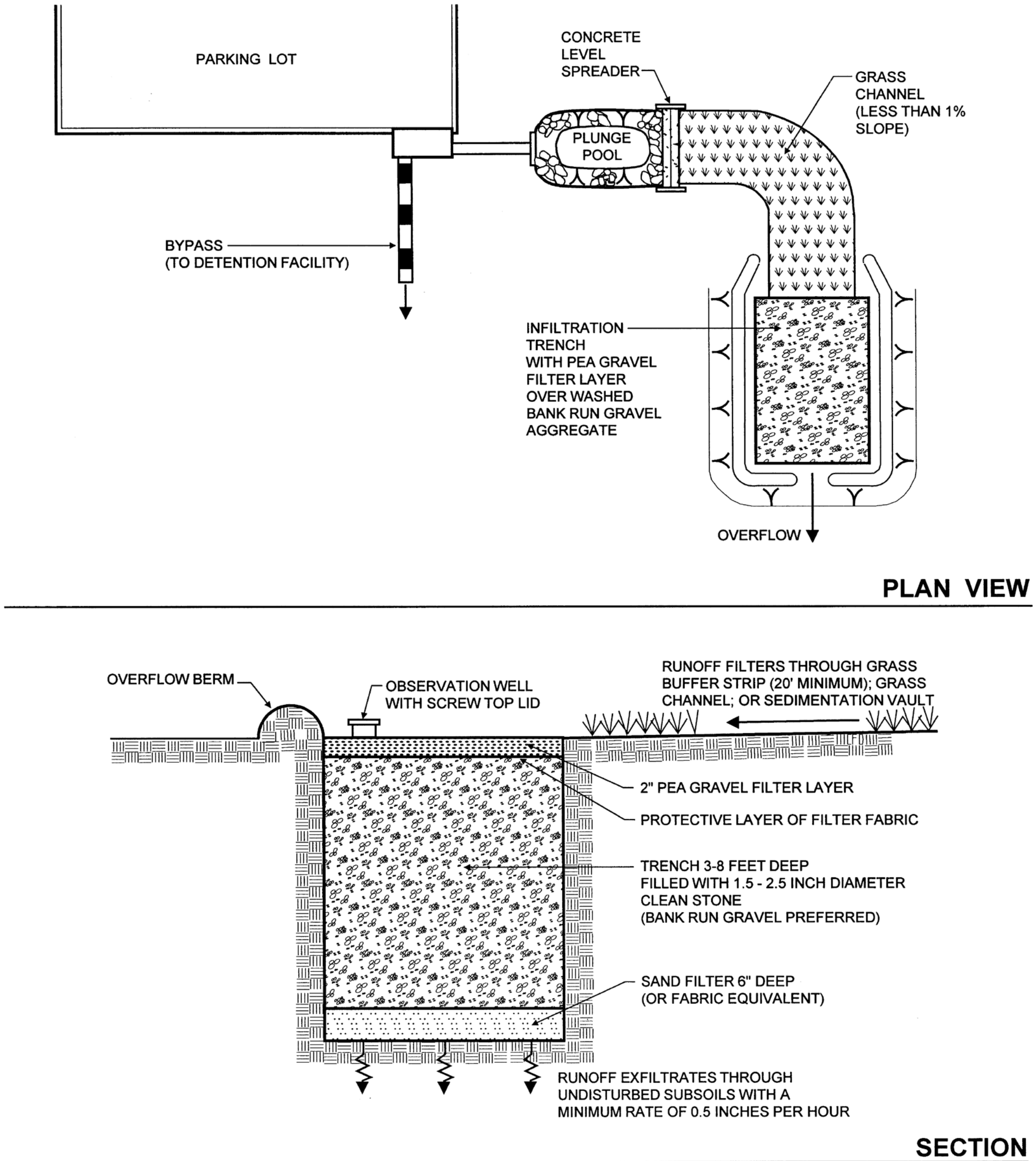
Section 3.2 Storm Water Infiltration

Definition: Practices that capture and temporarily store the V_w before allowing it to infiltrate into the soil over a two day period. Design variants include:

- I-1 infiltration trench
- I-2 infiltration basin

Infiltration practices may also provide storm water detention storage in certain limited cases. Extraordinary care shall be taken to assure that long-term infiltration rates are achieved through the use of performance bonds, post construction inspection and long-term maintenance.

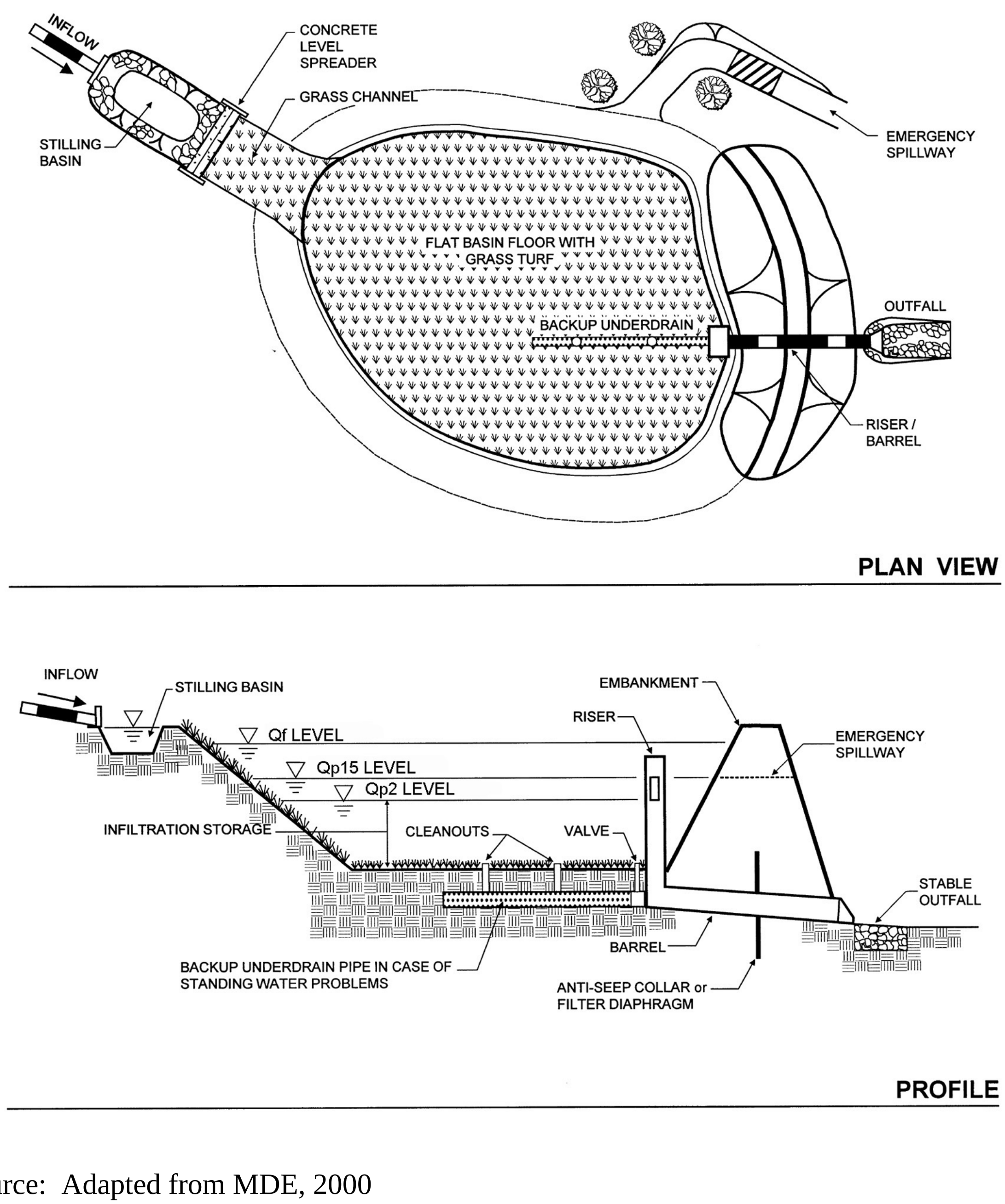
I-1	**Figure 3.15** Example of Infiltration Trench	I-1



Source: Adapted from MDE, 2000

The V_w is retained in an infiltration trench, where it percolates through the floor of the trench in a two day period.

I-2	**Figure 3.16** Example of Infiltration Basin	I-2



Source: Adapted from MDE, 2000

The V_w is retained in an infiltration basin, where it percolates through the floor of the basin in a two day period.

3.2.1 Infiltration Feasibility Criteria

The maximum contributing area to an individual infiltration practice should generally be less than 5 acres for trenches and less than 10 acres for basins.

Infiltration design depends primarily on soil percolation rates. The soils at the bottom and in the surrounding area of the retention structures must be tested to determine the final infiltration rates and to locate the water table depth. Soil boring locations should correspond to the location of the proposed infiltration device, and should have a minimum of one boring for every 50' length of infiltration device.

To be suitable for infiltration, underlying soils shall have an infiltration rate (f_c) of 0.52 inches per hour or greater, as initially determined from NRCS soil textural classification, and subsequently confirmed by field geotechnical tests. Geotechnical testing requirements are outlined in Appendix E.

Soils shall have a clay content of less than 20% and a silt/clay content of less than 40%.

Infiltration shall not be located on slopes greater than 6% or within fill soils.

The soil borings must indicate the depth to the seasonally high water table and bedrock, if any. The minimum distance acceptable between the bottom of the trench and the seasonally high water table is 4 feet. The minimum distance acceptable between the bottom of the trench and bedrock is 2 feet.

Infiltration systems designed to handle runoff from commercial or industrial impervious parking areas shall be a minimum of 100 feet from any water supply well.

A minimum of 5 feet horizontal distance shall be maintained between a utility line and infiltration trench. No utility line shall be placed over, under or within an infiltration trench.

Infiltration practices shall not be placed in locations that cause water problems to downgrade properties. Infiltration systems greater than 3 feet deep shall be setback at least 15 feet down-gradient from building structures.

Soil boring location stakes shall be left in the field for inspection purposes.

Soils investigation shall be performed by a licensed soils or geotechnical engineer.

3.2.2 Infiltration Conveyance Criteria

The overland flow path of surface runoff exceeding the capacity of the infiltration system shall be evaluated to preclude erosive concentrated flow during large storm events. If computed flow velocities exceed the non-erosive threshold, an overflow channel shall be provided to a stabilized water course. The non-erosive threshold is typically 4 feet per second for the 2-year event and 6 feet per second for the 15-year event.

All infiltration systems shall be designed to fully de-water the entire V_w *within 72 hours after the storm event.*

If runoff is delivered by a storm drain pipe or along the main conveyance system, the infiltration practice shall be designed as an off-line practice. Pretreatment shall be provided for storm drain pipes systems discharging directly to infiltration systems.

3.2.3 Infiltration Pretreatment Criteria

Pretreatment Volume

A minimum pretreatment volume of at least 25% of the V_w *shall be provided prior to entry to an infiltration facility, and can be provided in the form of a sedimentation basin, sump pit, grass channel, grass filter strip, plunge pool or other measure.*

Exit velocities from the pretreatment chamber shall not be erosive (above 6 fps) during the 15-year design storm.

If the f_c *for the underlying soils is greater than 2.0 inches per hour, 50% of the* V_w *shall be treated by another method prior to entry into an infiltration facility.*

Pretreatment Techniques to Prevent Clogging

Each infiltration system shall have redundant methods to protect the long term integrity of the infiltration rate. Three or more of the following techniques must be installed in every facility:

- *grass channel*
- *grass filter strip (minimum 20 feet and only if sheet flow is established and maintained)*
- *bottom sand layer*
- *upper filter fabric layer*
- *use of washed bank run gravel as aggregate*

3.2.4 Infiltration Treatment Criteria

Filter cloth or an equivalent material (Woven Monofilament Geotextile 104F) shall be installed on top and sides of trench. The sides of infiltration practices shall be lined with an acceptable filter fabric that prevents soil piping but has greater permeability than the parent soil.

A 6" layer of clean, washed sand may be used on the bottom of the trench, this area will not be counted in the trench volume calculation. Filter cloth or an equivalent material (Woven Monofilament Geotextile 104F) must be used to separate the sand layer from the stone aggregate.

The minimum allowable volume of voids is 0.35, and the trench shall be filled with 1.5" to 3" washed bank-run gravel.

The following formulas shall be used to determine the infiltration trench volume:

$$V = \frac{R * A}{12 * V_v} \tag{3.37}$$

Where V = trench volume (ft^3)
R = runoff depth (in), see Table 2.2
A = infiltration trench surface area (ft^2)
V_v = volume of voids (0.35)
12 = conversion factor

The maximum trench depth shall be computed based on maximum detention time (T_d) of 72 hours. The head required for an inflow volume of R into the trench shall be determined using the following formula from TR-55:

$$Q_{pk} = R * I_a * q_u \tag{3.38}$$

Where: Q_{pk} = peak discharge (cfs)
R = runoff depth to be treated (Table 2.2) (in)
I_a = impervious area (mi^2)
q_u = unit peak discharge (csm/in) (from TR-55)

$$h = \frac{1}{2g} * \left(\frac{Q_{pk}}{CA}\right)^2 \tag{3.39}$$

Where: h = head loss (ft)

Q_{pk} = peak discharge (cfs)
C = 0.6 = entrance loss coefficient
A = infiltration trench surface area (ft^2)
g = 32.2ft/sec^2 (gravitational acceleration)

Infiltration practices shall be designed to exfiltrate the entire V_w through the floor of each practice.

Infiltration practices are best used in conjunction with other BMPs, and often downstream detention is still needed to meet the water quantity sizing criteria.

3.2.5 Infiltration Landscaping Criteria

A dense and vigorous vegetative cover shall be established over the contributing pervious drainage areas before runoff can be accepted into the facility.

3.2.6 Infiltration Maintenance Criteria

Infiltration systems may not receive runoff until the entire contributing drainage area has been completely stabilized.

An observation well shall be installed in every infiltration trench, consisting of an anchored 6" diameter perforated PVC pipe with a lockable cap installed flush with the ground surface.

Direct access shall be provided to all infiltration practices for maintenance and rehabilitation. If a stone reservoir or perforated pipe is used to temporarily store runoff prior to infiltration, the practice shall not be covered by an impermeable surface.

OSHA trench safety standards should be consulted if the infiltration trench will be excavated more than five feet.

A percolation test shall be required for infiltration trenches except for designs which drain through sand into a perforated pipe.