Worksheet 1

Design Procedure for BMP Design Volume

Designer: ______________________________

Company: ______________________________

Date: ______________________________

Project: ______________________________

Location: ______________________________

1. Determine the Tributary Area to the BMP (A_{trib})	A_{trib}= ____________ acres ***(1)***
2. Determine the impervious area ratio (*i*)	
a. Determine impervious area within (A_{trib})	A_{imp} = ____________ acres ***(2)***
b. Calculate *i* = **(2)** / **(1)**	*i* = ____________ acres/acre ***(3)***
3. Determine Runoff Coefficient (C) $C = 0.858 \cdot i^3 - 0.78 \cdot i^2 + 0.774 \cdot i + 0.04$ $C = 0.858 \cdot (3)^3 - 0.78 \cdot (3)^2 + 0.774 \cdot (3) + 0.04$	C = ____________ ***(4)***
4. Determine Unit Storage Volume (V_u) $V_u = 0.40 \cdot C$ $V_u = 0.40 \cdot$**(4)**	V_u = ____________ acre-in/acre ***(5)***
5. Determine Design Storage Volume	
a. V_{BMP} = ***(5)*** x ***(1)*** [acre-in]	V_{BMP} = ____________ acre-in ***(6)***
b. V_{BMP} = ***(6)*** / 12 [acre-ft]	V_{BMP} = ____________ acre-ft ***(7)***
c. V_{BMP} = ***(7)*** x 43560 [ft^3]	V_{BMP} = ____________ ft^3 ***(8)***

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Worksheet 2

Design Procedure Form for Design Flow

Uniform Intensity Design Flow

Designer: ______________________

Company: ______________________

Date: ______________________

Project: ______________________

Location: ______________________

1. Determine Impervious Percentage			
a. Determine total tributary area	A_{total} = ________	acres	***(1)***
b. Determine Impervious %	i = ________	%	***(2)***
2. Determine Runoff Coefficient Values Use **Table 4** and impervious % found in step 1			
a. A Soil Runoff Coefficient	C_a = ________		***(3)***
b. B Soil Runoff Coefficient	C_b = ________		***(4)***
c. C Soil Runoff Coefficient	C_c = ________		***(5)***
d. D Soil Runoff Coefficient	C_d = ________		***(6)***
3. Determine the Area decimal fraction of each soil type in tributary area			
a. Area of A Soil / ***(1)*** =	A_a = ________		***(7)***
b. Area of B Soil / ***(1)*** =	A_b = ________		***(8)***
c. Area of C Soil / ***(1)*** =	A_c = ________		***(9)***
d. Area of D Soil / ***(1)*** =	A_d = ________		***(10)***
4. Determine Runoff Coefficient			
a. C = ***(3)***x***(7)*** + ***(4)***x***(8)*** + ***(5)***x***(9)*** + ***(6)***x***(10)* =**	C = ________		***(11)***
5. Determine BMP Design flow			
a. Q_{BMP} = C x I x A = ***(11)*** x 0.2 x ***(1)***	Q_{BMP} = ________	$\frac{ft^3}{s}$	***(12)***

Design Procedure Form for Extended Detention Basin

Designer: ________________________________
Company: ________________________________
Date: ________________________________
Project: ________________________________
Location: ________________________________

1. Determine Design Volume (Use Worksheet 1) a. Total Tributary Area (minimum 5 ac.) b. Design Volume, V_{BMP}	A_{trib} = __________ acres V_{BMP} = __________ ft^3
2. Basin Length to Width Ratio (2:1 min.)	Ratio = __________ L:W
3. Two-Stage Design a. Overall Design 1) Depth (3.5' min.) 2) Width (30' min.) 3) Length (60' min.) 4) Volume (must be $\geq V_{BMP}$) b. Upper Stage 1) Depth (2' min.) 2) Bottom Slope (2% to low flow channel recommended) c. Bottom Stage 1) Depth (1.5' to 3') 2) Length 3) Volume (10 to 25% of V_{BMP})	Depth = __________ ft Width = __________ ft Length = __________ ft Volume = __________ ft^3 Depth = __________ ft Slope = __________ % Depth = __________ ft Length = __________ ft Volume = __________ ft^3
4. Forebay Design a. Forebay Volume (5 to 10% of V_{BMP}) b. Outlet pipe drainage time (≅ 45 min)	Volume = __________ ft^3 Drain time = __________ minutes
5. Low-flow Channel a. Depth (9" minimum) b. Flow Capacity (2 * Forebay Q_{OUT})	Depth = __________ ft $Q_{Low\ Flow}$ = __________ cfs

6. Trash Rack or Gravel Pack (check one)	Trash Rack ______ Gravel Pack ______
7. Basin Outlet a. Outlet type (check one) b. Orifice Area c. Orifice Type d. Maximum Depth of water above bottom orifice e. Length of time for 50% V_{BMP} drainage (24 hour minimum) f. Length of time for 100% V_{BMP} drainage (between 48 and 72 hours) g. Attached Documents (all required) 1) Stage vs. Discharge 2) Stage vs. Volume 3) Inflow Hydrograph 4) Basin Routing	Single orifice ☐ Multi-orifice plate ☐ Perforated Pipe ☐ Other ____________________ Area = __________ ft^2 Type ____________________ Depth = __________ ft Time 50% = __________ hrs Time 100% = __________ hrs Attached Documents (check) 1) ☐ 2) ☐ 3) ☐ 4) ☐
8. Increased Runoff (optional) Is this basin also mitigating increased runoff? Attached Documents (all required) for 2, 5, & 10-year storms: 1) Stage vs. Discharge 2) Stage vs. Volume 3) Inflow Hydrograph 4) Basin Routing	Yes ☐ No ☐ (if No, skip to #9) Attached Documents (check) 1) ☐ 2) ☐ 3) ☐ 4) ☐
9. Vegetation (check type)	☐ Native Grasses ☐ Irrigated Turf ☐ Other ____________________

10. Embankment a. Interior slope (4:1 max.) b. Exterior slope (3:1 max.)	Interior Slope = __________ % Exterior Slope = __________ %
11. Access a. Slope (10% max.) b. Width (16 feet min.)	Slope = ___________ % Width = ___________ ft

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Worksheet 4

Design Procedure Form for Infiltration Basin

Designer: ____________________
Company: ____________________
Date: ____________________
Project: ____________________
Location: ____________________

1. Determine Design Storage Volume (Use Worksheet 1) a. Total Tributary Area (maximum 50) b. Design Storage Volume, V_{BMP}	A_{trib} = ________ acres V_{BMP} = ________ ft^3
2. Maximum Allowable Depth (D_m) a. Site infiltration rate (I) b. Minimum drawdown time (48 hrs) c. Safety factor (s) d. D_m = [(t) x (I)]/[12s]	I = ________ in/hr t = ________ hrs s = ________ D_m = ________ ft
3. Basin Surface Area $A_m = V_{BMP} / D_m$	A_m = ________ ft^2
4. Vegetation (check type used or describe "other")	☐ Native Grasses ☐ Irrigated Turf Grass ☐ Other ____________________ ____________________

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Design Procedure Form for Infiltration Trench

Designer: ______________________________

Company: ______________________________

Date: ______________________________

Project: ______________________________

Location: ______________________________

1. Determine Design Storage Volume (Use worksheet 1) a. Total Tributary Area (maximum 10) b. Design Storage Volume, V_{BMP}	A_{trib} = ________ acres V_{BMP} = ________ ft^3
2. Maximum Allowable Depth (D_m = tI/12s) a. Site infiltration rate (I) b. Minimum drawdown time (t = 48 hrs) c. Safety factor (s) d. D_m = tI/12s	I = ________ in/hr t = ________ hrs s = ________ D_m = ________ ft
3. Trench Bottom Surface Area $A_m = V_{BMP} / D_m$	A_m = ________ ft^2

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Design Procedure Form for Porous Pavement

Designer: ______________________________
Company: ______________________________
Date: ______________________________
Project: ______________________________
Location: ______________________________

1. Determine Design Storage Volume (Use Worksheet 1) a. Total Tributary Area (maximum 10) b. Design Storage Volume, V_{BMP}	A_{trib} = __________ acres V_{BMP} = __________ ft^3
1. Basin Surface Area a. Detention Volume V_{BMP} b. $A_m = V_{BMP} / (0.17\ ft)$	V_{BMP} = __________ ft^3 A_m = __________ ft^2
2. Block Type a. Minimum open area = 40% b. Minimum thickness = 4 inches	Block Name = __________ Manufacturer = __________ Open Area = __________ % Thickness = __________ inches
3. Base Course a. ASTM C33 Sand Layer (1 inch) b. ASSHTO M43-No.8 Gravel Layer (9 inches)	Sand Layer ☐ (check) Gravel Layer ☐ (check)

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Design Procedure Form for Austin Sand Filter

Designer: ____________________
Company: ____________________
Date: ____________________
Project: ____________________
Location: ____________________

1. Determine Design Storage Volume (Use Worksheet 1) a. Total Tributary Area (maximum 100) b. Design Storage Volume, V_{BMP}	A_{trib} = ________ acres V_{BMP} = ________ ft^3
2. Maximum Water Height in Sedimentation Basin* a. Invert elevation at connection to storm drain system. b. Sand Filter invert elevation (consider min. grade (1%) from storm drain). Point A, Figure 9. c. Estimate filter depth or use min. (3'). d. Top elevation of filter bed. Point B, Figure 9. e. Surface elevation at BMP inlet. Point C, Figure 9. f. Determine max. allowable height (2h) of water in the sedimentation basin using the elevation difference between points C and B. (min. 2', max. 10') 2h = [(C-B) – 1' Freeboard]	Elev. Storm Drain = ________ ft Elev. Pt A = ________ ft Filter Depth = ________ ft Elev. Pt B = ________ ft Elev. Pt C = ________ ft 2h = ________ ft
3. Size Sedimentation Basin a. Find Sedimentation Basin Area, A_s $A_s = V_{BMP} / (2h)$ b. Determine basin length and width, using a length to width ratio ≥ 2:1 $A_s = 2 \times W^2$ length = 2 x width	A_s = ________ ft^2 width = ________ ft length = ________ ft

4. Size Filter Basin a. Determine Filter Basin Area, A_f $A_f = V_{BMP} / 18$ b. Determine Filter Basin Volume $V_f = A_f$ x filter depth (part 2c) c. Determine Required Volume, V_r $V_r = 0.2 \times V_{BMP}$ d. Check if $V_r \leq V_f$ If no, redesign with an increased filter depth or increase filter area.	A_f = ________ ft^2 V_f = ________ ft^3 V_r = ________ ft^3 Check $V_r \leq V_f$ ☐

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* Based on these elevations, is there a sufficient elevation drop to allow gravity flow from the outlet of the control measure to the storm drain system? If no, investigate alternative on-site locations for treatment control, consider another treatment control measure more suitable for site conditions, or contact the District to discuss on-site pumping requirements.

Design Procedure Form for Delaware Sand Filter

Designer: ________________________________

Company: ________________________________

Date: ________________________________

Project: ________________________________

Location: ________________________________

1. Determine Design Storage Volume (Use Worksheet 1) a. Total Tributary Area (maximum 100) b. Design Storage Volume, V_{BMP}	A_{trib} = ________ acres V_{BMP} = ________ ft^3
2. Maximum Water Height in Sedimentation Basin* a. Invert elevation at connection to storm drain system. b. Sand Filter invert elevation (consider min. grade (1%) from storm drain). c. Estimate filter depth or use min. (3'). d. Top elevation of filter bed. e. Surface elevation at BMP inlet. f. Determine max. allowable height (2h) of water that can pond over the filter using the elevation difference between the filter bed top and the BMP inlet. 2h = [(C-B) – 1' Freeboard]	Elev. Storm Drain = ________ ft Elev. Filter Bottom = ________ ft Filter Depth = ________ ft Filter bed top elev. (pt B) = ________ ft BMP inlet Elev. (pt C) = ________ ft 2h = ________ ft
3. Minimum Surface Area of the Chambers If 2h < 2.67 feet (2'-8") $A_f = A_s = V_{BMP} / (4.1h + 0.9)$ If 2h > 2.67 feet (2'-8") $A_f = A_s = [V_{BMP} \times d_s] / [k(h+d_s)t_f]$ a. Sand bed depth, ds b. Filter Coefficient, k c. Draw-down time, t d. ½ max. allowable water depth over filter, h	d_s = ________ ft k = ________ ft/hr t = ________ hr h = ________ ft

e. Sediment Chamber Area A_s, and Filter Surface Area A_f	A_s and A_f = ________ ft^2
4. Sediment Chamber and Filter Dimensions a. Select width ($W_s = W_f$ = 18" to 30") b. Filter length ($L_s = L_f = A_{fm}/W_f$) c. Adjusted length (rounded) d. Adjusted area ($A_s = A_f = W_f \times L_f$)	$W_s = W_f$ = ________ ft $L_s = L_f$ = ________ ft $L_s = L_f$ = ________ ft $A_s = A_f$ = ________ ft^2
5. System Storage Volume a. Storage in filter voids ($V_v = A_f \times 0.4(d_g + d_s)$) b. Volume of flow through filter ($V_Q = k \times A_f(d_s+h)$ 1hr / d_s) c. Required net storage ($V_r = V_{BMP} – V_v – V_Q$) d. Available storage ($V_a = 2h(A_f + A_s)$) If $V_a \geq V_r$, sizing is complete If $V_a < V_r$, repeat steps 4 and 5	V_v = ________ ft^3 V_Q = ________ ft^3 V_r = ________ ft^3 V_a = ________ ft^3 Check $V_r \geq V_a$ ☐
Notes: ________ ________ ________ ________ ________ ________ ________ ________	

* Based on these elevations, is there a sufficient elevation drop to allow gravity flow from the outlet of the control measure to the storm drain system? If no, investigate alternative on-site locations for treatment control, consider another treatment control measure more suitable for site conditions, or contact the District to discuss on-site pumping requirements.

Design Procedure Form for Grassed Swale

Designer: ____________________
Company: ____________________
Date: ____________________
Project: ____________________
Location: ____________________

1. Determine Design Flow (Use Worksheet 2)	Q_{BMP} = __________ cfs
2. Swale Geometry a. Swale bottom width (b) b. Side slope (z) c. Flow direction slope (s)	 b = __________ ft z = __________ s = __________ %
3. Design flow velocity (Manning n = 0.2)	v = __________ ft/s
4. Depth of flow (D)	D = __________ ft
5. Design Length (L) L = (7 min) x (flow velocity, ft/sec) x 60	L = __________ ft
6. Vegetation (describe)	____________________ ____________________
1. Outflow Collection (check type used or describe “other”)	☐ Grated Inlet’ ☐ Infiltration Trench ☐ Underdrain ☐ Other__________

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Design Procedure Form for Filter Strip

Designer: ______________________________

Company: ______________________________

Date: ______________________________

Project: ______________________________

Location: ______________________________

1. Determine Design Flow (Use Worksheet 2)	Q_{BMP} = __________ cfs
2. Design Width $W_m = (Q_{BMP})/0.005$ cfs/ft	W_m = __________ ft
3. Design Length (15 ft minimum)	L_m = __________ ft
4. Design Slope (4 % maximum)	S_D = __________ %
5. Flow Distribution (check type used or describe "other")	☐ Slotted curbing ☐ Modular Block Porous Pavement ☐ Level Spreader ☐ other ____________________
6. Vegetation (describe)	____________________ ____________________
5. Outflow Collection (check type used or describe "other")	☐ Grass Swale ☐ Street Gutter ☐ Storm Drain ☐ Underdrain ☐ Other ____________________

Notes:

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Design Procedure Form for Water Quality Inlets

Designer: ______________________________
Company: ______________________________
Date: ______________________________
Project: ______________________________
Location: ______________________________

1. Determine Design Flow Rate (Use Worksheet 2)	Q_{BMP} = __________ cfs
2. Water Quality Inlet Manufacturer Name Model Flow Capacity of Model Please include a technical sheet from the manufacturer with information on this model.	 Make __________________ Model __________________ Capacity ____________ cfs

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