## Sizing Worksheet - HM-1 Dry Extended Detention Basin

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| Designer:<br>Project Proponent:<br>Date:<br>Project:<br>Location: | |
| Type of Vegetation: | Native Grasses _____<br>Irrigated Turf _____<br>Other ________________________ |
| Outflow Collection:<br>Outlet Type (check one | Single Orifice _____<br>Multi-orifice Plate _____<br>Perforated Pipe _____<br>Other ________________________ |
| Depth of water above bottom orifice | Depth = _____ feet |
| Single Orifice Outlet<br>1)Total Area<br>2) Diameter or W x L | A = _____ square inches<br>D = _____ inches |
| Multiple Orifice Outlet<br>1) Area per row of perforations<br>2) Perforation Diameter (2 inches max.)<br>3) No. of Perforations (columns) per Row<br>4) No. of Rows (4 inch spacing)<br>5) Total Orifice Area<br>(Area per row) x (Number of Rows) | A = _____ square inches<br>D = _____<br>Perforations = _____<br>Rows = _____<br>Area = _____ square inches |
| **Step 1: Determine water quality design volume** | |
| 1-1. Enter Project area (acres), $A_{project}$<br>If this BMP captures runoff from a portion of the project area, enter the tributary area | $A_{project}$ = acres |
| 1-2. Enter Project impervious fraction, *Imp* (e.g. 60% = 0.60) | Imp= |
| 1-3. Determine pervious runoff coefficient using Table C-1, $C_p$ | $C_p$ = |

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| 1-4. Calculate runoff coefficient, *$C = 0.95*imp + C_p (1-imp)$* | C = | |
| 1-5. Enter design rainfall depth of the storm (in), $P_i$ | $P_i$ = | in |
| 1-6. Calculate rainfall depth (ft), $P = P_i/12$ | P = | ft |
| 1-7. Calculate water quality design volume ($ft^3$), $SQDV=43560•C*P*A_{project}$ | SQDV = | $ft^3$ |
| **Step 2: Calculate the volume of the active basin** | | |
| 2-1. Calculate basin active volume (includes water quality design volume + sediment storage volume) ($ft^3$), $V_a = 1.20 \times SQDV$ | $V_a$ = | $ft^3$ |
| **Step 3: Determine Detention Basin Location and Preliminary Geometry Based on Site Constraints** | | |
| 3-1. Based on site constraints, determine the basin geometry and the storage available by developing an elevation-storage relationship for the basin. For this simple example, assume a trapezoidal geometry for cell 1 (forebay) and cell 2. | | |
| 3-2. Enter the total surface area of the basin footprint based on site constraints ($ft^2$), $A_{tot}$ | $A_{tot}$ = | $ft^2$ |
| 3-3. Enter the length of the basin footprint based on site constraints (ft), $L_{tot}$ | $L_{tot}$ = | ft |
| 3-4. Calculate the width of the basin footprint (L:W = 1.5:1 min) (ft), $W_{tot} = A_{tot} / L_{tot}$ | $W_{tot}$ = | ft |
| 3-5. Enter interior side slope as length per unit height (H:V, min = 3), $Z$ | Z = | |
| 3-6. Enter desired freeboard depth (ft), $d_{fb}$ (min: 2 ft on-line; 1 ft offline) | $d_{fb}$ = | ft |
| 3-7. Calculate the length of the active volume surface area including the internal berm but excluding freeboard, $L_{av\text{-}tot} = L_{tot} - 2Zd_{fb}$ | $L_{av\text{-}tot}$ = | ft |
| 3-8. Calculate the width of the active volume surface area including the internal berm but excluding freeboard, $W_{av\text{-}tot} = W_{tot} - 2Zd_{fb}$ | $W_{av\text{-}tot}$ = | ft |
| 3-9. Calculate the total active volume surface area including the internal berm and excluding freeboard, $A_{av\text{-}tot} = L_{av\text{-}tot} \times W_{av\text{-}tot}$ | $A_{av\text{-}tot}$ = | $ft^2$ |
| 3-10. Enter the width of the internal berm (6 ft min), $W_{berm}$ | $W_{berm}$ = | ft |
| 3-11. Enter the length of the internal berm (ft), $L_{berm} = W_{av\text{-}tot}$ | $L_{berm}$ = | ft |

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| 3-12. Calculate the area of the berm (ft²), $A_{berm} = W_{berm} \times L_{berm}$ | $A_{berm}$ = | $ft^2$ |
| 3-13. Calculate the surface area excluding the internal berm and freeboard (ft²), $A_{av} = A_{av\text{-}tot} - A_{berm}$ | $A_{av}$ = | $ft^2$ |
| **Step 4: Determine Dimensions of forebay** | | |
| 4-1. Enter the percentage of $V_a$ in forebay (5-15% required), $\%V_1$ | $\%V_1$ = | % |
| 4-2. Calculate the active volume of forebay, $V_1 = V_a \bullet \%V_1$ | $V_1$ = | $ft^3$ |
| 4-3. Enter a desired average depth for the active volume of forebay, $d_1$ | $d_1$ = | ft |
| 4-4. Calculate the surface area for the active volume of forebay, $A_1 = V_1 / d_1$ | $A_1$ = | $ft^2$ |
| 4-5. Enter the width of forebay, $W_1 = W_{av\text{-}tot} = L_{berm}$ | $W_1$ = | ft |
| 4-6. Calculate the length of forebay (<u>Note:</u> inlet and outlet should be configured to maximize the residence time), $L_1 = A_1 / W1$ | $L_1$ = | ft |
| **Step 5: Determine Dimensions of Cell 2** | | |
| 5-1. Calculate the active volume of Cell 2, $V_2 = V_a - V_1$ | $V_2$ = | $ft^3$ |
| 5-2. Calculate the surface area of the active volume of Cell 2, $A_2 = A_{av} - A_1$ | $A_2$ = | $ft^2$ |
| 5-3. Calculate the average depth for the active volume of Cell 2, $d_2 = V_2 / A_2$ | $d_2$ = | ft |
| 5-4. Enter the width of Cell 2, $W_2 = W_1 = W_{av\text{-}tot} = L_{berm}$ | $W_2$ = | ft |
| 5-5. Calculate the length of Cell 2, $L_2 = A_2 / W_2$ | $L_2$ = | ft |
| 5-6. Calculate the width of Cell 2 at half of $d_2$, $W_{mid2} = W_2 - Zd_2$ | $W_{mid2}$ = | ft |
| 5-7. Calculate the length of Cell 2 at half of $d_2$, $L_{mid2} = L_2 - Zd_2$ | $L_{mid2}$ = | ft |
| 5-8. Verify that the length-to-width ratio of Cell 2 at half of $d_2$ is at least 1.5:1 with ≥ 2:1 preferred. If the length-to-width ratio is less than 1.5:1, modify input parameters until a ratio of at least 1.5:1 is achieved. If the input parameters cannot be modified as a result of site constraints, another site for the basin should be chosen, $LW_{mid2} = L_{mid2} / W_{mid2}$ | $LW_{mid2}$ = | |

| **Step 6: Ensure Design Requirements and Site Constraints are Achieved** |
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| 6-1. Check design requirements and site constraints. Modify design geometry until requirements are met. If the chosen site for the basin is inadequate to meet the design requirements, choose a new location or alternative treatment BMP. |
| **Step 7: Size Outlet Structure** |
| 7-1. The total drawdown time for the basin should be 36-48 hours. The outlet structure shall be designed to release the bottom 50% of the detention volume (half-full to empty) over 24-32 hours, and the top half (full to half-full) in 12-16 hours. A primary overflow should be sized to pass the peak flow rate from the developed capital design storm. |
| **Step 8: Determine Emergency Spillway Requirements** |
| 8-1. For online basins, an emergency overflow spillway should be sized to pass flows greater than the design peak runoff discharge rate for the 100-yr, 24-hr storm in order to prevent overtopping of the walls or berms in the event that a blockage of the riser occurs. For offline basins, an emergency spillway or riser should be sized to pass the 100-yr, 24-hr post-development peak storm water runoff discharge rate directly to the downstream conveyance system or another acceptable discharge point. For sites where the emergency spillway discharges to a steep slope, an emergency overflow riser, in addition to the spillway should be provided. |