MALONE O'REGAN
CONSULTING ENGINEERS

SOCIAL HOUSING BUNDLE 4
DEVELOPMENT AT THE STANLEY STEET DEPOT, DUBLIN 7

ENGINEERING REPORT

DUBLIN CITY COUNCIL

August 2024

Job: 23006

Contents Amendment Record

2B Richview Office Park, Clonskeagh, Dublin 14
Tel: +353-1-260 2655 Fax: +353-1-260 2660 E-mail: info@MORce.ie

MALONE O'REGAN

Title: **Social Housing Bundle 4, Development at the Stanley Street Depot, Dubin 7 / Engineering Report / Dublin City Council**

Job Number: **23006**

Prepared By: **Michelle Gaughan** **Signed:** Mgaughan

Checked By: **Douglas Weir** **Signed:**

Approved By: **Douglas Weir** **Signed:**

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2	13/09/2024	Planning	P3	MG	KA	DW

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1 INTRODUCTION

1.1 Introduction

This report is prepared on behalf of Dublin City Council to accompany a Part 8 Proposal for the construction of 167 apartments and duplex units at a site c. 1.15 ha at the former Dublin City Fire Brigade Maintenance Depot and Dublin City Council Mechanical Division, Stanley Street, Grangegorman Lower, Dublin 7.

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 Site Description

The location of the proposed development is illustrated in Figure 1-1. The site is situated in the north central area of Smithfield, Dublin city centre. There is existing two storey houses with back gardens and apartments bordering the development on the northwest and northeast respectively of the site. The western boundary is bordered by a mix of two storey housing/commercial units, a school and industrial yard off Manor Street. There are apartment developments beside period industrial units to the south of the site. There are historic tracks down the old Stanley Street which are to be preserved. There are apartments on the eastern boundary of the site on the opposite side of Grangegorman Lower. The proximity of the site to natural watercourses is outlined in Figure 1-2.

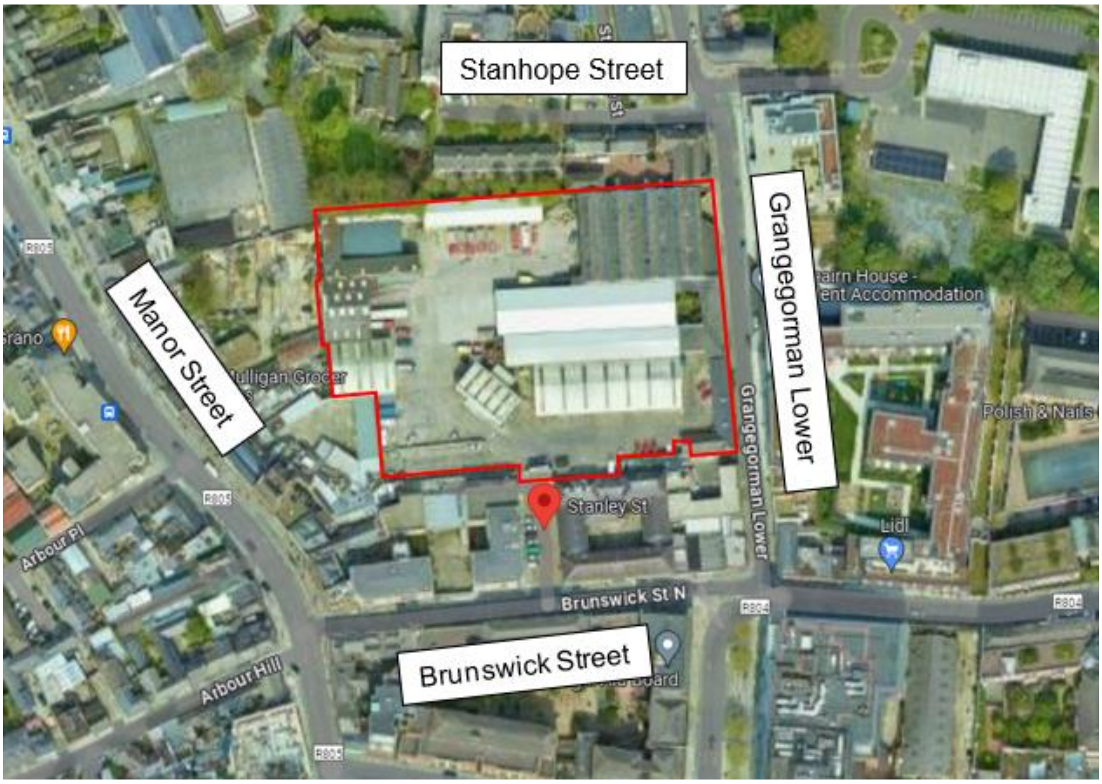


Figure 1-1 – Site location

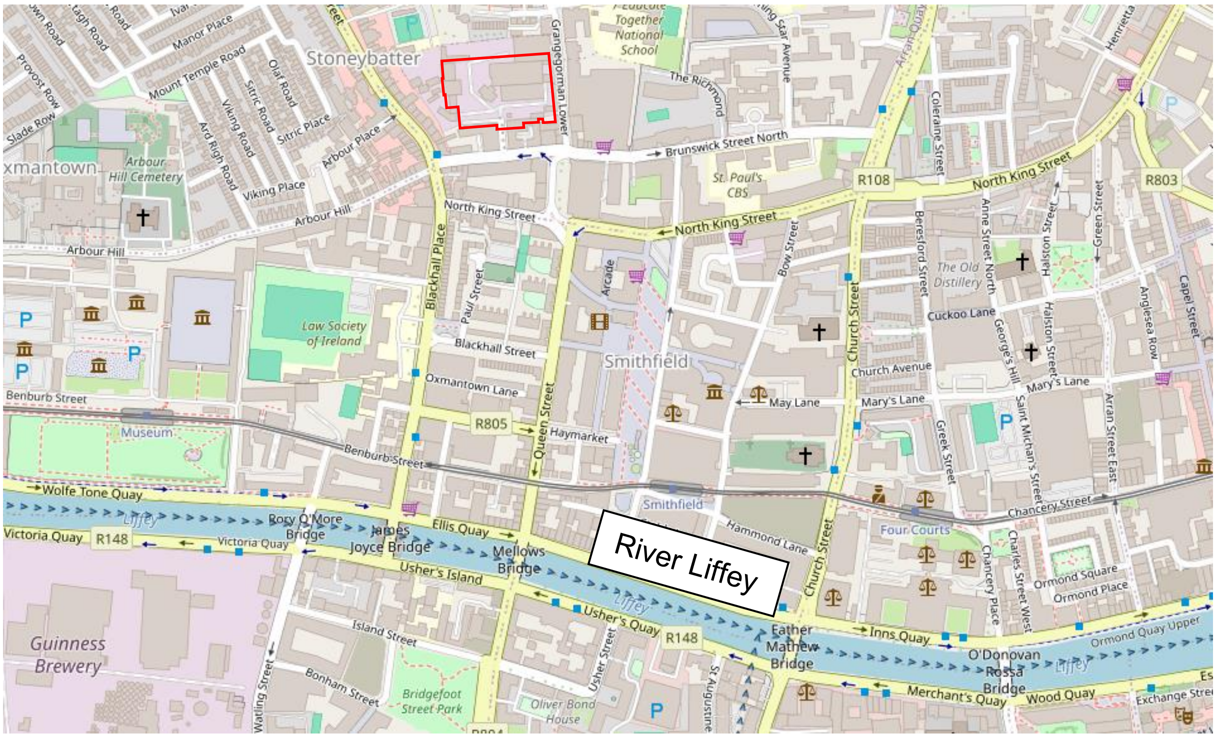


Figure 1-2 – Surrounding Watercourse (Extract from the EPA Maps)

1.3 Proposed Development

This engineering report is prepared for the construction of 167 apartments and duplex units at a site c. 1.15 ha at the former Dublin City Fire Brigade Maintenance Depot and Dublin City Council Mechanical Division, Stanley Street, Grangegorman Lower, Dublin 7.

Development at the site will consist of the following:

- The demolition and site clearance of the existing buildings, sheds, warehouses and garages.
- Retention and modification of the south and east elevation of an existing structure (facing onto Grangegorman Lower) to form part of apartment Block G at the southeast corner of the site.
- Construction of 167 no. apartment and duplex units across Blocks A-K (including frontage onto Grangegorman Lower).
    - Blocks A – C consist of 71 no. apartment units (43 no. 1 bed and 28 no. 2 bed units) and ranges from 5 to 6 storeys.
    - Blocks D-G consist of 84 no. apartment units (43 no. 1 bed units, 29 no. 2 bed units and 12 no. 3 bed units) and ranges from 4 to 5 storeys.
    - Blocks H-K consist of 12 no. duplex units (6 no. 1 bed and 6 no. 3 bed units) and are 3 storeys.
- Provision of 270 long-stay and 101 short-stay bicycle parking spaces, 19 no. car parking spaces and 1 no. motorcycle parking space.
- Construction of a 277.54 sqm creche.

- Provision of 552 sqm of community, cultural and arts space located at ground floor level across Blocks B, E, F and G.
- 0.113 ha of public open space and 1350 sqm of communal open space
- Vehicular access is proposed from Grangegorman Lower and vehicular egress is proposed onto Stanley Street
- Boundary treatments, public lighting, site drainage works, internal road surfacing and footpaths, ESB meter rooms, ESB substations, stores, bin and cycle storage, plant rooms, landscaping; and
- All ancillary site services and development works above and below ground.

Figure 1-3 – Proposed Development

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	5 years (Ref IS EN 752 Table 2 for ‘City centres / industrial / commercial areas’)
Attenuation Design Return Period	100 years
Allowance for climate change	20% (Ref. OPW Flood Risk Management Climate Change Sectoral Adaptation Plan, Mid-Range Future Scenario)
M5-60	16.3mm (Met Eireann data)
M5-2D	58.6mm (Met Eireann data)
Ratio, r	0.28
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 one side. These underground sewers carry surface water runoff towards existing catchment areas in the north 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 surface water drainage pipework installed. There is a 1020X640mm brick combined sewer and a 600mm concrete sewer running parallel to the eastern boundary on Grangegorman Lower.

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 SHB4-SSD-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 each detention basin and attenuation tank 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 Stanley Street was taken from the Flood Studies Report as 916mm.

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 4 (SPR Index 0.47). Soil Type 4 corresponds with clay or loamy soils with high runoff potential.

In January 2024, IGSL completed a comprehensive programme of site investigations for the site. These investigations showed that ground conditions varied across the site. Generally, the site was paved with a concrete ground slab varying in thickness from 140-350mm overlying a layer of dark grey brown sandy gravelly clay with brick, concrete rubble, seashells, pottery fragments and mortar. Ash fill, cabling, glass shards and cobbles were also present in some of the trial pits with little evidence of engineered hardcore present below the slab. This made ground varies in depth from 0.85m to at least 2m below ground level. The accumulation of made ground appears to reduce to the south and southeast of the site with firm to stiff indigenous soils present. The natural soils below the made ground layer consisted of soft brownish grey sandy gravelly clay with cobbles from 0.95m to 1.9m below ground level. This soil layer exhibited a strong hydrocarbon odour.

No natural soils were encountered in in some trial pits consisting predominantly of made ground. Underlying the above layers was a glacial till comprising of a firm to stiff grey brown to dark grey brown slightly sandy gravelly cobbly clay extending to depths of up to 5.5m below ground level. The bedrock consists of a Lucan formation limestone and shales.

A further Waste Characterisation Assessment was completed by O'Callaghan Moran & Associates in April 2024 and is included as part of this Planning package. Hazardous concentrations were encountered in 14no. of the samples. Materials removed from these can be classed as Soil and Stone containing hazardous substances (LoW Code 17 05 03). A colour-coded heatmap of the site is generated by the site engineer which can be used during the excavation process to properly identify and segregated each water type to be removed to appropriately licensed waste facilities.

2 no. infiltration tests were conducted across the site. The results of these tests yielded infiltration rates of f=2.77 x 10^{-6} m/s and 4.74 x 10^{-6} m/s. The report prepared by IGSL concludes that the site may not be suitable for soakaway design as the soils offer only low natural infiltration.

Given the site investigation report noted the soil as sandy clay with moderate runoff potential, it is considered appropriate to adopt a Soil Index value of Type 3 (SPR Index 0.37). Soil Type 3 corresponds to very find sand, silts, clay, permeable soils with moderate runoff potential.

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

For 50ha area $QBAR_{rural}$ = 0.00108 $[0.5]^{0.89}$ x $[916]^{1.17}$ x $[0.37]^{2.17}$

= 0.197 m^3/s

= 197.0 l/s (for 50ha)

$QBAR_{rural}$ = Area 1 is 0.815 l/s

$QBAR_{rural}$ = Area 2 is 0.871 l/s

$QBAR_{rural}$ = Area 3 is 1.224 l/s

For the purposes of surface water attenuation design, the site is dealt with as five catchments as shown in Figure 2-1, each sub-catchment represents each of the building blocks, with individual connections from each sub-catchment into a single surface water sewer on the road. The catchment layout therefore allows for only necessary proliferation of pipelines and manholes within the road.

Catchment area 1 (highlighted in orange) serves 50% of the apartment blocks A-C and has an area of 2070.707m². Surface water from this catchment area is attenuated for in the detention basin and using the blue roof and intensive green/blue roofs.

Catchment area 2 (highlighted in yellow) serves 50% of the apartment blocks A-C and the open space and has an area of 2212.529m². Surface water from this catchment area is attenuated for using an attenuation tank, permeable paving and green space.

Catchment area 3 (highlighted in green) serves apartment blocks D-G and has an area of 3111.449m². Surface water from this catchment area is attenuated for in the attenuation tank and using the blue roof and intensive green/blue roofs.

Catchment area 4 (highlighted in blue) serves the duplexes (blocks H-K) and has an area of 1509.839m². Surface water from this catchment area is attenuated for using the extensive green roofs and permeable paving.

Catchment area 5 (highlighted in turquoise) serves the road within the site and has an area of 2285.445m². Surface water from this catchment area is attenuated for through permeable paving and gullies at locations along the road feeding back into the main drainage line.

Figure 2-1 - Surface Water Drainage Catchment Areas

A breakdown of the impermeable areas contributing to the surface water drainage network in each catchment with applied runoff coefficients is provided in the below tables.

Table 2-3 - Breakdown of Impermeable Areas for Area 1 and 2 Green/ Blue Roof

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
1349.26	Roof - Apartments *	Standard - 28%	0.0	0.95	0.0	0.0	0.0	769.4
		Green/ Blue Roof - 72%	971.47	0.60	582.9	641.2	769.4	
	Permeable Paving inc. areas from hardstanding		0.0	0.50	0.0	0.0	0.0	
ha	Landscaped Areas inc. areas from hardstanding		0.0	0.20	0.0	0.0	0.0	ha
0.13								0.1
	Hardstanding		0.0	0.90	0.0	0.0	0.0	

*Blocks A-C are located across area 1 and 2 at a 50/50 spilt. These calulcations is for all blue roof in Blocks A-C

Table 2-4 - Breakdown of Impermeable Areas for Area 1

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
2070.707	Roof - Apartments*	Standard - 28%	194.11	0.95	184.40	202.84	243.41	993.70
		Green/ Blue Roof - 72%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		631.83	0.50	315.92	347.51	417.01	
ha	Landscaped Areas inc. areas from hardstanding		593.35	0.20	118.67	130.54	156.65	ha
0.21								0.1
	Hardstanding		148.69	0.90	133.82	147.20	176.64	

*As per subcatcments 50% of the standard roof from Blocks A-C is considered in these calculations, see area 2 for the other 50% of the standard roof

Table 2-5- Breakdown of Impermeable Areas for Area 2

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
2212.529	Roof - Apartments*	Standard - 28%	195.51	0.95	185.73	204.30	245.16	899.89
		Green/ Blue Roof - 72%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		643.82	0.50	321.91	354.10	424.92	
ha	Landscaped Areas inc. areas from hardstanding		870.48	0.20	174.10	191.51	229.81	ha
0.22								0.1
	Hardstanding		0.00	0.90	0.00	0.00	0.00	

*As per subcatcments 50% of the standard roof from Blocks A-C is considered in these calculations, see area 1 for the other 50% of the standard roof

Table 2-6 - Breakdown of Impermeable Areas for Area 3

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
3111.449	Roof - Apartments	Standard - 28%	559.19	0.95	531.23	584.35	701.23	1364.53
		Intensive Green/Blue Roof - 72%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		423.19	0.50	211.60	232.75	279.31	
ha	Landscaped Areas inc. areas from hardstanding		494.15	0.20	98.83	108.71	130.46	ha
0.31								0.14
	Hardstanding		197.00	0.90	177.30	195.03	253.54	

Table 2-7 - Breakdown of Impermeable Areas for Area 3 Green/ Blue Roof

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
1997.11	Roof - Duplex Units - Extensive Green Roof		0.0	0.60	0.0	0.0	0.0	1138.8
	Roof - Apartments	Standard - 28%	0.0	0.95	0.0	0.0	0.0	
		Green/Blue Roof - 72%	1437.9	0.60	862.8	949.0	1138.8	
	Permeable Paving inc. areas from hardstanding		0.0	0.50	0.0	0.0	0.0	
ha	Landscaped Areas inc. areas from hardstanding		0.0	0.20	0.0	0.0	0.0	ha
0.20								0.1
	Hardstanding		0.0	0.90	0.0	0.0	0.0	

Table 2-8 - Breakdown of Impermeable Areas for Area 4 Extensive Green Roof

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
467.813	Roof - Duplex Units - Extensive Green Roof		467.813	0.60	280.7	308.8	370.5	370.5
	Roof - Apartments	Standard - 28%	0.0	0.95	0.0	0.0	0.0	
		Green/Blue Roof - 72%	0.0	0.60	0.0	0.0	0.0	
	Permeable Paving inc. areas from hardstanding		0.0	0.50	0.0	0.0	0.0	
ha	Landscaped Areas inc. areas from hardstanding		0.0	0.20	0.0	0.0	0.0	ha
0.05								0.0
	Hardstanding		0.0	0.90	0.0	0.0	0.0	

Table 2-9 - Breakdown of Impermeable Areas for Area 4

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
1509.839	Roof - Duplex Units - Extensive Green Roof		0.0	0.60	0.0	0.0	0.0	520.2
	Roof - Apartments	Standard - 28%	0.0	0.95	0.0	0.0	0.0	
		Green/Blue Roof - 72%	0.0	0.60	0.0	0.0	0.0	
	Permeable Paving inc. areas from hardstanding		522.3	0.50	261.2	287.3	316.0	
ha	Landscaped Areas inc. areas from hardstanding		427.1	0.20	85.4	94.0	103.4	ha
0.15								0.1
	Hardstanding		92.6	0.90	83.3	91.7	100.8	

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)

The table below 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 2-8 - 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*	Yes	Tree pits have been specified in suitable areas beside the development roads and car parking.
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 buildings.
Blue Roofs *Provide attenuation storage, reducing requirement for storage elsewhere on site*	Yes	It is proposed to provide blue roofs for flat roofs above apartment.
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 hard surfaces and allow infiltration and absorption*	No	Rain gardens are not proposed within the development.
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 use.
Permeable paving *Allows runoff to percolate into the subsoil, reducing overall runoff volume*	Yes	Permeable paving is proposed within the development in footpaths 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 prioritising infiltration measures over holding water systems above ground.
Dry Ponds *Depressed area of site for water infiltration, planted to treat water, removing harmful impurities and provide attenuation*	Yes	Detention Basins are considered appropriate in the communal open spaces 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 Blocks A-C and Blocks D-G. 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.

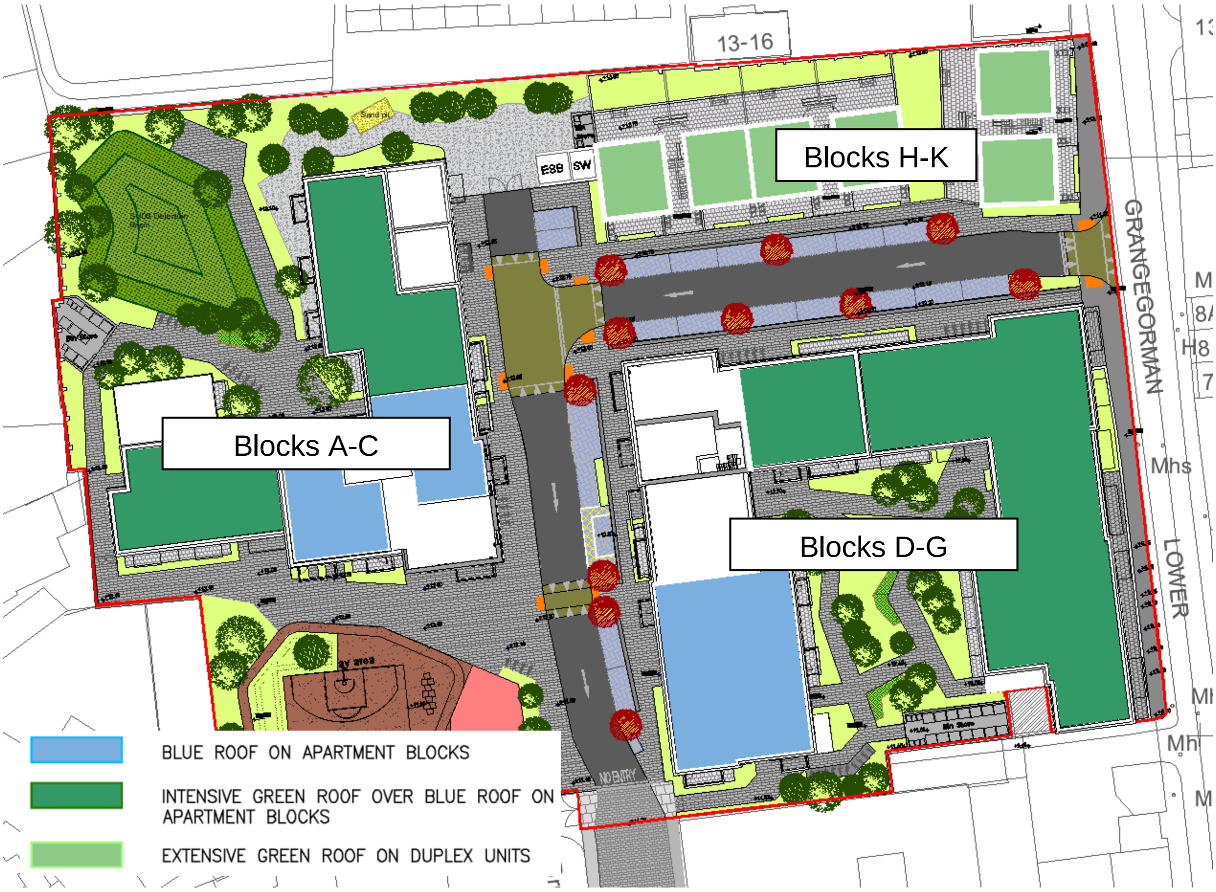


Figure 2-2 – Proposed Green/Blue Roof on Plan

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.

In the 1 in 100-year storm event, when the water can no longer be held within the vegetation layer or attenuation cells it will discharge into the surface water sewer located at ground level at a controlled rate via flow restrictors. Calculations for the intensive green roofs are provided in Appendix B.

For 50ha area $QBAR_{rural}$ $= 0.00108\,[0.5]^{0.89} \times [916]^{1.17} \times [0.37]^{2.17}$

$= 0.197\ m^3/s$

$= 197.0\ l/s$ (for 50ha)

$QBAR_{rural}$ for the roof area = Blocks A-C is 0.531 l/s

$QBAR_{rural}$ for the roof area = Blocks D-G is 0.786 l/s

$QBAR_{rural}$ for the roof area = Blocks H-K (duplexes) is 0.184 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 72% 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. Of the 72% Intensive green/blue roofs, 70% of these roofs are green/blue and 30% are blue with PV panels. Refer to Figure 2.2 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. SHB4-SSD-DR-MOR-CS-P3-151, an extract from which is provided in Figure 2.3 below.

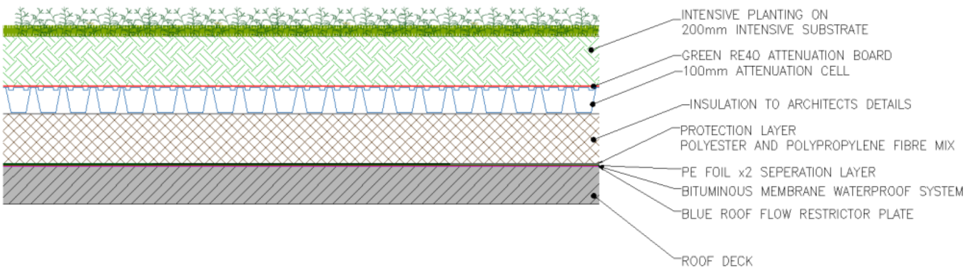


Figure 2-3 – Typical Intensive Green/ Blue Roof Section

2.5.3 Extensive Green Roofs

Extensive green roofs are proposed above 100% of the duplex units. Extensive green roofs allow low growing, low maintenance plants consisting of self-sustaining mosses, sedums, succulents, herbs or grasses over a drainage layer and waterproofing membrane. Extensive roofs are usually only accessed for maintenance. Extensive green roofs typically have a 20-150mm growing medium. Refer to Figure 2-2 for extensive green roof provision.

Flow restrictor outlets will be provided to control the rate of runoff from the roofs. The overflow from the green roof will be limited to 0.184l/s by a Hydrobrake flow control device which will control the rate of runoff from the roofs. Calculations for the Extensive Green Roof are provided in Appendix B.

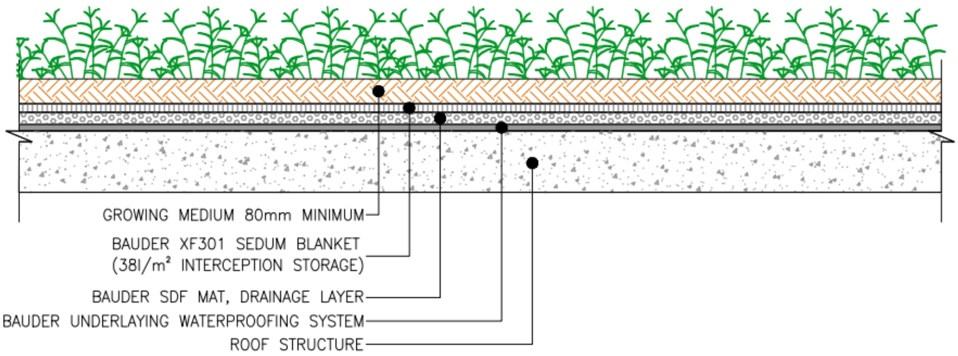


Figure 2-4 – Typical Extensive Green Roof Section

2.5.4 Blue Roofs

As well as proposing an Intensive Green/ Blue Roof, it is proposed to provide Blue Roof covering 20% of the total roof area of Apartments Blocks A-C and Blocks D-G in areas of the roof where solar panelling is provided. Refer to Figure 2-2 for blue roof provision. Similar to green roofs, the blue roof outlet restricts the discharge of stormwater to a calculated and defined flow rate to significantly slow down the volume of water leaving the site. As the storm passes, water continues to discharge from the roof at a controlled rate over a set period (typically up to 48 hrs).

As detailed in the 'Green & Blue Roof Guide 2021' by Dublin City Council, *"Where roofs include PV panels, the design should consider the appropriateness of the PV panels being positioned over the vegetated areas of the roof. Roof areas that are not considered for green roof should still be considered for blue roof".* Blue roofs can be vegetated, however in most cases where PV panels are to be located on roofs, vegetated layers are not appropriate instead allowance for ballast layer is recommended.

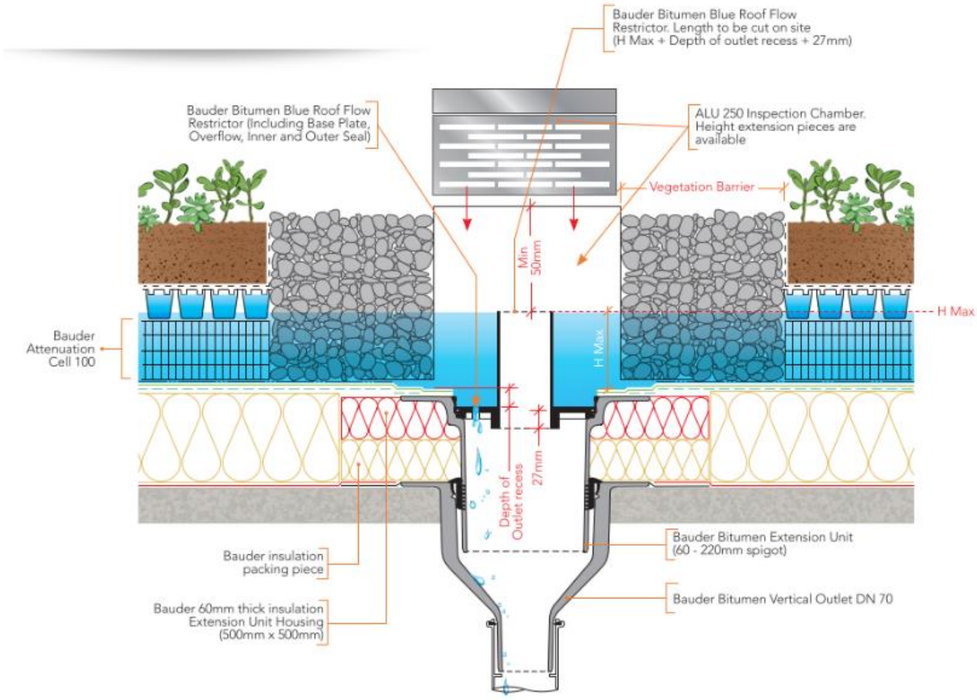


Figure 2-5 –Blue Roof Section

2.5.5 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. SHB4-SSD-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.

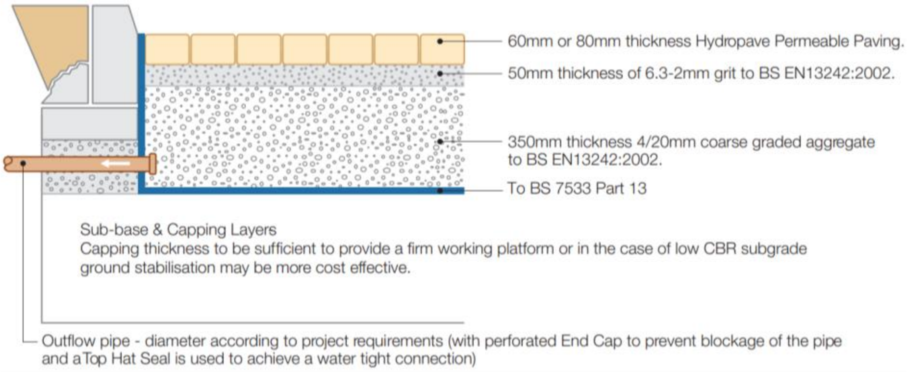


Figure 2-6 – Typical Section through Permeable Paving

2.5.6 Tree Pit

It is proposed to provide a number of tree pits adjacent to car parking and footpaths where feasible within the development. Runoff from the roads and footpaths will be directed towards these tree pits. Refer to drawing no. SHB4-SSD-DR-MOR-CS-P3-150 for location of tree pits on plan. Refer to landscape architects drawing for tree pit detail. Tree pits features will provide a level of storage to attenuate the runoff flows. It is anticipated that runoff from minor rainfall events will be able to percolate directly into the soil. An overflow from the tree pits will be provided. During larger storm events, the water in the bioretention areas will be able to overflow and drain towards the attenuation system.

The bioretention areas will be planted in order to promote biodiversity. Runoff will also be treated through the adsorption of particles by vegetation or by soil, and by biological activity. Tree pits can reduce the runoff rates and volumes of surface water although the area contributing is small. They are effective in delivering interception and treatment storage.

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.

2.7 Attenuation Design

Attenuation storage is provided on the site using a detention basin located at a green open space to the northwest of the site to cater for rainfall runoff from Blocks A-C. An attenuation tank is used to provide rainfall runoff for Blocks D-G.

The detention basin will provide a level of storage to attenuate the runoff flows and also permit settlement of coarse silts. As described in Section 2.3 above, the permeability of the underlying soils varies across the site. However, it is anticipated that runoff from minor rainfall events will be able to percolate directly into the soil. During larger storm events, the 1 in 30-year or 1 in 100-year storms for example, the runoff will be directed towards the detention basin where the water level may rise to 800mm above the base but will maintain a 300mm freeboard to the lowest FFL of any residence and to the lowest road level.

The detention basin will be planted in order to promote settlement of silt particles. Runoff will also be treated through the absorption of particles by vegetation or by soil, and by biological activity. Detention basins can reduce the volumes of surface water through evapotranspiration and filtration. They are very effective in delivering interception, treatment storage and attenuation.

The attenuation storage calculated for the detention basin and attenuation tank is sized to cater for a 1:100-year storm event. The attenuation volumes have 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. Based on those calculations, the volume runoff water that will be generated during the 1 in 100-year storm event for the site and the value at which the flow control device will restrict the flow is shown in the table below.

Table 2-9 – Attenuation Volumes

	Calculated Storage Capacity (m^3)	1:100-year flood event Calculated (m^3)	QBARrural (l/s)
Area 1 Detention Basin	104.590	37.340	0.815
Area 2 Attenuation Tank	48.200	31.316	0.871
Area 3 Attenuation Tank	74.700	48.997	1.224

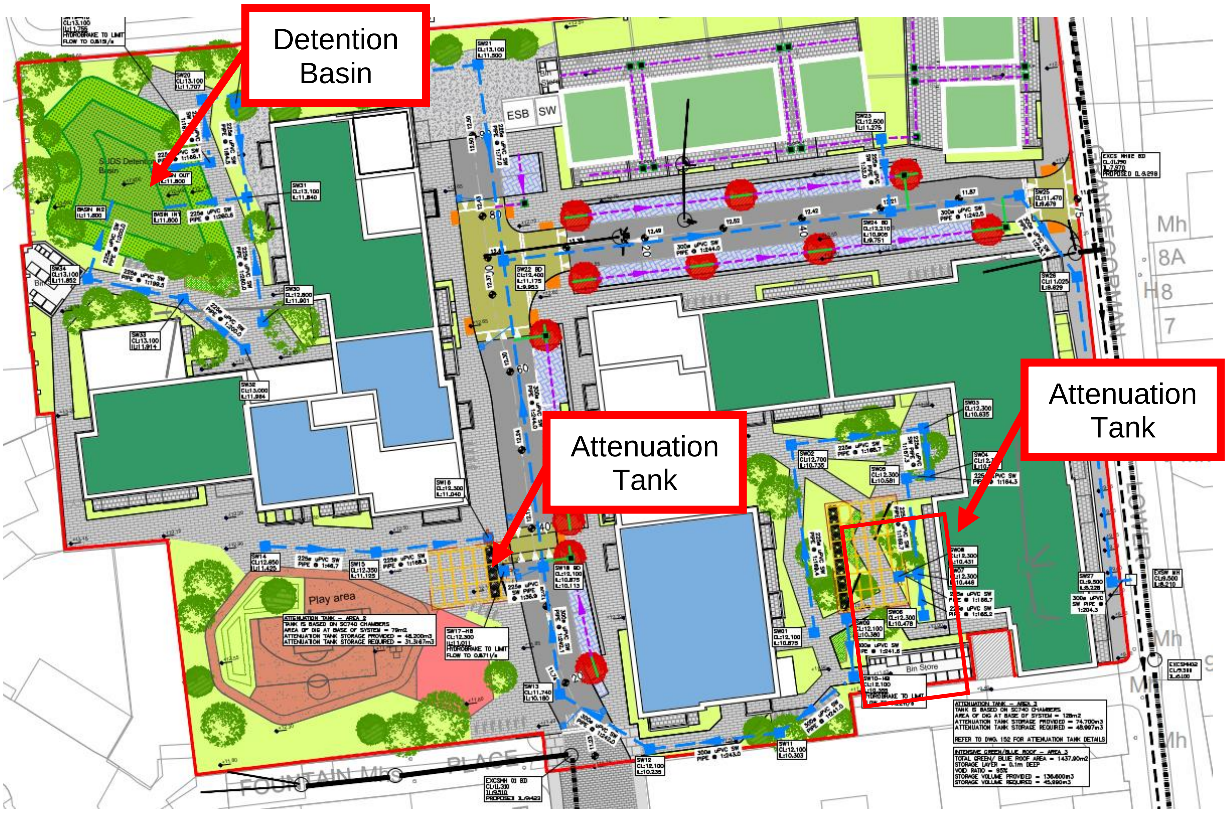


Figure 2-7 – Attenuation Locations

2.7.1 Groundwater Monitoring

A site investigation conducted by IGSL Ltd conducted trial and boreholes. The boreholes located within the detention basin zone were BH05 and BH06 and the borehole located closest to the attenuation tank were BH13 and BH14 as highlighted in Figure 2-.

Table 2-10 – Water Measurements in on-site exploratory holes (Extract from Site Investigation Report)

Exploratory hole	Water Struck m bgl (m OD)	Remarks/ Stratum of Water ingress (m OD)
BH04	5.50 (7.86)	Water was noted at 5.0m bgl (8.36m OD)
BH05	4.0 (9.43)	Water was noted at 2.0m bgl (11.43m OD)
BH05	-	Water was noted at 5.0m bgl (8.56m OD)
BH13	-	Water was noted at 3.0m bgl (8.70m OD)
BH14	-	Water was noted at 3.5m bgl (8.32m OD)

The ground level at the proposed detention basin is 13.100m OD and extends 1.50m bgl (11.600m OD). The ground level at the attenuation tank is approximately 12.100m – 12.30m OD and extends approximately 2m bgl. Based on the site investigation report, the groundwater levels are not within 1m of the underside of the detention basin and attenuation tank.

Figure 2-8 – Borehole locations

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 Regime 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 4 (SPR Index 0.47). Soil Type 4 corresponds with clay or loamy soils with high runoff potential.

In January 2024, IGSL completed a comprehensive programme of site investigations for the site. These investigations showed that ground conditions varied across the site. Generally, the site was paved with a concrete ground slab varying in thickness from 140-350mm overlying a layer of dark grey brown sandy gravelly clay with brick, concrete rubble, seashells, pottery fragments and mortar. Ash fill, cabling, glass shards and cobbles were also present in some of the trial pits with little evidence of engineered hardcore present below the slab. This made ground varies in depth from 0.85m to at least 2m below ground level. The accumulation of made ground appears to reduce to the south and southeast of the site with firm to stiff indigenous soils present. The natural soils below the made ground layer consisted of soft brownish grey sandy gravelly clay with cobbles from 0.95m to 1.9m below ground level. This soil layer exhibited a strong hydrocarbon odour.

2 no. infiltration tests were conducted across the site. The results of these tests yielded infiltration rates of f=2.77 x 10-6 m/s and 4.74 x 10-6 m/s. The report prepared by IGSL concludes that the site may not be suitable for soakaway design as the soils offer only low natural infiltration.

Given the site investigation report noted the soil as sandy clay with moderate runoff potential, it is considered appropriate to adopt a Soil Index value of Type 3 (SPR Index 0.37). Soil Type 3 corresponds to very find sand, silts, clay, permeable soils with moderate runoff potential.

Based on these calculations, the required attenuation storage for Area 1 (detention basin) is 37.340m^3 with a hydrobrake which restricts the flow to 0.815ls/. The required attenuation storage for Area 2 (attenuation tank) is 31.316m^3 with a hydrobrake which restricts the flow to 0.871l/s and for Area 3 (attenuation tank) is 48.997m^3 with a hydrobrake which restricts the flow to 1.224l/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 tree pits.

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 13th 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 confirms that, subject to a valid connection agreement being put in place, the proposed connection to the public sewer network can be facilitated. The letter further notes that Irish Water have reviewed the wastewater characteristics and hydraulic discharge load and determined that no upgrades are required to the Irish Water network or municipal wastewater treatment plant.

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

Hydraulic loading for the foul drainage i.e. domestic foul flows from toilets, sinks etc. have been calculated in accordance with the Irish Water Code of Practice for Wastewater Infrastructure which gives a flow rate of 150 litres per person per day for domestic dwellings.

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

3.2 Existing Services

An existing network of drainage runs around the perimeter of the site on one side. These underground sewers carry foul water towards existing treatment areas in the north 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. There is a 1020X640mm brick combined sewer running parallel to the eastern boundary on Grangegorman Lower.

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 drawings SHB4-SSD-DR-MOR-CS-P3-130. Foul water from new housing units will be collected within a gravity drainage network and directed towards the existing public sewer system.

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 = 167 units x 446 l/dwelling = 74,482 l/day = **0.862 l/sec**

Peak discharge = 6 x DWF = **5.172 l/sec**

3.4.2 Community Centre Water Demand

There is provision of 552m^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 = 276 people (Assumed 1person per 2m2 of floor area)

Average water demand = 40litres/person/day

Total daily discharge = 276 people x 40litres/person/day = 11,040 litres/day

Average Hour Demand = 11,040 litres/day / (24hr x 60min x 60sec)

= **0.128 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 **= 0.575 l/s**

3.4.2 Creche Water Demand

Consideration was given to the planned development of a 277.54m^2 creche. The table below is a schedule of accommodation to the proposed creche.

Table 3-3-2 - Creche Design Parameters

Age of children	No. of adults	No. of children	Floor area per child	Area	No. of adults	No. of children
0-1 year	1	3	3.5 sq metres	36	4	10
1-2 years	1	5	2.8 sq. metres	37	3	13
2-3 years	1	6	2.35 sq. metres	30	3	13
3-6 years	1	8	2.3 sq. metres	30	2	13
Total					**12**	**49**

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 90 litres per person per day for non-residential school with canteen cooking on site.

Total persons = 49 children + 12 staff = 61 people

Average water demand = 90litres/person/day

Total daily discharge = 61 people x 90litres/person/day = 5490 litres/day

Average Hour Demand = 5400 litres/day / (24hr x 60min x 60sec)

= **0.064 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 = **0.286 l/s**

Average and peak discharge rates for the proposed development is summarised in the Table below.

Table 3-2 – Average and Peak Foul Water Demands

Development Description	**Average Demand (l/s)**	**Peak Demand (l/s)**
Proposed development of residential units	0.862	5.172
Community Centre/ Retail Commercial	0.128	0.575
Creche	0.064	0.286
Total	**1.054**	**6.033**

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 13th December 2023, a Pre-Connection Enquiry Form was submitted to Irish Water in respect of this development. Irish Water provided a Confirmation of Feasibility (CoF) letter which confirms that, subject to a valid connection agreement being put in place, the proposed connection to the public water supply network can be facilitated.

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

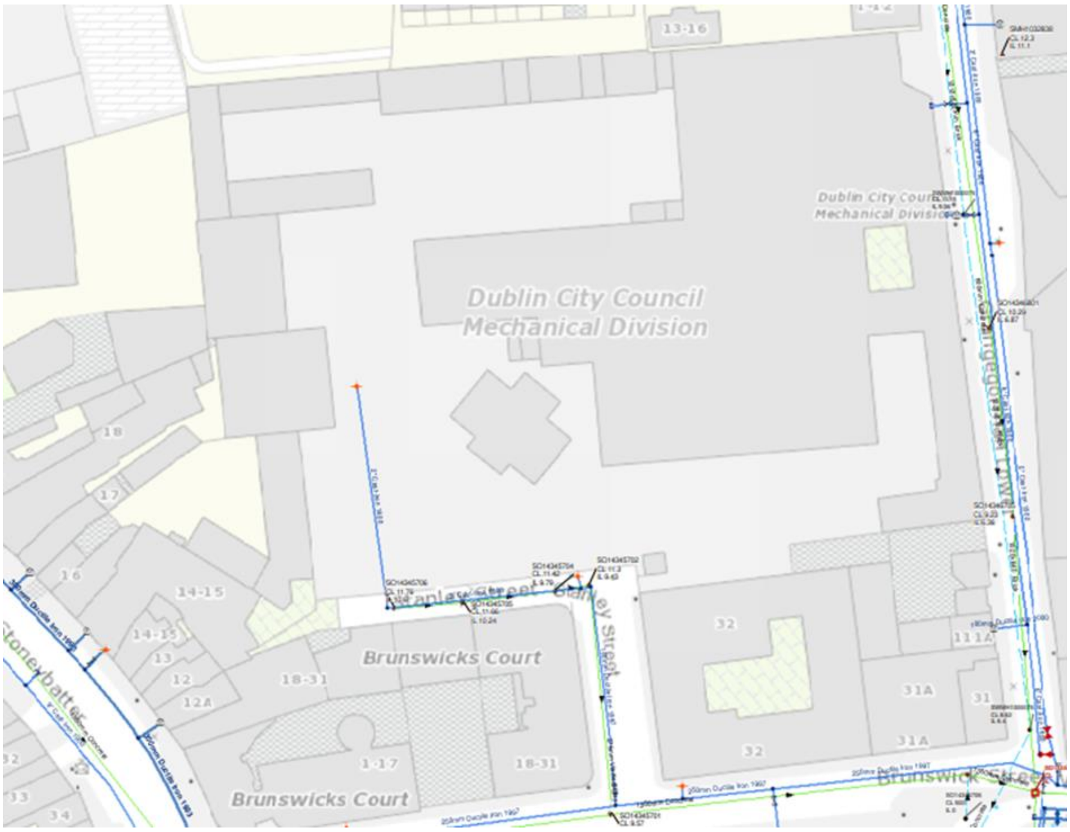


Figure 4-1 - Extract from Irish Water maps

4.2 Existing & Proposed Services

There are separate 75mm and 150mm watermains running parallel to the eastern boundary on Grangegorman Lower. There is a 100mm watermain coming in off Stanley Street decreasing to a 50mm main when entering the site and terminating in the southwest corner.

The proposed watermain layout is indicated on drawing SHB4-SSD-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 = 167 units x 2.7 persons x 150 litres per day per person
= 67,635 litres/day

Average Hour Demand = 67,635 litres/day / (24hr x 60min x 60sec)
= 0.783 litres/sec

Average Day / Peak Week Demand = 0.783 litres/sec x 1.25
= **0.979 litres/sec**

Peak Demand = 5 x 0.979 litres/sec = **4.893 litres/sec**

4.3.2 Community Centre Water Demand

There is provision of 552m^2 of community, cultural and arts space located within the development.

Total persons = 276 people (Assumed 1person per 2m2 of floor area)

Average water demand = 40litres/person/day

Total daily discharge = 276 people x 40litres/person/day = 11,040 litres/day = 0.128 l/s

Average Day Peak Week Demand = 1.25 x 0.128 = **0.160 litres/sec**

Peak Demand = 5 x 0.160 = **0.800 litres/sec**

4.3.3 Creche Water Demand

Consideration was given to the planned development of a 277.54m^2 creche. The table below is a schedule of accommodation to the proposed creche.

Table 4-1 - Creche Design Parameters

Age of children	No. of adults	No. of children	Floor area per child	Area	No. of adults	No. of children
0-1 year	1	3	3.5 sq metres	36	4	10
1-2 years	1	5	2.8 sq. metres	37	3	13
2-3 years	1	6	2.35 sq. metres	30	3	13
3-6 years	1	8	2.3 sq. metres	30	2	13
Total					**12**	**49**

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 90 litres per person per day for non-residential school with canteen cooking on site.

Total persons = 49 children + 12 staff = 61 people

Average water demand = 90litres/person/day

Total daily discharge = 61 people x 90litres/person/day = 5490 litres/day = 0.064 litres/sec

Average Day Peak Week Demand = 0.064 x 1.25 = **0.080 litres/sec**

Peak Demand = 5 x 0.080l/s = **0.400 litres/sec**

Average and peak discharge rates for all existing and proposed developments are summarised in the Table 4-2.

Table 4-2 - Average and Peak Foul Discharge Rates for All Developments

Development Description	**Average Demand (l/s)**	**Peak Demand (l/s)**
Proposed development of residential units	0.979	4.893
Community Centre/ Retail Commercial	0.160	0.800
Creche	0.080	0.400
Total	**1.219**	**6.093**

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

19 January 2024

Our Ref: CDS23009292 Pre-Connection Enquiry
New Apartments at Stanley Street, Stanley Street, Dublin 7, 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 176 unit(s) at New Apartments at Stanley Street, Stanley Street, Dublin 7, 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 Irish Water
- **Wastewater Connection** - Feasible without infrastructure upgrade by Irish Water

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?

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)

APPENDIX B – ATTENUATION VOLUME CALCULATIONS

Job Title	B4 07 Stanley Street - Area 1 and 2 Blue Roof	Job no.	23006
By:	Kezia Adanza	Checked by:	DW
Date	12/09/2024	Rev number	1

Part 1 **Permissible Runoff**

The regression equation recommended for use by the Greater Dublin Strategic Drainage Study 2005 calculates a value, QBARrural, 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		16.3
M5-2D (2 days - 5 years) mm		58.6
Ratio "r" (M5-60/ M5-2D)		0.28
SAAR mm		916
Soil/ SPR mm		0.37

Soil Type 3 - Based on Site Investigation - Sandy clay, moderate runoff potential, 2no soakaway tests = 2.77E -06m/s and 4.74E -06m/s

For 50 Ha Area ~ QBARrural =		0.197	m^3/s
QBARrural =		3.935	l/s/ha
For 0.13 Ha Area ~ QBARrural =		0.531	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 Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
1349.26	Roof - Apartments *	Standard - 28%	0.0	0.95	0.0	0.0	0.0	769.4
		Green/ Blue Roof - 72%	971.47	0.60	582.9	641.2	769.4	
	Permeable Paving inc. areas from hardstanding		0.0	0.50	0.0	0.0	0.0	
ha	Landscaped Areas inc. areas from hardstanding		0.0	0.20	0.0	0.0	0.0	ha
0.13								0.1
	Hardstanding		0.0	0.90	0.0	0.0	0.0	

*Blocks A-C are located across area 1 and 2 at a 50/50 spilt. These calulcations is for all blue roof in Blocks A-C

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	3.00	1.76	1.15	1	2.022	1.556	0.031856598	1.524
2min	5.00	2.93	1.15	1	3.370	2.593	0.063713196	2.529
5 min	9.00	5.27	1.16	1	6.118	4.707	0.15928299	4.548
10 min	12.90	7.56	1.17	1	8.844	6.805	0.318565981	6.486
15 min	15.50	9.08	1.18	1	10.718	8.246	0.477848971	7.769
30 min	20.70	12.13	1.18	1	14.314	11.013	0.955697943	10.057
60 min	27.00	15.82	1.18	1	18.670	14.365	1.911395885	12.453
2 hour	35.00	20.51	1.18	1	24.202	18.621	3.82279177	14.798
4 hour	44.00	25.78	1.17	1	30.167	23.211	7.64558354	15.565
6 hour	51.00	29.89	1.17	1	34.967	26.903	11.46837531	15.435
12 hour	65.00	38.09	1.16	1	44.184	33.996	22.93675062	11.059
24 hour	83.00	48.64	1.15	1	55.934	43.036	45.87350124	-2.838
48 hour	106.00	62.12	1.14	1	70.812	54.483	91.74700248	-37.264
Size of Attenuation for 1 in 10 year flood event m³								**15.565**

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	3.00	1.76	1.42	1	2.496	1.921	0.031856598	1.889
2min	5.00	2.93	1.43	1	4.190	3.224	0.063713196	3.160
5 min	9.00	5.27	1.48	1	7.806	6.006	0.15928299	5.846
10 min	12.90	7.56	1.50	1	11.339	8.724	0.318565981	8.406
15 min	15.50	9.08	1.54	1	13.988	10.762	0.477848971	10.284
30 min	20.70	12.13	1.54	1	18.681	14.373	0.955697943	13.417
60 min	27.00	15.82	1.54	1	24.366	18.747	1.911395885	16.836
2 hour	35.00	20.51	1.52	1	31.175	23.986	3.82279177	20.163
4 hour	44.00	25.78	1.50	1	38.676	29.757	7.64558354	22.112
6 hour	51.00	29.89	1.48	1	44.231	34.032	11.46837531	22.563
12 hour	65.00	38.09	1.45	1	55.231	42.494	22.93675062	19.558
24 hour	83.00	48.64	1.41	1	68.580	52.765	45.87350124	6.892
48 hour	106.00	62.12	1.39	1	86.341	66.431	91.74700248	-25.316
Size of Attenuation for 1 in 30 year flood event m³								**22.563**

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	3.00	1.76	1.74	1	3.059	2.354	0.031856598	2.322
2min	5.00	2.93	1.75	1	5.128	3.945	0.063713196	3.881
5 min	9.00	5.27	1.86	1	9.810	7.548	0.15928299	7.388
10 min	12.90	7.56	1.90	1	14.363	11.051	0.318565981	10.732
15 min	15.50	9.08	1.95	1	17.712	13.628	0.477848971	13.150
30 min	20.70	12.13	1.97	1	23.896	18.386	0.955697943	17.430
60 min	27.00	15.82	1.98	1	31.328	24.103	1.911395885	22.192
2 hour	35.00	20.51	1.93	1	39.584	30.456	3.82279177	26.633
4 hour	44.00	25.78	1.89	1	48.732	37.494	7.64558354	29.849
6 hour	51.00	29.89	1.85	1	55.289	42.540	11.46837531	31.071
12 hour	65.00	38.09	1.77	1	67.419	51.873	22.93675062	28.936
24 hour	83.00	48.64	1.72	1	83.657	64.366	45.87350124	18.493
48 hour	106.00	62.12	1.67	1	103.734	79.813	91.74700248	-11.934
Size of Attenuation for 1 in 100 year flood event m³								**31.071**

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 769.4 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' 3.69 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	1396.5	m²
	Interception Store 30 l/m²	0.03	l/m²
	Storage Volume	41.89	m³

Total interception volume provided for the overall site 41.89 m³
which exceeds the required volume calculated of 3.69 m³

Job Title	B4 07 Stanley Street - Area 1 (Detention Basin)	Job no.	23006
By:	Kezia Adanza	Checked by:	DW
Date	12/09/2024	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		16.3
M5-2D (2 days - 5 years) mm		58.6
Ratio "r" (M5-60/ M5-2D)		0.28
SAAR mm		916
Soil/ SPR mm		0.37

Soil Type 3 - Based on Site Investigation - Sandy clay, moderate runoff potential, 2no soakaway tests = 2.77E -06m/s and 4.74E -06m/s

For 50 Ha Area ~ QBARrural =		0.197	m^3/s
QBARrural =		3.935	l/s/ha
For 0.21 Ha Area ~ QBARrural =		0.815	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 Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
2070.707	Roof - Apartments*	Standard - 28%	194.11	0.95	184.40	202.84	243.41	993.70
		Green/ Blue Roof - 72%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		631.83	0.50	315.92	347.51	417.01	
ha	Landscaped Areas inc. areas from hardstanding		593.35	0.20	118.67	130.54	156.65	ha
0.21								0.1
	Hardstanding		148.69	0.90	133.82	147.20	176.64	

*As per subcatcments 50% of the standard roof from Blocks A-C is considered in these calculations, see area 2 for the other 50% of the standard roof

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	3.00	1.76	1.15	1	2.022	2.009	0.048890266	1.960
2min	5.00	2.93	1.15	1	3.370	3.348	0.097780533	3.251
5 min	9.00	5.27	1.16	1	6.118	6.079	0.244451331	5.835
10 min	12.90	7.56	1.17	1	8.844	8.789	0.488902663	8.300
15 min	15.50	9.08	1.18	1	10.718	10.650	0.733353994	9.917
30 min	20.70	12.13	1.18	1	14.314	14.224	1.466707988	12.757
60 min	27.00	15.82	1.18	1	18.670	18.552	2.933415975	15.619
2 hour	35.00	20.51	1.18	1	24.202	24.049	5.866831951	18.183
4 hour	44.00	25.78	1.17	1	30.167	29.977	11.7336639	18.244
6 hour	51.00	29.89	1.17	1	34.967	34.746	17.60049585	17.146
12 hour	65.00	38.09	1.16	1	44.184	43.906	35.2009917	8.705
24 hour	83.00	48.64	1.15	1	55.934	55.582	70.40198341	-14.820
48 hour	106.00	62.12	1.14	1	70.812	70.366	140.8039668	-70.438
Size of Attenuation for 1 in 10 year flood event m³								**18.244**

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	3.00	1.76	1.42	1	2.496	2.481	0.048890266	2.432
2min	5.00	2.93	1.43	1	4.190	4.164	0.097780533	4.066
5 min	9.00	5.27	1.48	1	7.806	7.756	0.244451331	7.512
10 min	12.90	7.56	1.50	1	11.339	11.268	0.488902663	10.779
15 min	15.50	9.08	1.54	1	13.988	13.900	0.733353994	13.166
30 min	20.70	12.13	1.54	1	18.681	18.563	1.466707988	17.096
60 min	27.00	15.82	1.54	1	24.366	24.212	2.933415975	21.279
2 hour	35.00	20.51	1.52	1	31.175	30.979	5.866831951	25.112
4 hour	44.00	25.78	1.50	1	38.676	38.432	11.7336639	26.699
6 hour	51.00	29.89	1.48	1	44.231	43.953	17.60049585	26.352
12 hour	65.00	38.09	1.45	1	55.231	54.883	35.2009917	19.682
24 hour	83.00	48.64	1.41	1	68.580	68.148	70.40198341	-2.254
48 hour	106.00	62.12	1.39	1	86.341	85.798	140.8039668	-55.006
Size of Attenuation for 1 in 30 year flood event m³								**26.699**

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	3.00	1.76	1.74	1	3.059	3.040	0.048890266	2.991
2min	5.00	2.93	1.75	1	5.128	5.095	0.097780533	4.997
5 min	9.00	5.27	1.86	1	9.810	9.748	0.244451331	9.503
10 min	12.90	7.56	1.90	1	14.363	14.272	0.488902663	13.784
15 min	15.50	9.08	1.95	1	17.712	17.600	0.733353994	16.867
30 min	20.70	12.13	1.97	1	23.896	23.746	1.466707988	22.279
60 min	27.00	15.82	1.98	1	31.328	31.130	2.933415975	28.197
2 hour	35.00	20.51	1.93	1	39.584	39.335	5.866831951	33.468
4 hour	44.00	25.78	1.89	1	48.732	48.425	11.7336639	36.691
6 hour	51.00	29.89	1.85	1	55.289	54.941	17.60049585	37.340
12 hour	65.00	38.09	1.77	1	67.419	66.995	35.2009917	31.794
24 hour	83.00	48.64	1.72	1	83.657	83.131	70.40198341	12.729
48 hour	106.00	62.12	1.67	1	103.734	103.081	140.8039668	-37.723
Size of Attenuation for 1 in 100 year flood event m³								**37.340**

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 993.7 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' 4.77 m³

Interception Storage Provided *Only fill in SuDS on your site

Permeable Paving	Area	301.1	m²
	Stone Layer 100mm deep	0.1	m
	Void Ratio	30%	
	Storage Volume	9.03	m³

*Storage depth will depend on your site

Total interception volume provided for the overall site 9.03 m³

which exceeds the required volume calculated of 4.77 m³

Job Title	B4 07 Stanley Street - Area 1 (Detention Basin)	Job no.	23006
By:	Kezia Adanza	Checked by:	DW
Date	12/09/2024	Rev number	1

Part 1 **Permissible Runoff**

The regression equation recommended for use by the Greater Dublin Strategic Drainage Study 2005 calculates a value, QBARrural, 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	16.3
M5-2D (2 days - 5 years) mm	58.6
Ratio "r" (M5-60/ M5-2D)	0.28
SAAR mm	916
Soil/ SPR mm	0.37

Soil Type 3 - Based on Site Investigation - Sandy clay, moderate runoff potential, 2no soakaway tests = 2.77E -06m/s and 4.74E -06m/s

For 50 Ha Area ~ QBARrural =	0.197	m^3/s
QBARrural =	3.935	l/s/ha
For 0.22 Ha Area ~ QBARrural =	0.871	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 Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
2212.529	Roof - Apartments*	Standard - 28%	195.51	0.95	185.73	204.30	245.16	899.89
		Green/ Blue Roof - 72%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		643.82	0.50	321.91	354.10	424.92	
ha	Landscaped Areas inc. areas from hardstanding		870.48	0.20	174.10	191.51	229.81	ha
0.22								0.1
	Hardstanding		0.00	0.90	0.00	0.00	0.00	

*As per subcatcments 50% of the standard roof from Blocks A-C is considered in these calculations, see area 1 for the other 50% of the standard roof

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	3.00	1.76	1.15	1	2.022	1.819	0.052238744	1.767
2min	5.00	2.93	1.15	1	3.370	3.032	0.104477487	2.928
5 min	9.00	5.27	1.16	1	6.118	5.505	0.261193718	5.244
10 min	12.90	7.56	1.17	1	8.844	7.959	0.522387435	7.437
15 min	15.50	9.08	1.18	1	10.718	9.645	0.783581153	8.861
30 min	20.70	12.13	1.18	1	14.314	12.881	1.567162306	11.314
60 min	27.00	15.82	1.18	1	18.670	16.801	3.134324612	13.667
2 hour	35.00	20.51	1.18	1	24.202	21.779	6.268649224	15.510
4 hour	44.00	25.78	1.17	1	30.167	27.147	12.53729845	14.610
6 hour	51.00	29.89	1.17	1	34.967	31.466	18.80594767	12.660
12 hour	65.00	38.09	1.16	1	44.184	39.761	37.61189535	2.149
24 hour	83.00	48.64	1.15	1	55.934	50.334	75.22379069	-24.890
48 hour	106.00	62.12	1.14	1	70.812	63.723	150.4475814	-86.724
Size of Attenuation for 1 in 10 year flood event m³								**15.510**

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	3.00	1.76	1.42	1	2.496	2.246	0.052238744	2.194
2min	5.00	2.93	1.43	1	4.190	3.770	0.104477487	3.666
5 min	9.00	5.27	1.48	1	7.806	7.024	0.261193718	6.763
10 min	12.90	7.56	1.50	1	11.339	10.204	0.522387435	9.682
15 min	15.50	9.08	1.54	1	13.988	12.587	0.783581153	11.804
30 min	20.70	12.13	1.54	1	18.681	16.810	1.567162306	15.243
60 min	27.00	15.82	1.54	1	24.366	21.927	3.134324612	18.792
2 hour	35.00	20.51	1.52	1	31.175	28.054	6.268649224	21.786
4 hour	44.00	25.78	1.50	1	38.676	34.804	12.53729845	22.267
6 hour	51.00	29.89	1.48	1	44.231	39.803	18.80594767	20.997
12 hour	65.00	38.09	1.45	1	55.231	49.701	37.61189535	12.089
24 hour	83.00	48.64	1.41	1	68.580	61.714	75.22379069	-13.510
48 hour	106.00	62.12	1.39	1	86.341	77.698	150.4475814	-72.750
Size of Attenuation for 1 in 30 year flood event m³								**22.267**

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	3.00	1.76	1.74	1	3.059	2.753	0.052238744	2.700
2min	5.00	2.93	1.75	1	5.128	4.614	0.104477487	4.510
5 min	9.00	5.27	1.86	1	9.810	8.828	0.261193718	8.566
10 min	12.90	7.56	1.90	1	14.363	12.925	0.522387435	12.403
15 min	15.50	9.08	1.95	1	17.712	15.939	0.783581153	15.155
30 min	20.70	12.13	1.97	1	23.896	21.504	1.567162306	19.937
60 min	27.00	15.82	1.98	1	31.328	28.191	3.134324612	25.057
2 hour	35.00	20.51	1.93	1	39.584	35.621	6.268649224	29.353
4 hour	44.00	25.78	1.89	1	48.732	43.853	12.53729845	31.316
6 hour	51.00	29.89	1.85	1	55.289	49.754	18.80594767	30.948
12 hour	65.00	38.09	1.77	1	67.419	60.670	37.61189535	23.058
24 hour	83.00	48.64	1.72	1	83.657	75.282	75.22379069	0.059
48 hour	106.00	62.12	1.67	1	103.734	93.349	150.4475814	-57.099
Size of Attenuation for 1 in 100 year flood event m³								**31.316**

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 tha 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 899.9 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' 4.32 m³

Interception Storage Provided *Only fill in SuDS on your site

Permeable Paving	Area	494.7	m²
	Stone Layer 100mm deep	0.1	m
	Void Ratio	30%	
	Storage Volume	14.84	m³

*Storage depth will depend on your site

Total interception volume provided for the overall site 14.84 m³

which exceeds the required volume calculated of 4.32 m³

Job Title	B4 07 Stanley Street - Area 3 Blue roof	Job no.	23006
By:	Kezia Adanza	Checked by:	DW
Date	12/09/2024	Rev number	1

Part 1 **Permissible Runoff**

The regression equation recommended for use by the Greater Dublin Strategic Drainage Study 2005 calculates a value, QBARrural, which is sourced from the Institute of Hydrology Report 124. This value is the mean annual flood flow from a rural catchment in m³/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		16.3
M5-2D (2 days - 5 years) mm		58.6
Ratio "r" (M5-60/ M5-2D)		0.28
SAAR mm		916
Soil/ SPR mm		0.37

Soil Type 3 - Based on Site Investigation - Sandy clay, moderate runoff potential, 2no soakaway tests = 2.77E -06m/s and 4.74E -06m/s

For 50 Ha Area ~ QBARrural =		0.197	m³/s
QBARrural =		3.935	l/s/ha
For 0.20 Ha Area ~ QBARrural =		0.786	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 Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
1997.11	Roof - Duplex Units - Extensive Green Roof		0.0	0.60	0.0	0.0	0.0	1138.8
	Roof - Apartments	Standard - 28%	0.0	0.95	0.0	0.0	0.0	
		Green/Blue Roof - 72%	1437.9	0.60	862.8	949.0	1138.8	
	Permeable Paving inc. areas from hardstanding		0.0	0.50	0.0	0.0	0.0	
ha	Landscaped Areas inc. areas from hardstanding		0.0	0.20	0.0	0.0	0.0	ha
0.20								0.1
	Hardstanding		0.0	0.90	0.0	0.0	0.0	

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	3.00	1.76	1.15	1	2.022	2.302	0.04715261	2.255
2min	5.00	2.93	1.15	1	3.370	3.837	0.09430522	3.743
5 min	9.00	5.27	1.16	1	6.118	6.967	0.23576305	6.731
10 min	12.90	7.56	1.17	1	8.844	10.072	0.4715261	9.601
15 min	15.50	9.08	1.18	1	10.718	12.206	0.70728915	11.499
30 min	20.70	12.13	1.18	1	14.314	16.301	1.414578301	14.886
60 min	27.00	15.82	1.18	1	18.670	21.262	2.829156601	18.433
2 hour	35.00	20.51	1.18	1	24.202	27.562	5.658313203	21.903
4 hour	44.00	25.78	1.17	1	30.167	34.355	11.31662641	23.039
6 hour	51.00	29.89	1.17	1	34.967	39.821	16.97493961	22.846
12 hour	65.00	38.09	1.16	1	44.184	50.319	33.94987922	16.369
24 hour	83.00	48.64	1.15	1	55.934	63.699	67.89975843	-4.201
48 hour	106.00	62.12	1.14	1	70.812	80.643	135.7995169	-55.156
Size of Attenuation for 1 in 10 year flood event m³								**23.039**

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	3.00	1.76	1.42	1	2.496	2.843	0.04715261	2.796
2min	5.00	2.93	1.43	1	4.190	4.772	0.09430522	4.677
5 min	9.00	5.27	1.48	1	7.806	8.889	0.23576305	8.653
10 min	12.90	7.56	1.50	1	11.339	12.913	0.4715261	12.442
15 min	15.50	9.08	1.54	1	13.988	15.930	0.70728915	15.222
30 min	20.70	12.13	1.54	1	18.681	21.274	1.414578301	19.859
60 min	27.00	15.82	1.54	1	24.366	27.749	2.829156601	24.919
2 hour	35.00	20.51	1.52	1	31.175	35.503	5.658313203	29.845
4 hour	44.00	25.78	1.50	1	38.676	44.045	11.31662641	32.729
6 hour	51.00	29.89	1.48	1	44.231	50.372	16.97493961	33.397
12 hour	65.00	38.09	1.45	1	55.231	62.898	33.94987922	28.948
24 hour	83.00	48.64	1.41	1	68.580	78.101	67.89975843	10.201
48 hour	106.00	62.12	1.39	1	86.341	98.328	135.7995169	-37.471
Size of Attenuation for 1 in 30 year flood event m³								**33.397**

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	3.00	1.8	1.74	1	3.059	3.484	0.04715261	3.436
2min	5.00	2.9	1.75	1	5.128	5.839	0.09430522	5.745
5 min	9.00	5.3	1.86	1	9.810	11.172	0.23576305	10.936
10 min	12.90	7.6	1.90	1	14.363	16.357	0.4715261	15.885
15 min	15.50	9.1	1.95	1	17.712	20.171	0.70728915	19.464
30 min	20.70	12.1	1.97	1	23.896	27.214	1.414578301	25.800
60 min	27.00	15.8	1.98	1	31.328	35.677	2.829156601	32.848
2 hour	35.00	20.5	1.93	1	39.584	45.080	5.658313203	39.422
4 hour	44.00	25.8	1.89	1	48.732	55.497	11.31662641	44.181
6 hour	51.00	29.9	1.85	1	55.289	62.965	16.97493961	45.990
12 hour	65.00	38.1	1.77	1	67.419	76.779	33.94987922	42.829
24 hour	83.00	48.6	1.72	1	83.657	95.272	67.89975843	27.372
48 hour	106.00	62.1	1.67	1	103.734	118.135	135.7995169	-17.664
Size of Attenuation for 1 in 100 year flood event m³								**45.990**

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 1138.8 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' 5.47 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	1991.0	m²
	Interception Store 30 l/m²	0.03	l/m²
	Storage Volume	59.73	m³

Total interception volume provided for the overall site 59.73 m³
which exceeds the required volume calculated of 5.47 m³

Job Title	B4 07 Stanley Street - Area 3 (Attenuation Tank)	Job no.	23006
By:	Kezia Adanza	Checked by:	DW
Date	12/09/2024	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 m³/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	16.3	
M5-2D (2 days - 5 years) mm	58.6	
Ratio "r" (M5-60/ M5-2D)	0.28	
SAAR mm	916	Soil Type 3 - Based on Site Investigation - Sandy clay, moderate runoff potential, 2no soakaway
Soil/ SPR mm	0.37	tests = 2.77E -06m/s and 4.74E -06m/s

For 50 Ha Area ~ QBARrural =	0.197	m³/s	
QBARrural =	3.935	l/s/ha	Discharge should be limited to QBAR or 2 l/s/ha whichever
For 0.31 Ha Area ~ QBARrural =	1.224	l/s	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 Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
3111.449	Roof - Apartments	Standard - 28%	559.19	0.95	531.23	584.35	701.23	1364.53
		Intensive Green/Blue Roof - 72%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		423.19	0.50	211.60	232.75	279.31	
ha	Landscaped Areas inc. areas from hardstanding		494.15	0.20	98.83	108.71	130.46	ha
0.31								0.14
	Hardstanding		197.00	0.90	177.30	195.03	253.54	

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	3.00	1.76	1.15	1	2.022	2.759	0.073462624	2.685
2min	5.00	2.93	1.15	1	3.370	4.598	0.146925248	4.451
5 min	9.00	5.27	1.16	1	6.118	8.348	0.367313121	7.981
10 min	12.90	7.56	1.17	1	8.844	12.069	0.734626241	11.334
15 min	15.50	9.08	1.18	1	10.718	14.625	1.101939362	13.523
30 min	20.70	12.13	1.18	1	14.314	19.531	2.203878724	17.327
60 min	27.00	15.82	1.18	1	18.670	25.476	4.407757449	21.068
2 hour	35.00	20.51	1.18	1	24.202	33.024	8.815514897	24.208
4 hour	44.00	25.78	1.17	1	30.167	41.164	17.63102979	23.533
6 hour	51.00	29.89	1.17	1	34.967	47.713	26.44654469	21.266
12 hour	65.00	38.09	1.16	1	44.184	60.291	52.89308938	7.398
24 hour	83.00	48.64	1.15	1	55.934	76.323	105.7861788	-29.463
48 hour	106.00	62.12	1.14	1	70.812	96.625	211.5723575	-114.947
Size of Attenuation for 1 in 10 year flood event m³								**24.208**

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	3.00	1.76	1.42	1	2.496	3.406	0.073462624	3.333
2min	5.00	2.93	1.43	1	4.190	5.717	0.146925248	5.570
5 min	9.00	5.27	1.48	1	7.806	10.651	0.367313121	10.284
10 min	12.90	7.56	1.50	1	11.339	15.472	0.734626241	14.738
15 min	15.50	9.08	1.54	1	13.988	19.087	1.101939362	17.985
30 min	20.70	12.13	1.54	1	18.681	25.490	2.203878724	23.286
60 min	27.00	15.82	1.54	1	24.366	33.248	4.407757449	28.840
2 hour	35.00	20.51	1.52	1	31.175	42.539	8.815514897	33.724
4 hour	44.00	25.78	1.50	1	38.676	52.774	17.63102979	35.143
6 hour	51.00	29.89	1.48	1	44.231	60.355	26.44654469	33.908
12 hour	65.00	38.09	1.45	1	55.231	75.363	52.89308938	22.470
24 hour	83.00	48.64	1.41	1	68.580	93.579	105.7861788	-12.208
48 hour	106.00	62.12	1.39	1	86.341	117.815	211.5723575	-93.758
Size of Attenuation for 1 in 30 year flood event m³								**35.143**

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	3.00	1.76	1.74	1	3.059	4.174	0.073462624	4.101
2min	5.00	2.93	1.75	1	5.128	6.997	0.146925248	6.850
5 min	9.00	5.27	1.86	1	9.810	13.386	0.367313121	13.018
10 min	12.90	7.56	1.90	1	14.363	19.598	0.734626241	18.864
15 min	15.50	9.08	1.95	1	17.712	24.168	1.101939362	23.066
30 min	20.70	12.13	1.97	1	23.896	32.607	2.203878724	30.404
60 min	27.00	15.82	1.98	1	31.328	42.747	4.407757449	38.340
2 hour	35.00	20.51	1.93	1	39.584	54.014	8.815514897	45.198
4 hour	44.00	25.78	1.89	1	48.732	66.496	17.63102979	48.865
6 hour	51.00	29.89	1.85	1	55.289	75.443	26.44654469	48.997
12 hour	65.00	38.09	1.77	1	67.419	91.995	52.89308938	39.102
24 hour	83.00	48.64	1.72	1	83.657	114.153	105.7861788	8.366
48 hour	106.00	62.12	1.67	1	103.734	141.547	211.5723575	-70.025
Size of Attenuation for 1 in 100 year flood event m³								**48.997**

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 1364.5 m^2 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' 6.55 m^3

Interception Storage Provided *Only fill in SuDS on your site

Permeable Paving	Area	545.9	m^2
	Stone Layer 100mm deep	0.1	m
	Void Ratio	30%	
	Storage Volume	16.38	m^3

*Storage depth will depend on your site

Total interception volume provided for the overall site 16.38 m^3
which exceeds the required volume calculated of 6.55 m^3

Job Title	B4 07 Stanley Street - Area 4 Extensive Blue Roof	Job no.	23006
By:	Kezia Adanza	Checked by:	DW
Date	12/09/2024	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	16.3	
M5-2D (2 days - 5 years) mm	58.6	
Ratio "r" (M5-60/ M5-2D)	0.28	
SAAR mm	916	Soil Type 3 - Based on Site Investigation - Sandy clay, moderate runoff potential, 2no soakaway tests
Soil/ SPR mm	0.37	= 2.77E -06m/s and 4.74E -06m/s

For 50 Ha Area ~ QBARrural =	0.197	m^3/s	
QBARrural =	3.935	l/s/ha	Discharge should be limited to QBAR or 2 l/s/ha whichever
For 0.05 Ha Area ~ QBARrural =	0.184	l/s	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 Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
467.813	Roof - Duplex Units - Extensive Green Roof		467.813	0.60	280.7	308.8	370.5	370.5
	Roof - Apartments	Standard - 28%	0.0	0.95	0.0	0.0	0.0	
		Green/Blue Roof - 72%	0.0	0.60	0.0	0.0	0.0	
	Permeable Paving inc. areas from hardstanding		0.0	0.50	0.0	0.0	0.0	
ha	Landscaped Areas inc. areas from hardstanding		0.0	0.20	0.0	0.0	0.0	ha
0.05								0.0
	Hardstanding		0.0	0.90	0.0	0.0	0.0	

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	3.00	1.76	1.15	1	2.022	0.749	0.011045262	0.738
2min	5.00	2.93	1.15	1	3.370	1.248	0.022090525	1.226
5 min	9.00	5.27	1.16	1	6.118	2.267	0.055226312	2.211
10 min	12.90	7.56	1.17	1	8.844	3.277	0.110452624	3.167
15 min	15.50	9.08	1.18	1	10.718	3.971	0.165678936	3.805
30 min	20.70	12.13	1.18	1	14.314	5.303	0.331357871	4.972
60 min	27.00	15.82	1.18	1	18.670	6.917	0.662715743	6.255
2 hour	35.00	20.51	1.18	1	24.202	8.967	1.325431486	7.642
4 hour	44.00	25.78	1.17	1	30.167	11.177	2.650862971	8.526
6 hour	51.00	29.89	1.17	1	34.967	12.955	3.976294457	8.979
12 hour	65.00	38.09	1.16	1	44.184	16.371	7.952588914	8.418
24 hour	83.00	48.64	1.15	1	55.934	20.724	15.90517783	4.819
48 hour	106.00	62.12	1.14	1	70.812	26.236	31.81035566	-5.574
Size of Attenuation for 1 in 10 year flood event m³								**8.979**

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	3.00	1.76	1.42	1	2.496	0.925	0.011045262	0.914
2min	5.00	2.93	1.43	1	4.190	1.552	0.022090525	1.530
5 min	9.00	5.27	1.48	1	7.806	2.892	0.055226312	2.837
10 min	12.90	7.56	1.50	1	11.339	4.201	0.110452624	4.091
15 min	15.50	9.08	1.54	1	13.988	5.183	0.165678936	5.017
30 min	20.70	12.13	1.54	1	18.681	6.921	0.331357871	6.590
60 min	27.00	15.82	1.54	1	24.366	9.028	0.662715743	8.365
2 hour	35.00	20.51	1.52	1	31.175	11.551	1.325431486	10.225
4 hour	44.00	25.78	1.50	1	38.676	14.330	2.650862971	11.679
6 hour	51.00	29.89	1.48	1	44.231	16.388	3.976294457	12.412
12 hour	65.00	38.09	1.45	1	55.231	20.463	7.952588914	12.511
24 hour	83.00	48.64	1.41	1	68.580	25.409	15.90517783	9.504
48 hour	106.00	62.12	1.39	1	86.341	31.990	31.81035566	0.180
Size of Attenuation for 1 in 30 year flood event m³								**12.511**

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	3.00	1.8	1.74	1	3.059	1.133	0.011045262	1.122
2min	5.00	2.9	1.75	1	5.128	1.900	0.022090525	1.878
5 min	9.00	5.3	1.86	1	9.810	3.635	0.055226312	3.579
10 min	12.90	7.6	1.90	1	14.363	5.322	0.110452624	5.211
15 min	15.50	9.1	1.95	1	17.712	6.562	0.165678936	6.397
30 min	20.70	12.1	1.97	1	23.896	8.854	0.331357871	8.522
60 min	27.00	15.8	1.98	1	31.328	11.607	0.662715743	10.944
2 hour	35.00	20.5	1.93	1	39.584	14.666	1.325431486	13.341
4 hour	44.00	25.8	1.89	1	48.732	18.056	2.650862971	15.405
6 hour	51.00	29.9	1.85	1	55.289	20.485	3.976294457	16.509
12 hour	65.00	38.1	1.77	1	67.419	24.979	7.952588914	17.027
24 hour	83.00	48.6	1.72	1	83.657	30.996	15.90517783	15.091
48 hour	106.00	62.1	1.67	1	103.734	38.434	31.81035566	6.624
Size of Attenuation for 1 in 100 year flood event m³								**17.027**

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 volume 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 370.5 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' 1.78 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	467.8	m²
	Interception Store 30 l/m²	0.03	l/m²
	Storage Volume	14.03	m³

Total interception volume provided for the overall site 14.03 m³

which exceeds the required volume calculated of 1.78 m³

Job Title	B4 07 Stanley Street - Area 4	Job no.	23006
By:	Kezia Adanza	Checked by:	DW
Date	12/09/2024	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	16.3
M5-2D (2 days - 5 years) mm	58.6
Ratio "r" (M5-60/ M5-2D)	0.28
SAAR mm	916
Soil/ SPR mm	0.37

Soil Type 3 - Based on Site Investigation - Sandy clay, moderate runoff potential, 2no soakaway tests = 2.77E -06m/s and 4.74E -06m/s

For 50 Ha Area ~ QBARrural =	0.197	m^3/s
QBARrural =	3.935	l/s/ha
For 0.15 Ha Area ~ QBARrural =	0.594	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 Area sq.m	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable Area ha
1509.839	Roof - Duplex Units - Extensive Green Roof		0.0	0.60	0.0	0.0	0.0	520.2
	Roof - Apartments	Standard - 28%	0.0	0.95	0.0	0.0	0.0	
		Green/Blue Roof - 72%	0.0	0.60	0.0	0.0	0.0	
	Permeable Paving inc. areas from hardstanding		522.3	0.50	261.2	287.3	316.0	
ha	Landscaped Areas inc. areas from hardstanding		427.1	0.20	85.4	94.0	103.4	ha
0.15								0.1
	Hardstanding		92.6	0.90	83.3	91.7	100.8	

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	3.00	1.76	1.15	1	2.022	1.052	0.035647936	1.016
2min	5.00	2.93	1.15	1	3.370	1.753	0.071295872	1.681
5 min	9.00	5.27	1.16	1	6.118	3.182	0.17823968	3.004
10 min	12.90	7.56	1.17	1	8.844	4.601	0.356479361	4.244
15 min	15.50	9.08	1.18	1	10.718	5.575	0.534719041	5.041
30 min	20.70	12.13	1.18	1	14.314	7.446	1.069438082	6.376
60 min	27.00	15.82	1.18	1	18.670	9.712	2.138876163	7.573
2 hour	35.00	20.51	1.18	1	24.202	12.589	4.277752326	8.312
4 hour	44.00	25.78	1.17	1	30.167	15.693	8.555504652	7.137
6 hour	51.00	29.89	1.17	1	34.967	18.189	12.83325698	5.356
12 hour	65.00	38.09	1.16	1	44.184	22.984	25.66651396	-2.682
24 hour	83.00	48.64	1.15	1	55.934	29.096	51.33302791	-22.237
48 hour	106.00	62.12	1.14	1	70.812	36.835	102.6660558	-65.831
Size of Attenuation for 1 in 10 year flood event m³								8.312

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	3.00	1.76	1.42	1	2.496	1.299	0.035647936	1.263
2min	5.00	2.93	1.43	1	4.190	2.180	0.071295872	2.108
5 min	9.00	5.27	1.48	1	7.806	4.060	0.17823968	3.882
10 min	12.90	7.56	1.50	1	11.339	5.898	0.356479361	5.542
15 min	15.50	9.08	1.54	1	13.988	7.276	0.534719041	6.742
30 min	20.70	12.13	1.54	1	18.681	9.717	1.069438082	8.648
60 min	27.00	15.82	1.54	1	24.366	12.675	2.138876163	10.536
2 hour	35.00	20.51	1.52	1	31.175	16.217	4.277752326	11.939
4 hour	44.00	25.78	1.50	1	38.676	20.119	8.555504652	11.563
6 hour	51.00	29.89	1.48	1	44.231	23.008	12.83325698	10.175
12 hour	65.00	38.09	1.45	1	55.231	28.730	25.66651396	3.064
24 hour	83.00	48.64	1.41	1	68.580	35.674	51.33302791	-15.659
48 hour	106.00	62.12	1.39	1	86.341	44.913	102.6660558	-57.753
Size of Attenuation for 1 in 30 year flood event m³								11.939

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	3.00	1.8	1.74	1	3.059	1.591	0.035647936	1.556
2min	5.00	2.9	1.75	1	5.128	2.667	0.071295872	2.596
5 min	9.00	5.3	1.86	1	9.810	5.103	0.17823968	4.925
10 min	12.90	7.6	1.90	1	14.363	7.471	0.356479361	7.115
15 min	15.50	9.1	1.95	1	17.712	9.213	0.534719041	8.679
30 min	20.70	12.1	1.97	1	23.896	12.431	1.069438082	11.361
60 min	27.00	15.8	1.98	1	31.328	16.296	2.138876163	14.157
2 hour	35.00	20.5	1.93	1	39.584	20.591	4.277752326	16.313
4 hour	44.00	25.8	1.89	1	48.732	25.350	8.555504652	16.794
6 hour	51.00	29.9	1.85	1	55.289	28.761	12.83325698	15.927
12 hour	65.00	38.1	1.77	1	67.419	35.071	25.66651396	9.404
24 hour	83.00	48.6	1.72	1	83.657	43.517	51.33302791	-7.816
48 hour	106.00	62.1	1.67	1	103.734	53.961	102.6660558	-48.705
Size of Attenuation for 1 in 100 year flood event m³								16.794

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 520.2 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' 2.50 m³

Interception Storage Provided *Only fill in SuDS on your site

Permeable Paving	Area	470.8	m²
	Stone Layer 100mm deep	0.1	m
	Void Ratio	30%	
	Storage Volume	14.12	m³

*Storage depth will depend on your site

Total interception volume provided for the overall site 14.12 m³

which exceeds the required volume calculated of 2.50 m³

APPENDIX C – SURFACE WATER PIPE NETWORK CALCULATIONS

Design Settings

Rainfall Methodology	FSR
Return Period (years)	2
Additional Flow (%)	0
FSR Region	Scotland and Ireland
M5-60 (mm)	16.300
Ratio-R	0.280
CV	0.750
Time of Entry (mins)	4.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Inverts
Minimum Backdrop Height (m)	0.500
Preferred Cover Depth (m)	1.000
Include Intermediate Ground	✓
Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
SW01	0.010	4.00	12.100	1200	1.225
SW02	0.010	4.00	12.700	1200	1.965
SW03	0.010	4.00	12.300	1200	1.665
SW04	0.010	4.00	12.300	1200	1.701
SW05	0.010	4.00	12.300	1200	1.719
SW06	0.010	4.00	12.300	1200	1.822
SW07	0.010	4.00	12.300	1200	1.854
SW08			12.300	1200	1.869
SW09			12.100	1200	1.720
SW10-HB			12.100	1200	1.745
SW11			12.100	1200	1.797
SW12			12.100	1200	1.865
SW13			11.740	1200	1.560
SW14	0.033	4.00	12.650	1200	1.225
SW15	0.033	4.00	12.350	1200	1.225
SW16	0.033	4.00	12.300	1200	1.260
SW17-HB			12.300	1200	1.289
SW18			12.100	1200	1.987
BASIN OUT		4.00	13.100	1200	1.300
SW19-HB			13.100	1200	1.345
SW20			13.100	1200	1.393
SW21			13.100	1200	1.600
SW22			12.400	1200	2.447
SW23		4.00	12.500	1200	1.225
SW24			12.210	1200	2.459
SW25			11.470	1200	1.791
SW26			11.025	1200	1.396
SW27			9.500	1200	1.272
EXSW MH			9.500	1200	1.284
SW28	0.010	4.00	13.100	1200	1.025
SW29	0.010	4.00	13.100	1200	1.118
SW30	0.010	4.00	12.800	1200	0.899
SW31	0.010	4.00	13.100	1200	1.260
BASIN IN1			13.100	1200	1.300
SW32	0.010	4.00	13.000	1200	1.036
SW33	0.010	4.00	13.100	1200	1.186
SW34	0.010	4.00	13.100	1200	1.248
BASIN IN2			13.100	1200	1.300

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	23.722	10.875	10.735	0.140	169.4	225	50.0
1.001	SW02	SW03	16.866	10.735	10.635	0.100	168.7	225	50.0
1.002	SW03	SW04	6.024	10.635	10.599	0.036	167.3	225	50.0
1.003	SW04	SW05	2.958	10.599	10.581	0.018	164.3	225	50.0
1.004	SW05	SW06	17.476	10.581	10.478	0.103	169.7	225	49.0
1.005	SW06	SW07	5.285	10.478	10.446	0.032	165.2	225	48.7
1.006	SW07	SW08	2.501	10.446	10.431	0.015	166.7	225	48.6
1.007	SW08	SW09	8.519	10.431	10.380	0.051	167.0	225	48.1
1.008	SW09	SW10-HB	6.041	10.380	10.355	0.025	241.6	300	47.8
1.009	SW10-HB	SW11	12.530	10.355	10.303	0.052	241.0	300	47.1
1.010	SW11	SW12	16.527	10.303	10.235	0.068	243.0	300	46.2
1.011	SW12	SW13	13.309	10.235	10.180	0.055	242.0	300	45.5
1.012	SW13	SW18	16.220	10.180	10.113	0.067	242.1	300	44.8
2.000	SW14	SW15	14.023	11.425	11.125	0.300	46.7	225	50.0
2.001	SW15	SW16	14.309	11.125	11.040	0.085	168.3	225	50.0
2.002	SW16	SW17-HB	4.781	11.040	11.011	0.029	164.9	225	50.0
2.003	SW17-HB	SW18	5.018	11.011	10.875	0.136	36.9	225	50.0
1.013	SW18	SW22	39.036	10.113	9.953	0.160	244.0	300	43.0
3.000	BASIN OUT	SW19-HB	7.477	11.800	11.755	0.045	166.1	225	50.0
3.001	SW19-HB	SW20	8.032	11.755	11.707	0.048	167.3	225	50.0
3.002	SW20	SW21	35.121	11.707	11.500	0.207	169.7	225	50.0
3.003	SW21	SW22	25.016	11.500	11.175	0.325	77.0	225	49.0
1.014	SW22	SW24	49.282	9.953	9.751	0.202	244.0	300	41.0
4.000	SW23	SW24	9.270	11.275	10.985	0.290	32.0	225	50.0

Name	Vel (m/s)	Flow (l/s)	US Depth (m)	DS Depth (m)
1.000	1.001	1.4	1.000	1.740
1.001	1.004	2.7	1.740	1.440
1.002	1.008	4.1	1.440	1.476
1.003	1.017	5.4	1.476	1.494
1.004	1.001	6.6	1.494	1.597
1.005	1.014	7.9	1.597	1.629
1.006	1.010	9.2	1.629	1.644
1.007	1.009	9.1	1.644	1.495
1.008	1.007	9.1	1.420	1.445
1.009	1.008	8.9	1.445	1.497
1.010	1.004	8.8	1.497	1.565
1.011	1.006	8.6	1.565	1.260
1.012	1.006	8.5	1.260	1.687
2.000	1.918	4.5	1.000	1.000
2.001	1.005	8.9	1.000	1.035
2.002	1.015	13.4	1.035	1.064
2.003	2.160	13.4	1.064	1.000
1.013	1.002	19.7	1.687	2.147
3.000	1.011	0.0	1.075	1.120
3.001	1.008	0.0	1.120	1.168
3.002	1.001	0.0	1.168	1.375
3.003	1.492	0.0	1.375	1.000
1.014	1.002	18.8	2.147	2.159
4.000	2.322	0.0	1.000	1.000

Links

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Rain (mm/hr)
1.015	SW24	SW25	17.457	9.751	9.679	0.072	242.5	300	40.3
1.016	SW25	SW26	12.153	9.679	9.629	0.050	243.1	300	39.9
1.017	SW26	SW27	38.822	9.629	8.228	1.401	27.7	300	39.5
1.018	SW27	EXSW MH	2.452	8.228	8.216	0.012	204.3	300	39.4
5.000	SW28	SW29	20.010	12.075	11.982	0.093	215.0	225	50.0
5.001	SW29	SW31	11.994	11.982	11.840	0.142	84.5	225	50.0
6.000	SW30	SW31	15.857	11.901	11.840	0.061	260.0	225	50.0
5.002	SW31	BASIN IN1	10.425	11.840	11.800	0.040	260.6	225	50.0
7.000	SW32	SW33	10.055	11.964	11.914	0.050	200.0	225	50.0
7.001	SW33	SW34	12.368	11.914	11.852	0.062	199.5	225	50.0
7.002	SW34	BASIN IN2	10.358	11.852	11.800	0.052	200.0	225	50.0

Name	Vel (m/s)	Flow (l/s)	US Depth (m)	DS Depth (m)
1.015	1.005	18.5	2.159	1.491
1.016	1.004	18.3	1.491	1.096
1.017	2.998	18.1	1.096	0.972
1.018	1.096	18.0	0.972	0.984
5.000	0.888	1.4	0.800	0.893
5.001	1.423	2.7	0.893	1.035
6.000	0.806	1.4	0.674	1.035
5.002	0.805	5.4	1.035	1.075
7.000	0.921	1.4	0.811	0.961
7.001	0.922	2.7	0.961	1.023
7.002	0.921	4.1	1.023	1.075

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	23.722	169.4	225	12.100	10.875	1.000	12.700	10.735	1.740
1.001	16.866	168.7	225	12.700	10.735	1.740	12.300	10.635	1.440
1.002	6.024	167.3	225	12.300	10.635	1.440	12.300	10.599	1.476
1.003	2.958	164.3	225	12.300	10.599	1.476	12.300	10.581	1.494
1.004	17.476	169.7	225	12.300	10.581	1.494	12.300	10.478	1.597
1.005	5.285	165.2	225	12.300	10.478	1.597	12.300	10.446	1.629
1.006	2.501	166.7	225	12.300	10.446	1.629	12.300	10.431	1.644
1.007	8.519	167.0	225	12.300	10.431	1.644	12.100	10.380	1.495
1.008	6.041	241.6	300	12.100	10.380	1.420	12.100	10.355	1.445

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW01	1200	Manhole	Adoptable	SW02	1200	Manhole	Adoptable
1.001	SW02	1200	Manhole	Adoptable	SW03	1200	Manhole	Adoptable
1.002	SW03	1200	Manhole	Adoptable	SW04	1200	Manhole	Adoptable
1.003	SW04	1200	Manhole	Adoptable	SW05	1200	Manhole	Adoptable
1.004	SW05	1200	Manhole	Adoptable	SW06	1200	Manhole	Adoptable
1.005	SW06	1200	Manhole	Adoptable	SW07	1200	Manhole	Adoptable
1.006	SW07	1200	Manhole	Adoptable	SW08	1200	Manhole	Adoptable
1.007	SW08	1200	Manhole	Adoptable	SW09	1200	Manhole	Adoptable
1.008	SW09	1200	Manhole	Adoptable	SW10-HB	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)
1.009	12.530	241.0	300	12.100	10.355	1.445	12.100	10.303	1.497
1.010	16.527	243.0	300	12.100	10.303	1.497	12.100	10.235	1.565
1.011	13.309	242.0	300	12.100	10.235	1.565	11.740	10.180	1.260
1.012	16.220	242.1	300	11.740	10.180	1.260	12.100	10.113	1.687
2.000	14.023	46.7	225	12.650	11.425	1.000	12.350	11.125	1.000
2.001	14.309	168.3	225	12.350	11.125	1.000	12.300	11.040	1.035
2.002	4.781	164.9	225	12.300	11.040	1.035	12.300	11.011	1.064
2.003	5.018	36.9	225	12.300	11.011	1.064	12.100	10.875	1.000
1.013	39.036	244.0	300	12.100	10.113	1.687	12.400	9.953	2.147
3.000	7.477	166.1	225	13.100	11.800	1.075	13.100	11.755	1.120
3.001	8.032	167.3	225	13.100	11.755	1.120	13.100	11.707	1.168
3.002	35.121	169.7	225	13.100	11.707	1.168	13.100	11.500	1.375
3.003	25.016	77.0	225	13.100	11.500	1.375	12.400	11.175	1.000
1.014	49.282	244.0	300	12.400	9.953	2.147	12.210	9.751	2.159
4.000	9.270	32.0	225	12.500	11.275	1.000	12.210	10.985	1.000
1.015	17.457	242.5	300	12.210	9.751	2.159	11.470	9.679	1.491
1.016	12.153	243.1	300	11.470	9.679	1.491	11.025	9.629	1.096
1.017	38.822	27.7	300	11.025	9.629	1.096	9.500	8.228	0.972
1.018	2.452	204.3	300	9.500	8.228	0.972	9.500	8.216	0.984
5.000	20.010	215.0	225	13.100	12.075	0.800	13.100	11.982	0.893
5.001	11.994	84.5	225	13.100	11.982	0.893	13.100	11.840	1.035
6.000	15.857	260.0	225	12.800	11.901	0.674	13.100	11.840	1.035
5.002	10.425	260.6	225	13.100	11.840	1.035	13.100	11.800	1.075
7.000	10.055	200.0	225	13.000	11.964	0.811	13.100	11.914	0.961
7.001	12.368	199.5	225	13.100	11.914	0.961	13.100	11.852	1.023

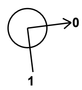
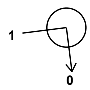
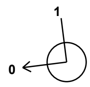
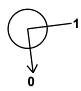
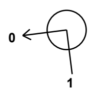
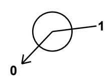
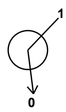
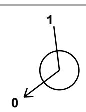
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.009	SW10-HB	1200	Manhole	Adoptable	SW11	1200	Manhole	Adoptable
1.010	SW11	1200	Manhole	Adoptable	SW12	1200	Manhole	Adoptable
1.011	SW12	1200	Manhole	Adoptable	SW13	1200	Manhole	Adoptable
1.012	SW13	1200	Manhole	Adoptable	SW18	1200	Manhole	Adoptable
2.000	SW14	1200	Manhole	Adoptable	SW15	1200	Manhole	Adoptable
2.001	SW15	1200	Manhole	Adoptable	SW16	1200	Manhole	Adoptable
2.002	SW16	1200	Manhole	Adoptable	SW17-HB	1200	Manhole	Adoptable
2.003	SW17-HB	1200	Manhole	Adoptable	SW18	1200	Manhole	Adoptable
1.013	SW18	1200	Manhole	Adoptable	SW22	1200	Manhole	Adoptable
3.000	BASIN OUT	1200	Manhole	Adoptable	SW19-HB	1200	Manhole	Adoptable
3.001	SW19-HB	1200	Manhole	Adoptable	SW20	1200	Manhole	Adoptable
3.002	SW20	1200	Manhole	Adoptable	SW21	1200	Manhole	Adoptable
3.003	SW21	1200	Manhole	Adoptable	SW22	1200	Manhole	Adoptable
1.014	SW22	1200	Manhole	Adoptable	SW24	1200	Manhole	Adoptable
4.000	SW23	1200	Manhole	Adoptable	SW24	1200	Manhole	Adoptable
1.015	SW24	1200	Manhole	Adoptable	SW25	1200	Manhole	Adoptable
1.016	SW25	1200	Manhole	Adoptable	SW26	1200	Manhole	Adoptable
1.017	SW26	1200	Manhole	Adoptable	SW27	1200	Manhole	Adoptable
1.018	SW27	1200	Manhole	Adoptable	EXSW MH	1200	Manhole	Adoptable
5.000	SW28	1200	Manhole	Adoptable	SW29	1200	Manhole	Adoptable
5.001	SW29	1200	Manhole	Adoptable	SW31	1200	Manhole	Adoptable
6.000	SW30	1200	Manhole	Adoptable	SW31	1200	Manhole	Adoptable
5.002	SW31	1200	Manhole	Adoptable	BASIN IN1	1200	Manhole	Adoptable
7.000	SW32	1200	Manhole	Adoptable	SW33	1200	Manhole	Adoptable
7.001	SW33	1200	Manhole	Adoptable	SW34	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)
7.002	10.358	200.0	225	13.100	11.852	1.023	13.100	11.800	1.075

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
7.002	SW34	1200	Manhole	Adoptable	BASIN IN2	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SW01	714493.369	734800.526	12.100	1.225	1200		0	1.000	10.875	225
SW02	714490.413	734824.063	12.700	1.965	1200		1	1.000	10.735	225
							0	1.001	10.735	225
SW03	714507.147	734826.167	12.300	1.665	1200		1	1.001	10.635	225
							0	1.002	10.635	225
SW04	714507.898	734820.190	12.300	1.701	1200		1	1.002	10.599	225
							0	1.003	10.599	225
SW05	714504.963	734819.821	12.300	1.719	1200		1	1.003	10.581	225
							0	1.004	10.581	225
SW06	714507.143	734802.482	12.300	1.822	1200		1	1.004	10.478	225
							0	1.005	10.478	225
SW07	714506.484	734807.726	12.300	1.854	1200		1	1.005	10.446	225
							0	1.006	10.446	225
SW08	714504.003	734807.414	12.300	1.869	1200		1	1.006	10.431	225
							0	1.007	10.431	225
SW09	714498.156	734801.219	12.100	1.720	1200		1	1.007	10.380	225
							0	1.008	10.380	300
SW10-HB	714498.914	734795.226	12.100	1.745	1200		1	1.008	10.355	300
							0	1.009	10.355	300

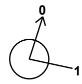
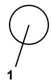
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW11	714488.926	734787.661	12.100	1.797	1200	1	1.009	10.303	300
						0	1.010	10.303	300
SW12	714472.528	734785.599	12.100	1.865	1200	1	1.010	10.235	300
						0	1.011	10.235	300
SW13	714461.177	734792.547	11.740	1.560	1200	1	1.011	10.180	300
						0	1.012	10.180	300
SW14	714423.943	734811.244	12.650	1.225	1200	0	2.000	11.425	225
SW15	714437.945	734810.472	12.350	1.225	1200	1	2.000	11.125	225
						0	2.001	11.125	225
SW16	714452.132	734812.334	12.300	1.260	1200	1	2.001	11.040	225
						0	2.002	11.040	225
SW17-HB	714454.120	734807.986	12.300	1.289	1200	1	2.002	11.011	225
						0	2.003	11.011	225
SW18	714459.096	734808.633	12.100	1.987	1200	1	2.003	10.875	225
						2	1.012	10.113	300
						0	1.013	10.113	300
BASIN OUT	714409.562	734858.799	13.100	1.300	1200	0	3.000	11.800	225
SW19-HB	714416.979	734859.742	13.100	1.345	1200	1	3.000	11.755	225
						0	3.001	11.755	225
SW20	714415.977	734867.711	13.100	1.393	1200	1	3.001	11.707	225
						0	3.002	11.707	225
SW21	714450.817	734872.147	13.100	1.600	1200	1	3.002	11.500	225
						0	3.003	11.500	225
SW22	714454.057	734847.342	12.400	2.447	1200	1	3.003	11.175	225
						2	1.013	9.953	300
						0	1.014	9.953	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW23	714501.784	734862.729	12.500	1.225	1200	0	4.000	11.275	225
SW24	714502.949	734853.533	12.210	2.459	1200	1	4.000	10.985	225
						2	1.014	9.751	300
						0	1.015	9.751	300
SW25	714520.268	734855.726	11.470	1.791	1200	1	1.015	9.679	300
						0	1.016	9.679	300
SW26	714526.499	734845.292	11.025	1.396	1200	1	1.016	9.629	300
						0	1.017	9.629	300
SW27	714530.937	734806.725	9.500	1.272	1200	1	1.017	8.228	300
						0	1.018	8.228	300
EXSW MH	714533.373	734807.005	9.500	1.284	1200	1	1.018	8.216	300
SW28	714440.018	734869.762	13.100	1.025	1200	0	5.000	12.075	225
SW29	714420.166	734867.250	13.100	1.118	1200	1	5.000	11.982	225
						0	5.001	11.982	225
SW30	714423.641	734839.617	12.800	0.899	1200	0	6.000	11.901	225
SW31	714421.663	734855.350	13.100	1.260	1200	1	6.000	11.840	225
						2	5.001	11.840	225
						0	5.002	11.840	225
BASIN IN1	714411.319	734854.050	13.100	1.300	1200	1	5.002	11.800	225
SW32	714421.419	734836.155	13.000	1.036	1200	0	7.000	11.964	225
SW33	714413.607	734842.486	13.100	1.186	1200	1	7.000	11.914	225
						0	7.001	11.914	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SW34	714401.511	734845.065	13.100	1.248	1200		1	7.001	11.852	225
							0	7.002	11.852	225
BASIN IN2	714404.684	734854.925	13.100	1.300	1200		1	7.002	11.800	225

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)	16.300	Additional Storage (m³/ha)	20.0
Ratio-R	0.280	Starting Level (m)	
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	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 SW19-HB Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	11.755	Product Number	CTL-SHE-0041-8000-1000-8000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.8	Min Node Diameter (mm)	1200

Node SW10-HB Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	10.355	Product Number	CTL-SHE-0049-1200-1200-1200
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.2	Min Node Diameter (mm)	1200

Node SW17-HB Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	11.011	Product Number	CTL-SHE-0044-9000-1000-9000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.9	Min Node Diameter (mm)	1200

Node BASIN OUT Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	10.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	11.800	Main Channel Slope (1:X)	999999.0
Safety Factor	2.0	Time to half empty (mins)	0	Main Channel n	0.025

Inlets

BASIN IN2 | BASIN IN1

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	53.5	0.0	0.800	208.0	0.0	0.801	0.0	0.0

Node SW09 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	10.380
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	128.0	0.0	0.760	128.0	0.0	0.761	0.0	0.0

Node SW16 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	11.040
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	79.0	0.0	0.760	79.0	0.0	0.761	0.0	0.0

Results for 2 year +20% CC Critical Storm Duration. Lowest mass balance: 98.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	10	10.906	0.031	1.7	0.0406	0.0000	OK
15 minute winter	SW02	10	10.779	0.044	3.4	0.0537	0.0000	OK
15 minute winter	SW03	10	10.693	0.058	5.0	0.0725	0.0000	OK
15 minute winter	SW04	10	10.670	0.071	6.6	0.0884	0.0000	OK
15 minute winter	SW05	10	10.649	0.068	8.2	0.0851	0.0000	OK
15 minute winter	SW06	10	10.642	0.164	9.8	0.2035	0.0000	OK
15 minute winter	SW07	10	10.637	0.191	14.1	0.2367	0.0000	OK
15 minute winter	SW08	10	10.633	0.202	16.0	0.2282	0.0000	OK
360 minute winter	SW09	248	10.453	0.073	2.1	9.4696	0.0000	OK
360 minute winter	SW10-HB	248	10.453	0.098	0.9	0.1111	0.0000	OK
360 minute winter	SW11	248	10.326	0.023	0.9	0.0263	0.0000	OK
360 minute winter	SW12	248	10.258	0.023	0.9	0.0264	0.0000	OK
360 minute winter	SW13	248	10.203	0.023	0.8	0.0260	0.0000	OK
15 minute winter	SW14	10	11.466	0.041	5.7	0.0693	0.0000	OK
360 minute winter	SW15	280	11.218	0.093	2.0	0.1546	0.0000	OK
360 minute winter	SW16	280	11.218	0.178	3.0	14.3220	0.0000	OK
360 minute winter	SW17-HB	280	11.218	0.207	0.8	0.2336	0.0000	OK
360 minute winter	SW18	256	10.144	0.031	1.6	0.0348	0.0000	OK
360 minute winter	BASIN OUT	336	11.929	0.129	1.9	0.1460	0.0000	OK
360 minute winter	SW19-HB	336	11.929	0.174	0.8	0.1968	0.0000	OK
15 minute winter	SW20	14	11.728	0.021	0.6	0.0232	0.0000	OK
360 minute winter	SW21	264	11.516	0.016	0.6	0.0185	0.0000	OK
360 minute winter	SW22	256	9.989	0.036	2.2	0.0409	0.0000	OK
15 minute summer	SW23	1	11.275	0.000	0.0	0.0000	0.0000	OK
360 minute winter	SW24	256	9.787	0.036	2.2	0.0411	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 winter	SW01	1.000	SW02	1.7	0.390	0.042	0.1035	
15 minute winter	SW02	1.001	SW03	3.3	0.495	0.083	0.1134	
15 minute winter	SW03	1.002	SW04	4.9	0.525	0.122	0.0565	
15 minute winter	SW04	1.003	SW05	6.5	0.626	0.161	0.0308	
15 minute winter	SW05	1.004	SW06	8.1	0.599	0.203	0.3596	
15 minute winter	SW06	1.005	SW07	12.6	0.592	0.313	0.1769	
15 minute winter	SW07	1.006	SW08	16.0	0.675	0.398	0.0919	
15 minute winter	SW08	1.007	SW09	18.4	1.503	0.459	0.1614	
360 minute winter	SW09	1.008	SW10-HB	0.9	0.136	0.012	0.1008	
360 minute winter	SW10-HB	Hydro-Brake®	SW11	0.9				
360 minute winter	SW11	1.010	SW12	0.9	0.340	0.012	0.0414	
360 minute winter	SW12	1.011	SW13	0.8	0.342	0.012	0.0330	
360 minute winter	SW13	1.012	SW18	0.8	0.276	0.012	0.0505	
15 minute winter	SW14	2.000	SW15	5.7	0.607	0.075	0.1353	
360 minute winter	SW15	2.001	SW16	2.0	0.510	0.050	0.3506	
360 minute winter	SW16	2.002	SW17-HB	0.8	0.172	0.019	0.1717	
360 minute winter	SW17-HB	Hydro-Brake®	SW18	0.7				
360 minute winter	SW18	1.013	SW22	1.6	0.369	0.022	0.1673	
360 minute winter	BASIN OUT	3.000	SW19-HB	0.8	0.161	0.019	0.2112	
360 minute winter	SW19-HB	Hydro-Brake®	SW20	0.6				
15 minute winter	SW20	3.002	SW21	0.6	0.484	0.015	0.0519	
360 minute winter	SW21	3.003	SW22	0.6	0.486	0.010	0.0319	
360 minute winter	SW22	1.014	SW24	2.2	0.456	0.031	0.2374	
15 minute summer	SW23	4.000	SW24	0.0	0.000	0.000	0.0000	
360 minute winter	SW24	1.015	SW25	2.2	0.442	0.031	0.0867	

Results for 2 year +20% CC Critical Storm Duration. Lowest mass balance: 98.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	SW25	256	9.717	0.038	2.2	0.0426	0.0000	OK
360 minute winter	SW26	256	9.651	0.022	2.2	0.0244	0.0000	OK
360 minute winter	SW27	256	8.265	0.037	2.2	0.0421	0.0000	OK
360 minute winter	EXSW MH	256	8.250	0.034	2.2	0.0000	0.0000	OK
15 minute winter	SW28	10	12.108	0.033	1.7	0.0441	0.0000	OK
15 minute winter	SW29	10	12.019	0.037	3.4	0.0485	0.0000	OK
15 minute winter	SW30	10	11.936	0.035	1.7	0.0472	0.0000	OK
360 minute winter	SW31	336	11.929	0.089	1.2	0.1148	0.0000	OK
360 minute winter	BASIN IN1	336	11.931	0.131	1.2	0.1480	0.0000	OK
15 minute winter	SW32	10	11.997	0.033	1.7	0.0435	0.0000	OK
15 minute winter	SW33	10	11.960	0.046	3.4	0.0595	0.0000	OK
360 minute winter	SW34	336	11.930	0.078	0.9	0.1011	0.0000	OK
360 minute winter	BASIN IN2	336	11.930	0.130	1.1	0.1475	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)
360 minute winter	SW25	1.016	SW26	2.2	0.613	0.031	0.0446	
360 minute winter	SW26	1.017	SW27	2.2	0.621	0.010	0.1405	
360 minute winter	SW27	1.018	EXSW MH	2.2	0.465	0.028	0.0116	59.8
15 minute winter	SW28	5.000	SW29	1.7	0.428	0.048	0.0790	
15 minute winter	SW29	5.001	SW31	3.4	0.448	0.059	0.0926	
15 minute winter	SW30	6.000	SW31	1.7	0.235	0.053	0.1196	
360 minute winter	SW31	5.002	BASIN IN1	1.2	0.338	0.037	0.1994	
360 minute winter	BASIN IN1	Flow through pond	BASIN OUT	1.9	0.020	0.012	8.5874	
15 minute winter	SW32	7.000	SW33	1.7	0.366	0.046	0.0470	
15 minute winter	SW33	7.001	SW34	3.4	0.483	0.092	0.0867	
360 minute winter	SW34	7.002	BASIN IN2	0.9	0.339	0.025	0.1867	
360 minute winter	BASIN IN2	Flow through pond	BASIN OUT	1.9	0.020	0.012	8.5874	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 98.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	10	10.918	0.043	3.2	0.0553	0.0000	OK
15 minute winter	SW02	10	10.795	0.060	6.4	0.0740	0.0000	OK
15 minute summer	SW03	10	10.729	0.094	9.5	0.1180	0.0000	OK
15 minute summer	SW04	10	10.720	0.121	12.0	0.1505	0.0000	OK
15 minute summer	SW05	10	10.706	0.125	15.5	0.1559	0.0000	OK
15 minute winter	SW06	9	10.688	0.210	20.8	0.2611	0.0000	OK
15 minute summer	SW07	9	10.682	0.236	25.0	0.2920	0.0000	SURCHARGED
15 minute summer	SW08	9	10.677	0.246	26.0	0.2779	0.0000	SURCHARGED
360 minute winter	SW09	272	10.520	0.140	3.5	18.0300	0.0000	OK
360 minute winter	SW10-HB	272	10.520	0.165	0.9	0.1862	0.0000	OK
360 minute winter	SW11	272	10.327	0.024	0.9	0.0273	0.0000	OK
360 minute winter	SW12	272	10.259	0.024	0.9	0.0275	0.0000	OK
360 minute winter	SW13	272	10.204	0.024	0.9	0.0270	0.0000	OK
15 minute summer	SW14	10	11.481	0.056	10.5	0.0938	0.0000	OK
480 minute winter	SW15	440	11.428	0.303	2.8	0.5067	0.0000	SURCHARGED
480 minute winter	SW16	440	11.428	0.388	4.0	31.3268	0.0000	SURCHARGED
480 minute winter	SW17-HB	440	11.428	0.417	0.8	0.4721	0.0000	SURCHARGED
480 minute summer	SW18	280	10.144	0.031	1.6	0.0352	0.0000	OK
360 minute winter	BASIN OUT	328	12.016	0.216	4.7	0.2448	0.0000	OK
360 minute winter	SW19-HB	352	12.016	0.261	0.8	0.2957	0.0000	SURCHARGED
15 minute winter	SW20	12	11.728	0.021	0.6	0.0236	0.0000	OK
30 minute winter	SW21	31	11.516	0.016	0.6	0.0185	0.0000	OK
60 minute winter	SW22	69	9.989	0.036	2.2	0.0412	0.0000	OK
15 minute summer	SW23	1	11.275	0.000	0.0	0.0000	0.0000	OK
60 minute winter	SW24	70	9.788	0.037	2.2	0.0415	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 winter	SW01	1.000	SW02	3.2	0.468	0.080	0.1627	
15 minute winter	SW02	1.001	SW03	6.3	0.553	0.158	0.1997	
15 minute summer	SW03	1.002	SW04	9.2	0.579	0.229	0.1127	
15 minute summer	SW04	1.003	SW05	12.4	0.715	0.307	0.0655	
15 minute summer	SW05	1.004	SW06	17.6	0.685	0.442	0.5226	
15 minute winter	SW06	1.005	SW07	23.0	0.709	0.570	0.2072	
15 minute summer	SW07	1.006	SW08	26.0	0.833	0.647	0.0995	
15 minute summer	SW08	1.007	SW09	27.8	1.775	0.692	0.1709	
360 minute winter	SW09	1.008	SW10-HB	0.9	0.136	0.013	0.2165	
360 minute winter	SW10-HB	Hydro-Brake®	SW11	0.9				
360 minute winter	SW11	1.010	SW12	0.9	0.349	0.013	0.0439	
360 minute winter	SW12	1.011	SW13	0.9	0.352	0.013	0.0351	
360 minute winter	SW13	1.012	SW18	0.9	0.296	0.013	0.0519	
15 minute summer	SW14	2.000	SW15	10.5	0.728	0.138	0.2055	
480 minute winter	SW15	2.001	SW16	2.6	0.551	0.066	0.5691	
480 minute winter	SW16	2.002	SW17-HB	0.8	0.178	0.019	0.1901	
480 minute winter	SW17-HB	Hydro-Brake®	SW18	0.7				
480 minute summer	SW18	1.013	SW22	1.6	0.373	0.023	0.1697	
360 minute winter	BASIN OUT	3.000	SW19-HB	0.8	0.161	0.021	0.2954	
360 minute winter	SW19-HB	Hydro-Brake®	SW20	0.6				
15 minute winter	SW20	3.002	SW21	0.6	0.487	0.016	0.0532	
30 minute winter	SW21	3.003	SW22	0.6	0.486	0.010	0.0319	
60 minute winter	SW22	1.014	SW24	2.2	0.458	0.032	0.2402	
15 minute summer	SW23	4.000	SW24	0.0	0.000	0.000	0.0000	
60 minute winter	SW24	1.015	SW25	2.2	0.444	0.031	0.0877	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 98.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	SW25	280	9.717	0.038	2.2	0.0429	0.0000	OK
480 minute summer	SW26	280	9.651	0.022	2.2	0.0246	0.0000	OK
480 minute summer	SW27	280	8.266	0.038	2.2	0.0424	0.0000	OK
480 minute summer	EXSW MH	280	8.251	0.035	2.2	0.0000	0.0000	OK
15 minute summer	SW28	10	12.121	0.046	3.2	0.0606	0.0000	OK
15 minute winter	SW29	10	12.033	0.051	6.4	0.0664	0.0000	OK
360 minute winter	SW30	304	12.020	0.119	0.5	0.1607	0.0000	OK
360 minute winter	SW31	336	12.019	0.179	2.0	0.2309	0.0000	OK
360 minute winter	BASIN IN1	320	12.022	0.222	1.8	0.2513	0.0000	OK
360 minute winter	SW32	344	12.020	0.056	0.5	0.0739	0.0000	OK
360 minute winter	SW33	344	12.020	0.106	1.0	0.1374	0.0000	OK
360 minute winter	SW34	272	12.020	0.168	1.5	0.2164	0.0000	OK
360 minute winter	BASIN IN2	352	12.023	0.223	1.4	0.2527	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)
480 minute summer	SW25	1.016	SW26	2.2	0.617	0.031	0.0451	
480 minute summer	SW26	1.017	SW27	2.2	0.624	0.011	0.1422	
480 minute summer	SW27	1.018	EXSW MH	2.2	0.467	0.029	0.0117	80.6
15 minute summer	SW28	5.000	SW29	3.2	0.515	0.091	0.1245	
15 minute winter	SW29	5.001	SW31	6.4	0.517	0.113	0.1526	
360 minute winter	SW30	6.000	SW31	0.8	0.160	0.024	0.4351	
360 minute winter	SW31	5.002	BASIN IN1	1.8	0.338	0.057	0.3827	
360 minute winter	BASIN IN1	Flow through pond	BASIN OUT	4.7	0.020	0.029	16.1766	
360 minute winter	SW32	7.000	SW33	0.5	0.253	0.014	0.1305	
360 minute winter	SW33	7.001	SW34	1.0	0.326	0.027	0.3095	
360 minute winter	SW34	7.002	BASIN IN2	1.4	0.339	0.038	0.3692	
360 minute winter	BASIN IN2	Flow through pond	BASIN OUT	4.7	0.020	0.029	16.1766	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 98.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW01	10	10.923	0.048	4.1	0.0626	0.0000	OK
15 minute winter	SW02	10	10.803	0.068	8.2	0.0841	0.0000	OK
15 minute summer	SW03	10	10.753	0.118	12.2	0.1482	0.0000	OK
15 minute summer	SW04	10	10.744	0.145	16.7	0.1812	0.0000	OK
15 minute winter	SW05	9	10.732	0.151	21.4	0.1888	0.0000	OK
15 minute summer	SW06	9	10.712	0.234	26.9	0.2900	0.0000	SURCHARGED
15 minute summer	SW07	9	10.697	0.251	32.0	0.3113	0.0000	SURCHARGED
15 minute winter	SW08	8	10.687	0.256	33.0	0.2896	0.0000	SURCHARGED
240 minute winter	SW09	224	10.574	0.194	6.3	24.9904	0.0000	OK
240 minute winter	SW10-HB	224	10.574	0.219	1.0	0.2471	0.0000	OK
600 minute winter	SW11	420	10.327	0.024	0.9	0.0275	0.0000	OK
600 minute winter	SW12	420	10.259	0.024	0.9	0.0276	0.0000	OK
240 minute winter	SW13	184	10.204	0.024	0.9	0.0272	0.0000	OK
480 minute winter	SW14	464	11.555	0.130	1.8	0.2168	0.0000	OK
480 minute winter	SW15	464	11.555	0.430	3.6	0.7178	0.0000	SURCHARGED
480 minute winter	SW16	464	11.555	0.515	5.2	41.5226	0.0000	SURCHARGED
480 minute winter	SW17-HB	464	11.555	0.544	0.8	0.6150	0.0000	SURCHARGED
480 minute winter	SW18	464	10.144	0.031	1.6	0.0353	0.0000	OK
600 minute winter	BASIN OUT	585	12.094	0.294	2.5	0.3323	0.0000	SURCHARGED
600 minute winter	SW19-HB	585	12.094	0.339	1.1	0.3833	0.0000	SURCHARGED
15 minute summer	SW20	12	11.728	0.021	0.6	0.0237	0.0000	OK
15 minute winter	SW21	18	11.516	0.016	0.6	0.0185	0.0000	OK
30 minute summer	SW22	40	9.989	0.036	2.2	0.0412	0.0000	OK
15 minute summer	SW23	1	11.275	0.000	0.0	0.0000	0.0000	OK
30 minute summer	SW24	41	9.788	0.037	2.2	0.0415	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 winter	SW01	1.000	SW02	4.1	0.502	0.103	0.1944	
15 minute winter	SW02	1.001	SW03	8.1	0.562	0.203	0.2553	
15 minute summer	SW03	1.002	SW04	12.6	0.588	0.315	0.1453	
15 minute summer	SW04	1.003	SW05	17.3	0.718	0.427	0.0807	
15 minute winter	SW05	1.004	SW06	22.3	0.746	0.561	0.5953	
15 minute summer	SW06	1.005	SW07	27.9	0.760	0.692	0.2102	
15 minute summer	SW07	1.006	SW08	32.7	0.934	0.814	0.0995	
15 minute winter	SW08	1.007	SW09	34.5	1.813	0.859	0.1751	
240 minute winter	SW09	1.008	SW10-HB	1.0	0.161	0.014	0.3112	
240 minute winter	SW10-HB	Hydro-Brake®	SW11	0.9				
600 minute winter	SW11	1.010	SW12	0.9	0.350	0.013	0.0443	
600 minute winter	SW12	1.011	SW13	0.9	0.353	0.013	0.0354	
240 minute winter	SW13	1.012	SW18	0.9	0.297	0.013	0.0524	
480 minute winter	SW14	2.000	SW15	1.8	0.414	0.024	0.4451	
480 minute winter	SW15	2.001	SW16	3.4	0.561	0.085	0.5691	
480 minute winter	SW16	2.002	SW17-HB	0.8	0.188	0.020	0.1901	
480 minute winter	SW17-HB	Hydro-Brake®	SW18	0.7				
480 minute winter	SW18	1.013	SW22	1.6	0.376	0.023	0.1694	
600 minute winter	BASIN OUT	3.000	SW19-HB	1.1	0.150	0.028	0.2974	
600 minute winter	SW19-HB	Hydro-Brake®	SW20	0.6				
15 minute summer	SW20	3.002	SW21	0.6	0.486	0.016	0.0533	
15 minute winter	SW21	3.003	SW22	0.6	0.486	0.010	0.0320	
30 minute summer	SW22	1.014	SW24	2.2	0.458	0.032	0.2403	
15 minute summer	SW23	4.000	SW24	0.0	0.000	0.000	0.0000	
30 minute summer	SW24	1.015	SW25	2.2	0.445	0.031	0.0877	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 98.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	SW25	42	9.717	0.038	2.2	0.0429	0.0000	OK
30 minute summer	SW26	42	9.651	0.022	2.2	0.0246	0.0000	OK
30 minute summer	SW27	43	8.266	0.038	2.2	0.0424	0.0000	OK
30 minute summer	EXSW MH	43	8.251	0.035	2.2	0.0000	0.0000	OK
15 minute summer	SW28	10	12.127	0.052	4.1	0.0690	0.0000	OK
600 minute winter	SW29	570	12.095	0.113	1.0	0.1486	0.0000	OK
600 minute winter	SW30	540	12.096	0.195	0.6	0.2639	0.0000	OK
600 minute winter	SW31	585	12.096	0.256	1.9	0.3308	0.0000	SURCHARGED
600 minute winter	BASIN IN1	540	12.099	0.299	2.1	0.3381	0.0000	OK
600 minute winter	SW32	585	12.101	0.137	0.7	0.1810	0.0000	OK
600 minute winter	SW33	585	12.101	0.187	1.0	0.2427	0.0000	OK
600 minute winter	SW34	585	12.102	0.250	2.2	0.3225	0.0000	SURCHARGED
720 minute winter	BASIN IN2	690	12.099	0.299	2.4	0.3380	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)
30 minute summer	SW25	1.016	SW26	2.2	0.617	0.031	0.0451	
30 minute summer	SW26	1.017	SW27	2.2	0.731	0.011	0.1422	
30 minute summer	SW27	1.018	EXSW MH	2.2	0.467	0.029	0.0117	31.9
15 minute summer	SW28	5.000	SW29	4.1	0.551	0.116	0.1492	
600 minute winter	SW29	5.001	SW31	1.3	0.250	0.022	0.3588	
600 minute winter	SW30	6.000	SW31	1.1	0.129	0.035	0.6052	
600 minute winter	SW31	5.002	BASIN IN1	2.1	0.336	0.066	0.4146	
600 minute winter	BASIN IN1	Flow through pond	BASIN OUT	2.5	0.007	0.015	24.0853	
600 minute winter	SW32	7.000	SW33	0.8	0.237	0.022	0.3041	
600 minute winter	SW33	7.001	SW34	2.0	0.298	0.054	0.4639	
600 minute winter	SW34	7.002	BASIN IN2	2.3	0.342	0.062	0.4119	
720 minute winter	BASIN IN2	Flow through pond	BASIN OUT	3.1	0.007	0.019	23.5640	

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	9.0	12.300	1200	1.425
FW02	9.0	12.300	1200	1.733
FW03	9.0	12.300	1200	1.787
FW04	9.0	12.300	1200	1.948
FW05	9.0	12.700	1200	2.739
FW06	9.0	12.700	1200	2.877
FW07	9.0	12.400	1200	2.613
FW08	9.0	12.100	1200	2.465
FW09		12.100	1200	2.555
EXCSMH 01		11.310	1200	1.887

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	18.492	10.875	10.567	0.308	60.0	225
1.001	FW02	FW03	3.227	10.567	10.513	0.054	60.0	225
1.002	FW03	FW04	9.656	10.513	10.352	0.161	60.0	225
1.003	FW04	FW05	23.481	10.352	9.961	0.391	60.0	225
1.004	FW05	FW06	8.300	9.961	9.823	0.138	60.0	225
1.005	FW06	FW07	5.394	9.823	9.787	0.036	150.0	225
1.006	FW07	FW08	22.827	9.787	9.635	0.152	150.0	225
1.007	FW08	FW09	13.497	9.635	9.545	0.090	150.0	225
1.008	FW09	EXCSMH 01	18.336	9.545	9.423	0.122	150.0	225

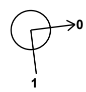
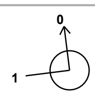
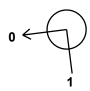
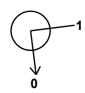
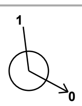
Name	Vel (m/s)	Flow (l/s)	US Depth (m)	DS Depth (m)
1.000	1.483	1.7	1.200	1.508
1.001	1.483	2.3	1.508	1.562
1.002	1.483	2.9	1.562	1.723
1.003	1.483	3.3	1.723	2.514
1.004	1.483	3.7	2.514	2.652
1.005	0.936	4.0	2.652	2.388
1.006	0.936	4.4	2.388	2.240
1.007	0.936	4.7	2.240	2.330
1.008	0.936	4.7	2.330	1.662

Pipeline Schedule

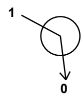
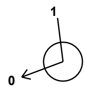
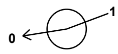
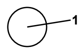
Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	18.492	60.0	225	12.300	10.875	1.200	12.300	10.567	1.508
1.001	3.227	60.0	225	12.300	10.567	1.508	12.300	10.513	1.562
1.002	9.656	60.0	225	12.300	10.513	1.562	12.300	10.352	1.723
1.003	23.481	60.0	225	12.300	10.352	1.723	12.700	9.961	2.514
1.004	8.300	60.0	225	12.700	9.961	2.514	12.700	9.823	2.652
1.005	5.394	150.0	225	12.700	9.823	2.652	12.400	9.787	2.388
1.006	22.827	150.0	225	12.400	9.787	2.388	12.100	9.635	2.240
1.007	13.497	150.0	225	12.100	9.635	2.240	12.100	9.545	2.330
1.008	18.336	150.0	225	12.100	9.545	2.330	11.310	9.423	1.662

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
1.004	FW05	1200	Manhole	Adoptable	FW06	1200	Manhole	Adoptable
1.005	FW06	1200	Manhole	Adoptable	FW07	1200	Manhole	Adoptable
1.006	FW07	1200	Manhole	Adoptable	FW08	1200	Manhole	Adoptable
1.007	FW08	1200	Manhole	Adoptable	FW09	1200	Manhole	Adoptable
1.008	FW09	1200	Manhole	Adoptable	EXCSMH 01	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
FW01	714508.344	734800.399	12.300	1.425	1200		0	1.000	10.875	225
FW02	714506.037	734818.747	12.300	1.733	1200		1	1.000	10.567	225
							0	1.001	10.567	225
FW03	714509.239	734819.149	12.300	1.787	1200		1	1.001	10.513	225
							0	1.002	10.513	225
FW04	714508.034	734828.730	12.300	1.948	1200		1	1.002	10.352	225
							0	1.003	10.352	225
FW05	714484.736	734825.801	12.700	2.739	1200		1	1.003	9.961	225
							0	1.004	9.961	225
FW06	714485.771	734817.566	12.700	2.877	1200		1	1.004	9.823	225
							0	1.005	9.823	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
FW07	714490.519	734815.007	12.400	2.613	1200		1	1.005	9.787	225
							0	1.006	9.787	225
FW08	714493.366	734792.358	12.100	2.465	1200		1	1.006	9.635	225
							0	1.007	9.635	225
FW09	714480.719	734787.643	12.100	2.555	1200		1	1.007	9.545	225
							0	1.008	9.545	225
EXCSMH 01	714462.607	734784.786	11.310	1.887	1200		1	1.008	9.423	225

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)
FW10	5.0	13.100	1200	1.725
FW11	5.0	13.150	1200	2.130
FW12	5.0	13.150	1200	2.207
FW13	5.0	13.000	1200	2.262
FW14	5.0	13.000	1200	2.369
FW15	5.0	12.500	1200	2.215
FW16	5.0	12.170	1200	2.125
FW17	5.0	13.100	1200	1.925
FW18	5.0	12.800	1200	1.425
FW19	5.0	12.800	1200	1.788
FW20	5.0	13.100	1200	2.540
FW21	5.0	13.100	1200	2.613
FW22	5.0	13.100	1200	3.048
FW23	5.0	12.400	1200	2.592
FW24	5.0	13.600	1200	2.025
FW25	5.0	12.500	1200	1.216
FW26	5.0	12.200	1200	2.751
FW27		11.870	1200	2.473
EXCS MH02		11.190	1200	1.892

Links

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	FW10	FW11	21.279	11.375	11.020	0.355	60.0	225
1.001	FW11	FW12	4.626	11.020	10.943	0.077	60.0	225
1.002	FW12	FW13	12.330	10.943	10.738	0.205	60.0	225
1.003	FW13	FW14	6.397	10.738	10.631	0.107	60.0	225
1.004	FW14	FW15	20.745	10.631	10.285	0.346	60.0	225
1.005	FW15	FW16	14.390	10.285	10.045	0.240	60.0	225
1.006	FW16	FW23	35.561	10.045	9.808	0.237	150.0	225
2.000	FW17	FW19	9.798	11.175	11.012	0.163	60.0	225

Name	Vel (m/s)	Flow (l/s)	US Depth (m)	DS Depth (m)
1.000	1.483	1.2	1.500	1.905
1.001	1.483	1.7	1.905	1.982
1.002	1.483	2.1	1.982	2.037
1.003	1.483	2.5	2.037	2.144
1.004	1.483	2.8	2.144	1.990
1.005	1.483	3.0	1.990	1.900
1.006	0.936	3.3	1.900	2.367
2.000	1.483	1.2	1.700	1.563

Links

Name	US Node	DS Node	Length (m)	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
3.000	FW18	FW19	5.724	11.375	11.280	0.095	60.0	225
2.001	FW19	FW20	27.127	11.012	10.560	0.452	60.0	225
2.002	FW20	FW21	4.355	10.560	10.487	0.073	60.0	225
2.003	FW21	FW22	26.100	10.487	10.052	0.435	60.0	225
2.004	FW22	FW23	20.499	10.052	9.808	0.244	84.0	225
1.007	FW23	FW26	53.870	9.808	9.449	0.359	150.0	225
4.000	FW24	FW25	17.477	11.575	11.284	0.291	60.0	225
4.001	FW25	FW26	5.027	11.284	11.200	0.084	59.8	225
1.008	FW26	FW27	7.871	9.449	9.397	0.052	150.0	225
1.009	FW27	EXCS MH02	14.801	9.397	9.298	0.099	150.0	225

Name	Vel (m/s)	Flow (l/s)	US Depth (m)	DS Depth (m)
3.000	1.483	1.2	1.200	1.295
2.001	1.483	2.1	1.563	2.315
2.002	1.483	2.5	2.315	2.388
2.003	1.483	2.8	2.388	2.823
2.004	1.253	3.0	2.823	2.367
1.007	0.936	4.6	2.367	2.526
4.000	1.483	1.2	1.800	0.991
4.001	1.486	1.7	0.991	0.775
1.008	0.936	5.1	2.526	2.248
1.009	0.936	5.1	2.248	1.667

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	21.279	60.0	225	13.100	11.375	1.500	13.150	11.020	1.905
1.001	4.626	60.0	225	13.150	11.020	1.905	13.150	10.943	1.982
1.002	12.330	60.0	225	13.150	10.943	1.982	13.000	10.738	2.037
1.003	6.397	60.0	225	13.000	10.738	2.037	13.000	10.631	2.144
1.004	20.745	60.0	225	13.000	10.631	2.144	12.500	10.285	1.990
1.005	14.390	60.0	225	12.500	10.285	1.990	12.170	10.045	1.900
1.006	35.561	150.0	225	12.170	10.045	1.900	12.400	9.808	2.367
2.000	9.798	60.0	225	13.100	11.175	1.700	12.800	11.012	1.563
3.000	5.724	60.0	225	12.800	11.375	1.200	12.800	11.280	1.295
2.001	27.127	60.0	225	12.800	11.012	1.563	13.100	10.560	2.315

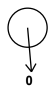
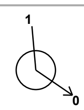
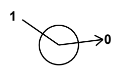
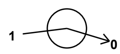
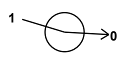
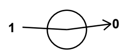
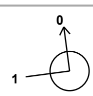
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	FW10	1200	Manhole	Adoptable	FW11	1200	Manhole	Adoptable
1.001	FW11	1200	Manhole	Adoptable	FW12	1200	Manhole	Adoptable
1.002	FW12	1200	Manhole	Adoptable	FW13	1200	Manhole	Adoptable
1.003	FW13	1200	Manhole	Adoptable	FW14	1200	Manhole	Adoptable
1.004	FW14	1200	Manhole	Adoptable	FW15	1200	Manhole	Adoptable
1.005	FW15	1200	Manhole	Adoptable	FW16	1200	Manhole	Adoptable
1.006	FW16	1200	Manhole	Adoptable	FW23	1200	Manhole	Adoptable
2.000	FW17	1200	Manhole	Adoptable	FW19	1200	Manhole	Adoptable
3.000	FW18	1200	Manhole	Adoptable	FW19	1200	Manhole	Adoptable
2.001	FW19	1200	Manhole	Adoptable	FW20	1200	Manhole	Adoptable

Pipeline Schedule

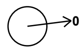
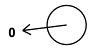
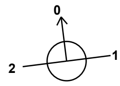
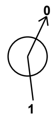
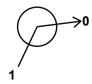
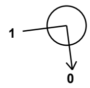
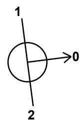
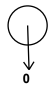
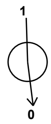
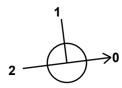
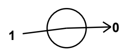
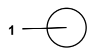
Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.002	4.355	60.0	225	13.100	10.560	2.315	13.100	10.487	2.388
2.003	26.100	60.0	225	13.100	10.487	2.388	13.100	10.052	2.823
2.004	20.499	84.0	225	13.100	10.052	2.823	12.400	9.808	2.367
1.007	53.870	150.0	225	12.400	9.808	2.367	12.200	9.449	2.526
4.000	17.477	60.0	225	13.600	11.575	1.800	12.500	11.284	0.991
4.001	5.027	59.8	225	12.500	11.284	0.991	12.200	11.200	0.775
1.008	7.871	150.0	225	12.200	9.449	2.526	11.870	9.397	2.248
1.009	14.801	150.0	225	11.870	9.397	2.248	11.190	9.298	1.667

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2.002	FW20	1200	Manhole	Adoptable	FW21	1200	Manhole	Adoptable
2.003	FW21	1200	Manhole	Adoptable	FW22	1200	Manhole	Adoptable
2.004	FW22	1200	Manhole	Adoptable	FW23	1200	Manhole	Adoptable
1.007	FW23	1200	Manhole	Adoptable	FW26	1200	Manhole	Adoptable
4.000	FW24	1200	Manhole	Adoptable	FW25	1200	Manhole	Adoptable
4.001	FW25	1200	Manhole	Adoptable	FW26	1200	Manhole	Adoptable
1.008	FW26	1200	Manhole	Adoptable	FW27	1200	Manhole	Adoptable
1.009	FW27	1200	Manhole	Adoptable	EXCS MH02	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
FW10	714398.017	734837.405	13.100	1.725	1200		0	1.000	11.375	225
FW11	714399.877	734816.207	13.150	2.130	1200		1	1.000	11.020	225
							0	1.001	11.020	225
FW12	714403.684	734813.579	13.150	2.207	1200		1	1.001	10.943	225
							0	1.002	10.943	225
FW13	714415.919	734815.105	13.000	2.262	1200		1	1.002	10.738	225
							0	1.003	10.738	225
FW14	714422.043	734813.255	13.000	2.369	1200		1	1.003	10.631	225
							0	1.004	10.631	225
FW15	714442.756	734812.112	12.500	2.215	1200		1	1.004	10.285	225
							0	1.005	10.285	225
FW16	714457.024	734813.984	12.170	2.125	1200		1	1.005	10.045	225
							0	1.006	10.045	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
FW17	714415.653	734834.221	13.100	1.925	1200		0	2.000	11.175	225
FW18	714431.054	734836.157	12.800	1.425	1200		0	3.000	11.375	225
FW19	714425.375	734835.443	12.800	1.788	1200		1	3.000	11.280	225
							2	2.000	11.012	225
							0	2.001	11.012	225
FW20	714421.991	734862.358	13.100	2.540	1200		1	2.001	10.560	225
							0	2.002	10.560	225
FW21	714423.854	734866.294	13.100	2.613	1200		1	2.002	10.487	225
							0	2.003	10.487	225
FW22	714449.748	734869.569	13.100	3.048	1200		1	2.003	10.052	225
							0	2.004	10.052	225
FW23	714452.395	734849.242	12.400	2.592	1200		1	2.004	9.808	225
							2	1.006	9.808	225
							0	1.007	9.808	225
FW24	714504.653	734878.475	13.600	2.025	1200		0	4.000	11.575	225
FW25	714505.210	734861.007	12.500	1.216	1200		1	4.000	11.284	225
							0	4.001	11.284	225
FW26	714505.837	734856.019	12.200	2.751	1200		1	4.001	11.200	225
							2	1.007	9.449	225
							0	1.008	9.449	225
FW27	714513.647	734857.001	11.870	2.473	1200		1	1.008	9.397	225
							0	1.009	9.397	225
EXCS MH02	714528.442	734857.418	11.190	1.892	1200		1	1.009	9.298	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	

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	

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	

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