Underground Detention

Stormwater BMP Type

Pretreatment BMP	□
Infiltration BMP	□
Filtering BMP	□
Stormwater Pond BMP	□
Stormwater Wetland BMP	□
Water Quality Conveyance BMP	□
Stormwater Reuse BMP	□
Proprietary BMP	□
Other BMPs and Accessories	■

Stormwater Management Suitability

Retention	□
Treatment	□
Pretreatment	□
Peak Runoff Attenuation	■

Pollutant Removal

Sediment*	**Low**
Phosphorus	**Low**
Nitrogen	**Low**
Bacteria	**Low**

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

Implementation

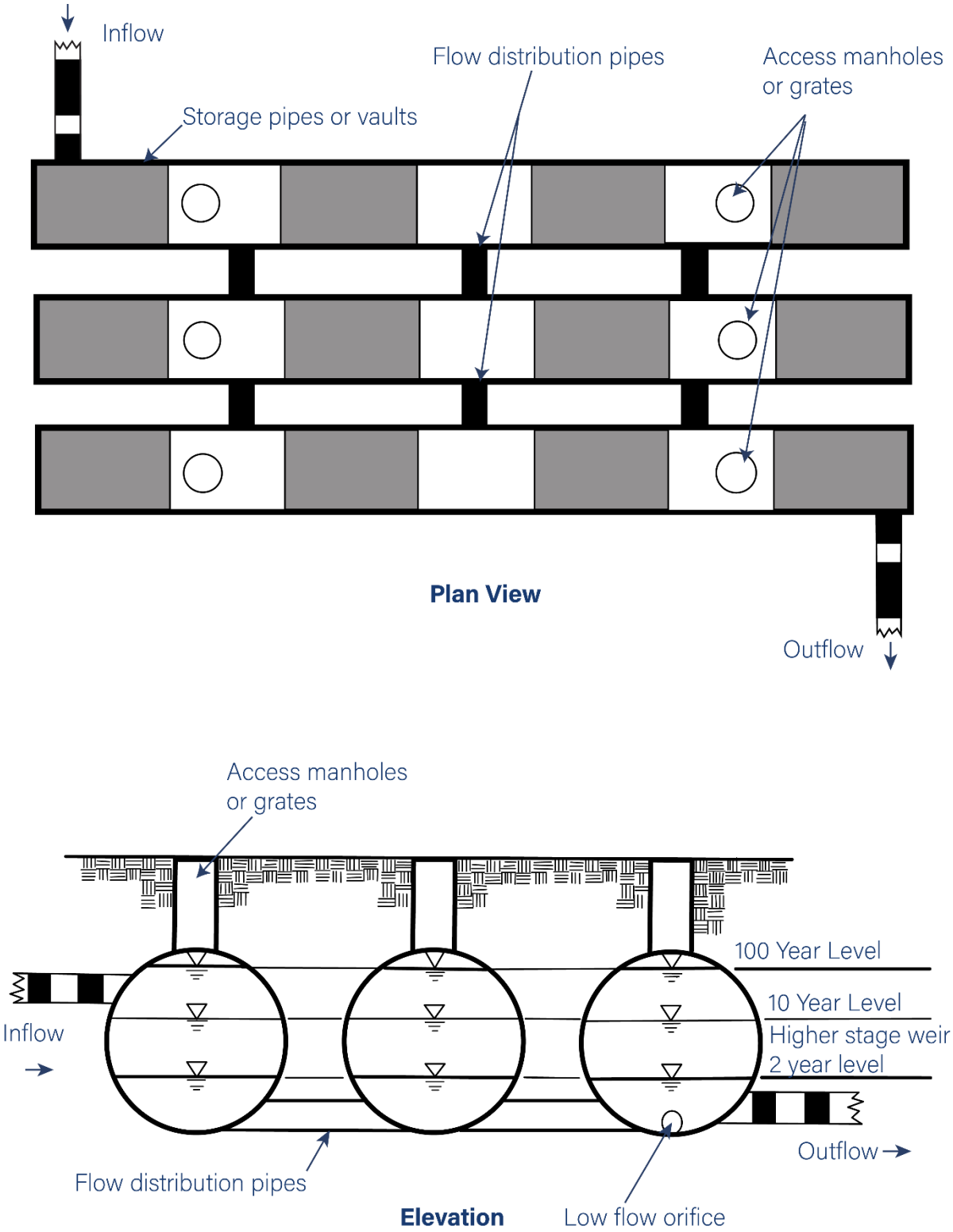
Capital Cost	**High**
Maintenance Burden	**High**
Land Requirement	**Low**

Description

Underground detention facilities are subsurface storage structures designed to temporarily store stormwater runoff and release it slowly at pre-development peak flow rates. Like aboveground dry detention basins, underground detention facilities are designed to drain completely between storm events, thereby providing storage capacity for subsequent events. Underground detention facilities are typically designed as on-line systems to attenuate peak flow rates. They provide little, if any, pollutant removal (i.e., settling of coarse sediment) and are susceptible to re-suspension of sediment during subsequent storms. They are not designed to provide infiltration and therefore cannot be used to meet the Standard 1 retention performance criterion of this Manual.

Underground detention systems are typically used at sites where land availability or land costs preclude the use of surface stormwater detention system. They are often used below parking lots, roads, and other paved areas. Underground detention structures are typically made of concrete (vaults or tanks), large diameter solid pipes, enclosed arches made of plastic, steel, or metal (aluminized steel, aluminum, and others), or other modular systems. Figure 13-35 is a schematic of an underground detention pipe system.

Figure 13-35. Underground Detention Pipe System Schematic



The underground structures described in the Underground Infiltration System section of this chapter can also be used as detention facilities if they are fully enclosed or used with a liner to prevent infiltration or interaction with groundwater. Open-bottom underground structures or perforated pipe should be designed as underground infiltration systems in accordance with the guidance provided in Chapter 10 and the Underground Infiltration System section of this chapter.

Advantages

- Efficient use of space in urban areas and for retrofits.
- Quick installation using prefabricated modular systems.
- Systems are durable with a long life with effective pretreatment and routine maintenance.
- Greater public safety as compared to deep surface storage ponds or basins.
- Ground provides insulation from freezing and some cooling of runoff from paved surfaces.
- Suitable for use as part of a stormwater treatment train, particularly in combination with off-line retention and treatment stormwater BMPs.
- Useful in stormwater retrofit applications to provide additional temporary storage volume and attenuate peak flows (not for retention or treatment).

Limitations

- Require extensive, costly excavation.
- Material and maintenance costs are high compared to surface detention systems.
- Routine maintenance can be overlooked because the practice is not readily visible.
- Strictly for water quantity control to attenuate peak flows, limit downstream flooding, and provide some degree of channel protection.
- Not suitable for treatment. Most underground detention systems have detention times of less than 24 hours, providing insufficient settling of particles, and minimal stormwater treatment. These systems are also susceptible to re-suspension of settled material by subsequent storms.
- Not suitable for stormwater retention or runoff reduction since underground detention systems drain completely between storms and do not provide infiltration.

Siting Considerations

- **Drainage Area:** Underground detention systems can be used on sites with a wide range of drainage areas. The maximum recommended drainage area to a single underground detention system is 25 acres.

- **Groundwater and Bedrock:** The system should be at or above the seasonal high groundwater table (SHGT) and bedrock. Anti-buoyancy measures may be needed if systems are designed at or below the water table.

- **Land Uses:** Underground detention systems are typically used at sites where land availability or land costs preclude the use of surface stormwater detention system. They are often used below parking lots, roads, and other paved areas. They should be installed in locations that are easily accessible for maintenance and should not be in areas or below structures that cannot be excavated in the event the system needs to be replaced.

- **Receiving Waters:** Underground detention systems are preferred over surface stormwater detention basins for sites that discharge to coldwater streams due to cooling of runoff in subsurface storage as opposed to a surface pool of water, which is more susceptible to warming and thermal impacts. Discharges from underground detention systems should not be located within 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.

Design Recommendations

Pretreatment

- Incorporate pretreatment measures at locations where runoff enters the underground detention system in accordance with the Pretreatment BMPs section of this Manual.

- Acceptable pretreatment measures are those that are suitable for piped drainage systems and include deep sump hooded catch basins,[91] oil grit separators, and proprietary pretreatment devices.

- Pretreatment measure(s) should treat at least the Water Quality Flow (WQF).

Storage

- Storage capacity and discharge rate from the system will depend on the peak runoff attenuation requirement (2-year, 10-year, 25-year and 100-year, 24-hour events) and design guidance of the product manufacturer.

- Deeper and larger excavated areas require more fill for maintaining the integrity of plastic or metal pipe. Pipes require more fill than concrete structures, thus using more excavated area. Pipes also store less water than concrete vaults per unit of land surface. For

[91] Only recommended for space constrained sites where no other Pretreatment BMPs are feasible.

underground pipe storage systems, use the largest pipe diameter possible, which can cost-effectively increase storage capacity.

- Access manholes should be provided for system maintenance. Manholes should be placed, at a minimum, near the inlet and outlet of the system and in intermediate locations. The number of manholes depends on maintenance methods and design guidance of the product manufacturer.
- A high water table can cause structures to displace due to uplift forces. In areas with high groundwater, buoyancy and anchoring requirements should be considered and addressed in the design.
- The detention system should completely drain within 48 hours after the end of a storm.
- Pipes and floors of vaults should be designed with a maximum of 2% slope.
- Follow manufacturer recommendations for minimum cover above the underground storage system to accommodate required loading conditions.
- Use appropriate bedding/foundation below the structure to support the design load associated with the structure, water storage, and adjacent backfill weight and to maintain its integrity during construction. Follow manufacturer recommendations related to bedding/foundation design.

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 and in accordance with design guidance of the product manufacturer.

Outlet & Overflow

- Design the outlet and any overflows in accordance with the Inlet and Outlet Controls section of this Manual and in accordance with design guidance of the product manufacturer.
- A low flow orifice or weir should be used within the storage system or inside a separate outlet control structure, 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 a trash rack.

- The system and outlet control structure should be sized to convey up to the 100-year, 24-hour storm event, at a minimum, to the storm drainage system or stabilized channel.
- Emergency surface overflows should be designed to convey or bypass flows in excess of the 100-year event in case the outlet becomes clogged.

Liner

- A liner may be needed to prevent infiltration or interaction with groundwater if open-bottom storage structures or perforated pipe are used.
- If used, should consist of a 30 mil (minimum) HDPE or PVC liner, or one of the alternative liner systems described in Chapter 10 with the approval of the review authority.

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 system
  - After placement and leveling of aggregate below the storage structure, placement of the structure(s) and inspection ports/manholes, and placement of backfill above the structure(s)
  - After installation of bypass, outlet/overflow, and inlet controls
  - After the system has been backfilled
- 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.
- The system should be fenced off during the construction period.
- The system should be excavated to the dimensions, side slopes, and elevations shown on the plans.

Maintenance Needs

- Underground infiltration systems should be designed with easy access to all components of the system for maintenance purposes. Refer to Chapter 7 for general design considerations to reduce and facilitate system maintenance.
- 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.
- Maintain underground structures in accordance with the manufacturer's guidelines.
- Typical maintenance includes removal of accumulated oil and grease, floatables, and sediment from the pretreatment structure using a vacuum truck and removal of accumulated sediment from the underground detention system using a high-pressure water nozzle (i.e., JetVac process) and vacuum truck.
- Confined space safety procedures as required by OSHA regulations must be followed by workers entering an underground stormwater storage facility.

Recommended Maintenance Activities

- Inspect after major storms (1 inch or more of precipitation) in the first few months following construction.
- Inspect the pretreatment structure twice a year.
- Inspect the remainder of the system annually.
- Refer to Appendix B for maintenance inspection checklists, including items to focus on during inspections.
- Remove sediment from the pretreatment structure when it accumulates to more than 50% of the design depth.
- Remove sediment from the storage structures when the sediment accumulation exceeds 2 inches throughout the length of the structures or when drawdown time exceeds 48 hours after the end of a storm event, indicating that the outlet may be clogged.