Southampton City Council Local SuDS Design Guidance

FINAL V1.0 2017

SOUTHAMPTON CITY COUNCIL

[Page intentionally left blank]

Contents

1. Introduction

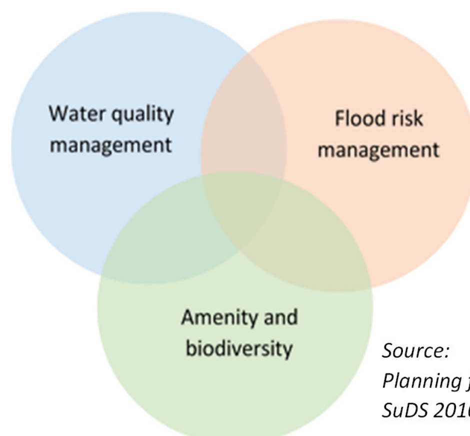
1.1 Sustainable Drainage Systems

For many years developers have dealt with surface water through the use of piped systems that collect and convey water away from the site as quickly as possible, discharging it directly into the nearest watercourse or sewer. Although this method may work in the reduction of surface water at the site, it can result in the increase of flood risk downstream, as well as pollution of watercourses from oil, silt and other pollutants carried directly from a development.

In order to help reduce the risk of surface water flooding to development sites across the city, we are now looking for opportunities to move away from traditional piped drainage towards softer engineering solutions which seek to mimic the natural drainage regime. This can be achieved through the use of Sustainable Drainage Systems (SuDS). SuDS aim to control surface water runoff as close to its origin as possible, before it is discharged to a watercourse or sewer.

The replication of natural drainage is referred to as the SuDS philosophy, which can be achieved through three objectives:

- **Water quality management:** SuDS can help prevent and treat pollution in surface water, contributing to the objectives of the Water Framework Directive.
- **Amenity and biodiversity:** SuDS provide opportunities to create visually attractive green spaces and blue (water) corridors in developments, connecting people to water whilst providing the opportunity to improve existing, and create new habitats for wildlife.
- **Flood risk management**: SuDS help reduce the quantity and flow rate of surface water runoff, lowering the risk of flooding at, and downstream of the development.



Source: Planning for SuDS 2010

Figure 1: *Objectives of the SuDS Philosophy*

Each of the three objectives (Figure 1) should be considered equally, however delivery will vary according to the constraints and opportunities presented on a site by site basis.

1.2 Planning context

Following consultation by Defra on the use of the planning system to secure SuDS, the Department for Communities and Local Government released written statement HCWS161 which came into effect on 6th April 2015. This states that local planning policies and decisions on planning applications should ensure that SuDS are put in place for major development, unless demonstrated to be inappropriate. Local Planning Authorities (LPAs) should consult the relevant Lead Local Flood Authority (LLFA) on the management of surface water.

Under the Flood and Water Management Act (2010), Southampton City Council is a LLFA and holds the responsibility for overseeing the management of flood risk from local sources which includes surface water, groundwater and ordinary watercourses. The LLFA is expected to provide support to Local Planning Authority and the development industry on sustainable drainage proposals.

Southampton City Council's Adopted Core Strategy (amended 2015) requires SuDS measures to be incorporated into all development unless they can be demonstrated to be inappropriate at a specific location. For minor developments, there is currently no requirement for the LPA to consult the LLFA on surface water drainage.

1.3 Purpose of this document

This document forms the local SuDS standards for Southampton and together with the National Standards for SuDS (Defra 2015), strongly promotes the use of SuDS to help reduce the risk of surface water flooding by better managing surface water runoff from new and existing developments. It is intended for use by developers, designers and consultants who are seeking guidance on the requirements for the design of sustainable surface water drainage in Southampton. It provides information on the planning, design and delivery of high quality SuDS schemes which offer multiple benefits to people and the environment.

This guidance should complement the National Standards and will be used by Southampton City Council when consulting on planning applications relating to sustainable drainage. Pre-application advice should be sought from the Council as early in the planning process as possible, in order to identify all design requirements, issues and opportunities, as well as to avoid delays later in the planning stages. Further information on incorporating SuDS at the master planning stage can be found in *A guide for master planning sustainable drainage into developments* (prepared by Lead Local Flood Authorities of the South East of England 2013).

The SuDS philosophy and concepts within Southampton City Council's SuDS guidance document are largely based upon and derived from *C753 The SuDS Manual* (CIRIA 2015). It is not the intention for this guide to replace or duplicate information contained within the SuDS Manual, therefore it is advised that users familiarise themselves with the content and incorporate advice from both documents into their SuDS proposals. References to relevant sections of The SuDS Manual are provided within this document for ease of use.

1.4 Structure of this document

This document aims to provide information, and an overview of design considerations specific to Southampton such as geology and landscape. It intends to provide advice on the standards that are expected not just in terms of flood prevention but also amenity, ecology and water quality. An overview of the structure of this document is given below.

Chapter number and title	Summary of contents
1. Introduction	Provides an overview of SuDS and information on the document purpose and structure.
2. SuDS and the Southampton environment	Gives information about the local environment in Southampton and where this may present constraints and opportunities in relation to SuDS.
3. Site constraints and opportunities	Provides advice on how SuDS can be designed around site constraints and on where opportunities can be sought to deliver SuDS appropriate to local site conditions.
4. Design and selection criteria	Gives detailed guidance on the design criteria that should be applied when designing SuDS within Southampton.
5. Planning for SuDS	Lists the information, in relation to SuDS, which will be required from a developer to inform Southampton City Council's consultation on a planning application.
6. Standing advice for minor development	Gives advice to planners and developers on how SuDS should be incorporated into minor development sites.

1.5 Further guidance and useful information

Throughout the guide, signposts to further information and advice are given, and it is recommended that developers and planners make use of this additional information when planning or designing SuDS.

- The Flood and Water Management Act 2010: http://www.legislation.gov.uk/ukpga/2010/29/contents

- National Standards for Sustainable Drainage (Defra 2015): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

- National Planning Policy Framework: https://www.gov.uk/government/collections/planning-practice-guidance

- C753 The SuDS Manual (CIRIA 2015): http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

- A guide for master planning sustainable drainage into developments (Lead Local Flood Authorities of the South East of England 2013): http://www.medway.gov.uk/pdf/SE7%20suds%20masterplanning%20FINAL%20low%20res[1].pdf

- Southampton Local Flood Risk Management Strategy 2014: http://www.southampton.gov.uk/environmental-issues/flooding/managing-flood-risk/local-flood-risk-strategy.aspx

- Level 2 Strategic Flood Risk Assessment 2010: http://www.southampton.gov.uk/environmental-issues/flooding/development-flood-risk/level2-flood-risk-assessment.aspx

- Flood Risk Assessments: climate change allowances (Environment Agency 2016): https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

2. SuDS and the Southampton environment

Various factors including geology, topography, landscape character, rainfall and possible site contamination influence the suitability of some SuDS features. This chapter summarises local conditions in Southampton and is intended to give an overview of the environment at a Southampton-wide scale. Advice on designing around these constraints and opportunities at site-specific level is provided in Chapter 3.

2.1 Geology and soils

The underlying bedrock geology of Southampton consists primarily of London Clay in the north, where pockets of Whitecliff Sand Member and Portsmouth Sand Member are also present. The south is dominated by Wittering formation with bands of Earnley Sand, Marsh Farm and Selsey Sand Formations along the coast.

Superficial geology consists of Tidal Flat Deposits in the areas adjacent to the rivers Test and Itchen. The higher ground areas away from the rivers are predominantly River Terrace deposits, with alluvium present in some of the smaller watercourses in the catchment. There are large areas of the city, mostly located in the area around the docks, which were constructed on reclaimed land.

Due to the urban environment, Southampton’s soils are largely un-surveyed; however site surveys shows that in some areas the soil is generally slowly permeable and seasonally waterlogged. This particularly affects areas surrounding the coastline on areas of previously reclaimed land.

2.2 Topography

Topographic surveys and LiDAR data show that Southampton generally slopes down towards the River Test and River Itchen. The highest parts of the city are in the north, along the boundaries with the Test Valley and Eastleigh where land heights are typically 50-60 metres above ordnance datum (mAOD). In contrast, the lowest parts of the city are the areas of reclaimed land along the coastal frontage including the docks, where ground elevations are as low as 0.5-1mAOD, but average 3mAOD. The steepest sloping areas are generally located in the northern and eastern parts of the city with flatter areas in the south, close to the tidal reaches of the River Itchen and River Test. The topography of Southampton is shown in Figure 2.

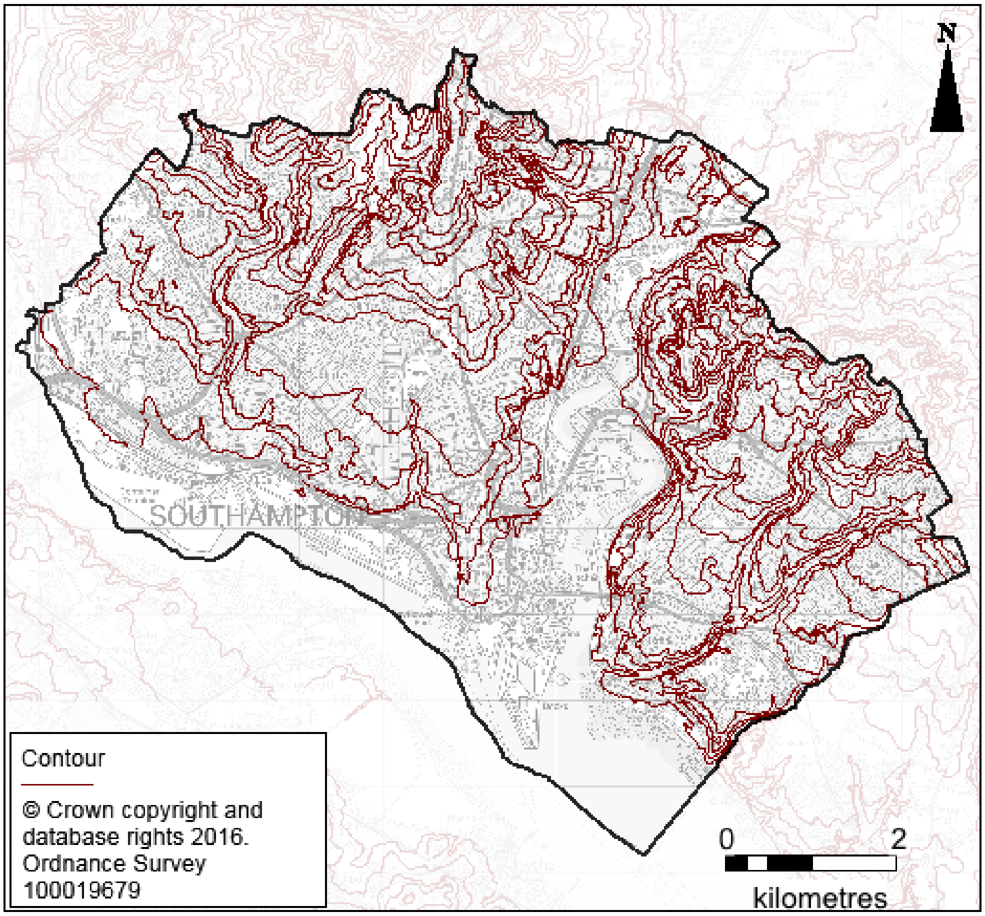


Figure 2: *Topography of Southampton*

2.3 Rivers and watercourses

Southampton is split between two catchments drained by two main rivers, the River Test to the west and River Itchen to the east. The geology of these catchments is typically dominated by chalk in the north, and clay to the south.

The Test and Itchen are both fed by groundwater from the chalk aquifers close to the source, which helps to regulate the flows throughout the year, maintaining a slow response to rainfall. The southern part of the catchment is more responsive to rainfall due to the presence of clay. Both the River Test and River Itchen are tidal estuaries throughout much of the city's administrative boundary, following a unique tidal regime, with a double high water and a young flood stand.

Southampton also has a variety of smaller rivers and watercourses that drain the city, as well as a number of lakes and ponds, including:

- Monks Brook
- Rolles Brook
- Tanners Brook
- Holly Brook
- Jurd's Lake Stream
- Bligmont Crescent Stream

2.4 Flood risk

Approximately 13% of the city is identified as currently at high or medium risk of flooding from tidal or fluvial sources (Environment Agency Flood Zones 2 and 3). Due to its urbanised nature, Southampton also has a high risk of surface water (pluvial flooding). The following sources of flooding are likely to present the greatest risks to developments within Southampton:

- **Tidal (coastal):** The primary source of flood risk in the city. There is approximately 35km of tidal frontage in the city, with the key areas at particular risk of flooding from the sea including the Docks, the Itchen frontage on both sides of the Itchen Bridge, the Northam and Millbank areas, Bevois Valley, St Denys and the Bitterne Manor Frontage.
- **Rivers (Fluvial):** The secondary source of flood risk in the city is from rivers and streams.
- **Surface water (pluvial):** Surface water flooding can occur almost anywhere due to the urbanised nature of the city.
- **Groundwater:** Records of groundwater are limited, however previous incidents of flooding have been noted in the Shirley area. In recent years, incidents of suspected groundwater flooding have been increasing.

2.5 Groundwater levels

Records of groundwater levels in the city are limited and continuous monitoring has not been widely implemented. However, it is known that areas close to the River Itchen and River Test can experience high groundwater levels, particularly where they are constructed on areas of reclaimed land. Groundwater levels may also be high in areas close to watercourses and other surface water bodies.

Due to the local geology some areas of the city are known to have perched water tables which result in the formation of localised springs.

2.6 Water quality

The River Test and River Itchen are regarded to be two of the finest chalk streams in the world, and are both designated as Sites of Special Scientific Interest (SSSI). The River Itchen is further designated as a Special Area of Conservation (SAC) under European legislation.

A number of waterbodies within Southampton have been classified under the Water Framework Directive as part of the second cycle of River Basin Management Plans (2015). The Itchen and the Lower Test are both classified as having good chemical and ecological status (River Basin Management Plan South East River Basin District 2015). Monks Brook and Tanner's Brook both have good chemical and moderate ecological status. Southampton water is classified as having moderate ecological status but is failing on chemical status due to a number of pollutants. No classification information is available for a number of other water bodies in Southampton but it is still important to maintain or improve water quality at these locations.

2.7 Rainfall and climate

The average annual rainfall for Southampton is around 779.4mm, making it one of the drier areas of the south of England which receives an average of 793.9mm (based on 1918-2010 data).

In February 2016, the Environment Agency released its updated guidance on climate change allowances for flood risk assessment and planning. These are based on UKCP09 UK Climate Projections for peak river flow, peak rainfall intensity, sea level rise, offshore wind speed and extreme wave height. Whilst the exact future climate of Southampton cannot be accurately predicted, the projections in the guidance give an indication of how the climate is likely to change over the next hundred years. The allowances indicate that an increase in peak river flow, peak rainfall intensity, sea level, offshore wind speed and extreme wave height is likely.

Further information on how the allowances should be used when designing SuDS can be found in Section 4.4.

2.8 Landscape and biodiversity

Land use in Southampton is predominantly urban and only around 20% of the land is open space, comprising a number of parks, playing fields, allotment areas and greenways. Although largely urban in character, Southampton still supports a vast variety of biodiversity, and has several internationally important and protected areas.

Several parks within the city have received green flag status. Of the 5 city parks, the Central Parks, Southampton Common and Weston Shore have green flag status along with Mayfield Park and Mansel Park. Out of the 35 local parks used by smaller communities, Hinkler Green has green flag status.

The River Test and River Itchen are regarded to be two of the finest chalk streams in the world with their pristine clear waters, and are both designated as Sites of Special Scientific Interest (SSSI). The River Itchen is also designated as a Special Area of Conservation under European Legislation. Other environmentally designated and important sites in Southampton include:

Designation	**Site**
Natura 2000	The Solent Maritime (Special Area of Conservation) The Solent and Southampton Water (Special Protection Area) The River Itchen (Special Area of Conservation)
Ramsar sites	The Solent and Southampton Water
Sites of Special Scientific Interest	Southampton Common Lower Test Valley Lee-on-Solent to Itchen Estuary The River Itchen
Local Nature Reserves	Chessel Bay
Sites outside of Southampton but may need consideration to ensure they are not impacted:	Eling and Bury Marshes (SSSI) Dibden Bay (SSSI) Hythe to Calshot Marshes (SSSI)

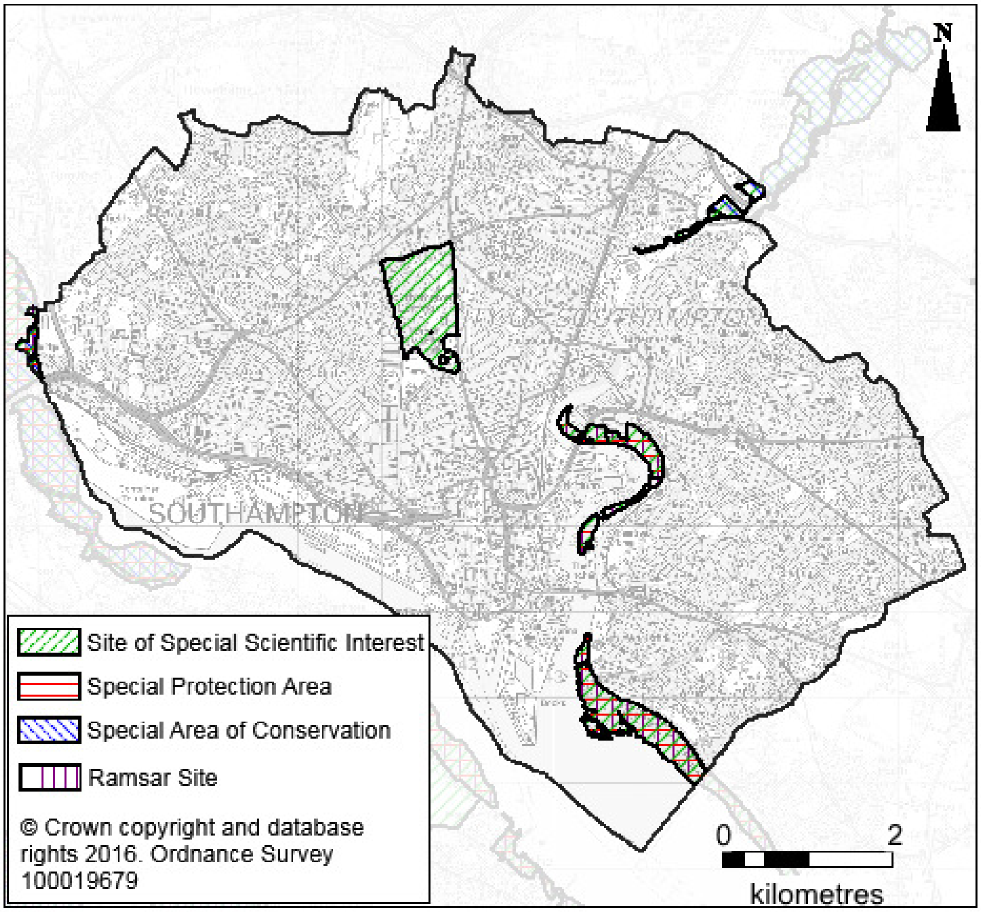


Figure 3: *Environmentally designated sites in Southampton*

2.9 Historic environment

Southampton has a rich historic and cultural association with water. As a historical port settlement, Southampton has seen a considerable volume of merchant vessels, and seaborne raids from enemy nations. Shipwrecks and other losses associated with maritime traffic have the potential to be very well preserved in the river and coastal sediments, therefore offer sites of archaeological interest. Today the port is the second busiest commercial port in the United Kingdom, serving 50% of the total national cruise industry market[1].

The historic environment also includes a range of assets including 20 conservation areas of special historic or architectural interest, 60 scheduled monuments, including town walls, medieval vaults and cellars, the Tudor House Museum and Roman remains at Bitterne Manor, 450 listed buildings and 3 registered parks and gardens.

2.10 Land contamination and land use

Considerable areas of the city are built on reclaimed or made ground, in particular, the docks are built up using dredged material from Southampton Water, over natural estuarine alluvium deposits. Many of the older parts of the city are built on rubble from previous buildings damaged during the war.

[1] Southampton City Council, 2005. *Southampton Cruise Tourism*

Pockets of in-filled former gravel, sand and clay pits consisting of a range of materials including rubble, commercial waste and domestic refuse also exist at various locations across the city, some of which fall within the tidal floodplain and if flooded could lead to contamination of water and surrounding soils and increased risk of erosion. Sites of current and historic industry also pose the risk of land contamination.

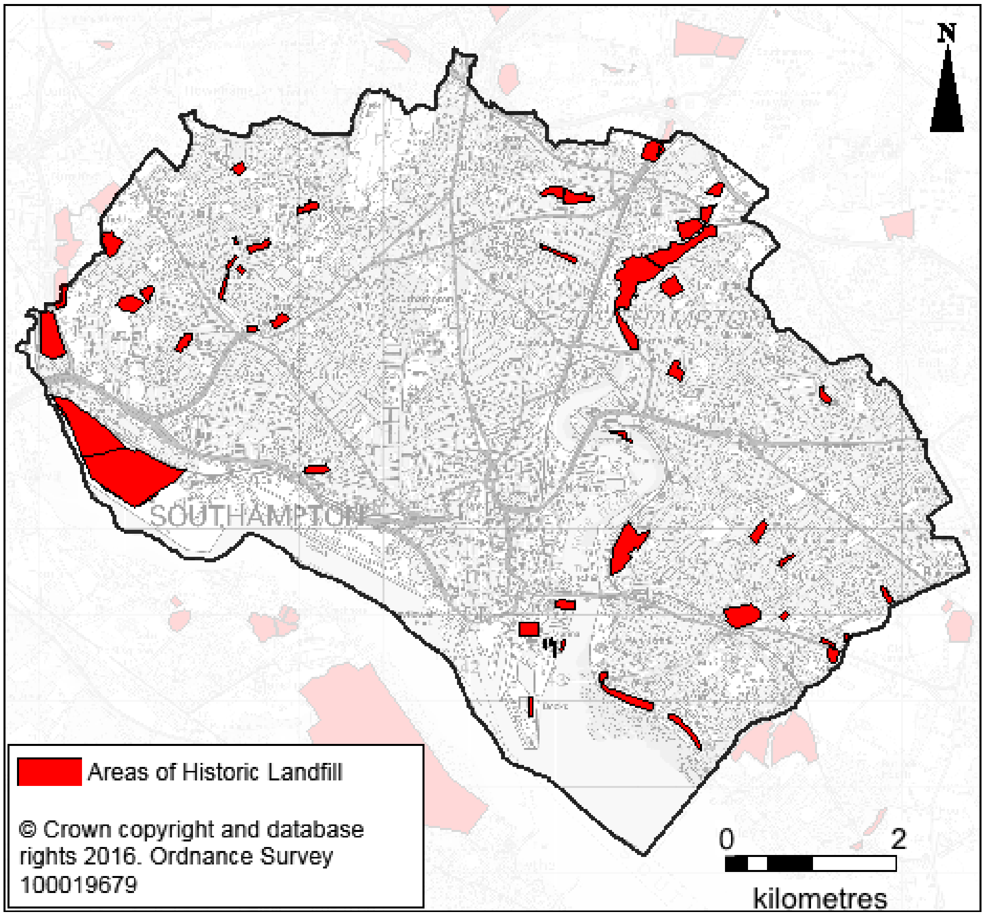


Figure 4: *Areas of historic landfill in Southampton*

2.11 Urbanisation and land availability

Land within the Southampton City Council administrative boundary is largely urbanised and the majority of proposed development sites are therefore expected to have been previously developed. As a result, there may be a number of constraints on site layout including site size, access routes and existing buildings and infrastructure.

2.12 Unexploded ordnance

Southampton was heavily bombed during the Second World War and large areas of the city have been rebuilt on former bomb sites. As a result there is a potential for unexploded ordnance to be unearthed during construction.

2.13 Proximity to airfields and flight paths

Southampton airport sits just outside of the city’s administrative boundary to the south of Eastleigh with flight paths crossing the city. Bird strikes pose a significant risk to aircraft and consultation with the aerodrome licence holder/operator is required within 13km of an aerodrome where development is likely to attract birds.

3. Site constraints and opportunities

This chapter discusses how the conditions identified in Chapter 2 may present constraints and opportunities at a site-specific level. There are many different SuDS components, however as each site has different characteristics not all SuDS will be appropriate at all sites. The unique characteristics of a site should guide the developer to the most appropriate SuDS techniques, therefore identification of all opportunities and constraints at an early stage is very important.

Consideration needs to be given to:

- **Land use characteristics**: The type of SuDS feature selected should be appropriate and best suited to the proposed land use of the area draining into the system, taking into consideration the potential pollution generated by the site.
- **Site characteristics:** Some site characteristics including soils, geology, space availability, slope and area draining into a single SuDS component, may restrict or preclude some SuDS techniques.
- **Catchment characteristics**: The suitability of a SuDS feature may depend upon the catchment, and the waterbody downstream where surface water will be discharged. Performance of a SuDS feature may be influenced by protected/designated sites or waterbodies, surface water for public supply, flood risk and habitat depended flow regime.

Further information on addressing site constraints at the master planning stage can be found in *A guide for master planning sustainable drainage into developments* (prepared by Lead Local Flood Authorities of the South East of England, 2013).

3.1 Geology and soils

The permeability of a site depends upon the geology, soil and groundwater levels present. Chalks, sands and gravels tend to be more permeable than clays, although winterbourne streams or springs can originate from areas of chalk that are saturated with high groundwater levels.

Where impermeable soils are present it is unlikely to be feasible to use infiltration-type SuDS, although in some cases infiltration to more permeable underlying bedrock may be possible. Ground investigations should be carried out to determine whether a more permeable layer exists below a shallow impermeable layer. In areas where more permeable ground conditions are present, opportunities can be sought for infiltration of runoff into the ground. This can provide multiple benefits including groundwater recharge and reduction in storage requirements. The potential for infiltration should be assessed on a site-by-site basis, ensuring that local potential for high groundwater, flooding of nearby sub-surface structures, slope instability and contaminated land are also considered.

Constraint	Opportunity
Ground or soil conditions mean that the site has poor permeability	SuDS focusing on attenuation and treatment above ground, rather that infiltration should be considered. Features including green roofs, rainwater harvesting, permeable surfaces, swales, ponds and wetlands may be suitable for the site.

3.2 Topography

The natural drainage characteristics of a site are strongly influenced by topography. Moderate slopes generally provide the most advantageous conditions for SuDS and drainage of water by gravity. Flat sites can present challenges when implementing SuDS as requirements for pipe cover and system gradient can lead to deep features at the downstream end of the system. Such features are likely to be unattractive and may pose health and safety issues. Steep slopes will increase runoff velocity, and storage and infiltration of water may have adverse effects on slope stability.

Constraint	Opportunity
The site is flat	Keep surface water on the surface as much as possible and manage runoff close to its source. Water can be conveyed on the surface using roadside kerbs, shallow rills and swales.
There is a steep slope on site	Slow down the flow of water by using a series of staged storage features such as ponds, check dams or bio-retention or wetland features staged in terraced arrangements. Consider slope stability when designing SuDS features.

3.3 Rivers and watercourses

Discharge directly to watercourses is generally the preferred option for SuDS where reuse of water or infiltration is not possible, in order to reduce stress on the local sewer network. However, appropriate discharge rates should be selected and water treatment provided so as not to increase flood risk or cause detriment to the watercourse. The ability of the system to discharge water during high river or tide levels should also be considered. Constraints associated with the presence of watercourses can include a localised high water table, access issues and flood risk.

Constraint	Opportunity
Drainage system unable to discharge due to high river or tide levels	Consider whether infiltration may be feasible. Design the system for storage of runoff until discharge is possible.

3.4 Flood risk

The increased use of SuDS provides an important opportunity to reduce flood risk in Southampton, both locally to a site and in the wider catchment. SuDS design should demonstrate how flood risk (as identified in a site-specific Flood Risk Assessment) can be managed within the site, without increasing flood risk elsewhere.

Flood risk can provide a significant constraint both to a development as a whole and specifically to the drainage system and it is important to understand the risk to the site early in the initial design stages. Some areas, such as those within a floodplain, may not be appropriate for some types of SuDS features, since these areas will naturally flood with river or coastal waters, making them ineffective for storing surface water runoff. Additionally, the presence of areas at flood risk on a site can reduce the developable area, resulting in spatial constraints. However the presence of a floodplain does not prevent the use of SuDS.

Constraint	Opportunity
The site is fully or partially located within a floodplain area	Storage features should generally be located outside of areas at significant flood risk to prevent a reduction in capacity through flooding of the system. The treatment capabilities of SuDS features are also likely to be reduced by flooding. SuDS design should limit grading and creation of surface features (e.g. berms and un-reinforced channels) that could be washed out during a flood. Attenuation periods for SuDS should be designed so that the feature empties within 24 hours in anticipation of further rainfall events.
Runoff enters the development site from a neighbouring site/development	SuDS such as swales can be used along the development boundary to intercept and divert flow away from buildings.
There is limited space available on site due to flood risk	Use space efficient SuDS including green roofs, permeable paving, rills, stepped canals, rainwater harvesting, bio-retention gardens and micro-wetlands, or those which have multi-functionality such as shallow attenuation basins that are only wet during rainfall.

3.5 Groundwater levels

Determination of the depth of the groundwater table at a site is essential in the planning stages. Groundwater levels tend to vary seasonally and it is important that this is taken into consideration when assessing the viability of unlined SuDS features. High groundwater levels at a site may mean that infiltration-type SuDS are not suitable. Furthermore, high groundwater levels may cause flooding or damage of SuDS features, reducing their capacity.

Constraint	Opportunity
Groundwater levels at the site are high	Shallow surface components that do not require infiltration are most appropriate. Green roofs and rainwater harvesting should also be considered to reduce runoff.

3.6 Water quality

SuDS should be designed so as not to contribute to a deterioration in water quality and, where possible, should look for opportunities to improve water quality in the receiving waterbody. Runoff discharged via infiltration to the ground, to a watercourse or other surface water body, and to a sewer, will all require sufficient on-site treatment. Consideration should be given to reducing and removing discharge to combined sewers to reduce the occurrence of overflows into the surface water system.

Constraint	Opportunity
Runoff will be infiltrated to ground	Provide sufficient levels of treatment before infiltration. Design to reduce the risk of mobilisation of contaminants through the ground.
Runoff will be discharged to watercourse or other surface water body	Provide sufficient levels of treatment before discharge.
Runoff will be discharged to sewer	Provide sufficient levels of treatment before discharge. Consider reduction and removal of discharges to combined sewers.

3.7 Rainfall and climate

SuDS present an important opportunity to lessen the impacts of climate change, particularly where they are implemented on sites which have previously been developed, as they can provide a reduction in peak runoff rate and runoff volume. It is important to consider the likely impacts of climate change on a proposed development site and its drainage system throughout its expected design life.

SuDS can provide further localised climate benefits. Grassed areas and green roofs can provide a localised reduction in temperature, compared to paved areas, and green roofs can provide insulation to buildings to moderate temperatures.

Constraint	Opportunity
Increased runoff due to climate change	The system should be designed to allow for the likely impacts of climate change throughout its lifetime. Opportunities should be sought to reduce the impacts of climate change.

3.8 Landscape and biodiversity

SuDS should be designed so as not to cause detriment to nearby environmentally designated areas. Outside of theses environmentally important areas, SuDS can provide opportunity for further biodiversity benefits on a more local scale, particularly where open surface features such as ponds and wetlands are constructed. Consideration should be given to the preservation and enhancement of existing habitats on a proposed development site and on the likely effects of maintenance on a habitat.

Constraint	Opportunity
Site located in close proximity to an environmentally designated area	SuDS should be designed not to cause detriment, and where possible complement, environmentally important areas.
Existing habitats present on site	SuDS should be designed to complement and enhance existing habitats.

3.9 Historic environment

SuDS features should be sympathetic to local character including the historic environment. SuDS should also be designed so as not to damage historic assets for example through undermining caused by infiltration or trees. Historic environment assets may present constraints on the location, scale and type of SuDS which can be used at a site. However, opportunities exist for SuDS features to complement the historic environment for example through use of SuDS already present in the area such as roadside rills. Sites located within conservation areas or close to historical assets should consult the relevant body on whether the proposed design is appropriate to the area.

Constraint	Opportunity
Site is located within a conservation area	Consult the relevant body on appropriate use of SuDS. Look for opportunities to complement and enhance the historic environment.
Historic environment assets located on or near the site	Look for opportunities to complement and enhance the historic environment. Design to prevent damage to historic assets.

3.10 Land contamination and land use

The potential for mobilization of existing contaminants present at the site should be considered as well as those that will be produced by the proposed land use. SuDS can still be incorporated into sites where contaminated land exists, although the use of infiltration may not be suitable, particularly in 'Groundwater Protection Zones' or areas where groundwater levels are high. This is because concentrated ground flow could lead to the mobilisation of pollutants in the ground and water-borne contaminants being transferred to deeper soils or sensitive aquifers. Instead, lined attenuation features should be considered. Excavation may also pose issues with mobilization of pollutants and this should be managed carefully. On-site ground investigations are important in the identification of any pockets of contaminated land, from previous or current land uses, in order to help select an appropriate SuDS design.

If heavy machinery or chemicals are to be used as part of the proposed land use, or other activities with a high risk of causing contamination will be present, careful consideration needs to be given to the SuDS design to reduce the risk of contaminated runoff causing detriment. In some cases it will be necessary to separate and contain serious pollutants for separate treatment as industrial waste leaving lower risk areas such as roofs and car parks to drain to the SuDS features.

Constraint	Opportunity
Contaminated land is present on site and there is a significant risk of mobilising contaminants	Lined SuDS features that are designed to attenuate water on or near to the surface should be used. Lining will allow the use of swales, wetlands, ponds and permeable paving on site, whilst preventing infiltration. Excavation should be managed carefully.
The site is within a Groundwater Protection Zone	Features that provide for the treatment of water prior to infiltration should be used to avoid contamination. Where infiltration is not allowed (following advice from the Environment Agency), SuDS features can be lined.
The site is, or will be, used for industry which poses a risk of contaminated runoff	Create sub-catchments to separate drainage. Runoff at high risk of contamination from chemicals, or other resinous water-borne pollution should be contained and treated as industrial waste. Runoff from roofs and car parks (or other non-hazardous hard areas) can be drained into normal SuDS features suitable for the type of development.

3.11 Urbanisation and land availability

In an urban setting there may be a number of constraints on site layout including site size, access routes and existing buildings and infrastructure. In some new developments there may be limited space for landscaped areas, for example high density housing or in commercial or industrial settings, but with careful design SuDS can easily fit into tight urban settings. Building up a network of SuDS that manage runoff close to its source can reduce the need for large storage areas, whilst smaller above ground features can enhance amenity by doubling as a water feature. Multifunctional spaces should be considered. Underground storage tanks should only be used as a last resort as they do not provide as many benefits as other types of SuDS features.

The location of buried infrastructure such as utilities, and the capacity of existing drainage infrastructure should be considered in SuDS design and construction as they can influence the suitability. This is especially important on pre-developed or brownfield sites. Features which require significant excavation may not be appropriate in areas where there are buried utilities as this will require disturbance and re-construction. It is important to note that utility owners are likely to have specific requirements on cover depths and buffer zones that will need to be met.

Constraint	Opportunity
High density development without adequate open space for surface water features, or open space is not suitably located	Consider location and space requirements for SuDS at master planning stage to maximise potential for usage. Use space-efficient SuDS including green roofs, permeable paving, rills, stepped canals, rainwater harvesting, bio-retention gardens and micro-wetlands, or those which have multi-functionality such as shallow attenuation basins that are only wet during rainfall.

Constraint	Opportunity
The development will require mostly paved or hard areas	Permeable paving should be used to drain hard areas. Storage can be provided above ground through hardscape depressions and rills, doubling as a water feature to enhance amenity.
There is existing utilities infrastructure within the site	Locate areas with buried utilities early on in the development in order to find suitable areas for SuDS. Consult infrastructure owner on requirements for cover and buffer zones. Consider the possibility of relocation of infrastructure if appropriate. Incorporate green roofs, rainwater harvesting and channels directing water away from major utilities.
Capacity in existing drainage infrastructure is low	Follow the discharge hierarchy, seeking opportunities to reuse water, infiltrate, or discharge to surface water bodies as appropriate before considering discharge to a sewer. Reduce peak flow and discharge volume from the site.

3.12 Unexploded ordnance

Due to extensive wartime bombing of the city there is the potential for unexploded ordnance to be discovered on site which will need to be removed. Whilst this does not provide any specific constraints on the type of SuDS available, designers should be aware of this risk and plan the design and construction of SuDS accordingly to minimize risks to site operatives and the public.

Constraint	Opportunity
Unexploded ordnance possible on site	Be aware of the risk and plan the construction process accordingly to minimize risks to site operatives and the public.

3.13 Proximity to airfields and flight paths

Bird strikes pose a significant risk to aircraft, therefore SuDS landscapes in those areas within 13km of aerodromes should be designed to support non-hazardous species such as passerines (song birds) rather than larger flocking birds. The use of large ponds, wetlands and tree/plant species producing berries are not likely to be suitable in these areas due to the potential for attraction of birds.

Additional guidance on SuDS in close proximity to airspaces, including design requirements, can be found in Section 36.3.5 of C753 The SuDS Manual (CIRIA 2015) and the Civil Aviation Authority publication, *Safeguarding of Aerodromes, Advice Note 3: Potential Bird Hazards from Amenity Landscaping and Building Design* (CAA, 2003).

Constraint	Opportunity
Site is close to an airport or under a flight path, and SuDS may attract birds increasing the risk of bird strike	Avoid large open water areas by using smaller mosaics of ponds that are netted or have edges accessible by predators. Avoid large plants and those with berries. Use long grass rather than the short grass preferred by geese. Design planting to reduce risk of roosting by large number of birds. Seek further advice from the aerodrome licence holder/operator where appropriate.

4. Design and selection criteria

The purpose of these design criteria is to provide a framework for designing a system in order to effectively drain the required area and to protect public health and safety and the environment without causing detriment elsewhere. The required design principles and standards are set out in the National Standards for SuDS, however to ensure SuDS respond to local conditions and priorities, Local Standards can be set. This guidance builds on the National Standards, outlining the expectations for SuDS in Southampton. Where guidance is based on that given in other documents, references are provided so that further information can be sought by the designer.

Each of the criteria which will need to be met are detailed below. The level of detail required to demonstrate fulfilment of these requirements is dependent on the stage of the design and planning process. Checklists are provided in Chapter 5 detailing the information that will need to be included in a planning submission to allow Southampton City Council to assess the proposals and provide a response to the developer and/or Local Planning Authority.

4.1 The SuDS management train

SuDS should be designed to mimic the natural drainage of a site as closely as possible, which can be achieved through the application of a management train. This concept uses a variety of drainage techniques in series to incrementally reduce pollution, flow rates and volumes, and is a fundamental requirement in the design of a successful SuDS scheme. When developing the management train, the hierarchy of techniques should be considered and applied progressively from prevention, source control and site control through to regional control. Figure 2 explains the management train.

Techniques that are higher in the hierarchy that manage rainfall at the source for example green roofs, rain gardens, soakaways and permeable paving are preferable to those further down managing runoff on a regional scale. Developers are advised to always consider prevention and control of water at source before site and regional controls. In general, the more techniques used in series, the better the performance is likely to be, and the lower the risk of system failure. Water should only be conveyed elsewhere if it cannot be dealt with onsite.

Surface water runoff should be managed in small, cost-effective landscape features located within small sub-catchments rather than being conveyed to, and managed in large systems at the bottom of drainage areas in end of pipe solutions. Natural overland conveyance systems to connect SuDS features should be used wherever possible.

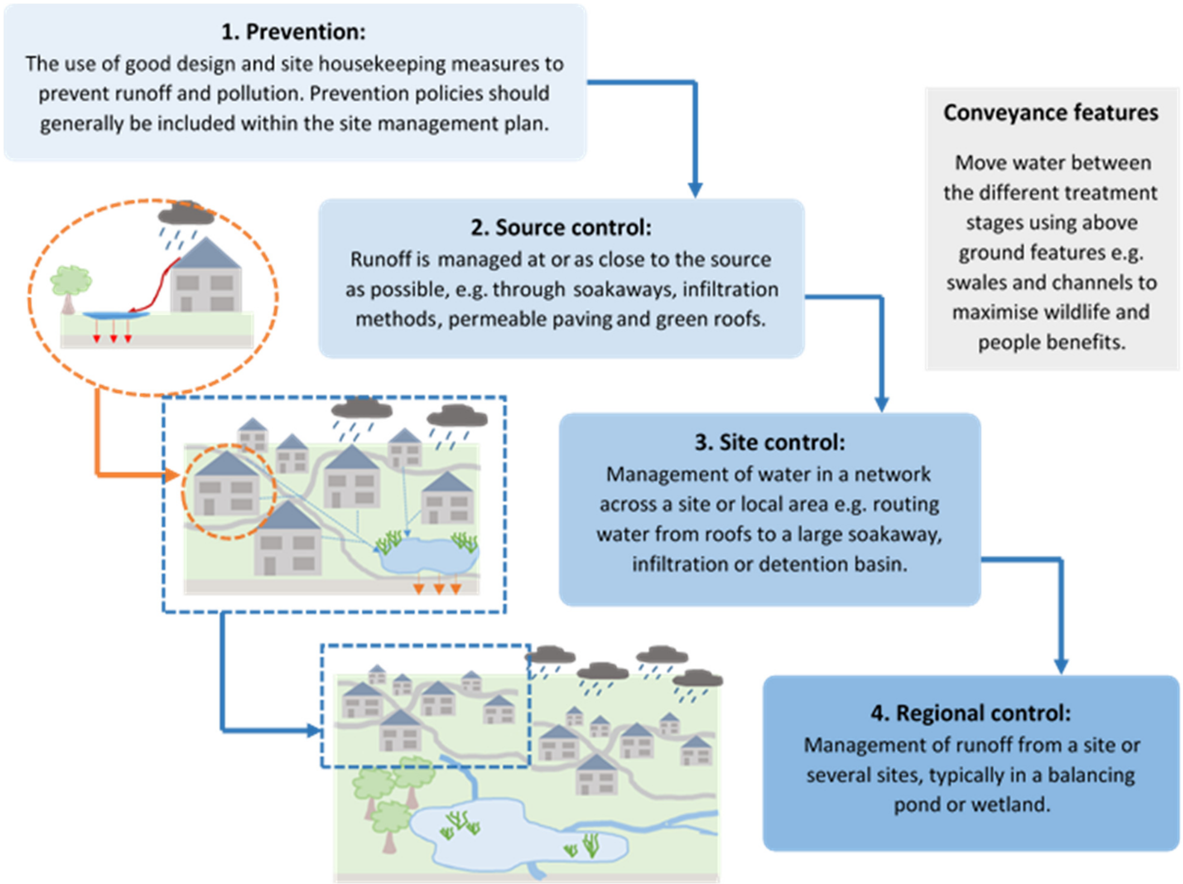


Figure 5: *SuDS management train*

4.2 Discharge location

Water is a valuable resource and opportunities should first be sought to reuse runoff on site once it has been appropriately treated. Following this, the discharge location of the drainage system should be selected according to the discharge hierarchy as detailed in Part H of the Building Regulations. The discharge location should be prioritised in the following order:

> **Guidance:** For further information on the discharge hierarchy, see Sections 3.2.2 and 3.2.3 of the C753 The SuDS Manual.

1. Infiltration to the ground
2. Discharge to a watercourse or other surface water body
3. Discharge to a surface water sewer, highway drain or another drainage system
4. Discharge to a combined sewer

Discharge to a foul sewer should not be considered with the exception of discharges which have been separated as they are hazardous or highly polluting. Systems which are drained by gravity are preferred as they are likely to be more sustainable and cost effective. Pumping should only be considered as a last resort.

4.3 Water quantity

In line with National Standards, for Greenfield developments the post-development peak runoff rates in the 1 in 1-year and 1 in 100-year events should not exceed the Greenfield runoff rate for the same event. Where reasonably practicable the post-development runoff volume in the 1 in 100-year 6-hour storm event should not exceed the Greenfield runoff volume for the same event.

Guidance: Further information on appropriate methods for the estimation of existing runoff rate can be found in Table 24.1 of C753 The SuDS Manual and in *Rainfall runoff management for developments Report SC030219* (Environment Agency, 2013).

The National Standards state that for developments on sites which have previously been developed (brownfield), the peak runoff rate in the 1 in 1-year and the 1 in 100-year events should be as close to Greenfield rate as is reasonably practicable. In Southampton, there is significant flood risk from surface water and it is therefore a requirement for all developments (including brownfield) that peak runoff rates do not exceed Greenfield conditions. Where this is not likely to be feasible, due to other site constraints, this should be discussed with Southampton City Council at pre-planning stage and acceptable discharge rates agreed. There should never be an increase in runoff from the site post-development. Post-development runoff volumes in the 1 in 100-year 6-hour storm event should be as close as reasonably practicable to the Greenfield runoff volume for the same event.

Consistent areas should be considered when calculating the pre- and post-development runoff.

Where it is not feasible to constrain the discharge volume in line with the requirements above, runoff should be discharged at a rate which will not adversely affect flood risk on the site or elsewhere. Post-development runoff rate and volume should include an allowance for urban creep of 10%, where appropriate.

Where impractically small flow controls would be required to meet the design discharge rate (e.g. on small sites) a discharge rate of 5l/s can be used.

If discharge to a sewer is proposed, the sewerage undertaker (Southern Water) should be consulted to confirm their requirements for discharge rate and volume and to check sewer capacity. However, it should be noted that, where Southampton City Council requirements state a lower discharge rate or volume than those of the sewerage undertaker, Southampton City Council requirements should still be met. This is to reduce the risk of an increase in flood risk in the downstream catchment.

Where the surface water system discharges to a surface water body which can accommodate uncontrolled discharges (e.g. the sea or a large estuary), it may be appropriate to allow free discharge provided that there is no increase in flood risk or detriment to the environment. However, where discharge is likely to be restricted during high tide conditions, sufficient storage should be provided within the system to store runoff until it can be discharged at lower tide levels.

Storage features should be used to retain runoff on site and release it at the required discharge rate.

4.4 Water quantity: climate change

It is important that SuDS are designed to allow for the likely effects of climate change throughout the lifetime of the development. A climate change factor should therefore be applied to the peak rainfall intensity for the 1 in 100-year event and the system designed to accommodate this increase.

The Environment Agency's *Flood risk assessments: climate change allowances* guidance (2016) should be used to determine the appropriate climate change factors which should be applied. The system should be designed for the Central allowance but with sufficient freeboard to accommodate the higher Upper end allowance. For the majority of proposed development it will be appropriate to use the allowances for the 2070 to 2115 epoch meaning that a Central allowance will be 20% and the Upper end will be 40%.

Guidance: Further information on the climate change allowances can be found at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

4.5 Water quality

Surface water discharging from a site must not have an adverse impact on the receiving water body (e.g. a groundwater aquifer or a river). SuDS are an effective method of improving water quality, as they can be designed to remove pollutants from surface water before it is discharged.

Runoff from small rainfall events can pose particular water quality issues and the system should therefore be designed to intercept runoff from small rainfall events (<5mm) with no runoff discharged from the site. For all events, sufficient levels of treatment should be provided for the proposed land use.

Guidance: For further information on water quality management in SuDS, see Chapter 4 and Chapter 26 of C753 The SuDS Manual.

For the majority of developments the simple index approach, as detailed in Section 26.7.1 of C753 The SuDS Manual, should be used to demonstrate that the proposed SuDS features will provide sufficient treatment to runoff. This approach assigns a hazard index by land use to each of three pollutant types (Total Suspended Solids, metals and hydrocarbons). Mitigation indices are assigned for each pollutant to different types of SuDS component and the system should be designed so that the total mitigation index exceeds the total hazard index for each contaminant type. Where a series of components are used, the reduced performance of the secondary or tertiary components should be accounted for. Further detail can be found in Section 26.7.1 of C753 The SuDS Manual. It is important to note that for each SuDS component to achieve its mitigation indices minimum design requirements will need to be met.

The simple index approach may not be appropriate for land uses with a high pollution hazard level, such as major roads and sites with heavy pollution, or where there is a risk of polluting groundwater. Further guidance on this can be sought from Table 4.3 of C753 The SuDS Manual.

4.6 Design for flood risk

The following three events should be considered when designing the drainage system to mitigate flood risk at a development site:

- 1 in 30-year event – Water should be managed underground or in areas specifically designated to hold and/or convey water. Flooding should not occur in any part of the site.

- 1 in 100-year event – Flooding should not occur to any part of a building or in any utility plant susceptible to water within the development. Discharge of water from the site in this event should be controlled as detailed in Section 4.3. Uncontrolled discharges from the site (e.g. overland flows) should not occur as they are likely to increase flood risk elsewhere.

- Events exceeding the 1 in 100-year event – Flows within and from the site should be managed in exceedance routes so as to minimise the risks to people and property as far as reasonably practicable.

The drainage system should be designed so that it will continue to perform as required during and following flood events from all sources. This is usually achieved by locating the drainage system outside of areas which are at risk of flooding from other sources. This should also reduce the risk of sediment which has been mobilised from elsewhere accumulating within the system. Where “tide-locking” of the system is likely to occur, due to downstream tide or river levels, an allowance should be made for the additional storage volume which will be required whilst the system is unable to discharge.

4.7 Design for exceedance

Exceedance of a system can be caused by blockage, element or system failure, or by rainfall events in excess of the design capacity. It is of vital importance to design for exceedance and to know where water will travel in such events. It is particularly important to consider the likely depth and velocity of flows and the resulting hazard that this may pose to site occupants. The risk of scour and other damage should also be considered, as should risk of breach for any raised features.

The developer should identify the likely effects of exceedance of the system and demonstrate that risks have been designed out or reduced where possible. The system should always have a degree of freeboard and measures such as ground modifications to redirect flow and raised floor levels can also be used. Blockage risks can be reduced by allowing self-cleansing velocities in piped systems, through provision of appropriately designed outlets and inlets, and through an appropriate maintenance regime.

All features should be designed so that there is early warning of system failure or blockage. In surface features it is often clear when a blockage has occurred but this may be hidden in sub-surface systems. It is therefore prudent to provide localised low spots above ground where water will first escape before the whole site is flooded. This may allow the failure to be observed and action to be taken before flooding is widespread.

Exceedance routes should be protected from any future changes in land use in order to protect future users of the site.

4.8 Design for low flows

Frequent waterlogging of SuDS features can cause issues such as ground instability, environmental issues and a reduction in amenity value. Some areas are designed to remain wet or partially wet during normal conditions (e.g. ponds and wetlands) but others may experience detriment. It is therefore important to consider how the system will operate in low flow conditions which will occur much more frequently than the larger events for which the system is designed. In some features, it may be appropriate to provide a low flow channel or to only allow water to enter in larger events (e.g. via an overflow).

As stated in Section 4.5, above, smaller events generally pose particular pollution issues and it is therefore necessary to ensure that sufficient treatment is provided within the low flow system before discharge. Flow depths and velocities should therefore be limited in low flow events.

4.9 Maintenance and Adoption

SuDS should be designed with ease, safety and cost of maintenance in mind. SuDS that deal with water above ground, and those that are vegetated, should be given priority over hard engineered features. If maintenance is considered early in the design stages, SuDS should be no more expensive to maintain than traditional drainage systems. The choice of materials used can impact the efficiency and future maintenance of SuDS. It is also important to consider health and safety aspects of any maintenance activities associated with the proposed system throughout the design process, in line with the Construction (Design and Management) Regulations 2015.

Guidance: For further information on operation and maintenance of SuDS see Chapter 32 of C753 The SuDS Manual. Specific maintenance requirements for individual SuDS components can be found in Part D of The SuDS Manual.

Underground pipes or storage tanks should be avoided as they are harder and more costly to maintain as the replacement of a particular component is likely to require excavation which could disturb the rest of the system. Additionally, systems that will require entry into confined spaces (e.g. manholes) for maintenance should be avoided for health and safety reasons. Access requirements for maintenance should be considered for all features. Passive flow controls and gravity-drained systems are preferred as they are likely to have a lower maintenance burden.

For all proposals, information should be provided on who will be responsible for the long-term operation and maintenance of the system, the likely maintenance requirements, and any associated health and safety considerations.

A management plan should be provided as part of the detailed design proposal and should include:

- A site plan showing the location of all SuDS components on site (including inlets and outlets) and maintenance areas, access routes and buffers
- A management statement to set out the management aims, and how the system should function and how it is likely to develop over time
- Specification of who is responsible for maintaining each component
- A maintenance schedule setting out timings, frequency and triggers for maintenance actions
- Specification notes to describe how to maintain each feature, including which materials to use
- A maintenance record pro-forma
- Explanation of the purpose of each maintenance activity and how the feature, and the system as a whole, is likely to respond if not maintained
- Any other supporting documents

There are a number of aspects which should be considered when formulating the management plan including: safe access and egress, waste management, effect on any existing or proposed habitats, funding of the maintenance throughout the design life of the system, and health and safety considerations for maintenance operatives and members of the public.

Southampton City Council may be able to adopt SuDS features if they are located in multifunctional open spaces of 0.25 hectares or greater and provisions for long-term funding of maintenance operations are made through a commuted sum. Developers wishing for adoption of SuDS by Southampton City Council should begin consultations at pre-planning stage so that key requirements can be agreed as early as possible. Consultation should then continue throughout the design process.

4.10 Biodiversity

SuDS provide an important opportunity to contribute to the enhancement of biodiversity within a development site. A linked network of SuDS can act as a green corridor supporting the movement of wildlife throughout the development, enhancing the quality and appeal of the site, since nature is brought to the door of those living, working and playing in the development. It is strongly recommended that developers consider above ground SuDS features that integrate biodiversity, maximising the opportunity to improve existing and create new habitats. However, it should be noted that there may be some restrictions on the type of features which can be used in areas close to Southampton airport, as discussed in Section 3.13 of this document.

The following biodiversity design criteria should be met where possible:

- Support and protect natural local habitat and species
- Contribute to the delivery of local biodiversity objectives
- Contribute to habitat connectivity
- Create diverse, self-sustaining and resilient ecosystems

Guidance: See Chapter 6 of C753 The SuDS Manual for more detail and information regarding design for biodiversity.

All planting in public open space SuDS features including swales, basins, ponds and wetlands should be native to Great Britain, ideally of local provenance, and from an accredited source to avoid the introduction of alien or invasive species. Plant species that require intensive maintenance, are susceptible to disease or attract undesirable predators should be avoided and extra care should be taken in the selection of plants for SuDS in close proximity to airfields. Further advice should be sought from a qualified ecologist where appropriate.

Developers should demonstrate how the proposed drainage system will provide biodiversity benefits to the development and the wider area. Where the opportunities for biodiversity are limited, evidence should be provided to demonstrate that this is the case.

4.11 Integration with public space: visual impact, amenity and multifunctional spaces

SuDS that are designed with aesthetics in mind are often more beneficial to the public, therefore use of vegetation, landscaping techniques and water in recreational spaces should be considered. Careful consideration also needs to be given to the historic environment, making sure the SuDS feature is appropriate to an area and does not negatively impact the historic environment, including buried archaeology.

Designing for amenity value can provide multiple benefits including: air quality improvements, temperature regulation, biodiversity and ecology, carbon emission reduction and sequestration, community cohesion, crime reduction, economic benefits, educational benefits, health and wellbeing, noise reduction and recreation.

Multifunctional spaces that combine both functional drainage and the provision of open space within public or communal areas can be created through an integrated approach to SuDS and landscape design, providing opportunities for recreation, education and play into development that may otherwise be deemed impractical by a developer. An appropriate maintenance programme is also recommended to ensure that the feature remains visually appealing and accessible throughout the year.

Hard features including rills, permeable paving and small rain gardens are more suited to, and can be easily incorporated into urban streets, squares or courtyards. Where there is more space, for example parks, sports fields or play areas, softer features including swales, ponds and wetlands may be appropriate. Infiltration basins are particularly useful in creating a multifunctioning space as they are dry, except in periods of heavy rainfall, so can easily fit into parkland.

SuDS features can be multifunctional on highways. Traffic calming measures such as the use of extended curbs can provide the opportunity to introduce bio-retention areas, while the addition of trees and smaller features can improve the streetscape and appeal of an area or development.

The following amenity design criteria should be met where possible:

- Maximise multi-functionality
- Enhance visual character
- Deliver safe surface water management systems
- Support development resilience and adaptability to future change
- Maximise visibility of features
- Support community environmental learning

Guidance: See Chapter 5 of C753 The SuDS Manual for more detail and information regarding design for amenity.

Developers should demonstrate how the proposed drainage system will provide amenity benefits. Where there are limited opportunities for such benefits, evidence should be provided to demonstrate that this is the case.

4.12 Detailed design and materials

SuDS can be used to create a new space that complements and enhances an area's unique identity. Opportunities can arise to add points of interest through details, for example patterns in rills or rain channels for hard paved areas, or shapes and patterns such as mazes in soft landscaped swales and basins. Inlets and outlets can be designed to be an interesting focal point in the system. Care should be taken to ensure that structures or features do not create hazards for the public. Designers should be mindful of policies within Southampton Adopted Core Strategy (amended 2015) and should contact the Local Planning Authority team for further guidance on appropriate materials and design for the local area.

Designers should consider using materials with known long term performance, and if bespoke materials are to be used which may need to be replaced at some point during the lifetime of the system, the future availability of the material should also be considered. C753 The SuDS Manual contains useful guidance on materials which are likely to be appropriate for each SuDS feature type and on detailed specification of materials.

For soft or planted features, soils should complement existing soils and be compatible for the type of planting used e.g. clay based or water retaining soils should be used for water loving plants. Soil depth should be appropriate to the root depth of proposed planting. Native plant species should be used.

Guidance: See Chapter 30 of C753 The SuDS Manual for more detail on specification of materials.

4.13 Construction method and phasing

The construction method and phasing should be considered throughout the design and construction process and not solely immediately prior to construction. Early contractor involvement can help inform the design of the system to ensure constructability and may provide opportunities to better inform the contractor of the function and requirements of the SuDS features.

Although SuDS features differ from the systems which have traditionally been installed on site, their construction usually only requires standard civil engineering construction methods and landscaping operations. Guidance and specification for works such as groundworks, pipe-laying, seeding and planting are already widely available from other sources and such skills are already present within the construction industry. However, it is important to ensure an understanding of how the SuDS features will function by the contractor and relevant site operatives.

There are a number of considerations which should be made when constructing SuDS:

- Programming and phasing of the work
- Pollution and sediment control
- Erosion control
- Location of access and storage areas
- Skills and knowledge of the contractor
- Protection of areas where infiltration is proposed
- Seasonal requirements for establishing planting and preventing soil erosion
- Process for inspection and handover

Phasing plays an important role in protecting both the SuDS features from damage and the receiving environment from increased flood risk and pollution from runoff. As the construction of a development takes place, there is typically a decrease in permeability both from compaction of soils and construction of impermeable surfaces and this will increase runoff. There is also likely to be an increase in pollutants, particularly fine sediments. Both of these increases must be mitigated and requirements for water quantity and quality of runoff leaving the site should be considered throughout the construction process and not just once the construction phase has been completed. This can be achieved through appropriate phasing of construction of the SuDS features and through implementation of a Construction Environmental Management Plan (CEMP).

The general form of the drainage system is usually constructed during the earthworks phase, for efficiency of plant use and to allow access, with final construction not occurring until later in the process. There should be no significant increase in flood risk, or other detriment to the environment, in the wider catchment during construction and it may be necessary to complete parts of the drainage system in advance of contributing impermeable areas being constructed, or to provide temporary flood and pollution prevention measures. It should be remembered that features which have not yet been completed (e.g. where planting is not yet established) are unlikely to perform to the design standard.

Whilst early construction of the SuDS can be an effective way of reducing flood risk and pollution off-site during the construction phase, it is noted that this will pose an increased risk of damage to the features themselves (e.g. through erosion, sedimentation and contamination) which may affect future performance. These effects should therefore be mitigated so that the final function of the system is not affected. Mitigation measures can include:

- Site practices such as good housekeeping, implementation of exclusion zones, and stockpiling of materials away from overland flow routes
- Temporary on-site prevention measures designed to capture pollutants and protect against erosion
- Inspection, repair and reinstatement of features throughout, and at the end of, the construction phase

Infiltration and filtration features are particularly at risk from sedimentation and compaction of soils and it may be necessary to implement an exclusion zone in these areas to prevent access by plant. Permeable paving is also at risk from sedimentation and from heavy loads causing damage and it is generally not appropriate to allow access to these areas by construction traffic once complete.

A Construction Method Statement should be submitted at the full planning stage to support the SuDS design statement. It is important that contractors are made fully aware of how the SuDS scheme will operate, the design requirements and how their actions on site can affect the final performance of the scheme. Construction planning should take account of erosion, sediment and pollution control measures, and construction should be carried out in line with best practice and following industry standards.

> **Guidance**: See Chapter 31 of C753 The SuDS Manual for more detail on construction of SuDS.

4.14 Health and safety

> **Guidance**: Further information on health and safety in SuDS design can be found in Chapter 36 of C753 The SuDS Manual.

SuDS can provide multiple benefits to site occupants and the wider community, however they must be designed to ensure that people are not put at excessive or unnecessary risk. In line with the Construction (Design and Management) Regulations 2015, health and safety must be considered throughout the design process. Potential risks associated with the construction, operation, maintenance and decommissioning of the system must be identified and designed out where possible. Where risks remain, these should be mitigated as far as reasonably practicable and any residual risk identified. Information on the identified risks and any mitigation should be passed on to relevant parties and updated throughout the lifetime of the development. This information should be documented in a Designer's Risk Assessment.

Construction phase risks

As with any construction project, there are a number of risks which may be present on site when building SuDS. Day-to-day construction site risks will be managed by the contractor but it is still important for the designer to consider the impact that their proposals may have on the safety of those building the drainage system. Additionally, information on site constraints (e.g. buried and overhead services and ground contamination) is usually collected early on in the design process and it is vital that this information is passed on to the contractor alongside the Designer's Risk Assessment which should document all risks identified.

Risks to site operatives can be designed out or reduced in a number of ways including, where possible:

- Locating features away from areas where there are known hazards
- Reducing the volume and depth of excavation
- Considering access requirements for construction

Early contractor involvement can help to identify other site-specific and general risks and mitigate them through design.

Operation phase risks

For the purposes of this guidance document, operation phase risks have been considered to be those present in the day-to-day use of the SuDS and surrounding area by the public. Risks arising from maintenance operations are discussed separately. The main operation phase risks associated with SuDS are:

- Slips, trips and falls
- Drowning
- Illness from waterborne disease or other contaminants
- Bird-strikes near airports

With good site design and layout, the majority of these risks can be designed out or reduced to acceptable levels. Inlets, outlets and other structures should be designed so as not to create a trip hazard and located away from large areas of open water. Inlets and outlets to SuDS features should be appropriately designed to ensure that people and animals cannot enter them. Small pipes are preferred, although this should be balanced with blockage risk. Grills can be considered to prevent entry but it should be noted that these have their own blockage and health and safety risks. An appropriate risk assessment should always be undertaken where a grill is proposed.

Shallow features with gentle side slopes should be created to reduce the risk of falling and to allow egress in the event of accidental entry, thereby reducing the risk of drowning. Side slopes of features will vary depending on site conditions and layout but should generally not exceed 1:3. Safe access points should be provided to allow entry for maintenance and in the event of an emergency.

Deep and/or fast-flowing water poses a significant hazard and should be avoided where possible. The Environment Agency's Hazard to People classification is a useful starting point for determining whether expected flows and water depths will pose a hazard to the site occupants. Additional guidance is provided in Chapter 36 of C753 The SuDS Manual. Storage features such as attenuation basins should generally be no deeper than 500mm and features with flowing water should be shallower. Risks are likely to be increased where the onset of flooding is sudden or unexpected so it is important to design for exceedance and for early warning of blockage and failure.

Guidance: Further information on the Environment Agency's Hazard to People Classification can be found in *Supplementary note on Flood Hazard ratings and thresholds for development planning and control purpose – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1* (Environment Agency, 2008).

Planting can be used to delineate areas which are to be used for water storage and conveyance and this approach is generally preferred over providing a large physical barrier. In some circumstances, however, it will be appropriate to install barrier measures to protect small children, particularly in school environments or residential developments. In these situations, low fencing should be used to prevent access to small children whilst allowing adults to step over as necessary. In public areas, signs may be necessary to educate site users and occupants on the potential hazards.

Enabling the interaction and access to water within a community can promote health and wellbeing benefits. Public health is important in the design of SuDS features, in particular where people are encouraged to interact with water. Appropriate water treatment stages must be included to ensure delivery of clean water to features. The risk of waterborne diseases and mosquito infestations can be reduced by designing SuDS where water is moving or held for only a short time to avoid stagnation.

A number of operation phase risks may be increased if the performance of the system is reduced and therefore it is also important that an appropriate maintenance regime is in place.

Guidance: Section 3.4.2 of the SuDS Manual (CIRIA 2007) provides information on the design requirements surrounding health and safety as well as mitigating the risks associated with SuDS

Maintenance risks

The maintenance requirements for the proposed SuDS features should be identified early in the design process and this should include consideration of the health and safety risks to maintenance operatives. Careful design of the drainage system can reduce the frequency of maintenance required, which will in turn reduce the exposure of operatives to hazards and thereby the risk. However, designing to reduce the maintenance requirements should always be balanced with other design criteria and with risks to the public through poor performance or failure of the system.

It is important that safe access and egress routes to the features for maintenance are provided and retained throughout the lifetime of the development. This is often achieved through maintenance buffer zones. Safe access to features can also be achieved by designing above ground features with shallow side slopes. Features which require access to confined spaces for maintenance should be avoided.

It should be noted that maintenance operations may also pose a risk to both maintenance operatives and the public and the system should be designed to reduce this where possible. Where risks remain this information should be passed on to the party responsible for maintenance of the system so that risks can be further mitigated.

Decommissioning risks

At the end of their design life SuDS components will require either rehabilitation or decommissioning and the risks associated with this work should be considered in the design. Disposal of fill material, geotextiles and sediment will be required and these elements may contain pollutants. It is also possible that infilling of excavated areas and excavation of sub-surface systems will be necessary which may pose risks. At design stage it will not always be possible to identify all specific end-of-life risks but components that are likely to be difficult or costly to safely remove in future should be avoided.

4.15 SuDS features: key design criteria

This section summarises some of the available SuDS features and the minimum design requirements and key considerations. Further information on appropriate design for each feature type should be sought from C753 The SuDS Manual. Evidence should be provided in support wherever the key design criteria are not met to justify any deviation and allow the proposal to be fully assessed.

SuDS Technique	Description and Key Design Points
Green roof	**Description**: A multi-layered system that covers the roof of a building or podium structure with vegetation cover/landscaping over a drainage layer. Designed to intercept and retain water providing a degree of attenuation and treatment of rainwater. **Key design criteria and considerations:** • Structural design of supporting structure for saturated load and other imposed loads • Access requirements for maintenance • Requirements for biodiversity and amenity • Minimum roof pitch 1:40 consistently graded, slopes steeper that 1:10 require additional design to prevent rapid runoff and slippage • Design of outlets to minimise blockage risk • Appropriate vegetation and lightweight soil
Soakaway	**Description**: Soakaways provide storm water attenuation, treatment and groundwater recharge. They typically consist of excavations filled with rubble or granular material although geocellular storage units can also be used. **Key design criteria and considerations:** • Appropriate pre-treatment to prevent contamination of groundwater and clogging by sediment • Minimum of 1m between the base and maximum likely groundwater level, and 5m from foundations and sub-surface structures • Flat base to allow uniform infiltration • Should be designed for the 1 in 30-year rainfall event, unless other features are provided • Should typically half empty in 24 hours • If used, fill material should provide >30 percent void space
Filter strips	**Description:** Vegetated strips of land designed to accept runoff as overland sheet flow from upstream development, treating runoff by vegetative filtering and promoting settlement of pollution. **Key design criteria and considerations:** • Minimum drop from adjacent surface onto filter strip of 50-100mm • Minimum slope in direction of flow 1:100, maximum 1:20 • Maximum flow depth 100mm • Maximum full flow velocity of 1.5m/s to limit erosion and maximum velocity in 1 in 1-year event of 0.3m/s for treatment • Minimum length dependent on slope and contributing catchment but should be greater than 3m • Do not use in locations where shade will limit grass growth • Runoff should be distributed evenly as sheet flow

<table>
<tr><td>Filter trenches and drains</td><td>Description: Linear trenches filled with rubble or stone to create temporary subsurface storage for infiltration or filtration of stormwater runoff. Can be used to convey stormwater to downstream components.
Key design criteria and considerations:
Width greater than 300mm
Depth of 1-2m
Upstream pre-treatment to prevent clogging with sediment
Choice of appropriate fill material, considering void ratio
Minimum of 1m between the base and maximum likely groundwater level
Consider potential loadings (e.g. traffic when used near roads)
Longitudinal slope should not exceed 1:50
Observation wells and/or access points for maintenance of any perforated pipe components are required</td></tr>
<tr><td>Swales</td><td>Description: Linear vegetated drainage features which can store or convey water, or be designed to allow infiltration.
Key design criteria and considerations:
Base width between 500mm and 2m
Side slopes should be a maximum of 1:3 where soil conditions allow
Longitudinal slope should be a maximum of 1:40 where soil conditions allow
Maximum flow velocity of 2m/s and depth of 600mm in full flow conditions
Maximum flow velocity of 0.3m/s and depth of 100mm in 1 in 1-year event
Length of any section of swale should be at least 5m
Maintain flow height of water during frequent events below the top of the vegetation</td></tr>
<tr><td>Bioretention systems</td><td>Description: Shallow landscaped depressions which are typically under-drained and rely on engineered soils and enhanced vegetation and filtration to remove pollution and reduce runoff downstream. Aimed at managing and treating runoff from frequent rainfall events.
Key design criteria and considerations:
Sufficient surface area to temporarily store design treatment event at a depth of less than 150mm on the surface
Design treatment event should drain fully in 24-48 hours
Minimum depth of filter bed 1m
Maximum longitudinal slope 1:20
Drop from adjacent curb onto system 50-100mm
Minimum of 1m between the base and maximum likely groundwater level</td></tr>
</table>

Pervious pavements	**Description**: Pavements which are suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate though the surface and into the underlying layers. Water is temporarily stored before infiltration into the ground, reuse or discharge into a watercourse. **Key design criteria and considerations:** • Consider lining where distance between base and maximum likely groundwater level is less than 1m • Where areas of impermeable surfaces are draining to the pervious pavement the ratio of impermeable to permeable area should not exceed 2:1 to minimise blocking of surface by sediment • Avoid where there is a high risk of silt loads • Consider forces from traffic loading – e.g. permeable block paving may not be suitable for heavy vehicles or areas where a large number of vehicle turning manoeuvres are expected • Structural design for vehicle loading • Consider location of existing services • Use a factor of safety of at least 10 for the surface infiltration rate • Geotextile likely to be required to meet water treatment objectives
Geocellular structures	**Description**: Modular plastic systems with a high void ratio to create below ground infiltration (soakaway) or storage structure. **Key design criteria and considerations:** • Structural design to relevant standards for appropriate surface loadings • Consider required cover depths, including those of incoming/outgoing pipes • Effective upstream treatment required to reduce risk of sediment build-up • Consider risk of root penetration from nearby trees or shrubs • Appropriate geotextile/geomembrane for wrapping and waterproofing
Infiltration basins	**Description**: Shallow landscaped depressions designed to store runoff and infiltrate it gradually into the ground. **Key design criteria and considerations:** • Maximum side slope 1:3 • Maximum bed slope 1:40 • Should generally be no deeper than 500mm • Minimum of 1m between the base and maximum likely groundwater level • Consider soil compaction issues where basin is multifunctional (e.g. used informally to play sport) • Effective pre-treatment required to remove sediments and fine silts prior to infiltration • Infiltration should not be used where groundwater is vulnerable or to drain polluted hotspots
Detention basins	**Description:** Landscaped depressions which are normally dry and which are designed to attenuate runoff. **Key design criteria and considerations:** • Maximum side slope 1:3 • Maximum bed slope 1:40 • Should generally be no deeper than 500mm • Pre-treatment or a sediment forebay can help to manage sediment build-up • Bioretention and/or wetland at outlets is desirable for enhanced pollution control

Ponds and wetlands	**Description**: Depressions that temporarily store surface water above a permanent water level. Wetlands generally have a greater proportion of shallow areas than ponds. Runoff is detained and treated in the pool, promoting pollutant removal through settlement of sediments and biological uptake. **Key design criteria and considerations:** • Minimum flow path length to width ratio of 3:1 • Maximum depth of permanent water 1.2m, with an aquatic bench a maximum of 400mm below the permanent water level • Maximum depth of temporary storage should not exceed 500mm • Maximum side slopes 1:3 • Permanent pool volume should be designed for water quality treatment • Provide a flat safety bench around perimeter of pond, a width of at least 3.5m and slope of less than 1:15 is recommended • Sediment forebay or upstream pre-treatment
Rainwater harvesting	**Description**: Features which collect rainwater from roofs and hard surfaces for reuse on site. **Key design criteria and considerations:** • Design dependent on demand requirements, contributing surface area, storm water management requirements, and seasonal rainfall characteristics • First flush often diverted away from tank to reduce pollutants in water for reuse

5. Planning for SuDS

Following publication of the Department for Communities and Local Government's written statement on SuDS (HCWS161), which came into effect on 6th April 2015, SuDS are required for all major development. The Local Planning Authority (LPA) should consult the relevant Lead Local Flood Authority (LLFA) on the management of surface water. Southampton City Council is the LLFA for all areas within its administrative boundary.

For all planning applications for major development within the city, the developer will need to demonstrate that the design criteria in the Southampton SuDS Guidance will be met by the drainage system. However, the level of detail required will be dependent on the type of application submitted. This chapter gives information on the evidence that will be required for each stage of the planning process, in order to allow Southampton City Council to assess the proposals and provide feedback to the Local Planning Authority.

For minor development, there is currently no requirement for the LPA to consult the LLFA on surface water drainage. Standing advice for minor development has therefore been provided in Chapter 6 of this document to assist the LPA in assessing SuDS proposals for small sites and to provide guidance to developers on expected standards for SuDS proposals.

5.1 Pre-planning advice

Pre-planning advice should be sought where there are site constraints which may result in deviation from the key design criteria. Where these are identified, it is important to consult the LLFA as early as possible to discuss potential solutions and to agree the key design principles and criteria which should be followed. Leaving this until later in the design and planning process is likely to result in delays whilst aligning the design with LLFA requirements. Pre-planning advice can be useful for all sites but particularly those which are large and/or complex.

It is important to consider SuDS requirements from the very start of the site master planning process to allow all of the opportunities and constraints to be considered and addressed. The required location and size of SuDS features should be used to inform the layout of buildings, roads and open spaces. Attempting to fit SuDS features into a site layout that has already been largely finalised is likely to increase the cost and adversely affect the viability the system. Failure to fit the required SuDS within the proposed site layout will not, in itself, be considered an acceptable reason for deviation from the design criteria unless other planning, environmental and technical constraints on SuDS feasibility are present.

5.2 Outline application

At outline planning application stage the applicant should provide a conceptual SuDS design proposal for review. At this stage the focus will be on demonstrating that a SuDS design which meets the required design criteria is viable within the proposed site layout and other site constraints. Evidence supporting this should usually be submitted as a drainage strategy report (which can be included as part of a site-specific flood risk assessment). Where it is not feasible to meet the design criteria within Southampton City Council's SuDS guidance, this should have already been discussed and agreed at pre-application stage but any deviation should also be documented in the drainage strategy report.

The following information will be required:

- **Site name, location, grid reference and total site area**
- **Summary of any site-specific constraints which may affect the provision of SuDS**
- **Area of existing and proposed impermeable surfaces on site**
- **Qualitative assessment of existing site drainage characteristics** – including information on topography, discharge location(s), watercourses, flood risk, geology/permeability and groundwater depth
- **Proposed discharge location for the drainage system.** Where infiltration is proposed, results from infiltration testing should be provided to demonstrate feasibility. Where discharge to a sewer is proposed, evidence of approval from Southern Water should be provided. Where these are not available, an alternative discharge point should be proposed in case the primary option is found not to be possible.
- **Existing and proposed peak flow and discharge volume leaving the site for the 1 in 1-year, 1 in 30-year, 1 in 100-year and 1 in 100-year with climate change allowance events.** Where existing rates are for brownfield, Greenfield rates should also be supplied for comparison. Information should be given on the calculation method used.
- **Estimate of total required on-site storage volume to meet the proposed discharge rates.** Information should be given on the calculation method used.
- **Qualitative assessment of likely blockage risk and exceedance routes** – What will happen in the event of a blockage? Where will water flow if the system's capacity is exceeded?
- **An indicative layout plan showing the approximate location, size, depth and available storage volume of the proposed features**
- **Assessment of the runoff treatment required and how this will be provided**
- **Initial demonstration that biodiversity and amenity opportunities have been considered**
- **Information on likely maintenance requirements** – including who will be responsible for each component, summary of required maintenance actions and an estimate of cost
- **An initial health and safety risk assessment**
- **For larger sites, information on the proposed phasing and the discharge rates and storage volumes for each plot**

Following approval of an outline application, planning conditions will be agreed which will identify where further details need to be provided before development can occur. The requirements of these conditions will be similar to those for a full planning application (see below).

5.3 Full application

At full planning application stage the applicant should submit a detailed drainage design for review, demonstrating that the key design criteria have been met or providing justification where criteria have not been met (this should already have been discussed and agreed at pre-application stage). The following should be provided as part of the detailed submission, in addition to the information listed above in the outline planning section:

- **Detailed drawings showing the final layout of the drainage system** (including all SuDS features) with levels and locations of all inlets, outlets, control structures

- **Detailed drawings showing the dimensions, invert levels and cover levels of any pipes, manholes and inspection chambers**
- **Detailed drawings showing existing and proposed ground levels at the site**
- **Detailed cross-section and, where appropriate, long-section drawings of all proposed SuDS components** with proposed materials, levels and slopes marked
- **Detailed calculations and/or hydraulic model results** demonstrating that the proposed system will meet the design discharge rates, volumes and flood risk design criteria
- **Assessment of exceedance routes and detail on the amount of freeboard provided**
- **Copies of all relevant consents, approvals and agreements** including those relating to discharge location and rate
- **Infiltration assessment results**, where infiltration has been proposed
- **Management Plan** identifying ownership and responsibility for maintenance of each component of the drainage system, the maintenance activities required, the timings and triggers for these actions and the likely cost.
- **Landscape Plan** for the site which should demonstrate amenity and biodiversity benefits
- **Construction Method Statement** detailing construction processes in place to protect the SuDS functionality
- **Detailed health and safety risk assessment for the system**
- **Details of how any potential contamination risk will be managed**

6. Standing advice for minor development

For planning applications for minor development, there is currently no requirement for the Local Planning Authority (LPA) to consult the Lead Local Flood Authority (LLFA) on surface water drainage. However, Southampton City Council's Adopted Core Strategy (amended 2015) requires SuDS measures to be incorporated into all development unless they can be demonstrated to be inappropriate at a specific location. This guidance has therefore been provided to assist the LPA in assessing SuDS proposals for minor developments and to provide guidance to developers on expected standards for SuDS proposals.

Southampton's highly urbanised character contributes to surface water flooding issues within the city and it is therefore important that all development minimises runoff. Whilst the quantity of runoff from a small site is generally of much smaller magnitude than that of a large site, the cumulative effect of just a few minor developments can potentially cause a large increase in runoff in the catchment. It is therefore important that every site plays a part in controlling runoff.

Generally, the key design criteria described above, which need to be met for major developments, are also applicable for minor developments within the city and developers should submit a drainage design meeting these requirements. However, it is noted that there may be constraints to meeting some of the requirements on a small site scale. Guidance has therefore been provided below on how the criteria could be met on a small site and on where there is likely to be a necessity for deviation from the design criteria. As is the case for major developments, any deviation from the required design criteria should be discussed and agreed at pre-application stage.

Design criterion	Advice on meeting the requirements for minor development
The SuDS management train (Section 4.1)	On small sites it is particularly important to make use of the prevention and source control techniques in the SuDS management train as larger site and regional controls are unlikely to be feasible or appropriate. Opportunities should be sought to reduce the impermeable areas on site as much as possible (prevention) and the potential for reuse of water on site can be investigated. Source control techniques such as soakaways, rain gardens, permeable paving and green roofs should be considered.
Discharge location (Section 4.2)	Minor development should still follow the discharge hierarchy: 1. Infiltration to the ground 2. Discharge to a watercourse or other surface water body 3. Discharge to a surface water sewer, highway drain or another drainage system 4. Discharge to a combined sewer
Water quantity (Section 4.3)	The Southampton standards for peak runoff rate and volume, described in Section 4.3, should still be met by minor development as the cumulative effect of several smaller developments is likely to adversely affect downstream flood risk. However, it is noted that for smaller sites this may require impractically small flow controls and in these circumstances a rate of 5l/s can be used. Where this is not feasible, appropriate discharge rates should be discussed and agreed at pre-application stage.

Water quantity: climate change (Section 4.4)	The climate change allowances discussed in Section 4.4 should still be applied to the design event.
Water quality (Section 4.5)	Water quality requirements (Section 4.5) should still be met by small developments where feasible. Permeable paving should provide a good level of treatment, if designed and constructed appropriately, and this should be considered for car parking spaces. Other features such as small bioretention systems (e.g. tree pits) and micro wetlands can be used to provide treatment. Proprietary treatment systems such as silt and oil traps can be used but should be considered a last resort as they are unlikely to provide the additional benefits available from other features.
Design for flood risk (Section 4.6)	The design criteria for flood risk management described in Section 4.6 should still be met. The 1 in 30-year event should be managed below ground or in features specifically designated to hold water. Flooding should not occur to any part of a building or in any utility plant susceptible to water within the development in the 1 in 100-year event.
Design for exceedance (Section 4.7)	The developer should provide information on the likely effects of exceedance of the system and how it has been designed to minimise risks to people, buildings and infrastructure from exceedance flows. It should also be demonstrated that the risk of blockage has been considered and measures have been put in place to minimise the risk and to provide early warning of blockage or failure of the system.
Design for low flows (Section 4.8)	The developer should provide information on how the system will operate for low flows. Smaller events generally pose particular pollution issues and it is therefore necessary to ensure that sufficient treatment is provided within the low flow system before discharge.
Maintenance (Section 4.9)	Regardless of the scale of development, it is important to make provisions for long term maintenance of the drainage system to prevent a reduction in performance over time. The developer should identify the party (or parties) which will be responsible for maintenance of the system and the maintenance actions which will be required over its lifetime.
Biodiversity (Section 4.10)	Opportunities should be sought where possible to provide biodiversity benefits. On small sites, features such as green roofs, bioretention features and micro wetlands can be used to provide habitats.
Integration with public space: visual impact, amenity and multifunctional spaces (Section 4.11)	On small sites it is particularly important to look for opportunities to create multifunctional spaces, as available space is likely to be limited. Small SuDS features can still provide amenity benefits and contribute to the overall character of an area.
Detailed design and materials (Section 4.12)	Designers should consider using materials with known long term performance, and if bespoke materials are to be used which may need to be replaced at some point during the lifetime of the system, the future availability of the material should also be considered. Materials should be selected which are appropriate to the development and its setting.
Construction method and phasing (Section 4.13)	For minor developments, phasing of construction is likely to be less relevant than for major developments. However, it is still important to follow the principles set out in Section 4.13 so as not to reduce the performance of SuDS features or to increase flood risk.

Health and safety (Section 4.14)	Regardless of the scale of development it is of vital importance to consider health and safety risks which may arise through construction, operation, maintenance and decommissioning. Consideration of these risks should occur from the very start of the design process and opportunities should be sought to design out and minimise risks.
SuDS features: key design criteria (Section 4.15)	They key design criteria and considerations given in Section 4.15 should still be met, where feasible, as deviation from these criteria may affect the performance of the SuDS features.