Northern Ireland

Managing Rainfall Runoff from Individual Properties

A Sustainable Approach

niwater

Contents

1.0 The purpose of this guide

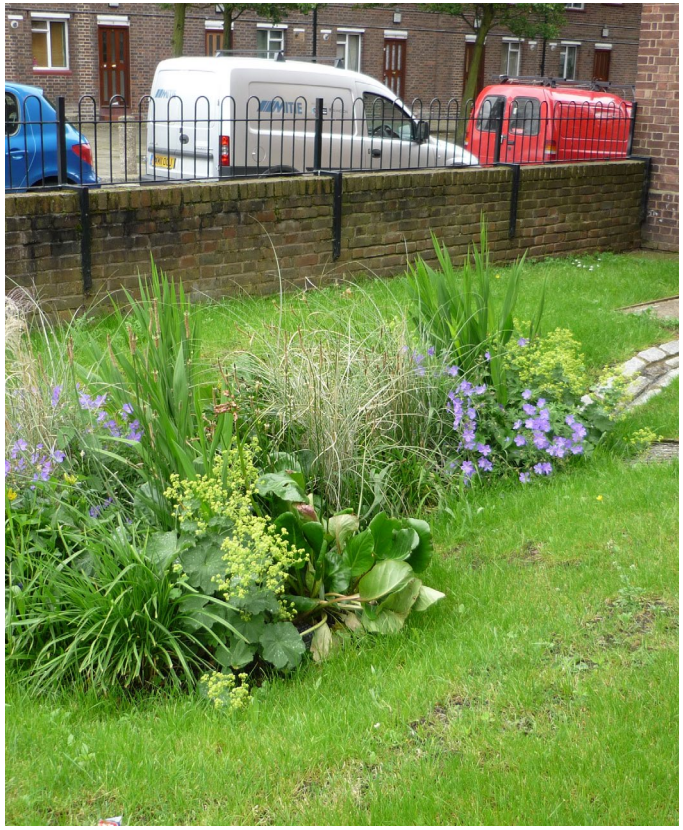
When you build or extend a property you create areas of hard surfacing such as roofs and driveways. Whenever it rains all the water that runs of the hard surfaces must go somewhere.

Continual development and addition of patios and driveways to our homes increases the amount of water that enters local sewers, drains and watercourses, increasing the risk of sewer flooding and environmental damage.

NI Water recommends Sustainable Drainage (SuDS) to minimise the amount of rainfall runoff going to the public sewer.

Integrating SuDS features such as rain gardens into your home will catch rainwater before it enters the sewer, allowing you to play an active part in reducing the risk of flooding and improving the quality of your local watercourses.

This Guide is written for homeowners, architects, civil engineers and builders/contractors involved in extending, modifying or building single properties. It relates to small scale development, including new and replacement dwellings as well as extensions to existing properties.



SuDS is integrated throughout this housing scheme in the form of a pond, permeable paving, swales, rill channels and a slightly sunken grass play area.

2.0 What is Sustainable Drainage?

'Sustainable Drainage or SuDS is a way of managing rainfall that minimises the negative impacts on the quantity and quality of runoff whilst maximising the benefits of amenity and biodiversity for people and the environment.'

SuDS mimic the way nature manages rainfall, and work by holding rainwater back and releasing it slowly. Using SuDS can be a flexible approach that can be integrated with the building or the spaces around the building.

These short videos explain what SuDS all are about:

Ever wondered where the rain goes?

SuDS – Let's get nibbling

SuDS can deliver a range of benefits:

People are connected with natural water cycle

Clean water flow supports wildlife

Reduce the effects of flooding from drains and rivers

Create more climate resilience

3.0 Why do we need property level SuDS?

Our existing drainage systems are under ever increasing pressure...

Over the last number of years, both small and large-scale developments have experienced difficulties in connecting to the sewer network in Northern Ireland as there is simply no capacity left within many parts of the sewer networks. Whilst NI Water are working to reintroduce capacity to the sewer network, this will take considerable time.

Even small increases in hard surfacing and roofs from new buildings, extensions and driveways, add further strain on the existing drainage networks.

Many of our older towns and cities have a combined sewer system where flow from toilets and sinks is combined with rainwater in a single pipe. In newer development (post 1960) it was recognised that combining human and industrial waste with rainwater was giving rise to environmental damage and new development used separate pipe systems.

One of the ways to relieve the pressure on our sewer system is to use SuDS to reduce the amount of rainwater getting to the sewer and slowing how quickly it enters the sewer.

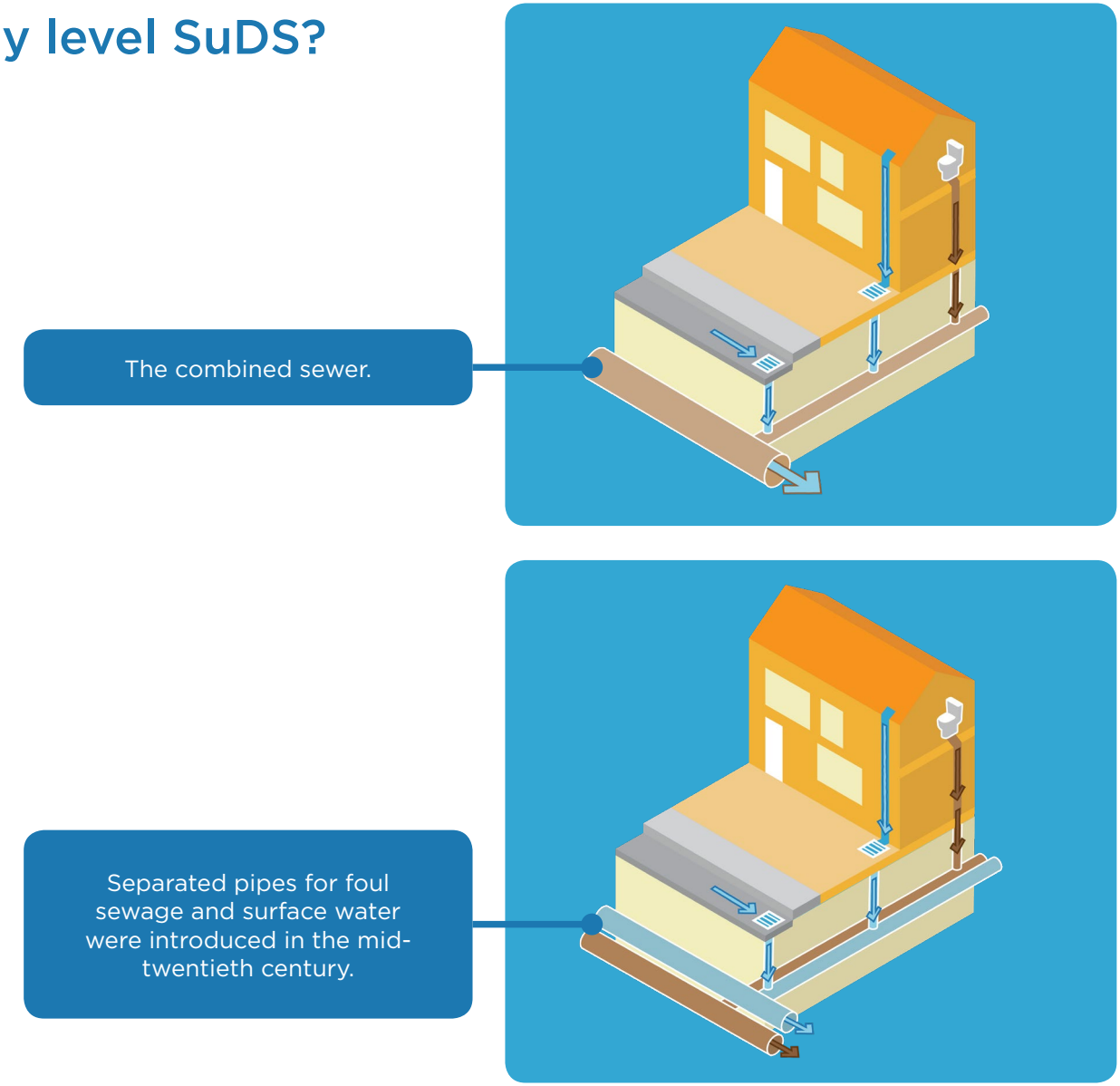


Image: Sewer flooding (credit: Belfast Telegraph)

Image: Combined sewer overflow

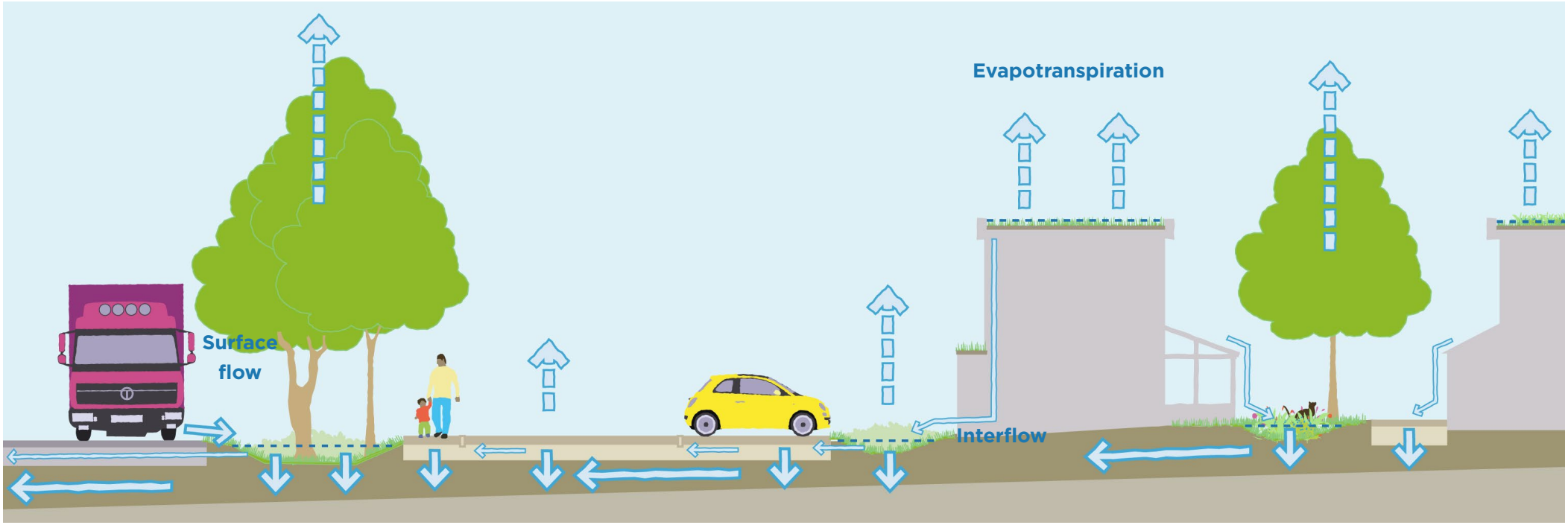
Increasing the amount of water contributing to sewer systems can result in increased risk of;

- **flooding** of our towns and cities
- dilute **sewage overflowing** (via combined sewer overflows) into our local streams and rivers.

SuDS deal with rainwater in a different way to existing drainage.

Integrating SuDS within your property will retain rainwater for a short period where it lands, releasing it slowly, reducing risks of flooding in your neighbourhood and pollution of your local rivers.

Diagram: SuDS collect rainfall, increasing the time that it takes water to reach the sewer



4.0 Designing SuDS for your property

4.1 Initial property assessment

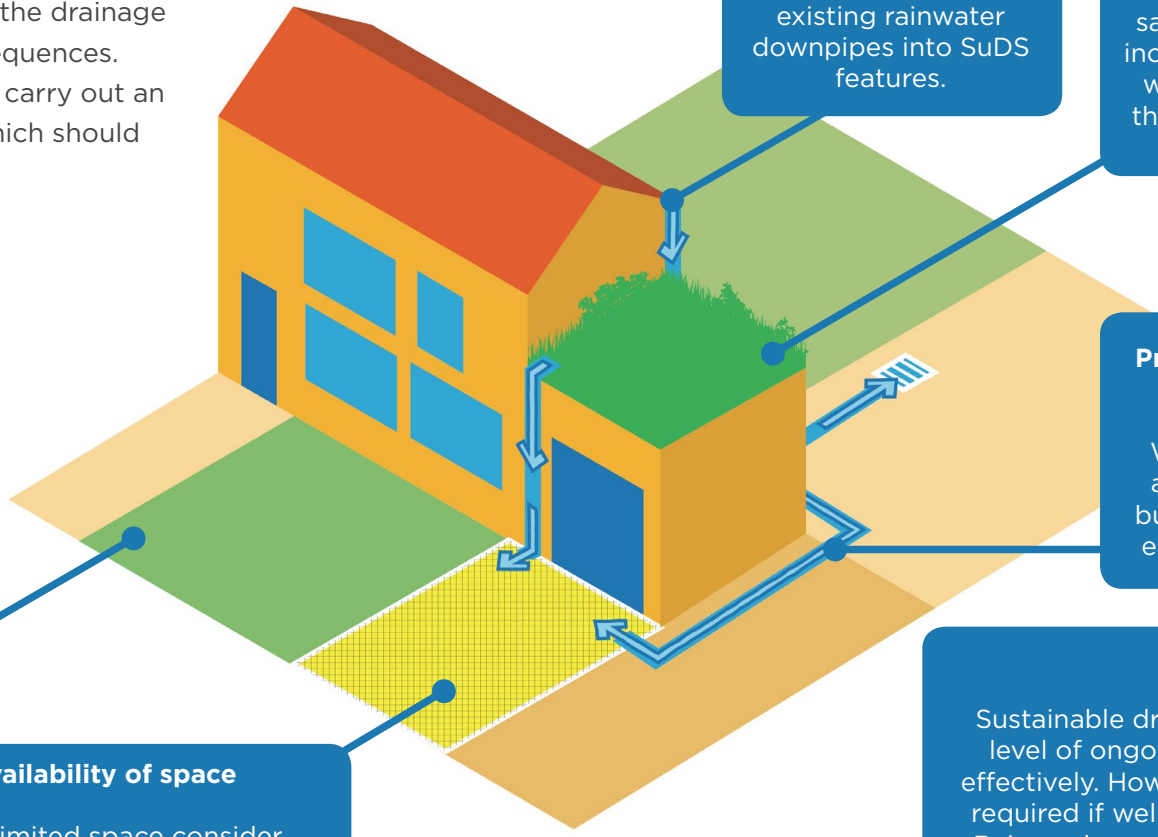
Using SuDS is different to simply draining all rainfall directly off your property into the drainage system without considering the consequences. Before you start it is advised that you carry out an initial assessment of your property which should include the following;

Locations of rainwater downpipes

Can these be directed into SuDS features? Consider opportunities to divert existing rainwater downpipes into SuDS features.

Cost

Different SuDS techniques will have different costs. Some rainwater management techniques such as de-paving will be low cost. Green roofs can save on *energy costs* in terms of increased insulation over flat roofs which saves on heating costs in the winter and air conditioning in the summer.



What is the nature of the soils?

Is your property located on clay soils or free draining soils. On clay soils, SuDS features can store rainfall and release it slowly to the storm sewer via an outlet. Where soils are free draining, rainwater could be allowed to soak into the ground naturally.

Property levels and surrounding ground levels

What are the levels of gardens and driveway in relation to the building. Can rainwater runoff be easily diverted to garden areas?

Availability of space

With limited space consider SuDS features such as Rainwater planters or integrating SuDS into the building (green roof) or driveway (permeable pavement).

Maintenance

Sustainable drainage systems require some level of ongoing maintenance to function effectively. However, the level of maintenance required if well installed can be over played. Raingardens and rain planters require some gardening for example. When selecting what types of SuDS features are suitable, the required level of maintenance should be a consideration.

Undertaking an initial assessment of the opportunities and potential limitations will allow you to think about and select the appropriate types of SuDS features for your property. There are a range of SuDS techniques that are suitable for application around the home and as part of residential developments. The following sections of this guide consider and provide initial advice on the range of SuDS techniques that would be suitable at property level.

4.2 Developing a strategy for managing rainfall runoff

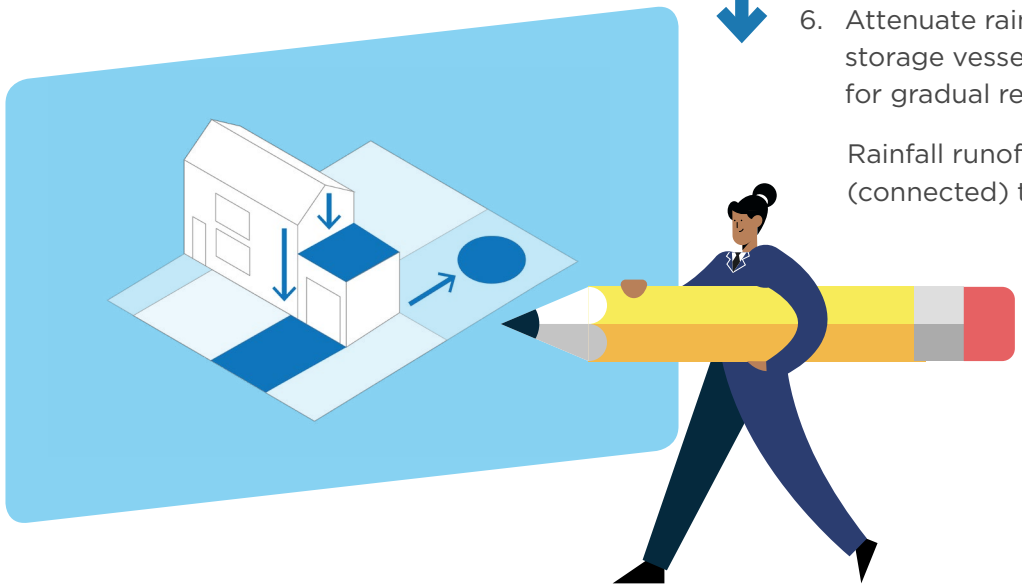
This Guide outlines a range of SuDS features which are suitable for application at property level, along with other runoff management practices such as de-paving, which help reduce the amount rainfall runoff leaving your property. The primary methods for reducing runoff from your property are:

- decrease the amount of hard surfacing from your property connected to the public sewer,
- temporarily hold rainwater with gradual release to the public sewer (typically over a period of 12-24 hours).

One of the simplest ways to store water within a property is to use shallow depressions in the ground, such as raingardens, that mimic the natural temporary pools, ponds and wetlands that used to be common in the Northern Irish countryside.

Your design does not need to be limited to a single feature, and multiple features / methods can be utilised to minimise the amount of rainfall leaving the property. For example, you could utilise a combination of de-paving and SuDS features to meet the objective of reducing runoff to the public sewer.

Important: Seek the advice from a Civil Engineer or Landscape Architect if you are unsure of how to approach the design.



In terms of how rainfall is used / released from your property, NI Water recommends the following preferential hierarchy:

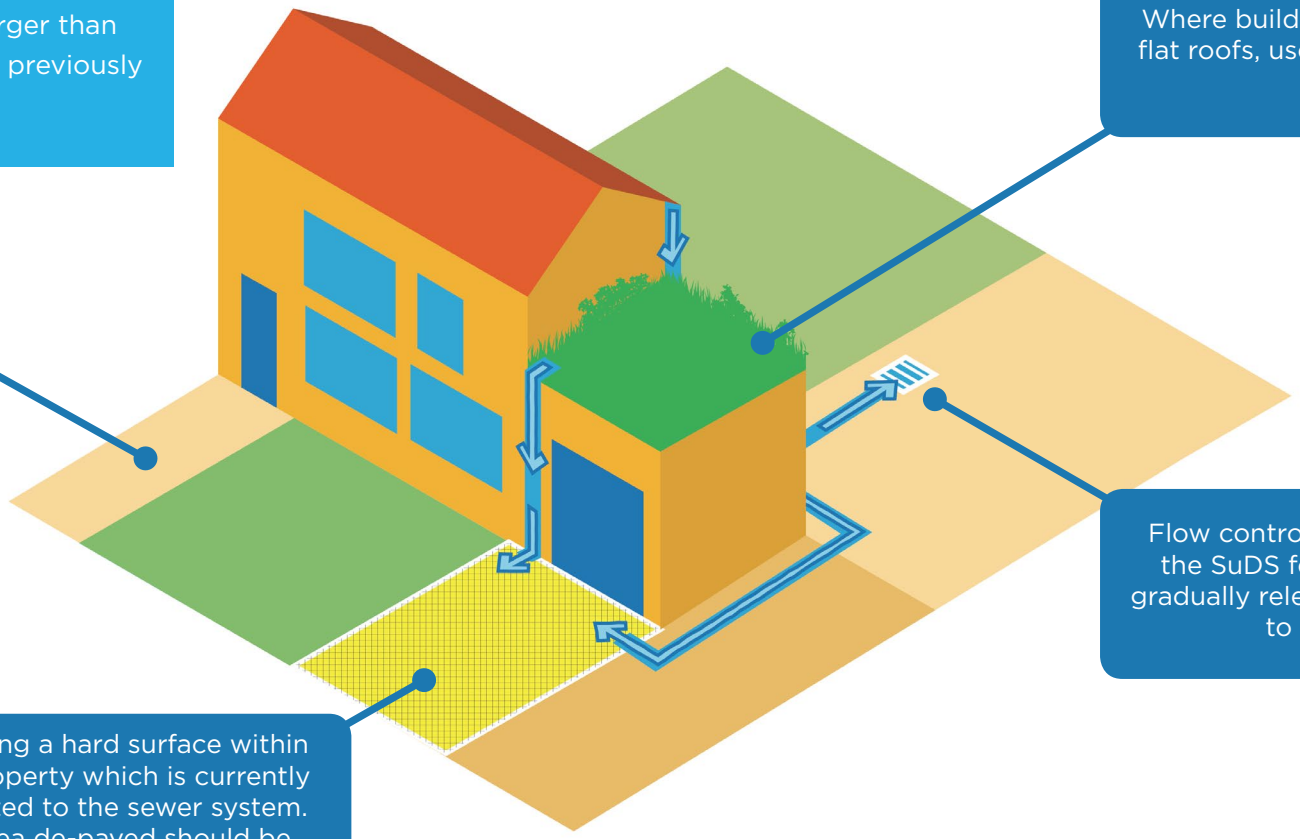
1. Maximise storage of rainfall runoff water within the development for later reuse.
2. Maximise infiltration potential with soakage of rainfall runoff to the ground.
3. Attenuate rainfall runoff in 'nature based' SuDS techniques for gradual release to a watercourse.
4. Attenuate rainfall runoff in underground storage vessels (such as oversized pipes) for gradual release to a watercourse.
5. Attenuate rainfall runoff in 'nature based' SuDS techniques for gradual release to the public sewer.
6. Attenuate rainfall runoff in underground storage vessels (such as oversized pipes) for gradual release to the public sewer.

Rainfall runoff should never be released (connected) to a foul sewer.

Top tip: For extensions where options may be limited, it may be more straightforward to adapt the drainage serving the existing property to divert rainfall runoff to a SuDS feature than to try and install SuDS to serve the extension. The impermeable surface area being drained by SuDS should be larger than the extension and should have been previously connected to the public sewer.

Where building extensions have flat roofs, use a vegetated green roof.

Diverting rainfall runoff from surfaces currently connected to public sewer to new infiltration feature or to a watercourse. Note that clay soils generally don't have sufficient infiltration capacity to infiltrate larger storms, so you should ensure that you have tested the soils to confirm that there is sufficient soakage capacity.



Flow control(s) are situated on the SuDS feature to allow for gradually release of rainfall runoff to the sewer.

De-paving a hard surface within your property which is currently connected to the sewer system. The area de-paved should be greater than the impermeable area proposed to be connected to the drainage system as part of the planning application.

The following sections of this guide give further advice on the SuDS features and rainfall management techniques appropriate to individual properties.

5.0 SuDS Features

5.1 Rainwater butt

Rainwater butts are a simple way of collecting water directly from a downpipe as it comes off a roof. However, if you don't consistently empty your rainwater butt, there may not be space for rainwater when it rains.

The use of rainwater butts is encouraged by NI Water as it reduces the demand on mains water supply for tasks such as watering the garden (plants and vegetables prefer clean rainwater to tap water).

To ensure that there will be sufficient storage whenever it rains, you can use a 'leaky' or 'smart' rainwater butt.

'Leaky' rainwater butts have valves positioned halfway up the container with the lower half collecting rainwater for residents to utilise and the upper-half filling and being released slowly after it rains.

Smart rainwater butts respond electronically to weather forecasting and release water in advance of significant rainfall events. The amount of rain forecast will determine how much stored rainwater will be released.

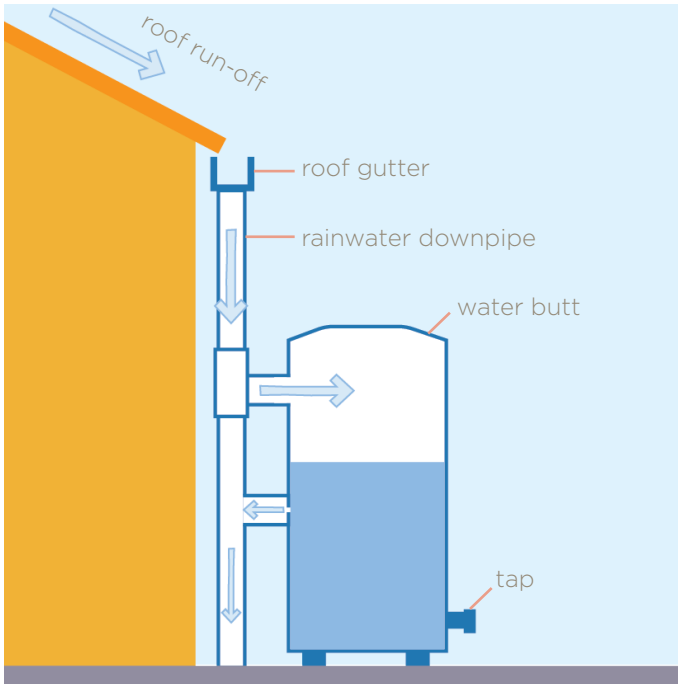
It is crucial to design the overflow system from both "Leaky" and "Smart" water butts.

The overflow provision should be connected to an appropriate discharge point to prevent waterlogging around the property or creating a hazard on footpaths in freezing conditions.

Smart Water Butts

Why save water at home?

How to Build a Rain Barrel



5.2 Rainplanters

A rainplanter box is a raised planter that makes the area around a downspout more attractive whilst also storing rainwater.

Top tip: Use plants that will tolerate both drought and saturation.

Here are some ideas for constructing a rain garden planter with key essentials in mind:

- Use an old wine barrel to create a planter. It allows plenty of room for gravel and drainage soil.
- Build a container of your own design using scrap wood.
- You can also get creative and grow veggies in a downspout planting bed. Just be sure to provide adequate drainage for this type of garden.

The guidance in the following link provides a step-by-step approach to designing and installing your own rainplanter.

Downspout Garden Planters – Plant A Rain Gutter Container Garden

How To Create A Rain Garden Planter

5.3 De-paving

When extending your property, there may also be an opportunity to reduce the extent of existing paved areas. Areas can be de-paved with the functionality of the space retained.

Rainwater downpipes can be directed towards the de-paved area and adjacent paved areas can be re-laid so that they fall towards the de-paved areas.

The de-paved areas can be finished in pea shingle gravel, similar to a gravel driveway, or topsoil, which can then be planted with a variety of plants.

At this property 2 strips of paving flags have been removed and underlying compacted subsoil removed to a depth of 400mm. The strip in front of the garage has been filled with pea shingle, whilst a planting area has been created in the other strip by infilling the excavation with a layer of drainage stone and topsoil. The adjacent paving flags have been re-laid with a slight fall towards the newly excavated strips.

Important: Be careful when lifting heavy paving slabs - use the right tools and protective clothing such as steel toe-capped footwear, protective glasses and gloves.

Image: Before depaving

Image: Immediately after depaving

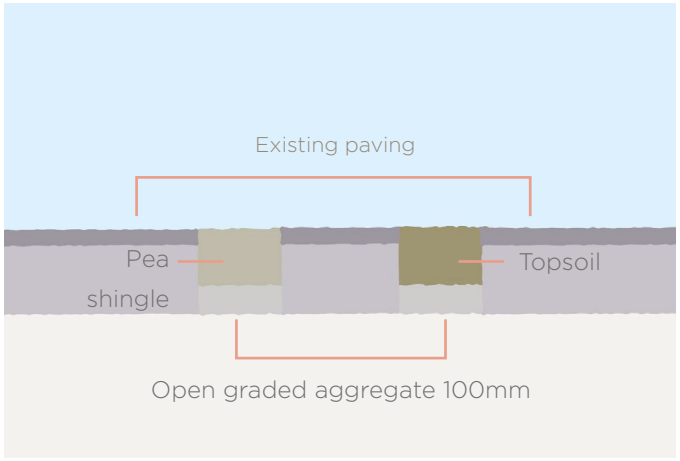


Image: De-paving construction detail

5.4 Green Roof

A green roof is a roof onto which vegetation is grown, or habitats for wildlife are established.

A combination of planting and a drainage layer is used as a covering on a flat roof.

Top tip: To minimise the risk of vegetation failing during prolonged drought periods it is suggested that the growing medium should be a minimum depth of 100mm. A lightweight green roof growing medium should be used.

Green Roofs: The Ultimate Guide

Easy and Simple DIY Green Roof with Flowering Alpine Plants and Sedums

Important: You need to check that the roof is structurally sound and can carry the weight of the green roof. A structural designer will be able to advise you on this.

Important: Designers of new buildings where a building warranty is being sought should consult with their appointed warranty providers technical standards, in relation to the design and roof build up for green roofs.

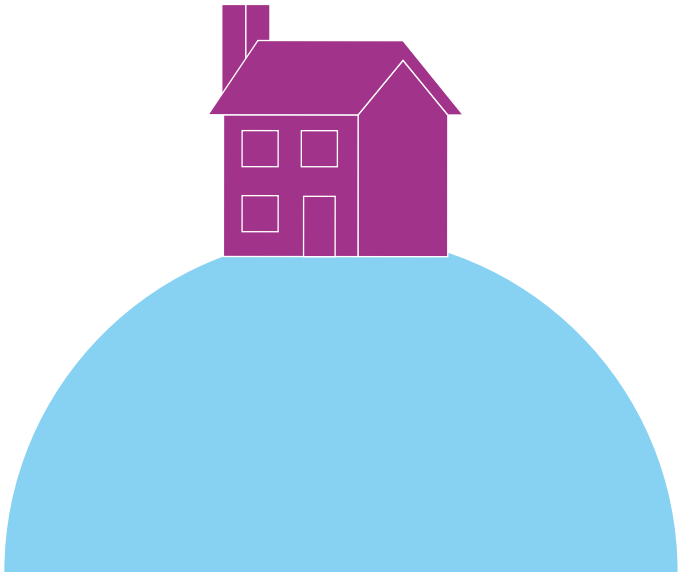
How to fit a green roof to a garden shed

We need to talk about Green Roofs

GRO Green Roof Code

Image: Green roof installed on an extension

Image: Green roof can provide a garden aesthetic to be enjoyed throughout the year



5.5 Raingardens

Raingardens give homeowners the chance to create an attractive garden feature that reduces the impact of runoff on surrounding streams and local piped drainage networks, whilst creating an attractive space in the garden.

Raingardens are usually located where water can soak naturally into the ground. Where soil is not free draining the raingarden can be under-drained with a layer of pea gravel or drainage stone to create a similar garden feature.

The raingarden can be gardened by anyone and can take on any character as long as water soaks into the ground and there is an overflow that connects back to the storm drainage pipe when the raingarden is full.

UK Rain Garden Guide

How to Make a Simple Rain Garden to Solve Stormwater Problems

UDL - Raingardens

Top tip: Check out *this website* for some helpful advice on designing your rain garden.

Image: Downpipe directed through water butt and then onwards to the rain garden.

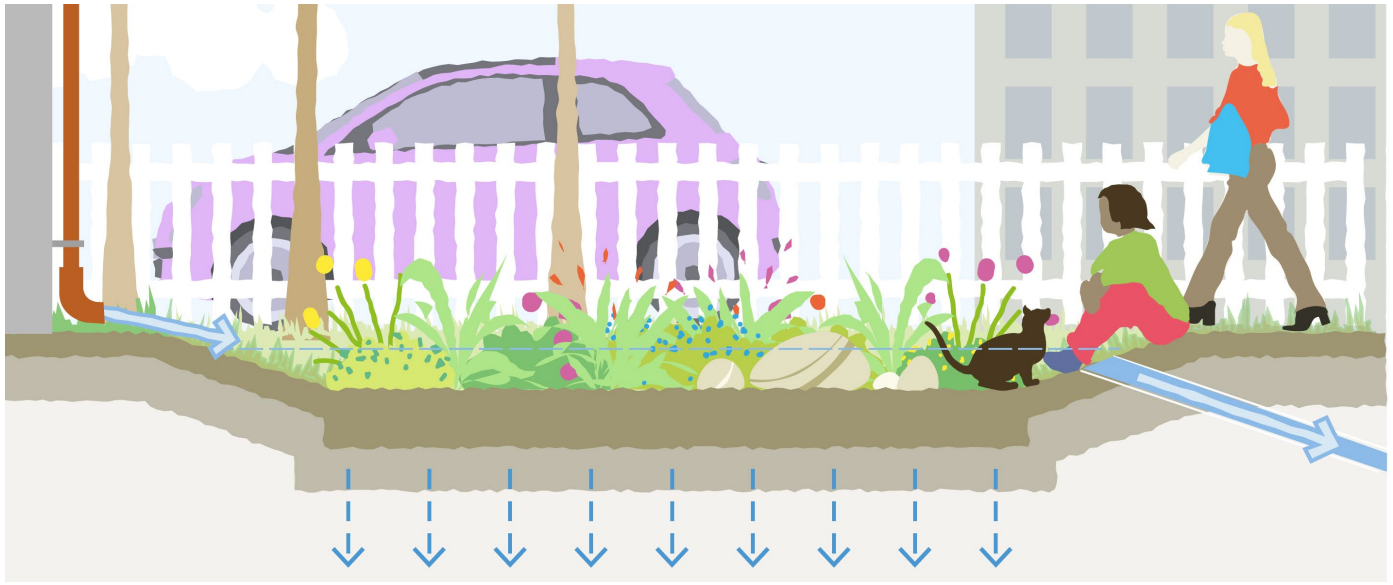


Diagram: Section of a typical raingarden.

5.6 Permeable Pavement

Permeable Pavement can be used where the surface is trafficked by car or foot. The technique is a variation on a gravel drive that allows rain to soak into the stone layer below the surface and then into the ground.

Special concrete blocks with extra wide joints is commonly used in most applications but other surfaces such as gravel in a plastic grid, grass grid, grasscrete or resin bound aggregate can also be used.

The water that flows through the surface into the pavement can flow laterally through the base layer of the permeable pavement and either connect to other SuDS features, or to the local drainage network. Water can also soak directly into the ground where free draining soils are present.

Understanding Permeable Paving

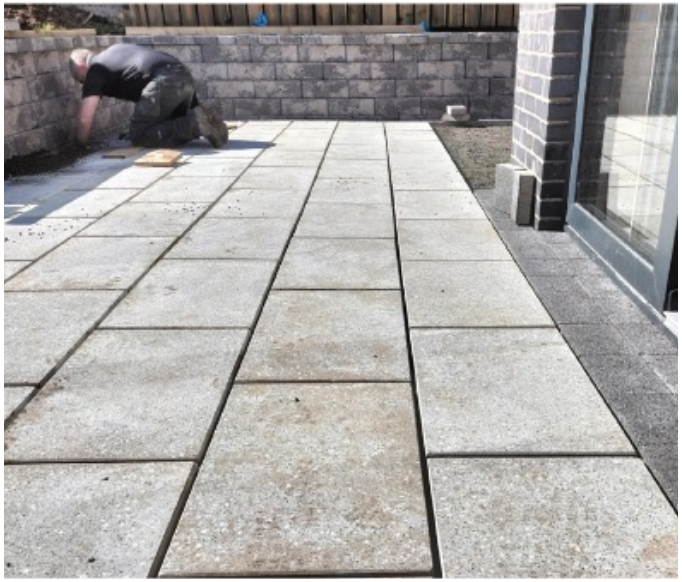


Image: Permeable paving being installed in rear patio using normal slabs with 10mm plastic spacers (Belfast).

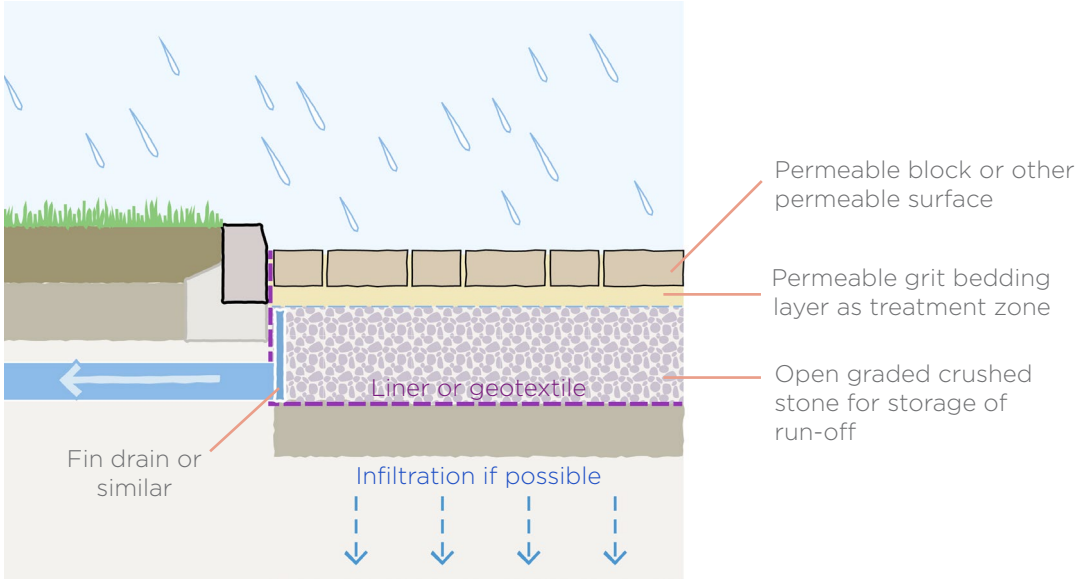


Diagram: Typical section of permeable pavement

5.7 Soakaways

Most SuDS features can allow natural soakage of water into the ground.

Soakaways are described as buried structures and can take the various forms;

- stone filled pits,
- concrete ring,
- geocellular plastic 'crates' wrapped in a geotextile fabric.

For soakaways to work properly there has to be

- Free draining soils.
- Sufficient storage volume within the soakaway to temporarily store rainfall to allow it to soak into the ground.

Important: Many areas of Northern Ireland are covered by stiff clay, which provides insufficient opportunity for infiltration. Don't assume that the soil at your property will infiltrate. Always carry out an infiltration test to establish how quickly rainwater soaks away.

Soakaways: What are They & How to Build Them

Managing Rainfall Runoff from Individual Properties

Ensure that the soakaway is placed a suitable distance from the building and property boundary so that it does not cause structural damage to the building. It is advised that you seek the guidance of a suitably qualified engineer where you are thinking of using soakaways / infiltration to manage rainfall from your property.

Northern Ireland Building Control guidance on drainage

Soakaways are sized based upon how quickly the soils will allow rainfall to soak into the ground.

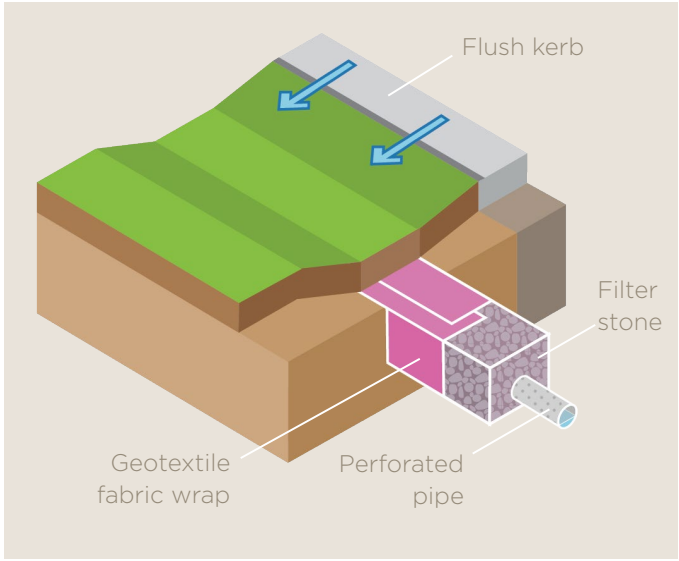
The BRE Digest 365 provides technical information on how to undertake a soakaway test and size a soakaway.

Top tip: If your soil infiltrates at a rate of 50mm per hour or more, it should be suitable for a soakaway.

One of the issues with a soakaway is that over time it can fill with silt and no longer function. Where rainwater runoff can be filtered through soil this filters out silt and considerably lengthens the lifespan of the soakaway.

Tree roots can undermine the structure of a soakaway, leading to its failure. Therefore, the proximity of trees and their potential growth should be considered during the planning and installation of a soakaway.

Image: Soakaway being installed



5.8 Underground storage

Stormwater attenuation tanks can take many forms, but using larger diameter storage pipes or plastic tanks are likely to be the most suitable at property level. A flow control is placed at the downstream end of the tank to hold water back during periods of rainfall.

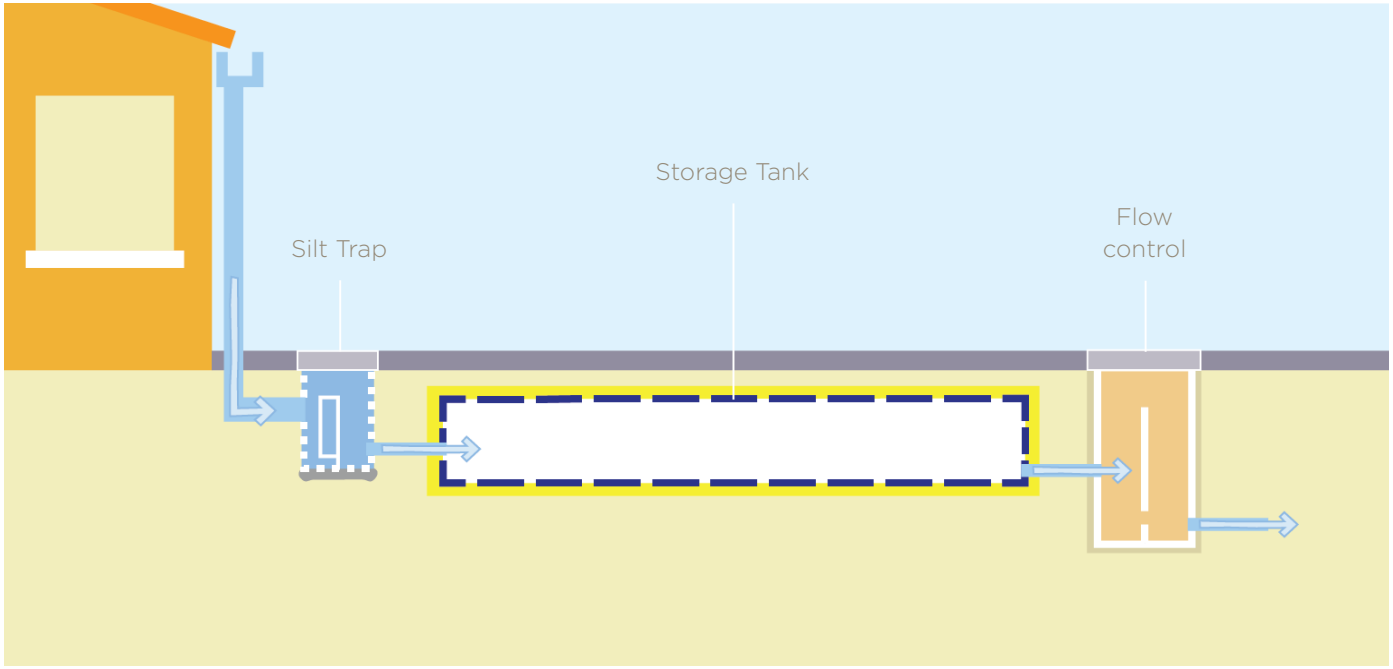
Providing underground storage does not deliver any of the other benefits that are provided by other nature-based SuDS features like green roofs or rain gardens.

It is recommended that the advice of a suitably qualified engineer is sought when determining the location of the underground storage, particularly when the underground storage is located near a building.

Tanks should always be installed in accordance with manufacturers requirements.

Important: Existing pipe work around properties tends to be shallow. Where incorporating underground storage you should ensure that you tie into existing pipe inverts and can achieve sufficient structural cover over the storage structure.

Pipe Volume Calculator



Managing Rainfall Runoff from Individual Properties

6.0 Sizing for load bearing conditions

Most SuDS features can be installed without detailed engineering knowledge. Care should be taken with suitably qualified engineering advice sought in the following situations:

- Installing a green roof onto a roof structure - check with a structural designer that the structure can adequately take the additional load from saturated soil and vegetation.
- Installing an unlined rain garden or permeable pavement within 5m of a building foundation – check if vulnerable soils such as chalk or running sands are present.
- Installing permeable pavement where it is likely to be trafficked by vehicles – ensure that there is sufficient build-up within the pavement for the intended vehicle loading.

Image: Sloped greenroof at a Co-housing Project

7.0 Sizing to hold rainwater

Increasing paved and roofed areas at your property increases the amount of rainfall runoff that leaves your property.

To mitigate this increase we can temporarily store rainfall runoff within SuDS structures allowing flow to leave gradually using a flow control, which is a small opening that rainfall runoff has to pass through (similar to water leaving a sink through a plughole).

7.1 Sizing Flow controls

By restricting flow out through a flow control, you need to ensure that the flow control is not prone to blockage, otherwise the flow control will require regular checking and maintenance.

Storing rainfall in open systems such as rain gardens means that leaf litter and other debris is visible and easier to remove. For underground storage structures, all points of inlet (gutter downpipes and gratings) should be protected from leaf, litter and silt getting into the storage structure.

The minimum suggested opening size of a flow control opening is 20mm diameter. A 20mm diameter opening would allow for all contributing surface areas up to 300m2.

'Off the shelf' Flows control products can reviewed at the following websites;

7.2 'Rule of thumb' sizing of SuDS

Free Flush

SuDS Store

Stainless Steel Mesh Basket

structures

The following table provides a practical 'rule of thumb' guide to the size that SuDS features should be to manage a reasonably heavy rainfall event.

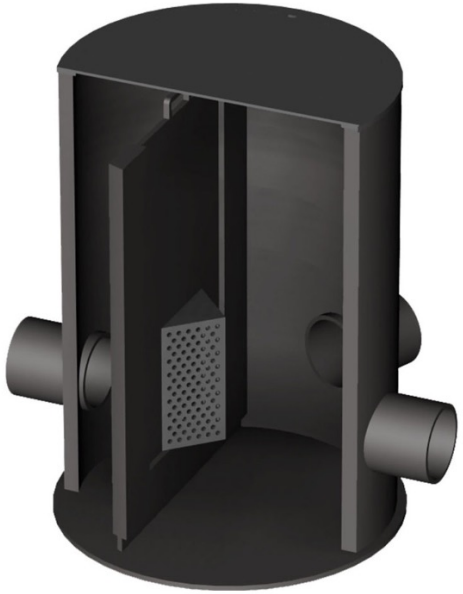
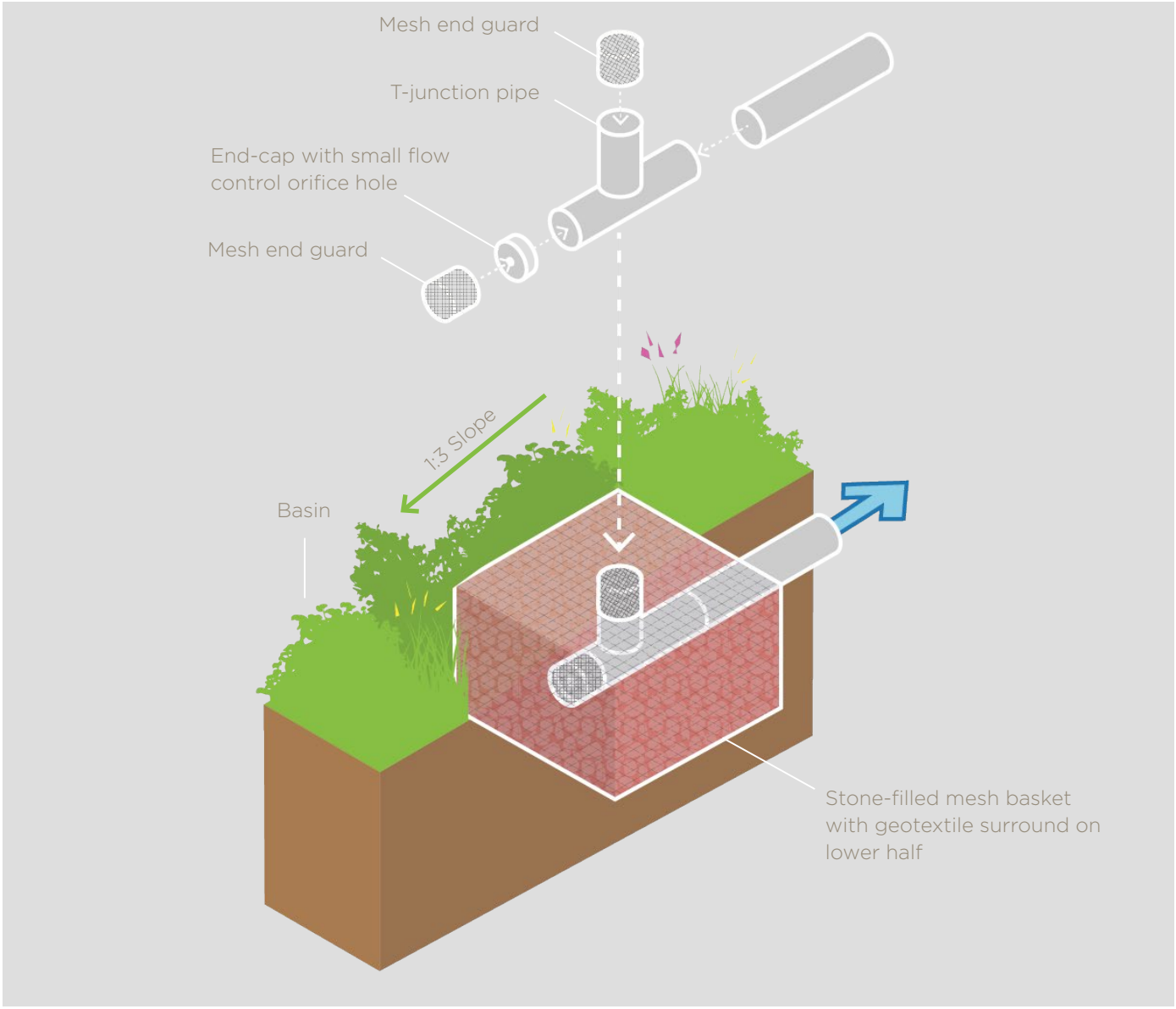


Image: Example of a proprietary flow control chamber - Controflow Universal 500

Feature	Sizing of structure	Notes
Leaky or Smart Rainwater Butt	Provide 36 litres of temporary attenuation storage for every 1 m^2 of impermeable area being drained.	Rainwater butts come in standard sizes. Both leaky and smart rainwater butts can be sourced from specialist suppliers.
Rain planter	Minimum Internal (soil) area of 1m^2. Provides storage for roof areas up to 18m^2.	Provide erosion control (cobbles and stones for example) where the downpipe puts water to the surface of the rain planter.
Green roof	Soil depth minimum of 100mm. Roof to be flat with maximum gradient of 1 in 80.	Ensure that roof structure has sufficient structural capacity to carry the extra weight from the green roof.
Permeable pavement for patio areas	Minimum depth of clean voided stone sub-base to be 150mm with a 50mm grit layer onto which the paving would be laid. Permeable pavement to be reasonably flat.	Ensure that the structural depth is considered to carry any intended vehicular loads and takes account of underlying soil conditions. Soft / clay soils may require a capping layer.
Rain garden	Based upon 150mm depth of rainwater stored – 1m^2 of rain garden for every 5m of impermeable area. 300mm depth of water stored – 1m^2 of rain garden for every 9m of impermeable area.	Selected plants should be both resilient to drought and saturation conditions. On clay soils ensure that the outlet is level with or below the level of the rain garden.
Soakaway	The soakaway should be sized based on the soakage potential of the soils within the property	Soils must be free draining. Carry out a soakaway test to establish / demonstrate the drainage capacity of the soil. Seek the advice of an appropriately qualified engineer, particularly where the soakaway is located within 5m of buildings or 3m from the property boundary.
De-paving	Minimum area of de-paving to equal the additional roofed or paved area being installed.	You may be required to provide evidence that the area indicated as de-paved has previously been paved.
Underground storage in an oversized pipe	Provide 36 litres of temporary attenuation storage for every 1m^2 of impermeable area being drained. 30cm diameter pipe (laid reasonably flat) – 1 m length of pipe for every 2m^2 of impermeable area. 45cm diameter pipe (laid reasonably flat) – 1m length of pipe for every 4.4m^2 of impermeable area	Provide a means of trapping silt and leaves prior to the soakaway (catchpit and leaf guard)

Examples of simple flow controls that can be made at home are shown in the following images.

Image: Completed flow control in stone-filled filter basket before planting



8.0 Preventing blockage and providing overflows

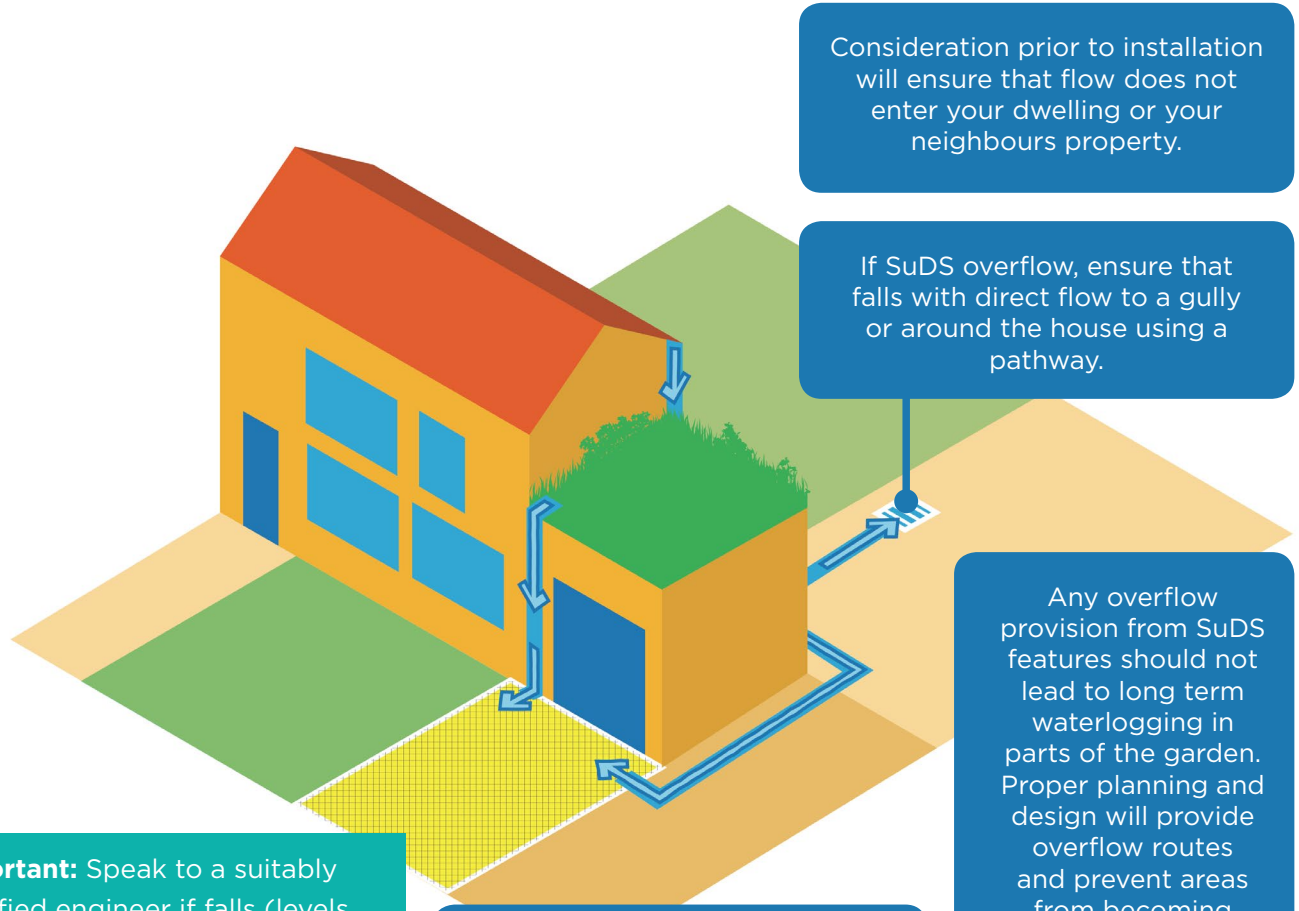
Drainage features can be susceptible to blockage from silt and other debris such as windblown litter and leaves.

When designing and installing you should always provide a means of trapping silt and leaves at the points of entry to the drainage system. When a blockage is found, this should be cleared immediately.

All drainage features must have a way to overflow to deal with potential blockage or extreme rainfall and to ensure that your home or your neighbours' properties do not get flooded.

Overflows are the point at which the SuDS structure over-tops. Rainfall runoff would pass over the overflow once the storage volume has been filled.

Overflow routes (safe passage of flow off the property) can be provided through using existing slopes or manipulation of ground levels to ensure that excess rainwater flows along pathways or landscaped areas and is deflected away from or around the property, whilst not impacting neighbouring properties.



9.0 SuDS upkeep

Like your roof gutters and lawn, SuDS will require some upkeep (maintenance) from time to time to ensure that they continue to perform and look well.

The type of upkeep for most SuDS features is the same as the types of activities that you are most likely already undertaking in your garden or outside space.

Check inlets and outlets to make sure that they are free from blockage and remove any blockages that you find.

Important: For green roofs make sure that you appropriately assess the risk of accessing your roof to ensure your own safety before undertaking any maintenance.

10.0 Permissions, consents and standards

When you build or extend a property you create areas of hard surfacing such as roofs and driveways. To ensure compliance with relevant regulations and avoid nasty surprises post construction or your new build property or extension, homeowners should ensure that:

- they understand relevant regulations and ensure correct permissions are in place for disposal of rainwater (and domestic wastewater)
- proposed SuDS do not impact the structural integrity of the building.
- where building warranty is being sought, SuDS are built to warranty provider standards.

10.1 NI Water

Where a new discharge of storm runoff from a property is proposed to a public main sewer, agreement will be required with NI Water under Article 163 of the Water and Sewerage Services Act (NI) 2016. A Pre-Development Enquiry should be made with NI Water to check for availability and if so, capacity within the receiving sewer. NI Water recommendation of approval is not guaranteed within highly constrained public sewer networks.

Pre-Development Enquiry Single Unit Developments (niwater.com)

10.2 Planning Permission

NI Water became a statutory consultee to the planning process in 2015.

"The Department for Infrastructure or water undertaker as defined under Article 13 of the Water and Sewerage Services (Northern Ireland) Order 2006, shall be consulted where a development proposal is likely to significantly impact upon the availability of suitable water and sewerage infrastructure to service development proposals."

NI Water may, when consulted by the local planning authority through the planning process, recommend approval for single property type developments up to a six bedroom home, if the applicant clearly demonstrates through the planning application that they have correctly applied the advice provided by this Guide.

The design of SuDS should meet the requirements of the local planning authority.

Belfast City Council SuDS Planning Guidance

New Sewer Connection Guidance Notes

10.3 Building Regulations (NI)

SuDS design should not conflict with the guidance set out within Building Regulations (Northern Ireland) 2012 Guidance technical booklets. Particular consideration should be given to Booklets E, N and R.

10.4 Building Warranty

Building Warranty providers may have their own set of building Standards which may include standards for design and construction of SuDS. Installations will have to ensure that Warranty provider standards are met to secure warranty provision.

10.5 DfI Rivers

Any discharge to a designated or non-designated watercourse (which by definition includes culverted streams, ditches, ponds and other natural water features which connect to a watercourse) will require Schedule 6 consent Drainage (NI) Order (1973). The developer should consult with DfI Rivers.

11.0 Before you apply for planning

Developers of individual properties have the opportunity to consult with NI Water through our single unit pre-development enquiry process.

The following information will assist NI Water in understanding your proposal and smooth the process of seeking a sewer connection for storm runoff along with providing comment on future planning applications.

- **a plan** showing how the roofed and paved surfaces from the property will be drained.
- **calculations** to demonstrate that SuDS features, and any other rainfall management techniques have been adequately sized.
- **a short statement** (1-2 pages maximum) describing how the development will be drained and how SuDS have been utilised.

12.0 Glossary

Biodiversity	The diversity of plant and animal life in a particular habitat.
Climate change	Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer).
Conventional drainage	The traditional method of draining surface water using gully pots and subsurface pipes.
Conveyance	Movement of water from one location to another.
Diffuse pollution	Pollution arising from land-use activities (urban and rural) that are dispersed across a catchment, and do not arise as a 'point' pollution load at a single identifiable location.
Evapotranspiration	Evapotranspiration is the sum of evaporation and plant transpiration from the surface to the atmosphere.
Storage	Volume within the SuDS structure used to temporiarly store rainfall runoff during extreme rainfall events.

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