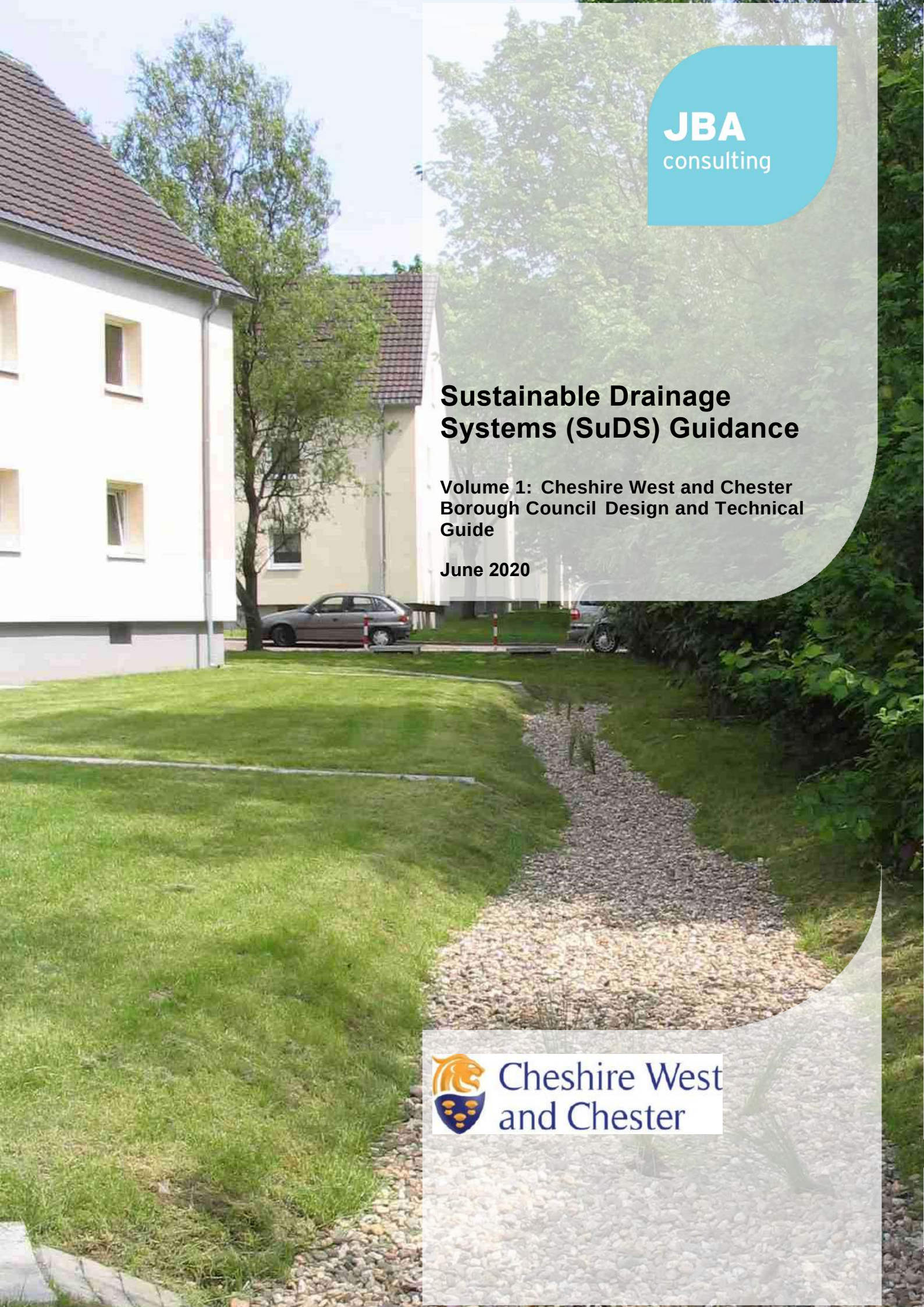


JBA consulting

Sustainable Drainage Systems (SuDS) Guidance

Volume 1: Cheshire West and Chester Borough Council Design and Technical Guide

June 2020

Cheshire West and Chester

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Purpose

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1 Introduction & Submission Requirements

WHAT THIS SECTION WILL COVER:

- Introduction – The Partnership Authority approach to SuDS
- What are SuDS and when should they be considered
- An Introduction to the SuDS guidance documents
- The SuDS Application Submission and Approval checklist
- How to use this guidance

1.1 Introduction – A Partnership Authority Approach to SuDS

Sustainable **D**rainage **S**ystems (SuDS) provides an approach to surface water management where water is drained in a more sustainable way than traditional methods. These approaches provide the opportunity to address pressures on the environment, by reducing the causes and impacts of flooding, allowing for the removal of pollutants from urban run off at source and providing green spaces with amenity, recreation and wildlife benefits.

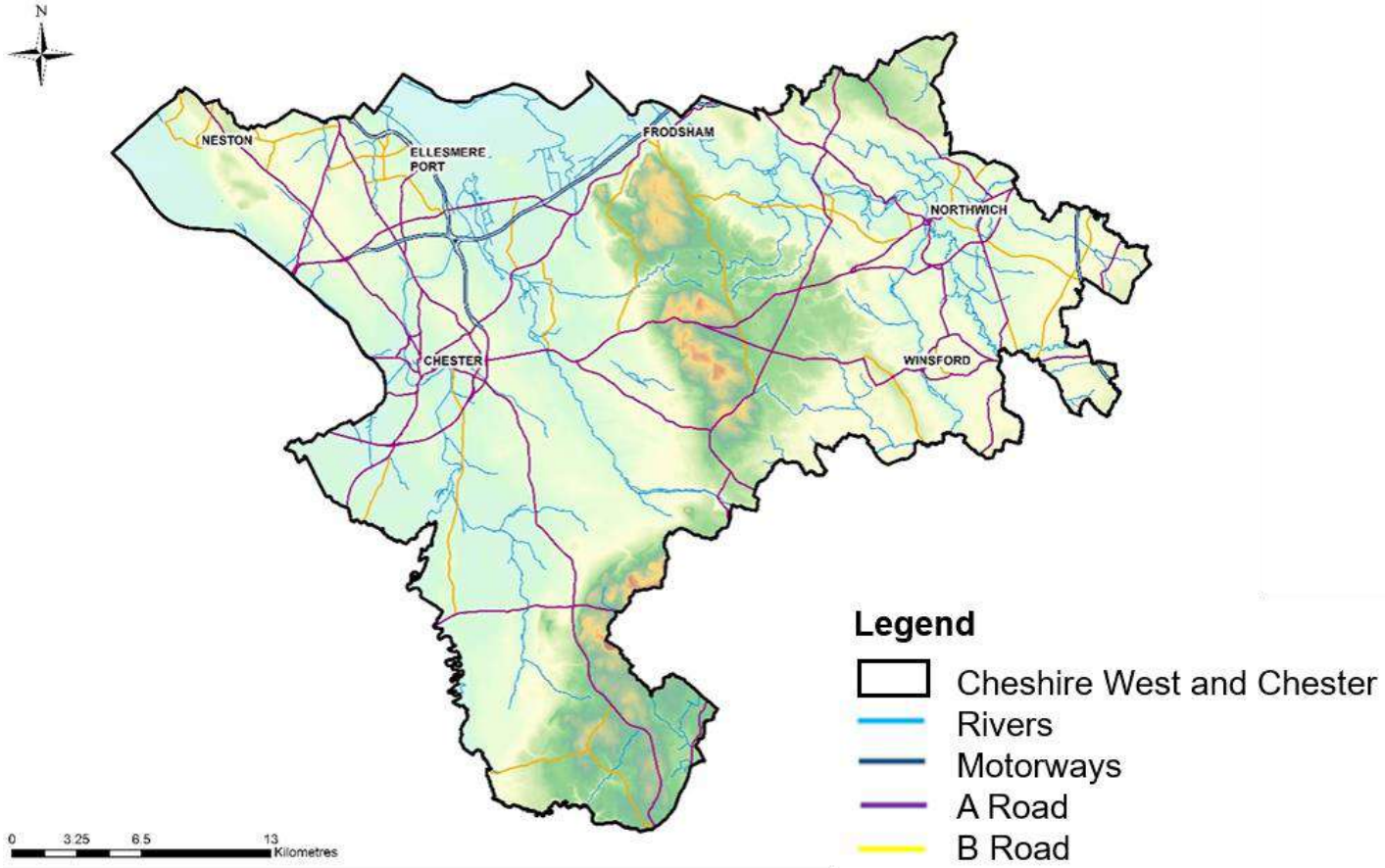
Cheshire West and Chester Borough Council has a SuDS policy document which is intended to provide continuity of approach and standardise requirements for the design and implementation of SuDS. The Council is encouraging SuDS design for developments of all sizes, including new development and redevelopment, incorporating SuDS at stages from masterplanning, to pre-application and application submission.

This guidance will support the Developer's selection and implementation of SuDS and confirm the minimum information required to enable the assessment of SuDS proposals within planning submissions.



Photo: JBA Consulting

Figure 1 Area Covered by this SuDS Guidance



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1.2 Who is This Guide For?

This guidance is primarily aimed at Developers, to identify the information that they need to provide to enable the assessment of SuDS proposals by the Local Planning Authority in consultation with the Lead Local Flood Authority (LLFA) and other Statutory Consultees.

This guidance is intended to provide a standardised approach to the selection of appropriate SuDS and identify the minimum information the Developer is required to provide to enable the Local Authority and Statutory Consultees to effectively review planning applications.

It is intended that this guidance is used by:

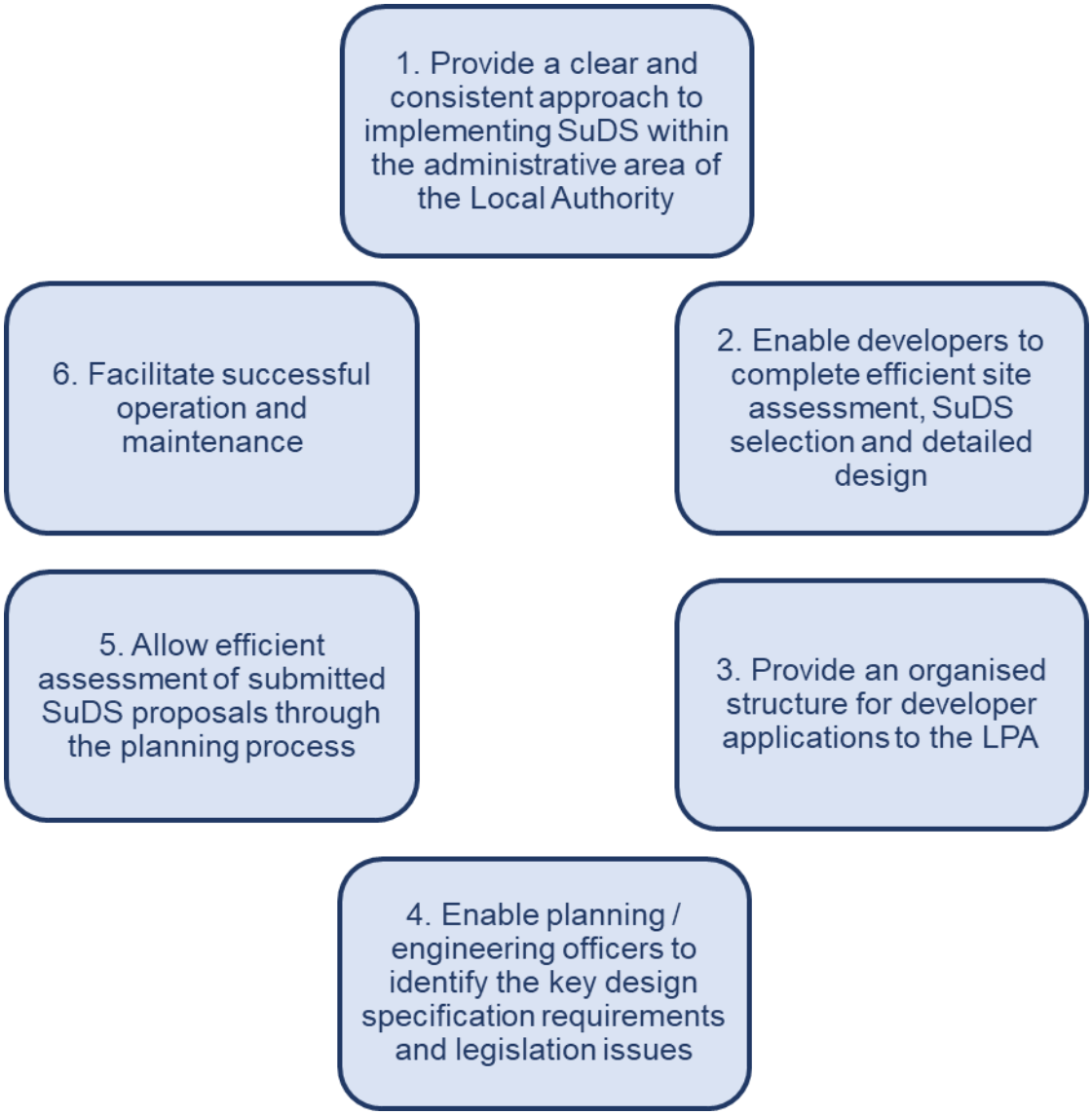
- Developers
- Architects and Urban Planners,
- Drainage Engineers,
- Landscape Designers,
- Local Authority Departments and internal stakeholders such as Planners, Building Control, Highways Maintenance and Design Engineers
- The Lead Local Flood Authority (LLFA) as a Statutory Consultee in their assessment of SuDS proposals.
- Other Statutory Consultees involved in the assessment of SuDS proposals.



Photo: JBA Consulting

1.3 What is This Guide For?

This guidance will:



In addition to this document reference should also be made to the Volume 2 Guidance Documents for Council Specific requirements.

1.4 What are SuDS?

Water is a defining feature of the landscape, from the large rivers and estuaries to the man-made canals and smaller watercourses that drain to them.



Photo: JBA Consulting

As urban areas grow, and impermeable areas increase, we face challenges to ensure effective management of surface water runoff and drainage.

These challenges include:

- reduction in green spaces,
- increased pressure on existing infrastructure,
- increased risk of flooding and erosion,
- effective management of impermeable soils on brownfield land and wider impacts on catchment surface water drainage.
- wider environmental impacts such as ground remediation in order to prevent pollution from spreading to controlled waters.

Development, and redevelopment of land has the potential to increase existing flood risk. The cumulative impacts of development on flood risk, if left unmanaged, may result in an adverse impact on the local environment.

Development planning, ensuring effective use of SuDS to manage and reduce surface water runoff, is considered an essential aspect of all new development proposals. It is intended that the Checklist and processes outlined in this Guidance are used by Developers and stakeholders as the basis of the SuDS approval process.

Sustainable **D**rainage **S**ystems (**SuDS**) provides an approach to surface water management where water is drained in a more sustainable way SuDS provides the opportunity to address pressures on the water environment by establishing systems which aim to control surface water run off close to where it falls. SuDS also aims to slow the rate of run-off and improve infiltration by mimicking the natural processes of interception, infiltration and conveyance both to the ground and existing rivers and streams. This reduces the risk of “flash-flooding” which occurs when rainwater rapidly flows into the public sewerage and drainage systems.

SuDS therefore provides valuable opportunities to:

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

1.5 When Should a Sustainable Drainage System be Considered?

The National Planning Policy Framework (NPPF) defines that the decision framework to whether a sustainable drainage will be considered will depend on the proposed development type, size and location. NPPF states that SuDS is mandatory for areas currently at risk of flooding and new development and developments greater than 1 hectare or ten residential units or more. Major Development (or equivalent mixed use or commercial development) will therefore only be considered appropriate if priority has been given to the use of sustainable drainage within design and the details of proposed discharge have been provided.

We require that sustainable drainage for both major and smaller developments should have the same level of emphasis and be assessed in the same way.

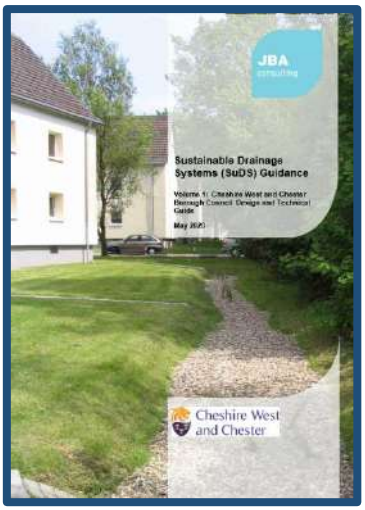
We place added emphasis on smaller developments due to the number of these in our area and the cumulative benefits that incorporating SuDS measures can have in reducing local flood risk now and in the future.

1.6 SuDS Guidance Documents

The SuDS guidance is contained within two separate volumes.

Volume 1 – SuDS Guidance Council Design & Technical Guide

The guidance describes the SuDS application submission process and the information that the Council requires to enable them to evaluate and subsequently validate SuDS as part of the Planning process.



Volume 1 Report Structure

1. INTRODUCTION AND SUBMISSION REQUIREMENTS
2. PURPOSE AND BENEFITS OF SUDS
3. THE APPROVAL AND ADOPTION PROCESS
4. SuDS DESIGN CONSIDERATIONS FOR GREENFIELD AND PRE-DEVELOPED SITES
5. SELECTION AND DESIGN REQUIREMENTS FOR SuDS COMPONENTS
6. SuDS MAINTENANCE AND MANAGEMENT

Volume 2 – SuDS Council Specific Guidance

Volume 2 provides additional Council specific technical and local planning policy information which should be considered when considering development.

The information provided in this document aims to be a comprehensive and accessible guide to SuDS and their applicability to the Council area.



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Volume 2 is divided into four colour coded sections.

Volume 2 – Report Structure

1. INTRODUCTION

2. BACKGROUND

3. LOCAL SuDS ZONES

4. MAPPING TO SUPPORT SuDS DESIGN / DECISION MAKING

Section Summarys and Way Markers

At the start of each section of the guidance there is a summary box which highlights the key topics under discussion in more detail. Throughout this guidance numerous 'way markers' can be found. These are snippets of information which provide definitions, or links to relevant supporting documents and legislation which describe in detail some features noted in this guidance.

1.7 The SuDS Submission Application Process

The **SuDS Submission Application and Approval Checklist** (**the SuDS Checklist**) included as Appendix A and downloaded from the Councils Website, identifies the SuDS related information which should be provided by the Developer in support of a Planning Application. The requirements, and level of detail needed is dependent on the current stage of application, as well as the scale of the proposed development (minor or major development).

The **SuDS Checklist** includes for:

- **Pre Application**
- **Minor Developments**
- **Major Developments:**
  - **a) Outline Application,**
  - **b) Full Applications; including reserved matters**

The Developer is required to provide all the information identified in the Checklist including specific links to key plans, calculations and supporting documents where required.

Way Marker 1 Defintion of "Major Development"

"Major Development" (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010) means development involving any one or more of the following:

a. the winning and working of minerals or the use of land for mineral-working deposits;

b. waste development;

c. the provision of dwelling houses where:

   (i) the number of dwelling houses to be provided is 10 or more; or

   (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 (c)(i);

d. the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or

e. development carried out on a site having an area of 1 hectare or more.

Changes to the National Planning Policy Framework (NPPF) came into effect on 06 April 2015 which made Lead Local Flood Authorities (LLFA) statutory consultees in planning applications for "**Major Development**" in relation to SuDS and Drainage.
The Development Management Procedure Order was also amended, designating Councils as the Lead Local Flood Authority, and therefore each Council is now a statutory consultee within the planning process on the management of surface water.

The **SuDS Checklist** identifies the information required as a series of questions and includes references to this Guidance where further information can be found. The checklist is in five sections:

1. **Application Details,**
2. **General Details and SuDS Proposals,**
3. **Hydraulic Assessment of SuDS Proposals,**
4. **SuDS Discharge Proposals and Agreements,**
5. **SuDS Maintenance and Management Proposals.**

Way Marker 2 How to Complete the SuDS Application and Approval Checklist

- The **SuDS Checklist** is in the form of an Excel spreadsheet which is included in Appendix A of this guidance document and can be downloaded from the Councils Website.
- The Checklist is designed for the Applicant to provide a response to each indicated questions, appropriate to the stage and type of the planning application (either minor or major development).
- The Applicants response should include a reference to their submitted reports, drawings and calculations where information to support their answer can be found.
- **Developers are to submit all SuDS information as a package digitally as part of the planning submission. A hard copy may be requested.**
- Through signing the declaration on the SuDS Checklist, the applicant will be required to confirm that the submitted SuDS documentation complies with the Council's SuDS Guidance Documentation, Local Planning Policies and all relevant National Legislation, Policies and Guidance.

1.7.1 Submission Validation & Assessment

Planning applications may be made either as an **Outline Application** (with one or more Reserved Matters for later determination) or as a **Full Application**. The level of information which would need to be submitted for each type of application within the planning process will vary depending on the size of the development, flood risk, constraints and proposed sustainable drainage system.

The Developer shall be wholly responsible for the design and construction of SuDS systems. The Developer and/or their designer shall certify that their design complies with Council Guidance and accept liability for compliance through their professional indemnity insurance. These responsibilities/liabilities shall not be discharged to Council following a satisfactory audit of their design.

The Council will assess SuDS applications to ensure proposed minimum standards of operation are appropriate and through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance of SuDS over the lifetime of the development.

Way Marker 3
Defra SuDS Non Statutory Technical Standards

Non-statutory technical standards for the design, maintenance and operation of sustainable drainage systems.

https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

Sustainable drainage systems may not be practicable for some forms of development (for example mineral extraction). The decision as to whether a sustainable system would be inappropriate in relation to a particular development proposal is a matter of judgement for the Local Planning Authority. Developers are advised to engage with the Lead Local Flood Authority early in the design period if they consider their development to fall into this category. The judgement of what is reasonably practicable will be by reference to the SuDS technical standards published by the Department for Environment Food and Rural Affairs and take into account design and construction costs.

Councils have no duty to adopt SuDS (and Cheshire West and Chester Council are not currently adopting new SuDS). Provision for the disposal and maintenance of runoff remains the responsibility of the Developer. The Developer must consider the requirements for maintenance and management of SuDS for the lifetime of the development and provide evidence of a maintenance strategy. This should include confirmation of those responsible for the management of the SuDS features.

Highway Authorities may adopt SuDS as part of Section 38 and Section 278 (Highways Act 1980) Agreements as a means of draining the highway.

A satisfactory Council audit does not authorise any activities by the Developer which may be in contravention of any enactment or any order, regulation or other instrument made, granted, or issued under any enactment, or in contravention of any rule, byelaw or in breach of any agreement or legal rights.

1.8 The SuDS Management Train

Individual SuDS, located both in public and private areas, should accounted for in the context of a **Management Train** that reinforces and, where possible, follows the natural pattern of drainage. **The Management Train** incorporates a hierarchy of techniques:

- **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution;
- **Source control** – control of runoff at, or very near, its source;
- **Site control** – management of water from several sub-catchments;
- **Regional control** – management of runoff from several sites

For small developments, consideration must be given to prevention and source controls, as site or regional controls such as detention ponds may not be practical. The reduction of runoff and the treatment of runoff at source should provide the required flood risk mitigation and treatment levels as required by **Section 4 and 5** of this guidance document.

The requirements for drainage should be considered at an early stage when determining the overall layout of the development as the natural features of the site, such as topography, will often dictate some aspects of the drainage system design and should be incorporated as green infrastructure.

The Developer shall liaise with the stakeholders identified in **Section 3** of this guidance document.

2. PURPOSE AND BENEFITS OF SUDS

2 Purpose & Benefits of SuDS

WHAT THIS SECTION WILL COVER:

- What is a Sustainable Drainage System.
- The purpose and philosophy of SuDS and key benefits of incorporating as part of development.

2.1 Sustainable Drainage Systems

The revision of SuDS National Standards (November 2015) provides the opportunity to address pressures on the water environment by establishing systems which aim to mimic the natural processes of interception, infiltration and conveyance to the ground and existing rivers and streams whilst also realising the additional benefits which SuDS can provide.

WAY MARKER 4
SuDS (Sustainable Drainage Systems)

An approach to water management designed to drain surface water in a more sustainable way than traditional methods.

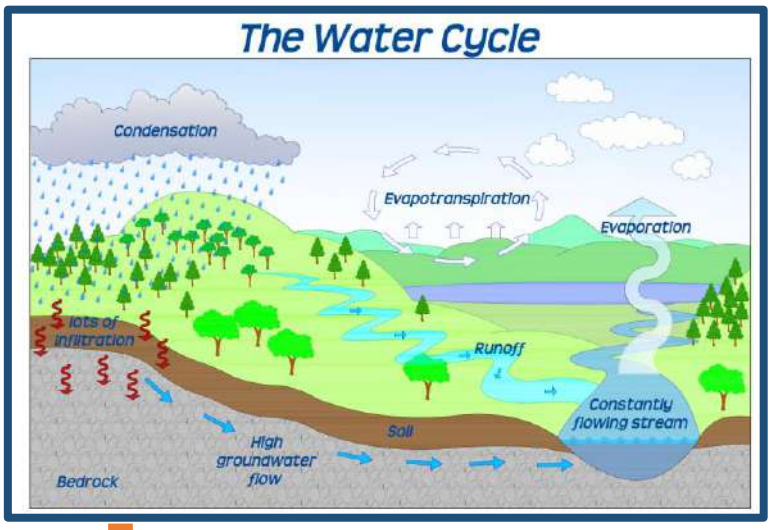
CIRIA SuDS Manual (C753)

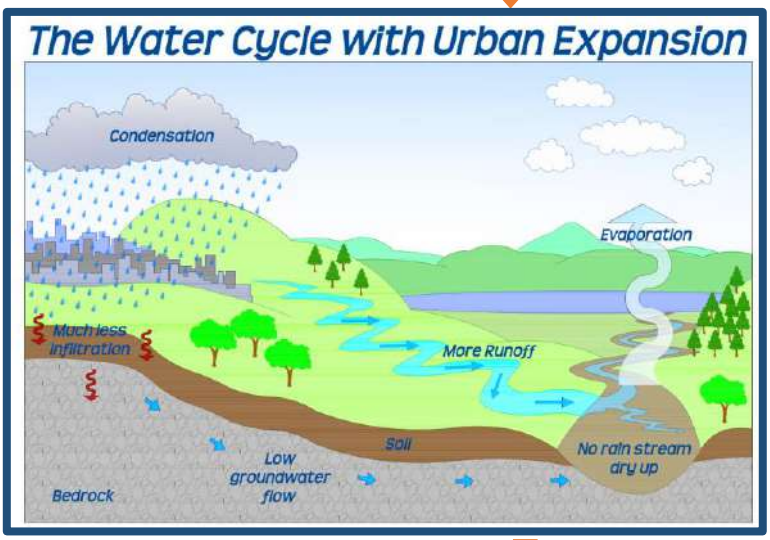
Additional guidance on the design and implementation of SuDS can be found in the CIRIA SuDS manual.
http://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx

National Legislation and Policy, including Local Policy Context, for Cheshire West and Chester Borough Council relating to SuDS is included in **Volume 2** of these guidance documents

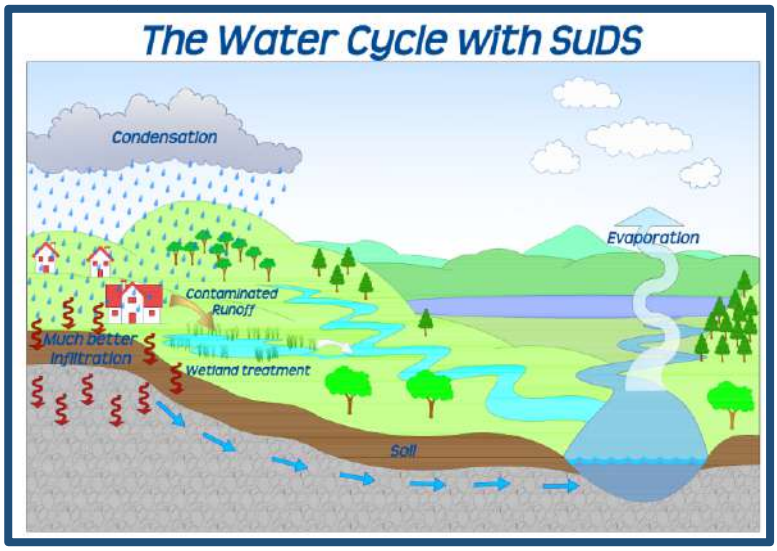
2.1.1 Purpose of SuDS

Impervious areas such as roads, footpaths, roofs, and car parks are traditionally connected to sewer systems that transport runoff away from urban areas quicker than natural, vegetated conveyances.





However, this can cause disruption to the natural water cycle as flows in downstream waterways can peak faster and in greater quantities than pre-developed conditions. This can exacerbate, or create new, surface water flood risks and can also increase pollution in our waterways.



SuDS aim to manage rainfall and surface runoff by allowing rainfall to be intercepted or absorbed into the ground through vegetation and specially designed landscape features. SuDS also convey any additional flows to the nearest surface water body (for example, groundwater, stream, river or drain) where it is discharged at the same rate and, where feasible, the same volume as would occur if the site was undeveloped. SuDS can also be used to provide biodiversity improvements to developed areas.

2.1.2 SuDS Philosophy

The SuDS philosophy is to replicate the natural drainage conditions which existed at a site prior to development regardless of whether this was through infiltration or runoff.

The variety of components means that SuDS are applicable for sites of any size, condition, topography, or environmental condition.

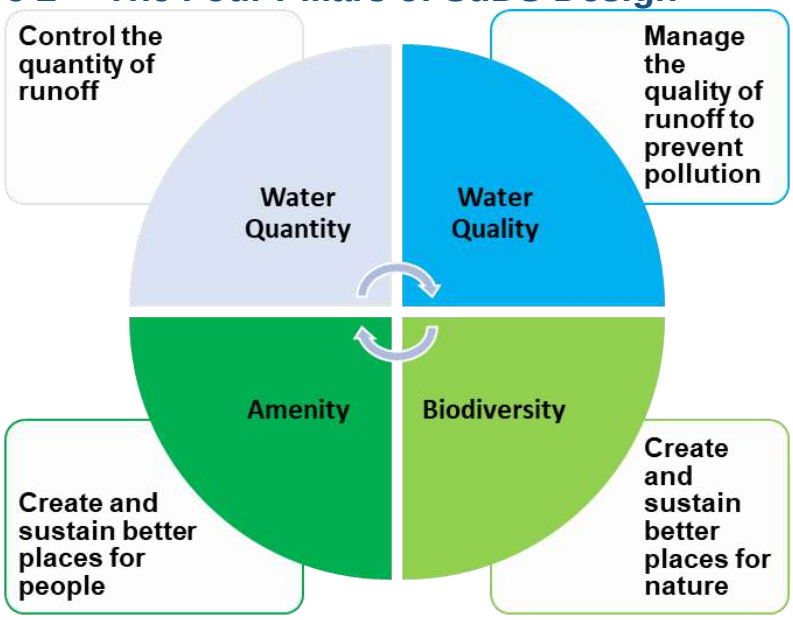
The benefits that can be achieved by SuDS fit into four categories. These are referred to in the CIRIA SuDS Manual as the **Four Pillars of SuDS Design:**

WAY MARKER 5
The Four Pillars of SuDS Design

1. **WATER QUANTITY**
   Controlling the quantity of runoff to:
   - **Support the management of flood risk, and**
   - **Maintain and protect the natural water cycle**
2. **WATER QUALITY**
   Manage the quality of runoff to prevent pollution
3. **AMENITY**
   Create and sustain better places for people
4. **BIODIVERSITY**
   Create and sustain better places for nature

It is important to note that these elements of SuDS philosophy are interrelated and that any SuDS proposal does not simply seek to address runoff but also considers other benefits which can be derived.

Figure 2 The Four Pillars of SuDS Design



Source; The SuDS Manual, CIRIA 2015

2.2 Why use SuDS?

Throughout this document, the following icons have been used to highlight the benefits and opportunities of each SuDS method. These can be used to identify and realise the maximum potential of incorporating SuDS within developments.



There are several proven benefits which can be derived from employing SuDS components, for both new and existing built environments. These include; water management benefits, such as temporary storage during a storm event to reduce flooding, improved runoff water quality and removal of sediments (an accumulation of sediments can reduce storage capacity and contribute to flooding).

SuDS can also have indirect social and environmental benefits for an area and community. SuDS components can be designed to create green areas used for recreation which also enhance the aesthetic qualities of the locality. In turn, these measures can improve the appeal of the area, and may also encourage investment in an area leading to economic benefits such as increased prices in the property market. SuDS can also provide air quailty improvements and reduced carbon footprints as part of the development process.

The implementation of SuDS within a development may have the following benefits:

Table 1 Benefits of SuDS

	**Management of increased water quantity** • Increased precipitation, as climate change occurs, is likely to lead to wetter winters **Management of more frequent extreme rainfall events** • SuDS can help reduce surface water discharge rates through infiltration, interception and attenuation. **Management of brownfield sites** • SuDS can provide betterment to drainage at brownfield sites through infiltration, interception and attenuation.
	**Assistance with the protection of all water bodies** • SuDS can contribute to the requirements of the Water Framework Directive (WFD) (Directive 2000/60/EC) **Protection of the water environment from diffuse pollution** • SuDS can contibute to the objectives described in the North West River Basin Management Plan 2009 **Potential to deliver long term benefits for pollution** • SuDS can contribute to meeting the challenges as defined in the Environment Agency 2013: North West River Basin District: Challenges and Choices.
 	**Increase green spaces and vegetated areas** • SuDS provide an array of amenity, recreational and biodiversity benefits and can help to reduce the urban heat island effect. **Components of Green Infrastructure** • SuDS can assist in providing green infrastructure and fulfilling several policies the Councils Local Plan Core Strategy. Further details of these can be found in Volume 2 of this SuDS Guidance.
	**Increase recreational areas** • SuDS can assist in achieving Council planning policies including encouraging the provision of opportunities for access, outdoor sport, and recreation

	Development of social cohesion to enhance community life quality • SUDs can provide social enhancements through the integration of wildlife areas and green spaces.
	**Understanding functionality of SuDS** • Enhance education of the public about the environmental importance of SuDS. **Informing younger generations** • Suds can provide wider educational benefits through encouraging younger people to learn about surface water management and application.
	**Perceived improvement of an area** • SuDS can enhance the visual attractiveness of a development and can increase property values **Connects areas** • SuDS can link public open spaces with green infrastructure and provide habitat corridors

3. THE APPROVAL AND ADOPTION PROCESS

3 The Approval Process

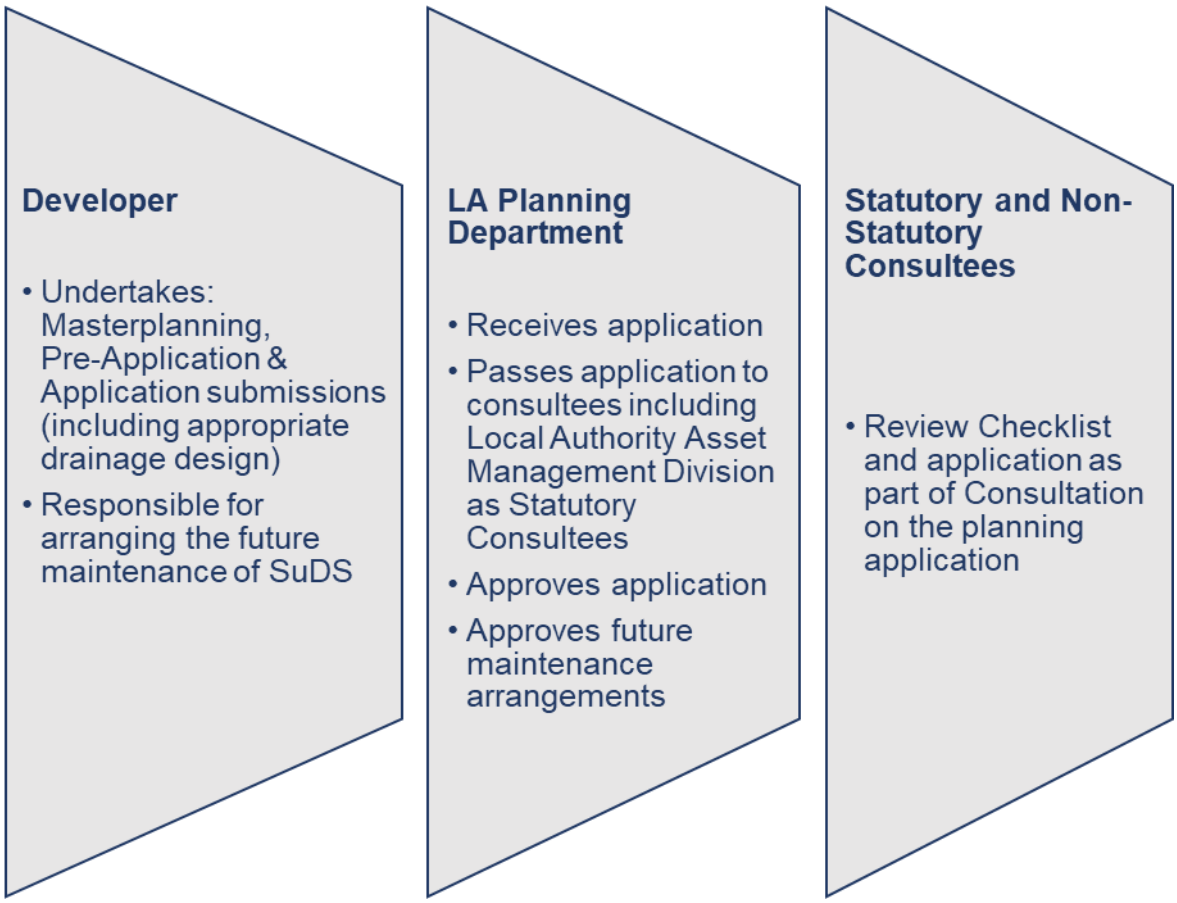
WHAT THIS SECTION WILL COVER:

- Responsibilities - who does what?
- Introduction to the planning application process
- Requirements for different types of planning applications
- Consultation requirements
- Flood Risk Assessment requirements

3.1 Responsibility – Who Does What

This Section details the approval process for implementing SuDS. SuDS proposals form part of an outline or full planning application and should adhere to both the **National Planning Practice Guidance** and the **Defra Non-Statutory Technical Standards for SuDS and individual Council Local Policies**. **Figure 3** outlines the responsibilities of the three key groups involved in SuDS from inception to implementation:

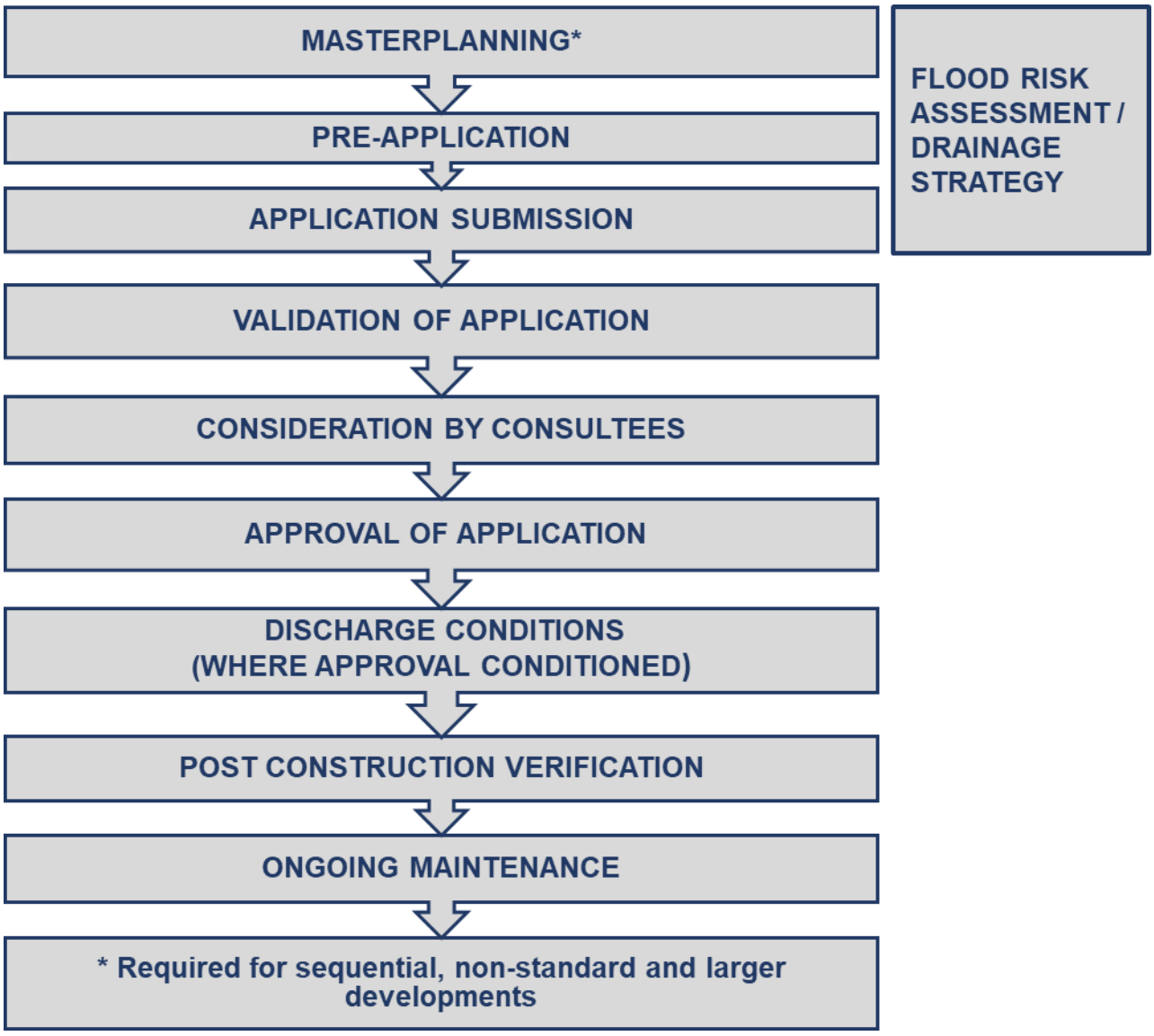
Figure 3 Responsibilities



3.2 Planning Application Process

Figure 4 below illustrates the stages involved in the submission of a Planning Application.

Figure 4 The Planning Application Process



The following Sections describe the considerations and actions which should be undertaken at each stage of the SuDS submission as part of a Planning Application.

For those cases where the developer is uncertain as to whether the application should be submitted as Permitted Development Application, Outline Application or a Full Planning Application, early consultation should be undertaken with the Councils Planning Department and Lead Local Flood Authority.

3.3 Development and Flood Risk

A suitable assessment of flood risk needs to be incorporated into the process as early as possible.

When considering new development, Developers will need to consider flood risk and development in accordance with the requirements of the **National Planning Policy Framework (NPPF)**.

Figure 5 overleaf summarises the process.

Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk of flooding. Where development is necessary, it should be demonstrated to be safe and should not result in an increase in flood risk elsewhere.

The **NPPF** sets of the aims of the Sequential Test, to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The **Council's Strategic Flood Risk Assessment (SFRA)** will provide the basis for applying this test although the most recent Environment Agency flood maps should also be reviewed. A sequential approach should be used in areas known to be at risk from any form of flooding.

A site-specific **Flood Risk Assessment (FRA)** will be required and this will need to demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere. Where possible overall flood risk should be reduced.

On brownfield sites the existing drainage systems should be appraised to demonstate actual pre-development surface water runoff. Appropriate consideration should be given to the existing system operation, including number and frequency of gullies, and existing attenuation and whether natural or artificial.

Appropriate reductions of surface water runoff should be achieved in accordance with Section 4.

A site-specific flood risk assessment is required for development proposals:

- of 1 hectare or greater in Flood Zone 1;
- all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3;
- or within Flood Zone 1 which has critical drainage problems. These are notified by the Environment Agency to the Local Planning Authority) or individual Councils may also have defined areas of critical drainage;
- and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

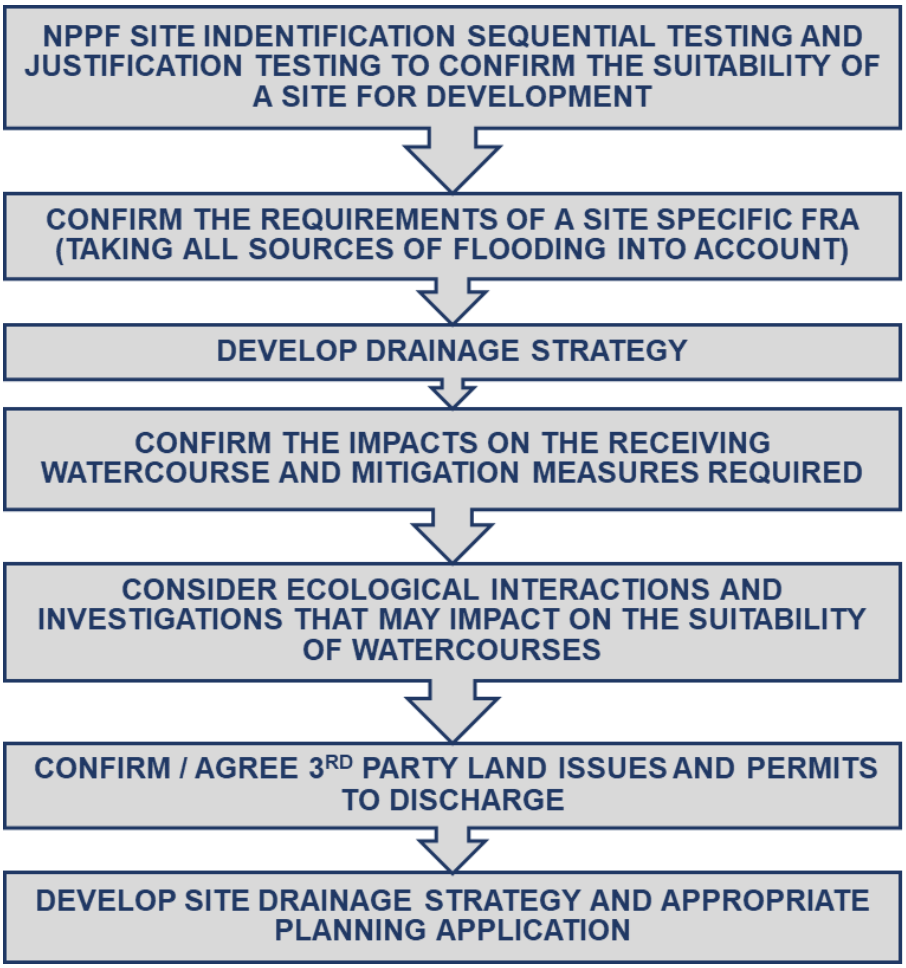
In accordance with the drainage hierarchy infiltration drainage should be given the highest priority. Drainage strategies will need to take local flooding into account. Where infiltration cannot be achieved, interactions with receiving ditches and watercourses (including culverts) will need to be fully appraised in order to ensure that surface water runoff is effectively managed without increasing flood risk elsewhere.

Proposals will need to include assessment of surface water interactions with other sources of flooding including fluvial and tidal interactions. This will need to including consideration of, for example, climate change, blockage scenarios and hydraulic capacity of for example, bridges and culverts during design flood events.

Developers will need to demonstrate that all land ownership and long-term maintenance issues have been resolved as prior to submitting a full planning application. Developers will also need to obtain relevant Permits to discharge, and include information on pollution control measures where required.

It is recommended that Developers consult with the Local Planning Authority and the Environment Agency to determine the requirements for a site specific FRA.

Figure 5 Development and Flood Risk Assessment



3.4 The Application Stages

3.4.1 Masterplanning

Masterplaning is a fundamental requirement for phased, unusual or larger developments. For example masterplanning should be carried out prior to the houses on the development being planned. For phased developments, Developers should provide a coherent drainage strategy for the entire development.

At the masterplanning stage it is specifically useful to establish design codes and principles and layout of development proposals.

At this stage the Developer or landowner should consult with the Council Planning Authority to understand the requirements of the development proposal. The Developer should plan the SuDS layout with regards to the flows, topography and geology of the area in order to mitigate flood risk, taking account of established industry standards - **CIRIA SuDS Manual C753 and BS8582:2013 Surface Water Management**. This stage also allows an initial costing of the process.

WAY MARKER 6
Checklist for masterplanning:

- Requirements are identified in the **SuDS Submission Application and Approval Checklist** provided in **Volume 1 - Appendix A** of this guidance.
- Review of key evidence flood risk base documents
- Pre and post developments, including any phasing
- Review of geology, hydrology, green infrastructure, flood risk
- Initial costing and maintenance

3.4.2 Pre-application

Undertaking early consultations with the Statutory Consultees as identified in Section 3.4 can avoid delays and misunderstandings which may increase flood risk and subsequent issues with enforcement. The management of surface water flood risk is important for SuDS planning. The Council offers a Pre-Application Advice Service involving a multi-disciplinary team advising on flood risk management delivery, asset management and planning.

WAY MARKER 7
Checklist for pre-application:

- Consult with statutory and non-statutory consultees
- Seek advice from the Council via the Pre-Application Advice Service using the **SuDS Submission Application and Approval Checklist** provided in **Volume 1 Appendix A** of this guidance to provide the relevant information to inform discussions.

3.4.3 Application Submission

The **SuDS Checklist** and the information it identifies as being required should be submitted by the Developer to the Local Planning Authority. Both the checklist and all supporting information should be supplied digitally A hardcopy may be requested.

With reference to the checklist, the LPA will confirm that the listed information has been provided and will pass the checklist and supporting information to the the Statutory Consultees for review.

WAY MARKER 8
Checklist for Application Submission

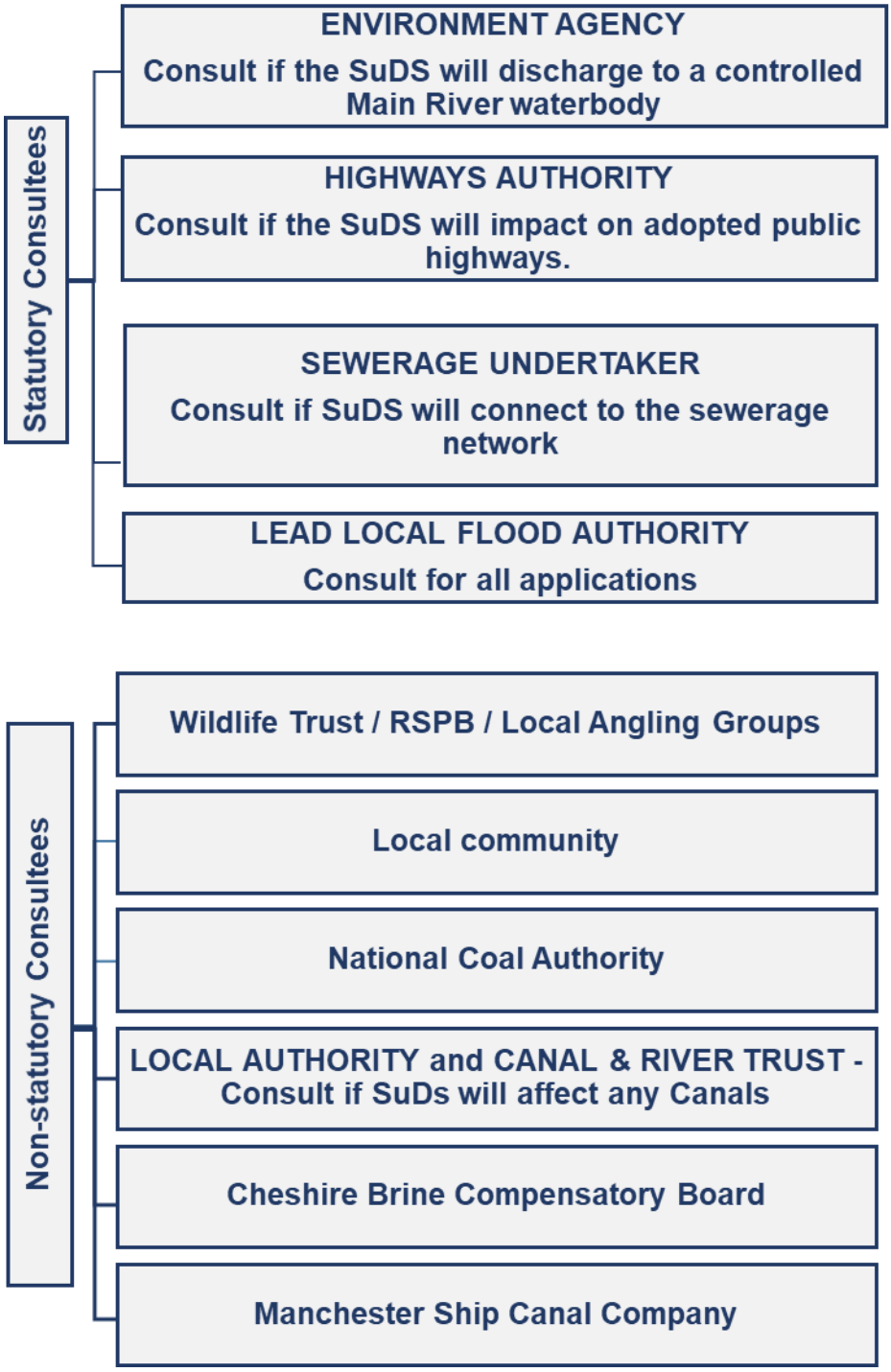
- The **SuDS Submission Application and Approval Checklist** is provided in **Section 1** of this guidance and is designed to be completed by developers, received by the LPA and reviewed by the LLFA.
- For larger developments where a masterplan is required, a detailed drainage layout, post development and pre-development layouts and development phasing will be required.

3.5 Consultation

Under the **Flood and Water Management Act 2010**, the Council are a Lead Local Flood Authority (LLFA) and according to the Defra Planning Practice Guidance, LLFA's as a Statutory Consultee will be consulted at the planning consultation stage to gain advice for surface water drainage.

Whilst not compulsory, it is also beneficial to consult with Non Statutory organisations, or groups as listed below, to gain further understanding of the implications and considerations which should be made when planning for SuDS.

Figure 6 Consultees



3.6 Approval

The approval of SuDS within an application will be determined by the Local Planning Authority, who will base their decision on the recommendations made by the LLFA and the other consultees. This may take the form of planning conditions which will need to be discharged

3.7 Post Construction Verification

A Condition of the Planning Approval will be the requirement to the Developer to confirm to the Local Planning Authority that the proposed SuDS scheme has been constructed in line with the proposed design. This will take the form of appropriate plans and other as constructed information.

3.8 Future Maintenance Responsibilities

To ensure that the proposed SuDS will be maintained to a high standard and ensure long term benefits, this stage of the planning application process should be considered before submission.

The **SuDS Checklist** (as described in Section 1 of this guidance document) has been designed for use by Planners, LLFA and Developers to ensure that the various requirements of who will be responsible for the maintenance have been carefully planned before submission. If sufficient provision has not been made, then absence of these details will be flagged and the planning application will be recommended for rejection by the LLFA.

It should be noted that the Council has no duty to adopt SuDS (and are not currently adopting new SuDS). Provision for the disposal and maintenance of runoff remains the responsibility of the Developer.

Evidence of an Agreement in Principle with the organisation who will adopt and maintain the SuDS, and any agreements for connections to the sewer networks is likely to be required at the submission stage together with a plan of the maintenance schedule and the likely activities to be involved.

Further details of SuDS Maintenance and Management requirements can be found in **Section 6** of this guidance document.

3.9 Other Consents

In addition to planning approval, developers may also need to obtain further consents to discharge. The LLFA will normally require evidence of compliance from the responsible authority, as outlined in the table below.

Table 2 Potential Consent Requirements

Consent	Responsible Authority
Land Drainage Consent (Ordinary Watercourse) (Land Drainage Act, 1991, Section 23)	LLFA
Flood Risk Activity Permits (Main River) (The Environmental Permitting (England and Wales) Regulations 2010)	Environment Agency
Environmental Permits for Waste or Emissions for discharges from Package treatment plants or large discharges to surface water	Environment Agency
Adoption of a sewer (Water Industry Act, 1991, Section 104)	Water and Sewerage Companies (United Utilities or Dwr Cymru Welsh Water)
Connection to a sewer (Water Industry Act, 1991, Section 106)	Water and Sewerage Companies (United Utilities or Dwr Cymru Welsh Water)
Building over or close to a sewer (within 8m) (Building Regulations, 2015, Document H)	Water and Sewerage Companies (United Utilities or Dwr Cymru Welsh Water)
Connection to an existing highway drain or adoption of highways drainage (Highways Act, 1980, Section 38)	Highway Authority
Highways Technical Approval Category D	Highway Authority
Third party landowner permissions	Third party landowner
Local Authority Land Drainage Byelaws	Lead Local Flood Authority
Approvals / Licenses for works impacting on Protected Species	Natural England

4. SuDS DESIGN CONSIDERATIONS FOR GREENFIELD AND PRE-DEVELOPED SITES

4 SuDS Design Considerations for Greenfield and Pre-Developed Sites

WHAT THIS SECTION WILL COVER:

- National Standards for SuDS
- The SuDS Management Train and runoff destination
- The SuDS philosophy, design process and design requirements
- Site challenges

4.1 National SuDS Standards

The **non-statutory technical standards for SuDS (March 2015)** provide guidance for Councils to define their own standards for approval of SuDS proposals within planning applications to ensure developments suit local requirements and address common site challenges for SuDS.

WAY MARKER 9
Non-statutory technical standards for SuDS

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

Ideally SuDS should be designed with the minimum amount of underground, or traditional piped linkage as possible. The designer should always aim to use conveyance channels, swales, or infiltration trenches to connect SuDS features wherever possible.

WAY MARKER 10
The SuDS Submission Application and Approval Checklist (the SuDS Checklist)

Contained within **Section 1** of this guidance.

This **SuDS Checklist** identifies the requirements for SuDS to be submitted as part of a planning application to the Council in line with the National Standards, Local Policy and these guidance documents.

SuDS should therefore be designed with these standards in mind: design, construction, maintenance, and operation. The following criteria should also be considered:

- **Function** - as well as treating and attenuating runoff, SuDS should be designed with multiple benefits in mind such as public friendly spaces, enhance and create new niche habitats, encouraging wildlife to flourish, in turn creating better places to live.
- **Maintenance** - all SuDS features should be easily maintained with suitable access provisions included.
- **Aesthetics** - designs should be appealing to the eye, use of native planting can enhance even the simplest of SuDS features.

4.2 The SuDS Management Train

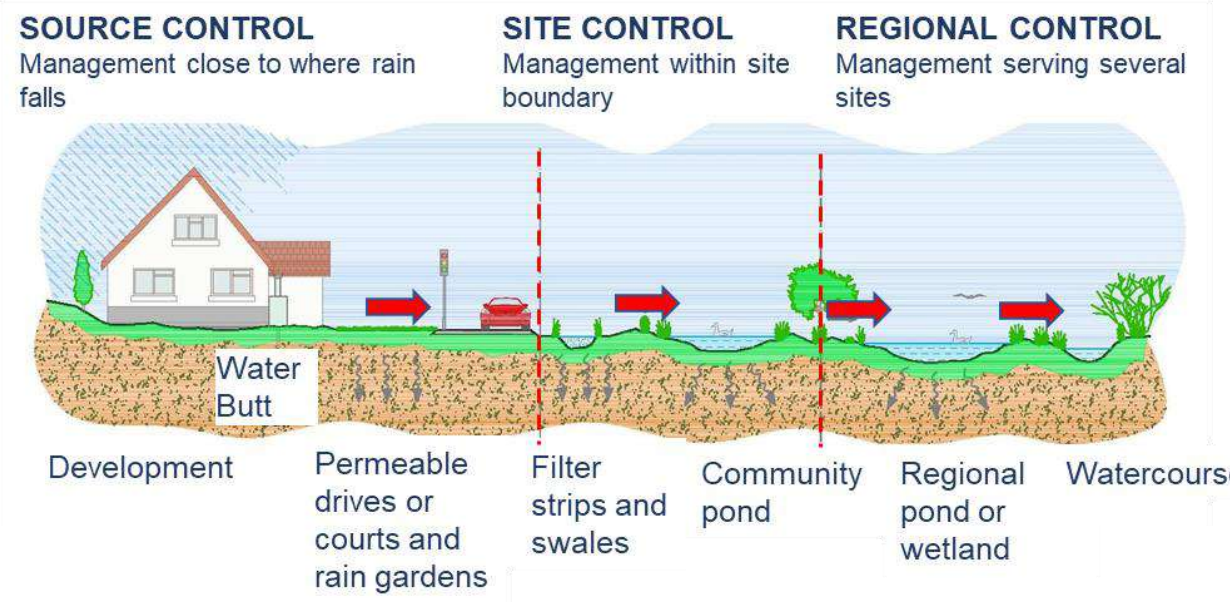
The 'management train' concept aims to highlight how a series of techniques may be employed in order to reduce the effect which the additional urban runoff from a development may have on the surrounding environment and watercourse as well as ensuring that pollutants and sediment are removed before water enters the watercourse.

This is considered in terms of:

- **prevention** (reducing the introduction of impermeable surfaces),
- **source control** (restricting and reducing runoff to receptors within the catchment),
- **site control** (managing surface water at the location of development),
- **regional controls** (maintaining and establishing blue networks and storage).

There are a number of SuDS features that can be incorporated into any drainage scheme. Features should be selected based on how they fit in the SuDS Management Train, how they would fit in the local context and the suitability of the site (function, maintenance, adoptability and land available).

Figure 7 Control Measures



4.3 The SuDS Design Philosophy

SuDS are designed to control surface water runoff close to where it falls, mimic natural drainage as closely as possible and provide similar drainage conditions post development to the pre-development site.

SuDS can provide betterment to drainage from brownfield sites and can also aim to reduce diffuse pollution in urban runoff and maximise environmental and social benefits.

SuDS design should focus on easy and efficient maintenance, to achieve low operation and maintenance costs and provide a safe operating environment for the maintenance operatives.

Urban runoff increases the volume of storm water runoff compared to greenfield runoff, especially for frequent rainfall events. Rainfall on developed land does not tend to infiltrate into the soil as much as greenfield, leading to higher runoff volumes. To minimise the impact of this additional runoff, the use of infiltration systems is encouraged where appropriate. For example infiltration could be provided using the following types of SuDS:

- **Soakaways**
- **Filter drains**
- **Infiltration trenches / blankets**
- **Filter strips**
- **Swales (dry and conveyance)**
- **Bio-retention systems**
- **Pervious pavements**

Where infiltration does not provide sufficient reduction of runoff, the use of long-term storage to address the additional runoff volume should be provided. Whilst the above SuDS features can be designed to provide attenuation storage, further attenuation storage could also be provided in the following types of SuDS:

- **Ponds and wetlands**
- **Detention basins**
- **Underground attenuation storage**

Subject to site constraints and the results of a risk assessment, ponds can provide the most effective water treatment and additional environmental and habitat benefits. Underground storage alone does not generally provide water quality benefits unless used in conjunction with other suitable water treatment SuDS features.

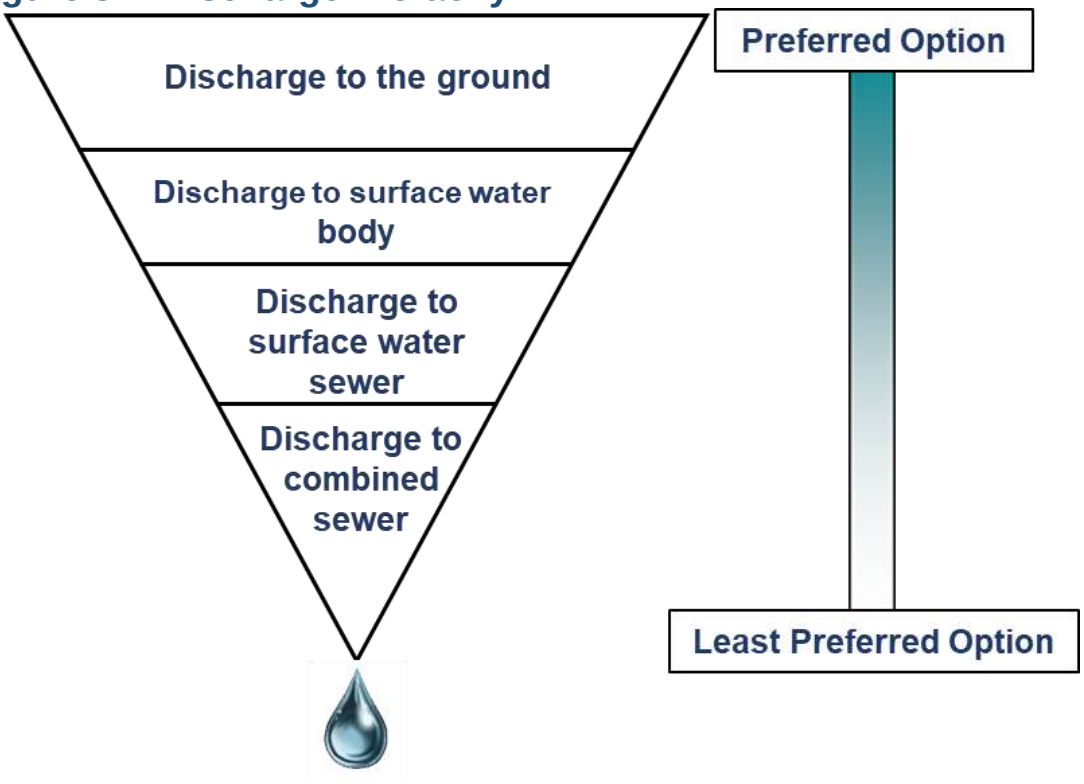
4.4 Prioritisation of Runoff Destination

The requirement is for the consideration for the discharge of surface water runoff is to the ground via infiltration SuDS. However, this may not be entirely possible for all sites due to soil permeability, contaminated land, topography of the area and quantity of sediments and contaminants within the surface water.

As shown in the runoff destination diagram below, other options of discharging to a surface water body, to a surface water sewer, or a combined sewer (in that order of preference) should be explored where infiltration is not fully possible.

Surface water should never be discharged to the foul sewer. Connections from developments are not permitted onto highway drainage unless they comprise solely water from highway gullies.

Figure 8 Discharge Hierachy



4.4.1 Calculations for surface water runoff

The preferred method of discharge should be decided throught the review of the Drainage hierarchy and an Infiltration Assessment. Following selection of the preferred discharge approach the, the following details are required to be included as identified on the **SuDS Checklist**. The checklist identifies the details required at each stage of the application process:

- Peak runoff flows calculations and results to demonstrate pre- and post-development runoff rates in relation to greenfield runoff rates. For redevelopment sites, actual existing brownfield rates will be taken into consideration. **See Volume 2 for further information.**
- Discharge volume calculations and results
- Simulation modelling of runoff (major applications)
- Flood risk (from surface water overland flow routes, exceedance flows, coastal, river and groundwater sources) as part of the Flood Risk Assessment

Details of how to undertake these calculations are provided in **Section 4.8** of this guidance.

4.5 The SuDS Design Process

4.5.1 Design Team for SuDS

The design team should incorporate a range of people and organisations in order to ensure a holistic approach to the design process. Identifying the likely considerations which need to be made for the SuDS design early on, may avoid potential delays to the SuDS application process.

As a minimum your design team should include:

- Suitably qualified drainage engineer, with experience of designing SuDS

Other potential design team members include:

- Urban designer
- Landscape architect
- Town planner
- Ecologist
- Highways Engineer
- Land developer
- Architect



Photo: JBA Consulting

4.5.2 SuDS Design Process Flowcharts

The SuDS Design Process can be broken down into the following four Stages:

1. **Set strategic surface water management objectives**
2. **Conceptual design – including initial design and layout**
3. **Outline design – including sizing and optimisation**
4. **Detailed design – including testing and finalisation of the scheme**

The flowchart diagrams that follow describes best practice for the SuDS design process based on the **CIRIA SuDS Manual**.

Figure 9 Design Stage 1 - Set Strategic Surface Water Management Objectives

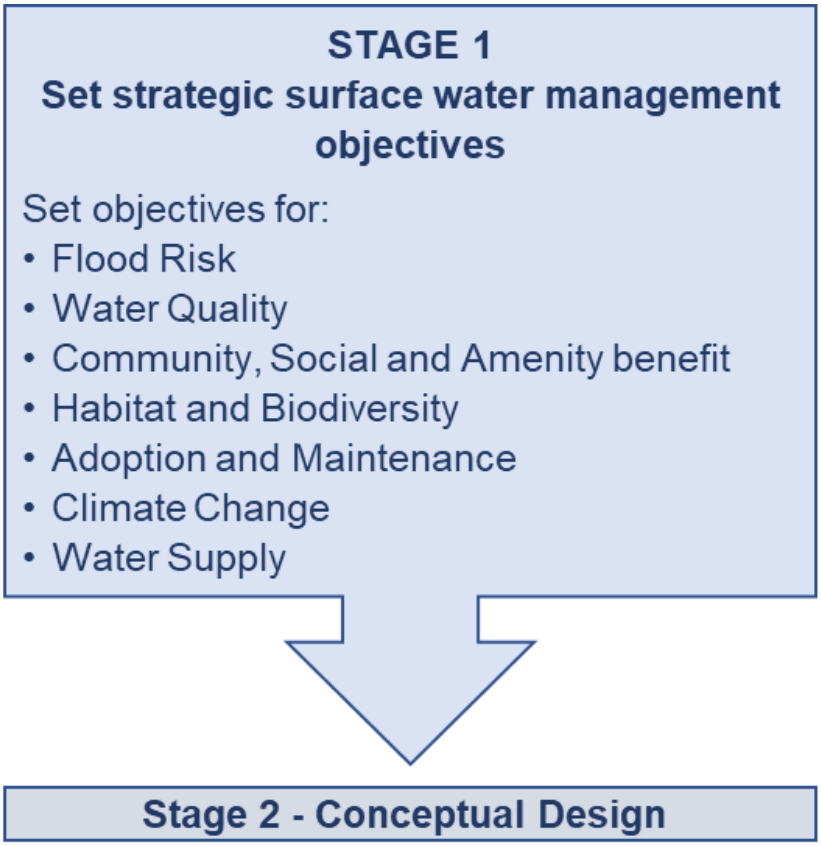


Figure 10 Design Stage 2 - Conceptual Layout

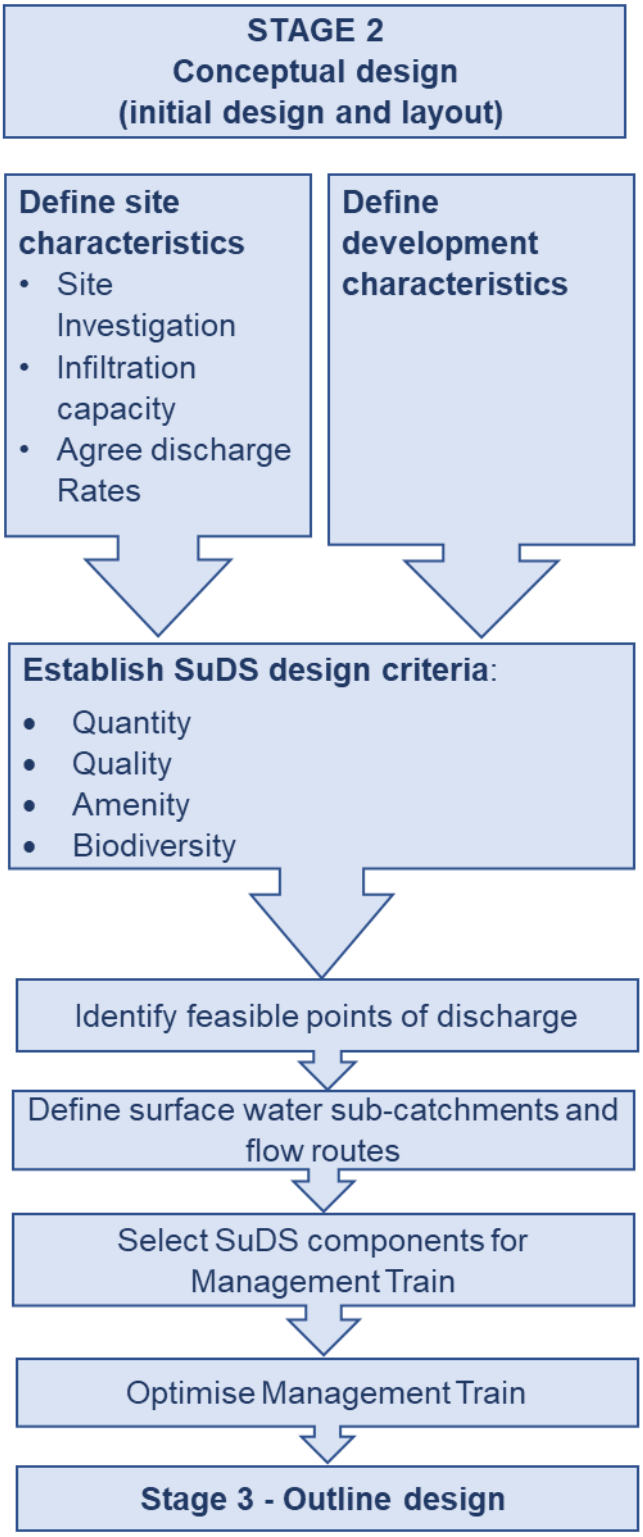


Figure 11 Design Stage 3 - Outline Design

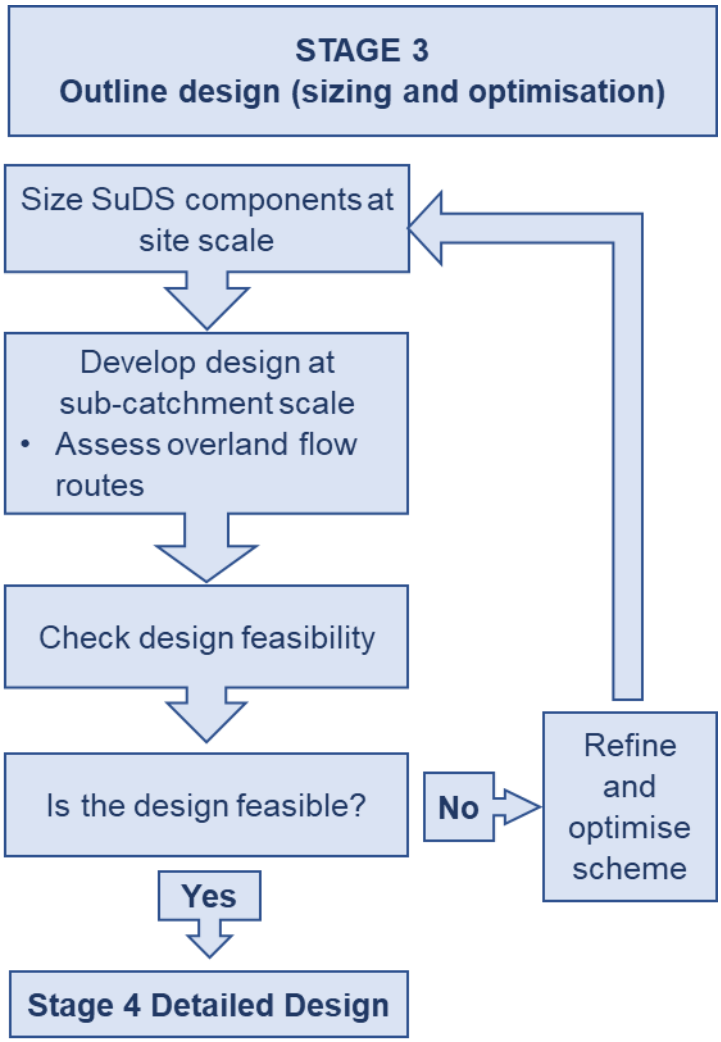
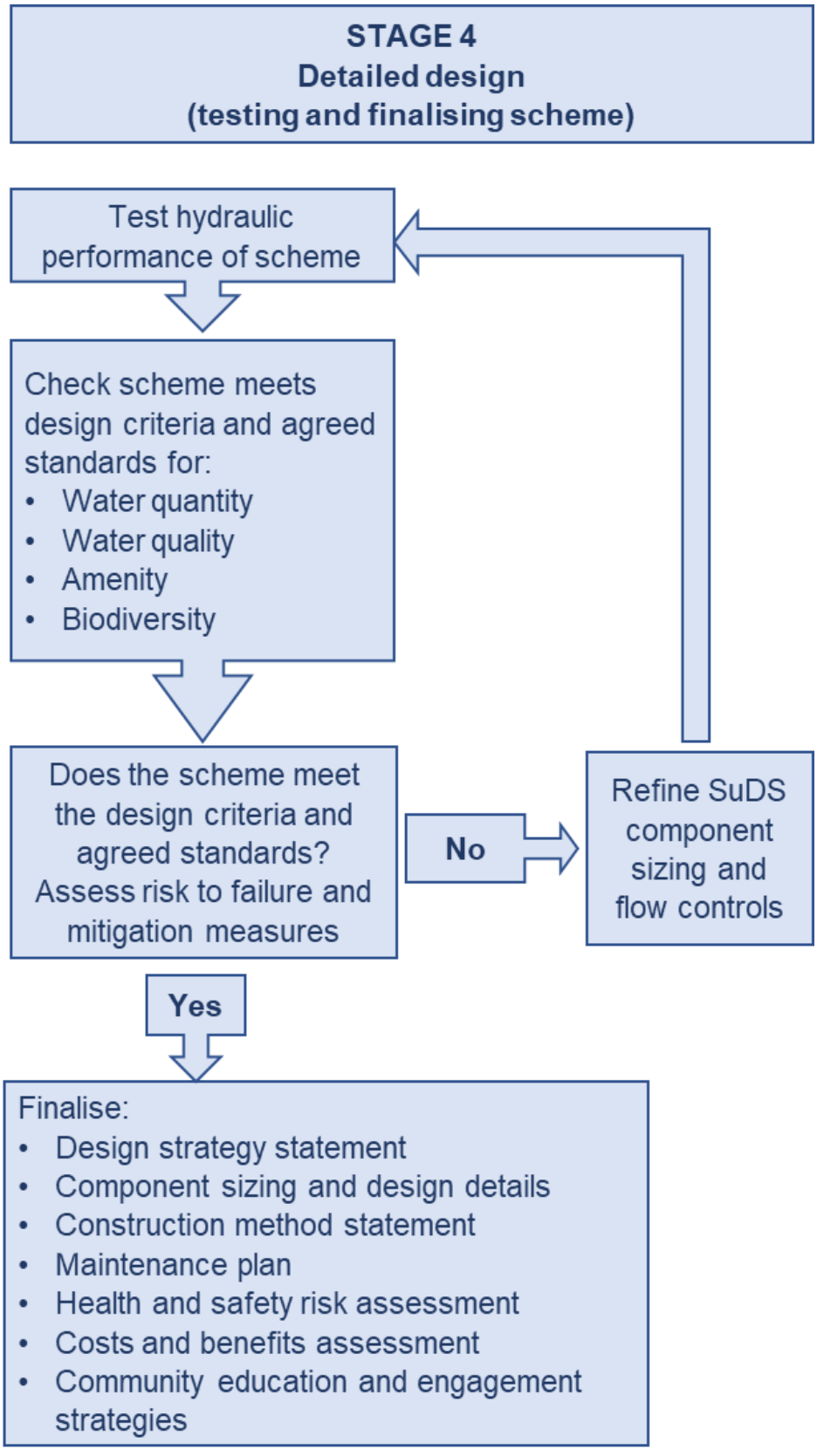
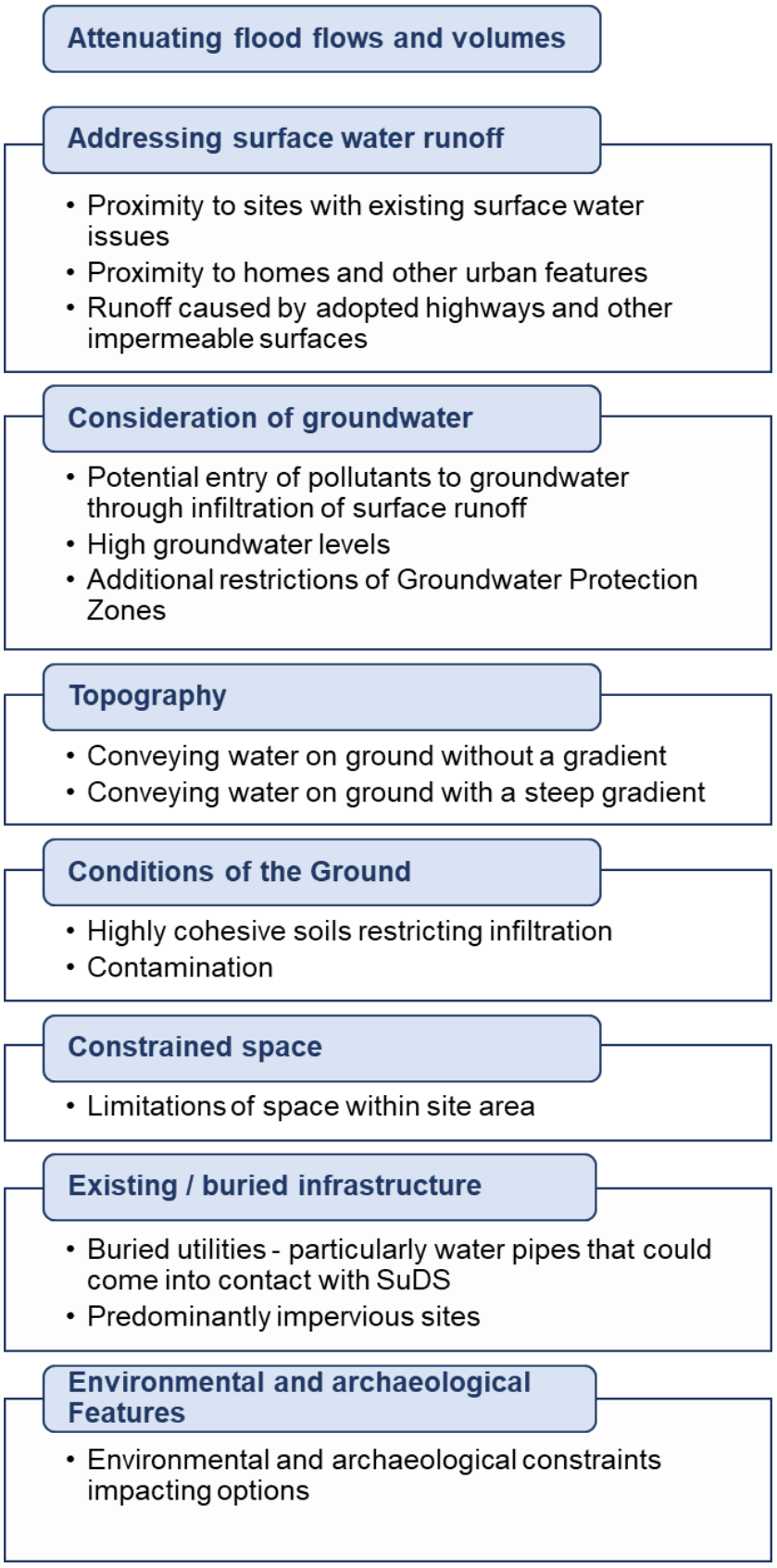


Figure 12 Design Stage 4 Detailed Design



4.6 Site challenges for Designing SuDS

Figure 13 Site Challenges for Designing SuDS



4.6.1 Brownfield sites

On uncontaminated brownfield sites, the water quality design criteria will depend on the existing sewerage infrastructure. If the water is discharged to a separate surface water sewer or directly to a watercourse, the site should be treated as an undeveloped site and the quality criteria will relate to the proposed land use.

If the site drains to a combined sewer that is unlikely to be converted to a separate system, the surface water should be treated with a single stage of treatment to remove grit and coarse solids. Foul sewage should be drained separately within the site.

An important criterion for all sites is the quantity of runoff. Storm flows can trigger combined sewer overflows, causing foul pollution and they can also overload wastewater treatment works, reducing treatment efficiencies. In exceptional circumstances the water authority might request that the runoff is detained completely and released only at night.

4.6.2 Contaminated land

Where a contaminated land site is proposed for redevelopment, SuDS may still be used for drainage of surface water. However, the design of the drainage system will be site-specific and dependent upon the contaminants at the site, the remediation strategy and the risks posed by any residual contamination, in addition to normal design considerations. Appropriate geotechnical investigations in line with best practice are critical to assess the level of risk.

The developer will need to consult with the planning authority and relevant consultees to inform the design and demonstrate that the proposed drainage system will not cause re-mobilisation of contaminants resulting in exposure to the wider environment. Infiltration systems may not be appropriate without remedial measures, and most techniques will require the use of liners. Remediation and redevelopment of contaminated land is a complex subject that requires specialist knowledge. The **CIRIA publication SP164 (Harris et al, 1998)** should be referred to for further information.

4.6.3 Design considerations

There are a variety of SuDS components which may be used independently or as a combination to fit into a SuDS management train.

The list below summarises the actions and considerations which should be made when designing SuDS.

- Plan SuDS at development proposal inception,
- Idemtify how SuDS fits with existing landscapes and slopes including regard for adjacent sites.
- Enhance landscape through SuDS design,
- Ensure access and maintenance is feasible,
- Promote and encourage biodiversity,
- Reduce waste produced from SuDS,
- Replicate natural drainage and avoid pipes / pumps,
- Promote water re-use,
- Maximise benefits and multi-use features,
- Ensure iterative design process.

4.7 SuDS Submission & Design Requirements

4.7.1 Acceptance of Design Submissions

Design Submissions will include the information identified in the **SuDS Checklist** in **Section 1.0** and follow the standards as described in the following sections.

SuDS located in public areas shall be limited to those identified in the **CIRIA SuDS Manual** and include rainwater harvesting, green roofs, infiltration systems, proprietary treatment systems, filter strips, filter drains, swales, bio-retention systems, trees, pervious pavements, attenuation storage tanks, detention basins and pond / wetlands. These SUDS techniques should be appropriately considered, for the best overall performance of the drainage systems and the water quality of the receiving water body.l

The Lead Local Flood Authority will assess the evidence and if in agreement they will confirm in writing the acceptance of the proposal. The developer may be asked to provide additional information supporting their proposal.

SuDS shall be located in passive public open space, private land (with easement agreements) or road side verges (if highway drainage), so that SuDS can be accessed for maintenance purposes. The Developer must tell the Planning Authority who will take on future maintenance of the SuDS.

4.7.2 SuDS Design & Submissions - General Requirements

The Developer is responsible for the design of SuDS. The design shall be supported by a risk assessment to ensure risks to both the local community and operators of the drainage system are minimised. The Developer and/or his designer shall certify that their design complies with this design guide and accept liability for compliance through their professional indemnity insurance. These responsibilities/liabilities shall not be discharged to Council or their representatives through the planning consent process.

SuDS designs shall be carried out in accordance with this Guide and the best practice principles in current UK drainage guidance.

Where, as a last resort, the Water Authority permits surface water to discharge to an adopted surface water sewer or where the Water Authority permits both surface and foul water to discharge to a combined sewer system the surface water sewer drainage shall be attenuated to the requirements of the water authority or Local Authority (whichever is the most stringent). The developer shall support their planning submission with written discharge consent from the water authority or alternatively the Lead Local Flood Authority (if discharging to Ordinary Watercourse) or Environment Agency (if discharging to Main River).

The developer should take account of the Councils Land Drainage Byelaws and Environment Agency Main River designations and regulatory requirements. For example the Developer shall paying particular attention in their masterplanning to the requirement for no obstructions typically within 8 meters of the edge of the watercourse. Flood Defence Consent and Land Drainage Consent information may be required as part of the submission. Easements for work adjacent to watercourses and culverts, drains, private sewers should be indicated and assumed to be 8m. It is the Developers responsibility to obtain all required discharge permits and evidence of this should be provided.

Point discharge SuDS are not to be located adjacent or within the adopted highway; carriageway or footway.

Design submission requirements to the Council (calculations, drawings and construction details) for private SuDS and pipe drainage, are presented in the **SuDS Checklist** and forms part of the audit for the design of the proposed system.

The complete surface water drainage system for a development (sewers and SuDS) could be partly private, partly adopted by the relevent Water Company and partly owned and maintained by a third party.

4.7.3 Drawings, Calculations, and Manhole Records Required

Drawings and calculations of the complete drainage system should be supplied with the SuDS application. Separate drawings of private systems should be supplied for record purposes only.

All drawings and calculations submitted should be in metric units.

The drawings should show all the necessary detailed information required by the the **SuDS Checklist**, **this Guidance** and **Appendix VI of Sewers for Adoption**.

Location and layout plans, sections and details should show the proposed SuDS and drainage system in full, including private SuDS. Plan scales should be those in common use, i.e. 1:20, 1:50 and 1:100 as appropriate.

Longitudinal sections should generally be to an exaggerated scale, with the horizontal scale the same as the plan (but no less than 1:500) and the vertical scale 1:100.

Record drawings shall contain the “as-built” information, with dimensions related to fixed Ordnance Survey features or Ordnance Survey co-ordinates to 1m accuracy (12-digit accuracy, e.g. 123456, 123456).

4.8 Surface Water Drainage Design

4.8.1 Hydraulic Design

The surface water drainage system shall be designed according to **Part C5 Hydraulic Design of Sewers for Adoption Edition**, so that flooding does not occur in any part of the site in a 1-in-30 year plus climate change return period design storm flood frequency. In addition, surface water is to be managed within the site for up to 1-in-100 year plus climate change.

Appropriate software shall be used to simulate the system and provide expected performance data. For all developments which utilise SuDS, the use of appropriate analytical tools are needed to demonstrate the required level of flood protection performance. For developments having less than ten houses, the procedure presented in **Part C3 Hydraulic Design of Sewers for Adoption Small Developments Version – September 2013** shall be followed.

Representation of SuDS in simulation software should be explicit, where possible. A copy of the model and results should be submitted to Council for acceptance. All hard surfaces draining to the network should be accurately allocated to the drainage network and represented in the model. All connecting manholes should be included in the model. Representation of the hard surfaces draining to the network should be accurately allocated to the drainage system and all manholes should normally be included in the model.

Surface water drainage should be designed for runoff from roofs and subject to the agreement of the Undertaker, roads (including verges) and other hard-standing areas. For these areas, an impermeability (runoff coefficient) of 100% shall be assumed.

An additional increase in the paved surface area of 10% shall be assumed for all areas to allow for future urban expansion (extensions and additional paved areas) unless this would produce a figure greater than 100% of the site.

An allowance for climate change in accordance with Environment Agency Guidance (by factoring the rainfall intensity hyetograph values) should be applied.

WAY MARKER 11
Climate Change & Peak Rainfall Intensity Allowance

Increased rainfall affects river levels and land and urban drainage systems. The table below shows anticipated changes in extreme rainfall intensity in small and urban catchments for North West England. For design, assess both the central and upper end allowances to understand the range of impact.

Table 3 Climate Change Rainfall Intensity Allowances

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%

Defra Climate Change Guidance
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

During severe wet weather, the capacity of the surface water drainage systems may be inadequate, even though they have been designed in accordance with this **Guide** and **Sewers for Adoption**.

Examples of different weather conditions which cause flooding include:

a. **High-intensity rainfall events bypassing gully inlets;**
b. **High-intensity rainfall events resulting in sewer surcharging and surface water escaping where the ground level is below the hydraulic gradient;**
c. **High-intensity rainfall events on areas adjacent to the development site (urban or rural) from which overland flooding can take place;**
d. **Long-duration rainfall which may result in the top water level in storage systems becoming full, resulting in overflow;**
e. **Extended periods of wet weather which may result in high receiving watercourse water levels affecting the hydraulics of the drainage system.**

Checks shall be made for the 1-in-100 plus climate change year return period to ensure that properties on and off site are protected against flooding for all these scenarios. The design of the site layout, or the drainage system should be modified where the required flood protection is not achieved. This is particularly relevant on undulating and steeply-sloping catchments and adjacent to watercourses. Developers should also demonstrate flow paths and the potential effects of flooding resulting from these storm events. Access roads into and through the site for emergency vehicles must be ensured for these events.

Where it is proposed to connect to an adopted drainage network, the developer shall consult with the Undertaker and the Lead Local Flood Authority regarding acceptable discharge criteria. Hydraulic performance modelling of the receiving drainage system may be required.

Where it is proposed to connect to other existing sewers, drainage networks (including but not limited to culverts, privately owned systems, open drainage ditches, or constrained watercourses) the developer shall consult with owner of the drainage network and the Lead Local Flood Authority to agree acceptable discharge criteria. Hydraulic and structural assessment of the receiving drainage network is likely to be required.

4.8.2 Attenuation Storage

The limiting discharge rates from the site should normally be assessed using the **'Flood Estimation for Small Catchments' (Institute of Hydrology 1994)**. For application sites, smaller than 50ha it should be applied for 50ha and linearly interpolated to the development area. Values should be determined for the 1-year, 1-in-30 year and 1-in-100 years plus climate change as a minimum. A tool for assessing greenfield runoff rates is provided in **Appendix B** using the calculation described in **Way Marker 12**.

The maximum 1-year water level in attenuation storage should not cause significant backing up of flows in the incoming sewer and a 1-year, 1-hour duration event should not surcharge the drainage network.

Simulation modelling of the contributing development area considering the head-discharge relationship of the proposed SuDS discharge outlet is required to calculate the attenuation storage volume. The model may be based on either the fixed percentage runoff of 100% runoff from all impermeable surfaces, or the UK variable runoff model (see **CIRIA document 'Drainage of Development Sites – A Guide' (2004)** for the runoff from the whole site. Appropriate allowance in the reduction in runoff should be made for infiltration systems serving any impermeable areas.

WAY MARKER 12
Calculation for greenfield runoff peak flows (Institute of Hydrology Report 124)

$$QBAR_{rural} = 1.08(AREA/100)^{0.89} SAAR^{1.17} SOIL^{2.17}$$

$QBAR_{rural}$ Mean annual runoff for rural (greenfield) areas (litres/second)

AREA Area of the site (hectares)
If the site is smaller than 50 hectares, the calculations should be undertaken using 50 hectares and then amended (by dividing by the actual site area) at the end of the calculation.

SAAR Standard Average Annual Rainfall (mm)

SOIL = Predominant soil type
The most suitable soil type should be selected from the table below:

Table 4 SOIL Parameter

Soil Description	Soil value for calculation
Peat (waterlogged)	0.50
Clay	0.50
Clayey loam	0.45
Loam	0.40
Sandy Loam	0.30
Sand	0.15

4.8.3 Peak flow rate and volume

Peak flow rate and volume does not apply to any surface runoff that is discharged:

- By infiltration; or
- To a coastal or estuarial water body; or
- To an alternative water body where the LLFA considers it appropriate to do so.

Developers will need to demonstrate that Consent to discharge and 3rd party land ownership issues/crossing have been agreed prior to planning application and detail these in the relevent sections of the **SuDS Checklist**.

4.8.4 Low rainfall

There should be no discharge to a surface water body, or sewer that results from the first 5mm of any rainfall event. In low permeability soils where this is not achievable, the developer shall demonstrate to Council that infiltration has been encouraged through the SuDS management train.

4.8.5 High rainfall

Either of the two approaches below must be used to manage the surface discharge:

Approach 1: Restricting both the peak flow rate and volume of runoff

The peak flow rates for the:

- 1 in 1 year rainfall event; and
- 1 in 100 year plus climate change rainfall event;

must not be greater than the equivalent greenfield runoff rates for these events. The critical duration rainfall event must be used to calculate the required storage volume for the 1 in 100 year plus climate change rainfall event.

The volume of runoff must not be greater than the greenfield runoff volume from the site for the 1 in 100 year plus climate change, 6-hour rainfall event.

Climate change should be considered in attenuation storage calculations by increasing the rainfall depth using a climate change factor. Current Environment Agency guidance should be referenced to apply the appropriate climate change factors relevant to the location and design life of the proposed development.

Approach 2: Restricting the peak flow rate

The critical duration rainfall event must be used to calculate the required storage volume for the 1 in 100 year plus climate change rainfall event. The flow rate discharged:

For the 1 in 1 year event, must not be greater than either:

- The greenfield runoff rate from the site for the 1 in 1 year event, or
- 2 litres per second per hectare (l/s/ha);

And for the 1 in 100 year plus climate change year event, must not be greater than either:

- The greenfield mean annual flood for the site, or
- 2 litres per second per hectare (l/s/ha).

4.8.6 Previously developed land

Where the site is on previously developed land and neither Approach 1 or 2 is reasonably practicable then:

a) An approach as close to Approach 1 as is reasonably practicable must be used (the Councils are seeking runoff from brownfield sites to mimic greenfield runoff rates wherever possible);
b) The flow rate discharged from the site must be reduced from that of the actual modelled pre-development rate, in accordance with the criteria set out in Volumes 2A to 2C of this Guidance. :
    - The 1 in 1 year event; and
    - The 1 in 100 year plus climate change event.
    - The volume of runoff may only exceed that prior to the proposed development where the peak flow rate is restricted to 2 l/s/ha.

4.8.7 Exceedance

The design of the drainage system must consider the impact of rainfall falling on any part of the site and also any estimated surface runoff flowing onto the site from adjacent areas.

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

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

Flows that exceed the design criteria (i.e. 1 in 100 year plus climate change rainfall event) must be managed in flood conveyance routes, preferably in green networks, that minimise the risks to people and property both on and off the site. Evidence of those conveyance routes must be submitted to the LLFA.

4.8.8 Water quality

The treatment train process described in **Section 4.2**, should be used to assess storm water quality requirements.

WAY MARKER 13
Runoff Hazard Levels

Table 5 Runoff Hazard Levels

Hazard	Level of hazard
Low	Roof drainage
Medium	Residential, amenity, commercial, industrial uses. Includes car parking and roads
High	Areas used for handling and storage of chemicals and fuels, handling and storage of waste. Includes scrap yards as well as lorry, bus or coach parking or turning areas

WAY MARKER 14
Treatment stages for discharge to groundwater

Table 6 Groundwater Treatment Stages

Groundwater Discharge Location		Minimum number of treatment stages		
Runoff Hazard Level		**Low**	**Medium**	**High**
G1	Source Protection Zone, within 50m of a well, spring or borehole that supplies potable water	1	3	Consult the Environment Agency
G2	Into or immediately adjacent to a sensitive receptor that could be influenced by infiltrated water. Includes designated nature conservation, heritage and landscape sites - including Biodiversity Action Plan (BAP) habitats and protected species.	1	3	
G3	Source Protection Zone II or III or Principal Aquifer	1	3	
G4	Secondary Aquifer	1	2	

- Surface runoff from roof drainage must be isolated from other sources where it is discharged to G1 and G2.
- Infiltration may only be used to discharge to G1 and G2 where a risk assessment has been undertaken and the SuDS design effectively addresses these risks.

WAY MARKER 15
Treatment stages for surface water bodies

Table 7 Surface Water Bodies Treatment Stages

Hazard	Normal surface water	Sensitive surface water
Low	0	1
Medium	2	3
High	Consult the Environment Agency	

- Where discharge to a sensitive surface water body (defined as any catchment smaller than 50km; any catchment with less than 20% urbanisation; any catchment with an environmental designation or national or international recognition, or any catchment where good ecological status is at risk), one extra treatment stage must be added.

4.8.9 Record Information for the completed Works

Upon completion of the works, the following items shall be supplied to the Local Authority to verify that the completed works have been installed as described within the application.

a) two sets of as-built record drawings in electronic format and compatible with AutoCAD Release 14 in *.DWG or *.DXF format;

b) where appropriate, closed circuit television (CCTV) survey of underground systems by a qualified contractor in accordance with **Clause E7.6 of Sewers for Adoption** in CD or DVD format with a hard copy of the written report. CCTV at completion is at the discretion of the Developer. The Developer is responsible for checking that the CCTV survey shows no defects or debris within the infrastructure.

c) Health & Safety File prepared in accordance with the Construction (Design & Management) Regulations 2015.

5. SELECTION & DESIGN REQUIREMENTS FOR SuDS COMPONENTS

5 Selection & Design Requirements for SuDS Components

WHAT THIS SECTION WILL COVER:

- Choosing SuDS components
- The SuDS selection matrix
- Considerations for discharge
- Local SuDS zones
- Types of Permitted SuDS and technical requirements

5.1 Choosing SuDS components

One of the key elements of designing a site with SuDS is the decision about which components to use. As described in the previous chapter, there are a variety of SuDS components but not all will be suitable for all sites. It is therefore vital to have a comprehensive understanding about the nature of the site, particularly if there is contaminated ground and to ensure that a constant review is undertaken from project inception to SuDS operation. **Figure 14** describes the best practice for this decision-making process based on the **CIRIA SuDS Manual**.

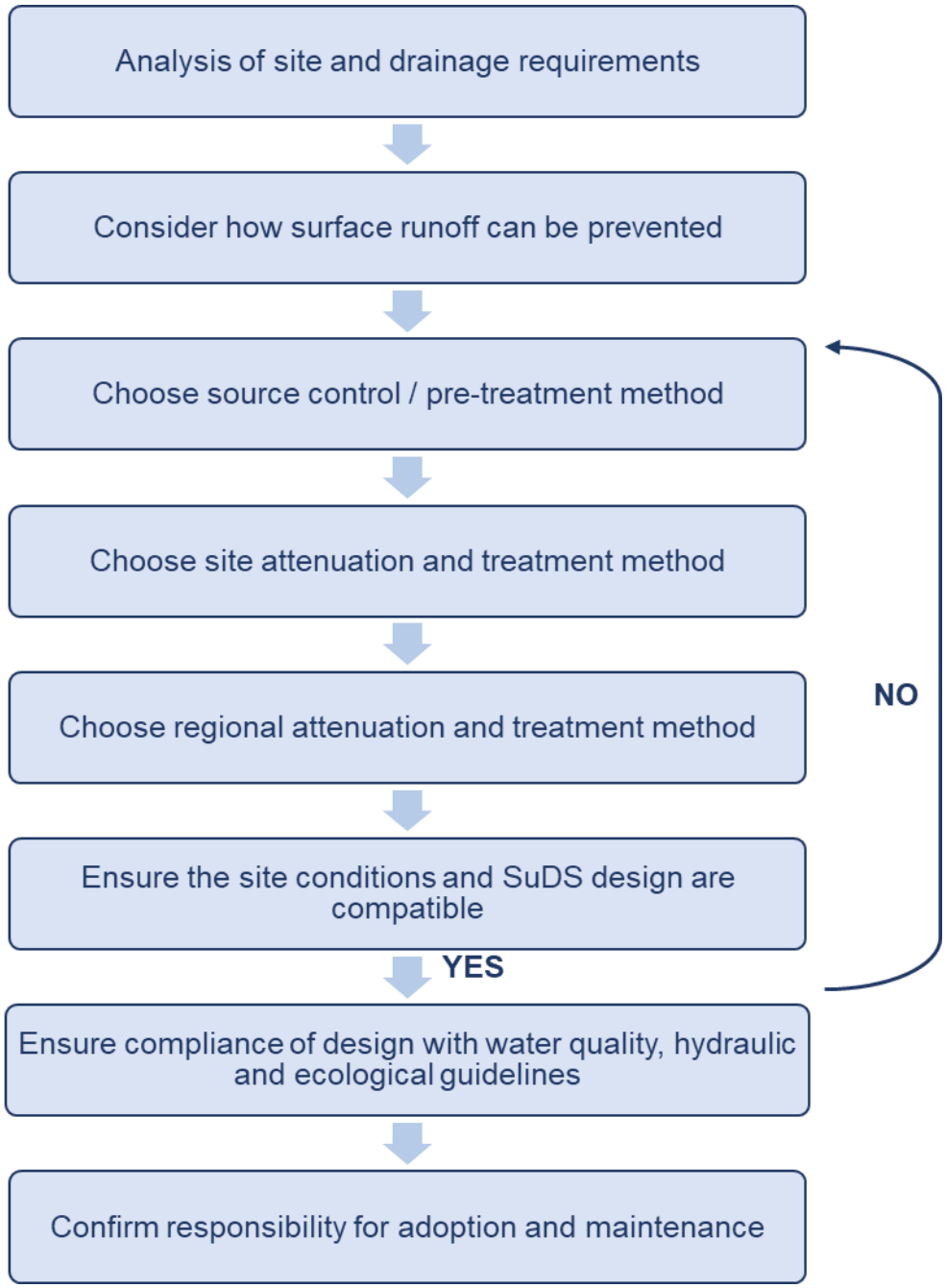
5.2 SuDS Suitability Selection Matrix

To assist in the selection of appropriate SuDS, **Appendix C** includes a **SuDS Suitability Selection Matrix** table which identifies the various benefits and constraints of common SuDS techniques.

This matrix table compares the various SuDS techniques against the following criteria:

- Land use suitability
- Water quantity suitability
- Water quality suitability
- Environmental benefits
- Cost suitability

Figure 14 How to Select SuDS Components



5.3 Discharge considerations

The types of SuDS should be chosen to suit the local conditions. Other considerations and actions that should be undertaken include:

- Calculations of pre- and post-development runoff rates to ensure a neutral or better impact as appropriate.
- Consideration of the method of attenuation.
- Identification of whether the site lies within the coastal / tidal, fluvial or surface water (pluvial) flood outlines, or affected by groundwater.
- Consideration of the effects of climate change upon surface water volumes and flow pathways.
- Consultation with the relevant bodies depending on the location to which surface water is to be discharged:
    - To the ground - consultation (where relevant) with the Environment Agency, National Coal Authority, British Geological Survey, Cheshire Brine Subsidence Compensation Board
    - To surface water bodies - consultation (where relevant) with the Environment Agency or Council or Lead Local Flood Authority or the Canal and River Trust (or appropriate navigation authority) for works near / to canals
    - To a surface water sewer or combined sewer - consultation (where relevant) typically with United Utilities, Dwr Cymru Welsh Water or the Highways Authority (for highway drainage only).

5.4 Local SuDS Zones

Volume 2 of this SuDS guidance provides a description and high level mapping of the predominant soil types within the Council area. This identifies possible SuDS opportunities and constraints associated with soil type and provides guidance as to which SuDS components may be suitable. It should be noted that appropriate site level ground investigation should be carried out prior to the design of the drainage system. Ground Investigations should comply with best practice requirements.

5.5 Examples of Preferred SuDS Solutions

There are a variety of SuDS components which are considered suitable within the Council area. They may be used independently or as a combination (SuDS management train). The list below (and the subsequent sections) summarises these SuDS components which have been categorised according to how they fit within the SuDS Management Train (source, site and regional controls). Technical design requirements are described following each SuDS Component.

The types of SuDS components listed here are likely to be those that the Council will consider most suitable. However, the Council recognises that other solutions may be suitable.

Indicative schematic design layouts for the SuDS components described are included in **Appendix D**.



5.6 Source Control

5.6.1 Source Control – Rainwater Harvesting



There are a variety of source control measures, the simplest being rainwater harvesting. Rainwater harvesting is the localised interception of rainwater runoff, normally for use at source. Runoff collected from roofs and impermeable surfaces can be stored and following appropriate treatment utilised for use within domestic or commercial properties. This approach can reduce surface water flood risk by reducing the volume of runoff from a site and can reduce the volume of attenuation storage required. This approach provides sustainability and climate resilience benefits and can be used to meet some or all of the properties water demands. Harvesting systems usually require the provision of a storage tank, pump, power controls and pipework.

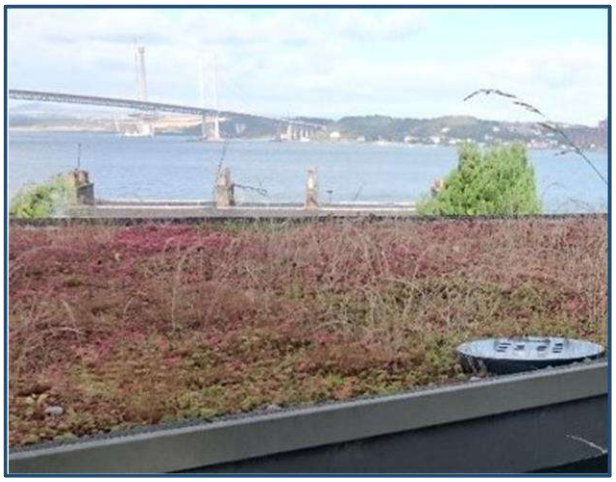
Within a residential context this may include the provision of individual water butts to collect rainwater from roofs. A commercial application could be the use of storage ponds to accumulate water for reuse as an alternative water supply for a garden center.

Rainwater harvesting offers significant opportunities both for incorporation in new development and also retrofitting within existing development. In addition to the potential savings from non-potable domestic water for use such as flushing toilets, individual sites may benefit from commercial or industrial use of the collected water.

5.6.2 Source Control – Green Roofs

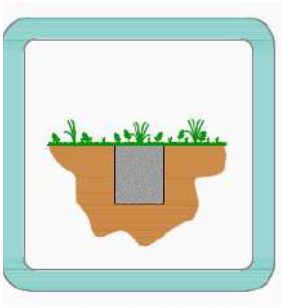


Green roofs involve the localised interception of rainwater through the installation of vegetated areas on building roofs. The intercepted rainfall is absorbed by the vegetation and substrate which reduces runoff most significantly from normal summer rainfall events due to the evapotranspiration process and temporary storage provided. Whilst it is recognised that green roofs are generally more expensive to install and maintain they can provide additional benefits such as improving the visual appearance of an area, providing ecological value and enhancing the buildings thermal performance (reducing energy use). They can also extend the design life of roof waterproofing by protecting it from mechanical damage, ultraviolet radiation and temperature extremes.



Green roofs offer opportunities to improve surface water management, are particularly suitable for incorporation in new development. Retrofitting, whilst less straightforward can often be undertaken providing the existing roofs have sufficient structural capacity (or are strengthened accordingly). Whilst it is recognised that lightweight industrial buildings may not normally have sufficient structural capacity to support a green roof, the cost of the green roof and extra structural provision can be offset against the long-term benefits in reduces attenuation costs and improved building efficiency.

5.6.3 Source Control – Infiltration Systems



There is a range of SuDS systems which collect and store runoff, allowing it to infiltrate into the ground. This contributes to reduce runoff rates and surface water flooding whilst supporting baseflow and groundwater recharge. The inclusion of overlying vegetation can reduce the risk of pollution to underlying soils through filtration. Types of infiltration systems include soakaways, infiltration trenches, infiltration blankets and infiltration basins. Bioretention systems and pervious pavements can also be designed to allow infiltration. Infiltration systems are reliant on groundwater levels being at least 1m below the base of the feature and soils having a suitable permeability. Infiltration to the ground at or near the source reduces reliance on downstream drainage systems.

Dependent on the groundwater levels and the permeability of the soil these systems are useful for small urban catchments as is characterised by the drainage within Bailrigg area. They can therefore potentially be used to intercept and infiltrate local surface flows. Infiltration systems can be compact and therefore are potentially suited for retrofitting in existing green space areas or other available areas within an area, however their suitability will require a consideration of the location of impermeable areas and flow routes. As the system facilitates discharge ultimately to groundwater it is critical to ensure runoff is suitably clean so that groundwater is not put at risk of contamination. They are subsequently best suited to deal with runoff from roofs. Retrofitting infiltration systems to existing sites and redirecting roof drainage from the existing drainage system to these areas components may provide the opportunity to reduce surface water flood risk and would be encouraged. New development will be expected to have considered infiltration as a means of managing both existing and post development surface water flood risk.

5.6.4 Source Control - Filter trench / Infiltration trench



Gravel or rubble filled trench that creates subsurface storage for infiltration, or filtration of surface water runoff. Trenches can be used to filter, attenuate and dissipate storm water into the ground through the base and sides of the trench and/or provide a level of treatment prior to reaching a secondary SuDS feature.



Photo: JBA Consulting

Key Benefits



Design Standards

- **CIRIA C753 The SuDS Manual Part D.**
- **Design Manual for Roads and Bridges HA 103/06**

Best practice

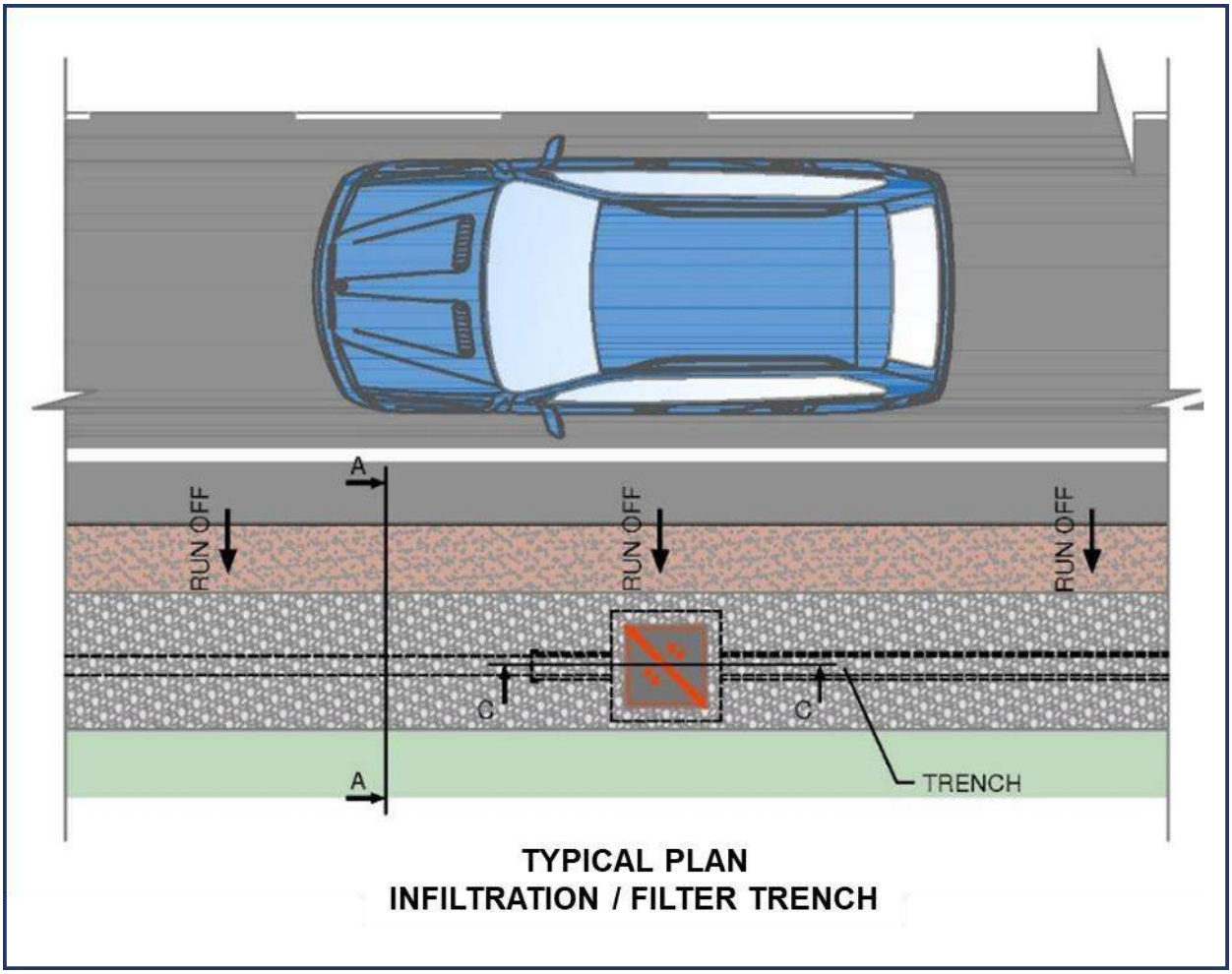
- The location of the filter trenches should be carefully considered so there is no interaction with people and vehicles
- Work best with SuDS components which provide attenuation of storm flows
- Use in combination with effective pre-treatment.
- Separate filter media from surrounding ground with a geotextile where infiltration is desirable, or a membrane where infiltration is not permitted.
- Include a geotextile layer within the upper gravel and incorporate observation wells and rodding points for maintenance.
- Use a distribution pipe in combination with point discharges
- Consider the impacts of stone scatter.

Local Context - Opportunities

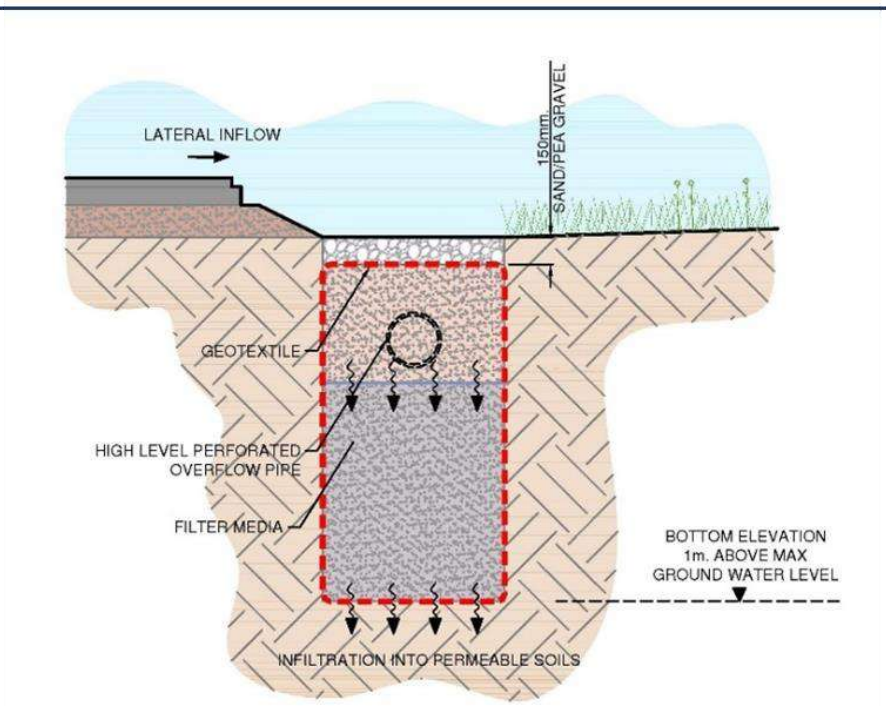
- Ideal for use with small contributing areas.
- The land-take is usually low, typically 0.5-1.5m wide.
- Can be used to reduce both runoff rate and volume.
- Good water quality treatment.
- Can be easily incorporated into site landscaping / along roads.

Local Context - Considerations

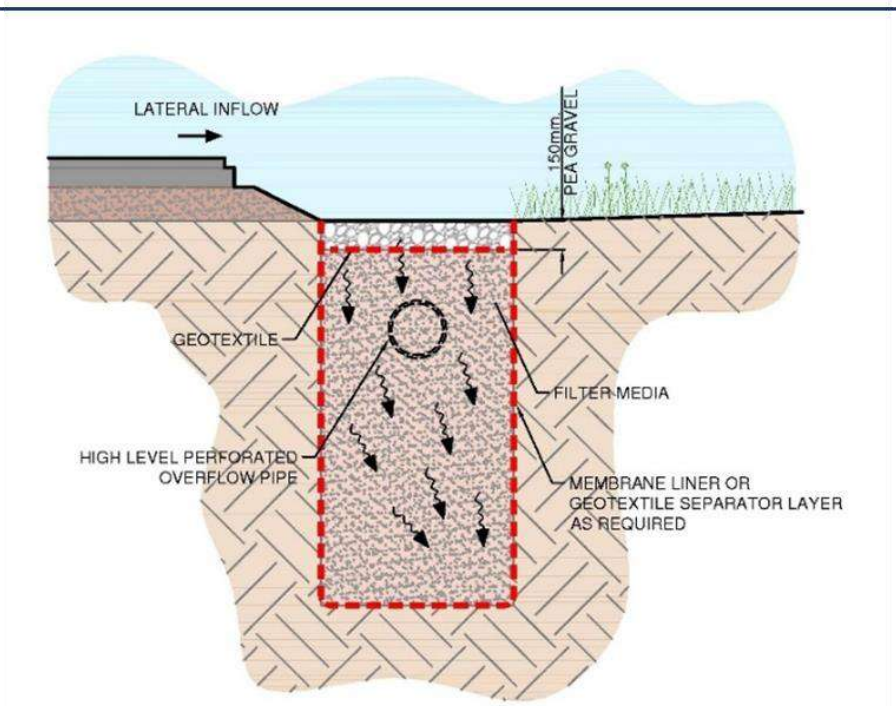
- Can be prone to blockage and work best in combination with pre-treatment such as filter strips to reduce sediment load.
- Features to help inspection and maintenance are critical.
- Can be expensive to replace the filter material if poorly designed or neglected maintenance.
- Difficult to identify pollution and maintenance issues .



TYPICAL PLAN
INFILTRATION / FILTER TRENCH



SECTION A-A
INFILTRATION TRENCH SCHEMATICS



SECTION B-B
FILTER TRENCH SCHEMATICS

5.6.5 Source Control - Filter strip



A vegetated strip of land located between the urbanised area and the receiving water body. Filter strips are designed to intercept sheet flows and provide vegetative filtration and encourage some infiltration.



Photo: JBA Consulting

Key Benefits



Design Standards

- **CIRIA C753 The SuDS Manual Part D.**

Local Context - Opportunities

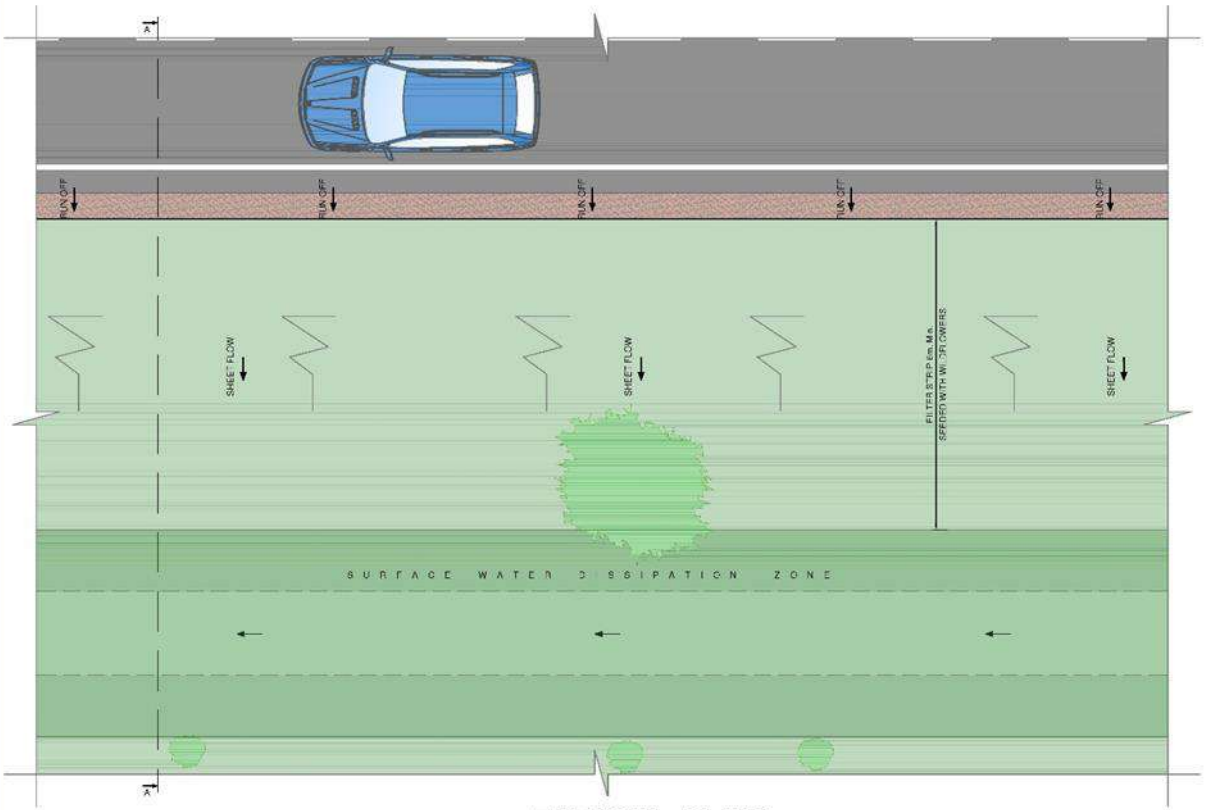
- Ideal for use with small contributing areas.
- Good for pre-treatment.
- The land take is usually moderate, minimum of 6m wide with a slope not exceeding 1 in 4.
- Moderate water quality treatment.
- Can be easily incorporated into site landscaping and alongside roads.
- Can be enhanced using grass/wildflower seed mixes.
- Can link green areas.
- Low cost and maintenance.

Best practice

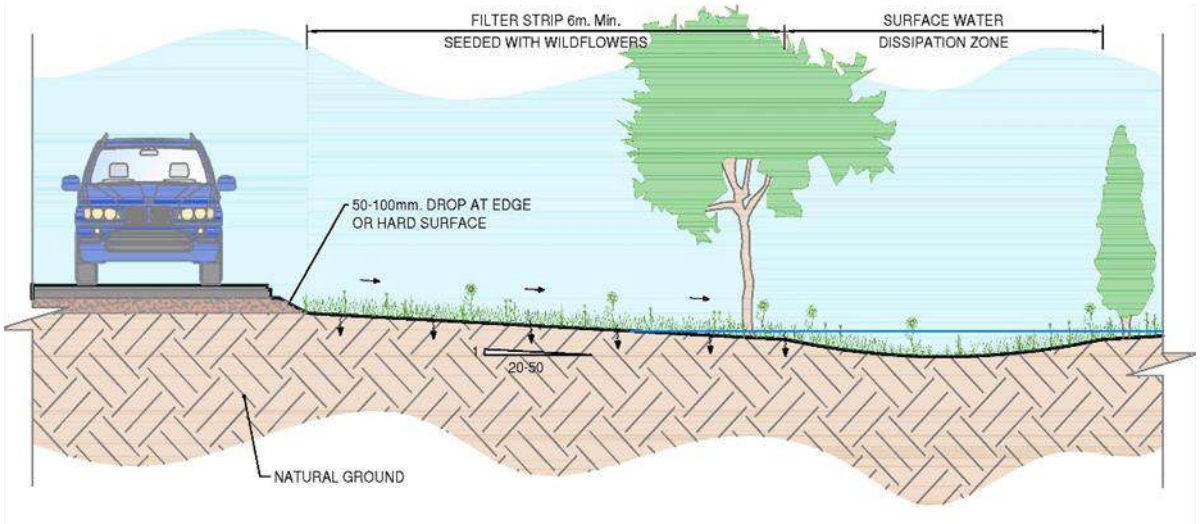
- Integrated into the site and surrounding landscape
- Consider opportunities for green corridors
- Can be used in conjunction with SuDS components offering attenuation

Local Context - Considerations

- Relatively large land-take.
- Not suitable for steep sites.
- Does not attenuate or significantly reduce peak flow or volume.



TYPICAL PLAN
BIORETENTION / FILTER STRIP



SECTION AA
BIORETENTION / FILTER STRIP

Technical Requirements – Infiltration Trenches & Filter Strips

Configuration and Dimensions of Infiltration Trenches & Filter Strips

- Filter / Infiltration Trenches should be used as source controls only.
- Filter / Infiltration Trenches should not be designed as sediment traps.
- Filter / Infiltration Trenches should be designed to the requirements of the **Design Manual for Roads and Bridges Volume 4, Section 2, Part 5, HA40/01 - Determination of Pipe and Bedding Combinations for Drainage Works, Drawing F2, trench Type H, the requirements of this document and Appendix D - Figure D1 and D2.**
- Filter / Infiltration Trenches should not exceed 3m in depth.
- It is preferred that storm water inflow be sheet flow from drainage areas. Where this is not practical point flow inputs will be acceptable.
- Where point flows are used, a pre-treatment stage be installed that will effectively remove particulate matter present in the water and prevent clogging of the trench.
- Point flow inputs should be connected to a slotted high level distributor pipe. The pipe should be capable of conveying the design flow.
- The stone filter material should be wrapped in geotextile to the diagram as shown on **Appendix D, Figure D1**, with a minimum 150mm overlap at all joins. The geotextile should meet the requirements of the **Specification for Highway Works Series 500**.
- Filter / Infiltration Trenches should be provided with a high-level overflow to accommodate design exceedance.

Hydraulic and Water Quality Design Criteria

- The trench design should be checked for design exceedance and modelled explicitly and holistically to demonstrate the impact to the downstream drainage components.
- Infiltration trenches should be designed to half-empty in 24 hours to allow for incoming flows from subsequent storms.
- The base of the trench should be at least 1m above the highest seasonal or permanent groundwater table.

Selection and Siting

- A risk assessment shall include all relevant safety and environmental issues associated with siting a filter / infiltration trench.
- The trench shall be designed for easy maintenance.
- Infiltration trenches should be sited on stable ground, soil and groundwater conditions should be assessed to verify ground stability.
- Design of infiltration trenches must comply with **groundwater protection regulations and with EA policy on infiltration.**

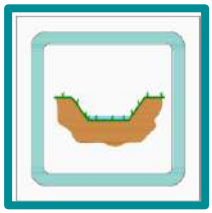
Safety

- A risk assessment shall include all relevant safety and environmental issues associated with the SuDS Feature.

Operation and maintenance

- All maintenance access points shall be clearly visible and documented in the Operation and Maintenance plan.

5.6.6 Source Control - Swales



A vegetated shallow channel or depression designed to treat, filter, store and convey runoff. Swales can be either 'dry' (where water is stored beneath the ground in a gravel layer) or 'wet' where runoff is stored above the surface in the channel so may be permanently wet. Lining can be added to enable infiltration even when there are known contaminants in the water.



Photo: JBA Consulting

Key Benefits



Design Standards

- **CIRIA C753 The SuDS Manual Part D.**
- **Design Manual for Roads and Bridges HA 103/06**

Local Context - Considerations

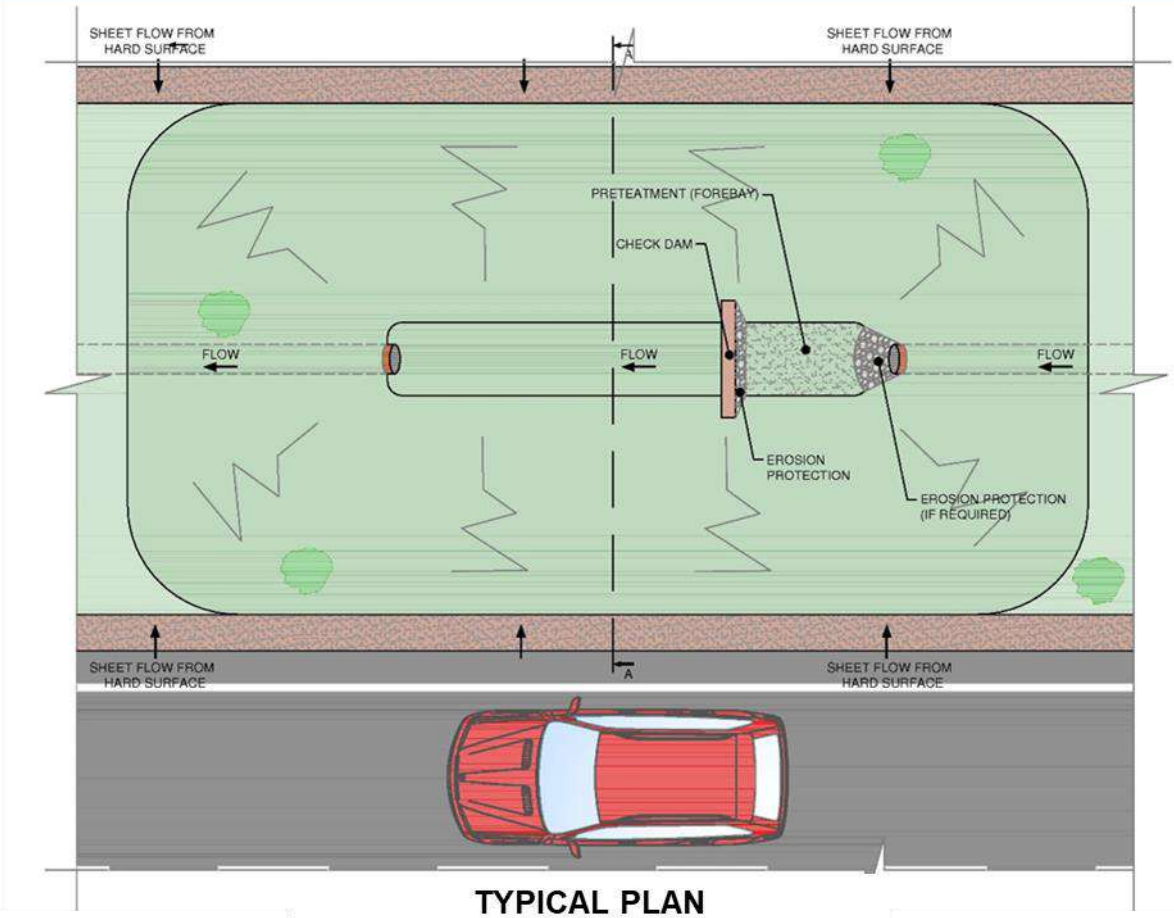
- Ideal for use with linear contributing areas like roads.
- Good for pre-treatment
- Can be enhanced to provide two stages of treatment.
- The land-take is usually moderate, minimum of 4m wide.
- Good water quality treatment.
- Can be easily incorporated into site landscaping and alongside roads.
- Can be enhanced using grass/wildflower seed mixes.
- Can be linked to create green corridors.
- Low/Medium cost and maintenance.

Local Context - Opportunities

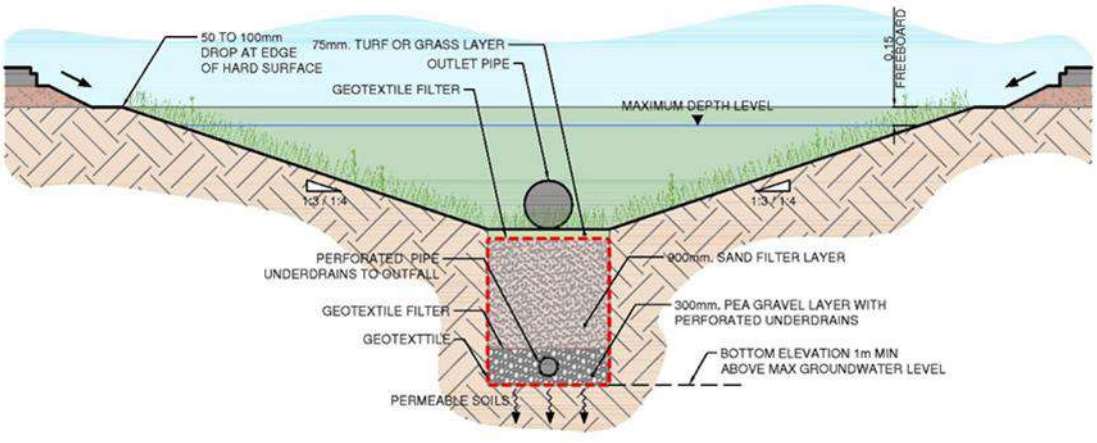
- Difficult to achieve minimum length in residential developments due to access crossings.
- Relatively moderate land-take.
- Checkdams needed for steeper sites.
- Needs to be enhanced to attenuate or significantly reduce peak flow or volume.
- May require lining on contaminated sites

Best Practice

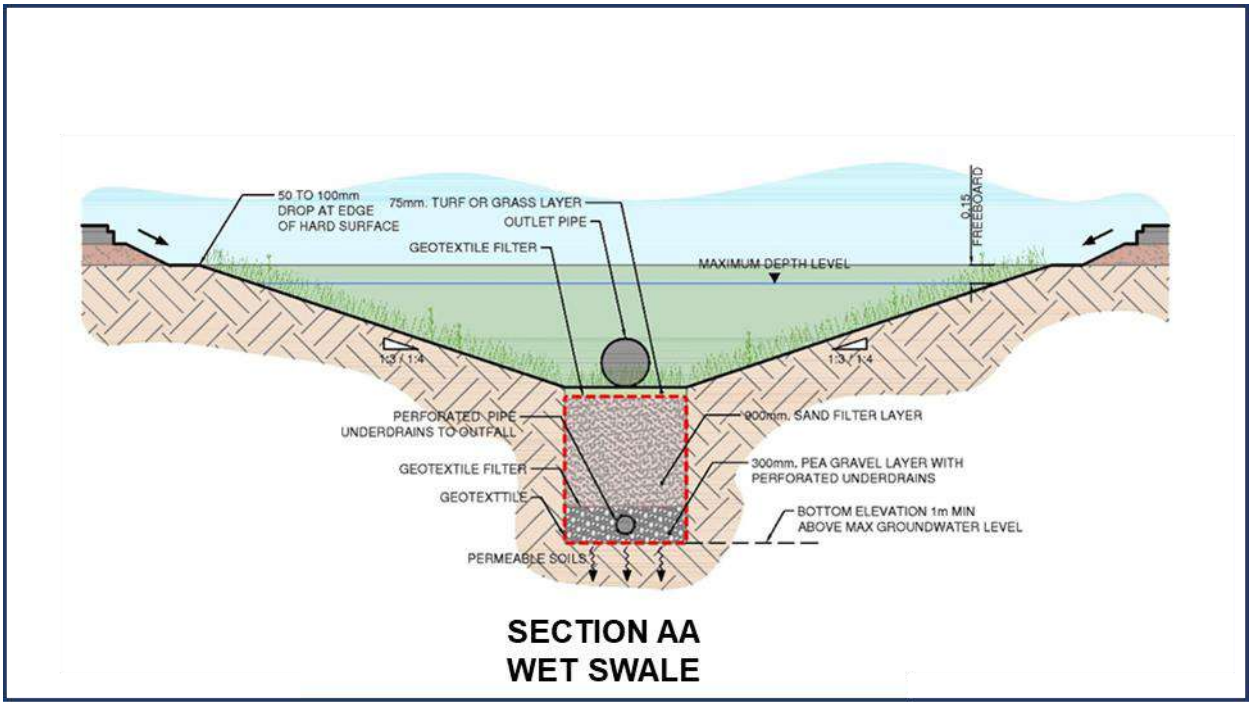
- Conveyance swales are suited to directing flow
- Dry swales provide additional filter treatment
- Wet swales encourage filtering and attenuation through wet and marsh like conditions



TYPICAL PLAN
SWALE



SECTION AA
DRY SWALE



Technical Requirements – Swales

Configuration and Dimensions of Swales

- Swales should be used as source controls only.
- Swales should be designed to the requirements of **CIRIA C753 The SuDS Manual, the requirements of this document and Appendix D - Figure D3**.
- Swales should be:
    - Trapezoidal or parabolic in cross section.
    - The side slopes of a swale shall be a maximum of 1 vertically to 4 horizontally.
    - The base of the swale shall be a minimum of 0.5 m and a maximum of 2 m wide and designed to avoid the formation of rills.
    - The depth of the swale shall be between 400 mm to 600 mm deep and achieve a freeboard of 150 mm during design flow conditions.
    - Swales shall be no less that 30m in length.
    - The longitudinal slope of the swale shall not exceed 1 vertically to 40 horizontally without the use of checkdams and shall not exceed 1 vertically to 10 horizontally.

Hydraulic and Water Quality Design Criteria

- Swales should be designed so that the flow arising from a 1 in 1 year 30-minute storm event does not exceed 0.3m/s or 100mm in depth.
- The average velocity should be calculated using Manning's equation with a roughness coefficient of 0.025 for flows up to the grass height. Grass

height in the channel should be assumed to be 100-150mm height. At depths of flow above the grass height the friction factor can be reduced to 0.01 for the analysis of design exceedance storm events.

- Storage volumes for the 1 in 1 year design event should dissipate within 24 hours, so that subsequent storms can be accommodated in terms of storage and treatment.
- Where practical, swales should form part of a wide blue/green network, designed for the temporary storage and conveyance of design exceedance storm events 30 to 100 year storm event. The maximum flow velocity should be below 1.0m/s. Higher velocities up to 2.0m/s may be permissible if erosion, soil stability and safety aspects can be demonstrated to the satisfaction of Council.

Selection and Siting

- Swales should be:
- Positioned as close to the source of receiving runoff as possible.
    - In a location that is easily and safely accessible by maintenance machinery.
    - On stable ground and where groundwater will not occur within 1 m of the base of the swale.
- Infiltration swales shall not be positioned adjacent to building foundations without a design certificate from a suitably qualified geotechnical engineer.
- Infiltration swales shall not dissipate water directly to ground without a suitable groundwater risk assessment.

Pre-treatment, inlets, and outlets

- Sheet flow is desirable to minimise erosion and increase treatment potential. Other options to provide an approximate to sheet flow, such as flush kerbs, shall be considered on a site by site basis.
- Point flow outlets such as road gullies and pipes shall flow into a flow spreader to minimise the risk of erosion and silting.
- A drop of 50 to 100mm shall be included at the edge of the hard surface to prevent the formation of a sediment lip.
- Conveyance swale discharge pipes and underdrain pipes shall be provided with a hydraulically designed outlet structure that is resistant to erosion.
- Swales shall include a suitably designed overflow to safely convey flows arising from design exceedance events. Overflows shall be incorporated within the development strategy for managing exceedance events and routed to planned temporary storage areas.

Landscaping and Amenity

- Swales shall be turfed or seeded at a rate of 40g/m2 over 100 – 150mm of topsoil with the following grass mix:

Table 8 Grass Mix

Species	Percentage
Perennial rye grass	25%
Smooth stalked meadow grass	25%
Slender creeping red fescue	30%
Chewings fescue	10%
Browntop bent	10%

- Where appropriate alternative specifications can be used such as wild flower species, where the developer can demonstrate that the proposed mix will be resistant to pollution and periods of prolonged dry and wet conditions.

Safety

- A risk assessment shall include all relevant safety and environmental issues associated with the SuDS Feature.

Operation and maintenance

- Access shall be provided to all areas of the swale for inspection and maintenance. All maintenance assess points shall be clearly visible and documented in the Operation and Maintenance plan.

5.6.7 Source Control - Bioretention



Larger areas of shallow vegetated open water with specially selected plant species and varying water levels and treatment areas. Water flows horizontally and is gradually treated prior to discharge; flow control is required.



Key Benefits



Design Standards

- **CIRIA C753 The SuDS Manual Part D.**
- **Design Manual for Roads and Bridges HA 103/06**

Best Practice

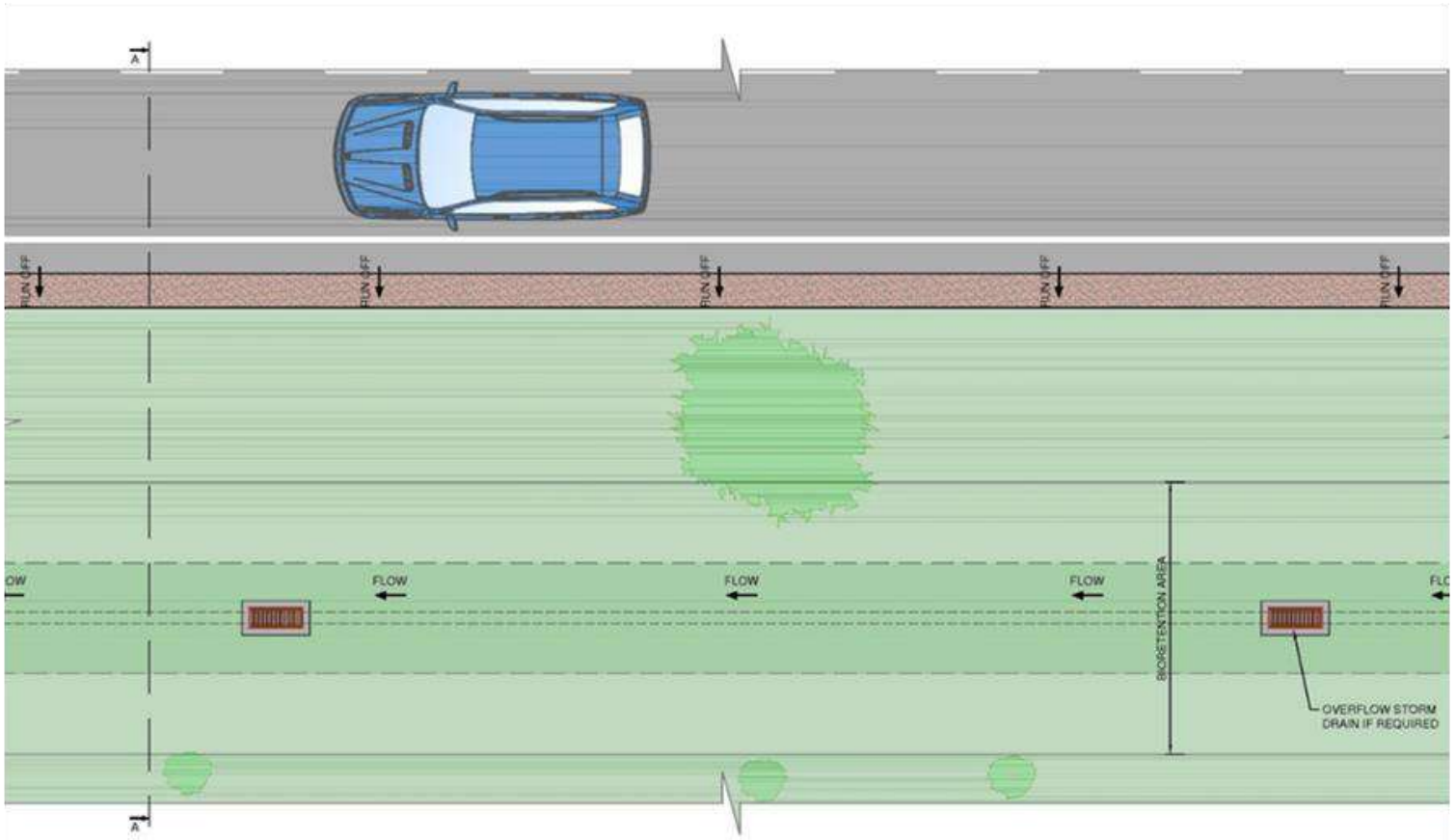
- Generally applied to small catchments and are typically 5% -10% of the contributing area.
- Bioretention should be lined where infiltration could cause slope stability or foundation problems.
- Groundwater table must be 1m below the base of the feature.
- Suggested width of 3m and a 2:1 length to width ratio to allow random planting of vegetation.
- Standard landscape mulch should be used for the top dressing not exceeding 75mm.
- Plants must be able to withstand pollution and extended dry and wet periods.

Local Context - Opportunities

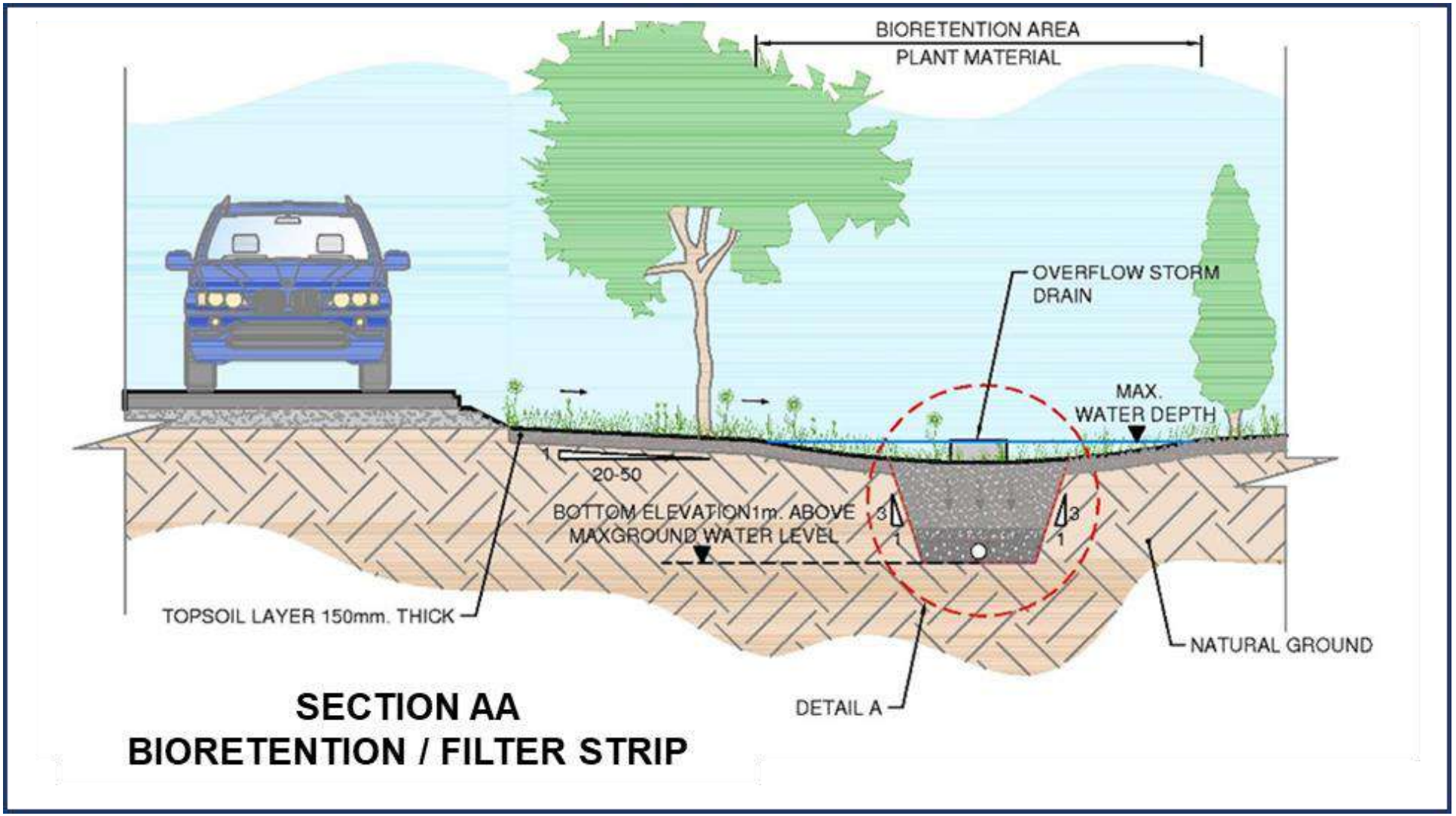
- Suitable for a variety of urban and rural environments.
- Good retrofit solution.
- Works well in low permeability soils.
- Can be very compact and used within streetscaping, or in larger landscaping areas.
- Good water quality treatment and volume reduction with infiltration.
- Can be adapted into a rain garden feature.

Local Context - Considerations

- Requires landscaping and management



TYPICAL PLAN
BIORETENTION / FILTER STRIP


BIORETENTION AREA
PLANT MATERIAL
OVERFLOW STORM DRAIN
MAX. WATER DEPTH
1
20-50
BOTTOM ELEVATION1m. ABOVE MAXGROUND WATER LEVEL
3
1
3
1
TOPSOIL LAYER 150mm. THICK
NATURAL GROUND
DETAIL A
SECTION AA
BIORETENTION / FILTER STRIP

Technical Requirements – Bioretention

Configuration and Dimensions of Bioretention

- Bioretention should be used as source controls only.
- Bioretention should be designed to **CIRIA C753 The SuDS Manual, the requirements of this document and Appendix D - Figure D4.**
- The use of proprietary bioretention units is permitted and shall be considered on a case by case basis.
- Performance of the bioretention units is independent of shape. Any shape can be used successfully. A minimum plan area of 20m2 with length to width of 2 to 1 should be considered to provide opportunities for diverse planting and easy access for maintenance.
- The 75mm mulch layer composed of shredded wood chips shall cover the bioretention area to reduce erosion and help to maintain moisture levels for plants.
- The filtration / bedding material shall comprise of engineered soil designed to sustain selected plants and achieve a permeability of 250 to 1000mm per hour under design conditions. The depth of the engineered soil will vary depending on the selected planting scheme, but shall be a minimum of 1m and a maximum of 2m.
- The engineered soil, transition sand later and coarse bedding material shall be wrapped in geotextile to the as shown on **Appendix D, Figure D4**, with a minimum 150mm overlap at all joins. The geotextile shall meet the requirements of the **Specification for Highway Works Series 500**.

Hydraulic and Water Quality Design Criteria

- Ponding in the bioretention area should not exceed 150mm.
- The bioretention design should be checked for design exceedance and modelled explicitly and holistically to demonstrate the impact to the downstream drainage components.
- The bioretention should be designed to half-empty in 24 hours to allow for incoming flows from subsequent storms.
- The base of the bioretention shall be at least 1m above the highest seasonal or permanent groundwater table.
- The underdrain pipe design should follow standard hydraulic design methods. Bioretention areas shall be provided with high level overflows and sub-surface collection pipe to accommodate design exceedance.
- A maintenance pipe for cleaning the underdrain should be provided and secured against vandalism.
- The transition layer below the soil filter media shall consist of 100mm of coarse sand with a grain size of 0.5 to 1mm.
- The gravel around the perforated underdrain shall be 5 to 20mm size.

Selection and Siting

- A risk assessment shall include all relevant safety and environmental issues associated with siting bioretention. This should be carried out by a qualified Engineer or Geologist where infiltration systems are proposed.
- The bioretention shall be designed for easy maintenance.
- Bioretention should be sited on stable ground, soil and groundwater conditions should be assessed to verify ground stability.
- Design of bioretention must comply with groundwater protection regulations and with Environent Agency policy on infiltration.

Pre-treatment, inlets, and outlets

- Sheet flow is desirable to minimise erosion and increase treatment potential. Other options to provide an approximate to sheet flow, such as flush kerbs, shall be considered on a site by site basis.
- Point flow outlets such as road gullies and pipes shall flow into a flow spreader to minimise the risk of erosion and silting.
- A drop of 50 to 100mm shall be included at the edge of the hard surface to prevent the formation of a sediment lip.
- Bioretention units shall include a suitably designed overflow to safely convey flows arising from design exceedance events. Overflows shall be incorporated within the development strategy for managing exceedance events and routed to planned temporary storage areas.

Landscaping and Amenity

- Bioretention unit design shall consider the different water availability regimes involved. Appropriate seed mix shall be applied to the wetter of the facility which will be subject to fluctuating water levels for extended periods.
- Planting of the higher parts of the bioretention shall include species resistant to extended dry periods as well as periods of excessive rainfall and wetting.

Health and Safety

- A risk assessment shall include all relevant safety and environmental issues associated with siting bioretention.

Operation and maintenance

- Access shall be provided to all areas of the swale for inspection and maintenance. All maintenance assess points shall be clearly visible and documented in the Operation and Maintenance plan.

5.6.8 Source Control - Pervious Pavements



Pervious pavements are structural paving in roadways, carparks, hard standings and pedestrian areas which are designed to allow runoff to soak through them. They can consist of block pacing (with gaps between the blocks) or porous blocks where water drains through the blocks themselves. Pervious pavements are designed with a sub base which allows water to be stored and discharge to the ground via infiltration and they provide an efficient means of managing surface water close to the source. They can contribute to reduce both the peak flow and volume of run off. The structure and underlying subsurface layer can also provide a water quality treatment function. Examples forms of permeable pavements include modular surfacing and block paving, porous asphalt, grass reinforcement or resin bound gravel. Pervious pavements can be designed to allow total infiltration to the sub soil, partial infiltration to the subsoil (where there is an overflow drainage connection used when the underlying soil can no longer infiltrate) or no infiltration (where infiltration is not technically feasible, and water is conveyed to an outfall point via perforated subsurface pipes). Pervious pavements systems can incorporate subsurface tanks to attenuate or collect flow before reuse within rainwater harvesting systems or discharge to downstream SuDS. In terms of maintenance, pervious pavements need to be cleaned of silt and other sediments to preserve their infiltration capacity.



Pervious pavements can be used on most sites and will be particularly suitable where new and existing development includes extensive areas of carparking and hardstanding. Pervious pavements are an effective alternative to impermeable surfaces and therefore require no extra development space for their construction. As they only require a small head difference between the runoff level and the outfall, they are suitable for use on flat terrain. Whilst they generally tend to be used in areas with low traffic volumes and light traffic loading (such as car parks) they are capable of supporting heavy goods vehicles. Pervious pavements can be used in most ground conditions and by incorporating suitable lining systems they can be used in brownfield areas. Runoff contamination, groundwater levels and existing services will require consideration and the design will need to consider proximity to existing building foundations as is the case with infiltration systems. Given their suitability and benefits, the use of permeable pavements should therefore be integral to the design of new surfaces. They can be combined with other SuDS solutions to effectively manage surface water. Retrofitting of pervious pavements to existing impermeable areas would also be encouraged.

5.6.9 Source Control - Trees



Trees can be incorporated within a range of SuDS components to improve their performance and contribute to effective surface water strategies. Including trees in new development can provide a number of surface water benefits by increasing transpiration, interception, increased infiltration and phytoremediation (where through drawing up water from the soil through transpiration harmful contaminants are taken into the tree and may be transformed into less harmful substances. In addition, trees within impermeable areas can effectively incorporate root storage systems as part of an effective bioremediation approach. Trees therefore contribute both to managing surface water quantities and contamination. Trees also have many other benefits to the surrounding environment including aesthetics, filtering harmful chemicals from the air, masking and reducing noise, creating wildlife habitats and absorbing and storing carbon dioxide.

Whilst incorporating trees alone may not be sufficient to manage surface water issues, the local and site wide benefits they can deliver as part of a coherent SuDS strategy is recognised. Their incorporation would therefore be encouraged both in new development as part of a retrofitting approach.

5.7 Site Control

5.7.1 Site Control - Detention Basins



Dry vegetated depressions in the ground that have been designed to attenuate storm water flows, provide temporary storage and some pollution removal through settling of particulates. They can also be designed to function as recreational areas.



Photo: JBA Consulting

Key Benefits



Design Standards

- **CIRIA C753 The SuDS Manual Part D.**
- **Design Manual for Roads and Bridges HA 103/06**

Best Practice

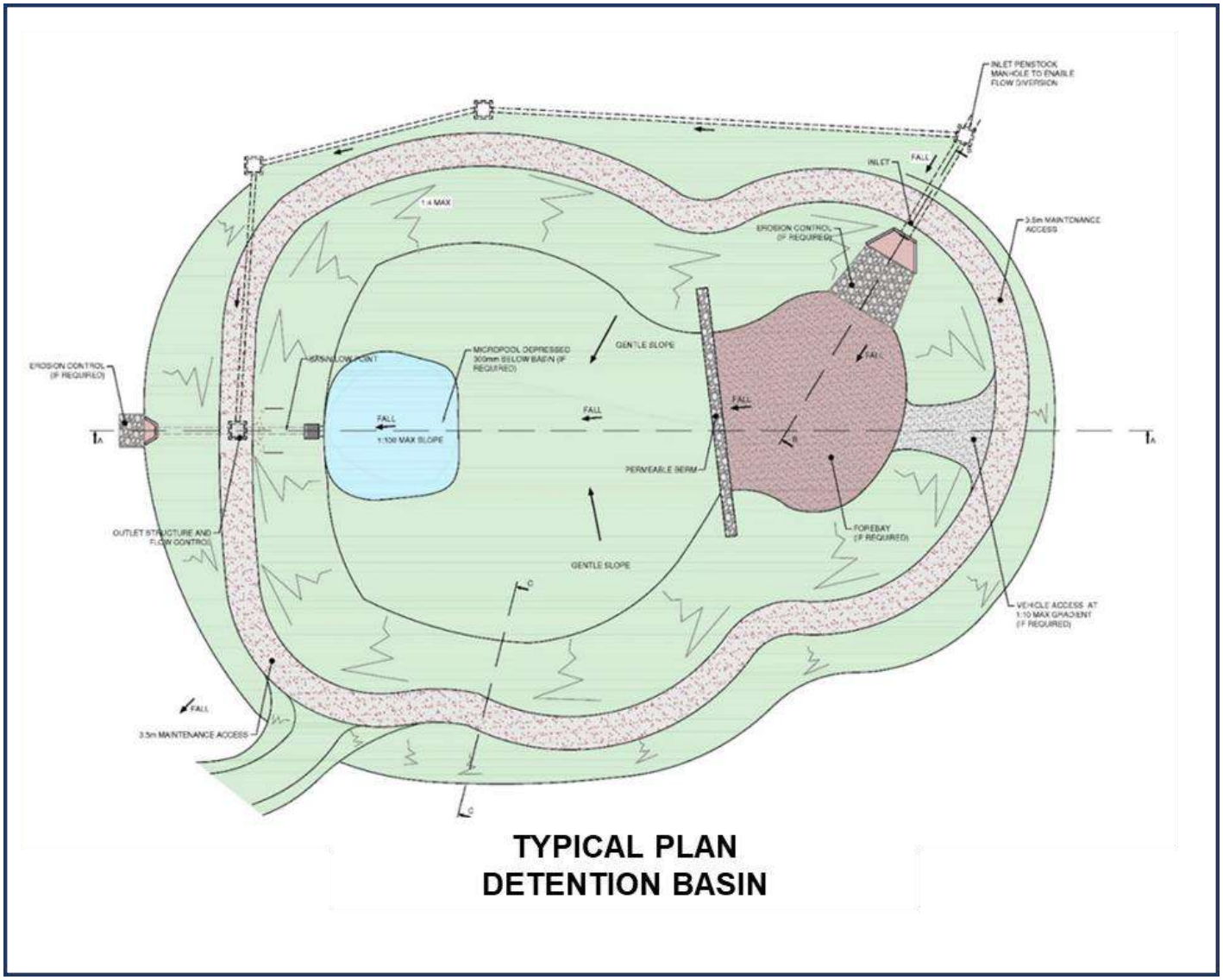
- Maximum water depth should not exceed 3m although local safety considerations may reduce this further.
- Length/width ratio should be between 1:2 and 5:1.
- Contouring inside the basin can assist with defining areas likely to be inundated.
- Maximum side slopes of 1 in 4 to allow easy access.
- Sediment forebay or pre-treatment option will improve the water quality
- Surface water bypass and drawdown is required to facilitate safe maintenance.
- Can be enhanced to improve ecological value

Local Context - Opportunities

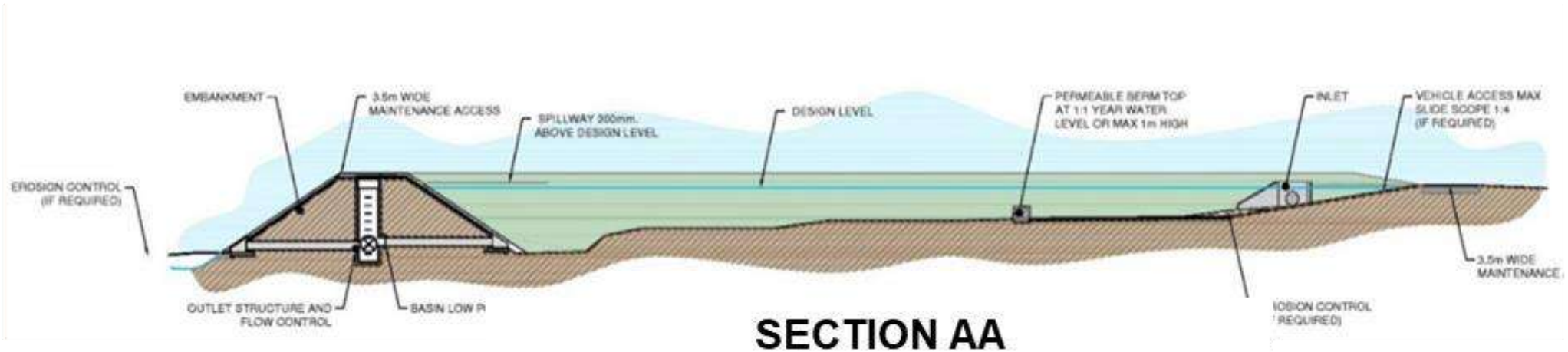
- Can be applied to large contributing catchments
- Works well in low permeability soils.
- Can be incorporated into larger landscaping.
- Good flow control.
- Easy to design, build and maintain.
- Can be used for sports, playgrounds or car parking if designed carefully.

Context - Local Considerations

- Low volume and pollution reduction.
- Requires landscaping and management.



TYPICAL PLAN
DETENTION BASIN



SECTION AA
DETENTION BASIN

Technical Requirements – Detention Basins

Configuration and Dimensions of Detention Basins

- Detention basins should be designed to **CIRIA 753 The SuDS Manual, the requirements of this document and Appendix D - Figure D6.**
- An irregular shape should be used for maximising the aesthetic aspect of the detention basins. Angular shapes should be avoided as far as practical in the design of basin elements and details.
- As a minimum detention basins should contain the following sections:
    - The sediment forebay if expected sediment loading is significantly high
    - The main basin
    - A part of the main basin depressed to form a micropool
- Additional elements to be included in the design of basins should be an inflow structure, an emergency overflow structure, bypass sewer piping and outlet with flow control device. The sedimentation forebay shall be separated from the permanent pool by a permeable berm.
- Detention basin bases shall be designed with gentle inner slopes (1 to 100 maximum) towards the centre.
- Embankment inner slopes shall be less than 1 to 4.
- The maximum design water depth of the basins shall be 3m.
- The length to width ratio for online detention basins shall be between 5:1 to 2:1.
- The maximum volume of the detention basins shall be 5000m^3

Hydraulic and Water Quality Design Criteria

- The drain down time should be a minimum of 24 hours, to allow for sedimentation to take place.

Selection and Siting

- A risk assessment should include all relevant safety issues associated with siting a basin.
- Siting of detention basins should follow a multicriteria analysis to provide the widest benefits to the public.
- The 100yr +Climate Change water level in any detention basin shall be at least 600mm below the finished floor level of any adjacent properties.
- Consideration should be given to the potential failure of any embankment and the subsequent flood flows through, and downstream, of the site.
- The maximum 1-year return period event basin water level shall be higher than the appropriate return period event water level of the adjacent watercourse, as specified by the Local Authority as part of its flood prevention duties. Appropriate hydraulic checks on the implications of high watercourse levels should be made, where appropriate.

- At sites of high groundwater table, the basin bottom level shall be built 500mm above the annual maximum groundwater level.
- At sites with contaminated soil, detention basins shall be designed water tight. Unlined detention basins should not be used on brownfield sites unless it has been clearly demonstrated that there is no risk of groundwater pollution.

Pre-treatment, inlets, and outlets

- Energy dissipation and erosion protection should be provided at the basin inlets. Basin inlets to be at least 300mm higher than the base of the basin.
- Safety grilles should be provided in all pipe inlets diameter greater than 350mm. During extreme events, operatives should be able to access safely the inlet pipe for cleaning.
- Detention basins should be designed with a slight depression in the inlet structures to encourage the water quality benefits of bioretention processes.
- A manhole and a flow control device should be provided at the outlet of the basin. Discharge from the basin should be limited to the allowable Council limit. The flow conditions in the receiving stream downstream of the basin should be modelled to the satisfaction of the Council.
- An overflow structure should be provided at the outlet. A spillway shall also be provided for an emergency. The spillway should be designed as a controlled overtopping of the embankment. It should not be designed to pass through the embankment. Emergency overflows should be routed back to the receiving watercourse to protect downstream properties.
- The top of embankment at the spillway should be 300mm above the 100 year + climate change allowance storm event.
- The outlet structure should be designed to operate and discharge the design discharge flow rate up to the 1 in 100 year + climate change 6-hour storm event. Appropriate hydraulic checks on the implications of high watercourse levels shall be performed, where applicable.

Landscaping and Amenity

- Consideration should be given to the suitable aesthetic design of the detention basin and its surrounds.
- The dual use of the detention basin as passive public open space for recreation activities should be considered where the area is subject to flooding from events less frequent than the 1-year return period and where it can be clearly distinguished from the area providing flood storage for frequent events.

Safety

- A safety risk assessment shall examine all relevant safety issues for both operatives and the public.

Operation and Maintenance

- Access road for maintenance of 3.5m minimum width access road shall be provided.
- A summary of the maintenance activities is provided below and shall be considered for basin accessibility design.
    - Removal of litter, debris and grass cutting.
    - Removal of unwanted plant species and dead plant growth.
    - Removal of aquatic plants if present.
    - Bank vegetation cutting and removal.
    - Sediment removal from forebays and micropools.
    - Reseeding of areas with poor vegetation growth.

Ecology

- Suitable native planting should be selected to maximise the ecological value of the detention basin and surrounds.

5.7.2 Site Control - Underground storage



Underground structures with capacity to store water below ground. They only provide attenuation and not treatment - cleaning of the water is therefore required prior to release.



Key Benefits



Design Standards

- **CIRIA C753 The SuDS Manual Part D.**
- **Design Manual for Roads and Bridges HA 103/06**

Best Practice

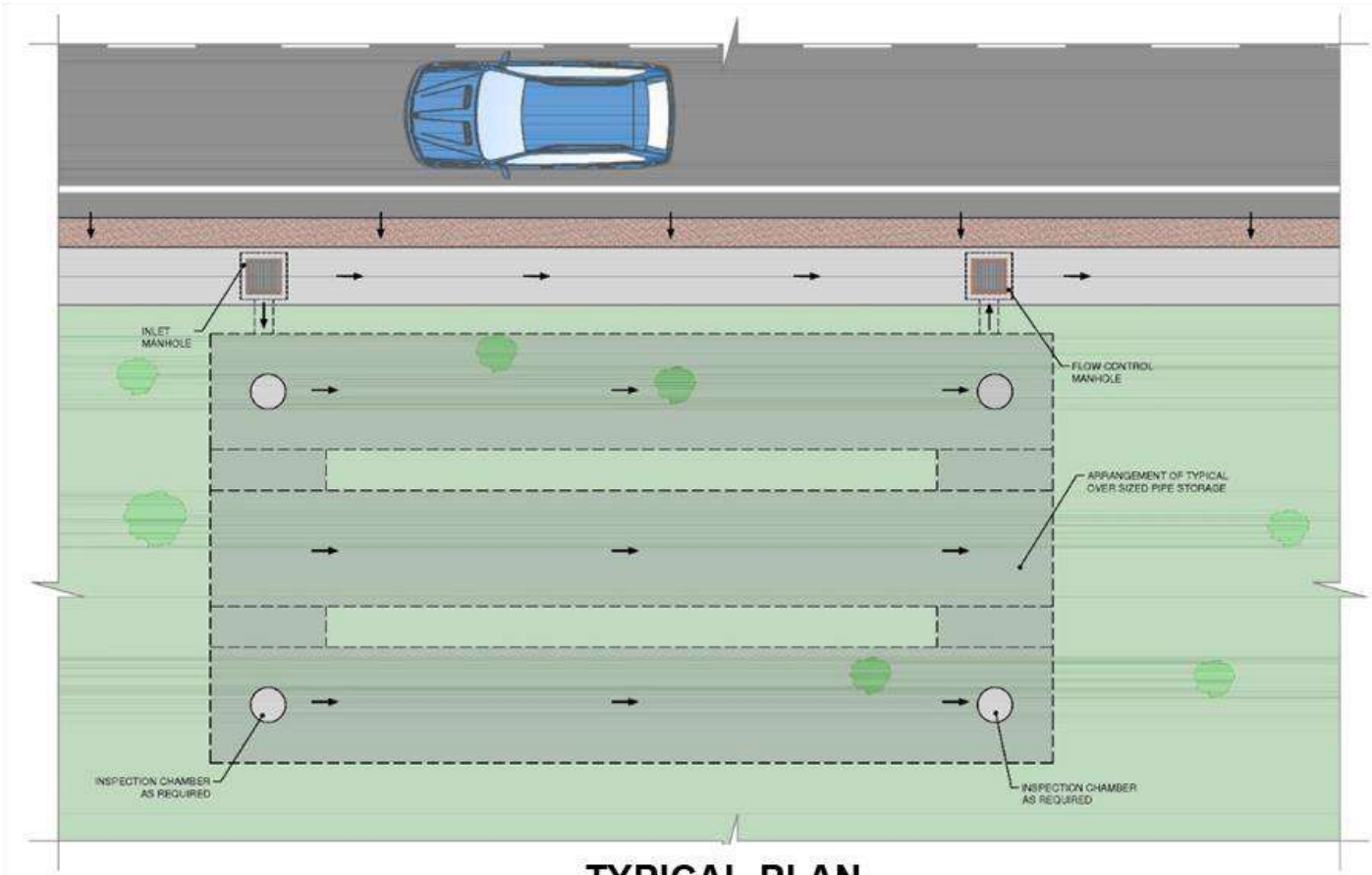
- Clear evidence of where the storage structure fits into a planned SuDS Management Train to provide silt removal and pollution treatment
- Examine possibility of enabling infiltration through geotextile layer
- Suitable internal void ratio of the structure (>90%)

Local Context - Opportunities

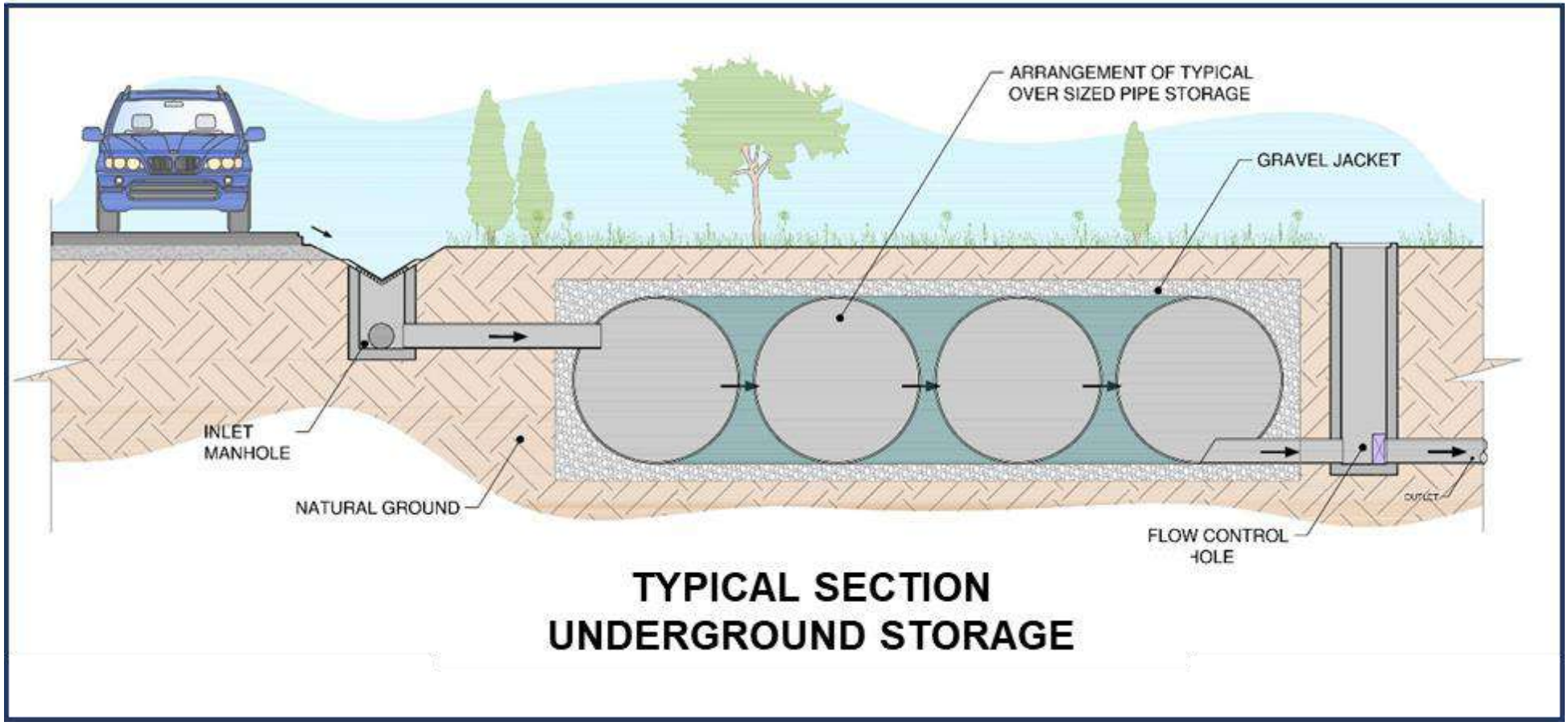
- Can be designed to attenuate stormwater from any drainage area
- Ideal where above ground space is not available
- Stable ground is required

Local Context - Considerations

- The underground storage must be part of a wider SuDS Management Train
- Designs should ensure avoidance of structural failure and collapse as well as expected loading



TYPICAL PLAN
UNDERGROUND STORAGE



TYPICAL SECTION
UNDERGROUND STORAGE

Technical Requirements – Underground Storage

Configuration and Dimensions of Underground Storage

- The use of underground storage (which provides no surface water treatment) shall only be allowed where the use of other SuDS methods are inappropriate.
- The design of the underground storage shall aim to minimise sedimentation. Underground storage should be designed to the **CIRIA C753 The SuDS Manual Part D, the requirements of this document and Appendix D - Figure D7.**
- Larger underground storage structures shall permit man-entry to enable inspection and maintenance activities to be carried out within the storage chambers. This shall include suitable clear opening and internal step irons for safe access/egress. Smaller underground storage structures should have suitable access points to permit remote cleaning and inspection to be readily carried out. Covers should be large enough to allow man-entry with breathing apparatus. Entry points should be on level ground to permit the erection of man-entry safety tripods.
- Design options that shall be acceptable for public areas are pre-fabricated structures, oversized pipes or cast in-situ concrete structures.
- The maximum water level in any underground storage structure shall be at least 600mm below the lowest floor level of any adjacent premises.
- Underground storage should normally be designed as off-line storage and should be sized in accordance with the hydraulic design requirements.
- Low-flow channels should be provided.
- The minimum gradient for storage systems should be 1:100 for off-line tanks and 1:200 for on-line tanks to minimise sedimentation.

Selection and Siting

- Underground storage should not be located beneath public areas or roads.

Pre-treatment, inlets, and outlets

- The outlet structure should be designed to operate and discharge the design-limiting discharge rates. Appropriate hydraulic checks on the implications of high downstream water levels should be made, where appropriate, and take account of the receiving watercourse or downstream sewer capacity.
- Flow controls shall be designed to the requirements of **Sewers for Adoption**. The minimum size of any orifice should be 75mm diameter.
- The outlet structure should have an overflow provided.

Safety

- A risk assessment shall include all relevant safety and environmental issues associated with the SuDS Feature.

Operation and maintenance

- All maintenance access points shall be clearly visible and documented in the Operation and Maintenance plan.

5.8 Site & Regional Controls

5.8.1 Site & Regional Control - Retention Ponds & Wetlands



Retention ponds are structures that provide both retention and treatment of contaminated storm water runoff. Retention ponds include a permanent pool of water into which storm water runoff is directed and outflows are controlled to reduce flow rate. A well-designed pond provides a community asset and opportunities for new habitats. The pond's physical, biological, and chemical processes work to remove storm water pollutants. Sedimentation processes remove particulates, organic matter, and metals, while dissolved metals and nutrients are removed through biological uptake. In general, a higher-level storm water quantity control can be achieved as well as providing positive amenity benefits.



Photo: JBA Consulting

Key Benefits



Design Standards

- **CIRIA C753 The SuDS Manual Part D.**
- **ROSPA Safety at Inland Water Sites - Operational Guidelines.**

Best Practice

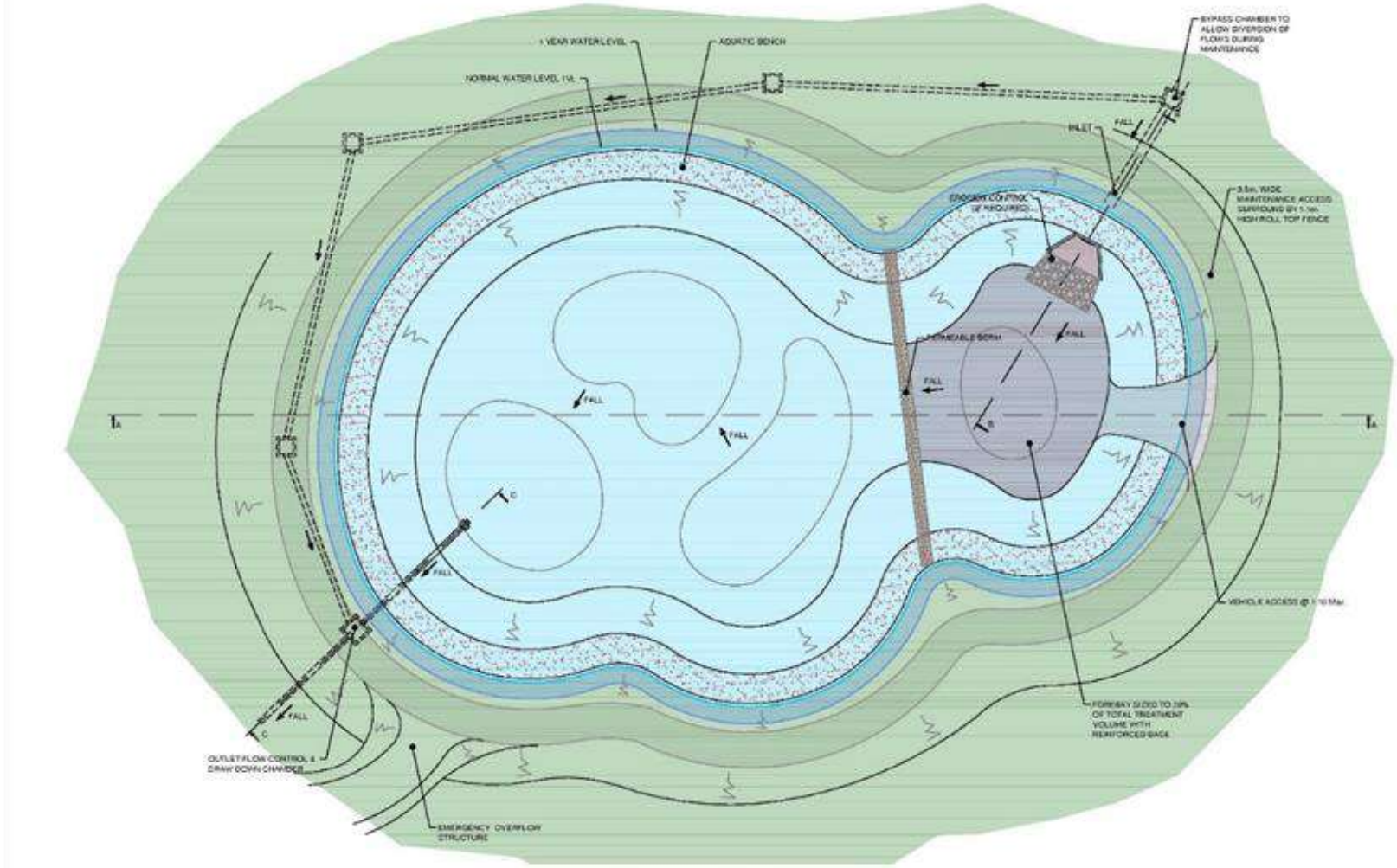
- The pond should have 4 zones - sediment forebay, permanent pool, temporary storage volume and shallow, wetland-type zone.
- Located outside the floodplain
- Water quality treatment levels required should determine design
- Depth should be <2m to prevent stratification
- A liner may be required to prevent infiltration if the water is polluted or if the pond is near an aquifer
- Maintenance should account for invasive species
- Health and safety should be considered to restrict proximity of the public to the pond

Local Context - Opportunities

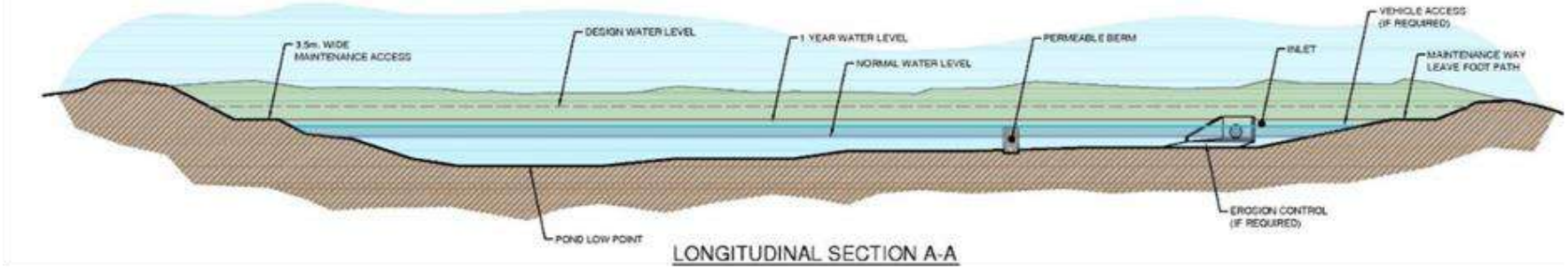
- Can be applied to large contributing catchments.
- Works well in low permeability soils and permeable soils with a liner.
- Good flow control.
- Easy to design, build, maintain.
- Can be used for amenity use.
- Can incorporate a drawdown zone to reduce runoff volume.

Local Context Considerations

- Large area of land required
- Not suited to sloping sites.
- Requires landscaping and management.
- Perceived safety risks need to be managed



TYPICAL PLAN
ATTENUATION POND



LONGITUDINAL SECTION A-A

SECTION AA
ATTENUATION POND

Technical Requirements – Retention Ponds

Configuration and Dimensions of Retention Ponds

- Retention ponds should be designed to **CIRIA 753 The SuDS Manual and the requirements of this of this document and Appendix D - Figure D5.**
- The aesthetic element should prevail in the design of ponds. Angular shapes and symmetry should be avoided in the design of pond layout and details. All ponds should contain several zones:
    - The sediment forebay
    - The permanent pool
    - The temporary storage volume
    - An aquatic bench
- Additional elements to be included in the design of ponds include:
    - A 3.5m wide maintenance route, suitable for vehicles.
    - An inflow structure.
    - A bypass sewer,
    - An outlet with flow control and drain down chamber.
    - An emergency overflow structure,
- The sedimentation forebay should be separated from the permanent pool by a permeable berm and have an average width of 5 to 10 times the inlet pipe diameter and a length of 10m or four times the width, whichever is greater.
- Inlets and outlets shall be placed at the maximum distance to maximise flow paths.
- The flow path length to width ratio shall be 3:1 minimum to avoid short circuiting.
- A maximum depth of 2m should be used for the permanent pool to prevent anoxic conditions and water stratification. The minimum water depth of the permanent water zone shall be 1.2m to prevent plant growth.
- The maximum depth of attenuation storage should not exceed 2m.
- The aquatic bench should be a minimum of 2m continuous around the pond, except at inlets and should range in depth up to 450mm below the design permanent pool level.
- The top level of the permeable berm shall be 150mm below the permanent pool water level.
- Energy dissipation should be provided at the inlet and outlet to the pond
- Ponds should be designed to hold a permanent volume of water equivalent to the treatment volume, also referred to as Vt.
- The treatment volume (Vt) should be calculated using the fixed depth method of 15mm of rainfall from impermeable (including paved and roofed) surfaces draining to the pond.
- The volume of the sediment forebay should be approximately 10% of the pond's permanent volume (Vt).

- The maximum volume of any retention pond should be 5000m^3.
- The Sedimentation forebay should be designed to provide efficient deposition of sediment and should be accessible for cleaning and maintenance operations in its entire area.
- The floor of the sedimentation forebay should be a minimum of 300mm above the main pond bottom
- The design should include a safe and efficient means of draining the lowest point in the detention pond.

Hydraulic and Water Quality Design Criteria

Ponds hydraulic design

- The top of the embankment should be 600mm above the maximum design water level.
- The outlet structure should be designed to operate and discharge the design discharge flow rates up to the 100yr + climate change 6-hour storm event.
- Ponds should provide a minimum permanent pool volume equal to one times the treatment volume for paved surfaces.
- Pond liners should be finished at a height 150mm below the outlet control unit where appropriate to encourage infiltration and to minimise discharges to the receiving water for small events. However, they should not be lower than the invert level if used on a site with a sensitive underlying groundwater zone or if used to treat runoff from a potential pollution hotspot.
- The by-pass sewer network should be designed for flows equal to the incoming flows.
- The hydraulic capacity of the draw down facility for emptying the pond should consider the geotechnical stability of the pond and associated embankments.

Selection and Siting

- The risk assessment should include all relevant safety issues associated with siting a pond.
- A detailed analysis and impact assessment of a flood exceedance event indicating flow paths shall be undertaken and submitted to Council. Where ponds are impounded behind engineered embankments, the unlikely scenario of embankment failure should be examined and potential impacts downstream of the pond assessed.
- The siting of retention ponds should follow a multicriteria analysis to provide the widest benefits to the public.
- The highest design water level in retention ponds should be at least 600mm below the floor level of any adjacent premises.
- The maximum 1-year return period event pond water level should be higher than the appropriate return period event water level of the adjacent watercourse, as specified by the Lead Local Flood Authority. Appropriate

hydraulic checks on the implications of high watercourse levels should be made, where appropriate.

- In sites containing contaminated soils or contaminated groundwater, ponds should be fully contained within an impermeable liner to prevent cross contamination of surface water.

Pre-treatment, inlets, and outlets

- Bypass structures shall be provided at both the inlet and outlet chambers. The risk to the embankment stability shall be kept to a minimum.
- A man entry chamber shall be provided at the inlet of the pond.
- The invert level of the incoming sewers to the inlet structure shall be at or above the 1-year water level in the pond.
- A man entry chamber shall be provided for the pond outlet equipped with a flow control device. Minimum diameter of the control device shall be 75mm.
- Bypass structures shall be provided at both the inlet and outlet chambers. The risk to the embankment stability shall be kept to a minimum.

Landscaping and Amenity

- Ponds should be designed to protect and enhance the landscape.
- Ponds should be planted and seeded with native species to promote variation in the physical habitat value of the pond.
- Trees shall not be planted within the pond or embankments.

Safety

- A safety risk assessment shall examine all relevant safety issues for both operatives and the public.

Operation and maintenance

- The pond shall be accessible to cleaning equipment by an access road 3.5m minimum width.
- A summary of the maintenance activities is given below and shall be considered for pond accessibility design.
    - Removal of litter, debris and grass cutting.
    - Removal of nuisance plant species and dead plant growth.
    - Removal of submerged and emergent aquatic plants if present.
    - Bank vegetation cutting and removal.
    - Sediment removal from forebays and main pond body.
    - Reseeding and replanting as required.
- Pond outlet design shall provide for removal of blockages.

5.8.1 Wetlands



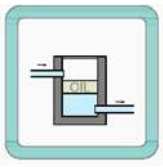
Landscaped depressions containing permanent pools of water, retention ponds are similar in many respects to detention basins, in that they can collect and temporarily store / attenuate surface water runoff and release it more slowly to the discharge point. The attenuation storage volume is provided above the permanent water level and thus they provide a smaller storage volume than the equivalent sized detention pond. However, they can provide an enhanced level of water quality treatment and also provide biodiversity and amenity benefits by supporting emergent and submerged vegetation along the waterline and within shallow marshy areas. Retention ponds need to be designed with suitable upstream pre-treatment systems to prevent open water areas becoming blocked with silt, odorous due to pollution or stagnant. Well managed ponds and wetlands can add significant economic value to a development.

Similar to detention basins retention ponds are generally suitable to most types of development and can be used for retrofitting where existing drainage networks and land availability allows. They will however provide less storage than detention basins and therefore their siting and use will require consideration of existing and future flood volumes. They do however provide an effective means to manage surface water flood risk and can provide valuable multifunctional benefits aesthetic, amenity and biodiversity benefits.

5.9 Pre- Treatment Options

5.9.1 Pre Treatment – Propiertary Systems Catchpits & Oil and Sediment separators





Oil and sediment separators can be used as pre-treatment, or as a last resort, site treatment for the removal of sediment, litter, and oil from surface water runoff. These systems which include catchpits can be installed in a standard size manhole. Captured pollutants are retained within the separator, providing a single point of maintenance.

These manufactured SuDS systems are designed to provide treatment of surface water through the removal of contaminants. They are generally most suitable where site constraints such as available space limitations preclude the use of other more natural treatment measures.

Typical treatment systems include proprietary bioretention systems, treatment channels, hydrodynamic or vortex separators, filtration systems and oil and multi process system and catchpits. These types of treatment systems are generally used alongside SuDS techniques which are designed to manage water quantity.

Vortex Seperators Key Benefits	Oil & Sediment Separators
	
Design Standards	**Design Standards**
• Require designing so that regular maintenance can be undertaken • As the vortex separator requires a velocity to function, a filtration chamber or detention basin should be used for small flow events	• Must comply with BS EN standards for separating systems • Require maintenance to prevent re-suspension of pollution • Should be situated close to the pollution source
Best Practice	**Best Practice**
• Most effective for removal of heavy particulate matter rather than solids or dissolved pollutants	• Depending on the location to which the water is to be drained and the type / severity of pollutants, different classes of separators should be used

Technical Requirements – Oil and Sediment Separators

Configuration and Dimensions of Oil and Sediment Separators

- Oil separators used for the removal of oil and grease present in storm waters operate on the flotation principle. Separated oils are floating on the water surface inside the unit.
- The use of proprietary units is permitted and shall be considered on a case by case basis.

Hydraulic and Water Quality Design Criteria

- Facility design shall be in accordance with **BS EN 858-1:2002 Separator systems for light liquids (e.g. oil and petrol). Principles of product design, performance, and testing, marking and quality control.**

Selection and Siting

- Oil separator units should be installed underground. The installation site shall be within passive open space accessible by a vacuum tanker for cleaning and maintenance.

Health and Safety

- A risk assessment shall include all relevant safety and environmental issues associated with siting the oil separators.

Operation and maintenance

- Regular inspection of the unit in accordance with the manufacturer's maintenance requirements but no longer than every six months. The volumes of bottom sludge and the floating layer shall be estimated and cleaning of the unit should be scheduled.
- Cleaning of the oil separator shall be performed by a licenced waste management company to ensure appropriate disposal of the collected oils, floatables and sediment.
- Following cleaning the separator shall be filled with clean water, ready to fully operate with the first rainfall.

6. SuDS MAINTENANCE AND MANAGEMENT

6 SuDS Maintenance and Management

WHAT THIS SECTION WILL COVER:

- SuDS maintenance and management plan
- Who should undertake maintenance?
- Maintenance activities and frequency

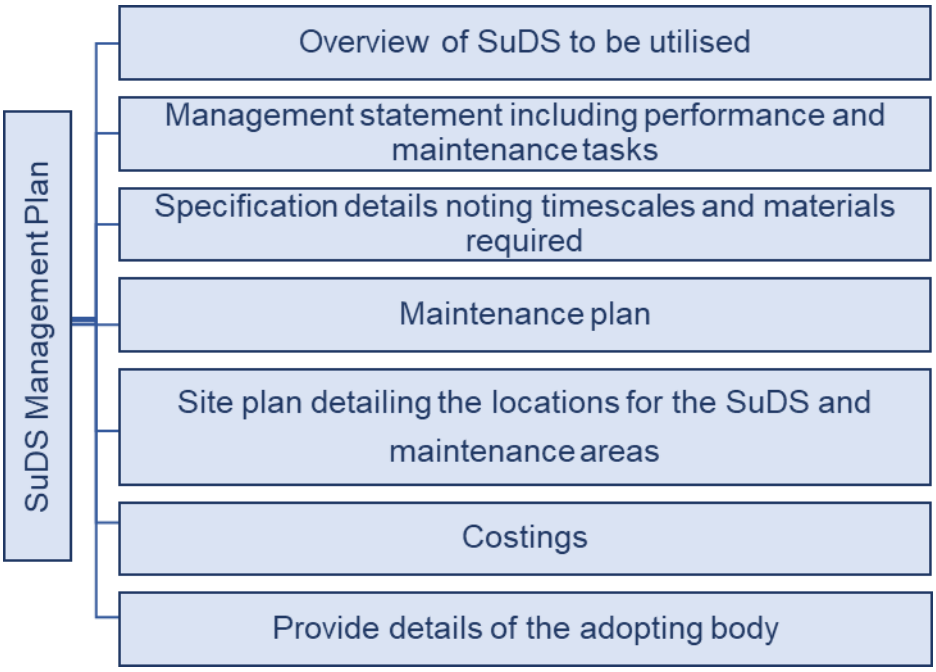
SuDS should be designed to be visible and function under anticipated loading conditions over the design life of the development. This will enable those who are responsible for maintenance to easily identify and remediate problems as they occur. When systems are properly designed, operated, and maintained, SuDS performance can be easily monitored against the expected performance.

6.1 SuDS Maintenance and Management Plan

The maintenance and management of SuDS should be recorded within a SuDS Management Plan which should form part of the information submitted by the Developer at the planning application stage.

The approved Maintenance and Management plan must include information on the safe operation, design assumptions, maintenance of SuDS components and how SuDS components interact. The Maintenance and Management Plan must include an estimate of the ongoing maintenance costs. Where appropriate the management plan must make provision for a warning system and contingency arrangements. If undertaken correctly, the design of SuDS will ensure that day to day and long term maintenance is feasible, cost-efficient, and easy to undertake. Most the SuDS components are features of the landscape and so should be managed according to existing landscape practices. Maintenance fits into the management plan as shown on **Figure 15.**

Figure 15 SuDS Maintenance and Management Plans



6.2 Responsibility for Maintenance?

It is the responsibility of the developer to establish a maintenance agreement that ensures the drainage system is maintained and continues to function as designed in perpetuity for the lifetime of the development. National guidance indicates that this maintenance should be undertaken by any of the bodies shown on **Figure 16**. **It should be noted that the Councils are currently not adopting or maintaining SuDS schemes.**

Figure 16 Parties Responsible for Maintenance



6.3 Post Construction Verification

A Condition of the Planning Approval will be the requirement to the Developer to confirm to the Local Planning Authority that the proposed SuDS scheme has been constructed in line with the proposed design. This will take the form of appropriate plans and other as constructed information.

6.4 Maintenance of SUDS Components

Maintenance of SuDS components is important to ensure their ongoing effectiveness. Table 6-4 identifies the principal “Frequent”, “Occasional” and “Remedial” maintenance works for a range of SuDS components. Further details are available in the CIRIA SuDS Guidance.

Figure 17 SuDS Maintenance Requirements

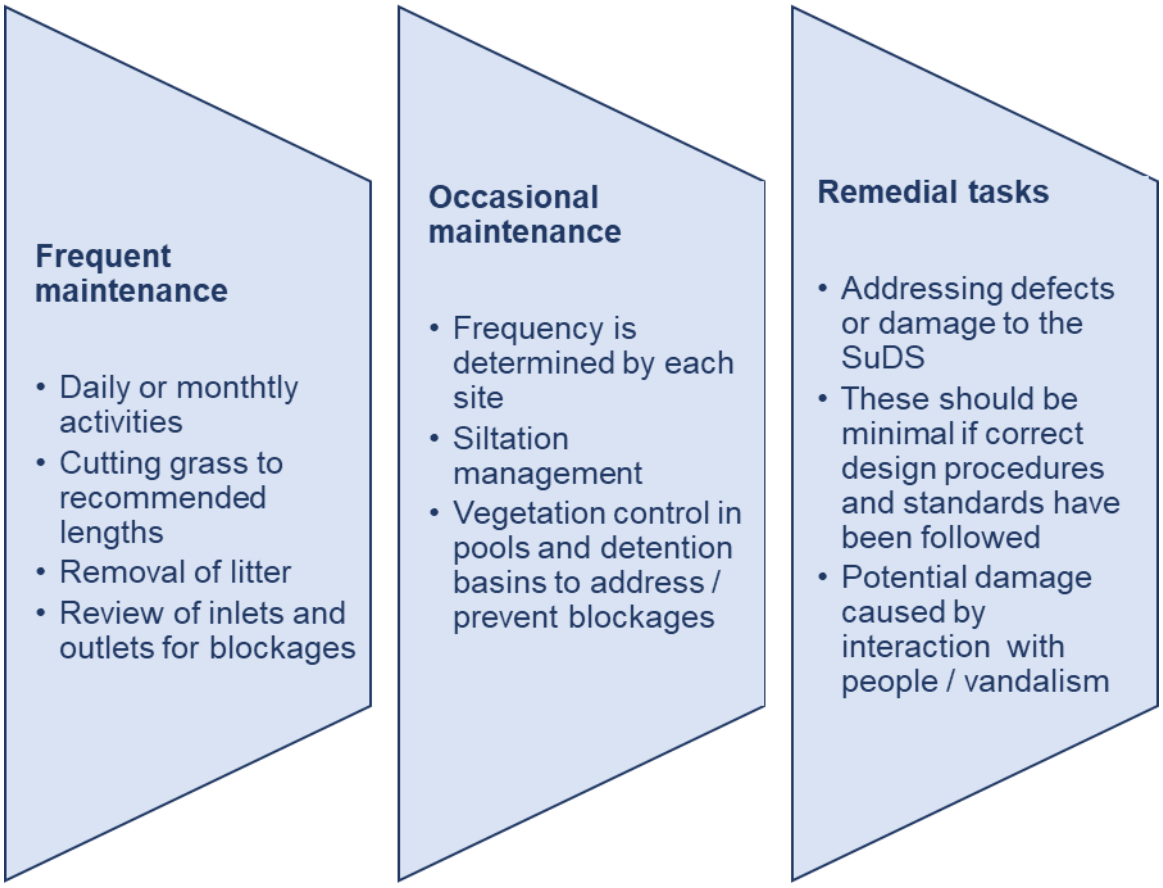


Table 9 SuDS Maintenance Requirements

	Activity	Rainwater Harvesting	Green Roofs	Infiltration Systems	Filter Trench	Filter Strips	Swales	Bio Retention	Pervious Pavement	Trees	Detention Basin	Underground Storage	Retention Ponds & Wetlands	Pre Treatment Options
Frequent	Inspection	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Removal of litter/debris				✓	✓	✓	✓	✓	✓	✓		✓	✓
	Pruning grass and SuDS vegetation				✓	✓	✓	✓	✓		✓		✓	✓
	Maintenance of surrounding plants							✓		✓	✓		✓	
	Removal of debris and litter clogging of inlet drains.		✓											
	Manage planting and remove fallen leaves and debris and replace dead plants as required.		✓											
	Clearance of inlets/outlets	✓		✓	✓	✓	✓				✓	✓	✓	

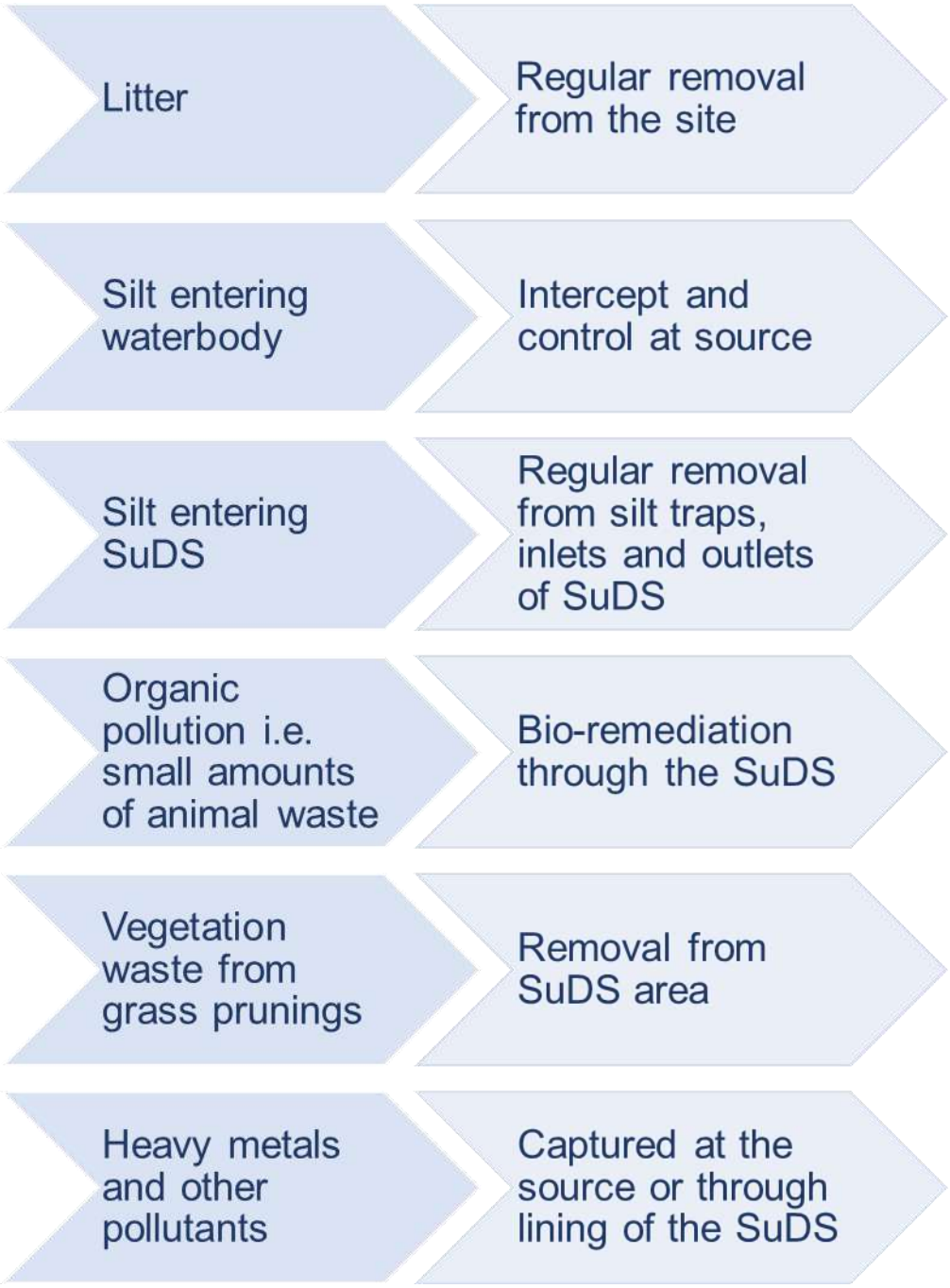
	Activity	Rainwater Harvesting	Green Roofs	Infiltration Systems	Filter Trench	Filter Strips	Swales	Bio Retention	Pervious Pavement	Trees	Detention Basin	Underground Storage	Retention Ponds & Wetlands	Pre Treatment Options
	Silt removal	✓		✓				✓	✓				✓	✓
	Removal of compost						✓							
	Replenish mulch							✓						
	Surface scarification							✓						
	Brushing and vacuuming								✓					
Occasional	Silt removal / review of silt levels			✓	✓	✓				✓	✓		✓	✓
	Cleaning and replacement of filters	✓												
	Replenish mulch													
	Excess vegetation removal						✓		✓		✓		✓	✓
	Removal of weeds from surface								✓					

	Activity	Rainwater Harvesting	Green Roofs	Infiltration Systems	Filter Trench	Filter Strips	Swales	Bio Retention	Pervious Pavement	Trees	Detention Basin	Underground Storage	Retention Ponds & Wetlands	Pre Treatment Options
Remedial	Repaor of overflow erosion damage to tank and pump repairs	✓												
	Review of erosion						✓							
	Review / repair of inlets and outlets				✓		✓	✓			✓		✓	✓
	Replace filter stones			✓	✓	✓								
	Readjust retention levels							✓						
	Replace geotextile layer				✓	✓								
	Silt removal				✓	✓	✓					✓		✓
	Remediate asjacent lansdcaping								✓					
	Remedial works to depressions / broken blocks								✓					
	Rehabilitation of surface								✓					

6.5 Waste management for SuDS

A maintenance programme should also include plans for addressing waste produced by SuDS:

Figure 18 SuDS Waste Management Plan



Appendices

Appendix A SuDS Submission Application and Approval Checklist (the Checklist)

Please refer to Council Website for downloadable copy of checklist.

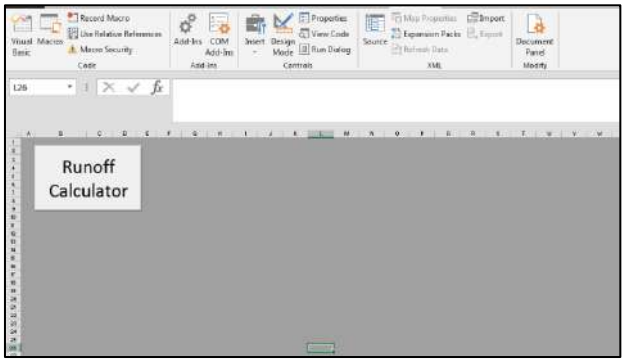
Appendix B
Runoff Calculator Guide

Please refer to Council Website for downloadable copy of runoff calculator

Appendix B Runoff Calculator Guide

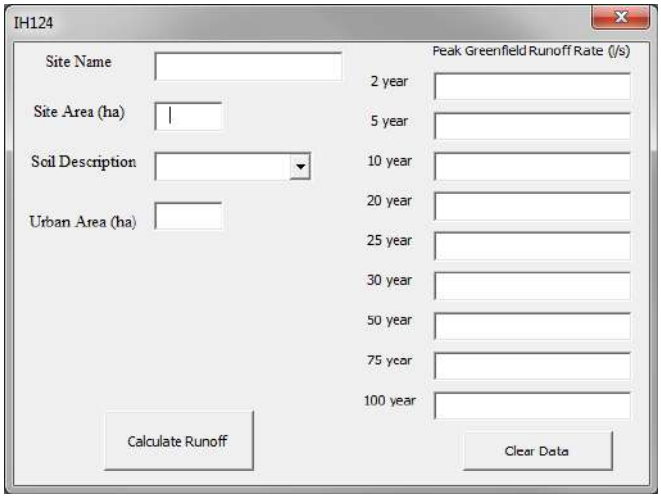
The Runoff Calculator is a programme constructed in Microsoft Excel. The runoff calculator can be downloaded from the Councils Website. To use the programme, open the file **"Runoff Calculator.xlsm"** and ensure macros are enabled. When open, the file should look similar to Figure B-1.

Figure B-1



To use the Calculator, press the "Runoff Calculator Button" A window should be displayed similar to Figure B-2.

Figure B-2



This window in **Figure B-2** should be completed as follows:

Site Name:	A name for the Site.
Site Area:	The area of the site in hectares.
Soil Description:	Select the best description of the prevailing ground conditions for the Site.
Urban Area	The area of impermeable surface within the site in hectares.

Once these have been completed press the "Calculate Runoff" button to calculate the peak Greenfield Runoff Rate in litres per second for the displayed return periods.

Appendix C
SuDS Suitability Matrix

Please refer to Council Website for downloadable copy of SuDS Suitability Matrix

Appendix D
SuDS Indicative Design Layouts

Figure D1 Filter Drain / Infiltration Trench

Figure D2 Detention Filter Strip

Figure D3 Swales

Figure D4 Bioretention

Figure D5 Retention and Detention Basin

Figure D6 Underground Storage

Figure D7 Vortex Separator

Figure D1 Filter Drain / Infiltration Trench

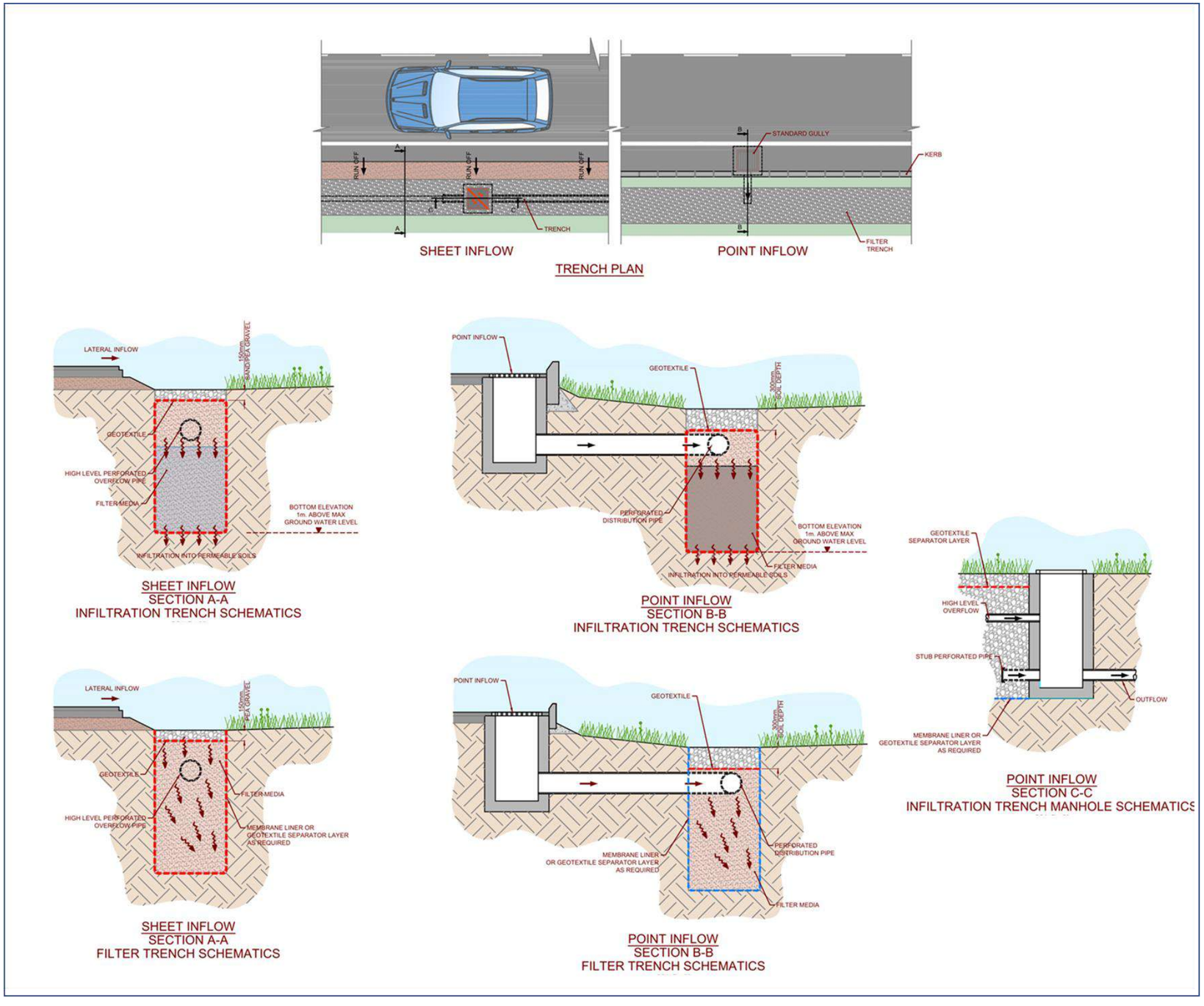
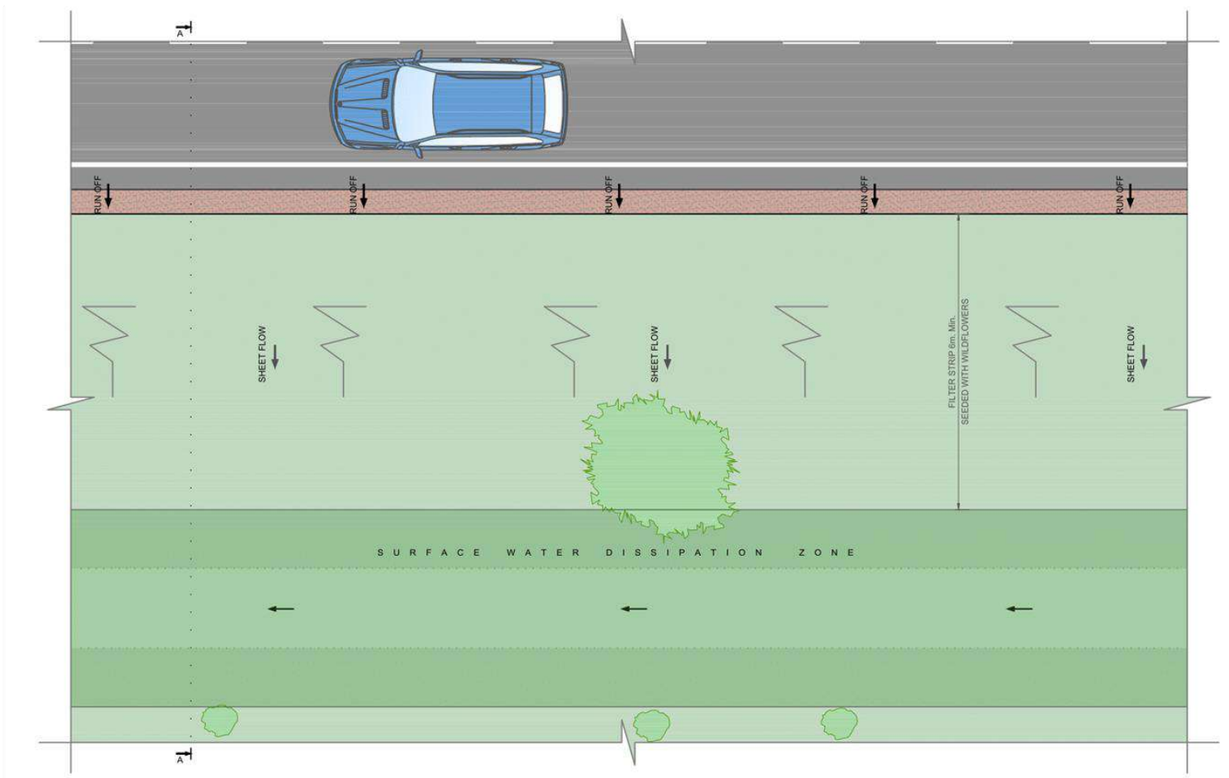
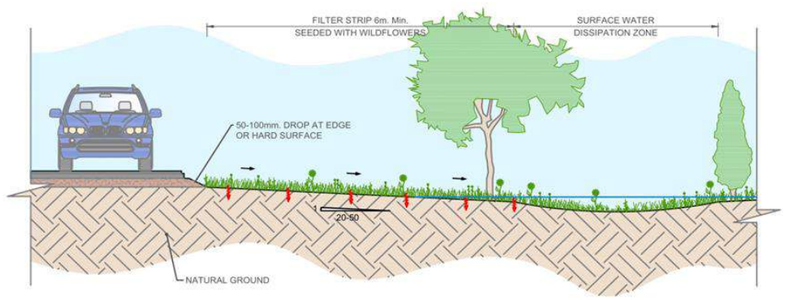


Figure D2 Detention Filter Strip



BIORETENTION / FILTER STRIP PLAN



SECTION A-A

Figure D3 Swales

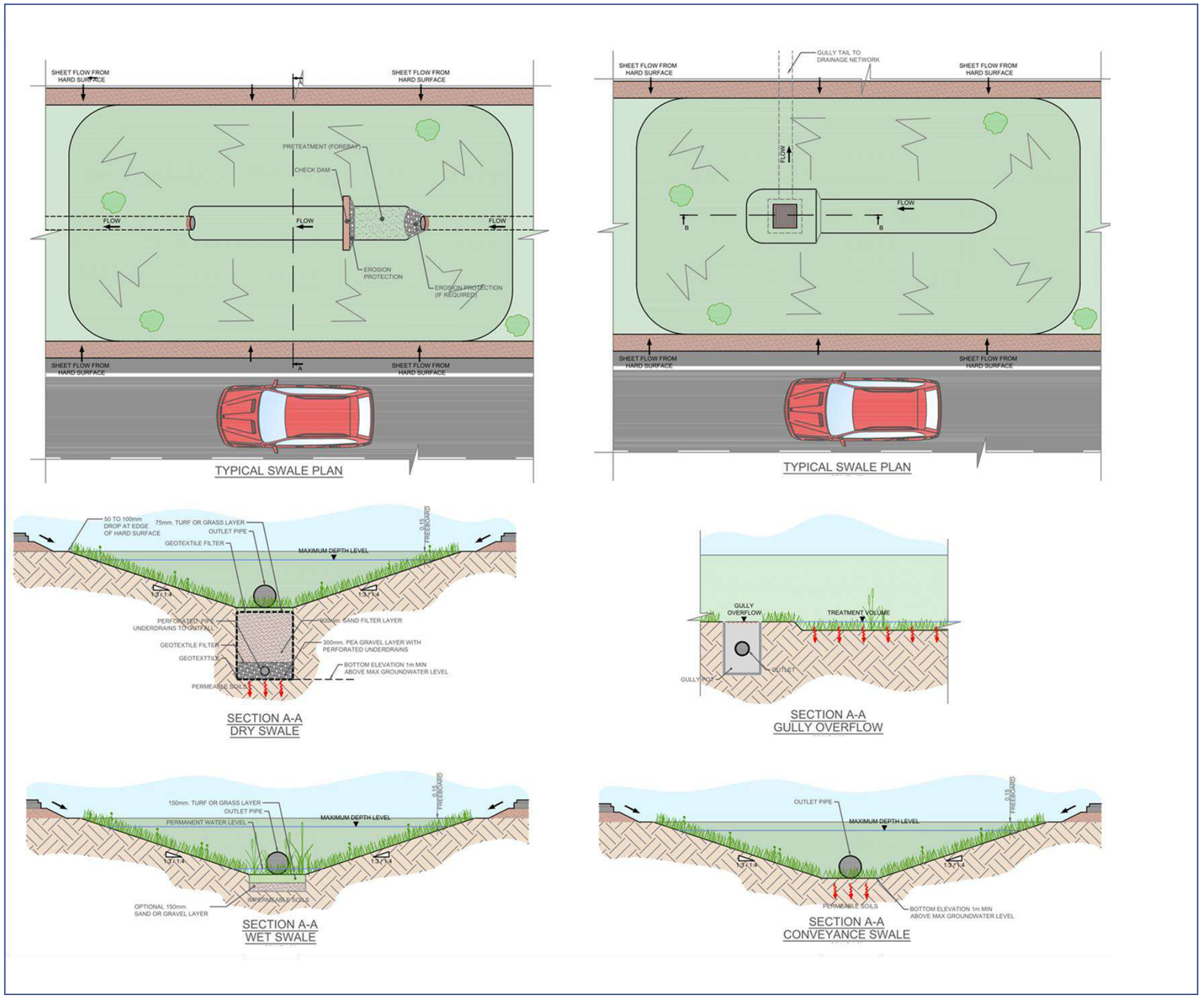


Figure D4 Bioretention

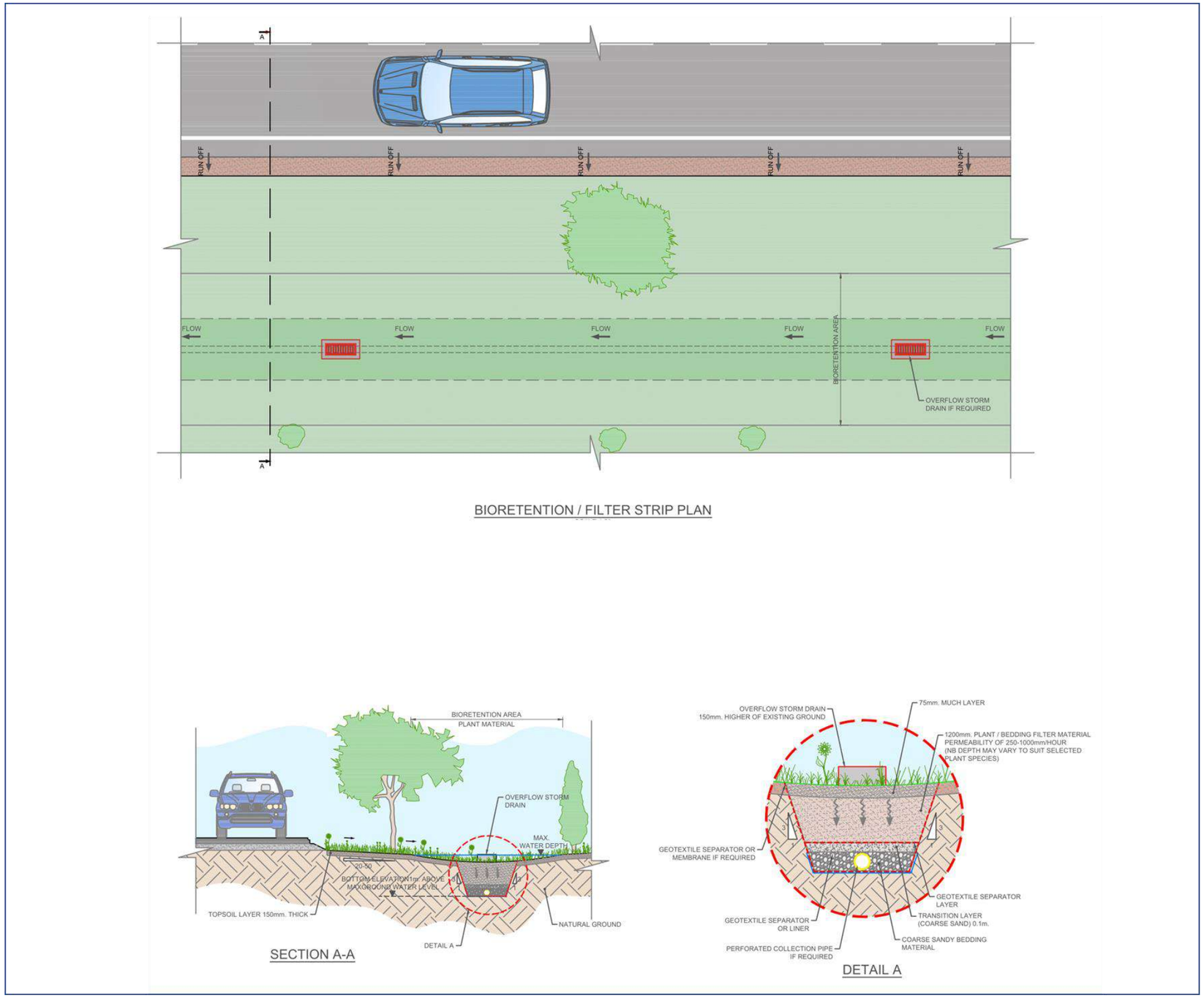


Figure D5 Retention and Detention Basin

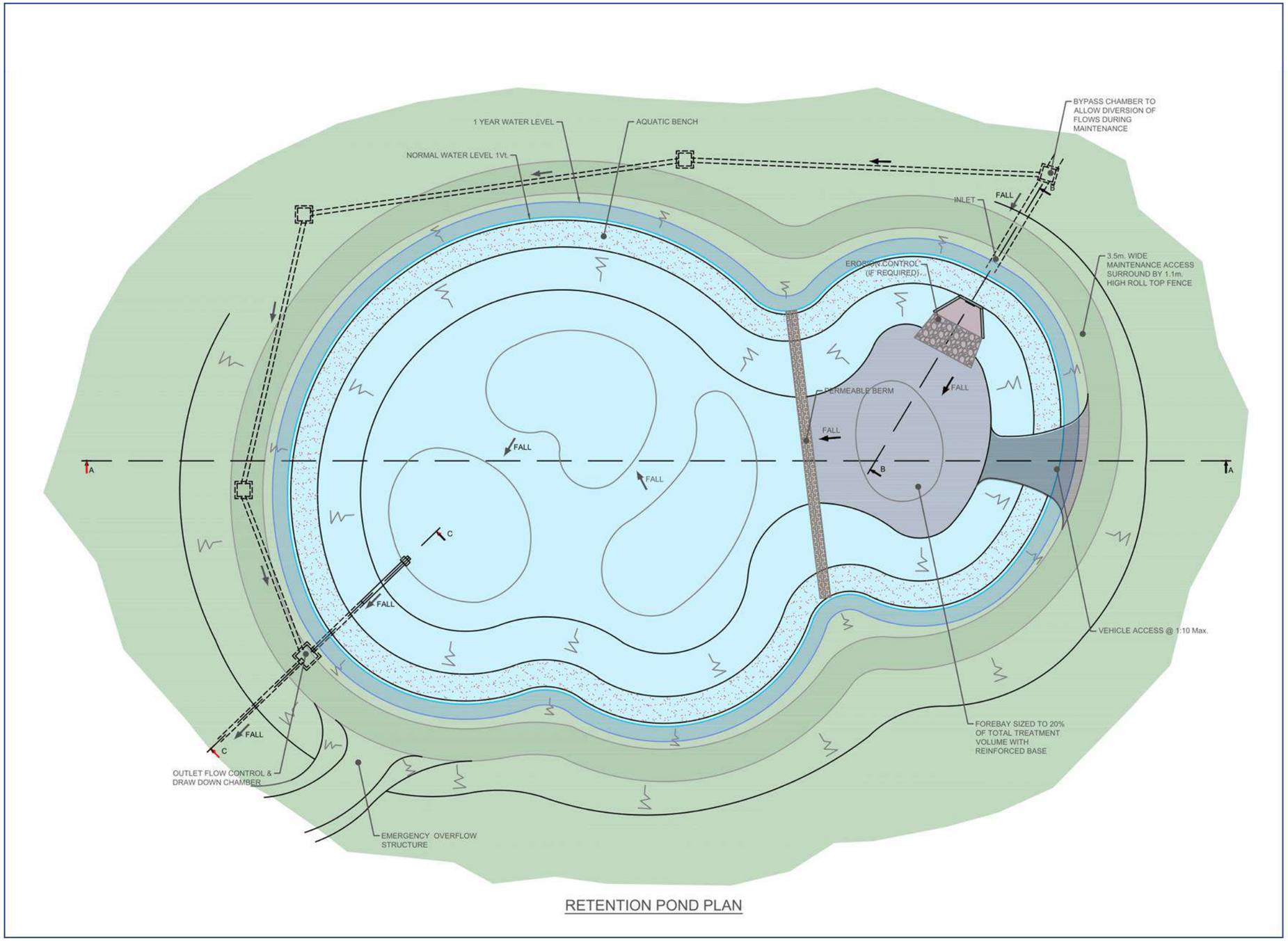


Figure D5.1 Retention Basin Section AA

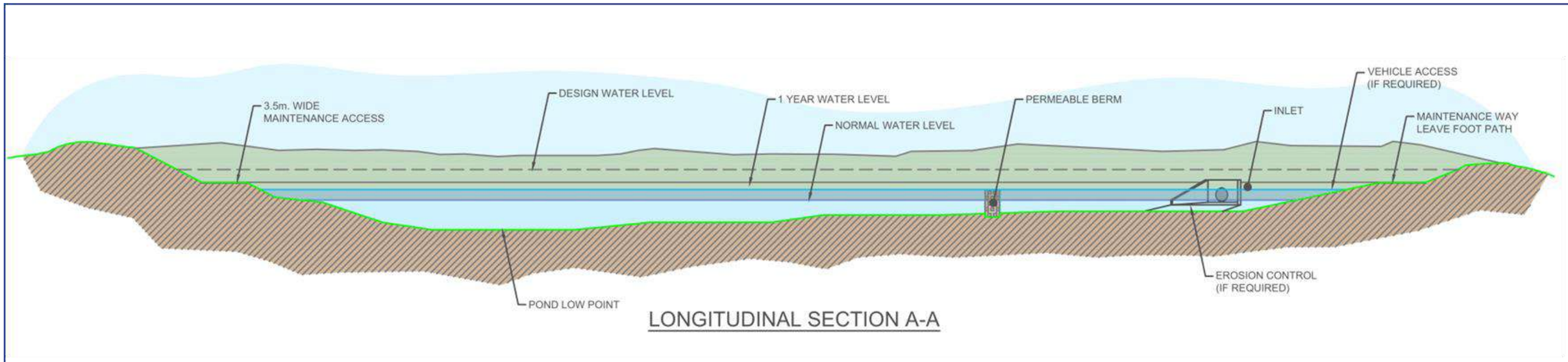


Figure D5.2 Retention Basin Section BB and CC

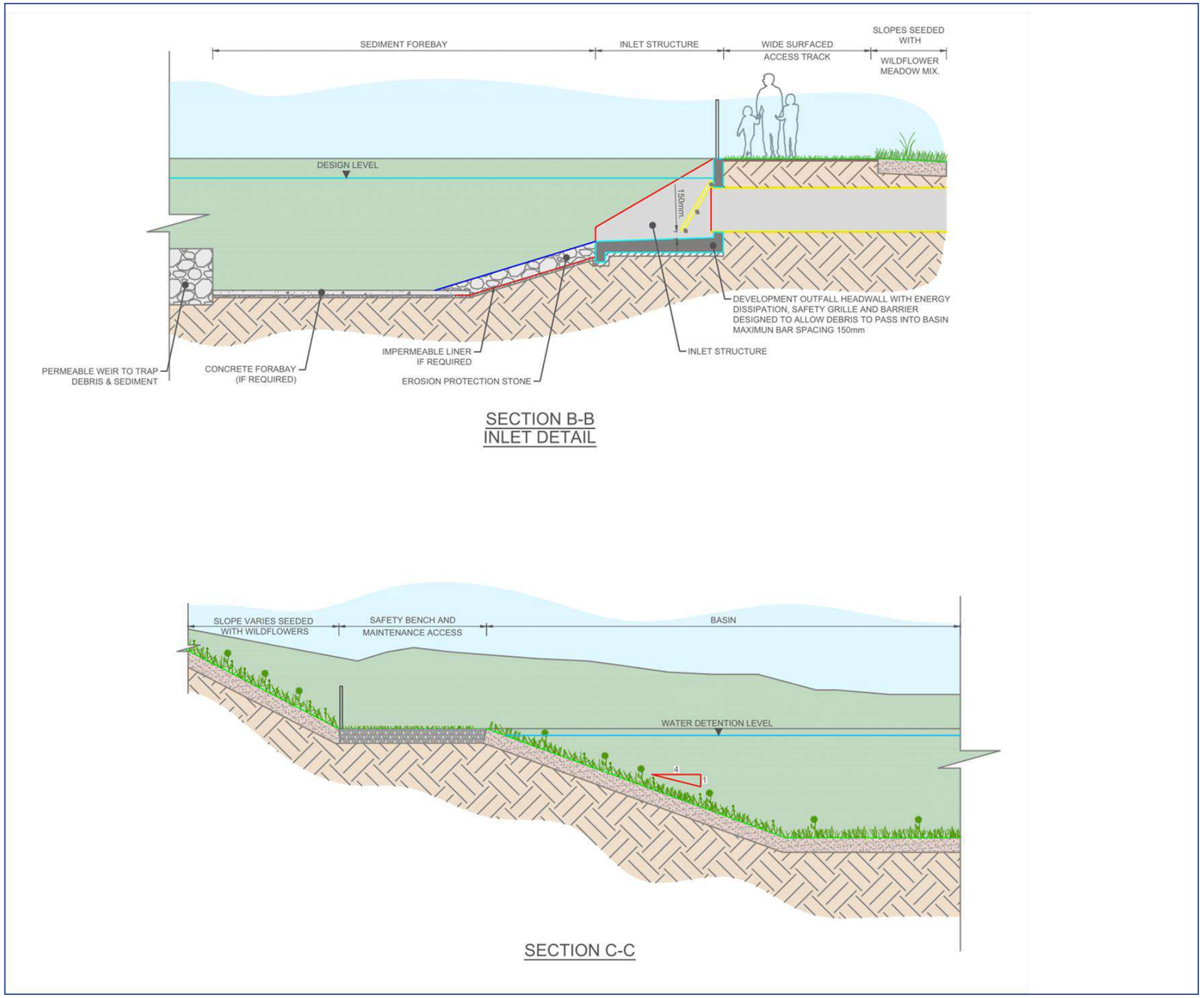


Figure D8 Underground Storage

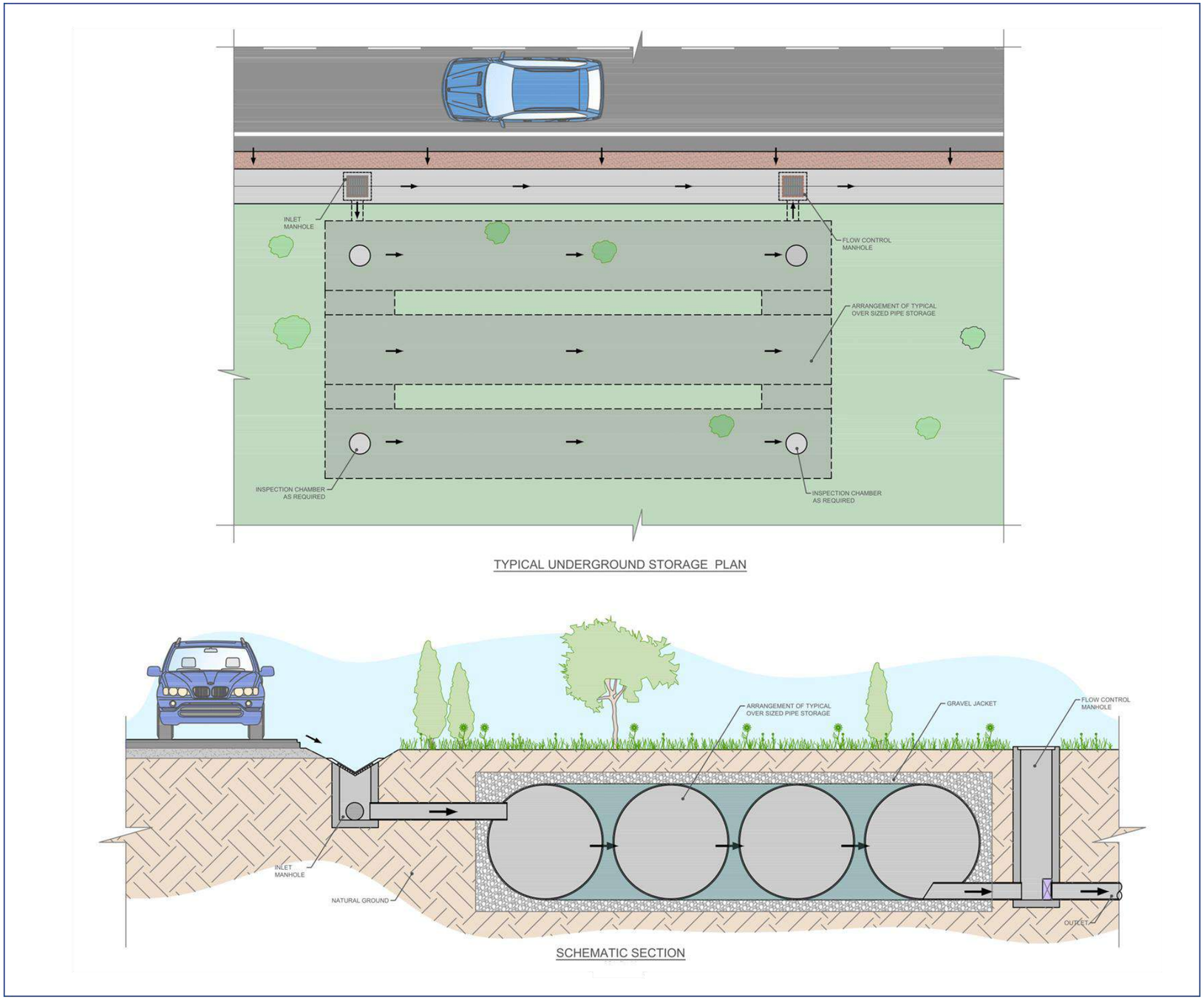
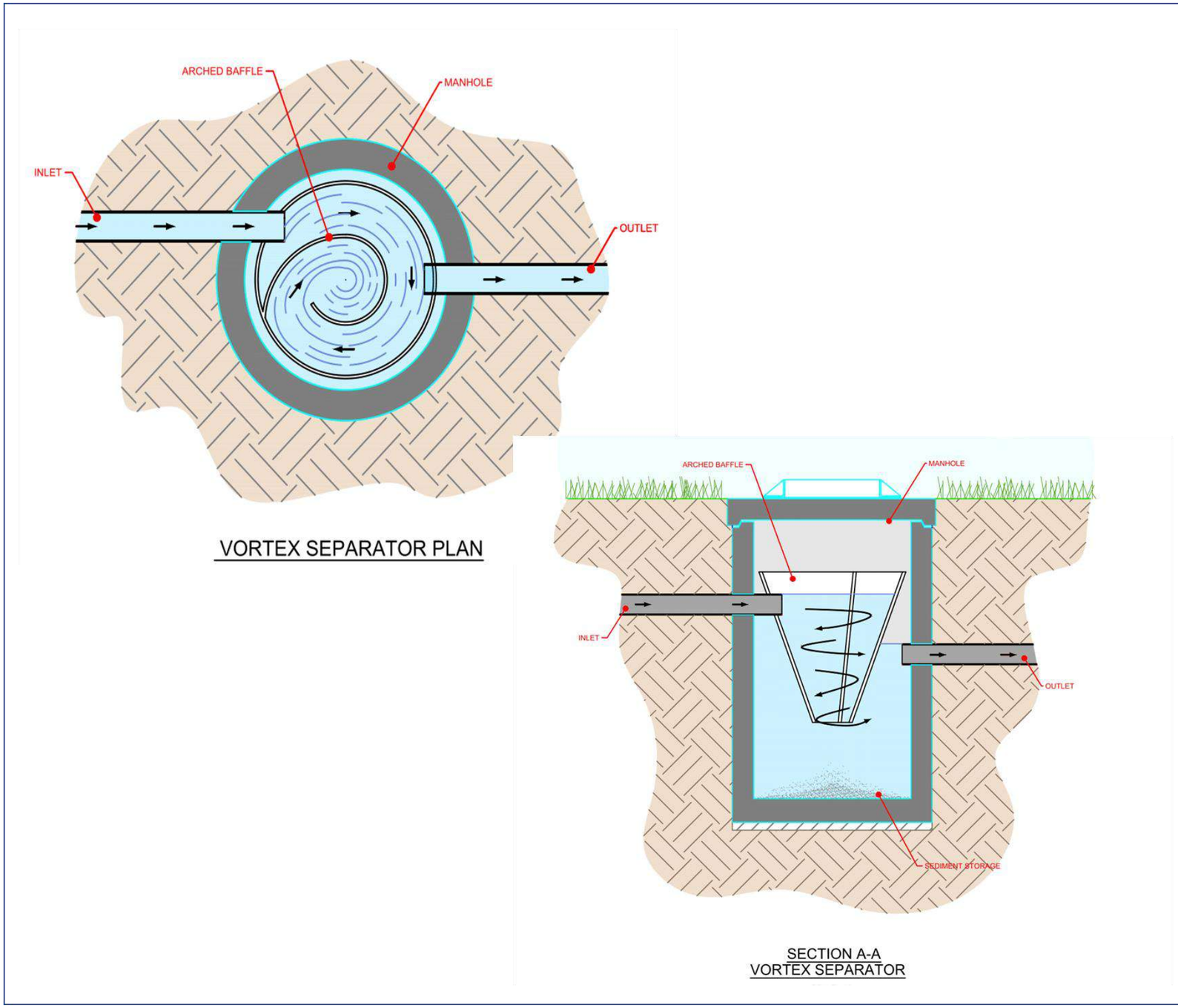


Figure D9 Vortex Separator



Appendix E
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