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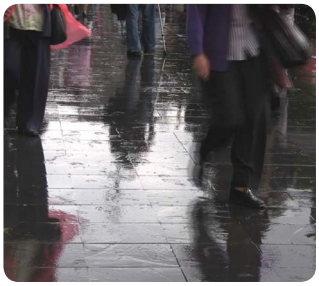
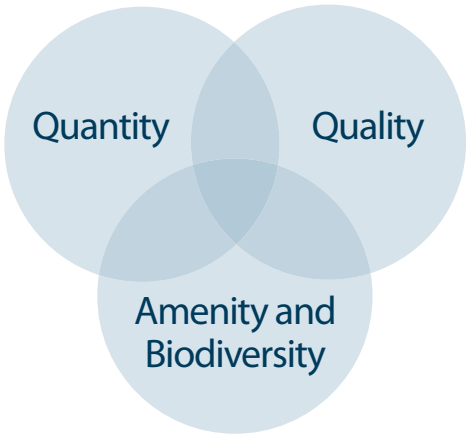
CLEANING UP WATER QUALITY.

Over two thirds of the 57,000 homes affected by the 2007 summer floods were flooded not by swollen rivers but by surface water run-off or overloaded drainage systems. The Government's Foresight report estimates that currently 80,000 properties are at very high risk from surface water flooding causing, on average, £270 million of damage every year.



Therefore there is clearly a need for a sustainable approach to all surface water drainage. Sustainable Drainage Systems (SUDS) are a design philosophy which, when using a range of techniques manage rainfall in a way that mimics natural drainage.

SUDS objectives minimise the impacts from developments on the quantity and quality of the runoff and maximise biodiversity opportunities. This is known as the SUDS triangle.



Large amounts of surface water run-off can cause water quality problems, hence the need for SUDS solutions. As water runs over hard urban surfaces, it picks up pollutants that are washed into water-courses. For example, run-off from roads contains heavy metals and hydrocarbons which can seriously impact on water quality.

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The Question – Do geotextiles provide a benefit to water quality?

A permeable pavement can help to improve water quality by filtering out some of the pollutants contained in the water which passes through it. Often a geotextile is specified within the sub-base of a permeable pavement to assist in improving water quality by filtering out oil, heavy metals and hydrocarbons. Claims have been made, implicitly or explicitly, that a geotextile is necessary to achieve good environmental performance. However, there is little information available in the literature from comparative studies where parallel testing of permeable paving systems both with and without a geotextile layer have been undertaken. For this reason Marshalls commissioned the University of Abertay to conduct some testing to see what level of pollutants a permeable paving on its own and with the inclusion of a geotextile actually remove.

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Marshalls selected The Urban Water Technology Centre, a specialist centre at The University of Abertay, because they, through Professor Chris Jefferies, are leaders in SUDS research. Professor Chris Jefferies is recognised internationally for his experience in the planning, design, operation and maintenance of sustainable drainage systems (SUDS). He is actively involved with and maintains a high profile for the Centre within international and national bodies.

The test methodology.

The main scope of the testing was to determine whether or not an upper geotextile within a permeable paving system is beneficial to water quality. To do this physical testing was required.

A field study at Dundee Airport was carried out on eight test rigs 1m x 1m x 0.5m deep. Each test rig was constructed using marine plywood and had a clear acrylic front 'window' for inspection.

Test rigs.

Test site.

Rig construction.

The rigs contained Marshalls Priora paving installed with sub base in accordance with BS 7533-13:2009. A perforated pipe was installed at the base of the rig leading to a v-notch for drainage of the paving panels, flow measurement and sample collection.

PANELS WITH GEOTEXTILE	PANELS WITHOUT GEOTEXTILE
• One layer Priora paving block 200x100x80mm • 50mm depth of 2/6.3mm laying course graded aggregate • Upper permeable membrane • 350mm depth of 4/20 sub base aggregate • Impermeable membrane liner	• One layer Priora paving block 200x100x80mm • 50mm depth of 2/6.3mm laying course graded aggregate • 350mm depth of 4/20 sub base aggregate • Impermeable membrane liner

Sub base.

Aggregate with geotextile.

Paving rig with geotextile.

Of the eight rigs constructed, 4 contained an upper geotextile and 4 did not so that results could be compared. Each set, one with and without geotextile, was then subjected to an application of metals, oils and metals and oils. A pair of control rigs was also used.

RIG NUMBER	CONSTRUCTION	TEST
1	No geotextile	Metals
2	Geotextile	Metals
3	No geotextile	Oils
4	Geotextile	Oils
5	No geotextile	Control
6	Geotextile	Control
7	No geotextile	Metals and oils
8	Geotextile	Metals and oils

Rainfall simulation.

Rainfall was simulated using a branch sprinkler system fed from a 1200 litre tank. 1200 litres was used as the UK annual rainfall is 1201.3mm (Met office: 2010). The rainfall was applied to the paving area by gravity until the tank was emptied.

The water passed through the paving and was collected by the perforated pipe and conveyed into a sampling pot with a v-notch weir where flow rate and volume were measured.

Rainfall simulator.

Pollution application.

Three different categories of pollutant were applied; a suite of five heavy metals, motor oil and a combination of both. The metals were applied to the paving rigs in solution via the rainfall simulator and the oil was dripped onto the paving rigs prior to the application of 'rainfall'.

Application of pollutants

Rainfall simulation.

Ten years' simulation of pollutants flowing on to the block paving was carried out in 3 simulation periods of 1 year, 2 year and 7 years equating to 1, 3 and 10 years, cumulative, equivalent of pollutants. This was to assess the longer term performance of the pavements.

Sampling chamber.

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Summary of results.

This field study enabled parallel tests to take place reviewing whether the inclusion of a geotextile with a permeable pavement provided significant water quality benefits over pavements that didn't use a geotextile.

The tests showed that after 10 years of application of heavy metals both rigs showed high metal removal rates for all 5 metals applied. The rigs with a geotextile did remove a greater percentage of metals compared to the test rigs without a geotextile, but the differences were minimal (3%) and it can be concluded that the presence of the geotextile provided no real benefit.

There was a high removal rate of oils poured on to the paving panels, although this declined from an average of 94% to 79% between the first and tenth year (equivalent). On average, removal of oil in the rigs with geotextile was only marginally better than in the rigs without but the differences were not significant.

To summarise, the tests clearly conclude that the use of a geotextile does not provide any significant benefit in terms of water quality.

Marshalls will continue to carry out research like this to further improve industry understanding of permeable paving and SUDS issues in general so that clients are always provided with the data they need to make informed decisions and so that collectively as an industry we can keep progressing in order to ensure that we all strive towards creating better landscapes.

To learn more on Marshalls work with Abertay University contact one of our field drainage engineers on **08704 11 33 44.**