Sustainable Drainage Systems

Design Guide

Essex County Council. February 2020

Essex County Council

Contents

Please note: The following document is only a basic summary of what we expect to see within an application for developments within Essex. If you require further information or details, please refer to the **CIRIA SuDS Manual C753** and/or consider using our **SuDS Planning Advice** service (the link to which can be found throughout this guide).


››Temple Farm, Chelmsford

1. Introduction

1.1 Surface water and urbanisation

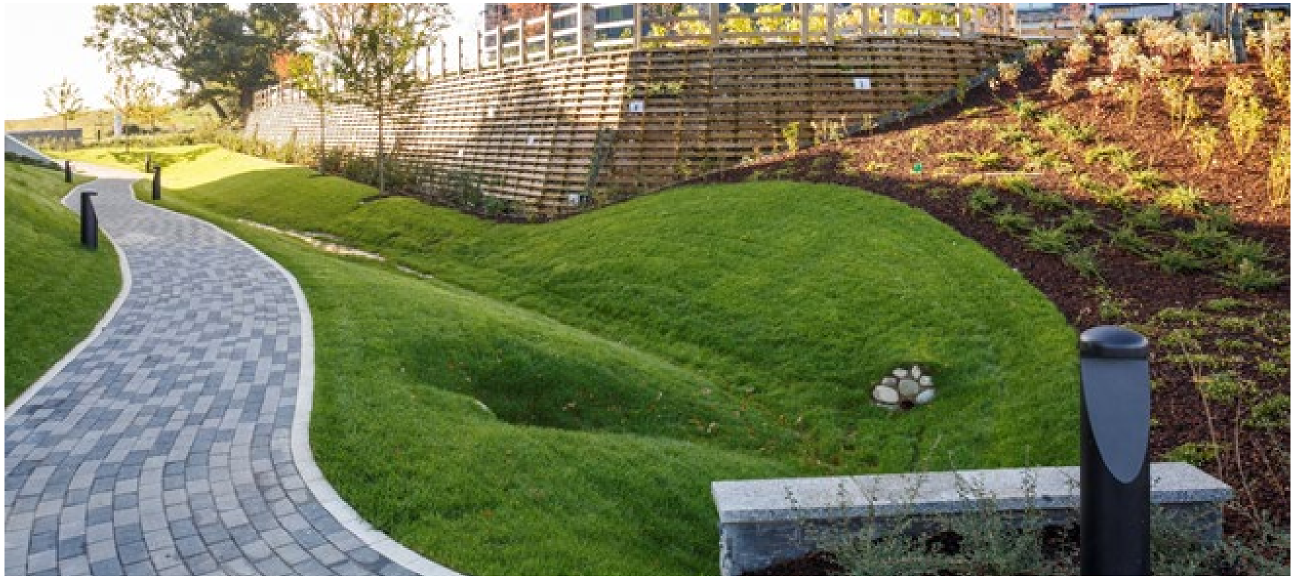
Sustainable Drainage Systems (SuDS) are not a new concept. They have been nature's way of dealing with rainfall, since time began. At its simplest, rain falling on the land may evaporate or be absorbed into the soil, nourishing our natural habitat, or else flows overland into ponds, ditches, watercourses and rivers, helping to sustain life by replenishing our precious water resource.

It is only recently that the balance of this natural water cycle has been disrupted. Modern urban development with its houses, roads and other impermeable surfaces has increasingly altered the way that rainwater finds its way into our soils, rivers and streams. Surface water has for many years been allowed to be collected and piped directly into our ditches and rivers. Conveying water away as quickly as possible from a development may adequately protect the immediate development from flooding but increases the risk of flooding occurring downstream. This unsustainable approach to surface water drainage, together with the potential effects of a changing climate, has contributed to some very serious consequences on life, property and the environment as evidenced by the disastrous experiences throughout the UK during the summer of 2007.

1.2 Planning requirements

Essex County Council became statutory consultations on all major developments in regard to surface water drainage on 15th April 2015. **The Sustainable drainage systems: Written Statement (HCWS161)**(1) should be read in conjunction with policy in the revised **National Planning Policy Framework**(2) (NPPF) (paragraphs 155 to 165) in February 2019, advice in the **Planning Practice Guidance – Flood Risk and Coastal Change**(3), and the **CIRIA SuDS Manual C753**(4).

Furthermore, to assist local planning authorities in their determination of an application as to whether their prior approval is required for a change of use of agricultural buildings, or a change from office to dwelling houses in an area at risk of flooding, the applicant should provide with their application an assessment of flood risk. This should demonstrate how the flood risks to the development will be managed so that it remains safe through its lifetime.



Temple Farm, Chelmsford

On 24 March 2015, the Government laid a statutory instrument making the Lead Local Flood Authority (LLFA) a statutory consultee in relation to these major applications which applies from 15 April 2015. As part of this role, in advising on 'surface water' the LLFA will consider surface water flood risk to and from the development as well as the provision of appropriate SuDS in line with best practice and the criteria outlined in this guide.

The Town and Country Planning (Development Management Procedure) (England) Order 2015[5] defines a 'major development' as any development involving one or more of the following:

1. The winning and working of minerals or the use of land for mineral-working deposits
2. Waste development
3. The provision of dwelling houses where
    i) the number of dwellings to be provided is 10 or more
    ii) the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within sub-paragraph 3i)
4. The provision of a building or buildings where the floor space is to be created by the development is 1,000 square metres or more
5. Development carried out on a site having an area of 1 hectare or more

It should be noted that the acceptance of flows from specific areas of development site may be subject to approval from the adopting organisation. Before making an application please speak to the relevant adoption bodies first.

This guide forms the local standards for Essex and, together with the National Standards, strongly promotes the use of SuDS to help reduce surface water runoff and mitigate flood risk. It also strongly promotes the use of SuDS as they greatly benefit:

- **Water quality** – SuDS can help prevent and treat pollution in surface water runoff, protecting and enhancing the environment and contributing towards Water Framework Directive objectives.
- **Amenity** – SuDS can have visual and community benefits for the community.
- **Biodiversity** – SuDS can provide the opportunity to create and improve habitats for wildlife, enhancing biodiversity, and enable multi-functional green infrastructure.

1.3 Sustainable development

Essex County Council is committed to making our county a place which provides the best possible quality of life for all who live and work here. Making Essex more sustainable is an important part of supporting this vision and it is therefore implicit that new development should incorporate sustainability measures that help achieve this goal.

Appropriately designed, constructed and maintained SuDS support sustainable development through combining water management with green space with benefits for amenity, recreation and wildlife. SuDS are more sustainable than conventional surface water drainage methods as they can mitigate many of the adverse effects that stormwater run-off has on the environment. This can be achieved by:

- Reducing run-off rates, thereby lessening the risk of flooding downstream.
- Minimising additional run-off emanating from urban development, which could exacerbate the risk of flooding and impair water quality.
- Encouraging natural groundwater recharge (as appropriate) and so reduce the impact on aquifers and rivers.
- Reducing pollution risks associated with development.
- Contributing to and enhancing the amenity and landscape of an area and to promoting community involvement and enjoyment.
- Providing habitats for wildlife and opportunities for biodiversity enrichment.

1.4 The purpose of this guide

At present, the majority of planning applications submitted to the LLFA do not satisfactorily address the flood risk issues affecting a development site or those identified in the accompanying site-specific flood risk assessment. Consequently, a ‘holding objection’ is often necessary by the LLFA until further evidence-based work is submitted. The most common reasons that the LLFA issue holding objections are:

- Insufficient **water quality**
- Incorrect **discharge rates**
- Insufficient **storage volumes**
- Incorrect or missing **infiltration testing**
- Failure to meet the **drainage hierarchy**
- Missing **urban creep**
- Missing **drainage plan**
- Incorrect **climate change provision**

This guide is primarily intended for use by developers, designers and consultants who are seeking guidance on the LLFAs standards for the design of sustainable surface water drainage in Essex. It provides guidance on the planning, design and delivery of attractive and high-quality SuDS schemes which should offer multiple benefits to the environment and community alike. It should also show that meeting these standards need not be an onerous task and can help add to development. By doing this it should improve the calibre of the applications received which not only benefits the LLFA but also the developer. This is because it can save the developer time and money through reducing unnecessary delays in the planning process.

Essex County Council (ECC), as LLFA, will refer to this Guide when it is consulted on planning applications relating to sustainable drainage. **SuDS Planning advice** should be sought from the County Council as early on in the process as possible. This guide provides a steer as to what is expected and should complement national requirements whilst prioritising local needs. The SuDS philosophy and concepts are based upon and derived from the **CIRIA SuDS Manual C753**(4). This guide seeks to complement The Ciria SuDS Manual, and both should be incorporated into any SuDS proposals for the development.

The level of information expected at each stage of the planning application process varies. A list of what is expected to be seen at each stage can be seen below. At the outline stage it is expected that the drainage strategy includes enough information to demonstrate that the principles of our standards are met and that the drainage system itself is viable. As an application progresses through the planning process it is expected that there will be increasing levels of detail provided. Where necessary, conditions will be placed on a full or outline application to ask for further information, however this recommendation will only be made following a sufficient level of information. As from 1st October 2018 it has become a requirement for precommencement conditions such as these to be agreed between the applicant and the Local Planning Authority. Moreover, the LLFA will only formally comment on discharge of conditions applications unless the Local Planning Authority have signed up to a Service Level Agreement (SLA). Therefore, the Local Planning Authority should be contacted in the first instance in relation to discharge of conditions applications. This however does not mean that SuDS Consultation Advice cannot be applied for in regard to discharge of condition applications, regardless of whether or not an SLA is in place.

When applying for planning permission, a completed pro-forma may be required as outlined in **Appendix 1**. This will help facilitate a more efficient review of individual planning applications as well as identify any missing key information necessary for considering the planning application and its impacts.

It should be noted that this document doesn't cover every possible drainage scenario, there may be individual cases where elements within this guide do not apply 100% to your situation. In these cases, it is recommended that you seek **SuDS Planning Advice**. ECC, as the LLFA, provides a SuDS Planning Advice service which can be used at any point during the planning process. It is recommended that the LLFA is consulted as early as possible to ensure sufficient space is provided within the site layout for necessary SuDS features. The SuDS Planning Advice service can significantly increase your chances of satisfying the LLFA's SuDS requirements therefore reducing delays in the determination of the application. Where appropriate for large scale development, suds planning advice may be provided via **planning performance agreement** (PPA).

1.5 What the LLFA expect to see and when

With any stage of the application, the LLFA would expect submission of all relevant documents from the previous stages. This would help give a full overview of the history of the application and will help the review process. Large strategic sites may also require drainage information to be provided as part of the master planning process. Chapter 7 of the **CIRIA SuDS Manual C753**[4] provides a conceptual overall of the implementation of SuDS during master planning. For more information please speak to a representative from the LLFA to find out what will be involve at this stage.

Outline	Reserved Matters	Full	Discharge of Conditions	Documents expected	Further information
Preliminary information is acceptable	✓	✓	✓	The LLFA required Pro Forma	**Appendix 1**
✓	✓	✓	✓	Flood Risk Assessment (as in the NPPF)	**Flood Risk Assessments**
✓	✓	✓	✓	Drainage strategy (this can be included within the FRA)	
✓				Preliminary layout drawings showing potential features, and location of discharge points	
✓				Preliminary storage calculations and greenfield runoff rate calculations	**A Drainage Calculations Guide**
✓				Preliminary landscape proposals	**Green spaces/ promotion of biodiversity**
✓		✓		Preliminary ground investigation report, to show potential viability of infiltration	**Infiltration**
✓	✓	✓	✓	Evidence of third-party agreement for discharge to their system (in principle/ consent)	End of **greenfield runoff rates**

Outline	Reserved Matters	Full	Discharge of Conditions	Documents expected	Further information
	✓	✓	✓	Detailed storage calculations	**A Drainage Calculations Guide** and **Attenuation storage**
	✓	✓	✓	Detailed drainage network calculations	**A Drainage Calculations Guide**
	✓	✓	✓	Detailed drainage layout including location of features, exceedance routes, finished floor levels, discharge locations (and rates)	**Exceedance routes**
			✓	Detailed landscape proposals	**Green spaces/ promotion of biodiversity**
			✓	Detailed flood and drainage design engineering drawings and modelling	**A Drainage Calculations Guide**
	✓	✓	✓	Full structural, hydraulic and ground investigations, including detailed infiltration testing in line with BRE365 (6), groundwater level	**Infiltration testing**
			✓	Development management and construction phasing plan	**Construction management**
			✓	Maintenance program and on-going maintenance responsibilities	**Maintenance and adoption**

››18th-19th century duck decoy pond, Old Hall Marshes, Maldon, Essex

2. SuDS design standards

2.1 Flood risk assessments

A flood risk assessment is required[2] to ensure that all flooding risks have been considered when designing the drainage scheme.

What the LLFA expect to see
When submitting a Flood Risk Assessment (FRA), flood zone maps, surface water flood maps, critical drainage area (CDA) mapping, ground water flood maps and reservoir flood maps should be provided. In addition to this any information regarding relevant mitigation should be provided.

Within a Flood Risk Assessment (FRA), any risk of flooding that the development may be subject to should be made clear. This should include, fluvial flooding risk, reservoir flood risk, ground water flood risk and surface water flood risk. Appendix 5 shows the surface water flooding map for the entirety of Essex.

When creating the FRA, it should be checked to see if the development site is situated within a critical drainage area. This can be done by visiting the **'Check If You're At Risk Of Flooding'** page on the Essex County Council's website. If it is found to be within a CDA, it should be shown how the site does not make this risk worse for itself and nearby developments. More emphasis may need to be put on increasing offsite betterment.

2.2 The drainage hierarchy

All sites must manage surface water via the following hierarchy.

When managing rainfall, the SuDS network should be designed to match natural drainage routes, infiltration rates and discharge rates as far as possible. In addition to this, with concern over climate change and increasing risk of water scarcity, re-use of rainwater wherever possible should be utilised. Therefore, in accordance with the drainage hierarchy contained in **Approved Document H of the Building Regulations**[7] , **Planning Practice Guidance**[8] and the need to mitigate against water scarcity, all surface water run-off must aim to be discharged as high up the following hierarchy as possible:

- **Rainwater re-use (rainwater harvesting/ greywater recycling)**
- **An adequate soakaway or other infiltration system**
- **Hybrid solution of infiltration and discharging to a surface water body**
- **To a surface water body (e.g. an ordinary watercourse)**
- To a surface water sewer, highway drain, or another drainage system
- To a combined sewer

It should be noted that if out falling to public sewer or watercourse that is not in or adjacent to the development site then it is necessary to demonstrate permission in principle or third-party agreement.

2.3 The need for interception

Interception storage should be provided for the first 5mm of rainfall as much as possible in order to closely mimic greenfield scenarios.

Interception is the capture and retention for the first 5mm of the rainfall resulting in no runoff. Interception and evaporation can account for 15-50% of yearly precipitation. Interception should be utilised to closely reflect the greenfield runoff behaviour, and to decrease the risk of pollution downstream further. Where possible infiltration or other techniques, such as rainwater reuse, should be used to try to achieve no runoff to either surface water sewers or watercourses for the first 5mm of rainfall.

Interception is however not guaranteed due to the variability of soil moisture and in evapotranspiration, therefore as stated in Chapter 24.8 of the **CIRIA SuDS Manual C753**[4] compliance for 80% of rainfall events should be required during summer months and 50% compliance during winter months. The **CIRIA SuDS Manual C753**[4] box 24.3 highlights some simple approaches which can be undertaken for interception delivery and compliance assessment, whilst table 24.6 shows some mechanisms for interception.

2.4 Rainwater re-use

Rainwater and stormwater re-use helps to control discharge volumes and it helps to mitigate against water scarcity. There may be government funded grants for developments who incorporate rainwater reuse and rainwater harvesting.

The below information in this section is based upon **BS EN 16941-1:2018**[9] article on On-site non-potable water systems - Part 1: Systems for the use of rainwater.

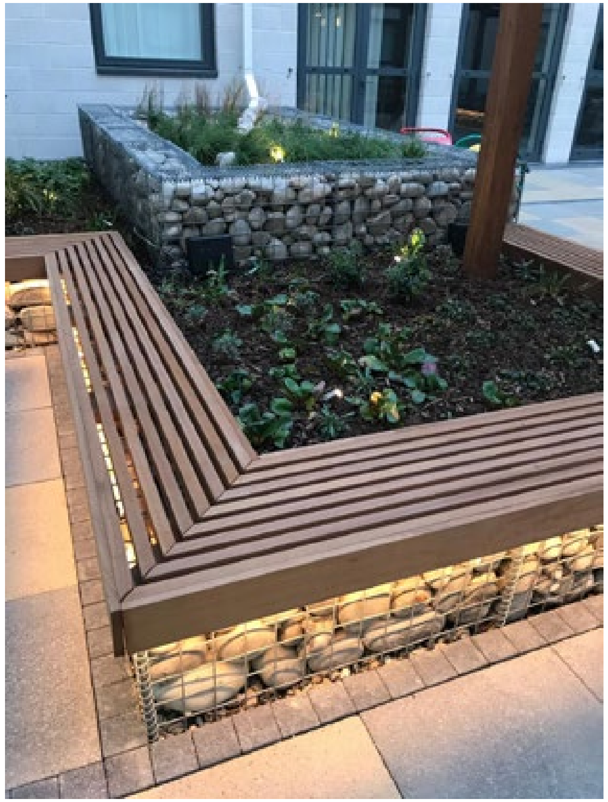
Wherever possible new developments should employ rainwater re-use (e.g. rainwater harvesting and stormwater harvesting), which helps reduce potable water demand and the discharge of water. Rainwater can be utilised for a variety of applications e.g. cleaning, irrigation, flushing toilets. Designers and planners should where possible obtain from the local water supply company information about the degree of water scarcity in the area of the development (including climate change implications for water resource security and likely increases in demand). Where there is pressure on water resources, rainwater re-use systems should form part of the surface water management strategy for the site. It is also good for sites where it is difficult to meet the 1 in 1 greenfield discharge rate. Rainwater and stormwater re-use can be seen as both a stand-alone option, as well as part of a wider strategy including SuDS, flood alleviation and water conservation measures, in response to changing climate and increased usage pressures. Rainwater and stormwater re-use systems can be incorporated into the storage capacity of the development. This can be shown by providing average figures for the specific feature. These figures should show how much water the feature can hold and how much of this water on average will be used, therefore highlighting its average capacity. This can therefore be used towards the storage totals. Whilst water butts fall within the definition of rainwater harvesting, the use of water butts must not be included in any storage calculations, as they rely on their owners emptying them before storm events.

Any rainwater or stormwater re-use system should have 4 main elements; collection, treatment, storage and distribution of water. Any system should be economic and practical; considering the local rainfall pattern, the size of the collection surface, the surface's materials and their drainage characteristics, sizing and material of piping systems, the levels of pollution of the collection surface and the risk of contaminating the system. Effective rainwater treatment should consider the materials coming into contact with the runoff e.g. traffic/industry. Rainwater must not discharge into open gullies due to potential risk of contamination.

Treatment covers several options; removal of coarse particles upstream of the storage, retention of fine particles by sedimentation and flotation in the storage device and filtering downstream of the storage device which depends on the intended use.

Overflows should also have provisions in place to avoid pollution risk. Potential overflows should be accounted for to ensure rainwater harvesting systems do not cause flooding. Storage devices shall be equipped with an overflow to allow excess water to be discharged. Ideally the over flow should be set at a height that would allow the temporary storage of a small event to be slowly released to the main SuDS system, with a high-level overflow which prevents the tank from flooding the property. Any additional excess water should be infiltrated or otherwise evacuated into surface water bodies. The sizing of the volume of the rainwater storage device results from an analysis of the relationship between the rainwater that can be harvested and the demand of the non-potable water. The following factors shall be considered in order to be able to calculate the size of the storage device; namely the rainfall data (amount, intensity, pattern of rainfall, dry periods), the size and type of the collection surface, the number and type of intended applications, both present and future and the hydraulic efficiency of equipment used (e.g. filters).

Storage devices should be protected against frost, extreme temperatures and direct sunlight. The location of an underground storage device should be outside the tree protection area or a minimum distance of 3 m from any tree or plant that develops a significant root system, whichever is greater. Site specific factors, such as contamination risk, should be considered. There should be labelling of systems to distinguish between non-potable water distribution systems and potable water distribution systems. A control and monitoring system should be incorporated into the rainwater system to ensure, as a minimum, that users are aware of whether the system is operating effectively. The system must inform about the status of the water supply and any malfunctions.



Basildon Hospital, Basildon

A risk assessment should be carried out to determine whether the system is safe and fit for purpose, considering the potential effects on people, the environment and physical assets. Maintenance of the system should be undertaken regularly, and details should be provided on the frequency and type of maintenance within the maintenance plan. Where greywater recycling is proposed, average water use across the site should be demonstrated over a year to show the likely storage capacity provided at any given period of time.

2.5 Infiltration

Where possible infiltration must be used in order to prevent increased volumes of water leaving the site.

After reuse, infiltration is the next option within the drainage hierarchy. As the potential for infiltration can vary across the county due to soil types, ground water levels, and topography, sufficient ground investigations and infiltration testing should be undertaken and supplied to support any application.

Any ground investigations should include data from the British Geological Society, intrusive testing such as borehole tests (to determine soil type, depth and the depth of water table), detailed topographic drawings, and infiltration testing in line with the **BRE365**[6] testing procedure and the infiltration testing methods found in chapter 25.3 of the **CIRIA SuDS Manual C753**[4]. This testing requests that three consecutive tests are required within each test pit and if infiltration is found to be viable then the lowest rate should be used. In addition, when conducting detailed infiltration testing, the tests should be carried out at the location, depth and head of water that replicates the proposed design. Groundwater monitoring should preferably be undertaken between November and April. When seasonal groundwater levels are below average levels, consideration should be taken, and onsite monitoring should be adjusted accordingly.

At the outline stage of the planning process it is accepted that intensive infiltration testing is not always achievable, therefore a preliminary investigation on the soil and geology of the site is acceptable. The LLFA would accept borehole testing or a desktop study with the condition that infiltration testing is undertaken at a later stage. Where the capacity to infiltrate is undetermined from a desk study a borehole percolation test could be undertaken to ascertain the likelihood of infiltration. If infiltration is the chosen discharge option within an outline application and detailed testing has not been possible, then an alternative approach should also be provided in case subsequent infiltration testing demonstrates that discharge to the ground will not be viable.

What the LLFA expect to see

For outline applications, preliminary ground investigations, or a desk top study highlighting the potential capacity for infiltration should be provided.

For full applications or where necessary for discharge of conditions applications, full detailed infiltration testing needs to be provided in line with **BRE365**[6] *and the infiltration testing methods found in chapter 25.3 of the* **CIRIA SuDS Manual C753**[4]*. This should include the locations and results. The lowest found rate should be used as a conservative approach.*

Ground stability should be taken into consideration when infiltration is proposed. The base of the soakaway should be 1 metre or higher than the highest ground water levels. Point infiltration features such as soakaways should not be within 5 metres of a building. If infiltrating into chalk, where it is medium to high density, soakaways should be 5m away from all structures, roads, and railways. Where it is low density soakaways should be a minimum of 10m away, and where dissolution features are known to be prevalent soakaways should be at least 20m away from roads, structures, and railways. In addition, Essex Highways require that point infiltration should not be within 6m of the highway. Blanket infiltration however, (such as permeable paving) can be located as close as possible to buildings as long as there is an impermeable barrier between the two. However, if the permeable paving is to infiltrate additional water from other surfaces e.g. roof areas an offset from the building foundations is needed. In addition, infiltration should not occur on made ground.

The minimum acceptable rate of infiltration is $1x10^{-6}$ m/s. Rates found to be slower than this may potentially have to deliver a **hybrid drainage solution**. If rates are found to be too slow for formal infiltration this does not rule out the possibility of some soakage taking place. Features (for example permeable/ porous paving) should be unlined or use permeable lining wherever possible regardless of infiltration rates in order to maximise infiltration capacity. This should be approached with care, as should all infiltrating sites, when dealing with areas that are subject to previous contamination or other issues such as structural stability. Whilst Essex Highways will not adopt permeable paving within roads, if this option is to be used, the features should be lined. This lining can be permeable to encourage infiltration, but there has to be a material separating the storage medium from the formation.

Temple Farm, Chelmsford

2.6 Greenfield runoff rates

Where possible infiltration must be used in order to prevent increased volumes of water leaving the site.

What the LLFA expect to see
For all applications where infiltration is not viable the LLFA expect to see that the discharge rates are being restricted to 1 in 1-year greenfield runoff rate (or matched rates). It is expected that if this is not the case then evidence is provided to show why. The greenfield runoff rates provided should be accompanied by their calculations in order to understand if it has been calculated with the correct inputs.

It should also be shown that the discharge location is in line with the drainage hierarchy and that the necessary permissions have been granted.

SuDS networks should be designed to mimic natural drainage routes. When discharging to a watercourse it should be proven that the final discharge location is the same as where it currently drains otherwise runoff is being increased elsewhere due to the development. In addition, where the predevelopment site has multiple discharge locations, a catchment-based approach should be utilised in order to not increase runoff.

Surface water runoff can be discharged in three ways:

Restricting to the 1 in 1-year greenfield rate

Restricting to the 1 in 1-year greenfield rate
The LLFA preference is that runoff must not increase due to the development and all runoff should be first restricted to the greenfield 1 in 1-year runoff rate during all events up to and including the 1 in 100-year rainfall event with **climate change**.

Restricting to flow matching rates

Alternatively, if restricting to the 1 in 1-year greenfield rate approach is not possible discharge rates can be limited to a range of equivalent greenfield discharge rates. For example, the 1 in 1-year storm event will be limited to the 1 in 1-year greenfield run-off rate, the 1 in 30-year storm event will be limited to the 1 in 30-year storm event and the 1 in 100-year rate will be limited to the 1 in 100-year storm event (inclusive of a climate change allowance). If this alternative approach is used, then there should also be an inclusion of **long-term storage**. It is however the LLFA's preference that a single rate discharge is used unless it is proven that a flow matching scheme is the more conservative approach.

Discharging to a tidal estuary

In instances where the final discharge location is to a tidal estuary then it is accepted that discharge rates are unrestricted. However, evidence should be provided to ensure that the surface water will be managed during a tide locking scenario. This should be demonstrated by showing that the surface water can be managed for a 1 in 100-year pluvial storm event plus climate change and a 1 in 20 year fluvial/tidal storm event coinciding. Likewise, when discharging to a main river, consideration should be given to a 1 in 20-year fluvial event coinciding with a 1 in 100-year pluvial event plus climate change at the development site.

Why the LLFA doesn't accept QBar

The LLFA do not accept discharge rates being limited to QBAR (mean annual maximum flow rate). The QBAR estimation procedure is based on higher return periods (>2), and results in higher estimated values for final discharge from the site than 1 in 1 Greenfield runoff rates. There are significant differences in storage volumes and final discharge rates when considering QBAR as an allowable discharge from the site. Further it could have potential increase in risk of surface water flooding due to increased discharge rates that opposed natural greenfield runoff. Therefore, the LLFA require discharge rates to be limited to 1 in 1 Greenfield rates.

The risk of blockages

Historically, minimum discharge rates have been limited to 5l/s due to the risk of blockage of outlets with an orifice size of smaller than 50mm. However, through the use of appropriate design such as checked dams, trash screens, and sufficient upstream treatment orifice sizes can be made larger with discharge rates being limited far below 5l/s without causing an unacceptable risk of blockage. Other features such as permeable paving, and vortex flow control devices are also proficient in reducing the risk of blockages. The LLFA require that runoff rates are limited to 1l/s or the 1 in 1-year greenfield rate, whichever is higher, unless discharge is via **permeable paving** which is further able to reduce the risk of blockage.

The Junipers at the Mulberries, Witham

If all surface water first goes through features like permeable/porous paving then the majority of pollution and debris will be prevented from reaching the outfall, therefore discharge rates will be able to be lower than 1l/s. An exception for this is when discharging to an Anglian Water surface water sewer, the minimum final outlet size that they will accept is 75mm. Therefore, if discharging to an Anglian Water surface water sewer the discharge rate should be as close to the greenfield 1 in 1 year run-off rate as possible with a minimum final outlet size limit of 75mm. Additionally to minimise the risk of blockage, the LLFA expect materials that may cause blockages to be removed from the system as high up the system as possible.

Where it is not possible to limit rates back to the 1 in 1-year greenfield rate because this may cause blockages, additional consideration should be given to **rainwater and stormwater re-use** to minimise the impact of smaller storm events. This consideration can be in the form of the average figures for the specific feature, showing how much water it can hold and how much of this water on average is used, highlighting its average capacity. This can therefore be used towards the storage totals.

This however does not include water buts as these have to be emptied manually and therefore have an unreliable storage volume.

Discharging to a surface water sewer

When discharging to a surface water sewer, permission in principle or in full (depending on what stage in the application process it is) should be demonstrated to show that there is a viable outfall from the site. Where this is the case the LLFA still expect the 1 in 1-year greenfield runoff rate or flow matching discharge limit to be met. If this is unviable due to the service providers requiring minimum orifice sizes (such as Anglian Water) then the lowest rate possible will be accepted in line with this, as long as evidence is provided to support its use. It should also be noted that discharge rates should not be limited to the maximum capacity as given by the provider.

It is recommended that if you intend for the drainage of your site to be adopted by a third party that they are engaged early on in the design process to ensure that features meet the adoptable standards.

2.7 Brownfield runoff rates

Brownfield sites should where possible revert the drainage back to its natural state.

What the LLFA expect to see

At all stages of the planning process, when developing a brownfield site and once it has been proven that discharging to the 1 in 1-year greenfield rate (or matched rates) or as close as feasibly possible is not possible. The current brownfield rates accompanied by their calculations should be provided to ensure that a minimum 50% betterment is provided.

The LLFA expects surface water drainage schemes on brownfield development sites to follow the same principles as if the site is greenfield. If it is unfeasible to restrict runoff rates back to the 1 in 1-year greenfield runoff rate or the alternative **flow matching approach**, the LLFA will accept discharge rates to be restricted to as close as feasibly possible to the 1 in 1-year greenfield runoff rate or flow matching rates with limiting to a

50% betterment of the brownfield 1 in 1-year runoff rate or flow matching rates as a last resort. If this approach is to be chosen, then it should be clearly evidenced that restricting to the greenfield rate is unfeasible and that the new rate proposed is as close as feasibly possible to the 1 in 1-year greenfield runoff rate or flow matching rates. This supporting evidence should include a range of rates and the corresponding storage volumes associated with those rates. It should be noted that a 50% betterment is a last resort option and is only acceptable when lower rates are proven to be unviable.

2.8 Hybrid drainage plans

Where infiltration can be utilised hybrid solutions may be possible.

Where a site has some infiltration capacity, but rates are too slow to meet formal infiltration requirements for the site (1×10^{-6} m/s), the LLFA may accept a well-designed hybrid solution, which uses low level infiltration for smaller storm events and a piped outfall for larger events. This maximises the capacity of the **attenuation storage** for larger infrequent events and allows for appropriate half drain times to be met for all events. An example of this would be where a site has demonstrated infiltration rates of 1 x 10 -7 m/s. Infiltration could be used for events up to the 1 in 5-year event assuming that 50% of the attenuation capacity of the storage feature is available 24 hours after a storm. Any event larger than the 1 in 5-year event would then discharge via a piped network at the 1 in 1-year greenfield rate.

2.9 Calculating runoff rates

Calculating runoff rates should be completed using the most conservative rates in order to prevent an increase in flooding offsite.

Runoff rates should be calculated based on the full development site area subtracting any areas of large open space that will not be draining via the proposed SuDS. Unrestricted rates will only be allowed where the outfall is to a tidal estuary.

The LLFA preference is that greenfield runoff rates should be calculated using the following rainfall data: FSR and FEH, and should be calculated using the IH124 method. Alternatively, the ICP SuDS method can be used which is the IH124 with sites below 50ha having a pro rata applied. These methods should be adjusted as appropriate to site conditions. Calculations of greenfield rates can use a range of calculation methods, as rates and storage requirements will vary depending on different storm criteria it should be demonstrated during the later stages (reserved matters or discharge of conditions) of the planning process that

What the LLFA expect to see

For greenfield runoff rates we would expect to see the calculations used, including the inputs and outputs.

For brownfield runoff rates, within outline applications the modified rational method or the urbanisation method found in the ReFH2 software are acceptable. The calculations themselves along with their inputs should be provided. However, at a more detailed design stage more site-specific calculations should be provided and modelled to show what influence factors such as the current pipe sizes have.

the method selected is the most conservative of the options available. For brownfield sites, the Modified Rational Method can be used to calculate the peak brownfield rate for the 1 in 1-year storm event, 1 in 30-year storm event, and the 1 in 100-year storm event. The inputs for this calculation should be based upon the inputs recommended by **The Wallingford Procedure - for design and analysis of urban storm drainage**(10) and **BS8005 - Sewerage. Guide to new sewerage construction**(11). Alternatively, runoff from a brownfield site can be estimated using the urbanisation methods within the ReFH2 software. When calculating the brownfield runoff rate, surveying and modelling should be undertaken to confirm how the site currently drains. For example, if the brownfield site is currently drained by a 225mm pipe the brownfield runoff rates should take account of the limits this poses.

2.10 Climate change

An allowance for rainfall intensities changing due to climate change should be incorporated into storage capacities.

In February 2019 the Government updated it's **'Flood risk assessments; climate change allowances'**(12) document. This guidance provides updated climate change figures which should be used for flood risk assessments and drainage strategies to help minimise vulnerability and provide resilience to flooding and coastal change in the future. Within this is an update on the Peak Rainfall Intensity Allowance in small and urban catchments as shown in the table below. The climate change allowance required is dependent on the lifespan of the development after it has been completed. The LLFA take a conservative, risk adverse approach to flood and water management and therefore expect the Upper End figures to be used.

Table below shows the peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline).

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

2.11 Water quality

All surface water should go through stringent treatment in order to protect water sources and biodiversity.

What the LLFA expect to see

At the outline application stage, it should be shown that consideration has been given to water quality. This can be shown by discussing the potential options in treatment, and how this will tie in with the scheme.

At the full application stage and at discharge of conditions it is expected that the simple index approach is used to ensure that there is sufficient treatment for the site. This should be shown by the hazard pollution level indices and the mitigation indices that the features used provide.

The level of pollution found within surface water runoff will depend on the nature of the development from which it arises, the time since the last rainfall event, and the duration and intensity of rainfall. An appropriate 'train' of SuDS components should be installed to reduce the risk of pollutants entering watercourses and groundwater. The suitability of different SuDS components within a well-designed treatment train can be found within table 26.7 of the **CIRIA SuDS Manual C753**(4). This should incorporate treatment from all sources of pollution, including rooftops. A well planned, and designed SuDS network can be cost effective when the appropriate conveyance, infiltration, and attenuation work harmoniously with surface water treatment.

Interception storage should be utilised as part of the beginning of the treatment train to ensure that pollutants are managed as close to the source as possible. In addition to this sediment should be removed as far upstream in the system as possible. Doing so provides the important removal of a range of contaminants that are adsorbed onto sediment surfaces and at the same time protects downstream components from damage or poor performance due to sediment built up. When selecting features, it is important to minimise the risk of remobilisation of, and washout of any pollutants such as sediments. Although some gullypots and catchpits can trap sediment, their performance is linked closely to the regularity of their maintenance. There is a significant risk of pollutants contained within them being dislodged and washed downstream; and hence the LLFA do not consider these an appropriate form of treatment.

A SuDS system can employ a myriad of processes in order to treat surface water, for example: infiltration, sedimentation, filtration, adsorption, biodegradation, oxidisation, reduction, or separation. These processes are strongly linked to the hydraulic control of runoff i.e. the velocity control and the retention time. However, with these processes' biodiversity is a sensitive contributing factor and therefore polluted surface water runoff should not run directly into permanent ponds in order to protect biodiversity and amenity, and to prevent maintenance problems caused by heavy silts and oil.

Chapter 26 of the **CIRIA SuDS Manual C753**(4) offers a range of different features and their treatment values through it's Simple Index Approach. To measure and mitigate the potential pollution hazard risk that certain surfaces give, the LLFA expect all sites to follow the Simple Index Approach to demonstrate that appropriate treatment is applied to mitigate the impact of new development. This includes Highway development. **HAWRAT (Highways Agency Water Risk Assessment Tool)**[13] is not considered robust enough and may allow increased pollutant flows into a receiving watercourse, which is contrary to paragraph 170 of the NPPF. When submitting an application, it is necessary to demonstrate that the pollution hazard impact indices being created by the development, are offset by the pollution hazard mitigation indices that the proposed SuDS scheme offers. In addition, when assessing the pollution hazard level, the LLFA recommend that the national trip analysis, which suggests that an average of 5 traffic movements per day per dwelling is used unless a more specific transport risk assessment can be provided. When proprietary systems are proposed (such as vortex separators) the LLFA expect details about the level of mitigation provided to be consistent with the Simple Index Approach.

Beaulieu Park, Chelmsford

Beaulieu Park, Chelmsford

The potential pollution hazard indices and the SuDS features mitigations indices stated within Tables 26.2, 26.3, and 26.4 from the **CIRIA SuDS Manual C753**(4) can be seen below.

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 potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. <300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail) all roads except low traffic roads and trunk roads/motorways, and roads that have more than 300 traffic movements daily	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

- Motorways and trunk roads should follow the guidance and risk assessment process set out in the Highways Agency (2009).
- Where a site land use falls outside the defined categories, the indices should be adapted (and agreed with the LLFA) or else the more detailed risk assessment should be adopted.

Indicative SuDS mitigation indices for discharges to surface waters

Mitigation indices			
Types 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 paving	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

- SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in this guide and the **CIRIA SuDS Manual C753**[(4)].
- Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements and this should be taken into account in the design and maintenance plan.
- Ponds and Wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.
- Where a wetland is not specifically designed to provide significantly enhance treatment it should be considered as having the same mitigation indices as a pond.

For more information regarding the simple index approach and surface water treatment please see chapter 26 of the **CIRIA SuDS Manual C753**[(4)].

The Junipers at the Mulberries, Witham

2.12 Attenuation storage

Where discharge rates have to be restricted, attenuation storage should be utilised in order to prevent flooding.

What the LLFA expect to see
At the full application stage, it should be shown that the attenuation storage provided can provide enough storage for all storms up to the 1 in 100 year plus climate change storm event. Additionally, it should be shown that all attenuation features can either have 50% capacity available 24 hours after a 1 in 30-year storm event or have the capacity to store a subsequent 1 in 10-year storm event after a 1 in 30-year storm event.

The provision of storage helps to reduce flooding whilst helping to control the peak allowable runoff rate. In addition, well-designed SuDS schemes can significantly improve and promote biodiversity and amenity in an area through the use of above ground storage.

Storage should be provided to manage all storms up to and including the 1 in 100-year storm event plus climate change. Above ground storage should primarily be considered in order to enhance biodiversity and green areas. If above ground storage is not proposed the LLFA will need to be satisfied through evidence the reasons why it is not feasible. The provision of SuDS and green infrastructure provides numerous socio-economic benefits and is consistent with national and local policies in seeking to conserve and where appropriate enhance biodiversity. In order to minimise the land take associated with SuDS features in developments wherever possible, above ground storage should be integrated with public open space. The integration of above ground storage and open space does not always have to be in the form of an empty detention/infiltration basin. Where possible, basins and amenity features such as informal play areas can be merged to create multifunctional spaces. By doing so, the amenity of the basin is greatly enhanced whilst still providing its primary purpose.

Any site subject to unplanned development, for example through permitted development rights, should account for an additional 10% of roof area within the storage calculations to accommodate for urban creep.

Where necessary, suitable features should be provided upstream of attenuation storage to prevent the build-up of silt and sediment which would have a negative effect on the storage volume provided. This can be achieved through features such as sediment forebays, **permeable paving**, **swales** etc. Furthermore, appropriate **maintenance** measures should be in place to retain the capacity within storage features over the longer term.

Forest Road, Witham

2.13 Capacity for consecutive events

Storage features and infiltration features should be able to half drain within 24 hours for all storms up to and including the 1 in 30-year storm.

When sizing **attenuation storage** it is necessary to demonstrate that all storage features have capacity for the 1 in 100-year storm event plus climate change. In addition to this it should be shown that there is 50% of the storage available within 24 hours of a 1 in 30-year storm event plus climate change. If it is not possible to have a half drain time of less than 24 hours the LLFA expects that the feature is capable of storing a 1 in 30-year storm event plus climate change and subsequent 1 in 10-year event. This is also the case for all infiltration features. It should be noted that the feature should still have the capacity to attenuate water for the 1 in 100-year storm event plus climate change.

2.14 Long term storage

Where using flow matching long term storage should be included.

The introduction of new areas of hardstanding as part of development is likely to increase runoff volumes from a site. When limiting all discharge back to the 1 in 1-year greenfield rate the benefit of the reduction is discharge rates for larger events will offset the negative impact that this increase in volume may have. However, if flow matching is used to manage discharge rates from a site then such benefits will not be gained, and it will be necessary to provide additional mitigation for the impact of increased volumes of water leaving the site. This can be achieved through the use of online long-term storage (LTS). Where ground conditions allow LTS should be delivered in a method similar to the **hybrid approach** mentioned earlier in this document. Infiltration should be used to manage discharge for the initial LTS volume and piped discharge should only be considered when this volume of water has been accounted for. On sites that do not allow this approach LTS volumes should be limited back to no greater than 2l/s/ha.

Rivenhall Park, Witham

2.15 Exceedance routes

Suitable exceedance routing should be identified during times of flooding.

What the LLFA expect to see
Exceedance routes should be provided at either full application, or where necessary they can be conditioned. It should be shown that when flooding does occur, where this flooding will go, where it will sit, and how it will behave. Further information may need to be provided to show that all flooding is directed away from buildings. This can be done through detailed modelling which can be provided.

During times where the system may flood due to blockages, failure or a very large storm event, all excess water that cannot be contained within the pipe network or SuDS features should be maintained within suitable exceedance areas and routes. These routes should direct towards the highways and towards public open space whilst avoiding any risk to people and property. All flows should be contained on site.

2.16 Green spaces/ promotion of biodiversity

The implementation of SuDS can greatly benefit green spaces and biodiversity and therefore should be used as much as feasibly possible.

SuDS can become even more advantageous in providing multi-functional benefits where they can deliver green infrastructure and support high quality development. Essex defines green infrastructure as being:

Made up of natural and semi-natural assets and habitat types, of green and blue spaces, and of other environmental features that maintain and enhance ecosystem services. It provides multi-functional benefits integral to the health and wellbeing of our communities and to the ecology and economy of the county. Green infrastructure is often referred to as a network of these natural and semi-natural assets and spaces, which are joined together connecting urban and rural areas and are habitually strategically planned.

Green infrastructure can contribute to making areas less vulnerable to flood risk whilst ensuring development doesn't increase flood risk to third parties.

Through its key role in:

- sustainable drainage,
- drought mitigation,
- flood and water stress reduction,
- providing opportunities for attenuation or infiltration that can help to recharge aquifers,
- maintaining levels in watercourses or other blue infrastructure features,
- influence water quality through limiting diffuse pollution in watercourses.

Using SuDS in the context of green infrastructure, especially the end design solutions offer opportunities to create:

- attractive amenity features with the development,
- provide for habitat and biodiversity enhancement,
- vegetated green open spaces,
- green and blue corridors; and
- deliver multi functions and benefits to a community (e.g. recreational opportunities, improve health and wellbeing and place making).

Place making recognises the character and distinctiveness of different locations and can provide the opportunity to use water management, in the case of SuDS to help deal with flood risks whilst integrating into and enhancing the landscape settings. Especially when natural flood management techniques are considered within the flood management schemes design.

Natural flood management involves techniques that aim to work with natural features and characteristics to manage the sources and pathways of flood waters, rather than through engineered process. These features can be incorporated into the attenuation volumes associated with the storage for a site. Techniques could include for example:

- The creation of water rain gardens
- Green roofs and walls
- **Bioretention** areas (i.e. **Swales**, infiltration ponds and wetlands)
- Coastal and estuary management (i.e. saltmarshes)
- Woodland creations and leaky dams

Effective SuDS management should incorporate green infrastructure to maximise the opportunity for flood management and to improve water quality in Essex by:

- Ensuring that SuDS and other urban natural flood management measures are linked into the overall green infrastructure network.
- Create SuDS which are appropriate to the distinctive local context which will enhance landscape character and quality.
- Seek to positively influence urban design and landscape value through provision of green space / blue corridors, vegetation and by integrating water into the built environment, while protecting and conserving the historic environment, and providing opportunities for biodiversity.
- Consider how the retained water from SuDS can be used for active and passive irrigation for urban plants and green spaces, for example by designing green corridors and street trees as stormwater planters.
- Encourage take up of small-scale urban drainage measures such as green roofs, green facades, rain gardens and ponds to be implemented on an individual level by households and businesses.
- Explore possibilities of returning arable land to woodland and grassland in mid and upper catchments to stabilise soils, reduce sediment and nutrient run-off and improve flood management.
- Use of SuDS and other urban flood management measures to be incorporated into new developments and into proposals to refurbish existing neighbourhoods.
- Design SuDS for wildlife and amenity (e.g. by planting native species, providing ponds, green space paths, implementing street/ park furniture (i.e. benches, interpretation etc.) where appropriate).
- Natural barriers (e.g. planting) and appropriate side slopes should be

Temple Farm, Chelmsford

introduced to help manage perceived safety risks. Safety fencing and restricting access should be a last resort and should be avoided to enhance biodiversity and amenity. Some third parties may have additional safety requirements for adoption purposes. When features are to be adopted please contact the appropriate third party as early on in the process as possible.

- Determine the suitability of SUDS for different soil
- Allow sufficient land take for SUDS when planning the site layout
- Ensure there is an operational and maintenance plan in place and explore funding mechanisms for the long-term management of SuDS and Green infrastructure.

Temple Farm, Chelmsford

Where appropriate and possible, educational signs and information boards should be implemented near SuDS features. Educating the homeowners and local public about the role of the SuDS features and the benefits they bring will provide a long-term approach in regard to increasing the chance that the maintenance and cleanliness of the features is upheld. For example, it may reduce the amount of litter and debris build-up which could end up blocking pipes and outlets.

Currently national legislation isn't in place to address mandatory biodiversity net gain as part of the planning process. However, following recent consultation on this subject, the government has stated that they will enshrine in law their commitment to deliver environmental policy that will make a real difference in local communities. The delivery mechanism for this will be the Environment Bill. This will require developers to ensure habitats for wildlife are enhanced, with a 10% increase in habitat value for wildlife compared with the pre-development baseline. While delivery of this increase won't be limited to the use of SuDS, we see above ground structures as an excellent way to work towards meeting this goal. The use of features such as swales will provide a way to introduce green/blue corridors across the site. While the use of well-designed wetlands, ponds, bioretention areas and other green elements will present opportunities for habitat creation. These benefits will be in addition to the water quality and quantity benefits that are traditionally associated with these kinds of feature.

2.17 Multiple phases

When an application proposal is subject to multiple phases, clear information should be provided.

When submitting planning applications with multiple phases of development, an executive summary or a technical note should be provided with every application explaining how the whole drainage system is linked over the different phases. This will provide the LLFA with the wider context needed to fully understand how the drainage system works which will make the assessment and review a much smoother and more straight forward procedure.

2.18 Construction management in regard to surface water

A Construction Management Plan (CMP) should be provided to ensure that during construction the drainage network and surrounding environments are not impacted negatively.

What the LLFA expect to see

A construction management will usually be conditioned. When applying to discharge this condition, a document highlighting how surface water will be managed during construction and how pollution is mitigated against should be provided. Within this it should highlight how the drainage scheme and SuDS features are to be built as early on as possible and that they will be flushed and restored to their full working order at the end of construction.

A construction management plan (CMP) is most commonly asked for at the discharge of conditions stage. Any scheme should ensure that appropriate mitigation procedures are in place to limit the impact of construction works on off-site flooding through surface water run-off or on ground water. If left unmanaged the removal of topsoil prior to construction may result in excess water being discharged from site.

The drainage scheme should be implemented as early on as possible in order to ensure surface water is managed throughout not only the life time of the development but also the life time of the construction. An exception to this should be the installation of permeable paving. Permeable paving should be constructed towards the end to maintain its porosity and structural integrity.

Unless temporary drainage solutions are provided during construction, all drainage features and SuDS features should be fully maintained and restored to their full intended working capacity. This includes processes such as removing all sediment build up that may have occurred during construction. Care should be used in order to not remobilise these and flush them into the water system. Care should also be taken to minimise the compaction of any soil during construction particularly when infiltration is relied upon to manage surface water on site.

2.19 SuDS Maintenance and adoption

All Surface Water Drainage proposals should be accompanied with a stringent maintenance plan in order to ensure its efficiency throughout its intended lifespan. This should also include information on who is adopting and maintaining the scheme.

What the LLFA expect to see
The maintenance scheme should be provided at either full application stage or discharge of conditions stage. It should highlight what maintenance work will be done, how frequently and by who. It should be shown where necessary that an agreement has been made with those in charge of the maintenance. The maintenance requirements and frequency shown within Part D of the ***CIRIA SuDS Manual C753***[4] *are a good example of what should be provided.*

Every surface water drainage scheme should include a stringent maintenance plan to ensure that the features will work at optimum levels throughout the lifespan of the development. Without this maintenance, the reliability and efficiency of the drainage network will be

Basildon Hospital, Basildon

affected and consequently the risk of flooding and damage to the surrounding environments will be dramatically increased. Therefore, a maintenance plan detailing what maintenance is needed, who will undertake the work, and at what frequency the work will be carried out should be provided. The majority of common SuDS features available have their maintenance requirements and frequencies outlined within Part D of the **CIRIA SuDS Manual C753**[4].

The maintenance plan should incorporate details over who is responsible for the maintenance of individual SuDS features, and how they are to be funded in the long term. Who will be carrying out the maintenance is very important, and there are a range of potential adopters. It should be assured and clear that the design of the features meets both the adopters design criteria and those specified by the LLFA. Where necessary, features may have to be privately adopted.

Often the most challenging part of design a drainage scheme is the adoption of features. It is recommended that if you intend for the drainage of your site or ay features within the site to be adopted by a third party that they are engaged early on in the design process to ensure that features meet the adoptable standards.

It should be noted that Essex Highways do not generally adopt SuDS, however this should not be regarded a reason for avoiding their use. Where the use of SuDS is necessary to manage surface water runoff from the highway, features should be located outside the adoptable carriageway and should be privately maintained. Further information on construction within highways can be found within the Essex Highways **Developers Construction Manual**[14] and the Essex Highways **Street Materials Guide**[15].

Applications which have soakaways/ features serving more than one household (for example, across two gardens) should refrain from assigning maintenance responsibility to homeowners, as in the event of neighbour disputes there is an increased risk of maintenance standards lapsing. Where homeowners are assigned to the maintenance of features, they should be given clear instructions on what needs doing, how it can be done, and how maintenance can be carried out on their behalf by any onsite maintenance company.

Compliance with the proposed maintenance strategy for a site will typically be required by planning condition. Additionally, the LLFA requests that yearly logs are maintained and are made available to the Local Authority upon request. There may also be occasions when compliance is managed via legal agreement in consultation with the local planning authority.

Educational signage and interaction with the local residents and future homeowners are a good way for ensuring features are maintained. If those benefiting from the features understand what the SuDS are there for and how they work, they may be more inclined to ensure that they are kept clean and in a good working order.

2.20 Ordinary watercourse consent

If works are to be undertaken involving an ordinary watercourse then consent must be given by the LLFA.

The Land Drainage Act 1991[16] gave Essex County Council the responsibility for ordinary watercourse consents or Section 23 Consents (S23 Consents). This mean that if you are proposing to undertake the following works you will require ordinary watercourse consent from the Lead Local Flood Authority (Essex County Council) under Section 23 of the Land Drainage Act 1991:

a) erection of any mill dam, weir or other like obstruction to the flow of any ordinary watercourse or raise or otherwise alter any such obstruction; or
b) erection of a culvert in an ordinary watercourse, or
c) alteration a culvert in a manner that would be likely to affect the flow of an ordinary watercourse.

For works affecting main rivers the prior written consent of the Environment Agency is required under the Water Resources Act 1991 and Environment Agency Byelaws.

Therefore, if you would like to pipe, bridge or alter a watercourse as a part of your application then a S23 Consent is required from the LLFA. However, it must be made clear that a S23 Consent is a separate application and not part of the planning application process. More information on how to apply for consent can be found **here**. If you require more information on the LLFA's culvert policy please click **here**. Alternatively, if you require more information on the LLFA's culvert policy, or you would like further advice and assistance in regards to gaining ordinary watercourse consent, then please apply for the LLFA's **ordinary watercourse preapp advice service**.

Temple Farm, Chelmsford

›› Rivenhall Park, Witham

3. Specific feature design guidance

3.0 Specific feature design guidance

Each SuDS feature has its own specific design specifications, which are expected to be followed unless agreed otherwise with the LLFA. The LLFA ask that where possible softer more environmentally and aesthetically pleasing approaches be taken rather than features such as concrete culverts or metal fencing. For example, where possible gabions, sand sacks and meadow planted sides that encourage wildlife can be used.

The following section is simply a general summary of the design requirements found within Part D of the **CIRIA SuDS Manual C753**(4). For more detailed technical guidance please see the **CIRIA SuDS Manual C753**(4).

3.1 Rainwater and stormwater harvesting

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

- Water butts should not be incorporated into site storage calculations due to the efficiency being down to the regular emptying before storm events by the homeowner.
- Primary screening devices used to prevent leaves and debris from entering the tank should be installed to maintain capacity and to prevent blockages.

3.2 Soakaway

These are square or circular excavations, filled with aggregate or lined with brickwork, or pre-cast storage structures surrounded by granular backfill.

- If soakaways are the only form of discharge, they should be designed for the 1 in 100-year plus climate change rainfall event as a minimum. If there are alternative outfalls, then soakaways should be designed as minimum for the 1 in 30-year storm event with further storage to be designed to cater for the 1 in 100-year storm event plus climate change.
- The base of the soakaway should be at least 1m from the highest average groundwater level
- They should be a minimum of 5m away from any foundations and up to 20m if infiltrating into chalk.
- Should be no closer than 6m to an adjacent highway
- May not be permitted above utilities and services.

3.3 Filter strips

These are vegetated strips of land designed to accept overland sheet flow

- Where infiltration is proposed, there should be a minimum of 1 metre between the invert level and the ground water level.
- Slopes should not be exceeding 1 in 20, with a minimum of 1 in 50.

3.4 Swales

These are linear vegetated features in which surface water can be stored or conveyed. They can be wet or dry and can be designed to allow infiltration where appropriate.

- Maximum side slopes of 1 in 3, 1 in 4 preferred.
- Check dams and appropriate pre-treatment systems can be used to improve both hydraulic and water quality performance by reducing velocities increasing resistance time and increasing infiltration/storage.
- Natural barriers such as planting can be used to help manage perceived safety risks with a minimum of 1 in 50.

Rivenhall Park, Witham

3.5 Bioretention areas

These are shallow landscaped depressions or pre-cast units which rely on engineered soil and vegetation to remove pollution and reduce runoff.

- Minimum depth to highest average groundwater of 1m, if unlined.
- Should have overflow/bypass facilities for extreme events.
- Maximum recommended area that should drain to a bioretention system is 0.8ha.

Beaulieu Park, Chelmsford

3.6 Infiltration basins

These are vegetated depressions designed to store runoff and allow infiltration gradually into the ground.

- Maximum side slopes of 1:3.
- Maximum water depth of 1.2m for safety reasons. This can be raised to 2m if sufficient measures have been put in place to reduce any risk. However fencing should be avoided as much as possible to enhance the multifunctional benefits.
- There should have a minimum of a 1m distance between the base and the groundwater level for water quality reasons.
- May not be permitted above utilities and services

3.7 Detention basins

These are surface storage basins that provide attenuation of stormwater runoff and facilitate settling of particulate pollutants. They are normally dry and may also function as a recreational facility.

- Maximum side slopes of 1:3
- Low flow channels are key in preventing erosion at the inlet and to route last remain

run-off to the outlet.

- Maximum water depth of 1.2m for safety reasons. This can be raised to 2m if sufficient measures have been put in place to reduce any risk. However fencing should be avoided as much as possible to enhance the multifunctional benefits.
- May not be permitted above utilities and services.

3.8 Ponds

These provide for stormwater attenuation and treatment. Permanent pools to support aquatic vegetation and retention time promotes sediment removal.

- Aquatic benches so support planting, acting as a biological filter and providing ecology, amenity and safety benefits.
- Maximum water depth of 1.2m for safety reasons. This can be raised to 2m if sufficient measures have been put in place to reduce any risk. However fencing should be avoided as much as possible to enhance the multifunctional benefits.
- Maximum side slopes of 1:3.
- Consideration should be taken for the overall aesthetic and design of the pond.

Temple Farm, Chelmsford

3.9 Pervious/permeable pavements

Permeable surface allow rainwater to infiltrate through into underlying layer where it is temporarily stored.

- 30% porosity or Type 3 sub-base should be used. Permavoid can be used however this does not provide treatment without the appropriate filtering material.
- Unless unfeasible pervious/permeable pavements should be left unlined to encourage as much infiltration as possible.
- Can be up against buildings (blanket infiltration) as long as there is an impermeable barrier between the two.
- Should be constructed towards the end of the construction period to avoid it becoming blocked. If it is constructed earlier, it will have to be sufficiently cleaned and restored back to its original working order.

››Beaulieu Park, Chelmsford, Essex

Appendix 1. Pro-forma

Appendix 1. Pro-forma

When submitting a planning application, you should fill out and include the the pro-forma shown on the following pages. To download the form please follow this link: **pro-forma**

Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Introduction

This proforma identifies the information required by Essex LLFA to enable technical assessment the Designers approach to water quantity and water quality as part of SuDS design approach in compliance with Essex SuDS Design Guide.

Completion of the proforma will also allow for technical assessment against Non-statutory technical standards (NSTS) for Sustainable Drainage. The proforma will accompany the site specific Flood Risk Assessment and Drainage Strategy submitted as part of the planning application.

Please complete this form in full for full applications and the coloured sections for outline appllications. This will help us identify what information has been included and will assist with a smoother and quicker application.

Instructions for use

Use the units defined for input of figures

Numbers in brackets refer to accompanying notes.

Where ....m^3 ....m^3/m^2 *are noted – both values should be filled in.*

Site details

1.1 Planning application reference (if known)

1.2 Site name

1.3 Total application site area (1) ha

1.4 Predevelopment use (4) Please select

1.5 Post development use Please select

If other, please sepcify

1.6 Urban creep applicable Please select if yes, factor applied:

1.7 Proposed design life / planning application life

1.8 Method(s) of discharge: (5)

☐ *Reuse* ☐ *Infiltration* ☐ *Hybrid* ☐ *Waterbody* ☐ *Storm sewer* ☐ *Combined sewer*

1.9 Is discharge direct to estuary / sea Please select

1.10 Have agreements in principle (where applicable) for discharge been provided Please select

Essex County Council

SuDS Water quantity and Quality – LLFA Technical Assessment

Calculation inputs

2.1 Area within site which is drained by SuDS (2) m^2

2.2 Impermeable area drained pre development (3) m^2

2.3 Impermeable area drained post development (3) m^2

2.4 Additional impermeable area (2.3 minus 2.2) m^2

2.5 Method for assessing greenfield runoff rate

2.6 Method for assessing brownfield runoff rate

2.7 Coefficient of runoff (Cv) (6)

2.8 Source of rainfall data (FEH Preferred) Please select

2.9 Climate change factor applied %

Attenuation (positive outlet)

2.10 Drainage outlet at risk of drowning (tidal locking, elevated water levels in watercourse/sewer)
Note: Vortex controls require conditions of free discharge to operate as per manufacturers specification.

2.11 Invert level at final outlet mAOD

2.12 Design level used for surcharge water level at point of discharge (16) mAOD

Infiltration (Discharge to Ground)

2.13 Have infiltration tests been undertaken Please select

2.14 If yes, which method has been used

2.15 Infiltration rate (where applicable) m/s

2.16 Depth to highest known ground water table mAOD

2.17 If there are multiple infiltration features please specify where they can be found in the FRA

2.18 Depth of infiltration feature mAOD

2.19 Factor of safety used for sizing infiltration storage

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Calculation outputs

Sections 3 and 4 refer to site where storage is provided by full attenuation or partial infiltration. Where all flows are infiltrated to ground go straight to Section 6.

3.0	**Greenfield runoff rates** (incl. Urban Creep)		
3.1	1 in 1 year rainfall	l/s/ha,	l/s for the site
3.2	1 in 30 year rainfall	l/s/ha,	l/s for the site
3.3	1 in 100 year rainfall + CCA	l/s/ha,	l/s for the site
4.0	**Brownfield runoff rates** (incl. Urban Creep)		
4.1	1 in 1 year rainfall	l/s/ha,	l/s for the site
4.2	1 in 30 year rainfall	l/s/ha,	l/s for the site
4.3	1 in 100 year rainfall + CCA	l/s/ha,	l/s for the site
5.0	Proposed maximum rate of runoff from site (incl. Urban Creep) (7)		
5.1	1 in 1 year rainfall	l/s/ha,	l/s for the site
5.2	1 in 30 year rainfall	l/s/ha,	l/s for the site
5.3	1 in 100 year rainfall + CCA	l/s/ha,	l/s for the site
6.0	Attenuation storage to manage flow rates from site (incl. **Climate Change Allowance** (CCA) and Urban Creep)		
6.1	Storage - 1 in 100 year + CCA (9)	m^3	m^3/m^2
6.2	50% storage drain down time 1 in 30 years		hours
7.0	Controlling volume of runoff from the site(10)		
7.1	Pre development runoff volume(12) (development area)		m^3 for the site
7.2	Post development runoff volume (unmitigated) (12)		m^3 for the site
7.3	Volume to be controlled (5.2 - 5.1)		m^3 for the site

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7.4 Volume control provided by:

- Interception losses[13] m^3
- Rain harvesting [14] m^3
- Infiltration m^3
- Attenuation m^3
- Separate volume designated as long term storage[15] m^3

7.5 Total volume control (sum of inputs for 5.4) m^3 [17]

8.0 Site storage volumes (full infiltration only)

8.1 Storage - 1in 30 year + CCA [8] m^3 m^3/m^2 (of developed impermeable area)

8.2 Storage - 1 in 100 year + CCA [11] m^3 m^3/m^2

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Design Inputs

Proposed site use

Pollution hazard category (see C753 Table 26.2)

High risk area defined as area storing fuels chemicals, refuelling area, washdown area, loading bay.

Design Outputs

List order of SuDS techniques proposed for treatment

Note that gully pots, pipes and tanks are not accepted by Essex LLFA as a form of treatment (for justification see C753 Section 4.1, Table 26.15 and Box B.2)

Are very high pollution risk areas drained separate from SuDS to foul system Please select

Other

Please include any other information that is relevant to your application

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SuDS Water quantity and Quality – LLFA Technical Assessment Proforma

Notes

1. All area with the proposed application site boundary to be included.
2. The site area which is positively drained includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system.
3. Impermeable area should be measured pre and post development. Impermeable surfaces include, roofs, pavements, driveways and paths where runoff is conveyed to the drainage system.
4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to GF (Essex SuDS Design Guide).
5. Runoff may be discharge via one or more methods.
6. Sewers for Adoption 6th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the applicant should justify the selection of Cv.
7. It is Essex County Council's preference that discharge rates for all events up to the 1 in 100 year event plus climate change are limited to the 1 in 1 greenfield rate. This is also considered to mitigate the increased runoff volumes that occur with the introduction of impermeable surfaces. If discharge rates are limited to a range of matched greenfield flows then it is necessary to provide additional mitigation of increased runoff volumes by the provision of Long-term Storage.
8. Storage for the 1 in 30 year must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.
9. Runoff generated from rainfall events up to the 1 in 100 year will not be allowed to leave the site in an uncontrolled way. Temporary flooding of designated areas to shallow depths and velocities may be acceptable.
10. The following information should only be provided if increased runoff volumes are not mitigated by limiting all discharge rates back to the greenfield 1 in 1 year rate.
11. Climate change is specified as 40% increase to rainfall intensity, unless otherwise agreed with the LLFA / EA.
12. To be determined using the 100 year return period 6 hour duration winter rainfall event.
13. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of subcatchments and source control techniques. Further information is available in the SuDS Design Guide.
14. Please refer to Rain harvesting BS for guidance on available storage.
15. Flows within long term storage areas should be infiltrated to the ground or discharged at low flow rate of maximum 2 l/s/ha.
16. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Outlets can be tidally locked where discharge is direct to estuary or sea. Calculations should demonstrate that risk of downed outlet has been taken into consideration. Vortex controls require conditions of free discharge to operate as per specification.
17. In controlling the volume of runoff the total volume from mitigation measures should be greater than or equal to the additional volume generated.

››Beaulieu Park, Chelmsford, Essex

Appendix 2. Minor applications

Appendix 2. Minor applications

As LLFA we are now looking to provide comments on minor applications, applying slightly less stringent criteria than we do for major applications. As we have been consulted, we are assuming that there is a potential flood risk on site, therefore we are considering the impact of increased run-off rates. The cumulative impacts of minor developments can increase flood risk in an area. Current processes for assessing major applications cannot be applied in the same way to minor applications as reduced orifice sizing to meet the greenfield 1 in 1 rate can increase the risk of blockages and therefore flood risk.

Minor sites should minimise the areas of hardstanding, and where hard surfaces are necessary unlined permeable paving should be used. This allows any infiltration potential on the site to be utilised, reducing off-site run-off. This is in line with the drainage hierarchy if water re-use is not possible on the site. If the site is directing water to a single point of infiltration, then we would need to see infiltration testing for that location. However, if the water is being distributed evenly across the site as the rain lands on the ground then we do not ask for infiltration testing as it is mimicking natural processes.

Information regarding existing surface water risk at the site should be submitted in order for us to make a complete assessment of potential flood risk on the site. Discharge rates should be limited to the 1 in 1-year greenfield rate or 1l/s, whichever is greater. It is also possible to restrict to flow matching rates, however **long term storage** will be required. The required storage volume and run-off for the site can be calculated using the **UK SUDS website**[17]. A 10% allowance for urban creep should also be included when calculating the required storage. Where it is not possible to meet the 1 in 1-year greenfield rate, rainwater re-use can be used to increase storage and reduce the run-off rate from the site. It should be demonstrated why this is not feasible if it is not proposed. Please refer back to the section on **rainwater re-use** for more information.

All water should have sufficient treatment before leaving the site in line with the Simple Index Approach found within Chapter 26 of the **CIRIA SuDS Manual C753**[4]. The use of above ground features is preferable in order to provide treatment on site, and to provide biodiversity and amenity benefits. A maintenance plan detailing the maintenance arrangements of the SUDS features should be submitted including who is responsible for different elements of the surface water drainage system and the maintenance activities/frequencies.

A drainage plan should be submitted which includes the site layout, location of features, outfall location and conveyance. The drainage plan should also consider exceedance flows to ensure potential off-site flooding is managed. Engineering drawings of the components being used within the scheme should also be included.

››Beaulieu Park, Chelmsford, Essex

Appendix 3. What we offer

Appendix 3. What we offer

SuDS Planning Advice

We strongly recommend the use of our SuDS Planning Advice service. We suggest that you use the SuDS Planning Advice service as early on in the planning process as possible in order to avoid complications and unnecessary delays. Despite best being utilised at the beginning, this service can be used at any stage during the planning application process.

We understand that each application is unique and encounters its own difficulties and challenges, that's why we offer a range of varying services to meet your requirements.

The SuDS Planning Advice Service can:

- indicate whether your SuDS drainage proposal would be unacceptable, saving you the cost of a formal application;
- reduce the time you spend on developing a SuDS drainage strategy;
- confirm all relevant information is included within your SuDS drainage strategy;
- save you time and avoid any unnecessary delays during the planning application process.

To apply for SuDS planning advice, please complete our Flood and Water Management Products and Service Application form. As part of your application, we would require supporting documentation to improve our understanding of your development and maximise the benefits of your planning service. The documents will differ on a case by case basis, but can include:

- A drainage plan, layout or proposal
- A location map
- A site plan
- A draft Flood Risk Assessment (FRA)
- A summary of the site restrictions

To apply for our SuDS Planning Advice service please follow the below link: **https://flood.essex.gov.uk/new-development-advice/apply-for-suds-advice/**

Flood Information Request

We can also provide information on flood and water management in the form of either basic or detailed requests, as outlined below:

Basic Requests;
When you make a basic request, we will provide you with all historic flood incidents relating to your site along with any known watercourse issues in the area.
We will also confirm whether your site falls within a Critical Drainage Area (CDA) and if we have carried out any flood investigations within a 5-mile radius.

Examples of information available through a basic request include:

- Sites at risk of flooding as identified on the Essex County Council flood map
- Surface Water Management Plans (SWMP) for different areas located on the map
- Critical Drainage Areas in Essex
- Records of historic flood incidents
- Information about property flood incidents
- Flood investigations we have conducted
- The types of assets on our asset register
- The types of watercourses in Essex
- Designated assets

Detailed Requests;
When you make a detailed request, we will provide you with the above information along with further engineer commentary on that particular request.

To submit a flood information request please follow the below link:
https://flood.essex.gov.uk/know-your-flood-risk/make-an-information-request/

Guidance on an ordinary watercourse consent
The Development and Flood Risk Team do not comment on watercourse consents. They must be dealt with by the appointed Ordinary Watercourse Consent Engineer. Ordinary watercourse consent forms a separate application.

To apply for ordinary watercourse consent please use the following link:
https://flood.essex.gov.uk/maintaining-or-changing-a-watercourse/apply-for-a-watercourse-consent/

You can contact us to check if you need consent for your development or whether it could affect the flow of water in an ordinary watercourse. If you do need consent, you will need to:

- Fill in the watercourse consent application form and show that your work will not have a negative effect on the environment or flood risk.
- Attach any required documents such as drawings.
- Make a payment of £50 per structure.

Within the application we will require certain information, and includes:

- A description of your development. We would like you to tell us the purpose of the development / works and the number of structures you need consent for.
- Reasons for it to be built. Please ensure that all proposed works are in line with our Culvert Policy. Please not that applications made for the purpose of gaining garden space will most likely be rejected.
- Construction details. Is your structure permanent or temporary? We will need details of when you plan to carry out the work and how long it will take.
- Planning approvals. You'll need to provide details of planning permissions you may have or are applying for that relate to your development.
- Information on the maintenance of the structure. You must tell us in your application who will be responsible for maintaining the structure during development and after.
- Information on the effect of the watercourse on the environment. We will consider the effects your structure may have on the environment. We will need detailed evidence that shows the impact on the environment and you may need to include an Ecological Statement.
- An assessment to make sure you are meeting the terms of the **Water Framework Directive (WFD)** . Your development proposal must meet the terms of the Water Framework which protects watercourses and wildlife that live in them.

We also need detailed information on the design proposals and methodology to include:

I. Site location plan highlighted in Red.
II. Site as existing prior to development.
III. Plans and drawings showing all of the structures, Location and the adjacent watercourse.
IV. Sections for the drawings.
V. Photographs.

VI. Flood maps.

Essex County Council also offers a pre-app service for ordinary watercourse consent. This is a 1-month process and will require a description of your development and reasons for it to be built. It would also be beneficial to include:

- A site location plan highlighted in Red.
- A plan showing the site as existing prior to development.
- Plans and drawings showing proposed structures, location and the adjacent watercourse.
- Photographs.
- Flood maps.

The ordinary watercourse consent form can be found below:
https://flood.essex.gov.uk/maintaining-or-changing-a-watercourse/guidance-on-applying-for-watercourse-consent/

Appendix 4. A drainage calculations guide

››Temple Farm, Chelmsford

Appendix 4. A Drainage Calculations Guide

Introduction

This document is intended for those applicants proposing to submit designs and modelling outputs as part of planning applications for sites within Essex. It should only be used when read in conjunction with the Essex SuDS Design Guide.

The document focusses solely on variables so that the outputs from all drainage design software can be submitted. It will specifically detail the appropriate parameters and to use in order to meet the requirements of the Essex Sustainable Drainage Design Guide (2019). In doing so this will allow for the more efficient processing of applications and reduce the likelihood of comments and questions being returned and minimise the risk for design changes to be asked for.

Parameters and the specific values that **are required to be used** to meet the LLFA standards are given in **RED**. Values that are advised but can be changed from the recommended figures are given in **BLUE**. All other values should be left as defaults. Justification will need to be provided where advised values are changed from those suggested and also where parameters not specifically referred to are changed from their defaults.

SuDS Planning advice can be sought from the Development and Flood Risk Team at any stage of the development process and it is recommended that this be considered if applicants have any questions or concerns regarding designs and their potential to meet standards.

CV value

A CV value of 1 should be used for sites where the majority of the site area is impermeable. It is expected that a newly developed site should be designed in a way where no surface water can collect and pool unintentionally in areas of depressions or cracks. If large areas of a site are permeable it should be considered whether these large areas will contribute to the positive drainage system. If they do not then an equivalent area should be removed from calculations associated with site runoff.

HR Wallingford have addressed the incorrect use of 84% as a runoff coefficient value on their **UK SUDS website** stating that " This approach was justified in a paper in the 1990s based on the original runoff model in the Wallingford Procedure which was issued in 1983. This justification is a misuse of the correlation equation which had been developed and has since which been rendered obsolete based on the fact that the original equation was shown to under-predict runoff for large rainfall events."

Input parameters and system design settings

This section details the input parameters and variable values necessary to design a drainage system that will meet the LLFA's SuDS standards.

Rainfall: FSR or FEH can be used.
M5-60 (mm) and Ratio-R: For software including in built mapping the exact site location should be selected. Where manual location values are entered supporting evidence should be provided to demonstrate the correct location and values have been used.

Design Return Period: Should be set to 1 year as a default.
Time of Entry (mins): Should be set to 5 minutes as a default.
Maximum Rainfall Rate (mm/hr): Should be set to the maximum value the software allows. This parameter can cap the maximum rainfall intensity able to enter a system so if a modelled storm has an intensity higher than the input value then all water above this is lost. Whilst few events exceed this, and only for short periods when they do (meaning the volume lost by capping is small), it can still lead to water being unaccounted for. Therefore, it is recommended that the maximum value be entered to avoid this. Justification and details must be provided if values less than 150 mm/hr are used.
Volumetric Run-off Coefficient (Cv): This can be left as the default value but it is preferred to set it to 1 to remove any losses between rainfall landing and reaching the drainage network.
Minimum Backdrop, Cover Depth and Pipe Flow: This should be set based on conversations and agreements with the body adopting the drainage post completion.
Additional Flow/Climate Change: This should be used to set an appropriate value for urban creep, accepted as 10% of roof areas only. Climate change values **should not** be entered here. Alternatively, a 10% urban creep allowance on roof areas can be added to the overall site area, however it should be clear within the text that this has been done.

Areal Reduction Factor: Should be left as the default value of 1 unless a site is of a significant size.
MADD Factor: This must be set to 0. The default value assumes that 20m3 of water is lost between hitting the ground and reaching the drainage network. The value has been determined from real world developments where storage is created from things such as localised depressions and cracks in paved surfaces. For new developments these should not exist so to avoid underestimating volumes entering the drainage network this value should be set to 0.
Storage Volume in Pipe Network (m3): This must be set to 0. If pipes have been deliberately oversized to provide storage this volume will be taken account of in the modelling and this value should still be set to 0.

Storm modelling

The following parameters should be used when modelling the designed drainage system to check performance during different return period events. Matching system design values should be used where required.

Summer Volumetric Run-off Coefficient (Cv): This can be left as the default value but it is preferable to set it to 1.
Winter Volumetric Run-off Coefficient (Cv): This can also be left as the default value but it is preferable to set it to 1.
Modelled Storms: System performance should be modelled for the 1, 30- and 100-year return period storms.
Climate Change Values: Appropriate climate change values are only required to be included for the 100 year return period storm.

Greenfield runoff calculations

The methods outlined within the **calculating runoff rates** section should be utilised.
Note that the Q (1yrs) (l/s) pre-development runoff values are expected to be met by developments in Essex for greenfield sites. For brownfield sites a 50% betterment must be achieved and therefore rates cannot exceed 50% of the calculated pre development runoff rate.

Area (ha): Must be the total pre-development site area, in hectares.
SAAR and Soil Index: These should be set based on the specific site location.
Climate Change: This should be set to 0 to produce a current day value.
Urban: This must be set to 0 to allow calculations for an undeveloped site. If it is a brownfield site, the percentage of impermeable area should used.
Region: This must be set to Region 6.

Storage estimation and calculation

Quick estimates can be provided for developments at the outline stage to demonstrate compliance however full and detailed calculations should be supplied for developments seeking full planning permission or where they are required to discharge conditions. All other values previously covered should be used relevant to the site location or match those previously entered.

Rainfall: FSR or FEH can be used.
Return Period: This should be set to an appropriate value to size the storage. Designs demonstrating that there will be no flooding for the 30 year (no climate change) and 100 year (plus climate change) must be provided for developments in Essex.
Storm Duration: Results for the critical storm should be provided and as such it is recommended that all periods from 15 minutes to 1 week are run to ensure this is identified. Storm ranges should be run for both summer and winter rainfall profiles.
Map: For FSR Rainfall only. The exact site location should be selected using the in-built map. Justification and supporting evidence should be provided if manual values are entered.
Cv (Summer): This can be left as the default value, but it is preferable to set it to 1.
Cv (Winter): This can also be left as the default value, but it is preferable to set it to 1.
Maximum Allowable Discharge (l/s): This is the 1 in 1-year greenfield runoff rate calculated for

the site. If the 'Rural Runoff Tool' is not utilised the value should be determined from another appropriate source and justification and evidence of the calculations provided. For brownfield sites a minimum of 50% betterment is expected and therefore discharge rates cannot exceed 50% of the calculated 1-year rate.
Infiltration Coefficient (m/hr): Only values calculated from site infiltration testing should be input. A specific value can be entered manually, or a rate can be calculated by clicking on the calculator to the right and entering the appropriate site test result values. Generic infiltration rates based on publicly available soil and geology data can be used for outline applications and these values and information sources must be clearly stated.
Climate Change: This should be used to set an appropriate value for urban creep, accepted as 10%. Climate change values **should not** be entered here. Alternatively, a 10% urban creep allowances on roof areas can be added to the overall site area, however it should be clear within the text that this has been done.
Safety Factor: An appropriate value should be entered here, most likely 2. Safety Factors should align with the contents of the Table 25.2 in section 25 of the CIRIA C753 SuDS Manual, however in Essex it has been agreed that a factor of 10 for infiltration structures has a significant impact on sizing and therefore a value of 2 can be used instead of this.

Outputs

This section provides details on the specific outputs that can be included with planning application submissions to allow the drainage to be appropriately assessed. They can be provided as pdf documents or excel tables. The listed variables are the minimum that should be included to meet the requirements of the Design Guide. Please note that failure to provide certain aspects, or failure to include sufficient detail, will result in questions and requests for further information, which will likely cause delays. Whilst additional outputs can be provided please be aware that these will require additional time to assess and could cause avoidable delays.

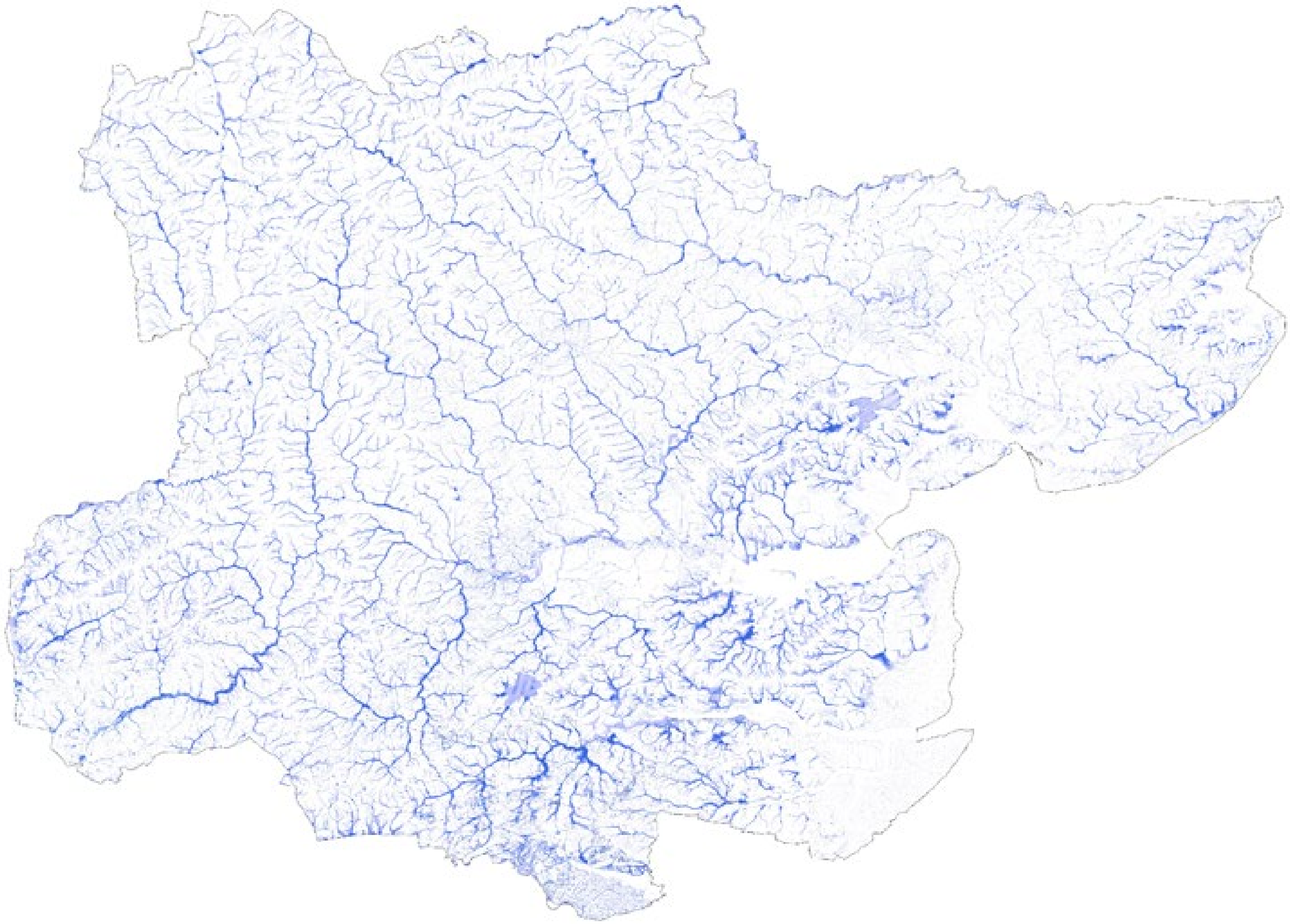
The following aspects should be appropriately covered within the outputs to allow them to be assessed:

- Design criteria and input variables.
- Drainage network details.
- Manhole schedule.
- Area summaries.
- Outfall details.
- Modelled storm details and simulation criteria.
- Online flow control structure details.
- Offline controls structure details (if these exist within the design).
- Summary of results for critical storms. Results should be provided for the 1yr, 30yr and 100yr plus 40% climate change storms.
- Greenfield runoff rate calculations.
- Storage calculations.
- Storage feature details.
- Drawings. A pdf drawing should be provided at an appropriate scale showing the layout of the drainage system/s with the pipe and manhole numbers clearly labelled to allow cross-referencing. The locations of all storage and at-tenuation features must also be clearly shown.

›› Temple Farm, Chelmsford

Appendix 5. Surface water flooding map in Essex

Appendix 5. Surface water flooding map in Essex



›› Temple Farm, Chelmsford

Appendix 6. Acronym List, Glossary and References

Acronym list

Acronym	Meaning
SuDS	Sustainable Drainage Systems
FSR	Flood Studies Report
ECC	Essex County Council
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
SLA	Service Level Agreement
PPA	Planning Performance Agreement
FRA	Flood Risk Assessment
Refh2 method	Revitalised Flood Hydrograph
LTS	Long Term Storage
CDA	Critical Drainage Area
S23 consents	Section 23 Consents
FEH	Flood Estimation Handbook
NPPF	National Planning Policy Framework
SWMP	Surface Water Management Plan
WFD	Water Framework Directive
Ha	Hectare

Glossary

A	
Adsorption	The process by which a solid holds molecules of a gas or liquid or solute as a thin film.
Attenuation	Attenuation is the process of storing surface water run-off and is one of the key features of sustainable drainage systems (SuDS).
B	
Biodegradation	Biodegradation is the process by which organic substances are decomposed by micro-organisms (mainly aerobic bacteria) into simpler substances such as carbon dioxide, water and ammonia
Blanket infiltration	Blanket infiltration occurs only when the surface water is intercepted and infiltrated at the point it lands. For example, when permeable paving infiltrates only the rainfall that lands upon it.
Blue corridors	Blue Corridors encompass the idea that both new and existing development within the urban environment is set back from, or planned around, watercourses, overland flow paths and surface water ponding areas to create a network of urban corridors designed to facilitate natural hydrological processes whilst minimising urban flooding, enhancing biodiversity, improving access to recreation and helping to adapt to climate change.
Brownfield	Denoting or relating to urban sites for potential building development that have had previous development on them
Brownfield runoff rates	Brownfield runoff is usually calculated as the peak rate of runoff for a specific return period due to rainfall falling on a given area of already developed land
C	
Check dams	A check dam is a small, sometimes temporary, dam constructed across a swale, drainage ditch, or waterway to counteract erosion by reducing water flow velocity.
Critical Drainage area	An area within Flood Zone 1 which has critical drainage problems, and which has been notified to the local planning authority by the Environment Agency.

E	
Evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.
Exceedance Routes	The routing of excess surface water when the drainage system is full or blocked
F	
Filtration	Filtration is any of various mechanical, physical or biological operations that separates solids from fluids by adding a medium through which only the fluid can pass. The fluid that passes through is called the filtrate
Fluvial	Of or found in a river
G	
Green infrastructure	Green infrastructure or blue-green infrastructure is a network providing the “ingredients” for solving urban and climatic challenges by building with nature
Greenfield	Denoting or relating to previously undeveloped sites for commercial development or exploitation.
Greenfield runoff rates	Greenfield runoff is usually calculated as the peak rate of runoff for a specific return period due to rainfall falling on a given area of vegetated land
Greywater recycling	The treatment of wastewater from appliances such as showers, baths and sinks, to be re-used and fed back into a property for non-potable purposes such as flushing toilets.
I	
Interception storage	Interception can be defined as that segment of the gross precipitation input which wets and adheres to aboveground objects until it is returned to the atmosphere through evaporation.
Infiltration	Infiltration is the process by which water on the ground surface enters the soil
M	
Made ground	Made ground is land where natural and undisturbed soils have largely been replaced by man-made or artificial materials

N	
Non-potable water	Non-potable water is water that is not of drinking quality, but may still be used for many other purposes, depending on its quality.
O	
Ordinary watercourse	Ordinary watercourses include every river, stream, ditch, drain, cut, dyke, sluice, sewer and passage through which water flows and which does not form part of a main river.
Oxidisation	The addition of oxygen to a compound with a loss of electrons; always occurs accompanied by reduction
P	
Percolation test	A percolation test (colloquially called a perc test) is a test to determine the water absorption rate of soil (that is, its capacity for percolation) in preparation for the building of a septic drain field (leach field) or infiltration basin
Planning performance agreement (PPA)	A Planning Performance Agreement (PPA) is a project management tool which the local planning authority and applicants can use to agree timescales, actions and resources for handling particular applications.
Pluvial	Relating to or characterized by rainfall
Point infiltration	Infiltration where all water is infiltrated through a particular point location
Potable water	Potable water is water of a quality suitable for drinking, cooking and personal bathing
Q	
QBAR	Mean annual maximum flow rate, estimates higher return period ranging from 1.5 to 2 years.
R	
Rainfall intensity	It is measured by the amount of rain that falls over time and expressed in mm per hour (mm/h)
Rainwater harvesting	Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff). One method of rainwater harvesting is rooftop harvesting

S

Sediment forebays	A forebay is an artificial pool of water in front of a larger body of water. The larger body of water may be natural or man-made. Forebays have a number of functions. They may be used upstream of basins to trap sediment and debris (sometimes called a sediment forebay) in order to keep the basin clean.
Sedimentation	The process of settling or being deposited as a sediment
Soakaway	A pit, typically filled with hard core, into which water is piped so that it drains slowly out into the surrounding soil.
Surface water proprietary devices/system	Technology based devices/systems designed to manage, treat, control surface water

U

Urban Creep	Urban Creep is the loss of permeable surfaces within urban areas creating increased runoff which contributes to flooding and other problems.

V

Vortex Flow control device	Vortex Flow Controls (VFCs) are commonly used in drainage schemes to regulate the stormwater runoff from urban areas. These include accurately controlling stormwater flow, minimising upstream storage requirements and reducing the risk of blockages compared to traditional orifice plates.

W

Water butts	A large barrel used for catching and storing rainwater

References

1	The Sustainable drainage systems: Written Statement (HCWS161)
2	National Planning Policy Framework
3	Planning Practice Guidance – Flood Risk and Coastal Change
4	CIRIA SuDS Manual C753
5	The Town and Country Planning (Development Management Procedure) (England) Order 2015
6	Soakaway design BRE365
7	Approved Document H of the Building Regulations
8	Planning Practice Guidance
9	BS EN 16941-1:2018 article on On-site non-potable water systems - Part 1: Systems for the use of rainwater
10	The Wallingford Procedure - for design and analysis of urban storm drainage
11	BS8005 - Sewerage. Guide to new sewerage construction
12	Flood risk assessments; climate change allowances
13	HAWRAT (Highways Agency Water Risk Assessment Tool)
14	Essex Highways Developers Construction Manual
15	Essex Highways Street Materials Guide
16	The Land Drainage Act 1991
17	UK SUDS website
18	Water Framework Directive (WFD)
19	Ciria C574 – Engineering in Chalk

This document is issued by:
Sustainability and resilience
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