

Dry Extended Detention Basin



Description

Dry extended detention basins, also called “dry ponds” or “detention basins”, are stormwater basins designed to capture, temporarily hold, and gradually release a volume of stormwater runoff to attenuate and delay stormwater runoff peaks. Dry extended detention basins are typically designed as on-line systems and provide stormwater quantity control but only limited water quality benefit. The primary outlet structure of a dry extended detention basin is located at the bottom of the basin and sized to limit the maximum flow rate from the basin for the water quality storm. The higher stages of the basin attenuate the peak rates of runoff from larger storm events. Dry basins are designed to completely empty between storms, typically in 24 to 48 hours, resulting in limited settling of particulate matter and the potential for re-suspension of sediment by subsequent runoff events.

Dry extended detention basins differ from wet extended detention ponds, which provide a permanent pool and greater pollutant removal (see Stormwater Ponds section of this chapter). Dry extended detention basins are not suitable as infiltration or groundwater recharge measures, and therefore do not reduce runoff volumes and cannot be used to meet the Standard 1 retention or treatment performance criterion of this Manual. Figure 13-34 shows a schematic of a typical dry extended detention basin.

Advantages

- Low-density residential, industrial, and commercial developments with adequate space and low visibility.

Stormwater BMP Type

Pretreatment BMP	<input type="checkbox"/>
Infiltration BMP	<input type="checkbox"/>
Filtering BMP	<input type="checkbox"/>
Stormwater Pond BMP	<input type="checkbox"/>
Stormwater Wetland BMP	<input type="checkbox"/>
Water Quality Conveyance BMP	<input type="checkbox"/>
Stormwater Reuse BMP	<input type="checkbox"/>
Proprietary BMP	<input type="checkbox"/>
Other BMPs and Accessories	<input checked="" type="checkbox"/>

Stormwater Management Suitability

Retention	<input type="checkbox"/>
Treatment	<input type="checkbox"/>
Pretreatment	<input type="checkbox"/>
Peak Runoff Attenuation	<input checked="" type="checkbox"/>

Pollutant Removal

Sediment*	Moderate
Phosphorus	Low
Nitrogen	Low
Bacteria	Low

*Includes sediment-bound pollutants and floatables (with pretreatment)

Implementation

Capital Cost	Medium
Maintenance Burden	Medium
Land Requirement	High

- Suitable for use as part of a stormwater treatment train, particularly in combination with off-line retention and treatment stormwater BMPs. The size of dry detention basins can be reduced substantially by placing them at the end of the treatment train to take advantage of reduced runoff volume resulting from upstream practices that employ infiltration.
- Less frequently used portions of larger or regional dry detention basins can offer recreational, aesthetic, and open space opportunities (e.g., athletic fields, jogging and walking trails, picnic areas).

Limitations

- Strictly for water quantity control to attenuate peak flows, limit downstream flooding, and provide some degree of channel protection.
- Not suitable for treatment. Most dry extended detention basins have detention times of less than 24 hours and lack a permanent pool, providing insufficient settling of particles, and minimal stormwater treatment.
- Not suitable for stormwater retention or runoff reduction since dry detention basins drain completely between storms and do not provide significant infiltration.
- Susceptible to re-suspension of settled material by subsequent storms.

Siting Considerations

- **Drainage Area:** Dry extended detention basins generally require a drainage area of 10 acres or greater to avoid an excessively small outlet structure susceptible to clogging. Dry extended detention basins are impractical and less cost-effective for drainage areas smaller than 1 acre.
- **Groundwater and Bedrock:** The lowest point in the bottom of the basin should be at least 1 foot above the seasonal high groundwater table (SHGT) and bedrock. Intercepting groundwater or shallow bedrock may result in the loss of runoff storage volume. An impermeable liner is recommended when the lowest point in the bottom of the basin is less than 1 foot above SHGT.
- **Land Uses:** Land uses will dictate potential pollutants-of-concern and potential safety risks. A liner is required for dry detention basins that receive runoff from Land Uses with Higher Potential Pollutant Loads (LUHPPLs) (see [Chapter 10 - General Design Guidance for Stormwater Infiltration Systems](#)) or on contaminated sites. The basin's temporary pool may pose a safety risk in residential areas and areas with public access, sometimes requiring fencing to limit access to the basin.
- **Soils:** Well-drained soils are preferred (HSG A and B soils). A liner is recommended for use in HSG C and D soils to prevent groundwater inflow and loss of storage volume.

- **Site Slopes:** Site slopes greater than 6% may result in the need for a large embankment to be constructed to provide the desired storage volume, which could be subject to CT DEEP dam safety regulatory requirements. Steep slopes may also present design and construction challenges, and significantly increase the cost of earthwork.
- **Receiving Waters:** Stormwater ponds should not be used for sites that discharge within 200 feet of cold-water streams, 200 feet from a public water supply reservoir, or 100 feet from streams tributary to a public water supply reservoir.

Soil Evaluation

- Conduct an evaluation of the soil characteristics and subsurface conditions at the location of the proposed system including soil type, depth to the seasonal high groundwater table, and depth to bedrock. Perform test pits or soil borings in accordance with the soil evaluation guidance in [Chapter 10 - General Design Guidance for Stormwater Infiltration Systems](#).

Design Recommendations

Pretreatment – Sediment Forebay

- A sediment forebay is recommended for dry extended detention basins, although other forms of pretreatment may be used at locations where runoff enters the basin.
- The sediment forebay and other pretreatment measures should be designed in accordance with the Pretreatment BMPs section of this Manual.
- The sediment forebay should be sized to contain at least 10% of the Water Quality Volume (WQV).

Extended Detention Storage

- Extended detention requires sufficient storage capacity to hold stormwater for at least 24 hours to allow solids to settle out.
- The primary outlet structure of a dry extended detention basin is located at the bottom of the basin and sized to limit the maximum flow rate from the basin for the water quality storm. The higher stages of the basin attenuate the peak rates of runoff from larger storms (2-year, 10-year, 25-year and 100-year, 24-hour events).
- The detention basin should completely drain within 48 hours after the end of a storm.
- Thermal impacts of dry extended detention basins may be mitigated by:
 - Planting of shade trees around the perimeter of the basin (but at least 25 feet away from inlet/outlet structures and the basin embankment) to reduce solar warming of the temporary pool
 - Use of an underdrained gravel trench outlet.

- A minimum length-to-width ratio of 2:1 is recommended, although a 3:1 ratio is preferred for longer flow path lengths and enhanced sedimentation.
- Irregularly shaped basins are desirable due to their more natural and less engineered appearance.
- To enhance safety by minimizing standing water depths, the depth of the temporary pool associated with the water quality design storm should be no greater than 3 feet.
- Maximum ponding depths of 4 feet are recommended to avoid CT DEEP dam safety regulatory requirements, unless the basin is excavated below existing grade and does not require an embankment that may be subject to CT DEEP dam safety provisions.

Conveyance

- Stormwater should be conveyed to and from all stormwater management practices safely and to minimize erosion potential.

Inlet

- Design the inlet in accordance with the Inlet and Outlet Controls section of this Manual.
- The number of inlets should be minimized, and one inlet is preferable. The inlet should be located at the most hydraulically remote point from the outlet to minimize the potential for short-circuiting and should be in a manner that meets or exceeds desired length to width ratios.

Outlet & Overflow

- Design the outlet and any overflows in accordance with the [Inlet and Outlet Controls](#) section of this Manual.
- A low flow orifice or weir should be located at the lowest point in the bottom of the detention basin with the size of the orifice sufficient to avoid clogging (recommended minimum orifice diameter of 6 inches, although orifice diameters as small as 3 inches are allowed if required to provide the necessary hydraulic control). The low flow orifice should be protected from clogging using an external trash rack.
- Multiple orifices or weirs in the outlet structure provide stormwater quantity control of larger storm events.
- The outlet structure should be sized to convey up to the 10-year, 24-hour storm event, at a minimum, to the storm drainage system or stabilized channel. An emergency spillway is required to convey the 100-year storm event if the outlet structure is not designed to pass the 100-year storm event.

Low Flow Channel

- A stone-lined low flow channel should be installed in the bottom of the basin to convey low flows from the basin inlet(s) to the outlet structure.

Bottom and Side Slopes

- Bottom of the basin should be sloped from the inlet to the outlet with a minimum slope of 1%.
- 3(H):1(V) slopes or flatter are preferred.

Riser in Embankment

- The riser should be located within the embankment for maintenance access and safety.
- Lockable manhole covers and manhole steps within easy reach of valves and other controls should provide access to the riser.

Liner

- A liner is required for dry detention basins that receive runoff from LUHPPLs or on contaminated sites. A liner is recommended when the lowest point in the bottom of the basin is less than 1 foot above SHGT or for use in HSG C and D soils to prevent groundwater inflow and loss of storage volume.
- If used, should consist of a 30 mil (minimum) HDPE or PVC liner, or one of the alternative liner systems described in [Chapter 10 - General Design Guidance for Stormwater Infiltration Systems](#) with the approval of the review authority.

Safety Features

- The principal spillway opening must not permit access by small children, and endwalls above pipe outfalls greater than 48 inches in diameter should be fenced to prevent a hazard.
- Fencing around the perimeter of the basin is generally not encouraged but may be required by some municipalities. The preferred method is to grade the basin to eliminate dropoffs or other safety hazards.

Maintenance Reduction Features

- Dry detention basins should be designed with non-clogging outlets, such as a weir, or by incorporating trash racks for orifice openings.
- Orifices should be less than 6 inches in diameter with a trash rack to prevent clogging. Smaller orifice diameters (3 inches or larger) are allowed if required to provide the necessary hydraulic control.

- Metal components of outlet structures should be corrosion resistant, but not galvanized due to the contribution of zinc to water.
- Outlet structures should be resistant to frost heave and ice action in the basin.

Vegetation

- Select vegetation and develop a planting plan with the guidance provided in [Appendix F](#) of this Manual.
- Vegetation in a dry extended detention basin typically consists of grasses that can tolerate temporary inundation by up to 4 feet of water for 24 to 48 hours in duration.
- Woody vegetation may not be planted or allowed to grow within 25 feet of the toe of the embankment and 25 feet from the principal spillway structure.
- Use salt-tolerant vegetation if the basin receives road runoff.

Winter Operations

- Detention basins should not be used as dedicated snow storage areas. To the extent feasible, locate and design the system to avoid snow storage areas and potential damage from snow plowing activities. Refer to Chapter 7 - Overview of Structural Stormwater Best Management Practices for general design considerations related to winter operations.

Construction Recommendations

- The designing qualified professional should develop a detailed, site-specific construction sequence.
- The designing qualified professional should inspect the installation during the following stages of construction, at a minimum:
 - After excavation of the basin
 - After internal grading of basin bottom, low-flow channel, microtopography, berms, etc.
 - After installation of outlet/overflow and inlet controls
 - After seeding and final stabilization of the basin
- The designing qualified professional should provide an as-built plan of the completed system along with a certification that the system was designed in accordance with the guidance contained in this Manual and other local or state requirements and that the system was installed in accordance with the approved plans.
- The entire contributing drainage area should be completely stabilized prior to directing any flow to the system. Adequate vegetative cover must be established over any pervious area adjacent or contributing to the system before runoff can be accepted.

- Erosion and sediment controls should be in place during construction in accordance with the [Connecticut Guidelines for Soil Erosion and Sediment Control](#) and the Soil Erosion and Sediment Control (SESC) Plan developed for the project.
- During clearing and grading of the site, measures should be taken to avoid soil compaction at the location of the proposed system to promote growth of vegetation.
- The system should be fenced off during the construction period to prevent disturbance of the soils.
- The system should be excavated to the dimensions, side slopes, and elevations shown on the plans.
- Install vegetation in accordance with the planting plan and plant schedule on the plans. Water vegetation thoroughly immediately after planting and as necessary until fully established.
- Dry extended detention basins classified as dams under the CT DEEP dam safety program should be constructed, inspected, and maintained in accordance with applicable CT DEEP dam safety regulations and guidance.

Maintenance Needs

- Detailed inspection and maintenance requirements, inspection and maintenance schedules, and those parties responsible for maintenance should be identified on the plans and in the Stormwater Management Plan.
- Maintenance should be detailed in a legally binding maintenance agreement.
- Maintenance activities such as sediment removal, mowing, and repairs should be performed with rakes and light-weight equipment rather than heavy construction equipment to avoid soil compaction and damage to vegetation. Heavy equipment may be used for sediment removal and other maintenance activities if the equipment is positioned outside the limits of the system. Heavy construction equipment should not be allowed within the limits of the system for maintenance purposes.

Maintenance Access

- Dry detention basins should be designed with easy access to all components of the system for maintenance purposes. In addition to the maintenance reduction design factors described in this section, also refer to [Chapter 7 - Overview of Structural Stormwater Best Management Practices](#) for general design considerations to reduce and facilitate system maintenance.
- A maintenance right-of-way or easement should extend to the basin from a public road.

- Maintenance access should be at least 12 feet wide, have a maximum slope of no more than 15 percent, and be appropriately stabilized to withstand maintenance equipment and vehicles.
- The maintenance access should extend to the forebay and outlet structure/spillway and be designed to allow vehicles to turn around.

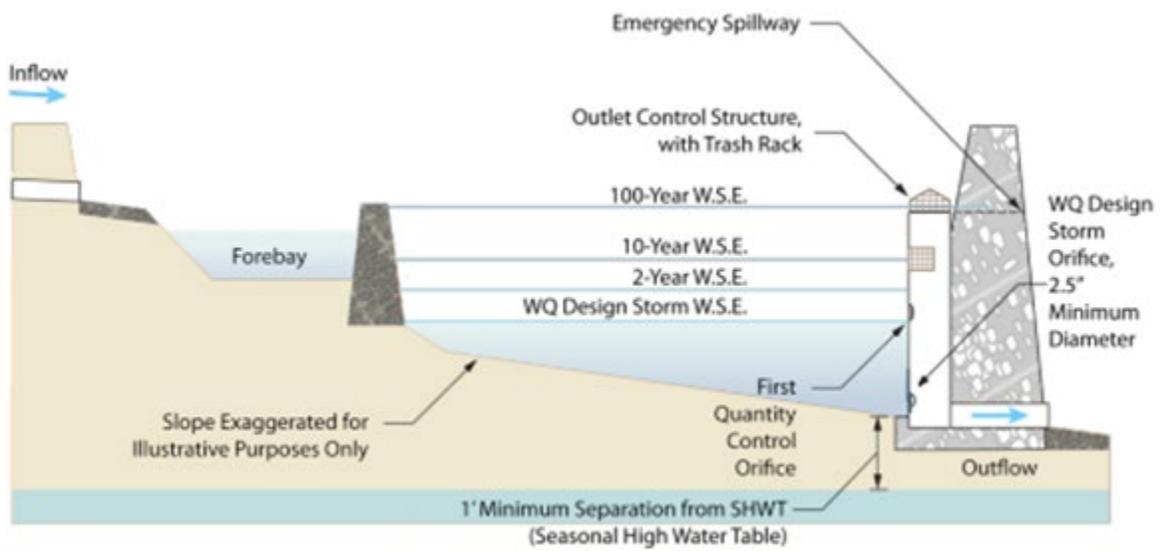
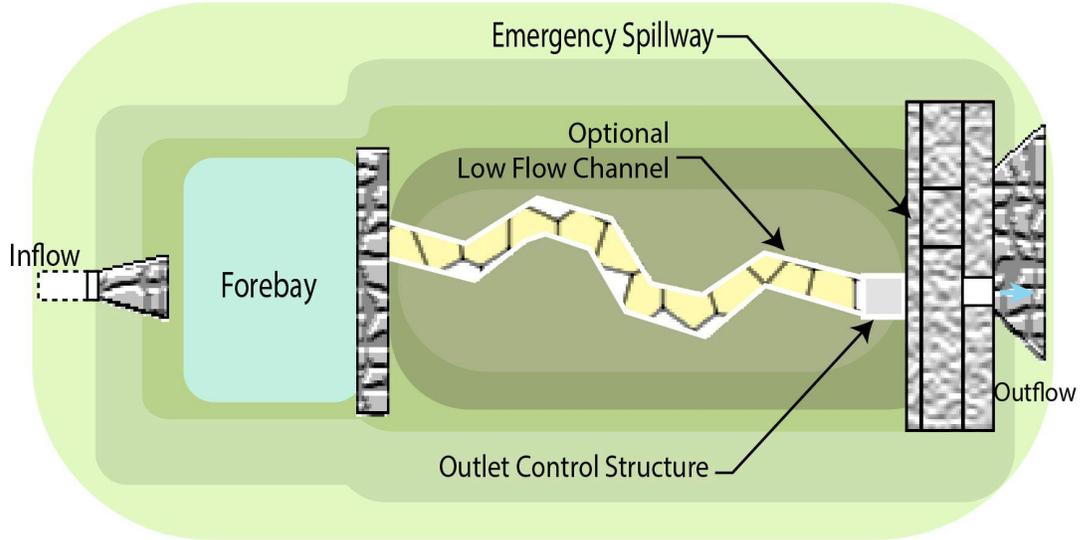
Recommended Maintenance Activities

- Inspect after major storms (1 inch or more of precipitation) in the first few months following construction.
- Inspect sediment forebay twice per year and the rest of the system annually, including inlet and outlet control structures and the pond embankment.
- Refer to [Appendix B](#) for maintenance inspection checklists, including items to focus on during the inspections.
- Remove trash and organic debris (leaves) in the Spring and Fall.
- Remove sediment from the sediment forebay or other pretreatment area when it accumulates to a depth of more than 24 inches or 50% of the design depth.
- Remove sediment from the main portion of the basin when the basin volume has become reduced significantly.
- The vegetative cover should be maintained at 85%. If vegetation has damage, the area should be reestablished in accordance with the original specifications.
- Periodically mow the basin during the growing season. Maintain vegetation at 6 inches or higher.
- Inspect and remove invasive vegetation as necessary.
- Remove trees and woody vegetation within the basin and within 25 feet of all risers, pipe outlet structures, spillways, and downstream embankments that hold back water.

Other References

New Jersey Department of Environmental Protection (NJDEP). 2021. *New Jersey Stormwater Best Management Practices Manual*. New Jersey Department of Environmental Protection (NJDEP). 2021. *New Jersey Stormwater Best Management Practices Manual*. https://nj.gov/dep/stormwater/bmp_manual2.htm

Figure 13-34. Dry Extended Detention Basin Schematic



NOTE:
 = Direction of Runoff

Not to Scale

Source: Adapted from New Jersey Stormwater Best Management Practices Manual, 2021.