Worksheets from Orange County Technical Guidance Document (12-20-2013)

See TGD for instructions and/or examples related to these worksheets:
www.ocwatersheds.com/WQMP.aspx

Table 2.7: Infiltration BMP Feasibility Worksheet

<table>
<tr><th></th><th>Infeasibility Criteria</th><th>Yes</th><th>No</th></tr>
<tr><td>1</td><td>Would Infiltration BMPs pose significant risk for groundwater related concerns? Refer to Appendix VII (Worksheet I) for guidance on groundwater-related infiltration feasibility criteria.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>2</td><td>Would Infiltration BMPs pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level? (Yes if the answer to any of the following questions is yes, as established by a geotechnical expert):
• The BMP can only be located less than 50 feet away from slopes steeper than 15 percent
• The BMP can only be located less than eight feet from building foundations or an alternative setback.
• A study prepared by a geotechnical professional or an available watershed study substantiates that stormwater infiltration would potentially result in significantly increased risks of geotechnical hazards that cannot be mitigated to an acceptable level.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>3</td><td>Would infiltration of the DCV from drainage area violate downstream water rights?</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
</table>

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

<table>
<tr><th></th><th>Partial Infeasibility Criteria</th><th>Yes</th><th>No</th></tr>
<tr><td>4</td><td>Is proposed infiltration facility located on HSG D soils or the site geotechnical investigation identifies presence of soil characteristics which support categorization as D soils?</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>5</td><td>Is measured infiltration rate below proposed facility less than 0.3 inches per hour? This calculation shall be based on the methods described in Appendix VII.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>6</td><td>Would reduction of over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?</td><td></td><td></td></tr>
<tr><td colspan="4">Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>7</td><td>Would an increase in infiltration over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?</td><td></td><td></td></tr>
<tr><td colspan="4">Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
</table>

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

Infiltration Screening Results (check box corresponding to result):		
8	Is there substantial evidence that infiltration from the project would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated? (See Appendix XVII) Provide narrative discussion and supporting evidence: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.	
9	If any answer from row 1-3 is yes: infiltration of any volume is **not feasible** within the DMA or equivalent. Provide basis: Summarize findings of infeasibility screening	
10	If any answer from row 4-8 is yes, infiltration is **permissible but is not presumed to be feasible for the entire DCV.** Criteria for designing biotreatment BMPs to achieve the maximum feasible infiltration and ET shall apply. Provide basis: Summarize findings of infeasibility screening	
11	If all answers to rows 1 through 10 are no, infiltration of the full DCV is potentially feasible, BMPs must be designed to infiltrate the full DCV to the maximum extent practicable.	

Worksheet A: Hydrologic Source Control Calculation Form

Drainage area ID	________________
Total drainage area	________________ acres
Total drainage area Impervious Area (IA_{total})	________________ acres

HSC ID	HSC Type/ Description/ Reference BMP Fact Sheet	Effect of individual HSC_i per criteria in BMP Fact Sheets **(**XIV.1**)** (d_{HSCi})[1]	Impervious Area Tributary to HSC_i (IA_i)	$d_i \times IA_i$
Box 1:		$\sum d_i \times IA_i =$		
Box 2:		$IA_{total} =$		
[Box 1]/[Box 2]:		$d_{HSC\ total} =$		
		*Percent Capture Provided by HSCs (*Table III.1*)*		

1 - For HSCs meeting criteria to be considered self-retaining, enter the DCV for the project.

Worksheet B: Simple Design Capture Volume Sizing Method

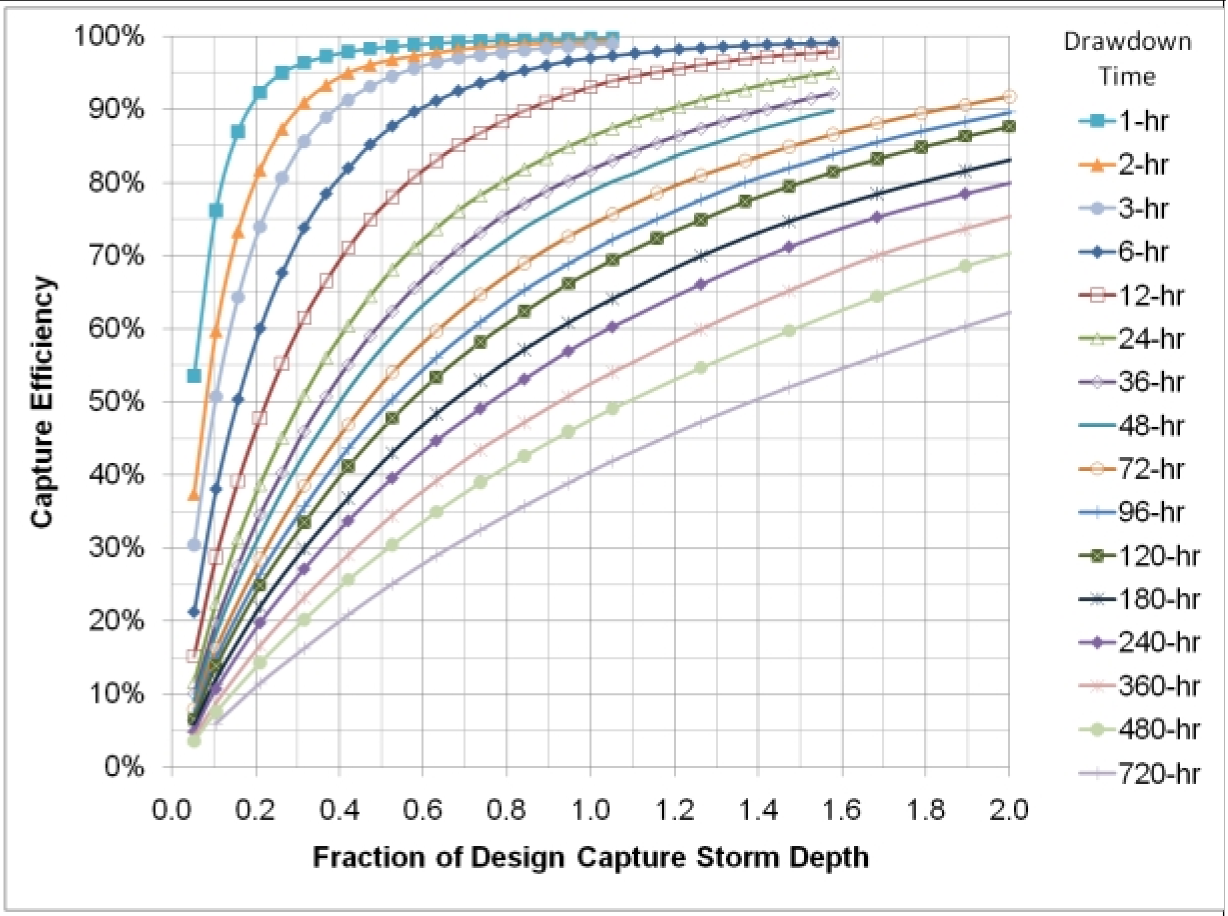
Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, d (inches)	$d=$		inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	$d_{HSC}=$		inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}=$		inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), A (acres)	$A=$		acres
2	Enter Project Imperviousness, imp (unitless)	$imp=$		
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	$C=$		
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	$V_{design}=$		cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (Appendix VII)	$K_{observed}=$		In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	$S_{total}=$		
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	$K_{design}=$		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, T (max 48 hours)	$T=$		Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	$D_{max}=$		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	$A_{min}=$		sq-ft

1 - $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$.

Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, d (inches)	d=		inches
2	Enter calculated drawdown time of the proposed BMP based on equation provided in applicable BMP Fact Sheet, T (hours)	T=		hours
3	Using Figure III.2, determine the "fraction of design capture storm depth" at which the BMP drawdown time (T) line achieves 80% capture efficiency, X_1	X_1=		
4	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=		inches
5	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=		%
6	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the equivalent of the upstream capture efficiency(Y_2), X_2	X_2=		
7	Calculate the fraction of design volume that must be provided by BMP, $fraction = X_1 - X_2$	fraction=		
8	Calculate the resultant design capture storm depth (inches), $d_{fraction} = fraction \times d$	$d_{fraction}$=		inches
9	SOC Only: When using this method for biofiltration sizing, check that the resulting volume in ponding plus pore spaces is at least 0.75× the remaining DCV (after accounting for upstream HSC/retention BMPs). (See Worksheet SOC-1)		Y / N / NA	
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), A (acres)	A=		acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=		
4	Calculate runoff volume, $V_{design} = (C \times d_{fraction} \times A \times 43560 \times (1/12))$	V_{design}=		cu-ft
Supporting Calculations				
Describe system:				

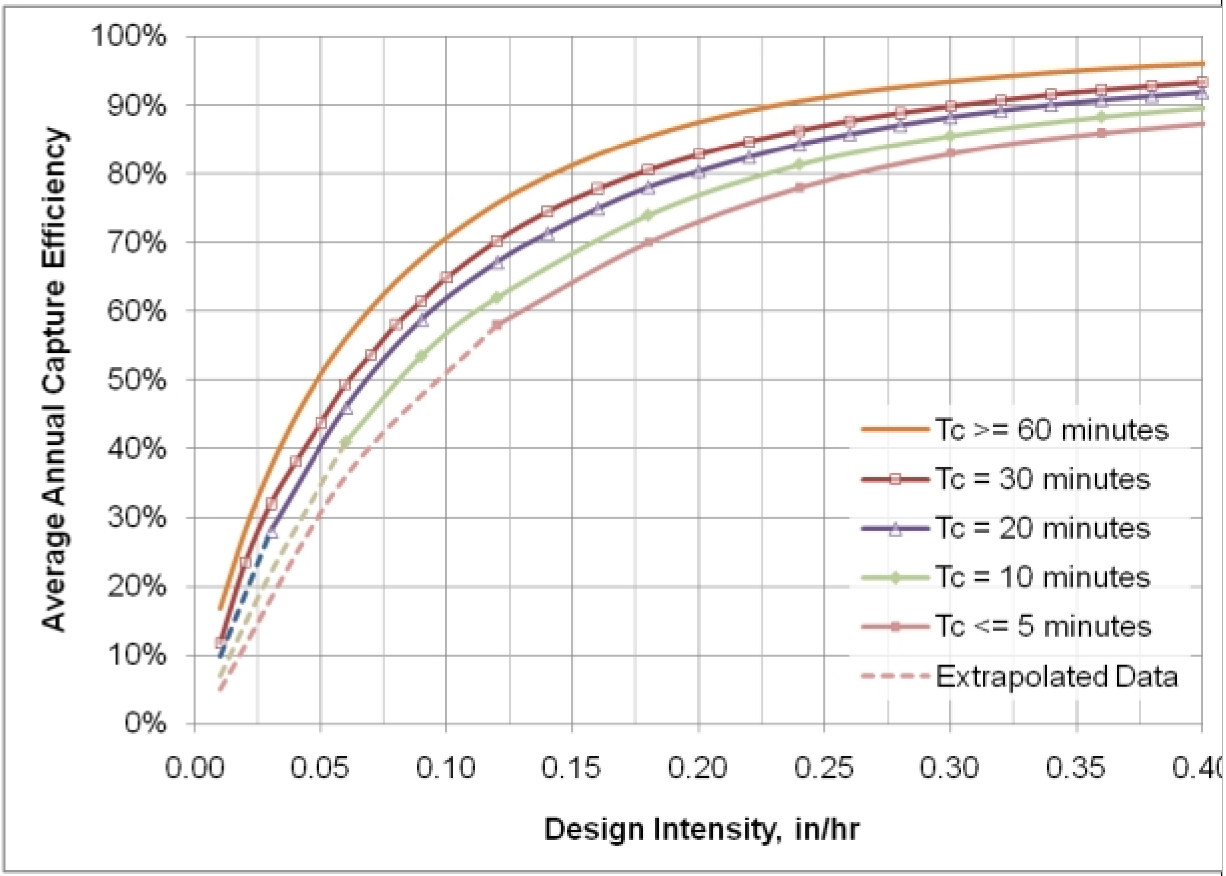
Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Provide drawdown time calculations per applicable BMP Fact Sheet:
Graphical Operations

Provide supporting graphical operations. See Example III.6.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=		
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=		in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=		inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=		%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=		
6	Determine the design intensity that must be provided by BMP, $_{design}= I_1 - I_2$	I_{design}=		
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=		acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=		
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=		cfs
Supporting Calculations				
Describe system:				
Provide time of concentration assumptions:				

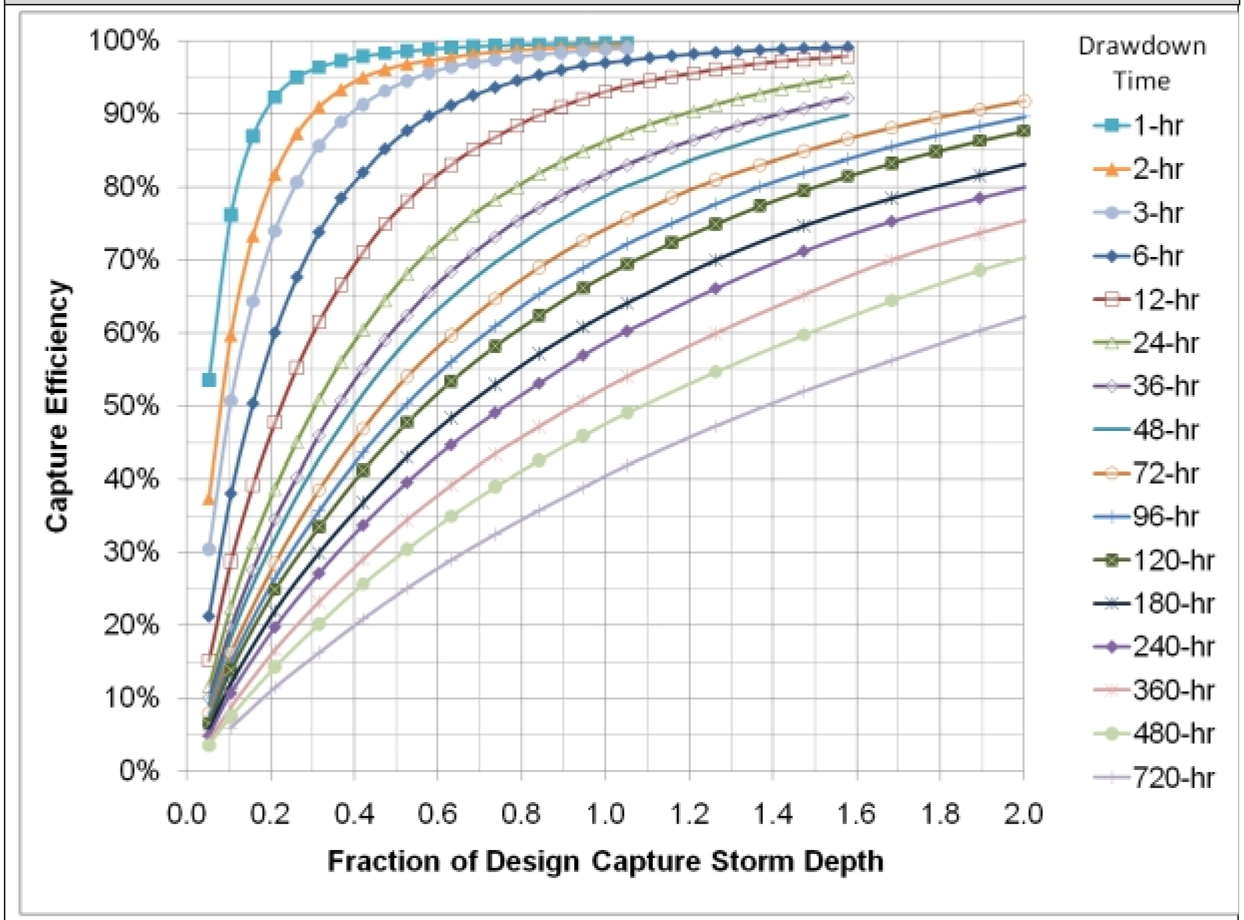
Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations

Provide supporting graphical operations. See Example III.7.

Worksheet E: Determining Capture Efficiency of Volume Based, Constant Drawdown BMP based on Design Volume

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, d (inches)	d=		inches
2	Enter the storage volume provided in the BMP, V (cu-ft)	V=		cu-ft
3	Enter Project area tributary to BMP (s), A (acres)	A=		acres
4	Enter Project Imperviousness, *imp* (unitless)	imp=		
5	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=		
6	Calculate the effective design storm depth provided (inches), $d_{provided} = (V \times 12)/(C \times A \times 43560)$	$d_{provided}$=		inches
7	Calculate the design storm depth as a fraction of the design capture depth, $X_{fraction} = d_{provided}/d$	$X_{fraction}$=		
Step 2: Calculate the capture efficiency of the BMP system				
1	Determine the drawdown time of the proposed BMP based on equations provided in the applicable BMP Fact Sheet, T (hours)	T=		hours
2	Enter the effect of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=		inches
3	Enter capture efficiency corresponding to d_{HSC} from Table 6.7 (regionally based), Y_1 (Worksheet A)	Y_1=		%
4	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the upstream capture efficiency(Y_1), X_1	X_1=		
5	Determine the fraction of design capture storm depth corresponding to the cumulative capture efficiency, $X_2 = X_1 + X_{fraction}$	X_2=		
6	Using Figure III.2, determine the capture efficiency corresponding to total fraction of design storm depth (X_2) for drawdown time (T), Y_2	Y_2=		%

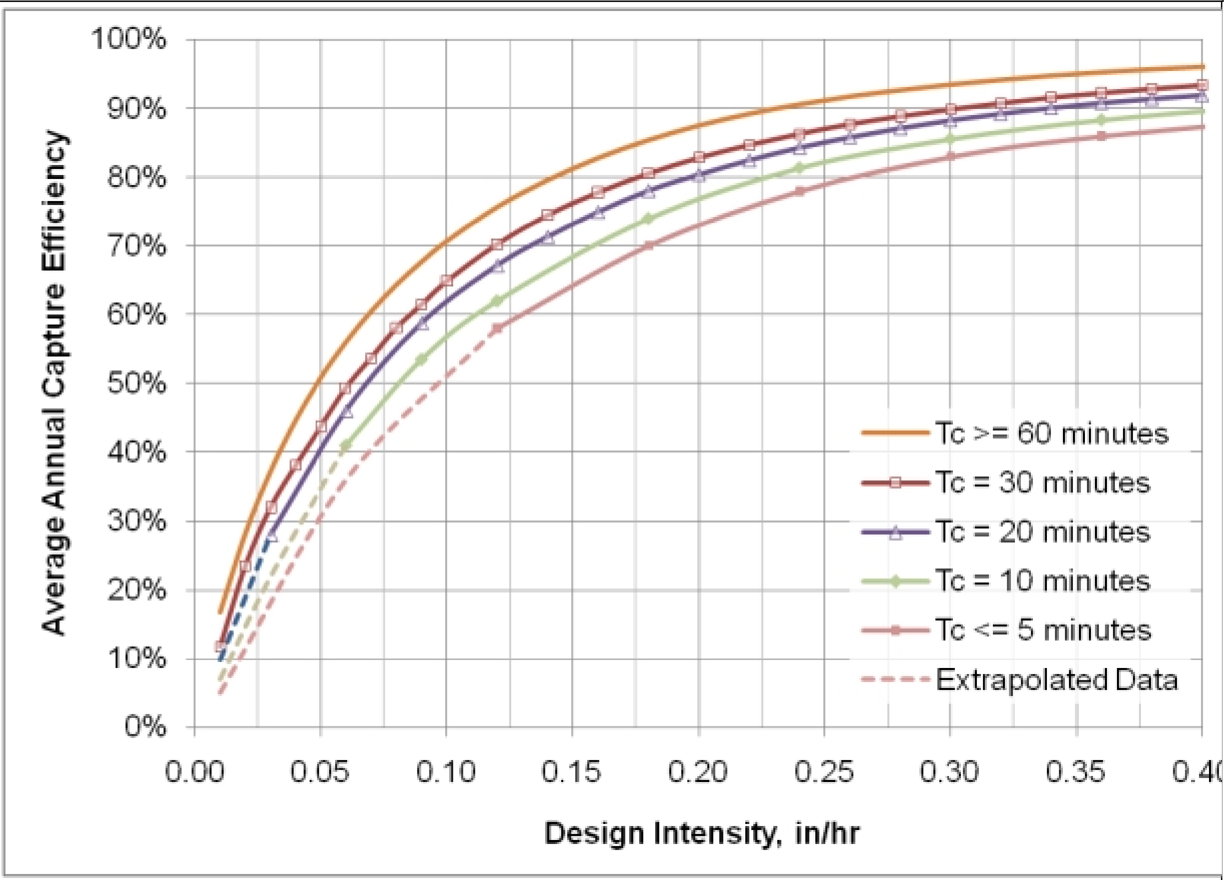
Worksheet E: Determining Capture Efficiency of Volume Based, Constant Drawdown BMP based on Design Volume

Supporting Calculations
Describe system:
Provide drawdown calculations per equations in applicable BMP Fact Sheet:
Graphical Operations

Use this graph to provide the supporting graphical operations. See Example III.8.

Worksheet F: Determining Capture Efficiency of a Flow-based BMP based on Treatment Capacity

Step 1: Determine the design intensity used for calculating design flowrate				
1	Determine the design flowrate of the BMP, *Q* (cfs)	Q=		cfs
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=		
4	Back calculate the equivalent intensity of rainfall treated in the BMP (cfs), $i_{provided} = Q/C$	$i_{provided}$=		in/hr
Step 2: Calculate the capture efficiency of theflow-based BMP				
1	Enter the time of concentration, T_c (min) (Section IV.2)	T_c=		
2	Enter the effect of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=		inches
3	Enter the upstream capture efficiency corresponding to d_{HSC} from Table III.1 (regionally based), Y_1 (Worksheet A)	Y_1=		%
4	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_1), I_1	I_1=		in/hr
5	Determine the cumulative design intensity that is provided by upstream and project BMPs, $I_2 = I_{provided} + I_1$	I_2=		in/hr
6	Using Figure III.4, determine the capture efficiency corresponding to the total intensity captured (I_2) for time of concentration (T_c) for upstream and Project BMPs, Y_2	Y_2=		%
Supporting Calculations				
Describe system:				
Provide time of concentration assumptions:				

Worksheet F: Determining Capture Efficiency of a Flow-based BMP based on Treatment Capacity

Graphical Operations

Provide supporting graphical operations.

Worksheet G: Alternative Compliance Volume Worksheet

Step 1: Determine the alternative compliance volume without water quality credits				
1	Determine the capture efficiency achieved in upstream BMPs using Appendix III, X_1 (%)	X_1=		%
2	Enter design capture storm depth from Figure III.1, *d* (inches)	d=		inches
3	Using Figure VI.1, pivot from where X_1 intersects the curve to determine the fraction of design capture storm depth remaining to be met, Y_1	Y_1=		
4	Calculate the design depth that must be managed in alternative compliance BMPs, $d_{alternative} = Y_1 \times d$	$d_{alternative}$=		inches
5	Compute the alternative compliance volume corresponding to $d_{alternative}$ using the hydrologic methods described in Section III.1.1, *ACV* (cu-ft)	ACV=		cu-ft
Step 2: Determine Credit Volume				
Method 1: Determine Credit Volume based on Reducing Impervious Footprint				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=		inches
2	Using d, calculate the DCV using the pre-project imperviousness and the methods described in Appendix III, DCV_{pre} (cu-ft).	DCV_{pre}=		cu-ft
3	Using d, calculate the DCV using the proposed imperviousness and the methods described in Appendix III, DCV_{post} (cu-ft).	DCV_{post}=		cu-ft
4	Calculate the $Credit\ Volume = DCV_{pre} - DCV_{post}$ (cu-ft).	Credit Volume=		cu-ft
Method 2: Determine Credit Volume based on Project Type and Density				
1	Determine the sum of the Credit Percentages applicable to the Project, ∑*Credit Percentages* (%). (See Section 3.1 of the Model WQMP)	∑*Credit Percentages* =		%
2	Enter design capture storm depth from Figure III.1, *d* (inches)	d=		inches
3	Using d, calculate the DCV using the proposed imperviousness without BMPs and the methods described in Appendix III, $DCV_{post\ no\ BMP}$ (cu-ft).	$DCV_{post\ no\ BMP}$=		cu-ft
4	Calculate the $Credit\ Volume = DCV_{post\ no\ BMP} \times \sum Credit\ Percentages$	Credit Volume=		cu-ft

Worksheet G: Alternative Compliance Volume Worksheet

Step 3: Determine the Alternative Compliance Volume after WQ Credits				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=		inches
2	Using d, calculate the DCV using the proposed imperviousness and the methods described in Appendix III, DCV_{post} (cu-ft).	DCV_{post}=		cu-ft
3	Calculate the alternative compliance volume, $ACV = DCV_{post}$ - *Credit Volume*	ACV=		cu-ft

Worksheet H: Factor of Safety a nd Design Infiltration Rate Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25		
		Predominant soil texture	0.25		
		Site soil variability	0.25		
		Depth to groundwater / impervious layer	0.25		
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			
B	Design	Tributary area size	0.25		
		Level of pretreatment/ expected sediment loads	0.25		
		Redundancy	0.25		
		Compaction during construction	0.25		
		Design Safety Factor, $S_B = \Sigma p$			
Combined Safety Factor, $S_{total} = S_A \times S_B$					
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)[1]					
Design Infiltration Rate, in/hr, $K_{design} = K_{observed} / S_{total}$					

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

1 - $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$.

Worksheet I: Summary of Groundwater-related Feasibility Criteria

1	Is project large or small? (as defined by Table VIII.2) circle one	Large		Small
2	What is the tributary area to the BMP?	A		acres
3	What type of BMP is proposed?			
4	What is the infiltrating surface area of the proposed BMP?	A_{BMP}		sq-ft
5	What land use activities are present in the tributary area (list all)			
6	What land use-based risk category is applicable?	L	M	H
7	If M or H, what pretreatment and source isolation BMPs have been considered and are proposed (describe all):			
8	What minimum separation to mounded seasonally high groundwater applies to the proposed BMP? See Section VIII.2 (circle one)	5 ft		10 ft
9	Provide rationale for selection of applicable minimum separation to seasonally high mounded groundwater:			
10	What is separation from the infiltrating surface to seasonally high groundwater?	SHGWT		ft
11	What is separation from the infiltrating surface to mounded seasonally high groundwater?	Mounded SHGWT		ft
12	Describe assumptions and methods used for mounding analysis:			

Worksheet I: Summary of Groundwater-related Feasibility Criteria

13	Is the site within a plume protection boundary (See Figure VIII.2)?	Y N N/A
14	Is the site within a selenium source area or other natural plume area (See Figure VIII.2)?	Y N N/A
15	Is the site within 250 feet of a contaminated site?	Y N N/A
16	If site-specific study has been prepared, provide citation and briefly summarize relevant findings:	
17	Is the site within 100 feet of a water supply well, spring, septic system?	Y N N/A
18	Is infiltration feasible on the site relative to groundwater-related criteria?	Y N
Provide rationale for feasibility determination:		

Note: if a single criterion or group of criteria would render infiltration infeasible, it is not necessary to evaluate every question in this worksheet.

Worksheet J: Summary of Harvested Water Demand and Feasibility

1	What demands for harvested water exist in the tributary area (check all that apply):			
2	Toilet and urinal flushing		◻	
3	Landscape irrigation		◻	
4	Other:____ _		◻	
5	What is the design capture storm depth? (Figure III.1)	d		inches
6	What is the project size?	A		ac
7	What is the acreage of impervious area?	IA		ac
	For projects with multiple types of demand (toilet flushing, irrigation demand, and/or other demand)			
8	What is the minimum use required for partial capture? (Table X.6)			gpd
9	What is the project estimated wet season total daily use (Section X.2)?			gpd
10	Is partial capture potentially feasible? (Line 9 > Line 8?)			
	For projects with only toilet flushing demand			
11	What is the minimum TUTIA for partial capture? (Table X.7)			
12	What is the project estimated TUTIA?			
13	Is partial capture potentially feasible? (Line 12 > Line 11?)			
	For projects with only irrigation demand			
14	What is the minimum irrigation area required based on conservation landscape design? (Table X.8)			ac
15	What is the proposed project irrigated area? (multiply conservation landscaping by 1; multiply active turf by 2)			ac
16	Is partial capture potentially feasible? (Line 15 > Line 14?)			
Provide supporting assumptions and citations for controlling demand calculation:				

Worksheet SOC-1: Calculating Provided Biofiltration Volume as a Fraction of Remaining DCV (SOC Only)

Step 1: Determine the remaining DCV				
1	Enter total DCV for the DMA (see Section III.1)	DCV		cu-ft
2	Enter the DCV that has already been retained in the DMA (either upstream of BMP or in sump below outlet of BMP)	$V_{retained}$		cu-ft
3	Enter the DCV that has already been retained (either upstream of BMP (such as by HSCs) or in sump below outlet of BMP) (Line 1 minus Line 2)	DCV_{remain}		cu-ft
Step 2: Compare pre-filter detention volume plus pore volume to remaining DCV				
4	Enter BMP ponding volume based on proposed BMP design (for simple designs, multiple effective footprint area by ponding depth to estimate volume)	V_{pond}		cu-ft
5	Enter any additional pre-filter detention volume provided, such as in a cistern or tank.	V_{detain}		cu-ft
6	Enter BMP available pore space volume by multiplying soil and gravel volumes by respective available porosity. Available porosity should be estimated based on material properties. In general, available pore space of 0.2 for amended media and 0.4 for open graded drain rock are considered to be reasonable.	V_{pores}		cu-ft
7	Calculate total pre-filter detention plus pore volume (add Lines 4 through 6)	$V_{pond+pores}$		cu-ft
8	Calculate total pre-filter plus pore volume as fraction of remaining DCV (Line 7 divided by Line 3)			unitless
9	Does pre-filter detention plus pore volume greater than 0.75 of remaining DCV? Enter Y or N			Y or N
Provide description of system and/or calculations justifying the volumes entered under Step 2.				