Guernsey Suds Guides

Permeable Surfaces

Guernsey Water

Permeable Surfaces

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PURPOSE OF THIS GUIDE

This guide is part of a series of documents introducing different aspects of Sustainable Drainage Systems (SuDS).

Permeable Surfaces play a valuable role in SuDS and this document explains the concept, performance and correct application of such surfaces, in order to better manage rainwater on our island.

This guide is relevant to any new or retrofit developments where pedestrian and vehicular surfaces are required.

Front Cover: Bridget Joyce Square, London
By Robert Bray Associates

Facing Page: Lighthouse, St. Peter Port

CHAPTER 2.1

A New Requirement

2.1

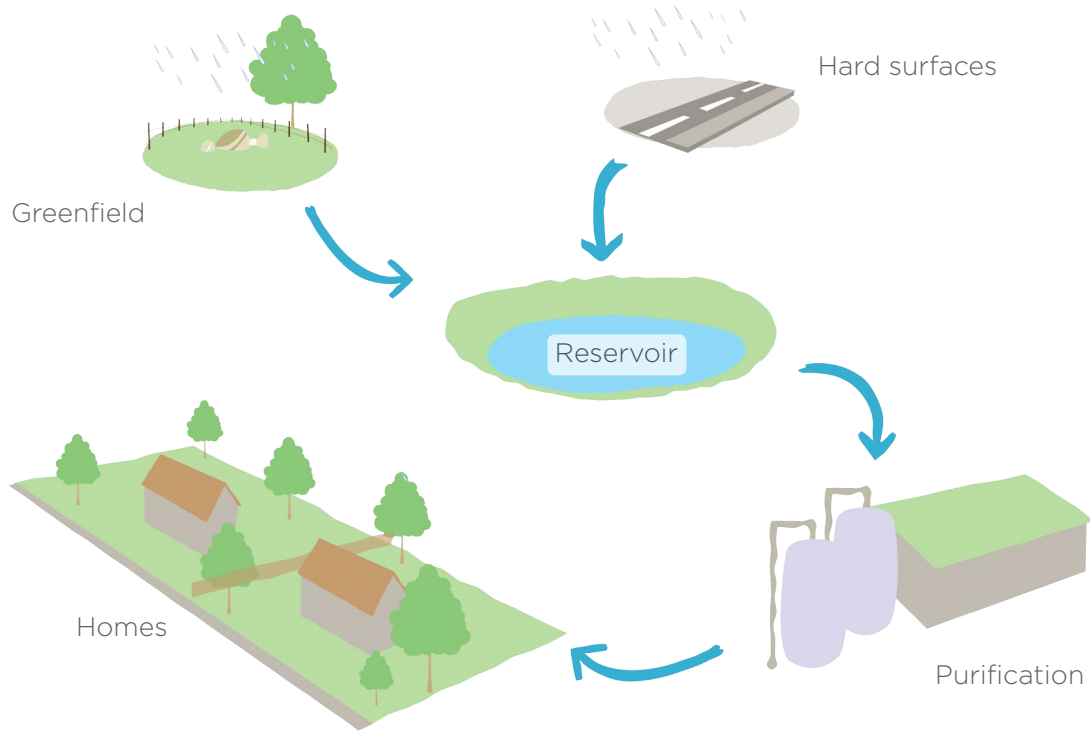
To protect Guernsey from flooding, and to help keep our drinking water and marine environment clean, conventional hard surfaces need to be phased out.

All new developments, redeveloped sites and new driveways or parking areas in Guernsey are are encouraged to use permeable surfaces. These are constructed in such a way as to allow rainwater to pass through and either soak into the ground below, or be released slowly to a sewer or stream or to further Sustainable Drainage features if required.

Permeable paving within a new housing development on Guernsey

Permeable Grasscrete
Car park ©Grasscrete

The diagram to the right represents the water cycle on Guernsey. Guernsey relies on the rainwater that falls on the island for its drinking water. The way that runoff is treated before it enters the rivers and reservoirs is therefore vitally important to the quality of that water.



CHAPTER 2.2

Why Permeable Surfaces?

2.2

By not letting rainwater enter the sewer - or by slowing its entry - permeable surfaces help to reduce flooding and can reduce pollution on the island. This limits property damage, and helps to keep drinking water clean.

Permeable surfaces are also highly effective at removing tyre dust; by far the largest contributor of harmful micro-plastics found in the marine environment.

Permeable surfaces are just one of the techniques used in Sustainable Drainage Systems. To find out more about these new approaches to rainwater management please refer to our guide *'The Principles of SuDS'*.

Right: Rocquaine Bay, Guernsey

Facing page: Road runoff over a blocked gully

A Closer Look At Permeable Surfaces

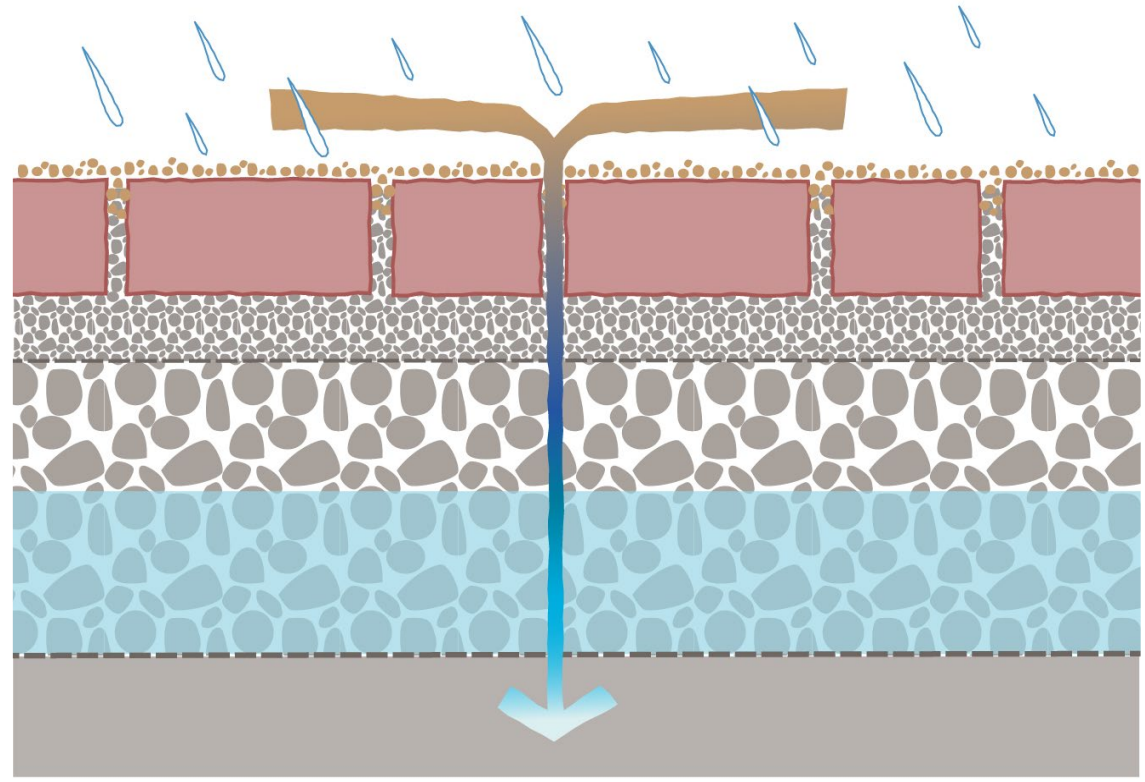
2.3

The example below shows a typical build up for permeable block pavoirs.

Construction elements will vary according to chosen surface finish and should always conform to manufacturers installation instructions.

Where required, use a 2-6mm grit (no fines) laying course to BS7533:3

The sub-base aggregate shall be a no fines hard crushed rock Type 4/20, voids ratio at least 30%.
To comply with BS EN 13242: 2002 – Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction.
If a hydraulically bound sub-base is also required (low CBR or high traffic load), it is to comply with BS EN 14227-1:2004 for hydraulically bound material.



Permeable surfaces come in different forms, from gravel to porous tarmac, but the top surface is only the start of the story.

What happens underneath the surface layer is critical to the permeable surface functioning properly.

In this chapter we will introduce the different surface options and explain the different construction layers that enable the cleaning and storage of rainwater.

P Car Parking

Pedestrian

Roadway

Icons that accompany the diagrams in this chapter indicate the suitability of each permeable surface to various typical uses.

Permeable paving with planted rill at Bewdley School, Worcestershire. RBA Associates

P

Permeable Block or Slab Paving

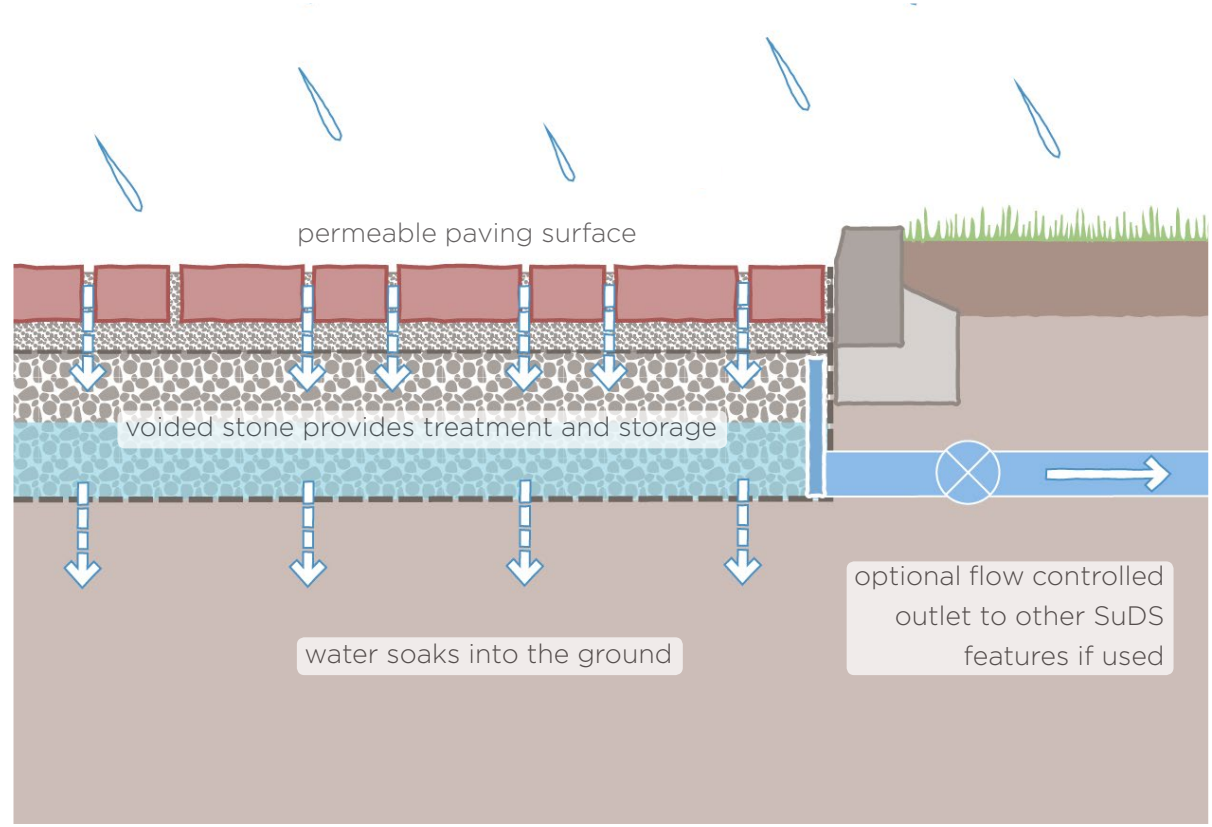
Permeable paving appears similar to traditional block paving, except widened joints filled with grit allows rainwater to enter between blocks, filtering it before it passes into the open-graded sub-base. Water is stored in the sub-base allowing it to slowly infiltrate into the ground.

There are a variety of colours, sizes, materials and finishes available in permeable blocks including up to slab-sizes in textured concrete and natural stone.

Special spacers can also be used to create open joints in regular slab paving to achieve the same results.

Permeable paving on Guernsey

Permeable Paving © Marshalls



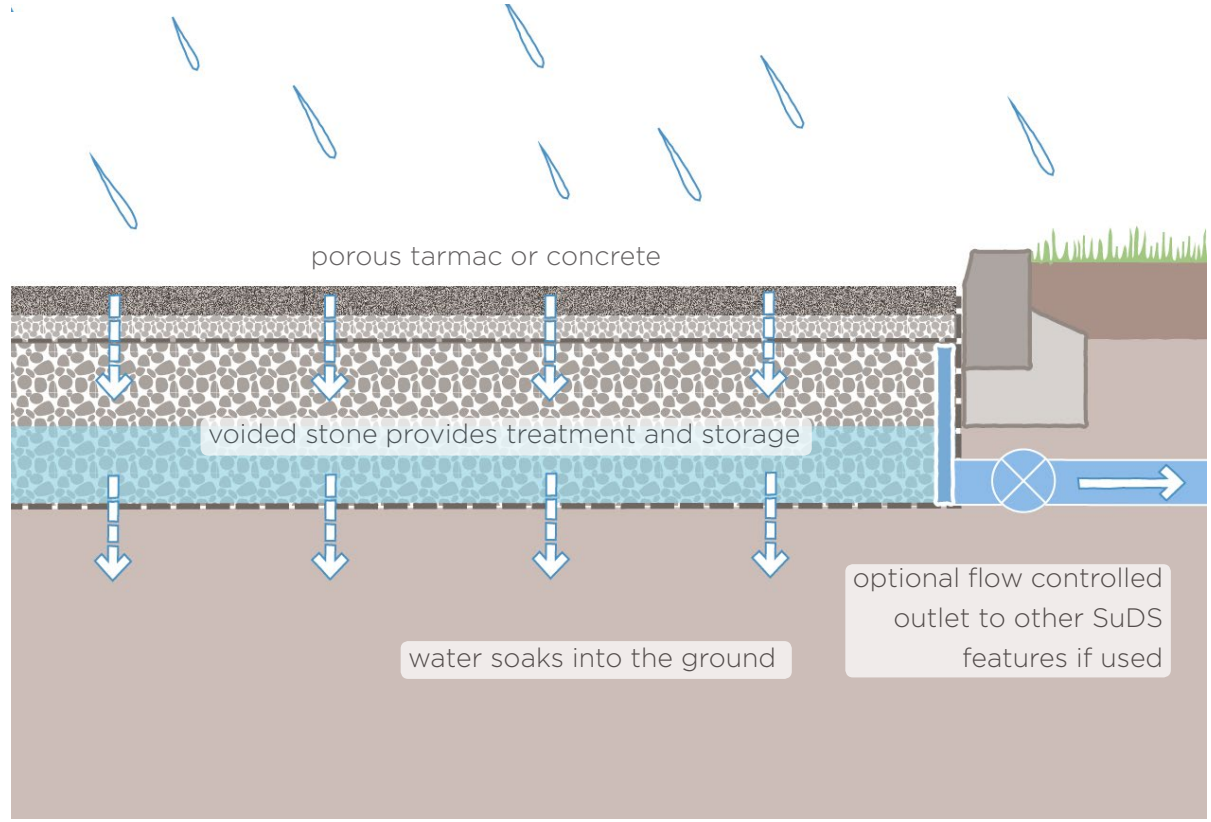
Porous Tarmac and Concrete

Porous tarmac and porous concrete both allow water through their surface layers which, unlike conventional tarmac and concrete, have an open aggregate structure which allow the water to pass through to the open-graded stone sub-base.

They look very similar to their conventional equivalents and can be line-marked for parking bays or circulation.

Porous tarmac © Tarmac

Porous tarmac © Tarmac



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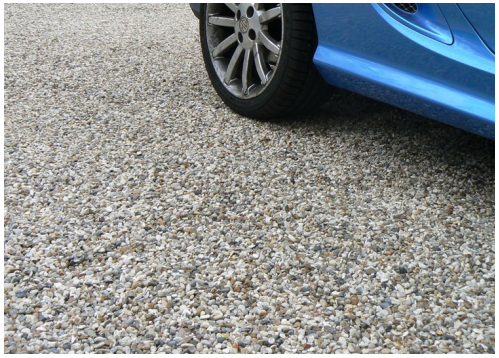
Loose gravel

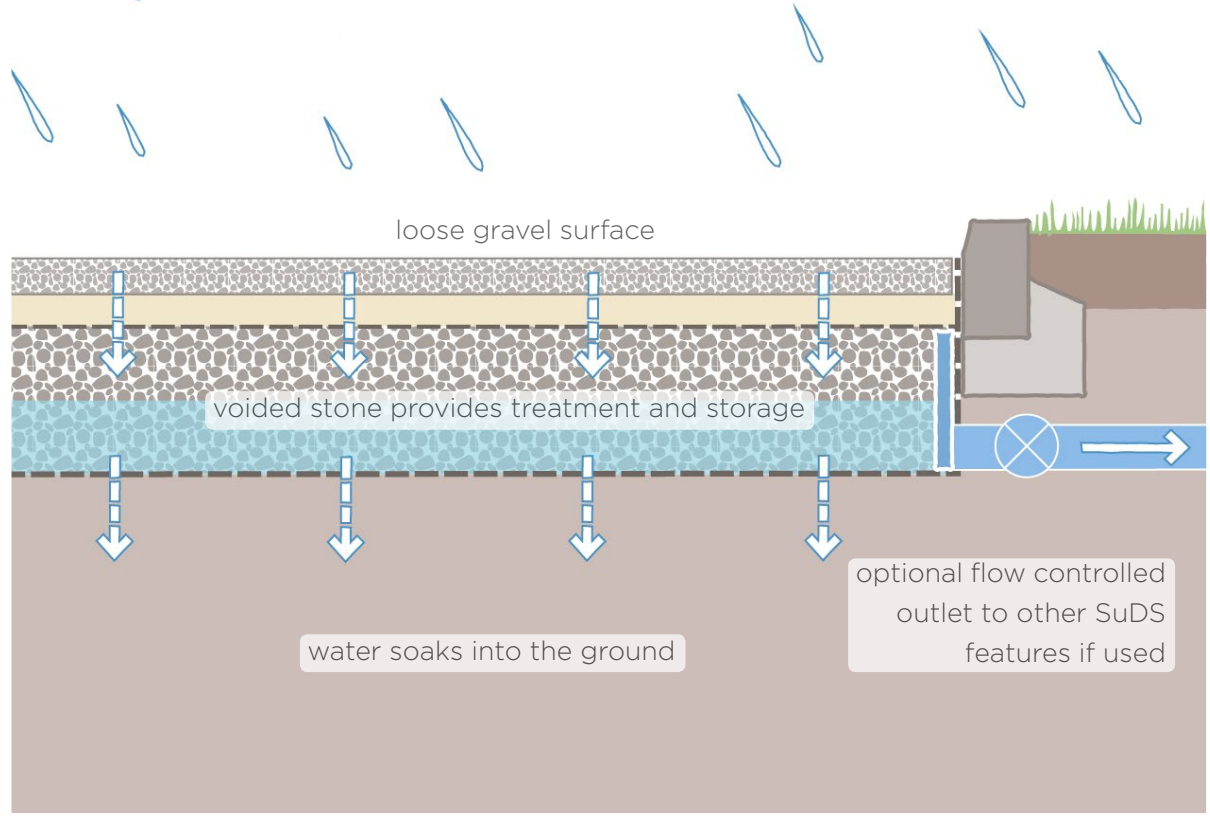
Loose gravel can be used as a permeable surface. Any gravel that does not contain 'fines' (fine particles) can be used as a permeable surface. All that is required is an open-graded sub-base, properly compacted with the gravel layer laid on top.

As gravel can move, it cannot be easily used on slopes without some form of stabilising structure - see cellular grass or gravel filled systems later.

Loose Gravel Surface © CED



Loose Gravel Surface © CED

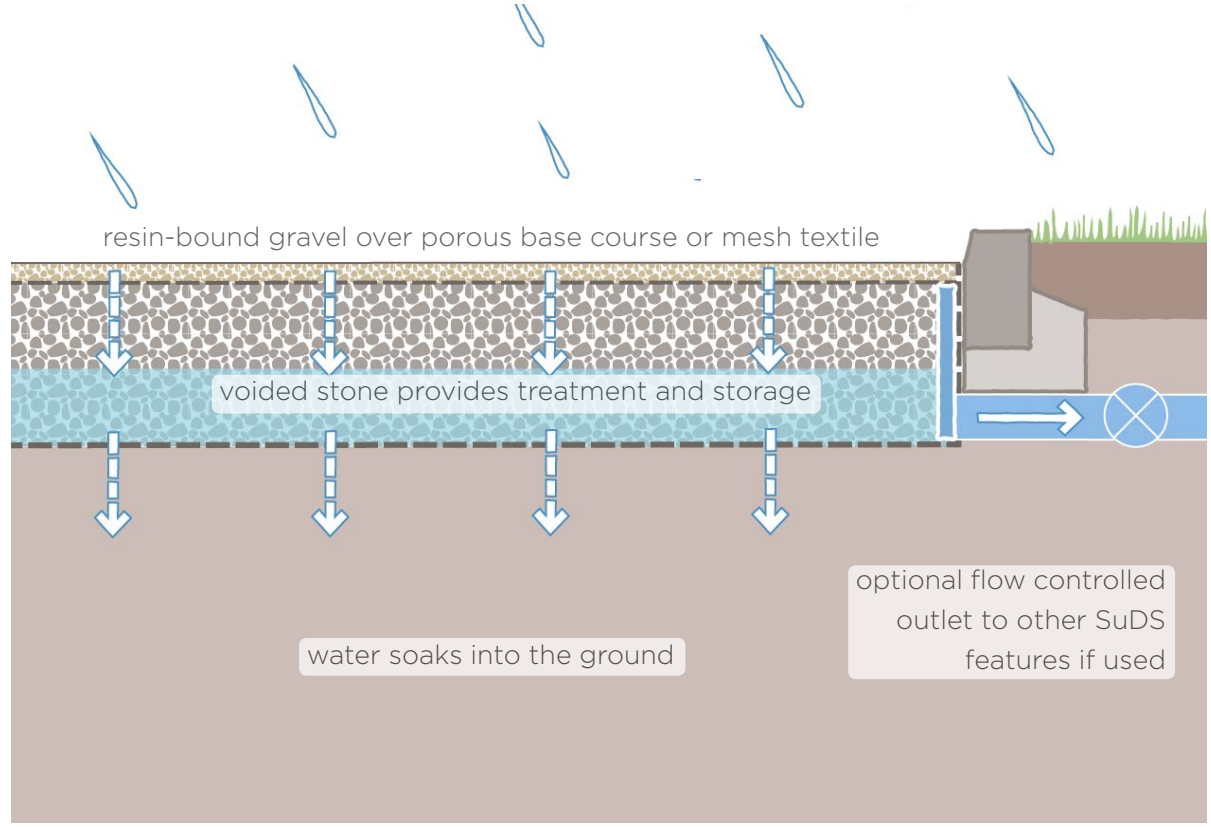


Resin-bound gravel

Resin-bound gravels use a transparent or coloured resin to bind together decorative gravel aggregates which come in a broad range of sizes and colours. The material onto which a permeable resin is bound must, of course, be permeable itself if the water is to penetrate any deeper: this can be a permeable tarmac, or compacted open-graded sub-base with a mesh reinforcement depending on the manufacturers' specification.

Resin Bound Surface © Addagrip

Resin Bound Aggregates © Addagrip



P

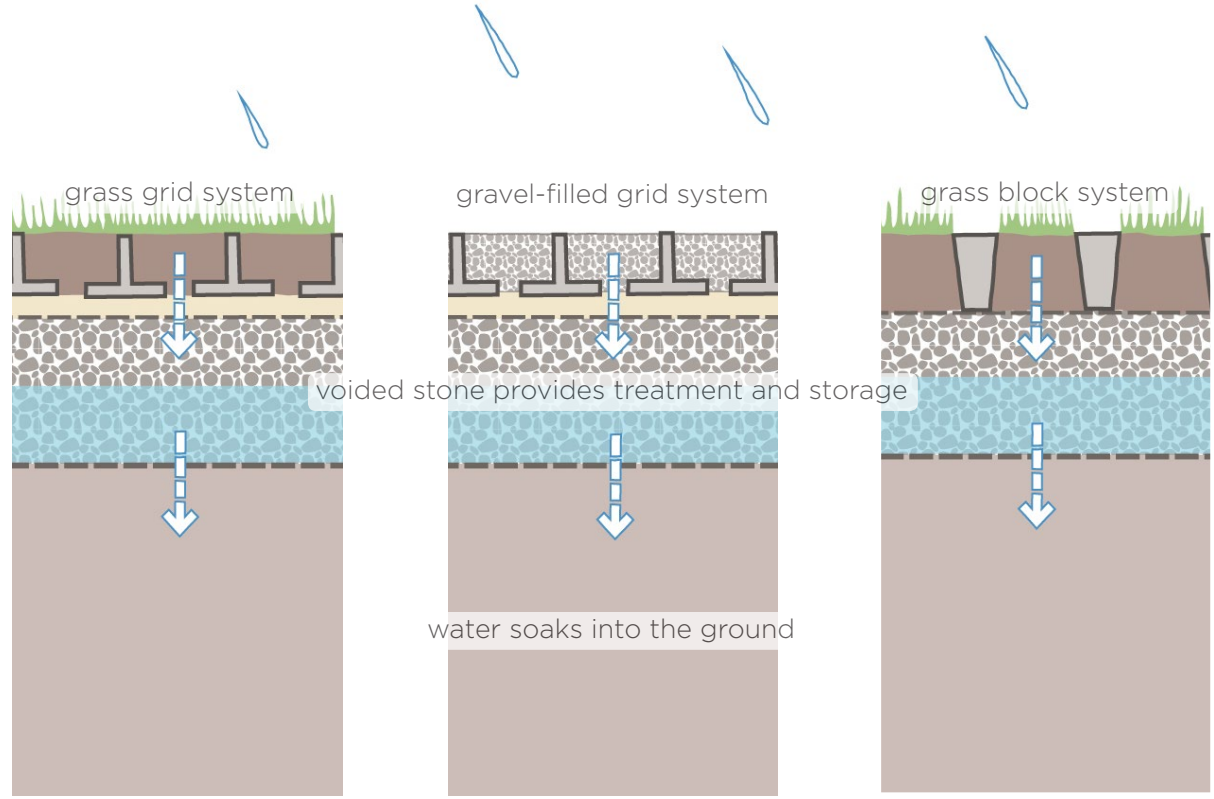
Cellular grass or gravel-filled systems

These plastic or concrete cells can stabilise a gravelled or grassed area and protect it from erosion, making it much more user-friendly to both pedestrians and vehicular traffic, as well as allowing them to be applied on slopes.

Rainwater can pass through the soil or gravel layers, through a grit layer separated by Hessian, before entering the open-graded sub-base layer for storage and infiltration.

Example of vegetated grid system
Exwick School, RBA Associates

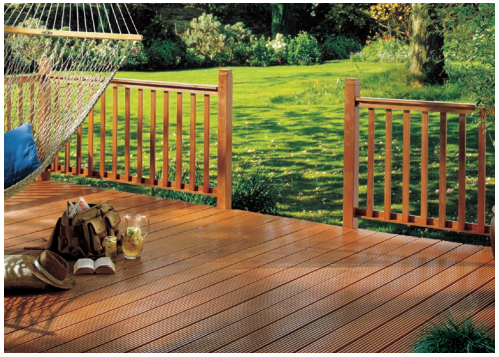
Grass Block System © Grasscrete



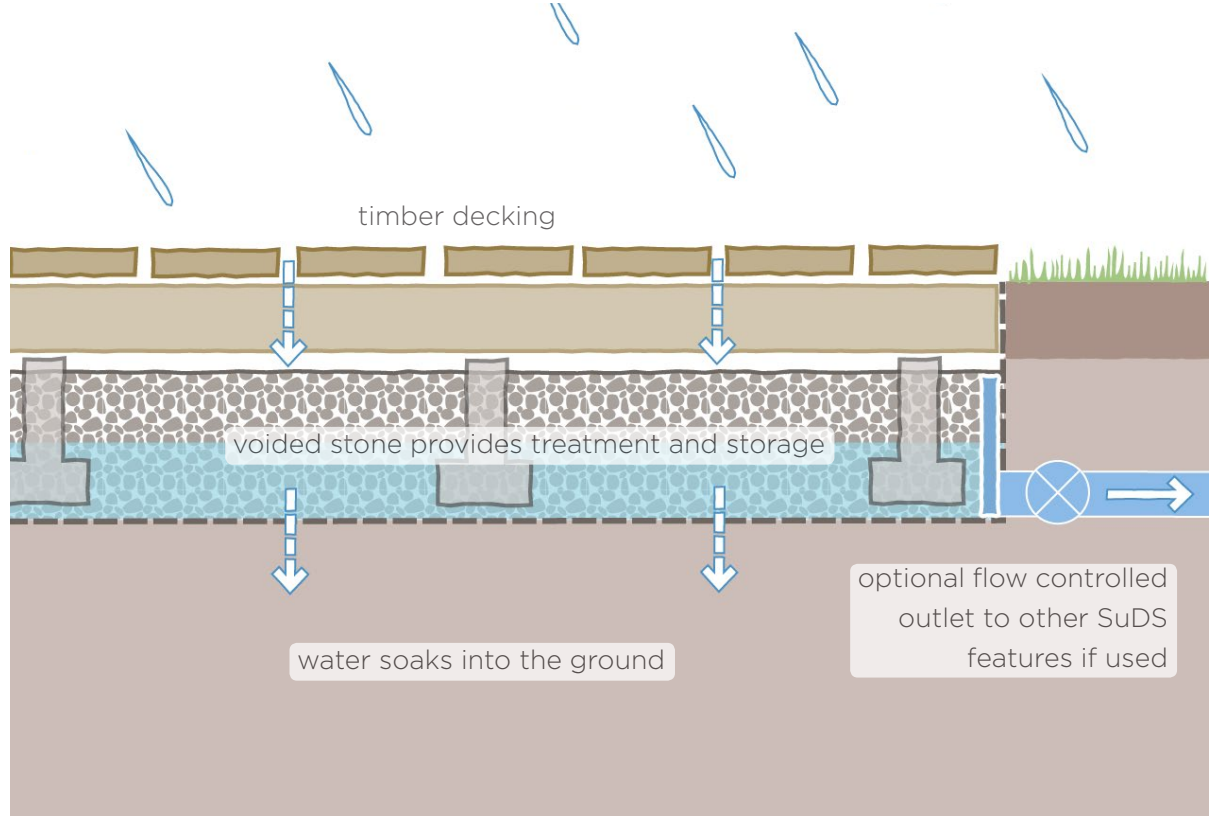
Decking

Decking can be considered a permeable surface as the voided joints allow rainwater to pass through. The sub-structure can be built on a well compacted permeable sub-base, providing opportunities for infiltration (where appropriate) or conveyance to further SuDS features along the management train.

Timber Decking © TDCA



Timber Decking © TDCA



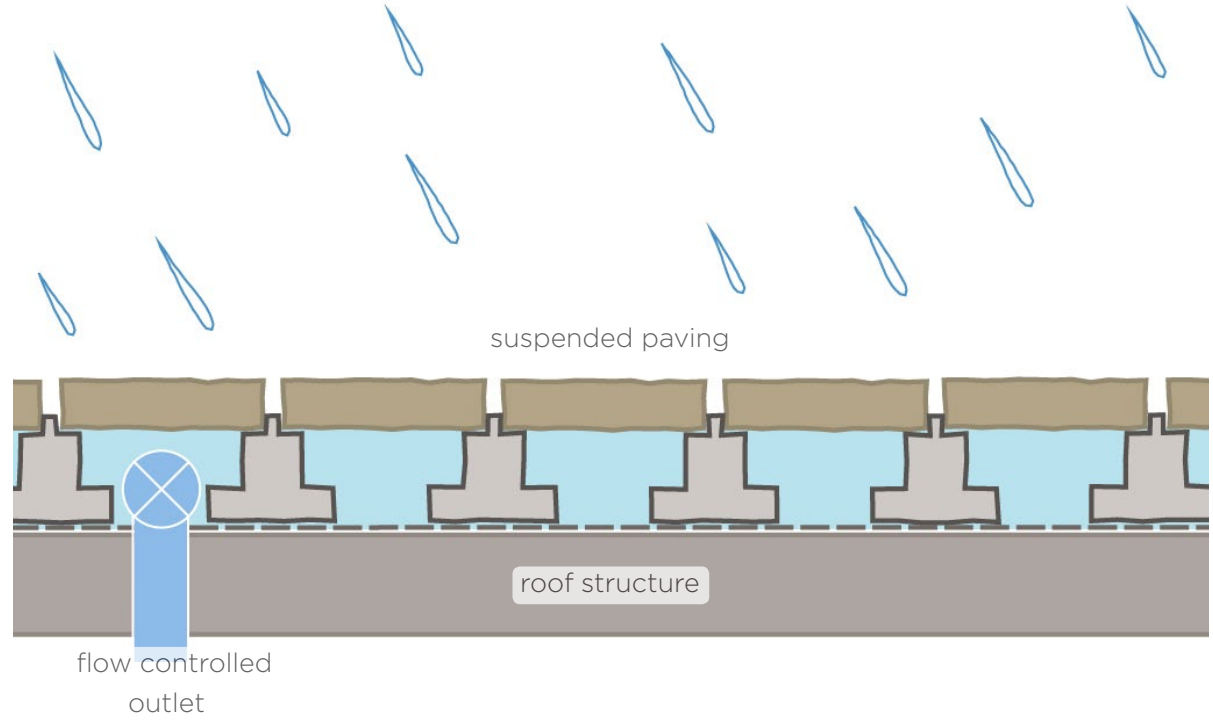
Podium decks

Podium decks can include multi-purpose roofs and green roofs. Although it doesn't involve infiltration into the ground, a podium deck can provide storage and attenuation. The example below shows one common approach - paving on supports - but this is not the only solution. A deck would also work.

The void below the paving can be used for storage if a simple orifice flow control with integrated overflow is installed at the drainage outlet.

Podium Decks © Wall Barn

Suspended Paving © khdlandscapesolutions



De-paving Driveways

The very simplest approach - and one that has been used for many years - is to provide hardstanding only where the vehicle tracks will run. This allows the remaining land to remain as grass in order to allow infiltration as before.

Because the additional impermeable area is so small, porous sub-bases for water storage are not considered necessary as most rain will soak through the grass.

© Hortus Design

© Ludodierckx Tuindesign

CHAPTER 2.4

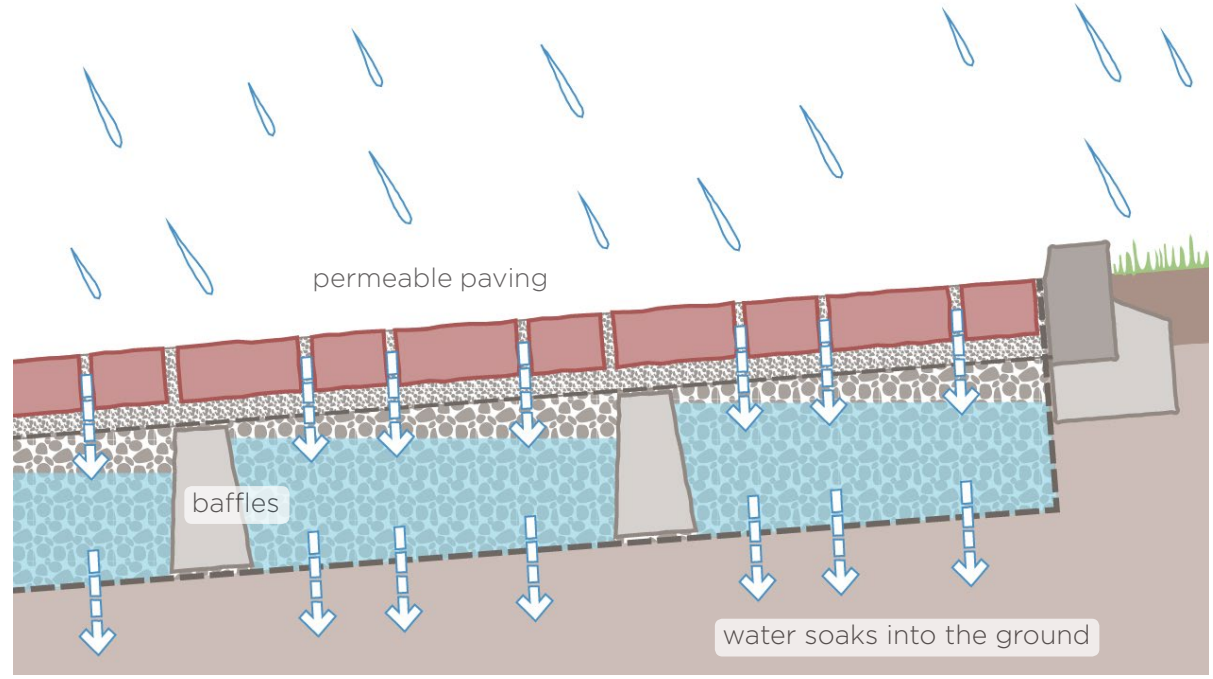
Installing on a slope

2.4

Installing permeable surfaces on a slope requires special measures to stop all the water flowing straight to the bottom before it has a chance to infiltrate.

The solution is to install baffles within the sub-base storage zone, across the slope, to stop water rushing downhill to the lowest part of the installation.

Baffles can be constructed in concrete or impermeable membranes which should project into the ground to stop water running underneath.



Storage Requirements

2.5

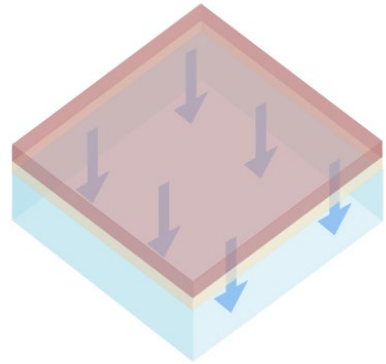
When installing permeable surfaces of any kind, it is important that they can temporarily store enough water to protect from flooding in extreme storms.

If the permeable surface is not collecting additional water running off from another impermeable surface, this can be achieved by using a minimum of 275mm depth of 4-20mm crushed stone 'Coarse Graded Aggregate' (CGA) or 'Type 3' sub-base layer.

Your site's ground may require a deeper sub-base in order to remain stable when people or vehicles pass over it. Check with an engineer or builder. It is fine if it does as it will simply store more rainwater or allow you to store water from adjacent surfaces or roofs as well.

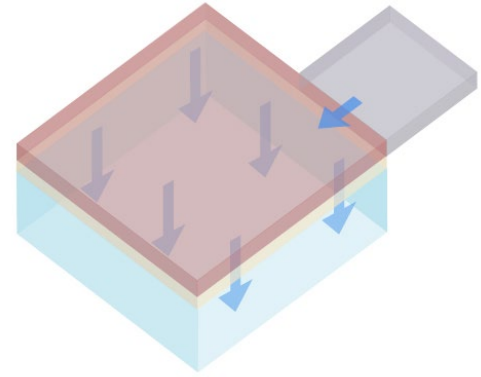
If you want to use the permeable surface to manage runoff from other impermeable areas, such as adjacent paving or a roof, you will need a deeper sub-base to store the extra rainwater. It shoud be no larger than twice the area of permeable surface.

To work out how much deeper it needs to be, calculate how large the additional area is as a percentage of the permeable paving area and make the sub-base deeper by the same proportion.



A permeable surface with 275mm deep sub-base can store the correct depth of rain in an extreme storm

(100% + % additional of impermeable area draining to the permeable surface) x 275mm = depth of subbase required (mm)



For example, for a permeable surface of 50m^2 also collecting 10m^2 of impermeable surface, a subbase depth of 330mm is required (120% x 275mm = 330mm)

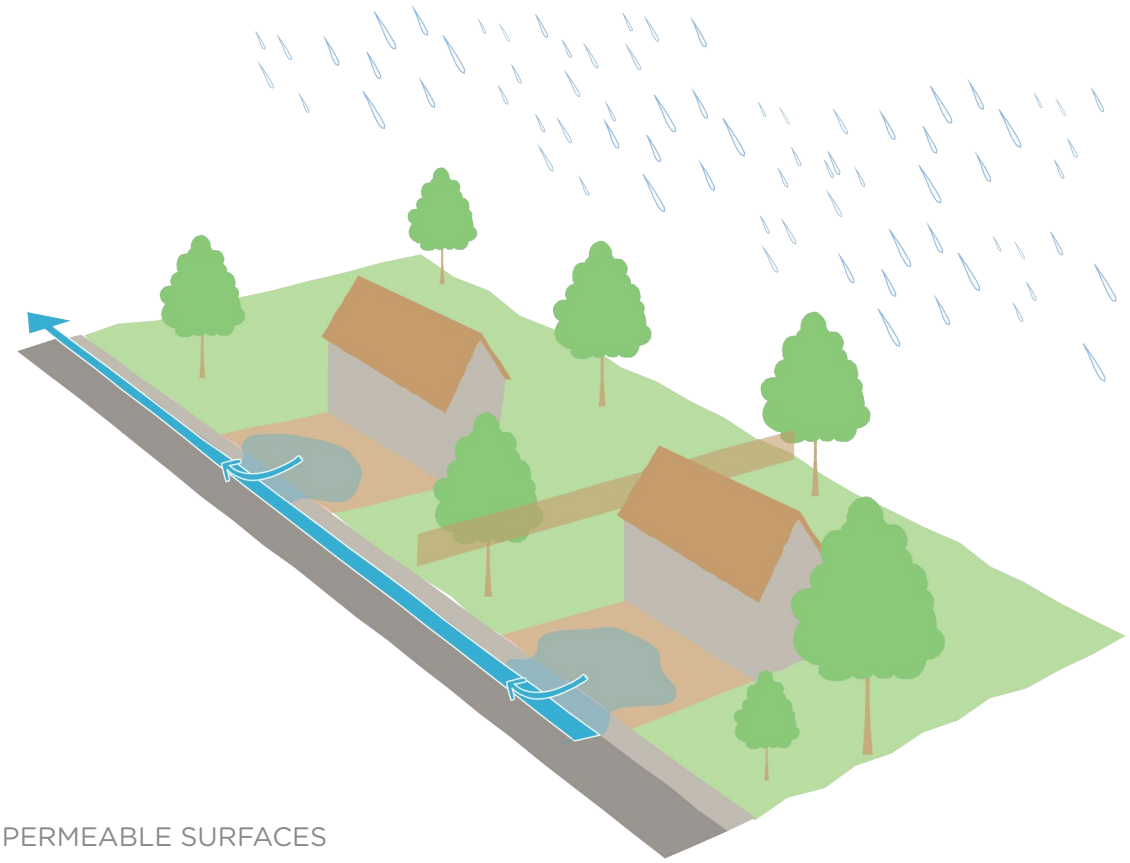
Designing for Exceedance

2.6

On very rare occasions we get storms that are bigger than the system is designed to hold - or something might go wrong with the system. Whilst in this case the permeable surface will still act to slow flows down, we need to have an escape route for the water that can't be held in the system.

We call this 'exceedance' and when designing an area of permeable surface, we need to determine where this water will travel and make sure it isn't flooding someone else's property.

Roads, kerbs and adjacent landscape can be used to contain exceedance flows on the permeable surface or you could take your exceedance route off the paving and through the landscape. Remember this would only happen in very rare circumstances.



Left: An exceedance route is necessary in order to direct excess water away from properties.

Maintenance

2.7

Routine maintenance should keep permeable surfaces functioning for between 10 and 20 years depending upon the site location and usage.

Permeable block and porous tarmac, concrete & resin-bound paving

Occasional sweeping and removal of dust and debris (hand brush or street cleaning machine) will typically keep the paving functioning for between ten and twenty years without problem.

After 10 to 20 years, when you notice water not draining through the surface properly, it may be time to carry out a deeper clean. This requires a suction-sweep machine to remove the clogged-up grit from paving joints or to suck out silt from the pores of concrete, tarmac or resin-bound gravel. Grit joints of block paving should then be

Loose gravel paving

Remove debris and leaf litter to reduce clogging-up of the gravel. If water is seen to pool on the surface try raking over to loosen the gravel. It may eventualy be necessary to clean the gravel through a seive to remove silt or the gravel could simply be replaced.

As well as protecting against silt and fine sands blocking up the surface, the following tasks are usual for the different types of permeable surface.

Podium decks

Silt or debris on podium decks will make it's way down into the void below the surface where it will slowly collect. It is likely to be a number of years before this is a problem.

A yearly inspection of the lowest part of the deck (typically by the flow-controlled outlet) should be carried out by lifting part of the surface. Silt and debris should be removed and the outlet checked and cleared of any potential blockage.

Decks

Decks should be maintained as usual. If the gravel underneath a decked area is prone to collecting excessive leaf litter this may require removal to allow adequate infiltration or install some protection to stop leaves getting under the deck.

Below: A sweep is appropriate for light cleaning

CHAPTER 2.8

Things to consider

2.8

When designing and installing permeable surfaces, as with other forms of Sustainable Drainage, care must be taken to ensure that it will work as intended into the future.

Protect surrounding landscape elements

The compaction of surrounding soils can result in many successive years of poor performance.
Avoid tracking on soils.

Ensure adequate tree protection - root damage will easily kill a tree.

Avoid silt & fine particles

The introduction of fine particles will clog a SuDS system and can prove a costly mistake to remedy.

Protect elements from siltation during construction

Having sourced open graded aggregates (CGA or Type 3), it is essential that they remain as such during construction. The siltation of elements (grit/sub-base/outlets) during construction is a common mistake that can be avoided with appropriate protection.

Protect surrounding buildings

SuDS elements must not breach an existing Damp Proof Course. An appropriate sub-grade fall - if not a fully infiltrating system - will ensure that water drains slowly through a controlled outlet.

Follow designed falls

Falls must be exactly followed to avoid problems. The exceedance route must be carefully designed and built to ensure that a safe overflow route can be guaranteed in all circumstance.

Follow manufacturers instructions

Proprietary products must be installed as per the installation instructions.

Specify Materials Exactly

It is important to note that resin-bonding results in an impermeable surface. Only resin-bound gives a permeable top surface.

Further Reading

2.9

General SuDS Guidance

ww.susdrain.org

www.ciria.org

The SuDS Manual (C753)
(available on the CIRIA website above)

Permeable Paving Guidance

Interpave - www.paving.org.uk

produced for Guernsey Water by
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