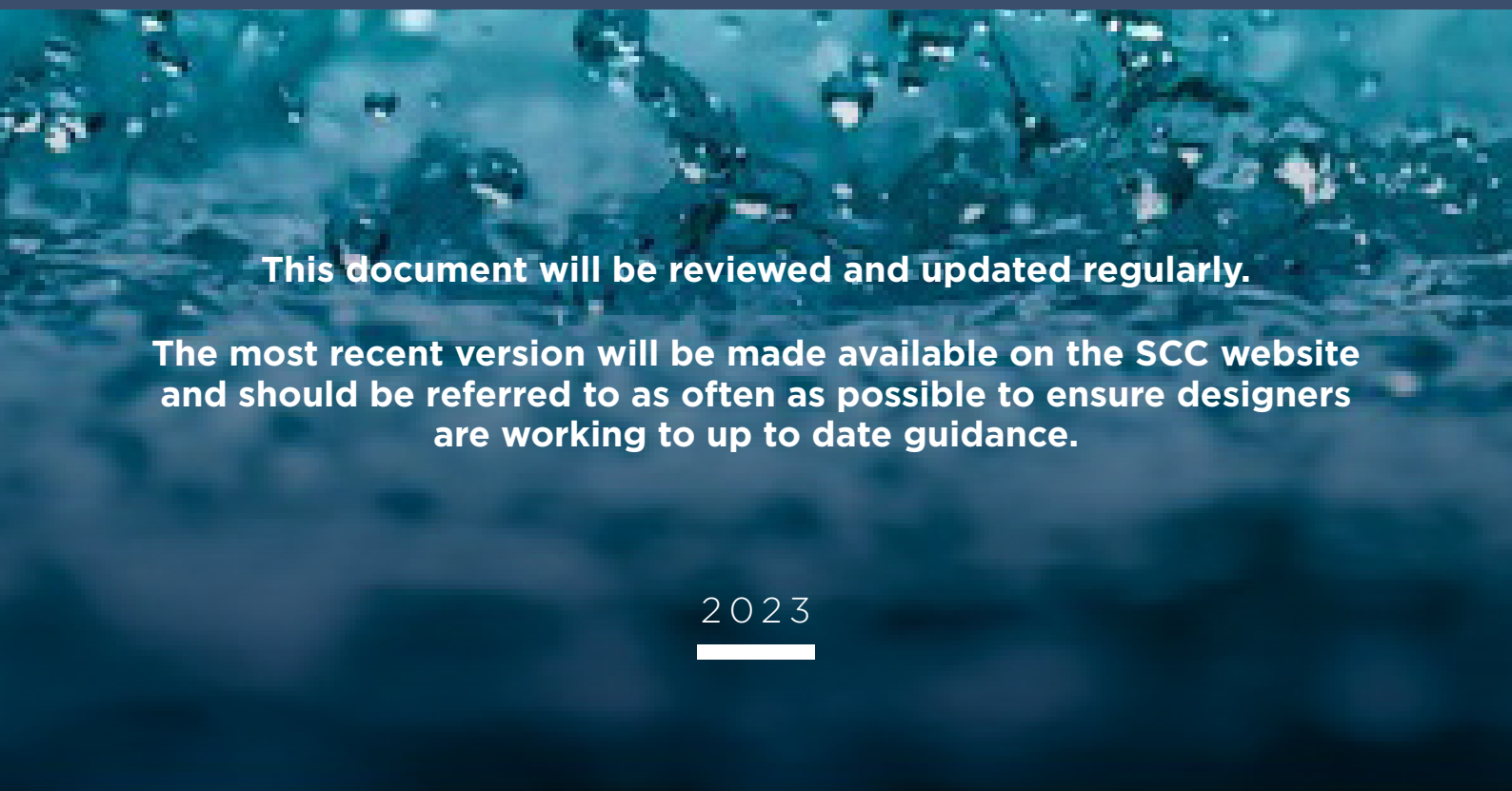
SUFFOLK FLOOD RISK

MANAGEMENT STRATEGY APPENDIX A SUSTAINABLE DRAINAGE SYSTEMS (SuDS): A LOCAL DESIGN GUIDE



This document will be reviewed and updated regularly.

The most recent version will be made available on the SCC website and should be referred to as often as possible to ensure designers are working to up to date guidance.

2023

Contents

Flood & Water Management Act 2010 Sustainable Drainage Systems (SuDS) definition:

"SUSTAINABLE DRAINAGE" means managing rainwater (including snow and other precipitation) with the aim of:

(a) Reducing damage from flooding.
(b) Improving water quality.
(c) Protecting and improving the environment.
(d) Protecting health and safety.
(e) Ensuring the stability and durability of drainage systems.

Acknowledgements:

CIRIA C768 Guidance on Construction of SuDS, Illman, S, Wilson, S (2017) London (ISBN: 978-0-86017-783-8). Go to: www.ciria.org
CIRIA C753 – SuDS Manual, Woods Ballard, B, Wilson, D, Udale-Clarke, H, Illman, S, Scott, T, Ashley, R, Kellagher, R (2015)
The SuDS Manual, CIRIA, C753, London (ISBN: 978-0-86017-759-3).
Go to: www.ciria.org
CIRIA Susdrain 2018, SuDS at All Saints Primary School, Newmarket, Suffolk, case study, viewed 23 November 2022, https://www.susdrain.org/case-studies/pdfs/all_saints_school_newmarket_cs_light_19_11_21.pdf.
Essex County Council Sustainable Drainage Systems, A Design Guide 2014, Infiltration Basin, Ravenswood, Ipswich, Suffolk, case study.

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1 Introduction

One of the actions of the Suffolk Flood Risk Management Strategy (SFRMS) is to produce this local guide on surface water drainage and SuDS. Since April 2016 planning applications for all ''major development'' should be accompanied by a site-specific drainage strategy and/or flood risk assessment that demonstrates that the proposed drainage scheme is compliant with the National Planning Policy Framework, Planning Practice Guidance and DEFRA Technical Standards.

Suffolk County Council (SCC), as the Lead Local Flood Authority (LLFA), are the statutory consultee that will provide advice to the Local Planning Authority (LPA) on the suitability of submitted applications.

The Four Objectives of Flood Risk Management in Suffolk are:

1. **Understanding Flood Risk –** Risk Management Authorities (including the LLFA) and their partners must have a clear understanding of the risk, their roles and responsibilities. This includes establishing a Flood Risk Asset Register to assist the LLFA in flood investigations.
2. **Reduce the Risk of Flooding & Building Resilience –** protection of people, business and key infrastructure. This includes the prioritisation of projects which deliver multiple benefits such as natural flood management, water quality improvements, beneficial water storage opportunities, biodiversity enhancement and public access.
3. **Resilient Growth, Planning & Development –** land use planning and development decision making that takes into account flood risk and appropriately contributes to environmental net gain and flood resilience.
4. **Resilient Communities –** empower and support communities so that they can act individually, jointly or in partnerships to protect themselves from flooding and its impacts.

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This document sets the local standards for Suffolk and, together with National Policy, steers developments to use high quality, multifunctional SuDS that will offer benefits to the community and the environment. It sets SCC's expectations on the provision of SuDS including preferred layout, key design elements and management of SuDS. The information set out in this document should be read in conjunction with the following national best practice documents (or subsequent updates to):

- The CIRIA SuDS Manual (C753).
- BS8582 Code of Practice for surface water management on development sites.
- DEFRA's Non-statutory technical standards for sustainable drainage systems.
- Association of SuDS Authorities (formerly LASOO) – Non-statutory technical standards for sustainable drainage systems - Practice Guidance.

Planning Practice Guidance Paragraph 55 states that "SuDS are designed to control surface water runoff close to where it falls", referred to as Source Control, they provide opportunities to:

- Reduce causes and impacts of flooding.
- Remove pollutants from urban runoff at source.
- Combine water management and green space with benefits for amenity, recreation and wildlife.

SuDS are designed to maximise the opportunities and benefits from surface water management. There are 4 main categories of benefits that can be achieved by SuDS: water quality, water quantity, amenity and biodiversity. These are referred to as the 4 pillars of SuDS design.

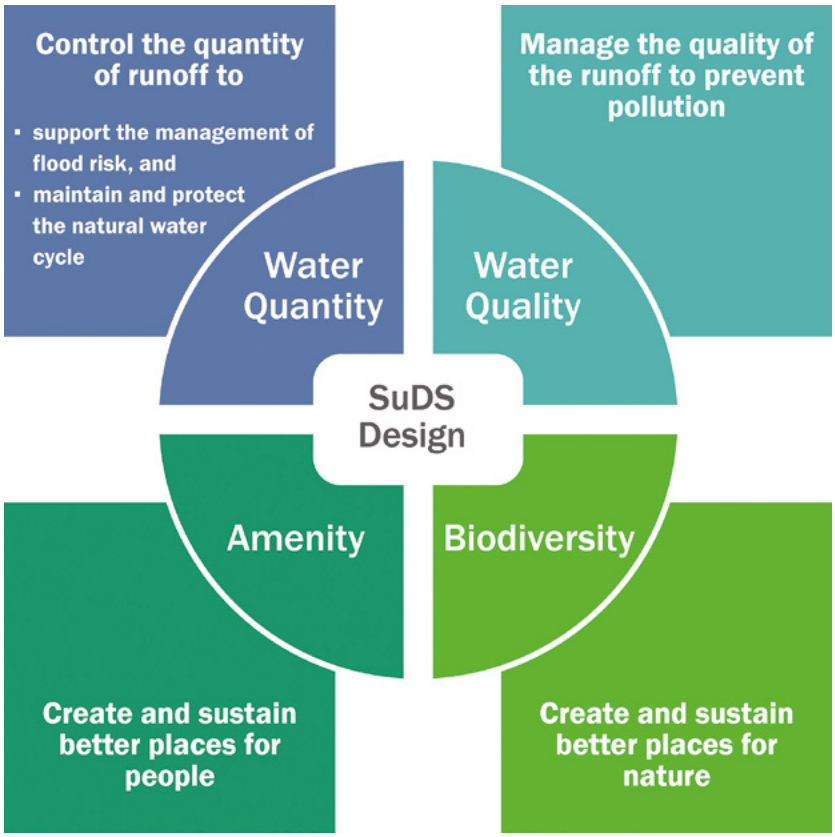

Figure 1 - 4 pillars of SuDS Diagram CIRIA C753 p.6

SuDS can take many forms, both above and below ground. Some types of SuDS include planting, others include proprietary/ manufactured products. In general terms, SuDS that are designed to manage and use rainwater where it falls, on the surface and incorporate vegetation, tend to provide the greatest benefits. Most SuDS schemes use a combination of SuDS components to achieve the overall objectives for the site.

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2 The SuDS Design Process

Pre-application advice should be sought from SCC LLFA as it is important to consider SuDS & flood risk as early as possible in the planning process.

The layout and function of sustainable drainage systems (SuDS) needs to be considered at the start of the design process for new development, as integration with road networks and other infrastructure can maximise the availability of developable land.

Consideration of the following will improve successful delivery of SuDS:

Assess the existing site constraints, including:

- Existing topography.
- Existing flows onto the site.
- On-site flow routes and outfalls.
- Potential for infiltration.
- Potential discharge destinations.
- On-site flood risks.
- Existing land use.
- Existing site infrastructure.
- Existing soils.
- Local habitats/biodiversity.

Assess the proposed development including:

- Proposed topography (avoiding creating isolated low spots).
- Proposed layout (avoiding obstructing Existing flow routes).
- Proposed flood risk mitigation.
- Proposed site infrastructure.
- Proposed adoption of SuDS.
- Proposed maintenance of SuDS.

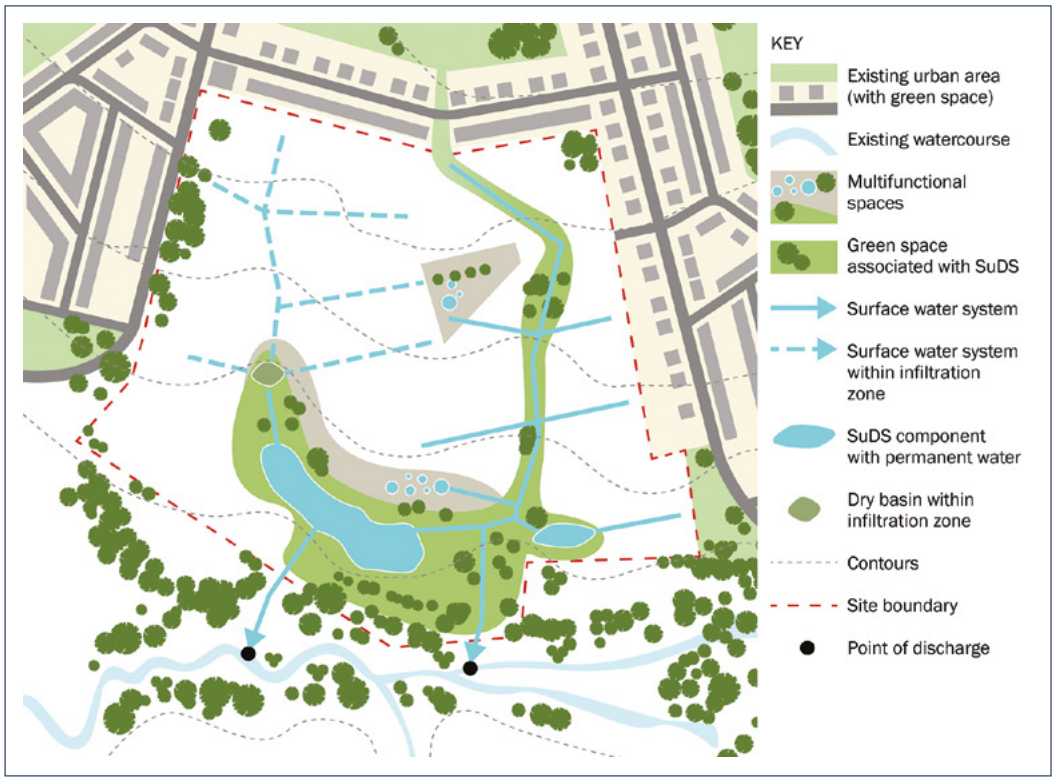

Figure 2 - Defining open spaces and corridors for surface water management CIRIA C753 p.111

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3 What SCC LLFA Expect:

As a minimum, SCC LLFA require the following to be submitted for each stage within the planning process (this incorporates the Interim Guidance (issued Feb 2020). Each authority, (East, West & Mid Suffolk, Babergh & Ipswich), will also have their own planning application validation requirements.

Document to be submitted, and brief description of details required:	**Pre- App**	**Outline**	**Full**	**Reserved Matters**	**Discharge Condition**
Details of how the proposed Drainage Strategy will deliver on each of the four pillars of SuDS.	✓	✓	✓	✓	✓
Flood Risk Assessment Evaluation of fluvial, tidal, pluvial, reservoir & groundwater flood risk onsite – this will guide layout and location of open spaces. (SCC may require flood modelling if EA Flood Maps are not available).	✓	✓	✓		
Contour Plan Assessment of topography/existing flow paths/blue corridors.	✓	✓	✓		
Drainage Strategy / Statement Document that explains how the site is to be drained using SuDS principles. Shall include information on: ■ Existing drainage (including adjacent highway systems) ■ Impermeable Area (Pre and Post Development), if unknown (at Outline) use conservative estimate eg. 60% and justify. ■ Proposed SuDS, recommended land take of 12-15% of the site if the proposed impermeable area is unknown (see below). ■ Hydraulic Calculations (see below). ■ Treatment Design (i.e. interception, CIRIA pollution indices). ■ Adoption/Maintenance Details.		✓	✓		
Impermeable Areas Plan Plan to illustrate new impervious surfaces and total areas.		✓	✓		

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Document to be submitted, and brief description of details required:	Pre- App	Outline	Full	Reserved Matters	Discharge Condition
Preliminary Layout Drawings (including landscaping details) Indicative drawings of layout, properties, open space and drainage infrastructure including: ■ Existing watercourses to be retained within or abutting the site, 3.5m wide maintenance strip must be provided. ■ All existing blue corridors must be retained/enhanced. ■ Cross section/plan views of basins; depicting area, side slopes, wet/dry benches, freeboard and volumes/depths (1:1, 1:30 and 1:100 + climate change allowance for all events). ■ Discharge location and invert of watercourse (outfall). ■ Form of SuDS and location on the site. ■ Main above ground conveyance network. ■ Maintenance strips/access points. ■ Legal easements/no planting zones. ■ Soakaway offsets.		✓			
Preliminary Site Investigation Report ■ Trial pits across the site to BRE365 with minimum infiltration rate of 10mm/hr if infiltration is to be the sole method of drainage. ■ Associated exploratory logs (including depth to peak seasonal groundwater). ■ Phase 1 Contamination Assessment Report.	✓	✓			
Preliminary hydraulic calculations ■ Greenfield discharge Rates (using suitable method i.e. FEH, IH124 (ICPSUDS), ReFH2. ■ Brownfield discharge rates if applicable. ■ Storage Volume/Water Depths. ■ Long Term Storage (if using complex flow control). ■ Source Control/Sketch Calculations (or similar).	✓	✓			
Evidence of any agreements to discharge to a third-party system (i.e. Anglian Water or adjacent landowner) Written evidence of any permissions or permits being obtained.		✓	✓		

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Document to be submitted, and brief description of details required:	Pre- App	Outline	Full	Reserved Matters	Discharge Condition
Detailed Development Layout and SuDS Provision Plan Dimensioned plans showing the detailed layout including SuDS, landscaping details, open spaces and exceedance routes.			✓	✓	
Full Site Investigation Report Detailed assessment of ground conditions ■ Widespread coverage of trial pits to BRE 365, proportionate to the scale of the proposal with an absolute minimum of 2 for the smallest development. ■ Contamination/Pollution check. ■ Groundwater Monitoring.			✓	✓	
Detailed Drainage Scheme Plan Dimensioned plan showing main aspects of the drainage infrastructure. Plans should include: ■ SuDS details (size/volume). ■ Pipe Numbers/Sizes/Levels. ■ Outfall & Permitted Discharge Rate (if applicable).			✓	✓	✓
Detailed SuDS Drawings (Open SuDS) Dimensioned plans of proposed SuDS components i.e. scaled cross sections/long sections.			✓	✓	✓
Full hydraulic calculations (MicroDrainage "Network", Causeway Flow or similar equivalent output) At this stage, SCC require simulations of the drainage network for 100%, 3.33% and 1%AEP (+allowance for cc) storm events. (Source Control files are useful but not enough on their own).			✓	✓	✓
Discharge Agreements Agreement to discharge to third party infrastructure if the scheme is reliant on it.			✓	✓	✓
Health and Safety Risk Assessment Where open SuDS (water level >0.3m) are proposed a CDM compliant designers risk assessment will be required.			✓	✓	✓
SuDS Maintenance & Management Plan Plans should include schedules which specify when and how maintenance should be undertaken.			✓		✓
Surface Water Construction Management Plan Plan of how surface water runoff is to be managed during the construction phase, including plans of any temporary drainage.					✓
SuDS Verification Report / Flood Risk Asset Register Form Report based on post construction inspection and containing evidence of compliance and/or changes from the approved design.					✓

Generally, Nationally Strategic Infrastructure Projects are expected to provide a level of information equivalent to that of an Outline application. However, the size and location of such projects may require a site specific approach and as such, early engagement with SCC LLFA is encouraged.

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4 Suffolk General Design Principles

National Planning Guidance & Policy states that SuDS should:

- Not increase flood risk off-site for all events up to and including the 1% annual event probability (AEP) plus an allowance for climate change (cc), volumes of above ground flooding in excess of $5m^3$ must be assessed by the applicant to establish risks to occupants/site users etc. Non-statutory technical standards (NSTS S2, S3 & S8).
- Ensure no internal flooding on-site during all events up to and including the 1% AEP plus an allowance for cc and no above ground flooding on-site, other than designated storage areas, during all events up to and including the 3.33% AEP, plus an allowance for cc, NSTS S7.
- Runoff must be managed at source with residual flows conveyed downstream using above ground conveyance to further above ground storage or treatment components where required, NPPG para 055.
- Take account of the construction, operation and maintenance requirements of SuDS allowing for any maintenance access required to undertake this work, NSTS S10, S13 & S14.
- Accommodate climate change, the allowance for which is 45%, (with some parts of Suffolk being less than this in accordance with the Environment Agency's catchment based approach) for residential development (with a lifetime of 100 years) at the time of writing. This value is regularly updated, at such time it will take precedence over this.
  https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall

Best practice maximises treatment, amenity and biodiversity potential by using multifunctional, open SuDS close to source, thereby reducing downstream requirements for storage and volume control.

Managing Existing Surface Water Runoff:

Existing surface water flows and pluvial flood risk must be taken into consideration when developing a site. This includes both on-site flood risk and flows entering the site from adjacent land.

As a general rule of thumb, for areas shown as having a **high risk** of pluvial flooding:

- Avoid constructing residential & commercial properties with water compatible land uses such as SuDS and/or public open space being preferable. Flood volumes should not be displaced.

For areas shown as having a **medium/low risk** of pluvial flooding:

- Avoid constructing residential properties in these areas. Flood resilient commercial properties could be located in these areas. Water compatible uses are again encouraged e.g. SuDS. Flood volumes should not be displaced.

For areas shown as having a **very low risk** of pluvial flooding:

- Manage the residual risk through raising finished floor levels and exceedance routes. The development should not increase off-site flood risk through the channelling of flows.

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Managing Runoff Quantity:

Destination:

Surface water runoff should be managed via a method as high up the following SuDS hierarchy as reasonably possible, with more sustainable options ruled out only where sufficient evidence can be provided to support the decision:

- **Rainwater Harvesting**/Re-Use Onsite.
- **Shallow infiltration** (circa 2.0m, see section on infiltration systems).
- **Gravity** discharge to a **watercourse.**
- **Gravity** discharge to a **surface water sewer**/highway drain.
- **Gravity** discharge to a **combined sewer.**

The following options are listed as a last resort, rather than a hierarchical order and are based on site specific constraints

- **Deep infiltration**
- **Pumped** discharge to a **watercourse** or infiltration feature.
- **Pumped** discharge to a **surface water sewer**/highway drain.
- **Pumped** discharge to a **combined sewer.**
- **Gravity or pumped** discharge to a **foul sewer.**

*Note re pumping requirements - onsite storage should be provided for up to the 1in100 (1%) AEP storm + climate change to allow for pump failure. Further, the pumping station should be adopted by a Water and Sewerage Company to ensure long term maintenance requirements are met.

The developer will need to obtain the relevant permits and permissions, dependent upon the runoff destination (e.g. Anglian Water, Internal Drainage Board (IDB), an adjacent landowner or SCC).

Rate and Volume:

To simplify the design, **discharge should be restricted to QBAR (SCC LLFA preference).**
Please note that discharging at QBAR is SCC LLFA's preferred approach and if this approach is not feasible then full justification must be provided as to why an alternative strategy is proposed.
The following are exceptions to the above:

- For discharges to **tidal watercourses,** the rate of runoff often **need not be restricted,** however the impact of a tide locking scenario must be considered with capacity for onsite storage up to and including the 1 in 200 plus cc tidal scenario and the 1 in 30 plus cc pluvial scenario occurring in conjunction.
- Where discharging to an **Anglian Water sewer,** Anglian Water must be consulted as to whether any **additional criteria or limiting discharge rates** are required.
- On smaller sites a **100mm minimum orifice size** should be used to reduce the risk of blockage, where this results in a higher discharge rates than would otherwise be acceptable, any resultant flood risk implications must be assessed by the applicant. A smaller sized orifice may be used for discharge from pervious surfacing where the risk of blockage is lower.
- On **brownfield sites, runoff should be restricted to greenfield rates** where possible, with a minimum 30% betterment offered for the 1 hour storm in each modelled rainfall event otherwise (calculated by modelling the existing system or in the same way as greenfield runoff but using Soil Type 5).

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- On major sites, where the proposed **discharge rate is greater than QBAR,** or if complex flow controls are proposed, the **runoff volume must be managed.** This can be achieved through rainwater harvesting or a separate area of long term storage must be provided on-site with this volume discharged via infiltration or at 2 l/s/ha. Refer to the CIRIA SuDS Manual and sudsguide.uk for further details.
- Commercial and industrial developments must undertake a demand/yield assessment for rainwater harvesting to determine feasibility. Where demand is 3 x greater than yield, options for rainwater harvesting should be explored in detail in accordance with CIRIA SuDS Manual (C753 p.220 and NPPG paragraph 56).
- Where private sewage treatment works are proposed, comprising a discharge of treated effluent to the watercourse, this should be included within the total discharge rate such that **the discharge of effluent combined with surface water should not exceed QBAR.**
- **The local** surface water management plan **(SWMP),** if available, should be consulted as it **may require discharge rates to be reduced below QBAR** due to local flood risk concerns.

Greenfield rates should be calculated in accordance with the CIRIA SuDS Manual (C753 p.509-518), **based only on the area of the site to be positively drained, with no climate change allowance.** For example, if only impermeable areas are used in the network model, the greenfield runoff rate should only be calculated for the proposed impermeable areas. The areas considered in greenfield runoff rates and network models must be consistent. Large SuDS features, such as basins, should be considered as impermeable areas.

For assessing water quantity, SCC LLFA's **preferred method for calculating greenfield runoff rates is the FEH** methodology (C753 p.510). In areas where surface water runoff is a critical issue, sensitivity checks should be undertaken to establish which runoff estimation method is the most conservative, with this method being used.

For sites on steep slopes or where **overland flows of surface water** are known to present issues locally, even if this hasn't been identified on national pluvial flood mapping, an allowance should be made for this within the location and design of SuDS features (e.g. including interception features to safely divert flows).

Calculations of residential impermeable areas should include an allowance of **10% for urban creep.**

A **Cv value** (volumetric runoff coefficient) of **1.0** should be used for runoff from impermeable surfaces (Susdrain Fact Sheet – Attenuation Storage) with justification provided where a lower value is used.

Exceedance flows should be identified on a plan demonstrating where water would travel should a rainfall event occur that was in excess of the design capacity of the network or in the event of a blockage or failure of the system. Exceedance flows should be mitigated where necessary (i.e. where they cannot be directed away from existing/proposed buildings).

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Improving Amenity & Biodiversity:

Water is a valuable natural resource, and the management of rainfall and runoff can support sustainable development. Good urban design aims to deliver attractive, pleasant, useful and above all "liveable" urban environments that support and enhance local communities. Water, managed on the surface in areas of green open space, rather than underground, can deliver amenity & biodiversity benefits such as:

- Air quality improvements.
- Air and building temperature regulation.
- Support & protect local habitats & species.
- Carbon emission reduction/sequestration.
- Community cohesion and crime prevention.
- Support education.
- Support health & wellbeing.
- Noise reduction.
- Encourage recreation.
- Create diverse and resilient ecosystems.

Where possible, SuDS and amenity features can be merged to create multifunctional spaces. By doing so, the amenity of the SuDS feature is maximised while still providing its primary purpose. SCC recommend that **early consultation** with the planning case officers, landscape planning officers and parks team (where applicable) **ensures the SuDS features are as multifunctional** as possible. SCC LLFA strongly recommend the use of our pre-application service (currently available in West Suffolk, Mid Suffolk & Babergh).

Landscape planting should be done to both **replicate existing habitats,** provide treatment of the surface water and offer biodiversity and amenity value. However, the planting should also be done to create new habitat, where appropriate, so that it is **adaptable to climate change** within Suffolk.

Thus, SuDS can help developments to be more resilient to climate change. Further information regarding landscaping and planting can be found in the **Suffolk SuDS Palette** which has been produced in conjunction with Anglian Water and is available on the SCC website.

The following table includes suggestions on how to improve SuDS schemes to offer higher amenity and biodiversity value. Please note it is not exhaustive and intends to guide rather than to restrict.

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How to improve the amenity and biodiversity value of SuDS features
Consider the concept of 'place making' and creating a pleasant environment to live in.
Engineers should design SuDS in conjunction with planners and landscape architects.
Incorporate tree pits, vegetated strips, swales, green roofs and downpipe planters.
Rainwater harvesting provides irrigation resources and improves the security of water supply.
Incorporate SuDS throughout the site in shared areas and areas of public open space.
Create permanent pond and wetland areas (lined if required) within basins and introduce diversity in the slope profile.
Include planting schedules with SuDS designs, with habitats and species being linked with or supporting natural and diverse local habitats.
Store exceedance flows in multifunctional areas such as sports pitches, car parking etc.
Maximise the visibility and accessibility of SuDS.
Incorporate SuDS into hard landscaping, eg. bioretention systems as traffic calming measures.
Ensure the water quality of surface water discharged from sites is high enough to not cause damage to downstream environments.
SuDS maintenance plans should take account of breeding seasons and be sympathetic towards the habitats created within the SuDS features.
Use SuDS to count towards "Biodiversity Net Gain" requirements on-site.
Acknowledge existing landscape features e.g. trees and hedges in SuDS designs.

Opportunities for the creation of SuDS can be found in even the smallest of spaces and lack of space should not be a reason for not using SuDS.

Managing Runoff Quality:

The drainage system should be designed and constructed so **surface water runoff does not adversely impact the water quality of the receiving water bodies,** both **during construction** and when **operational.**

Interception storage should be provided to capture the **first 5mm of rainfall,** in the form of initial losses into the ground, this can be achieved by using above ground conveyance, vegetated surfaces, permeable surfaces or long-term storage (for further information see Table 24.6 of C753 p.529-530).

Treatment of surface water should be designed in accordance with the Simple Index Approach as described in Chapter 26 of the CIRIA SuDS Manual, a summary of which is included on the following page. An example can be found on p888-937 of the CIRIA SuDS Manual. Treatment should be provided for the 100% AEP storm including an allowance for climate change using FSR rainfall data not FEH as it is less accurate when modelling more frequent events.

Where the mitigation index of an individual component is insufficient, two components or more in series will be required, where: Total SuDs mitigation index=mitigation index#1+(0.5x(mitigation index#2))

In order for each SuDS component to achieve the desired level of treatment, it must be designed and constructed in accordance with CIRIA SuDS Manual (C753) Treatment & Hydraulic Design Criteria and best practice. This includes effective upstream pre-treatment required to remove sediment and silt loads to prevent long term clogging within SuDS features.

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Steps of the Simple Index Approach:

1. Allocate suitable pollution hazard indices for the proposed land use

Pollution hazard indices for different land use classifications

Land use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Other roofs (typically commercial /industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is the potential for metals to leach from the roof)	0.05
Individual driveways, residential car parks, low traffic roads (cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie. <300 traffic movements per day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where fuels are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

2. Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index for discharges to surface waters (below) or ground (overleaf).

Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation Indices		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent event up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Contact manufacturers for indices of proprietary products/ treatment systems, it should be noted that these systems when used in isolation are not able to treat all pollutants and should therefore be used to supplement a treatment train rather than act as a standalone measure.

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Indicative SuDS mitigation indices for discharges to groundwater			
Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates	**TSS**	**Metals**	**Hydrocarbons**
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential of at least 300mm in depth	0.6	0.5	0.6
A soil with good contaminant attenuation potential of at least 300mm in depth	0.4	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20mm gravel) underlain by soil with good contaminant attenuation potential of at least 300mm in depth	0.4	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential of at least 300mm in depth	0.7	0.6	0.7
Bioretention underlain by a soil with a good contaminant potential of at least 300mm in depth	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Contact manufacturers for indices of proprietary products/treatment systems, it should be noted that these systems when used in isloation are not able to treat all pollutants and should therefore be used to supplement a treatment train rather than act as a standalone measure.

3. Allocate suitable pollution hazard indices for the proposed land use

Where the discharge is to protected surface waters or groundwater, consider the need for a more precautionary approach

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5 Suffolk Specific Design Principles

Full design details of all SuDS features are contained within the CIRIA SuDS Manual (C753); however, for ease, we have included some of the key design criteria that should be applied as follows:

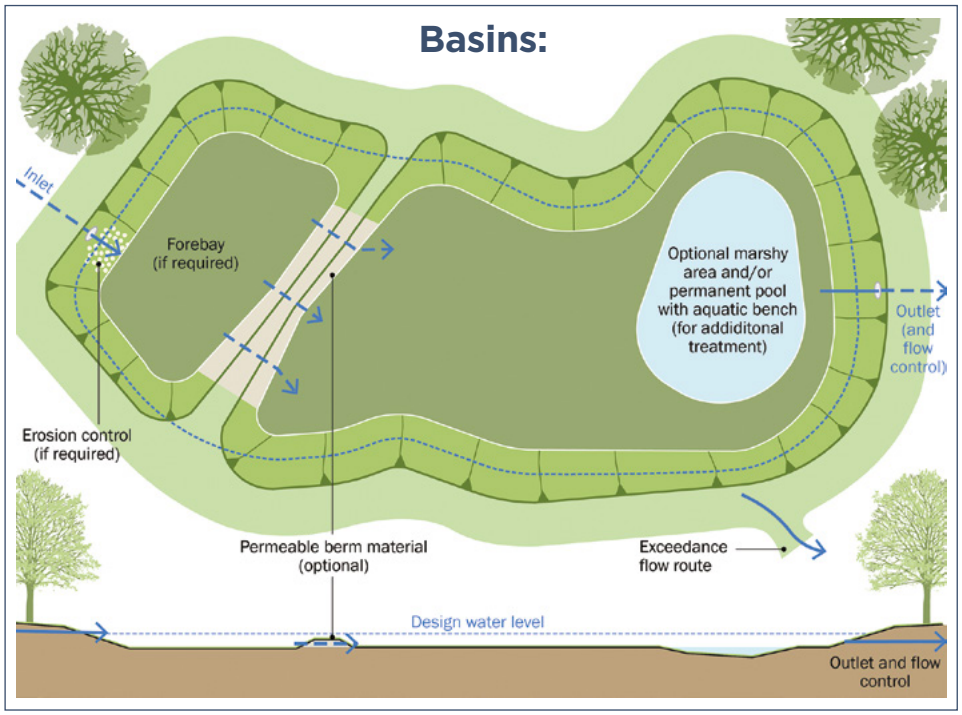

Figure 3 - Plan & elevation of basin CIRIA C753 p.474

- Effective upstream pre-treatment required to remove sediment and silt loads to prevent long term clogging and/or a forebay should be incorporated (C753 p.474).
- Maximum depth of the basin should not exceed 1.5m (C753 p.763) while the maximum water depth within the basin should not exceed 1.0m (C753 p.847).
- A minimum of 300-500mm freeboard should be provided between the maximum 1% AEP + cc water level and the top of structure (C753 p.491).
- Sides slopes should not exceed 1 in 4 unless specific site/safety/maintenance arrangements allow for steeper slopes (C753 p.490 & 651).
- A 1.5m wide wet/dry bench should be provided 600mm above the base (SCC Local Standard).
- A 3.5m wide, level maintenance strip should be provided to allow maintenance access (C753 p.501).
- The recommended length:width ratio for online basins is 3:1 to 5:1, maximising retention times for treatment purposes (C753 p.475).
- The feature should have a maximum half drain time of 24 hours for the 3.33% + cc AEP storm with space for an additional 10% + cc AEP storm if it exceeds 24 hours (C753 p.262).
- Water should not be allowed to enter until vegetation has established (SCC Local Standard).
- SuDS features with open water should consider bird strike risks if in close proximity to high risk areas such as airports or military bases (SCC Local Standard).

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Swales:

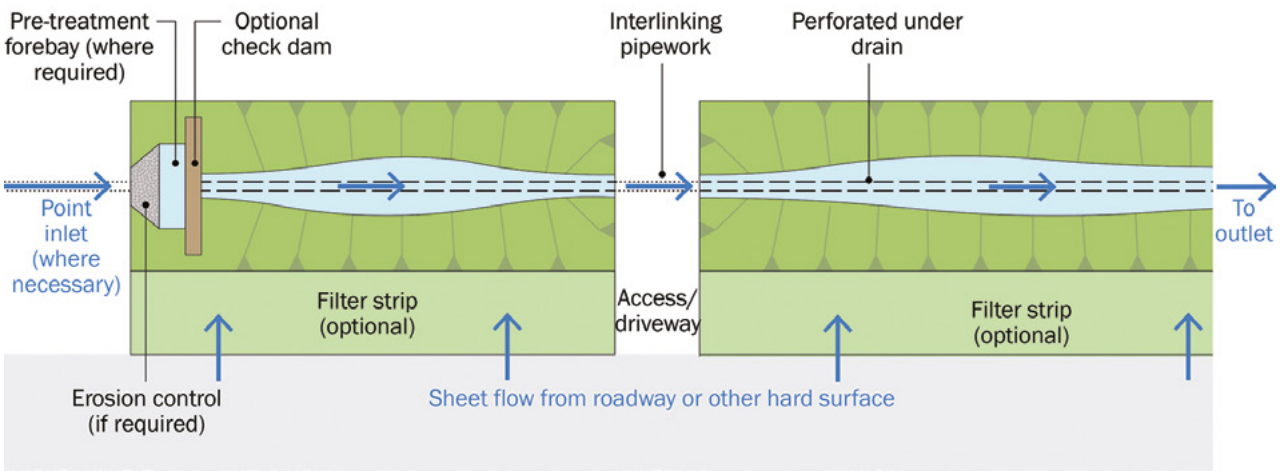

Figure 4 – Plan View of a Swale CIRIA C753 p.316

- Sides slopes should not exceed 1 in 4, longitudinal slopes should be 0.5-6% unless specific site/safety arrangements allow for alternative criteria (C753 p.316).
- A maximum swale depth of 400-600mm, with a base width of 0.5-2.0m unless specific site/safety arrangements allow for alternative criteria (C753 p.316).
- Runoff should preferably be directed laterally into a swale (by draining runoff as a sheet flow) rather than entering the swale as a single point flow (C753 p.323).
- There should be at least a 50mm drop between the top of the soil layer and the contributing adjacent surface (highway/ footway etc) to ensure flows can enter the rain garden easily (SCC Local Standard).
- An exceedance route is required for rainfall events exceeding the design capacity (C753 p.321).

Bio-rentention systems (rain gardens and treepits etc):

Figure 5 – Rain garden, Nottingham – Ribblesdale Road, Sherwood

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- Plant selection should take into account the need for tolerance of wide fluctuations in soil moisture levels (SCC Local Standard).
- There should be at least a 50mm drop between the top of the soil layer and the contributing adjacent surface (highway/ footway etc) to ensure flows can enter the raingarden easily (SCC Local Standard).
- Underdrains can be used to connect overflows to the wider surface water management system (C753, p.348).
- Trials are currently being undertaken by SCC Highways in Felixstowe to establish the options for adoptability.
- Soil or filter mediums for bioretention areas should be sufficiently permeable to allow water to pass through, so that the surface does not become waterlogged. It also needs to contain sufficient organic matter and nutrients to support the proposed vegetation. An indicative specification is provided within the CIRIA SuDS Manual (C753, p.350).

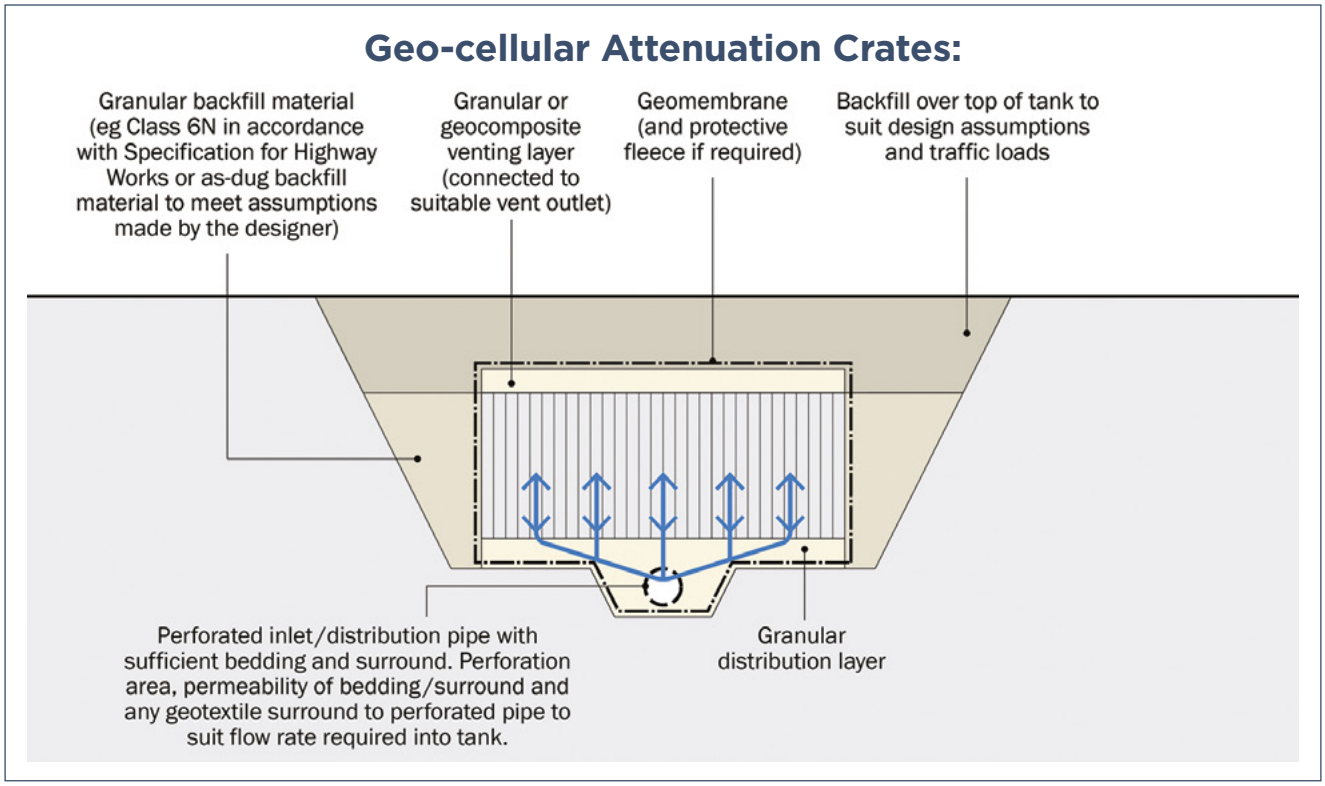

Figure 6 - Schematic of Attenuation Storage Tank CIRIA C753 p.441

- Provide upstream silt prevention and allow an additional 10% capacity to allow for silt accumulation that is not possible to remove within the structure (C753 p.459).
- Provide access system, e.g. pipe through the base of the unit with catchpits and observation/maintenance manholes at either end and no more than a 2 cell width from main channel to permit maintenance/ inspection (SCC Local Standard/ Manufacturer's Guidance).
- The feature should have a maximum half drain time of 24 hours for the 3.33% + cc AEP storm with space for an additional 10% + cc AEP storm if it exceeds 24 hours (C753 p.262).

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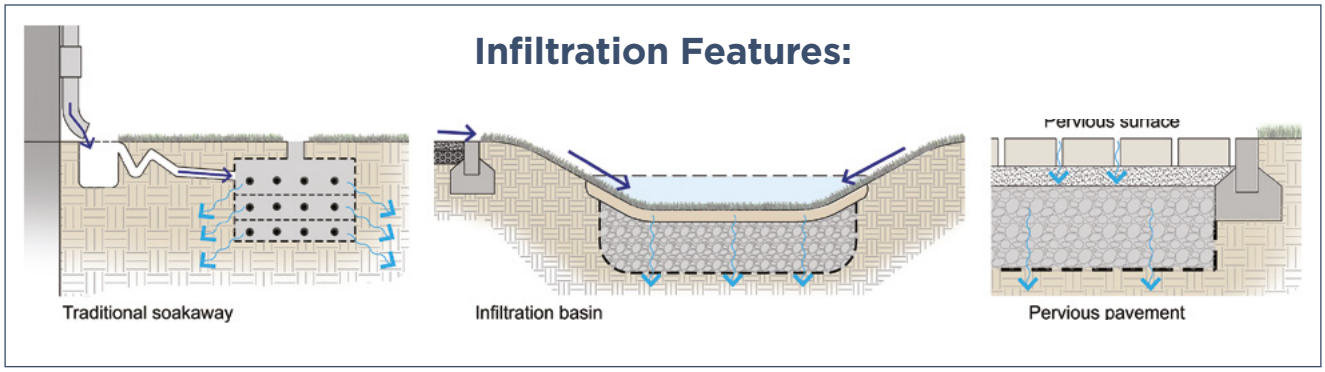

Figure 7 - Infiltration Systems C768 p.151

- The base should not exceed 2.0m below pre-development ground level, however, should a limited depth of material beneath it need to be replaced with permeable fill allowing connectivity to granular geology, this may be acceptable subject to EA approval (SCC local standard).
- Minimum of 1.2m clearance between the base of the infiltration feature and the highest groundwater level (GOV.UK Infiltration systems: groundwater risk assessments).
- Direct discharges to chalk in Source Protection Zones are discouraged, where reasonably practicable the base of the infiltration feature should be located within superficial geology (GOV.UK Infiltration systems: groundwater risk assessments).
- Individual soakaways are preferred for maintenance reasons, however shared soakaways may also be acceptable as a last resort (SCC local standard).
- Ring soakaways to have a solid base slab and no perforations within 300mm of the base (SCC local standard).
- Soakaways should be located a minimum of 5m from structures and highways (C753 p.547), increasing to 10-20m in areas underlain by chalk, or avoided altogether where dissolution features are present (C574 p.235) unless otherwise specified by a geotechnical specialist.
- Infiltration features should discharge from full to half full within 24 hours for the 3.33% + cc AEP storm with space for an additional 10% + cc AEP storm if it exceeds 24 hours so the risk of it not being able to manage a subsequent rainfall event is minimised (C753 p.262).
- Areas of permeable paving should be designed with a low point centrally to identify occurrences of failure as early as possible (SCC Local Standard).
- Particular care should be taken of permeable surfaces during construction (C768 p.209-214).
- No services should be placed under Type A permeable paving (C753 p.842), It should be demonstrated where services will be positioned, with separate service strips where appropriate.
- Soakage rates should be a minimum of 10mm/hr (SCC Local Standard) with evidence provided in the form of BRE365 compliant tests. Tests must be at the location, depth and use a relevant head of water to reflect the proposed design.
- To account for the reduction of infiltration over time (lack of effective pre-treatment and/or poor maintenance), the following factors of safety should be introduced, reducing the recorded infiltration rate (C753 p.553).

Size of area to be drained (m^2)	No damage or inconvenience	Minor inconvenience (surface water on car parking areas)	Damage to structures/ buildings or major inconvenience (highway flooding)
<100m^2	1.5	2	10
100-1000m^2	1.5	3	10
>1000m^2	1.5	5	10

Table 1 - Safety Factors for Designing Infiltration Features CIRIA C753 p.553

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6 Local Information, Policies and Processes

SCC's protocol for advising LPAs on surface water drainage and flood risk aspects of planning and development control is detailed in Appendix C of the Suffolk Flood Risk Management Strategy. It includes relevant policies and outlines information that can be supplied by SCC in order to assist the production of flood risk assessments or drainage strategies, such as flood records and mapping.

Strategic Flood Risk Assessments produced by LPAs will often provide information that needs to be considered when developing a site or designing SuDS schemes.

Local and Neighbourhood Plans often contain their own policies regarding SuDS and drainage to accommodate specific local circumstances and should be consulted as part of the design process.

Sufficient space (a minimum easement of 3.5m) should be left adjacent to existing watercourses for future access and maintenance. When designing the layout of the site; existing watercourses should not be fenced off behind rear gardens. Areas of public open space, landscaped areas, SuDS, footpaths and roads are more appropriate adjacent to existing features.

Figure 8 - Rain garden, M6 Motorway Services

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7 SuDS Construction, Adoption & Maintenance

National planning policy requires maintenance arrangements to be in place to ensure an acceptable standard of operation for the lifetime of the development. Under the same legislation, SuDS maintenance and operation requirements must be "economically proportionate".

The LPA will usually ensure these details are in place using planning conditions.

Before planning applications are made, developers should discuss and agree maintenance options and costs with SCC, the LPA, Highway Authority, Water and Sewerage Company (WaSC), Internal Drainage Board or other potential adopting bodies. SCC expects that the developers will undertake the required maintenance until SuDS are adopted.

The following table outlines SCC's preferred adoption arrangements:

Adopting Body	Type & Location
Individual property owners (residential or commercial)	SuDS serving a single property and situated within that property's curtilage.
Local Authority (Parks Team) where applicable	By agreement, Local Authorities maintain open SuDS within or adjacent to public open space.
Water and Sewerage Companies (WaSC)	The Developer and WaSC enter into an adoption agreement via s.104 of the Water Industry Act and must design SuDS in accordance with the DCG.
Local Highways Authority	For SuDS serving publicly maintained highway only. Discussions with highways should be sought over what types of SuDS are acceptable.
Internal Drainage Board (IDB) where applicable	The Board will consider the adoption of SuDS within its Drainage District (IDD) where the SuDS cater for more than one property. The Board may also consider adopting SuDS outside the IDD but within the catchment, if it will be of benefit to drainage and flood risk in the IDD. The decision whether to adopt will be dependent on WLMA Policy 10.
Private Maintenance Company	Householders pay an annual service charge or the developer pays a commuted sum to the Maintenance Company.

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Maintenance plans are a planning requirement. Plans should include schedules which specify when maintenance items are due. Owners & maintainers of SuDS should record when these actions are undertaken.

A Construction Surface Water Management Plan is required to be submitted for approval to ensure that surface water is managed effectively throughout the construction phase and also that the SuDS features are protected during construction. **A template can be found on the SCC website.**

Temporary SuDS designed and built for the construction phase only must be designed to manage runoff for all events up to and including the 1in100 (1%) AEP storm (SCC local standard), but no allowance for climate change is required (subject to national climate change guidance) unless construction is intended to take place over a long period of time (i.e. 10+ years).

Figure 9 – Multifunctional SuDS Basin at Haverhill Research Park delivering all 4 Pillars of SuDS – Amenity, Biodiversity, Water Quantity and Water Quality

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8 SuDS Verification Report & Asset Register

As a statutory consultee in the planning process, the LLFA has standard planning conditions which we advise the LPAs to add to planning decision notices. These now include a condition requiring a **Surface Water Verification Report** to be submitted to the LPA within 28 days of practical completion of the last dwelling/building.

The surface water drainage verification report should confirm that the surface water drainage system has been built, maintained and operates in accordance with the approved design and specification. **The report shall be produced by a suitably qualified and competent engineer, independent of the developer,** main contractor or subcontractor.

The report shall be based on site inspection(s) and contain evidence of compliance and highlight any failures, problems or changes from the approved design. It should include, but not be limited to:

- Site location plan, OS reference and address.
- Date of inspection(s) & inspecting Engineer (name/signature/date).
- Phasing Plan (if applicable).
- Any works outstanding e.g. landscaping/headwall construction.
- Approved drawings, marked up with any significant as built departures from the design
- Evidence of compliance can include;
  - photos taken during construction, typically showing significant underground drainage structures prior to back filling, showing how infiltration basins were excavated and protected from compaction, how topsoil was stored etc.
  - photos indicating performance after construction, typically showing outfalls, water within detention basins, infiltration basin vegetation on bases and side slopes.
  - CCTV survey video and/or report for pipelines greater than 150mm diameter.
  - Inspection records for catchpits and trapped gullies (recording sediment depths)
- Maintenance plan & access arrangements.
- Details of maintenance company/adoption agreements in place including contact details (registered address).
- Copies of any statutory approvals i.e. Environmental Permits, Land Drainage Consents etc.
- Details of any post construction maintenance and/or reinstatement.

A flood risk asset record shall be included as an appendix. The **Flood Risk Asset Record** shall include details of all strategic SuDS components and piped networks, in an agreed form for inclusion on the LLFA's Flood Risk Asset Register.

Note: it is not the intention that every minor pipe should be listed, simply the integral/strategic features of the system. A template can be found on the SCC website.

SCC will add SuDS records to its Asset Register in order to assist with its duty to investigate and report flooding instances. If necessary, maintenance records/plans will be investigated and enforcement action by the LPA may be required.

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9 SuDS Case Studies

There are a large number of case studies available on the susdrain website showcasing different approaches to sustainable drainage both throughout Suffolk and the UK. They vary greatly according to the type of site, the scale of the project and the objectives of the client. It is possible to search for case studies using different categories, such as SuDS type, new build or retrofit, type of development etc. There is also an interactive map showing the location of projects.

Figure 10 – Example of urban raingarden in Bridget Joyce Square, London. Courtesy of Susdrain.

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CASE STUDY – NEWMARKET RETROFIT

Figure 11 - Rain garden and Tree Pit at All Saints School, Newmarket

1. Surface water disconnected from foul sewer to increase capacity in sewerage network.
2. Roof runoff discharged into rain gardens and planters designed to accommodate all runoff during low intensity events.
3. During high intensity events, surface water is discharged to one of a number of soakaways with an overflow should the soakaway be overwhelmed.
4. Where a rain garden becomes saturated, surface water will overflow into the adjacent tree pit.

The town centre is downstream of the school and has a history of both fluvial and pluvial flooding. The overall strategy was to remove impermeable surface area draining to the foul network and infiltrate the rainfall runoff into the ground.

Raised attenuating planters with fun features, a rain garden, tree pit and soakaways were installed by Anglian Water which removed 0.14 Ha of impermeable surface from the foul/combined network. More information can be found on the CIRIA Susdrain website regarding this case study.

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CASE STUDY – IPSWICH NEW BUILD

Figure 12 - Infiltration Basin at Ravenswood, Ipswich

1. Grassed base of infiltration basin; treats surface water runoff, prevents erosion and is attractive.
2. Vegetated banks; prevent erosion and presents opportunities for amenity whilst the feature is dry.
3. Native vegetation and naturalistic aesthetic supports biodiversity and amenity.
4. Natural surveillance of amenity space as opposed to fencing off the facility ensures safety.

Figure 7 - Elements of Good Design Demonstrated by the SuDS Feature

The developers of this housing scheme designed the site so that all surface water runoff is drained through a combination of soakaways, swales and infiltration basins. Using SuDS, there is no discharge from the site up to the 1 in 100 year storm including an allowance for climate change.

The SuDS are managed by Ipswich Borough Council as public open space using commuted sums. Over its lifetime, the scheme has the potential to save £600,000 in construction compared to a traditional piped drainage system. Individual homeowners are also eligible for refunds of their sewerage charge.

CASE STUDY – Bromsgrove SuDS

Many informative and interesting case studies from across the country can be found on the Susdrain website. One in particular with an innovative approach to storing exceedance flows at Bromsgrove can be found at the following link; **https://www.susdrain.org/case-studies.pdf.**

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10 Design Tools & Guidance in Other Publications

This guide has been kept brief by avoiding repeating additional guidance listed in the following table,

Document Title	Publisher & Date (correct at time of issue)
National Planning Policy Framework & Planning Practice Guidance to the National Planning Policy Framework	Communities & Local Government 2022
Flood & Water Management Act	UK Act of Parliament 2010
Suffolk Flood Risk Management Strategy (including Appendices A, B, C & D)	Suffolk County Council 2016 - 2023
Rainfall Runoff Management for Developments	Environment Agency 2013
HR Wallingford SuDS Tools	N/A
C687 Planning for SuDS – Making it Happen	CIRIA, 2010
C753 SuDS Manual	CIRIA, 2015
C698 Site Handbook for the Construction of SuDS	CIRIA, 2007
C738 Managing Urban Flooding from Heavy Rainfall – Encouraging the Uptake of Designing for Exceedance	CIRIA, 2014
C635 Designing for Exceedance in Urban Drainage – Good Practice	CIRIA, 2006
C625 Model Agreements for Sustainable Drainage Systems	CIRIA, 2004
Cost estimation for SUDS - summary of evidence report – SC080039/R9	Environment Agency 2015
Health & Safety Principles for SuDS; Framework and Checklists	CIRIA, 2013
C582 Source Control Using Constructed Pervious Surfaces	CIRIA, 2002
Susdrain Fact Sheets	Susdrain, Circa 2012
R156D Infiltration Drainage – Manual of Good Practice	CIRIA, 1996
BRE Digest 365 Soakaway Design	Building Research Establishment, 2016
Groundwater Protection Position Statements	GOV.UK 2017

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Document Title	Publisher & Date (correct at time of issue)
Design & Construction Guidance for Foul & Surface Water Sewers	Water.Org, 2020
Drainage & Waste Disposal Approved Document H	GOV.UK, 2010
Anglian River Basin District River Basin Management Plan	GOV.UK, 2016
The Town and Country Planning (Development Management Procedure) (England) Order	Communities & Local Government 2015
Reservoirs Act	Environment Agency, 1975
Drain & Sewer Systems Outside Buildings BS EN 752:2008	British Standard
Suffolk SuDS Palette	SCC Local Guidance

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Notes

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Thank you for reading our document.

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