Chapter

4

Selecting and Locating the Most Effective BMP System

4.0 Selecting the Best BMP at a Site

This chapter outlines a process for selecting the best BMP or group of BMPs for a development site, and provides guidance on factors to consider on where to put them. The process is used to screen which BMPs can meet the pollutant removal targets for the V_w, and guides the designer through four steps that progressively screen:

- Storm Water Management Suitability
- Physical Feasibility Factors
- Community and Environmental Factors
- Checklist: Location and Permitting Considerations

More detail on the step-wise screening process is provided below:

Step ❶ Storm Water Management Suitability

Can the BMP meet all storm water sizing criteria at the site or are a combination of BMPs needed? In this step, designers can screen the BMP list using Matrix No. 1 to determine if a particular BMP can meet the V_w, Q_p, and/or Q_f storage requirements. In addition, the first matrix provides comparative indices on land consumption and safety risk that may preclude a BMP. At the end of this step, the designer can screen the BMP options down to a manageable number and determine if a single BMP or a group of BMPs are needed to meet storm water sizing criteria at the site.

Step ❷ Physical Feasibility Factors

Are there any physical constraints at the project site that may restrict or preclude the use of a particular BMP? In this step, the designer screens the BMP list using Matrix No. 2 to determine if the soils, water table, drainage area, slope or head conditions present at a particular development site might limit the use of a BMP. In addition, the matrix indicates which BMP options work well in highly urbanized areas.

Step ❸ Community and Environmental Factors

Do the remaining BMPs have any important community or environmental benefits or drawbacks that might influence the selection process? In this step, a matrix is used to compare the BMP options with regard to maintenance, habitat, community acceptance, cost and other environmental factors.

Step ❹ Location and Permitting Considerations

What environmental features must be avoided or considered when locating the BMP system at a site

to fully comply with local and federal regulations? In this step, the designer follows an environmental features checklist that asks whether any of the following are present at the site: wetlands, waters of the United States, floodplains, and development infrastructure. Brief guidance is then provided on how to locate BMPs to avoid impacts to sensitive resources. If a BMP must be located within a sensitive environmental area, a brief summary of applicable permit requirements is provided.

Section 4.1 Storm Water Management Suitability

The first matrix (Table 4.1) examines the capability of each BMP option to meet the storm water management sizing criteria outlined in Chapter 2. Thus, it shows whether a BMP has the:

Ability to Meet the Water Quality Volume Requirement (V_w). It should be noted that not all practices are capable of meeting the V_w requirement. Thus, if a BMP cannot meet the V_w requirement, the matrix can help identify supplemental practices that can.

Ability to Provide Quantity Control (Q_{p2} and/or Q_{p15}). The matrix shows whether a BMP can typically meet the peak discharge requirement for the site. Again, the finding that a particular BMP cannot meet the requirement does not necessarily mean that it should be eliminated from consideration, but rather, is a reminder that more than one practice may be needed at a site (e.g., a bioretention area and a downstream storm water detention pond or detention structure).

Safety Index. A comparative index that expresses the potential safety risk of a BMP when designed according to the performance criteria outlined in Chapter 3. The safety factor is included at this stage of the screening process because liability and safety are of paramount concern in many residential settings.

Space Consumption Index. This comparative index expresses how much space a BMP typically consumes at a site. Again, this factor is included in this early screening stage because many BMPs are severely constrained by land consumption.

Table 4.1 BMP Selection Matrix No. 1 - Storm Water Management Suitability

Code	BMP List	V_w Ability	Q_p Control	Q_f Control	Safe	Space
F-1	Surface SF	●	○	○	safe	low
F-2	1-Chamber Underground SF	●	○	○	depends	low
F-3	3-Chamber Underground SF	●	◗	○	depends	low
F-4	Perimeter SF	●	○	○	safe	low
F-5	Vertical SF	●	○	○	safe	low
F-6	Organic Filter	●	○	○	safe	low
F-7	Bioretention	●	○	○	safe	medium
F-8	Roof Downspout System	●	○	○	safe	low
I-1	Infiltration Trench	●	◗	◗	safe	low
I-2	Infiltration Basin	●	◗	◗	safe	medium
S-1	Underground Vault	○	●	●	safe	low
S-2	Dry Pond	○	●	●	safe	medium
P-1	Micropool ED Pond	●	●	●	safe	low
P-2	Wet Pond	●	●	●	depends	medium
P-3	Wet ED Pond	●	●	●	depends	low
P-4	Pocket Pond	●	●	●	depends	low
W-1	Shallow Wetland	●	●	●	safe	high
W-2	ED Shallow Wetland	●	●	●	depends	medium
W-3	Pocket Wetland	●	●	●	safe	medium
O-1	Dry Swale	●	○	○	safe	medium
O-2	Wet Swale	●	○	○	safe	medium

V_w , Q_p, Q_f:
● = Yes
○ = No
◗ = Depends

Safety:
safe = low risk
unsafe = potential safety risks
depends = depends on site-specific conditions

Space:
low = BMP consumes relatively small amount of land
high = BMP consumes relatively high fraction of land
medium = depends on design

Section 4.2 Physical Feasibility Factors

At this point, the designer has narrowed down the BMP list to a manageable size and can evaluate the remaining options given the actual physical conditions at a site. This matrix (Table 4.2) will ultimately cross-reference the testing protocols needed to confirm physical conditions at the site. The six primary factors are:

Soils. The key evaluation factors are based on an initial investigation of the NRCS hydrologic soils groups at the site. Note that more detailed geotechnical tests are usually required for infiltration feasibility and during design to confirm permeability and other factors.

Water Table. This column indicates the minimum depth to the seasonally high water table from the bottom or floor of a BMP.

Drainage Area. This column indicates the minimum or maximum drainage area that is considered suitable for the practice. If the drainage area present at a site is slightly greater than the maximum allowable drainage area for a practice, some leeway is permitted. The minimum drainage areas indicated for ponds and wetlands should not be considered inflexible limits, and may be increased or decreased depending on water availability (baseflow or groundwater) or the mechanisms employed to prevent clogging or ensure an impermeable pond bottom.

Slope. This column evaluates the effect of slope on the practice. Specifically, the slope restrictions refer to how flat the area where the practice is installed must be.

Head. This column provides an estimate of the elevation difference needed at a site (from the inflow to the outflow) to allow for gravity operation within the practice.

Ultra-Urban Sites. This column identifies BMPs that work well in the ultra-urban environment, where space is limited and original soils have been disturbed. These BMPs are frequently used at redevelopment sites.

Table 4.2 BMP Selection Matrix No. 2 - Physical Feasibility Factors

Code	Bmp List	Soils	Water Table	Drainage Area	Site Slope	Head	Ultra Urban
F-1	Surface SF	OK	4 ft	10 ac max[1]	6% max	5 ft	depends
F-2	1-Chamber Underground SF			10,000 sq ft max		5 to 7ft	OK
F-3	3-Chamber Underground SF			2 ac max[1]			
F-4	Perimeter SF					2 to 3 ft	
F-5	Vertical SF					4 to 5 ft	
F-6	Organic Filter			5 ac max[1]		2 to 4 ft	
F-7	Bioretention	Made Soil				5 ft	
F-8	Roof Downspout System	OK		20,000 sq ft		N/A	
I-1	Infiltration Trench	f_c > 0.52 inch/hr	4 ft	5 ac max	6% max	1 ft	depends
I-2	Infiltration Basin			10 ac max		3 ft	not practical
S-1	Underground Vault	OK	4 ft	no limit[2]	no limit[4]	2 to 3 ft	OK
S-2	Dry Pond	"A" soils may require pond liner "B" soils may require testing	no restrictions		15% max		not practical
P-1	Micropool ED Pond	"A" soils may require pond liner "B" soils may require testing	4 ft if hotspot or aquifer	10 ac min[3]	15% max	6 to 8 ft	not practical
P-2	Wet Pond			25 ac min[3]			
P-3	Wet ED Pond						
P-4	Pocket Pond	OK	below WT[4]	5 ac max[1]		4 ft	OK
W-1	Shallow Wetland	A soils may require liner	4 ft if hotspot or aquifer	25 ac min	8% max	3 to 5 ft	not practical
W-2	ED Shallow Wetland						
W-3	Pocket Wetland	OK	below WT[4]	5 ac max		2 to 3 ft	depends
O-1	Dry Swale	Made Soil	4 ft	5 ac max	4% max	3 to 5 ft	not practical
O-2	Wet Swale	OK	below WT[4]			1 ft	

Notes: OK= not restricted; f_c= infiltration rate or permeability; WT= water table; N/A= not applicable; PT = pretreatment

1. drainage area can be larger in some instances.
2. no limit but practical drainage area limitations may exist due to minimum orifice size (e.g., 1" diameter with internal orifice)
3. unless adequate water balance and anti-clogging device installed
4. may not be used to accept runoff from storm water hotspot areas

Section 4.3 Community and Environmental Factors

The third step assesses community and environmental factors involved in BMP selection. This matrix (Table 4.3) employs a comparative index approach. The table indicates whether a BMP has a high, medium, or low benefit in each of four categories. A fifth category includes miscellaneous factors to consider.

Maintenance. This column assesses the relative maintenance effort needed for a BMP, in terms of three criteria: frequency of scheduled maintenance, chronic maintenance problems (such as clogging) and reported failure rates. It should be noted that **all BMPs** require routine inspection and maintenance.

Community Acceptance. This column assesses community acceptance, as measured by three factors: market and preference surveys, reported nuisance problems, and visual orientation (i.e., is it prominently located, or is it in a discrete underground location). It should be noted that a low rank can often be improved by a better landscaping plan.

Affordability. The BMPs are ranked according to their relative construction cost per impervious acre treated as determined from cost surveys and local experience.

Habitat. BMPs are evaluated on their ability to provide wildlife or wetland habitat, assuming that an effort is made to landscape them appropriately. Objective criteria include size, water features, wetland features and vegetative cover of the BMP and its buffer.

Other Factors. This column indicates other considerations in BMP selection.

Table 4.3 BMP Selection Matrix No. 3 - Community and Environmental Factors

Code	Bmp List	Ease of Maintenance	Community Acceptance	Affordability	Habitat	Other Factors
F-1	Surface SF	Medium	Medium	Low	Low	Minimize concrete
F-2	1-Chamber Underground SF	Low	High	Low	Low	Out of sight
F-3	3-Chamber Underground SF	Low	High	Low	Low	Out of sight
F-4	Perimeter SF	Low	High	Low	Low	Traffic bearing
F-5	Vertical SF	Low	High	Low	Low	
F-6	Organic SF	Medium	High	Low	Low	Change compost
F-7	Bioretention	Low	Medium	Medium	Low	Landscaping
F-8	Roof Downspout System	Low	High	Medium	Low	Frequent inspection
I-1	Infiltration Trench	Low	High	Medium	Low	Avoid large stone
I-2	Infiltration Basin	Low	Low	Medium	Low	Frequent pooling
S-1	Underground Vault	Medium	High	Low	Low	
S-2	Dry Pond	Medium	Medium	High	Low	
P-1	Micropool ED Pond	Medium	Medium	High	Medium	Trash/debris
P-2	Wet Pond	High	High	High	High	High pond premium
P-3	Wet ED Pond	High	High	High	High	
P-4	Pocket Pond	Low	Medium	High	Low	Drawdowns
W-1	Shallow Wetland	Medium	High	Medium	High	
W-2	ED Shallow Wetland	Medium	Medium	Medium	High	Limit ED depth
W-3	Pocket Wetland	Low	Low	High	Medium	Drawdowns
O-1	Dry Swale	High	High	Medium	Low	
O-2	Wet Swale	High	Medium	High	Low	Possible mosquitos

High = High Benefit
Medium = Medium Benefit
Low = Low Benefit

Section 4.4 Checklist: Location and Permitting Considerations

In the last step, a designer assesses the physical and environmental features at the site to determine the optimal location for the selected BMP or group of BMPs (Table 4.4). The checklist below provides a condensed summary on current BMP restrictions as they relate to common site features that may be regulated under local or federal law. These restrictions fall into one of three general categories:

1. Locating a BMP within an area that is expressly *prohibited* by law.

2. Locating a BMP within an area that is *strongly discouraged*, and is only allowed on a case by case basis. Local and/or federal permits shall be obtained, and the applicant will need to supply additional documentation to justify locating the BMP within the regulated area.

3. BMPs must be *setback* a fixed distance from the site feature.

This checklist is only intended as a general guide to location and permitting requirements as they relate to siting of storm water BMPs. Consultation with the appropriate regulatory agency is the best strategy.

Table 4.4 Location and Permitting Considerations

Site Feature	Location And Permitting Guidance
Jurisdictional Wetland U.S. Army Corps of Engineers Section 404 Permit	■ Wetlands should be delineated prior to siting storm water BMPs. ■ Use of natural wetlands for storm water treatment is *strongly discouraged*. ■ BMPs are also *restricted* in the 25 to 100 foot required wetland buffer. ■ Buffers may be utilized as a non-structural filter strip (i.e., accept sheetflow). ■ Must justify that no practical upland treatment alternatives exist. ■ Storm water must be treated prior to discharge into a wetland. ■ Where practical, excess storm water flows should be conveyed away from jurisdictional wetlands.
Stream Channel (Waters of the U.S.) U.S. Army Corps of Engineers Section 404 Permit	■ Stream channels should be delineated prior to design. ■ In-stream ponds (should be located near the origin of first order streams) and require review and permit. ■ Must justify that no practical upland treatment alternatives exist. ■ Temporary runoff storage (Cp_v) preferred over permanent pools (V_w). ■ Implement measures that reduce downstream warming.
100 Year Floodplain District of Columbia Emergency Management Agency District of Columbia Department of Health	■ Grading and fill for BMP construction is *strongly discouraged* within the ultimate 100 year floodplain, as delineated by FEMA flood insurance rate maps, FEMA flood boundary and floodway maps, or more stringent local floodplain maps. ■ Floodplain fill cannot raise the floodplain water surface elevation by more than a tenth of a foot.
Utilities District of Columbia Water and Sewer Authority	■ Locate existing utilities prior to design. ■ Note the location of proposed utilities to serve development. ■ BMPs are *discouraged* within utility easement or right of way for public or private utilities.

Table 4.4 Location and Permitting Considerations

Site Feature	Location And Permitting Guidance
Roads District of Columbia Department of Public Works	■ Consult DPW for any *setback* requirement from local roads. ■ Approval must also be obtained for any storm water discharges to a District-owned conveyance channel.
Structures District of Columbia Department of Public Works District of Columbia Water and Sewer Authority Department of Consumer and Regulatory Affairs	■ Consult local review authority for BMP *setbacks* from structures. ■ Recommended *setbacks* for each BMP group are provided in the performance criteria in Chapter 3 of this manual.
Water Wells District of Columbia Bureau of Water Quality	■ 100 foot *setback* for storm water infiltration. ■ 50 foot *setback* for all other BMPs. ■ Water appropriation permit needed if well water used for water supply to a BMP.
Combined Sewer Watersheds District of Columbia Water and Sewer Authority	■ Provide full quantity and quality control.