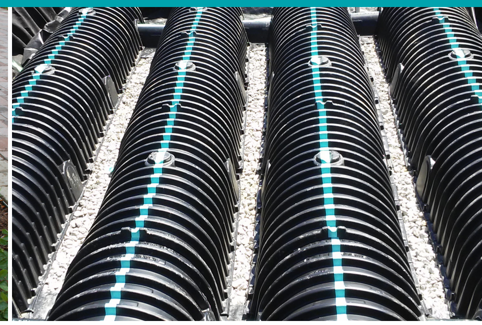
Sustainable Technologies
EVALUATION PROGRAM

Soakaways, Infiltration Trenches & Chambers

Soakaways, **infiltration trenches** and **infiltration chambers** are similar in that they consist of sub-surface reservoirs that store and infiltrate stormwater runoff from roofs, walkways, parking lots, and low to medium traffic roads without consuming a large amount of land.

Soakaways typically consist of rectangular or trapezoidal geotextile-lined excavations, filled with stone or other void-forming structures, that receive runoff from a perforated pipe inlet and infiltrate it into the native soil. They typically service individual lots and receive roof and walkway runoff, but can also receive overflows from stormwater practices.

Infiltration Trenches (also referred to as 'infiltration galleries') are design variations that consist of linear, rectangular or trapezoidal, geotextile-lined excavations with a level or gently sloping bottom grade. Like soakaways, they are also filled with stone or other void-forming structures. They are well suited to sites where available space for infiltration is limited to strips of land between buildings or properties, or along road rights-of-way. See 'Exfiltration Trench Systems' fact sheet for guidance on infiltration trench systems integrated with conventional storm sewers to also provide conveyance functions.

Infiltration chambers include a range of proprietary manufactured, modular structures installed underground (embedded in clean, crushed angular stone) to create large void spaces that temporarily store and infiltrate runoff into the underlying native soil. Typically installed under parking or landscaped areas, they can be used in various configurations. They are well suited to sites where available land area is limited, or where it is desirable for the facility to have a minimal surface footprint. They can be designed with enough load bearing capacity to support the weight of structures above them.

DESIGN

GEOMETRY AND SITE LAYOUT

Infiltration chambers and soakaways can be designed in various shapes, while infiltration trenches are typically rectangular or trapezoidal, with a bottom generally between 0.6 and 2.4 m wide. Linear trench geometries will drain faster than round or square shapes due to larger perimeters. Facilities should have nearly level bottoms to spread flow evenly. They are typically designed with an impervious drainage area to pervious facility footprint ratio (I:P ratio) between 5:1 on low permeability soils, like hydrologic soil groups (HSG) C and D, and 20:1 on high permeability soils (HSG A & B) and not usually > 4 m deep. Refer to local criteria for required drainage time.

INLETS

Recommended to distribute inflow between multiple inlets to reduce risk of failure. May include delivery of runoff to the facility as concentrated overland or concentrated underground (i.e. pipe) flow.

PRE-TREATMENT

It is important to prevent sediment, trash and debris from entering infiltration facilities because they could contribute to clogging and failure of the system. Infiltration practices may be used to treat runoff from roofs and pavements with sedimentation or filtration pre-treatment. See 'General Specifications' section for pre-treatment options that facilitate maintenance and confine sediment and debris to an accessible area so that the risk of system clogging is reduced.

STORAGE RESERVOIR

Depth must meet both runoff storage and structural support requirements. See STEP LID Planning and Design Guide wiki page, 'Infiltration: Sizing and modelling', for guidance and tool for determining the reservoir depth and area required to store the design storm runoff volume. See 'General Specifications' for further details.

GEOTEXTILE

Storage reservoirs should be lined on the sides and top with geotextile filter fabric to maintain separation from the native soil. Geotextile on the base is optional but may be prone to blinding and eventual clogging.

PERFORATED PIPE

Continuously perforated, smooth interior HDPE or PVC drainage pipe, ≥200 mm interior diameter where possible to reduce risk of freezing and facilitate push camera inspection and cleaning with jet nozzle equipment. Including geotextile socks around perforated pipes is optional. May include an orifice plate or valve flow restrictor to provide erosion control and optimize infiltration.

CONVEYANCE AND OVERFLOW

Typically designed to be offline where a flow control structure or inlet allows only the design storm runoff volume to enter the facility. Excess flows are conveyed to a downstream storm sewer or other best management practice (BMP) by a flow-splitting manhole (i.e. flow through riser) containing a weir and overflow outlet pipe, or by by-passing the curb opening and flowing into a down-gradient catch basin.

MONITORING WELLS

Recommended for monitoring drainage time between storms. Monitoring well should be a vertical standpipe consisting of an anchored 100 to 150 mm diameter pipe with perforations along the length within the reservoir, installed to the bottom of the facility, with a lockable cap. Flow-splitting manholes may also be used for drainage time monitoring.

ACCESS STRUCTURES

Manholes or maintenance hatches connected to infiltration chambers, or standpipe inspection ports connected to infiltration trench or soakaway perforated pipe that provide access for inspection and maintenance. Should be installed at inlets and outlets at a minimum. Couplings used for standpipe connections should be 45° to facilitate pipe access by push camera and jet nozzle cleaning equipment.

BMP	Ability to meet stormwater criteria		
	Water balance	Water quality	Stream erosion control
Infiltration Trenches, Chambers and Soakaways	Yes	Yes	Yes

Infiltration Chamber System Under Parking Lot

PLANNING CONSIDERATIONS

Native Soil | Infiltration trenches, chambers and soakaways can be constructed over any soil type, but HSG A or B soils are best for achieving water balance and erosion control objectives. Facilities should be located on portions of the site with the highest infiltration rates. Native soil infiltration rate at the proposed location and depth should be confirmed through in-situ hydraulic conductivity measurements under field saturated conditions. Do not install in swelling clays or contaminated soils.

Wellhead Protection | Facilities receiving road or parking lot runoff should not be located within two (2) year time-of-travel wellhead protection areas (see Drinking Water Source Protection Plan).

Available Space | Recommended under parking, walkway or landscape areas and require little surface space. Need to plan carefully for location of inlets, outlets and access structures.

Site Topography | Facilities cannot be located on natural slopes greater than 15%.

Water Table | Maintaining a separation of one (1) metre between the elevations of the base of the practice and the seasonally high-water table, or top of bedrock is recommended. Lesser or greater values may be considered based on groundwater mounding analysis. See STEP LID Planning and Design Guide wiki page, 'Groundwater' for further guidance and spreadsheet tool.

Pollution Hot Spot Runoff | To mitigate groundwater contamination, runoff from hot spots should not be treated by infiltration trenches, chambers or soakaways.

Proximity to Underground Utilities | Designers should consult local utility design guidance for horizontal and vertical clearances required between storm drains.

Karst | Infiltration trenches, chambers and soakaways are not suitable in areas of known or implied karst topography.

Setback from Buildings | Facilities should be at least 4 m from building foundations.

CONSTRUCTION

Soil Disturbance and Compaction | Before site work begins, locations of facilities should be clearly marked. Ideally, infiltration practice locations should remain outside the limit of disturbance until construction of the facility begins to prevent soil compaction by heavy equipment.

Excavation | If >2 m in depth, trench shorings will be required to support the sidewalls. Use a toothed bucket to excavate and roughen the excavation bottom and sides prior to backfilling.

Erosion and Sediment Control (ESC) | Infiltration practice locations should not be used as sediment basins during construction. To prevent clogging, ESC measures should remain in place and runoff should be diverted from the facility until the contributing drainage area is fully stabilized and sediment has been removed from catch basins, pre-treatment devices and maintenance hole sumps.

OPERATION AND MAINTENANCE

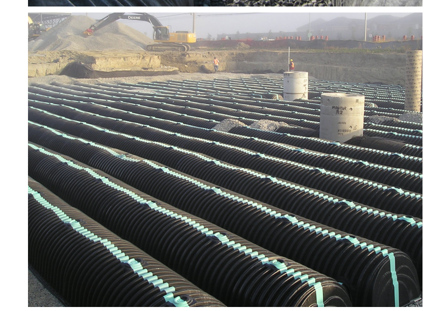
Infiltration trenches, chambers and soakaways will continue to function during winter months if the overflow outlet is located below the local frost line.

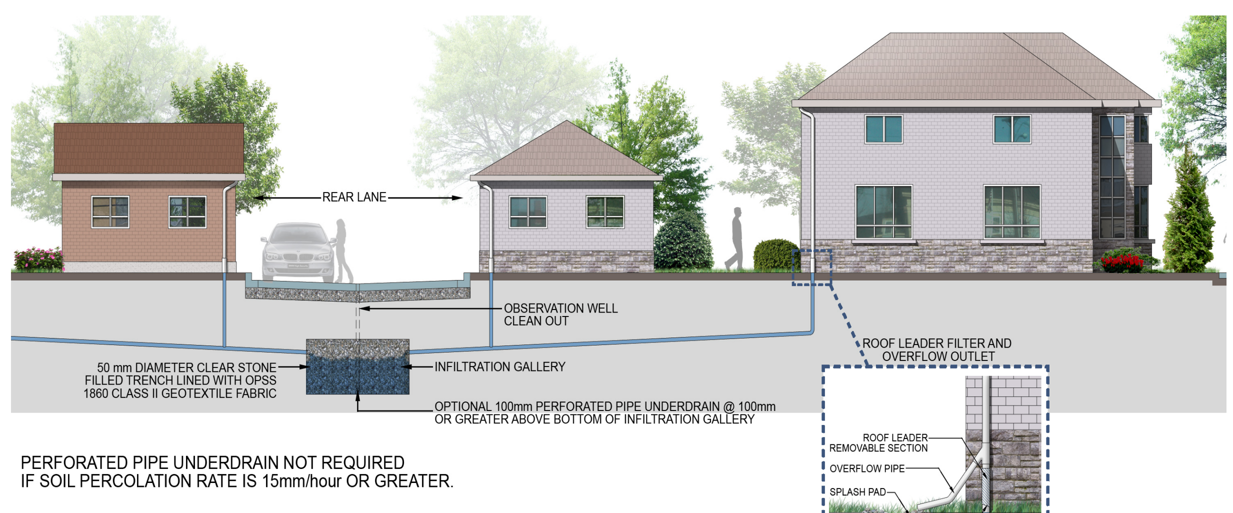
Routine inspection and maintenance consists of checking and cleaning trash, debris and sediment from pre-treatment devices, inlets and outlets twice a year in the spring and/or late fall, or when pre-treatment device sump is half full. Use a hydro-vac truck to remove sediment from catch basin sumps, OGS and isolated chamber row filter pre-treatment devices. For isolated chamber row filters use a vacuum truck with rear-facing jet nozzle to clean large diameter pipes / culverts.

Periodic monitoring of storage reservoir water level during and after natural or simulated storm events using the monitoring well should be performed to verify facility drainage time (typically 72 hours). This should occur as part of inspections following construction or major rehabilitation prior to assumption, and at least every 15 years to track drainage performance over time.

GENERAL SPECIFICATIONS

Material	Specification
Inlets	• For concentrated overland flow: (i) Catch basins or other inlet structures should be located at all sag points in the gutter grade and immediately upgrade of median breaks, crosswalks and street intersections, (ii) inlet types include curb openings, side inlet catch basins, trench drains and other pre-fabricated inlet structures, (iii) spillways aid in turning flow 30, 45 or 90 degrees into the practice, (iv) if the inlet structure itself does not provide sedimentation or filtration pre-treatment, incorporate a geotextile and stone filter inlet at curb opening or spillway locations to isolate sediment, trash and debris for ease of removal, and (v) provide a 50 to 100 mm drop in elevation between inlet invert and top elevation of the stone cover. • For concentrated underground flow, inlets may include plastic or concrete pipes from roof drains or catch basins, storm sewers, oil and grit separators (OGS) or outlet leader from an upstream BMP. Solid pipe transitions to perforated pipe within the storage reservoir 0.3 m from the sides. Trench plugs should be installed around solid pipes where they enter and exit the storage reservoir.
Pre-Treatment	• Leaf screens are mesh screens installed either on the building eavestroughs or roof downspouts and are used to remove leaves and other large debris from roof runoff. • Catch basin, manhole or other inlet structure sumps in combination with a shield, baffle, trap, or filter insert device, or goss trap, are used to pre-treat concentrated overland flow. They can be designed to retain both coarse and fine particulate sediments in the sump, and floatables (i.e. hydrocarbons, trash and debris). A variety of proprietary pre-treatment devices are available. • OGSs are used for concentrated underground flow. • Infiltration chambers are designed with an isolated filter row at inlets, not connected by pipes to the other chambers, that isolates the bulk of sediment and associated pollutants and is designed for ease of access by jet flushing cleaning equipment. • Grass swales can be used to pre-treat road and parking lot runoff. Provide a 75 to 150 mm elevation drop between the inlet invert and swale surface. • Geotextile and stone filter inlets are square or rectangular curb openings located directly over the practice, filled with clean aggregate, covered with a layer of geotextile filter fabric and stone, graded level and installed at concentrated overland flow inlets. Elevation change of 75 to 100 mm from pavement to top of the stone cover. Stone cover may be 50 to 150 mm diameter crushed angular stone, river rock/beach stone or rip rap.
Storage Reservoir	• Should be filled with uniformly graded, washed 25 or 50 mm diameter crushed angular stone (max. wash loss of 0.5%) with a porosity of 0.4. • For facilities located under load-bearing structures like pavements, aggregate should have a minimum durability index of 35 and a maximum abrasion of 10% for 100 revolutions and 50% for 500 revolutions. • Include organic material derived from untreated wood (e.g. chips, mulch or shavings) to enhance nitrogen removal. • Void-forming structures: Includes chambers, vaults, crates or perforated pipes that provide large water storage volume per unit area, reduce required facility footprint area and conserve aggregate. Plastic chamber systems should be compliant with CSA B184 SERIES 11 (R2015) or ASTM F2418-16A. Maximum allowable load for plastic chambers must be determined in accordance with ASTM F2787-13. • Concrete vault systems should be compliant with CSA A23.3-14 and CSA A23.1-09/A23.2-09 (R2014) or ASTM C858-10e1. See manufacturer for product specific specifications regarding maximum load, minimum cover depth and porosity or water storage per unit area.
Geotextile	• Material specifications should conform to Ontario Provincial Standard Specification (OPSS) 1860 for Class II geotextile fabrics. • Material should be woven monofilament or non-woven needle punched, or woven monofilament with a minimum overlap of 300 mm. Woven slit film and non-woven heat bonded fabrics should not be used as they are prone to clogging. Specification of geotextile fabrics should consider the apparent opening size (AOS) for non-woven fabrics, or percent open area (POA) for woven fabrics, to maintain water flow even with sediment and microbial film build-up. Other factors that need consideration include maximum forces to be exerted on the fabric, and the load bearing ratio, texture (i.e., grain size distribution) and permeability of the native soil in which they will be installed. Geotextile socks around perforated pipes should conform to ASTM D6707 with minimum water flow rate conforming to ASTM D4491 (12,263 L/min/m^2 at 5 cm head).
Perforated Pipes	• Continuously perforated, smooth interior HDPE or PVC drainage pipe, ≥200 mm interior diameter where possible to reduce risk of freezing and facilitate push camera inspection and cleaning with jet nozzle equipment. Including geotextile socks around perforated pipes is optional. • May include an orifice plate or valve flow restrictor to provide erosion control and optimize infiltration.





Rear lane infiltration gallery

For more information:

Visit the online Low Impact Development Stormwater Management Planning and Design Guide for more information including links to all sources cited: wiki.sustainabletechnologies.ca.

LID Stormwater Inspection and Maintenance Guide (TRCA, 2016): sustainabletechnologies.ca.

LID Construction Guide (CVC, 2012): sustainabletechnologies.ca.

The water component of the Sustainable Technologies Evaluation Program is a collaboration of:

Toronto and Region Conservation Authority,

Credit Valley Conservation, and

Lake Simcoe Region Conservation Authority