2.2.11 Underground Detention

Description: Detention storage located in underground pipe/tank systems or vaults designed to provide water quantity control through detention and/or extended detention of stormwater runoff.

KEY CONSIDERATIONS

ADVANTAGES / BENEFITS:

- Does not take up surface space
- Used in conjunction with water quality structural control
- Concrete vaults or pipe/tank systems can be used.

DISADVANTAGES / LIMITATIONS:

- Controls for stormwater quantity primarily – not intended to provided water quality protection
- Intended for space limited applications
- High initial construction cost as well as replacement cost at the end of its useful life

STORMWATER MANAGEMENT SUITABILITY

S	Water Quality Protection
P	Streambank Protection
P	On-Site Flood Control
P	Downstream Flood Control

IMPLEMENTATION CONSIDERATIONS

L	Land Requirement
H	Capital Cost
M	Maintenance Burden

Residential Subdivision Use: No
Hi Density/Ultra-Urban: Yes
Drainage Area: 160 Ac. max.
Soils: No restrictions

L = Low M = Moderate H = High

2.2.11.1 General Description

Detention vaults are box-shaped underground stormwater storage facilities typically constructed with reinforced concrete. Detention pipe/tank systems are underground storage facilities typically constructed with large diameter metal or plastic pipe. Both serve as an alternative to surface dry detention for stormwater quantity control, particularly for space-limited areas where there is not adequate land for a dry detention basin or multi-purpose detention area.

Both underground vaults and pipe/tank systems can provide streambank protection through extended detention of the streambank protection volume (SP_v), and flood (in some cases extreme flood Q_f) control through normal detention. Basic storage design and routing methods are the same as for detention basins except that the bypass for high flows is typically included.

Underground detention vaults and pipe/tank systems are not intended for water quality treatment and must be used in a treatment train approach with other structural controls that provide treatment of the WQ_v (see Section 2.1). This will prevent the underground vault or tank from becoming clogged with trash or sediment and significantly reduces the maintenance requirements for an underground detention system.

Prefabricated concrete vaults are available from commercial vendors. In addition, several pipe manufacturers have developed packaged detention systems.

2.2.11.2 Design Criteria and Specifications

Location

- Underground detention systems are to be located downstream of other structural stormwater controls providing treatment of the water quality volume (WQ_v). See Section 2.1 for more information on the use of multiple structural controls in a treatment train.
- The maximum contributing drainage area to be served by a single underground detention vault or tank is 200 acres.

General Design

- Underground detention systems are sized to provide extended detention of the streambank protection volume over 24 hours and temporarily store the volume of runoff required to provide the desired flood protection.
- Routing calculations must be used to demonstrate that the storage volume is adequate. See Section 4.5 (*Storage Design*) for procedures on the design of detention storage.
- Detention Vaults: Minimum 3,000 psi structural reinforced concrete may be used for underground detention vaults. All construction joints must be provided with water stops. Cast-in-place wall sections must be designed as retaining walls. The maximum depth from finished grade to the vault invert should be 20 feet.
- Detention Pipe/Tank Systems: The minimum pipe diameter for underground detention tanks is 36 inches.
- Underground detention vaults and pipe/tank systems must meet structural requirements for overburden support and traffic loading if appropriate.
- Adequate maintenance access must be provided for all underground detention systems. Access must be provided over the inlet pipe and outflow structure. Access openings can consist of a standard frame, grate and solid cover, or a removable panel. Vaults with widths of 10 feet or less should have removable lids.

Inlet and Outlet Structures

- A separate sediment sump or vault chamber sized to 0.1 inches per impervious acre of contributing drainage should be provided at the inlet for underground detention systems that are in a treatment train with off-line water quality treatment structural controls.
- For SPv control, a low flow orifice capable of releasing the streambank protection volume over 24 hours must be provided. The streambank protection orifice should have a minimum diameter of 3 inches and should be adequately protected from clogging by an acceptable external trash rack. The orifice diameter may be reduced to 1 inch if internal orifice protection is used (i.e., an overperforated vertical stand pipe with 0.5-inch orifices or slots that are protected by wirecloth and a stone filtering jacket). Adjustable gate valves can also be used to achieve this equivalent diameter.

For on-site flood control, an additional outlet is sized for control of the chosen return period (based upon hydrologic routing calculations) and can consist of a weir, orifice, outlet pipe, combination outlet, or other acceptable control structure.

See Section 4.6 (*Outlet Structures*) for more information on the design of outlet works.

- Riprap, plunge pools or pads, or other energy dissipators are to be placed at the end of the outlet to prevent scouring and erosion. See Section 4.7, *Energy Dissipation Design*, for more guidance.
- A high flow bypass is to be included in the underground detention system design to safely pass the extreme flood flow.

2.2.11.3 Inspection and Maintenance Requirements

Table 2.2.11-1 Typical Maintenance Activities for Underground Detention Systems

Activity	Schedule
• Remove any trash/debris and sediment buildup in the underground vaults or pipe/tank systems.	Annually
• Perform structural repairs to inlet and outlets.	As needed, based on inspection

2.2.11.4 Example Schematics

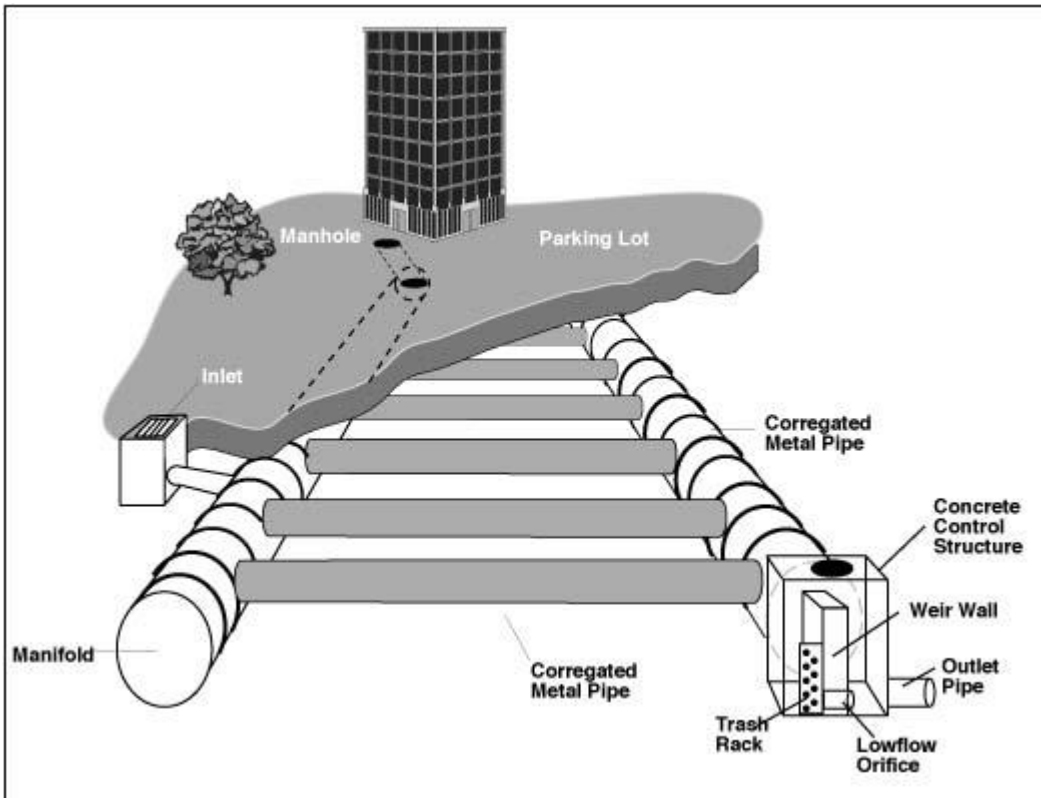
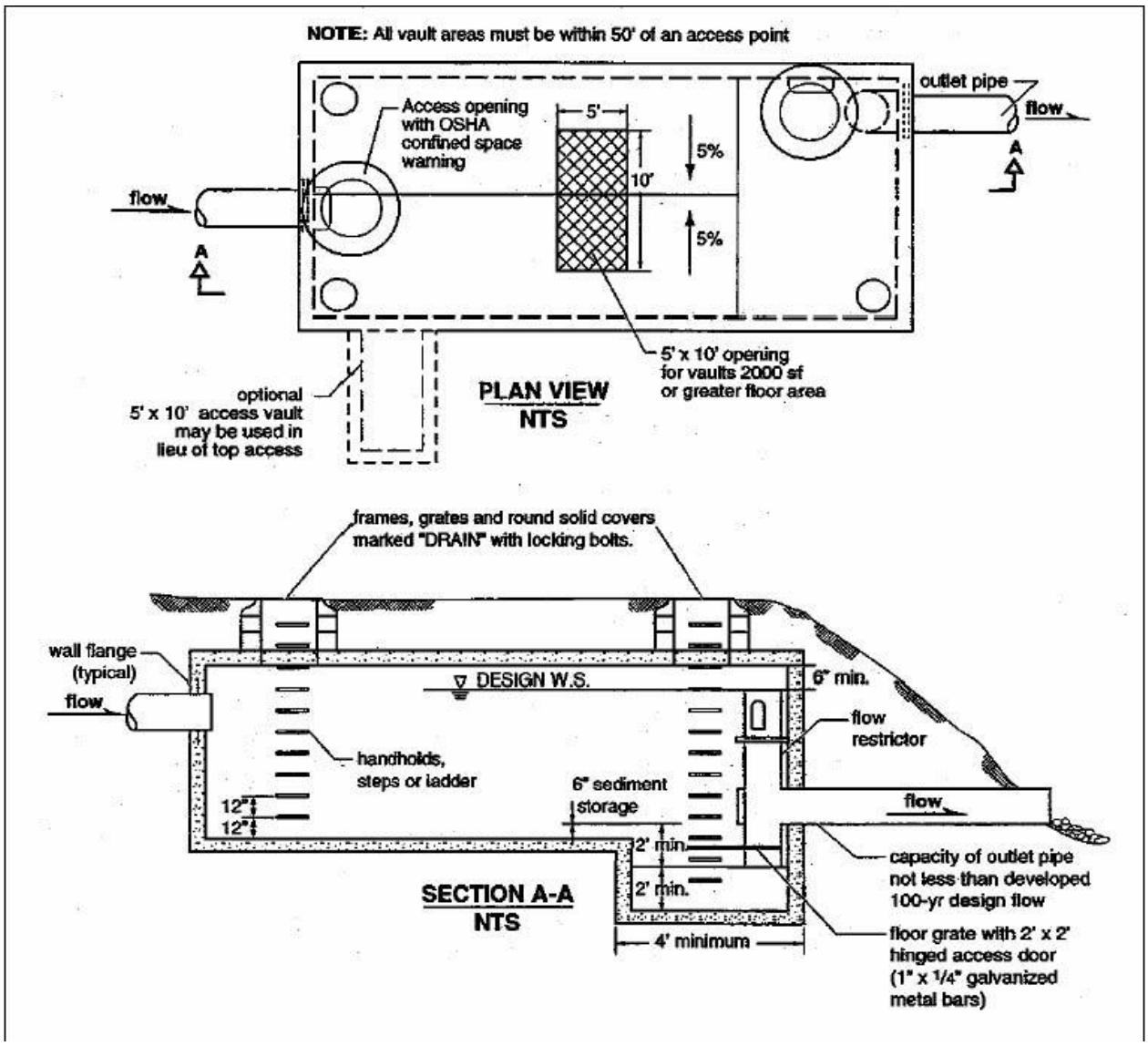


Figure 2.2.11-1 Example Underground Detention Tank System Figure 2.2.11-2 Schematic of Typical Underground Detention Vault



(Source: WDE, 2000)

Underground Detention – end