Environment Agency

Sustainable Drainage Systems (SUDS)

A guide for developers

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The Environment Agency – out there, making your environment a better place.

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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 downstream flood risk as a result of the run-off from roofs and paved areas. This also causes sudden rises in flow rates and water levels in local watercourses.

- rainwater diverted to piped systems reduces the amount of water soaking into the ground. As a result, ground water levels fall and dry weather flows in watercourses are reduced;

- 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 of water through the drainage system is often highly polluting;

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 is impractical. But Sustainable Drainage Systems (SUDS) can significantly reduce the harm to our water resources, and improve the quality of our built environments, by moderating flows and filtering run-off.

Towards sustainable development

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

- to control the quantity and rate 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, incorporate SUDS into development proposals.

SUDS - the benefits

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

- gully pots;
- 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 making the best use of 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 the United Kingdom and Europe. They incorporate cost-effective techniques that are applicable to any development scheme. These range 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 Statement 25 for England on Development and Flood Risk emphasises the role of SUDS and introduces a general presumption that they will be used. SUDS are being incorporated in other planning policies 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.

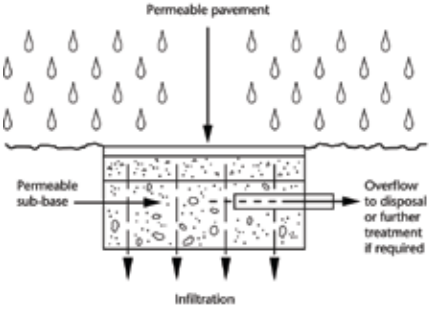
Adoption and future maintenance

The arrangements for adoption and future maintenance of the system should be considered during the early stages of design. 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. This will often call for the payment of a commuted sum or a legal agreement, possibly backed up by the deposit of a financial bond. The adopting organisation will probably wish to approve the design before construction.

Sustainable Drainage Systems (SUDS)

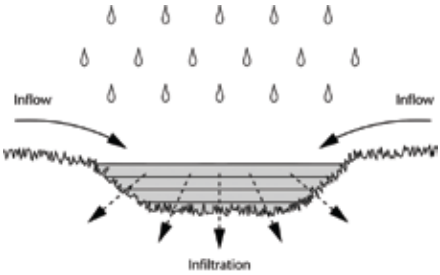
Sustainable drainage is a design philosophy that uses a range of techniques to manage surface water as close to its source as possible. To produce a workable and effective scheme, SUDS must be incorporated into the development at the earliest site-planning stage.

Permeable pavements



The need for surface water drains and off-site sewers can be reduced or eliminated where run-off is encouraged to flow through porous pavements made from materials like concrete blocks, crushed stone or 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

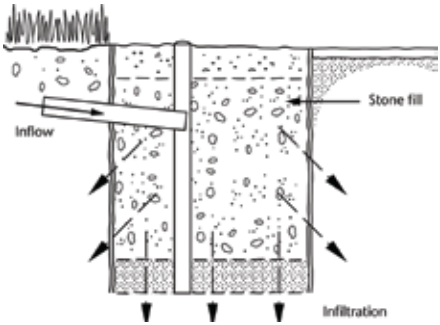


These can be created as features within the landscaped areas of the site, or they can be incorporated into ornamental, amenity and screen-planted areas where they would be looked after as part of the normal maintenance contract. They provide temporary storage for storm water, reduce peak flows to receiving waters and facilitate the filtration of pollutants (deposited and incorporated into the substrate). They also encourage microbial decomposition and allow 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 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 flushing toilets.

Infiltration trenches and filter drains

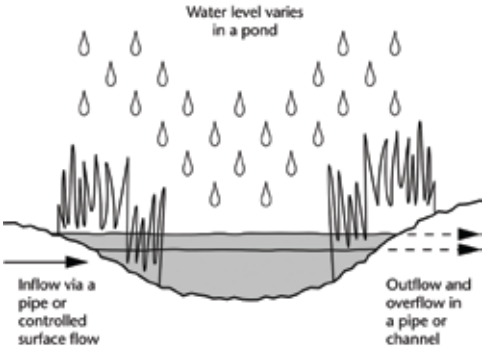


Infiltration trenches are stone-filled reservoirs to which stormwater run-off is directed, and from which the water gradually infiltrates into the ground. Their longevity is enhanced by incorporating a filter strip, gully or sump pit to remove excessive solids at the inflow. Filter drains (sometimes known as French Drains) are widely used by highway authorities. They are similar to infiltration trenches with a perforated pipe which carries flow along the trench. This enables 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.

SUDS on brownfield sites

SUDS can be very effective on brownfield sites. But the use of infiltration-based solutions requires careful thought where there is a risk of environmental damage from land contamination. The focus must be to avoid mobilisation of contaminants.

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.

The level of solids removal can be significant when enough time for detention is allowed. The algae and plants of wetlands provide a particularly good level of filtering and nutrient removal. Ponds and wetlands can be fed by swales, filter drains or piped systems, and the use of silt traps will help to manage sedimentation.

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SUDS during construction

The early implementation of appropriate SUDS techniques can prevent the pollution of watercourses during construction.

Choosing the right SUDS system

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

- 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;
- the presence of 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 the right SUDS techniques for a site. 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. Near old mine workings, SUDS must be designed to avoid linking to underground workings.

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

Acknowledgements

Oxfordshire County Council for the photograph on page 4

Further information

Sustainable Drainage Systems – an introduction
Environment Agency

SUDS Manual C697, CIRIA ISBN 978 0 86017 697 8
Tel: 020 7549 3300
Also see CIRIA website on SUDS: **www.ciria.org/suds**

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

Environment Agency Internet address:
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For further information about Groundwater Source Protection Zones, call us on 08708 506 506

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