This document was classified as: OFFICIAL

TEES VALLEY

SUSTAINABLE DRAINAGE SYSTEMS (SuDS) GUIDANCE

DESIGN GUIDE & LOCAL STANDARDS

DARLINGTON BOROUGH COUNCIL

HARTLEPOOL BOROUGH COUNCIL

Middlesbrough moving forward

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Tees Valley Sustainable Drainage Systems (SuDS) Guidance

Design Guide & Local Standards

Revisions

See individual Sections for details of revisions

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Contents

Executive Summary 8
How to use this guide 9
Volume 1: Tees Valley Design Guide 10
1. Background and Legislation 11
1.1 Flood and Water Management Act 2010 11
1.2 National Policy 11
2. The Application Processes 13
2.1 Introduction to the planning process 13
2.2 Planning Application Requirements 13
2.3 Pre-Application discussions 13
2.4 Master Planning 14
2.5 Requirements for a Planning Application 14
2.6 Checklist 15
3. Introduction to SuDS 16
3.1 SuDS Techniques 16
3.2 SuDS Management Train 17
3.3 Education 17
3.4 SuDS Management Train 18
4. Principles of SuDS 19
4.1 Local principles and requirements 19
4.2 Health and Safety 21
5. Design Criteria 23
5.1 Geology and Soil Type 23
5.2 Rainfall 24
5.3 Topography 24
6. SuDS components 25
6.1 Rainwater Harvesting (Ref: CIRIA the SuDS Manual) 25
6.2 Green Roofs 26
6.3 Water Butts 27
6.4 Filter strips 28
6.5 Swales 29
6.6 Bioretention areas and Rain Gardens 30
6.7 Filter drains and trenches (Ref CIRIA the SuDS Manual) 32
6.8 Permeable Pavements 33

6.9 Geocellular structures, oversized pipes/ tanks 34
6.10 Detention basins (Ref CIRIA the SuDS Manual) 34
6.11 Ponds (Ref CIRIA the SuDS Manual) 35
6.12 Wetlands (Ref CIRIA the SuDS Manual) 37
6.13 Maintenance of slopes 38
6.14 Inlets, Outlets and control specification and requirements 38
6.15 Inlets and outfalls protections 39
7. Landscape Design Criteria 40
7.1 Accreditation of plant sources 40
7.2 Planting design strategy 40
7.3 Invasive plants and alien species 40
7.4 Planting requirements 41
7.5 Planting list for SuDS 41
7.6 Contaminated Land 41
7.7 Landscape Maintenance during construction period 42
7.8 Landscape maintenance during operation 42
8.0 Water Quality 44
8.1 Protection of the groundwater or receiving watercourse 44
8.2 Creating opportunities for wildlife – biodiversity (ecology) 44
9.0 Green Infrastructure 46
10. Open space 47
Volume 2: Specific Local Standards 50
11. Runoff Destinations 51
11.1 Local Standards 51
11.2 Informative 51
12. Flood Risk outside the Development 53
12.1 National Standard 53
12.2 Local Standards 53
12.3 Informative 53
13. Peak Flow Control 55
13.1 National Standard 55
13.2 Local Standards 55
13.3 Informative 56
14. Volume Control 57
14.1 National Standard 57
14.2 Local Standards 57
15. Flood Risk within the Development 58
15.1 National Standard 58

15.2 Local Standards 58
15.3 Informative 62
16. Structural Integrity 64
16.1 National Standard 64
16.2 Local Standards 64
16.3 Informative 64
17. Designing for Maintenance considerations 66
17.1 National Standard 66
17.2 Local Standards 66
17.3 Informative 67
18. Construction 69
18.1 National Standard 69
18.2 Local Standards 69
18.3 Informative 70
Appendix 1: Pre-Application Stage 71
Appendix 2: OUTLINE Application Stage 72
Appendix 3: FULL Application Stage 73
Appendix 4: Discharge of Condition Checklist 74
Appendix 5: Plants suitable for SuDS in the Tees Valley 80
Appendix 6: SuDS Glossary of Terms 82

Figure 1 - Conceptual Rainwater Harvesting System 25
Figure 2 -Green Roof Multi Layered System 26
Figure 3 - Conceptual Water Butt Design 27
Figure 4 - Typical Filter Strip 28
Figure 5 - Typical Swale 29
Figure 6 - Typical Bioretention area and Rain Garden 30
Figure 7 - Pervious pavement system types: Partial infiltration 33

Executive Summary

This document has been produced by a working group from the Local Authorities of Darlington, Hartlepool, Middlesbrough, Redcar & Cleveland and Stockton Borough Councils (Tees Valley Authorities). The Tees Valley Authorities are committed to making our area a place that provides the best possible quality of life for all who live and work here. Making it more sustainable is an important part of supporting this vision and it is therefore implicit that new development should incorporate sustainability measures that help achieve this goal. In designing and implementing SuDS, consideration should be given to ensuring that they: reduce damage from flooding, improve water quality, protect and improve the environment, protect health and safety and ensure stability and durability of drainage

This document has been split into two sections. Volume 1 provides an overview into SuDS techniques and policy requirements. Volume 2 highlights the Tees Valley specific local standards intended to provide clarity to the national standards. The whole document has been produced to strongly promote the use of sustainable drainage systems and help manage increased surface water runoff from new developments and help mitigate flood risk. It indicates the minimum standards to ensure a satisfactory scheme is constructed, they are not intended to preclude any requirement for a higher standard that may be deemed necessary.

The document is intended to be used by architects, engineers, planners and developers involved in the preparation of schemes for new development. It is not intended to be a prescriptive document, although Volume 2 does set certain standards which will normally be required as a condition for new developments.

Volume 2 is intended to be a live document and will be updated to reflect emerging good practice which can be adopted by Tees Valley Authorities. Developers and designers are encouraged to contribute to the future development of this document.

How to use this guide

Volume 1 aims to;

- Provide a clear and consistent approach to the implementation of SuDS;
- Enable developers to complete efficient site assessment, SuDS selection and detailed design;
- Provide an organised structure for planning applications for the Tees Valley area;
- Provide key design specification requirements;
- Facilitate successful operation and maintenance.

Key Information is highlighted in green boxes throughout this document.

Volume 2 aims to;

- Provides technical guidance relating to the Tees Valley local standards for the management of surface water runoff.

National Standards are highlighted in grey boxes. Information has been obtained from Defra's 'Non-Statutory Technical Standards for Sustainable Urban Drainage Systems' – March 2015

Specific Local SuDS Standards for the Tees Valley are highlighted in blue boxes.

Who should use the document;

- Developers;
- Architects and Urban Planners;
- Drainage Engineers;
- Landscape Designers;
- Each of the Tees Valley Lead Local Flood Authorities (LLFA).


HARTLEPOOL
STOCKTON-ON-TEES
REDCAR & CLEVELAND
DARLINGTON
MIDDLESBROUGH

1. Background and Legislation

1.1 Flood and Water Management Act 2010

The Flood and Water Management Act 2010 (FWMA) was introduced to address the concerns and recommendations raised in the Pitt Report following the 2007 floods.

To aid this, the Government strengthened existing planning policy which makes it clear that the Government's expectation is that sustainable drainage systems will be provided in future developments wherever this is appropriate. Local planning policies and decisions on planning applications relating to major development - developments of 10 dwellings or more; buildings of more than 1,000m^2 or development sites over 1 hectare (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010). National Planning Policy Framework, Section 14 will assist in ensuring that sustainable drainage systems for the management of surface water run-off are put in place, unless demonstrated to be inappropriate.

1.2 National Policy - other relevant legislation to the considered;

National Planning Policy Framework
Written Statement on Sustainable Drainage Systems (HCWS161)
Non-Statutory Technical Standards for Sustainable Drainage Systems (SuDS)
Planning Practice Guidance

Each Lead Local Flood Authority is a statutory consultee to the relevant Planning Authority, who are jointly responsible for approving all surface water drainage systems, in line with the Government's National Standards and to the specific local standards set out in Volume 2 of this document.

The Planning Authority are to be satisfied that the proposed drainage system is appropriate and will ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for on-going maintenance over the lifetime of the development.

The documents have been produced as a guide for developers to enable them to submit the appropriate information to the LLFA for approval, handover and maintenance of SuDS schemes. In order to be approved, the proposed drainage system will have to meet the local standards. It is considered that discussions should be held at the earliest possible stage with the Planning Authority and LLFA to discuss the proposals.

In designing and implementing SuDS, consideration should be given to ensuring that they: reduce damage from flooding, improve water quality, protect and improve the environment, protect health and safety and ensure stability and durability of drainage.

2. The Application Processes

2.1 Introduction to the planning process

This section details the approval process for implementing SuDS.
The points below indicate the various stages of the planning application process;

- Pre-Application;
- Planning Application Submission;
- Validation of Application;
- Consideration by Statutory and Non-Statutory Consultees;
- Approval or negotiations of Application;
- Discharge of conditional approval (if appropriate);
- Future maintenance and adoption.

2.2 Planning Application Requirements

Applicants and developers should be aware that from the 6th April 2015 the Lead Local Flood Authority became statutory consultee on all major developments. A major development is;

- 10 or more dwellings;
- buildings of more than 1,000m^2 floor space or;
- development sites over 1 hectare.

There is a legal requirement to incorporate SuDS drainage proposals into planning applications for major development. For other developments the use of SuDS is encouraged as part of drainage proposals.
The level of information which would need to be submitted for each type of application or stage within the planning process will vary depending on the size of the development, and should take into account flood risk, site constraints and the proposed sustainable drainage system.

2.3 Pre-Application discussions

The LLFA should be involved in any pre-application discussions relating to all future major development. It is recognised that the most appropriate surface water drainage systems are likely to be achieved through early discussions prior to the master planning stage of the development. It would be beneficial for a range of people to be involved at the pre-application stage, including the Local

Planning Authority (LPA), LLFA, Environment Agency, sewerage undertakers, the developer, consultants, drainage engineers, landscape architects or urban designers and ecologists.

Pre-application discussions are encouraged as they will help identify the design criteria which apply to your development.

Any application should clearly identify who will be responsible for maintaining the sustainable drainage systems and the funding regime for maintenance in perpetuity.

2.4 Master Planning

Should be undertaken at the beginning to develop an area wide strategy especially where a number of developments could resolve SuDS issues together. This would enable the creation of larger schemes with lakes, ponds, basins etc. Including access paths within the green infrastructure area. When undertaking master planning the following should be taken into consideration:

- Natural design criteria – blue/green corridor analysis of the site;
- Provision of real amenity and nature conservation value;
- Landscape character – fit with the local character, paving and other materials, plant species, and take influence from historic watercourses;
- Existing topography to develop interesting shapes to the SuDS features;
- Local materials;
- Provision of structures that should fit naturally into the landscape.

2.5 Requirements for a Planning Application

In order to assist in the assessment of planning applications the LLFA would require the information detailed below to accompany any major planning application. The Tees Valley Technical Guidance Documents Vol 1 & 2 will assist with the local standards along with other requirements when designing your developments drainage.

<u>Detailed Desktop Study</u>

- Topographic Survey of the development site;
- Existing surface water flow routes/ drainage infrastructure and identification of any watercourses that are present;
- Flood risk from rivers/surface water and/or groundwater;
- Geological and soil types generic to the area.

Flood Risk Assessment (FRA)

- An appropriate site-specific FRA where specified as a requirement by the Environment Agency (EA) to see criteria; Site-specific flood risk assessment: Checklist (https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section)
- Evidence of discussions/agreements with Sewerage Undertaker

Drainage Strategy

- Sustainable drainage proposals;
- Outfall locations;
- Discharge rates;
- Storage requirements and supporting calculations;
- Management & Maintenance Strategy/Plan;
- Ground investigations (dependant on type of drainage proposal).

The above should be accompanied by

- Detailed Drainage Drawings including; Details of inlets, outlets and flow control specifications, Scalable Long and Cross Sections of the proposed drainage system;
- Flow paths for the storm events 1 in 1yr, 1 in 2yr, 1 in 30yr and 1 in 100yr + Climate Change (as specified in Volume 2 of this document);
- Storm simulation results/reports (e.g. Micro Drainage);
- A full checklist of items required for applications can be found in Volume 2 of this document.

2.6 Checklist

A full checklist of items required for applications can be found in Appendices 1, 2 3 & 4 at the end of this document.

3. Introduction to SuDS

SuDS manage surface water flows, with the aim of reducing flooding, pollution and improving biodiversity & amenity value. SuDS assist in the replication of natural drainage conditions. SuDS components can be applied to any development regardless of size, condition, topography or environmental condition.

The SuDS philosophy has 4 key pillars as detailed below:

- Quantity – reduce the risk of flooding and erosion by controlling flow volumes and the frequency of surface water runoff
- Quality – assist in the treatment of pollution in surface water runoff
- Amenity – provide visual and community benefits for people
- Biodiversity – enhance and create habitats for wildlife

It is recognised that SuDS should be considered early and fully integrated into the surface water management and urban design process.

SuDS are a sequence of management practices, control structures and strategies which are designed to effectively drain surface water, while minimising pollution and managing the impact on the water quality of local water bodies. These systems are more sustainable than conventional drainage methods because they:

- Manage runoff volumes and flow rates, reducing the impact of urbanisation on flooding
- Protect or enhance water quality
- Are sympathetic to the environmental setting and the needs of the local community
- Provide a habitat for wildlife alongside urban watercourses
- Encourage natural groundwater recharge (where appropriate)

3.1 SuDS Techniques

SuDS use a number of techniques generally based on natural drainage features to collect, treat, store and discharge storm water slowly to the environment. The techniques are formulated around Prevention, Source Control, Site Control and Regional Control. These in sequence are normally referred to as a SuDS management train.

3.2 SuDS Management Train

The most appropriate method to manage surface water is to implement a management train. Reducing the impacts of increased surface water runoff from proposed developments can be facilitated by controlling surface water at all stages along the source/pathway/receptor model.

Redevelopment within all sites should seek a reduction in surface water peak discharges along the surface water runoff pathway, as close to source as is practicable.

3.3 Education

SuDS present an opportunity to educate and engage communities about water management and to grow a greater appreciation and respect for urban water and sustainable design.

3.4 SuDS Management Train

What?	How?	Example
Prevention	Good housekeeping and site design to reduce/manage runoff and pollution	 Rain garden
Source Control	Runoff managed as close to source as possible, e.g. green roofs, permeable paving, filter drains and soak ways.	 Green roof
Site Control	Management of water in a local area, e.g. swales, detention basins	 Swale
Regional Control	Management of runoff from a whole site/catchment, e.g. retention ponds, wetlands	 Regional wetland

4. Principles of SuDS

4.1 Local principles and requirements

a) Plan for SuDS

SuDS should be incorporated into the early design process. Investing in good design and identifying the requirements, issues and opportunities for SuDS at the early stages of a project is likely to be repaid in the long-term.

b) Integrate with public spaces

Where possible SuDS should be combined with public space to create multi-functional use areas and provide amenity. For example, SuDS features, could be incorporated into Public Open Spaces.

c) Manage rainfall at source

Surface water runoff should be captured as close to where it falls as possible. Management and conveyance of surface water runoff should be kept on the surface as far as possible.

d) Mimic natural drainage

SuDS networks should be designed to match natural drainage routes, infiltration rates and discharges as far as possible.

e) Design for water scarcity

New development should consider incorporating rainwater/grey water re-use facilities.

f) Enhance Biodiversity

Consideration for landscape and biodiversity is critical to delivering contextually appropriate SuDS schemes.

g) Link to wider landscape

Opportunities to link SuDS to existing or potential future blue and green infrastructure should be explored. SuDS schemes should fit with the local landscape character. Designers should take advantage of local topography and other landscape features such as trees, hedgerows, fence lines and local materials to enhance local character.

h) Design to be maintainable

It is extremely important that from the outset maintenance requirements for SuDS are considered and reflected in the design. Throughout the process, it should be considered how features can be accessed, who will be responsible for maintaining them, longer term management aims and how much it is likely to cost. Good management and design go together.

i) Use a precautionary approach

The natural floodplain must be protected and considered during the design process. Developments within the fluvial floodplain must to be avoided because SuDS will be ineffective when flooded. SuDS should be carefully designed where there is the presence of contaminated soils. System components should be designed to maximise their adaptive capacity.

j) Have regard to the historic environment

SuDS design and construction should be complementary to the character and cultural heritage of the area.

k) Show attention to detail

SuDS must be carefully designed using attention to detail to ensure they function as intended.

l) All SuDs elements should be designed to minimise risk to the general public.

4.2 Health and Safety

The main health and safety concerns regarding SuDS with a permanent water feature include;

- The risk of drowning;
- Waterborne disease;
- The risk of wildfowl strikes to aircraft near airports.

Good design practices that reduces risk includes:

- Slopes of 1:5 or less allow people to enter and leave SuDS features easily and safely.
- Unrestricted visibility is required to all accessible water features.
- All structures in the SuDS landscape should be assessed for health and safety during the design process.
- A good SuDS design will generally mitigate the need for a fencing around a SuDS features. Fences can create their own hazards, prevent rescue and become visually unacceptable.
- A level dry bench at the top of all open structures, a minimum of 1.5m wide, allows stationary rest and safe access.
- A wet bench, minimum of 2m wide, to all water features allows a stationary rest and safe access at the water’s edge.
- Safe maintenance access is required for appropriate machinery.
- A minimum permanent depth of 1.2m for wetlands and ponds is considered acceptable for SuDS and wildlife needs, unless the feature is designed as an amenity lake.
- Dense marginal planting is advised to reduce accidental access to permanent water but should not obscure visibility.
- Headwalls, manholes, inlets, outlets, control structures and other sumps or hard vertical surfaces that can be a trip hazard or create a hard surface near open water should generally be located a safe distance from the water’s edge.

Wherever possible, surface water runoff from roads and hard standing should pass through a filtering structure such as under-drained swales, bioretention and permeable pavement to enhance trapping of potential contamination.

Where ponds and other habitat associated with SuDS are located within eight miles of an airport, guidance provided by the Civil Aviation Authority (CAA) should be followed which minimises the risk of aircraft bird strike. Further information can be found in The SuDS CIRIA C697 Manual 20.3.5.

There is a potential risk of waterborne infection, such as Weil's disease and Leptospirosis which is transmitted through open cuts through the vector of rat urine, which should be considered in the management of open water features. It is important to recognise that the risk of infection is low.

Where ponds, either singularly or in combination with adjoining SuDS, fall under the Reservoirs Act 1975 or the Flood and Water Management Act 2010, then additional requirements may be needed.

The Construction (Design and Management) Regulations 2007 (CDM) must be applied to the planning, design, construction and long term maintenance of SuDS and a risk assessment undertaken for the design, construction and future maintenance (see The SuDS Manual CIRIA C697), for example:

- All SuDS features must provide safe access for maintenance;
- All SuDS features must provide a safe environment for the general public;
- Access points for vehicles should be level, secure and stable;

As part of any submission to the LLFA it will be a requirement for a suitable risk assessment to be included.

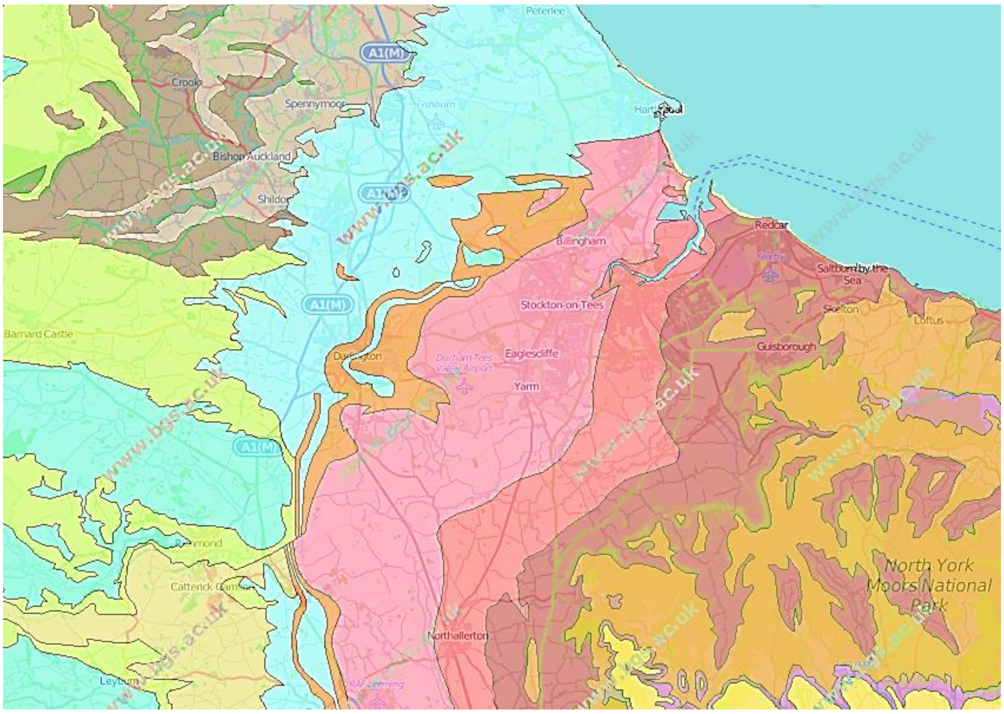
Danger signs and lifesaving equipment should not be necessary where the conditions set out above are followed, as SuDS should be considered inherently safe features in the landscape.

The drainage designer should demonstrate that amenity has been provided in the SuDS design and that all components conform with recognised health and safety best practice as required by the local authority.

5. Design Criteria

5.1 Geology and Soil Type

The superficial geology of the area will be an important factor in determining the types of SuDS that can be used at the proposed development sites. The bedrock geology of the upper and middle Tees Valley is largely carboniferous, with alternating limestones, shale, sandstones and thin coal seams and Millstone Grit. Towards the lower reaches of the Tees, the estuarine geology is Triassic marls and sandstones. Strategic scale mapping of the geology and soils in the Tees Valley shows the predominant soil type to be slowly permeable, seasonally wet basic loams and clays.



Courtesy of BGS	
	KELLAWAYS FORMATION AND OXFORD CLAY FORMATION (UNDIFFERENTIATED) – MUDSTONE, SILTSTONE AND SANDSTONE
	RAVENSCAR GROUP – SANDSTONE, SILSTONE AND MUDSTONE
	LIAS GROUP – MUDSTONE, SILSTONE, LIMESTONE AND CONGLOMERATE, INTERBEDDED
	TRIASSIC ROCKS (UNDIFFERENTIATED) – SANDSTONE AND CNGLOMERATE, INTERBEDDED
	ZECHSTEIN GROUP – DOLOMITISED LIMESTONE AND DOLOMITE
	PERMIAN ROCKS (UNDIFFERENTIATED) – MUDSTONE, SILTONE AND SANDSTONE

	PERMIAN ROCKS (UNDIFFERENTIATED) – SANDSTONE AND CONGLOMERATE, INTERBEDDED
	PENNINE UPPER COAL MEASURES FORMATION – MUDSTONE, SILTSTONE, SANDSTONE, COAL, IRONSTONE AND FERRICRETE
	YOREDALE FROUP – LIMSTONE WITH SUBORDINATE SANDSTONE AND ARGILLACEOUS ROCKS

5.2 Rainfall

The Tees Valley has an oceanic climate typical for the United Kingdom. Being sheltered by the Pennines to the West. The Tees Valley is in one of the relatively drier parts of the country, receiving on average 660 millimetres of rain a year.

10-year average rainfall data for Tees Valley

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Precipitation mm	54.3	43.5	40.4	55.7	43.2	64.4	49.5	65.1	62.3	63.7	58.2	59.2

5.3 Topography

The topography of an area can dramatically influence drainage flows. Areas of shallow topography can be utilised as attenuation but may also take time to drain down thus creating a flood risk. Whereas steep topography is likely to decrease the time it takes for rainfall to reach local towns and villages, which can exacerbate the risk of flooding to the lower lying areas. SuDS techniques can assist in mitigating these affects and reduce flood risk by managing the flow.

6. SuDS components

Hydraulic – SuDS must be designed to mitigate the flood risk to the development and occupants and ensure that off-site flood risk is not increased. Where possible SuDS should aim to reduce the overall risk of flooding off-site.

6.1 Rainwater Harvesting (Ref: CIRIA the SuDS Manual)

Rainwater harvesting is the process of collecting and using rainwater. If designed appropriately the system can be used to reduce the rates and volumes of surface water runoff and:

- Can range from complex district-wide systems to simple household systems linked to a water butt;
- Are relatively easy to manage;
- Can be combined with grey water recycling systems to form an integrated process.

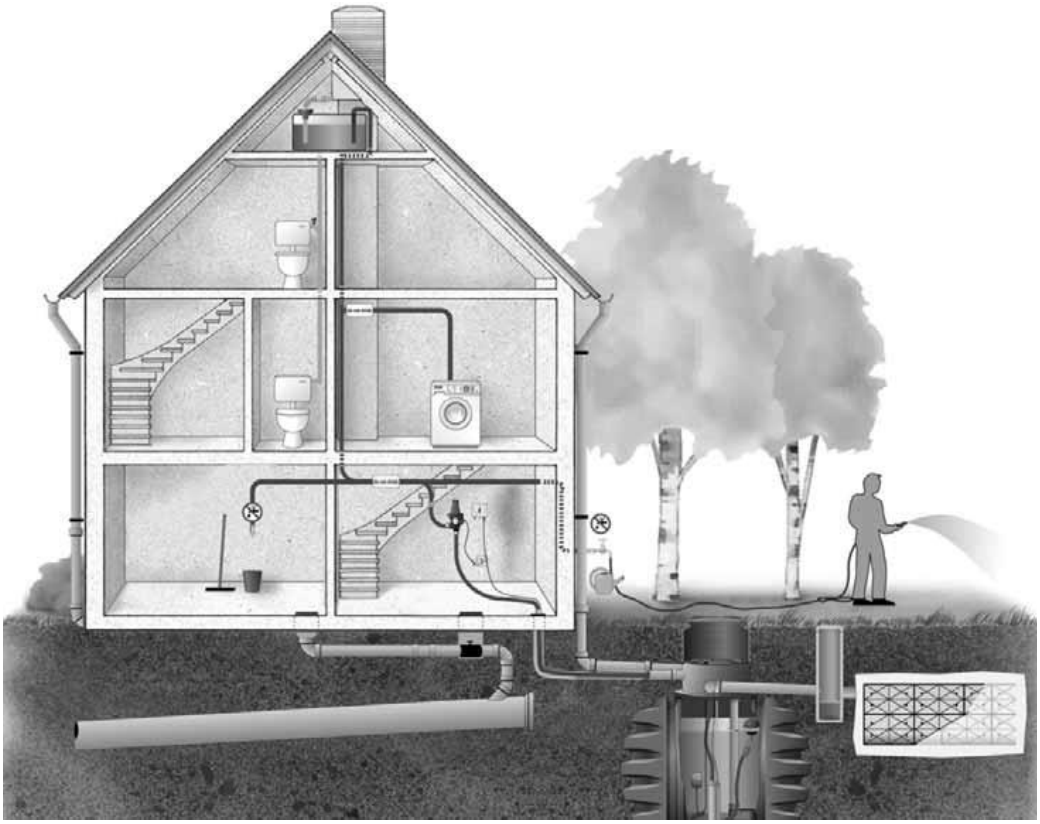


Figure 1 - Conceptual Rainwater Harvesting System

6.2 Green Roofs

Green roofs are a multi layered system for intercepting and storing rainwater. They often comprise a waterproof membrane overlain with granular material, topped off with low maintenance planting such as sedum to reduce or eliminate run-off from roof areas.

They add weight to the structure so should be considered at the construction stage of a new build. For an existing building, an extensive system is recommended as it adds less weight, but you should always consult a structural engineer to make sure that the structure is safe.

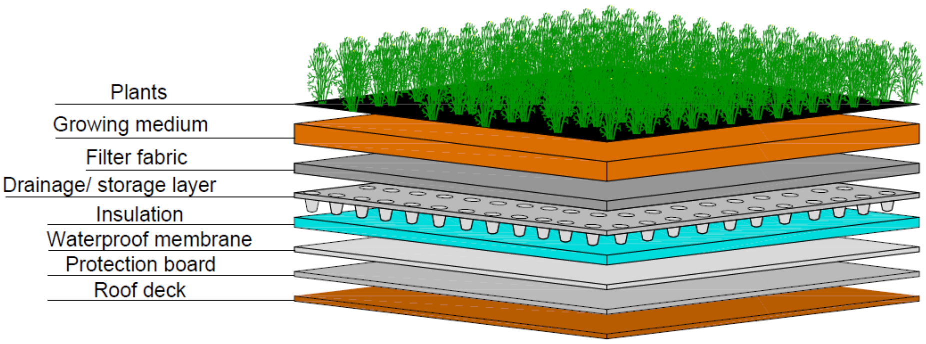


Figure 2 -Green Roof Multi Layered System

6.3 Water Butts

Water Butts are the most common means of harvesting rainwater for garden use. They are small, off-line storage devices that are designed to capture and store roof runoff. They should not be taken into consideration when calculating drainage sizes.

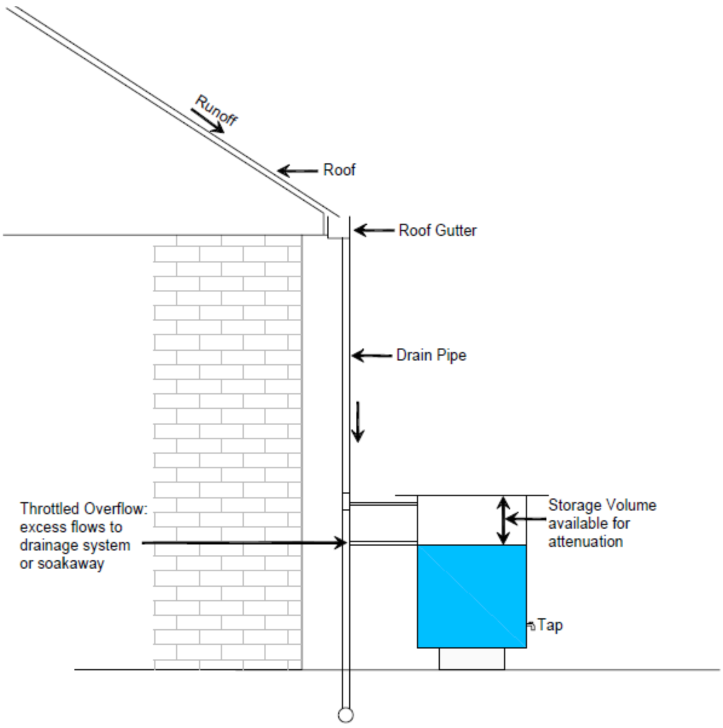


Figure 3 - Conceptual Water Butt Design

6.4 Filter strips

Vegetated strips of land designed to accept overland sheet flow:

- Runoff must be evenly distributed across the filter strip;
- Gradients should not exceed 1 in 20 and be a minimum of 1 in 50.

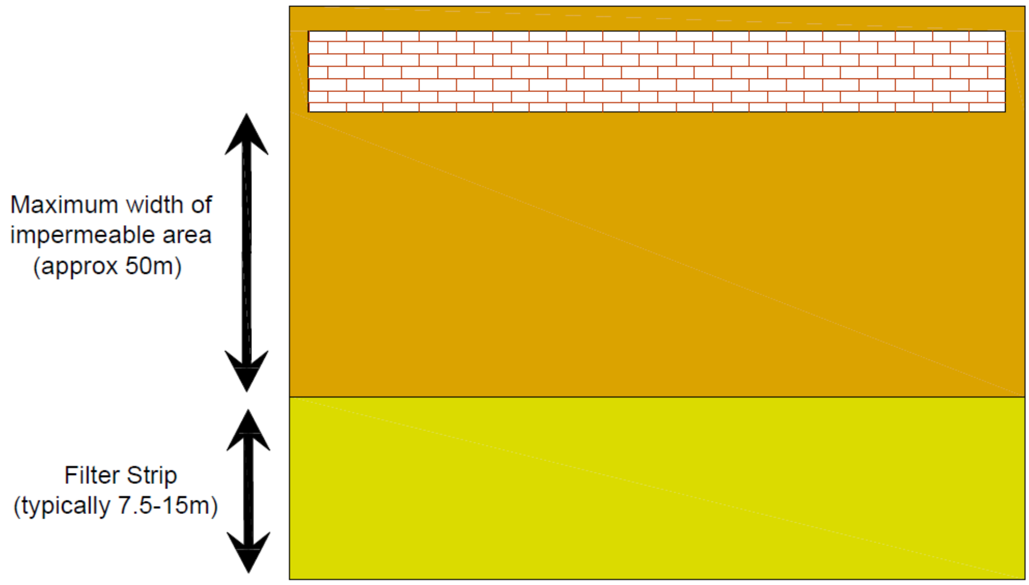
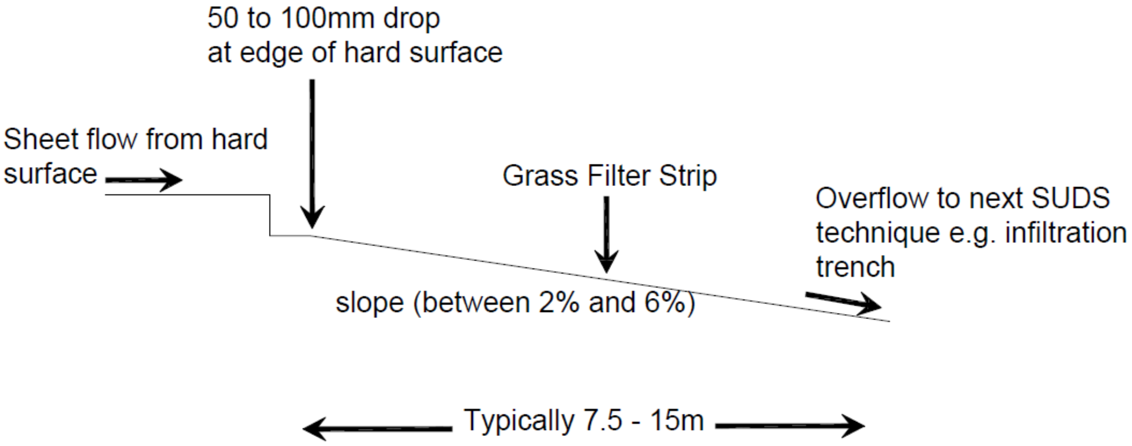


Figure 4 - Typical Filter Strip



6.5 Swales

Linear vegetated features in which surface water can be stored and/or conveyed. Can be designed to allow infiltration where appropriate.

- Swales should be shallow with side slopes no more than 1:4 to allow flow across the edge, easy maintenance and safe access;
- Swale depth should not exceed 450mm wherever possible;
- A 100-150mm depth for normal flows uses the vegetation to reduce flow and allow filtration;
- A maximum 300mm storage above normal flow depth, to include freeboard if necessary;
- Flow rate should be restricted to 1-2m/s or 1:50 maximum gradient to prevent erosion and ensure effective pollution control. Check dams and other flow restrictions should be used if the layout is steeper;
- A minimum base width of 0.5m;
- Reasonable access for maintenance by mowers should be provided.

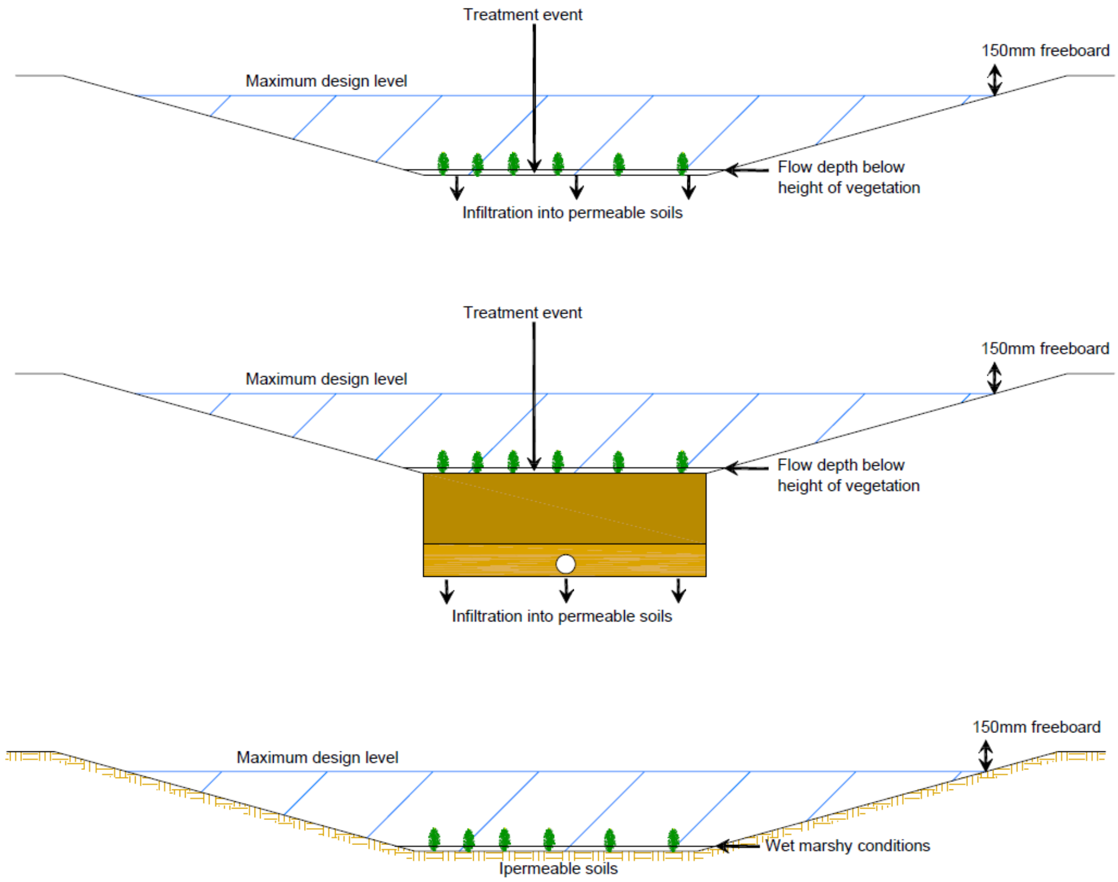


Figure 5 - Typical Swale

6.6 Bioretention areas and Rain Gardens

Bioretention areas and rain gardens are planted areas that are designed to provide a drainage function as well as contribute to the soft landscape.

They are located where surface water runoff flows from the surrounding impermeable hard surfaces and they collect the polluted first flush volume in shallow planted basins.

A bioretention area should collect and temporarily store the treatment volume or first flush volume (10-15mm from contributing hard surfaces) at a usual depth of 150mm:

- A grass filter strip or silt forebay for point inlets is required to control siltation and blockage of the basin
- The water must drain down within 24 hours to anticipate the next storm
- They should be constructed at least 1m above the groundwater table
- They usually require a drainage layer with perforated pipe and overflow
- Should be planted to enhance the local landscape with robust species appropriate to the site and drainage requirements

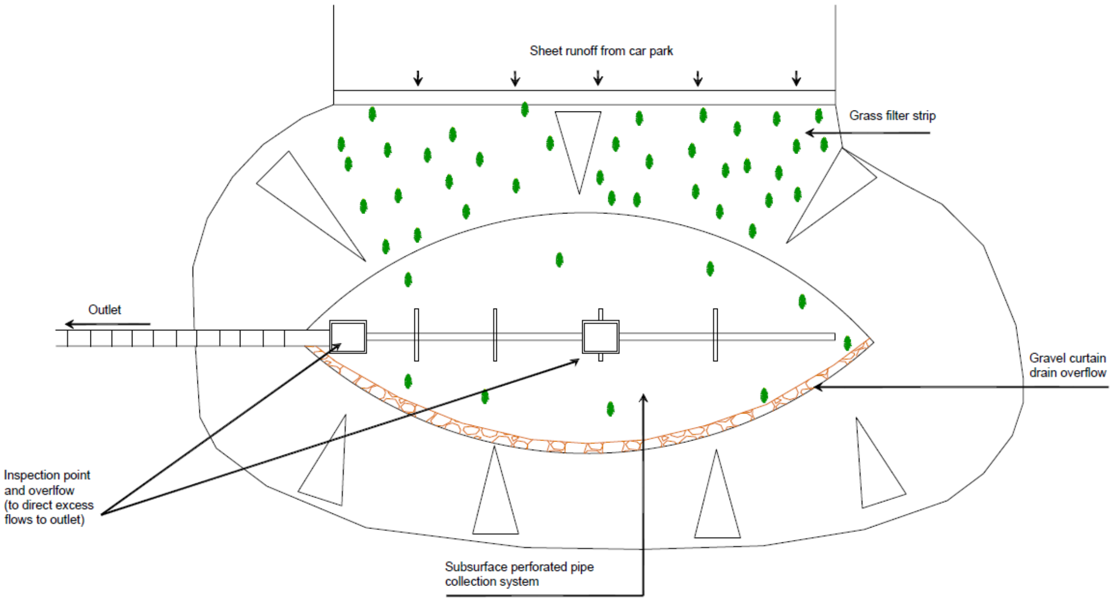
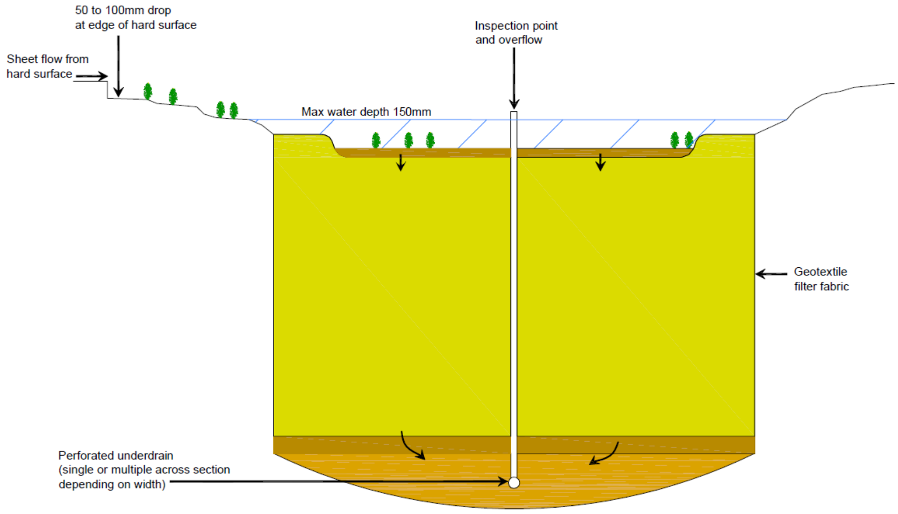
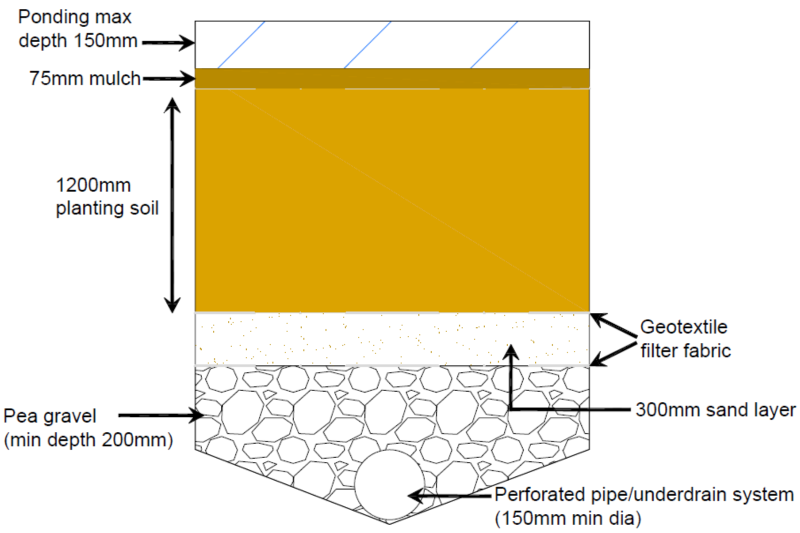


Figure 6 - Typical Bioretention area and Rain Garden


50 to 100mm drop
at edge of hard surface
Sheet flow from
hard surface
Inspection point
and overflow
Max water depth 150mm
Geotextile
filter fabric
Perforated underdrain
(single or multiple across section
depending on width)

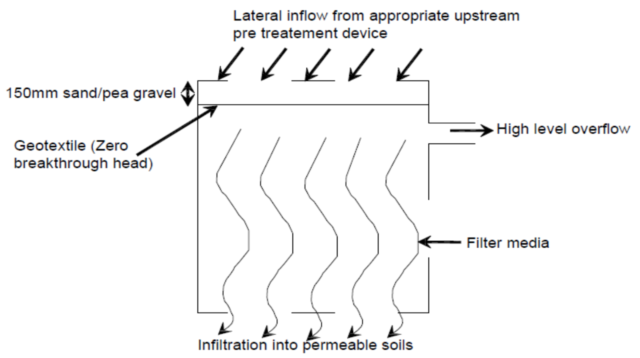
Profile


Ponding max
depth 150mm
75mm mulch
1200mm
planting soil
Geotextile
filter fabric
300mm sand layer
Pea gravel
(min depth 200mm)
Perforated pipe/underdrain system
(150mm min dia)

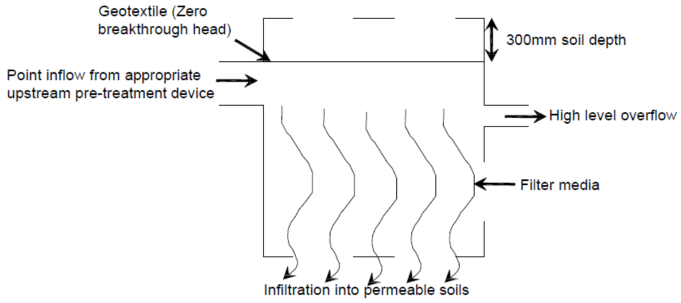
6.7 Filter drains and trenches (Ref CIRIA the SuDS Manual)

Filter drains and trenches (often called French drains) are linear excavations filled with a suitable aggregate that ideally collects surface water runoff laterally as sheet flow from impermeable surfaces, although point inlets can be used with care to prevent damage to the structure.

- Effective upstream pre-treatment to remove sediment and fine silts. A perforated pipe may be appropriate to convey water onward from the drain and should include access for rodding or jetting with open outfalls;
- Perforated pipes should normally be provided for the last few metres of the trench to maximise filtration;
- The edge of the drain should be level to encourage sheet flow and prevent gully erosion where taking a lateral flow.



(b) Infiltration trench
lateral inflow



(a) Infiltration trench
point inflow

6.8 Permeable Pavements

Permeable pavements provide a surface that is suitable for pedestrian or vehicular traffic while allowing surface water runoff to percolate directly through the surface into underlying open stone construction.

The ground conditions within the Tees Valley area are not suitable for infiltration therefore permeable paving should not be considered as part of the minimum requirement for storage. However permeable paving can be used for additional storage and form part of the treatment train.

- Permeable pavements need to be designed structurally to meet loading and traffic requirements;
- Permeable surfaces are susceptible to silt blockage and the surrounding landscape details, slopes and maintenance plans must take this into account;
- Sub-bases can be augmented with geocellular structures with the advantage that surface water runoff is clean before it enters underground storage;
- Utility apparatus would not be allowed in these areas.

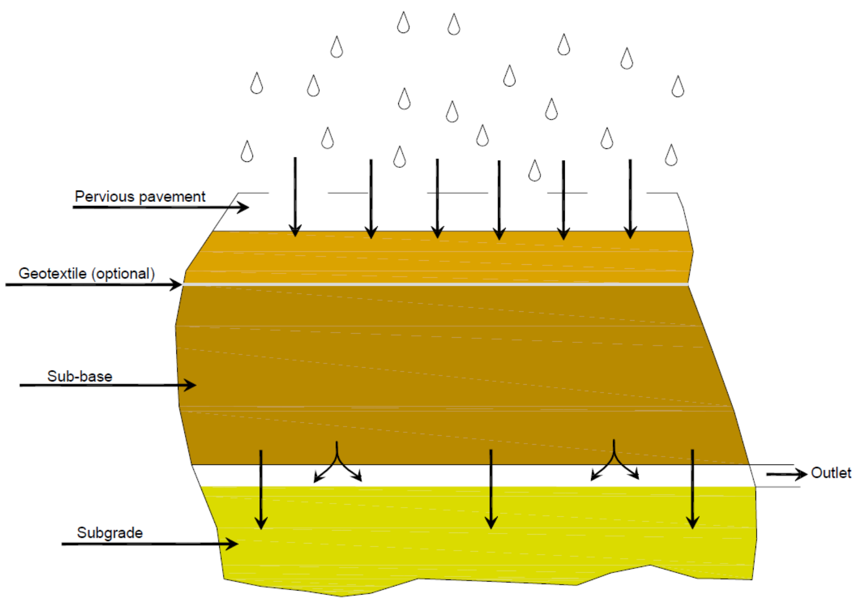


Figure 7 - Pervious pavement system types: Partial infiltration

6.9 Geocellular structures, oversized pipes/ tanks

Modular plastic geocellular structures, with a high void ratio, are a below ground storage arrangement that can replace underground pipes or tanks that have been used to store water. These should be designed to the current Sewers for Adoption and manufactures recommendations.

It is important to recognise that all below ground storage structures only provide attenuation of surface water runoff and not treatment. Cleaning of surface water runoff, preferably before entering the structures, is required before release to the environment.

- Structural design must be provided to ensure integrity of the box, pipe or tank under loading;
- Silt interception and management is critical to the long-term effectiveness of these structures and this must be demonstrated at design stage and confirmed for the design life of the development;
- Standard storage design using limiting discharges to determine storage volumes.

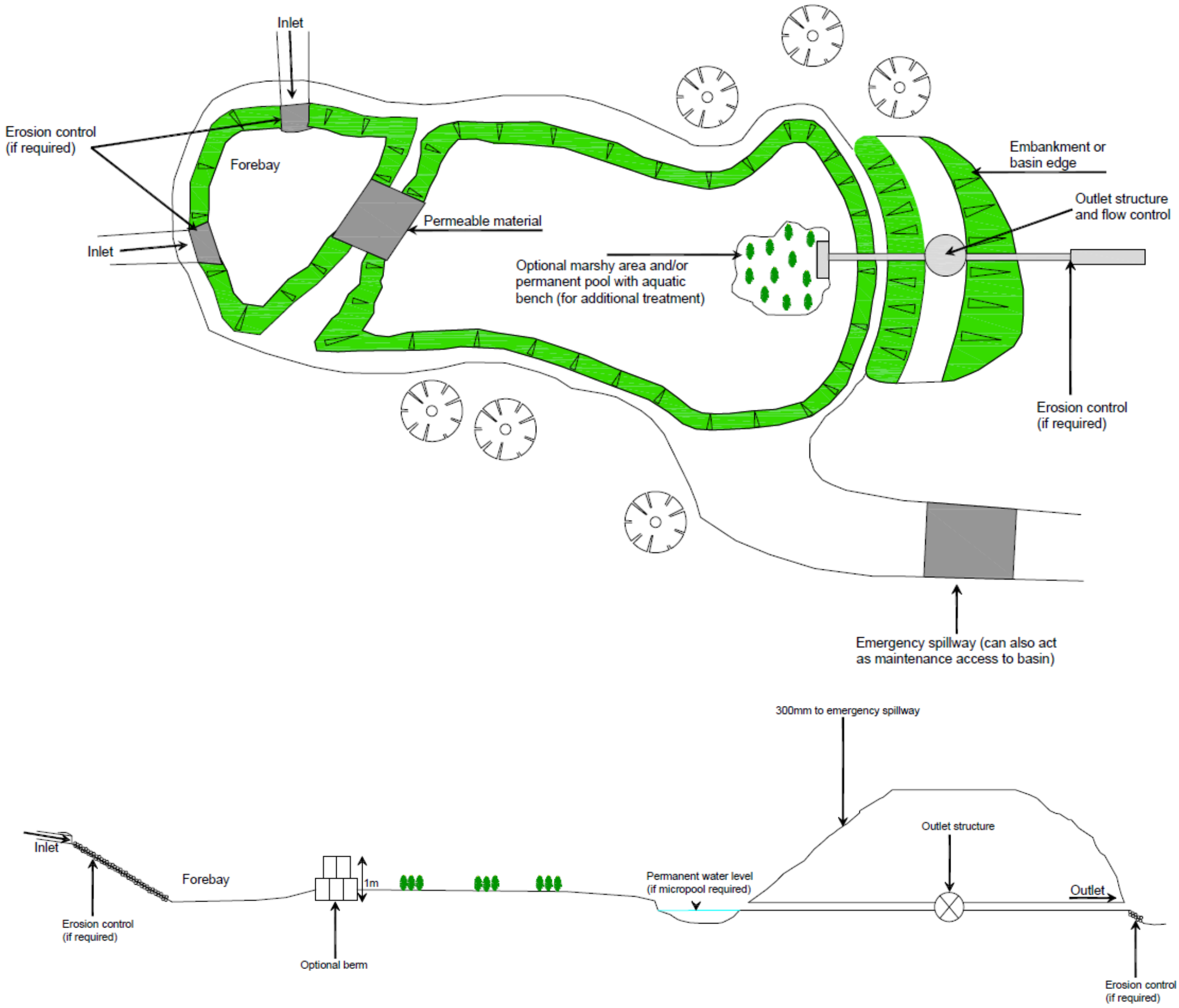
6.10 Detention basins (Ref CIRIA the SuDS Manual)

Detention basins are vegetated depressions in the ground designed to temporarily store surface water runoff and either allow it to soak into the ground or flow out at a controlled rate.

They should be designed as multifunctional landscape features that in addition to their visual enhancement of an area allow other amenity leisure uses when dry and habitat creation. These opportunities are enhanced when there are source control features upstream that prevent silt and pollution reaching the basin and reduce the frequency at which surface water runoff reaches the basin:

- Silt should be intercepted at source wherever possible or be intercepted in a forebay where surface water runoff enters the basin;
- Surface water runoff should flow into the basin as controlled sheet flow from source control features to reduce the risk of erosion but if entry is uncontrolled through a point inlet then a low flow channel will be necessary to manage the flow.
- Detention basins should have a 2:1 to 5:1 length to width ratio to provide maximum opportunities for settlement at the inlet and filtration of surface water runoff;
- There should be a gentle fall to the outlet of about 1:100 to encourage surface sheet flow by gravity;

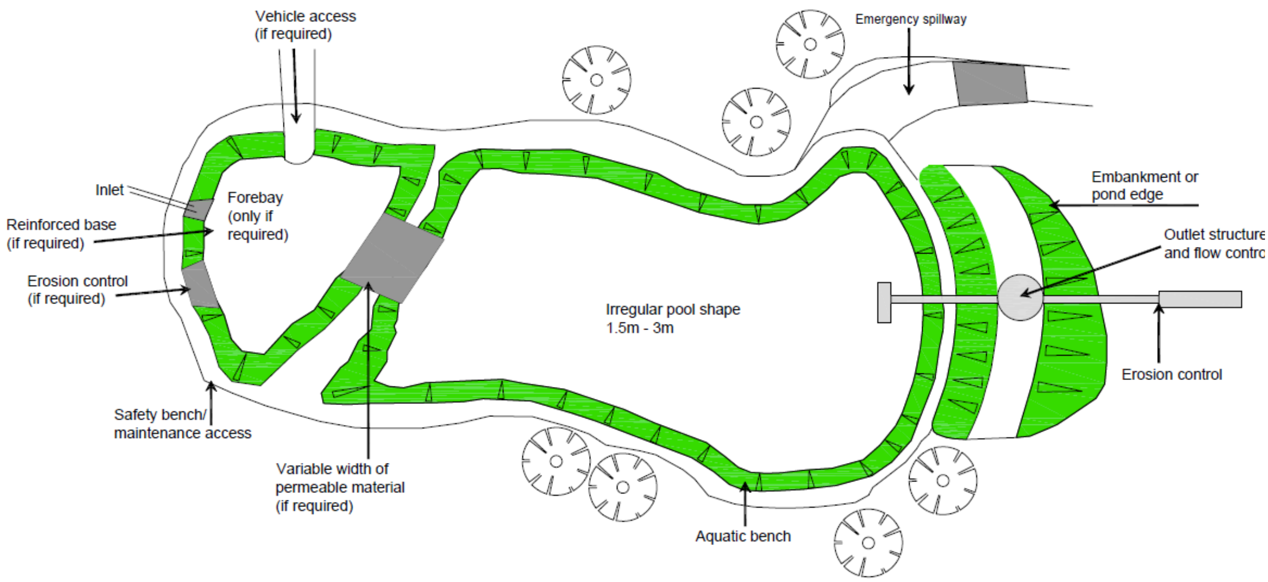
- A controlled outfall at or just below ground level is usual to ensure drain down unless preceded by a micro-pool. This ensures a generally dry surface when it is not raining. A micro-pool enhances treatment, avoids a muddy area at the outlet and provides biodiversity interest;
- Side slopes to the basin should be 1:5 maximum, with clear access for maintenance;
- Basins require an overflow to allow for design exceedance or outlet blockage.

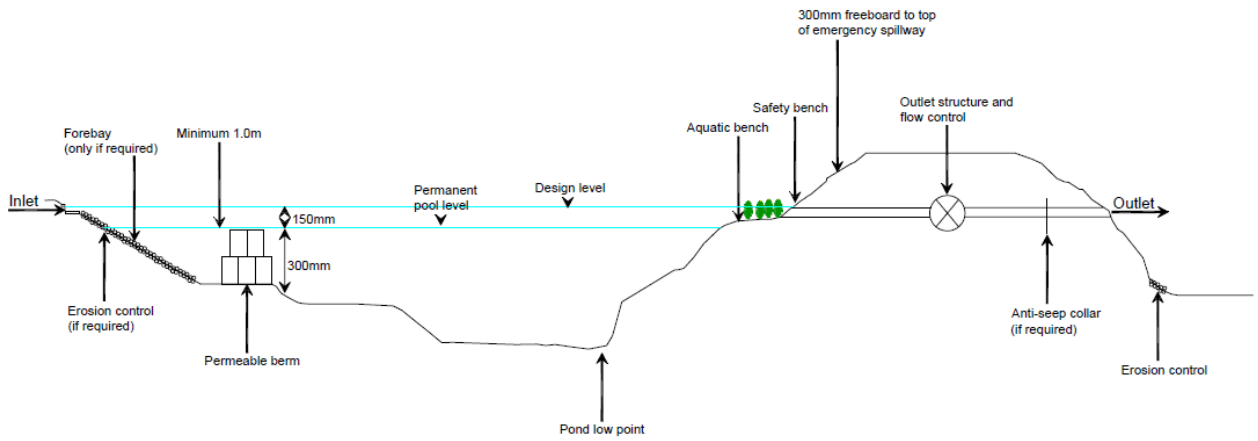


6.11 Ponds (Ref CIRIA the SuDS Manual)

SuDS ponds are usually separate structures with a storage capacity above the permanent water volume and a defined edge design to satisfy safety concerns. They should be designed as landscape and ecological features as well as flood storage. Ponds should provide amenity enhancements and create ecological habitat that will contribute to the character and quality of the development. In all other characteristics they should mimic natural pond systems. Ponds and wetlands should be designed to receive silt-free surface water runoff with light loading of dissolved pollution that can be processed in the water column by microorganisms:

- SuDS ponds should mimic natural ponds wherever possible;
- There should be a dry bench minimum width of 1m, to allow people to stand safely before descending towards the pond;
- Slopes down to the ponds and within them should be no more than 1:5, both for ease of access and maintenance;
- There should be a level wet bench, minimum width of 1.5m unless the pond is very small, to allow people to stand safely before the water's edge;
- The storage volume above permanent water level should be 450-600mm deep for safety and management reasons with an infiltration option at the pond edge;
- A robust, simple and easily maintained control structure will be necessary to limit flows from the pond unless all flows have been controlled further up the management train;
- Basins require an overflow to allow for design exceedance or outlet blockage.

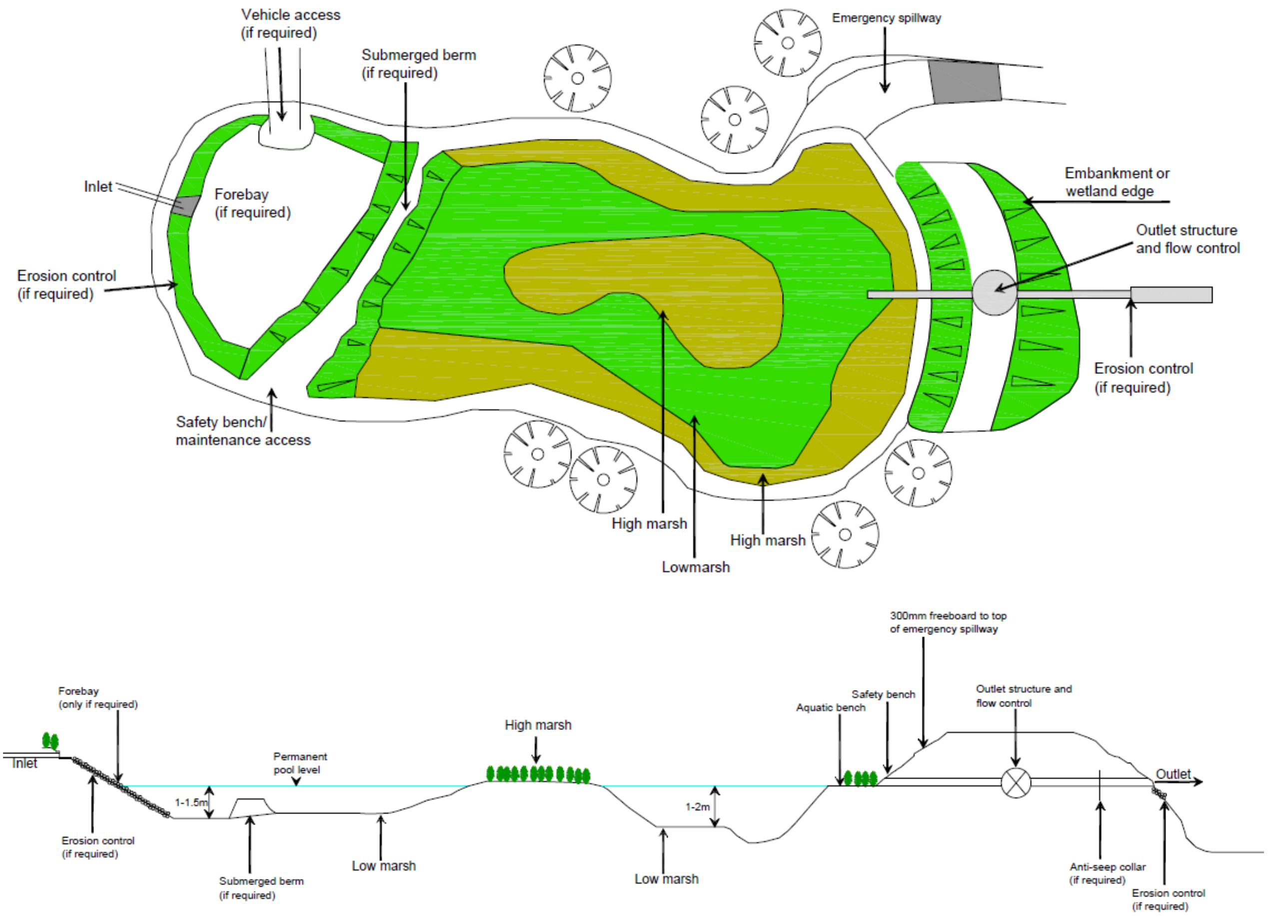




6.12 Wetlands (Ref CIRIA the SuDS Manual)

Wetlands are shallow depressions that are nearly or completely covered in marsh vegetation, generally with little open water:

- SuDS wetlands should be longer than they are wide, with a ratio greater than 3:1;
- A sediment forebay is often recommended to intercept silt but is unnecessary if source control measures are in place higher up the management train;
- A variation in depth is recommended for treatment and ecological reasons but water depths in excess of 600mm are not required for habitat reasons and can affect safety assessments and maintenance operations;
- Basins require an overflow to allow for design exceedance or outlet blockage.



6.13 Maintenance of slopes

If any gradient which is to be grassed with a slope of more than 1:5 discussions are required with the relevant Engineer.

- Slopes greater 1:5 managed though normal maintenance methods using ride on mowers with specific risk assessment;
  - Slopes up to 1:5 cut using approved pedestrian machines in line with site specific risk assessments;
  - Slopes of 1:4 or 1:3 cut with specialist equipment only, such as pedestrian bank mower or brush cutter, and only with a site specific risk assessment;
  - Slopes of over 1:3 to be cut with side-arm flail or remote control mower only no pedestrian based operations.

6.14 Inlets, Outlets and control specification and requirements

Inlets, outlets and other control structures are key elements of well-designed SuDS. Inlet and outlet features allow water to flow into and out of features and also limit the rate at which water flows along and out of the system.

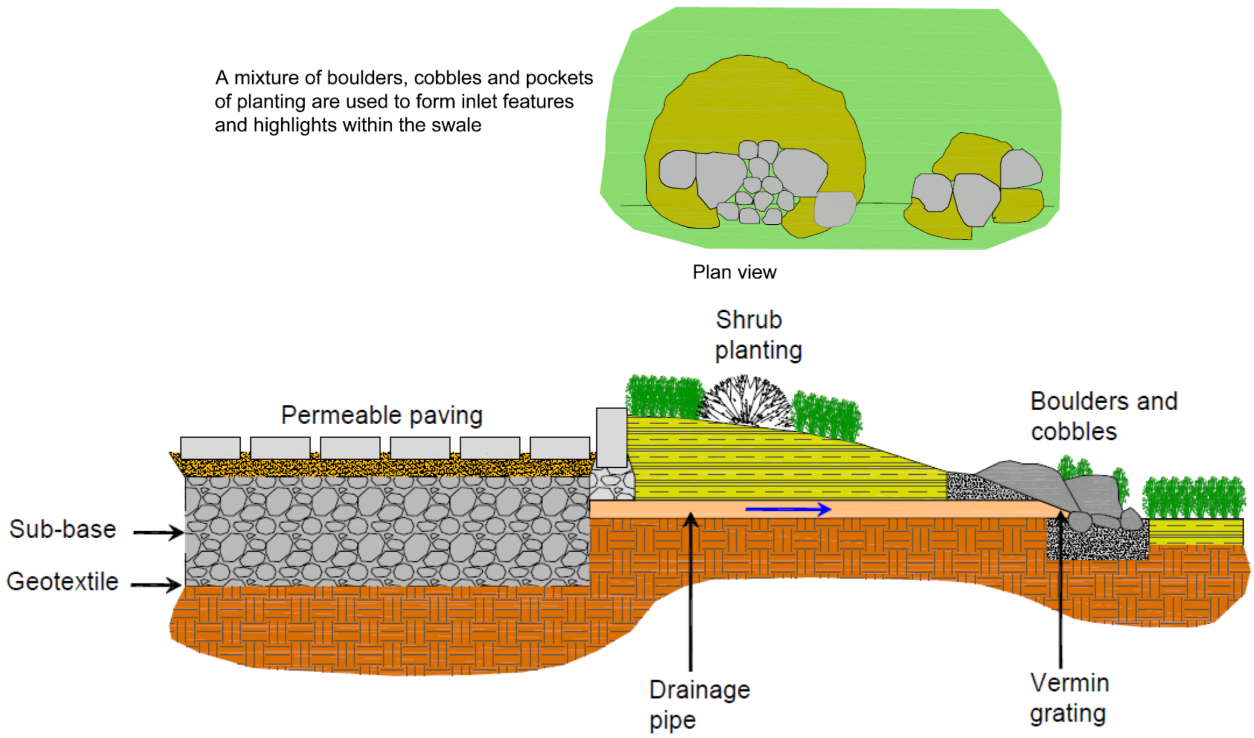
There are many different designs and variations, including landscaped pipes, perforated pipes, weirs, orifices, vortex control devices and spillways. Each inlet or outlet structure should be designed specifically for its location utilising site appropriate materials to add interest to the urban landscape. All structures should consider the implications of maintenance, as regular inspections and cleaning may be required.

It's preferable for surface water runoff to flow across the surface into a SuDS component but sometimes it is necessary to collect it into a pipe from a grating, channel or chute gully. The collection pond should not include a silt trap or pot, as in gully pots, as they add to the risk of blockage and maintenance costs. Silt and pollution control is managed within the source control SuDS components.

Surface water runoff collected through permeable surfaces or other filter mechanisms, such as an under-drained swale, will not contain debris so can enter SuDS components through a grille or hidden inlet. The advantage with a covered inlet, particularly in public open space, is that they are difficult to block from the inlet end of the pipe. No orifice should be less than 100mm as this should prevent blockages.

6.15 Inlets and outfalls protections

All SuDS inlet and outlets will require protection to stop debris or animals gaining access to the system. However, these structures should become part of the natural environment and enhance the SuDS features and discussions will be required with LLFA to ascertain the most appropriate design.



7. Landscape Design Criteria

7.1 Accreditation of plant sources

Where seeding and planting is considered necessary or beneficial then the source and provenance of seeds and plants should be from accredited sources. Ideally local provenance species will be sourced from fully accredited plant sources and suppliers to avoid alien species.

Approval of all plant sources will be required before seeding and or planting takes place. The removal of any alien species will be at the expense of the developer and should be included within the maintenance regime.

7.2 Planting design strategy

Planting as part of a SuDS scheme should be designed specifically for that location. All planting in public open space SuDS features including swales, basins, ponds and wetlands should be native to UK, ideally of local provenance. Planting proposals should comprise common generalist species that are easily established and give visual interest to local people. Later colonisation by locally occurring species will stabilise the habitat.

The planting objective for most SuDS is to establish a robust vegetation cover as soon as possible that will assist the drainage function asset. This is particularly true of grassed surfaces within detention basins and ponds. To achieve a successful planting scheme it is recommended that developers seek advice from an ecologist/Landscape Architect or other suitably qualified person particularly in relation to seed mixes and waters-edge planting that is located within the potential wet or flooded areas of the SuDS system.

Planting of marginal floating-leaved and aquatic plant species in SuDS ponds should be avoided Tall emergent plants such as reeds could be planted in some SuDS schemes where pollutants need to be mitigated.

7.3 Invasive plants and alien species

The planting of invasive and vigorous colonising species will not be permitted. See Appendix 5.

The Wildlife and Countryside Act 1981 (Variation of Schedule 9) (England and Wales) Order 2010 has an up to date list of plants that cannot be planted.

7.4 Planting requirements

Soiling for areas to be seeded are usually specified at 10-20mm above hard surfaces to allow for mowing. In SuDS where surfaces shed water to grassed areas, it must be 20 to 25mm below the edge of the hard surface, assuming the grass will be cut to a height of 50 to 100mm. Planted areas should also be lower than adjacent hard surfaces.

Subsoil and topsoil layers must be deposited in separate layers and must not be compacted by excessive tracking of machinery. Compaction results in roots not being able to penetrate the soil and anaerobic soil conditions. Nutrient rich topsoil should not be used as this can add pollutants to the system.

Planting techniques in SuDS areas should also be varied slightly. Where drainage systems are to be planted the use of grass or a dense ground cover is preferable, without mulch. This avoids soil erosion and prevents soil and mulch washing into the SuDS.

Seed, plant species and stock size section and the soil preparation areas should be specified to avoid the need for initial fertilizers. No application of herbicide, fertilizer or other chemical applications, which can cause pollution shall be permitted during the maintenance period. All cutting arising's to be removed off site.

7.5 Planting list for SuDS

A list of potential plants known to be suitable for use in SuDS with UK can be found in Appendix 5. The developer shall be responsible for final species selection appropriate to the site and will be a requirement to provide an as constructed drawing, listing all plants, their species, stock size, stock type together with a planting plan illustrating the density (grouped numbers) of the planted species and the interrelationship of the individual species.

7.6 Contaminated Land

SuDS should be designed taking contamination on site into consideration and this needs to be factored in when calculating remedial targets and remediation design.

Use of SuDS on brownfield sites is as relevant as it is for Greenfield sites. If a site is affected by contamination, SuDS must not mobilise contaminants or act as a preferential flow path to convey such contaminants - SuDS design can be adapted to ensure that this does not occur.

SuDS which use infiltration will not be suitable where capping layers have been formed over contaminated areas or where infiltration is through land containing contaminants which are likely to be mobilised into surface water or groundwater. Where capping layers are not present on the contaminated site, SuDS with an impermeable base layer to separate the surface water drainage system from the contaminated area must be formed. SuDS which do not use infiltration are still effective at treating and attenuating surface water.

The introduction of SuDS may provide a pathway along which contaminants in the aqueous or non-aqueous liquid phase can migrate and enter groundwater or surface water. The likelihood of this should always be considered and the system located to a different area or redesigned as required. It should be noted however that a traditional piped drainage system is also likely to act as a contaminant conduit in this way.

SuDS can be used during construction to trap and remove contaminants from development. For example, when a site has been cleared runoff can be rapid and may contain high levels of silts, sediments and polluted material.

7.7 Landscape Maintenance during construction period

Once a SuDS system has becomes operational it must be maintained by the developer throughout the remaining development construction period until handover. This shall include all aspects of soft landscape maintenance such as grass cutting and plant establishment maintenance as well as operational checks on the function of the SuDS. The LLFA will require to approve in writing details of the establishment maintenance.

7.8 Landscape maintenance during operation

All SuDS must be well maintained to ensure it functions as designed. A detailed management plan shall be prepared and agreed in writing by the LLFA for all SuDS elements detailing a programme of works to be undertaken by a suitably qualified contractor for perpetuity. This shall include all aspects of soft landscape maintenance such as grass cutting, thinning and pruning works, weeding etc. The maintenance and management plan may form part of the wider landscape management plan for the site, or form part of the SuDs management plan.

8.0 Water Quality

The SuDS design will demonstrate that the Water Quality Criteria set out in The SuDS Manual CIRIA C697 section 3.3 and the requirements of the LLFA and Environment Agency have been considered and incorporated in the SuDS design. An appropriate management train of SuDS components should be implemented to effectively mitigate the pollution risks associated with different site users/activities.

8.1 Protection of the groundwater or receiving watercourse

- To remove the major proportion of pollution from surface water runoff, it is necessary to;
- Capture and treat the surface water runoff from frequent, small events;
- Capture and treat a proportion of the initial surface water runoff (the first flush) from larger and rarer events.

8.2 Creating opportunities for wildlife – biodiversity (ecology)

The key principles to creating opportunities for wildlife are:

- Structural diversity;
- Locate near to existing habitat where possible;
- Good water quality to ensure ecological benefits and is provided by using the SuDS quality concepts of the management train, source control, treatment stages and by intercepting silt and pollution using pre-treatment techniques.

Surface water runoff must pass through source control features before passing onward to conveyance techniques, ideally on the surface in swales or other filtering techniques, before reaching ponds, wetlands or other biodiversity features.

Biodiversity will develop naturally in conveyance structures such as swales, or in open storage structures like basins, ponds and wetlands, providing the water quality is good. The design of open landscape structures and the landscape that surrounds SuDS features should be designed and maintained for biodiversity.

Ecological design must take into account that SuDS need to meet drainage functions as a priority. Therefore:

- The management train must remain unobstructed at all times;
- All open soft surfaces that receive flows must be protected and remain well vegetated during the lifetime of the system;

- All landscape areas adjacent to SuDS must develop a robust ground vegetation to prevent silt migration;
- Swale, basin, pond and wetland vegetation will be necessary to retain the drainage function but this can easily be compatible with ecological objectives;
- Tree and shrub selection and subsequent care must take into account the requirement of a permanent ground vegetation cover;
- Planting must not compromise future access.

Good ecological practice includes:

- Creating ecologically designed corridors between habitat areas;
- Avoiding the use of pesticides, herbicides and fertilizers;
- Using accredited suppliers of native plants to ensure UK or local provenance and avoid alien species;
- Using local plant material and allowing natural colonisation of SuDS features;
- Reduced maintenance intensity with 25-30% maximum vegetation removal at any one time;
- Retaining and enhancing natural drainage features;
- Including shallow aquatic edges to 450mm max depth and 1m minimum width to ponds and wetlands;
- Increasing vertical and horizontal structural diversity in open SuDS features.

9.0 Green Infrastructure

Green Infrastructure (GI) includes all green spaces, blue spaces and other environmental features that occur in and around the built environment linking urban areas to the wider rural hinterland. This includes parks, commons, open land, woodland, private gardens, street trees and green roofs, as well as areas of water such as rivers, streams, wetlands, swales, ponds and temporary flood storage areas.

GI should be strategically planned and delivered on a range of scales to provide usable space with support for natural and ecological processes. GI should be planned and managed in ways which make space for water. For example, urban green spaces can reduce run-off and increase natural infiltration, helping to reduce flood risk and improve water quality. SuDS should be seen as part of that 'multi-functional' green infrastructure network, delivering multiple amenity, landscape and biodiversity benefits, alongside their primary function to deliver sustainable water management. This will influence their detailed design and layout; for example, wherever possible they should help to link together existing or new wildlife habitats and be integrated with path networks and open space to provide attractive areas for recreation and play.

10. Open space

Designing green space and public realm with SuDS that work well when both wet and dry can provide valuable community recreational space as well as important environmental infrastructure. Sports pitches, squares, courtyards, playgrounds, landscapes around buildings, urban parks, green corridors and woodlands are all popular types of open space which can be integrated with SuDS.

SuDS can also contribute to development targets for amenity open space where they are designed to be multi-functional.

SuDS Technique	Brief Description	Water Quantity	Water Quality	Biodiversity	Amenity
Permeable Paving's	Infiltration through the surface into the underlying layer	✓	✓	X	X
Filter Drains	Drain filled with permeable material with a perforated pipe along the base	✓	✓	X	X
Infiltration Trenches	Similar to filter drains but allows infiltration through the sides and base	✓	✓	X	X
Soakaways	Underground structure used for store and infiltration	✓	✓	X	X
Detention Basins	Dry depressions outside of storm periods, provides temporary attenuation, treatment and possibly infiltration	✓	✓	✓	✓
Retention Ponds	Designed to accommodate water all times, provides attenuation, treatment and enhance site amenity value	✓	✓	✓	✓
Wetlands	Similar to Retention Ponds but are designed to provide continuous flow through vegetation	✓	✓	✓	✓
Rainwater Harvesting	Capturing and reusing water for domestic or irrigation uses	✓	X	X	X
Green Roofs	Layer of vegetation or gravel on roof areas providing absorption and storage	✓	✓	✓	✓
Tanks/Oversized Pipes	Below ground storage arrangement	✓	X	X	X

Volume 2: Specific Local Standards

11. Runoff Destinations

This section details the preference of discharge as follows (1) most preferable, (4) least preferable; Planning Practice Guidance states: “Generally the aim should be discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:

1. Into the ground (infiltration)
2. To a surface water body;
3. To a surface water sewer, highway drain or another drainage system;
4. To a combined sewer.”

11.1 Local Standards

LS1: The Tees Valley area is predominantly underlain with clay and silt soils therefore option 1 (infiltration) is not considered a suitable option for the primary method of the disposal of surface water.

LS2: Where a developer proposes to connect surface water to the existing sewer system they must submit robust evidence to the LPA, which demonstrates that it is not reasonably practicable to discharge surface water elsewhere as detailed in the preference of hierarchy above. Early discussions with the sewerage undertaker and the LLFA to establish the point of connection and discharge rate is required.

11.2 Informative

11.2.1 The sewerage undertaker has no duty to accept runoff from highway drainage. The developer should note that acceptance of this runoff into the public sewer system is only by agreement through a permit under S115 of the Water Industry Act 1991.

11.2.2 The sewerage undertaker has no duty to accept land drainage runoff, flows from watercourse or groundwater. The developer should note that permission to discharge these flows into their system is not normally given. Flows entering the development site, for example an ordinary watercourse must not enter the surface water system serving the development site.

11.2.3 Drainage design should always aim to make as much use of the runoff as practicable, discharging the remainder to the ground or surface water bodies in a way that allows for evaporation, evapo-transpiration and further infiltration by managing water at the surface. There may be a number of runoff destinations, flow rate and volume standards that the LLFA are likely to take into account when approving SuDS and drainage plans.

11.2.4 Runoff should be managed as close to the source as possible, and as many of the SuDS components should be visible on the surface.

12. Flood Risk outside the Development

12.1 National Standard

S1. Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from the surface water body (e.g. the sea or a large estuary) the peak flow control standards (S2 & S3) and volume control Standards (S4 to S5) need not apply.

12.2 Local Standards

LS3: Where appropriate, the design of a drainage system which discharges to tidal water will need to take account of the effect of "tide locking", storm surge or submergence of the outfall.

LS4: An appropriate allowance for sea levels over the lifetime of the development should be incorporated.

LS5: Where appropriate, the design of a drainage system which discharges to a watercourse will need to take account of the effect of submergence of the outfall.

LS6: The design of storage should take into account the frequency and extent of any surcharge in the downstream watercourse.

LS7: Where appropriate, the design of a drainage systems which discharges to an existing drainage system, waterbody and/or ordinary watercourse will require a full survey or evidence of its condition to be provided.

LS8: Where appropriate, any existing watercourses situated within the boundary of the proposed development site must be protected and the Lead Local Flood Authority must be informed of any proposed works to the existing watercourse.

12.3 Informative

12.3.1 Coastal or estuarine waters can be deemed sufficient to accommodate uncontrolled surface water discharges. Any discharge to coastal or estuarine waters may require Environment Agency consent in line with Environmental Permitting regulations for discharge to controlled waters, as well as consent from the Marine Management Organisation for any building of infrastructure within the marine environment.

13. Peak Flow Control

13.1 National Standard

S2. For Greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

S3. For developments which were previously developed (Brownfield Site), the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

13.2 Local Standards

LS9: All discharge rates will be restricted to QBar/2 year return period for all storm events.

LS10: The drainage design should be tested using 1 in 1, 1 in 2, 1 in 30, 1 in 100 and 1 in 100+ climate change rainfall events to determine the maximum storage volume.

LS11: For Greenfield development and for developments which have been previously developed (Brownfield sites) surface water discharge rates should be restricted to Greenfield runoff rates.

LS12: Previously developed land is likely to have had positive (piped) drainage systems to drain surface water runoff from the site. Where the systems are still operational (this must be demonstrated) and the details of the drainage network can be provided (diameter/levels/lengths/layout etc.), these should be modelled for assessment and design purposes, along with the contributing area characteristics of the site, to define the existing flow discharge for all outfalls from the site.

LS13: Greenfield runoff rates shall be calculated using the total site area excluding any parkland area or public open space, if situated within the development site, which will remain largely unchanged and not provided with positive drainage.

LS14: For small scale catchments (less than 50ha) the Flood Studies Report or IH124 rainfall model should be used to calculate the greenfield runoff rate.

LS15: For detailed design and modelling purposes, design event rainfall should be based on the use of the most recent version of the 'Flood Estimation Handbook' specific to the location of the development.

13.3 Informative

13.3.1 Where site run-off is to be discharged to the surface water sewer or combined sewer, the sewerage undertaker should be consulted as to whether any additional or alternative discharge controls are required.

13.3.2 Where site run-off is to be discharged to a highway drainage network, the highway authority should be consulted.

14. Volume Control

14.1 National Standard

S4. Where reasonably practicable, for Greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the Greenfield runoff volume for the same event.

S5. Where reasonably practicable, for developments which have been previously developed (Brownfield Sites), the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for the event.

S6. Where it is not reasonably practicable to constrain the volume of the runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

14.2 Local Standards

LS16: All development must be in accordance with National Standard S6 and the runoff volume must be discharged at a rate that does not adversely affect flood risk.

15. Flood Risk within the Development

15.1 National Standard

S7. The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

S8. The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement) or in any utility plant susceptible to water (e.g. pumping station or electricity substation within the development).

S9. The design of the site must ensure that so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

15.2 Local Standards

LS17: An additional increase in impermeable area allowance for urban creep where applicable shall be included within the design to all for the potential increase in runoff in the future (due to extensions or permeable surface being sealed etc),. The table below contains the urban creep allowances to be applied;

Residential development density Dwellings per hectare	Urban Creep allowance % of impermeable area	Runoff coefficient to be applied
<25	10%	0.75
26-30	8%	0.75
31-35	6%	0.84
36-45	4%	0.84
>50	2%	1
Flats & Apartments	0%	1

LS18: The roughness value (ks) for designing surface water systems shall be set to 0.6mm.

LS19: The allowance for climate change requires both +20% scenario and +40% scenario. Therefore new surface water drainage systems designed within the Flood Risk Assessement/Drainage Strategy requires at least three sets of calculations as follows; 1 in 30 year event; 1 in 100 year +20% climate change, and 1 in 100 year +40% climate change.

- A drainage system can be designed to include a +20% allowance for climate change;
- A sensitivity test against the +40% allowance for climate change which will ensure that the additional runoff is wholly contained within the site and there is no increase in the rate of runoff discharged from the site. It must be demonstrated that there are no implications to people from the increased flood hazard (volume between 20% and 40% allowance). It is crucial that the additional runoff from the 40% scenario is contained within the site and does not contribute to an increased flood risk to people/property/crtical infrastructure/third parties elsewhere.
- If the flows cannot be contained within the site without increasing flood risk to properties or main infrastructure a +40% allowance must be provided.

LS20: Drainage systems must be designed so that, unless an area is designated for flood management in the Local Flood Risk Management Strategy or functional flood plain in SFRA, flooding from the drainage system does not occur:

- On any part of the site for a 1 in 30 year event; and
- During a 1 in 100 year plus climate change rainfall event in any part of:
- a building (including a basement); or
- Utility plant susceptible to water (e.g. pumping station or electricity substation); or on a neighbouring site during a 1 in 100 year plus climate change rainfall event.

LS21: Any surcharging of the drainage system must be stored on site without risk to people or property and without overflowing into drains or watercourses.

LS22: Finished floor levels and the level of any basement should be 300mm or more above the maximum flood level (on Site), up to and including the 1 in 100 year return period event plus Climate Change.

LS23: All SuDS features serving more than one property must be located in areas of Public Open Space (POS), highways or public car parks, they will not be accepted within private curtilages.

LS24: An orifice should be no smaller than 100mm in diameter. Hydrobrake orifice no smaller than 75mm. The use of hydraulic throttle controls with diameters less than 100mm are discouraged due to the risk of blockages.

LS25: The runoff coefficient to be applied to all impermeable areas should be as follows;

Residential development density Dwellings per hectare	**Urban Creep allowance % of impermeable area**	**Runoff coefficient to be applied**
<25	10%	0.75
26-30	8%	0.75
31-35	6%	0.84
36-45	4%	0.84
>50	2%	1
Flats & Apartments	0%	1

LS26: For dry basins the graident of the low flow channel connecting the inlet and outlet structures should be no less than 1:100 fall, and the cross fall of the base of the basin towards the low flow channel should no less than 1:50 to ensure aqduate drainage.

LS27: For SuDS features such as dry basins, low flow channels must be considered as part of the design.

LS28: The drainage designer should demonstrate that the SuDS features will accommodate 1 in 100 year storm event plus an allowance for climate change, without causing any significant flooding. To assist auditing, the following should be provided;

- Design calculations including mdx file if possible.
- Drawings, plans and specifications, as required by the LLFA to demonstrate the function of the drainage system.
- Flow paths should be clearly shown for the above and below ground drainage system to demonstrate that flooding does not occur in any part of a building or utility plant for the design areas.
- Flow routes should be clearly shown for events that exceed the system to demonstrate that conveyance routes do not increase risks to people and property on or off site.

LS29: Land drainage that forms an integral element of SuDS features may be allowed to enter into the surface water system, for example when contained within the limits of a SuDs detention basin to aid with drawdown time and functionality. Therefore, for the purpose of above; land drains that form part of SuDS features will not be deemed as land drainage and for the avoidance of doubt will be referred to as ‘under drains’. Early discussions with the sewerage undertaker should be carried out.

LS30: SuDS features located in public areas shall be limited to infiltration/filter trenches, filter strips, swales, bio-retention and detention basins, underground storage, retention ponds and pipes. These SuDs techniques should be appropriately considered, for both the best overall performance of the drainage system and the water quality to the receiving water body.

LS31: Surface water drainage system components should be located in areas, so as to minimise the risk of damage to buildings or critical infrastructure in the event of flooding.

LS32: Underground drainage systems should be designed under pipe full conditions to accept the following design rainfall (i.e. without surcharging above pipe soffit):

- Sites with average ground slopes greater than 1% 1 year
- Sites with average ground slopes 1% or less 2 year;
- Sites where consequences of flooding are severe 5 year

(E.g. existing basement properties adjacent to new development)

Design in relation to existing drainage

LS33: The layout of the development site and the drainage system should be designed to mimic natural drainage flow paths, utilising existing natural low-lying areas and conveyance pathways where appropriate.

LS34: The existing flows entering and exiting the development site shall be allowed to flow through the site unimpeded.

LS35: The impact of overland flows from and on adjacent land should be considered for a range of return periods including as a minimum the 2, 30 and 100 year events. The duration of flooding, maximum depth, maximum velocity and the route of flood flows should be established and managed to mitigate the impact of flooding to people and property. The impact of exceedance flows from and on adjacent land should also be considered. The return period of this assessment will be related to the potential consequences associated with its impact.

LS36: The proposed drainage system must be designed to accommodate any existing flows from upstream catchments that are intercepted or affected by the development. (See informative below 15.3.4).

Design for exceedance

LS37: Flows that exceed the design criteria must be managed in flood conveyance routes, preferably in green networks, that minimise the risks to people and property both on and off the site.
In designing the site drainage and layout, developers should identify the flow paths and understand the potential effects of flooding. They should further design flood exceedance routes to mitigate its impacts where practicable. Guidance on design of flood exceedances routes can be found in CIRIA report C635 Designing for exceedance in urban drainage – good practice.

15.3 Informative

15.3.1 The layout of the development is fundamental to the performance and affordability of the drainage system, as well as wider benefits including the character of the development, amenity, biodiversity, connectivity and the use of the site. **The layout of the whole development including drainage layout should therefore be considered at the earliest stages of the design of the development**. The type of SuDS feature will have an impact on the layout.

The capacity of pipes should be increased further where it is necessary to comply with the flooding protection requirements.

15.3.2 Building for Life 12 recommends that designers 'Explore how a holistic apporach to design can be taken to the deisgn of SuDS by exploiting the topography and geology.' Holistic design should utilise the topography, existing features within the site and vegetation to create a harmonious and practical physical and visual layout that integrates various types of access and transport modes (including walking and cycling), drainage, public open space, an attractive street scene and enhances biodiversity.

15.3.3 Rainfall may result in overland flows onto the site, within the site, and from the site to adjacent areas. Understanding the causes and consequence of surface water flooding is crucial for making well informed decisions on how to manage flood risk within your development. Available sources of information should be analysed to gain an understanding of the sources, pathways, receptors and adverse impacts of flooding (flood hazard and flood risk), and the findings communicated clearly to the LLFA.

15.3.4 In relation to LS36, blue-green areas within the development may be specifically designated for temporary flood storage or conveyance as part of the design of the surface water management system. The consequence of flows entering the site should be accounted for in the site drainage design and where over land flows or flooding is planned the depth, duration, and velocity for any location should be assessed for an appropriate range of return periods and for the impact on the operation and use of the site. Temporary flooding of any area which has a dual purpose use (e.g. footpath, recreation, car park etc.) should be considered in terms of its impact during a period of flooding and its rehabilitation requirements following an event. Clear signage explaining the flood control function of the site, with relevant contact details, should be installed and maintained.

16. Structural Integrity

16.1 National Standard

S10. Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.

S11. The materials, including products, components, fitting or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.

16.2 Local Standards

LS38: All components that require replacement and/or maintenance should be designed to be accessible without undue impact on the drainage system and adjacent structures or infrastructure.

LS39: Material must not react and/or degrade over time to the detriment of the system or adjacent infrastructure. The suitability of the material proposed for a particular drainage component should be assessed as fit for purpose ensuring the structural stability of structures/features during extreme events e.g. long period of rainfall causing saturation.

16.3 Informative

16.3.1 Any drainage component installed below or adjacent to new infrastructure, such as highways or foul sewers, should have a design life compatible with that infrastructure. For any drainage component installed below or adjacent to existing infrastructure such as retaining walls, which are outside the ownership of the applicant, the applicant should have due regard to its existing condition and the design should not have any adverse impact on the existing infrastructure.

16.3.2 SuDS need to be designed to mitigate risks of structural failure or unacceptable deformation of drainage system components or other infrastructure over the proposed development design life. The design should also facilitate the replacement/or repair of drainage components, reduce unnecessary maintenance and replacement of drainage or other infrastructure. This statement applies to all elements of the SuDS including green infrastructure.

16.3.3 Compliance Assessment

Compliance with structural integrity requirements would be demonstrated by:

- Provision of information relating to the design life of the components and/or adjacent infrastructure. This includes information regarding materials and installation, including any compliance with relevant standards;
- Health and Safety assessment;
- Consideration of all relevant infrastructure, and structural calculations if appropriate.

For those components which have a shorter design life than the development, then a repair/replacement procedure must be included within the maintenance document as per LS45. With this scenario, a commuted sum will also be requested.

17. Designing for Maintenance considerations

17.1 National Standard

See also the written ministerial statement of 18 December 2014:
(https://www.gov.uk/government/speeches/sustainable-drainage-systems)
This states that: “Under these arrangements, in considering planning applications, local planning authorities should consult the relevant lead local flood authority on the management of surface water; satisfy themselves that the proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development. The sustainable drainage system should be designed to ensure that the maintenance and operation requirements are economically proportionate.”

S12. Pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.

17.2 Local Standards

LS40: Conventional Drainage Pipes, Subsurface Drainage and Storage
To be constructed in accordance with the latest version of Sewers for Adoption produced by WRc plc.

LS41: Surface water pumping stations should only be used where there is no other practicable method of surface water drainage and an adequate exceedance flood route should be provided in the event of failure of the pumping station. Justification should be given for any underground storage required in conjunction with pumping.

LS42: Where a developer proposes to construct a surface water pumping station, they should discuss this with the LLFA and sewerage undertaker at the earliest opportunity. The use of overland/surface storage should be considered, to remove the need for a pumping station.

LS43: Future maintenance requirements to be considered at all stages in the design and construction process and suitable access provided to facilitate all reasonably foreseeable future inspection, monitoring, maintenance or repair works.

LS44: For below-ground SuDS such as permeable paving and modular geocellular storage the manufacturer or designer should provide maintenance advice. This should include routine and long-term actions that can be incorporated into the maintenance plan. The level of inspection and maintenance will vary depending on the type of SuDS component and scheme, the land use, types of plants as well as biodiversity and amenity requirements.

LS45: It is essential to ensure that the SuDS installation can be maintained easily over the lifetime of the development. Like all drainage systems SuDS components should be regularly inspected and maintained to ensure efficient operation and prevent failure.
Usually SuDS components are near the surface and can be managed using landscape and watercourse management techniques. Inlets, outlets, control structures or other below ground features should be shallow to allow easy access for maintenance and to reduce safety risks.

The SUDS Management/Maintenance Document should include:

- Site description;
- A description of the surface water drainage scheme including any SuDS components, how it works and a general explanation of how it should be managed in the future;
- Operation and Maintenance Requirements – including a schedule of works to set out the tasks required to maintain the site and the frequency necessary to achieve an acceptable standard of work;
- Inspections and Reporting;
- Shrub Management;
- Sediment Removal;
- Construction Requirements;
- Section 104 Adoption Plan (Drawing);
- Funding Arrangement (life expectancy and replacement cost);
- Maintenance specifications;
- A spillage control procedure should also be included;
- A Site Plan (Drawing) – showing maintenance areas, access routes, inlets, outlets and control structure positions, location of any other chambers, gratings, overflows and exceedance routes;
- A drawing highlighting Landscaping/planting;
- Health and Safety issues.

17.3 Informative

17.3.1 The choice of materials and drainage components should take account of future maintenance and operational needs; and available viable maintenance options may play a part in dictating choices better made in the design phase. The management and control of erosion and sediment should be a key consideration throughout design and construction, operation and maintenance.

17.3.2 Each SuDS component should be designed with appropriate upstream sediment management controls. If the component provides the pre-treatment function itself, then appropriate maintenance activities should be undertaken.

17.3.3 Where in accordance with the maintenance plan, access is anticipated to be required for tankers or other maintenance vehicles, an access road with an appropriate surface and rights of way should be provided.

17.3.4 SuDS will be designated as a flood risk management asset by the LLFA.

18. Construction

18.1 National Standard

S13. The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the sewerage or drainage system.

S14. Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is considered to be completed.

18.2 Local Standards

LS46: A construction programme should be made available to the LLFA, which details the timeframe for installation of critical drainage components.

LS47: The relevant Tees Valley Authority should be informed prior to the commencement on site of the installation of the surface water infrastructure and SuDS features. Also before these works commence the following documents should be provided:

- Method statement of construction and of protection of the SuDS during the construction phase
- An inspection sequence for use during construction.
- Post-construction maintenance.

The impact of ongoing construction works on SuDS features should be minimised therefore it is important that the SuDS is protected from construction traffic during construction of the development.

LS48: Runoff from the construction site must not be allowed to enter the SuDS drainage systems unless it has been allowed for in the design and specification. Construction runoff is heavily laden with silt which can clog infiltration systems, build up in storage systems and pollute receiving watercourses. No traffic should be allowed to run on permeable surface components if it is likely to introduce sediments onto the pavement surface from dusty or muddy areas, or result in over compaction. Discharge of contaminated or nutrient rich water must be positively treated to reduce the impact on the receiving watercourse.

It is essential during the SuDS establishment phase that run off from bare soils is minimised,

- green cover on slopes should be rapidly established
- base of slope trenches should be used to intercept run off and sediments

- construction should be timed to avoid high run off rates

LS49: The Lead Local Flood Authority must be notified if any previously unknown drainage system is identified on site during construction works.

18.3 Informative

18.3.1 Construction must comply with appropriate applicable standards. The materials specified for the SuDS components must be fit for purpose. Construction of the drainage system must be in accordance with the approved plans and specification sheets for materials used in construction

18.3.2 The mode of communication between the proposed and the existing drainage system, which is a watercourse, consideration to be given to ensuring there is no consequential damage to the feature e.g. erosion.

18.3.3 The mode of communication between the new drainage systems and the watercourse may be inspected by the landowner or consenting authority.

18.3.4 Failure to rectify any damage to the drainage system may be subject to enforcement action by the relevant enforcement authority or owner.

18.3.5 Provision should be made in the construction process for inspections at key stages, and on completion of construction, to ensure that that the system has been constructed in accordance with the approved design and specification. As constructed drawings should be provided and an as-constructed survey undertaken to ensure that design levels have been achieved. Final inspection should take place at the end of the maintenance period.

Appendix 1: Pre-Application Stage

No formal submission of information is required at pre-application stage, however the Lead Local Flood Authority would strongly recommend that the following information is provided;

Item	**Description**	**Submitted (Tick as appropriate)**
1.	Location Plan	
2.	Site Assessments including the existing drainage characteristics, geology and topography.	
3.	Existing Flood Risk – Surface Water, Flood Zone & historical records	
4.	Natural flow paths, discharge rate and locations, sub-catchments	
5.	Identification of any watercourses running through the site	
6.	Identification of any potential off-site flood risk impact	
7.	Potential Sustainable Urban Drainage locations considering the existing blue/green corridors	
8.	Sustainable Management Train, Source control etc.	
9	Adoption options/ownership	
10.	Maintenance and access arrangements	
11.	Evidence of discussion with Northumbrian Water and the Environment Agency, where appropriate.	

It important that all these points above are considered at a very early stage as these may effect land value and developer costs.

Appendix 2: OUTLINE Application Stage

The following information should be submitted at outline application stage in order to obtain an ‘agreement in principle’.

The LLFA will be consulted on outline planning applications. An outline planning application should therefore include a conceptual Drainage Design for the LLFA to provide comments on, otherwise more information may be required at the reserved matters stage and the developer may discover problems later on that will be harder to resolve.

Item	Description	Submitted (Tick as appropriate)
1.	Detailed Site-Specific Flood Risk Assessment: Guidance (https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section)	
2.	Conceptual Drainage Strategy/Statement	
3.	Impermeable Areas Estimate	
4.	Confirmed discharge location/s and its condition	
5.	Discharge rate	
6.	Drainage sub-catchments	
7.	Storage Volume Estimate	
8.	Storage locations	
9.	Flow Controls	
10.	Ecology and water quality implications, e.g. treatment train	
11.	Public Health and safety consideration	
12.	Identification of adoption responsibilities	
13.	Maintenance and access arrangements	

Appendix 3: FULL Application Stage

Item	Description	Submitted (Tick as appropriate)
1.	Detailed Site-Specific Flood Risk Assessment: Guidance (https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section)	
2.	Detailed Drainage Strategy	
3.	Detailed Design	
4.	Flow calculations (.mdx files where possible) print outs	
5.	Details of inlets, outlets and flows controls	
6.	Construction details	
7.	Phasing of development including construction management plan	
8.	SuDS Design Statement	
9.	Cross sections including design levels	
10.	Operation and Maintenance Plan Health and safety risk assessment	
11.	Full Structural, Hydraulic & Ground Investigations, if appropriate.	

Appendix 4: Discharge of Condition Checklist

Application Number:	
Condition Reference:	

The following information must be submitted to the LLFA at **DISCHARGE OF CONDITION stage.**			
Item	**Description**	**Reference** **(To be completed by applicant)**	**Submitted** **(Tick as appropriate)**
1.	**Detailed Flood & Drainage Design Drawings**		
1.1	Detailed flow calculations (mdx file) that makes reference to a site layout drawing; This should include the following micro drainage printouts:- • Design Criteria • Network Design table • Pipeline schedules • Outfall details for storm • Online controls for storm • Storage structures • Simulation results for 2yr, 30yr, 100yr, 100yr+20%cc and 100yr+40%cc,		
Comments:			
1.2	Detailed drawing must highlight; • total site area, • total impermeable area, • total permeable area, • the drainage catchment area for phased development sites.		
Comments:			
1.3	A drainage site layout drawing of the whole development highlighting any flooding that is not contained in the drainage system between a 1 in 30 year event up to the 1 in 100 year event plus 40% climate change. The drawing must include; • the extent of the flooded area, • its volume, • flooded depths, • duration (time the flood water will be present), • pipe run numbers, • manhole numbers including manhole cover & invert levels, • flow controls, • plot finished floor levels.		

	• existing and proposed site levels including falls, • discharge rate & location, • storage volumes.		
Comments:			
1.4	A drawing highlighting the exceedance flow routes for events greater than 1 in 100 plus 40% climate change **<u>that will not be contained within the development site</u>**. The drawing should highlight the storm event that will result in surface water flows exiting the site and the direction of flow.		
Comments:			
1.5 1.5.1 1.5.2 1.5.3	Detailed drawings of any proposed on the surface SuDS features, must include; • details of any suitable silt interception upstream of system, • detailed design parameters for inlet/outlet structures, flow control devices, overflow arrangements, slopes/gradients, erosion control, finished site levels, • access arrangements for maintenance, • designed return period(s) (years), maximum designed water depth(s) and levels, maximum designed storage volume(s) (m^3), • highlight the 1 in 30 year event flood level & depth and the flood level/depth for the 1 in 100 plus 40% climate change on any proposed SuDS features, including freeboard. Details of any proposed water quality treatment; Critical materials/product specifications – details of finished ground materials, Geomembrane, Geotextile (non-woven), Topsoil, Other etc. Long/cross-section drawings including dimensions; ***Please refer to the 'Ciria Design Assessment Checklist' for more information and the detail required for individual SuDS features.***		
Comments:			
1.6	Detailed drawings of any proposed underground structures, must include; • manufactures specification and maintenance requirements; • the expected design life;		

	• access for maintenance;		
1.7	Full Structural, Hydraulic & Ground Investigations, if appropriate.		
Comments:			
2.	**Maintenance Programme and On-going Maintenance Responsibilities**		
2.1	A detailed Maintenance and Management Plan, setting out the maintenance arrangements of any SuDS features to be privately maintained must include: • a detailed drawing • a maintenance schedule • funding arrangements • maintenance specifications • life expectancy and replacement cost		
2.2	A plan highlighting what is to be adopted under S104 agreement.		
Comments:			
2.3	A Health and safety plan, if appropriate, considering area of open water.		
Comments:			
3.	**Detailed Landscaping Details**		
3.1	Detailed drawing indicating the landscape proposals for the Sustainable Urban Drainage Systems to resolve all elements of the layout, appearance and character of the feature including: • Hard landscaping – footpaths and access track surfacing materials, boardwalks, boulders, fences, and any other furniture, etc • Soft landscaping – proposed new tree and shrub planting, grass seed mixes, aquatic plants etc. • Details of recreational features, if appropriate. • Ecological enhancements – such as habitat creation.		
Comments :			

4.	**Construction Phasing Plan**		
4.1	How surface water will be managed during construction phase must include: • Prevention of silts entering surface waterbodies • Details of how surface water runoff will be contained within the site boundary during construction • Details of measures to be taken to protect and maintain the natural flows of the watercourse through the proposed site. • The mitigation measures to be taken to manage natural surface water flows from outside the site boundary that currently flow through and exist the site.		
5.	**A build programme for the provision of critical surface water infrastructure**		
5.1	The build programme/grant chart should include the following activities and sequence they should be undertaken: • Outfall connection • Control device • Provision of 30 year storage • Provision of 100 year plus climate change storage • Commencement of landscaping The programme should also include the following activities: • Commencement of show village • Commencement of plot foundations • Completion/handovers • Live connections to the system ***It is the duration and order of each activity rather than the commencement date that is required by the LLFA.***		
Comments:			

Appendix 5: Plants suitable for SuDS in the Tees Valley

Plants should be locally native species, preferably of local origin. The plants listed below are all common in the five Tees Valley local authority areas.

Any nursery supplied plants must be ensured that they are 'clean' and free of invasive species. A good guide to invasive species is in the INNS site: http://www.nonnativespecies.org/index.cfm?sectionid=47

Suitable species for the water's edge;

Caltha palustris – Marsh Marigold

Eleocharis palustris –Common Spike Rush

Filipendula ulmaria – Meadowsweet

Juncus inflexus – Hard Rush (*Juncus species are very vigorous, inadvisable to plant in small shallow ponds)*

Juncus effusus – Soft Rush *(Juncus species are very vigorous, inadvisable to plant in small shallow ponds)*

Lychnis floc-cuculi - Ragged Robin

Mentha aquatica– Water Mint

Myosotis scorpioides – Water Forget-me–not

Veronica beccabunga – Brooklime

Suitable aquatic plants for standing water;

Carex riparia - Greater Pond Sedge *(Can be aggressive)*

Carex acutiformis – Lesser Pond Sedge

Glyceria maxima – Sweet Reed Grass

Iris psuedacorus – Yellow Flag Iris

Phalaris arundinacea – Reed Canary Grass *(Can be aggressive)*

Sparganium erectum – Branched Burr-reed *(Can be invasive)*

Native Tree and shrub species

Tolerant of more winter flooding

Alnus glutinosa - Alder

Cornus sanguinea - Dogwood

Corylus avellane – Hazel

Crataegus monogyna - Hawthorn

Salix alba Tristis - Weeping Willow

Salix cinerea -Grey Willow

Salix caprea – Goat Willow

Viburnum opulus – Guelder Rose

Less tolerant of flooding –

Betula pubescens - Downy Birch

Prunus padus – Bird Cherry

AVOID

Phragmites australis – common reed - too invasive

Typha latifolia – reedmace sometimes called bulrush – too invasive

Also avoid all species mentioned in the list on the INNS site at the address above which includes:

- *Azolla filiculoides* - Water Fern
- *Crassula helmsii* - New Zealand Swamp-stonecrop
- *Elodea canadensis* - Canadian Pondweed
- *Elodea nuttallii* - Nuttalls Pondweed
- *Hydrocotyle ranunculoides* - Floating Pennywort
- *Lagarosiphon major* - Curly Waterweed
- *Myriophyllum aquaticum* - Parrots-feather

Appendix 6: SuDS Glossary of Terms

Amenity - The quality of place being pleasant or attractive i.e. agreeableness. A feature that increases attractiveness or value, especially of a piece of real estate or a geographic locations

Attenuation - The reduction of peak water flow by spreading it over a longer time period. This is done by providing storage in sewers, tanks or soft SuDS structures. The principle of SuDS is to provide flow attenuation in order to manage surface water effectively. Any form of flow attenuation is a form of SuDS

Base-flow - The sustained flow in a channel or drainage system

Basin - A ground depression that acts as a flow control or water treatment structure that is normally dry and has a proper outfall, but is designed to detain storm water temporarily. These types of structures include flood plains and detention basins.

Biodiversity - The diversity of plant and animal life in a particular habitat

Bioretention area - A depressed landscaping area that is allowed to collect runoff so it percolates through the soil below the area into an under drain, thereby promoting pollutant removal.

Catchment - The area contributing surface water flow to a point on a drainage or river system.

Combined sewer - A sewer designed to carry foul sewage and surface runoff in the same pipe.

Combined Sewer Overflow - Heavy or prolonged rainfall can rapidly increase the flow in a combined sewer until the volume becomes too much for the sewer to carry and excess storm sewage is discharged to river or sea via relief "valves" known as combined sewer overflows (CSO's).

Conventional drainage - The traditional method of draining surface water using subsurface pipes and storage tanks

Conveyance - The movement of water from one location to another

CSO - See definition for Combined Sewer Overflow

Culvert - A closed channel carrying a watercourse beneath an obstruction such as a road, railway or canal

Curtilage - Land area within property boundaries

Design criteria - A set of standards agreed by the developer, planners and regulators that the proposed system should satisfy.

Designing for Exceedance - An approach that aims to manage exceedance flows during rainfall events such as using car parks during extreme events.

Diffuse pollution - Pollution that comes from non-point source contamination in urban and rural land-use activities spread out across a catchment or sub-catchment. significant.

Ecology - All living things, such as trees, flowering plants, insects, birds and mammals, and their habitats

Environment - Both the natural environment (air, land water resources, plant and animal life) and habitats

Evapotranspiration- - The process by which the Earth's surface or soil loses moisture by evaporation of water and by uptake and then transpiration from plants.

FEH - Flood Estimation Handbook (FEH), produced by Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology) to aid calculation of the possible severity of flooding.

Filtration - The act of removing sediment or other particles from a fluid by passing it through a filter

First flush - The initial runoff from a site or catchment following the start of a rainfall event and as runoff travels over a catchment it will pick up or dissolve pollutants and the "first flush" portion of the flow may be the most contaminated as a result.

Flood frequency - The probability of a flow rate being equalled or exceeded in any year

Flood Routeing - Design and consideration of above-ground areas that act as pathways permitting water to run safely over land to minimise the adverse effect of flooding.

Floodplain - Land adjacent to a watercourse that would be subject to repeated flooding under natural conditions.

Flora - The plants found in a particular physical environment.

Flow control device - A device used to manage the movement of surface water into and out of an attenuation facility, for example a weir.

Forebay - A small basin or pond upstream of the main drainage component with the function of trapping sediment

Greenfield runoff - This is the surface water runoff regime from a site before development,

Greywater - Wastewater from sinks, baths, showers and domestic appliances this water before it reaches the sewer (or septic tank system).

Groundwater - Water that is below the surface of ground in the saturation zone

Highway Authority - A local authority with responsibility for the maintenance and drainage of highways maintainable at public expense

Highway drain - A conduit draining the highway.

HOST - Hydrology of Soil Types (HOST). A classification used to indicate the permeability of the soil and the percentage runoff from a particular area.

Hydrograph - A graph illustrating changes in the rate of flow from a catchment with time

Impermeable surface - An artificial non- porous surface that generates a surface water runoff after rainfall

Infiltration device - A device specifically designed to aid infiltration of surface water into the ground.

Lateral drain - a) That part of a drain which runs from the curtilage of a building (or buildings or yards within the same curtilage) to the sewer with which the drain communicates or is to communicate

Model agreement - A legal document that can be completed to form the basis of an agreement between two or more parties regarding the maintenance and operation of sustainable water management systems.

Nutrient - A substance (such as nitrogen or phosphorus) that provides nourishment for living organisms

Off Stream - Dry weather flow bypasses the storage area.

On Stream - Dry weather flow passes through the storage area.

Orifice plate - Structure with a fixed aperture to control the flow of water

Passive treatment - Natural processes used to remove and break down pollutants from surface water runoff.

Pathway - The route by which potential contaminants may reach targets

Permeability - A measure of the ease with which a fluid can flow through a porous medium. It depends on the physical properties of the medium, for example grain size, porosity and pore shape.

Permeable pavement - A paved surface that allows the passage of water through voids between the paving blocks/slabs.

Pervious surface - A surface that allows inflow of rainwater into the underlying construction or soil

Pitt Review - Sir Michael Pitt was asked by Ministers to conduct an independent review of the flooding emergency that took place in June and July 2007..

Piped system - Conduits generally located below ground to conduct water to a suitable location for treatment and/or disposal.

Private Sewer - Private sewers are those owned by either the owner of the land it runs through,

Public sewer - A sewer that is vested in and maintained by a sewerage undertaker

Recharge - The addition of water to the groundwater system by natural or artificial processes

Recurrence interval - The average time between runoff events that have a certain flow rate, e.g. a flow of 2 m/s might have a recurrence interval of two years in a particular catchment.

Rill - Open surface water channels with hard edges.

Runoff - The amount of water from precipitation, which flows from a catchment area past a given point over a certain time period.

Section 102 or 104 - Section within the Water Industry Act 1991 permitting the adoption of a sewer, lateral drain or sewage disposal works by the sewerage undertaker. Sometimes referred to as S102 or S104.

Section 106 (Water Industry Act 1991) - A key section of the Water Industry Act 1991, relating to the right of connection to a public sewer

Site and regional controls - Manage runoff drained from several sub-catchments. The controls deal with runoff on a catchment scale rather than at source.

Source control - The control of runoff or pollution at or near its source, the principles of SuDS are to mimic as far as possible the natural drainage characteristics of a site to maintain the drainage regime.

By returning water to the natural drainage system as close to where it falls as possible represents effective management of surface water. Source control devices include Soakaways, Permeable surfaces, Infiltration basins and Swales.

Sub-catchment - A division of a catchment, allowing runoff management as near to the source as is reasonable.

Surface Water - Water that appears on the land surface, i.e. lakes, rivers, streams, standing water and ponds.

Transpiration - The loss of water vapour through plant leaves.

Treatment volume - The volume of surface runoff containing the most polluted portion of the flow from a rainfall event.

UKCIP - The UK Climate Impacts Programme (UKCIP) has developed the UK Climate Projections (UKCP09). These projections of our changing climate provide information for the UK up to the end of this century. Sea levels will also rise partly due to melting of polar ice caps. Drier summers will cause pollution problems in watercourses with reduced flow and increased periodic liberation of pollutants that have gathered during extended drier periods.

Water Cycle - The continuous circulation of water in systems throughout the planet, involving condensation, precipitation, runoff, evaporation and transpiration. It is also known as the hydrological cycle.

Water Table - The point where the surface of groundwater can be detected. The water table may change with the seasons and the annual rainfall.

Water Framework Directive - The Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy) is a European Union directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies (including marine waters up to one nautical mile from shore) by 2015. It is a framework in the sense that it prescribes steps to reach the common goal rather than adopting the more traditional limit value approach.

Water Resource Act - This Act aims to prevent and minimise pollution of water. The policing of this act is the responsibility of the Environment Agency. Under the act it is an offence to cause or knowingly permit any poisonous, noxious or polluting material, or any solid waste to enter any controlled water. Silt and soil from eroded areas are included in the definition of polluting material. If eroded soil is found to be polluting a water body or watercourse, the Environment Agency may prevent or clear up the pollution, and recover the damages from the landowner or responsible person.