Dry Ponds

Description: A surface storage basin or facility designed to provide water quantity control and limited water quality benefits through detention and/or extended detention of stormwater runoff.

Components:

- Pool area –fills during a storm and releases water slowly through bottom outlet
- Forebay – settles out larger sediments in an area where sediment removal (maintenance) will be easier
- Spillway system – provides outlet for stormwater runoff when large storm events occur

Advantages/Benefits:

- Typically less costly than stormwater (wet) ponds for equivalent flood storage, as less excavation is required
- Provides recreational and other open space opportunities between storm runoff events

Disadvantages/Limitations:

- Controls for stormwater quantity—not intended to provide for total water quality treatment; assumed to achieve 60% TSS removal
- Must be used in conjunction with other water quality controls
- Tends to re-suspend sediment

Design considerations:

- Applicable for drainage areas up to 75 acres
- Drawdown of 24 to 48 hours
- Shallow pond with large surface area performs better than deep pond of same volume
- Assumed to provide 60% TSS removal

Selection Criteria:

- [ ] **Water Quality 80 % TSS Removal**
- [ ] **Accepts Hotspot Runoff**
- [x] **Residential Subdivision**
- [x] **High Density / Ultra Urban Use**

Maintenance:

- Remove debris from basin surface
- Remove sediment buildup
- Repair and revegetate eroded areas.
- Perform structural repairs to inlet and outlets.
- Mow unwanted vegetation

L **Maintenance Burden**

L = Low M = Moderate H = High

General Description

Dry extended detention (ED) basins, as shown in Figure 6.1, are surface facilities intended to provide for the temporary storage of stormwater runoff to reduce downstream water quantity impacts. These facilities temporarily detain stormwater runoff, releasing the flow over a period of time. They are designed to completely drain following a storm event and are normally dry between rain events. For the purposes of this application, dry detention and dry extended detention are considered the same treatment.

Dry detention basins, when used for flow attenuation, can be designed to control the 100-year storm event, the detention requirement for Metro.

Dry detention basins provide limited pollutant removal benefits and are not intended for sole water quality treatment. Detention-only facilities must be used in a treatment train approach with other structural controls that provide treatment of the WQ_v. This type of facility is assumed to provide 60% TSS removal. While the ponds may be providing peak flow attenuation in addition to water quality treatment (in-line ponds), the other water quality treatment controls in the treatment train must be off-line.

Compatible multi-objective use of dry detention facilities is strongly encouraged.

Site and Design Considerations

Location

1. Dry detention basins are to be located downstream of other structural stormwater controls providing treatment of the water quality volume (WQ_v). See Volume 4, PTP Section 6 Introduction, sub-section 6.2 for more information on the use of multiple structural controls in a treatment train.
2. The maximum contributing drainage area to be served by a single dry detention basin is 75 acres.

General Design

3. Dry detention basins can be sized to hold the WQ_v or, if used for flow attenuation, they can be sized to temporarily store the 100-year storm. Routing calculations must be used to demonstrate that the storage volume is adequate for flow attenuation. See Volume 2 for procedures on the design of detention storage.
4. Tennessee Safe Dams Act may apply to ponds with storage volumes and embankment heights large enough to fall under the regulation.
5. Vegetated embankments shall be less than 20 feet in height and shall have side slopes no steeper than 3:1 (horizontal to vertical). Riprap-protected embankments shall be no steeper than 2:1. Geotechnical slope stability analysis is recommended for embankments greater than 10 feet in height and is mandatory for embankment slopes steeper than those given above. All embankments must be designed to Tennessee state

Site and Design Considerations (Continued)

guidelines for dam safety, as applicable.

6. The maximum depth of the basin should not exceed 10 feet.
7. Areas above the normal high water elevations of the detention facility (that is, the largest event for which the facility is sized) should be sloped toward the basin to allow drainage and to prevent standing water. Careful finish grading is required to avoid creation of upland surface depressions that may retain runoff. A low flow or pilot channel across the facility bottom from the inlet to the outlet (often constructed with riprap) is recommended to convey low flows and prevent standing water conditions.
8. Adequate maintenance access must be provided for all dry basins.

Inlet and Outlet Structures

9. Inflow channels are to be stabilized with flared riprap aprons, or the equivalent. A sediment forebay sized to 0.1 inches per impervious acre of contributing drainage should be provided for dry detention basins.
10. For a dry detention basin used for flow attenuation, the outlet structure is sized for 100-year peak flow control (based upon hydrologic routing calculations) and can consist of a weir, orifice, outlet pipe, combination outlet, or other acceptable control structure. Small outlets that will be subject to clogging or are difficult to maintain are not acceptable. A low flow orifice capable of releasing the WQ_v over 24 hours must be provided.
11. Seepage control or anti-seep collars should be provided for all outlet pipes.
12. Riprap, plunge pools or pads, or other energy dissipaters are to be placed at the end of the outlet to prevent scouring and erosion. If the basin discharges to a channel with dry weather flow, care should be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone in the shortest possible distance.
13. An emergency spillway is to be included in the stormwater pond design to safely pass the extreme flood flow. The spillway prevents pond water levels from overtopping the embankment and causing structural damage. The emergency spillway must be designed to State of Tennessee dam safety requirements and must be located so that downstream structures will not be affected by spillway discharges.
14. A minimum of two feet of freeboard must be provided, measured from the top of the water surface elevation for the 100-year storm, to the lowest point of the dam embankment not counting the emergency spillway.

As-Built Certification Considerations

After the pond is constructed, an as-built certification of the pond, performed by a registered Professional Engineer, must be submitted to Metro. The as-built certification verifies that the BMP was installed as designed and approved. The following components must be addressed in the as-built certification:

1. Pretreatment for coarse sediments must be provided.
2. Surrounding drainage areas must be stabilized to prevent sediment from clogging the filter media.
3. Correct ponding depths and infiltration rates must be maintained to prevent killing vegetation.
4. A mechanism for overflow for large storm events must be provided.

Maintenance

Each BMP must have an Operations and Maintenance (O&M) Agreement submitted to Metro for approval and maintained and updated by the BMP owner. Refer to Volume 1 Appendix C for the Operation and Maintenance Agreement for dry detention ponds, as well as an inspection checklist. The O&M Agreement must be completed and submitted to Metro with site plan. The O&M agreement is for the use of the BMP owner in performing routine inspections. The developer/owner is responsible for the cost of maintenance and annual inspections. The BMP owner must maintain and update the BMP operations and maintenance plan. At a minimum, the operations and maintenance plan must address:

1. Inspect and repair/replace treatment components.
2. Perform annual verification of infiltration rates.
3. Remove debris or dead vegetation.

Design Procedures

Refer to PTP-01 Wet Ponds for further information on pond design.

Step 1. Compute the Water Quality Volume to Receive 60% TSS Credit.

Calculate (WQ_v). *If flow attenuation is not required, the pond can be sized for the WQ_v only.*

$$WQ_v = P \times Rv \times A/12$$

Where:

- WQ_v = water quality treatment volume, ac-ft
- P = rainfall for the 85% storm event (1.1 in)
- Rv = runoff coefficient (see below)
- A = site area, acres

$$Rv = 0.015 + 0.0092I$$

Where:
I = site impervious cover, % where 50% is 50

Step 2. Determine if the development site and conditions are appropriate for the use of a dry pond.

Consider the *Site and Design Considerations* previously in this section. This type of treatment must be used in conjunction with another water quality measure in order to achieve 80% TSS removal.

Step 3. Determine pretreatment volume.

A sediment forebay is sized for each inlet, unless the inlet provides less than 10% of the total design storm inflow to the pond. The forebay should be sized to contain 0.1 inches per impervious acre of contributing drainage and should be 4-6 feet deep. The forebay storage volume counts toward the total WQ_v requirement and may be subtracted from the WQ_v for subsequent calculations.

$$F_v = 0.1 \times A_I \times 3630$$

Where:
F_v = Forebay volume (ft^3)
A_I = Impervious area of drainage basin, acres
3630 = conversion factor from Ac/in to cubic feet

Step 4. Size the outlets for storm events.

If the pond is to serve as a multifunctional pond addressing peak flow attenuation, the downstream impacts must be considered for the 2- through 100-year events.

Design Procedures (Continued)

Establish a stage-storage-discharge relationship for the design storms of interest, based upon the downstream analysis (see Section 6.8.1 in Volume 1).

Refer to PTP-01 Stormwater Ponds and Volume 2, Chapter 8 for more information on design of outlet orifices and weirs.

Step 5. Size the low flow outlet for the water quality volume.

Size low flow orifice using the following equation. If different equation is used or different type of low flow orifice is used, provide supporting calculations.

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

a = area of orifice (ft^2)
A = average surface area of the pond (ft^2)
C = orifice coefficient, 0.66 for thin, 0.80 for materials thicker than orifice diameter
T = drawdown time of pond (hrs)(must be greater than 24 hours)
g = gravity (32.2 ft/sec^2)
H = elevation when pond in full (ft)
H_o= final elevation when pond is empty (ft)

Step 6. Design embankment and emergency spillway.

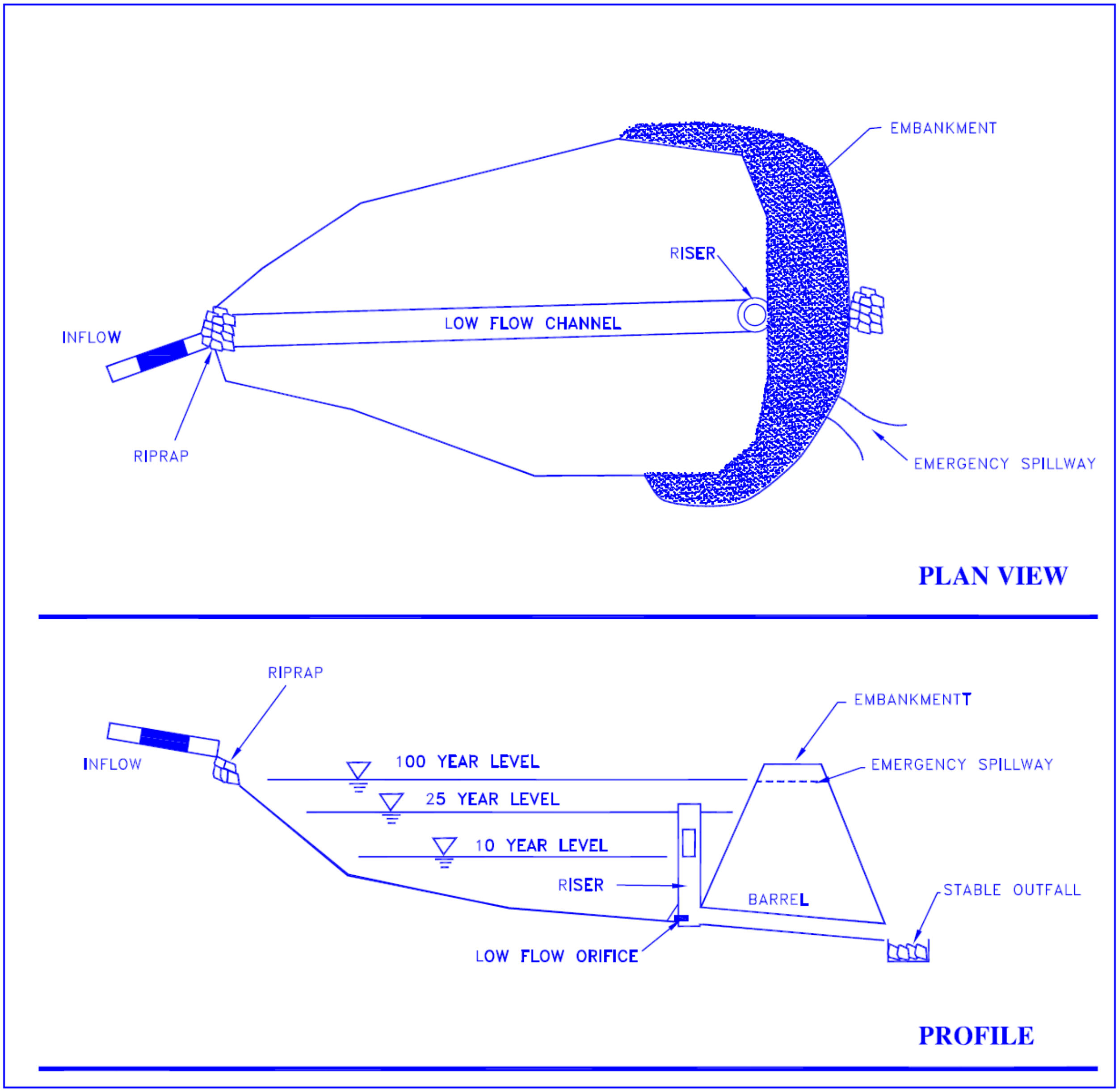
Size emergency spillway for any overtopping of pond in case of rain event in excess of 100-year storm and for instances of malfunction or clogging of primary outlet structure.

Step 7. Investigate potential dam hazard classification.

The design and construction of ponds in Tennessee must follow the requirements of the Safe Dams Act. Contact the Tennessee Department of Environment and Conservation, Division of Water Supply for more information about building dams in Tennessee.

Step 8. Design inlets, sediment forebays, outlet structures, maintenance access and safety features.

See the *Site and Design Considerations* section for information on design.



Note: Storm attenuation levels vary depending on site detention requirements.

(Adapted from the Center for Watershed Protection)

Figure 6.1 Schematic of Dry Extended Detention Basin

References

ARC, 2001. Georgia Stormwater Management Manual Volume 2 Technical Handbook.

CDM, 2000. Metropolitan Nashville and Davidson County Stormwater Management Manual Volume 4 Best Management Practices.

Suggested Reading

California Storm Water Quality Task Force, 1993. California Storm Water Best Management Practice Handbooks.

City of Austin, TX, 1988. Water Quality Management. Environmental Criteria Manual. Environmental and Conservation Services.

City of Sacramento, CA, 2000. Guidance Manual for On-Site Stormwater Quality Control Measures. Department of Utilities

Metropolitan Washington Council of Governments (MWCOG), March, 1992, "A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zone".

Merritt, F.S., Loftin, M.K., Ricketts, J.T., *Standard Handbook for Civil Engineers*, Fourth Edition McGraw-Hill, 1996.