FACT SHEET

Sustainable Technologies
EVALUATION PROGRAM

Underground Infiltration Systems

Inspection and Maintenance of Stormwater Best Management Practices

Underground infiltration systems is a general term that refers to best management practices (BMPs) that capture and temporarily store rainwater and snowmelt (i.e., stormwater) from hard surfaces (e.g., roofs and pavements) below ground in geotextile filter fabric lined excavations filled with washed gravel or other void space forming structures. These systems treat stormwater by detaining it to allow suspended sediments to settle out and soaking it into the ground where it is filtered and cleansed by interaction with soil. Runoff water is delivered to the practice through pipes connected to catchbasins, hydrodynamic (i.e., oil and grit) separators, filters, manholes, sub-drains of other features or roof downspouts. They are installed below the local maximum frost penetration depth to ensure they continue to drain year-round. Water that is in excess of the storage capacity overflows to an adjacent drainage system (e.g., municipal storm sewer or other BMP), typically via pipe or manhole containing a control structure (e.g., weir wall), to safely convey flows during flood events. Depending on the permeability of the underlying soil, such practices may be designed without a sub-drain for full infiltration or with a sub-drain for partial infiltration. The sub-drain pipe may feature a flow restrictor (e.g., orifice cap, valve) for gradually releasing detained water and optimizing the amount drained by infiltration. Key components of underground infiltration systems for inspection and maintenance are described in Figure 1 and Table 1.

Since most stormwater infiltration systems are installed below ground and out of sight, monitoring wells are needed to track drainage performance over their operating life cycle. Periodically checking that they drain to at least half empty within 48 to 72 hours of the end of a rain or snowmelt event is an important part of owning and operating one.

DESIGN TIP

It is important to include pretreatment devices such as hydrodynamic (oil and grit) separators, filters or catchbasin inserts (e.g., baffles, snouts, filters) and sumps upstream of underground infiltration system inlets, and to clean them out regularly. These devices limit the amount of trash, debris, sediment, oil and grease entering the infiltration system, which helps to prevent clogging and maintain its drainage performance.

RELATED TERMS

Soakaways: Typically service individual lots and receive only roof and walkway runoff but can also be designed to receive overflows from other BMPs (e.g., rain barrels or cisterns, rain gardens, green roofs. Also known as infiltration galleries, French drains, dry wells or soakaway pits.

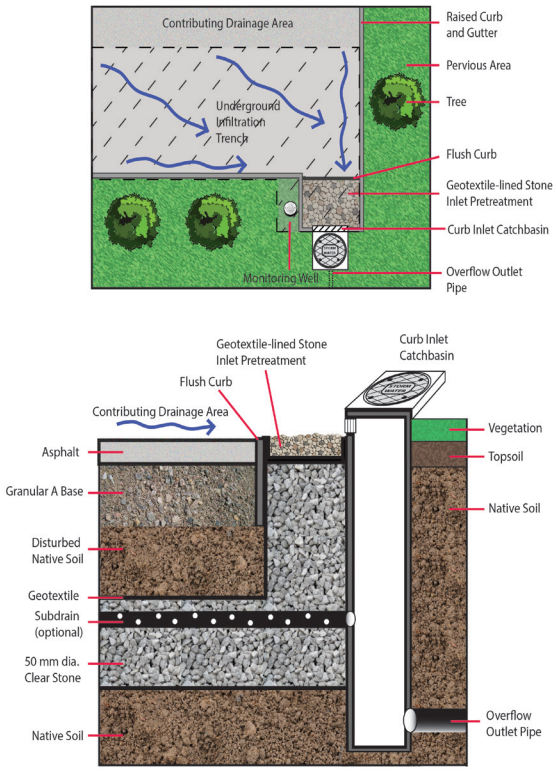
Infiltration trenches: Linear oriented soakaways designed to fit into narrow strips of land between structures or properties, or along road rights-of-way; can also receive road runoff with adequate pretreatment devices upstream of inlets.

Infiltration chamber systems: Include a range of proprietary modular structures installed underground that create large void spaces for temporary storage of stormwater while providing sufficent load bearing capacity to allow construction of structures on top of them. Applications are similar to infiltration trenches. Also known as infiltration tanks or vaults.

Perforated pipe storm sewer systems: Linear-oriented infiltration trenches installed parallel with conventional storm sewer pipes and catchbasins that receive stormwater from them. May include manholes with perforated risers. Also known as exfiltration storm sewer, percolation drainage, or clean water collector systems.

KEY COMPONENTS AND INSPECTION AND MAINTENANCE TASKS

Figure 1. Generalized plan and cross-section views showing key components of an infiltration trench.



* NOT TO SCALE *

BENEFITS

- Reduce the quantity of pollutants and runoff being discharged to municipal storm sewers and receiving waters (i.e., rivers, lakes and wetlands)

- Replenish groundwater resources and keep the flow of water to our rivers and lakes cool for temperature-sensitive fish like trout and salmon;

- Can be adapted to fit into many contexts (e.g., below roadways, parking lots, plazas, parks and yards).

- In densely developed urban areas, where the value of land is high, this can make them preferable to surface practices like detention ponds.

TIPS TO HELP PRESERVE BMP FUNCTION

- Prohibit stockpiling of soil, sand, compost or unwashed gravel within the contributing drainage area of underground infiltration systems to prevent clogging with sediment;

- Pretreatment devices that retain trash, debris, sediment, oil and grease should be installed upstream of all inlets, or isolator rows/water quality forebay units should be part of the design to prevent obstructions (particularly those with flow restrictors on sub-drains) and extend the operating lifespan of the BMP.

- When cleaning pretreatment devices like hydrodynamic (oil and grit) separators, filters or catchbasin inserts (baffles, snouts, filters) and sumps, remove floating trash and debris first using a bucket strainer. Floating oils and grease should then be removed from the surface water using a petroleum absorbing sponge. Then use a hydrovac truck to wash and vacuum out water and sediment.

- Provide a means of draining systems by gravity (e.g., pipe and valve through the control structure weir wall) to make inspection and maintenance work that requires drainage of the BMP (e.g., control structure and isolator row/water quality forebay inspection, sediment removal and repairs) easier to perform; and

- To remove accumulated sediment from sub-drain pipes and chamber system isolator rows or water quality forebays, a hydro-vac truck equipped with a JetVac nozzle should be employed that uses high pressure jets of water to propel itself through the structure while scouring and directing sediments to a downstream collection point (e.g., manhole or catchbasin sump) for removal by vacuuming. Selecting an appropriate JetVac nozzle will depend on the structure being cleaned. For chamber system isolator row or water quality forebay units, fixed nozzles designed for culverts or large diameter pipe cleaning with rear-facing jets are preferable (consult product manufacturer for further guidance).

Table 1. Key components, descriptions and routine inspection and maintenance tasks.

Component	Description	Inspection and Maintenance Tasks
Contributing drainage area (CDA)	Area(s) from which runoff directed to the BMP originates; includes both impervious (i.e., roofs and pavements) and pervious (i.e., landscaped) areas.	• Remove trash, debris and sediment regularly from pavements (biannually to quarterly) and eavestroughs (annually); • Replant or seed bare soil areas as needed.
Pretreatment	Devices or features that retain trash, debris, sediment, oil and grease; help to prevent obstructions and clogging of the infiltration area. Examples are eavestrough screens, geotextile-lined inlets, catchbasin inserts (screens, baffles, filters) and sumps, hydrodynamic (oil and grit) separators (HDS), filters, isolator rows, water quality forebay units.	• Remove trash, debris and sediment annually to biannually or when the device sump is half full; • Measure sediment depth or volume during each cleaning, or annually to estimate accumulation rate and optimize frequency of maintenance.
Inlets	Structures that deliver water to the BMP such as curb-cuts and geotextile-lined inlets or pipes connected to catchbasins, hydrodynamic (oil and grit) separators (HDS), filters, manholes, sub-drains of other features or roof downspouts.	• Keep free of obstructions.; • Remove trash, sediment and debris biannually (spring and late fall) to quarterly (spring, summer, early fall, late fall/early winter).
Sub-drain	Comprised of perforated pipe(s) surrounded by gravel and may be wrapped in geotextile filter fabric; installed in the gravel water storage layer or chamber unit openings to collect and convey treated water to an adjacent drainage system or other BMP; may also include a flow restrictor.	• Keep perforated pipes and flow restrictors free of obstructions; • Inspect flow restrictor and flush with a garden hose or pressure washer regularly (biannually to quarterly).
Overflow outlet or control structure	Structures (e.g., sub-drain pipe connected to a manhole, conventional storm sewer pipe, or control manhole with weir wall) that convey flow exceeding the storage capacity to another drainage system or BMP.	• Keep free of obstructions; • Remove trash, sediment, debris, oil and grease biannually (spring and late fall) to quarterly (spring, summer, early fall, late fall/early winter).
Monitoring well	Perforated standpipe or manhole that extends from the bottom of the BMP to ground surface that allows measurement of subsurface water level; used to track drainage performance over time.	• Standpipes should be securely capped on both ends and protected from damage by vehicular or foot traffic by a casing.

Figure 2. Views inside perforated pipe and infiltration chamber systems

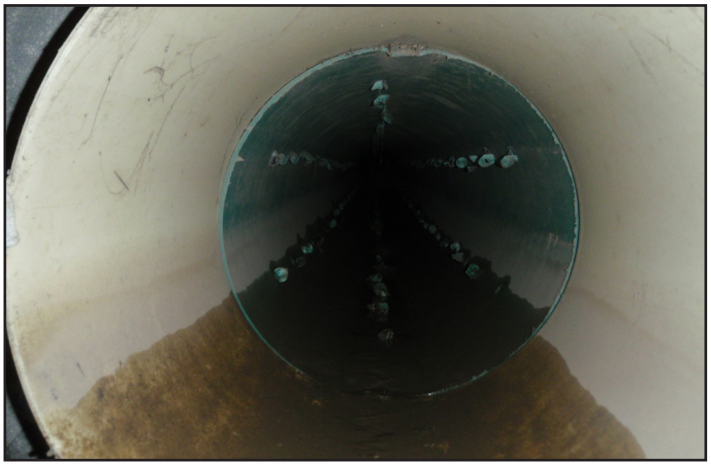


Figure 3. Before and after maintenance at an inlet to an infiltration trench

REHABILITATION

Table 2. Key components, typical problems and rehabilitation tasks.

Component	Problem	Rehabilitation Tasks
Sub-drain	Sub-drain perforated pipe is obstructed	Schedule hydro-vac truck or drain-snaking service to remove the obstruction.
	Perforated pipe caps are missing or damaged	Replace missing or damaged caps.
Isolator Row or Water Quality Forebay Unit	Sump is ≥ half full or average sediment depth is ≥ 8 cm	Schedule maintenance work; First remove floating trash and debris by bucket strainer, then oil and grease by petroleum absorbing sponge. Then fully drain the row or unit by gravity, pumping or vacuuming, and remove accumulated sediment through use of a hydro-vac truck equipped with JetVac nozzle.
Manhole control structure	Structure or pipe connection is leaking and impairing the water storage capacity or function of the BMP	Schedule work to repair cracks or seal leaking components. The BMP may need to be fully drained to make such repairs.

Figure 4. Filter fabric protecting gravel inlet to infiltration trench and the gravel inlet

TYPES OF INSPECTIONS

Routine Operation: Regular inspections (twice annually, at a minimum) done as part of routine maintenance tasks over the operating phase of the BMP life cycle to determine if frequencies are adequate and when rehabilitation or further investigation into BMP function is warranted.

Maintenance and Performance Verification: Periodic inspections done every 5 years (maintenance verifications) and every 15 years (performance verifications) post-construction over the operating life cycle of the BMP to ensure compliance with the maintenance agreement (e.g., Environmental Compliance Approval permit) conditions, evaluate functional performance and determine when rehabilitation or replacement is necessary.

Requirements of the Ontario Occupational Health and Safety Act regulation for individuals working in confined spaces (O. Reg. 632/05) must be adhered to during any inspection or maintenance work on underground infiltration systems that involves entry into confined spaces (e.g., catchbasins, manholes, access hatches). Individuals working in such environments should be adequately trained on the use and maintenance of the necessary safety equipment and review hazards and safety plans regularly. Further information about Ontario's Confined Spaces Regulation and Guideline can be accessed at: https://www.labour.gov.on.ca.

Figure 5. Residential soakaway under construction

INSPECTION TIME COMMITMENTS AND COSTS

Estimates are based on a typical infiltration trench design that receives roof and road runoff and includes a hydrodynamic separator as pretreatment; estimates for infiltration trenches that receive roof runoff only are described in the Low Impact Development (LID) Stormwater Management Practice Inspection and Maintenance Guide available at https://sustainabletechnologies.ca.

Table 3. Time commitments and costs for inspection of an infiltration trench

Infiltration Trench	Routine Operation	Maintenance Verification	Performance Verification
Tasks to complete	9	10	10
Visits (per year)	1	1 every 5 years	1 every 15 years
Time (hours per m^2 BMP area)	0.020	0.023	0.023
Cost	$1.22	$1.32	$1.32
Performance Verification Options ($ per m^2 BMP area)			
Simulated storm event testing: $22.65			
Natural storm event testing: $21.65, 2 months monitoring			

Figure 6. Infiltration chamber system under construction

Table 4. Task cost estimates for maintenance and rehabilitation of an underground infiltration trench

Infiltration Trench	Costs per m^2 of BMP area	
Tasks	**Min.**	**High**
Remove litter	$0.18	$0.34
Replace filter cloth & dispose sediment	$3.76	$3.76
Clean out HDS - Starts year 2	$12.99	$25.97
Flush out pipes	$1.30	$1.30

For a detailed description of construction, inspection, maintenance and rehabilitation cost assumptions see section 7.1.7 of the LID Stormwater Management Practice Inspection and Maintenance Guide. To generate BMP-specific cost estimates use the LID Life Cycle Costing Tool available at https://sustainabletechnologies.ca.

Table 5. Construction and life cycle cost estimates

Infiltration Trench	**Costs per m^2 of BMP area + CDA**	
	Minimum	**High**
Construction	$27.55	
LIFE CYCLE COSTS		
25 year evaluation period		
Average annual maintenance	$0.75	$1.30
Maintenance and rehabilitation	$18.45	$32.90
50 year evaluation period		
Average annual maintenance	$0.70	$1.20
Maintenance and rehabilitation	$34.20	$60.50

Figure 7. Infiltration trench under construction

Figure 8. Concrete infiltration chamber system

This communication has been prepared by the Sustainable Technologies Evaluation Program (STEP) with funding support from the Toronto and Region Remedial Action Plan (RAP), Region of Peel, York Region and City of Toronto. The contents of this fact sheet do not necessarily represent the policies of the supporting agencies and the funding does not indicate an endorsement of the contents.

For more detailed information on inspection, testing and maintenance of underground infiltration systems and a field data form (checklist) to use for collecting and recording inspection results, please refer to Appendix D of the Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide, available at **https://sustainabletechologies.ca**.

For more information about STEP and other resources and studies related to stormwater management, visit our website or email us at **STEP@trca.on.ca**.

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