Infiltration Basin

Description

An infiltration basin is a water impoundment over permeable soils which receives stormwater runoff and contains it until it infiltrates the soils. These basins remove *fine* sediment and the pollutants associated with them. *Coarse* sediment must be removed from the stormwater by other methods prior to entering the basin. This BMP serves drainage areas up to 50 acres in size.

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

Infiltration basins can provide recreational, wildlife habitat or aesthetic benefits in addition to stormwater control. Multiple uses of these basins are recommended whenever possible.

Other Terms Used to Describe

Exfiltration Basin
Infiltration Pond
Recharge Basin
Retention Basin
Seepage Basin

Pollutants Controlled and Impacts

Infiltration basins are effective at removing fine sediment and the pollutants associated with them. Coarse sediment and oils will plug the basin and must be removed prior to entering it (i.e. pretreated). Some soluble pollutants can be effectively removed if proper vegetation is planted and managed, and detention time is maximized. The degree to which soluble pollutants are removed is dependent primarily on uptake by vegetation in the basin, degree of bacterial transformation, bonding to soils, and holding time.

Infiltration basins can provide full control of peak discharges for large design storms. 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.

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, source elimination of the contaminants should be pursued.

Application

Land Use
Primarily urban and urbanizing

Soil/Topography/Climate
The soil at the site selected for the basin is extremely important. Acceptable soils are those with infiltration rates greater than 0.52 inches per hour, and a clay content less than 30%. Basins should not be constructed in areas where fill has been used.

Infiltration basins are not feasible where the slope of the contributing watershed is greater than 20%.

When to Apply
Normally, the basin would not be put into use until after the work site is stabilized. If the basin will also serve as a Sediment Basin during construction, it should only be excavated down to two feet above the design floor. Sediment which accumulates in the basin can then be excavated when the basin is constructed and after all other construction is complete.

Where to Apply
Infiltration basins may be used for sites five to 50 acres in size.

Randomly sited basins with regular discharges to a surface water may add to peak discharges at some points in the receiving stream. Basin placement and discharge rates should be determined based on a hydrologic analysis of the watershed.

Basins can be designed for multiple uses, such as playgrounds or parks. This is particularly attractive in urban areas where available land is limited.

Relationship With Other BMPs

Sediment Basins and Buffer/Filter Strips are needed to remove larger particles from stormwater prior to entering the basin. Riprap is used at inlets and outlets to prevent scouring, reduce flow velocities, and trap sediment. Oil/Grit Separators are used to remove oil, grease and large solids from stormwater before it enters the basin. Extended Detention Basins and Wet Detention Basins are often used in a treatment train prior to the infiltration basin.

Specifications

Planning Considerations:
The **location** of basins must be determined through a hydrologic analysis of the watershed. If the peak discharge from a particular basin is delayed to coincide with the peak discharge from an upstream tributary, or release from an upstream basin, the actual stream discharge peak can increase.

The location of any Sediment Basins should logically correspond with the location of any stormwater basins, including infiltration basins.

Basins should be sited a minimum 100 feet from drinking water wells.

Basins should be sited a minimum 100 feet up-gradient and 20 feet down-gradient from building foundations.

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

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

Adequate **access** right-of-way must be assured. The access should be a minimum 10 feet wide and stabilized to provide for passage of heavy equipment.

A **spill response plan** must be developed which clearly defines 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.

Infiltration basins may be designed several ways:

On-Line Basin: The basin is a part of the stormwater conveyance system. That is, all runoff that reaches the conveyance system will be retained in, or pass through the infiltration basin. A protected low-flow channel and outlet structure are necessary parts of this design.

Off-Line Infiltration Basins: Flow is diverted from a storm sewer or surface channel by a device such as a weir, to an infiltration basin. At some determined volume, additional flows are directed to the receiving stream by means of a spillway.

Exhibits 1 through 3 are diagrams of different types of infiltration basin design.

Watershed Size:
Infiltration basins should not be used on sites greater than 50 acres.

Soil Infiltration Capacity:
The infiltration capacity of the soil must be greater than 0.52 inches/hour to insure that the basin 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 basin efficiency by sediment accumulation or soil compaction between maintenance visits.

Buffer Strip:
At a minimum, a 25-foot grass buffer strip should surround the infiltration basin.

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 pollutants leaching to groundwater. BMPs which precede these infiltration practices should remove oils and course solids at a minimum.

Volume:
Minimum design volume should be no less than 0.5 inches of runoff from the entire contributing watershed. Larger volumes will provide more effective treatment and are recommended. If some portion of the volume is to release directly to a receiving water, as in a detention facility, the design of the outlet can be very complex. An outlet design method is discussed in the "Stormwater Management Guidebook" by Bruce E. Menerey, which is available from the Department of Natural Resources, Land and Water Management Division.

Holding Time:
The basin should hold water for not less than six hours nor greater than 72 hours. Less than six hours of holding time provides little treatment, while greater than 72 hours can create nuisance problems and capacity problems for back-to-back storms.

Basin Configuration:
The basin floor should be as flat as possible, with no significant depressions. Side slopes should be no more than 3:1 (h:v) to allow for mowing and bank stabilization.

Infiltration is enhanced with increasing surface area of the basin floor. Therefore, maximize basin floor surface area and reduce depth.

Emergency Spillway:
An emergency spillway must be provided in order to direct overflows from storms larger than the design storm.

Vegetation:
Vegetation on the basin bottom and sides must be capable of surviving up to 72 hours under water. Tall fescues or bermuda grass are often used. **Native** vegetation is most desirable. The vegetation can maintain and possibly improve infiltration, prevent erosion, and remove soluble nutrients in the stormwater.

Access:
Adequate access to the basin floor for maintenance must be provided.

Construction Considerations:
To prevent soil compaction, avoid the use of heavy equipment on the bottom of the basin.

At the conclusion of construction, stabilize the surrounding area following the guidance in the Seeding and Mulching, or Sodding BMPs.

Maintenance

Existing infiltration basins have the highest failure rate of any BMP. The primary reasons are lack of pretreatment for removal of substances which can clog the basin, and lack of maintenance. Maintenance is essential for the long-term use of this practice.

The most critical maintenance item for this BMP is the periodic removal of accumulated sediment from the basin bottom. If sediment is allowed to accumulate, surface soils will become clogged and the basin will cease to operate as designed. Sediment should be removed only when the surface is dry and "mud-cracked." Light equipment must be used in order to avoid compacting soils. After removal of sediment, the infiltration area should be deep tilled to restore infiltration rates. Normally, sediment should be removed at least once a year. More frequent tilling may be necessary in areas with soils that are only marginally permeable.

Other maintenance items include mowing buffer/filter strips, side slopes, and the basin floor. Debris and litter accumulated in the basin must be removed. Eroding or barren areas must be revegetated as soon as possible.

Exhibits

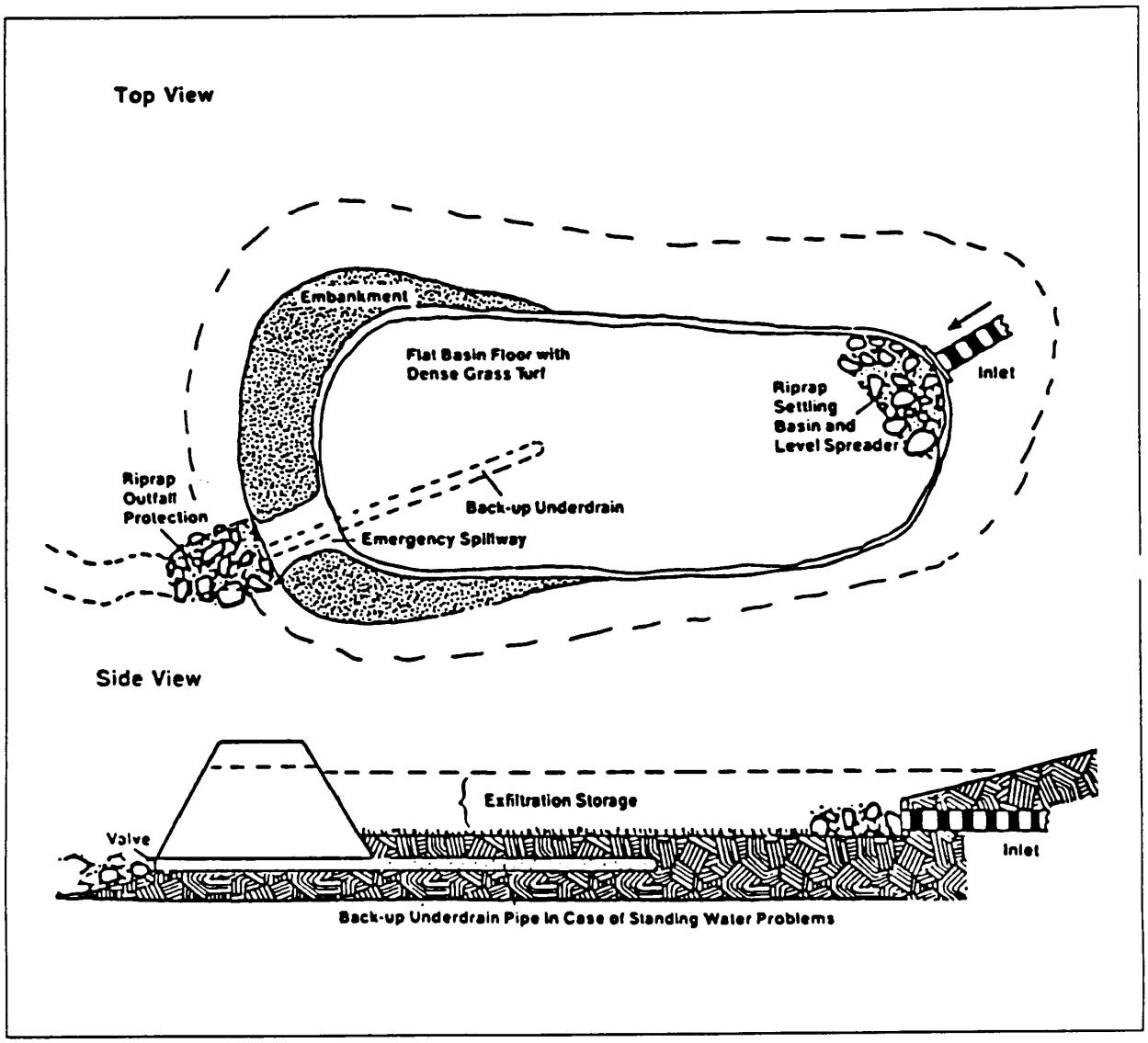
All three exhibits were taken from: Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments (Schueler). 1987.

Exhibit 1: Full Infiltration Basin.

Exhibit 2: Combined Infiltration/Detention Basin.

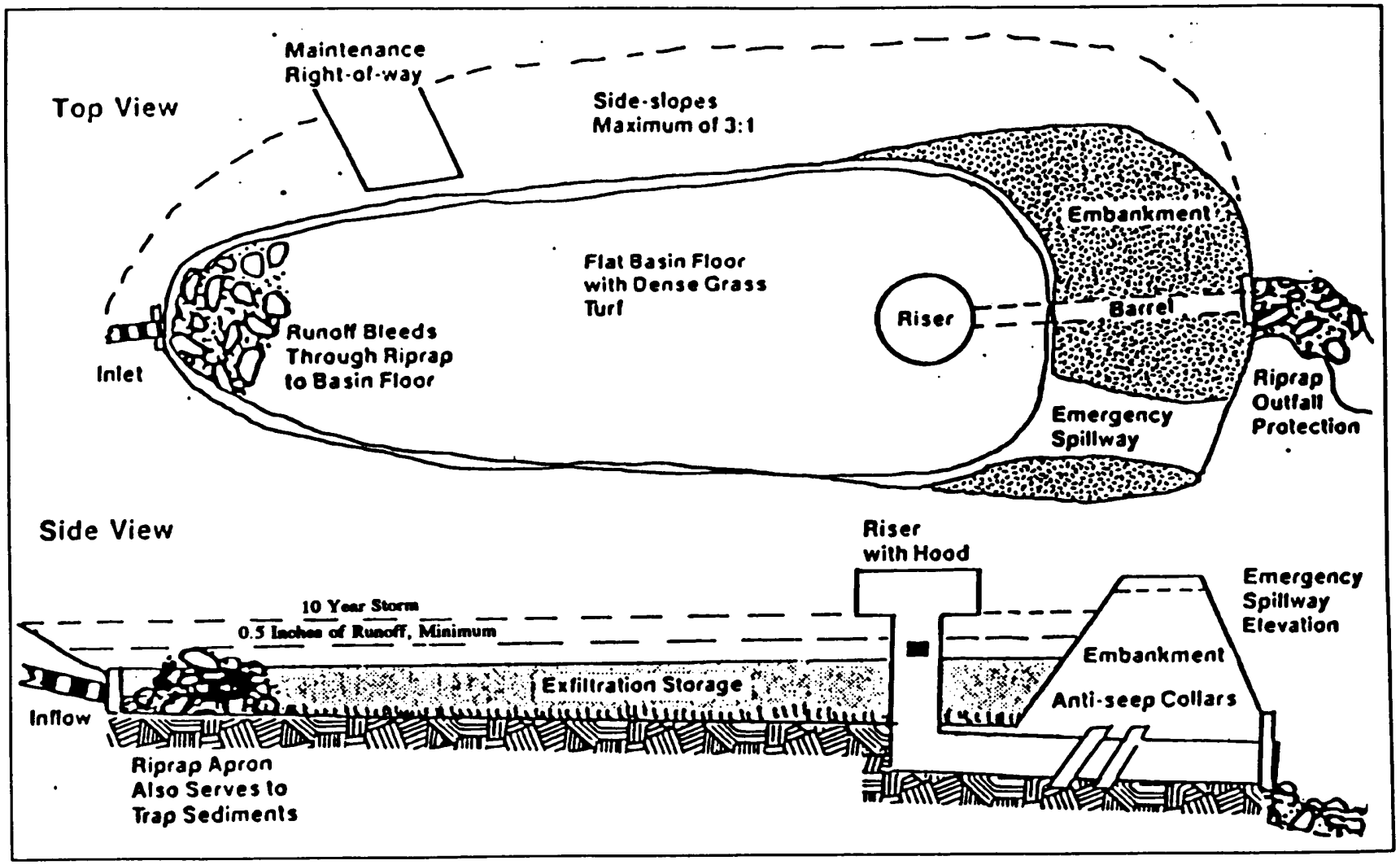
Exhibit 3: Off Line Infiltration Basin.

Exhibit 1 – Full Infiltration Basin



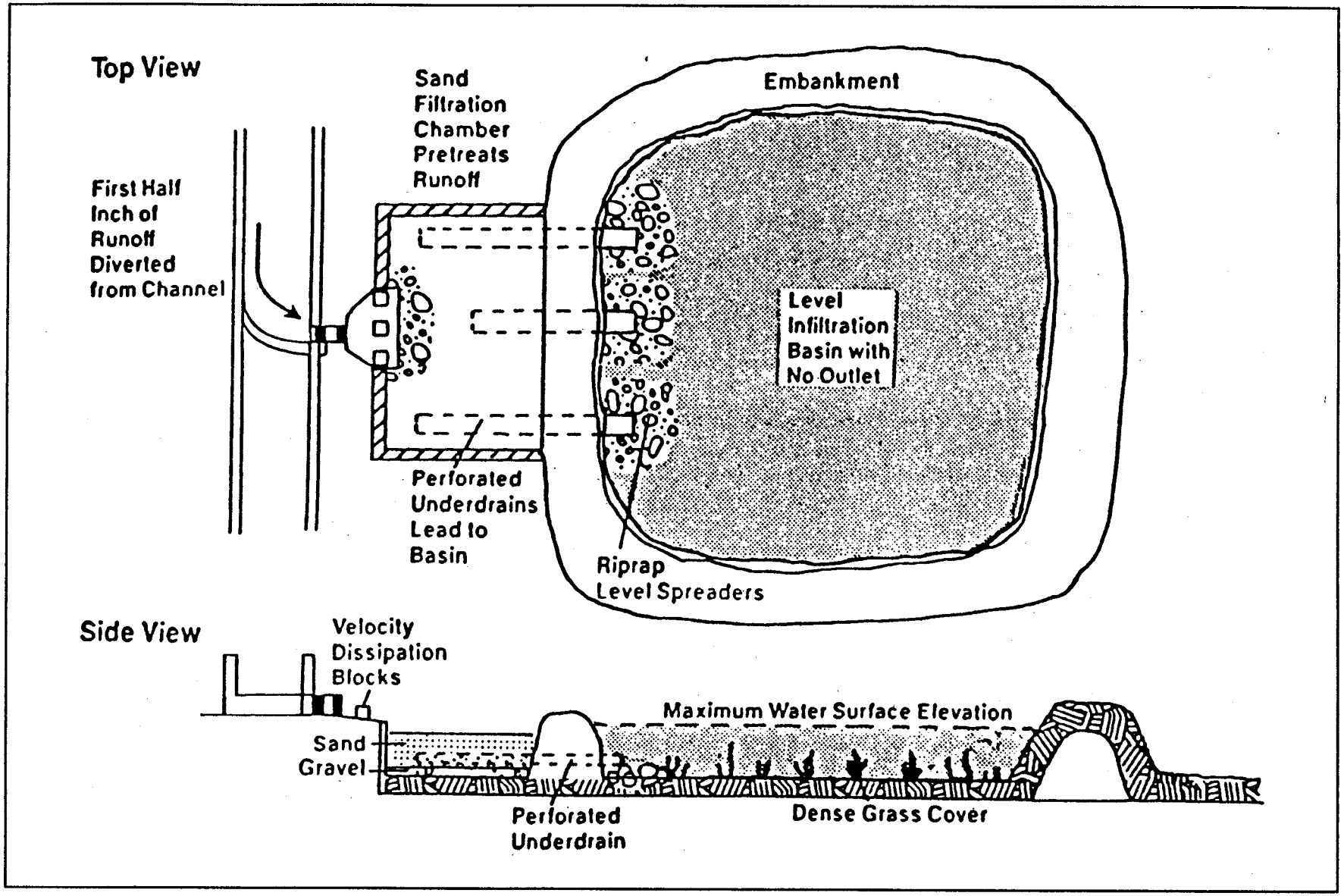
Source: Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments (Scheuler). 1987.

Exhibit 2 – Combined Infiltration/Detention Basin



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

Exhibit 3 – Off-Line Detention Basin



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