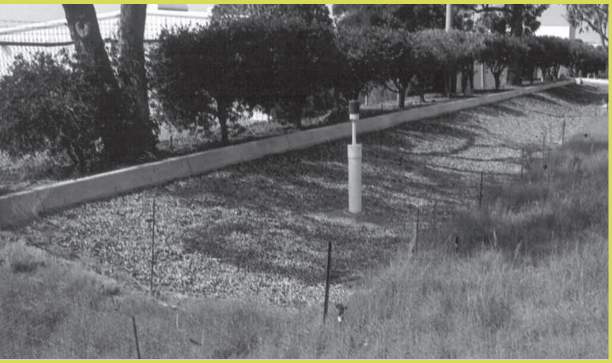
Low Impact Development strategies use careful site design and decentralized stormwater management to reduce the environmental footprint of new growth. This approach improves water quality, minimizes the need for expensive pipe-and-pond stormwater systems, and creates more attractive developments.

MASSACHUSETTS **LOW IMPACT DEVELOPMENT** TOOLKIT

FACT SHEET #5

INFILTRATION TRENCHES AND DRY WELLS



Overview

Infiltration trenches and dry wells are standard stormwater management structures that can play an important role in Low Impact Development site design. Dispersed around the site, these infiltration structures can recharge groundwater and help to maintain or restore the site's natural hydrology. This approach contrasts with conventional stormwater management strategies, which employ infiltration as a secondary strategy that occurs in large basins at the end of a pipe.

Dry wells and infiltration trenches store water in the void space between crushed stone or gravel; the water slowly percolates downward into the subsoil. An overflow outlet is needed for runoff from large storms that cannot be fully infiltrated by the trench or dry well. Bioretention, another important infiltration technique, is discussed in another fact sheet. Infiltration trenches do not have the aesthetic or water quality benefits of bioretention areas, but they may be useful techniques where bioretention cells are not feasible.

Applications and Design Principles

Infiltration structures are ideal for infiltrating runoff from small drainage areas (<5 acres), but they need to be applied very carefully. Particular concerns include potential groundwater contamination, soil infiltration capacity, clogging, and maintenance. Pretreatment is always necessary, except for uncontaminated roof runoff. Trenches and dry wells are often used for stormwater retrofits, since they do not require large amounts of land; directing roof runoff to drywells is a particularly cost-effective and beneficial practice. Whether for retrofits or new construction, multiple infiltration structures will be needed to treat large sites; they are often used in the upland areas of large sites to reduce the overall amount of runoff that must be treated downstream.

Trenches and dry wells are tough to site in dense urban settings, due to the required separation from foundations, and because urban soils often have poor infiltration capacity due to many years of compaction. Infiltration trenches and dry wells should not receive runoff from stormwater hotspots

Management Objectives

- Remove suspended solids, heavy metals, trash, oil and grease.
- Reduce peak discharge rate and total runoff volume.
- Provide modest infiltration and recharge.
- Provide snow storage areas.
- Improve site landscaping.

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(such as gas stations) unless the stormwater has already been fully treated by another stormwater treatment practice to avoid potential groundwater contamination.

Infiltration structures must be constructed with adequate vertical separation from the groundwater table, generally 2' or more between the bottom of the trench or pit and the seasonally high groundwater table. Soils must be sufficiently permeable (at least 0.3"/hour) to ensure that trenches can infiltrate quickly.

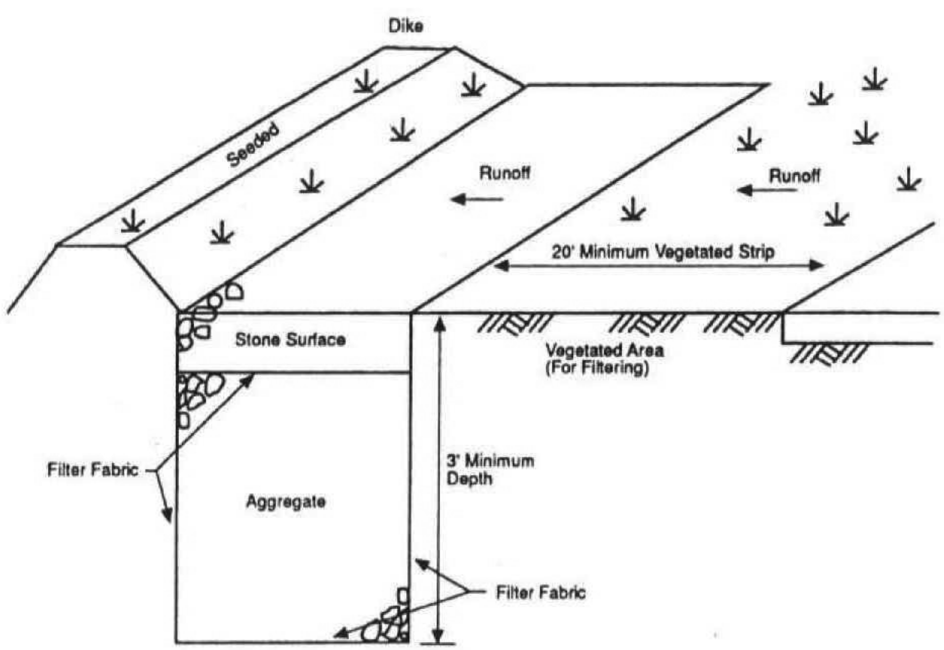
Infiltration trenches and dry wells operate on similar principles, though trenches are linear troughs and dry wells are round or square in plan view. In both cases, the excavated hole or trench, 3'-12' deep, is lined with filter fabric and backfilled with washed, crushed stone 1.5"-3" in diameter. The bottom of infiltration trenches is often filled with a 6"-12" filter layer of washed, compacted sand. A 4"-6" perforated PVC observation well will permit monitoring of the structure and observation of drainage time.

Trenches and dry wells should be designed to store the design volume and infiltrate it into the ground through the bottom of the trench or well within 72 hours. Because of their limited size, infiltration structures are best used to infiltrate the first inch/half inch of runoff from frequent small storms; they are not effective for infiltrating the runoff from large storms. Overflow from trenches and dry wells should be directed to a swale or other conveyance, sized to prevent erosion.

Because dry wells and infiltration trenches can be prone to clogging, pretreatment of stormwater runoff is a necessity. Where dry wells accept roof runoff through a system of gutters and downspouts, screens at the top of downspouts should suffice. For runoff from paved surfaces, designers should use grass swales, filter strips, settling basins, sediment forebays, or a combination of two or more strategies to pretreat stormwater before it is discharged to an infiltration trench or dry well. In groundwater protection areas (Zone II and Interim Wellhead Protection Areas) infiltration may only be used for uncontaminated rooftop runoff.

Above, top: A perforated pipe delivers rooftop runoff to the full length of this infiltration trench, under construction. After completion the area will be covered with sod and the trench will be invisible. *Photo: Cahill Associates, Inc. 2004*

Above: A roadside infiltration trench that receives runoff via periodic curb cuts; this trench may be prone to clogging because there is no pretreatment. *Photo: Lower Columbia River Estuary Partnership*



Right: A schematic section of an infiltration basin. *Image: American Groundwater Trust, Plainfield CT Stormwater Manual*

Above, and Cover: The parking lot runoff directed to this infiltration basin is pretreated by a vegetated filter strip. Note concrete level spreader (at right) to facilitate sheetflow across filter strip. *Photo:California Stormwater Quality Association*

Benefits and Effectiveness

- Dry wells and infiltration trenches reduce stormwater runoff volume, including most of the runoff from small frequent storms. Consequently, downstream pipes and basins are smaller, and the local hydrology benefits from increased base flow.
- Dry wells and infiltration trenches also reduce peak discharge rates by retaining the first flush of stormwater runoff and creating longer flow paths for runoff.
- Infiltration structures are moderately expensive to construct and can help to reduce the size of downstream stormwater management structures.
- These techniques have an unobtrusive presence; they do not enhance the landscape (like bioretention areas do), but they have a lower profile than large infiltration basins.

Limitations

- Infiltration trenches and dry wells cannot receive untreated stormwater runoff, except rooftop runoff. Pretreatment is necessary to prevent premature failure that results from clogging with fine sediment, and to prevent potential groundwater contamination due to nutrients, salts, and hydrocarbons.
- Infiltration structures cannot be used to treat runoff from portions of the site that are not stabilized.
- Rehabilitation of failed infiltration trenches and dry wells requires complete reconstruction.
- Infiltration structures are difficult to apply in slowly permeable soils or in fill areas.
- Where possible, the design should maintain a minimum separation from paved areas (generally 10', depending on site conditions) to prevent frost heave.
- Unlike bioretention areas, infiltration trenches and dry wells do not help meet site landscaping requirements.

Above: Precast concrete drywell inserts prior to installation.
Photo: Lower Columbia River Estuary Partnership

Maintenance

- After construction, inspect after every major storm for the first few months to ensure stabilization and proper function.
- On a monthly basis, remove sediment and oil/grease from pretreatment devices, overflow structures, and the surface of infiltration trenches.
- Semi-annually, check observation wells 3 days after a major storm. Failure to percolate within this time period indicates clogging
- Semi-annually, inspect pretreatment devices and diversion structures for sediment build-up and structural damage.
- If ponding occurs on the surface of an infiltration trench, remove and replace the topsoil or first layer of stone and the top layer of filter fabric.
- Upon failure, perform total rehabilitation of the trench or dry well to maintain storage capacity within 2/3 of the design treatment volume and 72-hour exfiltration rate.

Cost

Infiltration trenches and dry wells are moderately expensive to construct. Because trenches and dry wells can infiltrate stormwater closer to the source, conveyance structures such as swales and pipes can be downsized. It is important that developers and property owners provide a budget for maintenance activities, since lack of maintenance is the primary cause for premature failure of infiltration structures.

Design Details

- Determine infiltration rate of underlying soil through field investigations; use a minimum of one boring at each dry well, two borings at each infiltration trench, with at least one additional boring every 50 feet for trenches over 100 feet. Base trench/drywell sizing on the slowest rate obtained from soil infiltration tests. Determine the infiltrative capacity of the soil through an infiltration test using a double-ring infiltrometer. Do not use a standard septic system percolation test to determine soil permeability.
- Do not use trenches or dry wells where soils are >30% clay or >40% silt clay.
- Use of vertical piping for distribution or infiltration enhancement may cause the trench or drywell to be classified as an injection well which needs to be registered with the state.
- Trim tree roots flush with the trench sides in order to prevent puncturing or tearing the filter fabric. Since tree roots may regrow, it may be necessary to remove all trees within 10 feet of the infiltration structure and replace them with shallow-rooted shrubs and grasses.
- If used, distribution pipes should have perforations of 0.5" and should be capped at least 1 foot short of the wall of the trench or well.
- For infiltration trenches receiving runoff via surface flow, a horizontal layer of filter fabric just below the surface of the trench, covered with 2"-6" of gravel or crushed stone, will help to retain sediment near the surface; this will prevent clogging and allow for rehabilitation of the trench without complete reconstruction.
- Required set backs for surface water supply (Zone 1 and Zone A): 400 feet setback from a source and 100 feet from tributaries. Required setback from private wells: 100 feet
- Required setback from septic systems: 100 feet. Required setback from building foundations: 10 feet for drywells and 20 feet for infiltration trenches.
- Because of clogging problems, infiltration trenches and drywells should never be used to infiltrate runoff from drainage areas that are not completely stabilized. For best performance, contractors, should avoid compaction of soils around trenches and dry wells during construction.

Additional information

Massachusetts Stormwater Management Policy: Volume Two: Stormwater Technical Handbook; MA DEP & MA CZM; 1997

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