Section 3: Surface water drainage

3.1 This section gives guidance on the design of surface water drainage systems. It is applicable to the drainage of small catchments with impervious areas up to 2 hectares. For the design of systems serving larger catchments, reference should be made to BS EN 752-4 (see paragraph 3.36).

Outlets

3.2 Surface water drainage should discharge to a soakaway or other infiltration system where practicable.

3.3 Discharge to a watercourse may require a consent from the Environment Agency, who may limit the rate of discharge. Maximum flow rates can be limited by provision of detention basins (see paragraph 3.35).

3.4 Where other forms of outlet are not practicable, discharge should be made to a sewer.

Combined systems

3.5 Some sewers carry both foul water and surface water (combined systems) in the same pipe. Where they do the sewerage undertaker can allow surface water to discharge into the system if the sewer has enough capacity to take the added flow (see Approved Document H1 paragraph 2.1). Some private sewers (drains serving more than one building that have not been adopted by the sewerage undertaker) also carry both foul water and surface water. If a sewer operated as a combined system does not have enough capacity, the surface water should be run in a separate system with its own outfall.

3.6 In some circumstances, where a sewer is operated as a combined system and has sufficient capacity, separate drainage should still be provided (see Approved Document H5).

3.7 Surface water drainage connected to combined sewers should have traps on all inlets.

Design rainfall intensities

3.8 Design rainfall intensities of 0.014 litres/second/m² may be assumed for normal situations. Alternatively the rainfall intensity may be obtained from Diagram 2.

3.9 Where low levels of surface flooding could cause flooding of buildings the rainfall intensities should be obtained from BS EN 752-4 (see paragraph 3.36).

Design

3.10 Where there is evidence of a liability to surcharging from sewers, or levels in the building or on the site make gravity connection impracticable, surface water lifting equipment will be needed (see Approved Document H1 paragraphs 2.8 to 2.12).

Layout

3.11 Refer to paragraphs 2.13 to 2.21 of Approved Document H1.

Depth of pipes

3.12 Refer to paragraphs 2.27 and 2.28 of Approved Document H1.

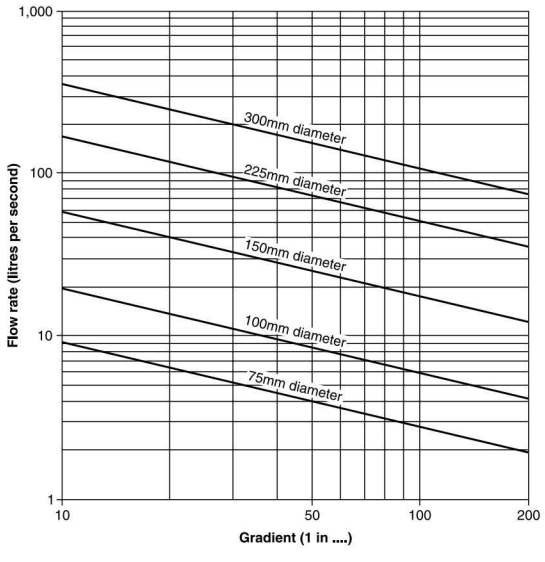
Pipe gradients and sizes

3.13 Drains should have enough capacity to carry the flow. The capacity depends on the size and gradients of the pipes.

3.14 Drains should be at least 75mm diameter. Surface water sewers (serving more than one building) should have a minimum size of 100mm. Diagram 3 shows the capacities of drains of various sizes at different gradients. However the capacity can be increased by increasing the gradient, or by using larger pipes.

3.15 75mm and 100mm rainwater drains should be laid at not less than 1:100. 150mm drains and sewers should be laid at gradients not less than 1:150 and 225mm drains should be laid at gradients not less than 1:225. For minimum gradients for larger pipes see BS EN 752-4 (see paragraph 3.36).

Diagram 3 **Discharge capacities of rainwater drains running full**



Materials for pipes and jointing

3.16 See paragraph 2.40 of Approved Document H1.

Bedding and backfilling

3.17 See paragraphs 2.41 to 2.45 of Approved Document H1.

Clearance of blockages

3.18 See paragraphs 2.46 to 2.54 of Approved Document H1.

Workmanship

3.19 See paragraphs 2.55 to 2.58 of Approved Document H1.

Testing and inspection

3.20 See paragraphs 2.59 to 2.62 of Approved Document H1.

Contaminated runoff

3.21 Where any materials which could cause pollution are stored or used, separate drainage systems should be provided. This should include an appropriate form of separator or treatment system or the flow should be discharged into a system suitable for receiving polluted effluent.

3.22 On car parks, petrol filling stations or other areas where there is likely to be leakage or spillage of oil, drainage systems should be provided with oil interceptors (see Appendix H3-A).

Soakaways and other infiltration drainage systems

3.23 Infiltration devices include soakaways, swales, infiltration basins and filter drains.

3.24 Further information on the design of infiltration drainage systems can be found in CIRIA Report 156 – *Infiltration drainage – Manual of good practice*.

3.25 Infiltration drainage is not always possible. Infiltration devices should not be built:

a. within 5m of a building or road or in areas of unstable land (see Planning Policy Guidance Note 14 Annex 1);

b. in ground where the water table reaches the bottom of the device at any time of the year;

c. sufficiently far from any drainage fields, drainage mounds or other soakaways so that the overall soakage capacity of the ground is not exceeded and the effectiveness of any drainage field is not impaired (see Approved Document H2);

d. where the presence of any contamination in the runoff could result in pollution of a groundwater source or resource.

3.26 **Soakaways** for areas less than 100m² are generally formed from square or circular pits, filled with rubble or lined with dry-jointed masonry or perforated ring units. Soakaways serving larger areas are generally lined pits or trench type soakaways.

3.27 Soakaways should be designed to a return period of once in ten years. The design should be carried out with storms of differing durations to determine the duration which gives the largest storage volume. For small soakaways serving 25m² or less a design rainfall of 10mm in 5 minutes may be assumed to give the worst case. For soakaways serving larger areas reference should be made to the sources listed in paragraph 3.30. Where the ground is marginal overflow drains can be acceptable.

3.28 Percolation tests should be carried out to determine the capacity of the soil (see Approved Document H2 paragraphs 1.34 to 1.38). Where the test is carried out in accordance with Approved Document H2, the soil infiltration rate (f) is related to the value Vp derived from the test by the equation:

$$f = \frac{10^{-3}}{3V_p}$$

3.29 The storage volume should be calculated so that, over the duration the storm, it is sufficient to contain the difference between the inflow volume and the outflow volume. The inflow volume is calculated from the rainfall depth (see paragraph 3.26) and the area drained. The outflow volume (O) is calculated from the equation:

$$O = a_{s50} \times f \times D$$

Where a_{s50} is the area of the side of the storage volume when filled to 50% of its effective depth, and D is the duration of the storm in minutes.

3.30 Soakaways serving larger areas should be designed in accordance with BS EN 752-4 (see paragraph 3.36), or BRE Digest *365 Soakaway design*.

Other types of infiltration system

3.31 **Swales** are grass-lined channels which transport rainwater from a site as well as controlling flow and quality of surface runoff. Some of the flow infiltrates into the ground. There may be an overflow at the end into another form of infiltration device or a watercourse. They are particularly suitable for treatment of runoff from small residential developments, parking areas and roads.

3.32 **Infiltration basins** are dry grass-lined basins designed to promote infiltration of surface water to the ground.

3.33 **Filter drains** or french drains consist of the trench, lined with a geotextile membrane and filled with gravel. Much of the flow infiltrates into the ground. A perforated pipe is often laid through the gravel to assist drainage.

3.34 Flow enters the top of the filter drain directly from runoff, or is discharged into it through drains.

Detention ponds

3.35 Detention ponds are used to attenuate the flow from a drainage system, to limit the peak rate of flow into a sewer system or watercourse. Further information on design may be found in the references given in paragraph 3.36 and in *Sustainable Urban Drainage Systems – A Design Manual for England and Wales* published by CIRIA.

Alternative approach

3.36 The requirement can also be met by following the relevant recommendations of BS EN 752-4 *Drain and sewer systems outside buildings*. The relevant clauses are in Part 4 *Hydraulic design and environmental considerations* Clauses 3 to 12 and National Annexes NA, NB and ND to NI. BS EN 752, together with BS EN 1295 and BS EN 1610, contains additional detailed information about design and construction.

Appendix H3-A: Oil separators

Legislation

A.1 Under Section 85 (Offences of polluting controlled waters) of the Water Resources Act 1991, it is an offence to discharge any noxious or polluting material into a watercourse, coastal water or underground water. Most surface water sewers discharge to watercourses.

A.2 Under Section 111 (Restrictions on use of public sewers) of the Water Industry Act 1991, it is an offence to discharge petrol into any drain or sewer connected to a public sewer.

A.3 Premises keeping petrol must be licensed under the Petroleum (Consolidation) Act 1928. Conditions may be placed on licences.

A.4 The Environment Agency issues guidance notes on the provision of oil separators.

A.5 The Health and Safety Executive issues guidance notes on the storage of oil.

Technical guidance

A.6 For most paved areas around buildings or car parks where a separator is required, a by-pass separator should be provided which has a nominal size (NSB) equal to 0.0018 times the contributing area. In addition it should have a silt storage volume in litres equal to 100 times NSB.

A.7 In fuel storage areas and other high risk areas full retention separators are required. These should have a nominal size (NS) equal to 0.018 times the contributing area. In addition it should have a silt storage volume in litres equal to 100 times NS.

A.8 Separators discharging to infiltration devices or surface water sewers should be Class I.

A.9 Separators should be leak tight. Inlet arrangements should not be direct to the water surface. Adequate ventilation should be provided.

A.10 Separators should comply with the requirements of the Environment Agency and with BS EN 858-2002 A1 2004 and BS EN 858-2:2003. In addition, where the Petroleum Act applies, they should comply with the requirements of the licensing authority.

A.11 Separators should be maintained regularly to ensure their continued effectiveness. Provision should be made for access for inspection and maintenance.

A.12 Further information on provision of separators is available in *Use and design of oil separators in surface drainage systems*, Pollution Prevention Guideline No. 3. This can be obtained from the Environment Agency.