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Scoping study for a groundwater protection code for surface water drainage

Scoping study
July 2003

ENVIRONMENT AGENCY

EA- GROUNDWATER

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Rio House
Waterside Drive, Aztec West
Almondsbury, Bristol BS32 4UD
Tel: 01454 624400 Fax: 01454 624409

Authors:
Dr B Fretwell & Dr M. Carey, Entec UK Ltd

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This report presents the results of a scoping study that will assist in the development of a code of practice highlighting the risks to groundwaters and surface waters due to surface water drainage systems (including SUDs).

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The document was produced on contract to the Environment Agency by:
Entec UK Ltd, 160-162 Abbey Foregate, Shrewsbury, Shropshire, SY2 6BZ

Environment Agency project manager:
Heather MacLeod,
National Groundwater and Contaminated Land Centre

Environment Agency project board:
Phil Humble, Phil Chatfield, Nigel Crane, Tony Marsland, Mark Morton, Prosper Paul, Environment Agency
David Broyd, DEFRA
David Harlev. SEPA

EA NGWCLC
(BOX 4)

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Executive Summary

The Groundwater Regulations 1998 (GWR98) complete the transposition of the EC Groundwater Directive (80/68/EEC) into UK law. The purpose of the Regulations is to protect groundwater from pollution by certain listed substances as defined in Lists I and II of the Directive and the GWR98. For List I substances measures should be taken to prevent their introduction to groundwater. For List II substances measures should be taken to restrict their introduction into groundwater, so as to prevent any groundwater pollution. The Environment Agency may not authorise direct or indirect discharges that would have an effect on groundwater except if specific criteria are met. It is also an offence to allow List II substances to enter groundwater without prior investigation and authorisation by the Agency. Any disposals, or tipping for the purpose of disposal, to land of listed substances similarly require prior investigation and authorisation by the Agency.

A variety of activities utilise List I and II substances, but do not make deliberate discharges to the environment. Such activities do not normally require an authorisation under the GWR98. Nevertheless, these activities could result in a non-deliberate or accidental discharge. Regulation 19 provides the Environment Agency with powers to serve notices to control any activity which might lead to an indirect discharge of any substance in List I or the pollution of groundwater as a result of an indirect discharge of any substance in List II. These notices can either prohibit the activity or impose conditions under which the activity can be carried out. Failure to comply with such a notice is an offence under Section 85 of the Water Resources Act 1991 (WRA).

Regulation 21 of the GWR98 allows Ministers to approve codes of practice (CoP) for any activity that has potential to cause pollution of groundwater by listed substances. Approved codes cover good practice and techniques thereby reducing the risk of impact on groundwater.

The purpose of this document is to scope the requirements of a groundwater protection code for surface water drainage. In this context surface water is defined as rainwater falling within the boundary of a site or property. Surface water drainage systems perform the function of collecting and conducting surface water to a point of discharge, but may also include storage, attenuation and treatment. The scoping study addresses all surface water drainage systems, including highway drainage, with the exception of trade effluent and adopted sewers. The scoping study: considers the types of surface water drainage systems to which a CoP should apply; undertakes a review of the relevant legislative background and existing guidance on surface water drainage and identifies the regulators and authorities involved in the approval of new surface water drainage. An understanding of the hazard and environmental risks posed by surface water drainage is presented with a review of the application process for new schemes. Methods and criteria for controlling or reducing risks from surface water drainage systems are identified including a description of the criteria against which compliance with a CoP could be judged. In addition, decommissioning of surface water drainage systems has been considered. Recommendations are provided within and at the end of each chapter of this report detailing points that should be included in the CoP.

It should be noted that this scoping study has considered the legislation and guidance prevailing at the time of writing (July 2003) and does not attempt to anticipate future legislation.

Contents

Acknowledgements

This document has been produced in consultation with the Contract's Project Board.

The Project Board consisted of:

Phil Humble	National Groundwater and Contaminated Land Centre
Heather MacLeod	National Groundwater and Contaminated Land Centre
Tony Marsland	Groundwater Quality and Protection Policy Manager
Mark Morton	Groundwater Quality and Protection Policy Team
Tony Peacock	Groundwater Quality Process Team
Nigel Crane	Groundwater Quality Process Team
David Broyd	DEFRA
David Harley	SEPA

1 Introduction

1.1 Background

The purpose of this document is to scope the requirements of a groundwater protection code for surface water drainage under the Groundwater Regulations 1998 (GWR98).

This document has considered the legislative background governing surface water drainage. Existing guidance has been reviewed to identify design and operational criteria that need to be adopted to ensure protection of surface water and groundwater with the objective of complying with the Groundwater Regulations, 1998.

The process by which surface water drainage is regulated has also been reviewed and described both for new proposals and for existing systems.

1.2 The Groundwater Regulations 1998

The Groundwater Regulations 1998 came fully into force on 1st April 1999, and completed the transposition of the EC Groundwater Directive into United Kingdom law. The Regulations supplement the provisions of the Water Resources Act 1991. Guidance on the implementation of the Regulations has been issued by DEFRA (as DETR, 2001)

The purpose of the Regulations is to protect groundwater from pollution by certain listed substances. These substances are defined in Lists I and II of the Directive and the Groundwater Regulations 1998. For List I substances, which include mineral oils and hydrocarbons, measures should be taken to prevent their introduction to groundwater. For List II substances measures should be taken to restrict their introduction into groundwater, so as not to cause any groundwater pollution. In the UK it is an offence to allow List I substances to enter groundwater. The Environment Agency may not authorise direct or indirect discharges that would have this effect except in very rare and specific circumstances. It is also an offence to allow List II substances to enter groundwater without prior investigation and authorisation (containing any necessary pollution prevention conditions) by the Agency. Any disposals, or tipping for the purpose of disposal, to land of listed substances similarly require prior investigation and authorisation by the Agency.

A variety of activities utilise List I and II substances, but do not make deliberate discharges to the environment. Such activities do not normally require an authorisation under the Groundwater Regulations. Nevertheless, these activities could result in a non-deliberate or accidental discharge. Regulation 19 provides the Environment Agency with powers to serve notices ('Groundwater Notices') to control any activity which might lead to an indirect discharge of any substance in List I or the pollution of groundwater as a result of an indirect discharge of any substance in List II. These notices can either prohibit the activity or impose conditions under which the activity can be carried out. Failure to comply with such a notice is an offence under Section 85 of the Water Resources Act 1991 (WRA).

In considering whether to issue a notice, the Agency would take account of adherence to a code of practice, having regard to individual site circumstances, and whether or not the code is being, or is likely to be, complied with. On this basis, compliance with a code should normally be of assistance in ensuring that the Agency does not need to issue a Prohibition Notice. However, the fact that a code is being followed does not mean that a notice cannot be served, and would not be a defence in respect of the provisions in the Regulations derived from Section 85 of the Water Resources Act 1991.

Additionally, Section 161A of the WRA confers powers to serve "Works Notices" where it considers water pollution to be likely to occur or to have occurred. The contents of these notices are prescribed in the Anti-Pollution Works Regulations 1999. The person to whom the notice is served might be required to carry out specific preventative or remedial works.

The drainage of surface water is an activity that might lead to an indirect discharge of a List I substance into groundwater. Therefore, it may be subject to control under Regulation 19 of the Groundwater Regulations.

1.3 Codes of practice

Regulation 21 of the GWR98 allows Government Ministers to approve Codes of Practice (CoP) for any activity that has potential to cause pollution of groundwater by listed substances. Codes of practice have been proposed, or issued, for a number of common activities (such as the "Use and disposal of sheep dip compounds", DEFRA 2001) which have the potential to pollute groundwater. The codes of practice describe good practice for the activity with the objective of minimising the risk of an adverse effect on groundwater.

Where there is a serious risk of pollution of groundwater, the Environment Agency may serve a Notice prohibiting this activity or allowing it to continue subject to conditions. Adherence to codes of practice will be a factor to consider when deciding whether a notice should be served.

1.4 Surface water drainage

In the context of this scoping study, surface water is defined as rainwater falling within the boundary of a site or property. Surface water drainage systems may perform one or more of the following functions:

- collection of runoff
- storage / attenuation of runoff
- conveyance of water to an outfall to a surface water body, adopted sewer or infiltration point / zone
- treatment of runoff
- infiltration of water into the ground
- prevention of flooding.

Many of these functions may be combined in a single device, for example a swale may collect and convey water to an outfall. It may also permit infiltration and could be used for temporary storage to attenuate flows.

The scoping study addresses all surface water drainage systems, including highway drainage, with the exception of those systems listed in Section 1.5.

Water in surface water drainage is typically characterised by low contaminant concentrations and does not normally require a Discharge Consent. However, it is essential that developers / operators adopt good practice in minimising the risk of pollution of surface water downstream of their site and groundwater beneath and downgradient of their site. The Code of Practice is intended to cover good practice and techniques to be followed to minimise the risk of pollution due to surface water drainage.

1.5 Exclusions from the scoping study

The following are specifically excluded from the scoping study because they are considered to be covered by existing arrangements or are considered to be beyond the scope of the Code of Practice (CoP):

- adopted sewers. The design of such systems is covered by the document 'Sewers for adoption' (WRc, 2001) and the Environment Agency has arrangements with statutory undertakers to control such systems but 'Sewers for adoption' does not specify maintenance standards. Adopted systems may be subject to a separate CoP at a later date. This scoping study and resultant CoP will be relevant to adopted sewers in setting out minimum standards in respect of maintenance issues unless, and until, a specific CoP is written for adopted sewers.

- trade effluent. The Environment Agency, in its Water Quality Consenting Manual, have interpreted "Trade effluent" to mean 'any effluent which is discharged from premises used for carrying on any trade or industry, other than surface water and domestic sewage, and for the purposes of this definition any premises wholly or mainly used (whether for profit or not) for agricultural purposes of fish farming or for scientific research or experiment shall be deemed to be premises used for carrying on a trade'. Trade effluent includes surface water generated at certain industrial and commercial premises'. In summary, any contaminated water will be classified as trade effluent. Trade effluent disposal requires a Discharge Consent (under the WRA91) which serves as an authorisation under the GWR98.

1.6 Purpose and contents of this scoping study

This report describes a scoping study for a groundwater protection code of practice (CoP) under the Groundwater Regulations (1998). Although this document and the subsequent CoP focus on the protection of groundwater, the steps taken to prevent pollution and ensure the proper functioning of a surface water drainage system are good practice and will also help to protect all controlled waters. The CoP includes:

- a description of the types of surface water drainage systems to which a CoP should apply
- a review of the relevant legislative background for surface water drainage
- a review of relevant existing guidance on surface water drainage
- identification of the regulators and authorities involved in the approval of new surface water drainage systems
- an understanding of the hazard and environmental risks posed by surface water drainage
- a review of the application process for new surface water drainage schemes, including roles and responsibilities
- identification of the methods and criteria for controlling or addressing risks from surface water drainage systems
- a review of good practice in relation to the design, construction, operation, maintenance and decommissioning of surface water drainage systems
- a description of the criteria against which compliance with a CoP can be judged.

The document provides recommendations within and at the end of each chapter on those points that should be included in the CoP.

It should be noted that this scoping study has considered the legislation and guidance prevailing at the time of writing (May 2003) and does not attempt to anticipate future legislation.

2 Surface water drainage systems

2.1 Surface water drainage devices

Surface water drainage systems perform the functions listed in Section 1.4. The principal types of drainage device that can be used to manage surface water runoff are listed in Table 1 and their function briefly described. Additional details on the various types of surface drainage devices are given in CIRIA (2000).

Many of the devices listed in Table 1 combine functions and may incorporate treatment measures. Additional treatment may be incorporated in the form of:

- silt traps and gully pots, used to trap sediment
- oil separators. Oil separators retain immiscible floating liquids (e.g. fuel oil) whilst permitting the flow of water
- containment systems. Containment systems are used in the event of a spill and can retain a volume of liquid to prevent it entering the drainage system.

A surface water drainage system will often include more than one of these devices depending upon the design requirements and the need for treatment.

2.2 Sustainable drainage systems (SUDS)

Sustainable drainage systems, referred to as SUDS, are an approach to drainage which attempts to control surface water runoff as close to its origin as possible and to minimise pollution. Conventional drainage systems simply pipe water to a point of disposal. The purpose of using a SUDS system as opposed to a conventional piped system is to:

- reduce flood risk resulting from development
- minimise diffuse pollution
- minimise environmental impact
- maintain or restore natural flow regimes in natural watercourses
- maintain recharge to groundwater (subject to not causing pollution of groundwater)
- achieve environmental enhancement by improving wildlife habitats and enhancing amenity and landscape quality

SUDS systems also help to meet the requirements for Sustainable Development set out in 'Local Agenda 21 – A framework for local sustainability', by reducing the impact of development on the environment.

Note for CoP.
The CoP should include a brief description of the surface water drainage devices, including their principal features, together with simplified figures showing each of the devices.

Table 1 – Summary of principal surface water drainage devices

Drainage option	Description	Operation and maintenance	Groundwater issues	Comments
Piped systems	Conduits generally located below ground to conduct water to a suitable location for treatment and / or disposal.	Removal of blockages, emptying of silt traps and gully pots	Leakage may occur due to poor sealing or damage. Final disposal point may be to ground or groundwater. Wrong-connections may be an issue (see Section 5).	
Filter strips	Gently sloping areas of vegetation through which surface water flow is directed. They are designed to filter out silt and other particulates.	Vegetation management	Can permit infiltration. Accumulation of potentially contaminated sediments	Infiltration is likely to be limited.
Swales	Shallow vegetated channels that can conduct and retain water but also permit infiltration. The vegetation within the swale filters particulate materials.	Vegetation management and control, desilting	Can permit infiltration. Accumulation of potentially contaminated sediments.	Can be lined to prevent infiltration to ground
Filter drains	Perforated or porous pipes in a trench surrounded by granular material. They store and conduct water, but also permit infiltration.	Sediment removal vegetation control, replacement of granular fill materials.	Designed to permit infiltration. Accumulation of potentially contaminated sediments.	Can be lined to prevent infiltration to ground
Porous and permeable surfaces	Load bearing surfaces that permit direct infiltration to an underlying granular layer. The granular layer may then drain laterally or permit infiltration to ground.	Weed control, vacuum sweeping, surface renovation, replacement of granular fill materials.	May be designed to permit infiltration to ground. Need careful design so that pollutants are attenuated before discharge to ground.	Can be lined to prevent infiltration to ground
Soakaways and infiltration trenches	Pits or trenches either filled with permeable granular material or constructed from concrete rings that permit infiltration to ground.	Desilting, removal of debris, emptying silt traps, control of roots, replacement of granular fill materials.	Designed to permit infiltration. Potential for significant point discharge to groundwater with reduced attenuation. Accumulation of potentially contaminated sediments.	Soakways discharging direct to groundwater are not acceptable.
Detention basins	Vegetated depressions that are dry except for periods immediately following storm events whose purpose is to attenuate flows and permit settlement of suspended solids.	Desilting, vegetation management and control	Can permit infiltration. Accumulation of potentially contaminated sediments.	Can be lined to prevent infiltration
Ponds and wetlands	Permanently wet features that are designed to retain stormwater for several days and permit settlement of suspended solids.	Desilting, vegetation management and control	Can permit infiltration. Accumulation of potentially contaminated sediments.	Can be lined to prevent infiltration

3 Legislation

3.1 Introduction

The disposal of surface water to ground and / or into surface water bodies has the potential to cause pollution of controlled waters and requires appropriate control. Control is exercised over new surface water drainage systems by a number of legislation regimes (Table 2 gives examples of controls for surface water drainage from a variety of land uses). Those of particular relevance are listed below, further details are given in the section referenced.

- The Groundwater Regulations (1998) SI 1988/2746 (Section 3.2)
- The Water Resources Act (1991) (Section 3.3)
- Town and Country Planning Act (1990) (Section 3.4)
- Highways Act (1980) (Section 3.5)
- Building Regulations (2000) SI 2000/2531 and Building (Amendment) Regulations (2001) SI 2001/3335 (Section 3.6).

Existing systems are controlled by the first two pieces of legislation listed above with respect to protection of water resources. Other legislation will be relevant in certain circumstances and includes:

- The Environment Act (1995) (Section 3.7)
- Land Drainage Act (1991) and Land Drainage Act 1994 (Section 3.8)
- Building Act (1984) (Sections 59, 61 and 62)
- Public Health Act (1936) (Section 48)
- Water Industry Act (1990) (Section 3.9)
- The Environmental Protection Act)1990)
- Conservation (Natural Habitats etc.) Regulations (1994).
- Sewerage Act (1989). *It should be noted that Sewerage Act 1989 is mentioned in CIRIA (2000) but its relevance to surface water drainage is not clear and is not mentioned in other guidance.*

In addition, Health and Safety legislation will apply to the design, construction, maintenance and decommissioning of surface water drainage systems. Relevant legislation includes, *inter alia*:

- The Workplace (Health Safety and Welfare) Regulations (1992)
- Construction (Health, Safety and Welfare) Regulations (1996) SI 1996/1592
- Construction (Design and Management) Regulations (1994) SI 1994/3140
- Confined Spaces Regulations (1997), SI 1997/1713.

The principal pieces of environmental legislation are reviewed below and their relevance to the proposed CoP considered.

3.2 Groundwater Regulations. 1998

3.2.1 General

The Groundwater Regulations 1998 (GWR98) complete the transposition of the EC Groundwater Directive (80/68/EEC) into UK law. Their purpose is to ensure protection of groundwater[1] from polluting (List I and List II) substances. The GWR98 require:

- prohibition of all direct discharges of List I substances to groundwater (subject to certain exclusions)
- prior investigation before authorising any direct discharges of List II substances, so as to prevent pollution of the receiving groundwater
- prior investigation before authorising any disposal onto or into land that might lead to an indirect discharge of List I or List II substances to ensure no entry of List I to groundwater and no pollution of groundwater by List II substances.

Contravention of the GWR98 is an offence under Section 85 of the WRA91.

With the exception of the four instances detailed below, all deliberate disposals of listed substances onto or into land that might lead to a discharge to groundwater should be authorised under GWR98.

- discharges comprising or containing radioactive matter, which are controlled under the Radioactive Substances Act (1993)
- discharges of domestic effluent from an isolated dwelling which is not connected to a mains sewer and is outside Zone 1 of a Source Protection Zone (SPZ)
- discharges found by the Agency to contain substances in List I and List II in a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater [including clean surface water]
- any activity for which a Waste Management Licence is required

Regulation 21 of the GWR98 allows Ministers to approve codes of practice for any activity that has potential to cause pollution of groundwater by listed substances with the intention of improving practice and thereby minimising the risk of an unacceptable impact on groundwater.

Authorisations under the GWR98 can be a WRA91 consent, (or a Section 86 Prohibition Notice for discharges from highway drains), an Integrated Pollution Control (IPC) authorisation under the Environmental Protection Act 1990 for disposal of listed substances. For the purposes of this document authorisation is used to refer to all of these measures, whilst Authorisation (with capital A) refers to one issued directly under the GWR98. It should be noted that Discharge Consents can also be required for discharges to surface water and therefore a Discharge Consent for this discharge is not necessarily an authorisation under the GWR98.

Once a discharge onto or into ground has been authorised the Environment Agency must ensure that it is subject to 'requisite surveillance of groundwater'.

Regulation 19 allows the Environment Agency to issue GWR98 Notices which may prohibit or impose conditions on activities, other than disposal, which could result in an indirect discharge of listed substances to groundwater. GWR98 Notices can either be used to allow the activity to continue subject to conditions (including adherence to a CoP) and thereby improve practice, or prohibit the activity, where the risks to groundwater are considered unacceptable.

[1] Regulation 1(2) defines groundwater as 'all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil'. It should be noted that this is distinct to the definition of ground waters given in the Water Resources Act 1991 (Section 104) which are defined as 'any waters contained in underground strata'. For the purposes of the CoP the GWR98 definition should be applied

Activities that involve a deliberate discharge, disposal or tipping for the purposes of disposal of List I or List II substances, or substances that contain them, will normally require control by means of an authorisation. Activities that could give rise to accidental loss of listed substances which could enter groundwater may be controlled by reference to codes of practice or, where ongoing control is needed, by a GWR98 Notice.

3.2.2 Relevance to surface water drainage

For disposal of surface water run-off, where this is not designated as trade effluent, and the risks of groundwater or surface water pollution are minimal, a CoP, or good practice guidance, may be used to give control. However, some surface water drainage may contain both List II substances e.g. metals, and List I substances (e.g. pesticides, fuel hydrocarbons) above "de minimus" levels and may require control by means of a GWR98 authorisation or notice where there is a risk of groundwater pollution occurring.

Highways drainage has an exclusion from the requirements of an authorisation under the WRA91 but can be controlled, where necessary, by a WRA91 Prohibition Notice. Highways drainage is not exempt from the requirements of the GWR98.

Table 2 gives examples of disposal and non-disposal activities associated with surface water drainage and describes the preferred means of control.

Table 2 – Preferred means of control of surface water drainage infiltration (extract from Environment Agency Groundwater Process Manual 4.3.2 Preferred Controls)

Disposal activity	Preferred control mechanism
Trade effluent	WRA91 Consent
Vehicle washdown	Presumption against; WRA91 Consent where trade effluent.
Road run-off Highways	WRA91 Prohibition Notice
Non-highways	CoP preferred; GWR98 Notice if necessary
Parking area run-off (car, coach, lorry, motorway service stations)	WRA91 Consent if trade effluent and ongoing control needed; otherwise CoP preferred; GWR98 Notice if additional control needed.
Delivery areas, loading bays, storage areas(e.g. supermarkets, garden centres, business premises, maintenance depots)	WRA91 Consent if trade effluent and ongoing control needed; otherwise CoP preferred; GWR98 Notice if additional control needed.
Run-off from airfields/runways	WRA91 Consent
Railway track	WRA91 Consent if sewage or trade effluent and ongoing control needed; otherwise CoP preferred; GWR98 Notice if additional control needed.
Petrol filling stations – run-off	WRA91 Consent if trade effluent and ongoing control needed; otherwise CoP preferred; GWR98 Notice if additional control needed.
Farmyards	
• run-off not a threat to groundwater	CoP preferred
• run-off amounts to discharge or disposal	WRA91 Consent if trade effluent; if not GWR98 Authorisation.

Note 1 If control is needed additional to voluntary adherence to a code of practice then an appropriate Notice (Works, Groundwater Regulations., SSAFO) should be served.

Note 2 If the activity is of such extent that it should be considered discharge, disposal or tipping for the purposes of disposal of listed substances then it may be necessary to control this by means of an authorisation.

Where there is discharge or disposal of listed substances the appropriate control is normally an authorisation. However, Environment Agency policy is to prioritise significant discharges and CoPs or GWR98 Notices with provisions may be used for to control activities where GWR98 exclusions can be applied. For example 'any discharge found by the Agency to contain substances in List I or II in a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater', GWR98, Regulation 2 (1) (c). This will need to be considered on a case by case basis and may need to be reviewed in future to ensure that the requirements of the GWR98 are not compromised.

The information contained in Table 2 should be considered for use in the CoP with reference to the Environment Agency Groundwater Process manual (see also Section 4.4.3) and the conditions contained therein.

3.2.3 Summary

In summary, a surface water discharge to ground will only require a WRA91 Consent, or be subject to a GWR98 Authorisation or GWR98 Notice, where it is suspected of being contaminated. In all other situations, adherence to a CoP is the preferred means of control.

3.3 Water Resources Act. 1991 (as amended)

Under Section 85 of the WRA91 it is an offence to "discharge or knowingly permit the entry of polluting matter into controlled waters[2]". Under Section 88 a Discharge Consent can be issued by the Environment Agency which offers protection against prosecution provided that the conditions of the consent have been followed and those conditions of the consent adhered to.

The WRA91 gives the Environment Agency two methods of control:

- Discharge Consents. These permit a discharge subject to conditions which can be quantitative or qualitative
- Notices. Under Section 86 of the WRA91 a Prohibition Notice can be served to prevent a discharge.

The WRA91 requires that the discharge of sewage or trade effluents to controlled waters is consented. A Discharge Consent may also be required for any discharge into a soakaway or self-contained pond. Table 2 gives examples of situations where a Discharge Consent is likely to be required for surface water drainage.

Notices may be used to prohibit a discharge absolutely or permit a disposal subject to certain conditions regarding the design, siting, construction and maintenance of the system. If on-going control of the activity is required then a Prohibition Notice may be used to require the applicant to obtain a Discharge Consent.

Under PPG 23, Planning and pollution control, and in order to prevent pollution, foul and surface water drainage systems are required for most developments.

Where pollution of controlled waters results from highway drainage, the Highways Authority has a special defence against criminal prosecution under Section 86 of the WRA91 (Section 89 of the WRA91) where it is performing its duties in keeping drains open in accordance with Section 100 of the Highways Act (1980). This defence may be overridden by a Prohibition Notice. It does not, however, have a defence against civil proceedings.

3.4 Town and Country Planning Act. 1990

The role of the planning system is to control the development or the use of land in the public interest and focuses on whether a proposed development is an acceptable use of the land.

[2] Controlled waters are defined in Section 104 of the WRA91and include *"territorial waters ... which extend seawards for three miles.., coastal waters..., freshwaters, that is to say, the waters of any relevant lake or pond in so much of any relevant river or watercourse as is above the freshwater limit, any groundwaters, that is to say any waters contained in underground strata"*.

Most developments requiring planning permission will involve surface water drainage. As part of the planning permission application the applicant will be required to state how surface water will be managed. The level of detail that an applicant is required to give on surface water management will depend upon the nature of the development. Depending upon how surface water is dealt with by a Planning Authority consultees to a planning application may include the Local Authority, County Council or Unitary Authority, the sewerage undertaker, the Environment Agency and the Internal Drainage Board (IDB).

Under PPG 23, Planning and pollution control, and in order to prevent pollution, foul and surface water drainage systems are required for most developments.

Planning permission may be an express planning permission (the submission of a planning application), or may be granted in accordance with the Town and Country Planning General Permitted Development Order 1995, and form a deemed planning permission.

3.5 Highways Act. 1980

Highways are defined as "a way over which the public has a right of way to pass freely, without hindrance at all times of the year". Section 299 of the Highways Act 1980 authorises the discharge of surface water from a highway drain into any inland water. Highways drainage does not require a Discharge Consent (Section 89 of the WRA91) but the Environment Agency can serve a WRA91 Prohibition Notice (Section 86) to prevent or control a discharge. Highways drainage is not exempt from the requirements of the GWR98.

Note
Further clarification on the compliance of highways drainage with respect to the GWR98 should be sought at departmental (DEFRA / Dept. for Transport) level to ensure that there is no duplication of effort or conflict between the roles of the Highways Agency, Highways Authorities and the Environment Agency.

It is the Environment Agency's view that highways drainage must comply with the GWR98 and therefore they will require either; an authorisation; be required to comply with a CoP; or be controlled by a Notice. The Environment Agency is the competent body for issuing of authorisations under GWR98.

Highway authorities are either the Minister with transport responsibilities or local Highways Authorities. The Highways Authority has a duty to maintain the road open and free of danger. Under Section 100 of the Act, the Highways Authority may "lay in the highway or in land adjoining or nearby, such drains as it considers necessary; erect barriers in the highway or in such land to divert surface water into or through any existing drain and scour, cleanse and keep open all drains situated in the highway or in such land".

Drains from a highway are vested in the Highways Authority. The Authority has the continued right to use drains that were used for drainage at the time when it first became maintainable at public expense.

A private individual has no right to connect his drains or sewers to a highway drain and has no defence against prosecution should they cause pollution by doing so.

3.6 Building Regulations. 2000 (SI 2000/2531) as amended by the Building Regulations (Amendment) (SI 2001/3335)

Prior to construction of a surface water drainage system, Building Control approval is required under the Building Regulations.

These regulations (regulation 12) require that building work is, as a minimum, notified to the Local Authority and, for certain larger works, the applicant is required to deposit full plans with the Local Authority Building Control or an Approved Inspector.

The Regulations set out minimum standards for building work (including rainwater drainage). Particular requirements with respect to drainage are given in Schedules 1, Part H (Drainage and waste disposal), this is further divided into H1 (foul water drainage), H2 ((Wastewater treatment systems and cesspools)H3 (rainwater drainage) , H4 (building over sewers), H5 (separate systems of drainage and H6 (solid waste storage.

The Building Regulations provide for Local Authority inspection and testing of surface water drainage (Regulation 18) and give periods of notice for covering up drainage systems.

3.7 Building Act. 1984

There are powers in the Building Act 1984 to ensure that drainage systems remain in good order. Section 59 empowers local authorities to serve notice on the owners of buildings where the drainage is not in a satisfactory condition.

Section 61 of the Building Act 1984 requires that notice is given to the local authority when drains are being repaired or altered. Section 62 requires that disused drains are disconnected from any active drainage system.

These provisions of the Building Act are summarised in Appendix H1-B of the Approved Document to Part H.

3.8 Environment Act. 1995

In cases where surface water drainage systems result in harm and/or pollution the Environment Act 1995, provides the Regulator powers to serve:

- an Enforcement Notice on a consent holder where they are contravening, or likely to contravene any condition of a consent
- a Works Notice to prevent, mitigate or remedy pollution of controlled waters.

3.9 Public Health Act. 1936

Local authorities have powers under Section 48 of the Public Health Act 1936 to enter premises and inspect drainage systems.

3.10 Land Drainage Act. 1991 and Land Drainage Act. 1994

These acts stipulate the requirement for consent from the Land Drainage Authority (Environment Agency or Internal Drainage Board) for the construction of surface water outfall structures on main rivers and modification to existing water courses or drains under the jurisdiction of the relevant drainage authority.

3.11 Water Industry Act. 1991

Sets out the process for adoption (Section 104) of sewers.

3.12 Forthcoming legislation - Water Framework Directive

The Water Framework Directive (WFD) (2000/60/EEC) requires that sources of diffuse pollution, such as infiltration drainage systems are considered.

The requirements of the WFD for surface water drainage discharge to ground have not been addressed in this scoping study. The scoping report and resultant CoP will need to be reviewed with respect to the WFD 'binding rules' requirements and the outcome of the new Groundwater Directive, which was still under discussion at the time of completion of this report. However, where the WFD is likely to affect surface water drainage systems then this should be incorporated into the CoP.

Notes for CoP

The key pieces of legislation for groundwater protection are the GWR98 and the WRA91 and the CoP should emphasise the requirements of these, i.e. the requirements for authorisations (GWR98 Authorisations, PPC authorisations and Discharge Consents) for certain types of surface water discharges to ground. The CoP should emphasise that operation in accordance with a CoP should, in most surface water drainage cases avoid the need for an authorisation and that, in many cases, this will be the Environment Agency's preferred means of control.

Of the other legislation that can also be used to control surface water drainage, it is the planning and building control regulations that are most relevant.

The CoP should emphasise the requirements of the GWR98 in relation to construction and maintenance.

Other legislation only applies in certain circumstances to surface water drains and it could be possible to construct surface water drains without reference to much of this legislation.

The requirements for authorisations and Discharge Consents need to be clearly spelt out. The points from this chapter, which should be included in the CoP are as follows:

- a brief summary of the regulations (principally the GWR98 and WRA91) covering surface water drainage systems
- how to comply with the regulations without requiring an authorisation
- those systems that the regulations cover and those that are exempt
- an explanation of the consequences of contravening the GWR98, i.e. Notices and prosecution.

4 Guidance

4.1 Introduction

This section reviews guidance available on surface water drainage and SUDS systems that may have implications for pollution of groundwater. The guidance is reviewed in sections that relate to the issuing body. A brief overview of the regulatory framework is given to indicate which regulatory body uses what guidance.

The GWR98 apply equally to existing surface water drainage systems as to those being developed or new systems. Therefore, the CoP is likely to focus on issues relating to new systems that are identified via Planning and Building Control; and control measures for existing or updated systems and where retrofitting of SUDS takes place.

Problem sites may come to the Environment Agency's attention when nuisance or pollution of surface or groundwater occurs. Additionally such systems may require review during property transactions and due diligence work (when companies are bought and sold).

Highways drainage forms a special case as a result of exclusion from the requirements of consenting under the WRA91 (see Section 3.5).

4.2 Regulatory bodies

Surface water drainage may, at different stages, be subject to control and/or regulation by:

- Office of the Deputy Prime Minster (ODPM) (overall responsibility for the planning system and the Building Regulations)
- DEFRA (environmental legislation and review of Environment Agency held consents)
- Planning Authority (usually the Local Authority, but also National Parks)
- Local Authority drainage department (flood defence, land drainage and maintenance of public open space)
- Local Authority Building Control (LABC) or Approved Inspectors
- Environmental Regulator, in most cases this will be the Environment Agency
- Highways Authority (for highway drainage)
- Sewerage Undertaker (for adopted surface water drains).

Table 3 provides a summary of the roles of these bodies, legislation and regulations, and guidance documents.

Notes for CoP
The CoP should describe:

- the role of the Local Authority (planning, building control, Highways Authority) in the control and regulation of surface water drainage systems
- the importance for the Local Authority and applicant of consulting the Environment Agency at an early stage

Table 3 – Summary of regulator role, relevant legislation and guidance documents (new applications)

Regulator	Role	Legislation/ Regulation	Guidance and Standards[A]
Local Authority Planners (or National Park Authority)	• Formulate development strategy • Determine whether planning permission is required for a system and process the application • Obtain relevant information from the applicant • Liase with statutory and non-statutory consultees • Evaluate whether the activity is acceptable on environmental, amenity, sustainability and public health grounds • Evaluate whether the proposal is acceptable to prevent pollution	Town and Country Planning Act. 1990 GPDO. 1995	• PPG23[B] • PPG25[B] • Planning Guidance (Wales) Planning Policy
Local Authority	• Flood defence, land drainage and maintenance of public open space		• National SUDS Working Group, 2003. Framework for SUDS in England and Wales (currently confidential and in draft)
Building control bodies (Local Authority or Approved Inspector	• Approved inspectors are responsible for ensuring compliance of design and construction of system with Building Regulations. • Local knowledge	Building Regulations. 2000	• Building Regulations. 2000. Approved Document H (revised 2002): Drainage and Waste Disposal
Environment Agency	• Protection of groundwater and surface water quality and resources • Flood defence • Provide advice to planning authorities • Determine whether a Discharge Consent is required (i.e. is trade effluent being discharge) or a Prohibition Notice should be served	• Groundwater Regulations. 1998 • Water Resources Act, 1991 • Environmental Protection Act, 1990 • Environment Act, 1995 • Conservation Regulations. 1994	• Policy and Practice for the Protection of Groundwater, 1998 • Joint Agencies PPG1[C], PPG3 and others as applicable • Environment Agency Groundwater Regulations. Process Manual • Environment Agency Discharge Consents Process Manual

Table 3 – Summary of regulator role, relevant legislation and guidance documents (new applications) (continued)

Regulator	Role	Legislation/ regulation	Guidance and Standards[A]
Highways Authority	• To ensure drainage of roads.	Highways Act, 1980	• Design Manual for Roads and Bridges 1998 • National SUDS Working Group, 2003. Framework for SUDS in England and Wales (currently confidential and in draft)
Sewerage undertaker (Water companies, Local authorities)	• Provide and maintain sewerage.	Water Industry Act, 1991	• Sewers for Adoption • National SUDS Working Group, 2003. Framework for SUDS in England and Wales

[A]Note: general guidance documents, such as CIRIA (2000) have not been included in this table.
[B]Planning policy guidance (Section 4.3.3)
[C]Pollution prevention guidance (Section 4.4.2)

4.3 Central government guidance

4.3.1 DETR. 2001 - Guidance on the Groundwater Regulations 1998

This document explains the purpose, contents and scope of the GWR98.

4.3.2 Planning Policy Guidance 23 (PPG23). Planning and pollution control

General guidance for planners for dealing with planning applications and pollution control issues is given in Planning Policy Guidance Note PPG 23 (Planning and Pollution Control). This guidance gives advice on the relationship between planning and pollution control to avoid unnecessary operational overlap between the two systems. The document also provides guidance to Local Authorities over planning issues and how they should regard advice given to them by consultees.

4.3.3 Planning Policy Guidance 25 (PPG25) Development and flood risk

This guidance sets out the need to undertake flood risk assessment for new development.

4.3.4 Building Regulations Approved Document H. 2002

The Building Regulations 2000 provide minimum standards for construction activities. Approved Document H provides guidance on the requirements of the Regulations. It is noted that alternative designs, which meet the requirements of the Regulations, are acceptable.

Section H3 of this document addresses rainwater drainage, including roof drainage and piping arrangements. It sets out soakaways or infiltration drainage as the preferred option for discharge before watercourses and surface water sewers. Consideration is given to the design of small (<25 m^2) soakaways (for larger soakaways reference is made to BRE Digest 365). Design storms are considered. Contaminated runoff and SUDS devices such as swales and detention ponds receive a brief mention.

Section H5 requires that separate systems of drainage are provided where there are separate foul and surface water sewers or where a storm sewer is being constructed.

4.3.5 Highways Agency. 1998. Design manual for roads and bridges. Volume 11 environmental assessment, Section 3, Part 10 water quality and drainage.

This document provides advice on assessing the impacts of highway drainage on controlled waters. The characteristics of road drainage are described and summarised from literature sources in a series of tables.

The document suggests that impacts are, in general, restricted to roads with greater than 30,000 annual average daily traffic (AADT).

With respect to accidental spillages, it is noted that the probability of spillages increases with traffic volume. Only a small number of serious accidents involving spillages occur in any one year. It is also noted that the consequences of spillages depend upon the response time of emergency services.

The legislative background for road drainage is described.

Mitigation measures are described in Annex II of the document and a method for calculating impact from accidental spillages is given in Annex III.

Annex III suggests that groundwater quality is more influenced by annual averages than peak concentrations and gives a table of likely water quality (dependent on traffic volume) and also includes a method for calculating serious accidental spillage probability.

4.4 Policy and practice guidance

4.4.1 Environment Agency. 1998. Policy and Practice for the Protection of Groundwater (PPPG)

This document was written prior to the implementation of the GWR98. The Environment Agency is currently rewriting the document as their 'Groundwater Strategy'. The status of the revised document should be checked with the Groundwater Quality Policy Manager prior to writing the CoP.

Section F of the groundwater protection policy statements has specific statements with regard to discharges of surface water into underground strata.

Matrix 3c of the PPPG document illustrates the Environment Agency's likely response to applications to dispose of surface water to ground. The Agency's position is given for a range of activities and locations with regard to Source Protection Zones (Zones 1, II or III) or resource protection (major, minor or non-aquifer). These position statements predate the GWR98.

This is a key document and will need to be consulted when writing the CoP, therefore further details are not given here.

4.4.2 Pollution Prevention Guidance Notes (PPG's)

These are joint publications of the Environment Agency, the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment and Heritage Service (NIEHS) that set out guidance on pollution prevention.

There are PPGs covering a wide range of activities. Those of particular relevance to surface water drainage and the CoP are:

- PPG1 'General Guide to the Prevention of Water Pollution' (1997). This is a general document on prevention of pollution but much of the advice refers to issues of surface water drainage. Site drainage is specifically dealt with in Section 3 where advice is given on surface water drainage systems, surface water treatment, wrong connections, garage forecourt drainage, cleaning activities, sewage disposal

and chemical storage areas. Advice on surface water treatment refers to 'A guide to sustainable urban drainage' and to PPG3 (see below). Recommendations are made for contingency plans to deal with spillages and fire fighting runoff. As part of the contingency plan, a site-drainage plan is required.

- PPG2 'Above ground oil storage tanks'
- PPG3 'The use and design of oil separators'. These guidelines are intended to assist in determining the need for an oil separator at a site.

In addition, a number of PPG's cover specific activities, these include:

- PPG5 'Works in near or liable to affect watercourses'
- PPG9 'The prevention of pollution of controlled waters by pesticides'
- PPG11 'Preventing pollution on industrial sites'
- PPG15 'Retail stores'
- PPG17 'Dairies and other milk handling operations'
- PPG18 'Control of spillages and fire-fighting run-off
- PPG19 'Garages and vehicle service centres'
- PPG21 'Pollution incident response planning'
- PPG22 'Dealing with spillages on highways'

The main points in these PPGs with regard to surface water drainage are the need to separate surface water from foul water and trade effluent, and to ensure that up-to-date plans of the sewer system are kept. Different drainage systems should be clearly marked and site maintenance staff briefed on the drainage network. The opportunity to dispose of potentially contaminated water to the surface water drainage system should be limited, e.g. roof drainage should be connected directly to the surface water drainage system and not via grills or gullies. Certain activities are identified that may require the use of oil separators, the need for maintenance is highlighted and it is noted that these will be ineffective where detergents are used. These points, i.e. separate system for surface water, plans, maintenance, knowledge of system, and construction and design are the critical elements for the CoP. Proper implementation of these features will go a long way to satisfying the requirements of the GWR98 and avoiding the need for authorisation.

Care should be taken when referring to these PPGs to distinguish them from planning policy guidance documents, also referred to as PPG's, issued by the ODPM and its predecessor departments.

See also Environment Agency leaflet "Making the right connection" (1998).

4.4.3 Environment Agency. groundwater regulations process

This document gives guidance to Environment Agency staff on the use of the GWR98. With reference to surface water drainage it indicates that control for essentially clean surface water is likely to be via a CoP or good practice guidance. Where additional controls are necessary then these will take the form of GWR98 Notices or measures available in the WRA91 (Discharge Consents and Prohibition Notices). Table 2 of this report lists the preferred method of control for a range of activities. Advice on the use of the provisions of the WRA91 is given in the Water Quality Consenting Manual (see below).

GWR98 Notices will normally be served where voluntary action is not achieved, in order to prevent pollution of groundwater. They may also be used to control risk activities in sensitive locations where the Environment Agency has need for ongoing monitoring or inspection.

It should be noted that this document may need to be updated to take account of the proposed CoPs, rather than the CoP adapting to the requirements of the manual. Compliance with a CoP may be used in place of a Discharge Consent for certain surface water discharges.

4.4.4 Environment Agency. Water quality consenting process

The consenting manual details the Environment Agency's approach to considering the need for Discharge Consents, the consenting process and the serving of Notices.

The surface run-off paper (ref. EAS/2301/3/07) states that uncontaminated discharges of surface water do not require a Discharge Consent but potentially contaminated discharges may require a Discharge Consent. The feasibility of eliminating contamination, by pollution prevention measures or treatment, should be explored before a consent is issued. It is noted that the site operator is responsible for the quality of water from their site. New consents may include maintenance requirements for oil separators and sewage systems. Consent conditions for surface water are likely to be minimal. For the purpose of consenting, surface water is described as 'matter other than trade or sewage effluent' if considered to be uncontaminated, or 'trade effluent consisting of site drainage' if considered to be contaminated.

A Prohibition Notice can be served in respect of the discharge of any matter other than trade or sewage effluent into controlled waters from a highway drain or a drain or a sewer, if it serves an adjoining building or yard. A Notice cannot be served in respect of such discharges from open areas unconnected with buildings e.g. certain car parks.

The Environment Agency may impose such conditions on the consent as it thinks fit (Environment Agency 2001a, DCM 148.02 VI).

As with the Groundwater Regulations process manual, this document may require updating to take into account the CoP.

4.4.5 Environment Agency. 2001. Guidance on requirements for 'Prior Investigation' and monitoring (including 'Requisite Surveillance of groundwater') for activities authorised under the Groundwater Regulations. R&D Technical Report P2-174.

This document describes the requirements of 'prior investigation' and 'requisite surveillance'. The risks from soakaways are dealt with briefly in this document. The proposed CoP is aimed at activities that do not require an authorisation.

4.4.6 Environment Agency liaison with Local Planning Authorities

This guidance explains how the Environment Agency contributes to local planning systems. The Agency is identified as a statutory consultee for *inter alia*:

- structure plans
- unitary development plans
- local plans
- developments within or adjacent to any watercourse or which includes a discharge to a watercourse
- development in areas at risk of flooding
- development which may affect an aquatic / wetland site of conservation interest
- development of contaminated land
- development which could affect groundwater protection zones
- development within 250 m of a landfill
- development within 500 m of a process subject to Integrated pollution control
- development involving the raising or reclamation of land
- development which falls within the Environmental Assessment Regulations 1999

4.5 Technical advice

4.5.1 CIRIA. 2000. Sustainable urban drainage systems - design manual for good practice. Report C522.

This document describes the need for sustainable urban drainage systems (SUDS). The concept of a management train, to deal with water as close to its source as possible, is introduced.

The drainage methods that make up SUDS are then described. These are grouped as:

- filter strips and swales
- filter drains / permeable surfaces
- infiltration devices (such as soakaways and infiltration trenches)
- basins and ponds (such as detention basins and ponds)
- constructed wetlands.

The interface between SUDS and the planning system is described in general terms. The approvals process is likely to involve:

- consultation
- ownership
- maintenance.

The SUDS selection process is reviewed. From an understanding of the existing situation, including the catchment and ground conditions and the impact of the proposed development, design criteria are drawn up. The design criteria are then used to select appropriate drainage techniques. Details are given on the design aspects of the various types of SUDS approaches in general terms. A number of worked examples are also provided.

Quality considerations are reviewed and the requirement for treatment identified for different land uses (residential, non-residential and industrial). Treatment methods are reviewed. The document also advocates pollution prevention measures and stresses the importance of education of the occupiers of the site and good house keeping.
The concept of an event mean concentration (EMC) is advocated for the assessment of impacts. Contaminant concentrations vary through a rainfall event but the total mass can be captured in the EMC. For groundwater, where small-scale variations in concentration are likely to be smoothed during flow through the unsaturated and saturated zones, the EMC may be a useful concept.

The document also identifies that when treatment occurs before infiltration, the treatment device may have to be lined. The degree of treatment will be dependent on the catchment land use, groundwater vulnerability and method of infiltration.

A introduction to this document is given in the publication 'Sustainable urban drainage systems – design manual for good practice'. (CIRIA, 2000).

4.5.2 CIRIA. 1994. Control of pollution from highway drainage discharges. Report 142.

This document first identifies the sources of pollution resulting from highway drainage, in terms of both routine discharges and accidental spillages. Pollutants are divided into 6 classes (sediment, hydrocarbons, metals, salts and nutrients, microbial, others) and their characteristics described.

The sources of pollutants from routine use of highways are discussed in terms of traffic (vehicle emissions, abrasion and corrosion and turbulence) and maintenance (de-icing, weed control and re-surfacing). It is also noted that runoff from highways may contain pollutants from other users, through atmospheric fall out.

Literature derived data on runoff quality is presented and discussed. Consideration is given to accidental spillages and to the number of recorded incidents. The potential for pollution of groundwater by highway drainage is described in some detail. The legislative aspects of highway drainage are reviewed in detail, however, the review predates the implementation of the GWR98.

Current practice for the design of highway drainage is described (although this is set out elsewhere in the Design Manual for Roads and Bridges (DETR 1998)) and the components of a highway drainage system discussed. The discussion includes consideration of treatment systems. Pollution management as part of highways maintenance is also described.

Appendix A describes a method for assessing the impact of highway drainage on surface water, however, this does not consider assessment of the impacts on groundwater.

Typical pollutant loadings are given as design criteria and the use of appropriate techniques to achieve acceptable water quality discussed. The report reviews mitigation measures to reduce the impact of highway drainage.

Additional data on rural highway runoff will be available in the near future from an Environment Agency / Highways Agency study of runoff from a rural motorway.

4.5.3 CIRIA. 1996. Infiltration drainage - manual of good practice. Report 156.

The manual examines the many different types of infiltration drainage system and recognises their importance in minimising stormwater runoff, and helping to retain water in a catchment for slower release as stream baseflow.

The 'manual provides a guide to good practice for those involved in the planning, appraisal, approval, funding, design, construction and maintenance of infiltration drainage systems who wish to use infiltration drainage as a method to control and dispose of stormwater.' It recognises that water quality is an important aspect of their design and provides guidance on these issues and suitable pollution prevention measures.

The manual recognises, with reference to the PPPG, the important factors in examining groundwater protection from soakaway discharges as:

- likely pollution loads (normally categorised by the type of surface being drained)
- the nature of soil, and drift and solid geology
- the depth of the unsaturated zone
- the proximity to groundwater abstractions and resources

The manual gives the following checklist to be considered when planning to construct an infiltration system for the disposal of stormwater:

- categorise the surface area over which runoff flows
- assess the types and concentrations of pollutants (from samples of stormwater where possible)
- carry out a hydrogeological risk assessment
- check the PPPG and consult the Environment Agency on groundwater vulnerability and the sort of pollution controls required and the need for a Discharge Consent
- decide the type and design of infiltration system and pollution control methods

- following construction, the system should be monitored and regularly maintained

Again, these are important aspects for the CoP to deal with, by following good practice in these areas discharge to and pollution of groundwater is avoided.

4.5.4 CIRIA. 1992. Scope for control of urban runoff.

This report consists of 4 volumes. The guidance is superseded by subsequent publications (CIRIA, 1994, 1996, 2000) which have been reviewed above.

4.5.5 BRE. 1991. Soakaway design. BRE Digest 365.

This brief document describes design criteria for soakaways and is frequently cited by other guidance documents (e.g. Approved Document H, CIRIA 1996; CIRIA 1994). Infiltration systems rely on there being sufficient infiltration capacity and this is determined by use of a soakaway test.

Soakaway design (capacity) is based on the rate of infiltration into the soakaway, the area over which runoff is generated and a design-storm. BRE suggest a design-storm of a 10 year return period but indicate that an iterative approach should be taken to determine what duration gives the worst case (longer-duration storm events have a lower intensity). The worst-case will be dependent upon the infiltration characteristics of the soakaway.

Conservative assumptions are made regarding the infiltration characteristics to account for long-term reduction in performance due to siltation.

4.5.6 Highways Agency. 2002. Fate of highway contaminants in the unsaturated zone: Phase 1.

This report is a literature review of information on the fate and behaviour of highway pollutants in the unsaturated zone of UK aquifers. The report also attempts to determine whether sufficient information exists to provide interim advice on the fate and behaviour of highway pollutants whilst also specifying the requirements of additional studies to assess highway drainage installations.

4.5.7 University of Leeds. 2002. Urban development and non-point source water pollution: A generic assessment tool.

Information on urban water quality has been collated from available literature to identify principal contaminants and is presented in this report. Statistical analysis has been applied to the data to determine appropriate concentrations to be used as source terms in designing SUDS and other urban drainage measures.

It is likely that the document will serve as a useful source of information for designers of urban drainage systems. It is noted that the data collection exercise identified that there was only a limited quantity of data on urban runoff quality, particularly for organic (List I) compounds.

Notes for CoP
The quantity of guidance available means that, in terms of describing surface water drainage systems, the CoP does not need to go into detail. The principal guidance document is the CIRIA (2000) SUDS Design Manual for England and Wales. Much of the existing guidance does not fully explore the potential threat to groundwater from surface water drains and this threat needs to be brought out in the CoP. The CoP should include a reference table to enable relevant guidance to be quickly identified.

4.6 Standards

The guidance on the Building Regulations (Approved Document H) identifies the relevant standards, key documents are identified here.

4.6.1 National SUDS Working Group. 2003. Draft framework for sustainable drainage systems in England and Wales

This document sets out minimum design standards and regulatory agreements for SUDS systems, including maintenance schedules. It has been developed in consultation with a large number of interested bodies, including DEFRA, National Assembly for Wales, Office of Water Services, the water industry, Local Government Association, Planning Officers Society, English Nature, the Environment Agency, Association of Highways Authorities, House Builders Federation, Association of British Insurers.

A consultation version of this document is available on the Environment Agency website. This should form a key reference for the CoP and should therefore be consulted prior to writing the CoP. Appendix H contains a summary of those surface water disposal activities that are likely to be exempt from requiring a Discharge Consent or GWR98 Authorisation. The key aims of the Framework are to provide surface water drainage solutions that reduce flooding, and improve or stop pollution of surface and groundwater. To achieve these aims a number of mainly 'soft engineering' structures and techniques are specified.

4.6.2 Water UK. 2001. Sewers for Adoption, 5th Edition: A design and construction guide for developers. WRc plc.

This document sets out design and construction standards for the sewers intended to be adopted by statutory undertakers. Adoption is the process by which sewers are invested in the sewerage undertaker and subsequently maintained at its expense. The document identifies relevant standards for the design and construction of surface water drains. The document does not identify maintenance standards because it is aimed at developers and maintenance will be the responsibility of the undertaker following adoption. SUDS are specifically excluded from the standard and will be covered by a new framework agreement (Section 4.6.1).

4.6.3 BS EN 752-4 Drain and sewer systems outside buildings

This standard applies to gravity drains from the point where it leaves a building or enters a road gully to the point of discharge. It is divided into 7 parts. The emphasis of the standard is on flow in pipes. Part 4 contains general advice regarding the prevention of pollution ('environmental considerations').

4.6.4 BS EN 858 Installations for separation of light liquids

This standard sets out standards for oil separators (see also Environment Agency PPG3).

Notes for CoP

Surface water drainage systems must comply with standards set out in the CoP, some higher standards may be defined in other documents.

It is noted that where surface water drainage systems are not intended for adoption, then lower standards are likely to be applied to reduce expense. However, in areas of high groundwater vulnerability these lower standards may not be acceptable to the Environment Agency.

The need for maintenance of all surface water drainage systems must be identified and emphasised.

5 Hazard and risk

5.1 Introduction

This chapter considers the hazard that surface water drainage can present to the quality of groundwater and other waters and the risks of contamination. First the terms hazard and risk are identified, then the potential hazard presented by surface water is described. For the hazard to present a risk to groundwater quality, there must be a pathway from the hazard to groundwater and this is also considered.

5.2 Definitions

It is important to be clear about the definition of the key terms hazard and risk. The CoP should use the terminology adopted by DETR (now DEFRA) in their guidance document 'Guidelines for the Environmental Risk Assessment and Management' (2000) to maintain consistency with other DEFRA documentation which has the following definitions:

"Hazard" is: A property or situation that in particular circumstances could lead to harm.

"Risk" is: A combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

5.3 Hazard

5.3.1 General

Surface water drainage may in many situations have only a low potential hazard, e.g. most roof drainage (CIRIA, 2000). However, it can contain substances that may make it a hazard or may, as a result of interaction with materials in the soil, become a hazard within the surface water drainage system.

5.3.2 Sources of contamination

The hazard results from activities which could lead to the contamination of surface water during different stages of the life of a drainage system including:

- construction. Spillage or leakage of fuel or chemicals, silt-laden runoff, wrong-connections[3] (particularly for additional construction at a later stage, or multi-user sites)
- operation (wear and tear of vehicles, surfaces and structures; atmospheric fall out; contaminated land runoff; small spills and leaks of fuels and chemicals, oil from parked vehicles, poor housekeeping)
- maintenance (use of pesticides and cleaning products, disturbance of potentially contaminated sediments, damage to linings, use of de-icers)
- renovation/rehabilitation works (as for construction)
- flooding of contaminated areas and leaching or mobilisation of contaminants. In some instances the surface water runoff may not represent a significant hazard at the point of generation, but may become a hazard through interaction with soils. For example, directing surface water drainage across or into contaminated land may lead to the mobilisation of the contaminants. In addition, contaminated groundwater may enter parts of the surface water drainage system, e.g. via unsealed pipes, if not prevented from doing so. Some natural deposits also contain soluble compounds that may contaminate water.

[3]wrong-connections occur when a foul sewer is connected to a surface water sewer and will result in pollution. In piped systems wrong-connections can go undetected for long periods of time. See "Making the right connection" Environment Agency (1998).

- secondary sources. The accumulation of potentially contaminated sediments in parts of a surface water drainage system (e.g. gully pots) can result in a secondary source of contamination, particularly where the contamination can be released at a later date in a more concentrated form, e.g. by short duration, high intensity storm events. Surface water is particularly at risk from this type of event.
- accidents such as:
    - incompetent or inappropriate maintenance and renovation (resulting in damage and leakage)
    - collisions and breakages leading to discharges to surface water drains
    - illegal use (deliberate disposal of contaminants to surface water drains)
    - fires and explosions (and the subsequent disposal of fire-fighting substances (e.g. foam) and contaminated water from clean-up operations)
    - component failure (pumps, pipes etc.), leading to backing up / overflowing of contaminated liquids and overspill into surface water drains
    - ignorance of drainage systems resulting in inappropriate discharges (particularly in the event of spills and emergencies).

5.3.3 Contaminants

Urban runoff and road drainage will contain contaminants derived from vehicles, structures and from the drained surface and may contain the following groups of contaminants (DMRB, 1998; University of Leeds, 2002):

- hydrocarbons (poly aromatic hydrocarbons (PAHs), benzene, toluene, ethylbenzene, xylenes (BTEX) compounds, aliphatic hydrocarbons,) from bitumen, diesel, petrol, lubricating oils
- alcohols and antifreeze
- fuel additives (e.g. Methyl-tert-butyl-ethylene (MTBE), tertiary-amyl-methyl-ether (TAME), ethanol etc.) from petrol
- herbicides and pesticides used for weed and pest control
- metals (copper, cadmium, chromium, nickel, manganese, zinc, iron) from vehicle components, brake linings, tyres, herbicides, road grit, roadside furniture (street signs, lamp posts etc) and road salt
- nitrates from NO_x emissions related to the burning of fossil fuels (by atmospheric deposition)
- phosphorus (atmospheric deposition, fertilisers, leaf litter, detergents, animal faeces and bird droppings)
- de-icers (road salt, cyanide [anti-caking agent], sulphate, urea [alternative to salt used on concrete structures], glycol [airfields])
- particulates (litter, silt, vegetation).

In addition, a range of contaminants may be mobilised from contaminated land or result from spillages of chemicals.

Hydrocarbons, and many herbicides, and some metals (cadmium and mercury) are List I substances (under the GWR98) and many of the other metals are List II substances.

The potential contaminants in surface water (listed above) represent a wide range of substances. These may be present in a variety of phases, principally:

- aqueous (dissolved, complexed)
- emulsions and free-phase
- in particulate form
- absorbed on to particles.

The phase that a contaminant is in will depend upon a number of factors, including:

- its solubility
- the presence of other contaminants, (for instance, lead is more soluble in the presence of sodium as found in road salt; hydrocarbons that would normally form a separate phase may be emulsified by the presence of surfactants)
- its partition coefficient.

Water soluble components will tend to partition into the aqueous phase. Suspended solids will also be present in surface water and the finer particulate fragment will contain a high proportion of organic carbon (soot, tyres, decayed vegetation, bitumen, etc.) to which poorly soluble organic compounds are likely to partition. Poorly soluble metals are also likely to partition to the organic solid or particulate phase as well as to clay minerals.

Leaks and spills of large volumes of hydrocarbons (fuels and oils) can lead to the movement of a separate, immiscible phase to the water in the drainage system, although this may become emulsified under turbulent flow conditions.

Suspended solids within the drainage water may contain many of the common contaminants previously listed and transport them to other parts of the drainage system where the contaminants may leach out.

DMRB (1998) indicates that predicting the quality of surface drainage is difficult, however, as a general rule, surface water can probably be considered to have a low contaminant loading, particularly when the design incorporates appropriate treatment stages prior to discharge and measures are put in place to control pollution.

5.3.4 Surface water as a hazard

The composition of surface water under routine use of the drainage system will vary according to: the use to which the drained area is put and the sources of contamination within that area; the drainage characteristics of the area; and upon climatic factors (rain intensity, antecedent dry period).

There is little published information on the quality of water from surface water drainage systems but in general much of the published guidance indicates that quality is likely to be acceptable (i.e. comply with the GWR98) for discharge to ground or surface water courses following appropriate treatment. The principal quality problem appears to be suspended solids.

Sources of contamination (listed in Section 5.2.2) within the drained area result from the use to which the drained area is put, and from the materials used in the surface water drainage system. These may include secondary sources of contamination resulting from accumulated sediments within the drainage system.

The extent to which contamination is mobilised to and within surface water drains, and the quality of water in the system will be related to:

- flow velocities –which will be dependent upon:
    - storm intensity and duration
    - surface roughness. A rough surface will trap more particulate matter (one of the major sources of contaminants) than a smooth surface. Vegetated surfaces, in particular, are likely to trap particulates.

- distance to drain. Longer overland flow distances will give greater opportunity for attenuation of particulates and flow.
- piped systems. Pipe size gradient and rate of entry of water

- runoff /recharge split – what proportion of surface runoff infiltrates into the ground (this will vary depending upon soil characteristics; soil moisture conditions and rainfall intensity).

Climate will influence runoff quality due to the length of time since the last storm event (the antecedent dry period) and to the intensity and duration of a storm event. Long periods between storm events permit particulate matter to build up on hard surfaces due to both activities in the drained area and to dry deposition. The rate of dry deposition will depend upon the prevailing atmospheric conditions. Particulates may only be mobilised by rainfall of a sufficient intensity to dislodge them.

The combination of rainfall intensity and duration of rainfall events will also determine the dilution available for any contaminants. For example, a short, intense storm may dislodge contaminants from a surface and move them into a drainage system but not be of a sufficient duration to result in significant dilution.

For storms of longer duration, water quality will evolve with time during a storm event. After periods of dry weather there may be a 'first flush' of poor quality water in which contaminant concentrations are higher. The first flush concentration may represent the critical concentration for assessment of impacts on certain types of surface water systems, e.g. where the biological oxygen demand (BOD) loading of the first flush may have a deleterious effect on oxygen levels of the receiving water course.

Snowmelt after a period of subzero temperatures may also result in the sudden release of contaminants, e.g. salt, particulates, etc., that have accumulated during the period over which accumulations of snow were present.

For groundwater (and in locations where storm water collects, e.g. detention basins), the best estimate of contaminant concentration in surface water comes from either the Event Mean Concentration (EMC) or long-term mean concentration values. The EMC represents the mean concentration of contaminants in the surface water derived during a specific rainfall event due to the effects of mixing, dispersion and dilution. The EMC will be lower than the first flush concentration. The long-term mean concentration is the concentration of contaminants (in the surface water averaged over, say, one year).

The bulk of relevant literature on surface water drainage quality regards highways, and the composition of run-off has been characterised in a number of studies. For studies of highway drainage there is an important distinction between:

- high traffic (>30,000 AADT) volumes. At high traffic volumes highway runoff water quality may have significant contaminant loading, depending upon the circumstances for a particular road
- low traffic (<15,000 AADT) volumes. At low traffic volumes the Highways Agency guidance (DMRB, 1998) and CIRIA (2000) suggest that surface water runoff contains only low concentrations of contaminants
- highway runoff from predominantly rural roads, where the road use is likely to be the principal source of contamination and is characterised by vehicles travelling at high speed
- highway runoff from predominantly urban roads where roads may collect deposits resulting from atmospheric fallout and from a variety of urban sources (litter, dog faeces etc.) and in addition, there are high numbers of vehicles engaged in stop-start motion at low speed or parked at the road side. There is also an increased incidence of collisions (but at lower speeds). In urban areas, roads will also receive runoff from other areas of hard standing, of which there is a much greater percentage than in rural areas and less vegetation to reduce particulate movement.

However, despite these obvious differences, the University of Leeds document (2002) suggests that the literature on urban road runoff does not contain sufficient detail to permit division into separate categories. Little information is available on run-off water quality from other forms of surface water drainage.

Accidents

The composition of surface water following an accident will depend upon the nature of the event, the response to that event and the contaminants released. The degree to which this represents a hazard to groundwater will depend upon the likelihood of such spills reaching groundwater (this forms part of the risk assessment discussed in Section 6.4).

5.3.5 Defining the hazard

It is difficult to quantitatively define the hazard that a particular site is likely to present to groundwater and surface water in terms of contaminants, concentrations and loading. For this reason existing guidance (e.g. PPPG, 1998; National SUDS Working Group, 2003) make a qualitative assessment of hazard based upon land use. Activities illustrated (impermeable areas only) by PPPG (1998) are:

- roof drainage
- public amenity
- large car parks
- lorry parks
- garage forecourts (note: fuel dispensing facilities incorporating underground storage tanks are the subject of a separate CoP- DEFRA (2002) but the principles of surface water drainage in this CoP still apply)
- major roads
- industrial sites.

National SUDS Working Group, (2003) identify the following sources of drainage water, in addition to those listed in PPPG (1998):

- residential (defined in same category as public amenity)
- local roads
- surface water sewers

Given the small number of studies of surface water drainage and their focus on highway drainage, there may be a need to undertake site-specific research for large schemes (although the obvious difficulty is that until the scheme is in place the quality of the water cannot be determined). Additional research on typical values of surface water runoff quality may be required. It should be noted that the analysis of surface water drainage quality is not simple, as it depends upon a large number of variables (seasonal, recent climate, location in the system, rainfall intensity, timing of sampling with respect to the start of the rainfall event). Meaningful sampling by a site operator is therefore probably generally not possible. Where monitoring is to be carried out guidance should be sought from the Environment Agency.

Sources of information on likely surface water quality are given in:

- CIRIA (1994)
- University of Leeds (2002)
- DMRB (1998)
- Highways Agency (2002)

These information sources contain a degree of duplication, i.e. they cite data from the same studies. The most comprehensive report (University of Leeds, 2002) is possibly the most useful in identifying likely contaminant concentrations. However, where surface water runoff is primarily derived from roads then the advice given in DMRB (1998) is likely to be appropriate, although it does not consider hydrocarbons in

detail. Additional research undertaken jointly by the Environment Agency and Highways Agency on motorway runoff is due for publication in the near future.

The University of Leeds document contains recommended screening values for EMC for North European situations. For each contaminant, 5 land use categories are defined:

- urban open
- industrial / Commercial
- residential
- motorways
- other main roads.

Note for CoP
In the absence of quantitative information the initial assessment of hazard will be based upon land use. Land use categories should be consistent with existing (PPPG) guidance and / or National SUDS Working Group (2003) – Appendix H.

5.4 Risks to Groundwater

5.4.1 Introduction

Water in surface water drainage systems is a potential hazard to groundwater. The risk of groundwater and surface water pollution arises where there is a pathway from the hazard to the receptor (groundwater or surface water). This section focuses on the risk to groundwater.

It should also be noted that directing large volumes of water to groundwater may change the strength of the ground (through dissolution, removal of fine particles, swelling, reduction in effective stress).

5.4.2 Pathways

Where the deliberate, planned disposal of runoff to ground, e.g. at a soakaway, is practised then the pathway is obvious. However, a pathway may also exist as a result of the unintentional leakage from any part of a surface water drainage system.

Pathways from deliberate introduction of surface water into the groundwater include:

- infiltration of water from systems designed to direct water to ground, e.g. soakaways (infiltration trenches), permeable surfaces and filter drains, and subsequent migration to the water table
- direct infiltration to groundwater via deep soakaways and boreholes (note this practice is not encouraged by the Environment Agency and is likely to be prohibited under the WFD).

Pathways from either the indirect or unintentional discharge of surface water drainage to groundwater arise when:

- drainage systems are designed primarily to conduct water but permit infiltration, e.g. some swales, permeable surfaces, ponds, wetlands and detention basins. These devices may not be constructed with a low permeability liner and, in the case of ponds, may be constructed at or below the water table. Diversion of storm water to such devices will result in temporary rise in water levels increasing hydraulic heads and infiltration rates to the ground. Use of devices which permit infiltration requires care to prevent the unintentional disposal of contaminated water or liquid waste. Deliberate misuse

may be difficult to prevent but appropriate levels of security for the drainage system where there is a risk should be considered.

- leakage from sealed drainage systems (not intended to permit infiltration) resulting from:
    - poor construction practices (e.g. leakage from defective joints)
    - poor maintenance (damage to lining systems). Where storm water is known, or suspected to be, contaminated, designers may choose to use lined channels, basins and ponds in addition to pipes to prevent or minimise infiltration. These measures will only be effective where the integrity of the lining is maintained
    - post-construction damage e.g. from heavier-than-anticipated traffic loads over buried pipes, tree roots etc.
    - deliberate misuse and ignorance. As with unintentional infiltration, deliberate misuse may be difficult to prevent but appropriate levels of security for the drainage system where there is a risk should be considered.

In some instances, indirect infiltration may be advantageous to the functioning of a surface water drainage system, without providing a threat to groundwater, for example, by providing additional attenuation of surface water flows. In other instances, where surface water flow is known to be contaminated and passing over areas of vulnerable groundwater, then indirect infiltration should be avoided.

The infiltration of water where the ground is contaminated may pose an additional risk from the leaching and subsequent transport of contaminants within the ground.

5.4.3 Factors affecting the degree of risk

The degree of risk will depend upon the nature of the hazard (contaminant concentration, volume and mass loading of surface water, toxicity, polluting potential, etc.) and upon the attenuation processes that occur between the hazard and the receptor. Factors that affect the attenuation of contaminants between surface water and groundwater include:

- ground conditions. The unsaturated zone may play a key role in the attenuation process. Attenuation processes will be affected by:
    - thickness of the unsaturated zone (depth to the water table), if this is thin (shallow water table) then residence time is likely to be short with limited attenuation. Seasonal variations / maximum anticipated levels will dictate the minimum thickness.
    - attenuation properties of the contaminant and soil / rock. Contaminant movement may be retarded by being sorbed onto soil and rock. The degree to which this process is important will depend upon the partition coefficient of the contaminant between water and solid phase and upon the number of sorption sites available on the solid phase. Few sorption sites, or a low partition coefficient will result in rapid contaminant transport with minimal attenuation. Solid particles may be filtered out in the unsaturated zone (but this may result in clogging)
    - flow mechanisms, in rocks and soils subject to rapid bypass flow, e.g. fractured rock, Karstic systems, flow via fissures will rapidly transport surface water to the water table with minimal attenuation. Whilst in intergranular flow systems flow will be slower permitting more time for attenuation
    - hydraulic conductivity is a factor in determining the rate at which contaminants can migrate through the unsaturated zone, a high hydraulic conductivity will result in a rapid travel time
    - moisture content can influence the rate at which contaminants can migrate through the unsaturated zone, a low moisture content can result in short travel times. Moisture content also affects potential for biodegradation of (organic) pollutants

- saturated zone. Additional attenuation is possible in the saturated zone between the point of entry into groundwater and a designated receptor (e.g. a water supply borehole, surface water, useable groundwater resources). However, in the context of a risk assessment to satisfy the requirements of the GWR98, this can only be taken into account for List II substances. The extent to which attenuation may occur will depend upon dilution, degradation and sorption processes. If the discharge is too close to a receptor, then there may be insufficient attenuation. Attenuation within the saturated zone will therefore depend upon:

    - direction of flow (and hence receptors affected)
    - distance to the receptor (if too close there may be insufficient time fordilution and other attenuation processes to occur)
    - proximity to groundwater protection zones (particularly Zone 1) or potable groundwater sources
    - attenuation properties of the contaminant and rock (as for unsaturated zone above).
    - flow mechanisms, in fissured and fractured rocks rapid flow via fissures will transport water to a receptor with minimal attenuation, whilst in intergranular flow systems flow will be slower permitting more time for attenuation
    - hydraulic conductivity (as for unsaturated zone above)
    - aquifer thickness and available mixing zone in both the vertical and horizontal directions, i.e. is there sufficient dilution available
    - throughflow of groundwater in relation to release of contaminants (the higher the ratio of throughflow to contaminant release results in greater dilution)
    - geological conditions (such as the location of deeper impermeable strata between the site and the water table that may result in horizontal flow and breakout downslope)
    - proximity to other discharges and the effects of cumulative discharges in potentially overwhelming the attenuation capacity of the aquifer.

- design and maintenance. The design of a surface water drainage system can reduce the risk of contamination by incorporating one or more treatment devices. These will only function if correctly designed and constructed and adequately maintained. Treatment stages will not function correctly if they are subject to:

    - higher than anticipated hydraulic loading. Systems are designed for a particular loading a higher hydraulic loading (e.g. by connecting additional drainage areas to a system) will result in reduced residence times within the treatment system, resulting in reduced attenuation
    - infrequent or inadequate maintenance. Maintenance of treatment systems is necessary to remove accumulated sediments and free-phase liquids and to maintain their hydraulic function. If not removed the accumulated sediments may form a secondary source of contamination.

- operational practice. Risks are increased where a surface water drainage system is misused. Misuse can result from:

    - ignorance resulting in inappropriate discharges to the surface water system (such as the disposal of antifreeze to drains)
    - illegal use of the surface water drainage system for disposal of trade effluent or sewage
    - poor decommissioning of redundant parts of a drainage system (i.e. pipework is still active) (See Appendix H1-B in Approved Document H to the Building Regulations).

- accidents and unexpected events. Risk of contamination of groundwater may be increased due to:
    - accidental spillages of fuel and chemicals which may enter the surface water drainage system. Spills may also adversely affect some treatment systems
    - accidental damage, e.g. during maintenance, or as a result of heavy traffic over buried pipes, from tree roots and other vegetation damage
    - contamination from wrong-connections. Wrong-connections, where foul sewers are connected to surface water sewers (or vice-versa), are believed to be common and can result in unforeseen consequences. Where discharges are intermittent, or unobserved, these can continue undetected for many years. The problem of wrong-connections is believed to be particularly prevalent at private multi-user sites where development has taken place over a number of years.

Through appropriate design and an adequate maintenance regime, surface water drainage systems should represent a minimal risk to groundwater.

Note for CoP
Designers need to be made aware of risks to groundwater from surface water drainage systems so that risks can be mitigated by treatment, or avoided by appropriate design.

The CoP should:

- explain how activities within the catchment can result in the contamination of surface water
- provide a brief summary of the substances that could be present in surface water (as dissolved, suspended solids or as immisicible liquids)
- explain how, through good practice, the users contribution can minimise the risks to groundwater
- explain the value of groundwater and how the user can help to protect this resource (See 'Groundwater- our hidden asset' BGS/Earthwise, 1998).
- explain how the risk to groundwater can be minimised through appropriate location, design and operation of a the surface water system (see Chapter 6).

5.5 Summary

In summary the main problems associated with surface water drainage systems are usually a result of:

- inappropriate location
- poor construction practice
- poor drainage design
- lack of treatment, inadequate treatment or lack of maintenance of treatment devices
- failure of infiltration systems
- lack of, or inappropriate, maintenance (e.g. use of herbicides)
- poor awareness of site staff and maintenance contractors.

It should be noted that many surface water systems incorporate treatment systems that remove contaminants from surface water by sedimentation or filtration. However, the accumulated sediment may then represent a secondary source of contamination of both ground and surface water if not removed.

6 Planning, design and construction

6.1 Introduction

The CoP will need to describe the different stages of surface water drainage systems (including the discharge of runoff to the ground and/or surface water), these are:

- outline design
- selection of design criteria
- detailed design
- application for permission to construct system (including liaison with regulatory bodies)
- assessment and approval of system (through planning permission, issue of any necessary consent or authorisation)
- construction of the system
- operation, maintenance and monitoring of system
- decommissioning of the system.

These different stages are covered in the following sections focussing on the factors and measures that need to be taken into account to reduce the risk to groundwater. Where appropriate the responsibilities of the different parties (i.e. planning, building control, regulator, developer and operator) are also described. The CoP should mainly be targeted at the developer, designer and operator.

This scoping document does not go into the details of the design, construction and maintenance of surface water systems (except where this is relevant to the protection of groundwater) as these details are covered in standard texts on the subject.

A recent development, currently being trialled in parts of Scotland, is the undertaking of Drainage Impact Assessments (DIAs) for new developments (except where less than 10 houses are being constructed) at an early stage in the development. DIAs formalise the requirements for consideration of drainage (both foul and surface water) for planning purposes. The trial in Scotland focuses on the use of DIAs to ensure consideration of SUDS, but there is no reason why non-SUDS systems could not be subject to a DIA.

6.2 Planning

At a strategic level Local Authorities will set out basic principles in Development Plans. These may be supported by Supplementary Planning Guidance documents on particular subjects, such as SUDS.

All new development will require surface water management that, as a minimum, must meet the requirements of the Building Regulations. For small residential developments, the requirements may not be particularly onerous.

The relevant regulatory bodies are identified in Table 3. Table 3 also describes their role and identifies relevant legislation and guidance. Table 4 identifies the roles of the site owner, designer and regulators in assessing new developments.

The Environment Agency will be a consultee on developments that involve work to a stream or river, but are not necessarily consulted with regard to surface water drainage measures. There does not appear to be a statutory consultee for surface water drainage that does not connect to a surface watercourse. In general, the statutory undertaker (Local Authority or Sewerage Undertaker) may be consulted with regard to the adequacy of surface water drainage.

Consent may also be required where drainage is to an Internal Drainage Board (IDB) system, depending upon local bye-law requirements.

Building Control has a duty to ensure that the development is undertaken in accordance with the Building Regulations and may undertake tests to ensure adequacy of the drainage system.

Systems for adoption will require the approval of the sewerage undertaker or other relevant body and will have to meet the requirements of 'Sewers for Adoption' for piped systems or the 'Framework for SUDS in England and Wales' (draft) for SUDS systems.

It should be noted that existing sewerage systems may have capacity constraints that will prevent connection of additional surface drainage systems to them.

Early consultation will ensure that planning applications contain a sufficient level of detail to permit assessment. Consideration should be given to the use of DIAs at an early stage as an aid to discussion with planners and statutory consultees.

Note for CoP

The CoP should include a flow-chart identifying those schemes that are likely to require an authorisation and those where adherence to a CoP alone will be sufficient.

With regard to the protection of groundwater the key interface will be between the designer and the Environment Agency and the CoP should emphasise the importance of this consultation process.

Table 4 – Assessment roles to determine risk to groundwater

Party	Information used	Role/task
Developer / site owner	Type of use (domestic/commercial/industrial) Location of development.	Appoint designer Agree construction, operation and maintenance standards with designer and regulators and ensure appropriate arrangements are put in place Consult Environment Agency Check Local Strategic Plans and any Supplementary Guidance Notes
Designer	Location of existing surface water drainage Details of development • catchment area • surfaces to be drained Design criteria and selection process • climate data • design flows Investigation results • description of soils • percolation tests Assessment of hydrogeology: • geology • groundwater vulnerability • licensed abstractions (location/abstraction rate) • direction of groundwater flow if available • environmentally sensitive receptors • depth to water table (unsaturated zone thickness) if known • aquifer thickness • groundwater quality Location of contaminated land Surface water quality / sensitivity	Identify appropriate design criteria Undertake site inspection and investigation • site walkover survey • intrusive investigation Consultation with regulators Undertake initial assessment of design Undertake drainage impact assessment Provision of information to planning Authority and building control Apply for Discharge Consent (if applicable / desired) Undertake more detailed investigation and risk assessment where advised Undertake detailed design
Building Control	Information provided by applicant (notification, or full plans) Local knowledge of suitable systems	Assess compliance with Building Regulations Check design calculations Assess percolation test results Inspect construction

Table 4 – Assessment roles to determine risk to groundwater (continued)

Party	Information used	Role/task
Local Authority Planning Dept.	Information provided by applicant	Identify omissions in data Assess whether connection should be made to sewer Ensure consultation with statutory consultees and other relevant bodies (if accepted) Process planning application and apply conditions recommended by consultees
Sewerage Undertaker / Local Authority	Capacity of existing surface water sewers	Determine whether existing sewers have capacity Agree standards for adoption
Environment Agency	Licensed abstractions (location/abstraction rate/use) Depth to and direction of groundwater flow if available Environmentally sensitive receptors Local knowledge of problem areas	Review information and obtain further data where necessary Review risk assessments to determine risks to groundwater and surface water Determine whether to: • object to scheme • permit scheme (no conditions) • permit scheme (with conditions) • ask for a Discharge Consent application • issue Prohibition Notice Advise on alternative design or location for system.

Notes for CoP
The lack of a role as a statutory consultee for the Environment Agency means that in some cases (difficult to quantify) new developments will escape scrutiny. A way of capturing applications for high risk developments needs to be considered. The Agency is looking at links to Local Plannning Authorities with a view to developing good constraint guidance and standing comments for planners to use. Consultation with the EA should be encouraged by planners and building control.

The key interface with regard to groundwater protection at the planning and design stage will be between the EA and the designer / developer.

Local Authorities should be encouraged to adopt the CoP and incorporate it into their planning policy.

6.3 Design

6.3.1 Introduction

All development requires surface water management. The earlier that surface water management is considered in the design process, the more likely it is that an appropriate solution, which is protective of groundwater and surface water, can be incorporated into the development.

The main objectives in the design of a surface water drainage system are to:

- manage surface water runoff in order to minimise the impact on and, where possible, enhance the existing surface water and groundwater regime
- minimise the risk of flooding
- protect or enhance surface water and groundwater quality
- minimise erosion of soils and receiving watercourses
- ensure continuing safe use of development / site
- incorporate sustainable development
- provide amenity through landscaping, land use, wildlife habitats and water resources.

The hydraulic aspects of design are beyond the scope of the CoP and are adequately covered by existing guidance, notably CIRIA (2000) and references therein. The CoP should direct the site owner/designer to these references.

The design should take into account the way in which the site is likely to be used and the level of maintenance that will be available.

A phased approach to design should be encouraged, starting with an initial, outline design and moving to detailed design as additional information is gathered and following consultation and agreement with regulators.

It should be noted that there may be conflicting requirements between, for example, the need to prevent flooding in downstream watercourses (and hence a preference for infiltration drainage) and the requirement to protect groundwater (by preventing infiltration at sensitive sites) and these will require resolution at an early stage.

6.3.2 Outline proposals and selection of drainage system or scheme

At an early stage in the planning of the development the surface water drainage design criteria should be determined. These will indicate general principles, for example, whether infiltration drainage is required and appropriate.

The initial assessment should consider:

- an understanding of existing drainage arrangements and catchment topography
- location of the surface water drainage system
- how surface water drainage will be managed (including types of drainage device)
- disposal route for surface water (e.g. infiltration to ground, discharge to surface water)
- volumes of water that will need to be managed
- activities that could give rise to contamination (and how these could be minimised) and likely quality of surface water drainage
- acceptability, in principle, of infiltration to the ground to the Environment Agency
- practicality of discharge to ground (i.e. is ground sufficiently permeable)
- likelihood that Discharge Consents or authorisations will be required
- operation and maintenance issues.

The above issues could be considered as part of a Drainage Impact Assessment. Further guidance, on the issues that need to be considered, is given in CIRIA (2000).

A number of pieces of information may be required at this early stage to determine what is likely to be the most favourable surface water management approach. Depending upon the likely drainage option, this information may include:

- existing surface water drainage arrangements (including natural drainage patterns)
- surface water drainage system catchment topography
- type of development (Is a trade effluent consent required? What will be the likely contaminants?)
- size of development (area of hardstanding and area of roofs)
- likely discharge points
- available space for surface water drainage systems
- an assessment of infiltration characteristics (from winter rainfall acceptance potential (WRAP) or hydrology of soil types (HOST) classification used in the Flood studies report or Flood estimation handbook published by the Institute of Hydrology, and / or from infiltration tests)
- distance to existing surface water sewers and available capacity
- ground conditions (contamination, stability, runoff and infiltration characteristics of ground)
- climate (rainfall)
- distance to, and quality of, surface water bodies
- groundwater vulnerability from Environment Agency published maps and SPZ status (available on the Environment Agency web site www.environment-agency.gov.uk). It should be noted that groundwater vulnerability should be reassessed from site-specific data at the detailed design stage
- adjacent land drainage arrangements (to identify cumulative effects).

The initial information gathering exercise will be used to establish design criteria to permit selection of an appropriate surface water drainage system. CIRIA (2000) provides advice on selection of surface water drainage device but notes that this is likely to be an iterative process and dependent on a number of considerations such as protection of the environment, amenity, property values.

The developer/designer should also undertake an assessment on whether the proposed surface water drainage system is likely to be acceptable in terms of the risk to groundwater where the scheme is likely to result in the direct or indirect infiltration of surface water to the ground. This assessment process is described in Section 6.4 and should involve consultation with the Environment Agency. This assessment should determine whether the proposed design will be:

- probably acceptable (go forward to detailed design stage)
- probably acceptable subject to certain conditions (to be determined as part of design phase) such as:
    - incorporation of additional measures to prevent infiltration of surface water to the ground (such as lining)
    - treatment of the surface water prior to infiltration to the ground and/or discharge to surface water
    - Discharge Consent or authorisation
- not likely to be acceptable and an alternative scheme will need to be proposed
- further assessment (including investigation) required before acceptance or rejection of the scheme.

For larger / mixed developments the catchment will be need to be subdivided and a separate assessment undertaken for each subcatchment.

6.4 Groundwater Risk Assessment

6.4.1 Introduction

This section provides background information on the risk assessment process. The objective of the assessment should be to demonstrate that the proposed surface water system is acceptable in terms of the risk to surface water and groundwater.

The hazard and risk to groundwater from surface water runoff are described in Section 5. In summary the risk to groundwater will be a function of:

- activities within the catchment that could result in contamination of surface water run-off
- design of surface water system (including treatment) and whether surface water will infiltrate to the groundwater or be discharged to a surface water body.
- vulnerability of groundwater.

The assessment will be based on the prior investigation requirements of the GWR98, with the objective of determining whether there could be a discharge of List I substances to groundwater or pollution of groundwater by List II substances.

The assessment of risk should follow a phased or tiered approach as follows (as described in DETR *et al.* 2000):

- Tier 1 risk screening or generic assessment based on land use in surface water catchment, aquifer vulnerability status and proximity to water supply. Sites not passed by this tier move to Tier 2 unless the applicant incorporates an acceptable level of treatment of surface water prior to discharge to the ground. *This assessment should allow proposals with potential minimal impact on groundwater to be assessed quickly and easily.*
- Tier 2 generic quantitative risk assessment: Quantitative assessment using generic (conservative) data for discharges to ground that may pose a higher level of risk due to the sensitivity of the location and / or contaminant loading. Sites not passed by this tier move to Tier 3 unless the applicant incorporates an acceptable level of treatment of surface water prior to discharge to the ground.
- Tier 3 detailed quantitative risk assessment: Quantitative assessment using site specific data for discharges to ground. This tier of assessment is only likely to be required for the most sensitivity sites and it is not anticipated that this level of assessment will be required in many situations.

NB. The onus would be upon the applicant to provide any necessary independent surveys and analysis for Tier 2 and 3 assessments and in most cases the applicant is likely to need to engage specialist consultants, although in most cases this task should not be onerous.

The scope of the risk assessment (including requirement for site-specific information), particularly for Tiers 2 and 3, should be agreed with the Environment Agency.

The assessment of risks should be undertaken using site-specific information obtained by the applicant, published sources (e.g. geological maps, groundwater vulnerability maps) and upon information and the local knowledge of the Environment Agency.

The assessment process may be iterative, the applicant will identify their preferred option, but following risk assessment and consultation with the Environment Agency then modifications may be required (including addition of treatment schemes or devices) or an alternative system or location identified.

6.4.2 Tier 1 Risk screening or generic assessment

Existing guidance (Environment Agency PPPG 1998; CIRIA, 2000) on the acceptability of the infiltration of surface water run-off to the ground is based on a risk screening (qualitative assessment) approach, based on the land use in the catchment, the aquifer type and groundwater protection zone status (Section 3.3 and 3.4).

The CoP should describe how risk screening should be undertaken. A matrix to assist this assessment is presented in Table 5 (based on the National SUDS Working Group, Draft Framework for SUDS in England and Wales (2003)). This table should be used to determine whether:

- the proposed drainage scheme is acceptable
- the proposed drainage scheme is acceptable, subject to implementation of additional treatment
- further assessment is required (Tier 2) before acceptance or rejection of the scheme
- the scheme is unacceptable and an alternative scheme needs to be proposed.

This assessment is based on:

- land use within the catchment. This assessment is based on the likely quality of surface water draining different catchment areas. For some catchments there may be a number of different land use types, such that the catchment will need to be broken down into sub catchments and a separate assessment undertaken for each. Dependent on the outcome of the risk assessment it may be necessary to design and construct a separate drainage system for some sub catchments.
- aquifer type (major, minor or non-aquifer). *Note the definition of aquifer type may change with implementation of the Water Framework Directive*
- type of surface water drainage system and whether infiltration to groundwater will occur (either directly or indirectly). The infiltration area will need to be defined. The design of the drainage system and area of infiltration will be an iterative process in response to the risk assessment
- infiltration characteristics of strata. The applicant should have determined from percolation tests that infiltration is possible particularly for poorly permeable aquifers (formerly non-aquifer) (see BRE, 1991) for guidance on conducting tests and number of tests required)
- depth to water table (thickness of unsaturated zone). Shallow water tables will need a higher level of protection than aquifers where the water table is at depth and, in some cases, a discharge to the ground will be unacceptable. This will involve some qualitative assessment of the depth to the water table.
- nature of underlying strata and in particular whether the ground is highly permeable or fissures are present
- potential for flooding (and subsequent mobilisation of contaminants)
- likely operation and maintenance requirements. Will maintenance depend upon the use of pesticides? Is access provided for maintenance activities? Are maintenance schedules realistic given the intended use of the site?
- location of source protection zone status (Zone I, Zone II) or distance (<50m) to a private groundwater abstraction.

The Tier 1 assessment is based largely on information that will be required as the basis for the design of a surface water drainage system. As a result, information gathering and assessment by the designer/site developer is anticipated to require little additional effort. However, it should be emphasised that responsibility for information gathering and assessment will rest with the applicant.

Table 5 Source hazard assessment for SUDS to determine whether the requirement for an authorisation for the discharge may be relaxed[1] [2] (taken from Framework for sustainable drainage systems in England and Wales. National SUDS Working Group, 2003).

Source (catchment)[3]	Requirement for Authorisation
Roof drainage	Not normally required – provided it is via a sealed system[4]
Residential area, amenity area	Not normally required, provided discharge is not direct to soakaway[5] and in accordance with good practice
Car park	Not normally required – if properly constructed (ie in accordance with CIRIA C522, this document, and good practice)
Lorry park, garage forecourt -outside canopy	Required
Local roads	Not normally required - but if necessary to prevent listed substances entering or polluting groundwater or polluting surface waters the Environment Agency will serve notice to control the discharge
Major road[6]	Not normally required – but if necessary to prevent listed substances entering or polluting groundwater the Environment Agency will serve notice to control the discharge
Industrial site, major commercial site	Required
Surface water sewer	Required

Notes:

[1] For general guidance only – individual circumstances may vary depending on specific activities in the catchment of the SUDS.

[2] It is assumed that no treatment is included (such as oil separators, wetlands or reed beds).

[3] Source (catchment) areas are taken from CIRIA C522 – "Design manual"

[4] Sealed system for roof drainage means downpipes are cemented in or otherwise sealed at ground level and do not discharge to an opening to the drain.

[5] Soakaway in this context means a point source structure designed for direct discharge of drainage to ground (direct discharge to groundwater is strongly discouraged).

[6] The Environment Agency has a duty to control the discharge of road drainage by serving a notice under Section 86 of the WRA 1991 if it is necessary to do so for the purpose of: (i) preventing the introduction of List I substances into groundwater; or (ii) pollution of groundwater by List II substances; or (iii) pollution of surface water. (Groundwater Regulations 1998 Regulation 4(4) and 5(3) and WRA 1991 S86(1)). The Agency will generally only serve such a notice where it considers that the pollution risk is too great.

This initial assessment takes no account of the volume of water that will be discharged to the ground. The CoP should stress that the design should not result in a hydraulic overloading of the infiltration device and that further assessment may be required where infiltration tests indicate a high permeability for the ground. The CoP should allow for hybrid systems, which incorporate infiltration devices with overflows to conventional piped systems.

It should be emphasised in the CoP that this represents a qualitative risk assessment and the Environment Agency should be consulted to confirm its findings.

If the risk is deemed to be acceptable then no further assessment is required. If the risk is not acceptable, following a Tier 1 assessment, then a more detailed Tier 2 assessment may be required.

6.4.3 Tier 2 and 3 quantitative assessments

The objective of a Tier 2 assessment is to undertake a generic quantitative assessment of the risk to groundwater of schemes that are passed on from Tier 1. This tier of assessment will require the use of generic data available publicly or from the Environment Agency and possibly supported with limited site specific data. The assessment may make use of analytical solutions to pollution fate and transport equations or spreadsheet solutions (semi-analytical) such as the Environment Agency's P20 approach (Environment Agency, 1999).

Tier 3 risk assessments may be required where further detailed assessment of risk is necessary in order for discharges to be demonstrated as compliant. This level of assessment is likely to require the collection of additional site investigation data to support more site specific assessments using the Environment Agency's P20 approach or more sophisticated quantitative risk assessment using numerical computer modelling.

Tier 2 and 3 assessments should include an assessment of the risk of List I substances reaching groundwater and/or of the potential concentrations of List II substances polluting groundwater based on:

- estimation of travel times (residence) in the unsaturated zone
- estimation of dilution by groundwater flow below the site
- estimate of the effectiveness of attenuation processes in the unsaturated and saturated zone (such as degradation, sorption) in reducing contaminant concentrations to acceptable levels.

The assessment will need to define the contaminant loading based on the estimated volume of surface water to be discharged to the ground and the potential concentration of any contaminants. The hydraulic loading can be derived based on existing guidance, such as CIRIA (2000). Contaminant concentrations will need to be determined based on literature data or from sampling of runoff from similar catchments. The assessment should be undertaken based an event mean contaminant concentration (see Section 3.5) or long-term average. DMRB (1998) suggests that groundwater quality is more influenced by annual averages than peak concentrations and gives a table of likely water quality (dependent on traffic volume) and also includes a method for calculating serious accidental spillage probability.

In addition, the assessment may also need to consider the potential impact of releases of contaminants from specific events (accidents) and the effectiveness of the surface water drainage design in preventing these releases entering the surface water drainage system or groundwater.

The method of assessment and the information required will be determined on a site-specific basis. They will be dependent on the size and type of surface water drainage system; the type of potential contaminants and loading; the hydrology and hydrogeology of the catchment and the sensitivity of the groundwater and surface water receptors. The Environment Agency should be consulted to agree the scope of the risk assessment and where necessary specialist consultants should be appointed by the developer.

Guidance on the selection of risk assessment tool/method and the assessment of discharges to ground is given in (Environment Agency, 2001a and 2001b).

Examples of the information that may be required, in addition to that required for Tier 1, is given below (but will vary according to the site):

- total flow rates (based on climate, surface water catchment area). CIRIA (2000) provides guidance on the estimation of flow volumes
- assessment of soil type and thickness
- measured depth to water table (allowing for seasonal variations) and therefore thickness of the unsaturated zone
- hydraulic properties of the unsaturated and saturated zone (hydraulic conductivity) and the nature of unsaturated zone flow (e.g. fractured, karstic (limestone) or intergranular)
- physio-chemical properties of the unsaturated and saturated zones (such as fraction of organic carbon, cation exchange capacity, clay content)
- geology (geological units)
- hydrogeology (location of aquifers and aquitards, vertical and horizontal hydraulic gradient, nature of flow (fissure or intergranular)
- direction of saturated groundwater flow (and hence possible receptors)
- available dilution in the saturated zone based on aquifer thickness, hydraulic conductivity, width of infiltration zone and mixing zone thickness
- local groundwater quality (to evaluate dilution capacity available)
- quality of water discharged from surface water drainage system

Additional information may be available to the Environment Agency (Table 4) from internal sources (e.g. monitoring boreholes) and from published, but not widely held, information such as geological and hydrogeological maps. This information should be identified as part of the consultation process with the Environment Agency.

6.4.4 Additional risk factors

Additional issues that will need to be addressed as part of the risk assessment are:

- whether the proposed surface water drainage system will result in the accumulation of potentially contaminated materials (due to settlement, filtration and/or adsorption of particulates) and whether this will form a secondary source of surface water and groundwater contamination. The assessment may identify that additional measures may be required including routine removal of the accumulated material or the incorporation of measures to prevent infiltration to the ground of material draining through these deposits (e.g. impermeable lining systems)
- whether the ground underlying the site is contaminated and, if so, will infiltration to the ground result in leaching/mobilisation of contaminants with the consequent risk of contamination of groundwater. Information will need to be obtained as part of the assessment, to determine whether there is contamination (based on the site history) and to identify the need to undertake investigations to determine the degree and extent of any contamination. In this case a further risk assessment will need to be undertaken to determine whether this contamination poses a risk to groundwater and if so how the surface water drainage design should be modified, including relocation of infiltration areas or incorporation of measures to prevent infiltration to the ground.

6.4.5 Regulatory assessment

Advice on the risk to groundwater will, in most cases, be provided by the Environment Agency who are a statutory consultee on many planning applications. The CoP should encourage the applicant and Local Authorities to consult the Environment Agency to:

- determine the need and scope of any risk assessment
- agree information that should be used in the assessment
- agree whether the proposed scheme is acceptable (subject to any additional requirements) or whether an alternative scheme needs to be proposed.
- determine the need for a Discharge Consent or other authorisation

6.4.6 Initial assessment by the applicant

The CoP should encourage the developer/applicant to undertake drainage impact assessments, which the groundwater risk assessment would form a part of, at an early stage as this may:

- allow unsuitable sites for the infiltration of water to be screened out and the need for an alternative design to be identified
- ensure an appropriate surface water drainage system is selected, with an appropriate level of treatment
- allow the developer to identify possible changes in the location and design of the system which may improve the likelihood of obtaining permission
- ensure that the appropriate information is provided with the application
- identify the need for consultation with the Environment Agency
- save time and cost (for all parties) by avoiding the need to undertake further investigation, modify the design, resubmit the application
- identify mitigating measures (e.g. treatment) to be incorporated in the design.

The applicant should obtain the necessary information for the risk assessment. This information will also need to be used in the design of the surface water drainage system.

6.4.7 Recommendations for research

It is recommended that research be undertaken to determine the risk that accumulated sediment within surface water drainage systems poses for different land use areas.

Notes for CoP
The CoP should detail the information that the applicant will need to provide for a groundwater risk assessment and describe briefly how this assessment should be undertaken, with reference to existing Environment Agency guidance.

A worked example in the CoP could be used to help show that risk assessment does not have to be onerous.

The potential benefits of undertaking a drainage impact assessment should be set out.

It would also be useful for the CoP to have a simple checklist of questions that would form the basis of a generic risk assessment.

6.5 Detailed design

6.5.1 Introduction

Detailed design will be required prior to construction of the system and to obtain Building Control approval.

With regard to pollution prevention, the design will need to consider:

- the management of clean and dirty (contaminated) water
- pollution prevention measures
- treatment of contaminated water.

The design of surface water treatment systems is covered by a range of existing guidance, including CIRIA (2000). The main factors that should be considered in the design to protect groundwater are identified below. In particular, the GWR98 requirement that the there will not be any discharge of List I substances into groundwater or pollution of groundwater by List II substances.

Infiltration systems should be designed to prevent a direct discharge of surface water at the water table and the CoP should recommend against the use of borehole soakaways.

6.5.2 Hydraulic control

Infiltration system design should be based on the results of percolation/infiltration tests (BRE, 1991) and the results of a risk assessment. The main factors that need to be addressed are:

- area required for infiltration of surface water flows
- requirement for storage capacity to deal with storm flows
- the surface water flow should not result in exceedance of the hydraulic capacity of the infiltration device (design storage and infiltration capacity) except where overflows are provided (hybrid systems).
- need to incorporate pollution prevention or treatment measures (see below).

Where infiltration tests indicate a high permeability (and therefore high discharge rates), then a risk assessment may have identified that the rate of infiltration permitted by the drainage system may need to be limited to prevent rapid transport of potentially contaminated water through the unsaturated zone with limited attenuation.

Where infiltration to the ground is not acceptable, additional measures may be required to ensure no unintentional discharges to groundwater. Such measures might include: higher construction standards for pipework (e.g. sealed joints); low permeability sealing layers beneath swales and detention basins.

6.5.3 Pollution prevention

The design (and subsequent maintenance) of a surface drainage scheme should identify measures to minimise the potential for pollution (refer to Environment Agency PPG's for specific activities). Measures that can be incorporated into the design are:

- containment (e.g. bunds) to prevent potentially polluting substance reaching the drainage system
- separation of 'clean' water from 'dirty' (contaminated) water (such as routing roof run-off directly to the ground)
- access for maintenance of treatment systems / use of low maintenance systems
- minimising the volume of the water that could become contaminated (for example by placing canopies over areas of potentially high contamination)
- maintenance of the system by keeping surfaces (paved areas, roads) clean by sweeping (Section 7.1.4)
- education of site occupiers in good house keeping (Section 7.1.2)

- avoidance of wrong connections. Open surface water drainage systems limit the need for underground drains and allow any polluted discharges to be identified and corrected
- provision for emergency procedures (Section 7.1.5).

6.5.4 Treatment

Surface water drainage systems should be designed to retain the most contaminated water and to manage the flow of 'clean' water. Most drainage devices incorporate some form of treatment. The main aim of the treatment design is to ensure contaminants are removed before reaching the point of discharge (such as to ground or to a watercourse). Treatment options can include:

- source control (prevention of potentially polluting substances entering the surface water system)
- collection and removal of contaminated water
- use of oil separators
- filtration to remove particulates (by vegetation and/or soils)
- physical settlement
- biological treatment on filter media and in wetlands
- adsorption of particles on plants or filter media
- dilution by 'clean' surface water.

Further details of treatment options are given in CIRIA (2000). The majority of these systems are based on physical treatment and are unlikely to reduce the loading from dissolved contaminants. The risk assessment for the acceptability of a discharge to ground (Section 6.4) will need to take this into account.

Treatment systems that involve settlement, filtration or adsorption of particulates may result in the accumulation of potentially contaminated material, which may provide a secondary source for groundwater and surface contamination. The design of the scheme should consider:

- whether this material represents an unacceptable risk to groundwater (refer to Section 6.4)
- whether this material should be routinely removed as part of maintenance of the system
- whether this material will need to be sampled to confirm that levels of contamination are acceptable or to determine the waste classification for this material prior to disposal.

The design of infiltration systems should also seek to optimise the potential for treatment of surface water infiltrating through the soil and the unsaturated zone.

There is limited guidance on the design of infiltration systems in terms of additional treatment measures that could be incorporated into the design where there is likely to be direct or indirect infiltration to the ground. The degree of treatment of surface water that infiltrates into the ground is qualitatively assessed in Section 6.4, but the design should consider the following:

- hydraulic capacity of the infiltration device (soakaway, infiltration trench) and underlying strata and that this will not be overloaded by surface drainage leading to reduced residence times (BRE 1991, CIRIA 1996, Highways Agency, 1998 provide guidance on the design of soakaways)
- the area of the base and sides of the infiltration device with the objective of distributing the contaminant loading over a greater area
- thickness and physical and chemical properties of the materials used to construct the infiltration device

- thickness of the unsaturated zone. Minimising disturbance of soil and subsoil, or replacing natural material with media with a higher attenuation capacity (for example soils will have a significantly greater attenuation potential than the underlying strata).

These factors may influence the location of the infiltration device, selection and design of device. For example shallow infiltration devices (such as infiltration basins) may be a preferred option to soakaways.

6.6 Consenting and approval

Prior to construction, surface water drainage systems will need:

- planning permission (unless exempt under the GDPO 1995)
- Building Control Approval (followed by inspection during construction).

Although design and operation of a surface water drainage system under a CoP will often be sufficient, some drainage systems will need a Discharge Consents or GWR98 authorisation for the point of discharge. Guidance on where Discharge Consents are likely to be required is given in the Environment Agency's PPPG (1998), matrix 3c. However, this document pre-dates the introduction of the GWR98 and therefore does not refer to GWR98 authorisations. Discharge Consents are considered to be authorisations for the purposes of the GWR98.

Guidance on where an Authorisation (but not a Discharge Consent) under the GWR98 is required is given in the Environment Agency's Groundwater Process Manual and reproduced in Table 2.

Discharge Consents and other authorisations must be applied for directly from the Environment Agency. The application will require sufficient supporting information to permit the Environment Agency to evaluate the risks to groundwater and surface water. The supporting information requirements may include a quantitative risk assessment.

The need for a Discharge Consent or other authorisation should be identified at an early stage in the design process through discussions with the Environment Agency. The type of approval required may impact on timescales and the authorisation may require incorporation of additional design measures.

All approvals must be obtained prior to the start of construction of the surface water drainage system.

6.7 Construction

Surface water systems should be constructed in accordance with the detailed design, relevant standards and to the satisfaction of Building Control. Reference should be made to CIRIA guidance on 'Control of pollution from construction sites' (CIRIA, 2001).

During the construction phase and prior to the establishment of the final surface water drainage system, temporary measures are likely to be required to prevent pollution of controlled waters or damage (e.g. by clogging) of surface water drainage systems. Some systems, particularly those that rely in part on vegetation, will require time to establish themselves and should be constructed sufficiently far in advance of the time when they will be needed.

A construction-phase surface water management plan should be drawn up in advance of the works and agreed with the relevant authorities. The surface water management plan should be strictly adhered to during the works.

Following construction, surface water drainage systems must be reinstated to remove any accumulated silt and repair any damage incurred during construction. This is standard good practice for conventional, piped systems but needs to be stressed for SUDS.

Construction should be fully documented in drawings and records, copies of which should be held at the site where possible.

7 Operation and maintenance

7.1 Operational phase

Appropriate operation and maintenance is important to the effective functioning of a surface water drainage system and in minimising the risk(s) to groundwater from the infiltration to ground of potentially contaminated surface water. These factors must be considered and their requirements determined as part of the design phase.

The GWR98 require that requisite surveillance be undertaken for an activity authorised under those regulations. Monitoring, inspection and record keeping are considered to come under the definition of requisite surveillance. To demonstrate compliance with the GWR98 the operators of surface water drainage schemes will be required to produce appropriate records. Monitoring, inspection and record keeping are important for:

- identifying potential problems with operation of the system (such as polluted water entering the drainage system, accumulation of sediments and flooding of infiltration devices)
- demonstrating compliance with CoP and GWR98
- providing a record for either the regulator or operator in the event of prosecution or a defence in the event of a pollution incident
- identifying responsibilities (ownership, maintenance, emergency response).

7.1.1 Record keeping

As surface water drainage systems are likely to be tailored to the requirements of a particular site, each system is likely to be different. Consequently it will be important to ensure that a particular system is fully documented. The CoP should recommend that a drainage manual be compiled for each site to include both foul and surface water drainage systems. The manual should be drawn up by the system designer and should include:

- construction details (materials used, date of construction, capacity, hydraulic basis for design, drawings, design life of materials / replacement schedule)
- drawings showing layout of site buildings and structures, labelled to indicate their purpose
- schematic drawings showing the location of surface water drains (marked in blue) and foul sewers (marked in red)
- a description of the purpose of the elements of the surface water drainage system
- the location of entry points to the surface water drainage system and the location of on-site and off-site discharge points (including soakaways, SUDS, discharges to surface water, sewage pumping stations, sewage treatment works)
- the identification of any bunded areas and areas where hazardous substances are stored
- the identification of any surface water treatment areas or devices
- the location of pollution control devices, shut-off points and containment areas
- maintenance requirements. Including maintenance frequencies, maintenance activities, materials / chemicals to be used
- design life / service life of the various components of the surface water drainage system
- record keeping requirements. Records should be kept of maintenance activities and repairs

- log book of emergency responses and responsibilities
- additions to systems
- emergency response procedures
- identify those responsible for the system.
- following a change of use, an assessment of whether the system is still appropriate needs to be included.

It is suggested that the CoP should encourage the use of a standard format for a drainage manual.

7.1.2 Information and education

Surface water drainage systems should be clearly marked to distinguish them from other drainage systems. Users of a site (including contractor's staff) should be made aware of the markings and their significance. The CoP should advocate the use of signs giving information on the drainage system, particularly for multi-user sites.

Site users need to be aware of the location of drainage systems (particularly where there is more than one system) at a site. They also need to be aware of emergency procedures to follow to prevent pollution entering surface water and groundwater.

Changes to a system must be recorded in the drainage manual. Where additions are made, they should be recorded at the same level of detail as for new systems. It must be clear who is responsible for the drainage system.

Site owners / operators and tenants should be aware of the good house keeping measures such as:

- maintaining the site in a clean and tidy condition
- avoidance of cross connections of drains
- appropriate disposal of potential contaminants such as car oil, antifreeze, car wash detergents, household chemicals, garden chemicals
- selection and use of chemicals and pesticides.
- those detailed in other groundwater protection codes.

Good housekeeping should be stressed in the CoP as a key component in pollution prevention.

7.1.3 Monitoring

The monitoring requirements for a surface water drainage scheme are likely to be site-specific and dependent on land use in the drainage catchment, area of the drainage catchment, type of drainage system and sensitivity of surface and groundwater risk receptors at risk.

The requirement and scope of monitoring will normally be identified at the design stage and in consultation with the Environment Agency, such that monitoring facilities can be incorporated into the design.

To demonstrate compliance with a CoP (and hence the GWR98) it is likely to be necessary to keep records of inspections, maintenance activities, servicing and emptying of separators. For low risk sites these activities are likely to constitute the principal, or only, monitoring activities. The majority of surface water drainage schemes will not require any form of water quality monitoring due to the low risk of pollution of groundwater. For large systems, or for sensitive receptors, sample analysis may be considered, although it is inherently difficult to undertake representative sampling due to the natural variability of drainage water.

Monitoring may be undertaken for a number of reasons including:

- demonstrate that the drainage system is performing in accordance with design specifications
- demonstrate that the system is being managed effectively
- demonstrate compliance with any Discharge Consents/ authorisations
- demonstrate that there is no risk of groundwater pollution.

At a basic level (for low risk sites) monitoring could include:

- record keeping of inspection and maintenance activities
- visual inspection to ensure correct functioning of the system and to identify areas of erosion, waterlogging or health of the vegetation

More involved monitoring (for higher risk sites) may include:

- measurement of surface water flows and water quality
- sampling of accumulated sediment (for chemical analysis) to determine whether this sediment poses a potential risk to groundwater and/or determine whether this material needs to be treated as contaminated material.

The results of such monitoring should be included in the surface water drainage manual and any remedial actions identified and incorporated into the operation and maintenance of the site (e.g. identify the need for corrective action).

7.1.4 Maintenance

All surface water drainage systems require regular maintenance. Maintenance is required to ensure that drainage systems continue to function, and in particular, that treatment systems continue to perform effectively. In the context of this scoping study, maintenance refers to routine activities and is distinguished from renovation or replacement of parts of the system. Higher levels of maintenance are likely to increase the service life of a system, particularly by reducing silt clogging of granular fill and retention structures. In sensitive locations higher maintenance standards may be required.

At the detailed design stage a maintenance schedule should be drawn up which details the frequency and type of maintenance required for each of the devices used. Tthese should be passed to the site owner / operator and should form part of any documentation passed to new site owners or contractors.

Advice on good practice for the maintenance of different devices are given in CIRIA (2000), DMRB (1998) and will be given in National SUDS Working Group (2003) for adopted systems.

Maintenance activities should be recorded (this may be used to show adherence to the CoP). The maintenance schedule should detail where it is not appropriate to use chemicals, such as herbicides, pesticides and cleaning products, on the site. The use of such substances should be considered at design stage and clear instructions given in the manual.

Maintenance may involve;

- inspection and removal of blockages. Systems should be inspected at suitably frequent intervals to ensure that they are functioning correctly. Inspections may involve removal of minor blockages and foreign material
- cleaning and emptying. Hard surfaces should be regularly cleaned to prevent the build up of contaminants. Separators, gully pots and silt traps require regular emptying

- grounds maintenance. Vegetated surfaces will require regular maintenance (e.g. mowing) to retain their attenuation properties and appearance. Swales and filter strips require that vegetation is maintained at a uniform short height to prevent channelling.

7.1.5 Emergency procedures

Emergencies, such as fires or spills of hazardous chemicals may, if not correctly managed, result in hazardous substances being washed into surface water drainage systems. Emergency response procedures should be drawn up to in accordance with PPG23 'Pollution incident response planning' and PPG22 'Dealing with spills on highways'.

7.1.6 Major works / renovation

Surface water drainage systems will occasionally require major works to restore their function. This may include:

- excavation and refilling of drainage material in filter trenches and soakaways
- renovation and replacement of permeable surfaces. Permeable surfaces may over time clog or become filled with silt and debris.
- desilting of ponds and detention basins.

Renovation activities, may in themselves represent a hazard to groundwater due to the disturbance of accumulated sediments and care will be needed to minimise any such contamination. During renovation, alternative drainage arrangements will need to be made and this should be dealt with in the same way as construction (see Section 6.7).

The need for renovation will depend upon a number of factors, including:

- the quality of materials used
- the design approach
- the frequency and type of maintenance (higher intensity maintenance can extend the active life of a system)
- the intensity of use (heavy traffic)

In addition, some components of a surface water drainage system may have a limited design life and these will require replacement.

7.2 Decommissioning

Surface water drainage systems may be decommissioned due to changes in drainage systems at a site, for example to accommodate additional development, or during demolition works.

Decommissioning should be undertaken carefully to ensure that no residual risk is presented to groundwater. Good practice will be to remove connections and permeable materials to prevent conveyance and infiltration of surface water drainage. Particular attention should be given to removal of entry points to the surface water drainage systems.

Section 62 of the Building Act requires that redundant drains are disconnected from the active drainage system.

In addition, deep soakaways should be decommissioned carefully following consultation with the Environment Agency. Advice is also available in the Environment Agency publication 'Decommissioning of redundant boreholes and wells',

Decommissioning should be accurately recorded.

Notes for CoP
The operation and maintenance of surface water drainage systems is important in ensuring that risks are minimised and that the GWR98 are being complied with. The CoP should emphasise the importance of:

- maintenance of all systems (even where surface water drainage is directed to surface water sewers via pipe)
- monitoring of the system as this can help in identifying problems at an early stage so that corrective action can be taken
- good house keeping as a pollution prevention measure
- recording keeping to demonstrate adherence to the CoP
- careful decommissioning

8 Considerations in developing a code of practice

8.1 Target audience

The CoP must be brought to the attention of anyone developing a site for new surface water drainage systems. In many cases compliance with the CoP will be the primary means of control to comply with the GWR98. Proposals are likely to come from a range of people and organisations, including:

- developers
- consultants
- contractors
- site owners
- trade/industry associations
- wildlife/amenity groups
- internal drainage boards

Those assessing planning applications (planners, building control, Environment Agency staff, Local Authority drainage departments) will also need to be familiar with the contents of the CoP. Manufacturers of specialist equipment who offer advice to their customers on options for drainage will also need to be aware of and understand the CoP.

Following a successful application and installation of a surface water drainage system, site owners / operators will need to ensure the system is correctly operated, maintained and monitored.

Compliance with the CoP will be required in situations where poor practice in the past has resulted in problems.

8.2 Style and type of language

The target audience may reasonably be expected to be technically proficient, able to understand technical terms regarding surface water drainage (but not necessarily groundwater) and with some knowledge of surface water drainage systems. The CoP may, therefore, be written as a reasonably technical document but at the same time accessible to a wide audience. The code must be accessible to the 'reluctant' reader. Those drafting the code should refer to, and consider, the style and language used in previously published groundwater protection codes.

8.3 Key messages

The key messages of the CoP should be:

- the importance of protecting water quality
- the importance of groundwater and groundwater protection
- the responsibilities of developers and site owners / operators and their agents
- the importance of considering groundwater protection throughout the design process
- the importance of maintenance in ensuring the performance of surface water drainage systems

- adopting good practice has the benefit of protecting the environment, can save unnecessary costs and avoids the risk of prosecution
- the need to comply with the GWR98 (and the consequences of not doing so)
- link to surface water requirements and protection
- risk assessments do not have to be onerous (a worked example would help to demonstrate this)
- the potential benefits of undertaking a drainage impact assessment

8.4 Contents and figures

A summary of the proposed contents of the code of practice is given in Appendix 1.

9 Glossary of terms

Proposed list of terms for inclusion in glossary.

Reference should also be made to the glossary included in the National SUDS Working Group Framework for SUDS in England and Wales (2003).

direct discharge
Discharge Consent
groundwater
indirect discharge
pollution
prior investigation
requisite surveillance of groundwater
saturated zone
soakaway
unsaturated zone
water table
List I and List II substances
Attenuation of 1) Pollution 2) Flow

10 List of abbreviations

AADT	Annual average daily traffic
EMC	Event mean concentration
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
GDPO	General Permitted Development Order
GWR98	Groundwater Regulations, 1998
HOST	Hydrology of Soil Types (IoH, 1995)
MTBE	methyl-tert-butyl ether
ODPM	Office of the Deputy Prime Minister
PPG	Planning Policy Guidance (ODPM)
PPG	Pollution Prevention Guidelines (Environment Agency)
PPPG	Policy and Practice for the Protection of Groundwater
SPZ	Source Protection Zone
SSAFO	Silage, Slurry and Agricultural Fuel Oil Regulations 1991 as amended 1997
SUDS	Sustainable drainage system
TAME	tertiary-amyl-methyl ether
WFD	Water Framework Directive
WRA91	Water Resources Act, 1991
WRAP	Winter rainfall acceptance potential

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PPG2 'Above ground oil storage tanks'

PPG3 'The use and design of oil separators'.

PPG5 'Works in near or liable to affect watercourses'

PPG9 'The prevention of pollution of controlled waters by pesticides'

PPG11 'Preventing pollution on industrial sites'

PPG15 'Retail stores'

PPG17 'Dairies and other milk handling operations'

PPG18 'Control of spillages and fire-fighting run-off

PPG19 'Garages and vehicle service centres'

PPG21 'Pollution incident response planning'

PPG22 'Dealing with spillages on highways'

(All Pollution Prevention Guidelines are available by calling Direct marketing services on 08457 337700 or by e-mail to environment-agency@DMSLTD.co.uk)

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Appendix 1 List of potential consultees

A large number of organisations are likely to have an interest in any requirements relating to planning, designing, constructing and maintaining surface water drainage systems to protect of groundwater. This appendix lists organisations that represent those organisations and are therefore potential consultees for a CoP for surface water drainage.

Sewerage Undertakers

Water UK
1 Queen Anne's Gate
London
SW1H 9BT
Tel: 020 7344 1827/1811
(www.water.org.uk)

Note: some sewerage undertakers are not members of Water UK

Construction Industry

Construction Industry Council (CIC)
CIC, 26 Store Street, London, WC1E 7BT.
Tel: 0171 637 8692
Fax: 0207 580 6140
(www.cic.org.uk)

House Builders Federation
56-64 Leonard Street
London EC2A 4JX
Tel: 020 7608 5100
Fax: 020 7608 5101
www.hbf.co.uk

Federation of Master Builders
Gordon Fisher House
14-15 Great James Street
London
WC1N 3DP
Tel: 020 7242 7583
Fax: 020 7404 0296
(www.fmb.org.uk)

National House-Building Council
NHBC registered office:
Buildmark House,
Chiltern Avenue,
Amersham,
Bucks
HP6 5A
01494 735363
(nhbc.co.uk)

Construction Confederation
56-64 Leonard Street
London
EC2A 4JX
Tel: 020 7608 5100

Learned Societies

The Institution of Civil Engineers,
One Great George Street,
Westminster,
London
SW1P 3AA
United Kingdom
Tel 0207 222 7722
Fax 0207 222 7500
(www.ice.org.uk)

The Geological Society
Burlington House
Piccadilly
London W1J 0BG
Tel: 020 7434 9944
Fax: 020 7439 8975
(www.geol-soc.org.uk)

Chartered Institute of Water and Environmental Management (CIWEM)
15 John Street
London WC1N 2EB
Tel: 020 7831 3110
Fax: 020 7405 4967
(www.ciwem.org.uk)

Royal Institution of British Architects
66 Portland Place,
London W1B 1AD
Tel: 020 7580 5533
Fax 020 7255 1541
(www.architecture.com)

The Landscape Institute
6-8 Barnard Mews
London SW11 1QU
Tel: 020 7350 5200
Fax: 020 7350 5201

Construction Industry Research and Information Association (CIRIA)
6 Storey's Gate,
London SW1P 3AU,
Tel: 020 7222 8891
Fax: 020 7222 1708
(www.ciria.org)

Maintenance

British Institute of Facilities Management
67 High Street
Saffron Walden
Essex CB10 1AA
Telephone: 01799 508608
Facsimile: 01799 513237
(www.bifm.org.uk)

Local Authority
Local Government Association,
35 Great Smith Street,
London,
SW1P 3BJ.
Tel: 0207-664-3022
Fax: 0207-664-3008

Planners

The Royal Town Planning Institute (RTPI)
41 Botolph Lane
London EC3R 8DL
Telephone: 020 7929 9494
Main Fax: 020 7929 9490
www.rtpi.org.uk

Planning Officers Society (no fixed address)

Building Control

Local Authority Building Control
LABC Services
137 Lupus Street
London
SW1V 3HE
Tel: 020 7641 8737
Fax: 020 7641 8739
(www.labc.co.uk)

Royal Institute of Chartered Surveyors (RICS)
Head Office
12 Great George Street
Parliament Square
London
SW1P 3AD
United Kingdom
020 7222 7000
www.rics.org.uk

Association of Consultant Approved Inspectors (ACAI)
www.acai.org.uk

Association of Building Engineers (ABE)
Lutyens House
Billing Brook Road
Weston Favell
Northampton
NN3 8NW
Tel: 01604 404121
Fax: 01604 784220
www.abe.org.uk

Government departments, agencies and committees

Environment Agency
Rio House
Waterside Drive
Aztec West
Bristol
BS32 4UD
(www.environment-agency.gov.uk)
Tel: 01454 624400
Fax: 01454 624409

Scottish Environment Protection Agency (SEPA)
Eskine Court
The Castle Business Park
Stirling
FK9 4TR
Tel: 01786 457700
Fax: 01786 446885
(www.sepa.org.uk)

Environment and Heritage Service, Northern Ireland (EHS NI).
Calvert House
23 Castle Place
Belfast
BT1 1FY
Tel: 028 9025 7700
Fax: 028 9025 4700
(www.ehsni.gov.uk)

Highways Agency
Romney House,
43 Marsham Street,
LONDON, SW1P 3HW
Tel: 08459 556575
(www.highways.gov.uk)

Office for the Deputy Prime Minister (ODPM)
26 Whitehall
London
SW1A 2WH
Tel: 020 7944 4400
(www.odpm.gov.uk)

Department for Transport (DfT)
Department for Transport
Great Minster House
76 Marsham Street
London SW1P 4DR
Tel: 020 7944 8300
(www.dft.gov.uk)

Property Owners

British Retail Consortium
Second Floor,
21 Dartmouth Street,
London
SW1H 9BP
Tel. 020 7854 8900
Fax. 020 7854 8901
(www.brc.org.u)

Association of British Insurers
51 Gresham Street,
London,
EC2V 7HQ
Tel: 020 7600 3333
Fax: 020 7696 8999

The Welcome Break Group Ltd
2 Vantage Court
Tickford,
Newport Pagnel
MK16 9EZ
Tel: 01908 299700
Fax: 01908 299888
(www.welcomebreak.co.uk)

Moto
Head Office
PO Box 218
Toddington
Bedfordshire
LU5 6HR
Tel: 01525 878400
Fax: 01525 878411
(www.moto-way.com)

Other owners of commercial property, e.g. English Partnerships and Regional Development Agencies

Appendix 2 Proposed table of contents for the Code of Practice (CoP)

1. The purpose of the code

Why a code?

The Groundwater Regulations

Other legislation

Context [flooding, water quality]

What the code covers (including exclusions)

How to use the code

Other guidance

2. Using the code

Overview

Definition of surface water drainage

[this section should describe the principal surface water drainage systems and SUDS systems]

Key elements to ensure groundwater protection

Hazard (Source)

- General description
- List I and List II Substances

Risks to groundwater

- Pathways for pollution
- Pollution receptors

3. Control of risk to groundwater - new systems

The need for control

Overview of process for being exempt

Responsibilities

- [this section should detail the responsibilities of the applicant, planners, Building Control and the Environment Agency]

Design

- [to cover assessment of options; sizing and siting]

Investigation

- [inspection, intrusive investigation and percolation tests]

Application

Assessment

- Applicant
- Planning
- Building control
- Statutory consultees
- Result

Consenting and approval

- Types of consent

Responsibilities

Appeal

Installation

Materials

Installation

Inspection

Commissioning

4. Operating surface water drainage to minimise risks to groundwater

[note: this refers to existing and new systems]

The need for control

Operations Manual

Responsibilities

Operators

Regulators

Monitoring

Maintenance

Routine

Renovation

5. Decommissioning

Additional information sources

Glossary

Bibliography

Figures

Illustration of surface water drainage devices

Flow diagram of regulatory process

Illustration of potential routes for groundwater pollution (cross-sections for a range of scenarios including):

proximity to stream or borehole

high water table

low permeability ground (i.e. poor drainage)

fissured rock and rapid pathways

Illustration of how poor maintenance can lead to problems.

We welcome views from our users, stakeholders and the public, including comments about the content and presentation of this report. If you are happy with our service, please tell us about it. It helps us to identify good practice and rewards our staff. If you are unhappy with our service, please let us know how we can improve it.

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CONTACTS:

ENVIRONMENT AGENCY HEAD OFFICE

Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS32 4UD
Tel: 01454 624 400 Fax: 01454 624 409

www.environment-agency.gov.uk
www.environment-agency.wales.gov.uk

NATIONAL GROUNDWATER & CONTAMINATED LAND CENTRE

Olton Court, 10 Warwick Road, Olton, Solihull B92 7HX
Tel: 0121 711 5885 Fax: 0121 711 5925 Email: ngwclc@environment-agency.gov.uk

ENVIRONMENT AGENCY REGIONAL OFFICES

ANGLIAN
Kingfisher House
Goldhay Way
Orton Goldhay
Peterborough PE2 5ZR
Tel: 01733 371 811
Fax: 01733 231 840

MIDLANDS
Sapphire East
550 Streetsbrook Road
Solihull B91 1QT
Tel: 0121 711 2324
Fax: 0121 711 5824

NORTH EAST
Rivers House
21 Park Square South
Leeds LS1 2QG
Tel: 0113 244 0191
Fax: 0113 246 1889

NORTH WEST
PO Box 12
Richard Fairclough House
Knutsford Road
Warrington WA4 1HG
Tel: 01925 653 999
Fax: 01925 415 961

SOUTHERN
Guildbourne House
Chatsworth Road
Worthing
West Sussex BN11 1LD
Tel: 01903 832 000
Fax: 01903 821 832

SOUTH WEST
Manley House
Kestrel Way
Exeter EX2 7LQ
Tel: 01392 444 000
Fax: 01392 444 238

THAMES
Kings Meadow House
Kings Meadow Road
Reading RG1 8DQ
Tel: 0118 953 5000
Fax: 0118 950 0388

WALES
Rivers House/Plas-yr-Afon
St Mellons Business Park
Fortran Road
St Mellons
Cardiff CF3 0EY
Tel: 029 2077 0088
Fax: 029 2079 8555

Please note

The new contact details of:

The Regional Welsh Office is:
29 Newport Road, Cardiff CF24 0TP.
Tel: 029 2077 0088
Fax: 029 2079 8555

The National Groundwater and Contaminated Land Centre.
Tel: 0121 708 4714
Fax: 0121 708 4637

ENVIRONMENT AGENCY
GENERAL ENQUIRY LINE
0845 9 333 111

ENVIRONMENT AGENCY
FLOODLINE
0845 988 1188

ENVIRONMENT AGENCY
EMERGENCY HOTLINE
0800 80 70 60

ENVIRONMENT AGENCY