9.0 Infiltration Practices

Definition: Structures used to infiltrate runoff and to facilitate percolation through the subsoil. Whenever possible naturally vegetated areas should be protected and used for infiltration of runoff from impervious surfaces. Plant-soil relationships are the most effective means for removing fine sediments, bioavailable nutrients, and other pollutants from urban stormwater.

Purpose: To infiltrate stormwater runoff from impervious surfaces with no direct discharge to surface waters.

Applicability: Infiltration systems are applicable for treating runoff from any impervious surface that has been pretreated to meet the effluent limits for discharges to infiltration outlined in Chapter 1. While soils in the Tahoe Basin are usually highly permeable, permeability tests should be performed to ensure infiltration rates are sufficient for treatment. Infiltration structures should not be installed in areas with a high water table where untreated stormwater may affect groundwater quality. A minimum four feet separation from invert of the structure to seasonally high groundwater is required.

Advantages: If properly installed and maintained, infiltration structures can prevent discharge of runoff from impervious surfaces. Infiltration practices also recharge local groundwater supplies and help maintain vegetation. Onsite infiltration is particularly effective for phosphorus removal (Hydroscience, March 2000).

Disadvantages: Infiltration systems convey surface water to groundwater regardless of quality. If not treated, stormwater flows may negatively affect groundwater. In particular, infiltration practices are not effective for nitrogen removal. Furthermore, infiltration methods are generally ineffective in areas with a high groundwater table. In other areas, infiltration systems may alter natural groundwater flows by dewatering some areas and saturating others. Heavy sediment loads and organic particulates from leaves and needles may reduce infiltration capacity; infiltration structures must be carefully monitored to ensure such clogging does not hinder effective treatment. Soils can also become saturated with pollutants, reducing treatment capacity.

Infiltration can be a very effective method for stormwater treatment, especially when coupled with native vegetation. Effective removal of dissolved constituents is highly dependent on soil type. Loamy soils are particularly suited for removal of dissolved nutrients and fine particulates; coarse soils are generally less effective. Beyond pollutant removal, infiltration practices help restore the natural hydraulic balance of developed areas by returning storm water flows to the soil and attenuating storm water peak flows. Such attenuation serves to prevent channel erosion and protect downstream BMPs.

Common infiltration systems:

9.1 - Infiltration Trench
9.2 - Infiltration Gallery
9.3 - Dry Well

References

More detailed construction specifications can be found in:

Goldman, et al. 1986. Erosion and Sediment Control Handbook. McGraw Hill.

Maryland Department of the Environment. 2000. 2000 Maryland Storm water Design Manual.

TRPA. 1988. Handbook of Best Management Practices

9.1 Infiltration Trench

Please read section 9.0 for important information applicable to all infiltration practices.

Description: An infiltration trench is a shallow trench back-filled with gravel to allow for enhanced runoff infiltration. Runoff is diverted into the trenches, from which it percolates into the subsoil. Vegetated conveyance swales may also serve as infiltration trenches (see Section 7.5 – Vegetated Ditches).

Planning Considerations: Infiltration trenches are most common along the drip line of elevated impervious surfaces, such as rooftops. Trenches used to drain large, heavily used paved areas, such as parking lots or other impervious surfaces should include pretreatment to remove heavy sediments and hydrocarbons. The sizing of infiltration trenches is dependent on the design storm, soil type, and the total area of impervious surface.

Removal Efficiencies: According to a study performed by West Yost and Associates for TRPA in 1996, the standard design 18" wide by 8" deep trench infiltrates approximately 1.6 inches per hours per 20 square feet of contributing area (p. 5-13). West Yost and Associates also estimated the annual load reductions *per foot* of infiltration trench based on seven rainfall storm events in the Lake Tahoe Basin, as listed in the following table:

Table 1: Estimated Annual Load Reductions per foot of infiltration trench.

Pollutant	Annual Load Reduction
NO3-N (nitrate)	0.061 g
TKN (total Kjeldhal nitrogen)	0.16 g
SRP (soluble reactive phosphorus)	0.0043 g
TP (total phosphorus)	0.031 g

West Yost and Associates determined from the BMP Effectiveness Study that

"…infiltration trenches are very effective at infiltrating runoff and the associated pollutants it contains (p. 2-7)."

The State of Idaho's *Catalog of Storm Water Best Management Practices for Idaho Cities and Counties* indicates that the expected pollutant removal effectiveness of infiltration trenches is 75% for sediment, 55% for phosphorus, and greater than 70% for trace metals, bacteria, and petroleum hydrocarbons (Storm Water Program: Watershed and Aquifer Protection Bureau, Idaho Division of Environmental Quality, 1997).

Tips for Installation:

1. Excavate a trench of the required size along roof drip line or adjacent to impervious surface. Over size, if space permits.
2. Add filter cloth (optional) and gravel to fill the trench.
3. Infiltration trenches installed on steep slopes benefit from wood borders with cross-slope stops to prevent gravel from moving down slope.

Maintenance: Infiltration trenches require extensive maintenance to ensure effectiveness. In most circumstances their life expectancy is 8 to 19 years. Accumulated debris must be periodically cleaned from the surface to allow flows to infiltrate. If trenches become ineffective, they should be replaced or reworked immediately. Rock or gravel should be removed and washed of accumulated sediment or replaced with clean rock.

Where to Use: Infiltration trenches are best suited to treating rooftop runoff. They may also be used for treating runoff from small impervious surfaces with light sediment loads and minimal oil and grease buildup. Use pretreatment structures or source control methods to prevent clogging in areas where sediment loads are high and prevent soil contamination where oil and grease concentrations are high.

Where NOT to Use: Infiltration trenches are inappropriate for treating large impervious areas where high pollutant loads will likely overwhelm infiltration capacities.

Field Experience:

- El Dorado County reports success using infiltration trenches to treat runoff from the Black Bart project. The project used Infiltrator Systems to improve infiltration capacity (see section 9.4 – Infiltrators).
- The use of geotextile fabrics in infiltration trenches to prevent soil intrusion into the gravel fill may significantly reduce infiltration capacity.

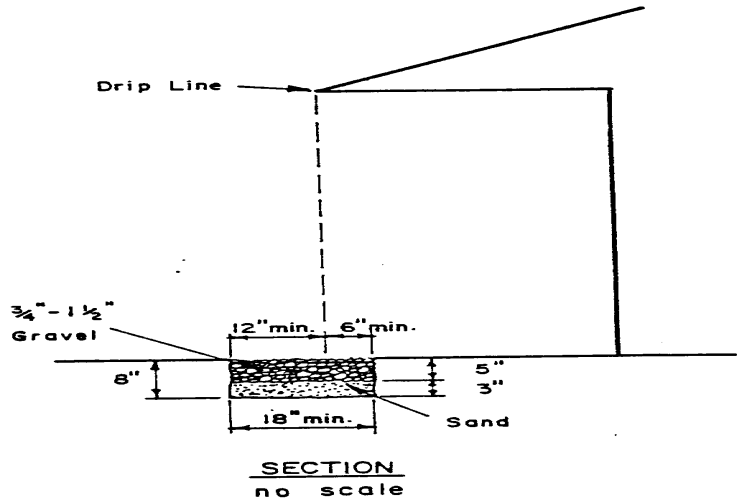

Figure 1 – Typical Drip Line Infiltration Trench – Source: TRPA Handbook of Best Management Practices, 1988

9.2 Infiltration Gallery

Please read section 9.0 for important information applicable to all infiltration practices.

Description: Infiltration structures designed to deliver captured runoff to the subsoil through subsurface reservoirs usually composed of rock or gravel.

Planning Considerations: Below grade infiltration structures can provide innovative stormwater treatment in areas where space is limited. As with other infiltration practices, percolation tests should be performed to ensure adequate infiltration rates. It is important to consider possible pollutant loads and include pretreatment devices to help minimize maintenance cost. High flow bypasses should also be included in the design. Infiltration galleries are most appropriate as secondary treatment for runoff from impervious surfaces such as parking lots that have pretreatment structures in place. Be aware runoff discharged to groundwater is subject to the maximum pollutant loads discussed in Section 1.0. It is also important to consider potential impacts of structural subgrade materials and the possibility of surface instability caused by soil piping and/or slope destabilization.

Tips for Installation:

1. Consult a qualified soil scientist to determine if soil conditions are appropriate for infiltration.

Maintenance: Since infiltration galleries are below grade, they are extremely difficult to maintain. Inlets should be inspected regularly for pine needles and other debris that may clog the system. If infiltration rates have visibly diminished, the system must be dug up and rehabilitated.

Where to Use: Infiltration galleries are appropriate for treating runoff from small impervious areas where space is limited.

Where NOT to Use: Avoid installation in larger areas with high sediment loads, high oil and grease accumulation, and in soils with limited permeability. Like other infiltration methods, galleries should not be used in areas with high groundwater or shallow depth to an impervious layer.

Field Experience:

- Washoe County installed a 4 foot by 48 inch underground basin as part of a water quality improvement project. Pine needles and other debris frequently plug the inlet causing system bypass. Maintaining the underground basin is extremely time consuming.
- Infiltration facilities installed under roadways as part of California Tahoe Conservancy funded projects at Black Bart Avenue and Apache Street have not shown any apparent damage to roadway sections after several years of operation.

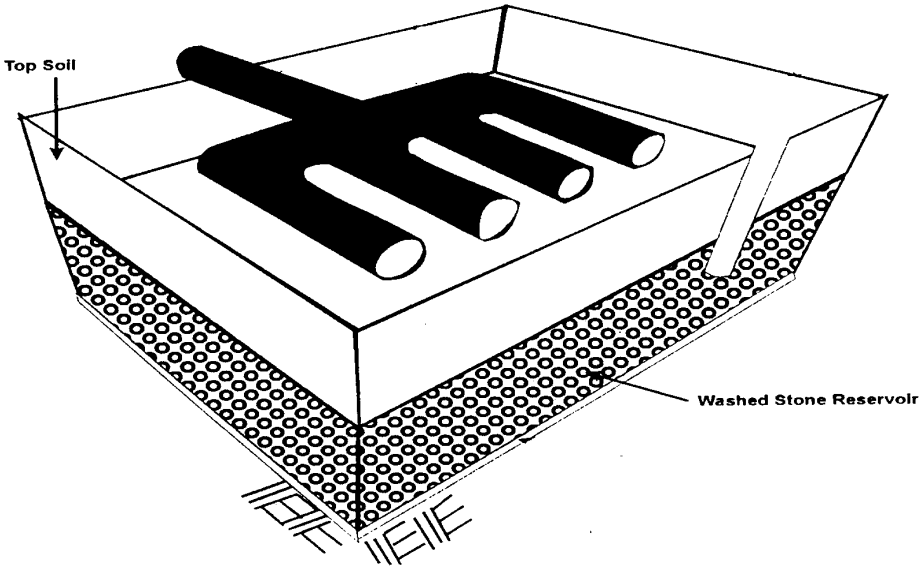

Figure 2 - Typical Infiltration Gallery – Source: Metropolitan Washington Council of Governments, 1987

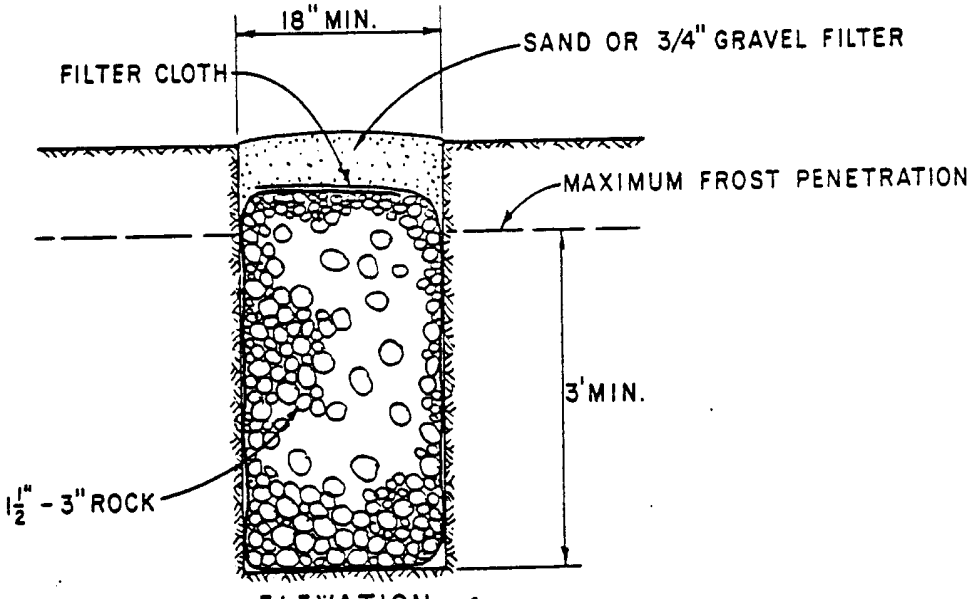

Figure 3 – Typical Dry Well – Source: TRPA Handbook of Best Management Practices, 1988

9.3 Dry Wells

Please read section 9.0 for important information applicable to all infiltration practices.

Description: A stone or gravel filled pit used to infiltrate runoff from impervious surfaces.

Planning Considerations: Several shallow dry wells are more effective than a single large, deep well. As with other infiltration practices, pretreatment is necessary to prevent clogging by coarse sediment and debris. Percolation tests must be performed to ensure adequate infiltration rates.

Tips for Installation:

1. Consult a qualified soil scientist to determine if soil conditions are appropriate for infiltration.
2. Excavate a pit of the required size.
3. Backfill the well with 1-1 ½inch stone or gravel.
4. For easy maintenance, backfill to within 6 inches of the top and place a layer of filter fabric over the stone or gravel. Top off with a layer of 1-1 ½inch gravel.

Maintenance: Dry wells can require extensive maintenance to sustain effectiveness in areas where inadequate source control does not prevent sediment and debris from reaching dry wells. Accumulated debris must be periodically cleaned from the surface to allow flows to infiltrate. If wells become clogged then the top layer and filter fabric should be removed and cleaned or replaced to reestablish satisfactory percolation rates.

Where to Use: Dry wells are well suited for treating small impervious areas as an alternative to infiltration trenches and may be appropriate on steeper slopes where trenches or other facilities cannot be installed. Dry wells are particularly appropriate to treat runoff from residential driveways or rooftop downspouts.

Where NOT to Use: Avoid installation in larger areas with higher sediment loads and in soils with limited permeability. As with other infiltration practices, dry wells should not be used in areas with high groundwater. Dry wells are not suited for treating runoff from large impervious surfaces such as parking lots.

Field Experience:

- The City of South Lake Tahoe uses dry wells in areas with low discharge volumes. They are easy to install and inexpensive to maintain.
- El Dorado and Placer Counties often install rock infiltration basins with sand cans for pretreatment.

9.4 Infiltrator Systems

Please read section 9.0 for important information applicable to all infiltration practices.

Description: Infiltrator Systems Inc. distributes several different types of infiltration enhancement chambers. The systems consist of plastic open bottom chambers with louvered sidewalls. Each chamber stores up to 122 gallons of runoff. Multiple chambers can be fitted together to form hollow beds of any size and shape.

Planning Considerations: Infiltrator Systems should be designed and installed by a professional engineer. Consult Infiltrator Systems Inc. for guidance.

Tips for Installation:

1. Consult a qualified soil scientist to determine if soil conditions are appropriate for infiltration.
2. Installation guidelines are available from Infiltrator Systems Inc.

Where to Use: Infiltrator Systems can be incorporated as part of any infiltration practice, including infiltration trenches, dry wells, and infiltration galleries. These systems are especially appropriate where percolation rates may limit infiltration capacities.

Where NOT to Use: As with other infiltration techniques, Infiltrator Systems should not be used in areas of high groundwater or shallow depth to an impervious layer.

Field Experience:

- El Dorado County used Infiltrator Systems in infiltration trenches installed as part of the Black Bart project.

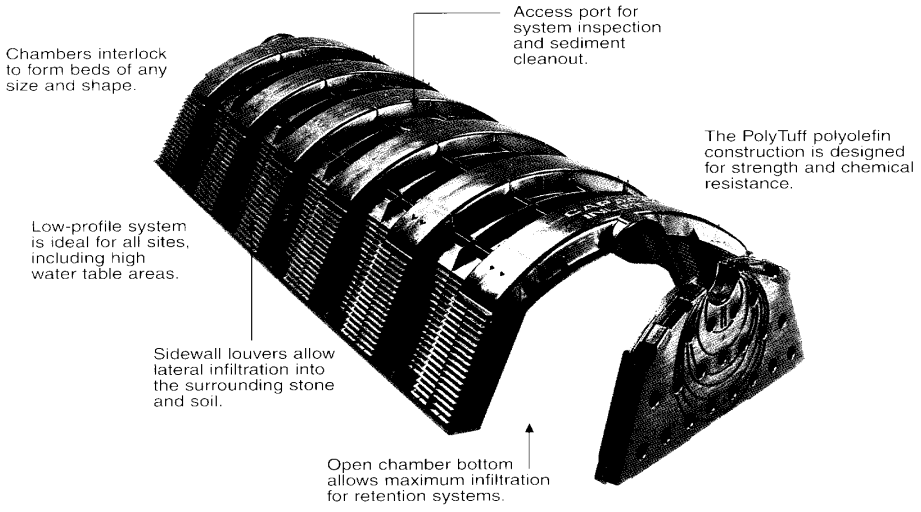

Figure 4 – High Capacity Infiltrator Chamber System