

Appendix B
Stormwater Quality Best Management Practice
Design Handbook

Austin Sand Filter Example

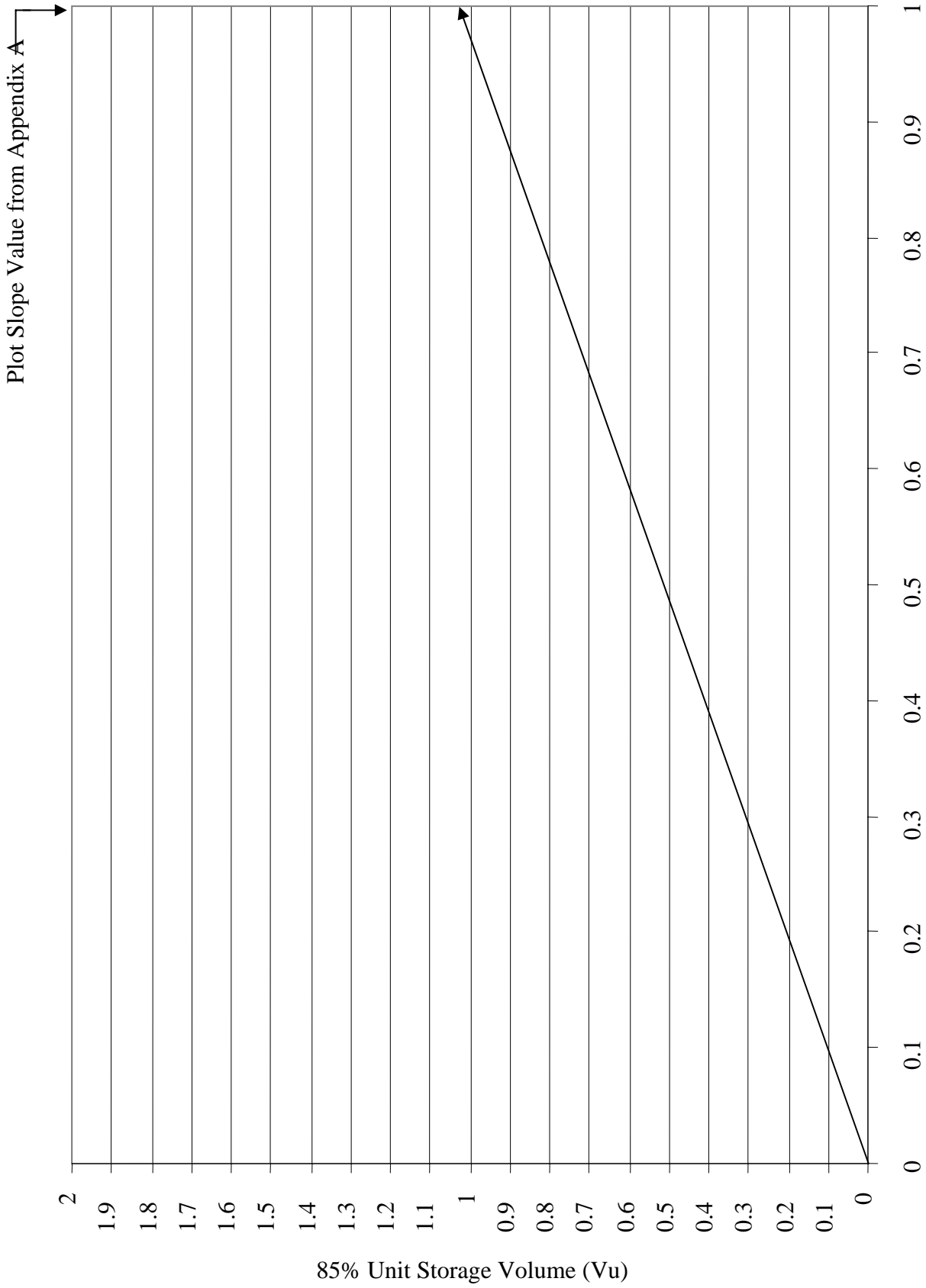


Figure 2 Unit Storage Volume Graph

Datasheet

Site Conditions:

$A_{\text{total}} = 40$ acres	(from worksheet 1)
$V_{\text{BMP}} = 50820$ ft ³	(from worksheet 1)
L:W Ratio = 2:1	(min 2:1, consider site constraints)
Site Elevation = 1509.1'	(at proposed BMP location)
Outlet Elevation = 1500'	(storm drain system to serve as outlet)

Design Assumptions:

Sedimentation Basin Design:

The sedimentation basin volume must be greater than or equal to the V_{BMP} . The maximum depth of water in the sedimentation basin, $2h$, is determined based on the total elevation difference between the BMP inlet and outlet.

Using Figure 9:

Elev. of point A = 1500.1 ft	(assuming 10' to connect to outlet at 1% slope)
Filter Depth = 3 ft	(assuming the minimum depth of 3 ft)
Elev. of point B = 1503.1 ft	
Elev. of point C = 1509.1 ft	(site elevation)
$2h = [(C-B)-1'$ freeboard]	
= 5 ft	

Sedimentation Basin Area

$$A_s = V_{\text{BMP}} / (2h) = 50820 \text{ ft}^3 / (5 \text{ ft}) = 10164 \text{ ft}^2$$

$$L = 2 * W$$

$$A_s = 2W^2$$

$$10164 \text{ ft}^2 = 4*W^2$$

$$W = 71.3 \text{ ft} \rightarrow \text{round to } 72 \text{ ft}$$

$$L = 144 \text{ ft}$$

$$A_s = 10368 \text{ ft}^2$$

Filter Basin Design:

The minimum filter basin surface area is determined with the following equation:

$$\begin{aligned} A_f &= V_{\text{BMP}} / 18 \\ &= 50820 \text{ ft}^3 / 18 = 2823 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} V_{\text{fb}} &= A_f * \text{filter depth} \\ &= 2823 \text{ ft}^2 * 3 \text{ ft} = 8469 \text{ ft}^3 \end{aligned}$$

The required filter basin volume shall be at least 20 percent of the VBMP:

$$V_r = 0.2 * V_{BMP} = 10164 \text{ ft}^3 \geq V_{fb} \rightarrow \text{Not Ok, increase filter area}$$

$$A_f = V_r / \text{filter depth} \\ = 10164 \text{ ft}^3 / 3 \text{ ft} = 3388 \text{ ft}^2$$

$$\text{width} = 72 \text{ ft} \quad (\text{same as sedimentation basin}) \\ \text{length} = 3388 \text{ ft}^2 / 72 \text{ ft} = 47.1 \rightarrow \text{round to 50 ft}$$

$$A_f = 3600 \text{ ft}^2 \\ V_f = 3600 \text{ ft}^2 * 3 \text{ ft} = 10800 \text{ ft}^3$$

$$V_{fb} = A_f * \text{filter depth} \\ = 3600 \text{ ft}^2 * 3 \text{ ft} = 10800 \text{ ft}^3 \geq V_r \rightarrow \text{Ok}$$

Design Procedure Form for Austin Sand Filter

Designer: Jennifer Otterson
 Company: Riverside County Flood Control and Water Conservation District
 Date: 5/20/04
 Project: BMP Example
 Location: Winchester/Antelope Valley Area

<p>1. Determine Design Storage Volume (Use Worksheet 1)</p> <p>a. Total Tributary Area (maximum 100)</p> <p>b. Design Storage Volume, V_{BMP}</p>	$A_{total} = \underline{40} \text{ acres}$ $V_{BMP} = \underline{50820} \text{ ft}^3$
<p>2. Maximum Water Height in Sedimentation Basin*</p> <p>a. Invert elevation at connection to storm drain system.</p> <p>b. Sand Filter invert elevation (consider min. grade (1%) from storm drain). Point A, Figure 9.</p> <p>c. Estimate filter depth or use min. (3').</p> <p>d. Top elevation of filter bed. Point B, Figure 9.</p> <p>e. Surface elevation at BMP inlet. Point C, Figure 9.</p> <p>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')</p> $2h = [(C-B) - 1' \text{ Freeboard}]$	$\text{Elev. Storm Drain} = \underline{1500} \text{ ft}$ $\text{Elev. Pt A} = \underline{1500.1} \text{ ft}$ $\text{Filter Depth} = \underline{3} \text{ ft}$ $\text{Elev. Pt B} = \underline{1503.1} \text{ ft}$ $\text{Elev. Pt C} = \underline{1509.1} \text{ ft}$ $2h = \underline{5} \text{ ft}$
<p>3. Size Sedimentation Basin</p> <p>a. Find Sedimentation Basin Area, A_s $A_s = V_{BMP} / (2h)$</p> <p>b. Determine basin length and width, using a length to width ratio $\geq 2:1$ $A_s = 2 \times W^2$ length = 2 x width</p>	$A_s = \underline{10164} \text{ ft}^2$ $\text{width} = \underline{72} \text{ ft}$ $\text{length} = \underline{144} \text{ ft}$
<p>4. Size Filter Basin</p> <p>a. Determine Filter Basin Area, A_f minimum $A_f = V_{BMP} / 18$</p>	$A_f = \underline{3600} \text{ ft}^2$

<p>b. Determine Filter Basin Volume $V_f = A_f \times \text{filter depth (part 2c)}$</p> <p>c. Determine Required Volume, V_r $V_r = 0.2 \times V_{\text{BMP}}$</p> <p>d. Check if $V_r \geq V_f$? If no, redesign with an increased filter depth or increase filter area.</p>	<p>$V_f = \underline{10800} \text{ ft}^3$</p> <p>$V_r = \underline{10164} \text{ ft}^3$</p> <p>Check $V_r \geq V_f$ <u>ok</u></p>
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Notes:

The total surface area occupied by this BMP is 0.32 Acres

* 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.