MALONE O'REGAN
CONSULTING ENGINEERS

SOCIAL HOUSING BUNDLE 5
DEVELOPMENT AT BASIN VIEW FLATS,
DUBLIN 8

ENGINEERING REPORT

DUBLIN CITY COUNCIL

October 2024

Job: 23006

Contents Amendment Record

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Title: **Social Housing Bundle 5, Development at Basin View Flats, Dubin 8 / Engineering Report / Dublin City Council**

Job Number: **23006**

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Revision Record

Issue No.	Date	Description	Remark	Prepared	Checked	Approved
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2	02/10/2024	Planning	P3	MG	DW	DW

CONTENTS

1 INTRODUCTION

1.1 Introduction

The construction of 171 apartments at a site of c. 1.64 ha at Basin Street Flats, Basin View, Dublin 8. The site is bounded by Basin Grove and St. James Primary School to the south; Luas light rail line and St. James' Hospital Campus to the west, Basin Street Lower/Ewington Lane and Mary Aikenhead House Flats to the north and Basin View Street / Brandon Terrace to the east which will consist of the following:

- The demolition of four existing Basin Street Flats residential blocks; Building 1 (nos. 20-43), Building 2 (nos. 44-67), Building 3 (nos. 68-91) and Building 4 (nos. 92-115), ancillary structures, boundary walls and railings and site clearance works and renovation of one existing Basin Street Flats block (Building 5 nos. 116-151);
- Construction of 171 no. apartment units in three apartment blocks (Block A, Block B and Block C) comprising 171 residential units (83 no. 1-bed, 71 no. 2-bed, 13 no. 3-bed and 4 no. 4 beds);
  - Block A ranges from 4- 8 storeys with 48 units (17 no. 1-bed, 28 no. 2-bed, 3 no. 3-bed)
  - Block B ranges from 4 -8 storeys with 81 units (28 no. 1-bed, 39 no. 2-bed, 10 no. 3-bed, 4 no. 4 bed)
  - Block C is 5 storeys (renovation block) with extension to western gable with 42 units (38 no. 1-bed, 4 no. 2-bed)
- 382 bicycle parking spaces;
- 55 car parking spaces, which includes provision of 51 residential and 4 non-residential car parking spaces (2 creche and 2 community, arts and cultural car parking spaces);
- Provision of a childcare facility of 294 sq.m. at ground floor of Block A;
- Provision of 1114 sq.m. community, cultural and arts space comprising 516 sq.m. internal space at ground floor of Block B and 598 sq.m. external space, which includes a 468 sq.m. amphitheatre and 130 sq.m. space located externally at Block B;
- Relocation of public open space to a new central area of 3767 sq.m. (in place of Oisin Kelly Park) and 2748 sq.m. of communal open space;
- Two vehicular access/ egress points are proposed from Brandon Terrace/ Basin View Street and from Basin Street Lower/ Ewington Lane;
- Existing bollards and line marking fronting Wee Tots Creche Pre-School and Fountain Youth Project at building 2A Basin Lane along Basin View/ Brandon Terrace to be removed and replaced with paving, extension of kerb and flexible bollards;
- Boundary treatments, landscaping and public realm works, public lighting, site drainage works, new internal road layout, traffic calming raised table and pedestrian crossing points, footpaths, ESB substation and meter rooms, stores, bin and cycle storage, plant rooms; and
- All ancillary site services and development works above and below ground.

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.

Figure 1-1 – Proposed Site Layout

1.2 Site Description

The location of the proposed development is illustrated in Figure 1.1 below. The site is situated in the south-central area off James Street, Dublin city centre. The site is bounded by Basin Grove and St. James Primary School to the south; Luas light rail line and St. James' Hospital Campus to the west, Basin Street Lower/Ewington Lane and Mary Aikenhead House Flats to the north and Basin View Street / Brandon Terrace to the east. The proximity of the site to natural watercourses is outlined in Figure 1.2 below.

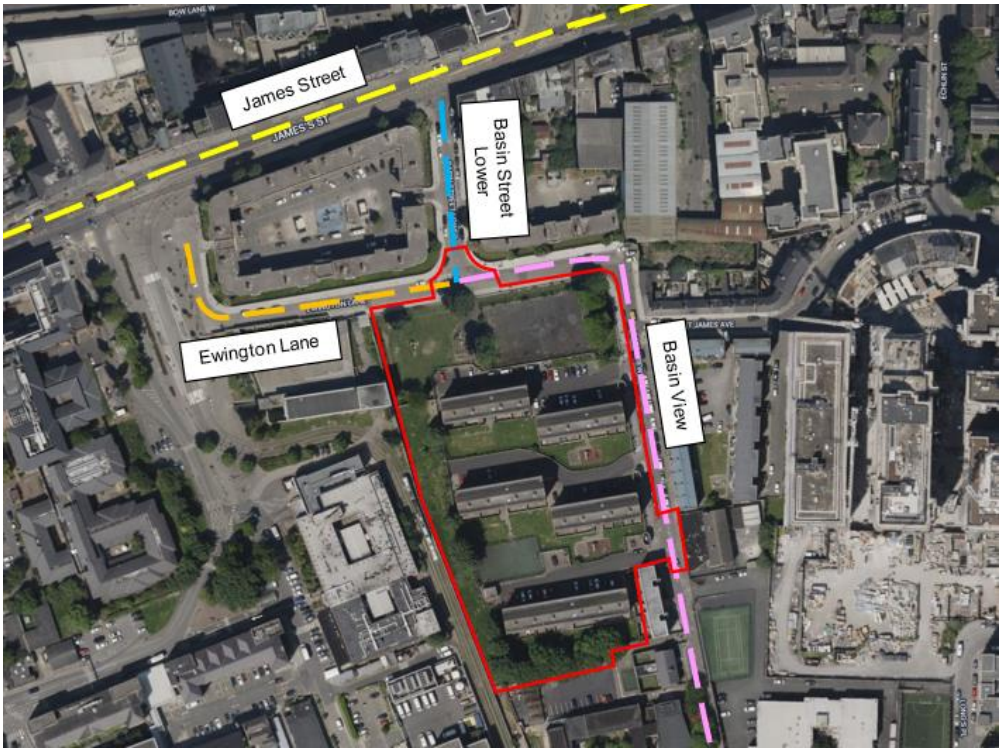


Figure 1-2 – Site location

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

2 SURFACE WATER DRAINAGE DESIGN

2.1 Introduction

This Chapter follows the guidelines set out in the 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, High-End Future Scenario)
M5-60	16.3mm (Met Eireann data)
M5-2D	58.7mm (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 two sides. These underground sewers carry surface water towards discharge in rivers in the Dublin central 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 1010X630mm brick combined sewer running parallel to the eastern boundary on Basin View and running down towards Ewington Lane before heading out to St. James Street.

2.3 Proposed Services

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

The proposed surface water drainage layout for the development is indicated on Malone O'Regan drawings SHB5-BVF-DR-MOR-CS-P3-130, 150 and 151. Surface water runoff from new internal road surfaces, footpaths, other areas of hardstanding and the roofs of buildings will be collected within a gravity drainage network and directed towards an attenuation storage system. The attenuation storage is sized to cater for a 1 in 100-year storm event. The outfall from the detention basins 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 Table 2-2. Calculations for the Surface Water Pipe Network are provided in Appendix C.

Table 2-2 -Runoff Coefficients

Type of Areas	CV
Landscaping (Grass / Soft)	0.2
Intensive Green Roof	0.6
Extensive Green Roof	0.6
Blue Roof	0.6
Permeable Paving	0.5
Impermeable Surface (Incl. tree pits)	0.9
Standard Roof (Impermeable)	0.95

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 Basin View Flats was taken from the Flood Studies Report as 943mm.

The Soil Type was taken from the Flood Studies Report as Soil Type 3 which has a corresponding Standard Percentage Runoff (SPR) coefficient of 0.37. Soil Type 3 is typically described as medium to fine-graded micaceous sandy silts, micaceous clayey silts, chert clays and shaly clays.

In January 2024, IGSL completed a comprehensive programme of site investigations for the site. The ground investigation findings demonstrate a variable sequence of soils mantling the site, thought to be Made Ground in the upper 1m to 3m. The findings in all the cable percussive boreholes suggest a stiff to very stiff over-consolidated clay underlies the cover of Made Ground. Groundwater strikes were largely absent in shallow excavations. The absence of water entry may be attributed to the permeability of the natural clay.

A Waste Acceptance Criteria (WAC) and Environmental Testing was completed on thirty soil samples from boreholes and trial pits. Asbestos (<0.001% to 0.095%) levels in the form of both Chrysotile and Amosite were found in samples from 0.30m to 2.0m depth. Given the abundance of rubble noted in the Made Ground cover on site, the potential to intercept similar "fibres/clumps" cannot be discounted.

2no. infiltration tests were performed to assess the suitability of the sub-soils for dispersion of storm water through a soakaway system. Both tests were carried out primarily in the Made Ground Clay soils within open excavations. Infiltration rates of $f = 6.492 \times 10^{-6}$ m/s and $f = 4.915 \times 10^{-6}$ m/s were calculated. The impermeable fine-grained nature of the soils may account for the low infiltration rates obtained.

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

For 50ha area $QBAR_{rural}$ $= 0.00108\ [0.5]^{0.89} \times [943]^{1.17} \times [0.3]^{2.17}$

$= 0.204\ m^3/s$

$= 204.0$ l/s (for 50ha)

$QBAR_{rural}$ = Area 1 is 0.694 l/s

= Area 2 is 1.345 l/s

= Area 3 is 4.024 l/s

For the purposes of surface water attenuation design, the site is dealt with as three catchments as shown in Figure 2-1 and is draining to an existing catchment/treatment system via existing public sewers.

- Catchment area 1 (highlighted in green) has an area of 1704.333m². It is serving block A and is being attenuated by a detention basin, permeable paving and green landscaped areas.
- Catchment area 2 (highlighted in blue) has an area of 3304.653m². It is serving block B and is being attenuated by a detention basin, permeable paving and green landscaped areas.
- Catchment area 3 (highlighted in purple) has an area of 9883.249m². It is serving block C and is being attenuated by swales, an attenuation tank, permeable paving and green landscaped areas.

A breakdown of the impermeable areas contributing to the surface water drainage network in each catchment with applied runoff coefficients is provided in Table 2-3 to

Table 2-8. Area 2 drains to a soakaway attenuation system while Area 1 drains to a detention basin.

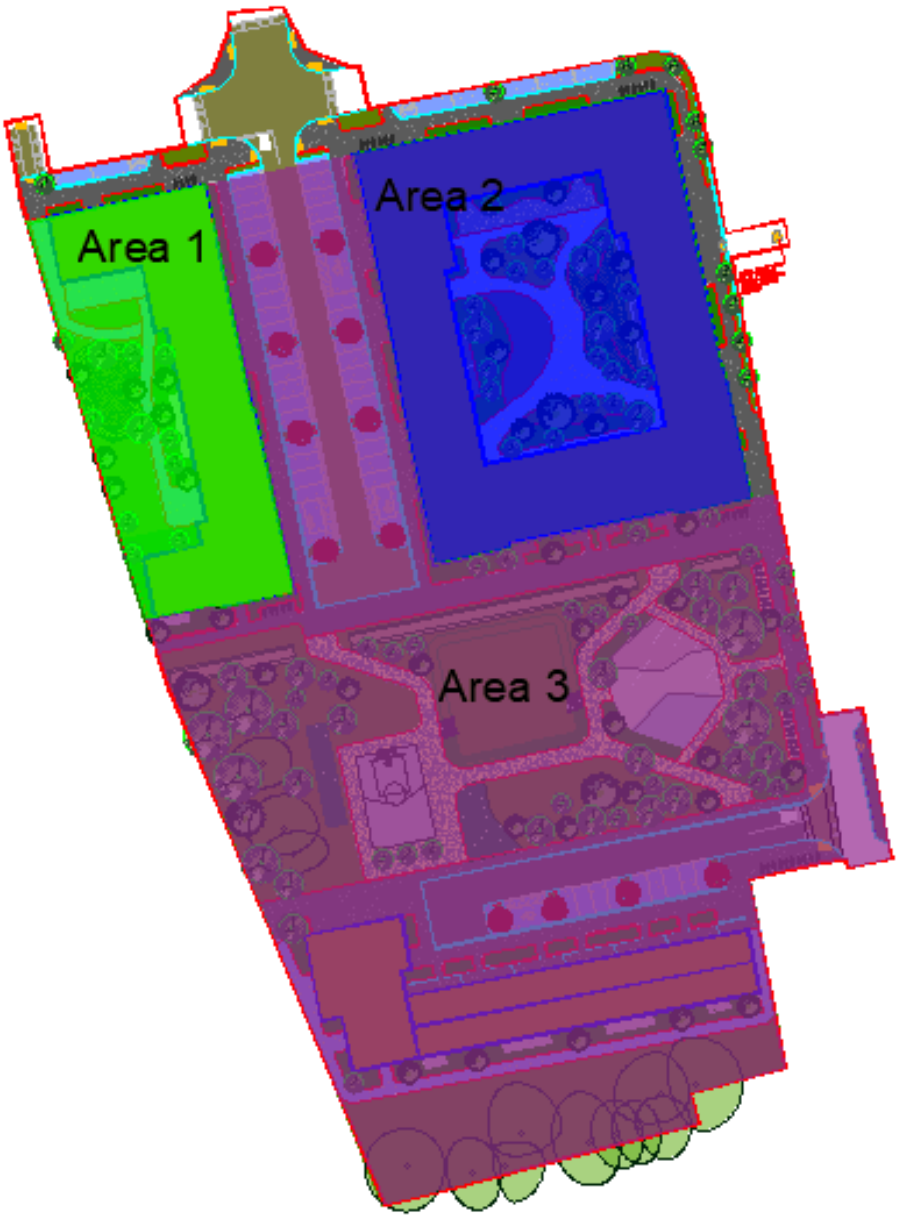


Figure 2-1 - Surface Water Drainage Catchment Areas

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

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
1,704.33	Roof	Standard - 15%	0.00	0.95	0.00	0.00	0.00	678.22
		Blue/ Green Roof - 85%	856.34	0.60	513.81	565.19	678.22	
	Permeable Paving inc. areas from hardstanding		0.00	0.50	0.00	0.00	0.00	
ha	Landscaped Areas inc. areas from hardstanding		0.00	0.20	0.00	0.00	0.00	ha
0.17								0.07
	Hardstanding (including strip of access road with area of 334m2)		0.00	0.90	0.00	0.00	0.00	

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	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
1,704.33	Roof	Standard - 15%	151.12	0.95	143.56	157.92	189.50	465.56
		Blue/ Green Roof - 85%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		232.54	0.50	116.27	127.90	153.48	
ha	Landscaped Areas inc. areas from hardstanding		464.33	0.20	92.87	102.15	122.58	ha
0.17								0.05
	Hardstanding (including strip of access road with area of 334m2)		0.00	0.90	0.00	0.00	0.00	

Table 2-5 - Breakdown of Impermeable Areas for Area 2 – Blue/ Green Roof

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
3,304.65	Roof	Standard - 10%	0.00	0.95	0.00	0.00	0.00	1528.28
		Blue/ Green Roof - 90%	1929.65	0.60	1157.79	1273.57	1528.28	
	Permeable Paving inc. areas from hardstanding		0.00	0.50	0.00	0.00	0.00	
ha	Landscaped Areas inc. areas from hardstanding		0.00	0.20	0.00	0.00	0.00	ha
0.33								0.15
	Hardstanding (including strip of access road with area of 334m2)		0.00	0.90	0.00	0.00	0.00	

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

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
3,304.65	Roof	Standard - 10%	214.41	0.95	203.69	224.05	268.86	829.96
		Blue/ Green Roof - 90%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		399.84	0.50	199.92	219.91	263.89	
ha	Landscaped Areas inc. areas from hardstanding		656.47	0.20	131.29	144.42	173.31	ha
0.33								0.08
	Hardstanding (including strip of access road with area of 334m2)		104.29	0.90	93.86	103.24	123.89	

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

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
9,883.25	Roof - Existing Roof - Pitch Roof		0.00	0.95	0.00	0.00	0.00	117.51
	Roof - New Build Extension	Standard - 50%	0.00	0.95	0.00	0.00	0.00	
		Blue/ Green Roof - 50%	148.37	0.60	89.02	97.92	117.51	
	Permeable Paving inc. areas from hardstanding		0.00	0.50	0.00	0.00	0.00	
ha	Landscaped Areas inc. areas from hardstanding		0.00	0.20	0.00	0.00	0.00	ha
0.99								0.00
	Hardstanding (including strip of access road with area of 334m2)		0.00	0.90	0.00	0.00	0.00	

Table 2-8 - Breakdown of Impermeable Areas for Area 3

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
9,883.25	Roof - Existing Roof - Pitch Roof		545.43	0.95	518.16	569.97	683.97	5016.80
	Roof - New Build Extension	Standard - 50%	148.37	0.95	140.95	155.05	186.06	
		Blue/ Green Roof - 50%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		3302.58	0.50	1651.29	1816.42	2179.70	
ha								ha
0.99	Landscaped Areas inc. areas from hardstanding		5249.20	0.20	1049.84	1154.82	1385.79	0.50
	Hardstanding (including strip of access road with area of 334m2)		489.30	0.90	440.37	484.41	581.29	

2.5 Sustainable Drainage Systems (SuDS)

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

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

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

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

2.5.1 Compliance with the principles of the CIRIA C753 SuDS Manual

The C753 SuDS Manual explains that the primary function of SuDS measures is to protect watercourses from any impact due to the new development. However, SuDS can also improve the quality of life in a new development and urban spaces by making them more vibrant, visually attractive, sustainable and more resilient to change. This document explains the wider social context of SuDS and how SuDS can deliver high quality drainage while supporting urban areas to cope better with sever rainfall both in present and future.

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

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

4. Biodiversity (create and sustain better places for nature)

Table 2-9 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 2-9 - 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*	Yes	Bioretention swales are proposed in areas beside roads and green spaces within the site.
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 in approx. 70% of the building roof structure. Refer to 'Green Roofs' above.
Green Living Walls *Planted walls which improve air quality and encourage biodiversity*	No	Green walls are not considered appropriate given the proposed residential building use.
Rain Gardens *Localised depressions in the ground that collect runoff from hard surfaces and allow infiltration and absorption*	Yes	The proposed residential development aims to provide rain gardens along planting strips.
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. Refer to M&E details.
Permeable paving *Allows runoff to percolate into the subsoil, reducing overall runoff volume*	Yes	Permeable paving is proposed within the development in homezones, driveways 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.
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 Bioretention Swales

It is proposed to provide a number of discrete, shallow landscaped areas, adjacent to the access roads in the site where feasible. Runoff from the roads will be directed towards these bioretention swales and will be able to run directly into them via short cut-out sections within the road kerbs. Refer to the details on drawing SHB5-BVF-DR-MOR-CS-P3-130, 150 and 151. These features 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. An overflow from the swales will be provided. This will take the form of a manhole with an open-grated access cover. During larger storm events, the water in the bioretention areas will be able to overflow through the grated access cover and will then drain towards the attenuation system.

The bioretention swales will be planted in order to promote settlement of silt particles. Runoff will also be treated through the adsorption of particles by vegetation or by soil, and by biological activity. Swales can reduce the runoff rates and volumes of surface water. They are very effective in delivering interception and treatment storage.

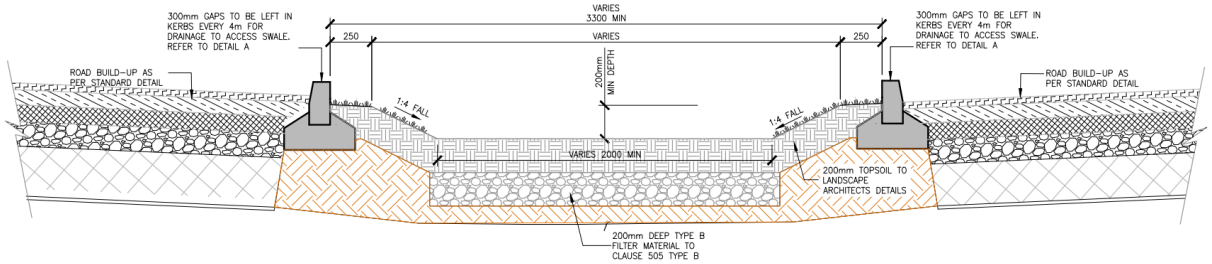


Figure 2-2 - Bio-Retention Area Detail

2.5.3 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 the details on drawings SHB5-BVF-DR-MOR-CS-P3-150 and 151. These 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.

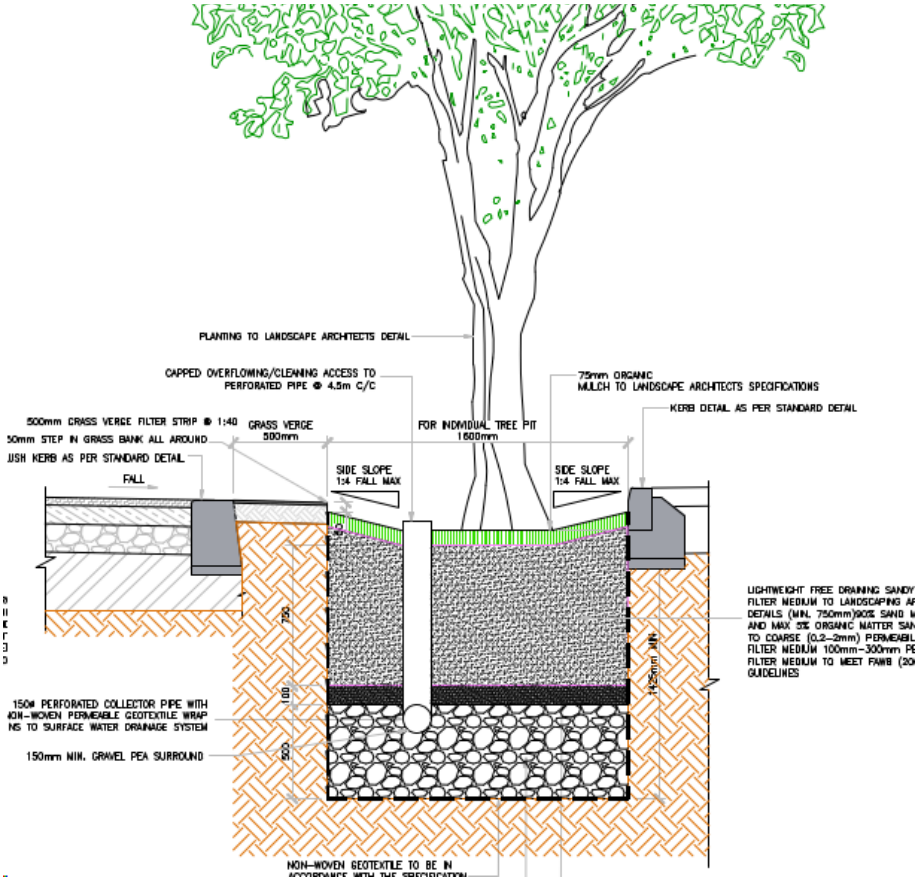


Figure 2-3 - Tree Pit

2.5.4 Intensive Green/ Blue Roofs

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 roof systems indicate that they will typically provide interception storage of 38 litres per square metre of roof covering.

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

The green roofs will be underlaid by a storage medium so that they also perform as blue roofs, capable of attenuating rainwater. The proposed green / blue roofs will provide initial storage of rainwater, while also reducing the rate at which rainwater from heavier rainfall events discharges to the attenuation systems. Flow restrictor outlets will be provided to control the rate of runoff from the roof. 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 located. Runoff from the green / blue roofs will connect to the surface water drainage pipework downstream of the main attenuation tank and associated Hydrobrake.

It is proposed to provide green / blue roofs over at least 72% of the total roof area in accordance with the Dublin City Council Green & Blue Roof Guidelines 2021. 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. 150 and 151, an extract from which is provided below.

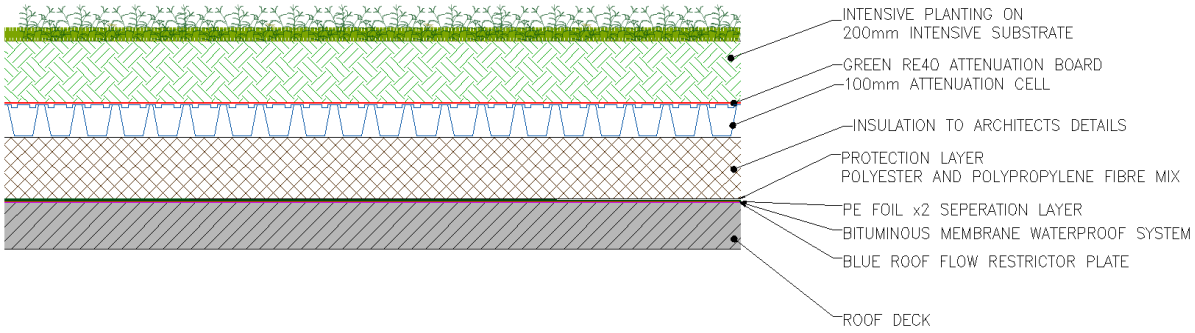


Figure 2-4 - Typical Intensive Green/ Blue Roof Landscaping

2.5.5 Rain Garden / Bioretention Area

It is proposed to provide a number of discrete, shallow landscaped areas in gardens of the housing units and landscape areas. Runoff from the roofs/hard surfaces will be directed towards these bioretention gardens. Refer to the details on drawing SHB5-BVF-DR-MOR-CS-P3-130, 150 and 151. These 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 rain gardens 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. Rain gardens can reduce the runoff rates and volumes of surface water. They are very effective in delivering interception and treatment storage.

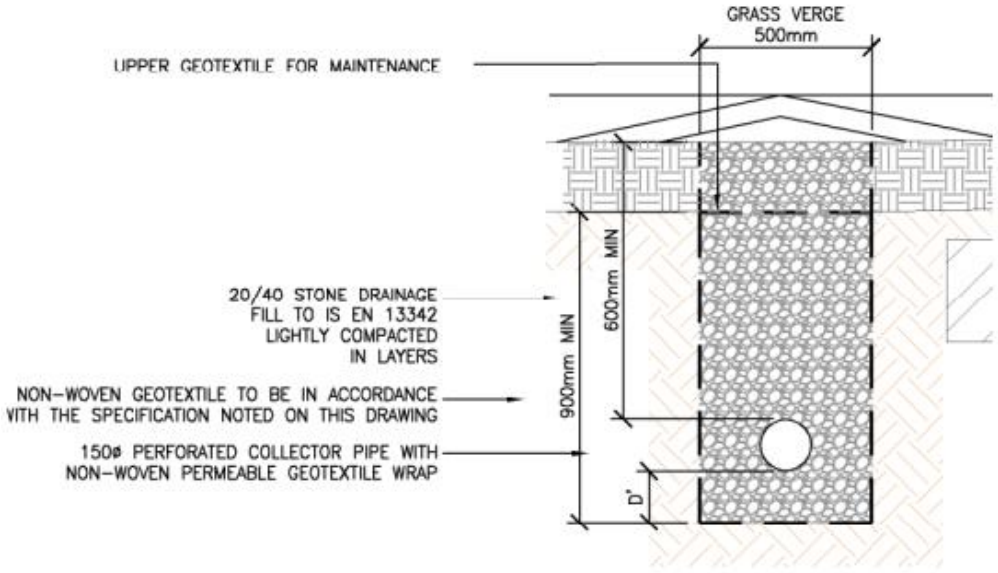


Figure 2-5 - Rain Garden

2.5.6 Permeable Paving

It is proposed to use permeable paving to surface the parking spaces and driveways 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 parking area is not flooded during severe rainfall events. The outlet from the permeable paving areas will be raised 100-150mm above formation level to provide interception storage within the stone sub-base; this gives 30mm interception storage @ 30% voids in the gravel.

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

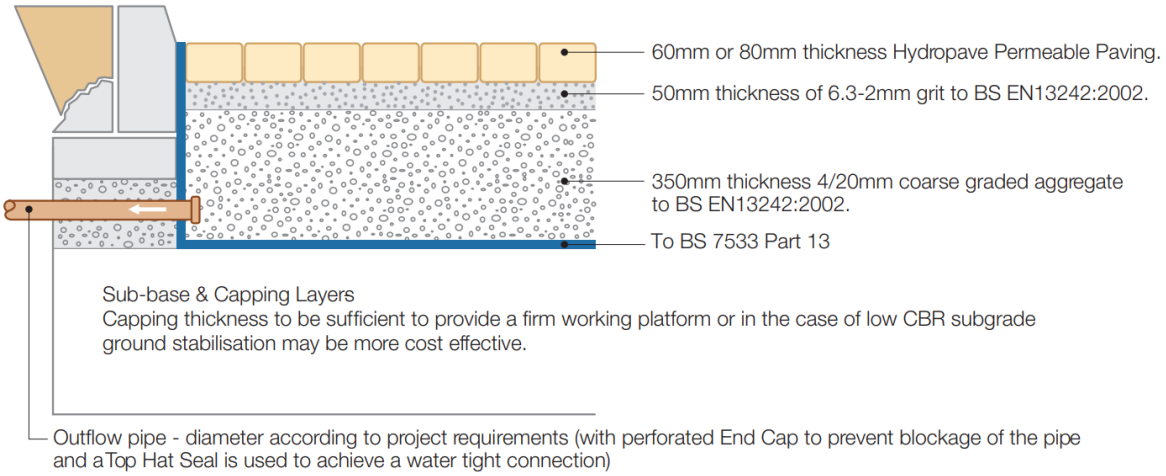


Figure 2-6 - Typical Section Through Permeable Paving in Parking Spaces

2.6 Attenuation Design

2.6.1 Dry Ponds

It is proposed to provide dry ponds (detention basins) located within the courtyard spaces of Block A and Block B. This system may also be referred to as a detention basin. Runoff from the roofs, footpaths and roads will be directed towards this basin via other SuDS drainage methods in the surface water drainage scheme. Refer to Malone O'Regan drawing no. 150 and 151. These features will provide a level of storage to attenuate the runoff flows and also permit settlement of coarse silts. As described in Section 2.4 above, the soakaway tests calculate a low infiltration rate due to the impermeable fine-grained nature of the soil. The dry ponds will operate as an attenuation facility.

The storage capacities have been sized with zero infiltration. However, the SuDS measures proposed i.e. permeable paving, bio-retention raingardens and swales has allowed for opportunities for runoff from minor rainfall events to percolate directly into the soil before reaching the dry ponds. The dry ponds have been sized to provide for a 1 in 100-year storm storage capacity. The basins will maintain a 500mm freeboard to the lowest FFL of any residence and a 300mm freeboard to the lowest road level.

The volume of surface water storage required has been calculated in accordance with the SuDS Manual Ciria C697. Calculations for the attenuation storage system is provided in Appendix B. The detention basins 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. Dry ponds can reduce the volumes of surface water through evapotranspiration and filtration. They are very effective in delivering interception treatment storage and attenuation.

For Block A, the size of attenuation calculated for a 1 in 100-year flood event is 14.091m3. The dry pond for Block A will store a maximum of 22m3 of surface water runoff. The outflow from the attenuation system will be limited by a Hydrobrake flow control devise which restricts the flow to 0.694l/s.

For Block B, the size of attenuation calculated for 1 in 100-year flood event is 24.338m3. The dry pond for Block B will store a maximum of 31m3 of surface water runoff. The outflow from the attenuation system will be limited by a Hydrobrake flow control devise which restricts the flow to 1.345l/s.

2.6.2 Attenuation Tank

Due to the ground levels and the calculated attenuation volume, surface water runoff from Area 3 will drain by gravity towards an attenuation tank under the road to the south of the site. This attenuation tank will collect runoff from the road, footpaths and carparking at the north of the site as well as runoffs from the roof of Block C, road, footpaths to the south of the site. During a 1 in 100-year flood event, the storage system will store a maximum of 207.600m3 surface water runoff. The outflow from the attenuation system will be limited by a Hydrobrake flow control devise which restricts the flow to 4.024l/s.

2.6.3 Groundwater

The Site Investigation report shows water strikes encountered in boreholes at of approximately 4m bgl. Refer to table below which shows water measurement in on-site exploratory holes.

Table 2-10 - Water measurements in on-site exploratory holes (Extract from Site Investigation report by IGSL 2024)

Exploratory Hole	Water Struck (m) bgl
BH04	4.0
BH07	4.60
BH10	4.0
BH12	3.80
BH13	2.90
TP10	1.90

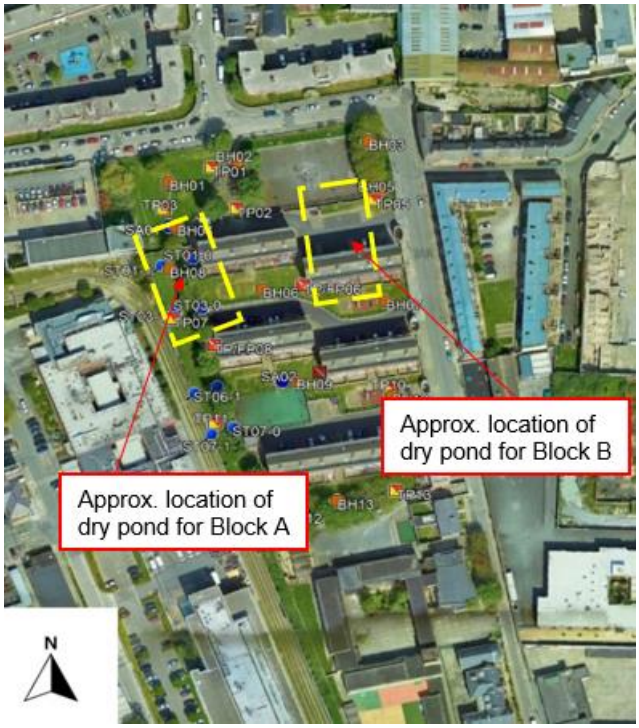


Figure 2-7 - Site Investigation Exploratory Hole Locations

The proposed dry pond for Block A extends 1.157m bgl and the dry pond for Block B extends 1.075m. The information received from the site investigation report shows that water strikes closer to the ponds are 4m bgl. The higher water strikes of BH12, BH13 and TP10 are no located near the dry ponds.

2.7 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 calculations for the required interception storage and provided interception storage is provided in Appendix B.

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 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 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 1-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 Causeway Flow software to confirm the above criteria is adequately met. The outputs are appended to this report.

2.8.3 Criterion 2 & 4 River Regime & Flood Protection

Regardless of the rainfall event, unchecked run-off from the developed site through traditional pipe networks will discharge into receiving waters at rates that are an order of magnitude greater than that prior to development. This can cause flash flow in the outfall river / stream that can cause scour, erosion & downstream flooding. Attenuation storage is provided to prevent this occurring by limiting the rate of run-off to that which took place from the pre-development greenfield site. In practice, the rate of run-off needs to be appropriately low for most rainfall events, and attenuation storage volumes should be provided for the 1 and 100-year storm event + 20% for climate change. The rate of outflow from such storage should be controlled so that it does not exceed the greenfield run-off rate of QBAR, which can be factored upwards by factors appropriate to the various return periods (given in the Flood Studies Report) if long term storage is provided. Notwithstanding that significant long-term storage will be provided in the form of interception storage, this does not equate to full long-term storage volume provision and so growth factors will not be applied to QBAR when calculating the attenuation storage volume required.

Qbar for the site has been calculated in accordance with the IH124 method as 10.74 l/s, based on the drained areas of the site. As the surface runoff flow rate discharged from the site does not exceed Qbar, there is a requirement for long-term storage to limit the impact on the receiving watercourse. Please refer to Permissible Runoff section of this report for the Qbar calculation.

Criterion 4 is intended to prevent flooding of the receiving system / watercourse by either:

- limiting the volume of run-off to the pre-development greenfield volume using 'long-term storage' (Option 1) or by
- limiting the rate of run-off for the 1 in 100-year storm to QBAR without applying growth factors using 'extended attenuation storage' (Option 2).

Significant long-term storage will be provided in the form of interception storage. This does not, however, equate to full long term storage volumes and it is not feasible to provide additional storage areas elsewhere on site to achieve the required volume.

Option (2) has therefore been used to comply with Criterion 4 and an attenuation volume will be provided in the dry ponds and attenuation tanks to limit the rate of discharge in the 1 in 100-year storm +20% event to QBAR without growth factors applied. Refer to Appendix B for surface water network design calculations.

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 roofs, bio-retention areas 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 15th January 2024, 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. 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 two sides. These underground sewers carry foul water towards existing treatment areas in the Dublin central 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 1010X630mm brick combined sewer running parallel to the eastern boundary on Basin View and running down towards Ewington Lane before heading out to St. James Street.

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 SHB5-BVF-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.

3.4 Foul Water Demand Calculations

3.4.1 Residential Water Demand

In accordance with the Irish Water Code of Practice for Wastewater Infrastructure the flow rates for domestic dwellings = 150 litres/ person/ day.

Number of people = 543

People x value of litres/person/day = 543 x 150 = 81.45 m3/day

Housing active approximately 12 hours/ day

12-hour day: 81.45m3/ day / 12 = 6.79 m3/hr

Typical flow = 6.79m3/hr or 1.89l/s

Using a peaking factor of 6 (Table 2.6) the peak effluent discharge rate for the design of the foul drainage pipework will be:

Average flow = 1.89l/s + 10% SW Infiltration = 2.08 l/s

Peak flow = 2.08 l/s x 6 = 12.47 l/s

3.4.2 Creche Water Demand

Consideration was given to the planned development of a 294m2 creche at ground floor of Block A. Table 3-2 is an assumed schedule of accommodation to the proposed creche:

Table 3-2 - Creche Design Parameters

Age	m^2 per child	Area	No. of children	Ratio adult: child	No. of staff
0–1-year-old	3.5	34m2	10	1 adult: 3 children	4
1-2-year-old	2.8	38m2	14	1 adult: 5 children	3
2-3-year-old	2.35	27m2	11	1 adult: 6 children	2
3-6-year-old	2.30	26m2	11	1 adult: 8 children	1
Total			46		10

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.

Number of people = 46 children + 10 staff = 56 people

People x value of litres/person/day = 56 x 90 = 5.04 m3/day

Creche active approximately 8 hours/ day

8-hour day: 5.04m3/ day / 8 = 0.63 m3/hr

Typical flow = 0.63m3/hr or 0.175l/s

Using a peaking factor of 6 (Table 2.6) the peak effluent discharge rate for the design of the foul drainage pipework will be:

Average flow = 0.175l/s + 10% SW Infiltration = 0.193 l/s

Peak flow = 0.193 l/s x 6 = 1.155 l/s

3.4.3 Community Centre Water Demand

There is provision of 1114m2 of community, cultural and arts space within the development comprising 516m2 internal space at ground floor of Block B and 598m2 external space, which includes a 468m2 amphitheatre and 130m2 space located externally at Block B.

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 40 l/person/day for a Local Community Sports Club.

Total persons = 557 people (Assumed 1 person per 2m2 of floor area)

Average water demand = 40 litres/ person/ day

Total daily discharge = 557 x 40 = 22,280 litres/ day

Average Hour Demand = 22,280 litres/ day / (24hr x 60min x 60sec) = 0.26 l/s

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

Peak discharge = 4.5 x DWF = 1.170 l/s

Average and peak discharge rates for all existing and proposed developments are summarised in Table 3-3.

Table 3-3 - Average and Peak Foul Discharge Rates for All Developments

Development Description	Average Demand (l/s)	Peak Demand (l/s)
Proposed development of residential units	2.080	12.470
Creche	0.193	1.155
Community Centre	0.260	1.170
Total	**2.533**	**14.795**

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 15th January 2024, 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 is a 150mm uPVC watermain running parallel to the eastern boundary on Basin View and running on towards Ewington Lane before heading out to James Street. There is a 450mm cast iron watermain running parallel to the western boundary off St. James hospital and the LUAS line running onto Ewington Lane before heading out to James Street.

The proposed watermain layout is indicated on drawing SHB5-BVF-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.

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 = 543 people x 150 litres per day per person
= 81,450 litres/day

Average Hour Demand = 81,450 litres/day / (24hr x 60min x 60sec)
= 0.943 l/s

Average Day Peak Week Demand = 0.943 litres/sec x 1.25
= 1.179 l/s

Peak Demand = 5 x 1.179l/s = 5.894l/s

4.3.2 Creche Water Demand

Consideration was given to the planned development of a 294m2 creche at ground floor of Block A. Using the assumed schedule of accommodation to the proposed creche detailed in Table 3-2.

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.

Number of people = 46 children + 10 staff = 56 people

Average water demand = 90litres/person/day

Total daily discharge = 56 people x 90litres/person/day = 5040 litres/day = 0.06 l/s

Average Day Peak Week Demand = 0.06 x 1.25 = 0.079 l/s

Peak Demand = 5 x 0.079l/s = 0.397 l/s

4.3.3 Community Centre Water Demand

There is provision of 1114m2 of community, cultural and arts space within the development comprising 516m2 internal space at ground floor of Block B and 598m2 external space, which includes a 468m2 amphitheatre and 130m2 space located externally at Block B.

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 40 l/person/day for a Local Community Sports Club.

Total persons = 557 people (Assumed 1 person per 2m2 of floor area)

Average water demand = 90litres/person/day

Total daily discharge = 557 people x 90litres/person/day = 50,130 litres/day = 0.580 l/s

Average Day Peak Week Demand = 0.580 x 1.25 = 0.725 l/s

Peak Demand = 5 x 0.725/s = 3.626 l/s

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

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

Development Description	Average Demand (l/s)	Peak Demand (l/s)
Proposed development of residential units	1.179	5.894
Creche	0.079	0.397
Community Centre	0.725	3.626
Total	**1.983**	**9.917**

APPENDIX A – IRISH WATER CONFIRMATION OF FEASIBILITY

CONFIRMATION OF FEASIBILITY

Ray O'Connor

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

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

8 February 2024

Our Ref: CDS24000384 Pre-Connection Enquiry
Apartments at Basin View Flats, Basin View Flats, Basin View Road, Dublin

Dear Applicant/Agent,

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

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Housing Development of 173 unit(s) at Apartments at Basin View Flats, Basin View Flats, Basin View Road, Dublin, (the **Development)**.

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

- **Water Connection**
  - Feasible without infrastructure upgrade by Irish Water

- The proposed Development indicates that Uisce Éireann assets are present on the site. For design submissions and queries related to diversion/build near or over, please contact UÉ Diversion Team via email address diversions@water.ie The proposed diversions and relevant method statements has to be approved by the Team prior any works on the site.

- **Wastewater Connection** - Feasible without infrastructure upgrade by Irish Water

- The Development has to incorporate Sustainable Drainage Systems/ Attenuation in the management of storm water and to reduce surface water inflow into the receiving combined sewer. Full details of these have to be agreed with the LA Drainage Division.

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

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

Where can you find more information?

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

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

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

Yours sincerely,

Dermot Phelan
Connections Delivery Manager

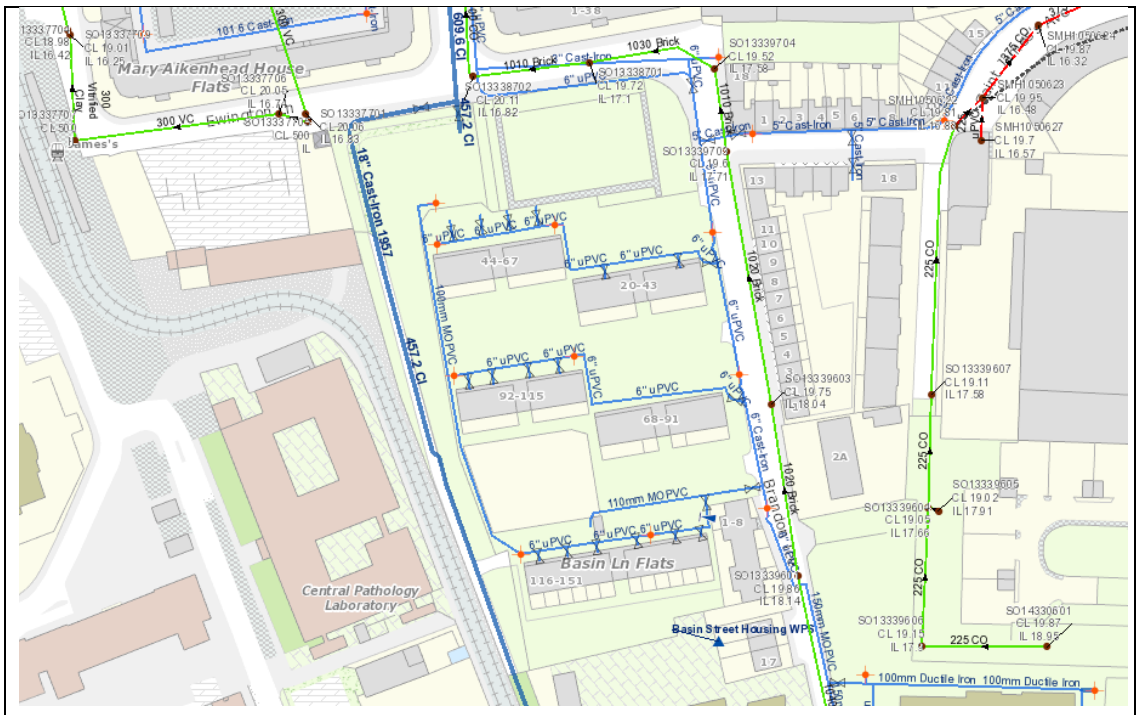
Section A - What is important to know?

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

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

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

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



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

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

APPENDIX B – ATTENUATION VOLUME CALCULATIONS

Job Title	Basin View - Area 1 Blue Roof	Job no.	23006
By:	MG	Checked by:	DW
Date	17/09/2024	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		58.7
Ratio "r" (M5-60/ M5-2D)		0.28
SAAR mm		943
Soil/ SPR mm		0.37

Soil Type 3 = 0.37 (very fine sands, silts and clays, permeable soils, moderate runoff potential)

For 50 Ha Area ~ QBARrural =	0.204	m^3/s	
QBARrural =	4.071	l/s/ha	Discharge should be limited to QBAR or 2 l/s/ha
For 0.17 Ha Area ~ QBARrural =	0.694	l/s	whichever is greater.

Part 2 **Impermeable Area**

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

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
1,704.33	Roof	Standard - 15%	0.00	0.95	0.00	0.00	0.00	678.22
		Blue/ Green Roof - 85%	856.34	0.60	513.81	565.19	678.22	
	Permeable Paving inc. areas from hardstanding		0.00	0.50	0.00	0.00	0.00	
ha	Landscaped Areas inc. areas from hardstanding		0.00	0.20	0.00	0.00	0.00	ha
0.17								0.07
	Hardstanding (including strip of access road with area of 334m2)		0.00	0.90	0.00	0.00	0.00	

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

Part 3 **Attenuation Volume Required**

1 in 10 Years								
Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M10 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.9	(M5-2D*Ratio)/100	Table 2.7		M5*M10	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3.1	1.8	1.15	1	2.093	1.419	0.041631224	1.378
2min	5.2	3.1	1.16	1	3.563	2.417	0.083262448	2.334
5 min	9.4	5.5	1.16	1	6.423	4.356	0.20815612	4.148
10 min	13.5	7.9	1.17	1	9.295	6.304	0.41631224	5.887
15 min	16.2	9.5	1.18	1	11.244	7.626	0.624468361	7.002
30 min	21.6	12.7	1.18	1	14.938	10.132	1.248936721	8.883
60 min	28.0	16.4	1.18	1	19.394	13.154	2.497873442	10.656
2 hour	36.0	21.1	1.18	1	24.936	16.912	4.995746885	11.916
4 hour	45.3	26.6	1.17	1	31.134	21.116	9.99149377	11.125
6 hour	52.3	30.7	1.17	1	35.942	24.377	14.98724065	9.389
12 hour	66.0	38.7	1.16	1	44.941	30.480	29.97448131	0.505
24 hour	83.7	49.1	1.15	1	56.479	38.306	59.94896262	-21.643
48 hour	106.0	62.2	1.14	1	70.933	48.108	119.8979252	-71.789
Size of Attenuation for 1 in 10 year flood event m³								**11.916**

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	3.1	1.8	1.41	1	2.566	1.740	0.041631224	1.699
2min	5.2	3.1	1.45	1	4.454	3.021	0.083262448	2.938
5 min	9.4	5.5	1.48	1	8.195	5.558	0.20815612	5.350
10 min	13.5	7.9	1.51	1	11.996	8.136	0.41631224	7.719
15 min	16.2	9.5	1.54	1	14.675	9.953	0.624468361	9.328
30 min	21.6	12.7	1.54	1	19.496	13.223	1.248936721	11.974
60 min	28.0	16.4	1.55	1	25.476	17.278	2.497873442	14.780
2 hour	36.0	21.1	1.51	1	31.909	21.642	4.995746885	16.646
4 hour	45.3	26.6	1.5	1	39.916	27.072	9.99149377	17.080
6 hour	52.3	30.7	1.48	1	45.465	30.836	14.98724065	15.848
12 hour	66.0	38.7	1.45	1	56.176	38.100	29.97448131	8.125
24 hour	83.7	49.1	1.41	1	69.248	46.966	59.94896262	-12.983
48 hour	106.0	62.2	1.39	1	86.489	58.659	119.8979252	-61.239
Size of Attenuation for 1 in 30 year flood event m³								**17.080**

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	3.1	1.8	1.74	1	3.166	2.147	0.041631224	2.106
2min	5.2	3.1	1.77	1	5.437	3.688	0.083262448	3.604
5 min	9.4	5.5	1.87	1	10.355	7.023	0.20815612	6.815
10 min	13.5	7.9	1.91	1	15.173	10.291	0.41631224	9.874
15 min	16.2	9.5	1.96	1	18.677	12.667	0.624468361	12.043
30 min	21.6	12.7	1.98	1	25.066	17.000	1.248936721	15.751
60 min	28.0	16.4	1.97	1	32.379	21.960	2.497873442	19.462
2 hour	36.0	21.1	1.94	1	40.996	27.805	4.995746885	22.809
4 hour	45.3	26.6	1.88	1	50.028	33.930	9.99149377	23.939
6 hour	52.3	30.7	1.85	1	56.831	38.544	14.98724065	23.557
12 hour	66.0	38.7	1.78	1	68.961	46.771	29.97448131	16.796
24 hour	83.7	49.1	1.72	1	84.473	57.292	59.94896262	-2.657
48 hour	106.0	62.2	1.67	1	103.911	70.475	119.8979252	-49.423
Size of Attenuation for 1 in 100 year flood event m³								**23.939**

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 678.2 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' 3.26 m³

Interception Storage Provided *Only fill in SuDS on your site

Green/Blue Roof to retain 30 l/m² of rainwater will be used on roof level	Area	856.3	m²
	Interception Store 30 l/m²	0.03	l/m²
	Storage Volume	25.69	m³

Total interception volume provided for the overall site 25.69 m³

which exceeds the required volume calculated of 3.26 m³

Job Title	Basin View - Area 1	Job no.	23006
By:	MG	Checked by:	DW
Date	17/09/2024	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		58.7
Ratio "r" (M5-60/ M5-2D)		0.28
SAAR mm		943
Soil/ SPR mm		0.37

Soil Type 3 = 0.37 (very fine sands, silts and clays, permeable soils, moderate runoff potential)

For 50 Ha Area ~ QBARrural =	0.204	m^3/s	
QBARrural =	4.071	l/s/ha	Discharge should be limited to QBAR or 2 l/s/ha
For 0.17 Ha Area ~ QBARrural =	0.694	l/s	whichever is greater.

Part 2 **Impermeable Area**

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

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
1,704.33	Roof	Standard - 15%	151.12	0.95	143.56	157.92	189.50	465.56
		Blue/ Green Roof - 85%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		232.54	0.50	116.27	127.90	153.48	
ha	Landscaped Areas inc. areas from hardstanding		464.33	0.20	92.87	102.15	122.58	**ha**
0.17								0.05
	Hardstanding (including strip of access road with area of 334m2)		0.00	0.90	0.00	0.00	0.00	

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

Part 3 **Attenuation Volume Required**

1 in 10 Years								
Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M10 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.9	(M5-2D*Ratio)/100	Table 2.7		M5*M10	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3.1	1.8	1.15	1	2.093	0.974	0.041631224	0.933
2min	5.2	3.1	1.16	1	3.563	1.659	0.083262448	1.576
5 min	9.4	5.5	1.16	1	6.423	2.990	0.20815612	2.782
10 min	13.5	7.9	1.17	1	9.295	4.327	0.41631224	3.911
15 min	16.2	9.5	1.18	1	11.244	5.235	0.624468361	4.610
30 min	21.6	12.7	1.18	1	14.938	6.955	1.248936721	5.706
60 min	28.0	16.4	1.18	1	19.394	9.029	2.497873442	6.531
2 hour	36.0	21.1	1.18	1	24.936	11.609	4.995746885	6.613
4 hour	45.3	26.6	1.17	1	31.134	14.495	9.99149377	4.504
6 hour	52.3	30.7	1.17	1	35.942	16.733	14.98724065	1.746
12 hour	66.0	38.7	1.16	1	44.941	20.923	29.97448131	-9.052
24 hour	83.7	49.1	1.15	1	56.479	26.295	59.94896262	-33.654
48 hour	106.0	62.2	1.14	1	70.933	33.024	119.8979252	-86.874
Size of Attenuation for 1 in 10 year flood event m³								**6.613**

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	3.1	1.8	1.41	1	2.566	1.195	0.041631224	1.153
2min	5.2	3.1	1.45	1	4.454	2.074	0.083262448	1.991
5 min	9.4	5.5	1.48	1	8.195	3.815	0.20815612	3.607
10 min	13.5	7.9	1.51	1	11.996	5.585	0.41631224	5.168
15 min	16.2	9.5	1.54	1	14.675	6.832	0.624468361	6.207
30 min	21.6	12.7	1.54	1	19.496	9.077	1.248936721	7.828
60 min	28.0	16.4	1.55	1	25.476	11.861	2.497873442	9.363
2 hour	36.0	21.1	1.51	1	31.909	14.856	4.995746885	9.860
4 hour	45.3	26.6	1.5	1	39.916	18.583	9.99149377	8.592
6 hour	52.3	30.7	1.48	1	45.465	21.167	14.98724065	6.180
12 hour	66.0	38.7	1.45	1	56.176	26.153	29.97448131	-3.821
24 hour	83.7	49.1	1.41	1	69.248	32.240	59.94896262	-27.709
48 hour	106.0	62.2	1.39	1	86.489	40.266	119.8979252	-79.632
Size of Attenuation for 1 in 30 year flood event m³								**9.860**

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	3.1	1.8	1.74	1	3.166	1.474	0.041631224	1.432
2min	5.2	3.1	1.77	1	5.437	2.531	0.083262448	2.448
5 min	9.4	5.5	1.87	1	10.355	4.821	0.20815612	4.613
10 min	13.5	7.9	1.91	1	15.173	7.064	0.41631224	6.648
15 min	16.2	9.5	1.96	1	18.677	8.695	0.624468361	8.071
30 min	21.6	12.7	1.98	1	25.066	11.670	1.248936721	10.421
60 min	28.0	16.4	1.97	1	32.379	15.074	2.497873442	12.577
2 hour	36.0	21.1	1.94	1	40.996	19.086	4.995746885	14.091
4 hour	45.3	26.6	1.88	1	50.028	23.291	9.99149377	13.300
6 hour	52.3	30.7	1.85	1	56.831	26.459	14.98724065	11.471
12 hour	66.0	38.7	1.78	1	68.961	32.106	29.97448131	2.131
24 hour	83.7	49.1	1.72	1	84.473	39.328	59.94896262	-20.621
48 hour	106.0	62.2	1.67	1	103.911	48.377	119.8979252	-71.521
Size of Attenuation for 1 in 100 year flood event m³								**14.091**

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 465.6 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' 2.23 m³

Interception Storage Provided *Only fill in SuDS on your site

Permeable Paving	Area	232.5	m²	
	Stone Layer 100mm deep	0.1	m	
	Void Ratio	30%		
	Storage Volume	6.9762	m³	*Storage depth will depend on your site

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

Bio-Retention Area/ Raingarden	Area	0.0	m²
	Depth of subgrade	0	m
	Storage Volume	0	m³

Total interception volume provided for the overall site 6.98 m³

which exceeds the required volume calculated of 2.23 m³

Job Title	Basin View - Area 2 Blue Roof	Job no.	23006
By:	MG	Checked by:	DW
Date	17/09/2024	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		58.7
Ratio "r" (M5-60/ M5-2D)		0.28
SAAR mm		943
Soil/ SPR mm		0.37

Soil Type 3 = 0.37 (very fine sands, silts and clays, permeable soils, moderate runoff potential)

For 50 Ha Area ~ QBARrural =	0.204	m^3/s	
QBARrural =	4.071	l/s/ha	Discharge should be limited to QBAR or 2 l/s/ha
For 0.33 Ha Area ~ QBARrural =	1.345	l/s	whichever is greater.

Part 2 **Impermeable Area**

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

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
3,304.65	Roof	Standard - 10%	0.00	0.95	0.00	0.00	0.00	1528.28
		Blue/ Green Roof - 90%	1929.65	0.60	1157.79	1273.57	1528.28	
	Permeable Paving inc. areas from hardstanding		0.00	0.50	0.00	0.00	0.00	
ha	Landscaped Areas inc. areas from hardstanding		0.00	0.20	0.00	0.00	0.00	ha
0.33								0.15
	Hardstanding (including strip of access road with area of 334m2)		0.00	0.90	0.00	0.00	0.00	

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

Part 3 **Attenuation Volume Required**

1 in 10 Years								
Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M10 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.9	(M5-2D*Ratio)/100	Table 2.7		M5*M10	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3.1	1.8	1.15	1	2.093	3.198	0.080721754	3.117
2min	5.2	3.1	1.16	1	3.563	5.446	0.161443508	5.285
5 min	9.4	5.5	1.16	1	6.423	9.817	0.403608771	9.413
10 min	13.5	7.9	1.17	1	9.295	14.205	0.807217542	13.398
15 min	16.2	9.5	1.18	1	11.244	17.184	1.210826312	15.973
30 min	21.6	12.7	1.18	1	14.938	22.830	2.421652625	20.408
60 min	28.0	16.4	1.18	1	19.394	29.640	4.843305249	24.797
2 hour	36.0	21.1	1.18	1	24.936	38.109	9.686610498	28.422
4 hour	45.3	26.6	1.17	1	31.134	47.582	19.373221	28.209
6 hour	52.3	30.7	1.17	1	35.942	54.930	29.05983149	25.870
12 hour	66.0	38.7	1.16	1	44.941	68.682	58.11966299	10.563
24 hour	83.7	49.1	1.15	1	56.479	86.316	116.239326	-29.923
48 hour	106.0	62.2	1.14	1	70.933	108.406	232.478652	-124.073
Size of Attenuation for 1 in 10 year flood event m³								**28.422**

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	3.1	1.8	1.41	1	2.566	3.921	0.080721754	3.841
2min	5.2	3.1	1.45	1	4.454	6.808	0.161443508	6.646
5 min	9.4	5.5	1.48	1	8.195	12.525	0.403608771	12.121
10 min	13.5	7.9	1.51	1	11.996	18.333	0.807217542	17.525
15 min	16.2	9.5	1.54	1	14.675	22.427	1.210826312	21.216
30 min	21.6	12.7	1.54	1	19.496	29.795	2.421652625	27.374
60 min	28.0	16.4	1.55	1	25.476	38.934	4.843305249	34.091
2 hour	36.0	21.1	1.51	1	31.909	48.766	9.686610498	39.080
4 hour	45.3	26.6	1.5	1	39.916	61.003	19.373221	41.630
6 hour	52.3	30.7	1.48	1	45.465	69.484	29.05983149	40.424
12 hour	66.0	38.7	1.45	1	56.176	85.853	58.11966299	27.733
24 hour	83.7	49.1	1.41	1	69.248	105.831	116.239326	-10.408
48 hour	106.0	62.2	1.39	1	86.489	132.179	232.478652	-100.300
Size of Attenuation for 1 in 30 year flood event m³								**41.630**

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	3.1	1.8	1.74	1	3.166	4.839	0.080721754	4.758
2min	5.2	3.1	1.77	1	5.437	8.310	0.161443508	8.148
5 min	9.4	5.5	1.87	1	10.355	15.825	0.403608771	15.422
10 min	13.5	7.9	1.91	1	15.173	23.189	0.807217542	22.382
15 min	16.2	9.5	1.96	1	18.677	28.543	1.210826312	27.333
30 min	21.6	12.7	1.98	1	25.066	38.308	2.421652625	35.886
60 min	28.0	16.4	1.97	1	32.379	49.484	4.843305249	44.641
2 hour	36.0	21.1	1.94	1	40.996	62.654	9.686610498	52.967
4 hour	45.3	26.6	1.88	1	50.028	76.457	19.373221	57.084
6 hour	52.3	30.7	1.85	1	56.831	86.854	29.05983149	57.795
12 hour	66.0	38.7	1.78	1	68.961	105.392	58.11966299	47.272
24 hour	83.7	49.1	1.72	1	84.473	129.099	116.239326	12.860
48 hour	106.0	62.2	1.67	1	103.911	158.805	232.478652	-73.674
Size of Attenuation for 1 in 100 year flood event m³								**57.795**

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 1528.3 m² including 10% for urban creep

Therefore, the total interception storage required is 'overall impermeable area x 80% x 0.005 x 1.2 for climate change' 7.34 m³

Interception Storage Provided *Only fill in SuDS on your site

Green/Blue Roof to retain 30 l/m² of rainwater will be used on roof level	Area	1929.7	m²
	Interception Store 30 l/m²	0.03	l/m²
	Storage Volume	57.89	m³

Total interception volume provided for the overall site 57.89 m³

which exceeds the required volume calculated of 7.34 m³

Job Title	Basin View - Area 2	Job no.	23006
By:	MG	Checked by:	DW
Date	17/09/2024	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		58.7
Ratio "r" (M5-60/ M5-2D)		0.28
SAAR mm		943
Soil/ SPR mm		0.37

Soil Type 3 = 0.37 (very fine sands, silts and clays, permeable soils, moderate runoff potential)

For 50 Ha Area ~ QBARrural =	0.204	m^3/s	
QBARrural =	4.071	l/s/ha	Discharge should be limited to QBAR or 2 l/s/ha
For 0.33 Ha Area ~ QBARrural =	1.345	l/s	whichever is greater.

Part 2 **Impermeable Area**

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

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
3,304.65	Roof	Standard - 10%	214.41	0.95	203.69	224.05	268.86	829.96
		Blue/ Green Roof - 90%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		399.84	0.50	199.92	219.91	263.89	
ha	Landscaped Areas inc. areas from hardstanding		656.47	0.20	131.29	144.42	173.31	ha
0.33								0.08
	Hardstanding (including strip of access road with area of 334m2)		104.29	0.90	93.86	103.24	123.89	

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	3.1	1.8	1.15	1	2.093	1.737	0.080721754	1.656
2min	5.2	3.1	1.16	1	3.563	2.958	0.161443508	2.796
5 min	9.4	5.5	1.16	1	6.423	5.331	0.403608771	4.928
10 min	13.5	7.9	1.17	1	9.295	7.714	0.807217542	6.907
15 min	16.2	9.5	1.18	1	11.244	9.332	1.210826312	8.121
30 min	21.6	12.7	1.18	1	14.938	12.398	2.421652625	9.977
60 min	28.0	16.4	1.18	1	19.394	16.097	4.843305249	11.253
2 hour	36.0	21.1	1.18	1	24.936	20.696	9.686610498	11.009
4 hour	45.3	26.6	1.17	1	31.134	25.840	19.373221	6.467
6 hour	52.3	30.7	1.17	1	35.942	29.830	29.05983149	0.771
12 hour	66.0	38.7	1.16	1	44.941	37.299	58.11966299	-20.821
24 hour	83.7	49.1	1.15	1	56.479	46.875	116.239326	-69.364
48 hour	106.0	62.2	1.14	1	70.933	58.872	232.478652	-173.607
Size of Attenuation for 1 in 10 year flood event m³								**11.253**

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	3.1	1.8	1.41	1	2.566	2.129	0.080721754	2.049
2min	5.2	3.1	1.45	1	4.454	3.697	0.161443508	3.535
5 min	9.4	5.5	1.48	1	8.195	6.802	0.403608771	6.398
10 min	13.5	7.9	1.51	1	11.996	9.956	0.807217542	9.149
15 min	16.2	9.5	1.54	1	14.675	12.179	1.210826312	10.969
30 min	21.6	12.7	1.54	1	19.496	16.181	2.421652625	13.759
60 min	28.0	16.4	1.55	1	25.476	21.144	4.843305249	16.301
2 hour	36.0	21.1	1.51	1	31.909	26.483	9.686610498	16.797
4 hour	45.3	26.6	1.5	1	39.916	33.129	19.373221	13.755
6 hour	52.3	30.7	1.48	1	45.465	37.734	29.05983149	8.674
12 hour	66.0	38.7	1.45	1	56.176	46.624	58.11966299	-11.496
24 hour	83.7	49.1	1.41	1	69.248	57.473	116.239326	-58.766
48 hour	106.0	62.2	1.39	1	86.489	71.782	232.478652	-160.697
Size of Attenuation for 1 in 30 year flood event m³								**16.797**

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	3.1	1.8	1.74	1	3.166	2.628	0.080721754	2.547
2min	5.2	3.1	1.77	1	5.437	4.513	0.161443508	4.351
5 min	9.4	5.5	1.87	1	10.355	8.594	0.403608771	8.191
10 min	13.5	7.9	1.91	1	15.173	12.593	0.807217542	11.786
15 min	16.2	9.5	1.96	1	18.677	15.501	1.210826312	14.290
30 min	21.6	12.7	1.98	1	25.066	20.804	2.421652625	18.382
60 min	28.0	16.4	1.97	1	32.379	26.873	4.843305249	22.030
2 hour	36.0	21.1	1.94	1	40.996	34.025	9.686610498	24.338
4 hour	45.3	26.6	1.88	1	50.028	41.521	19.373221	22.148
6 hour	52.3	30.7	1.85	1	56.831	47.168	29.05983149	18.108
12 hour	66.0	38.7	1.78	1	68.961	57.235	58.11966299	-0.885
24 hour	83.7	49.1	1.72	1	84.473	70.109	116.239326	-46.130
48 hour	106.0	62.2	1.67	1	103.911	86.242	232.478652	-146.237
Size of Attenuation for 1 in 100 year flood event m³								**24.338**

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 830.0 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' 3.98 m³

Interception Storage Provided *Only fill in SuDS on your site

Permeable Paving	Area	399.8	m²
	Stone Layer 100mm deep	0.1	m
	Void Ratio	30%	
	Storage Volume	11.9952	m³

*Storage depth will depend on your site

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

Bio-Retention Area/ Raingarden	Area	0.0	m²
	Depth of subgrade	0	m
	Storage Volume	0	m³

Job Title	Basin View - Area 3 Blue Roof	Job no.	23006
By:	MG	Checked by:	DW
Date	17/09/2024	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		58.7
Ratio "r" (M5-60/ M5-2D)		0.28
SAAR mm		943
Soil/ SPR mm		0.37

Soil Type 3 = 0.37 (very fine sands, silts and clays, permeable soils, moderate runoff potential)

For 50 Ha Area ~ QBARrural =		0.204	m^3/s
QBARrural =		4.071	l/s/ha
For 0.33 Ha Area ~ QBARrural =		4.024	l/s

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

Part 2 **Impermeable Area**

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

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
9,883.25	Roof - Existing Roof - Pitch Roof		0.00	0.95	0.00	0.00	0.00	117.51
	Roof - New Build Extension	Standard - 50%	0.00	0.95	0.00	0.00	0.00	
		Blue/ Green Roof - 50%	148.37	0.60	89.02	97.92	117.51	
	Permeable Paving inc. areas from hardstanding		0.00	0.50	0.00	0.00	0.00	
ha								**ha**
0.99	Landscaped Areas inc. areas from hardstanding		0.00	0.20	0.00	0.00	0.00	0.00
	Hardstanding (including strip of access road with area of 334m2)		0.00	0.90	0.00	0.00	0.00	

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

Part 3 **Attenuation Volume Required**

1 in 10 Years								
Rainfall Duration (D)	Ratio r (%)	M5 (mm)	M10 (mm)	Area	MT	Inflow "I"	Outflow "O"	Capacity Required
	Table 2.9	(M5-2D*Ratio)/100	Table 2.7		M5*M10	MT* Impermeable Area	(QBARrural/1000)*60	"I"-"O" ="S"
1 min	3.1	1.8	1.15	1	2.093	0.000	0.241415119	-0.241
2min	5.2	3.1	1.16	1	3.563	0.000	0.482830237	-0.483
5 min	9.4	5.5	1.16	1	6.423	0.000	1.207075593	-1.207
10 min	13.5	7.9	1.17	1	9.295	0.000	2.414151186	-2.414
15 min	16.2	9.5	1.18	1	11.244	0.000	3.621226779	-3.621
30 min	21.6	12.7	1.18	1	14.938	0.000	7.242453559	-7.242
60 min	28.0	16.4	1.18	1	19.394	0.000	14.48490712	-14.485
2 hour	36.0	21.1	1.18	1	24.936	0.000	28.96981423	-28.970
4 hour	45.3	26.6	1.17	1	31.134	0.000	57.93962847	-57.940
6 hour	52.3	30.7	1.17	1	35.942	0.000	86.9094427	-86.909
12 hour	66.0	38.7	1.16	1	44.941	0.000	173.8188854	-173.819
24 hour	83.7	49.1	1.15	1	56.479	0.000	347.6377708	-347.638
48 hour	106.0	62.2	1.14	1	70.933	0.000	695.2755416	-695.276
Size of Attenuation for 1 in 10 year flood event m³								**-0.241**

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	3.1	1.8	1.41	1	2.566	0.000	0.241415119	-0.241
2min	5.2	3.1	1.45	1	4.454	0.000	0.482830237	-0.483
5 min	9.4	5.5	1.48	1	8.195	0.000	1.207075593	-1.207
10 min	13.5	7.9	1.51	1	11.996	0.000	2.414151186	-2.414
15 min	16.2	9.5	1.54	1	14.675	0.000	3.621226779	-3.621
30 min	21.6	12.7	1.54	1	19.496	0.000	7.242453559	-7.242
60 min	28.0	16.4	1.55	1	25.476	0.000	14.48490712	-14.485
2 hour	36.0	21.1	1.51	1	31.909	0.000	28.96981423	-28.970
4 hour	45.3	26.6	1.5	1	39.916	0.000	57.93962847	-57.940
6 hour	52.3	30.7	1.48	1	45.465	0.000	86.9094427	-86.909
12 hour	66.0	38.7	1.45	1	56.176	0.000	173.8188854	-173.819
24 hour	83.7	49.1	1.41	1	69.248	0.000	347.6377708	-347.638
48 hour	106.0	62.2	1.39	1	86.489	0.000	695.2755416	-695.276
Size of Attenuation for 1 in 30 year flood event m³								**-0.241**

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	3.1	1.8	1.74	1	3.166	0.000	0.241415119	-0.241
2min	5.2	3.1	1.77	1	5.437	0.000	0.482830237	-0.483
5 min	9.4	5.5	1.87	1	10.355	0.000	1.207075593	-1.207
10 min	13.5	7.9	1.91	1	15.173	0.000	2.414151186	-2.414
15 min	16.2	9.5	1.96	1	18.677	0.000	3.621226779	-3.621
30 min	21.6	12.7	1.98	1	25.066	0.000	7.242453559	-7.242
60 min	28.0	16.4	1.97	1	32.379	0.000	14.48490712	-14.485
2 hour	36.0	21.1	1.94	1	40.996	0.000	28.96981423	-28.970
4 hour	45.3	26.6	1.88	1	50.028	0.000	57.93962847	-57.940
6 hour	52.3	30.7	1.85	1	56.831	0.000	86.9094427	-86.909
12 hour	66.0	38.7	1.78	1	68.961	0.000	173.8188854	-173.819
24 hour	83.7	49.1	1.72	1	84.473	0.000	347.6377708	-347.638
48 hour	106.0	62.2	1.67	1	103.911	0.000	695.2755416	-695.276
Size of Attenuation for 1 in 100 year flood event m³								**-0.241**

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 117.5 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' 0.56 m³

Interception Storage Provided *Only fill in SuDS on your site

Green/Blue Roof to retain 30 l/m² of rainwater will be used on roof level	Area	148.4	m²
	Interception Store 30 l/m²	0.03	l/m²
	Storage Volume	4.45	m³

Total interception volume provided for the overall site 4.45 m³

which exceeds the required volume calculated of 0.56 m³

Job Title	Basin View - Area 3	Job no.	23006
By:	MG	Checked by:	DW
Date	17/09/2024	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		58.7
Ratio "r" (M5-60/ M5-2D)		0.28
SAAR mm		943
Soil/ SPR mm		0.37

Soil Type 3 = 0.37 (very fine sands, silts and clays, permeable soils, moderate runoff potential)

For 50 Ha Area ~ QBARrural =		0.204	m^3/s
QBARrural =		4.071	l/s/ha
For 0.99 Ha Area ~ QBARrural =		4.024	l/s

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

Part 2 **Impermeable Area**

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

Total Area sq.m	Type of Surface		Area sq.m	Run-off Coefficient	Equivalent Impermeable	Urban Creep Allowance (10%)	Climate Change (20%)	Overall Impermeable
9,883.25	Roof - Existing Roof - Pitch Roof		545.43	0.95	518.16	569.97	683.97	5016.80
	Roof - New Build Extension	Standard - 50%	148.37	0.95	140.95	155.05	186.06	
		Blue/ Green Roof - 50%	0.00	0.60	0.00	0.00	0.00	
	Permeable Paving inc. areas from hardstanding		3302.58	0.50	1651.29	1816.42	2179.70	
ha								**ha**
0.99	Landscaped Areas inc. areas from hardstanding		5249.20	0.20	1049.84	1154.82	1385.79	0.50
	Hardstanding (including strip of access road with area of 334m2)		489.30	0.90	440.37	484.41	581.29	

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	3.1	1.8	1.15	1	2.093	10.498	0.241415119	10.257
2min	5.2	3.1	1.16	1	3.563	17.877	0.482830237	17.394
5 min	9.4	5.5	1.16	1	6.423	32.225	1.207075593	31.018
10 min	13.5	7.9	1.17	1	9.295	46.629	2.414151186	44.215
15 min	16.2	9.5	1.18	1	11.244	56.410	3.621226779	52.789
30 min	21.6	12.7	1.18	1	14.938	74.943	7.242453559	67.700
60 min	28.0	16.4	1.18	1	19.394	97.298	14.48490712	82.813
2 hour	36.0	21.1	1.18	1	24.936	125.098	28.96981423	96.128
4 hour	45.3	26.6	1.17	1	31.134	156.196	57.93962847	98.256
6 hour	52.3	30.7	1.17	1	35.942	180.314	86.9094427	93.405
12 hour	66.0	38.7	1.16	1	44.941	225.459	173.8188854	51.640
24 hour	83.7	49.1	1.15	1	56.479	283.345	347.6377708	-64.293
48 hour	106.0	62.2	1.14	1	70.933	355.857	695.2755416	-339.418
Size of Attenuation for 1 in 10 year flood event m³								**98.256**

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	3.1	1.8	1.41	1	2.566	12.872	0.241415119	12.631
2min	5.2	3.1	1.45	1	4.454	22.347	0.482830237	21.864
5 min	9.4	5.5	1.48	1	8.195	41.114	1.207075593	39.907
10 min	13.5	7.9	1.51	1	11.996	60.179	2.414151186	57.765
15 min	16.2	9.5	1.54	1	14.675	73.620	3.621226779	69.998
30 min	21.6	12.7	1.54	1	19.496	97.807	7.242453559	90.564
60 min	28.0	16.4	1.55	1	25.476	127.807	14.48490712	113.322
2 hour	36.0	21.1	1.51	1	31.909	160.083	28.96981423	131.113
4 hour	45.3	26.6	1.5	1	39.916	200.251	57.93962847	142.311
6 hour	52.3	30.7	1.48	1	45.465	228.090	86.9094427	141.180
12 hour	66.0	38.7	1.45	1	56.176	281.824	173.8188854	108.005
24 hour	83.7	49.1	1.41	1	69.248	347.406	347.6377708	-0.232
48 hour	106.0	62.2	1.39	1	86.489	433.896	695.2755416	-261.379
Size of Attenuation for 1 in 30 year flood event m³								**142.311**

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	3.1	1.8	1.74	1	3.166	15.885	0.241415119	15.643
2min	5.2	3.1	1.77	1	5.437	27.278	0.482830237	26.795
5 min	9.4	5.5	1.87	1	10.355	51.948	1.207075593	50.741
10 min	13.5	7.9	1.91	1	15.173	76.121	2.414151186	73.707
15 min	16.2	9.5	1.96	1	18.677	93.698	3.621226779	90.076
30 min	21.6	12.7	1.98	1	25.066	125.752	7.242453559	118.509
60 min	28.0	16.4	1.97	1	32.379	162.439	14.48490712	147.954
2 hour	36.0	21.1	1.94	1	40.996	205.669	28.96981423	176.700
4 hour	45.3	26.6	1.88	1	50.028	250.981	57.93962847	193.041
6 hour	52.3	30.7	1.85	1	56.831	285.112	86.9094427	198.202
12 hour	66.0	38.7	1.78	1	68.961	345.963	173.8188854	172.144
24 hour	83.7	49.1	1.72	1	84.473	423.786	347.6377708	76.148
48 hour	106.0	62.2	1.67	1	103.911	521.300	695.2755416	-173.976
Size of Attenuation for 1 in 100 year flood event m³								**198.202**

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 5016.8 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' 24.08 m³

Interception Storage Provided *Only fill in SuDS on your site

Permeable Paving	Area	3302.6	m²
	Stone Layer 100mm deep	0.1	m
	Void Ratio	30%	
	Storage Volume	99.07731	m³

*Storage depth will depend on your site

Swale	Area	183.8	m²
	*75mm	0.075	m
	Storage Volume	13.785075	m³

Bio-Retention Area/ Raingarden	Area	0.0	m²
	Depth of subgrade	0	m
	Storage Volume	0	m³

Total interception volume provided for the overall site 112.86 m³

which exceeds the required volume calculated of 24.08 m³

APPENDIX C – SURFACE WATER PIPE NETWORK CALCULATIONS

Drainage Design Report

Flow+

v10.8

Network	Storm Network
Filename	2024-06-05.pfd
Username	Kezia Adanza (kadanza@morce.ie)
Last analysed	10/06/2024 17:26:11
Report produced on	10/06/2024 17:35:01

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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)	0.80
Connection Type	Level Inverts
Minimum Backdrop Height (m)	0.500
Preferred Cover Depth (m)	1.000
Include Intermediate Ground	Yes
Enforce best practice design rules	Yes

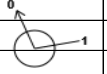
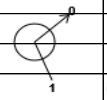
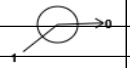
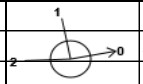
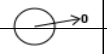
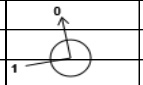
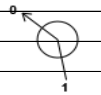
	Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Width (mm)	Sump (m)	Easting (m)	Northing (m)	Depth (m)	Notes
✓	SW01	0.035	4.00		20.270	Manhole	Adoptable	1200			713824.085	733647.840	1.225	
✓	SW02	0.035	4.00		20.270	Manhole	Adoptable	1200			713780.329	733639.448	1.394	
✓	SW03	0.035	4.00		20.270	Manhole	Adoptable	1200			713768.911	733666.947	1.507	
✓	SW04	0.035	4.00		20.270	Manhole	Adoptable	1200			713772.212	733669.857	1.519	
✓	SW05	0.035	4.00		20.425	Manhole	Adoptable	1200			713775.680	733722.376	1.225	
✓	SW06	0.035	4.00		20.245	Manhole	Adoptable	1200			713785.767	733670.380	1.530	
✓	SW07	0.035	4.00		20.270	Manhole	Adoptable	1200			713827.273	733648.451	1.225	
✓	SW08	0.035	4.00		20.270	Manhole	Adoptable	1200			713847.486	733652.328	1.304	
✓	SW09	0.035	4.00		20.270	Manhole	Adoptable	1200			713844.294	733668.756	1.368	
✓	SW10	0.035	4.00		20.270	Manhole	Adoptable	1200			713840.795	733671.679	1.386	
✓	SW11	0.035	4.00		20.270	Manhole	Adoptable	1200			713795.626	733662.909	1.561	
✓	SW12	0.035	4.00		20.040	Manhole	Adoptable	1350			713793.862	733671.953	1.375	
✓	SW13				20.040	Manhole	Adoptable	1350			713801.268	733673.383	1.413	
✓	SW14	0.035	4.00		20.040	Manhole	Adoptable	1200			713850.393	733683.256	1.225	
✓	SW15				20.040	Manhole	Adoptable	1200			713827.807	733678.869	1.313	
✓	SW16-HB				20.040	Manhole	Adoptable	1350			713800.722	733676.036	1.419	
✓	SW17				20.040	Manhole	Adoptable	1200			713798.579	733675.622	1.430	
✓	SW18				20.500	Manhole	Adoptable	1200			713790.576	733717.004	2.101	
✓	SW19				20.500	Manhole	Adoptable	1200			713783.771	733715.683	2.136	
✓	SW20	0.010	4.00		19.960	Manhole	Adoptable	1200			713819.914	733779.155	0.825	
✓	SW21	0.010	4.00		19.960	Manhole	Adoptable	1200			713799.865	733775.008	0.904	
✓	SW22	0.010	4.00		20.260	Manhole	Adoptable	1200			713804.913	733749.078	1.125	
✓	SW23	0.010	4.00		20.260	Manhole	Adoptable	1200			713802.589	733761.015	1.259	
✓	SW24				19.810	Manhole	Adoptable	1200			713819.424	733764.493	0.875	
✓	SW25	0.010	4.00		20.260	Manhole	Adoptable	1200			713806.894	733744.815	1.125	
✓	SW26	0.010	4.00		19.960	Manhole	Adoptable	1200			713828.129	733749.202	0.908	
✓	SW27	0.010	4.00		19.810	Manhole	Adoptable	1200			713823.060	733773.739	0.825	
✓	SW28	0.010	4.00		19.810	Manhole	Adoptable	1200			713824.119	733768.626	0.851	
✓	SW29				19.810	Manhole	Adoptable	1200			713821.441	733768.073	0.875	
✓	SW30		4.00		19.810	Manhole	Adoptable	1200			713822.314	733755.747	0.875	
✓	SW31-HB				19.810	Manhole	Adoptable	1200			713817.478	733754.743	0.900	
✓	SW32				20.260	Manhole	Adoptable	1200			713802.992	733744.276	1.418	
✓	SW33	0.010	4.00		20.550	Manhole	Adoptable	1200			713748.086	733729.107	0.825	
✓	SW34	0.010	4.00		20.550	Manhole	Adoptable	1200			713754.324	733730.396	0.849	
✓	SW35	0.010	4.00		20.400	Manhole	Adoptable	1200			713738.758	733760.414	0.825	

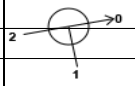
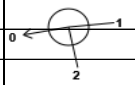
✓	SW36	0.010	4.00		20.400	Manhole	Adoptable	1200			713747.534	733762.153	0.859	
✓	SW37	0.010	4.00		20.550	Manhole	Adoptable	1200			713749.154	733754.578	1.039	
✓	SW38				20.450	Manhole	Adoptable	1200			713744.519	733753.587	0.957	
✓	SW39		4.00		20.450	Manhole	Adoptable	1200			713744.824	733746.974	0.957	
✓	SW40-HB				20.550	Manhole	Adoptable	1200			713746.585	733738.443	1.225	
✓	SW41				20.550	Manhole	Adoptable	1200			713752.345	733734.083	1.253	
✓	SW42				20.340	Manhole	Adoptable	1200			713778.841	733739.555	2.098	
✓	SW43				20.240	Manhole	Adoptable	1200			713769.457	733784.998	2.230	
✓	SW44				20.230	Manhole	Adoptable	1200			713768.228	733790.951	2.250	
✓	CS01				20.150	Manhole	Adoptable	1200			713772.520	733796.719	2.206	

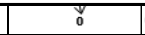
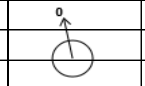
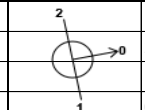
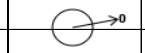
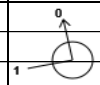
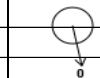
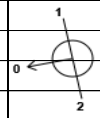
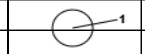
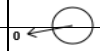
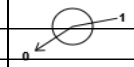
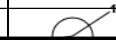
Name	US Node	DS Node	Length (m)	ks (mm) / n	Velocity Equation	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)	Con Offset (m)	Min DS IL (m)	Lateral Area (ha)	Lateral Ins Point (%)	Lateral T of E (mins)
1.000	SW01	SW02	44.553	0.600	Colebrook-White	19.045	18.876	0.169	263.6	225	Circular	4.93	49.7					
1.001	SW02	SW03	29.775	0.600	Colebrook-White	18.876	18.763	0.113	263.5	225	Circular	5.55	47.5					
1.002	SW03	SW04	4.401	0.600	Colebrook-White	18.763	18.751	0.012	366.7	300	Circular	5.64	47.3					
1.003	SW04	SW06	13.565	0.600	Colebrook-White	18.751	18.715	0.036	376.8	300	Circular	5.92	46.4					
2.000	SW05	SW06	52.965	0.600	Colebrook-White	19.200	18.715	0.485	109.2	225	Circular	4.71	50.0					
1.004	SW06	SW12	8.246	0.600	Colebrook-White	18.715	18.665	0.050	164.9	300	Circular	6.03	46.0					
3.000	SW07	SW08	20.581	0.600	Colebrook-White	19.045	18.966	0.079	260.5	225	Circular	4.43	50.0					
3.001	SW08	SW09	16.735	0.600	Colebrook-White	18.966	18.902	0.064	261.5	225	Circular	4.77	50.0					
3.002	SW09	SW10	4.559	0.600	Colebrook-White	18.902	18.884	0.018	253.3	225	Circular	4.87	50.0					
3.003	SW10	SW11	46.013	0.600	Colebrook-White	18.884	18.709	0.175	262.9	225	Circular	5.82	46.7					
3.004	SW11	SW12	9.214	0.600	Colebrook-White	18.709	18.665	0.044	209.4	300	Circular	5.96	46.2					
1.005	SW12	SW13	7.543	0.600	Colebrook-White	18.665	18.627	0.038	198.5	375	Circular	6.13	45.7					
1.006	SW13	SW16-HB	2.709	0.600	Colebrook-White	18.627	18.621	0.006	451.4	375	Circular	6.18	45.5					
4.000	SW14	SW15	23.008	0.600	Colebrook-White	18.815	18.727	0.088	261.5	225	Circular	4.48	50.0					
4.001	SW15	SW16-HB	27.233	0.600	Colebrook-White	18.727	18.621	0.106	256.9	300	Circular	4.94	49.7					
1.007	SW16-HB	SW17	2.183	0.600	Colebrook-White	18.621	18.610	0.011	200.0	300	Circular	6.22	45.5					
1.008	SW17	SW18	42.149	0.600	Colebrook-White	18.610	18.399	0.211	200.0	300	Circular	6.85	43.7					
1.009	SW18	SW19	6.932	0.600	Colebrook-White	18.399	18.364	0.035	200.0	300	Circular	6.95	43.4					
1.010	SW19	SW42	24.376	0.600	Colebrook-White	18.364	18.242	0.122	200.0	300	Circular	7.32	42.4					
7.000	SW20	SW21	20.473	0.600	Colebrook-White	19.135	19.056	0.079	260.0	225	Circular	4.42	50.0					
7.001	SW21	SW23	14.256	0.600	Colebrook-White	19.056	19.001	0.055	259.2	300	Circular	4.67	50.0					
8.000	SW22	SW23	12.161	0.600	Colebrook-White	19.135	19.074	0.061	200.0	300	Circular	4.18	50.0					
7.002	SW23	SW24	17.191	0.600	Colebrook-White	19.001	18.935	0.066	260.5	225	Circular	5.02	49.4					
9.000	SW25	SW26	21.683	0.600	Colebrook-White	19.135	19.052	0.083	260.0	225	Circular	4.45	50.0					
9.001	SW26	SW28	19.834	0.600	Colebrook-White	19.052	18.976	0.076	261.0	225	Circular	4.86	50.0					
10.000	SW27	SW28	5.222	0.600	Colebrook-White	18.985	18.959	0.026	200.0	225	Circular	4.09	50.0					
9.002	SW28	SW29	2.735	0.600	Colebrook-White	18.959	18.935	0.024	113.9	225	Circular	4.90	49.8					
5.000	SW30	SW31-HB	4.939	0.600	Colebrook-White	18.935	18.910	0.025	200.0	225	Circular	4.09	50.0					
5.001	SW31-HB	SW32	17.872	0.600	Colebrook-White	18.910	18.842	0.068	262.8	225	Circular	4.46	50.0					
5.002	SW32	SW42	24.608	0.600	Colebrook-White	18.842	18.748	0.094	261.8	225	Circular	4.97	49.6					
11.000	SW33	SW34	6.370	0.600	Colebrook-White	19.725	19.701	0.024	260.0	225	Circular	4.13	50.0					
11.001	SW34	SW37	24.728	0.600	Colebrook-White	19.701	19.606	0.095	260.3	225	Circular	4.64	50.0					
12.000	SW35	SW36	8.947	0.600	Colebrook-White	19.575	19.541	0.034	260.0	225	Circular	4.19	50.0					
12.001	SW36	SW37	7.746	0.600	Colebrook-White	19.541	19.511	0.030	258.2	225	Circular	4.34	50.0					
11.002	SW37	SW38	4.740	0.600	Colebrook-White	19.511	19.493	0.018	263.3	225	Circular	4.74	50.0					
6.000	SW39	SW40-HB	8.711	0.600	Colebrook-White	19.493	19.325	0.168	51.9	225	Circular	4.08	50.0					
6.001	SW40-HB	SW41	7.224	0.600	Colebrook-White	19.325	19.297	0.028	258.0	225	Circular	4.23	50.0					
6.002	SW41	SW42	27.055	0.600	Colebrook-White	19.297	19.115	0.182	148.7	225	Circular	4.65	50.0					
1.011	SW42	SW43	46.402	0.600	Colebrook-White	18.242	18.010	0.232	200.0	300	Circular	8.02	40.8					
1.012	SW43	SW44	6.079	0.600	Colebrook-White	18.010	17.980	0.030	200.0	300	Circular	8.11	40.6					
1.013	SW44	CS01	7.190	0.600	Colebrook-White	17.980	17.944	0.036	200.0	300	Circular	8.22	40.3					

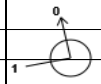
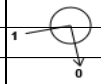
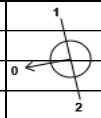
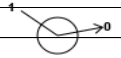
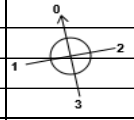
	Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)	Notes
✓	1.000	SW01	SW02	0.800	31.8	4.7	1.000	1.169	1.000	1.169	0.035	0.0	58	0.577	
✓	1.001	SW02	SW03	0.801	31.8	9.0	1.169	1.282	1.169	1.282	0.070	0.0	82	0.692	
✓	1.002	SW03	SW04	0.815	57.6	13.4	1.207	1.219	1.207	1.219	0.105	0.0	98	0.667	
✓	1.003	SW04	SW06	0.804	56.8	17.6	1.219	1.230	1.219	1.230	0.140	0.0	115	0.712	
✓	2.000	SW05	SW06	1.250	49.7	4.7	1.000	1.305	1.000	1.305	0.035	0.0	47	0.797	Fall increased to remove backdrop
✓	1.004	SW06	SW12	1.221	86.3	26.2	1.230	1.075	1.075	1.230	0.210	0.0	113	1.074	Fall increased to remove backdrop
✓	3.000	SW07	SW08	0.805	32.0	4.7	1.000	1.079	1.000	1.079	0.035	0.0	58	0.580	
✓	3.001	SW08	SW09	0.804	32.0	9.5	1.079	1.143	1.079	1.143	0.070	0.0	84	0.702	
✓	3.002	SW09	SW10	0.817	32.5	14.2	1.143	1.161	1.143	1.161	0.105	0.0	104	0.790	
✓	3.003	SW10	SW11	0.801	31.9	17.7	1.161	1.336	1.161	1.336	0.140	0.0	120	0.822	
✓	3.004	SW11	SW12	1.082	76.5	21.9	1.261	1.075	1.075	1.261	0.175	0.0	110	0.939	
✓	1.005	SW12	SW13	1.282	141.6	52.0	1.000	1.038	1.000	1.038	0.420	0.0	157	1.187	
✓	1.006	SW13	SW16-HB	0.846	93.4	51.9	1.038	1.044	1.038	1.044	0.420	0.0	200	0.867	
✓	4.000	SW14	SW15	0.804	32.0	4.7	1.000	1.088	1.000	1.088	0.035	0.0	58	0.579	
✓	4.001	SW15	SW16-HB	0.976	69.0	4.7	1.013	1.119	1.013	1.119	0.035	0.0	53	0.565	Fall increased to remove backdrop
✓	1.007	SW16-HB	SW17	1.108	78.3	56.1	1.119	1.130	1.119	1.130	0.455	0.0	188	1.201	
✓	1.008	SW17	SW18	1.108	78.3	53.8	1.130	1.801	1.130	1.801	0.455	0.0	183	1.191	
✓	1.009	SW18	SW19	1.108	78.3	53.5	1.801	1.836	1.801	1.836	0.455	0.0	183	1.190	
✓	1.010	SW19	SW42	1.108	78.3	52.3	1.836	1.798	1.798	1.836	0.455	0.0	180	1.184	
?	7.000	SW20	SW21	0.806	32.0	1.4	0.600	0.679	0.600	0.679	0.010	0.0	31	0.398	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	7.001	SW21	SW23	0.972	68.7	2.7	0.604	0.959	0.604	0.959	0.020	0.0	41	0.478	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	8.000	SW22	SW23	1.108	78.3	1.4	0.825	0.886	0.825	0.886	0.010	0.0	27	0.422	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	7.002	SW23	SW24	0.805	32.0	5.4	1.034	0.650	0.650	1.034	0.040	0.0	62	0.599	Downstream Depth is less than the specified minimum
?	9.000	SW25	SW26	0.806	32.0	1.4	0.900	0.683	0.683	0.900	0.010	0.0	31	0.398	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	9.001	SW26	SW28	0.804	32.0	2.7	0.683	0.609	0.609	0.683	0.020	0.0	44	0.494	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	10.000	SW27	SW28	0.921	36.6	1.4	0.600	0.626	0.600	0.626	0.010	0.0	29	0.439	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	9.002	SW28	SW29	1.224	48.7	5.4	0.626	0.650	0.626	0.650	0.040	0.0	51	0.813	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	5.000	SW30	SW31-HB	0.921	36.6	0.0	0.650	0.675	0.650	0.675	0.000	0.0	0	0.000	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	5.001	SW31-HB	SW32	0.802	31.9	0.0	0.675	1.193	0.675	1.193	0.000	0.0	0	0.000	Upstream Depth is less than the specified minimum
✓	5.002	SW32	SW42	0.803	31.9	0.0	1.193	1.367	1.193	1.367	0.000	0.0	0	0.000	
?	11.000	SW33	SW34	0.806	32.0	1.4	0.600	0.624	0.600	0.624	0.010	0.0	31	0.398	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	11.001	SW34	SW37	0.806	32.0	2.7	0.624	0.719	0.624	0.719	0.020	0.0	44	0.495	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	12.000	SW35	SW36	0.806	32.0	1.4	0.600	0.634	0.600	0.634	0.010	0.0	31	0.398	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	12.001	SW36	SW37	0.809	32.2	2.7	0.634	0.814	0.634	0.814	0.020	0.0	44	0.497	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	11.002	SW37	SW38	0.801	31.8	6.8	0.814	0.732	0.732	0.814	0.050	0.0	70	0.637	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	6.000	SW39	SW40-HB	1.820	72.4	0.0	0.732	1.000	0.732	1.000	0.000	0.0	0	0.000	Upstream Depth is less than the specified minimum
✓	6.001	SW40-HB	SW41	0.809	32.2	0.0	1.000	1.028	1.000	1.028	0.000	0.0	0	0.000	
✓	6.002	SW41	SW42	1.070	42.5	0.0	1.028	1.000	1.000	1.028	0.000	0.0	0	0.000	
✓	1.011	SW42	SW43	1.108	78.3	50.3	1.798	1.930	1.798	1.930	0.455	0.0	175	1.173	
✓	1.012	SW43	SW44	1.108	78.3	50.0	1.930	1.950	1.930	1.950	0.455	0.0	174	1.172	
✓	1.013	SW44	CS01	1.108	78.3	49.7	1.950	1.906	1.906	1.950	0.455	0.0	174	1.171	

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)	US Node	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type	DS Node	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type
1.000	44.553	263.6	225	Circular	20.270	19.045	1.000	20.270	18.876	1.169	SW01	1200			Manhole	Adoptable	SW02	1200			Manhole	Adoptable
1.001	29.775	263.5	225	Circular	20.270	18.876	1.169	20.270	18.763	1.282	SW02	1200			Manhole	Adoptable	SW03	1200			Manhole	Adoptable
1.002	4.401	366.7	300	Circular	20.270	18.763	1.207	20.270	18.751	1.219	SW03	1200			Manhole	Adoptable	SW04	1200			Manhole	Adoptable
1.003	13.565	376.8	300	Circular	20.270	18.751	1.219	20.245	18.715	1.230	SW04	1200			Manhole	Adoptable	SW06	1200			Manhole	Adoptable
2.000	52.965	109.2	225	Circular	20.425	19.200	1.000	20.245	18.715	1.305	SW05	1200			Manhole	Adoptable	SW06	1200			Manhole	Adoptable
1.004	8.246	164.9	300	Circular	20.245	18.715	1.230	20.040	18.665	1.075	SW06	1200			Manhole	Adoptable	SW12	1350			Manhole	Adoptable
3.000	20.581	260.5	225	Circular	20.270	19.045	1.000	20.270	18.966	1.079	SW07	1200			Manhole	Adoptable	SW08	1200			Manhole	Adoptable
3.001	16.735	261.5	225	Circular	20.270	18.966	1.079	20.270	18.902	1.143	SW08	1200			Manhole	Adoptable	SW09	1200			Manhole	Adoptable
3.002	4.559	253.3	225	Circular	20.270	18.902	1.143	20.270	18.884	1.161	SW09	1200			Manhole	Adoptable	SW10	1200			Manhole	Adoptable
3.003	46.013	262.9	225	Circular	20.270	18.884	1.161	20.270	18.709	1.336	SW10	1200			Manhole	Adoptable	SW11	1200			Manhole	Adoptable
3.004	9.214	209.4	300	Circular	20.270	18.709	1.261	20.040	18.665	1.075	SW11	1200			Manhole	Adoptable	SW12	1350			Manhole	Adoptable
1.005	7.543	198.5	375	Circular	20.040	18.665	1.000	20.040	18.627	1.038	SW12	1350			Manhole	Adoptable	SW13	1350			Manhole	Adoptable
1.006	2.709	451.4	375	Circular	20.040	18.627	1.038	20.040	18.621	1.044	SW13	1350			Manhole	Adoptable	SW16-HB	1350			Manhole	Adoptable
4.000	23.008	261.5	225	Circular	20.040	18.815	1.000	20.040	18.727	1.088	SW14	1200			Manhole	Adoptable	SW15	1200			Manhole	Adoptable
4.001	27.233	256.9	300	Circular	20.040	18.727	1.013	20.040	18.621	1.119	SW15	1200			Manhole	Adoptable	SW16-HB	1350			Manhole	Adoptable
1.007	2.183	200.0	300	Circular	20.040	18.621	1.119	20.040	18.610	1.130	SW16-HB	1350			Manhole	Adoptable	SW17	1200			Manhole	Adoptable
1.008	42.149	200.0	300	Circular	20.040	18.610	1.130	20.500	18.399	1.801	SW17	1200			Manhole	Adoptable	SW18	1200			Manhole	Adoptable
1.009	6.932	200.0	300	Circular	20.500	18.399	1.801	20.500	18.364	1.836	SW18	1200			Manhole	Adoptable	SW19	1200			Manhole	Adoptable
1.010	24.376	200.0	300	Circular	20.500	18.364	1.836	20.340	18.242	1.798	SW19	1200			Manhole	Adoptable	SW42	1200			Manhole	Adoptable
7.000	20.473	260.0	225	Circular	19.960	19.135	0.600	19.960	19.056	0.679	SW20	1200			Manhole	Adoptable	SW21	1200			Manhole	Adoptable
7.001	14.256	259.2	300	Circular	19.960	19.056	0.604	20.260	19.001	0.959	SW21	1200			Manhole	Adoptable	SW23	1200			Manhole	Adoptable
8.000	12.161	200.0	300	Circular	20.260	19.135	0.825	20.260	19.074	0.886	SW22	1200			Manhole	Adoptable	SW23	1200			Manhole	Adoptable
7.002	17.191	260.5	225	Circular	20.260	19.001	1.034	19.810	18.935	0.650	SW23	1200			Manhole	Adoptable	SW24	1200			Manhole	Adoptable
9.000	21.683	260.0	225	Circular	20.260	19.135	0.900	19.960	19.052	0.683	SW25	1200			Manhole	Adoptable	SW26	1200			Manhole	Adoptable
9.001	19.834	261.0	225	Circular	19.960	19.052	0.683	19.810	18.976	0.609	SW26	1200			Manhole	Adoptable	SW28	1200			Manhole	Adoptable
10.000	5.222	200.0	225	Circular	19.810	18.985	0.600	19.810	18.959	0.626	SW27	1200			Manhole	Adoptable	SW28	1200			Manhole	Adoptable
9.002	2.735	113.9	225	Circular	19.810	18.959	0.626	19.810	18.935	0.650	SW28	1200			Manhole	Adoptable	SW29	1200			Manhole	Adoptable
5.000	4.939	200.0	225	Circular	19.810	18.935	0.650	19.810	18.910	0.675	SW30	1200			Manhole	Adoptable	SW31-HB	1200			Manhole	Adoptable
5.001	17.872	262.8	225	Circular	19.810	18.910	0.675	20.260	18.842	1.193	SW31-HB	1200			Manhole	Adoptable	SW32	1200			Manhole	Adoptable
5.002	24.608	261.8	225	Circular	20.260	18.842	1.193	20.340	18.748	1.367	SW32	1200			Manhole	Adoptable	SW42	1200			Manhole	Adoptable
11.000	6.370	260.0	225	Circular	20.550	19.725	0.600	20.550	19.701	0.624	SW33	1200			Manhole	Adoptable	SW34	1200			Manhole	Adoptable
11.001	24.728	260.3	225	Circular	20.550	19.701	0.624	20.550	19.606	0.719	SW34	1200			Manhole	Adoptable	SW37	1200			Manhole	Adoptable
12.000	8.947	260.0	225	Circular	20.400	19.575	0.600	20.400	19.541	0.634	SW35	1200			Manhole	Adoptable	SW36	1200			Manhole	Adoptable
12.001	7.746	258.2	225	Circular	20.400	19.541	0.634	20.550	19.511	0.814	SW36	1200			Manhole	Adoptable	SW37	1200			Manhole	Adoptable
11.002	4.740	263.3	225	Circular	20.550	19.511	0.814	20.450	19.493	0.732	SW37	1200			Manhole	Adoptable	SW38	1200			Manhole	Adoptable
6.000	8.711	51.9	225	Circular	20.450	19.493	0.732	20.550	19.325	1.000	SW39	1200			Manhole	Adoptable	SW40-HB	1200			Manhole	Adoptable
6.001	7.224	258.0	225	Circular	20.550	19.325	1.000	20.550	19.297	1.028	SW40-HB	1200			Manhole	Adoptable	SW41	1200			Manhole	Adoptable
6.002	27.055	148.7	225	Circular	20.550	19.297	1.028	20.340	19.115	1.000	SW41	1200			Manhole	Adoptable	SW42	1200			Manhole	Adoptable
1.011	46.402	200.0	300	Circular	20.340	18.242	1.798	20.240	18.010	1.930	SW42	1200			Manhole	Adoptable	SW43	1200			Manhole	Adoptable
1.012	6.079	200.0	300	Circular	20.240	18.010	1.930	20.230	17.980	1.950	SW43	1200			Manhole	Adoptable	SW44	1200			Manhole	Adoptable
1.013	7.190	200.0	300	Circular	20.230	17.980	1.950	20.150	17.944	1.906	SW44	1200			Manhole	Adoptable	CS01	1200			Manhole	Adoptable

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type	Connections		Link	IL (m)	Dia (mm)	Link Type
SW01	713824.085	733647.840	20.270	1.225	1200			Manhole	Adoptable						
															
											0	1.000	19.045	225	Circular
SW02	713780.329	733639.448	20.270	1.394	1200			Manhole	Adoptable		1	1.000	18.876	225	Circular
											0	1.001	18.876	225	Circular
SW03	713768.911	733666.947	20.270	1.507	1200			Manhole	Adoptable		1	1.001	18.763	225	Circular
															
											0	1.002	18.763	300	Circular
SW04	713772.212	733669.857	20.270	1.519	1200			Manhole	Adoptable		1	1.002	18.751	300	Circular
															
											0	1.003	18.751	300	Circular
SW05	713775.680	733722.376	20.425	1.225	1200			Manhole	Adoptable						
															
											0	2.000	19.200	225	Circular
SW06	713785.767	733670.380	20.245	1.530	1200			Manhole	Adoptable		1	2.000	18.715	225	Circular
											2	1.003	18.715	300	Circular
											0	1.004	18.715	300	Circular
SW07	713827.273	733648.451	20.270	1.225	1200			Manhole	Adoptable						
															
											0	3.000	19.045	225	Circular
SW08	713847.486	733652.328	20.270	1.304	1200			Manhole	Adoptable		1	3.000	18.966	225	Circular
											0	3.001	18.966	225	Circular
SW09	713844.294	733668.756	20.270	1.368	1200			Manhole	Adoptable		1	3.001	18.902	225	Circular
															
											0	3.002	18.902	225	Circular
SW10	713840.795	733671.679	20.270	1.386	1200			Manhole	Adoptable		1	3.002	18.884	225	Circular
															
											0	3.003	18.884	225	Circular

SW11	713795.626	733662.909	20.270	1.561	1200			Manhole	Adoptable		1	3.003	18.709	225	Circular
											0	3.004	18.709	300	Circular
SW12	713793.862	733671.953	20.040	1.375	1350			Manhole	Adoptable		1	3.004	18.665	300	Circular
											2	1.004	18.665	300	Circular
											0	1.005	18.665	375	Circular
SW13	713801.268	733673.383	20.040	1.413	1350			Manhole	Adoptable		1	1.005	18.627	375	Circular
											0	1.006	18.627	375	Circular
SW14	713850.393	733683.256	20.040	1.225	1200			Manhole	Adoptable						
															
											0	4.000	18.815	225	Circular
SW15	713827.807	733678.869	20.040	1.313	1200			Manhole	Adoptable		1	4.000	18.727	225	Circular
															
											0	4.001	18.727	300	Circular
SW16-HB	713800.722	733676.036	20.040	1.419	1350			Manhole	Adoptable		1	4.001	18.621	300	Circular
											2	1.006	18.621	375	Circular
											0	1.007	18.621	300	Circular
SW17	713798.579	733675.622	20.040	1.430	1200			Manhole	Adoptable		1	1.007	18.610	300	Circular
											0	1.008	18.610	300	Circular
SW18	713790.576	733717.004	20.500	2.101	1200			Manhole	Adoptable		1	1.008	18.399	300	Circular
															
											0	1.009	18.399	300	Circular
SW19	713783.771	733715.683	20.500	2.136	1200			Manhole	Adoptable		1	1.009	18.364	300	Circular
											0	1.010	18.364	300	Circular
SW20	713819.914	733779.155	19.960	0.825	1200			Manhole	Adoptable						
															
											0	7.000	19.135	225	Circular
SW21	713799.865	733775.008	19.960	0.904	1200			Manhole	Adoptable		1	7.000	19.056	225	Circular
															

											0	7.001	19.056	300	Circular
SW22	713804.913	733749.078	20.260	1.125	1200			Manhole	Adoptable						
											0	8.000	19.135	300	Circular
SW23	713802.589	733761.015	20.260	1.259	1200			Manhole	Adoptable		1	8.000	19.074	300	Circular
											2	7.001	19.001	300	Circular
											0	7.002	19.001	225	Circular
SW24	713819.424	733764.493	19.810	0.875	1200			Manhole	Adoptable		1	7.002	18.935	225	Circular
SW25	713806.894	733744.815	20.260	1.125	1200			Manhole	Adoptable						
											0	9.000	19.135	225	Circular
SW26	713828.129	733749.202	19.960	0.908	1200			Manhole	Adoptable		1	9.000	19.052	225	Circular
											0	9.001	19.052	225	Circular
SW27	713823.060	733773.739	19.810	0.825	1200			Manhole	Adoptable						
											0	10.000	18.985	225	Circular
SW28	713824.119	733768.626	19.810	0.851	1200			Manhole	Adoptable		1	10.000	18.959	225	Circular
											2	9.001	18.976	225	Circular
											0	9.002	18.959	225	Circular
SW29	713821.441	733768.073	19.810	0.875	1200			Manhole	Adoptable		1	9.002	18.935	225	Circular
SW30	713822.314	733755.747	19.810	0.875	1200			Manhole	Adoptable						
											0	5.000	18.935	225	Circular
SW31-HB	713817.478	733754.743	19.810	0.900	1200			Manhole	Adoptable		1	5.000	18.910	225	Circular
											0	5.001	18.910	225	Circular
SW32	713802.992	733744.276	20.260	1.418	1200			Manhole	Adoptable		1	5.001	18.842	225	Circular

															
											0	5.002	18.842	225	Circular
SW33	713748.086	733729.107	20.550	0.825	1200			Manhole	Adoptable						
															
											0	11.000	19.725	225	Circular
SW34	713754.324	733730.396	20.550	0.849	1200			Manhole	Adoptable		1	11.000	19.701	225	Circular
											0	11.001	19.701	225	Circular
SW35	713738.758	733760.414	20.400	0.825	1200			Manhole	Adoptable						
															
											0	12.000	19.575	225	Circular
SW36	713747.534	733762.153	20.400	0.859	1200			Manhole	Adoptable		1	12.000	19.541	225	Circular
															
											0	12.001	19.541	225	Circular
SW37	713749.154	733754.578	20.550	1.039	1200			Manhole	Adoptable		1	12.001	19.511	225	Circular
											2	11.001	19.606	225	Circular
											0	11.002	19.511	225	Circular
SW38	713744.519	733753.587	20.450	0.957	1200			Manhole	Adoptable		1	11.002	19.493	225	Circular
															
SW39	713744.824	733746.974	20.450	0.957	1200			Manhole	Adoptable						
															
											0	6.000	19.493	225	Circular
SW40-HB	713746.585	733738.443	20.550	1.225	1200			Manhole	Adoptable		1	6.000	19.325	225	Circular
											0	6.001	19.325	225	Circular
SW41	713752.345	733734.083	20.550	1.253	1200			Manhole	Adoptable		1	6.001	19.297	225	Circular
															
											0	6.002	19.297	225	Circular
SW42	713778.841	733739.555	20.340	2.098	1200			Manhole	Adoptable		1	6.002	19.115	225	Circular
											2	5.002	18.748	225	Circular
											3	1.010	18.242	300	Circular
											0	1.011	18.242	300	Circular
SW43	713769.457	733784.998	20.240	2.230	1200			Manhole	Adoptable		1	1.011	18.010	300	Circular

															
											0	1.012	18.010	300	Circular
SW44	713768.228	733790.951	20.230	2.250	1200			Manhole	Adoptable		1	1.012	17.980	300	Circular
															
											0	1.013	17.980	300	Circular
CS01	713772.520	733796.719	20.150	2.206	1200			Manhole	Adoptable		1	1.013	17.944	300	Circular
															

Rainfall Methodology	FSR		Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
FSR Region	England and Wales		2	20	0	0
M5-60 (mm)	16.300		30	20	0	0
Ratio-R	0.280		100	20	0	0
Summer CV	0.750					
Winter CV	0.840					
Analysis Speed	Normal					
Skip Steady State	No					
Drain Down Time (mins)	240					
Additional Storage (m³/ha)	20.0					
Storm Durations (mins)	15					
	30					
	60					
	120					
	180					
	240					
	360					
	480					
	600					
	720					
	960					
	1440					
	2160					
	2880					
Check Discharge Rate(s)	No					
Check Discharge Volume	No					
100 year 360 minute (m³)						

Hydro-Brake®

Node	Flap Valve	Online / Offline	Downstream Link	Replaces Downstream Link	Loop to Node	Invert Level (m)	Design Depth (m)	Design Flow (l/s)	Objective	Sump Available	Product Number	Min Outlet Diameter (m)	Min Node Diameter (mm)
SW16-HB	No	Online		Yes		18.621	1.000	3.9	(HE) Minimise upstream storage	Yes	CTL-SHE-0094-3900-1000-3900	0.150	1200
SW40-HB	No	Online		No		19.325	1.000	0.7	(HE) Minimise upstream storage	Yes	CTL-SHE-0039-7000-1000-7000	0.075	1200
SW31-HB	No	Online		Yes		18.910	1.200	1.4	(HE) Minimise upstream storage	Yes	CTL-SHE-0053-1400-1200-1400	0.075	1200

Depth/Area/Inf Area													
Node	**Base Inf Coefficient (m/hr)**	**Side Inf Coefficient (m/hr)**	**Safety Factor**	**Porosity**	**Invert Level (m)**	**Time to half empty (mins)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**				
SW16-HB	0.00000	0.00000	2.0	1.00	18.621		0.000	185.0	0.0				
							1.145	185.0	0.0				
							1.146	0.0	0.0				
Flow through Pond													
Node	**Base Inf Coefficient (m/hr)**	**Side Inf Coefficient (m/hr)**	**Safety Factor**	**Porosity**	**Invert Level (m)**	**Time to half empty (mins)**	**Main Channel Length (m)**	**Main Channel Slope (1:X)**	**Main Channel n**	**Inlets**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
SW39	0.00000	0.00000	2.0	1.00	19.493	0	6.620	99999.0	0.025	SW38	0.000	2.2	0.0
											0.610	57.0	0.0
SW30	0.00000	0.00000	2.0	1.00	18.935	0	12.000	99999.0	0.025	SW29	0.000	7.2	0.0
										SW24	0.675	84.8	0.0

Default Values			**Overrides**					
Entry Loss (manhole)	0.250		**Link**	**Entry Loss**	**Exit Loss**		**Node**	**Flood Risk (m)**
Exit Loss (manhole)	0.250							
Entry Loss (junction)	0.000							
Exit Loss (junction)	0.000							
Apply Recommended Losses	No							
Flood Risk (m)	0.300							

Node Size	Yes
Node Losses	Yes
Link Size	Yes
Minimum Diameter (mm)	150
Link Length	Yes
Maximum Length (m)	100.000
Coordinates	Yes
Accuracy (m)	1.000
Crossings	Yes
Cover Depth	Yes
Minimum Cover Depth (m)	
Maximum Cover Depth (m)	3.000
Backdrops	Yes
Minimum Backdrop Height (m)	
Maximum Backdrop Height (m)	1.500
Full Bore Velocity	Yes
Minimum Full Bore Velocity (m/s)	
Maximum Full Bore Velocity (m/s)	3.000
Proportional Velocity	Yes
Return Period (years)	
Minimum Proportional Velocity (m/s)	0.750
Maximum Proportional Velocity (m/s)	3.000
Surcharged Depth	Yes
Return Period (years)	
Maximum Surcharged Depth (m)	0.100
Flooding	Yes
Return Period (years)	30
Time to Half Empty	No
Return Period (years)	
Discharge Rates	Yes
Discharge Volume	Yes
100 year 360 minute (m^3)	

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +20% CC 15 minute summer	122.760	34.737
2 year +20% CC 15 minute winter	86.147	34.737
2 year +20% CC 30 minute summer	83.782	23.707
2 year +20% CC 30 minute winter	58.794	23.707
2 year +20% CC 60 minute summer	59.404	15.699
2 year +20% CC 60 minute winter	39.467	15.699
2 year +20% CC 120 minute summer	38.659	10.217
2 year +20% CC 120 minute winter	25.684	10.217
2 year +20% CC 180 minute summer	30.754	7.914
2 year +20% CC 180 minute winter	19.991	7.914
2 year +20% CC 240 minute summer	24.961	6.597
2 year +20% CC 240 minute winter	16.584	6.597
2 year +20% CC 360 minute summer	19.805	5.096
2 year +20% CC 360 minute winter	12.874	5.096
2 year +20% CC 480 minute summer	16.008	4.230
2 year +20% CC 480 minute winter	10.635	4.230
2 year +20% CC 600 minute summer	13.384	3.661
2 year +20% CC 600 minute winter	9.145	3.661
2 year +20% CC 720 minute summer	12.138	3.253
2 year +20% CC 720 minute winter	8.157	3.253
2 year +20% CC 960 minute summer	10.254	2.700
2 year +20% CC 960 minute winter	6.793	2.700
2 year +20% CC 1440 minute summer	7.752	2.077
2 year +20% CC 1440 minute winter	5.210	2.077
2 year +20% CC 2160 minute summer	5.779	1.597
2 year +20% CC 2160 minute winter	3.982	1.597
2 year +20% CC 2880 minute summer	4.947	1.326
2 year +20% CC 2880 minute winter	3.324	1.326
30 year +20% CC 15 minute summer	229.503	64.941
30 year +20% CC 15 minute winter	161.055	64.941

30 year +20% CC 30 minute summer	158.968	44.982
30 year +20% CC 30 minute winter	111.556	44.982
30 year +20% CC 60 minute summer	113.260	29.931
30 year +20% CC 60 minute winter	75.247	29.931
30 year +20% CC 120 minute summer	73.396	19.396
30 year +20% CC 120 minute winter	48.762	19.396
30 year +20% CC 180 minute summer	57.848	14.886
30 year +20% CC 180 minute winter	37.602	14.886
30 year +20% CC 240 minute summer	46.439	12.273
30 year +20% CC 240 minute winter	30.853	12.273
30 year +20% CC 360 minute summer	36.061	9.280
30 year +20% CC 360 minute winter	23.441	9.280
30 year +20% CC 480 minute summer	28.792	7.609
30 year +20% CC 480 minute winter	19.128	7.609
30 year +20% CC 600 minute summer	23.829	6.518
30 year +20% CC 600 minute winter	16.281	6.518
30 year +20% CC 720 minute summer	21.419	5.741
30 year +20% CC 720 minute winter	14.395	5.741
30 year +20% CC 960 minute summer	17.828	4.694
30 year +20% CC 960 minute winter	11.809	4.694
30 year +20% CC 1440 minute summer	13.169	3.529
30 year +20% CC 1440 minute winter	8.850	3.529
30 year +20% CC 2160 minute summer	9.582	2.648
30 year +20% CC 2160 minute winter	6.602	2.648
30 year +20% CC 2880 minute summer	8.049	2.157
30 year +20% CC 2880 minute winter	5.409	2.157
100 year +20% CC 15 minute summer	293.791	83.133
100 year +20% CC 15 minute winter	206.169	83.133
100 year +20% CC 30 minute summer	206.213	58.351
100 year +20% CC 30 minute winter	144.711	58.351
100 year +20% CC 60 minute summer	148.278	39.186
100 year +20% CC 60 minute winter	98.513	39.186
100 year +20% CC 120 minute summer	96.536	25.512

100 year +20% CC 120 minute winter	64.136	25.512
100 year +20% CC 180 minute summer	76.018	19.562
100 year +20% CC 180 minute winter	49.413	19.562
100 year +20% CC 240 minute summer	60.840	16.078
100 year +20% CC 240 minute winter	40.421	16.078
100 year +20% CC 360 minute summer	46.864	12.060
100 year +20% CC 360 minute winter	30.463	12.060
100 year +20% CC 480 minute summer	37.216	9.835
100 year +20% CC 480 minute winter	24.726	9.835
100 year +20% CC 600 minute summer	30.664	8.387
100 year +20% CC 600 minute winter	20.951	8.387
100 year +20% CC 720 minute summer	27.458	7.359
100 year +20% CC 720 minute winter	18.453	7.359
100 year +20% CC 960 minute summer	22.706	5.979
100 year +20% CC 960 minute winter	15.041	5.979
100 year +20% CC 1440 minute summer	16.606	4.450
100 year +20% CC 1440 minute winter	11.160	4.450
100 year +20% CC 2160 minute summer	11.950	3.303
100 year +20% CC 2160 minute winter	8.234	3.303
100 year +20% CC 2880 minute summer	9.953	2.668
100 year +20% CC 2880 minute winter	6.689	2.668

Results for 2 year +20% CC Critical Storm Duration. Lowest mass balance: 99.36%																		
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Outflow)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)	Notes	
15 minute winter	SW01	10	19.109	0.064	5.9	0.1095	0.0000	OK	15 minute winter	1.000	SW02	5.8	0.480	0.182	0.5392			
15 minute winter	SW02	10	18.966	0.090	11.7	0.1473	0.0000	OK	15 minute winter	1.001	SW03	11.0	0.479	0.345	0.7022			
360 minute winter	SW03	272	18.937	0.174	3.3	0.2777	0.0000	OK	15 minute winter	1.002	SW04	17.2	0.435	0.299	0.1863			
360 minute winter	SW04	272	18.937	0.186	4.2	0.2963	0.0000	OK	15 minute winter	1.003	SW06	23.3	0.541	0.409	0.6246			
15 minute winter	SW05	10	19.252	0.052	5.9	0.0879	0.0000	OK	15 minute winter	2.000	SW06	5.8	0.329	0.117	1.1582			
360 minute winter	SW06	272	18.937	0.222	6.2	0.3527	0.0000	OK	15 minute summer	1.004	SW12	36.3	0.706	0.420	0.4542			
15 minute winter	SW07	10	19.110	0.065	5.9	0.1101	0.0000	OK	15 minute winter	3.000	SW08	5.9	0.462	0.184	0.2694			
15 minute winter	SW08	10	19.065	0.099	11.8	0.1647	0.0000	OK	15 minute winter	3.001	SW09	11.4	0.536	0.357	0.3563			
15 minute winter	SW09	10	19.041	0.139	17.3	0.2290	0.0000	OK	15 minute winter	3.002	SW10	16.9	0.665	0.519	0.1156			
15 minute winter	SW10	11	19.020	0.136	22.8	0.2222	0.0000	OK	15 minute winter	3.003	SW11	22.1	0.729	0.692	1.4302			
360 minute winter	SW11	272	18.937	0.228	5.4	0.3601	0.0000	OK	15 minute summer	3.004	SW12	29.3	0.569	0.382	0.5074			
360 minute winter	SW12	272	18.937	0.272	11.9	0.5278	0.0000	OK	15 minute summer	1.005	SW13	72.6	1.139	0.513	0.5458			
360 minute winter	SW13	272	18.937	0.310	11.6	0.4436	0.0000	OK	15 minute winter	1.006	SW16-HB	77.6	2.166	0.831	0.1109			
360 minute winter	SW14	264	18.937	0.122	1.1	0.2075	0.0000	OK	15 minute winter	4.000	SW15	5.9	0.628	0.185	0.2161			
360 minute winter	SW15	272	18.937	0.210	1.1	0.2375	0.0000	OK	15 minute winter	4.001	SW16-HB	6.0	0.887	0.088	0.5905			
360 minute winter	SW16-HB	272	18.937	0.316	12.2	58.9066	0.0000	SURCHARGED	360 minute winter	Hydro-Brake®	SW17	3.9						
360 minute winter	SW17	272	18.655	0.045	3.9	0.0513	0.0000	OK	360 minute winter	1.008	SW18	3.9	0.566	0.050	0.2904			
360 minute winter	SW18	272	18.446	0.047	3.9	0.0536	0.0000	OK	360 minute winter	1.009	SW19	3.9	0.568	0.050	0.0476			
480 minute winter	SW19	464	18.409	0.045	3.9	0.0515	0.0000	OK	360 minute winter	1.010	SW42	3.9	0.548	0.050	0.1837			
15 minute winter	SW20	10	19.170	0.035	1.7	0.0476	0.0000	OK	15 minute winter	7.000	SW21	1.7	0.360	0.052	0.0957			
180 minute winter	SW21	132	19.139	0.083	1.0	0.1127	0.0000	OK	15 minute winter	7.001	SW23	3.3	0.362	0.048	0.1509			
15 minute winter	SW22	10	19.166	0.031	1.7	0.0405	0.0000	OK	15 minute winter	8.000	SW23	1.7	0.451	0.021	0.0454			
180 minute winter	SW23	132	19.139	0.138	2.0	0.1784	0.0000	OK	15 minute winter	7.002	SW24	6.4	0.502	0.200	0.3686			
180 minute winter	SW24	132	19.139	0.204	1.7	0.2310	0.0000	OK	15 minute summer	Flow through pond	SW30	6.7	0.125	0.031	2.2706			
15 minute winter	SW25	10	19.170	0.035	1.7	0.0455	0.0000	OK	15 minute winter	9.000	SW26	1.7	0.331	0.052	0.1103			
180 minute winter	SW26	140	19.141	0.089	1.1	0.1202	0.0000	OK	15 minute winter	9.001	SW28	3.3	0.483	0.104	0.2360			
180 minute winter	SW27	140	19.140	0.155	0.5	0.2135	0.0000	OK	240 minute winter	10.000	SW28	1.6	0.166	0.045	0.1616			
180 minute winter	SW28	140	19.140	0.181	1.9	0.2469	0.0000	OK	15 minute summer	9.002	SW29	5.6	0.542	0.115	0.0670			
180 minute winter	SW29	140	19.144	0.209	2.2	0.2367	0.0000	OK	15 minute summer	Flow through pond	SW30	6.7	0.125	0.031	2.2706			
180 minute winter	SW30	132	19.139	0.204	2.5	0.2308	0.0000	OK	15 minute winter	5.000	SW31-HB	2.7	0.445	0.075	0.1545			
120 minute winter	SW31-HB	92	19.139	0.229	1.4	0.2591	0.0000	SURCHARGED	120 minute winter	Hydro-Brake®	SW32	1.1					Surcharge due to flow behind Hydro-brake	
180 minute winter	SW32	132	18.872	0.030	1.1	0.0334	0.0000	OK	180 minute winter	5.002	SW42	1.1	0.398	0.035	0.0698			
15 minute summer	SW33	10	19.761	0.036	1.7	0.0493	0.0000	OK	15 minute summer	11.000	SW34	1.7	0.338	0.053	0.0331			
15 minute winter	SW34	10	19.750	0.049	3.4	0.0671	0.0000	OK	15 minute winter	11.001	SW37	3.2	0.533	0.099	0.1489			
360 minute winter	SW35	328	19.722	0.147	0.3	0.2018	0.0000	OK	15 minute winter	12.000	SW36	1.7	0.317	0.053	0.1197			
360 minute winter	SW36	328	19.722	0.181	0.6	0.2469	0.0000	OK	15 minute summer	12.001	SW37	3.1	0.343	0.097	0.1403			
360 minute winter	SW37	328	19.722	0.211	1.3	0.2791	0.0000	OK	15 minute winter	11.002	SW38	7.5	0.722	0.234	0.1211			
360 minute winter	SW38	328	19.722	0.229	1.2	0.2590	0.0000	OK	15 minute summer	Flow through pond	SW39	7.4	0.182	0.022	1.1803			
360 minute winter	SW39	328	19.722	0.229	0.9	0.2590	0.0000	SURCHARGED	15 minute summer	6.000	SW40-HB	5.0	0.657	0.069	0.2848		Surcharge due to flow behind Hydro-brake	
360 minute winter	SW40-HB	328	19.722	0.397	0.8	0.4490	0.0000	SURCHARGED	15 minute summer	6.001	SW41	0.5	0.442	0.017	0.0117		Surcharge due to flow behind Hydro-brake	
960 minute summer	SW41	720	19.315	0.018	0.5	0.0200	0.0000	OK	15 minute summer	6.002	SW42	0.5	0.368	0.012	0.0387			
360 minute winter	SW42	264	18.295	0.053	5.5	0.0604	0.0000	OK	360 minute winter	1.011	SW43	5.5	0.613	0.070	0.4151			
360 minute winter	SW43	264	18.068	0.058	5.5	0.0652	0.0000	OK	360 minute winter	1.012	SW44	5.5	0.590	0.070	0.0565			
360 minute winter	SW44	264	18.036	0.056	5.5	0.0638	0.0000	OK	360 minute winter	1.013	CS01	5.5	0.624	0.070	0.0632	138.2		
360 minute winter	CS01	264	17.997	0.053	5.5	0.0000	0.0000	OK										

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.36%																
Node Event	**US Node**	**Peak (mins)**	**Level (m)**	**Depth (m)**	**Inflow (l/s)**	**Node Vol (m³)**	**Flood (m³)**	**Status**	**Link Event (Outflow)**	**Link**	**DS Node**	**Outflow (l/s)**	**Velocity (m/s)**	**Flow/Cap**	**Link Vol (m³)**	**Discharge Vol (m³)**
480 minute winter	SW01	464	19.336	0.291	1.6	0.4950	0.0000	SURCHARGED	15 minute winter	1.000	SW02	10.8	0.496	0.339	1.1406	
480 minute winter	SW02	456	19.335	0.459	3.2	0.7490	0.0000	SURCHARGED	15 minute winter	1.001	SW03	20.2	0.550	0.633	1.1483	
480 minute winter	SW03	456	19.335	0.572	4.2	0.9123	0.0000	SURCHARGED	15 minute summer	1.002	SW04	29.2	0.480	0.507	0.2886	
480 minute winter	SW04	456	19.335	0.584	5.5	0.9295	0.0000	SURCHARGED	15 minute winter	1.003	SW06	38.9	0.576	0.684	0.9306	
480 minute winter	SW05	472	19.335	0.135	1.6	0.2292	0.0000	OK	15 minute winter	2.000	SW06	10.8	0.369	0.218	1.3366	
480 minute winter	SW06	456	19.334	0.619	8.5	0.9833	0.0000	SURCHARGED	15 minute winter	1.004	SW12	59.3	0.850	0.687	0.5777	
480 minute winter	SW07	464	19.336	0.291	1.6	0.4959	0.0000	SURCHARGED	15 minute summer	3.000	SW08	10.3	0.509	0.321	0.8059	
480 minute winter	SW08	464	19.336	0.370	3.2	0.6165	0.0000	SURCHARGED	15 minute summer	3.001	SW09	18.6	0.554	0.581	0.6656	
480 minute winter	SW09	464	19.335	0.433	4.8	0.7110	0.0000	SURCHARGED	15 minute winter	3.002	SW10	26.4	0.668	0.812	0.1813	
480 minute winter	SW10	464	19.335	0.451	6.1	0.7372	0.0000	SURCHARGED	15 minute winter	3.003	SW11	35.0	0.880	1.099	1.8300	
480 minute winter	SW11	448	19.334	0.625	7.4	0.9870	0.0000	SURCHARGED	15 minute winter	3.004	SW12	44.1	0.631	0.577	0.6406	
480 minute winter	SW12	448	19.335	0.670	16.4	1.3002	0.0000	SURCHARGED	15 minute winter	1.005	SW13	111.9	1.259	0.790	0.6816	
480 minute winter	SW13	456	19.333	0.706	16.3	1.0105	0.0000	SURCHARGED	15 minute summer	1.006	SW16-HB	116.1	2.436	1.243	0.2021	
480 minute winter	SW14	448	19.334	0.519	1.6	0.8834	0.0000	SURCHARGED	15 minute summer	4.000	SW15	10.9	0.763	0.341	0.3754	
480 minute winter	SW15	448	19.334	0.607	1.4	0.6866	0.0000	SURCHARGED	15 minute winter	4.001	SW16-HB	11.3	0.972	0.163	1.4707	
480 minute winter	SW16-HB	448	19.334	0.713	17.5	132.9439	0.0000	SURCHARGED	30 minute winter	Hydro-Brake®	SW17	3.9				
30 minute winter	SW17	25	18.655	0.045	3.9	0.0513	0.0000	OK	60 minute summer	1.008	SW18	3.9	0.567	0.050	0.2905	
1440 minute winter	SW18	1440	18.447	0.048	3.9	0.0537	0.0000	OK	600 minute summer	1.009	SW19	3.9	0.568	0.050	0.0481	
1440 minute winter	SW19	1440	18.410	0.046	3.9	0.0520	0.0000	OK	600 minute summer	1.010	SW42	3.9	0.559	0.050	0.1836	
180 minute winter	SW20	164	19.310	0.175	0.9	0.2404	0.0000	OK	15 minute winter	7.000	SW21	3.1	0.431	0.096	0.2416	
180 minute winter	SW21	164	19.310	0.254	1.8	0.3434	0.0000	OK	15 minute winter	7.001	SW23	6.1	0.410	0.089	0.4593	
180 minute winter	SW22	164	19.310	0.175	0.9	0.2289	0.0000	OK	15 minute winter	8.000	SW23	3.1	0.537	0.039	0.1387	
180 minute winter	SW23	164	19.309	0.308	3.0	0.3976	0.0000	SURCHARGED	15 minute summer	7.002	SW24	11.0	0.545	0.345	0.5842	
180 minute winter	SW24	168	19.309	0.374	3.9	0.4231	0.0000	OK	15 minute summer	Flow through pond	SW30	11.7	0.129	0.055	4.3454	
180 minute winter	SW25	168	19.309	0.174	1.2	0.2272	0.0000	OK	15 minute winter	9.000	SW26	3.1	0.398	0.096	0.2612	
180 minute winter	SW26	168	19.309	0.257	1.8	0.3468	0.0000	SURCHARGED	15 minute winter	9.001	SW28	6.1	0.504	0.189	0.5659	
180 minute winter	SW27	172	19.308	0.323	0.9	0.4435	0.0000	SURCHARGED	15 minute summer	10.000	SW28	2.3	0.280	0.062	0.1791	
180 minute winter	SW28	168	19.308	0.349	3.1	0.4774	0.0000	SURCHARGED	15 minute winter	9.002	SW29	8.9	0.587	0.184	0.1071	
180 minute winter	SW29	160	19.309	0.374	12.5	0.4231	0.0000	OK	15 minute summer	Flow through pond	SW30	11.7	0.129	0.055	4.3454	
180 minute winter	SW30	168	19.308	0.373	5.8	0.4218	0.0000	SURCHARGED	15 minute winter	5.000	SW31-HB	3.3	0.533	0.090	0.1964	
180 minute winter	SW31-HB	168	19.307	0.397	1.5	0.4488	0.0000	SURCHARGED	15 minute summer	Hydro-Brake®	SW32	1.1				
15 minute summer	SW32	23	18.872	0.030	1.1	0.0334	0.0000	OK	15 minute summer	5.002	SW42	1.1	0.398	0.035	0.0698	
180 minute winter	SW33	168	19.897	0.172	0.9	0.2357	0.0000	OK	15 minute winter	11.000	SW34	3.1	0.372	0.096	0.0541	
180 minute winter	SW34	168	19.897	0.196	1.8	0.2674	0.0000	OK	15 minute winter	11.001	SW37	6.0	0.630	0.187	0.3214	
180 minute winter	SW35	168	19.897	0.322	0.9	0.4416	0.0000	SURCHARGED	15 minute summer	12.000	SW36	2.7	0.348	0.086	0.2633	
180 minute winter	SW36	168	19.897	0.356	1.6	0.4851	0.0000	SURCHARGED	15 minute summer	12.001	SW37	4.7	0.364	0.147	0.2742	
180 minute winter	SW37	168	19.897	0.386	3.9	0.5102	0.0000	SURCHARGED	15 minute summer	11.002	SW38	12.3	0.805	0.386	0.1839	
180 minute winter	SW38	168	19.897	0.404	3.4	0.4565	0.0000	OK	15 minute winter	Flow through pond	SW39	8.9	0.183	0.026	3.1053	
180 minute winter	SW39	168	19.897	0.404	2.0	0.4565	0.0000	SURCHARGED	15 minute winter	6.000	SW40-HB	5.2	0.755	0.073	0.3464	
180 minute winter	SW40-HB	168	19.897	0.572	1.0	0.6465	0.0000	SURCHARGED	180 minute winter	6.001	SW41	0.5	0.329	0.017	0.0119	
180 minute winter	SW41	172	19.315	0.018	0.5	0.0202	0.0000	OK	180 minute winter	6.002	SW42	0.5	0.372	0.013	0.0394	
30 minute winter	SW42	53	18.295	0.053	5.5	0.0605	0.0000	OK	30 minute winter	1.011	SW43	5.5	0.614	0.070	0.4165	
30 minute winter	SW43	54	18.068	0.058	5.5	0.0653	0.0000	OK	30 minute winter	1.012	SW44	5.5	0.590	0.070	0.0567	
30 minute winter	SW44	54	18.037	0.057	5.5	0.0639	0.0000	OK	30 minute winter	1.013	CS01	5.5	0.625	0.070	0.0634	78.9
30 minute winter	CS01	54	17.997	0.053	5.5	0.0000	0.0000	OK								

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.36%																
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Outflow)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	SW01	456	19.612	0.567	2.0	0.9657	0.0000	SURCHARGED	15 minute winter	1.000	SW02	13.3	0.525	0.418	1.6877	
480 minute winter	SW02	456	19.612	0.736	4.0	1.2023	0.0000	SURCHARGED	15 minute winter	1.001	SW03	25.0	0.629	0.786	1.1842	
480 minute winter	SW03	456	19.612	0.849	5.3	1.3546	0.0000	SURCHARGED	15 minute winter	1.002	SW04	35.3	0.501	0.612	0.3099	
480 minute winter	SW04	456	19.612	0.861	7.1	1.3715	0.0000	SURCHARGED	15 minute winter	1.003	SW06	47.4	0.673	0.835	0.9552	
480 minute winter	SW05	456	19.612	0.412	2.0	0.7018	0.0000	SURCHARGED	15 minute winter	2.000	SW06	13.9	0.449	0.281	1.3930	
480 minute winter	SW06	456	19.612	0.897	10.9	1.4246	0.0000	SURCHARGED	15 minute winter	1.004	SW12	72.9	1.036	0.845	0.5807	
480 minute winter	SW07	456	19.613	0.568	2.0	0.9663	0.0000	SURCHARGED	15 minute winter	3.000	SW08	11.5	0.499	0.359	0.8185	
480 minute winter	SW08	456	19.613	0.647	4.0	1.0787	0.0000	SURCHARGED	15 minute winter	3.001	SW09	22.9	0.576	0.717	0.6656	
480 minute winter	SW09	456	19.613	0.711	5.5	1.1677	0.0000	SURCHARGED	15 minute winter	3.002	SW10	34.1	0.858	1.050	0.1813	
480 minute winter	SW10	456	19.613	0.729	7.3	1.1921	0.0000	SURCHARGED	15 minute winter	3.003	SW11	45.2	1.137	1.418	1.8300	
480 minute winter	SW11	456	19.612	0.903	9.1	1.4261	0.0000	SURCHARGED	15 minute winter	3.004	SW12	57.3	0.814	0.749	0.6488	
480 minute winter	SW12	456	19.614	0.949	21.4	1.8403	0.0000	SURCHARGED	15 minute winter	1.005	SW13	142.5	1.379	1.007	0.7790	
480 minute winter	SW13	472	19.611	0.984	21.4	1.4083	0.0000	SURCHARGED	15 minute winter	1.006	SW16-HB	152.8	2.513	1.636	0.2846	
480 minute winter	SW14	456	19.612	0.797	2.0	1.3569	0.0000	SURCHARGED	15 minute winter	4.000	SW15	14.0	0.833	0.439	0.7928	
480 minute winter	SW15	456	19.612	0.885	1.8	1.0012	0.0000	SURCHARGED	15 minute summer	4.001	SW16-HB	14.3	0.946	0.208	1.6869	
480 minute winter	SW16-HB	456	19.612	0.991	22.3	184.7867	0.0000	SURCHARGED	15 minute winter	Hydro-Brake®	SW17	3.9				
30 minute winter	SW17	21	18.655	0.045	3.9	0.0513	0.0000	OK	30 minute summer	1.008	SW18	3.9	0.568	0.050	0.2905	
2160 minute winter	SW18	2280	18.447	0.048	3.9	0.0537	0.0000	OK	15 minute winter	1.009	SW19	3.9	0.596	0.050	0.0476	
2160 minute summer	SW19	2160	18.410	0.046	3.9	0.0520	0.0000	OK	15 minute winter	1.010	SW42	3.9	0.528	0.050	0.1840	
240 minute winter	SW20	228	19.444	0.309	0.9	0.4245	0.0000	SURCHARGED	15 minute winter	7.000	SW21	4.0	0.461	0.124	0.4112	
240 minute winter	SW21	228	19.444	0.388	1.6	0.5249	0.0000	SURCHARGED	15 minute winter	7.001	SW23	7.2	0.415	0.105	0.6272	
240 minute winter	SW22	228	19.444	0.309	0.9	0.4051	0.0000	SURCHARGED	15 minute winter	8.000	SW23	4.1	0.565	0.052	0.2724	
240 minute winter	SW23	228	19.444	0.443	2.8	0.5713	0.0000	SURCHARGED	15 minute summer	7.002	SW24	12.8	0.550	0.399	0.6476	
240 minute winter	SW24	236	19.447	0.512	3.1	0.5794	0.0000	OK	15 minute summer	Flow through pond	SW30	13.1	0.140	0.062	5.5973	
240 minute winter	SW25	228	19.442	0.307	0.9	0.4024	0.0000	SURCHARGED	15 minute winter	9.000	SW26	4.0	0.428	0.124	0.4540	
240 minute winter	SW26	228	19.442	0.390	3.4	0.5275	0.0000	SURCHARGED	15 minute summer	9.001	SW28	7.8	0.510	0.243	0.6428	
240 minute winter	SW27	228	19.443	0.458	0.9	0.6286	0.0000	SURCHARGED	15 minute winter	10.000	SW28	3.0	0.277	0.081	0.2076	
240 minute winter	SW28	228	19.443	0.484	5.3	0.6610	0.0000	SURCHARGED	15 minute winter	9.002	SW29	12.0	0.614	0.246	0.1088	
240 minute winter	SW29	224	19.444	0.509	6.3	0.5761	0.0000	OK	15 minute summer	Flow through pond	SW30	13.1	0.140	0.062	5.5973	
240 minute winter	SW30	228	19.442	0.507	6.7	0.5737	0.0000	SURCHARGED	15 minute summer	5.000	SW31-HB	3.2	0.537	0.086	0.1964	
240 minute winter	SW31-HB	224	19.442	0.532	1.5	0.6022	0.0000	SURCHARGED	15 minute summer	Hydro-Brake®	SW32	1.1				
15 minute summer	SW32	55	18.872	0.030	1.1	0.0334	0.0000	OK	15 minute summer	5.002	SW42	1.1	0.398	0.035	0.0698	
240 minute winter	SW33	228	20.014	0.289	0.9	0.3971	0.0000	SURCHARGED	15 minute winter	11.000	SW34	4.0	0.389	0.124	0.0667	
240 minute winter	SW34	228	20.014	0.313	1.6	0.4282	0.0000	SURCHARGED	15 minute winter	11.001	SW37	7.8	0.651	0.244	0.5421	
240 minute winter	SW35	228	20.014	0.439	0.9	0.6032	0.0000	SURCHARGED	15 minute winter	12.000	SW36	2.9	0.340	0.090	0.3449	
240 minute winter	SW36	228	20.014	0.473	1.7	0.6456	0.0000	SURCHARGED	15 minute summer	12.001	SW37	5.2	0.345	0.163	0.3055	
240 minute winter	SW37	228	20.014	0.503	3.8	0.6659	0.0000	SURCHARGED	15 minute summer	11.002	SW38	15.6	0.736	0.490	0.1885	
240 minute winter	SW38	228	20.014	0.521	3.7	0.5896	0.0000	OK	15 minute summer	Flow through pond	SW39	9.7	0.182	0.029	3.6896	
240 minute winter	SW39	228	20.014	0.521	2.1	0.5896	0.0000	SURCHARGED	15 minute summer	6.000	SW40-HB	5.1	0.784	0.070	0.3464	
240 minute winter	SW40-HB	228	20.014	0.689	1.0	0.7796	0.0000	SURCHARGED	240 minute winter	6.001	SW41	0.6	0.338	0.018	0.0126	
240 minute winter	SW41	228	19.316	0.019	0.6	0.0211	0.0000	OK	240 minute winter	6.002	SW42	0.6	0.381	0.014	0.0417	
30 minute summer	SW42	114	18.295	0.053	5.5	0.0605	0.0000	OK	30 minute summer	1.011	SW43	5.5	0.614	0.070	0.4165	
30 minute summer	SW43	115	18.068	0.058	5.5	0.0654	0.0000	OK	30 minute summer	1.012	SW44	5.5	0.590	0.070	0.0567	
30 minute summer	SW44	115	18.037	0.057	5.5	0.0639	0.0000	OK	30 minute summer	1.013	CS01	5.5	0.625	0.070	0.0634	82.3
30 minute summer	CS01	115	17.997	0.053	5.5	0.0000	0.0000	OK								

Results for 2 year +20% CC 15 minute summer. 255 minute analysis at 1 minute timestep. Mass balance: 99.85%																
Node Event	**US Node**	**Peak (mins)**	**Level (m)**	**Depth (m)**	**Inflow (l/s)**	**Node Vol (m³)**	**Flood (m³)**	**Status**	**Link Event**	**Link**	**DS Node**	**Outflow (l/s)**	**Velocity (m/s)**	**Flow/Cap**	**Link Vol (m³)**	**Discharge Vol (m³)**
15 minute summer	SW01	10	19.109	0.064	5.9	0.1092	0.0000	OK	15 minute summer	1.000	SW02	5.7	0.483	0.181	0.5332	
15 minute summer	SW02	11	18.965	0.089	11.6	0.1458	0.0000	OK	15 minute summer	1.001	SW03	10.8	0.467	0.339	0.7072	
15 minute summer	SW03	10	18.937	0.174	16.6	0.2769	0.0000	OK	15 minute summer	1.002	SW04	17.0	0.432	0.296	0.1900	
15 minute summer	SW04	10	18.931	0.180	22.9	0.2864	0.0000	OK	15 minute summer	1.003	SW06	23.0	0.523	0.405	0.6421	
15 minute summer	SW05	10	19.252	0.052	5.9	0.0878	0.0000	OK	15 minute summer	2.000	SW06	5.8	0.306	0.117	1.1783	
15 minute summer	SW06	10	18.917	0.202	34.5	0.3214	0.0000	OK	15 minute summer	1.004	SW12	36.3	0.706	0.420	0.4542	
15 minute summer	SW07	10	19.110	0.065	5.9	0.1101	0.0000	OK	15 minute summer	3.000	SW08	5.9	0.466	0.183	0.2678	
15 minute summer	SW08	10	19.064	0.098	11.8	0.1637	0.0000	OK	15 minute summer	3.001	SW09	11.3	0.538	0.355	0.3525	
15 minute summer	SW09	10	19.040	0.138	17.2	0.2267	0.0000	OK	15 minute summer	3.002	SW10	16.7	0.667	0.514	0.1141	
15 minute summer	SW10	11	19.018	0.134	22.6	0.2199	0.0000	OK	15 minute summer	3.003	SW11	21.7	0.709	0.682	1.4301	
15 minute summer	SW11	10	18.911	0.202	27.4	0.3195	0.0000	OK	15 minute summer	3.004	SW12	29.3	0.569	0.382	0.5074	
15 minute summer	SW12	10	18.902	0.237	70.4	0.4589	0.0000	OK	15 minute summer	1.005	SW13	72.6	1.139	0.513	0.5458	
15 minute summer	SW13	9	18.866	0.239	72.6	0.3426	0.0000	OK	15 minute summer	1.006	SW16-HB	74.2	2.211	0.794	0.1032	
15 minute summer	SW14	10	18.882	0.067	5.9	0.1140	0.0000	OK	15 minute summer	4.000	SW15	5.9	0.619	0.185	0.2194	
15 minute summer	SW15	10	18.791	0.063	5.9	0.0718	0.0000	OK	15 minute summer	4.001	SW16-HB	6.0	0.929	0.088	0.4775	
15 minute summer	SW16-HB	20	18.757	0.136	80.1	25.3372	0.0000	OK	15 minute summer	Hydro-Brake®	SW17	3.2				
15 minute summer	SW17	20	18.651	0.041	3.2	0.0462	0.0000	OK	15 minute summer	1.008	SW18	3.2	0.534	0.040	0.2490	
15 minute summer	SW18	21	18.442	0.043	3.2	0.0481	0.0000	OK	15 minute summer	1.009	SW19	3.1	0.534	0.040	0.0409	
15 minute summer	SW19	22	18.405	0.041	3.1	0.0460	0.0000	OK	15 minute summer	1.010	SW42	3.1	0.474	0.040	0.1626	
15 minute summer	SW20	10	19.170	0.035	1.7	0.0476	0.0000	OK	15 minute summer	7.000	SW21	1.7	0.360	0.052	0.0954	
15 minute summer	SW21	10	19.100	0.044	3.4	0.0595	0.0000	OK	15 minute summer	7.001	SW23	3.3	0.361	0.047	0.1300	
15 minute summer	SW22	10	19.166	0.031	1.7	0.0405	0.0000	OK	15 minute summer	8.000	SW23	1.7	0.451	0.021	0.0453	
15 minute summer	SW23	16	19.080	0.079	6.6	0.1020	0.0000	OK	15 minute summer	7.002	SW24	6.4	0.509	0.199	0.3389	
15 minute summer	SW24	17	19.080	0.145	6.4	0.1638	0.0000	OK	15 minute summer	Flow through pond	SW30	6.7	0.125	0.031	2.2706	
15 minute summer	SW25	10	19.170	0.035	1.7	0.0454	0.0000	OK	15 minute summer	9.000	SW26	1.7	0.330	0.052	0.1104	
15 minute summer	SW26	10	19.101	0.049	3.4	0.0659	0.0000	OK	15 minute summer	9.001	SW28	3.3	0.487	0.102	0.2052	
15 minute summer	SW27	18	19.081	0.096	1.7	0.1315	0.0000	OK	15 minute summer	10.000	SW28	1.4	0.275	0.037	0.0985	
15 minute summer	SW28	19	19.080	0.121	6.3	0.1649	0.0000	OK	15 minute summer	9.002	SW29	5.6	0.542	0.115	0.0670	
15 minute summer	SW29	19	19.081	0.146	5.6	0.1650	0.0000	OK	15 minute summer	Flow through pond	SW30	6.7	0.125	0.031	2.2706	
15 minute summer	SW30	17	19.080	0.145	6.7	0.1635	0.0000	OK	15 minute summer	5.000	SW31-HB	2.0	0.432	0.056	0.1459	
15 minute summer	SW31-HB	17	19.080	0.170	2.0	0.1919	0.0000	OK	15 minute summer	Hydro-Brake®	SW32	1.1				
15 minute summer	SW32	19	18.871	0.029	1.1	0.0331	0.0000	OK	15 minute summer	5.002	SW42	1.1	0.396	0.035	0.0689	
15 minute summer	SW33	10	19.761	0.036	1.7	0.0493	0.0000	OK	15 minute summer	11.000	SW34	1.7	0.338	0.053	0.0331	
15 minute summer	SW34	10	19.750	0.049	3.4	0.0668	0.0000	OK	15 minute summer	11.001	SW37	3.2	0.533	0.099	0.1478	
15 minute summer	SW35	17	19.632	0.057	1.7	0.0778	0.0000	OK	15 minute summer	12.000	SW36	1.7	0.320	0.053	0.1010	
15 minute summer	SW36	19	19.631	0.090	3.4	0.1234	0.0000	OK	15 minute summer	12.001	SW37	3.1	0.343	0.097	0.1403	
15 minute summer	SW37	18	19.632	0.121	8.0	0.1596	0.0000	OK	15 minute summer	11.002	SW38	7.4	0.720	0.231	0.1119	
15 minute summer	SW38	19	19.631	0.138	7.4	0.1566	0.0000	OK	15 minute summer	Flow through pond	SW39	7.4	0.182	0.022	1.1803	
15 minute summer	SW39	19	19.631	0.138	7.4	0.1565	0.0000	OK	15 minute summer	6.000	SW40-HB	5.0	0.657	0.069	0.2848	
15 minute summer	SW40-HB	18	19.633	0.308	5.0	0.3478	0.0000	SURCHARGED	15 minute summer	6.001	SW41	0.5	0.442	0.017	0.0117	
15 minute summer	SW41	97	19.315	0.018	0.5	0.0200	0.0000	OK	15 minute summer	6.002	SW42	0.5	0.368	0.012	0.0387	
15 minute summer	SW42	22	18.292	0.050	4.8	0.0563	0.0000	OK	15 minute summer	1.011	SW43	4.8	0.591	0.061	0.3738	
15 minute summer	SW43	23	18.064	0.053	4.8	0.0605	0.0000	OK	15 minute summer	1.012	SW44	4.8	0.569	0.061	0.0508	
15 minute summer	SW44	23	18.032	0.052	4.8	0.0593	0.0000	OK	15 minute summer	1.013	CS01	4.7	0.599	0.061	0.0570	30.2
15 minute summer	CS01	24	17.994	0.050	4.7	0.0000	0.0000	OK								

Results for 2 year +20% CC 15 minute winter. 255 minute analysis at 1 minute timestep. Mass balance: 99.85%																
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW01	10	19.109	0.064	5.9	0.1095	0.0000	OK	15 minute winter	1.000	SW02	5.8	0.480	0.182	0.5392	
15 minute winter	SW02	10	18.966	0.090	11.7	0.1473	0.0000	OK	15 minute winter	1.001	SW03	11.0	0.479	0.345	0.7022	
15 minute winter	SW03	9	18.934	0.171	16.9	0.2730	0.0000	OK	15 minute winter	1.002	SW04	17.2	0.435	0.299	0.1863	
15 minute winter	SW04	9	18.928	0.177	22.9	0.2812	0.0000	OK	15 minute winter	1.003	SW06	23.3	0.541	0.409	0.6246	
15 minute winter	SW05	10	19.252	0.052	5.9	0.0879	0.0000	OK	15 minute winter	2.000	SW06	5.8	0.329	0.117	1.1582	
15 minute winter	SW06	10	18.912	0.197	34.7	0.3128	0.0000	OK	15 minute winter	1.004	SW12	36.0	0.703	0.417	0.4423	
15 minute winter	SW07	10	19.110	0.065	5.9	0.1101	0.0000	OK	15 minute winter	3.000	SW08	5.9	0.462	0.184	0.2694	
15 minute winter	SW08	10	19.065	0.099	11.8	0.1647	0.0000	OK	15 minute winter	3.001	SW09	11.4	0.536	0.357	0.3563	
15 minute winter	SW09	10	19.041	0.139	17.3	0.2290	0.0000	OK	15 minute winter	3.002	SW10	16.9	0.665	0.519	0.1156	
15 minute winter	SW10	11	19.020	0.136	22.8	0.2222	0.0000	OK	15 minute winter	3.003	SW11	22.1	0.729	0.692	1.4302	
15 minute winter	SW11	10	18.909	0.200	27.8	0.3155	0.0000	OK	15 minute winter	3.004	SW12	28.5	0.557	0.373	0.4979	
15 minute winter	SW12	10	18.896	0.231	70.4	0.4482	0.0000	OK	15 minute winter	1.005	SW13	71.5	1.071	0.505	0.5633	
15 minute winter	SW13	8	18.882	0.255	71.5	0.3644	0.0000	OK	15 minute winter	1.006	SW16-HB	77.6	2.166	0.831	0.1109	
15 minute winter	SW14	10	18.882	0.067	5.9	0.1141	0.0000	OK	15 minute winter	4.000	SW15	5.9	0.628	0.185	0.2161	
15 minute winter	SW15	10	18.789	0.062	5.9	0.0701	0.0000	OK	15 minute winter	4.001	SW16-HB	6.0	0.887	0.088	0.5905	
15 minute winter	SW16-HB	19	18.774	0.153	83.6	28.4556	0.0000	OK	15 minute winter	Hydro-Brake®	SW17	3.4				
15 minute winter	SW17	19	18.653	0.043	3.4	0.0482	0.0000	OK	15 minute winter	1.008	SW18	3.4	0.547	0.044	0.2649	
15 minute winter	SW18	21	18.443	0.044	3.4	0.0502	0.0000	OK	15 minute winter	1.009	SW19	3.4	0.548	0.044	0.0434	
15 minute winter	SW19	21	18.406	0.042	3.4	0.0480	0.0000	OK	15 minute winter	1.010	SW42	3.4	0.491	0.044	0.1709	
15 minute winter	SW20	10	19.170	0.035	1.7	0.0476	0.0000	OK	15 minute winter	7.000	SW21	1.7	0.360	0.052	0.0957	
15 minute winter	SW21	10	19.100	0.044	3.4	0.0597	0.0000	OK	15 minute winter	7.001	SW23	3.3	0.362	0.048	0.1509	
15 minute winter	SW22	10	19.166	0.031	1.7	0.0405	0.0000	OK	15 minute winter	8.000	SW23	1.7	0.451	0.021	0.0454	
15 minute winter	SW23	17	19.088	0.087	6.7	0.1125	0.0000	OK	15 minute winter	7.002	SW24	6.4	0.502	0.200	0.3686	
15 minute winter	SW24	18	19.088	0.153	6.4	0.1734	0.0000	OK	15 minute winter	Flow through pond	SW30	6.1	0.132	0.029	2.4650	
15 minute winter	SW25	10	19.170	0.035	1.7	0.0455	0.0000	OK	15 minute winter	9.000	SW26	1.7	0.331	0.052	0.1103	
15 minute winter	SW26	10	19.101	0.049	3.4	0.0657	0.0000	OK	15 minute winter	9.001	SW28	3.3	0.483	0.104	0.2360	
15 minute winter	SW27	16	19.088	0.103	1.7	0.1416	0.0000	OK	15 minute winter	10.000	SW28	1.3	0.270	0.036	0.1074	
15 minute winter	SW28	18	19.088	0.129	6.3	0.1758	0.0000	OK	15 minute winter	9.002	SW29	5.2	0.571	0.107	0.0718	
15 minute winter	SW29	20	19.089	0.154	5.2	0.1742	0.0000	OK	15 minute winter	Flow through pond	SW30	6.1	0.132	0.029	2.4650	
15 minute winter	SW30	18	19.088	0.153	6.1	0.1730	0.0000	OK	15 minute winter	5.000	SW31-HB	2.7	0.445	0.075	0.1545	
15 minute winter	SW31-HB	18	19.089	0.179	2.7	0.2021	0.0000	OK	15 minute winter	Hydro-Brake®	SW32	1.1				
15 minute winter	SW32	18	18.871	0.029	1.1	0.0332	0.0000	OK	15 minute winter	5.002	SW42	1.1	0.397	0.035	0.0691	
15 minute winter	SW33	10	19.761	0.036	1.7	0.0493	0.0000	OK	15 minute winter	11.000	SW34	1.7	0.333	0.053	0.0332	
15 minute winter	SW34	10	19.750	0.049	3.4	0.0671	0.0000	OK	15 minute winter	11.001	SW37	3.2	0.533	0.099	0.1489	
15 minute winter	SW35	19	19.641	0.066	1.7	0.0909	0.0000	OK	15 minute winter	12.000	SW36	1.7	0.317	0.053	0.1197	
15 minute winter	SW36	17	19.641	0.100	3.4	0.1364	0.0000	OK	15 minute winter	12.001	SW37	2.9	0.339	0.090	0.1572	
15 minute winter	SW37	19	19.641	0.130	7.8	0.1717	0.0000	OK	15 minute winter	11.002	SW38	7.5	0.722	0.234	0.1211	
15 minute winter	SW38	18	19.641	0.148	7.5	0.1672	0.0000	OK	15 minute winter	Flow through pond	SW39	6.3	0.182	0.019	1.3258	
15 minute winter	SW39	18	19.641	0.148	6.3	0.1668	0.0000	OK	15 minute winter	6.000	SW40-HB	3.7	0.656	0.051	0.2934	
15 minute winter	SW40-HB	17	19.640	0.315	3.7	0.3567	0.0000	SURCHARGED	15 minute winter	6.001	SW41	0.5	0.437	0.016	0.0117	
15 minute winter	SW41	105	19.315	0.018	0.5	0.0200	0.0000	OK	15 minute winter	6.002	SW42	0.5	0.368	0.012	0.0387	
15 minute winter	SW42	22	18.293	0.051	5.0	0.0579	0.0000	OK	15 minute winter	1.011	SW43	5.0	0.600	0.064	0.3903	
15 minute winter	SW43	23	18.065	0.055	5.0	0.0624	0.0000	OK	15 minute winter	1.012	SW44	5.0	0.577	0.064	0.0531	
15 minute winter	SW44	24	18.034	0.054	5.0	0.0611	0.0000	OK	15 minute winter	1.013	CS01	5.0	0.610	0.064	0.0595	34.2
15 minute winter	CS01	24	17.995	0.051	5.0	0.0000	0.0000	OK								

Results for 2 year +20% CC 30 minute summer. 270 minute analysis at 1 minute timestep. Mass balance: 99.87%																
Node Event	**US Node**	**Peak (mins)**	**Level (m)**	**Depth (m)**	**Inflow (l/s)**	**Node Vol (m³)**	**Flood (m³)**	**Status**	**Link Event**	**Link**	**DS Node**	**Outflow (l/s)**	**Velocity (m/s)**	**Flow/Cap**	**Link Vol (m³)**	**Discharge Vol (m³)**
30 minute summer	SW01	18	19.105	0.060	5.3	0.1027	0.0000	OK	30 minute summer	1.000	SW02	5.1	0.465	0.160	0.4994	
30 minute summer	SW02	18	18.962	0.086	10.3	0.1400	0.0000	OK	30 minute summer	1.001	SW03	10.0	0.515	0.314	0.5817	
30 minute summer	SW03	18	18.900	0.137	15.0	0.2178	0.0000	OK	30 minute summer	1.002	SW04	14.5	0.464	0.252	0.1397	
30 minute summer	SW04	18	18.891	0.140	19.5	0.2232	0.0000	OK	30 minute summer	1.003	SW06	19.1	0.574	0.336	0.4754	
30 minute summer	SW05	18	19.248	0.048	5.3	0.0824	0.0000	OK	30 minute summer	2.000	SW06	5.1	0.333	0.103	0.9520	
30 minute summer	SW06	19	18.874	0.159	29.2	0.2523	0.0000	OK	30 minute summer	1.004	SW12	28.2	0.649	0.326	0.3571	
30 minute summer	SW07	17	19.106	0.061	5.3	0.1031	0.0000	OK	30 minute summer	3.000	SW08	5.2	0.450	0.161	0.2419	
30 minute summer	SW08	18	19.057	0.091	10.5	0.1515	0.0000	OK	30 minute summer	3.001	SW09	10.2	0.525	0.320	0.3260	
30 minute summer	SW09	18	19.033	0.131	15.2	0.2151	0.0000	OK	30 minute summer	3.002	SW10	15.2	0.644	0.469	0.1078	
30 minute summer	SW10	18	19.012	0.128	20.2	0.2096	0.0000	OK	30 minute summer	3.003	SW11	20.1	0.760	0.632	1.2363	
30 minute summer	SW11	19	18.871	0.162	25.1	0.2555	0.0000	OK	30 minute summer	3.004	SW12	24.1	0.555	0.316	0.4031	
30 minute summer	SW12	19	18.861	0.196	56.9	0.3802	0.0000	OK	30 minute summer	1.005	SW13	56.7	1.010	0.400	0.4264	
30 minute summer	SW13	19	18.814	0.187	56.7	0.2674	0.0000	OK	30 minute summer	1.006	SW16-HB	59.9	1.834	0.641	0.1342	
30 minute summer	SW14	17	18.878	0.063	5.3	0.1067	0.0000	OK	30 minute summer	4.000	SW15	5.2	0.632	0.162	0.1886	
30 minute summer	SW15	33	18.800	0.073	5.2	0.0825	0.0000	OK	30 minute summer	4.001	SW16-HB	5.2	0.575	0.075	0.7632	
30 minute summer	SW16-HB	34	18.797	0.176	64.7	32.7669	0.0000	OK	30 minute summer	Hydro-Brake®	SW17	3.6				
30 minute summer	SW17	34	18.653	0.043	3.6	0.0491	0.0000	OK	30 minute summer	1.008	SW18	3.6	0.553	0.046	0.2729	
30 minute summer	SW18	35	18.444	0.045	3.6	0.0513	0.0000	OK	30 minute summer	1.009	SW19	3.6	0.554	0.046	0.0448	
30 minute summer	SW19	35	18.407	0.043	3.6	0.0489	0.0000	OK	30 minute summer	1.010	SW42	3.6	0.500	0.046	0.1749	
30 minute summer	SW20	18	19.167	0.032	1.5	0.0442	0.0000	OK	30 minute summer	7.000	SW21	1.4	0.345	0.045	0.0867	
30 minute summer	SW21	32	19.098	0.042	2.9	0.0569	0.0000	OK	30 minute summer	7.001	SW23	2.9	0.347	0.042	0.1824	
30 minute summer	SW22	17	19.164	0.029	1.5	0.0376	0.0000	OK	30 minute summer	8.000	SW23	1.4	0.431	0.018	0.0407	
30 minute summer	SW23	31	19.098	0.097	5.7	0.1251	0.0000	OK	30 minute summer	7.002	SW24	5.7	0.419	0.178	0.4052	
30 minute summer	SW24	31	19.098	0.163	5.7	0.1845	0.0000	OK	30 minute summer	Flow through pond	SW30	5.1	0.075	0.024	2.7091	
30 minute summer	SW25	18	19.167	0.032	1.5	0.0422	0.0000	OK	30 minute summer	9.000	SW26	1.4	0.321	0.045	0.0989	
30 minute summer	SW26	32	19.099	0.047	2.9	0.0636	0.0000	OK	30 minute summer	9.001	SW28	2.9	0.451	0.089	0.2772	
30 minute summer	SW27	33	19.099	0.114	1.5	0.1565	0.0000	OK	30 minute summer	10.000	SW28	1.1	0.249	0.029	0.1207	
30 minute summer	SW28	33	19.099	0.140	5.1	0.1912	0.0000	OK	30 minute summer	9.002	SW29	4.0	0.492	0.081	0.0785	
30 minute summer	SW29	33	19.101	0.166	4.0	0.1883	0.0000	OK	30 minute summer	Flow through pond	SW30	5.1	0.075	0.024	2.7091	
30 minute summer	SW30	31	19.098	0.163	5.1	0.1844	0.0000	OK	30 minute summer	5.000	SW31-HB	1.6	0.391	0.045	0.1636	
30 minute summer	SW31-HB	30	19.098	0.188	1.6	0.2125	0.0000	OK	30 minute summer	Hydro-Brake®	SW32	1.1				
30 minute summer	SW32	31	18.871	0.029	1.1	0.0333	0.0000	OK	30 minute summer	5.002	SW42	1.1	0.397	0.035	0.0693	
30 minute summer	SW33	17	19.758	0.033	1.5	0.0452	0.0000	OK	30 minute summer	11.000	SW34	1.5	0.320	0.046	0.0298	
30 minute summer	SW34	18	19.747	0.046	3.0	0.0631	0.0000	OK	30 minute summer	11.001	SW37	2.9	0.515	0.089	0.1370	
30 minute summer	SW35	32	19.655	0.080	1.5	0.1094	0.0000	OK	30 minute summer	12.000	SW36	1.5	0.307	0.046	0.1458	
30 minute summer	SW36	31	19.655	0.114	3.0	0.1550	0.0000	OK	30 minute summer	12.001	SW37	2.5	0.319	0.078	0.1814	
30 minute summer	SW37	32	19.655	0.144	6.7	0.1903	0.0000	OK	30 minute summer	11.002	SW38	6.2	0.613	0.196	0.1358	
30 minute summer	SW38	33	19.654	0.161	6.2	0.1826	0.0000	OK	30 minute summer	Flow through pond	SW39	4.0	0.133	0.012	1.5428	
30 minute summer	SW39	33	19.654	0.161	4.0	0.1826	0.0000	OK	30 minute summer	6.000	SW40-HB	2.4	0.569	0.034	0.3061	
30 minute summer	SW40-HB	33	19.655	0.330	2.4	0.3730	0.0000	SURCHARGED	30 minute summer	6.001	SW41	0.5	0.396	0.016	0.0117	
30 minute summer	SW41	135	19.315	0.018	0.5	0.0200	0.0000	OK	30 minute summer	6.002	SW42	0.5	0.368	0.012	0.0387	
30 minute summer	SW42	35	18.294	0.052	5.2	0.0587	0.0000	OK	30 minute summer	1.011	SW43	5.2	0.604	0.066	0.3982	
30 minute summer	SW43	36	18.066	0.056	5.2	0.0633	0.0000	OK	30 minute summer	1.012	SW44	5.2	0.581	0.066	0.0542	
30 minute summer	SW44	37	18.035	0.055	5.2	0.0620	0.0000	OK	30 minute summer	1.013	CS01	5.2	0.614	0.066	0.0607	42.3
30 minute summer	CS01	37	17.996	0.052	5.2	0.0000	0.0000	OK								

Results for 2 year +20% CC 30 minute winter. 270 minute analysis at 1 minute timestep. Mass balance: 99.88%																
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	SW01	18	19.102	0.057	4.6	0.0967	0.0000	OK	30 minute winter	1.000	SW02	4.5	0.444	0.142	0.4603	
30 minute winter	SW02	18	18.957	0.081	9.1	0.1319	0.0000	OK	30 minute winter	1.001	SW03	9.0	0.500	0.281	0.5379	
30 minute winter	SW03	19	18.891	0.128	13.5	0.2044	0.0000	OK	30 minute winter	1.002	SW04	13.2	0.455	0.228	0.1289	
30 minute winter	SW04	19	18.883	0.132	17.7	0.2102	0.0000	OK	30 minute winter	1.003	SW06	17.4	0.558	0.307	0.4406	
30 minute winter	SW05	18	19.246	0.046	4.6	0.0777	0.0000	OK	30 minute winter	2.000	SW06	4.5	0.308	0.091	0.8890	
30 minute winter	SW06	19	18.865	0.150	26.5	0.2376	0.0000	OK	30 minute winter	1.004	SW12	26.0	0.655	0.302	0.3345	
30 minute winter	SW07	17	19.102	0.057	4.6	0.0967	0.0000	OK	30 minute winter	3.000	SW08	4.6	0.437	0.142	0.2177	
30 minute winter	SW08	18	19.049	0.083	9.2	0.1388	0.0000	OK	30 minute winter	3.001	SW09	9.1	0.517	0.284	0.2943	
30 minute winter	SW09	18	19.023	0.121	13.6	0.1995	0.0000	OK	30 minute winter	3.002	SW10	13.5	0.628	0.417	0.0985	
30 minute winter	SW10	18	19.003	0.119	18.0	0.1952	0.0000	OK	30 minute winter	3.003	SW11	17.9	0.732	0.563	1.1436	
30 minute winter	SW11	19	18.861	0.152	22.4	0.2404	0.0000	OK	30 minute winter	3.004	SW12	22.0	0.548	0.288	0.3774	
30 minute winter	SW12	19	18.852	0.187	52.3	0.3619	0.0000	OK	30 minute winter	1.005	SW13	52.3	1.026	0.370	0.3994	
30 minute winter	SW13	33	18.819	0.192	52.3	0.2746	0.0000	OK	30 minute winter	1.006	SW16-HB	58.1	1.696	0.621	0.1567	
30 minute winter	SW14	17	18.874	0.059	4.6	0.0997	0.0000	OK	30 minute winter	4.000	SW15	4.6	0.611	0.142	0.2029	
30 minute winter	SW15	32	18.822	0.095	4.6	0.1070	0.0000	OK	30 minute winter	4.001	SW16-HB	4.5	0.621	0.066	0.9286	
30 minute winter	SW16-HB	33	18.819	0.198	62.5	36.9003	0.0000	OK	30 minute winter	Hydro-Brake®	SW17	3.7				
30 minute winter	SW17	33	18.654	0.044	3.7	0.0498	0.0000	OK	30 minute winter	1.008	SW18	3.7	0.557	0.047	0.2786	
30 minute winter	SW18	34	18.445	0.046	3.7	0.0521	0.0000	OK	30 minute winter	1.009	SW19	3.7	0.559	0.047	0.0457	
30 minute winter	SW19	35	18.408	0.044	3.7	0.0496	0.0000	OK	30 minute winter	1.010	SW42	3.7	0.506	0.047	0.1777	
30 minute winter	SW20	18	19.166	0.031	1.3	0.0421	0.0000	OK	30 minute winter	7.000	SW21	1.3	0.331	0.041	0.0919	
30 minute winter	SW21	30	19.114	0.058	2.6	0.0782	0.0000	OK	30 minute winter	7.001	SW23	2.6	0.336	0.038	0.2402	
30 minute winter	SW22	18	19.162	0.027	1.3	0.0357	0.0000	OK	30 minute winter	8.000	SW23	1.3	0.417	0.017	0.0387	
30 minute winter	SW23	30	19.114	0.113	5.2	0.1455	0.0000	OK	30 minute winter	7.002	SW24	5.0	0.380	0.157	0.4610	
30 minute winter	SW24	31	19.114	0.179	5.0	0.2025	0.0000	OK	30 minute winter	Flow through pond	SW30	4.5	0.084	0.021	3.1471	
30 minute winter	SW25	18	19.166	0.031	1.3	0.0402	0.0000	OK	30 minute winter	9.000	SW26	1.3	0.309	0.041	0.1072	
30 minute winter	SW26	33	19.114	0.062	2.6	0.0843	0.0000	OK	30 minute winter	9.001	SW28	2.6	0.429	0.081	0.3399	
30 minute winter	SW27	34	19.114	0.129	1.3	0.1773	0.0000	OK	30 minute winter	10.000	SW28	1.1	0.228	0.029	0.1376	
30 minute winter	SW28	34	19.115	0.156	4.7	0.2127	0.0000	OK	30 minute winter	9.002	SW29	3.7	0.492	0.075	0.0861	
30 minute winter	SW29	31	19.115	0.180	3.7	0.2034	0.0000	OK	30 minute winter	Flow through pond	SW30	4.5	0.084	0.021	3.1471	
30 minute winter	SW30	31	19.114	0.179	4.5	0.2021	0.0000	OK	30 minute winter	5.000	SW31-HB	1.6	0.415	0.044	0.1769	
30 minute winter	SW31-HB	31	19.114	0.204	1.6	0.2304	0.0000	OK	30 minute winter	Hydro-Brake®	SW32	1.1				
30 minute winter	SW32	32	18.872	0.030	1.1	0.0334	0.0000	OK	30 minute winter	5.002	SW42	1.1	0.398	0.035	0.0696	
30 minute winter	SW33	18	19.756	0.031	1.3	0.0424	0.0000	OK	30 minute winter	11.000	SW34	1.3	0.308	0.041	0.0277	
30 minute winter	SW34	18	19.745	0.044	2.6	0.0600	0.0000	OK	30 minute winter	11.001	SW37	2.6	0.499	0.080	0.1379	
30 minute winter	SW35	32	19.673	0.098	1.3	0.1347	0.0000	OK	30 minute winter	12.000	SW36	1.3	0.295	0.040	0.1822	
30 minute winter	SW36	32	19.673	0.132	2.6	0.1796	0.0000	OK	30 minute winter	12.001	SW37	2.2	0.302	0.067	0.2120	
30 minute winter	SW37	32	19.673	0.162	5.7	0.2143	0.0000	OK	30 minute winter	11.002	SW38	5.2	0.555	0.164	0.1531	
30 minute winter	SW38	33	19.673	0.180	5.2	0.2034	0.0000	OK	30 minute winter	Flow through pond	SW39	3.1	0.141	0.009	1.8607	
30 minute winter	SW39	33	19.673	0.180	3.1	0.2034	0.0000	OK	30 minute winter	6.000	SW40-HB	2.8	0.572	0.038	0.3214	
30 minute winter	SW40-HB	31	19.673	0.348	2.8	0.3937	0.0000	SURCHARGED	30 minute winter	6.001	SW41	0.5	0.407	0.016	0.0117	
30 minute winter	SW41	156	19.315	0.018	0.5	0.0200	0.0000	OK	30 minute winter	6.002	SW42	0.5	0.368	0.012	0.0387	
30 minute winter	SW42	35	18.294	0.052	5.3	0.0592	0.0000	OK	30 minute winter	1.011	SW43	5.3	0.607	0.067	0.4033	
30 minute winter	SW43	36	18.066	0.056	5.3	0.0639	0.0000	OK	30 minute winter	1.012	SW44	5.3	0.584	0.067	0.0549	
30 minute winter	SW44	36	18.035	0.055	5.3	0.0625	0.0000	OK	30 minute winter	1.013	CS01	5.3	0.617	0.067	0.0614	48.2
30 minute winter	CS01	36	17.996	0.052	5.3	0.0000	0.0000	OK								

Results for 2 year +20% CC 60 minute summer. 300 minute analysis at 1 minute timestep. Mass balance: 99.89%																
Node Event	**US Node**	**Peak (mins)**	**Level (m)**	**Depth (m)**	**Inflow (l/s)**	**Node Vol (m³)**	**Flood (m³)**	**Status**	**Link Event**	**Link**	**DS Node**	**Outflow (l/s)**	**Velocity (m/s)**	**Flow/Cap**	**Link Vol (m³)**	**Discharge Vol (m³)**
60 minute summer	SW01	33	19.098	0.053	4.0	0.0900	0.0000	OK	60 minute summer	1.000	SW02	3.9	0.427	0.123	0.4151	
60 minute summer	SW02	33	18.951	0.075	7.9	0.1223	0.0000	OK	60 minute summer	1.001	SW03	7.7	0.486	0.243	0.4765	
60 minute summer	SW03	33	18.878	0.115	11.6	0.1839	0.0000	OK	60 minute summer	1.002	SW04	11.4	0.450	0.198	0.1119	
60 minute summer	SW04	33	18.870	0.119	15.3	0.1889	0.0000	OK	60 minute summer	1.003	SW06	15.2	0.551	0.267	0.3792	
60 minute summer	SW05	33	19.243	0.043	4.0	0.0724	0.0000	OK	60 minute summer	2.000	SW06	3.9	0.295	0.079	0.7820	
60 minute summer	SW06	34	18.848	0.133	23.0	0.2108	0.0000	OK	60 minute summer	1.004	SW12	22.6	0.635	0.261	0.2930	
60 minute summer	SW07	32	19.098	0.053	4.0	0.0900	0.0000	OK	60 minute summer	3.000	SW08	3.9	0.426	0.123	0.1929	
60 minute summer	SW08	33	19.042	0.075	7.9	0.1259	0.0000	OK	60 minute summer	3.001	SW09	7.9	0.508	0.247	0.2610	
60 minute summer	SW09	33	19.013	0.111	11.8	0.1826	0.0000	OK	60 minute summer	3.002	SW10	11.8	0.609	0.362	0.0883	
60 minute summer	SW10	33	18.994	0.110	15.7	0.1795	0.0000	OK	60 minute summer	3.003	SW11	15.6	0.715	0.489	1.0105	
60 minute summer	SW11	33	18.843	0.134	19.5	0.2121	0.0000	OK	60 minute summer	3.004	SW12	19.1	0.534	0.249	0.3292	
60 minute summer	SW12	61	18.837	0.172	45.4	0.3333	0.0000	OK	60 minute summer	1.005	SW13	45.2	0.970	0.319	0.4246	
60 minute summer	SW13	62	18.837	0.210	45.2	0.3003	0.0000	OK	60 minute summer	1.006	SW16-HB	45.2	1.322	0.483	0.1748	
60 minute summer	SW14	32	18.870	0.055	4.0	0.0929	0.0000	OK	60 minute summer	4.000	SW15	3.9	0.588	0.124	0.2440	
60 minute summer	SW15	63	18.837	0.110	3.9	0.1247	0.0000	OK	60 minute summer	4.001	SW16-HB	3.9	0.482	0.057	1.0574	
60 minute summer	SW16-HB	62	18.837	0.216	49.1	40.2415	0.0000	OK	60 minute summer	Hydro-Brake®	SW17	3.7				
60 minute summer	SW17	62	18.654	0.044	3.7	0.0503	0.0000	OK	60 minute summer	1.008	SW18	3.7	0.560	0.048	0.2822	
60 minute summer	SW18	63	18.445	0.046	3.7	0.0525	0.0000	OK	60 minute summer	1.009	SW19	3.7	0.562	0.048	0.0463	
60 minute summer	SW19	64	18.408	0.044	3.7	0.0501	0.0000	OK	60 minute summer	1.010	SW42	3.7	0.510	0.048	0.1795	
60 minute summer	SW20	32	19.164	0.029	1.2	0.0396	0.0000	OK	60 minute summer	7.000	SW21	1.1	0.320	0.036	0.0884	
60 minute summer	SW21	53	19.113	0.057	2.3	0.0766	0.0000	OK	60 minute summer	7.001	SW23	2.3	0.324	0.033	0.2353	
60 minute summer	SW22	32	19.161	0.026	1.2	0.0337	0.0000	OK	60 minute summer	8.000	SW23	1.1	0.406	0.015	0.0367	
60 minute summer	SW23	51	19.112	0.111	4.6	0.1438	0.0000	OK	60 minute summer	7.002	SW24	4.3	0.316	0.133	0.4565	
60 minute summer	SW24	52	19.113	0.178	4.3	0.2008	0.0000	OK	60 minute summer	Flow through pond	SW30	4.1	0.055	0.019	3.1149	
60 minute summer	SW25	32	19.164	0.029	1.2	0.0378	0.0000	OK	60 minute summer	9.000	SW26	1.1	0.300	0.036	0.1033	
60 minute summer	SW26	51	19.113	0.061	2.3	0.0827	0.0000	OK	60 minute summer	9.001	SW28	2.3	0.371	0.071	0.3365	
60 minute summer	SW27	56	19.113	0.128	1.2	0.1759	0.0000	OK	60 minute summer	10.000	SW28	0.8	0.198	0.021	0.1364	
60 minute summer	SW28	51	19.113	0.154	4.2	0.2098	0.0000	OK	60 minute summer	9.002	SW29	3.3	0.430	0.067	0.0858	
60 minute summer	SW29	62	19.116	0.181	3.3	0.2046	0.0000	OK	60 minute summer	Flow through pond	SW30	4.1	0.055	0.019	3.1149	
60 minute summer	SW30	52	19.113	0.178	4.1	0.2008	0.0000	OK	60 minute summer	5.000	SW31-HB	1.5	0.322	0.040	0.1761	
60 minute summer	SW31-HB	57	19.113	0.203	1.5	0.2293	0.0000	OK	60 minute summer	Hydro-Brake®	SW32	1.1				
60 minute summer	SW32	52	18.872	0.030	1.1	0.0334	0.0000	OK	60 minute summer	5.002	SW42	1.1	0.398	0.035	0.0696	
60 minute summer	SW33	32	19.754	0.029	1.2	0.0402	0.0000	OK	60 minute summer	11.000	SW34	1.2	0.298	0.036	0.0253	
60 minute summer	SW34	33	19.742	0.041	2.4	0.0564	0.0000	OK	60 minute summer	11.001	SW37	2.3	0.483	0.071	0.1398	
60 minute summer	SW35	60	19.675	0.100	1.2	0.1373	0.0000	OK	60 minute summer	12.000	SW36	1.1	0.271	0.036	0.1862	
60 minute summer	SW36	62	19.675	0.134	2.3	0.1826	0.0000	OK	60 minute summer	12.001	SW37	1.7	0.269	0.054	0.2152	
60 minute summer	SW37	62	19.675	0.164	5.1	0.2167	0.0000	OK	60 minute summer	11.002	SW38	4.4	0.444	0.140	0.1548	
60 minute summer	SW38	61	19.675	0.182	4.4	0.2055	0.0000	OK	60 minute summer	Flow through pond	SW39	2.9	0.103	0.009	1.8981	
60 minute summer	SW39	61	19.675	0.182	2.9	0.2055	0.0000	OK	60 minute summer	6.000	SW40-HB	1.2	0.498	0.017	0.3229	
60 minute summer	SW40-HB	61	19.675	0.350	1.2	0.3956	0.0000	SURCHARGED	60 minute summer	6.001	SW41	0.5	0.330	0.016	0.0117	
60 minute summer	SW41	188	19.315	0.018	0.5	0.0200	0.0000	OK	60 minute summer	6.002	SW42	0.5	0.368	0.012	0.0387	
60 minute summer	SW42	64	18.295	0.053	5.3	0.0596	0.0000	OK	60 minute summer	1.011	SW43	5.3	0.608	0.068	0.4069	
60 minute summer	SW43	65	18.067	0.057	5.3	0.0643	0.0000	OK	60 minute summer	1.012	SW44	5.3	0.585	0.068	0.0554	
60 minute summer	SW44	65	18.036	0.056	5.3	0.0629	0.0000	OK	60 minute summer	1.013	CS01	5.3	0.619	0.068	0.0620	57.4
60 minute summer	CS01	65	17.997	0.053	5.3	0.0000	0.0000	OK								

Results for 2 year +20% CC 60 minute winter. 300 minute analysis at 1 minute timestep. Mass balance: 99.90%																
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	SW01	33	19.092	0.047	3.2	0.0805	0.0000	OK	60 minute winter	1.000	SW02	3.1	0.398	0.099	0.3552	
60 minute winter	SW02	33	18.943	0.067	6.3	0.1094	0.0000	OK	60 minute winter	1.001	SW03	6.3	0.464	0.197	0.4035	
60 minute winter	SW03	34	18.864	0.101	9.4	0.1610	0.0000	OK	60 minute winter	1.002	SW04	9.3	0.441	0.162	0.0946	
60 minute winter	SW04	61	18.860	0.109	12.4	0.1741	0.0000	OK	60 minute winter	1.003	SW06	12.4	0.539	0.218	0.3872	
60 minute winter	SW05	32	19.238	0.038	3.2	0.0650	0.0000	OK	60 minute winter	2.000	SW06	3.1	0.276	0.063	0.7495	
60 minute winter	SW06	61	18.861	0.146	18.7	0.2311	0.0000	OK	60 minute winter	1.004	SW12	18.3	0.612	0.212	0.3402	
60 minute winter	SW07	32	19.092	0.047	3.2	0.0806	0.0000	OK	60 minute winter	3.000	SW08	3.2	0.399	0.099	0.1641	
60 minute winter	SW08	33	19.033	0.067	6.4	0.1118	0.0000	OK	60 minute winter	3.001	SW09	6.3	0.481	0.197	0.2201	
60 minute winter	SW09	33	18.999	0.097	9.5	0.1597	0.0000	OK	60 minute winter	3.002	SW10	9.4	0.576	0.290	0.0747	
60 minute winter	SW10	33	18.981	0.097	12.6	0.1587	0.0000	OK	60 minute winter	3.003	SW11	12.5	0.687	0.394	0.8714	
60 minute winter	SW11	61	18.861	0.152	15.6	0.2393	0.0000	OK	60 minute winter	3.004	SW12	15.3	0.515	0.200	0.3885	
60 minute winter	SW12	61	18.861	0.196	36.7	0.3795	0.0000	OK	60 minute winter	1.005	SW13	36.3	0.919	0.257	0.4914	
60 minute winter	SW13	61	18.861	0.234	36.3	0.3344	0.0000	OK	60 minute winter	1.006	SW16-HB	35.8	1.217	0.383	0.1985	
60 minute winter	SW14	32	18.864	0.049	3.2	0.0830	0.0000	OK	60 minute winter	4.000	SW15	3.2	0.545	0.099	0.3504	
60 minute winter	SW15	61	18.862	0.135	3.2	0.1523	0.0000	OK	60 minute winter	4.001	SW16-HB	3.1	0.536	0.046	1.2387	
60 minute winter	SW16-HB	61	18.861	0.240	38.9	44.6756	0.0000	OK	60 minute winter	Hydro-Brake®	SW17	3.8				
60 minute winter	SW17	61	18.655	0.045	3.8	0.0507	0.0000	OK	60 minute winter	1.008	SW18	3.8	0.563	0.049	0.2858	
60 minute winter	SW18	62	18.446	0.047	3.8	0.0530	0.0000	OK	60 minute winter	1.009	SW19	3.8	0.564	0.049	0.0469	
60 minute winter	SW19	63	18.409	0.045	3.8	0.0505	0.0000	OK	60 minute winter	1.010	SW42	3.8	0.514	0.049	0.1812	
60 minute winter	SW20	34	19.161	0.026	0.9	0.0354	0.0000	OK	60 minute winter	7.000	SW21	0.9	0.295	0.028	0.1313	
60 minute winter	SW21	58	19.133	0.077	1.8	0.1043	0.0000	OK	60 minute winter	7.001	SW23	1.8	0.291	0.026	0.3149	
60 minute winter	SW22	34	19.158	0.023	0.9	0.0301	0.0000	OK	60 minute winter	8.000	SW23	0.9	0.385	0.011	0.0641	
60 minute winter	SW23	58	19.133	0.132	3.6	0.1704	0.0000	OK	60 minute winter	7.002	SW24	3.0	0.352	0.095	0.5264	
60 minute winter	SW24	62	19.134	0.199	3.0	0.2246	0.0000	OK	60 minute winter	Flow through pond	SW30	3.2	0.072	0.015	3.7005	
60 minute winter	SW25	34	19.161	0.026	0.9	0.0338	0.0000	OK	60 minute winter	9.000	SW26	0.9	0.277	0.028	0.1491	
60 minute winter	SW26	62	19.134	0.082	1.8	0.1114	0.0000	OK	60 minute winter	9.001	SW28	1.8	0.354	0.056	0.4284	
60 minute winter	SW27	61	19.135	0.150	0.9	0.2057	0.0000	OK	60 minute winter	10.000	SW28	0.6	0.187	0.017	0.1603	
60 minute winter	SW28	62	19.134	0.175	3.3	0.2392	0.0000	OK	60 minute winter	9.002	SW29	2.7	0.452	0.056	0.0969	
60 minute winter	SW29	62	19.138	0.203	2.7	0.2298	0.0000	OK	60 minute winter	Flow through pond	SW30	3.2	0.072	0.015	3.7005	
60 minute winter	SW30	57	19.133	0.198	3.2	0.2240	0.0000	OK	60 minute winter	5.000	SW31-HB	1.4	0.382	0.037	0.1895	
60 minute winter	SW31-HB	58	19.133	0.223	1.4	0.2523	0.0000	OK	60 minute winter	Hydro-Brake®	SW32	1.1				
60 minute winter	SW32	59	18.872	0.030	1.1	0.0334	0.0000	OK	60 minute winter	5.002	SW42	1.1	0.398	0.035	0.0698	
60 minute winter	SW33	34	19.751	0.026	0.9	0.0356	0.0000	OK	60 minute winter	11.000	SW34	0.9	0.272	0.028	0.0215	
60 minute winter	SW34	34	19.738	0.037	1.8	0.0504	0.0000	OK	60 minute winter	11.001	SW37	1.8	0.454	0.056	0.2128	
60 minute winter	SW35	60	19.702	0.127	0.9	0.1741	0.0000	OK	60 minute winter	12.000	SW36	0.8	0.253	0.025	0.2388	
60 minute winter	SW36	60	19.702	0.161	1.6	0.2191	0.0000	OK	60 minute winter	12.001	SW37	1.2	0.243	0.039	0.2563	
60 minute winter	SW37	61	19.702	0.191	3.7	0.2521	0.0000	OK	60 minute winter	11.002	SW38	3.4	0.421	0.106	0.1761	
60 minute winter	SW38	61	19.702	0.209	3.4	0.2359	0.0000	OK	60 minute winter	Flow through pond	SW39	2.1	0.101	0.006	2.4240	
60 minute winter	SW39	61	19.702	0.209	2.1	0.2359	0.0000	OK	60 minute winter	6.000	SW40-HB	1.3	0.566	0.018	0.3407	
60 minute winter	SW40-HB	61	19.702	0.377	1.3	0.4259	0.0000	SURCHARGED	60 minute winter	6.001	SW41	0.5	0.385	0.016	0.0117	
60 minute winter	SW41	222	19.315	0.018	0.5	0.0200	0.0000	OK	60 minute winter	6.002	SW42	0.5	0.368	0.012	0.0387	
60 minute winter	SW42	63	18.295	0.053	5.4	0.0599	0.0000	OK	60 minute winter	1.011	SW43	5.4	0.610	0.069	0.4100	
60 minute winter	SW43	64	18.067	0.057	5.4	0.0646	0.0000	OK	60 minute winter	1.012	SW44	5.4	0.587	0.069	0.0558	
60 minute winter	SW44	64	18.036	0.056	5.4	0.0632	0.0000	OK	60 minute winter	1.013	CS01	5.4	0.621	0.069	0.0624	64.2
60 minute winter	CS01	64	17.997	0.053	5.4	0.0000	0.0000	OK								

Adoptable						
Max Width (mm)	**Diameter (mm)**	**Width (mm)**		**Max Depth (m)**	**Diameter (mm)**	**Width (mm)**
374	1200			1.500	1050	
499	1350			99.999	1200	
749	1500					
900	1800					
>900	Link+900 mm					

Circular			
Shape	Circular		**Dia (mm)**
Barrels	1		100
Height (mm)			150
Width (mm)			
Side Slope (1:X)			
Auto Increment (mm)	75		
Preferred Cover (m)			
Steep Slope (1:X)			
Follow Ground	No		
Velocity	Default		
ks (mm) / n			
uPVC			
Shape	Circular		**Dia (mm)**
Barrels	1		225
Height (mm)			
Width (mm)			
Side Slope (1:X)			
Auto Increment (mm)	75		
Preferred Cover (m)			
Steep Slope (1:X)			
Follow Ground	No		
Velocity	Colebrook-White		
ks (mm) / n	0.150		

APPENDIX D – FOUL WATER PIPE NETWORK CALCULATIONS

Drainage Design Report

Flow+

v10.8

Network	Foul Network
Filename	2024-06-05.pfd
Username	Kezia Adanza (kadanza@morce.ie)
Report produced on	10/06/2024 17:34:42

Causeway Sales

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Email:	marketing@causeway.com
Web:	www.causeway.com

Technical support web portal:

http://support.causeway.com

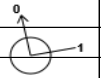
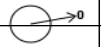
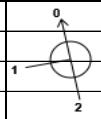
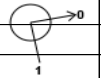
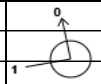
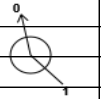
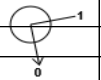
Frequency of use (kDU)	0.50
Flow per dwelling per day (l/day)	446
Domestic Flow (l/s/ha)	0.0
Industrial Flow (l/s/ha)	0.0
Additional Flow (%)	10
Minimum Velocity (m/s)	0.75
Connection Type	Level Inverts
Minimum Backdrop Height (m)	0.500
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	Yes

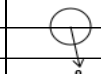
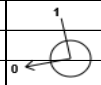
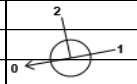
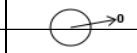
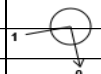
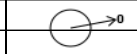
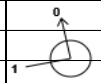
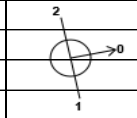
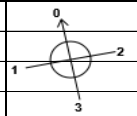
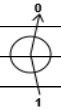
	Name	Area (ha)	Dwellings	Units	Add Inflow (l/s)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Width (mm)	Easting (m)	Northing (m)	Depth (m)	Notes
✓	FW01			10.5		20.270	Manhole	Adoptable	1200		713839.865	733670.480	1.425	
✓	FW02			10.5		20.270	Manhole	Adoptable	1200		713793.566	733661.490	2.211	
✓	FW03			10.5		20.270	Manhole	Adoptable	1200		713776.548	733666.905	1.425	
✓	FW04			10.5		20.245	Manhole	Adoptable	1200		713791.824	733669.924	2.330	
✓	FW05					20.245	Manhole	Adoptable	1200		713790.954	733674.140	2.359	
✓	FW06					20.245	Manhole	Adoptable	1200		713796.759	733675.268	2.398	
✓	FW07					20.425	Manhole	Adoptable	1200		713787.931	733720.796	2.810	
✓	FW08					20.425	Manhole	Adoptable	1200		713783.465	733725.274	2.842	
✓	FW09			16.0		19.960	Manhole	Adoptable	1200		713819.246	733782.650	1.425	
✓	FW10			16.0		19.960	Manhole	Adoptable	1200		713798.010	733778.257	1.786	
✓	FW11			16.0		19.810	Manhole	Adoptable	1200		713824.583	733771.299	1.225	
✓	FW12			16.0		19.960	Manhole	Adoptable	1200		713829.320	733748.369	1.765	
✓	FW13			16.0		20.260	Manhole	Adoptable	1200		713804.815	733743.306	2.679	
✓	FW14			9.6		20.400	Manhole	Adoptable	1200		713738.279	733762.473	1.425	
✓	FW15			9.6		20.400	Manhole	Adoptable	1200		713748.268	733764.452	1.595	
✓	FW16			9.6		20.550	Manhole	Adoptable	1200		713748.638	733726.479	1.425	
✓	FW17			9.6		20.550	Manhole	Adoptable	1200		713756.051	733728.011	1.551	
✓	FW18			9.6		20.550	Manhole	Adoptable	1200		713754.960	733733.296	2.542	
✓	FW19					20.340	Manhole	Adoptable	1200		713780.696	733738.610	2.882	
✓	FW20					20.240	Manhole	Adoptable	1200		713770.646	733787.343	3.031	
✓	CS01					20.150	Manhole	Adoptable	1200		713772.520	733796.719	2.989	

	Name	US Node	DS Node	Length (m)	ks (mm) / n	Velocity Equation	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	Con Offset (m)	Min DS IL (m)
?	1.000	FW01	FW02	47.164	1.500	Colebrook-White	18.845	18.059	0.786	60.0	225	Circular		
?	1.001	FW02	FW04	8.612	1.500	Colebrook-White	18.059	17.915	0.144	60.0	225	Circular		
?	2.000	FW03	FW04	15.571	1.500	Colebrook-White	18.845	18.585	0.260	60.0	225	Circular		
?	1.002	FW04	FW05	4.305	1.500	Colebrook-White	17.915	17.886	0.029	150.0	225	Circular		
?	1.003	FW05	FW06	5.914	1.500	Colebrook-White	17.886	17.847	0.039	150.0	225	Circular		
?	1.004	FW06	FW07	46.376	1.500	Colebrook-White	17.847	17.615	0.232	200.0	225	Circular		
?	1.005	FW07	FW08	6.324	1.500	Colebrook-White	17.615	17.583	0.032	200.0	225	Circular		
?	1.006	FW08	FW19	13.620	1.500	Colebrook-White	17.583	17.515	0.068	200.0	225	Circular		
?	3.000	FW09	FW10	21.686	1.500	Colebrook-White	18.535	18.174	0.361	60.0	225	Circular		
?	3.001	FW10	FW13	35.607	1.500	Colebrook-White	18.174	17.581	0.593	60.0	225	Circular		
?	4.000	FW11	FW12	23.414	1.500	Colebrook-White	18.585	18.195	0.390	60.0	225	Circular		
?	4.001	FW12	FW13	25.023	1.500	Colebrook-White	18.195	17.778	0.417	60.0	225	Circular		
?	3.002	FW13	FW19	24.572	1.500	Colebrook-White	17.581	17.458	0.123	200.0	225	Circular		
?	5.000	FW14	FW15	10.183	1.500	Colebrook-White	18.975	18.805	0.170	60.0	225	Circular		
?	5.001	FW15	FW18	31.867	1.500	Colebrook-White	18.805	18.008	0.797	40.0	225	Circular		
?	6.000	FW16	FW17	7.570	1.500	Colebrook-White	19.125	18.999	0.126	60.0	225	Circular		
?	6.001	FW17	FW18	5.396	1.500	Colebrook-White	18.999	18.909	0.090	60.0	225	Circular		
?	5.002	FW18	FW19	26.279	1.500	Colebrook-White	18.008	17.833	0.175	150.0	225	Circular		
?	1.007	FW19	FW20	49.758	1.500	Colebrook-White	17.458	17.209	0.249	200.0	225	Circular		
?	1.008	FW20	CS01	9.561	1.500	Colebrook-White	17.209	17.161	0.048	200.0	225	Circular		

Name	US Node	DS Node	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)	Notes
1.000	FW01	FW02	0.466	1.483	59.0	1.8	1.200	1.986	1.200	1.986	0.000	0	10.5	0.0	27	0.654	Proportional Velocity @ 1/3 Flow is less than the specified minimum
1.001	FW02	FW04	0.517	1.483	59.0	2.5	1.986	2.105	1.986	2.105	0.000	0	21.0	0.0	32	0.735	Proportional Velocity @ 1/3 Flow is less than the specified minimum
2.000	FW03	FW04	0.466	1.483	59.0	1.8	1.200	1.435	1.200	1.435	0.000	0	10.5	0.0	27	0.654	Proportional Velocity @ 1/3 Flow is less than the specified minimum
1.002	FW04	FW05	0.421	0.936	37.2	3.6	2.105	2.134	2.105	2.134	0.000	0	42.0	0.0	47	0.589	Proportional Velocity @ 1/3 Flow is less than the specified minimum
1.003	FW05	FW06	0.421	0.936	37.2	3.6	2.134	2.173	2.134	2.173	0.000	0	42.0	0.0	47	0.589	Proportional Velocity @ 1/3 Flow is less than the specified minimum
1.004	FW06	FW07	0.379	0.810	32.2	3.6	2.173	2.585	2.173	2.585	0.000	0	42.0	0.0	51	0.532	Proportional Velocity @ 1/3 Flow is less than the specified minimum | Downstream Depth is more than twice the specified minimum
1.005	FW07	FW08	0.379	0.810	32.2	3.6	2.585	2.617	2.585	2.617	0.000	0	42.0	0.0	51	0.532	Proportional Velocity @ 1/3 Flow is less than the specified minimum | Upstream Depth is more than twice the specified minimum | Downstream Depth is more than twice the specified minimum
1.006	FW08	FW19	0.379	0.810	32.2	3.6	2.617	2.600	2.600	2.617	0.000	0	42.0	0.0	51	0.532	Proportional Velocity @ 1/3 Flow is less than the specified minimum | Upstream Depth is more than twice the specified minimum | Downstream Depth is more than twice the specified minimum
3.000	FW09	FW10	0.501	1.483	59.0	2.2	1.200	1.561	1.200	1.561	0.000	0	16.0	0.0	29	0.696	Proportional Velocity @ 1/3 Flow is less than the specified minimum
3.001	FW10	FW13	0.550	1.483	59.0	3.1	1.561	2.454	1.561	2.454	0.000	0	32.0	0.0	36	0.786	Proportional Velocity @ 1/3 Flow is less than the specified minimum | Downstream Depth is more than twice the specified minimum
4.000	FW11	FW12	0.501	1.483	59.0	2.2	1.000	1.540	1.000	1.540	0.000	0	16.0	0.0	29	0.696	Proportional Velocity @ 1/3 Flow is less than the specified minimum | Upstream Depth is less than the specified minimum
4.001	FW12	FW13	0.550	1.483	59.0	3.1	1.540	2.257	1.540	2.257	0.000	0	32.0	0.0	36	0.786	Proportional Velocity @ 1/3 Flow is less than the specified minimum
3.002	FW13	FW19	0.421	0.810	32.2	4.9	2.454	2.657	2.454	2.657	0.000	0	80.0	0.0	59	0.584	Proportional Velocity @ 1/3 Flow is less than the specified minimum | Upstream Depth is more than twice the specified minimum | Downstream Depth is more than twice the specified minimum
5.000	FW14	FW15	0.466	1.483	59.0	1.7	1.200	1.370	1.200	1.370	0.000	0	9.6	0.0	27	0.654	Proportional Velocity @ 1/3 Flow is less than the specified minimum
5.001	FW15	FW18	0.593	1.818	72.3	2.4	1.370	2.317	1.370	2.317	0.000	0	19.2	0.0	29	0.837	Proportional Velocity @ 1/3 Flow is less than the specified minimum
6.000	FW16	FW17	0.466	1.483	59.0	1.7	1.200	1.326	1.200	1.326	0.000	0	9.6	0.0	27	0.654	Proportional Velocity @ 1/3 Flow is less than the specified minimum
6.001	FW17	FW18	0.517	1.483	59.0	2.4	1.326	1.416	1.326	1.416	0.000	0	19.2	0.0	31	0.722	Proportional Velocity @ 1/3 Flow is less than the specified minimum
5.002	FW18	FW19	0.430	0.936	37.2	3.8	2.317	2.282	2.282	2.317	0.000	0	48.0	0.0	49	0.602	Proportional Velocity @ 1/3 Flow is less than the specified minimum
1.007	FW19	FW20	0.473	0.810	32.2	7.2	2.657	2.806	2.657	2.806	0.000	0	170.0	0.0	73	0.653	Proportional Velocity @ 1/3 Flow is less than the specified minimum | Upstream Depth is more than twice the specified minimum | Downstream Depth is more than twice the specified minimum
1.008	FW20	CS01	0.473	0.810	32.2	7.2	2.806	2.764	2.764	2.806	0.000	0	170.0	0.0	73	0.653	Proportional Velocity @ 1/3 Flow is less than the specified minimum | Upstream Depth is more than twice the specified minimum | Downstream Depth is more than twice the specified minimum

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)	US Node	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type	DS Node	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type
1.000	47.164	60.0	225	Circular	20.270	18.845	1.200	20.270	18.059	1.986	FW01	1200			Manhole	Adoptable	FW02	1200			Manhole	Adoptable
1.001	8.612	60.0	225	Circular	20.270	18.059	1.986	20.245	17.915	2.105	FW02	1200			Manhole	Adoptable	FW04	1200			Manhole	Adoptable
2.000	15.571	60.0	225	Circular	20.270	18.845	1.200	20.245	18.585	1.435	FW03	1200			Manhole	Adoptable	FW04	1200			Manhole	Adoptable
1.002	4.305	150.0	225	Circular	20.245	17.915	2.105	20.245	17.886	2.134	FW04	1200			Manhole	Adoptable	FW05	1200			Manhole	Adoptable
1.003	5.914	150.0	225	Circular	20.245	17.886	2.134	20.245	17.847	2.173	FW05	1200			Manhole	Adoptable	FW06	1200			Manhole	Adoptable
1.004	46.376	200.0	225	Circular	20.245	17.847	2.173	20.425	17.615	2.585	FW06	1200			Manhole	Adoptable	FW07	1200			Manhole	Adoptable
1.005	6.324	200.0	225	Circular	20.425	17.615	2.585	20.425	17.583	2.617	FW07	1200			Manhole	Adoptable	FW08	1200			Manhole	Adoptable
1.006	13.620	200.0	225	Circular	20.425	17.583	2.617	20.340	17.515	2.600	FW08	1200			Manhole	Adoptable	FW19	1200			Manhole	Adoptable
3.000	21.686	60.0	225	Circular	19.960	18.535	1.200	19.960	18.174	1.561	FW09	1200			Manhole	Adoptable	FW10	1200			Manhole	Adoptable
3.001	35.607	60.0	225	Circular	19.960	18.174	1.561	20.260	17.581	2.454	FW10	1200			Manhole	Adoptable	FW13	1200			Manhole	Adoptable
4.000	23.414	60.0	225	Circular	19.810	18.585	1.000	19.960	18.195	1.540	FW11	1200			Manhole	Adoptable	FW12	1200			Manhole	Adoptable
4.001	25.023	60.0	225	Circular	19.960	18.195	1.540	20.260	17.778	2.257	FW12	1200			Manhole	Adoptable	FW13	1200			Manhole	Adoptable
3.002	24.572	200.0	225	Circular	20.260	17.581	2.454	20.340	17.458	2.657	FW13	1200			Manhole	Adoptable	FW19	1200			Manhole	Adoptable
5.000	10.183	60.0	225	Circular	20.400	18.975	1.200	20.400	18.805	1.370	FW14	1200			Manhole	Adoptable	FW15	1200			Manhole	Adoptable
5.001	31.867	40.0	225	Circular	20.400	18.805	1.370	20.550	18.008	2.317	FW15	1200			Manhole	Adoptable	FW18	1200			Manhole	Adoptable
6.000	7.570	60.0	225	Circular	20.550	19.125	1.200	20.550	18.999	1.326	FW16	1200			Manhole	Adoptable	FW17	1200			Manhole	Adoptable
6.001	5.396	60.0	225	Circular	20.550	18.999	1.326	20.550	18.909	1.416	FW17	1200			Manhole	Adoptable	FW18	1200			Manhole	Adoptable
5.002	26.279	150.0	225	Circular	20.550	18.008	2.317	20.340	17.833	2.282	FW18	1200			Manhole	Adoptable	FW19	1200			Manhole	Adoptable
1.007	49.758	200.0	225	Circular	20.340	17.458	2.657	20.240	17.209	2.806	FW19	1200			Manhole	Adoptable	FW20	1200			Manhole	Adoptable
1.008	9.561	200.0	225	Circular	20.240	17.209	2.806	20.150	17.161	2.764	FW20	1200			Manhole	Adoptable	CS01	1200			Manhole	Adoptable

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type	Connections		Link	IL (m)	Dia (mm)	Link Type
FW01	713839.865	733670.480	20.270	1.425	1200			Manhole	Adoptable						
															
											0	1.000	18.845	225	Circular
FW02	713793.566	733661.490	20.270	2.211	1200			Manhole	Adoptable		1	1.000	18.059	225	Circular
											0	1.001	18.059	225	Circular
FW03	713776.548	733666.905	20.270	1.425	1200			Manhole	Adoptable						
															
											0	2.000	18.845	225	Circular
FW04	713791.824	733669.924	20.245	2.330	1200			Manhole	Adoptable		1	2.000	18.585	225	Circular
											2	1.001	17.915	225	Circular
											0	1.002	17.915	225	Circular
FW05	713790.954	733674.140	20.245	2.359	1200			Manhole	Adoptable		1	1.002	17.886	225	Circular
															
											0	1.003	17.886	225	Circular
FW06	713796.759	733675.268	20.245	2.398	1200			Manhole	Adoptable		1	1.003	17.847	225	Circular
											0	1.004	17.847	225	Circular
FW07	713787.931	733720.796	20.425	2.810	1200			Manhole	Adoptable		1	1.004	17.615	225	Circular
											0	1.005	17.615	225	Circular
FW08	713783.465	733725.274	20.425	2.842	1200			Manhole	Adoptable		1	1.005	17.583	225	Circular
											0	1.006	17.583	225	Circular
FW09	713819.246	733782.650	19.960	1.425	1200			Manhole	Adoptable						
															
											0	3.000	18.535	225	Circular
FW10	713798.010	733778.257	19.960	1.786	1200			Manhole	Adoptable		1	3.000	18.174	225	Circular
															
											0	3.001	18.174	225	Circular

FW11	713824.583	733771.299	19.810	1.225	1200			Manhole	Adoptable						
											0	4.000	18.585	225	Circular
FW12	713829.320	733748.369	19.960	1.765	1200			Manhole	Adoptable		1	4.000	18.195	225	Circular
											0	4.001	18.195	225	Circular
FW13	713804.815	733743.306	20.260	2.679	1200			Manhole	Adoptable		1	4.001	17.778	225	Circular
											2	3.001	17.581	225	Circular
											0	3.002	17.581	225	Circular
FW14	713738.279	733762.473	20.400	1.425	1200			Manhole	Adoptable						
											0	5.000	18.975	225	Circular
FW15	713748.268	733764.452	20.400	1.595	1200			Manhole	Adoptable		1	5.000	18.805	225	Circular
											0	5.001	18.805	225	Circular
FW16	713748.638	733726.479	20.550	1.425	1200			Manhole	Adoptable						
											0	6.000	19.125	225	Circular
FW17	713756.051	733728.011	20.550	1.551	1200			Manhole	Adoptable		1	6.000	18.999	225	Circular
											0	6.001	18.999	225	Circular
FW18	713754.960	733733.296	20.550	2.542	1200			Manhole	Adoptable		1	6.001	18.909	225	Circular
											2	5.001	18.008	225	Circular
											0	5.002	18.008	225	Circular
FW19	713780.696	733738.610	20.340	2.882	1200			Manhole	Adoptable		1	5.002	17.833	225	Circular
											2	3.002	17.458	225	Circular
											3	1.006	17.515	225	Circular
											0	1.007	17.458	225	Circular
FW20	713770.646	733787.343	20.240	3.031	1200			Manhole	Adoptable		1	1.007	17.209	225	Circular
											0	1.008	17.209	225	Circular
CS01	713772.520	733796.719	20.150	2.989	1200			Manhole	Adoptable		1	1.008	17.161	225	Circular

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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	January 2024

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required Action	Typical Frequency
Permeable Paving	PPP management company for 25 years then Dublin City Council for public realm areas	Regular Maintenance	Brushing (Standard cosmetic sweep over whole surface)	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
			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	September 2023

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required Action	Typical Frequency
Bioretention Areas - Swales / tree pits / Rain gardens	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