Chapter 04
(Proposed Scheme Description) Appendices

Galway City Council

BusConnects Galway: Cross-City Link Scheme

Drainage Preliminary Design Report

Issue | August 2022

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 253352-00

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Contents

Page

1 Introduction, Description and Project Background 2

2 Purpose of the Drainage Preliminary Design Report 3

2.1 Overview of Drainage Strategy 3
2.2 Existing Watercourses and culverts 4
2.3 Existing Drainage Description 4
2.4 Overview of Impacts of Proposed Works on Drainage / Runoff 5
2.5 Preliminary drainage design 6
2.6 Drainage at New Bridge Structures 9

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1 Introduction, Description and Project Background

BusConnects is the National Transport Authority's (NTA) programme to improve bus and sustainable transport services. It is a key part of the Government's policies to improve public transport and address climate change.

BusConnects Galway Cross-City Link (CCL) is associated with the Galway Transport Strategy (GTS), Bus Connects Infrastructure Program and Project Ireland 2040.

The Cross-City Link provides dedicated space to serve all proposed city bus services, by providing bus priority through the city centre core. The objective of the Cross-City Link is to prioritise walking, cycling and public transport along its length, whilst facilitating essential private traffic on appropriate alternative routes.

The GTS identified the proposed improvements to the city transport network including the 'Cross-City Link', 'City Centre Access Network', and 'Inner City Access Route'. These three elements are illustrated below in Figure 1.

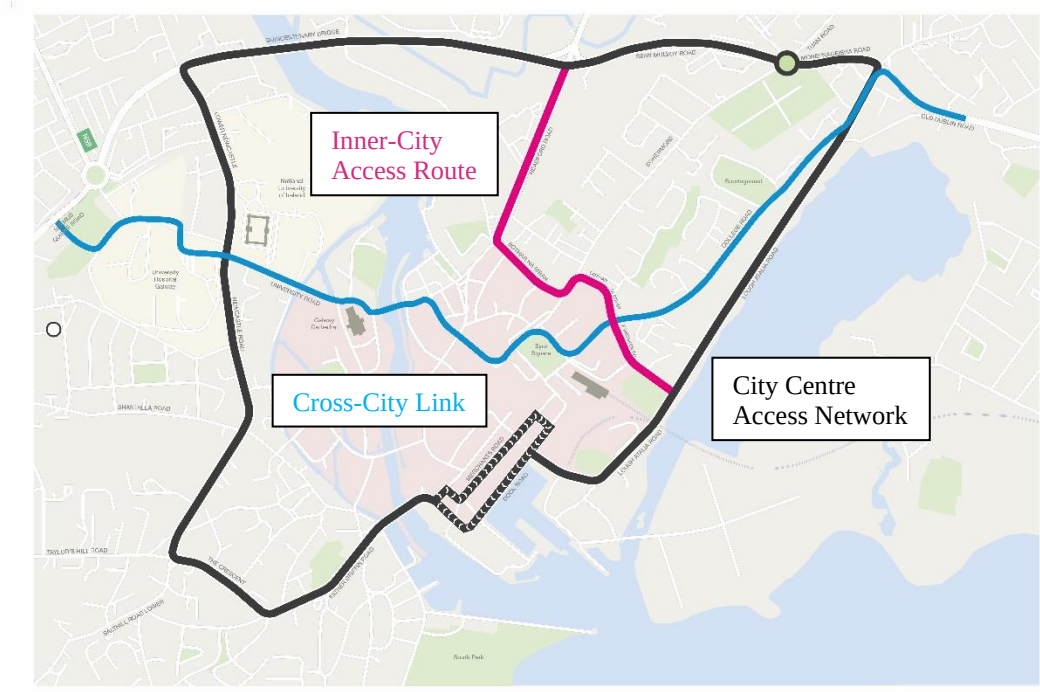

Figure 1: Cross-City Link, City Centre Access Network and Inner-City Access Route (source: Galway Transport Strategy)

2 Purpose of the Drainage Preliminary Design Report

The Drainage preliminary Design Report sets out the principal objectives, preliminary strategy and design criteria to be used as part of the Drainage Design of BusConnects Galway Cross-City Link Scheme.

The report runs through the existing watercourses and culverts, existing drainage networks, proposed drainage works, preliminary drainage design and summary of the surface water drainage including attenuation features, Sustainable Drainage Systems (SuDS) and Outfalls.

2.1 Overview of Drainage Strategy

The drainage preliminary design was developed following consultation with Galway City Council. The strategy and design parameters to be adopted throughout the Proposed Scheme is summarised in the Design Basis Statement Document No 253352-00 Drainage Design Basis included in Sub-Appendix 4.1A. The design basis statement was developed taking account of the Greater Dublin Strategic Drainage Study (GDSDS), Planning requirements of Galway City Council, Transport Infrastructure Ireland (TII) requirements and international best practices such as CIRIA The SuDS Manual (C753).

The principal objectives of drainage design are as follows:

- To drain surface water from existing and proposed pavement areas throughout the Proposed Scheme and maintain the existing standard of service.
- To maintain existing run-off rates from existing and newly paved surfaces using Sustainable Urban Drainage Systems (SuDS).
- To minimise the impact of the runoff from the carriageway on the surrounding environment using SuDS and/or silt traps.

No drainage features like gullies or manholes will be located at, or any ponding will be allowed to occur at, pedestrian cross-walk locations or at bus-stop locations. Drainage of newly paved areas includes SuDS measures to treat and attenuate any additional run-off where possible. These measures ensure that there is:

- No increase in existing run-off rates from newly paved areas; and
- Appropriate treatment to ensure run-off quality.

A hierarchical approach to the selection of SuDS measures has been adopted with ‘Source’ type measures e.g. Tree pits implemented in preference to catchment type measures e.g. attenuation tanks. Further details of the SuDS hierarchy are provided in the Drainage Design Basis Statement in Sub-Appendix 4.1A.

2.2 Existing Watercourses and culverts

All watercourse and crossing details in the vicinity of the Proposed Scheme have been identified as shown in Table 1 below. A Stage 1 Flood Risk Assessment (FRA) has been completed on the Preliminary Design and is summarised in Appendix 13.1.

The location of existing watercourses and culverts has been identified using OS Mapping (www.osi.ie) and The Galway Waterways Foundation (www.galwaywaterways.ie). The Proposed Scheme crosses the following watercourses:

Table 1: Location of Existing Watercourses

Watercourse	Crossing Detail
Eglinton Canal	Bridge
Gaol River	Bridge
Distillery River	Bridge
River Corrib	Bridge
Friar's River	Bridge

2.3 Existing Drainage Description

Based on the information received from Irish Water and Galway City Council, the Proposed Scheme is serviced by surface water and combined drainage networks. The surface water drainage system is managed by the Local Authority, whilst combined sewer systems are managed by Irish Water. Flows are typically collected in standard gully grates and routed via a gravity network to outfall points. There are no SuDS/attenuation measures on the existing drainage networks to treat or attenuate run-off from the existing carriageways.

The existing drainage network along the scheme can be split into 17 catchment areas based on topography and the existing pipe network details supplied by Irish Water and Galway City Council. The approximate catchment areas, existing sewer networks, outfalls and watercourses are shown on the existing catchment drawings, refer to drawing BCG-DN-01-01. The catchments are summarised in Table 2.

Table 2: Summary of Existing Catchments

Existing Catchment Reference	Approx. Drainage Catchment Area (km^2)	Existing Network Type	Existing Outfalls
Catchment 1	0.3399	Combined Sewer	Network outfalls to Mutton Island Wastewater Treatment Plant.
Catchment 2	0.0089	Combined Sewer	Network outfalls to Mutton Island Wastewater Treatment Plant.
Catchment 3	0.0093	Surface Water (Storm)	Network outfalls to the Distillery River.

Existing Catchment Reference	Approx. Drainage Catchment Area (km^2)	Existing Network Type	Existing Outfalls
Catchment 4	0.0121	Surface Water (Storm)	Network outfalls to the Distillery River.
Catchment 5	0.2280	Combined Sewer	Network outfalls to Mutton Island Wastewater Treatment Plant.
Catchment 6	0.0013	Surface Water (Storm)	Network outfalls to Friar's River.
Catchment 7	0.0068	Surface Water (Storm)	Network outfalls to the River Corrib.
Catchment 8	0.0181	Combined Sewer	Network outfalls to Mutton Island Wastewater Treatment Plant.
Catchment 9	0.3987	Surface Water (Storm) and Combined Sewer	Network outfalls to Mutton Island Wastewater Treatment Plant and to Galway Bay.
Catchment 10	0.0130	Surface Water (Storm)	Network outfalls to Lough Atalia.
Catchment 11	0.0356	Surface Water (Storm)	Network outfalls to Lough Atalia.
Catchment 12	0.0558	Combined Sewer	Network outfalls to Lough Atalia Pumping Station, then to Mutton Island Wastewater Treatment Plant.
Catchment 13	0.0093	Surface Water (Storm)	Network outfalls to Lough Atalia.
Catchment 14	0.0964	Surface Water (Storm)	Network outfalls to Lough Atalia.
Catchment 15	0.0008	Surface Water (Storm)	Network outfalls to Lough Atalia.
Catchment 16	0.0136	Surface Water (Storm)	Network outfalls to Lough Atalia.
Catchment 17	0.0065	Surface Water (Storm)	Network outfalls to Lough Atalia.

2.4 Overview of Impacts of Proposed Works on Drainage / Runoff

Whilst in some areas the Proposed Scheme increases the impermeable areas, additional permeable areas are also provided by the softening of public realm along the routes. The drainage design aims to sustain flow levels within the existing pipe network after a rainfall event by controlling discharge rates within each catchment. Flows are being controlled by the implementation of SuDS techniques. One of the principal objectives of the road drainage system is to minimise the impact of the run-off from the carriageway on the surrounding environment via the positioning of: filter drains, swales, bio retention areas, Tree pits, silt traps and attenuation features if necessary.

The proposed surface water drainage works are shown on the drawings BCG-DN-00.

Error! Reference source not found. 3 provides information of the proposed additional catchments (new paved areas) against the proposed permeable areas (current paved areas to become grassed).

Table 3: Summary of Increased Permeable and Impermeable Areas

Existing Catchment Reference	Road Corridor Area (m^2)	Change of use to Impermeable areas (m^2)	Change of use to Permeable areas (m^2)	Net Change (m^2)	Percentage Change (%)
Catchment 1	5675	0	333	-333	-5.9%
Catchment 2	2244	0	81	-81	-3.6%
Catchment 3	9185	19	693	-674	-7.3%
Catchment 4	3079	12	302	-290	-9.4%
Catchment 5	19894	16	830	-814	-4.1%
Catchment 6	323	0	21	-21	-6.5%
Catchment 7	2753	344	152	192	7.0%
Catchment 8	8109	0	405	-405	-5.0%
Catchment 9	27618	7	597	-590	-2.1%
Catchment 10	3182	0	37	-37	-1.2%
Catchment 11	8979	0	89	-89	-1.0%
Catchment 12	1116	276	87	189	16.9%
Catchment 13	3031	333	386	-53	-1.7%
Catchment 14	12356	1366	142	1224	9.9%
Catchment 15	830	6	29	-23	-2.8%
Catchment 16	501	35	0	35	7.0%
Catchment 17	523	0	0	0	0.0%

2.5 Preliminary drainage design

The existing drainage network is being maintained and used as the main discharge point for the new drainage system. The design aims to replicate the existing situation. Where new multiple gully connections discharging to a combined sewer are required, a new surface water pipe is being provided where possible and connected to the combined sewer as per Irish Water requirements.

The following drainage systems were considered for the Proposed Scheme where new paved areas are proposed:

- **Sealed drainage (SD)** comprises side entry gullies and sealed pipes. They collect, convey and discharge run-off. The side entry gullies are being located within the kerbline mostly between the cycle track and bus lane, and/or the footpath and the cycle track, depending on the carriageway profile.
- **Grass Surface Water Channels, Swales and bio-retention areas/rain gardens (SW/RG)** are provided as road edge/footpath edge drainage collection systems. They provide treatment and will provide attenuation if required. A filter drain can be laid under the bio-retention areas to keep them dry during low return period rainfall events.
- **Filter Drains (FD)** are provided as road edge channels. These comprise a perforated pipe with granular surround and are designed to convey, attenuate and treat run-off prior to discharge.
- **Tree pits (TP)** are provided in close proximity to the carriageway, where practicable. These receive flows from the sealed pipe network and from footpaths, and are designed to convey, attenuate and treat run-off prior to discharge.
- **Attenuation Tanks/oversize pipes (AT/OSP)** – Where there is insufficient attenuation volume provided by the proposed SuDS drainage measures, hard attenuation measures such as concrete attenuation tanks and/or oversize pipes are provided to meet the required attenuation volume.
- **Petrol Interceptors (PI)** are typically provided in areas where surface water is collected from trafficked roads, where a risk of oil entering the drainage network exists. They separate the oil prior to the surface water being discharged from the network.

2.5.1 Summary of Surface Water Drainage

The proposed drainage types for the Proposed Scheme are listed on **Table 4**.

Table 4: Summary of Proposed Surface Water Infrastructure

Catchment	Chainage	Drainage Type
Asset Owner/Location: Galway City Council		
Catchment 01	Canal Road Upper, discharging into the Eglington Canal	Sealed pipe network and petrol interceptor
Catchment 07	Dyke Road	Oversized pipe
Catchment 11/12	College Road, discharging to Lough Atalia	Sealed pipe network, petrol interceptor, tree pits and attenuation tank
Catchment 13/14	College Road, discharging to existing surface water sewer.	Oversized pipe and petrol interceptor

Catchment	Chainage	Drainage Type
Catchment 14	College Road, discharging to existing surface water sewer.	Oversized pipe and petrol interceptor
Catchment 14	Dublin Road, discharging to existing surface water sewer.	Oversized pipe and petrol interceptor
Catchment 14	Dublin Road, discharging to existing surface water sewer.	Oversized pipe and petrol interceptor
Catchment 14	Moneenageisha Court, discharging to existing surface water sewer.	Permeable paving
Catchment 14/16	Dublin Road, discharging to existing surface water sewer.	Oversized pipe and petrol interceptor
Asset Owner/Location: Irish Water		
Catchment 01	University Road, discharge into combined sewer network at junction with Canal Road Upper.	Sealed pipe network
Catchment 05	Junction of Headford Road and St. Brendan's Avenue to the junction of Eyre Street and Woodquay Street. Discharging to existing combined sewer network.	Sealed pipe network
Catchment 09	Merchant's Road and Forthill Street, discharging to existing combined sewer.	Sealed pipe network

2.5.2 Summary of Attenuation Features, SuDS and Outfalls

Where practicable, and in new areas of public realm gained as part of the design, a sustainable drainage system is considered in the form of rain gardens, bioretention areas, filter drains, swales, tree pits, permeable paving etc. SuDS are also being considered in existing areas, where practicable and possible.

The proposed attenuation measures from the Proposed Scheme is summarised for each proposed catchment. Refer to Table 5. Locations not shown in the table below do not require attenuation or SuDS.

Table 5: Summary of Proposed SuDS, Attenuation Features and Outfall Locations

Location	Approx. Impermeable Surface Area		Permitted Discharge (l/s)	Possible SuDS solution/ attenuation measure	Catchment Outfall
	Existing (m^2)	Change (m^2)			
Asset owner: Galway City Council					
Dyke Road	1,255	324	19.5	39m of 300mm OSP	Existing SW in Dyke Road
College Road	1,790	465	27.6	47m of 300mm OSP	Existing SW in College Road
College Road	1,666	421	26	64m of 300mm OSP	Existing SW in College Road

College Road	11,927	0	Tidally influenced receptor.*	279m^3 attenuation tank	Lough Atalia
Dublin Road	1,570	96	30.7	44m of 300mm OSP	Existing SW in Dublin Road
Dublin Road	2,330	255	43.3	51m of 300mm OSP	Existing SW in Dublin Road
Dublin Road	1,836	232	28.0	76m of 300 OSP	Exiting SW in Dublin Road

(*) With the exception of a small number of junctions with adjacent roads, the existing catchment from the start of College Road is predominantly draining downhill to existing gullies at the bottom of the road, close to the Abbey Lodge Guesthouse. A 150mmØ pipe collects the gullies and discharges to Lough Atalia, without any known attenuation or treatment. The existing pipe also collects surface water from a small residential section of Loyola Park Road, and it is expected to collect an overflow of up to 2l/s from the Galway Greyhound Stadium once planned upgrade works are complete. A new surface water pipe has been proposed to collect possible additional gullies and slot drains or aco channels expected in College Road as a result of geometry changes and footpath widenings. In order to replicate the existing situation a 150mm Ø orifice has been proposed downstream of the catchment in addition to an attenuation tank to avoid flooding in a 1 in 30 year rainfall event and a 20% climate change allowance. A petrol interceptor has been provided downstream of the orifice, as well as tree pits and catchpits to contribute to an additional level of treatment. The proposed new surface water pipe would collect the same flow as the existing 150mmØ pipe, and therefore the flows to Lough Atalia would not be altered. The existing 150mmØ will be retained.

2.6 Drainage at New Bridge Structures

There are no new bridge structures in the Proposed Scheme that require special surface water management techniques.

Galway City Council

BusConnects Galway: Cross-City Link

Drainage Design Basis

253352-00 Drainage Design Basis

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Contents

			Page
1	**Introduction**		**1**
	1.1	Purpose of the report	1
	1.2	Background and Overview of the Project	1
	1.3	General principles of drainage design	1
2	**Proposed Drainage Strategy**		**3**
	2.1	Relevant Standards and Guidance	3
	2.2	Storm Water Drainage Design	3
	2.3	Pipeline Network Design Criteria	4
	2.4	Galway Bay Complex Special Area of Conservation	6
3	**Sustainable Drainage Systems (SuDS) Eligibility**		**8**
	3.1	Introduction	8
	3.2	SuDS Proposals	8
	3.3	SuDS Selection Hierarchy	10

1 Introduction

1.1 Purpose of the report

The aim of this report is to establish the drainage strategy and design criteria to be used as part of the Drainage Design of the BusConnects: Galway-Cross-City Link Scheme.

1.2 Background and Overview of the Project

BusConnects is the National Transport Authority's (NTA) programme to improve bus and sustainable transport services. It is a key part of the Government's policies to improve public transport and address climate change.

BusConnects Galway Cross City Link (CCL) is associated with the Galway Transport Strategy (GTS), Bus Connects Infrastructure Program and Project Ireland 2040.

The aim of the BusConnects programme is to transform Galway City's bus system, with the Cross-City Link scheme providing dedicated space to serve all proposed city bus services, by providing bus priority through the city centre core. The objective of the Cross-City link is to prioritise walking, cycling and public transport along its length, whilst facilitating essential private traffic on appropriate alternatives. This project is fundamental to addressing the congestion issues in the Galway City region with the population due to grow by 50-60% by 2040, an increase of up to 50,000 more people.

The scheme aims to implement an optimum project cross-section to include footpaths and bus lanes on both sides of the road throughout the scheme network where feasible. Cycle Tracks will also be introduced, where feasible. In some instances, this will necessitate a Compulsory Purchase Order (CPO) process to include portions of private land to achieve the project objectives.

1.3 General principles of drainage design

The main general principles considered as part of the drainage design are as follow:

- The existing drainage network will be maintained and used as the main discharge point for the new drainage system. The idea of the design is replicating the existing situation. Where new multiple gully connections discharging to a combined sewer are required, a new surface water pipe is being provided where possible and connected to the combined sewer. This is applicable in areas where kerbs are changing, and gullies are being relocated as a result.
- One of the principal objectives of the road drainage system is to minimise the impact of the runoff from the roadways on the surrounding environment via the provision of Sustainable Drainage Systems (SuDS).

SuDS are being proposed as a first preference and in accordance with the SuDS hierarchy. Please refer to Section 3.

- At planning stage, the design is being developed based on assessment of existing drainage records, topographical survey and google street view and aerial imagery, along with some specific targeted surveys if required. If available, additional information from Galway City Council (GCC) or Irish Water (IW) will be reviewed and considered where relevant.
- Permeability tests are not being carried out and thus at Planning Stage infiltration rates are not being considered within the calculations. The use of measures such as bioswales/rain gardens or tree pits are being promoted where appropriate.
- The design is based on not increasing the flows to the existing network. In areas where impermeable areas increase, SuDS and attenuation are being provided. Where spatial or other constraints make the use of SuDS impractical, or when SuDS do not provide enough attenuation, oversized pipes or attenuation tanks are being provided. The choice of SuDS options to be considered are shown in Section 3.
- Existing services & utility information are being reviewed to support design and proposed location of the various drainage elements within the BusConnects corridors. There is limited information available of vertical alignment of existing services and utilities. The potential risk from clash of service with the proposed drainage will need to be assessed at the detailed design stage of the project.
- Narrow filter drains or fin drains are not proposed for inner city roads.
- Existing drainage gullies located in the bus lane are proposed to be removed when necessary and reused where possible. Side-entry kerb drainage/side-entry gullies are being proposed where practical, especially along bus lanes to be shared with cyclists. Conventional road gullies will be likely required in some areas, such as in recessed areas like loading bays. Other areas will be determined on a case-by-case basis.
- Exact location and type of gullies will be determined at the detailed design stage when the vertical geometry for the scheme is complete.

2 Proposed Drainage Strategy

2.1 Relevant Standards and Guidance

It is noted that the purpose of this report is to complement, and not supersede, existing guidance documents relating to the design of drainage in Galway City. Consultation with representatives of Galway City Council has highlighted that there are no strict standards for drainage publicly available. However, it was noted that the Greater Dublin Strategic Drainage Study was a commonly used best practice document on which internally available standards had been based. As a result, the proposed drainage strategy uses the guidance contained in this document in conjunction with the other documents listed. A non-exhaustive list of these guidelines is outlined below:

- TII Drainage Documents
- Greater Dublin Strategic Drainage Study (GDSDS)
- The SuDS MANUAL (C753) - CIRIA
- Galway City Council Planning Advisory Note 030308

2.2 Storm Water Drainage Design

The proposed scheme generally follows the existing road alignments and therefore catchment areas draining to the existing systems will mostly remain unchanged. However, there will be some areas where the existing road section will be widened to accommodate new bus lanes and cycle tracks. Specific requirements are outlined below for areas where additional catchments are proposed as part of the scheme.

The drainage design aims to sustain flow levels within the existing pipe network after a rainfall event by controlling the discharge rate within each catchment. Flows will be controlled by the implementation of SuDS techniques, where practicable

Each catchment is being broken down into sub-catchments to define the change in impermeable surface area as a result of the proposed scheme. The extra impermeable areas associated with scheme interventions is being attenuated before discharging to the existing drainage system. According to the available data, not all networks can be characterised. Therefore, allowable discharge rates can be assumed as a combination of a flow associated to a 1 in 5-years return period for the existing paved areas plus 2l/s/ha for existing greenfield areas to be paved (additional catchment areas). To achieve this, some SuDS and/or other attenuation facilities such as oversized pipes are being implemented with an outflow control equal to the allowable discharge rate. As a final step to the design process, it has been checked that no flooding occurs in the proposed infrastructure for a 1 in 30-year event plus a 20% of climate change allowance. A summary of these design standards is provided in Table 1.

Table 1: Design Standards

Parameter & Feature	Allowable Discharge Rate
Permitted Discharge Rates	
Combined New/Existing Paved Catchment Areas	Existing runoff rates maintained on the basis of: - the existing paved areas to **1 in 5-year flow,** plus - **2l/s/ha** for the existing grassed areas catchments to be paved (additional catchments). According to GDSDS Volume 2 Section 6.2, the minimum level of service for the existing network is a 1 in 5-years return period. Given that the scheme is in a fully urbanised area, it is assumed that the existing network was designed following these criteria. For operational purposes, it is recommended that the minimum throttle size for a pipe should be 75mm and the minimum allowable flow rate should be 2l/s.
Attenuation / SuDS Measures	
Combined new/existing paved areas	Attenuation/SuDS measures sized to contain the **1 in 30-year storm** with a 20% allowance for future climate change

In areas where the catchment remains unchanged which implies that no additional impermeable areas are proposed, the design consists of relocating the gullies to a suitable location. This location is based on the water pathway that will depend on the vertical alignment and tie-in requirements. The exact location and number of gullies will be determined in the detailed design stage of the project.

2.3 Pipeline Network Design Criteria

The following inputs sourced mainly from Met Éireann and GDSDS Volume 2 are used in the development of the drainage design for new catchment areas. Table 2 below shows Rainfall Design Criteria Variables.

Table 2: Rainfall Design Criteria Variables

Variable	Value
Region	Scotland/Ireland
Return Period (GDSDS Volume 2, Section 6.2 and Drainage Requirements for Planning Applications)	Drainage Network: 1 in 1 no surcharge, Drainage System: 1 in 30 years no flooding for extending urban areas
M5-60	15.4

Variable	Value
(Met Eireann. Return Period Rainfall Depths for sliding Durations. Irish Grid: Easting 129944, Northing: 225289. Values derived from a Depth Duration Frequency Model)	
Ratio R (Met Eireann. Return Period Rainfall Depths for sliding Durations. Irish Grid: Easting 129944, Northing: 225289. Values derived from a Depth Duration Frequency Model)	0.326
Minimum Global Time of Entry (Recommendation for Site Development Works for Housing Areas)	4 minutes
Max. Rainfall (Calculated using localised Met Eireann data)	75 mm/hr
Max. Time of Concentration (Wallingford Procedure States the Modified Rational Method has only been tested for time of concentration not greater than 30 minutes)	30 minutes
Climate Change (TII and Galway City Council consultation)	20%

Table 3 below summarises permeability factors to be used in the design and to be applied to the paved and grassed areas.

Table 3: Runoff Permeability Factors

Runoff Permeability Factors	
Location	Value
Grassed Areas (Based on Dublin soil type 2)	0.3
Paved	1

Table 4 below summarizes the Surface Water Drainage Pipes Design Criteria which states minimum pipe sizes, minimum depth of cover, minimum velocity, roughness coefficient and minimum slope.

Table 4: Surface Water Drainage Pipes Design Criteria

Parameter	Surface Water Sewers
Minimum depth (of cover)	0.6m under grassed areas 0.9m under footpaths 1.2m under carriageways 0.75m under carriageways (with concrete surround)
Maximum depth (of cover)	6m

Minimum sewer size	225mm, or 150mm for gully connections.
Minimum velocity (pipe full)	1m/s for a 1 in 1 year storm
Flooding	Must accommodate a one-year storm in-bore without surcharge (TII) Design must be checked against a five-year storm intensity to ensure that surcharge levels do not exceed the levels of chamber covers.
Roughness – ks	0.6mm for carrier drains 1.5mm for filter drains
Minimum slope	1 in 500 or steeper. Self-cleansing velocity will take preference.

In accordance with TII, Volume 4, Section 2, Part 3, NRA HD 33/15 Drainage Systems for National Roads the length of pipework from manhole to manhole should not exceed 100 metres.

2.4 Galway Bay Complex Special Area of Conservation

Galway Bay Complex is designated as a Special Area of Conservation (SAC) which forms part of the European Union (EU) wide Natura 2000 network. The SAC was designated to maintain or restore the favourable conservation status of the habitats and species present, as per the Habitats Directive. The SAC measures approximately 14,403 hectares, with a maritime area of approximately 89.6%.

The River Corrib and Eglinton Canal both flow from Galway City into the SAC. To the east, Lough Atalia forms part of the SAC. These bodies of water currently have surface water pipes discharging directly into them from urbanised areas of Galway City. Additionally, overflow pipes from the combined sewer networks currently discharge into both the River Corrib and Lough Atalia, representing a potential source of pollution in the existing scenario to the SAC.

Where impermeable areas are to be increased, SuDS and attenuation systems will be introduced to incorporate a variety of pollution control measures which will provide a level of treatment to surface waters, prior to their discharge into water bodies leading to the SAC. Petrol interceptors will be provided, where possible, prior to discharging into the existing network for catchments draining to the existing water bodies. This will ensure that the Proposed Scheme does not negatively impact on the SAC's water quality.

It is noted that most of the increase to Average Annual Daily Traffic (AADT) because of the proposed scheme is <1,000. Certain roads (lower section of College Road, Lough Atalia Road and various other roads) have displaced traffic <5,000. A notable increase (i.e., <10,000) is on Newcastle Road. However, the drainage system is connected to a separate system and outside of the study area. As such, no significant impact on receptors are considered likely.

3 Sustainable Drainage Systems (SuDS) Eligibility

3.1 Introduction

The drainage system design must manage on site the quality of runoff to prevent pollution in receiving waters and groundwaters. The types of SuDS features are chosen to achieve water quality targets.

Where possible and in new areas of public realm gained as part of the scheme, sustainable drainage systems should be considered in the form of rain gardens, bioretention areas, filter drains, swales, tree pits, etc.

3.2 SuDS Proposals

This section explores the range of SuDS solutions which will be considered for the Proposed Scheme. The eligibility of the choice of SuDS measure will be based on spatial constraints and likely pollution sources present.

3.2.1 Filter Drains

According to CIRIA SuDS Manual 2015, filter drains are shallow trenches filled with stone/gravel that create temporary subsurface storage for the attenuation, conveyance, and filtration of surface water runoff. A perforated pipe should be provided above the base of the filter drain to collect and convey water to downstream drainage component. Runoff flows slowly through the granular material, trapping sediments and providing attenuation.

Examples are shown in Figure 1 and Figure 2 below.

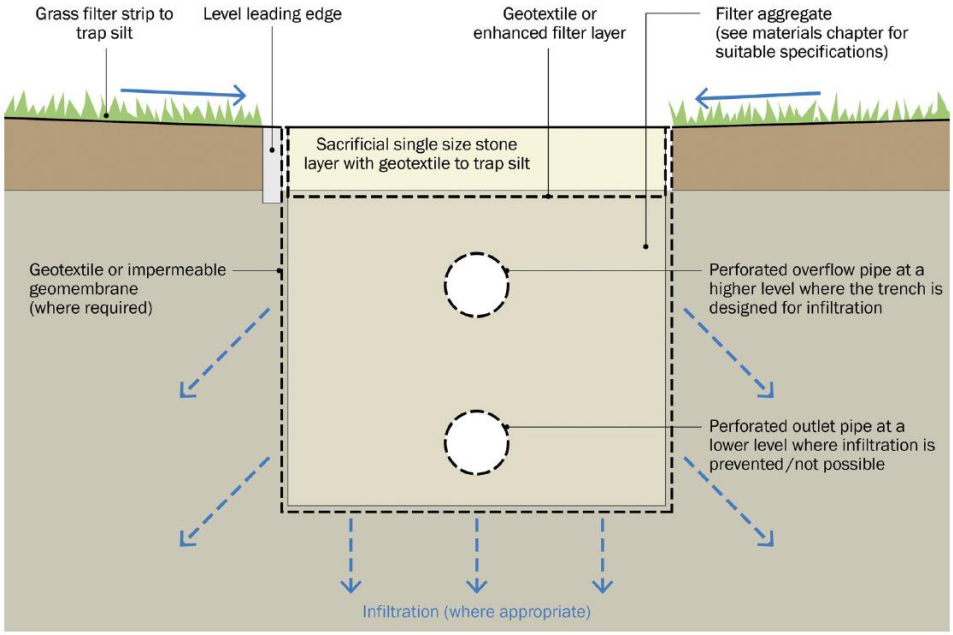

Figure 1: Filter Drain Schematic. Source: CIRIA SuDS Manual 2015 (Chapter 16, Figure 16.2)

Figure 2: Examples of Filter Drains. Source: CIRIA SuDS Manual 2015

3.2.2 Rain gardens

According to CIRIA SuDS Manual 2015, bioretention systems, such as rain gardens, are shallow landscaped depressions that can reduce runoff rates and volumes and treat pollution through the use of engineered soils and vegetation. They are particularly effective in delivering interception. Runoff collected by the systems ponds temporarily on the surface and then filters through the vegetation and underlying soils. There are many different approaches to the design of bioretention systems and rain gardens; however, the main components that are usually provided in a bioretention systems are shown in Figure 3.

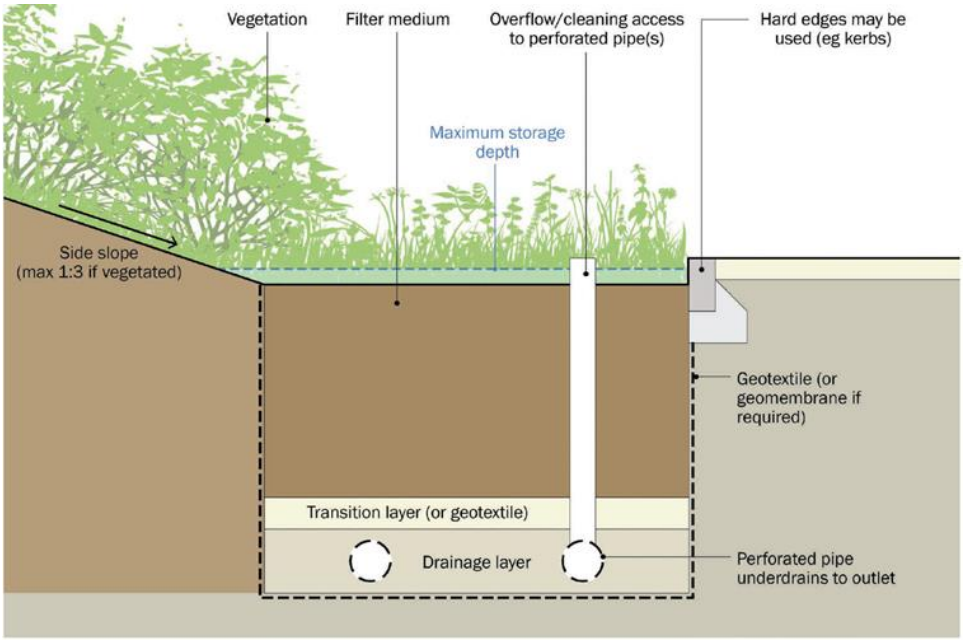

Figure 3: Bioretention System. Source: CIRIA SuDS Manual 2015 (Chapter 18, Figure 18.1)

3.2.3 Tree pits

Trees contribute to effective surface water management strategies. They also reduce annual building energy consumption by moderating the local climate, filter harmful pollutants from the air, and absorb and store atmospheric carbon dioxide (carbon sequestration). In the process of drawing water from the soil, trees also take up trace amounts of harmful chemicals, including metals, organic compounds, fuels and solvents that are present in the soil. Inside the tree, these chemicals can be transformed into less harmful substances, used as nutrients and/or stored in roots, stems, and leaves.

3.3 SuDS Selection Hierarchy

A hierarchical approach to selecting SuDS drainage solutions for the Proposed Scheme has been adopted. This draws upon the management train approach in the CIRIA SuDS Manual Hierarchy and consultation with Galway City Council.

Our approach to selecting appropriate SuDS solutions on the project recognises wider scheme constraints, principally land availability, to ensure proposed measures are proportionate and will not unduly impact on private lands and the SAC. We have followed a 5-stepped approach with Step 1 being the most preferable option and Step 5 being the least and option of last resort.

The SuDS measures aim to maximise the potential for runoff quality improvements. On this basis, ‘Source’ type measures are preferred as they provide early interception, treatment, and attenuation. Oversized pipes or attenuation tanks are only considered as a last resort, where no other measure is achievable. These are to be supplemented with source type measures where feasible.

The selection process is shown in Table 5 below.

Table 5: SuDS Selection Hierarchy

Step	Question	Action
1	Can a raingarden, Filter Drain, Swale/Bioretention area, Tree Pit or other Source Control type SuDS solution be implemented within the redline boundary?	Yes – Stop, preferred approach
		No – Move to Step 2
2	Can the redline boundary be extended into low impact lands e.g. public green space to accommodate a Raingarden, Filter Drain, Swale/Bioretention area, Tree pit or other Source Control type SuDS solution?	Yes – Stop, preferred approach. Use in combination with Step 1 if appropriate.
		No – Move to Step 3
3	Can a Site Control measure (e.g. Dry Detention Basin) be implemented in addition to Source Control within the redline boundary?	Yes – Stop, preferred approach, seek to maximise source control measures and minimise size of Site Control measures.
		No – Move to Step 4
4	Can the redline boundary be extended into low impact lands e.g. public green space to accommodate a Site Control measure (e.g. Dry Detention Basin) supplemented, where possible by a Raingarden, Filter Drain, Swale/Bioretention area, Tree Pit or other Source Control type SuDS solution?	Yes – Stop, preferred approach, seek to maximise source control measures and minimise size of Site Control measures.
		No – Move to Step 5
5	Can oversized pipes and/or an attenuation tank be used to ensure no increase in runoff?	Yes – Note option of last resort and source/site measures should be used in addition where possible. Any extension of the redline boundary is to be in low impact lands only.