MALONE O'REGAN
CONSULTING ENGINEERS

PROPOSED PART 8 RESIDENTIAL DEVELOPMENT

LAMBS CROSS, DUBLIN 18.

ENGINEERING REPORT

DUN LAOGHAIRE – RATHDOWN COUNTY COUNCIL

October 2024

Project No: 23006

Contents Amendment Record

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Title: **Proposed Part 8 Residential Development Lambs Cross, Dublin 18 Engineering Report**

Job Number: **23006**

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0	29/09/2023	Information	P1	PB	ND	ND
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0	10/07/2024	Planning	P3	KA	FM	FM
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CONTENTS

1 INTRODUCTION

1.1 Introduction

This report is prepared on behalf of the National Development Finance Agency (NDFA) in consultation with Dún Laoghaire-Rathdown County Council to accompany a Part 8 Proposal for the construction of a residential development on a site located in the townland of Balally, at Lamb's Cross, Dublin 18 situated at the junction of Sandyford Road and Hillcrest Road.

The purpose of this document is to describe the engineering proposals associated with the new development. These proposals are indicated on the drawings prepared by Malone O'Regan which accompany the planning submission. Where reference is made to drawings and drawing numbers within this report these should be taken as meaning those drawings produced by Malone O'Regan unless specifically stated otherwise.

1.2 Proposed Development

The proposed development of 37no. apartment dwelling units at a site c. 0.35 ha on a site located at Lambs Cross, Dublin 18 situated at the junction of Sandyford Road and Hillcrest Road, which will consist of the following:

i. 37 no. apartment units in a 3 - 5 storey building over undercroft area, including 29 no. one bed units; and 8 no. two bed units;
ii. 1 no. community facility at ground floor of 171sqm;
iii. Energy Centre at first floor level and external plant area set back at third floor level;
iv. Undercroft area at lower ground level comprising (a) 2 no. ESB substations (b) car, bicycle and motorcycle parking; (c) bin storage; (d) bulk storage area; and (e) supporting mechanical, electrical and water infrastructure.
v. Landscaping works including provision of (a) communal open space; and (b) public realm area fronting onto Sandyford Road and Hillcrest Road
vi. All associated site development works including (a) vehicular access off Hillcrest Road; (b) public lighting; (c) varied site boundary treatment comprising walls and fencing; and (e) temporary construction signage.

The site plan and lower-level layout is illustrated in Figure 1-1.

Figure 1-1 – Proposed Site Layout

The purpose of this document is to describe the engineering proposals associated with the new development. These proposals are indicated on the drawings prepared by Malone O'Regan which accompany the planning submission. Where reference is made to drawings and drawing numbers within this report, these should be taken as meaning those drawings produced by Malone O'Regan unless specifically stated otherwise.

1.3 Site Description

The location of the proposed development is illustrated in Figure 1-2. The site is situated in the residential area of Sandyford, approximately 9.4km from Dublin city centre. The lands to the north of the site border an existing housing development Lambs Brook. There are existing detached two storey houses opposite the development on the southern side of the site on the opposite side of Hillcrest Road. To the west of the site the new development faces onto the R117 Sandyford Road.

The east side of the development is facing onto Brewery Stream which enters a culvert at the northeast corner of the site. The proximity of the site to natural watercourses is outlined in Figure 1-3.

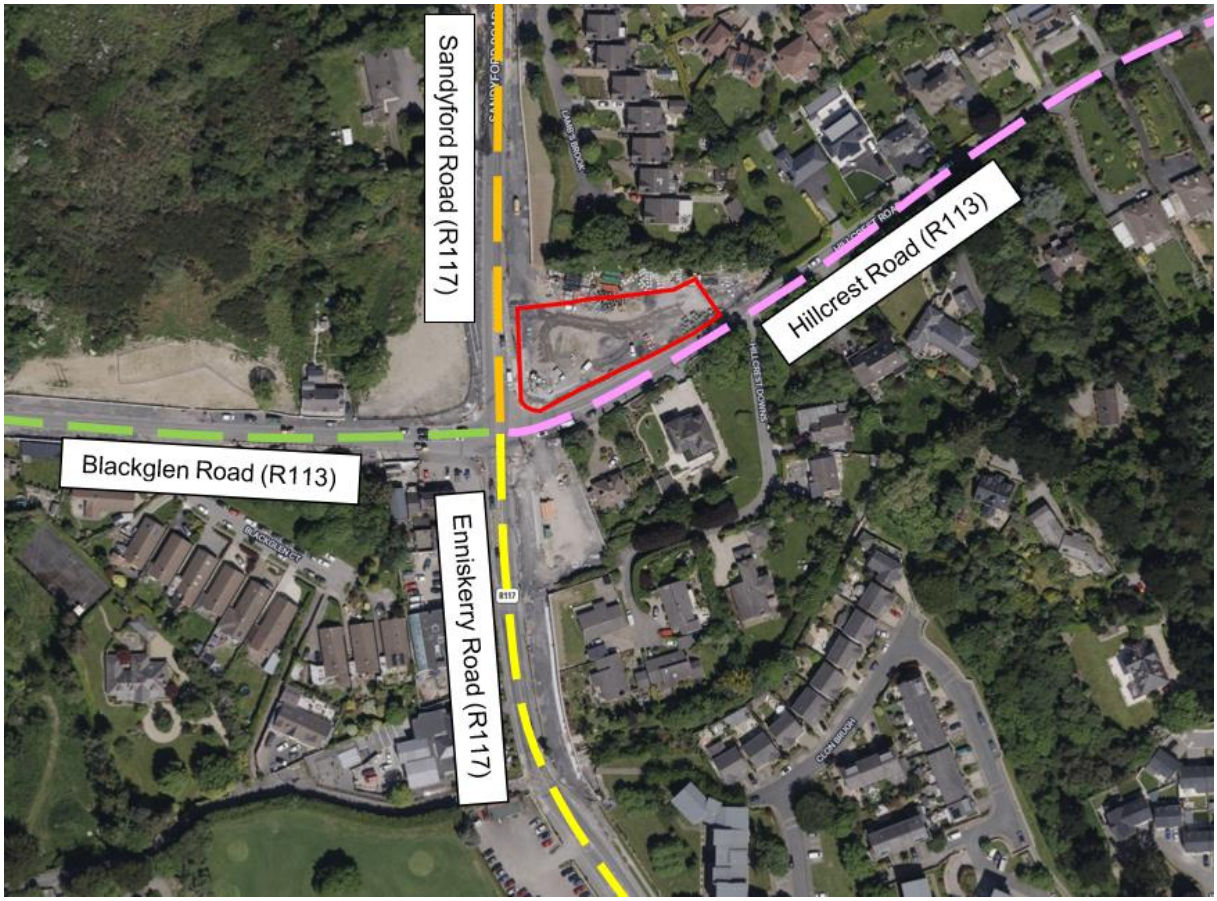


Figure 1-2– Site Location

Figure 1-3 - Surrounding Watercourse (Extract from the EPA Maps)

2 SURFACE WATER DRAINAGE DESIGN

2.1 Introduction

This chapter follows the guidelines set out in Greater Dublin Strategic Drainage Study (GDSDS) and the CIRIA 2015 SuDS Manual.

The aim of any SuDS strategy is to ensure that a new development does not negatively affect surrounding watercourse systems, existing surface water networks and groundwater systems. This SuDS strategy will achieve these aims by using a variety of SuDS measures within the site. These measures include water interception, treatment, infiltration and attenuation. The SuDS strategy will be developed with the following steps:

1. The existing greenfield run-off of the development site will be calculated and used as the minimum benchmark for the SuDS design. This run-off calculation is based on the drained area of the new development. The post development run-off will not exceed the greenfield run-off.
2. A set of SuDS measures will be chosen based on their applicability and usage for the site.
3. A “FLOW” model will be created to analyse the rainfall on the site and the effectiveness of the proposed SuDS measures.
4. If effective, these SuDS measures will be incorporated into the proposed design.

Table 2-1 outlines the parameters adopted in the design of the surface water drainage infrastructure.

Table 2-1 - Surface Water Design Parameters

Parameter Description	Assigned Value
Surface Water Drainage Pipework Design Return Period	2 years (Ref IS EN 752 Table 2 for ‘City centres / industrial / commercial areas’)
Attenuation Pond Design Return Period	100 years
Allowance for climate change	20% (Ref. OPW Flood Risk Management Climate Change Sectoral Adaptation Plan, High-End Future Scenario)
M5-60	18.3mm (Met Eireann data)
M5-2D	67.9mm (Met Eireann data)
Ratio, r	0.27
Time of Entry	4 min
Pipe roughness, Ks	0.6mm (Ref. GDSDS Volume 2, Table 6.4)
Minimum velocity	1.0 m/s (Ref. GDSDS Volume 2, Table 6.4)

2.2 Existing Services

An existing network of drainage runs around the perimeter of the site on two sides. There is an existing 225mm diameter surface drainage running parallel Sandyford Road to the western boundary. There is a 500mm diameter concrete sewer running parallel Blackglen Road to the south-west of the site boundary. These underground sewers carry surface water runoff towards existing catchment areas in the Dublin area. There is an existing 900mm diameter culvert at the northeastern boundary of the site. Due to the relative levels of the existing drainage within

the road and the proposed site levels, it is not possible to achieve a gravity connection to the surface water drainage pipework installed at Sandyford Road and Blackglen Road. It is proposed to achieve a gravity connection toward the culvert at the northeast boundary of the site.

2.3 Proposed Services

The proposed surface water drainage system is designed to comply with the 'Greater Dublin Strategic Drainage Study (GDSDS) Regional Drainage Policies Technical Document – Volume 2, New Developments, 2005' and the 'Greater Dublin Regional Code of Practice for Drainage Works, V6.0 2005'. CIRIA Design Manuals C753, C697 and C609 have also been used to design the surface water drainage system within the site.

The proposed surface water drainage layout for the development is indicated on Malone O'Regan drawings SHB5-LDR-DR-MOR-CS-P3 130, 150 and 151. Surface water runoff from new internal road surfaces, footpaths, other areas of hardstanding and the roofs of buildings will be collected within a gravity drainage network and directed towards an attenuation storage system. The attenuation storage is sized to cater for a 1 in 100-year storm event.

The outfall from the detention basin will be restricted to the applicable 'greenfield' runoff rate using a Hydrobrake flow control device. A number of sustainable drainage systems (SuDS) are proposed in order to minimise the volume and rate of runoff from the site. Further details on these SuDS measures are provided in Section 2.5. All surface water drainage will be designed and installed in accordance with the Greater Dublin Regional Code of Practice for Drainage Works. The runoff coefficients used in the calculations are as outlined in the Table 2-2.

Table 2-2 – Runoff Coefficients

Type of Areas	CV
Landscaping (Grass / Soft)	0.20
Intensive/Extensive Green Roof	0.60
Blue Roof	0.60
Permeable Paving	0.50
Impermeable Surface (Incl. tree pits)	0.90
Standard Roof (Impermeable)	0.95

Calculations for the Surface Water Pipe Network are provided in Appendix C.

2.4 Permissible Runoff

The regression equation recommended for use by the Greater Dublin Strategic Drainage Study 2005 calculates a value, $QBAR_{rural}$, which is sourced from the Institute of Hydrology Report 124. This value is the mean annual flood flow from a rural catchment in m^3/s and is given by the equation,

$$QBAR_{rural} = 0.00108[Area^{0.89}] \times [SAAR^{1.17}] \times [Soil^{2.17}]$$

Where:

$QBAR_{rural}$	Mean annual flood flow from a rural catchment in m^3/s
Area	Area of the catchment in km^2

SAAR	Standard Average Annual Rainfall in mm.
Soil	Soil index

For catchments smaller than 50 hectares, $QBAR_{rural}$ is first calculated assuming an area of 50ha and then $QBAR_{rural}$ for the site area is calculated on a pro rata basis.

Standard Average Annual Rainfall for the site in Lambs Cross was taken from the Flood Studies Report as 1014mm.

An appropriate Soil Index value was determined following a review of published data and site-specific ground investigation works.

The 1975 Flood Studies Report included a Soil Index map, a digitised version of which available at www.uksuds.com. This map indicated that the site lies within an area of Soil Type 2 (SPR Index 0.3). Soil Type 2 corresponds with a very permeable soil such as sand and gravel with low runoff potential.

Site Investigation works were completed by Causeway Geotech in February 2024. Ground types encountered during the investigation of the site consisted of:

- Made Ground: reworked sandy gravelly clay fill or sandy clayey gravel fill with varying fragments of concrete, plastic and red brick extending to a depth of 0.40-1.10m.
- Glacial Till: brown sandy gravelly clay encountered across the site, generally firm to stiff.

Groundwater was not encountered during drilling at any of the borehole locations. 2 no. infiltrations tests were conducted on site. One of the tests indicated an infiltration rate of f = 1.66667 $x10^{-5}$ m/s, however at the other test location, the water level dropped too slowly to allow calculation of the soil infiltration rate. The report prepared Causeway Geotech concludes that the rate of infiltration coupled with the soil descriptions imply that the subsoil may be considered suitable media for an infiltration drainage system.

Given the permeable nature of the subsoil it is considered appropriate to adopt a Soil Index value of Type 2.

When this equation is applied to the proposed development, the following value for $QBAR_{rural}$ is obtained.

For 50ha area $QBAR_{rural}$ $= 0.00108\,[0.5]^{0.89} \times [1014]^{1.17} \times [0.30]^{2.17}$

$= 0.141\ m^3/s$

$= 141.0$ l/s (for 50ha)

$QBAR_{rural}$ = 2.812 l/s/ha > 2l/s/ha

$QBAR_{rural}$ for the subject site (overall catchment area) = 2.812 l/s/ha x 0.35 ha

QBAR = 0.995 l/s

According to the GDSDS Chapter 6.3.14 if the separate long-term storage cannot be provided and temporary flood storage forms part of the single attenuation system, all the runoff from the site should be discharged at a rate of 2 l/s/ha or the average annual peak flow rate QBAR, whichever is greater. In this case QBAR is the higher value and has been adopted as the limiting discharge rate.

While it is possible to design and manufacture a Hydrobrake which will restrict flow rates to very low values, when the flow rate is less than 2 litres / second the Hydrobrake units are highly susceptible to blockage and are not necessarily suitable in a drainage network. The SuDS manual (CIRIA Document C753) specifies a minimum orifice diameter of 75mm which cannot be achieved while simultaneously limiting the flow to 0.995 l/s. Therefore, it is proposed to provide a Hydrobrake which will limit the outflow from the attenuation tank to 2 litres / second.

For the purpose of the surface water attenuation design, the site is dealt with as one catchment as shown in Figure 2-1. The breakdown of the impermeable areas contributing to the surface water drainage network in the catchment with the applied runoff co-efficient is provided in Table 2-3 and Table 2-4.

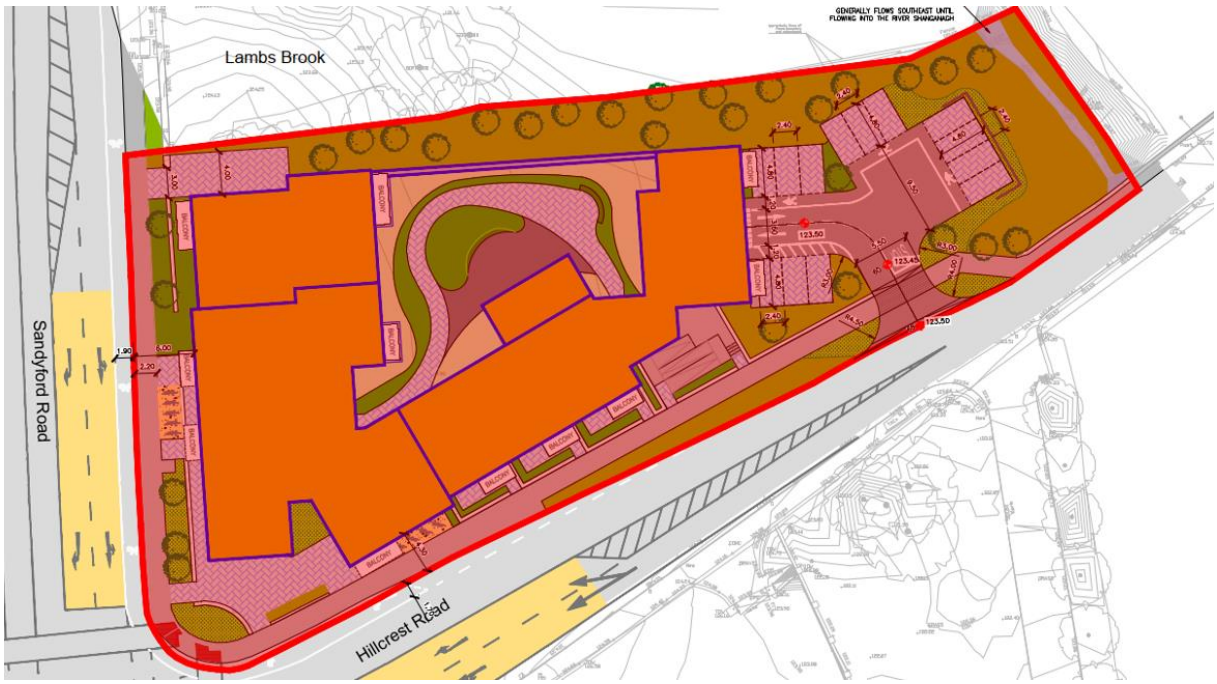


Figure 2-1 - Surface Water Drainage Catchment Area

For the purposes of surface water attenuation design, the site is dealt with as one catchment as shown in Figure 2-1 and is draining to an existing catchment/treatment system via existing public sewers. A breakdown of the impermeable areas contributing to the surface water drainage network in each catchment with applied runoff coefficients is provided in Table 2-3 and Table 2-4.

Table 2-3 - Breakdown of Impermeable Areas for Proposed Development

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
3,538.00	Roof	Standard roof (25%)	283.21	0.95	269.05	295.96	355.15	1414.32
		Green Roof (75%)	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		702.48	0.50	351.24	386.36	463.63	
ha	Landscaped Areas inc. areas from hardstanding		1544.64	0.20	308.93	339.82	407.78	ha
0.35								0.14
	Hardstanding		158.04	0.90	142.23	156.46	187.75	

Table 2-4 - Breakdown of Impermeable Areas for Proposed Development – Blue Green Roof

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
3,538.00	Roof	Standard roof (25%)	0.00	0.95	0.00	0.00	0.00	672.91
		Green Roof (75%)	849.64	0.60	509.78	560.76	672.91	
	Permeable Paving inc. areas from hardstanding		0.00	0.50	0.00	0.00	0.00	
ha	Landscaped Areas inc. areas from hardstanding		0.00	0.20	0.00	0.00	0.00	ha
0.35								0.07
	Hardstanding		0.00	0.90	0.00	0.00	0.00	

2.5 Sustainable Drainage Systems (SuDS)

The proposed development will be designed in accordance with the principles of Sustainable Drainage Systems (SuDS) as embodied in the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS) and will significantly reduce run-off rates and improve storm water quality discharging to the public storm water system. The GDSDS addresses the issue of sustainability by requiring designs to comply with a set of drainage criteria which aim to minimize the impact of urbanization by replicating the run-off characteristics of the greenfield site. The criteria provide a consistent approach to addressing the increase in both rate and volume of run-off, as well as ensuring the environment is protected from any pollution from roads and buildings. These drainage design criteria are as follows:

- Criterion 1 – River Water Quality Protection
- Criterion 2 – River Regime Protection
- Criterion 3 – Flood Risk Assessment
- Criterion 4 – River Flood Protection

The requirements of SuDS are typically addressed by provision of the following:

- Interception storage
- Treatment storage (commonly addressed in interception storage)
- Attenuation storage
- Long term storage (not applicable if growth factors are not applied to Qbar when designing attenuation storage)

2.5.1 Compliance with the principles of the CIRIA C753 SuDS Manual

The C753 SuDS Manual explains that the primary function of SuDS measures is to protect watercourses from any impact due to the new development. However, SuDS can also improve the quality of life in a new development and urban spaces by making them more vibrant,

visually attractive, sustainable and more resilient to change. This document explains the wider social context of SuDS and how SuDS can deliver high quality drainage while supporting urban areas to cope better with sever rainfall both in present and future.

There are four main categories of benefits that can be achieved by SuDS:

1. Water Quantity (mitigate flood risk & protect natural water cycle)
2. Water Quality (manage the quality of the runoff to prevent pollution)
3. Amenity (create and sustain better places for people)
4. Biodiversity (create and sustain better places for nature)

Table 2-5 includes a list of all current SuDS measures which would typically be considered when designing a new residential development such as that which is now proposed. This table also outlines the rationale behind the selection of SuDS measures and why other measures would not be appropriate. The runoff generated from the catchment will be attenuated in storage structures within and below ground and in the blue roof attenuation systems. The proposed attenuation systems are explained in section 2.5. A wide range of SuDS measures are proposed across the site to maximise interception and treatment.

Table 2-5 - Proposed SuDS Features

SUDS Measure	Measure Adopted?	Rationale for Selecting / Not Selecting Measure
Bioretention Swales *Shallow landscaped depressions that serve to reduce runoff rates / volumes as well as providing interception storage, treatment of runoff and encouraging biodiversity*	No	Bioretention swales are not proposed in areas beside roads and green spaces within the site due to lack of space.
Tree pits *Attenuate surface water runoff by utilising voids within the root zone*	No	Tree pits have not been specified in this development due to the confined space and maintaining existing trees on the site.
Green Roofs *Vegetated roofs used to reduce the rate and volume of runoff as well as encouraging biodiversity*	Yes	It is proposed to provide green roofs for flat roofs above apartment and duplex buildings.
Blue Roofs *Provide attenuation storage, reducing requirement for storage elsewhere on site*	Yes	It is proposed to provide blue roofs in areas where the building structure is appropriate to support such roofs. Refer to 'Green Roofs' above.
Green Living Walls *Planted walls which improve air quality and encourage biodiversity*	No	Green walls are not considered appropriate given the proposed residential building use.
Rain Gardens *Localised depressions in the ground that collect runoff from roofs/roads and allow infiltration and absorption*	Yes	The proposed residential development does aim to provide rain gardens.
Rainwater harvesting *Runoff captured from roofs is reused for non-potable purposes, thereby reducing overall runoff volume.*	No	In the case of the proposed residential development, it is not considered viable to gather the water for grey water usage in the maintenance aspect of the building.
Permeable paving *Allows runoff to percolate into the subsoil, reducing overall runoff volume*	Yes	Permeable paving is proposed within the development in footpaths, private curtilage areas and car parking spaces.
Porous asphalt *Allows runoff to percolate into the subsoil, reducing overall runoff volume*	No	Porous asphalt is not considered suitable for use in roads within the development

		as it does not comply with the Local Authority roads standards.
Integrated Constructed Wetlands (ICWs) *System of shallow ponds, planted to treat water, removing nutrients and harmful impurities*	No	ICWs are not considered appropriate due to the limited space available.

Further details of the principal SuDS features proposed for this development are provided in the following sections

2.5.2 Intensive Green/ Blue Roofs

As part of the proposed development, it is intended to provide intensive green/ blue roofs to the appropriate areas of the building. Green roofs provide ecological, aesthetic and amenity benefits and intercept and retain rainfall, at source, reducing the volume of runoff and attenuating peak flows. Details from the suppliers of green systems indicate that they will typically provide interception storage of 38 litres per square metre of roof covering.

Green roofs absorb most of the rainfall that they receive during normal rainfall events and treat surface water through removal of atmospherically deposited urban pollutants. They also reduce building heating requirements (by evaporating cooling). Intensive green roofs typically have a growing medium of 200mm allowing for a wider array of planting possibilities than extensive (sedum) green roof coverings.

The green roofs will be underlaid by a storage medium so that they also perform as blue roofs, capable of attenuating rainwater. The proposed green/ blue roofs will provide initial storage of rainwater, while also reducing the rate at which rainwater from heavier rainfall events discharges to the attenuation systems.

Flow restrictor outlets will be provided to control the rate of runoff from the roof. The overflow from the green/blue roof is limited by a Hydrobrake flow control device which will control the rate of runoff from the roof to 0.439l/s.

For 50ha area $QBAR_{rural}$ $= 0.00108 [0.5]^{0.89} \times [1014]^{1.17} \times [0.30]^{2.17}$

$= 0.141\ m^3/s$

$= 141.0$ l/s (for 50ha)

$QBAR_{rural}$ = 2.812 l/s/ha > 2l/s/ha

$QBAR_{rural}$ for the roof area = 2.812 l/s/ha x 0.11ha

$QBAR_{rural}$ = 0.309 l/s

Since the green/blue roofs provide their own attenuation with flow restrictor outlet on the roof, these areas will not drain towards the main attenuation tank on site. Runoff from the green/ blue roofs will connect to the surface water drainage pipework downstream from the main attenuation tank and associated Hydrobrake.

It is proposed to provide intensive green/ blue roofs over at least 75% of the total roof area, which exceeds the minimum coverage requirement of 50% as outlined in the Dublin City Council Green & Blue Roof Guidelines 2021. Refer to Figure 2-3 for the location of the Intensive Green/Blue roof on the proposed site plan.

Roof structures will be designed to cater for the additional loads associated with the blue roof storage layer and the overlying green roof build-up. Details of the proposed green/ blue roof build-up are provided on Malone O'Regan drawing no. SHB5-LDR-DR-MOR-CS-P3-151, an extract from which is provided in Figure 2-3.

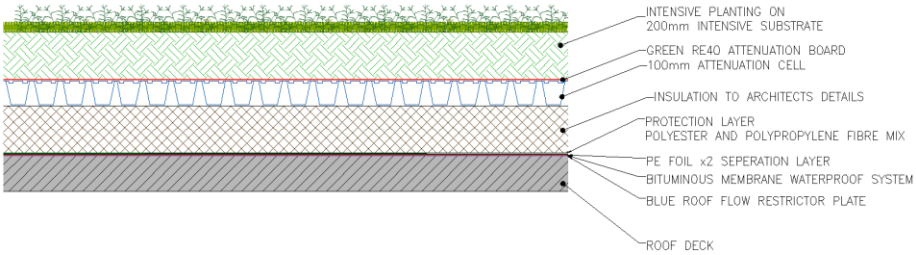


Figure 2-2 - Typical Intensive Green/ Blue Roof Section

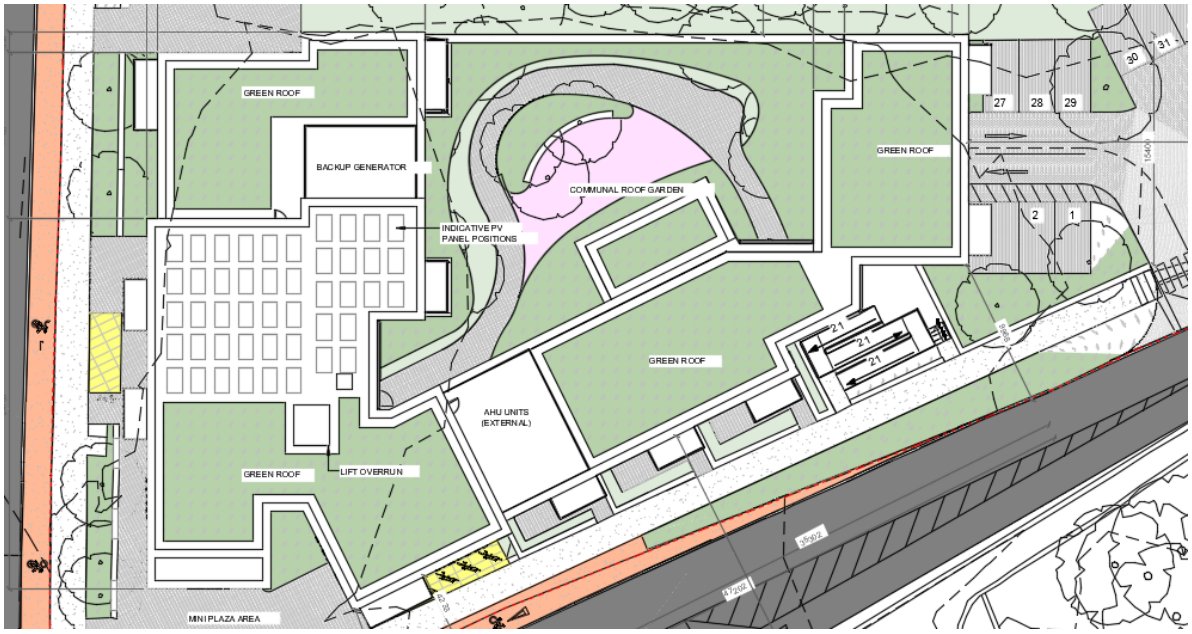


Figure 2-3 – Proposed Green/ Blue on Plan (Extract from Architects Drawing – Proposed Roof Level Plan)

2.5.3 Permeable Paving

It is proposed to use permeable paving to surface the private curtilage areas, parking spaces and footpaths in the development. It is anticipated that most of the rainwater will be able to percolate through the permeable paving and infiltrate into the underlying soils. However, it is proposed to provide a number of overflow outlets within the permeable paving build-up which will ensure the permeable area is not flooded during severe rainfall events. The outlet from the permeable paving areas will be raised 100-150mm above formation level to provide interception storage within the stone sub-base; this gives 30mm interception storage @ 30% voids in the gravel.

These permeable surfaces, together with their associated substructures, are an efficient means of managing surface water runoff close to source – intercepting runoff, reducing the volume and frequency of runoff, and providing treatment medium. Refer to the Malone O'Regan SuDS detail drawing no. SHB5-LDR-DR-MOR-CS-P3-151 for typical permeable paving details.

Permeable paving will be provided with a perforated underdrain pipe. The pipe shall be raised above the base of the stone sub-base so that minor accumulations of runoff water can percolate through the stone sub-base. During significant rainfall events, excess water will disperse through the perforated underdrain preventing flooding at surface level. The underdrain will connect to inspection manholes which will facilitate maintenance of the drainage pipework.

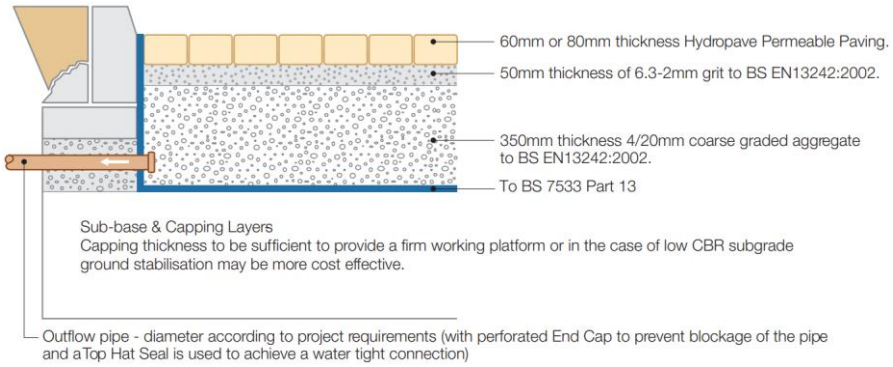


Figure 2-4 - Typical Section through Permeable Paving

2.5.4 Rain Garden / Bioretention Area

It is proposed to provide a number of bioretention rain gardens in the green open spaces of the development. A bioretention rain garden employs an engineered topsoil and is used to manage polluted urban rainfall runoff from hard surfaces areas. Refer to the Malone O'Regan SuDS detail drawing no. SHB5-LDR-DR-MOR-CS-P3-151 for typical rain garden detail.

The report prepared by Causeway Geotech imply that the subsoil may be considered suitable media for infiltration. It is anticipated that runoff from minor rainfall events will be able to percolate directly into the soil.

Key design aspects for bioretention raingardens include:

1. Silt collection in forebays to allow for easy removal of silt.
2. Space above the soil profile for water collection and stilling before infiltration through the engineered soil.
3. A surface mulch of organic matter, grit or gravel protects the infiltration capacity of the soil.
4. A free draining soil, typically 450 – 600mm deep, with 20 – 30% organic matter cleans, stores and conveys runoff to a drainage layer.
5. A transition layer of grit and/ or sand protects the under-drained drainage layer.
6. A surface overflow for heavy rain or in the event of blockage.
7. Perforated underdrain pipe.

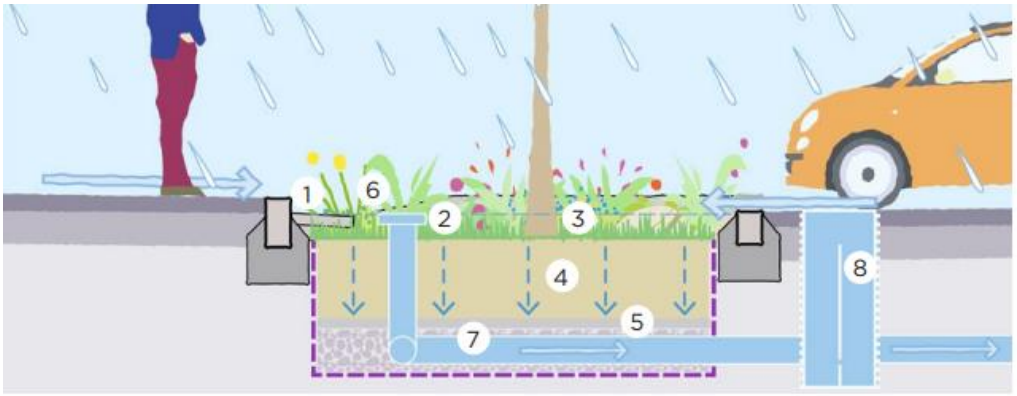


Figure 2-5 - Typical Section through Bioretention Rain Garden (Extract from South Dublin County Council – Sustainable Drainage Explanatory Design & Evaluation Guide 2022)

2.6 Interception Storage

To prevent pollutants or sediments discharging into watercourses the GDSDS requires "interception storage" to be incorporated into the drainage design for the development. The volume of interception required is based on 5-10mm of rainfall depth from 80% of the runoff from impermeable areas as defined in GDSDS. The interception volume attributable to each SuDS feature consists of the volume of water that can infiltrate to the ground, the quantity that evaporates into the atmosphere and the volume lost through transpiration in plants and vegetation. Additionally, there will be some loses of water due to absorption and wetting of stone and soil media.

The required interception storage and provided interception storage is provided in Appendix B of the report.

2.7 Attenuation Design

Attenuation storage is provided on site using an attenuation tank located along the eastern boundary, under the site entrance road. For the purpose of the surface water attenuation design, the site is dealt with as one catchment as shown above. The volume of surface water storage required has been calculated in accordance with the SuDS Manual Ciria C697, taking account of design invert levels, ground levels and allowable discharge rate. Calculations to size the attenuation tank for the 1 in 100-year flood event is provided in Appendix B.

Surface water runoff from the site will drain by gravity towards the attenuation tank. The calculated storage capacity is **73.000m^3**.

The volume of runoff water that will be generated during a 1 in 100-year storm event has been calculated to be **69.120m^3**. This volume has been calculated accommodating a 20% increase in future rainfall intensities as a result of climate change allowing for 10% urban creep. The attenuation storage has been assessed using the average annual peak flow rate QBAR. The overflow from the attenuation tank is limited by a Hydrobrake flow control device which restricts the flow to 0.995 litres/s.

2.8 GDSDS Criterion Compliance

2.8.1 Criterion 1 River Water Quality Protection

Run-off from natural greenfield areas contributes very little pollution and sediment to rivers and for most rainfall events direct run-off from greenfield sites to rivers does not take place as rainfall percolates into the ground. By contrast, urban run-off, when drained by pipe systems, results in run-off from virtually every rainfall event with high levels of pollution, particularly in the first phase of run-off, with little rainfall percolating to the ground. To prevent this happening, Criterion 1 requires that interception storage and/or treatment storage is provided, thereby replicating the run-off characteristics of the pre-development greenfield site.

2.8.2 Criterion 2 River Regine Protection

Attenuation storage is provided to limit the discharge rate from the site into the public network. As per the GDSGS, the required attenuation volume has been calculated for the 1-year, 30-year and 100-year return periods, identifying the critical storm for each – refer to the calculations included in Appendix B.

The 1975 Flood Studies Report included a Soil Index map, a digitised version of which available at www.uksuds.com. This map indicated that the site lies within an area of Soil Type 2 (SPR Index 0.3). Soil Type 2 corresponds with a very permeable soil such as sand and gravel with low runoff potential.

Site Investigation works were completed by Causeway Geotech in February 2024. Ground types encountered during the investigation of the site consisted of brown sandy gravelly clay, generally firm to stiff.

Groundwater was not encountered during drilling at any of the borehole locations. 2 no. infiltrations tests were conducted on site. One of the tests indicated an infiltration rate of f = 1.66667 $x10^{-5}$ m/s, however at the other test location, the water level dropped too slowly to allow calculation of the soil infiltration rate. The report prepared Causeway Geotech concludes that the rate of infiltration coupled with the soil descriptions imply that the subsoil may be considered suitable media for an infiltration drainage system.

Given the permeable nature of the subsoil it is considered appropriate to adopt a Soil Index value of Type 2 (SPR Index 0.3). The calculations use a Standard Average Annual Rainfall (SAAR) value of 1014mm, taken from HR Wallingfords SuDS map.

Based on these calculations, the required attenuation storage for the site is 69.120m^3. This volume is sufficient for the 1 in 100-year storm event, allowing for a 20% increase in future rainfall intensities as a results of climate change and 10% urban creep.

The proposed attenuation tank is located along the eastern boundary, under the site entrance road. Surface water runoff will be restricted via a Hydrobrake flow control device with discharge from the site limited to the average annual peak flow rate QBAR. The overflow from the attenuation tank is limited by a Hydrobrake flow control device which restricts the flow to 0.995 litres/s.

2.8.3 Criterion 3 Site Flooding

The GDSDS requires that no flooding should occur on site for storms up to and including the 1 in 30-year event. The pipe network and the attenuation storage volumes should, therefore, be checked for such storms to ensure that no site flooding occurs although partial surcharging of the system is allowed if it does not threaten to flood.

For the 1 in 100-year event, the pipe network can fully surcharge and cause the site flooding, but the top water level due to any such flooding must be at least 500mm below any vulnerable internal floor levels, and the flood waters should be contained within the site. In addition, the top water level in any attenuation device during the 100-year storm must be at least 500mm below any vulnerable internal floor levels.

Surface water drains have been sized to ensure the following:

- The system does not surcharge for the 2-year event.
- The system surcharges but does not flood for the 30-year event,
- The system surcharges but does not flood for the 100-year event.
- Detailed modelling of the surface water sewer network has been carried out using the Causeway Flow software to confirm the above criteria is adequately met. The outputs of the Causeway flow report are included in Appendix C for Surface Water calculations and Appendix D for Foul Water calculations.

2.8.4 Criterion 4 River Flood Protection

The long-term storage volume is a comparison of pre- and post- development runoff volumes. The objective is to limit the runoff discharged after development to the same as that which occurred prior to the development.

Of the three methods described in the GDSDS for establishing River Flood Protection by comparison of the pre- and post- development runoff volumes, (Criteria 4.1, 4.2 and 4.3 respectively), Criteria 4.3 is selected for use as the most practical criteria at this stage in the design.

The Criteria 4.3 approach is for all runoff to be limited to either QBAR or to 2l/s/ha, whichever is greater. As noted in Section 2.4, in this instance, the QBAR is greater than 2l/s/ha and has been adopted as the limiting discharge rate.

The proposed drainage system includes a flow control device to ensure that the discharge rate is limited to the greenfield equivalent and ample attenuation is provided for the 1 in 100-year flood event, accounting for 20% increase due to climate change.

2.9 Enhanced Biodiversity

Bioretention areas will be included as part of the proposed development. Biodiversity has been carefully considered when determining both the location and the detailed design of these elements. The proposed bioretention area offers the opportunity to create a planted vegetation zone for plants and animals which will encourage biodiversity on the site.

2.10 SuDS CIRIA Pillars of Design

2.10.1 Water Quantity

The "Water Quantity" design objective is to ensure that the surface water runoff from a developed site does not have a detrimental impact on people, property, or the environment, it is important to control:

- How fast the runoff is discharged from the site (i.e., the peak runoff rate) and
- How much runoff is discharged from the site (i.e., the runoff volume)

2.10.2 Water Quality

The "Water Quality" design objective seeks to ensure the surface water runoff from the site does not compromise the groundwater or surrounding water courses relating to the site.

2.10.3 Amenity

The "Amenity" design objective aims to deliver attractive, pleasant, useful and above all liveable urban environments. SuDS measures should be designed to replicate the existing natural environment and blend in with the urban development.

MOR have worked closely with the landscaping architect throughout the SuDS strategy design process to ensure that the measures which have been suggested and incorporated have a high sense of public use. Throughout the site, there are green/blue roofs and bio-retention areas.

2.10.4 Biodiversity

The encouragement of biodiverse environments within urban environments is incredibly important. The SuDS measures must not only replicate the pre-development surface water runoff systems and treatment for rainfall, but they should also aim to replicate the existing habitats from the pre- development stage.

By incorporating large, landscaped areas, green/blue roofs throughout the site and the bio-retention areas, biodiversity on site is promoted.

2.10.5 SuDS Conclusion

This section of the report has comprehensively discussed the various SuDS measures which can be applied to the site and then selected the applicable systems, based on the site layout. A wide range of measures have been employed.

Finally, the chosen SuDS measures have been analysed for various rainfall scenarios to ensure that all the SuDS design criteria are met an extensive range of SuDS measures are proposed with extensive coverage of the developed area of the site. These measures will be effective in treating rainfall on the site to meet GDSDS and CIRIA.

2.11 Maintenance and Management Plan

Refer to appendix E for details of maintenance requirements for individual SuDS drainage measures on the site.

2.12 Potential Future Expansion

No future expansion has been considered for the proposed drainage networks for the development.

3 FOUL WATER DRAINAGE DESIGN

3.1 General

The foul water drainage infrastructure has been designed in accordance with Irish Water Technical Standard for Wastewater Gravity Sewers (Document Number: IW-TEC-800-01) and the Irish Water Code of Practice for Wastewater Infrastructure (Document Number: IW-CDS-5030-03).

On the 5th of December 2023, a Pre-Connection Enquiry Form was submitted to Irish Water in respect of this development. Irish Water provided a Confirmation of Feasibility letter which stated that the proposed water connection was feasible without infrastructure upgrades and the wastewater connection was feasible subject to upgrades. A copy of the Irish Water Confirmation of Feasibility Letter is provided in Appendix A.

Table 3-1 outlines the parameters adopted in the design of the foul and process water drainage infrastructure.

Table 3-1 - Foul Water Design Parameters

Parameter Description	Assigned Value
Hydraulic Loading (Foul associated with domestic)	150 litres / person / day
Pipe Friction	1.5 mm
Minimum Velocity	0.7 m/s
Maximum Velocity	3.0 m/s
Peaking Factor (for domestic foul flows only)	6.0

3.2 Existing Services

There is an existing 300mm diameter concrete sewer running parallel to the western boundary of the site, on the Sandyford Road (R117). These underground drains carry foul water towards existing treatment areas in the Dublin area. Due to the relative levels of the existing drainage within the road and the proposed site levels, it is possible to achieve a gravity connection to the foul water drainage pipework installed.

3.3 Proposed Services

The proposed foul water drainage system is designed to comply with the 'Greater Dublin Strategic Drainage Study (GDSDS) Regional Drainage Policies Technical Document – Volume 2, New Developments, 2005' and the 'Greater Dublin Regional Code of Practice for Drainage Works, V6.0 2005'.

The proposed foul water drainage layout for the development is indicated on Malone O'Regan drawing no. SHB5-LDR-DR-MOR-CS-P3-130. Foul water from new apartment will be collected within a gravity drainage network and directed towards the existing public sewer system on Sandyford Road.

Calculations for the foul and process water pipe networks are provided in Appendix D.

3.4 Foul Water Demand Calculations

3.4.1 Residential Foul Water Demand

In accordance with the Irish Water Code of Practice for Wastewater Infrastructure works which carry domestic wastewater shall be designed to carry a wastewater volume of between 6 times the dry weather flow.

Dry weather flow (DWF) should be taken as 446 litres per dwelling.

DWF = 37 units x 446 l/dwelling = 16,502 l/day = **0.191 l/sec**

Peak discharge = 6 x DWF = **1.146 l/sec**

3.4.2 Community Centre Foul Water Demand

There is provision of 147m^2 of community, cultural and arts space within the development. The average and peak water demand rates were calculated in accordance with the Irish Water Code of Practice for Water Infrastructure guidelines which assumes a loading rater of 40 l/person/day for a Local Community Sports Club.

Total persons = 74 people (Assumed 1 person per 2m^2 of floor area)

Average water demand = 40litres/person/day

Total daily discharge = 74 people x 40litres/person/day = 2960 litres/day

Average Hour Demand = 2960 litres/day / (24hr x 60min x 60sec)
= **0.034 l/s**

In accordance with Table 2.7 Commercial Peaking Factors, the peaking factor applied to commercial wastewater flow for an area of 0 – 5.5ha is 4.5 x DWF.

Peak discharge = 4.5 x DWF = **0.153 l/s**

Average and peak foul discharge rates for the proposed development is summarised in Table 3-2.

Table 3-2 - Average and Peak Foul Discharge Rates for All Development

Development Description	Average Demand (l/s)	Peak Demand (l/s)
Proposed development of residential units	0.191	1.146
Community Centre	0.034	0.153
Total	**0.225**	**1.299**

3.5 Potential Future Expansion

No future expansion has been considered for the proposed drainage networks for the development.

4 WATER SUPPLY

4.1 General

The Proposed Development will use mains water. The proposed water supply infrastructure has been designed in accordance with the Irish Water Code of Practice for Water Infrastructure (Document Number: IW-CDS-5020-03).

On the 5th of December 2023, a Pre-Connection Enquiry Form was submitted to Irish Water in respect of this development. Irish Water provided a Confirmation of Feasibility letter which stated that the proposed water connection was feasible without infrastructure upgrades and the wastewater connection was feasible subject to upgrades.

A copy of the Irish Water Confirmation of Feasibility Letter is provided in Appendix A.

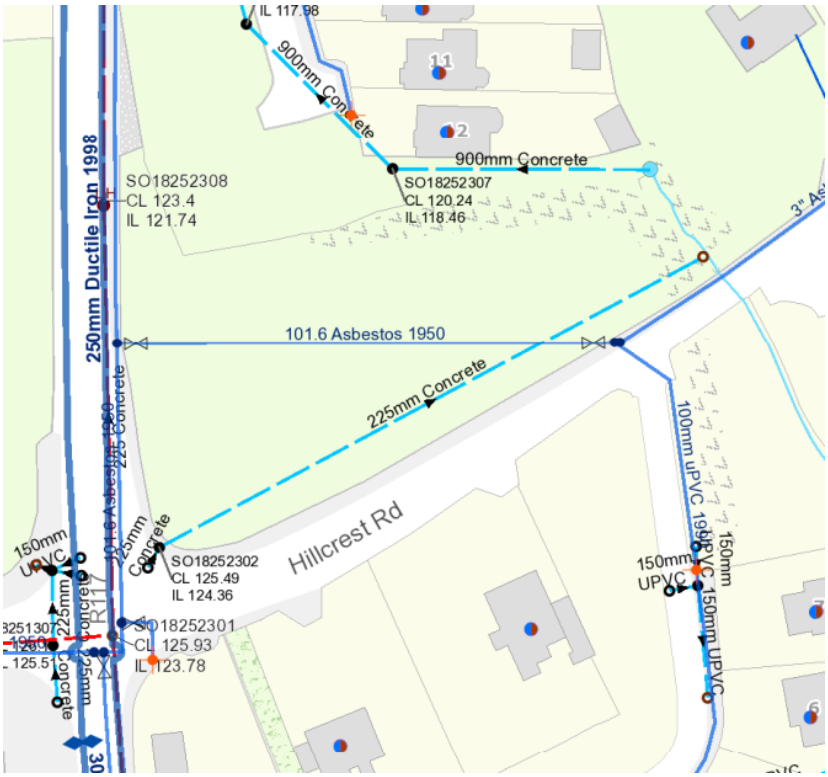


Figure 4-1 - Extract from Irish Water maps

4.2 Existing & Proposed Services

A 101.6mm diameter watermain is located running diagonally across the site. it is proposed to use this watermain and divert it around the new building as required.

The proposed watermain layout is indicated on drawing no. SHB5-LDR-DR-MOR-CS-P3-140 which accompanies this planning application.

4.3 Water Demand Calculations

4.3.1 Residential Water Demand

The average and peak water demand rates were calculated in accordance with the Irish Water Code of Practice for Water Infrastructure guidelines which assumes a loading rate of 150 litres per person per day and an occupancy rate of 2.7 persons per dwelling.

The average day/ peak week demand is taken as 1.25 times the average daily domestic demand. The peak demand is taken to be 5 times the average day/ peak week demand.

Total Daily Water Demand = 37 dwellings x 2.7 persons x 150 litres per day per person
= 14,985 litres/day

Average Hour Demand = 14,985 litres/day / (24hr x 60min x 60sec)
= 0.173 litres/sec

Average Day / Peak Week Demand = 0.173 litres/sec x 1.25
= **0.217 litres/sec**

Peak Demand = 5 x 0.217 litres/sec = **1.084 litres/sec**

4.3.2 Community Centre Water Demand

There is provision of 147m^2 of community, cultural and arts space.

Total persons = 74 people (Assumed 1person per 2m^2 of floor area)

Average water demand = 90litres/person/day

Total daily discharge = 74 people x 90litres/person/day = 6,660 litres/day = 0.077 litres/sec

Average Day Peak Week Demand = 0.077 x 1.25 = **0.096 litres/ sec**

Peak Demand = 5 x 0.096 litres/sec = **0.482 litres/sec**

Average and peak discharge rates for all existing and proposed developments are summarised in Table 4-1.

Table 4-1 - Average and Peak Foul Discharge Rates for All Developments

Development Description	Average Demand (l/s)	Peak Demand (l/s)
Proposed development of residential units	0.217	1.084
Community Centre	0.096	0.482
Total	**0.313**	**1.566**

Average and peak water demand rates have been calculated as follows, in accordance with the Irish Water Code of Practice for Water Infrastructure:

Domestic Water Demand

Total no. residents = 104

Irish Water Code of Practice for Water Infrastructure gives flow rate for Domestic Dwellings' as 150 litres per person per day.

Total Daily Water Demand = 104 people x 150 litres per day per person
= 15,600 litres/day

Average Hour Demand = 15,600 litres/day / (24hr x 60min x 60sec)
= 0.181 litres/sec

The average day, peak week demand is taken as 1.25 times the average daily domestic demand.

Average Day / Peak Week Demand = 0.181 litres/sec x 1.25
= 0.226 litres/sec

APPENDIX A – IRISH WATER CONFIRMATION OF FEASIBILITY

CONFIRMATION OF FEASIBILITY

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Uisce Éireann
PO Box 448
South City
Delivery Office
Cork City

www.water.ie

Ray O'Connor

Malone O' Regan
2B Richview Office Park
Clonskeagh
Dublin 14
D14 XT57

30 May 2024

Our Ref: CDS23009081 Pre-Connection Enquiry
New Apartments At Lambs Cross, Hillcrest Road, Dublin

Dear Applicant/Agent,

We have completed the review of the Pre-Connection Enquiry.

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Multi/Mixed Use Development of 39 unit(s) at New Apartments At Lambs Cross, Hillcrest Road, Dublin, (the **Development)**.

Based upon the details provided we can advise the following regarding connecting to the networks;

- **Water Connection** - Feasible without infrastructure upgrade by Uisce Éireann

- The proposed Development indicates that Uisce Éireann assets are present on the site. The Developer has to demonstrate that proposed structures and works will not inhibit access for maintenance or endanger structural or functional integrity of the assets during and after the works. For design submissions and queries related to diversion/build near or over, please contact UÉ Diversion Team via email address diversions@water.ie

- **Wastewater Connection** - Feasible Subject to upgrades

- In order to accommodate the proposed connection at the Premises, upgrade works are required downstream of the site. Uisce Éireann currently has a project on our current investment plan which will provide

the necessary upgrade and capacity. Estimated completion date for the project is Q3 2028 (subject to change).

- Additionally, the existing 375mm gravity sewer adjacent to the site, has to be connected to the proposed downstream infrastructure.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann infrastructure. Before the Development can be connected to our network(s) you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.

As the network capacity changes constantly, this review is only valid at the time of its completion. As soon as planning permission has been granted for the Development, a completed connection application should be submitted. The connection application is available at www.water.ie/connections/get-connected/

Where can you find more information?

- **Section A -** What is important to know?
- **Section B -** Details of Uisce Éireann's Network(s)

This letter is issued to provide information about the current feasibility of the proposed connection(s) to Uisce Éireann's network(s). This is not a connection offer and capacity in Uisce Éireann's network(s) may only be secured by entering into a connection agreement with Uisce Éireann.

For any further information, visit **www.water.ie/connections**, **email newconnections@water.ie** or contact 1800 278 278**.**

Yours sincerely,

Dermot Phelan
Connections Delivery Manager

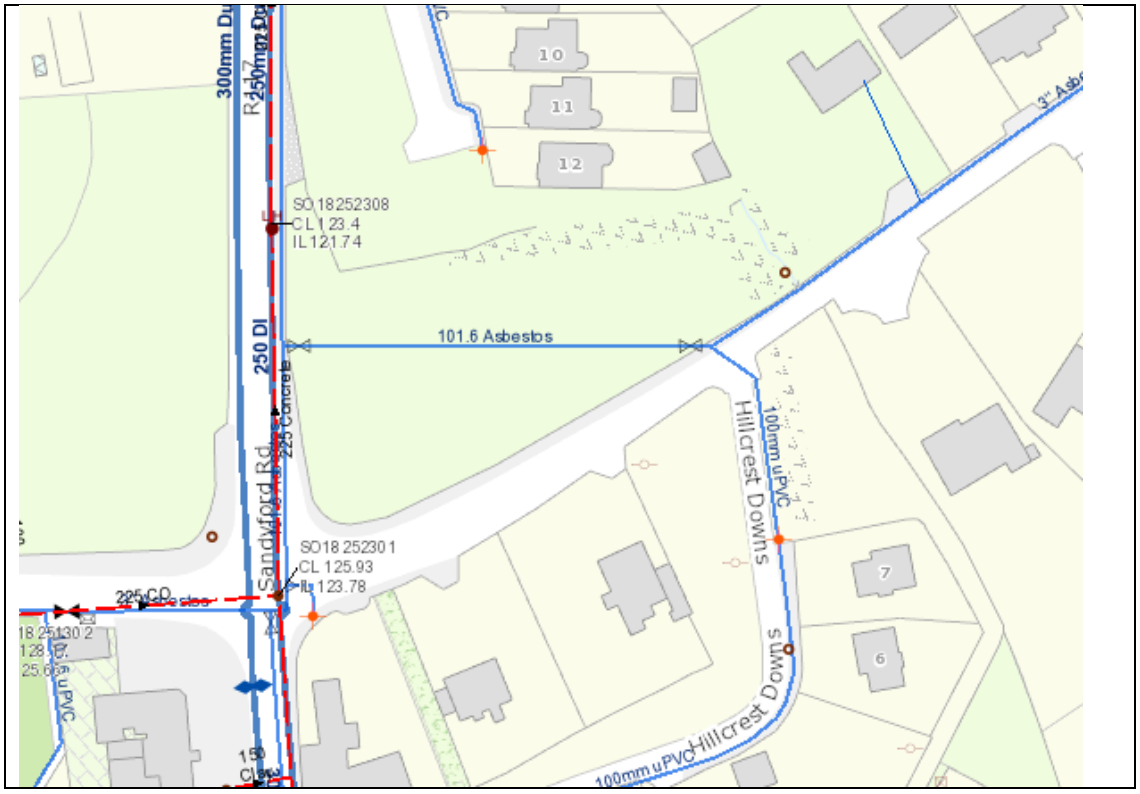
Section A - What is important to know?

What is important to know?	Why is this important?
Do you need a contract to connect?	• Yes, a contract is required to connect. This letter does not constitute a contract or an offer in whole or in part to provide a connection to Uisce Éireann's network(s). • Before the Development can connect to Uisce Éireann's network(s), you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.
When should I submit a Connection Application?	• A connection application should only be submitted after planning permission has been granted.
Where can I find information on connection charges?	• Uisce Éireann connection charges can be found at: https://www.water.ie/connections/information/charges/
Who will carry out the connection work?	• All works to Uisce Éireann's network(s), including works in the public space, must be carried out by Uisce Éireann*. *Where a Developer has been granted specific permission and has been issued a connection offer for Self-Lay in the Public Road/Area, they may complete the relevant connection works
Fire flow Requirements	• The Confirmation of Feasibility does not extend to fire flow requirements for the Development. Fire flow requirements are a matter for the Developer to determine. • **What to do?** - Contact the relevant Local Fire Authority
Plan for disposal of storm water	• The Confirmation of Feasibility does not extend to the management or disposal of storm water or ground waters. • **What to do?** - Contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges.
Where do I find details of Uisce Éireann's network(s)?	• Requests for maps showing Uisce Éireann's network(s) can be submitted to: datarequests@water.ie

What are the design requirements for the connection(s)?	• The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this Development shall comply with ***the Uisce Éireann Connections and Developer Services Standard Details and Codes of Practice,*** available at www.water.ie/connections
Trade Effluent Licensing	• Any person discharging trade effluent** to a sewer, must have a Trade Effluent Licence issued pursuant to section 16 of the Local Government (Water Pollution) Act, 1977 (as amended). • More information and an application form for a Trade Effluent License can be found at the following link: https://www.water.ie/business/trade-effluent/about/ **trade effluent is defined in the Local Government (Water Pollution) Act, 1977 (as amended)

Section B – Details of Uisce Éireann's Network(s)

The map included below outlines the current Uisce Éireann infrastructure adjacent the Development: To access Uisce Éireann Maps email datarequests@water.ie



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Note: The information provided on the included maps as to the position of Uisce Éireann's underground network(s) is provided as a general guide only. The information is based on the best available information provided by each Local Authority in Ireland to Uisce Éireann.

Whilst every care has been taken in respect of the information on Uisce Éireann's network(s), Uisce Éireann assumes no responsibility for and gives no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided, nor does it accept any liability whatsoever arising from or out of any errors or omissions. This information should not be solely relied upon in the event of excavations or any other works being carried out in the vicinity of Uisce Éireann's underground network(s). The onus is on the parties carrying out excavations or any other works to ensure the exact location of Uisce Éireann's underground network(s) is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

APPENDIX B – ATTENUATION VOLUME CALCULATIONS

Job Title	Lambs Cross Blue roof	Job no.	23006
By:	MG	Checked by:	DW
Date	21/10/2024	Rev number	1

Part 1 **Permissible Runoff**

The regression equation recommended for use by the Greater Dublin Strategic Drainage Study 2005 calculates a value, QBARural, which is sourced from the Institute of Hydrology Report 124. This value is the mean annual flood flow from a rural catchment in m^3/s and is given by the equation:

QBARrural = 0.00108[Area^0.89] x [SAAR^1.17] x [Soil^2.17]

Rainfall Data	
M5-60 (1 hour - 5 years) mm	18.3
M5-2D (2 days - 5 years) mm	67.9
Ratio "r" (M5-60/ M5-2D)	0.27
SAAR mm	1014
Soil/ SPR mm	0.3

Soil Type 4 - Based on SI findings - clay or loamy soils; high runoff potential

For 50 Ha Area ~ QBARrural =	0.141	m^3/s
QBARrural =	2.812	l/s/ha
For 0.35 Ha Area ~ QBARrural =	0.995	l/s

Discharge should be limited to QBAR or 2 l/s/ha whichever is greater.

Part 2 **Impermeable Area**

Breakdown of the impermeable areas contributing to the surface water drainage network in each catchment with applied runoff coeifficients is provided in the table below

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
3,538.00	Roof	Standard roof (25%)	0.00	0.95	0.00	0.00	0.00	672.91
		Green Roof (75%)	849.64	0.60	509.78	560.76	672.91	
	Permeable Paving inc. areas from hardstanding		0.00	0.50	0.00	0.00	0.00	
ha	Landscaped Areas inc. areas from hardstanding		0.00	0.20	0.00	0.00	0.00	**ha**
0.35								0.07
	Hardstanding		0.00	0.90	0.00	0.00	0.00	

These calculations are based on "Engineering Hydrology" by E.M.Wilson (4th Edition)
Ratio R (%) - Refer to Table 2.9 of "Engineering Hydrology
M10/M100 - Refer to Table 2.7 of "Engineering Hydrology

Part 3 **Attenuation Volume Required**

1 in 10 Years

Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M10 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.9	(M5-2D*Ratio)/100	Table 2.7		M5*M10	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3	2.0	1.15	1	2.343	1.576	0.059684789	1.517
2min	5	3.4	1.15	1	3.904	2.627	0.119369578	2.508
5 min	9	6.1	1.16	1	7.089	4.770	0.298423946	4.472
10 min	12.9	8.8	1.17	1	10.248	6.896	0.596847892	6.299
15 min	15.5	10.5	1.18	1	12.419	8.357	0.895271837	7.462
30 min	20.7	14.1	1.18	1	16.585	11.160	1.790543675	9.370
60 min	27	18.3	1.18	1	21.633	14.557	3.58108735	10.976
2 hour	35	23.8	1.18	1	28.043	18.870	7.1621747	11.708
4 hour	44	29.9	1.17	1	34.955	23.522	14.3243494	9.197
6 hour	51	34.6	1.17	1	40.516	27.264	21.4865241	5.777
12 hour	65	44.1	1.16	1	51.197	34.451	42.9730482	-8.522
24 hour	83	56.4	1.15	1	64.811	43.612	85.94609639	-42.334
48 hour	106	72.0	1.14	1	82.050	55.213	171.8921928	-116.679
Size of Attenuation for 1 in 10 year flood event m³								**11.708**

1 in 30 Years

Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M30 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.7	(M5-2D*Ratio)/100	Table 2.9		M5*M30	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3	2.0	1.43	1	2.913	1.960	0.059684789	1.900
2min	5	3.4	1.43	1	4.855	3.267	0.119369578	3.148
5 min	9	6.1	1.48	1	9.044	6.086	0.298423946	5.788
10 min	12.9	8.8	1.51	1	13.226	8.900	0.596847892	8.303
15 min	15.5	10.5	1.54	1	16.208	10.906	0.895271837	10.011
30 min	20.7	14.1	1.54	1	21.645	14.565	1.790543675	12.775
60 min	27	18.3	1.54	1	28.233	18.998	3.58108735	15.417
2 hour	35	23.8	1.51	1	35.885	24.148	7.1621747	16.985
4 hour	44	29.9	1.5	1	44.814	30.156	14.3243494	15.832
6 hour	51	34.6	1.48	1	51.251	34.487	21.4865241	13.001
12 hour	65	44.1	1.45	1	63.996	43.064	42.9730482	0.090
24 hour	83	56.4	1.41	1	79.463	53.472	85.94609639	-32.474
48 hour	106	72.0	1.39	1	100.044	67.321	171.8921928	-104.571
Size of Attenuation for 1 in 30 year flood event m³								**16.985**

1 in 100 Years

Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M100 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.7	(M5-2D*Ratio)/100	Table 2.9		M5*M100	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3	2.0	1.75	1	3.565	2.399	0.059684789	2.339
2min	5	3.4	1.77	1	6.009	4.044	0.119369578	3.924
5 min	9	6.1	1.86	1	11.366	7.649	0.298423946	7.350
10 min	12.9	8.8	1.9	1	16.642	11.199	0.596847892	10.602
15 min	15.5	10.5	1.96	1	20.628	13.881	0.895271837	12.986
30 min	20.7	14.1	1.97	1	27.689	18.632	1.790543675	16.842
60 min	27	18.3	1.98	1	36.299	24.426	3.58108735	20.845
2 hour	35	23.8	1.93	1	45.866	30.864	7.1621747	23.702
4 hour	44	29.9	1.89	1	56.466	37.996	14.3243494	23.672
6 hour	51	34.6	1.85	1	64.064	43.109	21.4865241	21.623
12 hour	65	44.1	1.77	1	78.119	52.567	42.9730482	9.594
24 hour	83	56.4	1.72	1	96.934	65.228	85.94609639	-20.718
48 hour	106	72.0	1.69	1	121.636	81.850	171.8921928	-90.042
Size of Attenuation for 1 in 100 year flood event m³								**23.702**

Part 4 **Interception Storage**

To prevent pollitant or sediments discharging into water courses the GDSDS required "interception storage" to be incorporated into the drainage design for the development. The volume of interception required is based on the 5-10mm of rainfall depth from 80% of the runoff from impermeable areas. The interception volume attributable to each of the SuDS features consists of the volyme of water that can infiltrate to the ground, the quanity that evaporates into the atmosphere and the volyme lost through transpiration in plants and vegitation. Additionally, there will be some loses of water due to absorption and westting of stone and soil media.

Required Interception Storage

Overall Impermeable area is 672.9 m² including 10% for urban creep

Therefore, the total interception storage required is 'overall impermeable area x 80% x 0.005 x 1.2 for climate change' 3.23 m³

Interception Storage Provided *Only fill in SuDS on your site

Green Roof A 'Bauder Sedume' or equivalent design to retain 30 l/m² of rainwater will be used on roof level	Area	849.64	m²
	Interception Store 30 l/m²	0.03	l/m²
	Storage Volume	25.49	m³

Total interception volume provided for the overall site 25.49 m³

which exceeds the required volume calculated of 3.23 m³

Job Title	Lambs Cross	Job no.	23006
By:	MG	Checked by:	DW
Date	21/10/2024	Rev number	1

Part 1 **Permissible Runoff**

The regression equation recommended for use by the Greater Dublin Strategic Drainage Study 2005 calculates a value, QBARural, which is sourced from the Institute of Hydrology Report 124. This value is the mean annual flood flow from a rural catchment in m^3/s and is given by the equation:

QBARrural = 0.00108[Area^0.89] x [SAAR^1.17] x [Soil^2.17]

Rainfall Data	
M5-60 (1 hour - 5 years) mm	18.3
M5-2D (2 days - 5 years) mm	67.9
Ratio "r" (M5-60/ M5-2D)	0.27
SAAR mm	1014
Soil/ SPR mm	0.3

Soil Type 4 - Based on SI findings - clay or loamy soils; high runoff potential

For 50 Ha Area ~ QBARrural =	0.141	m^3/s
QBARrural =	2.812	l/s/ha
For 0.35 Ha Area ~ QBARrural =	0.995	l/s

Discharge should be limited to QBAR or 2 l/s/ha whichever is greater.

Part 2 **Impermeable Area**

Breakdown of the impermeable areas contributing to the surface water drainage network in each catchment with applied runoff coeifficients is provided in the table below

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
3,538.00	Roof	Standard roof (25%)	283.21	0.95	269.05	295.96	355.15	1414.32
		Green Roof (75%)	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		702.48	0.50	351.24	386.36	463.63	
ha	Landscaped Areas inc. areas from hardstanding		1544.64	0.20	308.93	339.82	407.78	**ha**
0.35								0.14
	Hardstanding		158.04	0.90	142.23	156.46	187.75	

These calculations are based on "Engineering Hydrology" by E.M.Wilson (4th Edition)
Ratio R (%) - Refer to Table 2.9 of "Engineering Hydrology
M10/M100 - Refer to Table 2.7 of "Engineering Hydrology

Part 3 **Attenuation Volume Required**

1 in 10 Years

Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M10 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.9	(M5-2D*Ratio)/100	Table 2.7		M5*M10	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3	2.0	1.15	1	2.343	3.313	0.059684789	3.253
2min	5	3.4	1.15	1	3.904	5.522	0.119369578	5.402
5 min	9	6.1	1.16	1	7.089	10.026	0.298423946	9.727
10 min	12.9	8.8	1.17	1	10.248	14.494	0.596847892	13.897
15 min	15.5	10.5	1.18	1	12.419	17.564	0.895271837	16.669
30 min	20.7	14.1	1.18	1	16.585	23.457	1.790543675	21.666
60 min	27	18.3	1.18	1	21.633	30.596	3.58108735	27.015
2 hour	35	23.8	1.18	1	28.043	39.661	7.1621747	32.499
4 hour	44	29.9	1.17	1	34.955	49.437	14.3243494	35.113
6 hour	51	34.6	1.17	1	40.516	57.302	21.4865241	35.816
12 hour	65	44.1	1.16	1	51.197	72.408	42.9730482	29.435
24 hour	83	56.4	1.15	1	64.811	91.663	85.94609639	5.716
48 hour	106	72.0	1.14	1	82.050	116.045	171.8921928	-55.847

Size of Attenuation for 1 in 10 year flood event m³ **35.816**

1 in 30 Years

Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M30 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.7	(M5-2D*Ratio)/100	Table 2.9		M5*M30	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3	2.0	1.43	1	2.913	4.120	0.059684789	4.060
2min	5	3.4	1.43	1	4.855	6.866	0.119369578	6.747
5 min	9	6.1	1.48	1	9.044	12.791	0.298423946	12.493
10 min	12.9	8.8	1.51	1	13.226	18.706	0.596847892	18.109
15 min	15.5	10.5	1.54	1	16.208	22.923	0.895271837	22.028
30 min	20.7	14.1	1.54	1	21.645	30.613	1.790543675	28.823
60 min	27	18.3	1.54	1	28.233	39.930	3.58108735	36.349
2 hour	35	23.8	1.51	1	35.885	50.753	7.1621747	43.591
4 hour	44	29.9	1.5	1	44.814	63.381	14.3243494	49.057
6 hour	51	34.6	1.48	1	51.251	72.485	21.4865241	50.998
12 hour	65	44.1	1.45	1	63.996	90.510	42.9730482	47.537
24 hour	83	56.4	1.41	1	79.463	112.386	85.94609639	26.440
48 hour	106	72.0	1.39	1	100.044	141.494	171.8921928	-30.399

Size of Attenuation for 1 in 30 year flood event m³ **50.998**

1 in 100 Years

Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M100 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.7	(M5-2D*Ratio)/100	Table 2.9		M5*M100	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3	2.0	1.75	1	3.565	5.042	0.059684789	4.982
2min	5	3.4	1.77	1	6.009	8.499	0.119369578	8.379
5 min	9	6.1	1.86	1	11.366	16.076	0.298423946	15.777
10 min	12.9	8.8	1.9	1	16.642	23.537	0.596847892	22.941
15 min	15.5	10.5	1.96	1	20.628	29.175	0.895271837	28.279
30 min	20.7	14.1	1.97	1	27.689	39.161	1.790543675	37.370
60 min	27	18.3	1.98	1	36.299	51.339	3.58108735	47.758
2 hour	35	23.8	1.93	1	45.866	64.870	7.1621747	57.707
4 hour	44	29.9	1.89	1	56.466	79.860	14.3243494	65.536
6 hour	51	34.6	1.85	1	64.064	90.606	21.4865241	69.120
12 hour	65	44.1	1.77	1	78.119	110.485	42.9730482	67.512
24 hour	83	56.4	1.72	1	96.934	137.095	85.94609639	51.149
48 hour	106	72.0	1.69	1	121.636	172.032	171.8921928	0.140

Size of Attenuation for 1 in 100 year flood event m³ **69.120**

Part 4 Interception Storage

To prevent pollitant or sediments discharging into water courses the GDSDS required "interception storage" to be incorporated into the drainage design for the development. The volume of interception required is based on the 5-10mm of rainfall depth from 80% of the runoff from impermeable areas. The interception volume attributable to each of the SuDS features consists of the volyme of water that can infiltrate to the ground, the quanity that evaporates into the atmosphere and the volyme lost through transpiration in plants and vegitation. Additionally, there will be some loses of water due to absorption and westting of stone and soil media.

Required Interception Storage

Overall Impermeable area is 1414.3 m² including 10% for urban creep

Therefore, the total interception storage required is 'overall impermeable area x 80% x 0.005 x 1.2 for climate change' 6.79 m³

Interception Storage Provided *Only fill in SuDS on your site

Permeable Paving	Area	468.3	m²	
	Stone Layer 100mm deep	0.1	m	
	Void Ratio	30%		
	Storage Volume	14.04954	m³	*Storage depth will depend on your site

Swale	Area	0.0	m²
	*75mm	0	m
	Storage Volume	0	m³

Bio-Retention Area/ Raingarden	Area	147.6	m²
	Depth of subgrade	0.1	m
	Storage Volume	14.7643	m³

Total interception volume provided for the overall site 28.81 m³

which exceeds the required volume calculated of 6.79 m³

APPENDIX C – SURFACE WATER PIPE NETWORK CALCULATIONS

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Inverts
M5-60 (mm)	18.300	Minimum Backdrop Height (m)	0.500
Ratio-R	0.270	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
SW01	0.018	4.00	124.500	1400	1.425
SW02	0.018	4.00	125.000	1400	2.164
SW03	0.018	4.00	125.000	1400	2.251
SW04	0.018	4.00	123.600	1400	1.425
SW05	0.018	4.00	123.600	1400	1.516
SW06	0.018	4.00	123.430	1400	1.425
SW07	0.018	4.00	123.430	1400	1.470
SW08			123.430	1400	1.500
SW09-HB			123.200	1400	1.500
Headwall			120.000	1400	0.519

Links

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Rain (mm/hr)
1.000	SW01	SW02	36.998	123.075	122.836	0.239	155.0	225	50.0
1.001	SW02	SW03	13.004	122.836	122.749	0.087	150.0	225	50.0
1.002	SW03	SW06	57.040	122.749	122.005	0.744	76.7	225	50.0
2.000	SW04	SW05	13.687	122.175	122.084	0.091	150.0	225	50.0
2.001	SW05	SW06	7.329	122.084	122.005	0.079	92.8	225	50.0
1.003	SW06	SW07	4.501	122.005	121.960	0.045	100.0	225	50.0
1.004	SW07	SW08	2.677	121.960	121.930	0.030	89.2	300	50.0
1.005	SW08	SW09-HB	13.196	121.930	121.700	0.230	57.4	300	50.0
1.006	SW09-HB	Headwall	11.093	121.700	119.481	2.219	5.0	300	50.0

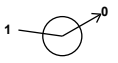
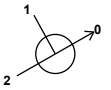
Name	Vel (m/s)	Flow (l/s)	US Depth (m)	DS Depth (m)
1.000	1.047	3.3	1.200	1.939
1.001	1.065	6.5	1.939	2.026
1.002	1.495	9.8	2.026	1.200
2.000	1.065	3.3	1.200	1.291
2.001	1.358	6.5	1.291	1.200
1.003	1.307	19.5	1.200	1.245
1.004	1.665	22.8	1.170	1.200
1.005	2.079	22.8	1.200	1.200
1.006	7.075	22.8	1.200	0.219

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	36.998	155.0	225	124.500	123.075	1.200	125.000	122.836	1.939
1.001	13.004	150.0	225	125.000	122.836	1.939	125.000	122.749	2.026
1.002	57.040	76.7	225	125.000	122.749	2.026	123.430	122.005	1.200
2.000	13.687	150.0	225	123.600	122.175	1.200	123.600	122.084	1.291
2.001	7.329	92.8	225	123.600	122.084	1.291	123.430	122.005	1.200
1.003	4.501	100.0	225	123.430	122.005	1.200	123.430	121.960	1.245
1.004	2.677	89.2	300	123.430	121.960	1.170	123.430	121.930	1.200
1.005	13.196	57.4	300	123.430	121.930	1.200	123.200	121.700	1.200
1.006	11.093	5.0	300	123.200	121.700	1.200	120.000	119.481	0.219

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW01	1400	Manhole	Adoptable	SW02	1400	Manhole	Adoptable
1.001	SW02	1400	Manhole	Adoptable	SW03	1400	Manhole	Adoptable
1.002	SW03	1400	Manhole	Adoptable	SW06	1400	Manhole	Adoptable
2.000	SW04	1400	Manhole	Adoptable	SW05	1400	Manhole	Adoptable
2.001	SW05	1400	Manhole	Adoptable	SW06	1400	Manhole	Adoptable
1.003	SW06	1400	Manhole	Adoptable	SW07	1400	Manhole	Adoptable
1.004	SW07	1400	Manhole	Adoptable	SW08	1400	Manhole	Adoptable
1.005	SW08	1400	Manhole	Adoptable	SW09-HB	1400	Manhole	Adoptable
1.006	SW09-HB	1400	Manhole	Adoptable	Headwall	1400	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW01	718142.930	725405.380	124.500	1.425	1400	 0	1.000	123.075	225
SW02	718145.480	725368.470	125.000	2.164	1400	 1	1.000	122.836	225
						0	1.001	122.836	225
SW03	718158.360	725366.680	125.000	2.251	1400	 1	1.001	122.749	225
						0	1.002	122.749	225
SW04	718216.163	725408.300	123.600	1.425	1400	 0	2.000	122.175	225
SW05	718204.356	725401.376	123.600	1.516	1400	 1	2.000	122.084	225
						0	2.001	122.084	225
SW06	718207.897	725394.959	123.430	1.425	1400	 1	2.001	122.005	225
						2	1.002	122.005	225
						0	1.003	122.005	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW07	718211.804	725397.193	123.430	1.470	1400	1	1.003	121.960	225
						0	1.004	121.960	300
SW08	718210.457	725399.507	123.430	1.500	1400	1	1.004	121.930	300
						0	1.005	121.930	300
SW09-HB	718221.040	725407.390	123.200	1.500	1400	1	1.005	121.700	300
						0	1.006	121.700	300
Headwall	718230.613	725412.994	120.000	0.519	1400	1	1.006	119.481	300

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
Rainfall Events	Singular	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	18.300	Additional Storage (m³/ha)	20.0
Ratio-R	0.270	Starting Level (m)	
Summer CV	1.000	Check Discharge Rate(s)	x
Winter CV	1.000	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	20	0	0
30	20	0	0
100	20	0	0

Node SW09-HB Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	121.700	Product Number	CTL-SHE-0067-2000-1000-2000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node SW08 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.80000	Safety Factor	2.0	Invert Level (m)	121.930
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	200

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	100.0	0.0	0.760	100.0	0.0	0.761	0.0	0.0

Results for 2 year +20% CC Critical Storm Duration. Lowest mass balance: 99.80%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW01	10	123.125	0.050	4.6	0.0893	0.0000	OK
15 minute summer	SW02	10	122.909	0.073	9.1	0.1252	0.0000	OK
15 minute summer	SW03	10	122.820	0.071	13.5	0.1205	0.0000	OK
15 minute summer	SW04	10	122.226	0.051	4.6	0.0908	0.0000	OK
15 minute summer	SW05	10	122.146	0.062	9.2	0.1109	0.0000	OK
15 minute summer	SW06	10	122.142	0.137	26.7	0.2451	0.0000	OK
15 minute winter	SW07	8	122.128	0.168	28.1	0.2998	0.0000	OK
240 minute summer	SW08	172	122.109	0.179	12.8	18.2095	0.0000	OK
240 minute summer	SW09-HB	160	122.115	0.415	9.7	0.6384	0.0000	SURCHARGED
15 minute summer	Headwall	1	119.481	0.000	2.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW01	1.000	SW02	4.5	0.516	0.109	0.3282	
15 minute summer	SW02	1.001	SW03	8.9	0.812	0.210	0.1427	
15 minute summer	SW03	1.002	SW06	12.9	0.736	0.218	1.0257	
15 minute summer	SW04	2.000	SW05	4.6	0.590	0.109	0.1070	
15 minute summer	SW05	2.001	SW06	9.2	0.543	0.170	0.1254	
15 minute summer	SW06	1.003	SW07	26.3	1.144	0.506	0.1091	
15 minute winter	SW07	1.004	SW08	28.4	1.878	0.241	0.0555	
240 minute summer	SW08	1.005	SW09-HB	9.7	0.251	0.066	0.7545	
240 minute summer	SW08	Infiltration		0.0				
240 minute summer	SW09-HB	Hydro-Brake®	Headwall	2.0				38.1

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.80%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW01	10	123.143	0.068	8.5	0.1222	0.0000	OK
15 minute summer	SW02	10	122.941	0.105	16.9	0.1788	0.0000	OK
15 minute summer	SW03	10	122.849	0.100	25.2	0.1701	0.0000	OK
240 minute winter	SW04	228	122.318	0.143	1.7	0.2563	0.0000	OK
240 minute winter	SW05	224	122.317	0.233	3.4	0.4132	0.0000	SURCHARGED
360 minute winter	SW06	296	122.317	0.312	7.4	0.5590	0.0000	SURCHARGED
360 minute winter	SW07	312	122.317	0.357	8.3	0.6368	0.0000	SURCHARGED
360 minute winter	SW08	296	122.316	0.386	9.3	39.1834	0.0000	SURCHARGED
240 minute winter	SW09-HB	232	122.316	0.616	8.7	0.9477	0.0000	SURCHARGED
15 minute summer	Headwall	1	119.481	0.000	2.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW01	1.000	SW02	8.4	0.602	0.203	0.5224	
15 minute summer	SW02	1.001	SW03	16.7	0.949	0.394	0.2287	
15 minute summer	SW03	1.002	SW06	24.6	0.856	0.414	1.5732	
240 minute winter	SW04	2.000	SW05	1.7	0.445	0.040	0.4542	
240 minute winter	SW05	2.001	SW06	3.4	0.400	0.062	0.2915	
360 minute winter	SW06	1.003	SW07	7.0	0.700	0.134	0.1790	
360 minute winter	SW07	1.004	SW08	8.3	0.848	0.071	0.1885	
360 minute winter	SW08	1.005	SW09-HB	9.1	0.239	0.062	0.9293	
360 minute winter	SW08	Infiltration		0.0				
240 minute winter	SW09-HB	Hydro-Brake®	Headwall	2.0				47.6

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.80%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW01	10	123.154	0.078	11.1	0.1406	0.0000	OK
15 minute summer	SW02	10	122.960	0.124	22.1	0.2111	0.0000	OK
15 minute summer	SW03	10	122.867	0.117	33.0	0.1996	0.0000	OK
360 minute winter	SW04	344	122.470	0.295	1.6	0.5286	0.0000	SURCHARGED
360 minute winter	SW05	344	122.469	0.385	3.2	0.6833	0.0000	SURCHARGED
360 minute winter	SW06	344	122.468	0.462	9.4	0.8287	0.0000	SURCHARGED
360 minute winter	SW07	352	122.467	0.506	10.2	0.9035	0.0000	SURCHARGED
360 minute winter	SW08	344	122.466	0.535	10.4	54.3721	0.0000	SURCHARGED
360 minute winter	SW09-HB	344	122.465	0.765	8.6	1.1779	0.0000	SURCHARGED
15 minute summer	Headwall	1	119.481	0.000	2.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW01	1.000	SW02	11.1	0.640	0.265	0.6412	
15 minute summer	SW02	1.001	SW03	21.9	1.010	0.516	0.2816	
15 minute summer	SW03	1.002	SW06	32.4	0.937	0.545	1.7320	
360 minute winter	SW04	2.000	SW05	1.6	0.419	0.038	0.5443	
360 minute winter	SW05	2.001	SW06	3.0	0.383	0.056	0.2915	
360 minute winter	SW06	1.003	SW07	8.6	0.688	0.166	0.1790	
360 minute winter	SW07	1.004	SW08	10.1	0.874	0.086	0.1885	
360 minute winter	SW08	1.005	SW09-HB	8.6	0.283	0.058	0.9293	
360 minute winter	SW08	Infiltration		0.0				
360 minute winter	SW09-HB	Hydro-Brake®	Headwall	2.0				58.9

APPENDIX D – FOUL WATER PIPE NETWORK CALCULATIONS

Design Settings

Frequency of use (kDU)	0.50	Minimum Velocity (m/s)	0.75
Flow per dwelling per day (l/day)	446	Connection Type	Level Inverts
Domestic Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.500
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	10	Include Intermediate Ground	✓

Nodes

Name	Units	Cover Level (m)	Diameter (mm)	Depth (m)
FW01	6.0	124.000	1200	1.425
FW02	6.0	124.750	1200	2.832
FW03	6.0	125.400	1200	3.904
FW04	6.0	125.400	1200	3.988
FW05	6.0	125.300	1200	3.952
FW06	6.0	124.000	1200	2.932
FW07		124.000	1200	2.985

Links

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	FW01	FW02	39.431	122.575	121.918	0.657	60.0	225
1.001	FW02	FW03	25.314	121.918	121.496	0.422	60.0	225
1.002	FW03	FW04	5.058	121.496	121.412	0.084	60.0	225
1.003	FW04	FW05	3.862	121.412	121.348	0.064	60.0	225
1.004	FW05	FW06	41.966	121.348	121.068	0.280	150.0	225
1.005	FW06	FW07	8.010	121.068	121.015	0.053	150.0	225

Name	Vel (m/s)	Flow (l/s)	US Depth (m)	DS Depth (m)
1.000	1.483	1.3	1.200	2.607
1.001	1.483	1.9	2.607	3.679
1.002	1.483	2.3	3.679	3.763
1.003	1.483	2.7	3.763	3.727
1.004	0.936	3.0	3.727	2.707
1.005	0.936	3.3	2.707	2.760

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	39.431	60.0	225	124.000	122.575	1.200	124.750	121.918	2.607
1.001	25.314	60.0	225	124.750	121.918	2.607	125.400	121.496	3.679
1.002	5.058	60.0	225	125.400	121.496	3.679	125.400	121.412	3.763
1.003	3.862	60.0	225	125.400	121.412	3.763	125.300	121.348	3.727

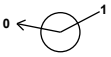
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	FW01	1200	Manhole	Adoptable	FW02	1200	Manhole	Adoptable
1.001	FW02	1200	Manhole	Adoptable	FW03	1200	Manhole	Adoptable
1.002	FW03	1200	Manhole	Adoptable	FW04	1200	Manhole	Adoptable
1.003	FW04	1200	Manhole	Adoptable	FW05	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	41.966	150.0	225	125.300	121.348	3.727	124.000	121.068	2.707
1.005	8.010	150.0	225	124.000	121.068	2.707	124.000	121.015	2.760

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	FW05	1200	Manhole	Adoptable	FW06	1200	Manhole	Adoptable
1.005	FW06	1200	Manhole	Adoptable	FW07	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
FW01	718205.408	725390.909	124.000	1.425	1200				
						0	1.000	122.575	225
FW02	718171.133	725371.414	124.750	2.832	1200	1	1.000	121.918	225
									
						0	1.001	121.918	225
FW03	718148.712	725359.663	125.400	3.904	1200	1	1.001	121.496	225
									
						0	1.002	121.496	225
FW04	718143.750	725360.642	125.400	3.988	1200	1	1.002	121.412	225
									
						0	1.003	121.412	225
FW05	718141.143	725363.491	125.300	3.952	1200	1	1.003	121.348	225
									
						0	1.004	121.348	225
FW06	718138.954	725405.400	124.000	2.932	1200	1	1.004	121.068	225
									
						0	1.005	121.068	225
FW07	718130.955	725404.982	124.000	2.985	1200	1	1.005	121.015	225
									

APPENDIX E – MAINTENANCE AND MANAGEMENT PLAN

Maintenance and Management Plan			
Project	NDFA Social Housing Bundles 4 & 5	Analysed by	Kezia Adanza
Job no.	23006	Date	July 2024

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required Action	Typical Frequency
Permeable Paving	PPP management company for 25 years then Dublin City Council	Regular Maintenance	Brushing (Standard cosmetic sweep over whole surface) Visual check on inspection chambers and removal of debris.	Once a year or reduced frequency as required
		Occasional Maintenance	Removal of weeds or management using glyphosate or other suitable weed killer.	As required – once a year on less frequently used pavements
		Remedial Action	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing materials.	As required
			Remediate any landscaping which has been raised within the level of the paving.	As required
			High pressure jetting of permeable pavement underdrains in the event of blockages. Inspections chambers provided to facilitate this work.	As required
			Rehabilitation of surface and upper sub-structure by remedial sweeping.	Every 10 to 15 years or as required (if performance is reduced due to significant flooding)
		Monitoring	Initial Inspection	Monthly for three months after installation
			Inspect for evidence of poor operation and/ or weed growth – if required, take remedial action,	Every 3 months, 48 hours after large storms in first six months

			Inspect slit accumulation rates and establish appropriate brushing frequencies.	Annually
			Monitor inspection chambers	Annually

Maintenance and Management Plan			
Project	NDFA Social Housing Bundles 4 & 5	Analysed by	Kezia Adanza
Job no.	23006	Date	July 2024

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required Action	Typical Frequency
Bioretention Areas	PPP management company for 25 years then Dublin City Council	Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain to determine if maintenance is necessary.	Quarterly
			Check operation of underdrains by inspection of flows after rain.	Annually
			Assess plants for disease infection, poor growth, invasive species etc. and replace as necessary.	Quarterly
			Inspect inlets and outlets for blockage.	Quarterly
		Regular Maintenance	Remove litter, surface debris and weeds.	Quarterly (or more frequently for tidiness or aesthetic reasons)
			Replace any plants to maintain plant density.	Quarterly to bi-annually
			Remove sediment, litter and debris build-up from around inlets.	As required
		Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required.	As required
			Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch.	As required
		Remedial Actions	Remove and replace filter medium and vegetation.	As required but likely to be > 20 years

Maintenance and Management Plan			
Project	NDFA Social Housing Bundles 4 & 5	Analysed by	Kezia Adanza
Job no.	23006	Date	November 2023

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required Action	Typical Frequency
Attenuation Storage	PPP management company for 25 years then Dun Laoghaire Rathdown County Council	Regular Inspections	Inspect infiltration surfaces for silting, record de-watering time of the facility and assess standing water levels in underdrain to determine if maintenance is necessary.	Quarterly
			Check operation of underdrains by inspection of flows after rain.	Annually
			Inspect inlets and outlets for blockage.	Quarterly
		Regular Maintenance	Remove sediment, litter and debris build-up from around inlets.	As required