Scottish Borders Council
Building Standards Service
Guidance

Building Standards (Scotland) Regulations 2004
Infiltration Systems - Mandatory Standard 3.9
Assessing the Suitability of the Ground – Percolation Test

Assessing the Suitability of the Ground for an Infiltration System:

The assessment of ground conditions and testing for porosity should be carried out by a competent person, for example; an architect, building surveyor, civil engineer or contractor. All competent persons should hold professional indemnity insurance for this type of work.

Alternatively, an applicant may carry out and record the first two percolation tests and request Building Standards witness the 3rd test. This service is charged at the current rate and also includes the minimum design criteria and size for the proposed Infiltration system.

An infiltration system serving a private wastewater treatment plant, septic tank or for greywater should be constructed in ground suitable for the treatment and dispersion of the wastewater discharged.

A ground assessment and soil percolation test should be carried out to determine the suitability of the ground. The following three step procedure should be followed:

1. Ground Assessment

Carry out a preliminary ground assessment. The following check list indicates the actions that should be taken and the type of information that should be collected:

- Consult SEPA, verifier and the Environmental Health Officer as required
- Consult SEPA's latest groundwater protection policy
- Identification of the underlying geology and aquifers
- Whether the ground is liable to flooding
- Nature of the sub-soil and groundwater vulnerability
- Implication of plot size
- Proximity of underground services
- Ground topography and local drainage patterns **(Note: The infiltration system should be laid on relatively level ground to avoid possible outcropping through a slope .The system should also be kept far enough away from retaining walls to avoid the possibility of effluent leaking through the wall)**
- Whether water is abstracted for drinking, used in food processing or farm dairies
- Implication for, and of, trees and other vegetation
- Location of surface waters and terrestrial ecosystems.

The preliminary assessment may indicate that the ground is unsuitable for the installation of an infiltration system, in which case an alternative disposal method should be considered. If in doubt about the suitability of the site please contact Building Standards.

2. Trial Holes

A trial hole should be dug to determine the position of the water table and soil conditions. This trial hole will enable the sub-soil type to be determined. The trial hole should be a minimum of 2.1 m deep, or a minimum of 1.5 m below the invert of the proposed distribution pipes. The trial hole should be left covered for a period of 48 hours before measuring any water table level. **(See Diagram 1)**

The trial hole must be inspected by a Building Standards Surveyor in order that the position and depth of any water table and ground conditions can be recorded.

Sub-soils that overlay bedrock allow water to move through the pore spaces between the grains of material of which they are composed. They are the first line of defence against pollution and act as a protecting filtering layer. Where these materials are unsaturated, pollution attenuation processes are often enhanced. Water flows through much of Scotland's bedrock via fissures. Attenuation of contaminants is limited in these cases. For safe and effective dispersal of the wastewater, the groundwater and bedrock should be at least 1 m below the bottom of the soakaway. It should also be noted that it is the seasonally highest level of the water table that should be determined for the infiltration area.

3. Percolation Tests

To determine the type of infiltration system and the area of ground required, percolation tests should be carried out. These percolation tests should be carried out using either of the following methods:

- Expert examination of the soil distribution analysis, using the method described in BS 1377: Part 2: 1990; or

- Expert in-situ testing using either the Constant Head or Tube Permeameter as described in CEN/TR 12566–2–2005; or

- Excavate a **minimum of two** percolation holes, not less than 5 m apart along the line of and below the proposed invert level of the effluent distribution pipe. Each hole should be 300 mm square to a depth of 300mm. Where deep drains are necessary, the holes should conform to this shape at the bottom but may be enlarged above the 300 mm level to facilitate safe excavation. Fill the 300 mm square section of the holes to a depth of at least 300 mm with water and allow them to seep away overnight. It is important to saturate the soil surrounding the test holes to simulate day to day conditions in an operational drainage field. Next day, refill the test sections of the percolation holes with water to a depth of at least 300 mm and observe the time (t) in seconds, for the water to seep away from 75% to 25% full level. Divide this time by 150 mm. The answer gives the average time in seconds (Vp) required for the water to drop 1mm. Take care when making the tests to avoid unusual weather conditions such as heavy rain, severe frost or drought. **To obtain consistent results carry out the test at least 3 times for each percolation hole and take the average figure. (See Diagram 2)**

The percolation test results should be recorded on the pro forma sheet attached to these guidance notes and this should be sent to the Building Standards Surveyor. **(See Diagram 3)**

Where Vp results vary more than 50% above or below the average result, further tests in at least 3 other locations within the area of the proposed infiltration field should be undertaken.

The plan area of a sub-surface drainage trench required to disperse effluent from treatment plants or septic tanks may be calculated from the following formula:

A= P x Vp x 0.25

A - is the area of the sub-surface drainage trench, in m^2
P - is the number of persons served by the tank, and
Vp - is the percolation value obtained, as described above, in secs/mm

For wastewater that has received the benefit of secondary treatment followed by settlement and where the discharge is for greywater, this area may be reduced by 20%, i.e.

A = P x Vp x 0.2

Design of Infiltration Fields:

Where **fast percolation rates** (percolation rates < 15 secs/mm) are recorded an infiltration system should be designed in accordance with SEPA's requirements.

Where **normal percolation rates** (percolation rates of 15 secs/mm to 100 secs/mm) are recorded a piped an infiltration system can be designed as:

- A piped infiltration **trench** system in accordance with national annex NA of BS EN 752: 2008, using perforated, rigid pipes with a smooth internal surface, or
- Any system described under 'slow and very slow percolation rates' below, or
- A piped infiltration **bed** system in accordance as described below **(See Diagram 4)**:

The area of the infiltration bed is determined by the calculations as described above. Where the soakaway is to be designed as a single trench, divide the area required by the width of the trench which should be between 300mm and 900mm. There should be a minimum of 1 metre of undisturbed ground between trenches and no single trench should be longer than 30 metres. Multiple trenches should be connected.

Where the soakaway is to have multiple distribution pipes over a single soakaway layer, there should be a distance of 2 metres between the pipes and the pipework should form a closed loop. A distribution box is also required to ensure even spread of the effluent.

Where the trench is on sloping ground, the pipework should follow the ground contours.

The base of the soakaway should be at least 1 metre above the ground water table.

The soakaway should consist of 150 – 300 mm of 20 – 50 mm clean gravel or broken stone below the invert of the distribution pipe(s). Shingle or broken stone graded 16 mm to 32 mm is also acceptable. A suitable barrier material should be installed on top of the gravel or broken stone backfill prior to backfill of the trench.

The distribution pipework should be perforate (slotted pipe should have a minimum open area equal to 1,000mm^2/m), rigid and smooth bore. **Perforate flexi-coil type pipework is not suitable for use in a infiltration system.** The distribution pipe should be laid at a gradient not exceeding 1:200 and at a depth greater than 200mm below ground level. For gravity systems the pipework should be at least 100 mm in diameter.

Where **slow percolation rates** (percolation rates of over 100 secs/mm to 140 secs/mm) are recorded an infiltration system can be designed as:

- A reed bed complying with the requirements of the BRE Good Building Guide: GBG 42, Parts 1 and 2 together with a piped infiltration system as described above, or a suitable outfall, or

- A constructed wetland, other than a reed bed, to a professionally prepared design and constructed by specialist contractor(s), or

- A proprietary filtration system designed, constructed and installed in accordance with the conditions of a notified body, or

- Any other equivalent filtration system designed by a specialist in this subject and constructed by specialist contractor(s)

Where **very slow percolation rates** (percolation rates of more than 140 secs/mm) are recorded:

- As a system described under 'slow percolation rate' that does not use an infiltration system for the final treated wastewater, or

- For domestic sized buildings, by designing and constructing a mound filter system in accordance with BR 478: 'Mound Filter Systems for the Treatment of Domestic Wastewater'

Rain and surface water drainage systems should not be installed within the vicinity of an infiltration system as it could prejudice the capacity of the system. Surface water systems should discharge away from or be diverted around infiltration systems. Infiltration systems should not contaminate land drains. No roof or surface water should enter the sewage treatment system.

Location of Infiltration Fields – Pollution:

An infiltration system serving a private wastewater treatment plant or septic tank should be located to minimise the risk of pollution. An infiltration field should be located in accordance with the following guidance:

- **At least 50 m** from any spring, well or borehole used as a drinking water supply, and

- **At least 10 m** horizontally from any watercourse (including any inland or coastal waters), permeable drain, road or railway

Location of Infiltration Fields – Damage to Buildings:

Research has shown that there are no health issues that dictate a safe location of an infiltration field relative to a building. However damage to the foundations of a building is likely to occur where discharge is too close to the building. It is sensible to ensure that any water bearing strata directs any effluent away from the building.

To prevent any such damage therefore, every part of an infiltration system serving a private wastewater treatment plant or septic tank should be located **at least 5 m** from a building. An infiltration system should also be located **at least 5 m** from a boundary in order that an adjoining plot is not inhibited from its full development potential.

However the ground strata or permeability of the soil may influence this dimension and it may be reduced slightly where the strata directs any groundwater away from the foundations or if the soil is free draining. Indeed, to preserve the structural integrity of the building, it may be prudent to increase the dimension where ground conditions would allow wastewater to collect around the building's foundations.

Treated Effluent Discharge to Existing Field Drains:

Where, following assessment of the ground and carrying out percolation tests, it is proving difficult to design a suitable infiltration system, it may be possible to connect into an existing field tile system. Where it is proposed to dispose of treated effluent in this manner the applicant should consult SEPA to ascertain if this method of disposal would be considered.

To assess suitability for connection to a field tile system the following process should be followed:

- At least three runs of the existing field tiles should be exposed for inspection by Building Standards staff. Please note SEPA normally require a minimum total field tile length of 300 metres is available.

- Water should be available on site so that it can be demonstrated the field tiles are functioning. The field tile positions, direction of flow and point of discharge should be recorded. It is likely that a dye test will need to be carried out to establish to discharge point.

- Following this assessment Building Standards will be able to inform the applicant if the field tiles are acceptable for use or not. If they are then the applicant should consult SEPA to request consent to discharge to the tiles. It is likely SEPA will require an ordnance survey plan showing the position and direction of flow of the tiles and the point of discharge.

The method of connecting an effluent discharge into the **head of existing field tiles** or drains should be as follows **(See Diagram 5)**:

- A 100 mm diameter rigid smooth bored perforated pipe should be laid at the head of at least three field tiles as described above for a piped infiltration system. I.e. on 150 – 300 mm of 20 – 50 mm clean gravel or broken stone or shingle or broken stone graded 16 mm to 32 mm. A suitable barrier material should be installed on top of the gravel or broken stone backfill prior to backfill of the trench.

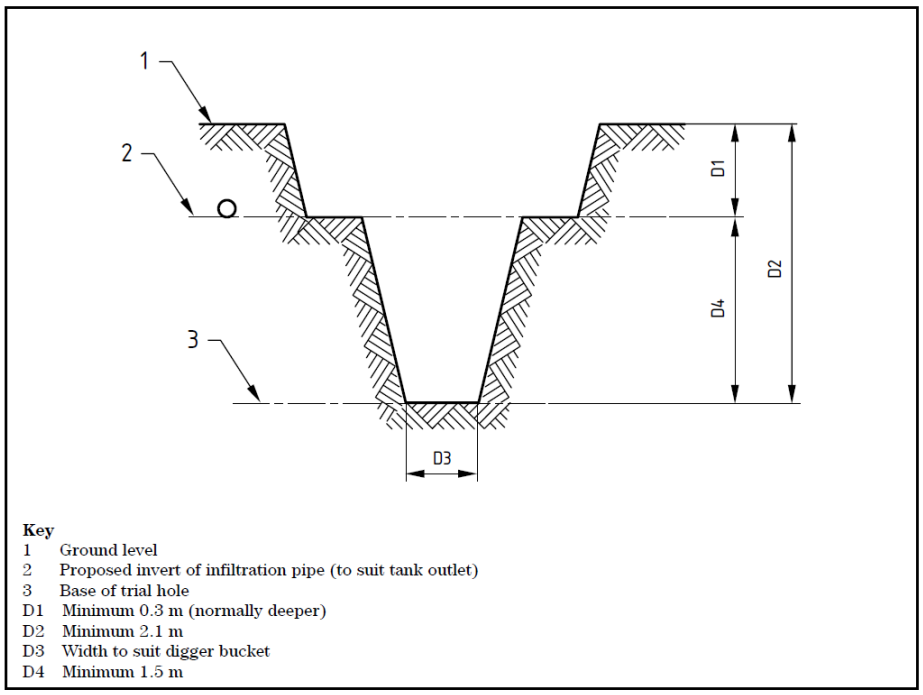
- The invert level of the effluent drain should be 25 mm below the existing field tile invert so that when the ground conditions permit the effluent will soakaway to ground and when the water table rises the effluent will overflow into the field drainage system.

The method of connecting an effluent discharge **across existing field tiles** or drains should be as follows **(See Diagram 5)**:

- A 100 mm diameter rigid smooth bored perforated pipe should be laid across at least three field tiles as described above for a piped infiltration system. I.e. on 150 – 300 mm of 20 – 50 mm clean gravel or broken stone or shingle or broken stone graded 16 mm to 32 mm. A suitable barrier material should be installed on top of the gravel or broken stone backfill prior to backfill of the trench.

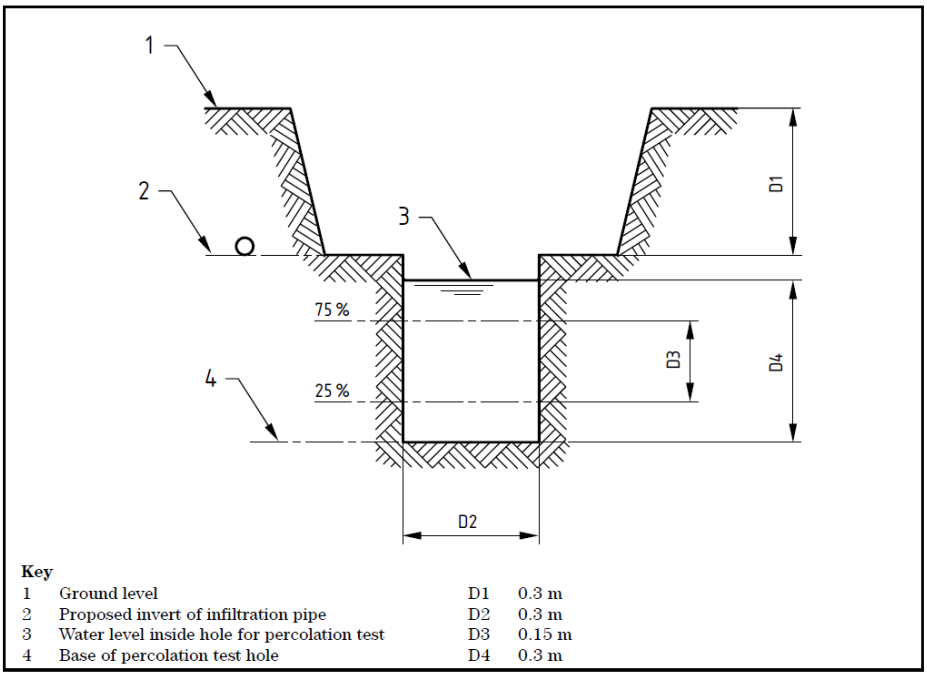
- The invert level of the effluent drain should be at least 50 mm above the crown of the existing field tile.

Diagram 1 – Trial Hole:



Key
1 Ground level
2 Proposed invert of infiltration pipe (to suit tank outlet)
3 Base of trial hole
D1 Minimum 0.3 m (normally deeper)
D2 Minimum 2.1 m
D3 Width to suit digger bucket
D4 Minimum 1.5 m

Diagram 2 – Percolation Test Hole: (D2 is 300 x 300 mm)



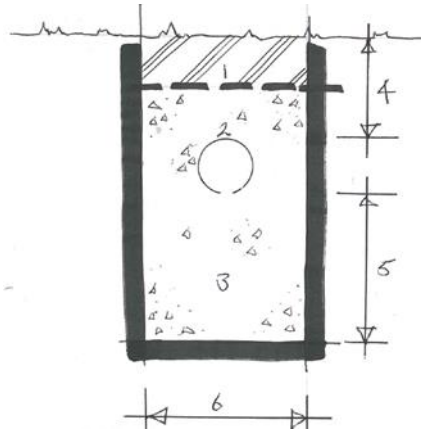
Key

1	Ground level	D1	0.3 m
2	Proposed invert of infiltration pipe	D2	0.3 m
3	Water level inside hole for percolation test	D3	0.15 m
4	Base of percolation test hole	D4	0.3 m

Diagram 3 – Percolation Test Result and Vp Calculation Table:

Hole No.	Test Date	Test No.	Start Time	Finish Time	Elapsed Time			Vp (s/mm)
					Hours/minutes (h/mins)	Minutes (mins)	Seconds (s)	Seconds divided by 150 mm
1		1						
		2						
		3						
Average Vp for hole 1								
2		1						
		2						
		3						
Average Vp for hole 2								
3 (Optional)		1						
		2						
		3						
Average Vp for hole 3								
Water table depth in test hole:						Total average Vp		

Diagram 4 – Piped Infiltration Drain:



1. Barrier material
2. Perforated distribution pipe
3. 20 – 50 mm gravel or broken stone or shingle or broken stone graded 16 mm to 32 mm
4. 200 mm minimum
5. 150 – 300 mm minimum, base of trench 1,000 mm minimum above water table or bedrock
6. 300 – 900 mm wide trench

Diagram 4 – Piped Infiltration Bed System:

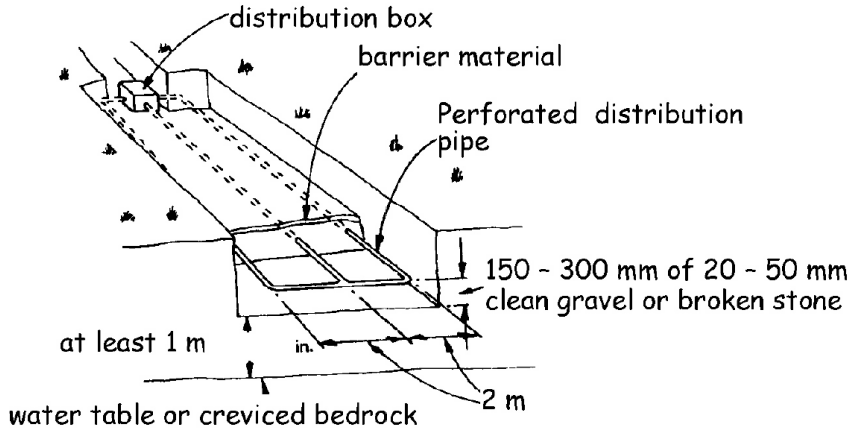
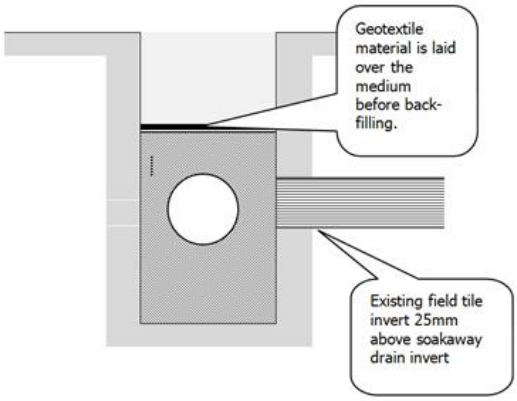


Diagram 5 – Effluent Drain Connection to Field Tile:

Effluent Drain Connecting to Head of Field Tile



Effluent Drain Connecting Across Field Tile