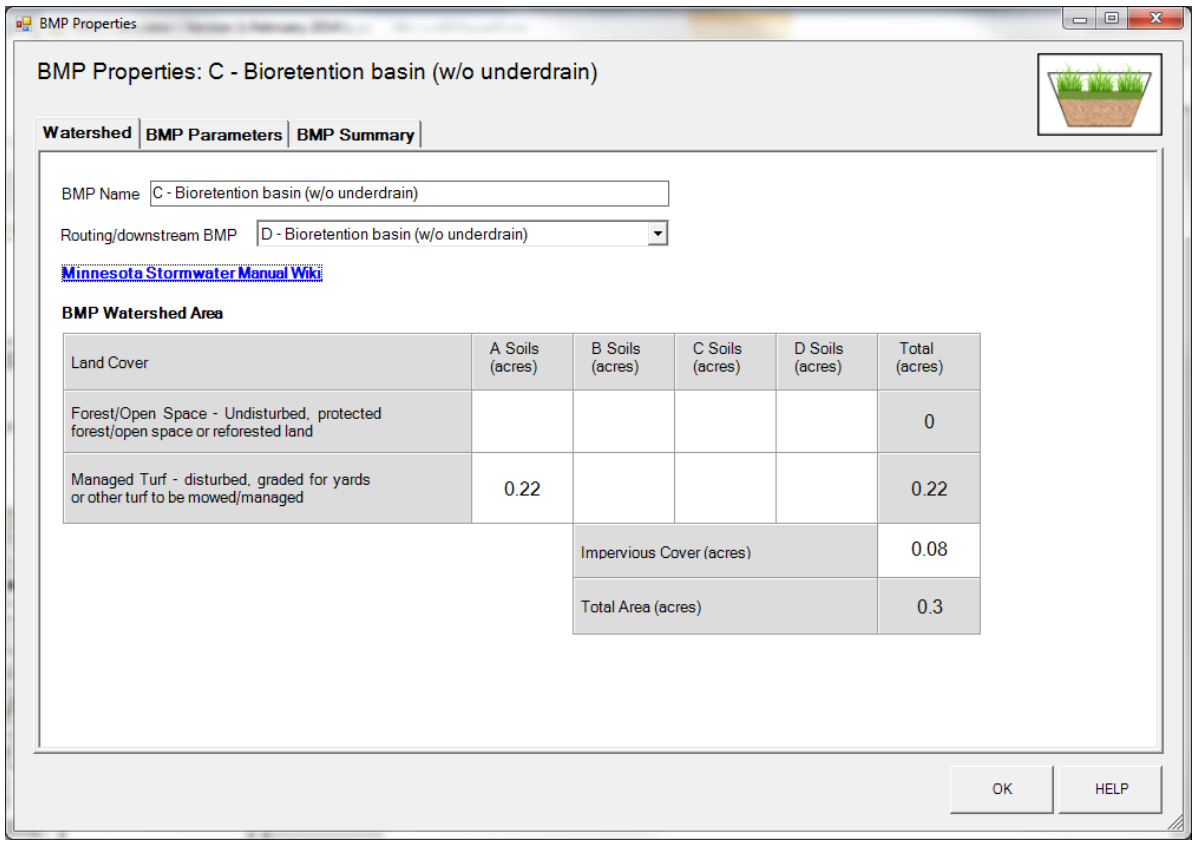

MIDS Calculator (Version 1: February 2014)
File
Summary Information:
Impervious area not routed to a BMP
0.68
acres
Pervious area not routed to a BMP
3.97
acres
Performance goal requirement
2715
ft3
Performance goal reduction achieved
ft3
Percent TP reduction achieved
%
Percent TSS reduction achieved
%
Site Information
Schematic
Results
BMPs
Other
Schematic
1 - Bioretention basin (w/o underdrain)
3 - Bioretention basin (w/o underdrain)
1 - Stormwater pond
2 - Bioretention basin (w/o underdrain)
4 - Bioretention basin (w/o underdrain)

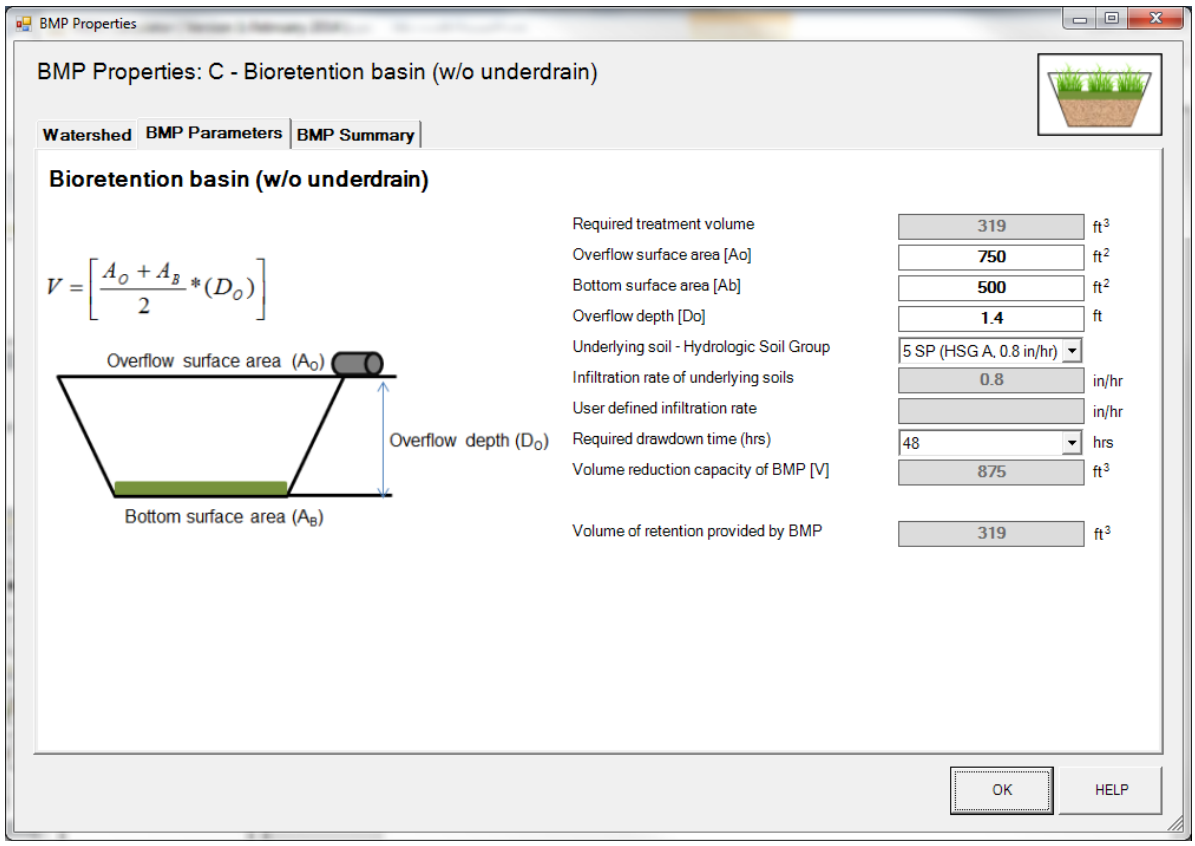

BMP Properties
BMP Properties: A - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
BMP Name
A - Bioretention basin (w/o underdrain)
Routing/downstream BMP
B - Bioretention basin (w/o underdrain)
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
1.08
1.08
Impervious Cover (acres)
0.22
Total Area (acres)
1.3
OK
HELP

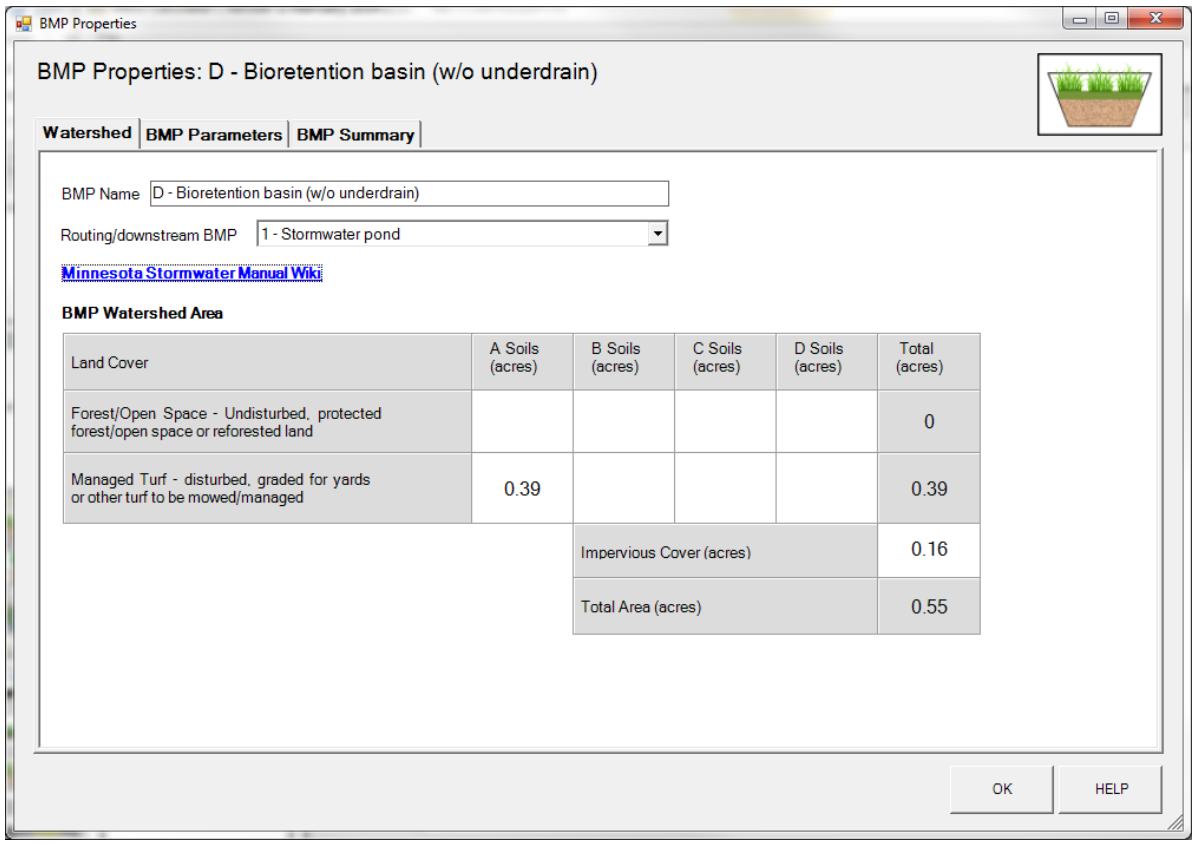

BMP Properties
BMP Properties: A - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
Bioretention basin (w/o underdrain)
$V = \left[\frac{A_O + A_B}{2} * (D_O)\right]$
Overflow surface area (A_O)
Overflow depth (D_O)
Bottom surface area (A_B)
Required treatment volume 878 ft3
Overflow surface area [Ao] 650 ft2
Bottom surface area [Ab] 600 ft2
Overflow depth [Do] 1.4 ft
Underlying soil - Hydrologic Soil Group 5 SP (HSG A, 0.8 in/hr)
Infiltration rate of underlying soils 0.8 in/hr
User defined infiltration rate in/hr
Required drawdown time (hrs) 48 hrs
Volume reduction capacity of BMP [V] 875 ft3
Volume of retention provided by BMP 875 ft3
OK
HELP

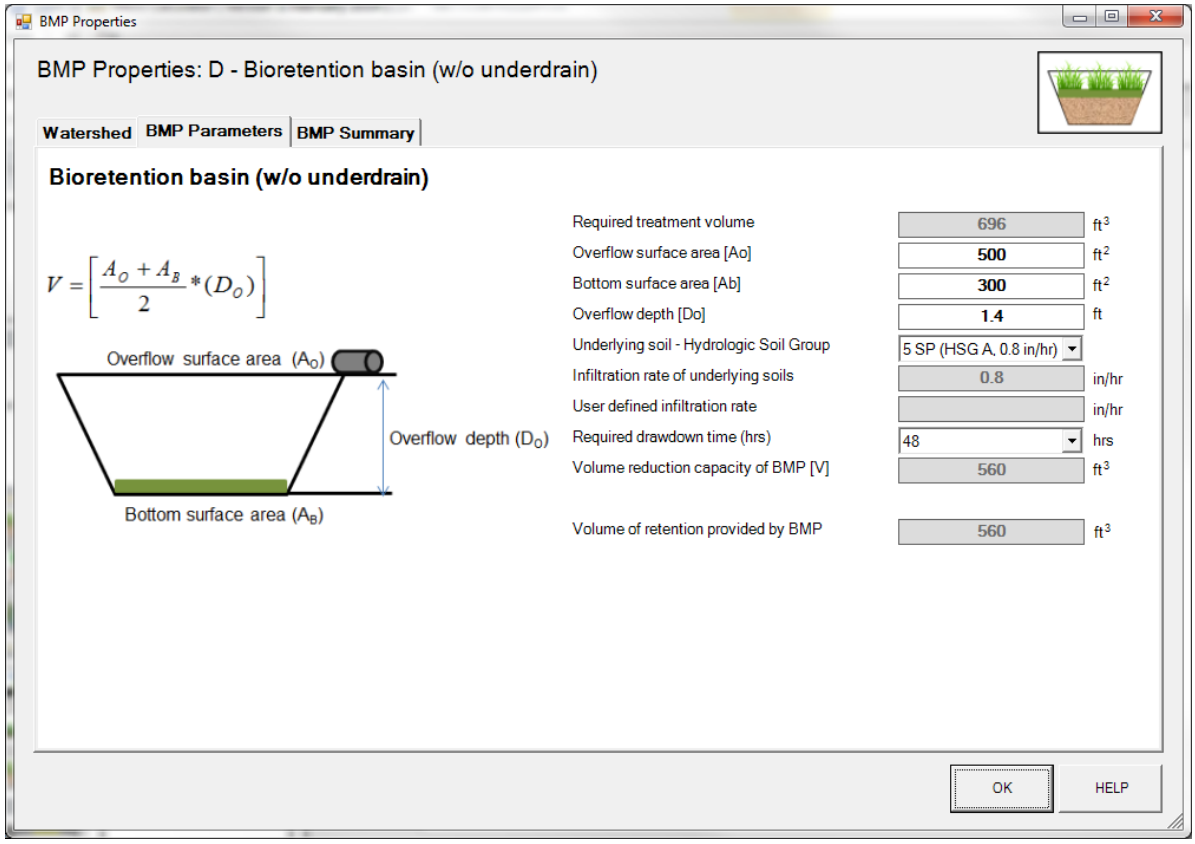

BMP Properties
BMP Properties: B - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
BMP Name B - Bioretention basin (w/o underdrain)
Routing/downstream BMP D - Bioretention basin (w/o underdrain)
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover | A Soils (acres) | B Soils (acres) | C Soils (acres) | D Soils (acres) | Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land | | | | | 0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed | 0.72 | | | | 0.72
Impervious Cover (acres) 0.18
Total Area (acres) 0.9
OK
HELP

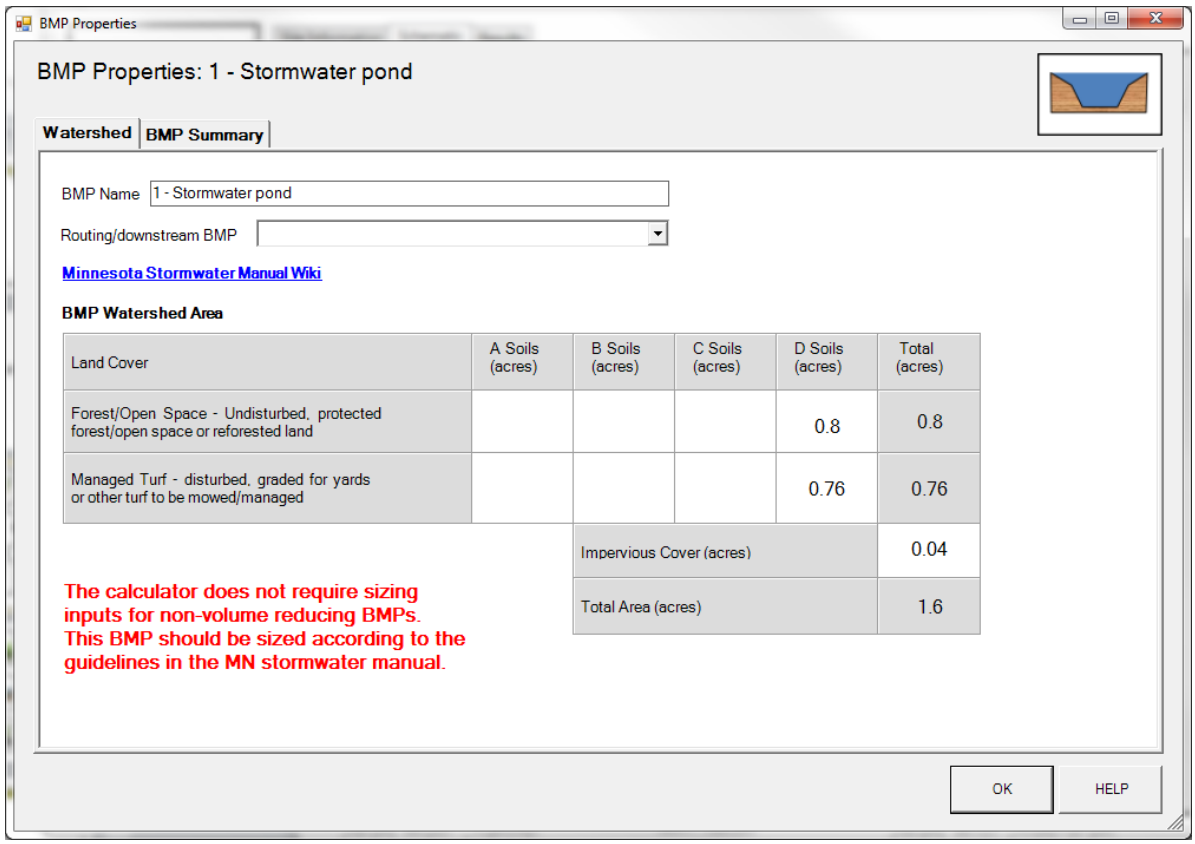

BMP Properties
BMP Properties: B - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
Bioretention basin (w/o underdrain)
$V = \left[\frac{A_O + A_B}{2} * (D_O)\right]$
Overflow surface area (A_O)
Overflow depth (D_O)
Bottom surface area (A_B)
Required treatment volume 722 ft3
Overflow surface area [Ao] 500 ft2
Bottom surface area [Ab] 450 ft2
Overflow depth [Do] 1.4 ft
Underlying soil - Hydrologic Soil Group 5 SP (HSG A, 0.8 in/hr)
Infiltration rate of underlying soils 0.8 in/hr
User defined infiltration rate in/hr
Required drawdown time (hrs) 48 hrs
Volume reduction capacity of BMP [V] 665 ft3
Volume of retention provided by BMP 665 ft3
OK
HELP

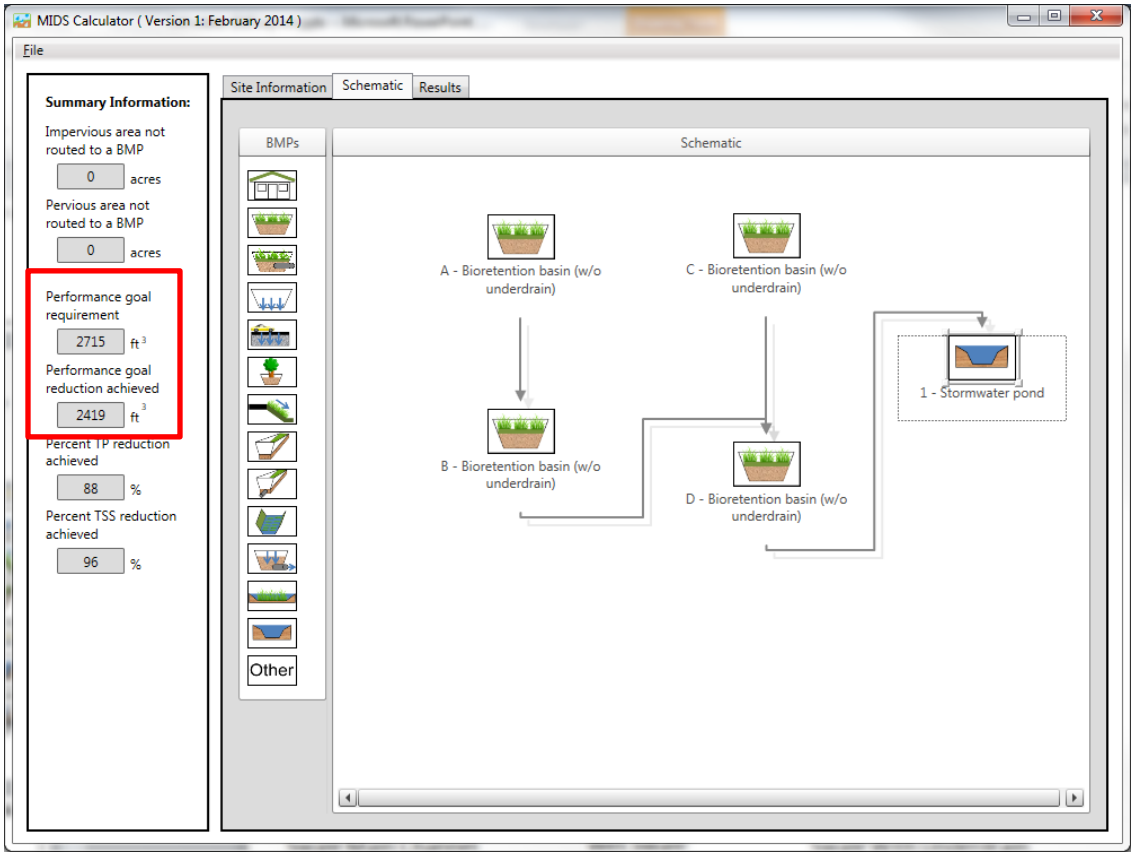

BMP Properties
BMP Properties: C - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
BMP Name C - Bioretention basin (w/o underdrain)
Routing/downstream BMP D - Bioretention basin (w/o underdrain)
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover | A Soils (acres) | B Soils (acres) | C Soils (acres) | D Soils (acres) | Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land | | | | | 0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed | 0.22 | | | | 0.22
Impervious Cover (acres) 0.08
Total Area (acres) 0.3
OK
HELP


BMP Properties
BMP Properties: C - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
Bioretention basin (w/o underdrain)
$V = \left[\frac{A_O + A_B}{2} * (D_O)\right]$
Overflow surface area (A_O)
Overflow depth (D_O)
Bottom surface area (A_B)
Required treatment volume 319 ft3
Overflow surface area [Ao] 750 ft2
Bottom surface area [Ab] 500 ft2
Overflow depth [Do] 1.4 ft
Underlying soil - Hydrologic Soil Group 5 SP (HSG A, 0.8 in/hr)
Infiltration rate of underlying soils 0.8 in/hr
User defined infiltration rate in/hr
Required drawdown time (hrs) 48 hrs
Volume reduction capacity of BMP [V] 875 ft3
Volume of retention provided by BMP 319 ft3
OK
HELP

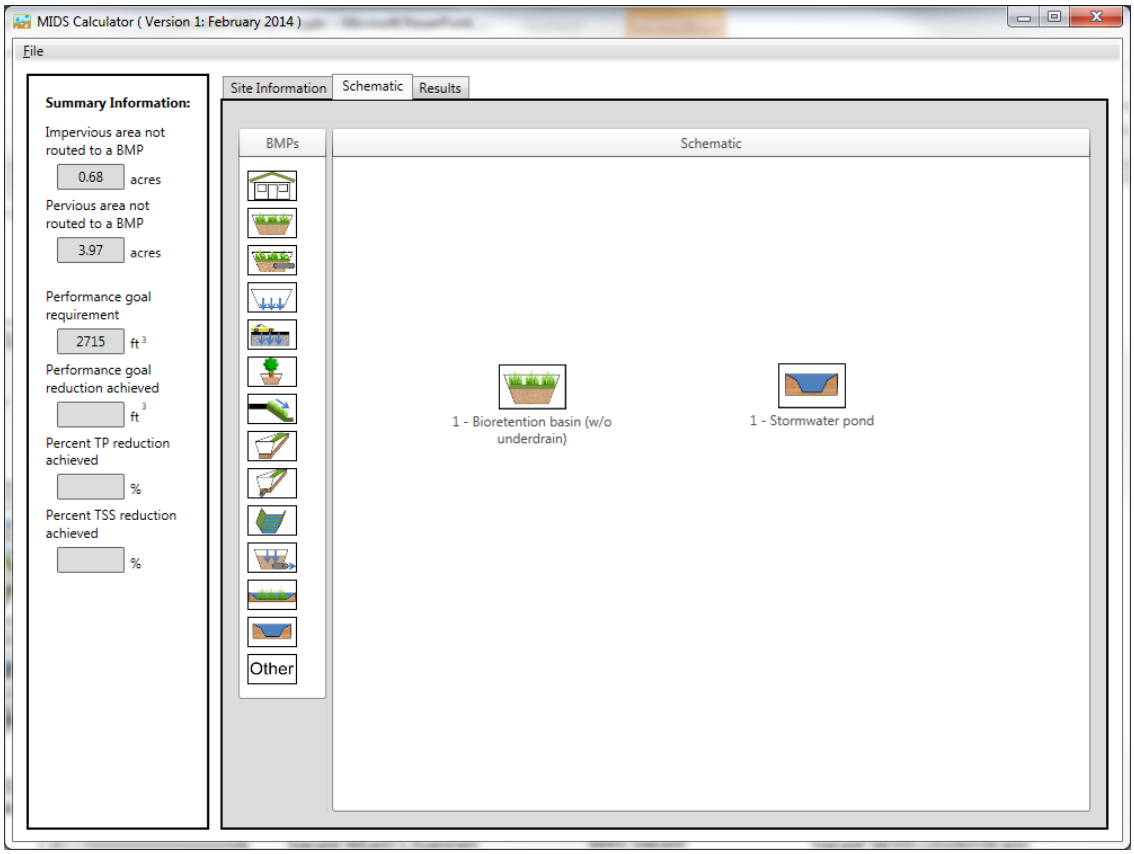

BMP Properties
BMP Properties: D - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
BMP Name D - Bioretention basin (w/o underdrain)
Routing/downstream BMP 1 - Stormwater pond
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover | A Soils (acres) | B Soils (acres) | C Soils (acres) | D Soils (acres) | Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land | | | | | 0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed | 0.39 | | | | 0.39
Impervious Cover (acres) 0.16
Total Area (acres) 0.55
OK
HELP

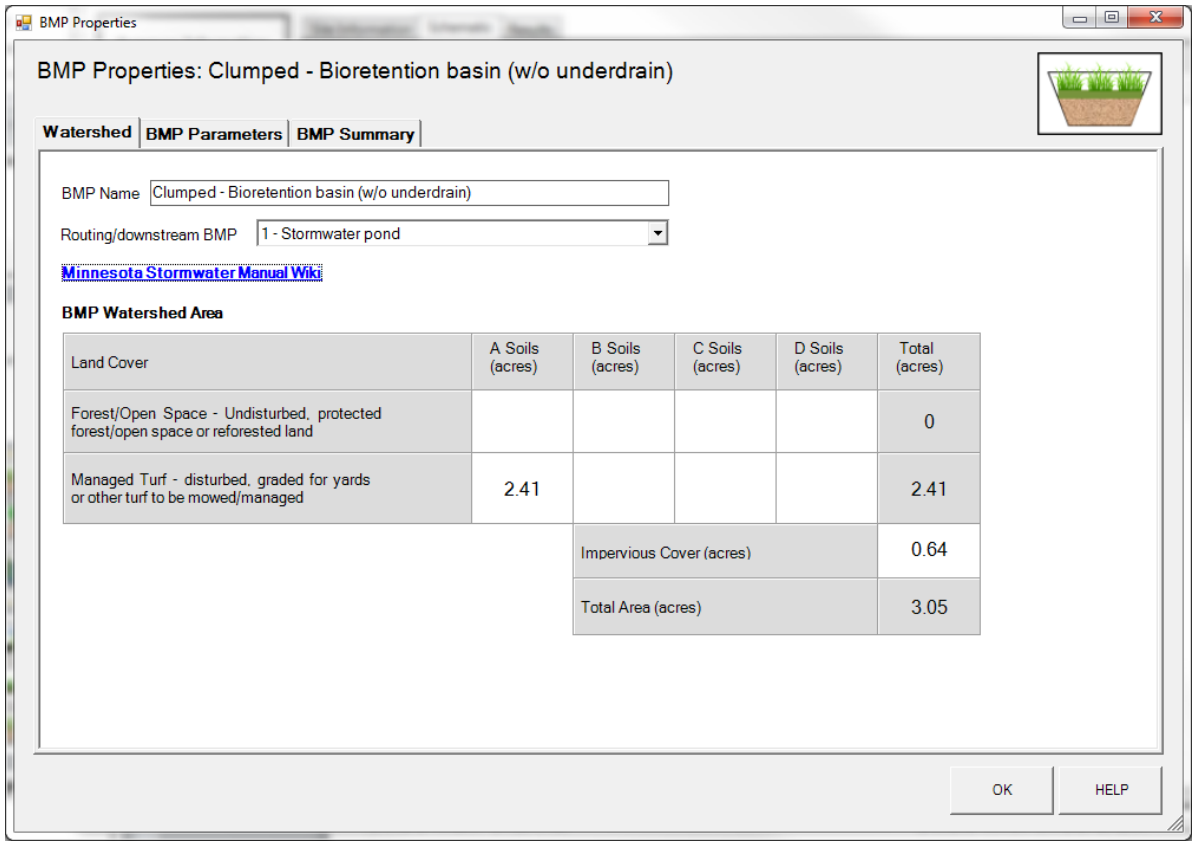

BMP Properties
BMP Properties: D - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
Bioretention basin (w/o underdrain)
$V = \left[\frac{A_O + A_B}{2} * (D_O)\right]$
Overflow surface area (A_O)
Overflow depth (D_O)
Bottom surface area (A_B)
Required treatment volume 696 ft3
Overflow surface area [Ao] 500 ft2
Bottom surface area [Ab] 300 ft2
Overflow depth [Do] 1.4 ft
Underlying soil - Hydrologic Soil Group 5 SP (HSG A, 0.8 in/hr)
Infiltration rate of underlying soils 0.8 in/hr
User defined infiltration rate in/hr
Required drawdown time (hrs) 48 hrs
Volume reduction capacity of BMP [V] 560 ft3
Volume of retention provided by BMP 560 ft3
OK
HELP

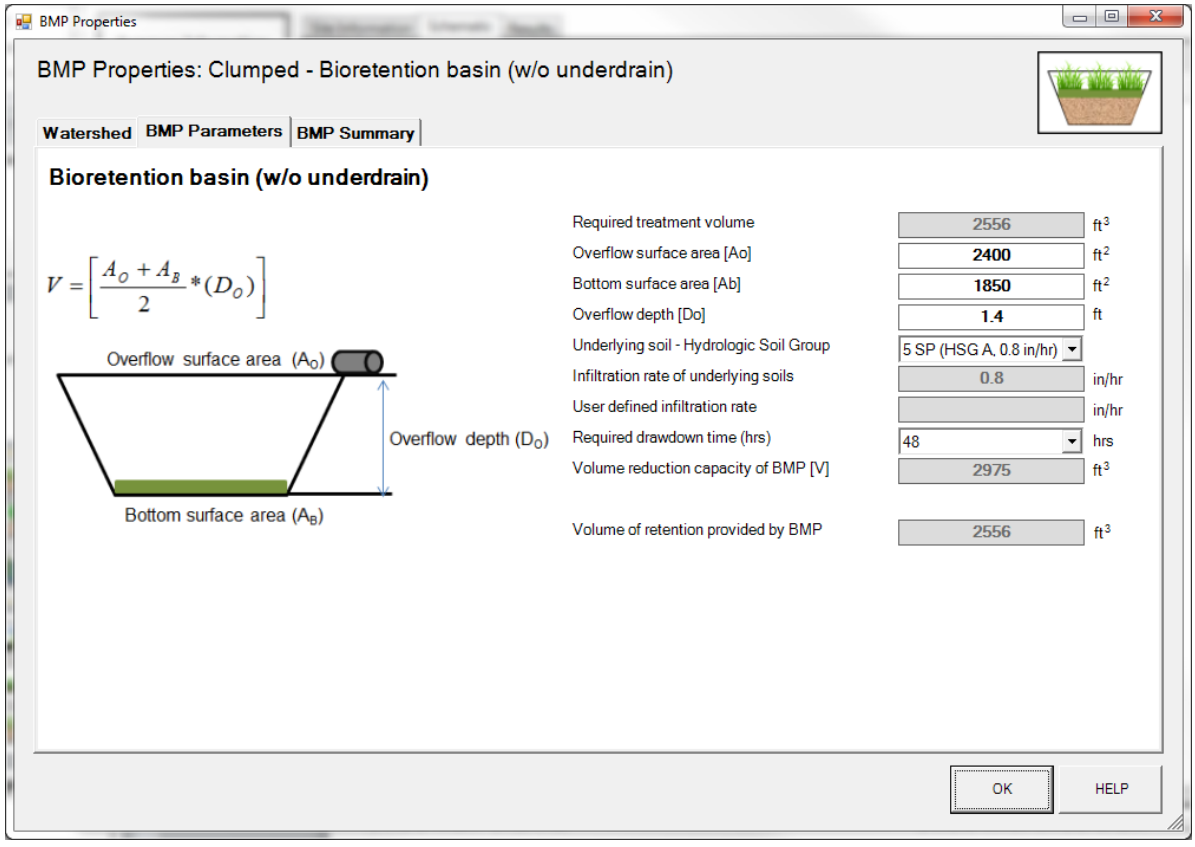

BMP Properties
BMP Properties: 1 - Stormwater pond
Watershed
BMP Summary
BMP Name 1 - Stormwater pond
Routing/downstream BMP
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover | A Soils (acres) | B Soils (acres) | C Soils (acres) | D Soils (acres) | Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land | 0.8 | 0.8
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed | 0.76 | 0.76
Impervious Cover (acres) 0.04
Total Area (acres) 1.6
The calculator does not require sizing inputs for non-volume reducing BMPs. This BMP should be sized according to the guidelines in the MN stormwater manual.
OK
HELP

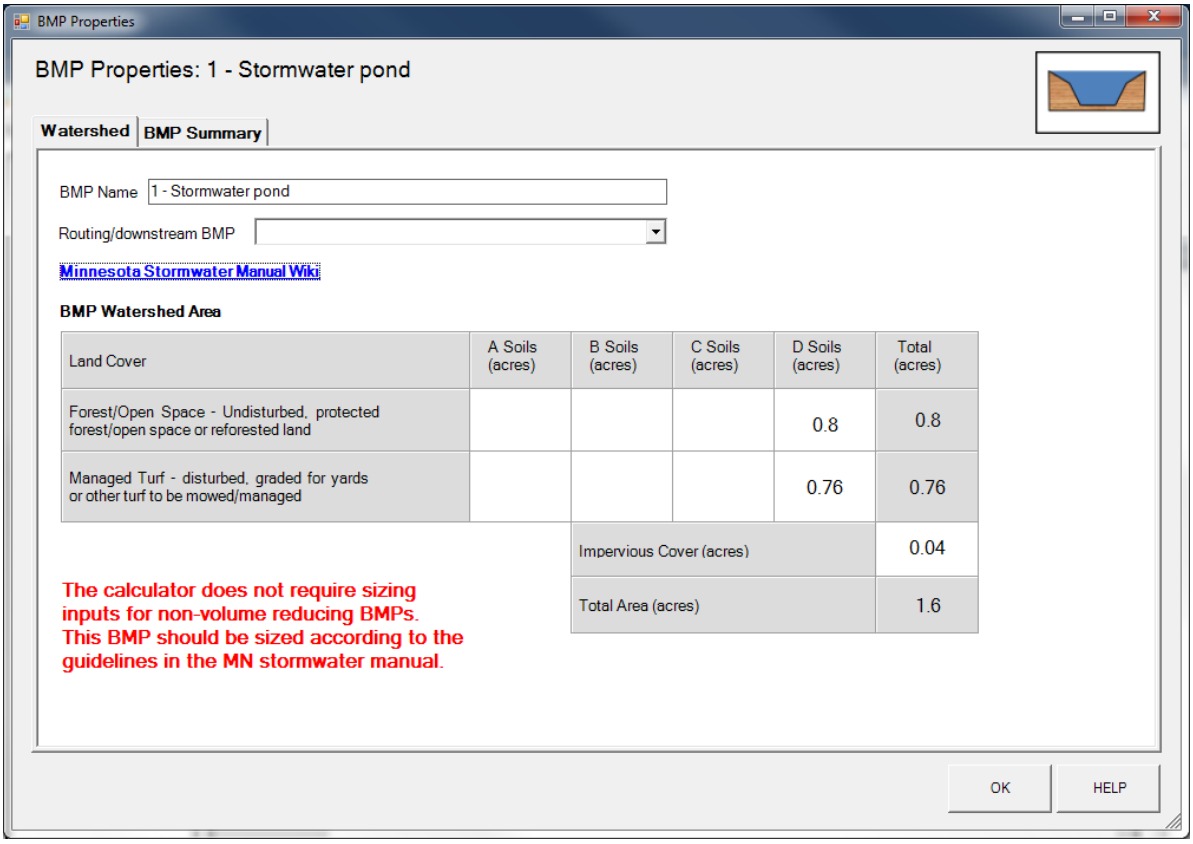

MIDS Calculator (Version 1: February 2014)
File
Summary Information:
Impervious area not routed to a BMP
0
acres
Pervious area not routed to a BMP
0
acres
Performance goal requirement
2715
ft 3
Performance goal reduction achieved
2419
ft 3
Percent TP reduction achieved
88
%
Percent TSS reduction achieved
96
%
Site Information
Schematic
Results
BMPs
Other
Schematic
A - Bioretention basin (w/o underdrain)
C - Bioretention basin (w/o underdrain)
B - Bioretention basin (w/o underdrain)
D - Bioretention basin (w/o underdrain)
1 - Stormwater pond

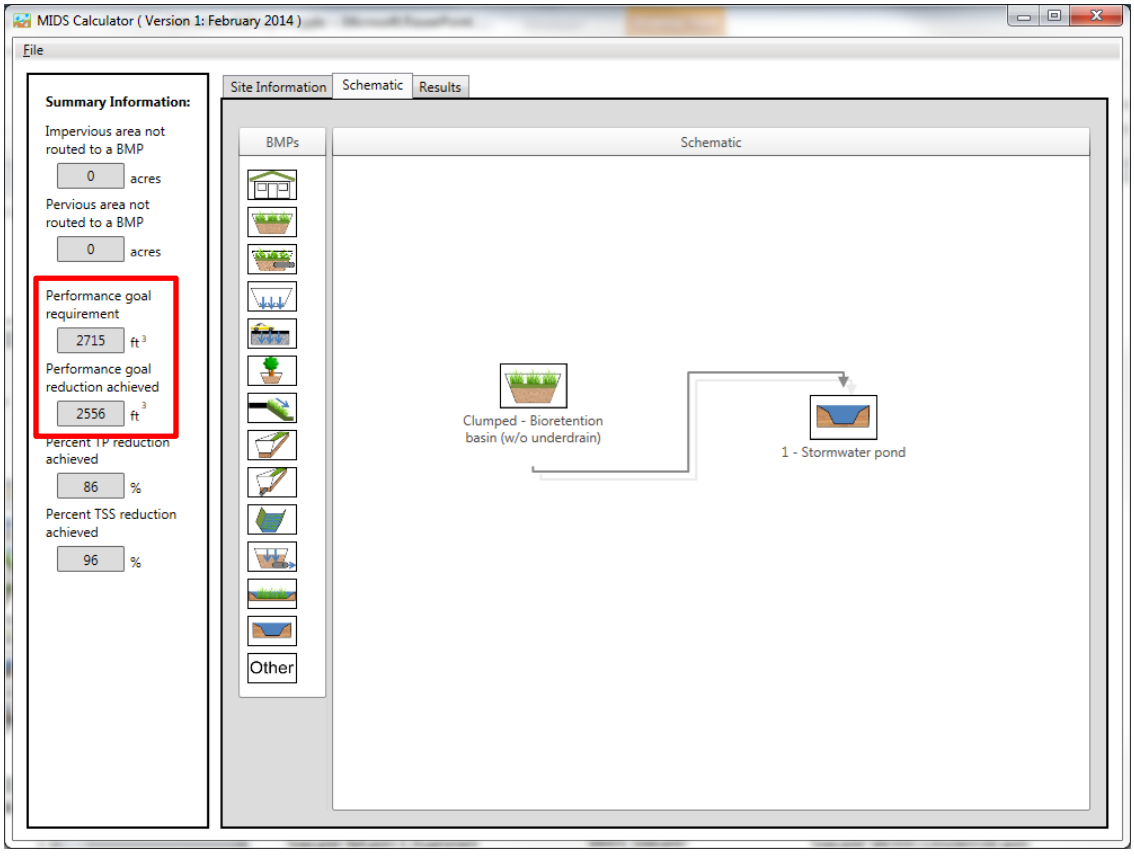
Clumped BMPs




BMP Properties
BMP Properties: Clumped - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
BMP Name
Clumped - Bioretention basin (w/o underdrain)
Routing/downstream BMP
1 - Stormwater pond
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
2.41
2.41
Impervious Cover (acres)
0.64
Total Area (acres)
3.05
OK
HELP


BMP Properties
BMP Properties: Clumped - Bioretention basin (w/o underdrain)
Watershed
BMP Parameters
BMP Summary
Bioretention basin (w/o underdrain)
$V = \left[\frac{A_O + A_B}{2} * (D_O)\right]$
Overflow surface area (A_O)
Overflow depth (D_O)
Bottom surface area (A_B)
Required treatment volume
2556
ft3
Overflow surface area [Ao]
2400
ft2
Bottom surface area [Ab]
1850
ft2
Overflow depth [Do]
1.4
ft
Underlying soil - Hydrologic Soil Group
5 SP (HSG A, 0.8 in/hr)
Infiltration rate of underlying soils
0.8
in/hr
User defined infiltration rate
in/hr
Required drawdown time (hrs)
48
hrs
Volume reduction capacity of BMP [V]
2975
ft3
Volume of retention provided by BMP
2556
ft3
OK
HELP


BMP Properties
BMP Properties: 1 - Stormwater pond
Watershed
BMP Summary
BMP Name 1 - Stormwater pond
Routing/downstream BMP
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0.8
0.8
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
0.76
0.76
Impervious Cover (acres)
0.04
Total Area (acres)
1.6
The calculator does not require sizing inputs for non-volume reducing BMPs. This BMP should be sized according to the guidelines in the MN stormwater manual.
OK
HELP


MIDS Calculator (Version 1: February 2014)
File
Summary Information:
Impervious area not routed to a BMP
0 acres
Pervious area not routed to a BMP
0 acres
Performance goal requirement
2715 ft3
Performance goal reduction achieved
2556 ft3
Percent TP reduction achieved
86 %
Percent TSS reduction achieved
96 %
Site Information
Schematic
Results
BMPs
Other
Schematic
Clumped - Bioretention basin (w/o underdrain)
1 - Stormwater pond

Exercise 4: Answer

Determine the results by calculating bioretention basins with individual drainage areas and as one clumped basin.

Are the results different? Why/why not?

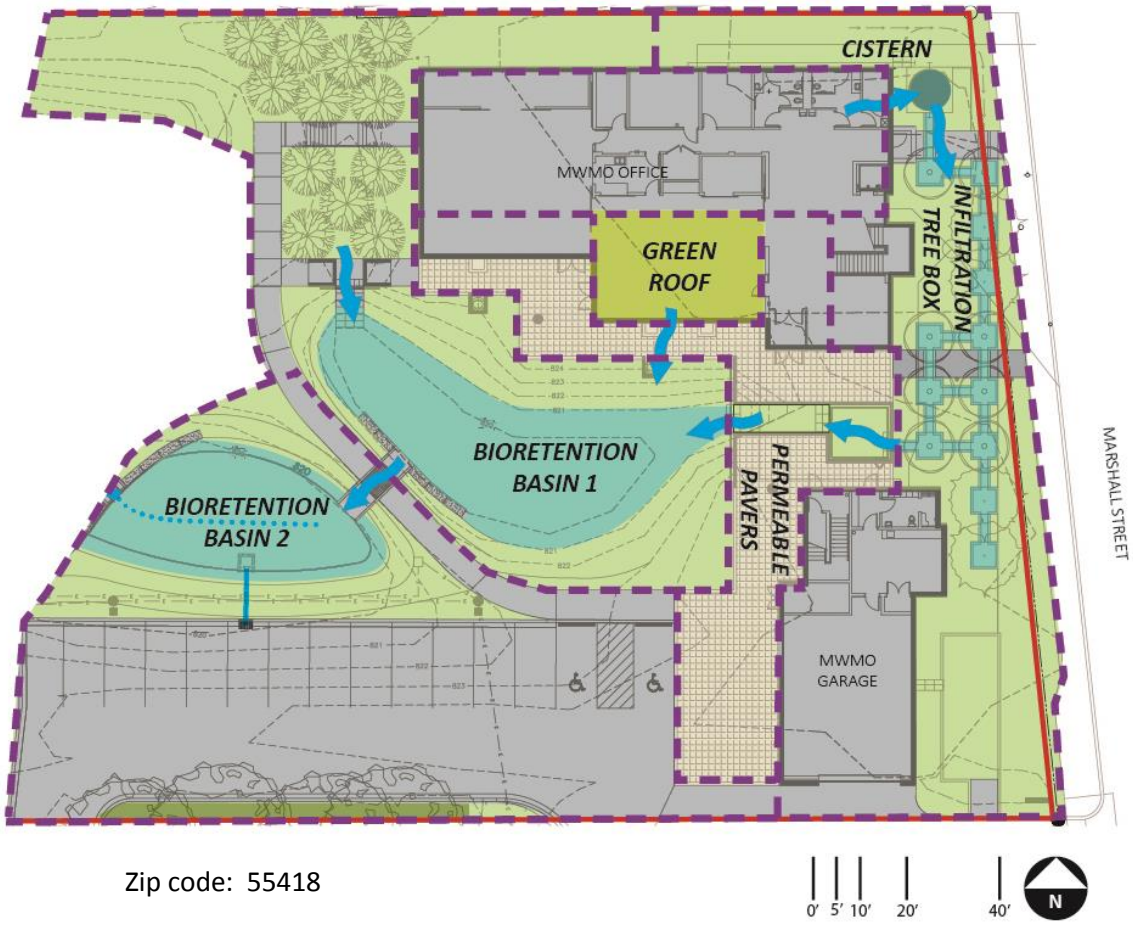
The results are different. Both scenarios require the same volume control treatment—2,715 cubic feet. The "individual" method provides 2,419 cubic feet of retention. The "clumped" method provides 2,556 cubic feet. The results from the two methods differ because in the "individual" method, Basin C is oversized for the Performance Goal, but Basins A, B, and D are undersized. Because Basin C is upstream of the other basins, the excess volume in it cannot be used to treat the excess runoff from the other basins. The "clumped" method is faster for the user to input into the calculator, but it doesn't account for basins that might not receive runoff, such as Basin C (or basins at the top of hills).

Exercise 5: Several BMPs in Series (green roof, permeable pavers, bioretention basins and "other") all in a series

Assignment:

Determine if the site meets the performance goal for new sites without restrictions?

Are any BMPs oversized or undersized?



Zip code: 55418

		Land Cover (acres)			
Watershed	Soil type (HSG)	Turf-disturbed	Forest-undisturbed	Impervious	Total (acres)
Cistern	B	0	0	0.080	0.080
Infiltration Tree Box	B	0.11	0	0.070	0.180
Basin 1	B	0.17	0	0.030	0.200
Green Roof (1)	B	0	0	0.020	0.020
Permeable Pavers (2)	B	0	0	0.080	0.080
Basin 2	B	0.09	0	0.150	0.240
Total		0.37	0	0.430	0.800

Notes:

(1) For "Site Information", Green roof area is considered impervious area. 4" media depth. Entire watershed is a green roof (871 sf)

(2) For "site Information", Permeable pavers are considered impervious area. 2,614 sf of pavers with 870 sf of roof draining onto the pavers

Watershed	BMP Description	Surface Area at Overflow (ft^2)	Surface Area at Media Surface (ft^2)	Surface Area at Underdrain (ft^2)	Bottom surface Area (ft^2)	Overflow Depth (ft)	Total Media Depth (ft)	Depth Below Underdrain (ft)
Cistern (1)	"Other" 10 ft. high, 500 ft^3	50	NA	NA	50	10	NA	NA
Infiltration Tree Box (2)	Infiltration Trench/Tree Box	562	562	NA	562	0.2	1.0	NA
Basin 1	Bioretention basin (w/o underdrain)	2200	NA	NA	1282	1	NA	NA
Green Roof (3)	Green Roof - 4 inch media depth	NA	NA	NA	NA	NA	NA	NA
Permeable Pavers (4)	Permeable Pavement	2614	NA	NA	2614	NA	NA	1.0
Basin 2 (5)	Bioretention basin (with elevated underdrain)	1546	1150	1100	1000	1	3.0	1.3

Notes:

(1) Assume 80% of annual runoff retained and used between storm events

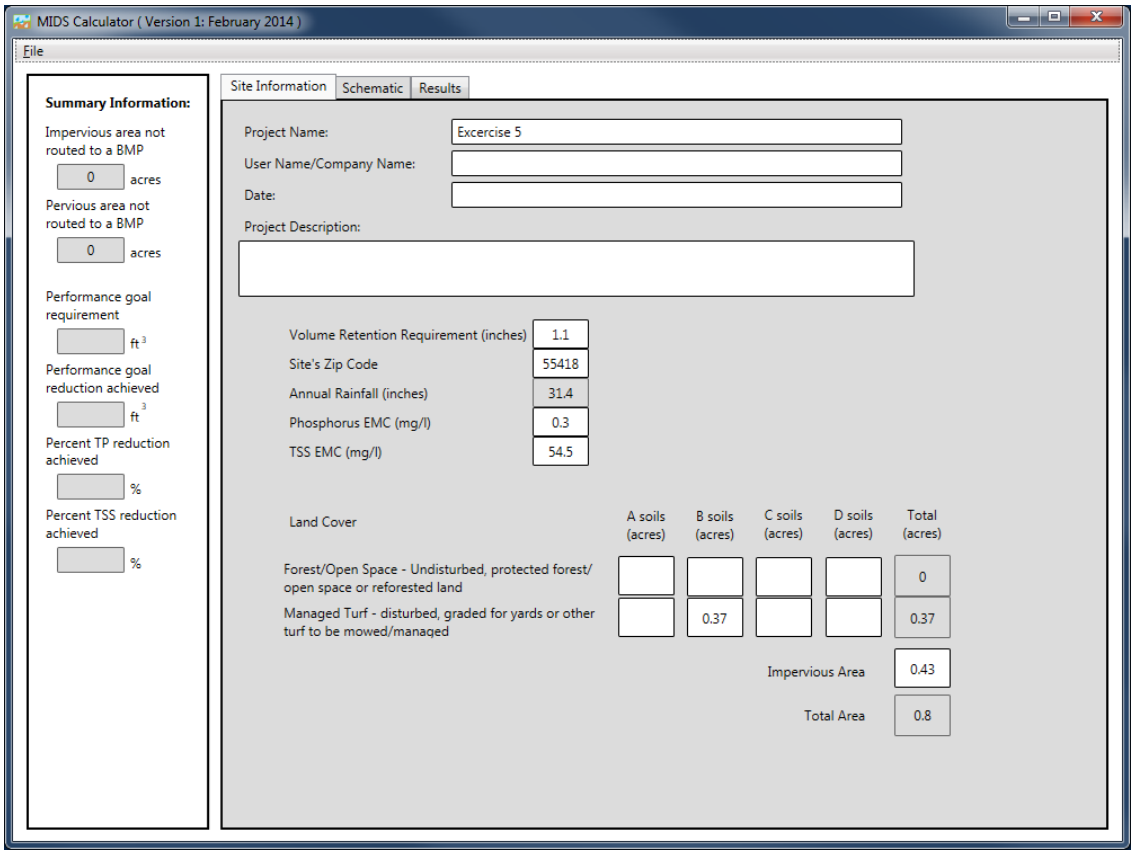
(2) Media porosity = 0.30. 5'x5' concrete walls connected by 7 ft x 1.5ft rills. Compacted A soil below walls acts like B soil

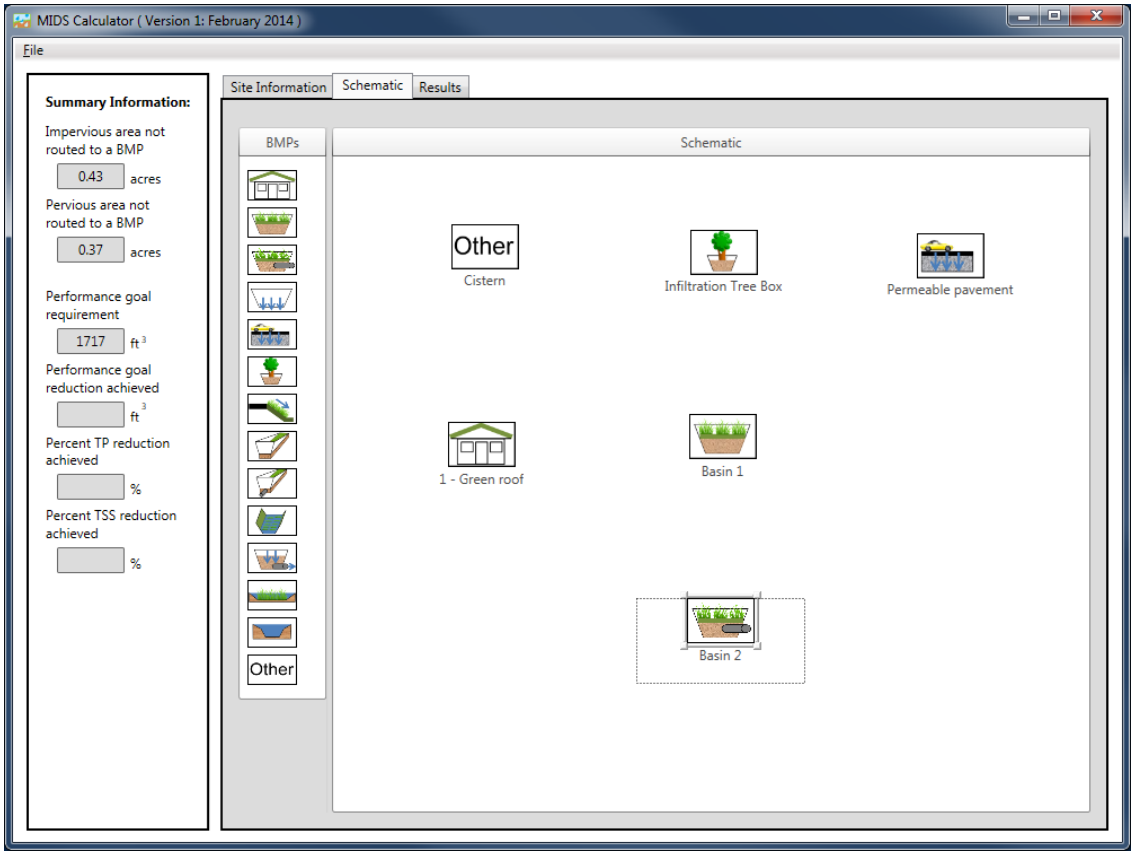
(3) For "Site Information", Green roof area is considered impervious area. 4" media depth. Entire watershed is a green roof

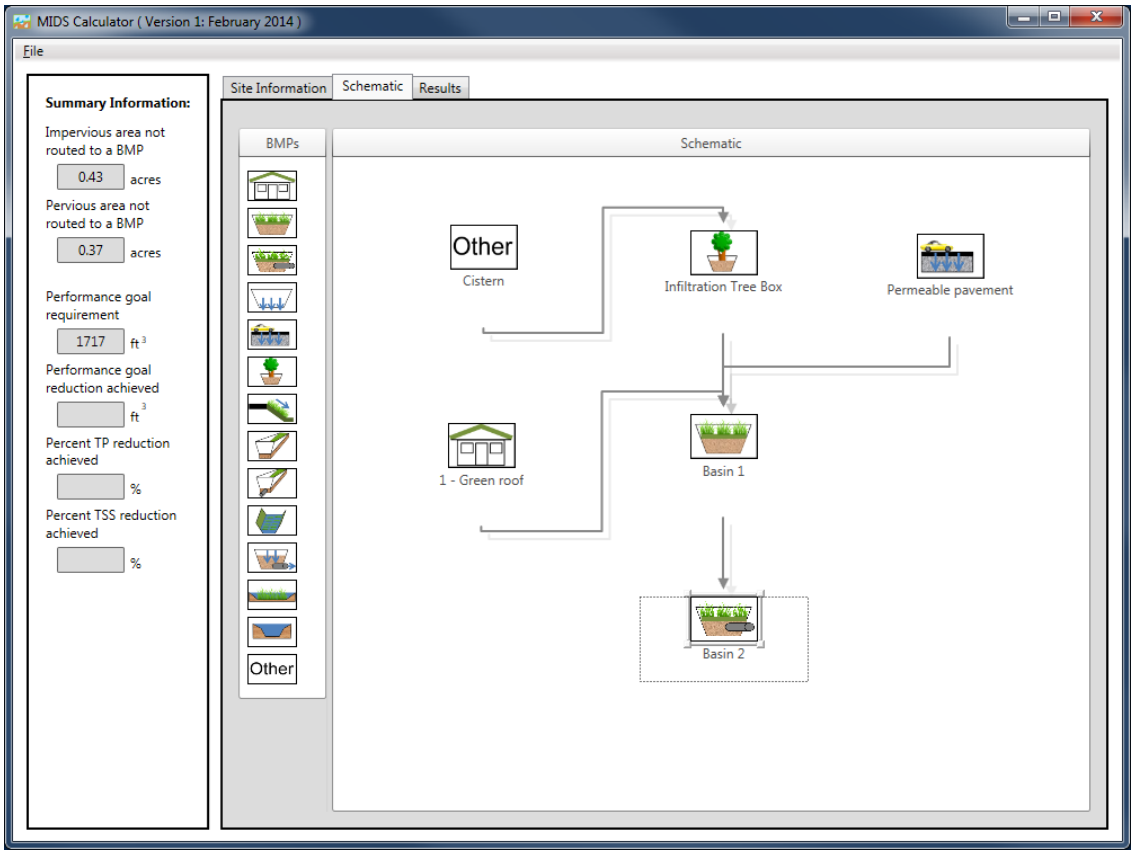
(4) For "Site Information", Permeable pavers are considered impervious area. 2,614 sf of pavers with 871 sf of roof draining onto the pavers. Media Porosity=0.40

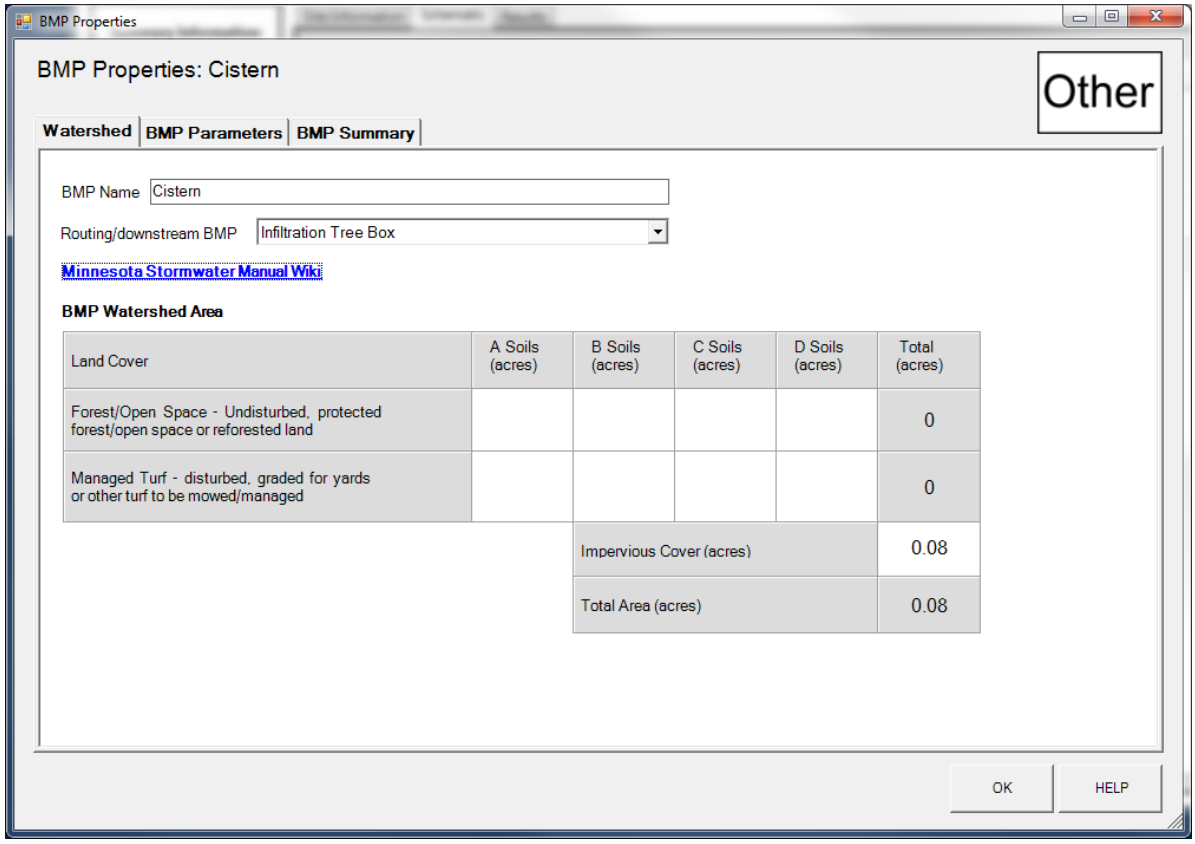
(5) Media field capacity = 0.15. Media porosity = 0.40. Planting media mix = C, P content of media is less than 30 kg/mg, and no soil amendments have been added

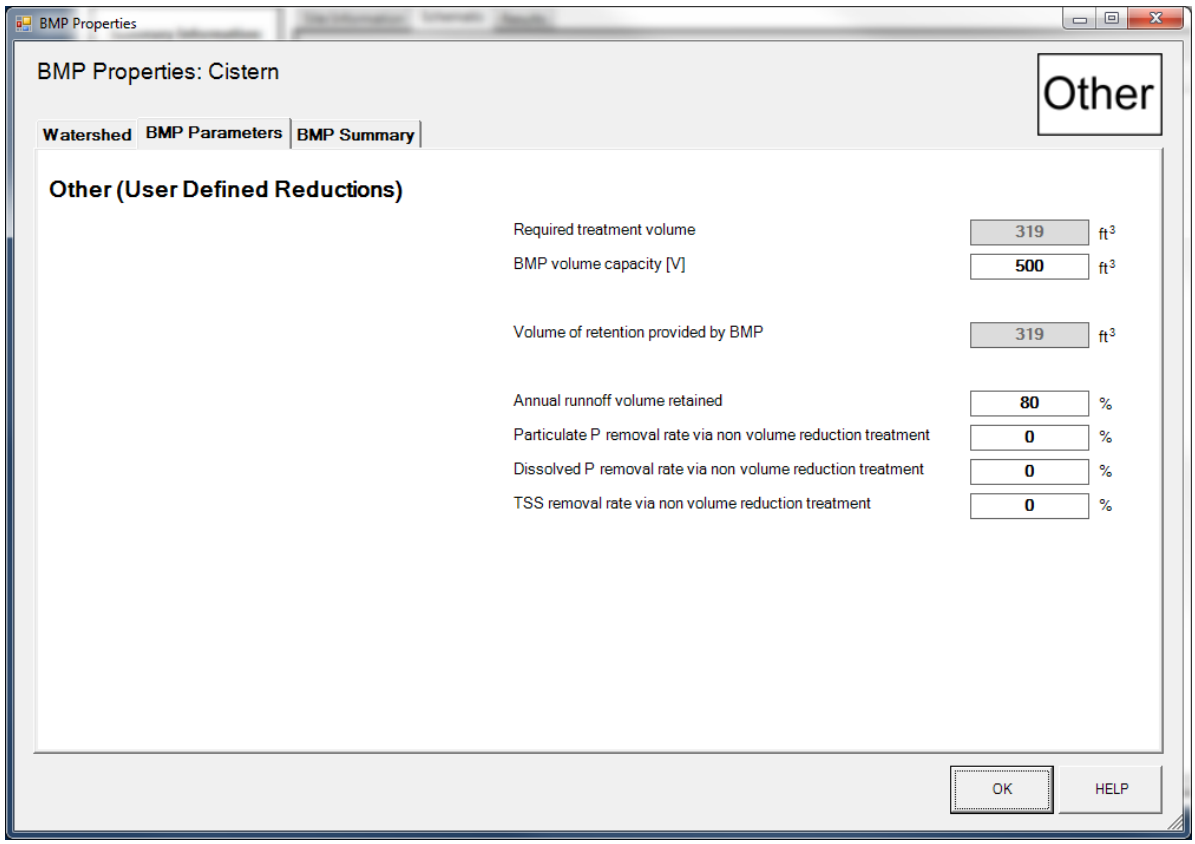
Exercise 5: Step-by-Step Calculator Inputs

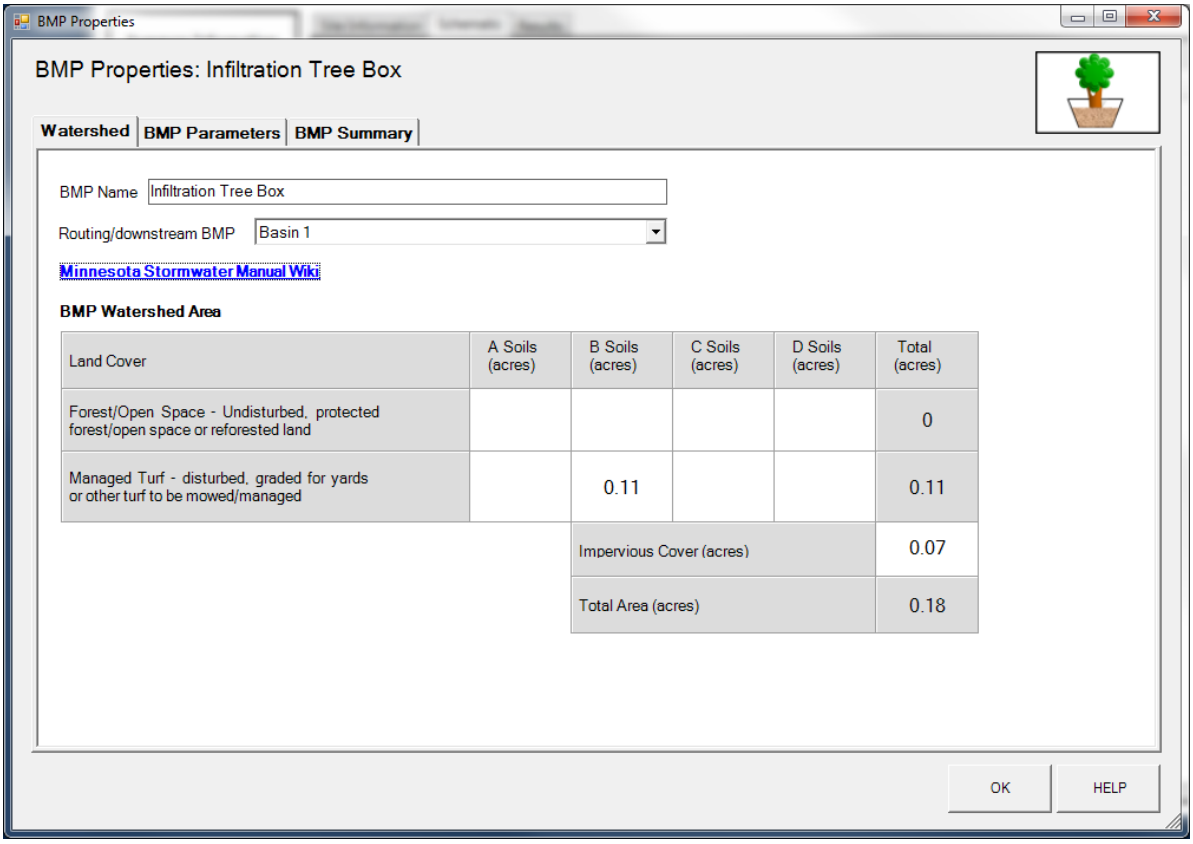


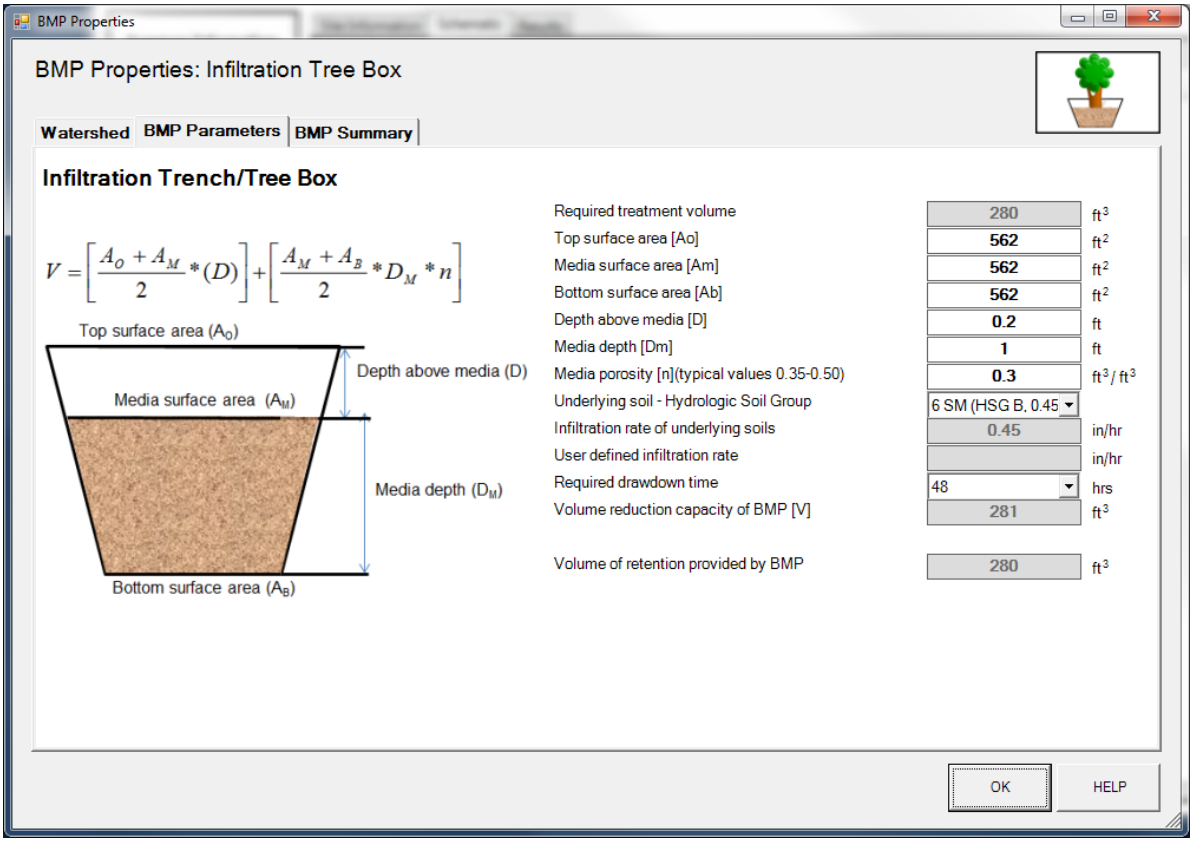

MIDS Calculator (Version 1: February 2014)
File
Summary Information:
Impervious area not routed to a BMP
0.43 acres
Pervious area not routed to a BMP
0.37 acres
Performance goal requirement
1717 ft3
Performance goal reduction achieved
ft3
Percent TP reduction achieved
%
Percent TSS reduction achieved
%
Site Information
Schematic
Results
BMPs
Other
Schematic
Other
Cistern
Infiltration Tree Box
Permeable pavement
1 - Green roof
Basin 1
Basin 2

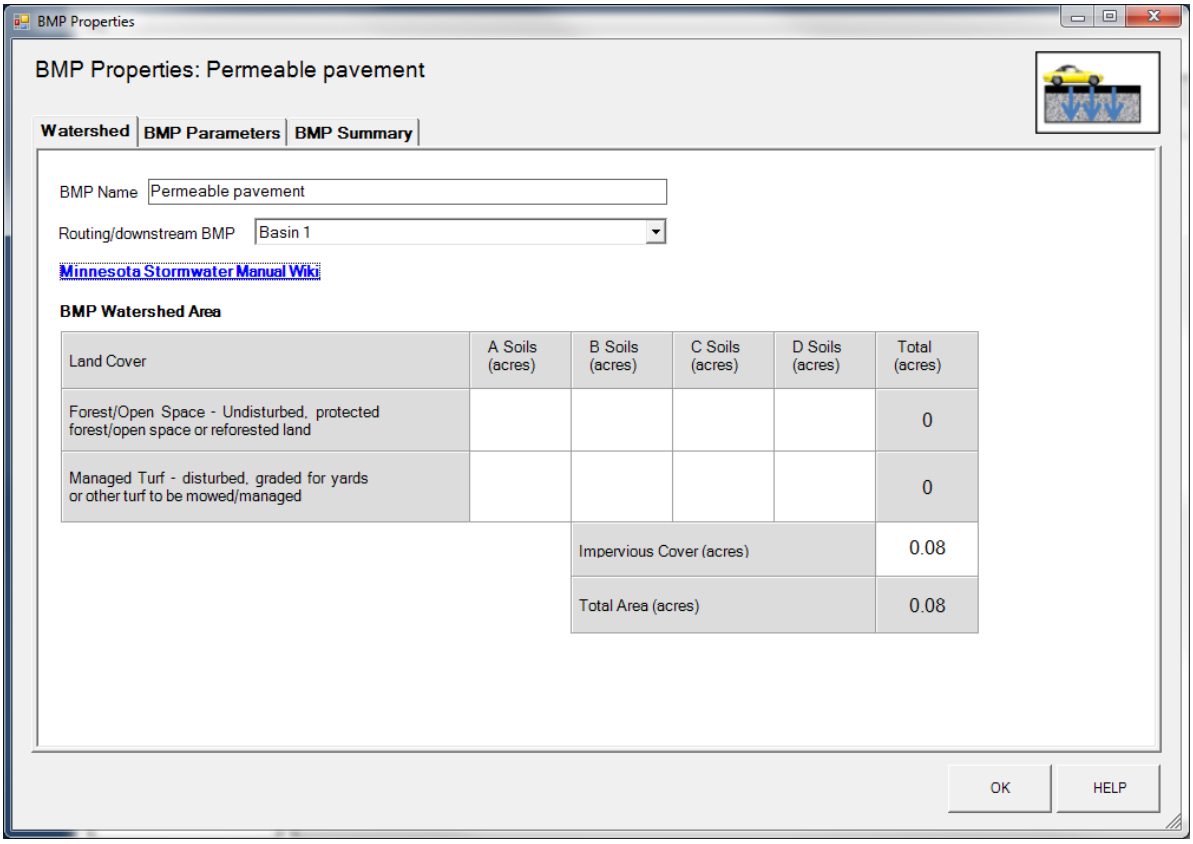

MIDS Calculator (Version 1: February 2014)
File
Summary Information:
Impervious area not routed to a BMP
0.43 acres
Pervious area not routed to a BMP
0.37 acres
Performance goal requirement
1717 ft3
Performance goal reduction achieved
ft3
Percent TP reduction achieved
%
Percent TSS reduction achieved
%
Site Information
Schematic
Results
BMPs
Other
Schematic
Other
Cistern
Infiltration Tree Box
Permeable pavement
1 - Green roof
Basin 1
Basin 2

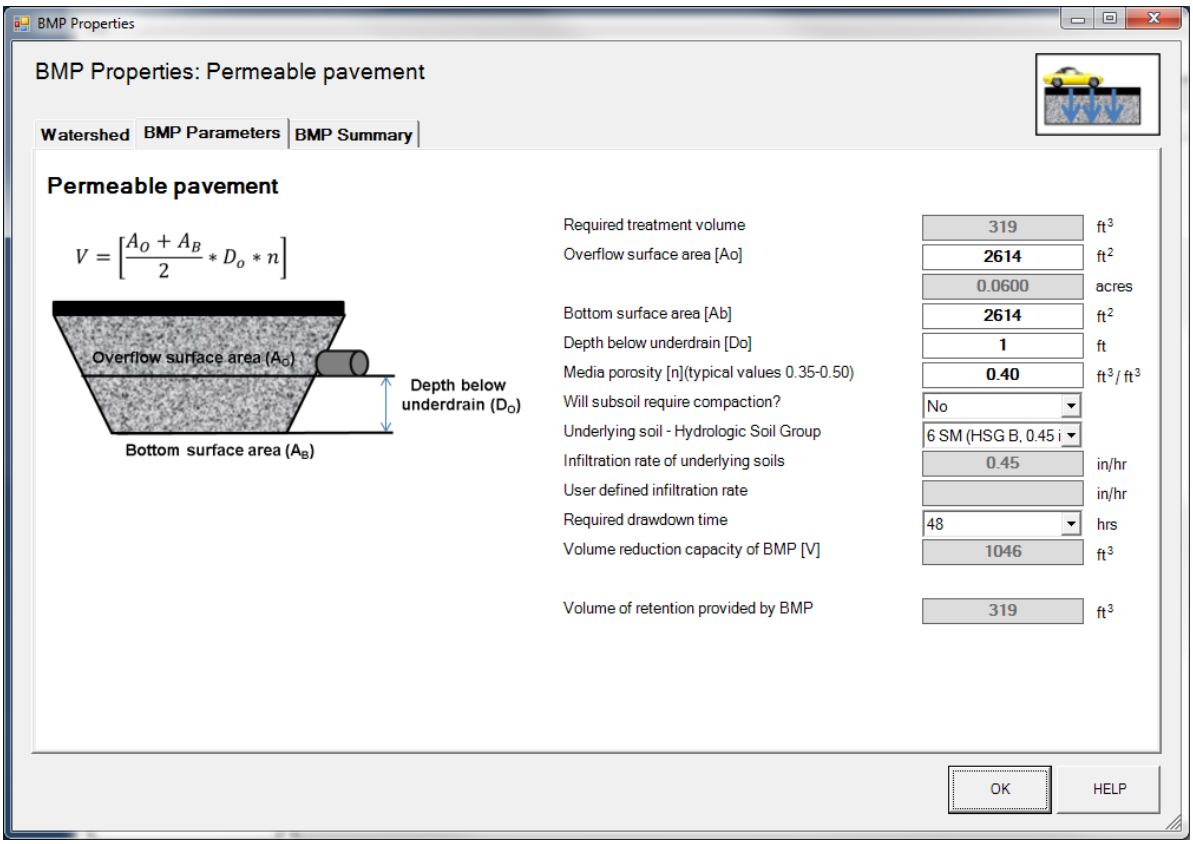

BMP Properties
BMP Properties: Cistern
Other
Watershed
BMP Parameters
BMP Summary
BMP Name
Cistern
Routing/downstream BMP
Infiltration Tree Box
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
0
Impervious Cover (acres)
0.08
Total Area (acres)
0.08
OK
HELP

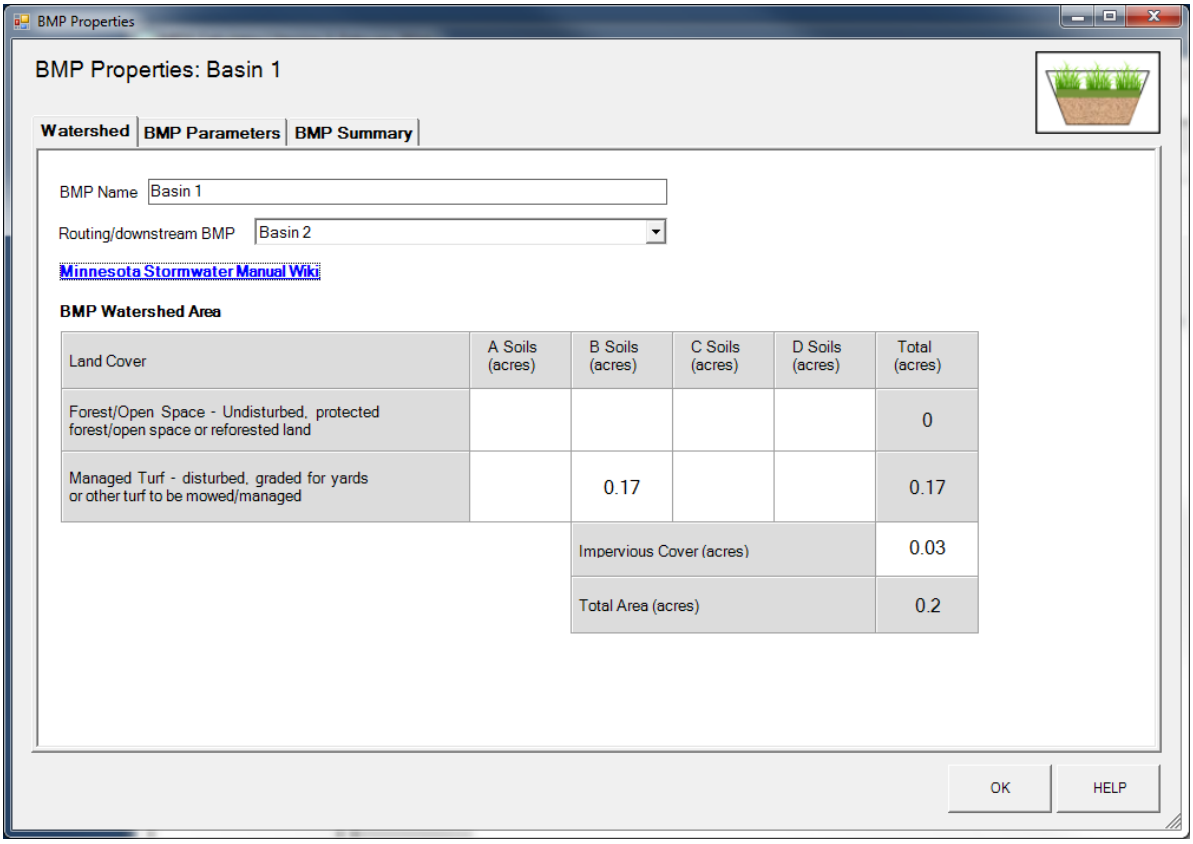

BMP Properties
BMP Properties: Cistern
Other
Watershed
BMP Parameters
BMP Summary
Other (User Defined Reductions)
Required treatment volume
319
ft3
BMP volume capacity [V]
500
ft3
Volume of retention provided by BMP
319
ft3
Annual runnoff volume retained
80
%
Particulate P removal rate via non volume reduction treatment
0
%
Dissolved P removal rate via non volume reduction treatment
0
%
TSS removal rate via non volume reduction treatment
0
%
OK
HELP

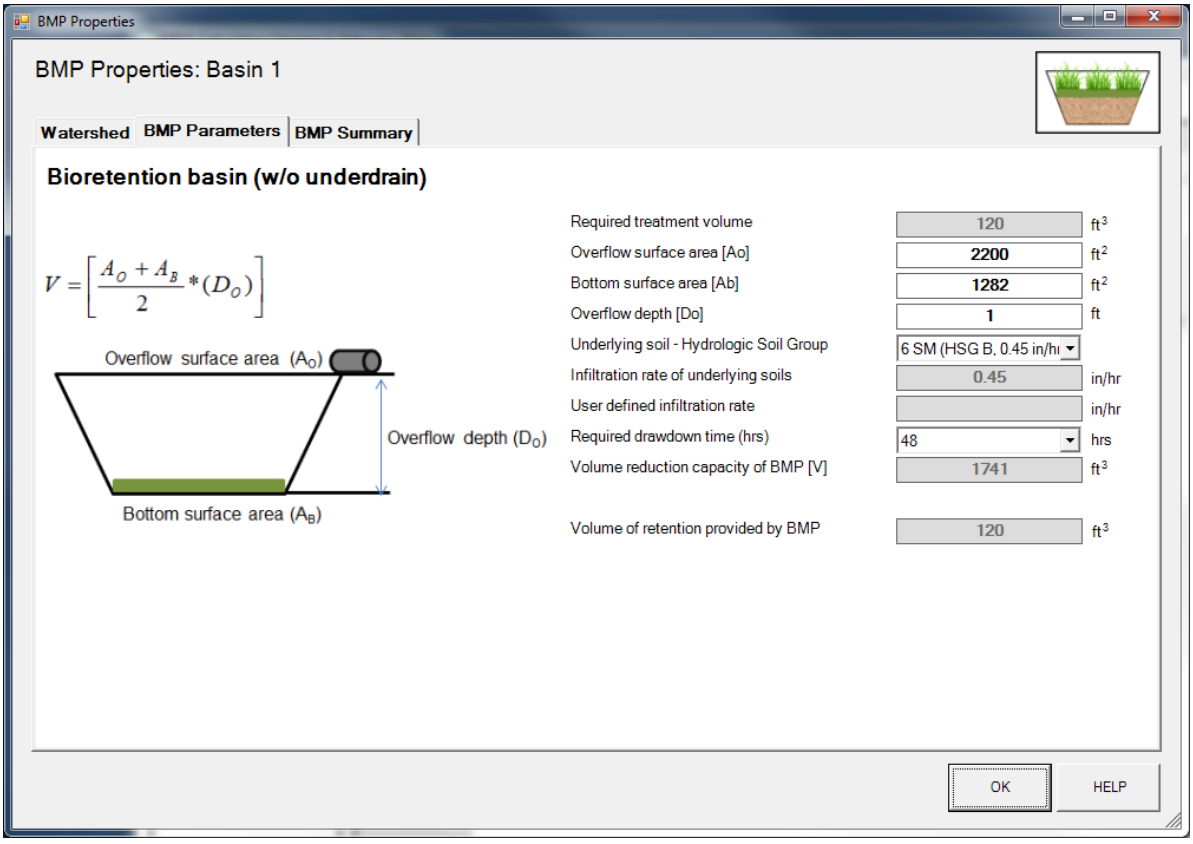

BMP Properties
BMP Properties: Infiltration Tree Box
Watershed
BMP Parameters
BMP Summary
BMP Name
Infiltration Tree Box
Routing/downstream BMP
Basin 1
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
0.11
0.11
Impervious Cover (acres)
0.07
Total Area (acres)
0.18
OK
HELP

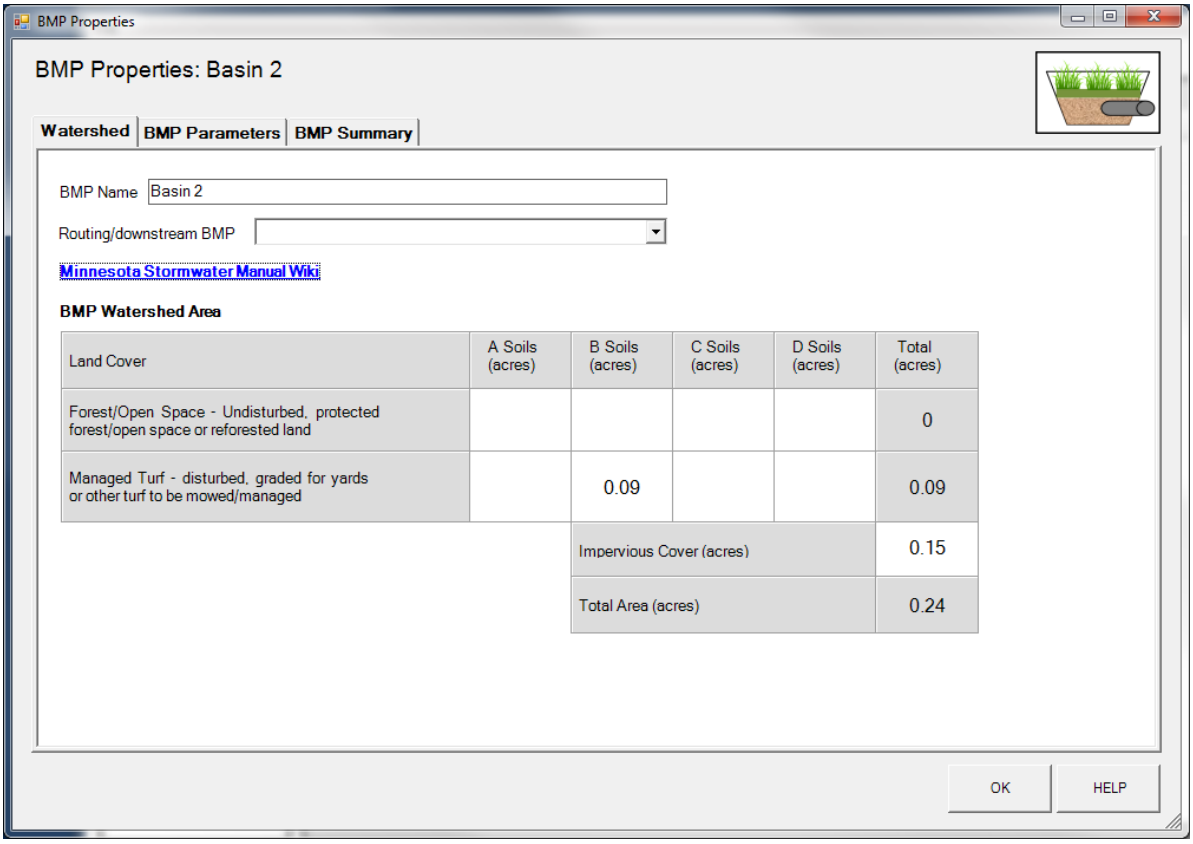

BMP Properties
BMP Properties: Infiltration Tree Box
Watershed
BMP Parameters
BMP Summary
Infiltration Trench/Tree Box
$V = \left[\frac{A_O + A_M}{2} * (D)\right] + \left[\frac{A_M + A_B}{2} * D_M * n\right]$
Top surface area (A_O)
Depth above media (D)
Media surface area (A_M)
Media depth (D_M)
Bottom surface area (A_B)
Required treatment volume
280
ft3
Top surface area [Ao]
562
ft2
Media surface area [Am]
562
ft2
Bottom surface area [Ab]
562
ft2
Depth above media [D]
0.2
ft
Media depth [Dm]
1
ft
Media porosity [n](typical values 0.35-0.50)
0.3
ft3 / ft3
Underlying soil - Hydrologic Soil Group
6 SM (HSG B, 0.45
Infiltration rate of underlying soils
0.45
in/hr
User defined infiltration rate
in/hr
Required drawdown time
48
hrs
Volume reduction capacity of BMP [V]
281
ft3
Volume of retention provided by BMP
280
ft3
OK
HELP

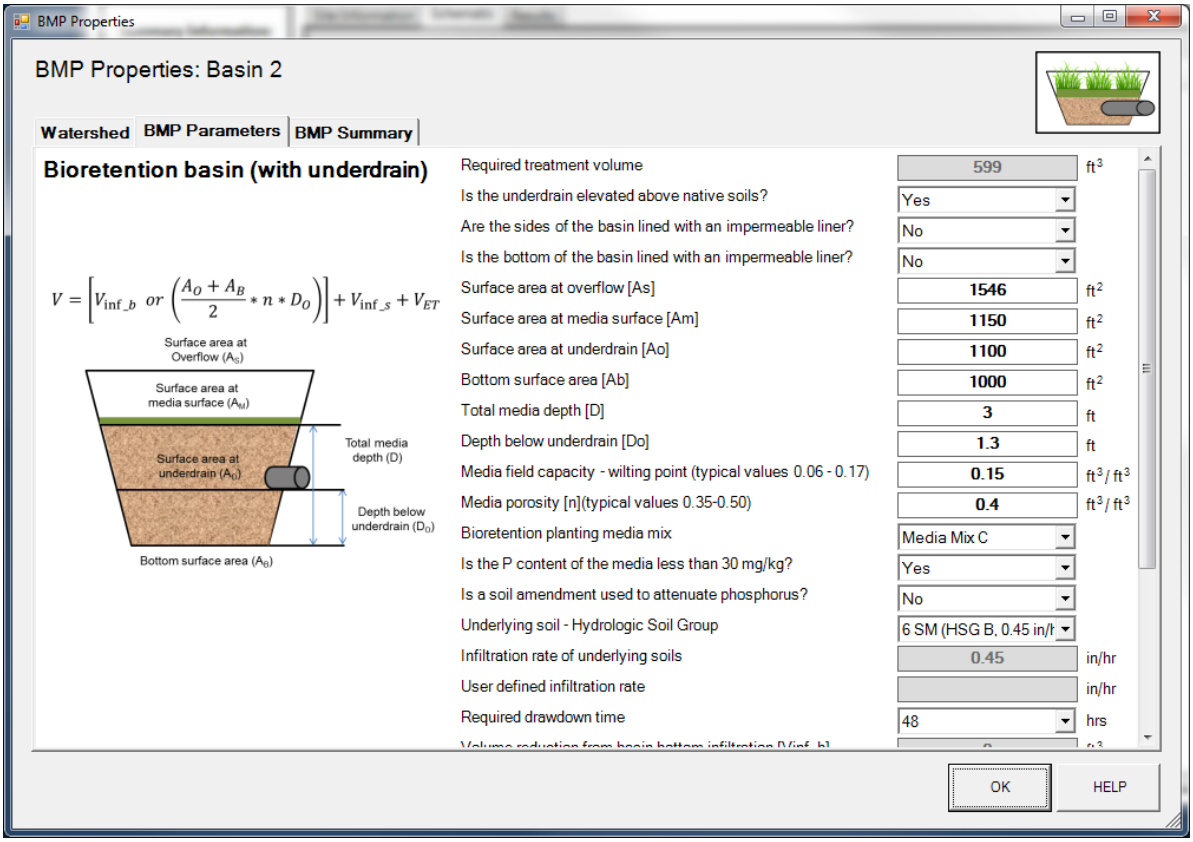

BMP Properties
BMP Properties: Permeable pavement
Watershed
BMP Parameters
BMP Summary
BMP Name
Permeable pavement
Routing/downstream BMP
Basin 1
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
0
Impervious Cover (acres)
0.08
Total Area (acres)
0.08
OK
HELP

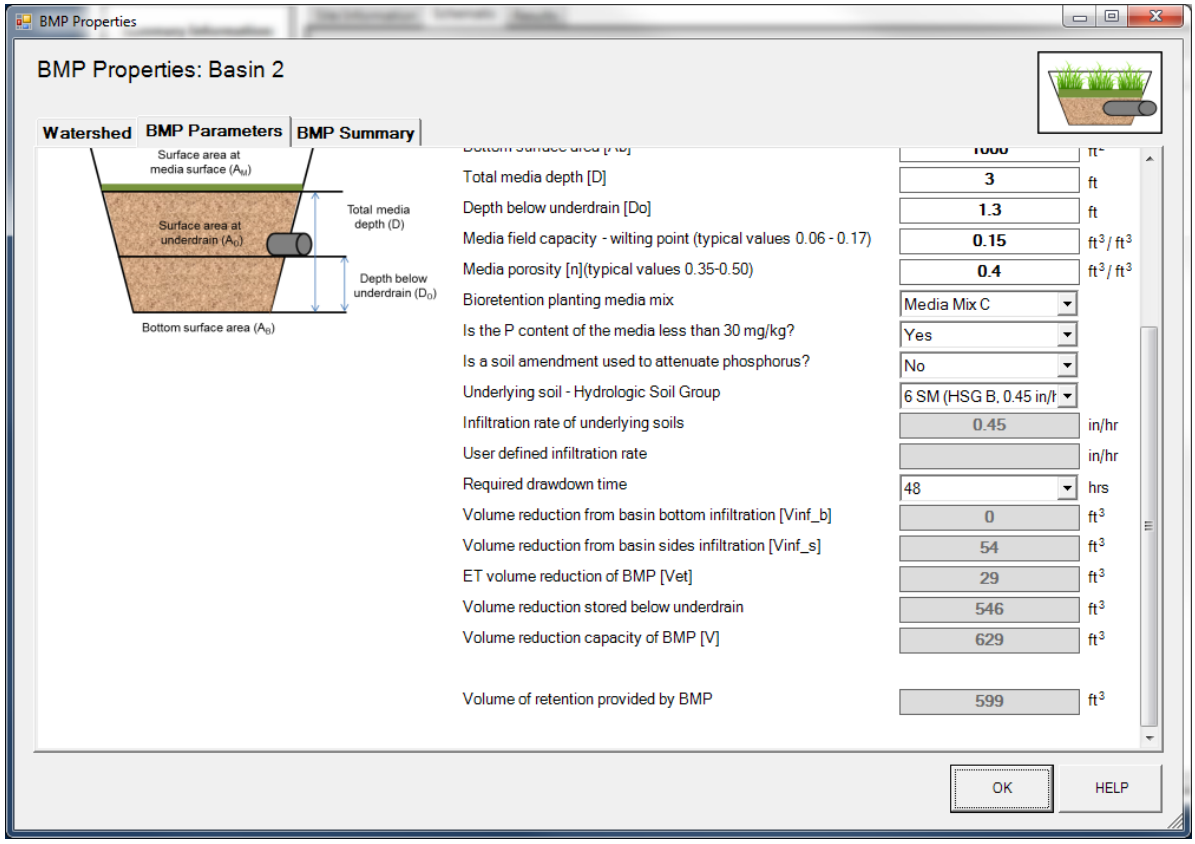

BMP Properties
BMP Properties: Permeable pavement
Watershed
BMP Parameters
BMP Summary
Permeable pavement
$V = \left[\frac{A_O + A_B}{2} * D_o * n\right]$
Overflow surface area (A_O)
Depth below underdrain (D_O)
Bottom surface area (A_B)
Required treatment volume
319
ft3
Overflow surface area [Ao]
2614
ft2
0.0600
acres
Bottom surface area [Ab]
2614
ft2
Depth below underdrain [Do]
1
ft
Media porosity [n](typical values 0.35-0.50)
0.40
ft3 / ft3
Will subsoil require compaction?
No
Underlying soil - Hydrologic Soil Group
6 SM (HSG B, 0.45 i
Infiltration rate of underlying soils
0.45
in/hr
User defined infiltration rate
in/hr
Required drawdown time
48
hrs
Volume reduction capacity of BMP [V]
1046
ft3
Volume of retention provided by BMP
319
ft3
OK
HELP

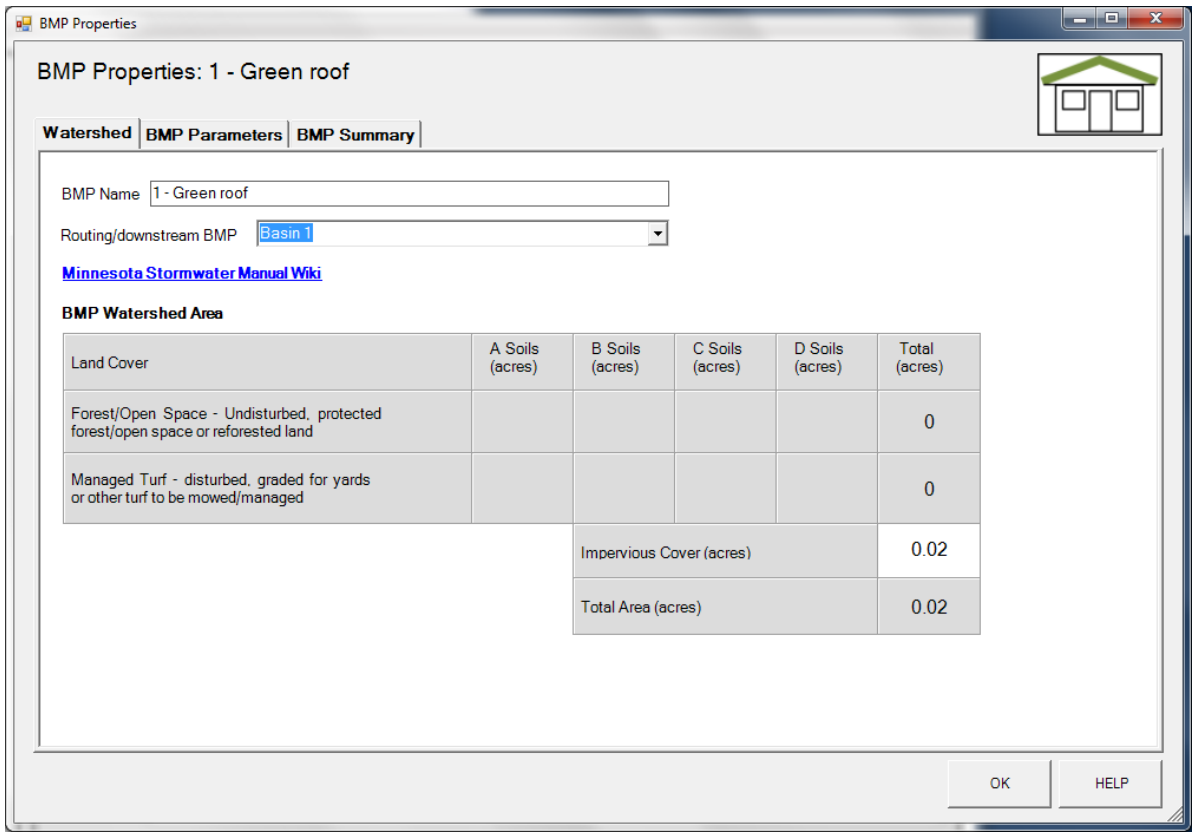

BMP Properties
BMP Properties: Basin 1
Watershed
BMP Parameters
BMP Summary
BMP Name
Basin 1
Routing/downstream BMP
Basin 2
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
0.17
0.17
Impervious Cover (acres)
0.03
Total Area (acres)
0.2
OK
HELP

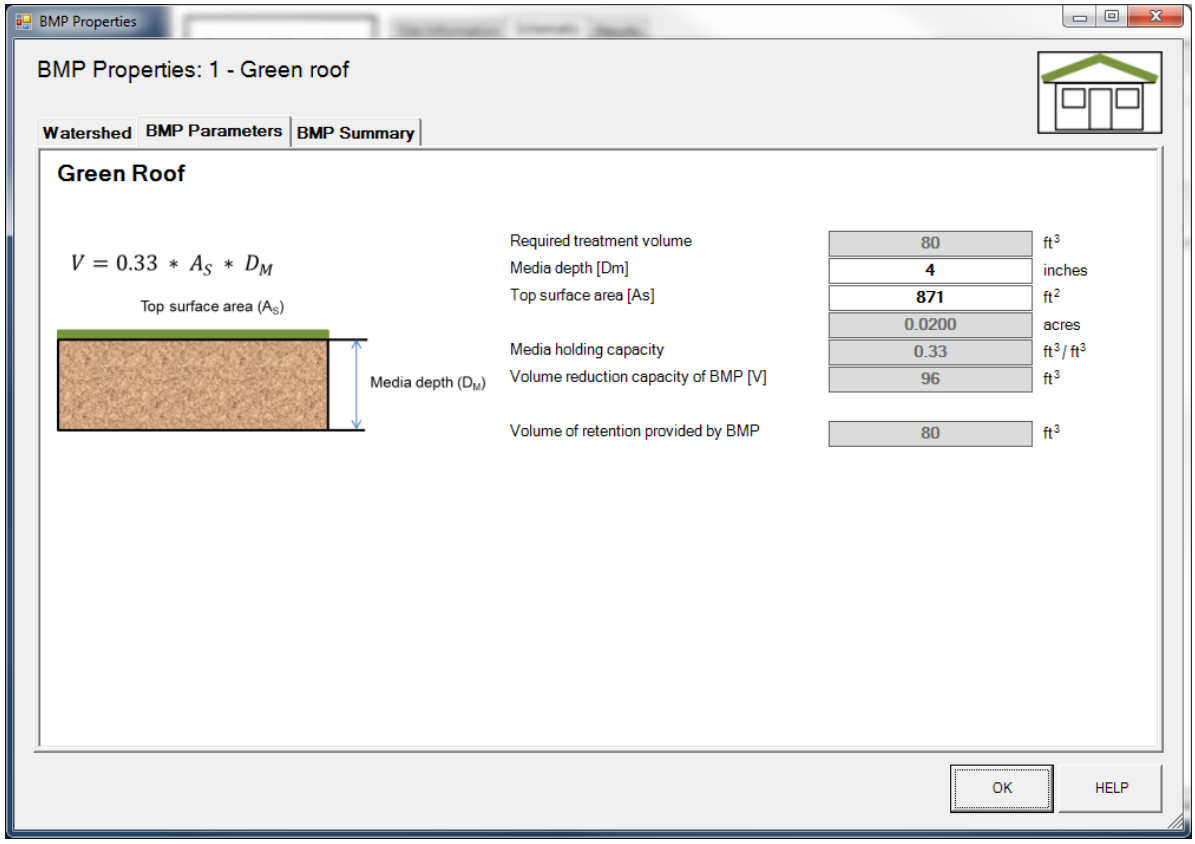

BMP Properties
BMP Properties: Basin 1
Watershed
BMP Parameters
BMP Summary
Bioretention basin (w/o underdrain)
$V = \left[\frac{A_O + A_B}{2} * (D_O)\right]$
Overflow surface area (A_O)
Overflow depth (D_O)
Bottom surface area (A_B)
Required treatment volume
120
ft3
Overflow surface area [Ao]
2200
ft2
Bottom surface area [Ab]
1282
ft2
Overflow depth [Do]
1
ft
Underlying soil - Hydrologic Soil Group
6 SM (HSG B, 0.45 in/hr
Infiltration rate of underlying soils
0.45
in/hr
User defined infiltration rate
in/hr
Required drawdown time (hrs)
48
hrs
Volume reduction capacity of BMP [V]
1741
ft3
Volume of retention provided by BMP
120
ft3
OK
HELP


BMP Properties
BMP Properties: Basin 2
Watershed
BMP Parameters
BMP Summary
BMP Name
Basin 2
Routing/downstream BMP
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover
A Soils (acres)
B Soils (acres)
C Soils (acres)
D Soils (acres)
Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land
0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed
0.09
0.09
Impervious Cover (acres)
0.15
Total Area (acres)
0.24
OK
HELP


BMP Properties
BMP Properties: Basin 2
Watershed
BMP Parameters
BMP Summary
Bioretention basin (with underdrain)
$V = \left[V_{\inf\_b} \ or \ \left(\frac{A_O + A_B}{2} * n * D_O\right)\right] + V_{\inf\_s} + V_{ET}$
Surface area at Overflow (A_S)
Surface area at media surface (A_M)
Surface area at underdrain (A_O)
Total media depth (D)
Depth below underdrain (D_O)
Bottom surface area (A_B)
Required treatment volume
599
ft3
Is the underdrain elevated above native soils?
Yes
Are the sides of the basin lined with an impermeable liner?
No
Is the bottom of the basin lined with an impermeable liner?
No
Surface area at overflow [As]
1546
ft2
Surface area at media surface [Am]
1150
ft2
Surface area at underdrain [Ao]
1100
ft2
Bottom surface area [Ab]
1000
ft2
Total media depth [D]
3
ft
Depth below underdrain [Do]
1.3
ft
Media field capacity - wilting point (typical values 0.06 - 0.17)
0.15
ft3 / ft3
Media porosity [n](typical values 0.35-0.50)
0.4
ft3 / ft3
Bioretention planting media mix
Media Mix C
Is the P content of the media less than 30 mg/kg?
Yes
Is a soil amendment used to attenuate phosphorus?
No
Underlying soil - Hydrologic Soil Group
6 SM (HSG B, 0.45 in/h
Infiltration rate of underlying soils
0.45
in/hr
User defined infiltration rate
in/hr
Required drawdown time
48
hrs
OK
HELP


BMP Properties
BMP Properties: Basin 2
Watershed
BMP Parameters
BMP Summary
Surface area at media surface (A_M)
Surface area at underdrain (A_U)
Bottom surface area (A_B)
Total media depth (D)
Depth below underdrain (D_O)
Total media depth [D] 3 ft
Depth below underdrain [Do] 1.3 ft
Media field capacity - wilting point (typical values 0.06 - 0.17) 0.15 ft³/ft³
Media porosity [n](typical values 0.35-0.50) 0.4 ft³/ft³
Bioretention planting media mix Media Mix C
Is the P content of the media less than 30 mg/kg? Yes
Is a soil amendment used to attenuate phosphorus? No
Underlying soil - Hydrologic Soil Group 6 SM (HSG B, 0.45 in/h
Infiltration rate of underlying soils 0.45 in/hr
User defined infiltration rate in/hr
Required drawdown time 48 hrs
Volume reduction from basin bottom infiltration [Vinf_b] 0 ft³
Volume reduction from basin sides infiltration [Vinf_s] 54 ft³
ET volume reduction of BMP [Vet] 29 ft³
Volume reduction stored below underdrain 546 ft³
Volume reduction capacity of BMP [V] 629 ft³
Volume of retention provided by BMP 599 ft³
OK
HELP

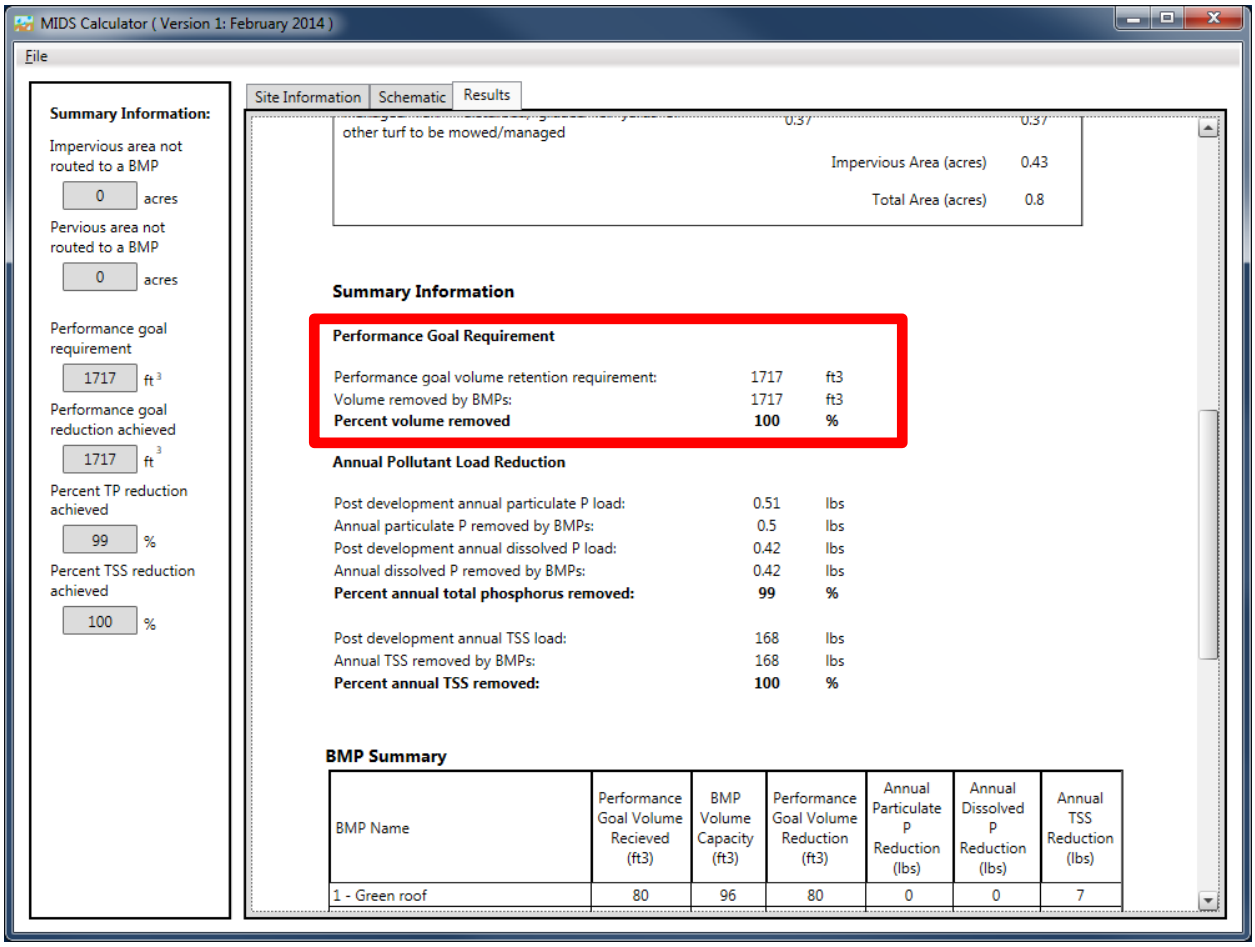

BMP Properties
BMP Properties: 1 - Green roof
Watershed
BMP Parameters
BMP Summary
BMP Name 1 - Green roof
Routing/downstream BMP Basin 1
Minnesota Stormwater Manual Wiki
BMP Watershed Area
Land Cover | A Soils (acres) | B Soils (acres) | C Soils (acres) | D Soils (acres) | Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land | 0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed | 0
Impervious Cover (acres) 0.02
Total Area (acres) 0.02
OK
HELP


BMP Properties
BMP Properties: 1 - Green roof
Watershed
BMP Parameters
BMP Summary
Green Roof
$V = 0.33 * A_S * D_M$
Top surface area (A_S)
Media depth (D_M)
Required treatment volume
80
ft3
Media depth [Dm]
4
inches
Top surface area [As]
871
ft2
0.0200
acres
Media holding capacity
0.33
ft3 / ft3
Volume reduction capacity of BMP [V]
96
ft3
Volume of retention provided by BMP
80
ft3
OK
HELP

Exercise 5: Answer

Determine if the site meets the performance goal for new sites without restrictions?

Answer: Yes



Are any BMPs oversized or undersized?

Answer: Yes.