# Surface water flooding: sustainable drainage to the ground

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During the exceptional rainfall events of summer 2007, floods inundated 7,300 businesses and 48,000 homes across the UK (PITT Review) with estimated costs of £3.2 billion.

A review of the causes and consequences of these events (PITT review) identified that extreme rainfall and overwhelmed drainage systems led to surface water being a primary cause of flooding. This type of flooding is particularly problematic in urban areas where rapid run-off from impermeable surfaces (roofs, pavements), exceeds the drainage capacity of that area leading to flooding in locations that are difficult to predict. The impacts are not restricted to water volume; the quality of water in receiving watercourses can also be compromised by pollutants entrained in run-off water and sewage contamination derived from Combined Sewer Overflow surcharging.

**The Policy Context**

DEFRA launched the Government's 'Future Water' strategy for England and Wales in 2008. This called for sustainable management of surface water, which included facilitating water re-use, storage and infiltration into the ground to decrease the reliance on traditional drainage systems. To promote this change, the strategy advocated a shift in policy to withdraw the automatic right for developers to connect to the drainage system and also to provide clarification on the ownership and maintenance responsibilities for systems which infiltrate to the ground. The current lack of clarification in this matter is limiting the development of new schemes because of their reliance on adequate maintenance. Such outcomes from the 'Future Water' and the preceding 'Making Space for Water' strategies are currently informing the draft Floods and Water Management Bill, which includes provision for the implementation of Sustainable Drainage Systems (SUDS) and associated National Standards.

**SUDS background**

SUDS modify surface water flows to replicate more natural flow rates thus reducing the impact of urbanisation on flooding at source and elsewhere in the catchment. They also aim to protect water quality, firstly by managing the pollutant load at source and secondly by reducing the volumes of surface water reaching combined sewers which may directly overflow into watercourses. SUDS can also increase the amenity and aesthetic value of urban areas and improve wildlife habitats and opportunities for biodiversity.

Systems can take a variety of forms including rainwater re-use, storage or infiltration to the ground. They can be as simple as a water butt or as complex as a multistage system designed to remove pollutants and sediments before allowing direct infiltration to the subsurface. In many areas of the UK, the subsurface has a huge capacity to attenuate surface water, providing opportunities for the installation of SUDS which infiltrate to the ground. In other areas however, subsurface conditions may be such that above ground re-use or storage schemes may be better placed.

**Importance of groundwater conditions in the design of SUDS**

There are a number of considerations that need to be taken into account when designing ground-draining systems. First is the ease with which stormwater will infiltrate the ground. This is not only dependent on the nature of the top soil (clay/sand/silt), but also what lies beneath. The permeability of the underlying deposits will dictate whether or not the ground is likely to accept the anticipated quantity of stormwater. In some systems where the infiltration capacity is limited, excess water may be stored for delayed infiltration or allowed to overflow to drainage networks. The infiltration rate must be considered in conjunction with the water table elevation, which for most schemes should be at least 1 m below the base of the SUDS scheme. This unsaturated thickness is necessary to ensure that there is space for a local rise in groundwater that may result from stormwater infiltration. A permanent unsaturated zone is also required in most systems as a final polishing step for the treatment of stormwater pollutants, the majority of which should be removed via above ground pre-treatment stages. Further to these design considerations, there are rare but significant geological hazards that may arise as a result of infiltrating water. Examples include voids and collapse features created by the dissolution of soluble rock and minerals, down-slope waterlogging leading to increased landslide risk and changes in subsurface water content leading to ground compression and subsidence.

Whilst careful thought is needed in system design, sustainable drainage systems nevertheless will play a part in reducing the catastrophic effects of extreme flooding events such as those during the 2007 floods.