Dec. 1, 1992

Infiltration Trench

Description

An infiltration trench is a long, narrow, shallow excavation located over porous soils and back-filled with stone to form a subsurface reservoir to hold stormwater and allow it to infiltrate the soil. It can be used on small sites up to five acres in size. Infiltration trenches remove fine sediment and the pollutants associated with them.

Trenches may be "open" to the surface or enclosed below ground. Open trenches receive sheet flow of stormwater from surrounding sources. The sheet flow enters the trench through a layer of vegetated porous soil on the top of the trench. Grass filter strips remove coarse sediments which would plug the spaces between the stones and make the trench ineffective.

Below-ground trenches may receive higher concentrations of flow than above-ground trenches. With below-ground trenches, stormwater enters the basin through an inlet and pipe from the surface. The stormwater entering the trench must be pre-treated using a combination of buffer strips and multi-chambered catch basins to remove coarse sediments and oils.

Although use of infiltration practices is encouraged, if not properly designed, constructed, and maintained, contamination of groundwater can occur. Infiltration trenches should only be used as part of a "treatment train," where soluble organic substances, oils, and coarse sediment are removed by other management practices prior to stormwater entering the infiltration trench. This practice should not be used in industrial parks, high density or heavy industrial areas, or chemical or pesticide storage areas, or fueling stations.

Pollutants Controlled and Impacts

Infiltration trenches remove fine sediment and the pollutants associated with them. Coarse sediment may prevent the trench from operating properly and must be removed prior to entering it.

Soluble pollutants can be effectively removed if detention time is maximized. The degree to which soluble pollutants are removed is dependent primarily on holding time, the degree of bacterial activity, and chemical bonding with the soil. It is important to remember that if stormwater runoff contains high amounts of soluble contaminants, groundwater contamination can occur. If soluble contaminants are known to be present, either pretreatment or source elimination of the contaminants must be pursued.

The efficiency of the trench to remove pollutants can be increased by increasing the surface area of the trench bottom. Infiltration trenches can provide full control of peak discharges for small sites. They provide groundwater recharge and may augment base stream flow. They are effective at replacing infiltration lost due to the addition of impervious areas, and may be used strictly as a means to maintain the hydrologic balance after stormwater runoff has been treated by other means.

Application

Land Use
Urban, urbanizing, transportation, and agricultural

Soil/Topography/Climate
Soil infiltration rates at the site selected for the basin are extremely important. Acceptable soils are those with infiltration rates greater than 0.52 inches per hour, with clay content less than 30%. Trenches should not be constructed in areas which have been filled in.

Infiltration trenches are not feasible where the slope of the site is greater than 20%, unless proper energy dissipation devices are installed. Infiltration trenches are not recommended where the slope of the contributing watershed is greater than 5%.

When to Apply
Infiltration trenches should not be constructed until after the entire work site is stabilized. The trenches or the area where they will be constructed must not be used as a sediment basin during construction. Heavy equipment must be kept off the site where the trenches are to be constructed to prevent compacting the underlying soils.

Where to Apply
Infiltration trenches should only be used for sites five acres or less in size. Examples include parking lot drainage, roof drainage and highway drainage.

Infiltration trenches are a good alternative at small sites where little land is available. Trenches can easily be incorporated into the existing landscape, causing no negative aesthetic impacts.

This practice should not be used in industrial parks, high density or heavy industrial areas, areas with chemical or pesticide storage, and fueling stations in order to reduce the risk of groundwater contamination from substances which may not be removed by this practice.

Relationship With Other BMPs

Sediment Basins and Buffer/Filter Strips are needed to remove larger soil particles from stormwater prior to entering the trench.

Oil/Grit Separators are constructed inlets used to provide settling of coarse sediments and skimming of oils prior to entering the infiltration trench. Primarily used for below-ground trenches.

Filter Fabric is used to line the sides and sometimes bottom of the trench. Filter fabric placed 6 to 12 inches below the surface of an open trench can prevent major rehabilitation.

Specifications

Planning Considerations:

Take **soil tests** to ensure that the soils meet the minimum infiltration capacity. (See below).

Determine the **site location**. Trenches should be sites:

> a minimum 100 feet from drinking water wells; and
>
> a minimum 100 feet up-gradient and ten feet down-gradient from building foundations.

A minimum of four feet from trench bottom to the seasonally high water table is recommended in order to insure proper operation. A minimum of four feet from trench bottom to bedrock is also recommended.

In order to remain operative in freezing weather, infiltration trenches need to be placed three feet below the frost line.

Develop a **spill response plan**. The plan should clearly define the emergency steps to be taken in the event of an accidental release of large quantities of harmful substances to the basin. Response time is critical in order to prevent groundwater contamination. As a result of this plan, design changes such as shut off valves, or gates may be needed.

Design Considerations:

NOTE: All structural best management practices should be designed by a registered professional engineer.

Exhibit 1 is a diagram of a recommended infiltration trench design.

Watershed Size:

Drainage of a single infiltration trench should be less than five acres.

Soil Infiltration Capacity:

The infiltration capacity of the soil must be greater than 0.52 inches/hour to insure that the trench operates properly. This corresponds to soils classified A or B by the Soil Conservation Service. It is prudent to multiply the actual soil infiltration capacity in the design by 0.5, as a margin of safety in order to account for lowered trench efficiency by sediment accumulation or soil compaction between maintenance visits.

Buffer/Filter Strip:

At a minimum, surface trenches should have a 25 foot wide grass buffer/filter strip approaching the trench. Water should be directed through the buffer strip in sheet flow, rather than as concentrated flow. An example of such a configuration is shown in Exhibit 2.

Pretreatment:
As with any BMP, this practice should be used as part of a treatment train. A treatment train is a series of BMPs used in conjunction with each other, such that each BMP removes certain pollutants. Infiltration practices should be considered to be the final stop in the treatment train because they can become clogged by oils and course solids, and because of the possibility of leaching pollutants to groundwater. BMPs which precede these infiltration practices should remove oils, and coarse solids at a minimum.

Volume:
Minimum design volume should be based on infiltration of 0.5 inches runoff over the entire drainage basin. Larger volumes will provide more effective treatment and are recommended.

To calculate the storage volume in the trench the void space between the aggregate must be determined. For the aggregate specified, assume a void space of 40% and use the formula:

$$\text{Storage Volume} = 0.4\ WHL\ Ft^3$$

Where W = Width
H = Depth
L = Length

Storage volume may be increased and trench length decreased if a perforated pipe is used in the trench design. The pipe must be placed a minimum of one foot above the bottom of the trench and six inches from either side. This pipe should be equipped with a solid overflow pipe for storms larger than design. In order to calculate storage volume of a trench with a perforated pipe, the above formula becomes:

$$\text{Storage Volume} = \text{Pipe Volume} + [0.4*(WHL\text{-Pipe Volume})]$$

This method is a conservative method which does not take into account infiltration, water depth, or soil saturation. More complex methods are available which more accurately describe the storage characteristics of the basin during a storm.

Holding Time:
The basin should hold water for a minimum of six hours and a maximum of 72 hours. Holding water for less than six hours provides little pollutant removal. Holding water for greater than 72 hours can create nuisance problems and capacity problems for back-to-back storms.

Overflow Pipe:
Where an overflow pipe is provided for flows in excess of design, the pipe should be placed near the surface of the trench and discharge to a non-erosive channel which leads to a surface water.

Underground trenches should receive water directed through a Oil/Grit Separator, or similar device which will remove both coarse solids and oils from the waste stream. An underground infiltration trench configuration is shown in Exhibit 3.

Filter:
Filter fabric must be used to line the sides of the trench. Either filter fabric or six inches of sand is used on the trench bottom. Cleaned, washed stone aggregate, 1.5 to 3 inches in diameter should be used as fill.

Observation Well:
An observation well, consisting of a perforated vertical pipe within the trench, should be installed in every trench to monitor performance.

Construction Considerations:
Avoid the use of heavy equipment which would compact the soil in the trench.

Do not construct the trench until the entire construction area is stabilized. Construct a diversion berm around the perimeter of the trench. Remove excavated soils to outside the berm.

The trench floor should be as flat as possible.

Maintenance

A very high failure rate occurs with infiltration trenches if they are not maintained. The most critical maintenance item for this BMP is the periodic removal of accumulated sediment. If sediment is allowed to accumulate, the storage volume of the trench for wastewater will become reduced as the space between rocks is filled with sediment. Surface soils can become clogged and the trench will cease to operate as designed. Normally, total rehabilitation of the trench will be needed if it becomes clogged.

Total rehabilitation can be avoided if filter fabric is placed 6 to 12 inches below the surface of the trench. If failure occurs, only the portion of the trench above the filter fabric will require replacement. This is most useful where systems to remove course sediment have a high probability of failure.

The observation well should be checked several times within the first few months of operation to be sure the trench is operating correctly. The well should be checked annually thereafter to determine when rehabilitation is needed.

Where Catch Basins or Oil/Grit Separators are used, the sediment and oil accumulated within them must be periodically removed. Follow the maintenance schedule in the BMP. Debris which can clog the inlets or outlets must also be removed.

Other maintenance items include mowing Buffer/Filter Strips. Follow specifications in the Buffer/Filter Strip BMP.

Eroding or barren areas must be revegetated as soon as possible.

Exhibits

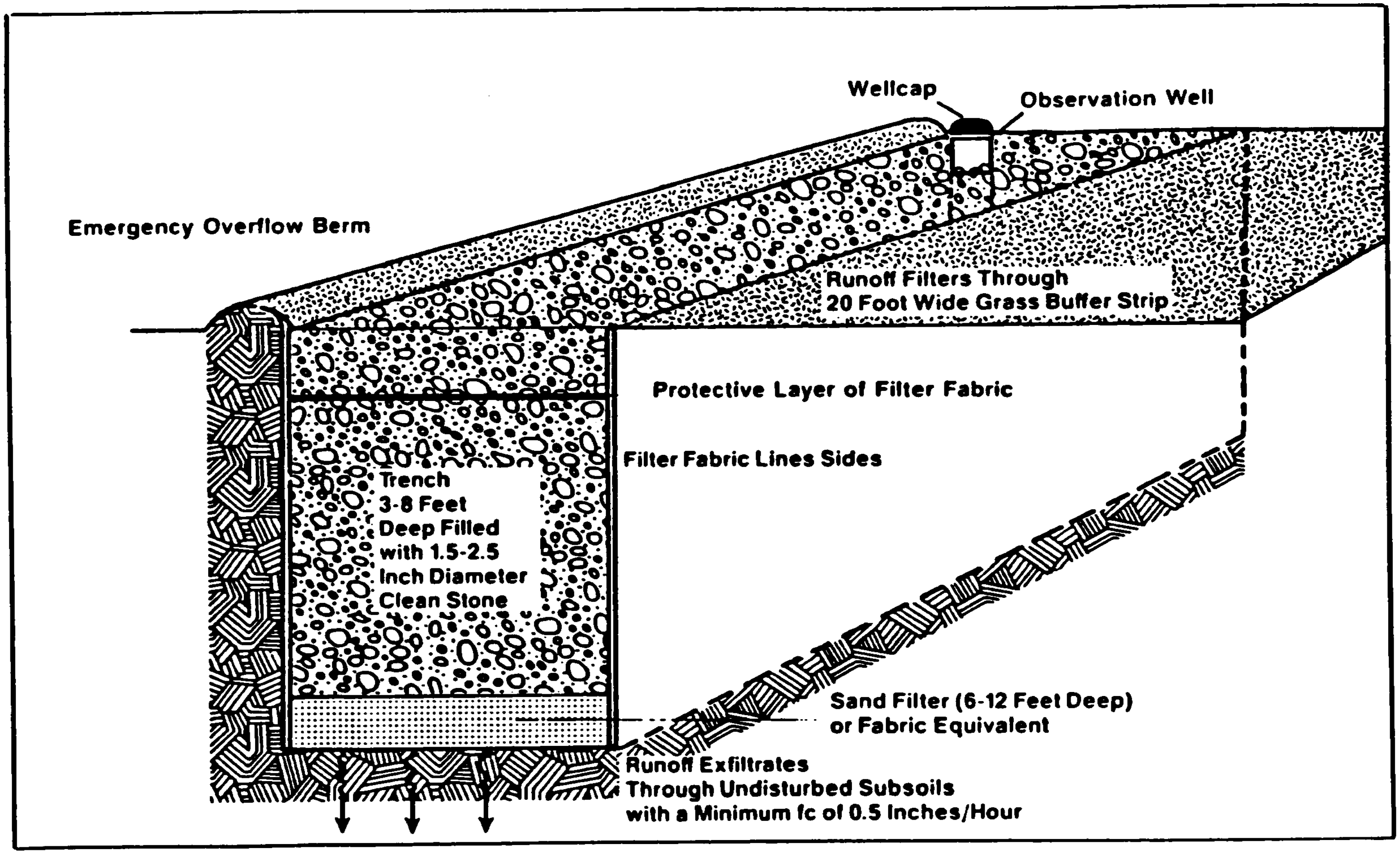
All three exhibits were taken from: Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments (Schueler). 1987.

Exhibit 1: Typical Infiltration Trench.

Exhibit 2: Example Surface Trench Configuration.

Exhibit 3: Example Underground Trench Configuration.

Exhibit 1 – Typical Infiltration Trench



Source: Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments (Scheuler). 1987.

Exhibit 2 – Highway Median Strip Trench Design

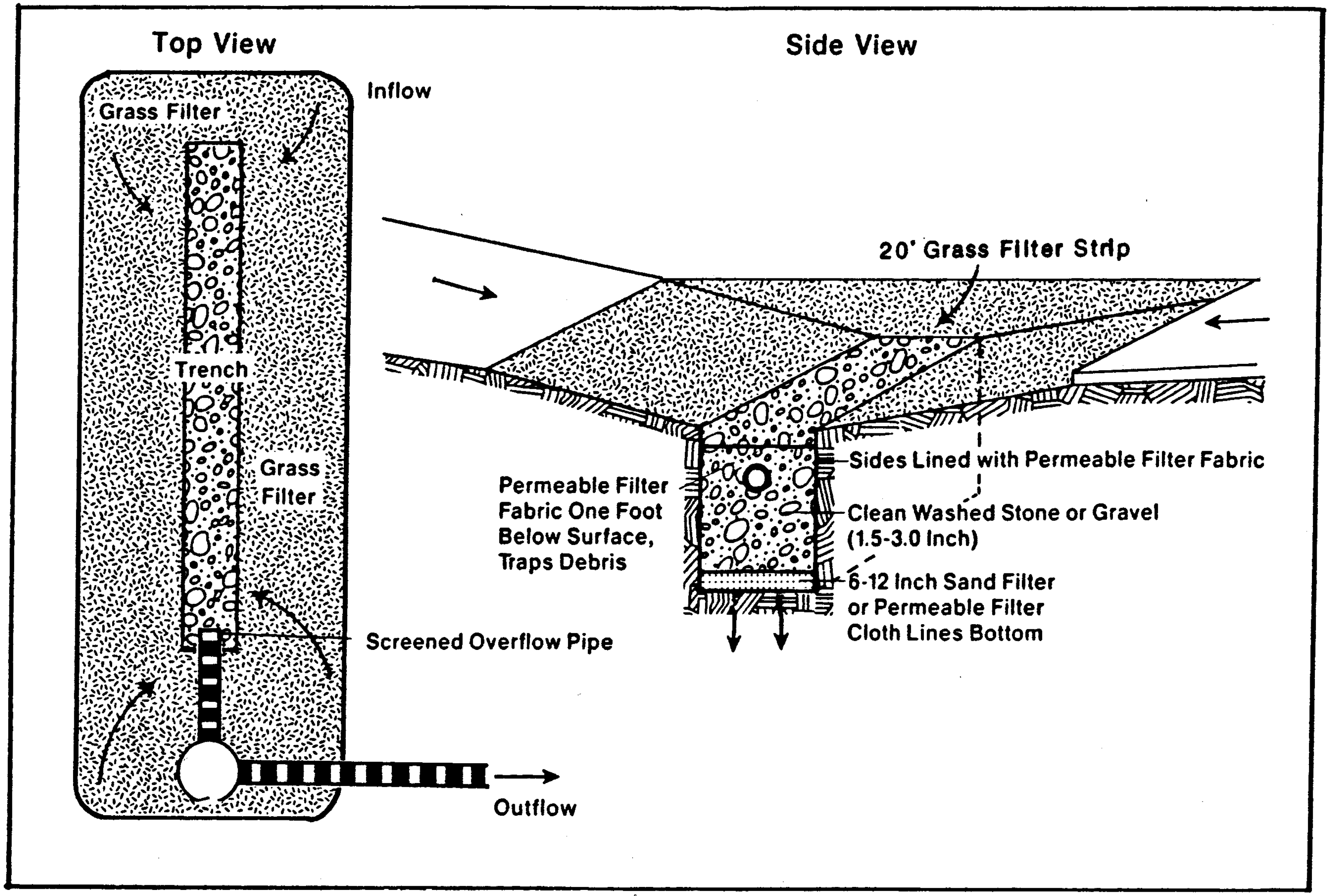


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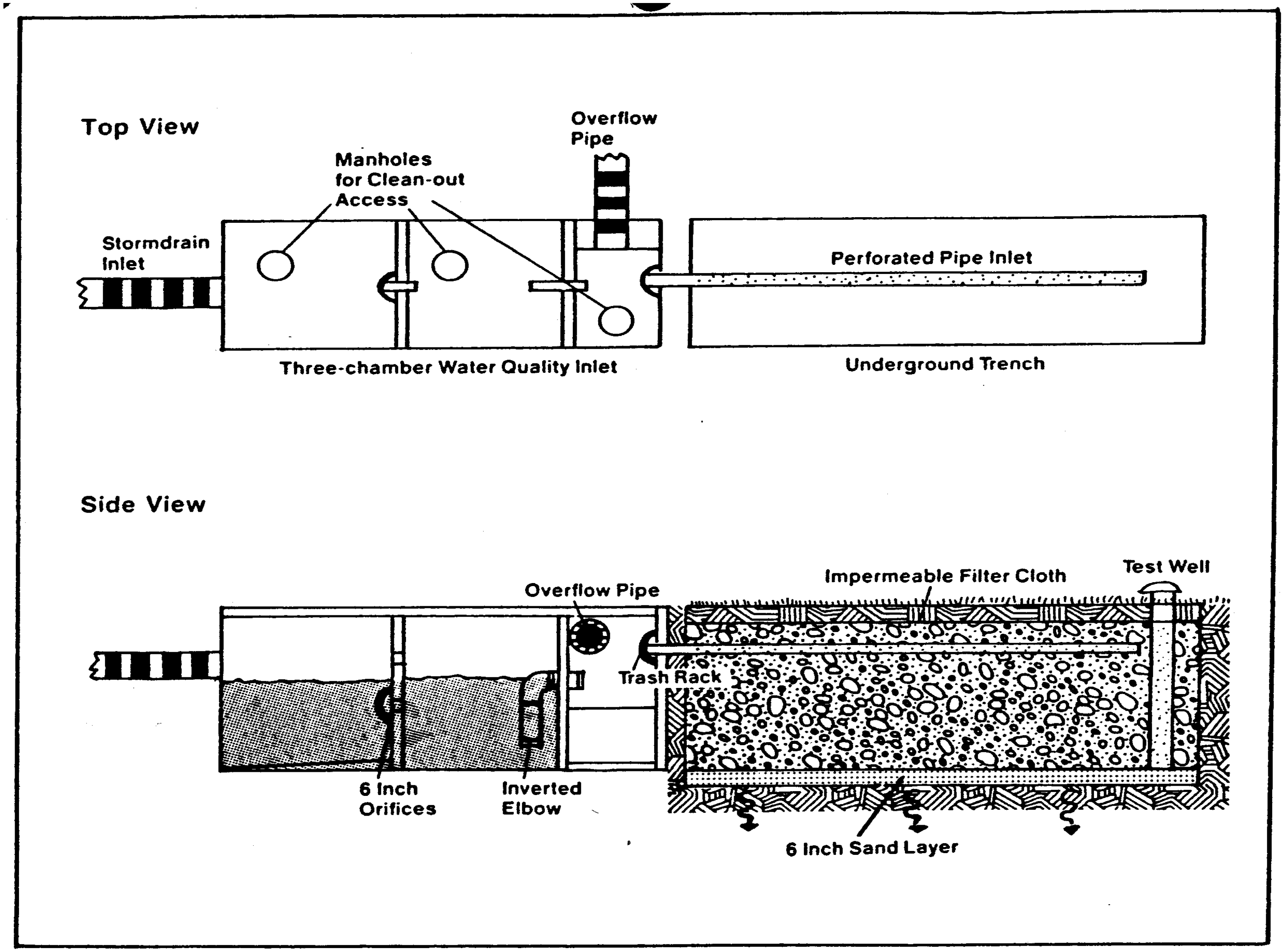
Exhibit 3 – Underground Infiltration Trench Design



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