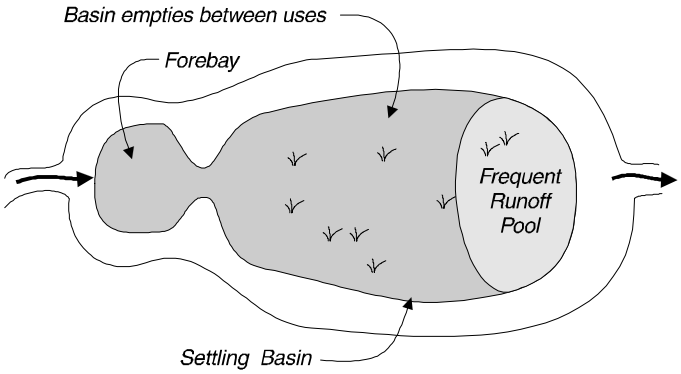
BMP DD: Dry Detention Basin



Definition and Purpose

A dry detention basin consists of a settling basin with an outlet sized to slowly release detained runoff over a 40-hour period. A "dry" detention basin is designed to be empty between usages.

Applications

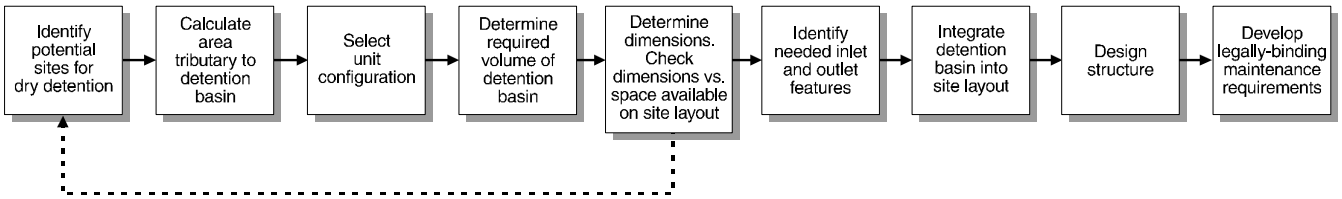
Dry detention basins are suitable for sites over 10 acres and are capable of removing particulate pollutants only. Land uses for which detention basins are appropriate include residential, commercial, and institutional uses and industrial uses, except for extractive, clay/glass/concrete works, food and printing. Most appropriate for sites with silt and expansive clay soils.

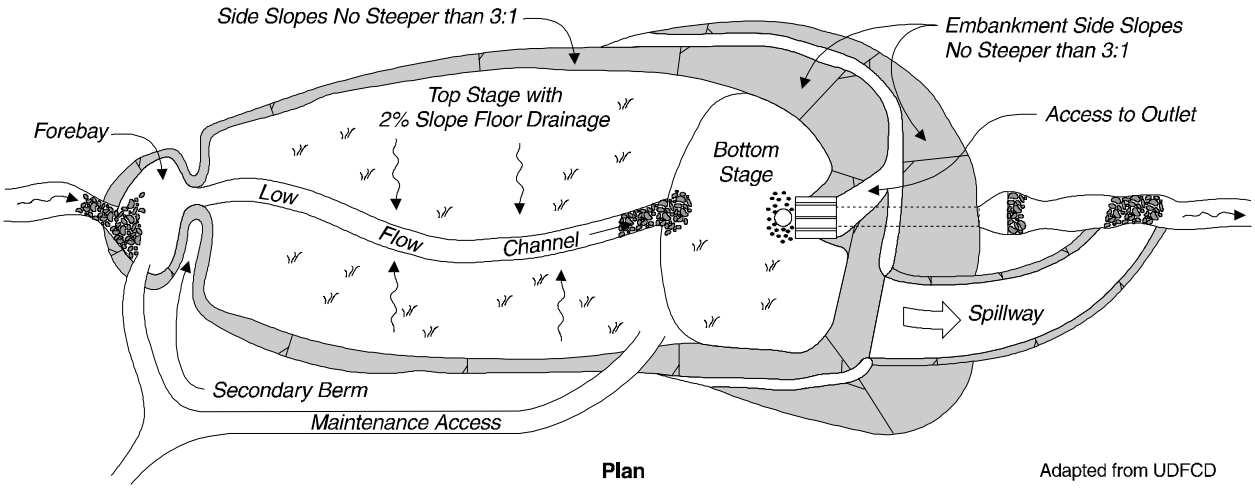
Limitations

- Not effective at removing liquid and dissolved pollutants.
- Small orifice diameter precludes use in small watersheds.
- Requires differential elevation between inlet and outlet.

Design Guidance, General

Dry detention basins improve stormwater runoff quality by detaining runoff and releasing it over an extended period (40 hours), allowing settling to occur. Basin layouts include a forebay, an outlet, a spillway and maintenance access roads (Figures DD-1 and DD-2). Dry detention basins are ideal in areas that do not have the consistent base flow available for the permanent pool used in wet detention basins, or in areas where supplemental water is too costly to be used. Dry basins are less likely to have mosquito problems and are less expensive to construct than wet basins. The following flow chart shows the general steps for designing this BMP.



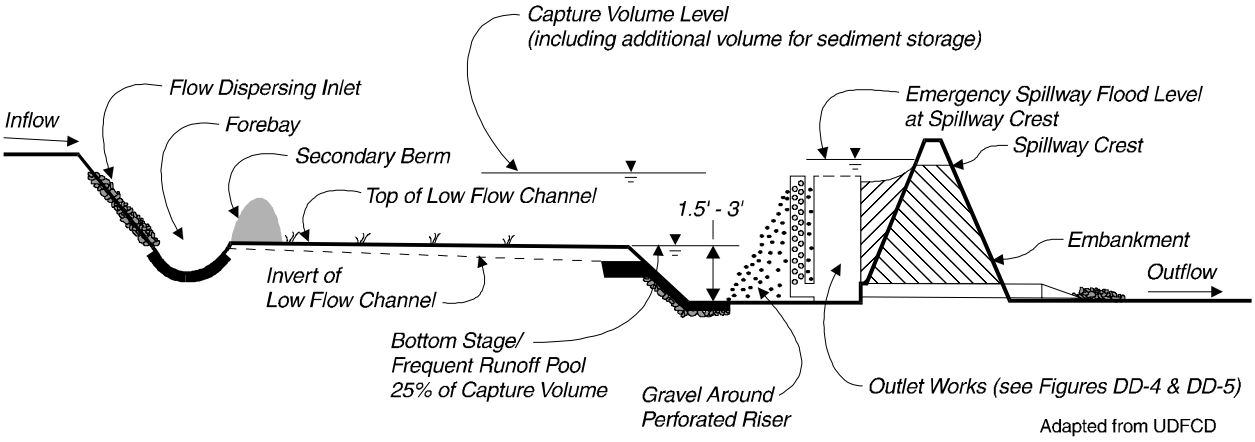


Plan

Adapted from UDFCD

Figure DD – 1

Dry Detention Basin (Top View)



Adapted from UDFCD

Section

Figure DD – 2

Dry Detention Basin (Side View)

Dry detention basins shall be designed to have gently sloping sides (4:1 or flatter recommended, 3:1 maximum). Shallow basins are recommended over deep ones with the same volume. In two-stage design, the bottom stage (the frequent runoff pool) should store 25 percent of the basin volume and should be deeper than the top stage (Figure DD-2). Even with mild slopes and low flow rates, erosion may be a problem. The use of vegetation will help to reduce erosion. Floatables may be addressed by including trash racks in the design.

Outlet structures for dry detention basins shall be tailored for suitability with the basin size and shape. In large detention basins, install the outlet in a concrete block structure to prevent floatation of the outlet (Figure DD-3). Figure DD-4 shows an outlet detail. For small basins, the outlet can be constructed in a berm or manhole located downstream of facility (Figure DD-5).

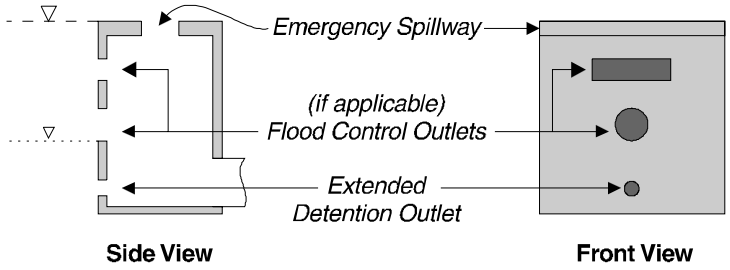


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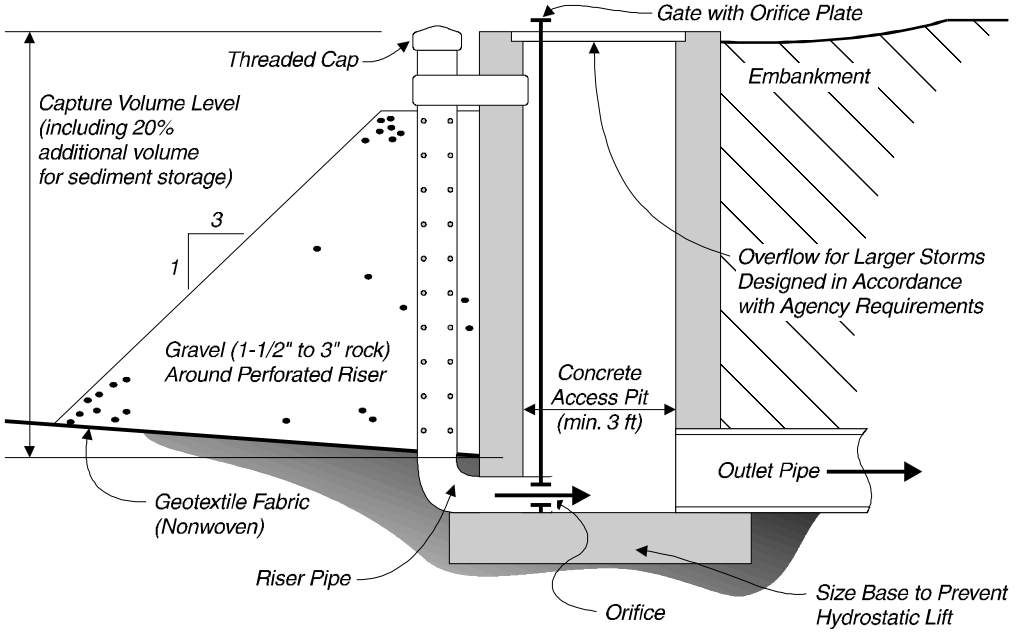
Figure DD – 3



Source: UDFCD

Figure DD – 4

Outlet with Perforated Riser Pipe

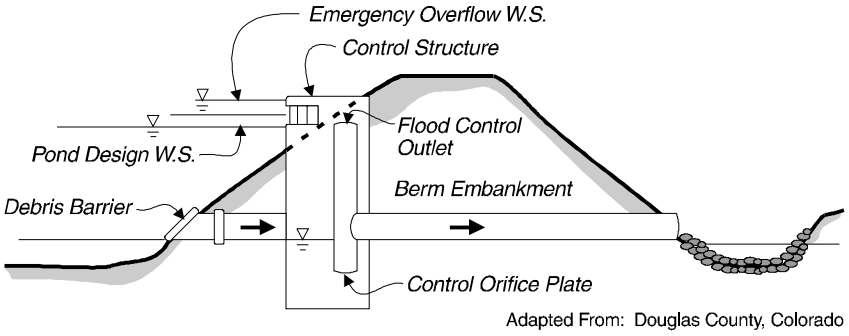


Figure DD – 5

Control Manhole

Dry Basin Design

Size the Basin

Review the unit's drainage area and determine the percentage of impervious area. Impervious area includes paved areas, roofs, and other developed, non-vegetated areas. Non-vegetated, compacted soil areas shall be considered an impervious area. Porous pavements installed and maintained as a stormwater quality control BMP may be considered a pervious area. The percentage of impervious area will be used to determine the runoff coefficient ("C").

Using Table B-1 (Appendix B), determine the runoff coefficient ("C") for the unit's drainage area based on the percentage of impervious area. The runoff coefficient ("C") will be used to determine the appropriate curve in Figure B-1.

Enter Figure B-1 (Appendix B) on the vertical axis at 80% Annual Capture. Move horizontally to the right across Figure B-1 until the curve corresponding to the drainage area's runoff coefficient ("C") is intercepted. Move vertically down Figure B-1 from this point until the horizontal axis is intercepted. Read the Unit Basin Storage Volume along the horizontal axis. Interpolation between curves may be necessary.

Calculate the required basin volume by multiplying the Unit Basin Storage Volume by the unit's drainage area. Convert the required storage volume to cubic feet.

Design the basin according to site constraints, with dimensions as noted in Figures DD-1 and DD-2, taking into account the following considerations.

< Include a forebay for initial course sediment settling. The forebay shall comprise 10 percent of the basin volume.

< Design for a top stage maximum depth (D_{max}) in feet:

$$D_{max} = 0.1 (A)^{0.5}$$

where: A = basin length (ft) x width (ft)

- Use a length to width ratio of at least 2:1, preferably 4:1 or more, with a minimum bottom width dimension of 30 feet. Ratio can be accomplished using baffles or multiple basins in series, if necessary.

- Provide access for maintenance equipment.

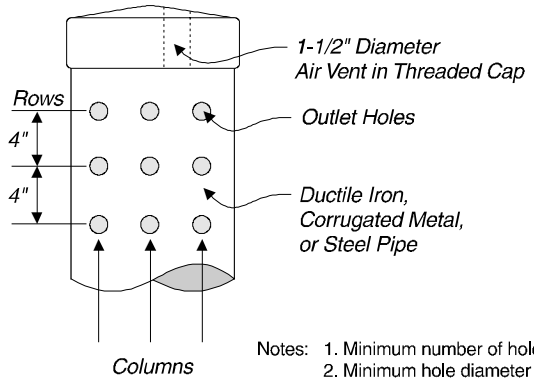
Size Outlet

It is important to size the basin outlet properly. Outlets that are too large result in partial filling of the basin and inadequate drawdown time. The outlet may be a single orifice, with or without a riser pipe. The outlet must be protected to avoid clogging from trash and debris. Use the following equation to size the outlet control orifice.

$$a = \frac{2A(H - H_0)^{0.5}}{3600cT(2g)^{0.5}}$$

where: a = area of orifice (ft^2)
A = average surface area of the full pond (ft^2)
c = orifice coefficient (use c=0.60)
T = drawdown time of full pond (use 40 hours)
g = gravity (32.2 ft/sec^2)
H = elevation when the basin is full (ft)
H_o = final elevation when basin is empty (ft).

A perforated riser pipe may be used (Figure DD-6). Use a sufficient number of columns and rows of outlet holes such that the sum of outlet hole areas equals "a" as defined above. Alternatively, install an orifice plate slide gate (DD-4), with the orifice size equal to "a". Then, install additional rows of holes in perforated riser to ensure that slide gate orifice size outflow of basin. Area of orifice (a) may need to be adjusted to account for installation specific hydraulic characteristics. Make adjustments to provide 40-hour drawdown.



Source: UDFCD

Figure DD – 6

Riser Pipe for Extended Detention Basin

Other Design Considerations

The following additional design considerations apply to dry detention basins:

Basins may be on-line or off-line with flood control facilities.

Incorporate a bypass for flows that exceed the design capacity of the BMP.

For on-line basins, the water quality outlet may be superimposed on the flood control outlet or may be constructed as a separate outlet.

Place inlets, outlets, baffles and berms to minimize short circuiting.

Protect inlet and outlet from erosion by incorporating an energy dissipator.

Include a gravel pack or trash rack at the outlet to prevent clogging.

Design embankments for stability to meet State of California Division of Safety of Dams requirements if structure falls within that agency's jurisdiction.

Use geotextile fabric with the minimum specifications listed in Table DD-1.

Table DD-1
Geotextile Properties (Nonwoven)

Property	***Test Reference***	***Minimum Specification***
Grab Strength	ASTM D4632	90 lbs
Elongation at peak load	ASTM D4632	50 %
Puncture Strength	ASTM D3787	45 lbs
Permitivity	ASTM D4491	0.7 sec^{-1}
Burst Strength	ASTM D3786	180 psi
Toughness	% Elongation x Grab Strength	5,500 lbs
Ultraviolet Resistance (Percent strength retained at 500 Weatherometer hours)	ASTM D4355	70%

Adapted from SSPWC, 1997.

Maintenance and Inspection Requirements

Dry detention basins require periodic maintenance and inspection including the following practices:

Inspect outlet periodically for clogging a minimum of twice a year, before and after the rainy season, after large storms, and more frequently if needed.

Check banks and bottom surface for erosion and fix problems.

Inspect the basin a minimum of twice a year, before and after the rainy season, after large storms, or more frequently if needed.

Remove sediment when accumulation reaches 25% of original design depth, or if resuspension is observed. Clean in early spring so vegetation damaged during cleaning has time to re-establish.

Clean forebay frequently to lesser frequency of main basin cleaning.

Control mosquitoes, as necessary.

Prepare a maintenance manual and submit it to the appropriate agency prior to facility installation.

Report on maintenance to the appropriate agency.