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Sustainable Drainage Systems (SUDS)

a guide for developers

ENVIRONMENT AGENCY

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It's our job to make sure that air, land and water are looked after by everyone in today's society, so that tomorrow's generations inherit a cleaner, healthier world.

Our work includes tackling flooding and pollution incidents, reducing industry's impacts on the environment, cleaning up rivers, coastal waters and contaminated land, and improving wildlife habitats.

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Surface water run-off

The problem

Development can harm our water resources if a traditional approach to drainage is adopted. Removing water from the site as quickly as possible causes a range of impacts:

- increased run-off resulting from more extensive hard paving and roofing can increase the risk of flooding downstream, as well as causing sudden rises in water levels and flow rates as the water is discharged into watercourses;
- surface water run-off can contain contaminants such as oil, organic matter and toxic metals. Although often at low levels, cumulatively they can result in poor water quality in rivers and streams, adversely affecting biodiversity and amenity value. After heavy rain, the first flush is often highly polluting;

- by diverting rainfall to piped systems, the amount of water infiltrating the ground is reduced, depleting ground water and reducing flows in watercourses in dry weather.

As a result, many urban watercourses are lifeless and unattractive, and are often hidden in culverts under the ground. Some pollution arising from urban run-off may be unavoidable, and water treatment at every outfall may be impractical. However, by moderating flows and filtering run-off, Sustainable Drainage Systems (SUDS) can deliver not only significant reductions in impacts on our water resources, but also improvements in the quality of our built environment.

Towards sustainable development

SUDS (Sustainable Drainage Systems) are designed with three objectives in mind:

- to control the quantity of run-off from a development;
- to improve the quality of the run-off ;
- to enhance the nature conservation, landscape and amenity value of the site and its surroundings.

SUDS deal with run-off as close to its source as possible and balance all three objectives, rather than focussing only on flood prevention.

Implementing SUDS contributes significantly towards achieving sustainable development. In recognition of this, Local Plans increasingly state that all applicants should, in the first instance, aim to incorporate SUDS into development proposals. SUDS are also considered suitable for mitigating adverse impacts and supporting water-conservation objectives.

SUDS - the benefits

Implementing SUDS may lead to cost savings, for example, by avoiding or reducing the need for:

- gully pots;
- constructing or requisitioning surface water sewers;
- piped connections to distant outfalls.

SUDS can be cost-effectively designed to work with retained natural features such as ditches or ponds, and to form an integral part of hard and soft landscaped areas. In this way, they can contribute towards an attractive scheme that enhances the nature conservation and amenity value of the development, while also recycling the valuable water resource.

SUDS and the planning process

SUDS include tried-and-tested techniques that are already being implemented on a range of projects in England and Wales as well as elsewhere. They incorporate cost-effective techniques that are applicable to a wide range of schemes, from small developments to major residential, leisure, commercial or industrial operations with large areas of hardstanding and roof. They can also be successfully retro-fitted to existing developments. Planning Policy Guidance Note 25 for England on development and flood risk emphasises the role of SUDS and introduces a general presumption that they will be used. SUDS will probably feature increasingly in such guidance documents as they are revised.

As with other key considerations in the planning process — transport, landscape, heritage and nature conservation — incorporating SUDS needs to be considered early in the site evaluation and planning process, as well as at the detailed design stage.

Many planning authorities will expect planning applications, whether outline or detailed, to demonstrate how a more sustainable approach to drainage is to be incorporated into development proposals, and for detailed design information to be submitted at the appropriate stage. Planning authorities may use planning conditions to secure the implementation of SUDS.

Adoption and future maintenance

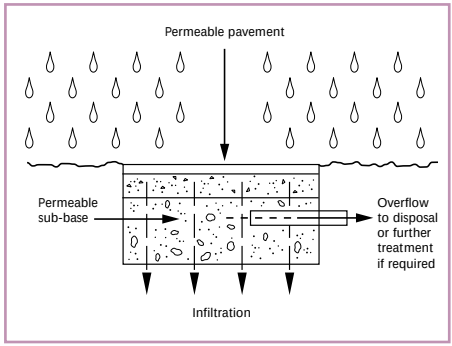
In the early stages of design, consideration should be given to the arrangements for adoption and future maintenance of the system. This is likely to influence the design just as much as technical considerations. It is recommended that maintenance should be the responsibility of a publicly accountable body, which will often necessitate the payment of a commuted sum or a legal agreement, possibly backed up by the deposit of a financial bond. The adopting organisation should approve the design before construction.

Sustainable Drainage Systems (SUDS)

Sustainable drainage is a design philosophy that uses a range of techniques to manage surface water as close to its source as possible. To produce a workable and effective scheme, SUDS must be incorporated into developments at the earliest site-planning stage.

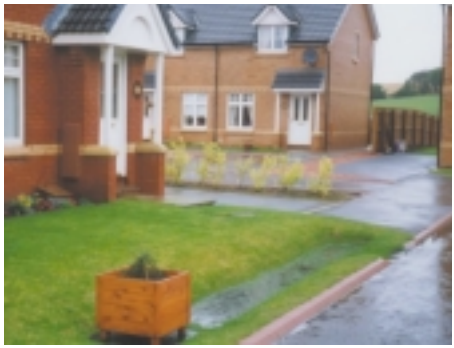
Permeable pavements

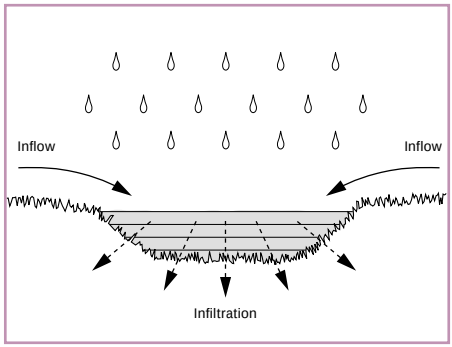
The need for surface water drains and off-site sewers can be reduced or eliminated where run-off is encouraged to permeate through a porous pavement, such as permeable concrete blocks, crushed stone and porous asphalt. Depending on the ground conditions, the water may infiltrate directly into the subsoil or be stored in an underground reservoir (for example, a crushed stone layer) before slowly soaking into the ground. If infiltration is not possible or appropriate (for example, because of ground contamination), an impermeable membrane can be used with an overflow to keep the pavement free from water in all conditions. Pollutant removal occurs either within the surfacing or sub-base material itself, or by the filtering action of the reservoir or subsoil.



Swales and basins

These can be created as features within the landscaped areas of the site, or they can be incorporated into ornamental, amenity and screen-planted areas where they would be looked after as part of the normal maintenance contract. They provide temporary storage for storm water, reduce peak flows to receiving waters, facilitate the filtration of pollutants (deposited and incorporated into the substrate) and encourage microbial decomposition, as well as allowing water infiltration directly into the ground. Swales and basins are often installed as part of a drainage network connecting to a pond or wetland, prior to discharge to a natural watercourse. They may be installed alongside roads to replace conventional kerbs, therefore saving construction and maintenance costs.



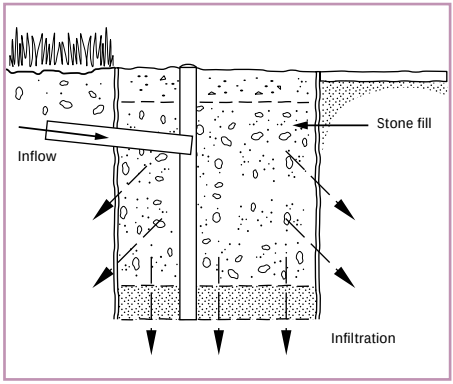


Green roofs and rainwater reuse

Other techniques which reduce flow rates and improve water quality include green roofs and rainwater reuse. Green roofs can reduce the peak flow and the total volume discharged and improve water quality. In addition, they can improve insulation and increase the lifespan of the roof. Rainwater reuse (or harvesting) involves the collection of the rainwater on site and its use as a substitute for mains water, for example in watering a garden or for flushing toilets.

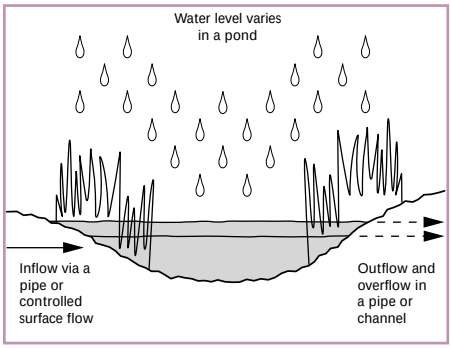
Infiltration trenches and filter drains

Infiltration trenches comprise stone-filled reservoirs to which stormwater run-off is diverted, and from which the water gradually infiltrates into the ground. Their longevity is enhanced by incorporating a filter strip, gully or sump pit to remove excessive solids at the inflow. Widely used by highway authorities for draining roads, filter drains are similar structures through which a perforated pipe runs. This facilitates the storage, filtering and some infiltration of water passing from the source to the discharge point. Pollutants are removed by absorption, filtering and microbial decomposition in the surrounding soil. Systems can be designed to successfully incorporate both infiltration and filter systems.



Ponds and wetlands

Although these can be designed as wet or dry ponds, or wetlands, they are most likely to contribute to visual amenity and biodiversity where they include a permanent water body. Ponds or wetlands can be designed to accommodate considerable variations in water levels during storms, thereby enhancing flood-storage capacity. By allowing adequate detention time, the level of solids removal can be significant. The algae and plants of wetlands provide a particularly good level of filtering and nutrient removal, as well as being able to recycle grey water. Ponds and wetlands can be fed by swales, filter drains or piped systems, and the use of silt traps is recommended to reduce sedimentation.



SUDS on brownfield sites

Where there is a risk of environmental damage from land contamination, the use of infiltration-based solutions requires careful thought. The focus must be to avoid mobilisation of contaminants.

SUDS during construction

The early implementation of appropriate SUDS techniques can prevent the pollution of watercourses during construction. However, it is essential that suitable measures are taken to either protect SUDS systems from siltation during construction or to restore them before the site is occupied.

Choosing the right SUDS system

The choice of SUDS system will depend on a number of factors such as:

- the pollutants present in run-off;
- the size of and drainage strategy for the catchment area;
- the hydrology of the area and infiltration rate of the soil;
- Groundwater Source Protection Zones or contaminated land.

Large-scale ponds and wetlands are generally more appropriate for sites larger than 5ha. Infiltration trenches, swales, filter strips and porous pavements are suitable for both large and small sites. The best drainage solution for a site will often incorporate a mix of mechanisms.

Soil permeability and hydrology

Soil permeability can have a significant effect on selecting SUDS mechanisms. Infiltration techniques may not be effective if the infiltration rate is below 10mm/hr for the upper soil layers. Swales and ponds, working by a combination of filtration and infiltration, are more tolerant of poor soils. In highly permeable soils, wet ponds need to be lined. SUDS must be designed to avoid discharge to old mine workings where they exist.

It is important for developers to establish the soil conditions and hydrology of their site at an early stage in the planning process. The results of such investigations should be provided to the planning authority with the proposals for a drainage system included with the planning application.

Acknowledgements

CIRIA (Construction Industry Research and Information Association) for images taken from the SUDS best practice manual (C535) and the SUDS design manual (C522)

Photos

Page 6: Permeable pavements, Formpave Ltd, Gloucestershire
Page 7: Swale, K McDonald, University of Abertay, Dundee

Further information

Sustainable Drainage Systems – an introduction, Environment Agency/SEPA/EHS

Designs that hold water – Sustainable Urban Drainage Systems explained, a 25-minute video or DVD, Environment Agency/SEPA

Both available through the Environment Agency National Call Centre, telephone 08708 506506, email: environment.agency@dmsltd.co.uk

Sustainable Urban Drainage Systems – design manual for England and Wales, CIRIA ISBN 0 86017 522 7

Scope for Control of Urban Run-off, CIRIA Report 124,

Both available from CIRIA, Tel: 020 7549 3300, www.ciria.org.uk

See also the CIRIA SUDS website, www.ciria.org.uk/suds

For further information about Groundwater Source Protection Zones, contact your local Agency office

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