MALONE O'REGAN
CONSULTING ENGINEERS

Noel Frisby Construction Ltd.

Student Accommodation at Cork Road, Waterford

Engineering Planning Report

Job No: W22076
Date: February 2024

Contents Amendment Records

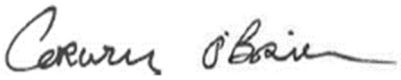
Document: Engineering Planning Report

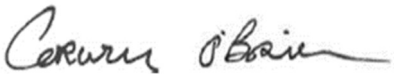
Project: Student Accommodation at Cork Road, Waterford

Client: Noel Frisby Construction Ltd.

Job Number: W22076

Prepared By: Caolan Carty **Signed:** 

Checked By: Corwun O'Brien **Signed:** 

Approved By: Corwun O'Brien **Signed:** 

Revision Record

Revision	Date	Description	Prepared By	Checked By	Approved By
P1	Feb 2024	Planning Issue	C Carty	C O'Brien	C O'Brien

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1.0 Introduction

Malone O'Regan have been commissioned by the applicant, Noel Frisby Construction Ltd. to prepare an Engineering Report in support of a planning application for a proposed Large Scale Residential Development at Cork Road, Waterford City, Co. Waterford. The site area is 1.99 Hectares.

The development consists of: 4 No. Apartment buildings, Blocks A, B, C & D with a commercial unit. Further information on the development description is included below.

Malone O'Regan Consulting Engineers, the firm appointed to provide civil and structural engineering design services for the project, have compiled this report to address the engineering aspects of the planning application.

Engineering drawings submitted with the application are listed in Appendix A of this Report.

The development description for the project is as follows:

Permission for the following Large-Scale Residential Development (LRD) comprising of the construction of a student accommodation development which will consist of the construction of 85 no. student accommodation apartments (ranging in size from 5-bed apartments to 8-bed apartments) comprising a total of 582 no. bed spaces in 4 no. blocks ranging in height from 4-6 storeys, with student amenity facilities including 1 no. retail/cafe unit, communal areas, laundry room, reception, student and staff facilities, storage, ESB substation/switch room, bin and general stores and plant rooms. The development also includes the provision of landscaping and amenity areas including a central courtyard space, public realm/plaza (fronting on to the Cork Road) the provision of a set down area, 1 no. vehicular access point onto Ballybeg Drive, car and bicycle parking, footpaths, signage, boundary treatment, road, pedestrian and cycle improvements to Lacken Road (including a pedestrian crossing) and all ancillary development including pedestrian/cyclist facilities, lighting, drainage (including 2 no. bio retention ponds) landscaping, boundary treatments and plant including PV solar at roof level.

A Natura Impact Statement (NIS) has been prepared and will be submitted to the planning authority with the application.

2.0 Location

2.1 The Site

The site is located 2.40km South West of Waterford City Centre in the townland of Killbarry, in close proximity to South East Technological University. The site is bound by Ballybeg Drive along the western boundary, the R680 (former Cork Road) along the northern boundary and the Lacken Road on the southern and eastern boundaries of the site.

The proposed residential development site area is 1.99 Hectares and gradually slopes from a high point at the western boundary of the site towards the east, where an existing stream runs along the boundary. The existing ground level at the south west of the site is approximately 9m O.D, and 4m O.D along the north eastern portion of the site. An existing

stream enters the site through a culvert at the Cork Road to the north west corner and is located inside the boundary of the site. The stream forms the boundary along the north east of the site and is located along part of the eastern boundary, where it crosses under the Lacken Road.
Upgrade works to the Lacken Road will be provided in this project, including an extension to the existing culvert to facilitate the road widening and provision of foot/cycle paths.

Ground Investigations have not yet been completed to determine the existing subsurface conditions at the site, and this will be completed post-planning. However, the site is overlaid by a relatively deep layer (approximately 4m) of fill material, and therefore shallow foundations are unlikely to be suitable for the apartment blocks. It is envisaged that the apartment blocks will be supported on pile foundations and this will be confirmed through Site Investigations and detailed design at a later date.

2.2 Cut and Fill Estimates

The proposed development will require earthworks to grade the site to suit the proposed levels and to form a suitable level platform for the construction of the apartments. Preliminary cut and fill volumes have been estimated for the site. Excavated material will be reused as fill material where possible, however this will need to be confirmed through Ground Investigations and soil testing to determine the suitability of excavated soils for re-use. The majority of the site is in cut, with a quantity of fill required towards the eastern boundary.

Preliminary volumes are as below;

- Cut – 7450 m^3.
- Fill – 1800m^3.

Ground Investigations will be carried out following the planning process and this will further inform the cut and fill volumes for the site.

2.3 Existing Services

An existing foul sewer pumping station is located to the south of the proposed development site. This existing foul sewer pumping station pumps sewage northwards through a rising main located along Ballybeg drive on the western boundary of the site. There is an existing watermain that runs along the R680 which is situated at the north of the site. The existing watermain and foul sewer pipe size are as follows:

- Existing foul rising main 225mm diameter
- Existing watermain 300mm diameter

The Engineering drawings submitted propose the connection to the existing foul pumping station to the south. The watermain will be connected to the 300mm diameter pipe in the Cork Road. Both proposals have been confirmed as feasible by Uisce Éireann.

Further details on the foul sewer and watermain networks and the connections are described in Section 4 and 5 of this Report.

3.0 SuDS and Storm Water Drainage

3.1 Proposed Surface Water Drainage System

For the proposed development, Sustainable urban Drainage Systems (SuDS) and Nature Based Solutions (NBS) measures will be provided with reference to the SuDS Best Practice Interim Guidance Document prepared by Department of Housing, Local Government and Heritage, The 2015 CIRIA SuDS Manual C753 and the Dublin City Council Sustainable Drainage Design and Evaluation Guide 2021.

Permeable paving, filter drains, tree pits, bio retention ponds, petrol interceptor and soft landscaping have been implemented within the proposed scheme. The provision of NBS and SuDS to minimise runoff from the site was requested during the preplanning meetings for the development.
Surface water from the roofs and impermeable roads will be collected by the surface water network. The surface water will discharge to bio retention pond to remove sediments before discharging to the local stream via a hydrobrake flow control that restricts the outflow to 2.0 L/s, as agreed with Waterford City and County Council.

The development proposal includes two types of permeable paving coverage, tanked and infiltration. The infiltration permeable paving is proposed for the parking on the west of the site. The rainwater will percolate through the permeable paving and infiltrate into the underlying soils. The permeable surface, 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 a treatment medium.
The tanked permeable paving is proposed for the plaza area to the north of the site. The rainwater will percolate through the permeable paving and is stored in the tanked subbase. A flow control will gradually discharge the stored surface water into the proposed surface water network. The permeable surface, together with their associated tanked subbase, are an efficient means intercepting runoff, controlling the rate of runoff, and providing a treatment medium close to source.

Water from the impermeable areas in the courtyard will be collected in filter drains which are integrated in to the landscaping plan. The drains will be constructed with free draining angular stone and perforated pipes. A lower perforated pipe will assist with natural water retention and infiltration and an upper pipe will act as an overflow to the surface water sewer network to cater for extreme rainfall events.

Two bio retention ponds are located in the open space towards the south of the site which provide attenuation storage for the surface water runoff from the site. A “hydrobrake” with a suitable orifice size will be installed to restrict the discharge flow from this tank to 2.0 L/s. The allowable discharge of 2.0 L/s was agreed with the Water Services Dept of Waterford City and County Council. Reference should also be made to the ‘Response to LRD Opinion’ document provided as part of this submission.

Details of the SuDS strategy are provided on Drawings P854 Rev P1 and P856 Rev P1.

Consideration was also given to alternative SuDS measures, but have been discounted on the following basis.

- Extensive green roof to the apartment buildings. This was discounted at design stage due to the requirement of routine maintenance and risks associated with

students on the roof of the building. The surface water runoff from the roof will be designed to discharge to the bio retention pond, as discussed further in Section 3.2

- Rainwater harvesting tanks. Rainwater harvesting for the development have been technically and economically assessed and were not suitable for the development

3.2 Compliance with the Principles of Sustainable Urban Drainage Systems

In order to reduce the surface water flow from the site, the proposed development will be designed in accordance with the principles of SuDS as embodied in the recommendations of Sustainable Drainage Design & Evaluation Guide 2021 (SDDEG). The SDDEG addresses the issue of urbanisation, integration of SuDS into the fabric of the development, softer engineered and nature-based approach to surface water drainage that mimic the run-off characteristics of the greenfield site.

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

- Interception Storage
- Treatment Storage (not required if interception storage is provided)
- Attenuation Storage

Interception Storage

In the case of the subject site interception storage will be provided for the surface water. This will be achieved in the bio retention pond, due to the capacity of pond to retain runoff below the level of the outlet pipes. Additionally, at source interception is provided by the filter drains to soft landscaping and permeable paving. Interception storage is provided to prevent pollutants or sediments discharging into watercourse. SuDS guidance 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. The SuDS design for the site is based on infiltration to soils through permeable paving and soft landscaping, and interception in the proposed ponds.

Surface Water Attenuation Storage

Calculations are included in Appendix C for the surface water drainage including attenuation ponds. The rainfall intensities are based on Met Eireann figures for Waterford City. The Met Eireann figures include 30 and 100-year return periods and these figures are used to establish the volume of attenuation required. An allowance of 30% increase in rainfall has been included in the design to account for climate change. The Met Eireann rainfall data figures are included in Appendix B. The location of the attenuation arrangement is indicated on drawing W22076-P853 Rev P1.

Surface Water Discharge from Site

The standard permissible runoff calculation recommended for use by the Greater Dublin Strategic Drainage Study (GDSDS) is based the calculation of Q $BAR_{RURAL,}$ which is sourced from the Institute of Hydrology Report IHR124. This value is the mean annual flood flow from a rural catchment in m^3/sec 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

Standard Average Annual Rainfall for the site was taken from Met Eireann data, SAAR was taken as 1018mm.

The Soil Type was taken from the Flood Studies Report as Soil Type 2 which has a corresponding Standard Percentage Runoff (SPR) coefficient of 0.3.

$QBAR_{rural} = 0.00108\ [0.0199]^{0.89} \times [1018]^{1.17} \times [0.3]^{2.17}$
$= 0.00801\ m^3/s$

$QBAR_{rural}$ = 8.013 L/s (limited to 2.0 L/s as described in Section 3.1)

The value for $QBAR_{RURAL}$ calculated above is in accordance with the Greater Dublin Strategic Drainage Study (GDSDS).
The following table indicates the values included in the design of the surface water drainage network. Full calculation outputs with the relevant information highlighted are provided in Appendix C. The pipes are designed for a rainfall intensity of 50 mm/hour as specified in Technical Guidance Document H of the Building Regulations.

Parameter Description	Assigned Value
Attenuation Design Return Period	100 years
Allowance for climate change	30% (Ref. OPW Flood Risk Management Climate Change Sectoral Adaptation Plan, High-End Future Scenario)
M5-60	18.7 mm (Met Eireann data)
M5-2D	68.9 mm (Met Eireann data)
Ratio, r	0.271
Time of Entry	5 min
Pipe roughness, Ks	0.6mm (Ref. GDSDS Volume 2, Table 6.4)

It is proposed to use a geo textile lined bio retention ponds to store the rainwater balance. The ponds are designed to store the 1:100-year rainfall event with an allowance of 30% for climate change. The site levels have been designed to form these two ponds that can accommodate this volume of water. The area is indicated on Drawing W22076-P853 Rev P1, with sections and details provided on P856 Rev P1.

Design calculations for the surface water network are included in Appendix C. The surface water calculations include the 1, 30 and 100-year return periods with an additional allowance of 30% for climate change, as required by the OPW Flood Risk Management Climate Change Sectoral Adaptation Plan, High-End Future Scenario.

The capacities of the proposed attenuation ponds are 320m^3 and 200m^3, which provides 50m^3 storage above the requirement for the 100-year storm (with 30% climate change).
Safety aspects for the proposed attenuation ponds and predicted water levels are included on MOR Drawing P854 Rev P1 – Bio Retention Ponds Sections. Toddler fencing will be provided to the full perimeter of both Bio Retention Ponds. In accordance with Dublin City Council Guidance Document, "Sustainable Drainage Design & Evaluation Guide" 2021, toddler fencing will be a 700mm bow-top fence as this stops most toddlers and allows adults to easily step over the fence. Additionally, the ponds are graded to include a shelf which will be dry the majority of times, as another safety feature. This shelf will remain dry for the 1-year return period and is at the same level as the maximum water level for the 30-year return period (+30%). The 100-year storm (+30%) results in a water depth of 250mm at this raised shelf. Reference should be made to the Planting Schedule submitted as part of the Landscape Architect's Masterplan in relation to the proposed planting at these ponds.

The attenuation ponds are designed in accordance with the Dublin City Council Guidance Document, "Sustainable Drainage Design & Evaluation Guide" 2021. The site has been separated into sub-catchments to maximise the available storage capacity. Sub-catchments are defined as small discrete areas that manage their own runoff. Discharge from the public plaza to the primary surface water network is limited via a flow control device. The car park runoff is managed by permeable paving, while the internal area utilises gravel paths and landscaped areas to provide infiltration to the ground, reducing the storage volume required in the retention ponds. The runoff from impermeable surfaces (roofs and roads) is collected in 3 separate pipe networks prior to discharging to the attenuation ponds as shown on Drawing P853 Rev P1 Surface Water Drainage Layout.

Outlets from these ponds are protected with mesh baskets filled with stone, and are located on a slope to encourage debris to pass over the outlet as required by the guidance document. The outlets are also raised above the invert level of the ponds to allow the initial interception storage and settlement of suspended solids.

Gradients for the pond embankments are to achieve a maximum slope of 1:3 as required by the guidance document and as shown on the Bio Retention Pond Sections.

MOR Drawing P854 Rev P1 – Bio Retention Ponds Sections provides the maximum storage volumes for the Bio Retention Ponds. Maximum water levels are shown for both the 1-year and 100-year return periods, with the additional allowance of 30% for climate change. The time required for the ponds to empty is also provided for both scenarios.

1-year storm maximum depth - 0.662m. Time to empty – 1.05 days.
100-year storm maximum depth – 1.302m. Time to empty – 2.7 days.

It is expected that the base of the ponds will be firm and dry during summer periods. The maximum expected level during typical yearly rainfall events is 300mm, which is the height of the outlet above the invert level of the pond.
The discharge from the ponds to the outfall is limited to 2.0 L/s by a Hydrobrake flow control device. A Klargester NSBE020 Bypass Interceptor will also be provided downstream of the Bio Retention Ponds.

The maintenance and management plan for the SuDS components is provided in Appendix G.

3.3 Surface Water Culverts

An existing stream runs along the north and east of the site. As part of the proposed development, it is necessary to culvert a section of this stream to form the new student plaza area. This will be achieved by a rectangular precast concrete culvert 3.2m wide and 1.2m deep. A proposed extension to the culvert at the Lacken Road is also proposed as part of the development, to the same dimensions. Details of the proposed culverts are provided on MOR Drawings P851 Rev P1 – Site Sections and P865 Rev P1 - Details of Lacken Road Culvert.

For more information on the proposed culverts, refer to IE consulting documents submitted with this application. The SSFRA completed by IE Consulting has been taken into account in the development of the civil engineering works. The culverts have been assessed for the 1 in 50-year, 1 in 100-year, and 1 in 1000-year flood volumes for the proposed dimensions, and both culverts have adequate hydraulic capacity to convey the flood volumes.

4.0 Foul Water Drainage

The foul drainage from the development will be collected in a new 225mm and 315mm diameter foul sewer which will be built as part of the development. The sewers flow by gravity to an existing pumping station at the south of the site through an approximate 51m extension outside of the site boundary. The foul drainage details are indicated on drawing W22076-P803 Rev P1.
A pre-connection enquiry form for the waste water connection to the development has been submitted to Uisce Éireann (Uisce Éireann reference: CDS22006904). A response has been received from Uisce Éireann and confirms feasibility subject to upgrade works being carried out outside of the site boundary. This response is included in Appendix F.

A calculation sheet for the foul drainage is detailed in Appendix D. This should be read in conjunction with the foul drainage drawing P855 Rev P1, for the development.

5.0 Water Supply

A 150mm diameter connection to the watermain will provide a water supply to the site. It is anticipated that the water demand for the development will be 97.2m^3/day. The proposed water supply will require approximately 38m of a network extension to connect the site to proposed connection point on the R680 (former Cork Road). The supply will be metred by a bulk meter at its entrance to the site and extend through the site forming local loops within the central open space.

The water supply to the apartment block will be metered by a bulk meter and individual apartments will be metered in the plantroom of the apartment block. The proposed watermain is 150mm internal diameter polyethylene pipe with 100mm branches serving each apartment block. The network includes air valves, anchor blocks, sluice valves and fire hydrants.

A pre-connection enquiry form for the water connection to the development has been submitted to Uisce Éireann (Uisce Éireann reference: CDS22006904). A response has

been received from Uisce Éireann and confirms feasibility subject to upgrade works. This response is included in Appendix F.

The watermain layout is indicated on MOR drawing P852 Rev P1.

6.0 Statement of Compliance with Irish Water's (Uisce Eireann) Standard Details and Codes of Practice

The proposals for the Watermain connection and the Foul Drainage connection have been designed in accordance with Irish Water Standard Details and Code of Practice. A statement of design acceptance has been applied for and the relevant drawings have been submitted to Uisce Eireann for design approval. We are waiting on the issue of a Statement of Compliance / Statement of Design Acceptance. Coordination of the connection points has been discussed with Uisce Eireann through the design stage. A copy of the drawings submitted for design approval to Uisce Eireann is included in Appendix H.

The following drawings have been submitted to Uisce Eireann;

- P852 – Watermain Layout
- P855 – Foul Drainage Layout
- P857 – Roads & Drainage Long Sections
- P860, P861, P862 & P864 – Site Development Details

7.0 Flood Risk Assessment

A Site-Specific Flood Risk Assessment (SSFRA) has been completed for the site by IE Consulting. For more information refer to IE Consulting documents IE 2807-5931, and IE 2807- 6201 submitted with this application. The results of the SSFRA have been implemented into the civil engineering proposals for the development.

A meeting was held between Waterford City and County Council and IE Consulting to agree the scope of the flood risk assessment. Refer to Sections 1 and 3 of the IE Consulting report for details of this meeting, the proposals that were presented and the response provided by IE Consulting in relation to the queries raised by Waterford City and County Council.

8.0 Vehicle Access and Visibility Splays

MOR Drawing P859 Rev P1 provides details of the proposed Lacken Road improvements including the raised pedestrian crossing, junction layouts and forward visibility splays. The southern Bio Retention Pond embankment has been modified to ensure the required sightlines are achieved. MOR Drawing P859 highlights the envelope of clear visibility to be maintained at the raised crossing in accordance with DMURS.

MOR Drawing P859 also provides vehicle swept path analyses for various vehicle types, which ensures the road is sufficiently wide to accommodate buses.

Appendix A

Engineering Drawing List

MALONE O'REGAN CONSULTING ENGINEERS

3-4 Canada Street, Tel : +353 51 876 855
WATERFORD. X91
V52K.
Drawings Issued from Waterford Office

Email : waterford@morce.ie

2B Richview Office Park, Tel : +353 1 2602655
Clonskeagh,
DUBLIN 14.
D14 XT57

Email : dublin@morce.ie

Sheet No.

01

DRAWING ISSUE FORM

Job No :	Job :		Date Issued									
W22076	STUDENT ACCOMMODATION AT CORK ROAD, WATERFORD	Day	19									
		Month	02									
		Year	24									

Drawing No.	Drawing Title	Revision No.									
P850	G.A. - Existing Site Survey	P1									
P851	G.A. - Surfacing & Levels Layout	P1									
P852	G.A. - Watermain Layout	P1									
P853	G.A. - Surface Water Drainage Layout	P1									
P854	G.A. - SuDS Strategy Layout	P1									
P855	G.A. - Foul Drainage Layout	P1									
P856	G.A. - Bioretention Ponds Sections	P1									
P857	G.A. - Long. Sections (Roads & Drainage)	P1									
P858	G.A. - Site Sections	P1									
P859	G.A. - Line Marking & Vehicle Access Layout	P1									
P860	Site Development Details (Sheet 1)	P1									
P861	Site Development Details (Sheet 2)	P1									
P862	Site Development Details (Sheet 3)	P1									
P863	Site Development Details (Sheet 4)	P1									
P864	Site Development Details (Sheet 5)	P1									
P865	Details of Existing Lacken Road Culvert	P1									

Issued to :		No. of Copies									
Client	Noel Frisby Construction Ltd.	X									
Contractor											
Architect	Fewer Harrington & Partners	X									
Quantity Sur.											
M&E Cont.											
Others	McCutcheon Halley Planning Consultants	X									
Others	Planning Department	X									
Others											

Purpose of Issue :	PL									
Issue Method :	E									
Issued by :	GL									

Purpose of Issue

PR = Progress/Preliminary PL = Planning F = Fire Cert T = Tender C = Construction

G = General

Issue Method

H = Hardcopy E = Email CD = Compact Disc D = Floppy Disc

Appendix B

Met Eireann Rainfall Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 259418, Northing: 110653,

	Interval		Years											
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	3.1,	4.3,	4.9,	5.9,	6.5,	7.0,	8.6,	10.4,	11.6,	13.3,	14.7,	15.9,	17.6,	19.0,	20.1,	N/A ,
10 mins	4.3,	6.0,	6.8,	8.2,	9.1,	9.7,	12.0,	14.5,	16.2,	18.5,	20.5,	22.1,	24.5,	26.4,	28.0,	N/A ,
15 mins	5.0,	7.0,	8.1,	9.6,	10.7,	11.5,	14.1,	17.1,	19.0,	21.7,	24.1,	26.0,	28.9,	31.1,	32.9,	N/A ,
30 mins	6.7,	9.1,	10.4,	12.4,	13.7,	14.7,	17.9,	21.5,	23.8,	27.1,	29.9,	32.2,	35.5,	38.1,	40.3,	N/A ,
1 hours	8.8,	11.9,	13.5,	15.9,	17.5,	18.7,	22.7,	27.0,	29.8,	33.7,	37.1,	39.8,	43.7,	46.8,	49.3,	N/A ,
2 hours	11.6,	15.5,	17.6,	20.5,	22.5,	24.0,	28.7,	34.0,	37.3,	42.0,	46.0,	49.1,	53.9,	57.5,	60.4,	N/A ,
3 hours	13.7,	18.2,	20.4,	23.8,	26.0,	27.7,	33.0,	38.8,	42.6,	47.7,	52.2,	55.6,	60.8,	64.8,	68.0,	N/A ,
4 hours	15.4,	20.3,	22.8,	26.4,	28.8,	30.6,	36.4,	42.7,	46.7,	52.3,	57.1,	60.8,	66.3,	70.5,	74.0,	N/A ,
6 hours	18.1,	23.7,	26.5,	30.6,	33.3,	35.3,	41.8,	48.8,	53.3,	59.4,	64.8,	68.8,	74.9,	79.5,	83.3,	N/A ,
9 hours	21.3,	27.7,	30.9,	35.5,	38.5,	40.8,	48.0,	55.8,	60.8,	67.6,	73.4,	77.9,	84.6,	89.6,	93.8,	N/A ,
12 hours	24.0,	30.9,	34.4,	39.4,	42.7,	45.2,	53.0,	61.4,	66.8,	74.0,	80.3,	85.0,	92.2,	97.6,	102.0,	N/A ,
18 hours	28.2,	36.1,	40.0,	45.7,	49.4,	52.2,	60.9,	70.2,	76.2,	84.2,	91.1,	96.3,	104.1,	110.0,	114.8,	N/A ,
24 hours	31.7,	40.3,	44.6,	50.7,	54.7,	57.8,	67.2,	77.3,	83.6,	92.2,	99.6,	105.1,	113.5,	119.8,	124.9,	142.2,
2 days	39.8,	49.6,	54.4,	61.2,	65.6,	68.9,	79.0,	89.8,	96.4,	105.4,	113.1,	118.8,	127.4,	133.8,	139.0,	156.5,
3 days	46.6,	57.3,	62.6,	69.9,	74.6,	78.1,	89.0,	100.3,	107.3,	116.8,	124.7,	130.7,	139.6,	146.2,	151.5,	169.4,
4 days	52.7,	64.2,	69.8,	77.6,	82.6,	86.4,	97.8,	109.7,	117.0,	126.8,	135.1,	141.3,	150.5,	157.3,	162.8,	181.1,
6 days	63.6,	76.5,	82.7,	91.4,	96.8,	100.9,	113.4,	126.3,	134.2,	144.7,	153.5,	160.1,	169.8,	177.0,	182.8,	202.0,
8 days	73.3,	87.5,	94.3,	103.6,	109.5,	113.9,	127.3,	141.0,	149.4,	160.5,	169.8,	176.7,	186.9,	194.5,	200.5,	220.5,
10 days	82.5,	97.7,	104.9,	115.0,	121.2,	125.9,	140.1,	154.5,	163.4,	175.0,	184.8,	192.0,	202.6,	210.5,	216.7,	237.5,
12 days	91.1,	107.3,	115.0,	125.6,	132.2,	137.2,	152.1,	167.2,	176.4,	188.6,	198.7,	206.2,	217.2,	225.4,	231.9,	253.3,
16 days	107.4,	125.4,	133.9,	145.5,	152.8,	158.1,	174.3,	190.7,	200.6,	213.7,	224.5,	232.5,	244.3,	252.9,	259.8,	282.4,
20 days	122.7,	142.3,	151.5,	164.0,	171.9,	177.6,	195.0,	212.4,	223.0,	236.8,	248.3,	256.8,	269.1,	278.2,	285.5,	309.2,
25 days	141.0,	162.4,	172.3,	185.9,	194.4,	200.6,	219.2,	237.9,	249.2,	263.9,	276.1,	285.0,	298.1,	307.7,	315.3,	340.2,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Appendix C

Surface Water Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	0.70
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	18.700	Minimum Backdrop Height (m)	0.200
Ratio-R	0.270	Preferred Cover Depth (m)	0.800
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S01			3.800	1200	659385.000	610631.000	1.250
S02			3.850	1200	659378.000	610608.000	1.170
S03			6.400	1200	659350.000	610576.000	1.600
S04	0.014	5.00	7.400	1200	659354.000	610602.000	2.300
S05	0.017	5.00	7.400	1200	659356.000	610613.000	2.250
S06	0.027	5.00	6.500	1200	659373.000	610613.000	1.250
S07	0.019	5.00	6.800	1200	659385.000	610654.000	1.300
S08	0.015	5.00	6.800	1200	659395.000	610689.000	1.150
S09	0.017	5.00	6.800	1200	659364.000	610700.000	1.000
S10	0.015	5.00	6.600	1200	659346.000	610728.000	0.650
S11	0.011	5.00	6.600	1200	659309.000	610728.000	0.500
S12	0.083	5.00	7.324	1200	659352.000	610623.000	2.124
S13	0.053	5.00	6.700	1200	659367.000	610669.000	1.300
S14	0.038	5.00	7.145	1200	659344.000	610690.000	1.545
S15	0.022	5.00	7.174	1200	659333.000	610706.000	1.474
S16	0.010	5.00	7.044	1200	659318.000	610706.000	1.244
S17	0.053	5.00	7.550	1200	659329.000	610626.000	2.200
S18	0.043	5.00	7.050	1200	659328.000	610657.000	1.550
S19	0.014	5.00	6.959	1200	659327.000	610690.000	1.259
S20	0.023	5.00	6.700	1200	659307.000	610598.000	1.620
S21	0.047	5.00	7.000	1200	659294.000	610605.000	1.880
S22	0.045	5.00	7.351	1200	659294.000	610646.000	2.071
S23	0.035	5.00	6.851	1200	659294.000	610686.000	1.411
S24		5.00	6.351	1200	659294.000	610725.000	0.751
P01	0.000		6.400	1200	659339.000	610577.000	1.400
P02	0.000		6.400	1200	659328.000	610592.000	1.400

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
S02-S01	S02	S01	24.042	0.600	2.680	2.550	0.130	184.9	160	10.62	50.0
S03-S02	S03	S02	42.521	0.600	4.800	2.680	2.120	20.1	160	10.09	50.0
P01-S03	P01	S03	11.045	0.600	5.300	4.800	0.500	22.1	160	9.79	50.0
P02-P01	P02	P01	18.601	0.600	5.150	5.000	0.150	124.0	160	9.71	50.0
S04-P02	S04	P02	27.857	0.600	5.100	5.000	0.100	278.6	315	9.38	50.0
S05-S04	S05	S04	11.180	0.600	5.150	5.100	0.050	223.6	315	8.90	50.0
S06-S05	S06	S05	17.000	0.600	5.250	5.150	0.100	170.0	225	8.73	50.0
S07-S06	S07	S06	42.720	0.600	5.500	5.250	0.250	170.9	225	8.44	50.0
S08-S07	S08	S07	36.401	0.600	5.650	5.500	0.150	242.7	225	7.73	50.0
S09-S08	S09	S08	32.894	0.600	5.800	5.650	0.150	219.3	225	7.00	50.0
S10-S09	S10	S09	33.287	0.600	5.950	5.800	0.150	221.9	225	6.38	50.0
S11-S10	S11	S10	37.000	0.600	6.100	5.950	0.150	246.7	225	5.74	50.0
S12-S05	S12	S05	10.770	0.600	5.200	5.150	0.050	215.4	315	7.21	50.0
S13-S12	S13	S12	48.384	0.600	5.400	5.200	0.200	241.9	225	7.04	50.0
S14-S13	S14	S13	31.145	0.600	5.600	5.400	0.200	155.7	225	6.08	50.0
S15-S14	S15	S14	19.416	0.600	5.700	5.600	0.100	194.2	225	5.58	50.0
S16-S15	S16	S15	15.000	0.600	5.800	5.700	0.100	150.0	225	5.23	50.0
S17-S12	S17	S12	23.195	0.600	5.350	5.200	0.150	154.6	225	6.48	50.0
S18-S17	S18	S17	31.016	0.600	5.500	5.350	0.150	206.8	225	6.11	50.0
S19-S18	S19	S18	33.015	0.600	5.700	5.500	0.200	165.1	225	5.54	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
S02-S01	0.767	15.4	81.5	1.010	1.090	0.601	0.0	160	0.782
S03-S02	2.355	47.4	81.5	1.440	1.010	0.601	0.0	160	2.399
P01-S03	2.244	45.1	81.5	0.940	1.440	0.601	0.0	160	2.286
P02-P01	0.940	18.9	81.5	1.090	1.240	0.601	0.0	160	0.957
S04-P02	0.967	75.3	61.1	1.985	1.085	0.451	0.0	216	1.073
S05-S04	1.080	84.2	59.2	1.935	1.985	0.437	0.0	195	1.167
S06-S05	1.000	39.7	14.1	1.025	2.025	0.104	0.0	93	0.917
S07-S06	0.997	39.6	10.4	1.075	1.025	0.077	0.0	79	0.844
S08-S07	0.835	33.2	7.9	0.925	1.075	0.058	0.0	74	0.685
S09-S08	0.879	34.9	5.8	0.775	0.925	0.043	0.0	62	0.654
S10-S09	0.873	34.7	3.5	0.425	0.775	0.026	0.0	48	0.561
S11-S10	0.828	32.9	1.5	0.275	0.425	0.011	0.0	33	0.424
S12-S05	1.101	85.8	42.8	1.809	1.935	0.316	0.0	157	1.100
S13-S12	0.836	33.2	16.7	1.075	1.899	0.123	0.0	113	0.837
S14-S13	1.045	41.6	9.5	1.320	1.075	0.070	0.0	73	0.848
S15-S14	0.935	37.2	4.3	1.249	1.320	0.032	0.0	51	0.626
S16-S15	1.065	42.3	1.4	1.019	1.249	0.010	0.0	28	0.489
S17-S12	1.049	41.7	14.9	1.975	1.899	0.110	0.0	93	0.963
S18-S17	0.905	36.0	7.7	1.325	1.975	0.057	0.0	71	0.725
S19-S18	1.015	40.3	1.9	1.034	1.325	0.014	0.0	33	0.520

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
S20-P02	S20	P02	21.840	0.600	5.080	5.000	0.080	273.0	225	8.26	50.0
S21-S20	S21	S20	14.765	0.600	5.120	5.080	0.040	369.1	225	7.80	50.0
S22-S21	S22	S21	41.000	0.600	5.280	5.120	0.160	256.3	225	7.43	50.0
S23-S22	S23	S22	40.000	0.600	5.440	5.280	0.160	250.0	225	6.59	50.0
S24-S23	S24	S23	39.000	0.600	5.600	5.440	0.160	243.8	225	5.78	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
S20-P02	0.786	31.3	20.3	1.395	1.175	0.150	0.0	132	0.836
S21-S20	0.675	26.8	17.2	1.655	1.395	0.127	0.0	131	0.715
S22-S21	0.812	32.3	10.8	1.846	1.655	0.080	0.0	90	0.735
S23-S22	0.822	32.7	4.7	1.186	1.846	0.035	0.0	58	0.587
S24-S23	0.833	33.1	0.0	0.526	1.186	0.000	0.0	0	0.000

Pipeline Schedule

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)
S02-S01	24.042	184.9	160	Circular	3.850	2.680	1.010	3.800	2.550	1.090
S03-S02	42.521	20.1	160	Circular	6.400	4.800	1.440	3.850	2.680	1.010
P01-S03	11.045	22.1	160	Circular	6.400	5.300	0.940	6.400	4.800	1.440
P02-P01	18.601	124.0	160	Circular	6.400	5.150	1.090	6.400	5.000	1.240
S04-P02	27.857	278.6	315	Circular	7.400	5.100	1.985	6.400	5.000	1.085
S05-S04	11.180	223.6	315	Circular	7.400	5.150	1.935	7.400	5.100	1.985
S06-S05	17.000	170.0	225	Circular	6.500	5.250	1.025	7.400	5.150	2.025
S07-S06	42.720	170.9	225	Circular	6.800	5.500	1.075	6.500	5.250	1.025
S08-S07	36.401	242.7	225	Circular	6.800	5.650	0.925	6.800	5.500	1.075
S09-S08	32.894	219.3	225	Circular	6.800	5.800	0.775	6.800	5.650	0.925
S10-S09	33.287	221.9	225	Circular	6.600	5.950	0.425	6.800	5.800	0.775
S11-S10	37.000	246.7	225	Circular	6.600	6.100	0.275	6.600	5.950	0.425

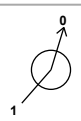
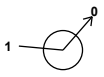
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
S02-S01	S02	1200	Manhole	Adoptable	S01	1200	Manhole	Adoptable
S03-S02	S03	1200	Manhole	Adoptable	S02	1200	Manhole	Adoptable
P01-S03	P01	1200	Manhole	Adoptable	S03	1200	Manhole	Adoptable
P02-P01	P02	1200	Manhole	Adoptable	P01	1200	Manhole	Adoptable
S04-P02	S04	1200	Manhole	Adoptable	P02	1200	Manhole	Adoptable
S05-S04	S05	1200	Manhole	Adoptable	S04	1200	Manhole	Adoptable
S06-S05	S06	1200	Manhole	Adoptable	S05	1200	Manhole	Adoptable
S07-S06	S07	1200	Manhole	Adoptable	S06	1200	Manhole	Adoptable
S08-S07	S08	1200	Manhole	Adoptable	S07	1200	Manhole	Adoptable
S09-S08	S09	1200	Manhole	Adoptable	S08	1200	Manhole	Adoptable
S10-S09	S10	1200	Manhole	Adoptable	S09	1200	Manhole	Adoptable
S11-S10	S11	1200	Manhole	Adoptable	S10	1200	Manhole	Adoptable

Pipeline Schedule

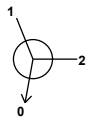
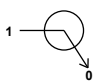
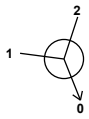
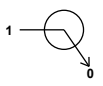
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
S12-S05	10.770	215.4	315	Circular	7.324	5.200	1.809	7.400	5.150	1.935
S13-S12	48.384	241.9	225	Circular	6.700	5.400	1.075	7.324	5.200	1.899
S14-S13	31.145	155.7	225	Circular	7.145	5.600	1.320	6.700	5.400	1.075
S15-S14	19.416	194.2	225	Circular	7.174	5.700	1.249	7.145	5.600	1.320
S16-S15	15.000	150.0	225	Circular	7.044	5.800	1.019	7.174	5.700	1.249
S17-S12	23.195	154.6	225	Circular	7.550	5.350	1.975	7.324	5.200	1.899
S18-S17	31.016	206.8	225	Circular	7.050	5.500	1.325	7.550	5.350	1.975
S19-S18	33.015	165.1	225	Circular	6.959	5.700	1.034	7.050	5.500	1.325
S20-P02	21.840	273.0	225	Circular	6.700	5.080	1.395	6.400	5.000	1.175
S21-S20	14.765	369.1	225	Circular	7.000	5.120	1.655	6.700	5.080	1.395
S22-S21	41.000	256.3	225	Circular	7.351	5.280	1.846	7.000	5.120	1.655
S23-S22	40.000	250.0	225	Circular	6.851	5.440	1.186	7.351	5.280	1.846
S24-S23	39.000	243.8	225	Circular	6.351	5.600	0.526	6.851	5.440	1.186

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
S12-S05	S12	1200	Manhole	Adoptable	S05	1200	Manhole	Adoptable
S13-S12	S13	1200	Manhole	Adoptable	S12	1200	Manhole	Adoptable
S14-S13	S14	1200	Manhole	Adoptable	S13	1200	Manhole	Adoptable
S15-S14	S15	1200	Manhole	Adoptable	S14	1200	Manhole	Adoptable
S16-S15	S16	1200	Manhole	Adoptable	S15	1200	Manhole	Adoptable
S17-S12	S17	1200	Manhole	Adoptable	S12	1200	Manhole	Adoptable
S18-S17	S18	1200	Manhole	Adoptable	S17	1200	Manhole	Adoptable
S19-S18	S19	1200	Manhole	Adoptable	S18	1200	Manhole	Adoptable
S20-P02	S20	1200	Manhole	Adoptable	P02	1200	Manhole	Adoptable
S21-S20	S21	1200	Manhole	Adoptable	S20	1200	Manhole	Adoptable
S22-S21	S22	1200	Manhole	Adoptable	S21	1200	Manhole	Adoptable
S23-S22	S23	1200	Manhole	Adoptable	S22	1200	Manhole	Adoptable
S24-S23	S24	1200	Manhole	Adoptable	S23	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S01	659385.000	610631.000	3.800	1.250	1200		1	S02-S01	2.550	160
S02	659378.000	610608.000	3.850	1.170	1200		1	S03-S02	2.680	160
							0	S02-S01	2.680	160
S03	659350.000	610576.000	6.400	1.600	1200		1	P01-S03	4.800	160
							0	S03-S02	4.800	160

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S04	659354.000	610602.000	7.400	2.300	1200		1	S05-S04	5.100	315
							0	S04-P02	5.100	315
S05	659356.000	610613.000	7.400	2.250	1200		1	S12-S05	5.150	315
							2	S06-S05	5.150	225
							0	S05-S04	5.150	315
S06	659373.000	610613.000	6.500	1.250	1200		1	S07-S06	5.250	225
							0	S06-S05	5.250	225
S07	659385.000	610654.000	6.800	1.300	1200		1	S08-S07	5.500	225
							0	S07-S06	5.500	225
S08	659395.000	610689.000	6.800	1.150	1200		1	S09-S08	5.650	225
							0	S08-S07	5.650	225
S09	659364.000	610700.000	6.800	1.000	1200		1	S10-S09	5.800	225
							0	S09-S08	5.800	225
S10	659346.000	610728.000	6.600	0.650	1200		1	S11-S10	5.950	225
							0	S10-S09	5.950	225
S11	659309.000	610728.000	6.600	0.500	1200		0	S11-S10	6.100	225
S12	659352.000	610623.000	7.324	2.124	1200		1	S17-S12	5.200	225
							2	S13-S12	5.200	225
							0	S12-S05	5.200	315
S13	659367.000	610669.000	6.700	1.300	1200		1	S14-S13	5.400	225
							0	S13-S12	5.400	225
S14	659344.000	610690.000	7.145	1.545	1200		1	S15-S14	5.600	225
							0	S14-S13	5.600	225
S15	659333.000	610706.000	7.174	1.474	1200		1	S16-S15	5.700	225
							0	S15-S14	5.700	225
S16	659318.000	610706.000	7.044	1.244	1200		0	S16-S15	5.800	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S17	659329.000	610626.000	7.550	2.200	1200	1	S18-S17	5.350	225
						0	S17-S12	5.350	225
S18	659328.000	610657.000	7.050	1.550	1200	1	S19-S18	5.500	225
						0	S18-S17	5.500	225
S19	659327.000	610690.000	6.959	1.259	1200	0	S19-S18	5.700	225
S20	659307.000	610598.000	6.700	1.620	1200	1	S21-S20	5.080	225
						0	S20-P02	5.080	225
S21	659294.000	610605.000	7.000	1.880	1200	1	S22-S21	5.120	225
						0	S21-S20	5.120	225
S22	659294.000	610646.000	7.351	2.071	1200	1	S23-S22	5.280	225
						0	S22-S21	5.280	225
S23	659294.000	610686.000	6.851	1.411	1200	1	S24-S23	5.440	225
						0	S23-S22	5.440	225
S24	659294.000	610725.000	6.351	0.751	1200	0	S24-S23	5.600	225
P01	659339.000	610577.000	6.400	1.400	1200	1	P02-P01	5.000	160
						0	P01-S03	5.300	160
P02	659328.000	610592.000	6.400	1.400	1200	1	S20-P02	5.000	225
						2	S04-P02	5.000	315
						0	P02-P01	5.150	160

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	18.700	Drain Down Time (mins)	240
Ratio-R	0.270	Additional Storage (m^3/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	30	0	0
30	30	0	0
100	30	0	0

Node S03 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	S03-S02	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0063-2000-1294-2000
Invert Level (m)	4.800	Min Outlet Diameter (m)	0.075
Design Depth (m)	1.294	Min Node Diameter (mm)	1200
Design Flow (l/s)	2.0		

Node P02 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	5.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	124.0	0.0	1.050	269.0	0.0	1.051	300.0	0.0	1.400	351.0	0.0

Node P01 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	5.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	69.0	0.0	1.050	173.0	0.0	1.051	200.0	0.0	1.400	240.0	0.0

Results for 1 year +30% 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
120 minute summer	S01	298	2.586	0.036	1.7	0.0000	0.0000	OK
120 minute summer	S02	298	2.716	0.036	1.7	0.0409	0.0000	OK
1440 minute winter	S03	1140	5.664	0.864	3.0	0.9766	0.0000	SURCHARGED
1440 minute winter	S04	1140	5.666	0.566	5.6	0.7086	0.0000	SURCHARGED
1440 minute winter	S05	1110	5.667	0.517	5.5	0.6623	0.0000	SURCHARGED
1440 minute winter	S06	1110	5.666	0.416	1.5	0.6497	0.0000	SURCHARGED
1440 minute winter	S07	1140	5.666	0.166	1.1	0.2360	0.0000	OK
15 minute winter	S08	12	5.729	0.079	8.9	0.1102	0.0000	OK
15 minute winter	S09	11	5.865	0.065	6.7	0.0958	0.0000	OK
15 minute winter	S10	11	6.001	0.051	4.2	0.0818	0.0000	OK
15 minute winter	S11	11	6.135	0.035	1.8	0.0546	0.0000	OK
1440 minute winter	S12	1140	5.666	0.466	4.1	0.8908	0.0000	SURCHARGED
1440 minute winter	S13	1140	5.666	0.266	1.6	0.5175	0.0000	SURCHARGED
15 minute winter	S14	11	5.680	0.080	11.6	0.1294	0.0000	OK
15 minute winter	S15	11	5.757	0.057	5.4	0.0808	0.0000	OK
15 minute winter	S16	10	5.830	0.030	1.7	0.0392	0.0000	OK
1440 minute winter	S17	1140	5.666	0.316	1.5	0.5095	0.0000	SURCHARGED
1440 minute winter	S18	1140	5.666	0.166	0.8	0.2796	0.0000	OK
15 minute winter	S19	11	5.736	0.036	2.3	0.0484	0.0000	OK
1440 minute winter	S20	1140	5.666	0.586	1.9	0.8290	0.0000	SURCHARGED
1440 minute winter	S21	1140	5.666	0.546	1.6	0.8903	0.0000	SURCHARGED
1440 minute winter	S22	1140	5.666	0.386	1.1	0.6043	0.0000	SURCHARGED
1440 minute winter	S23	1140	5.666	0.226	0.5	0.3676	0.0000	SURCHARGED
1440 minute winter	S24	1140	5.666	0.066	0.1	0.0744	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute summer	S02	S02-S01	S01	1.7	0.505	0.110	0.0806	20.5
1440 minute winter	S03	Hydro-Brake®	S02	1.7				
1440 minute winter	S04	S04-P02	P02	5.6	0.467	0.075	2.1690	
1440 minute winter	S05	S05-S04	S04	5.4	0.342	0.065	0.8705	
1440 minute winter	S06	S06-S05	S05	1.4	0.198	0.036	0.6761	
1440 minute winter	S07	S07-S06	S06	1.1	0.335	0.028	1.5196	
15 minute winter	S08	S08-S07	S07	8.7	0.686	0.262	0.4609	
15 minute winter	S09	S09-S08	S08	6.5	0.594	0.185	0.3596	
15 minute winter	S10	S10-S09	S09	4.0	0.495	0.116	0.2713	
15 minute winter	S11	S11-S10	S10	1.7	0.330	0.052	0.1975	
1440 minute winter	S12	S12-S05	S05	3.9	0.343	0.045	0.8386	
1440 minute winter	S13	S13-S12	S12	1.6	0.296	0.048	1.9243	
15 minute winter	S14	S14-S13	S13	11.4	0.666	0.274	0.5406	
15 minute winter	S15	S15-S14	S14	5.2	0.517	0.140	0.1977	
15 minute winter	S16	S16-S15	S15	1.7	0.311	0.039	0.0822	
1440 minute winter	S17	S17-S12	S12	1.4	0.281	0.033	0.9225	
1440 minute winter	S18	S18-S17	S17	0.8	0.300	0.022	1.1033	
15 minute winter	S19	S19-S18	S18	2.2	0.291	0.055	0.2633	
1440 minute winter	S20	S20-P02	P02	1.8	0.377	0.059	0.8686	
1440 minute winter	S21	S21-S20	S20	1.6	0.219	0.059	0.5872	
1440 minute winter	S22	S22-S21	S21	0.9	0.184	0.029	1.6306	
1440 minute winter	S23	S23-S22	S22	0.5	0.206	0.015	1.5904	
1440 minute winter	S24	S24-S23	S23	0.1	0.005	0.004	0.9631	

Results for 1 year +30% 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
1440 minute winter	P01	1140	5.664	0.664	3.9	68.4613	0.0000	SURCHARGED
1440 minute winter	P02	1140	5.666	0.666	7.3	113.9235	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	P01	P01-S03	S03	3.0	0.219	0.065	0.2212	
1440 minute winter	P02	P02-P01	P01	3.9	0.665	0.204	0.3726	

Results for 30 year +30% 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
1440 minute winter	S01	1380	2.589	0.039	2.0	0.0000	0.0000	OK
1440 minute winter	S02	1380	2.720	0.040	2.0	0.0447	0.0000	OK
1440 minute winter	S03	1380	6.120	1.320	2.0	1.4930	0.0000	FLOOD RISK
1440 minute winter	S04	1380	6.124	1.024	10.5	1.2828	0.0000	SURCHARGED
1440 minute winter	S05	1380	6.124	0.974	9.9	1.2486	0.0000	SURCHARGED
1440 minute winter	S06	1380	6.124	0.874	2.4	1.3659	0.0000	SURCHARGED
1440 minute winter	S07	1380	6.124	0.624	2.0	0.8877	0.0000	SURCHARGED
1440 minute winter	S08	1380	6.124	0.474	1.5	0.6599	0.0000	SURCHARGED
1440 minute winter	S09	1380	6.124	0.324	1.1	0.4769	0.0000	SURCHARGED
1440 minute winter	S10	1380	6.124	0.174	0.7	0.2769	0.0000	OK
15 minute winter	S11	11	6.152	0.052	4.1	0.0822	0.0000	OK
1440 minute winter	S12	1380	6.124	0.924	7.5	1.7673	0.0000	SURCHARGED
1440 minute winter	S13	1380	6.124	0.724	2.9	1.4087	0.0000	SURCHARGED
1440 minute winter	S14	1380	6.124	0.524	1.9	0.8502	0.0000	SURCHARGED
1440 minute winter	S15	1380	6.124	0.424	0.9	0.6057	0.0000	SURCHARGED
1440 minute winter	S16	1380	6.124	0.324	0.3	0.4183	0.0000	SURCHARGED
1440 minute winter	S17	1380	6.124	0.774	2.6	1.2483	0.0000	SURCHARGED
1440 minute winter	S18	1380	6.124	0.624	1.5	1.0516	0.0000	SURCHARGED
1440 minute winter	S19	1410	6.124	0.424	0.4	0.5742	0.0000	SURCHARGED
1440 minute winter	S20	1380	6.124	1.044	3.5	1.4770	0.0000	SURCHARGED
1440 minute winter	S21	1380	6.124	1.004	2.9	1.6372	0.0000	SURCHARGED
1440 minute winter	S22	1380	6.124	0.844	1.8	1.3213	0.0000	SURCHARGED
1440 minute winter	S23	1380	6.124	0.684	0.9	1.1127	0.0000	SURCHARGED
1440 minute winter	S24	1380	6.124	0.524	0.2	0.5927	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	S02	S02-S01	S01	2.0	0.531	0.131	0.0915	136.1
1440 minute winter	S03	Hydro-Brake®	S02	2.0				
1440 minute winter	S04	S04-P02	P02	10.3	0.518	0.137	2.1690	
1440 minute winter	S05	S05-S04	S04	10.1	0.429	0.120	0.8705	
1440 minute winter	S06	S06-S05	S05	2.3	0.207	0.059	0.6761	
1440 minute winter	S07	S07-S06	S06	1.7	0.331	0.043	1.6990	
1440 minute winter	S08	S08-S07	S07	1.5	0.380	0.045	1.4477	
1440 minute winter	S09	S09-S08	S08	1.1	0.355	0.031	1.3082	
1440 minute winter	S10	S10-S09	S09	0.7	0.299	0.020	1.2099	
15 minute winter	S11	S11-S10	S10	4.0	0.419	0.121	0.3578	
1440 minute winter	S12	S12-S05	S05	7.4	0.364	0.086	0.8386	
1440 minute winter	S13	S13-S12	S12	2.8	0.280	0.086	1.9243	
1440 minute winter	S14	S14-S13	S13	1.6	0.325	0.040	1.2387	
1440 minute winter	S15	S15-S14	S14	0.9	0.288	0.024	0.7722	
1440 minute winter	S16	S16-S15	S15	0.3	0.190	0.007	0.5966	
1440 minute winter	S17	S17-S12	S12	2.6	0.271	0.062	0.9225	
1440 minute winter	S18	S18-S17	S17	1.3	0.313	0.037	1.2335	
1440 minute winter	S19	S19-S18	S18	0.4	0.169	0.010	1.3130	
1440 minute winter	S20	S20-P02	P02	3.4	0.425	0.110	0.8686	
1440 minute winter	S21	S21-S20	S20	2.9	0.274	0.107	0.5872	
1440 minute winter	S22	S22-S21	S21	1.8	0.227	0.055	1.6306	
1440 minute winter	S23	S23-S22	S22	0.7	0.187	0.022	1.5908	
1440 minute winter	S24	S24-S23	S23	-0.2	-0.007	-0.005	1.5511	

Results for 30 year +30% 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
1440 minute winter	P01	1380	6.121	1.121	6.3	142.8718	0.0000	FLOOD RISK
1440 minute winter	P02	1380	6.124	1.124	13.7	230.0961	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	P01	P01-S03	S03	2.0	0.251	0.045	0.2212	
1440 minute winter	P02	P02-P01	P01	6.3	0.752	0.335	0.3726	

Results for 100 year +30% 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
1440 minute winter	S01	1410	2.590	0.040	2.1	0.0000	0.0000	OK
1440 minute winter	S02	1410	2.721	0.041	2.1	0.0461	0.0000	OK
1440 minute winter	S03	1410	6.298	1.498	3.2	1.6945	0.0000	FLOOD RISK
1440 minute winter	S04	1410	6.302	1.202	12.5	1.5062	0.0000	SURCHARGED
1440 minute winter	S05	1410	6.302	1.152	12.3	1.4765	0.0000	SURCHARGED
1440 minute winter	S06	1380	6.302	1.052	2.7	1.6444	0.0000	FLOOD RISK
1440 minute winter	S07	1380	6.302	0.802	2.0	1.1414	0.0000	SURCHARGED
1440 minute winter	S08	1410	6.302	0.652	1.6	0.9081	0.0000	SURCHARGED
1440 minute winter	S09	1410	6.302	0.502	1.3	0.7386	0.0000	SURCHARGED
1440 minute winter	S10	1380	6.302	0.352	0.8	0.5607	0.0000	FLOOD RISK
1440 minute winter	S11	1410	6.302	0.202	0.3	0.3172	0.0000	OK
1440 minute winter	S12	1410	6.302	1.102	9.1	2.1083	0.0000	SURCHARGED
15 minute winter	S13	13	6.417	1.017	42.5	1.9782	0.0000	FLOOD RISK
15 minute winter	S14	13	6.488	0.888	25.1	1.4409	0.0000	SURCHARGED
15 minute winter	S15	13	6.501	0.801	17.8	1.1439	0.0000	SURCHARGED
15 minute winter	S16	13	6.503	0.703	5.2	0.9084	0.0000	SURCHARGED
1440 minute winter	S17	1410	6.302	0.952	3.2	1.5356	0.0000	SURCHARGED
15 minute winter	S18	12	6.326	0.826	24.3	1.3920	0.0000	SURCHARGED
15 minute winter	S19	12	6.333	0.633	7.5	0.8561	0.0000	SURCHARGED
1440 minute winter	S20	1410	6.302	1.222	4.5	1.7289	0.0000	SURCHARGED
1440 minute winter	S21	1410	6.302	1.182	3.8	1.9275	0.0000	SURCHARGED
1440 minute winter	S22	1410	6.302	1.022	2.4	1.6000	0.0000	SURCHARGED
1440 minute winter	S23	1410	6.302	0.862	1.1	1.4024	0.0000	SURCHARGED
1440 minute winter	S24	1410	6.302	0.702	0.2	0.7940	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	S02	S02-S01	S01	2.1	0.539	0.139	0.0954	146.3
1440 minute winter	S03	Hydro-Brake®	S02	2.1				
1440 minute winter	S04	S04-P02	P02	12.6	0.588	0.167	2.1690	
1440 minute winter	S05	S05-S04	S04	12.1	0.452	0.143	0.8705	
1440 minute winter	S06	S06-S05	S05	2.7	0.211	0.068	0.6761	
1440 minute winter	S07	S07-S06	S06	1.9	0.326	0.048	1.6990	
1440 minute winter	S08	S08-S07	S07	1.5	0.385	0.045	1.4477	
1440 minute winter	S09	S09-S08	S08	1.2	0.355	0.034	1.3082	
1440 minute winter	S10	S10-S09	S09	0.8	0.298	0.023	1.3239	
1440 minute winter	S11	S11-S10	S10	0.3	0.204	0.009	1.4310	
1440 minute winter	S12	S12-S05	S05	9.2	0.398	0.107	0.8386	
15 minute winter	S13	S13-S12	S12	39.2	0.985	1.178	1.9243	
15 minute winter	S14	S14-S13	S13	23.4	0.741	0.564	1.2387	
15 minute winter	S15	S15-S14	S14	12.4	0.632	0.335	0.7722	
15 minute winter	S16	S16-S15	S15	6.1	0.389	0.145	0.5966	
1440 minute winter	S17	S17-S12	S12	3.1	0.272	0.075	0.9225	
15 minute winter	S18	S18-S17	S17	20.0	0.672	0.555	1.2335	
15 minute winter	S19	S19-S18	S18	6.5	0.362	0.162	1.3130	
1440 minute winter	S20	S20-P02	P02	4.4	0.355	0.142	0.8686	
1440 minute winter	S21	S21-S20	S20	3.8	0.277	0.141	0.5872	
1440 minute winter	S22	S22-S21	S21	2.3	0.224	0.072	1.6306	
1440 minute winter	S23	S23-S22	S22	1.0	0.197	0.030	1.5908	
1440 minute winter	S24	S24-S23	S23	-0.2	-0.010	-0.006	1.5511	

Results for 100 year +30% 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
1440 minute winter	P01	1410	6.300	1.300	7.6	181.9921	0.0000	FLOOD RISK
1440 minute winter	P02	1410	6.302	1.302	17.0	287.9494	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	P01	P01-S03	S03	3.2	0.401	0.070	0.2212	
1440 minute winter	P02	P02-P01	P01	7.6	0.796	0.403	0.3726	

Appendix D

Foul Water Calculations

Design Settings

Frequency of use (kDU)	1.00	Minimum Velocity (m/s)	0.10
Flow per dwelling per day (l/day)	150	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	1.0	Minimum Backdrop Height (m)	0.200
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.000
Additional Flow (%)	25	Include Intermediate Ground	✓

Nodes

Name	Dwellings	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
F13	64	6.959	Adoptable	659326.000	610690.000	1.309
F12	64	7.050	Adoptable	659326.000	610653.000	1.769
F11	106	7.550	Adoptable	659328.000	610624.000	2.569
F10	48	6.817	Adoptable	659304.000	610707.000	1.267
F09	48	7.174	Adoptable	659334.000	610707.000	1.939
F08	46	7.145	Adoptable	659345.000	610690.000	2.095
F07	104	6.700	Adoptable	659368.000	610671.000	1.951
F06	105	7.324	Adoptable	659353.000	610622.000	3.074
F05		5.952	Adoptable	659363.000	610606.000	1.865
F04		5.250	Adoptable	659363.000	610590.000	1.319
F03		5.405	Adoptable	659349.000	610566.000	1.728
F02		7.224	Adoptable	659332.000	610540.000	3.829
F01		7.761	Adoptable	659307.000	610513.000	4.694

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
F10-F09	F10	F09	30.000	1.500	5.550	5.235	0.315	95.2	225
F9-F8	F09	F08	20.248	1.500	5.235	5.050	0.185	109.5	225
F8-F7	F08	F07	29.833	1.500	5.050	4.749	0.301	99.1	225
F7-F6	F07	F06	51.245	1.500	4.749	4.250	0.499	102.7	225
F13-F12	F13	F12	37.000	1.500	5.650	5.281	0.369	100.3	225
F12-F11	F12	F11	29.069	1.500	5.281	4.981	0.300	96.9	225
F11-F6	F11	F06	25.080	1.500	4.981	4.250	0.731	34.3	225
F6-F5	F06	F05	18.868	1.500	4.250	4.087	0.163	115.8	315
F5-F4	F05	F04	16.000	1.500	4.087	3.931	0.156	102.6	315

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
F10-F09	0.148	1.176	46.8	0.1	1.042	1.714	0.000	48	0.0	0.0	8	0.227
F9-F8	0.195	1.097	43.6	0.2	1.714	1.870	0.000	96	0.0	0.0	12	0.275
F8-F7	0.223	1.153	45.8	0.3	1.870	1.726	0.000	142	0.0	0.0	14	0.319
F7-F6	0.268	1.132	45.0	0.5	1.726	2.849	0.000	246	0.0	0.0	17	0.368
F13-F12	0.165	1.146	45.6	0.1	1.084	1.544	0.000	64	0.0	0.0	9	0.239
F12-F11	0.207	1.166	46.4	0.3	1.544	2.344	0.000	128	0.0	0.0	13	0.308
F11-F6	0.382	1.963	78.1	0.5	2.344	2.849	0.000	234	0.0	0.0	14	0.546
F6-F5	0.319	1.330	103.7	1.3	2.759	1.550	0.000	585	0.0	0.0	25	0.452
F5-F4	0.329	1.413	110.2	1.3	1.550	1.004	0.000	585	0.0	0.0	24	0.465

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
F4-F3	F04	F03	27.785	1.500	3.931	3.677	0.254	109.4	315
F3-F2	F03	F02	31.064	1.500	3.677	3.395	0.282	110.2	315
F2-F1	F02	F01	36.797	1.500	3.395	3.067	0.328	112.2	315

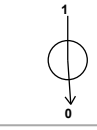
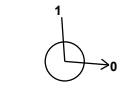
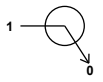
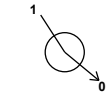
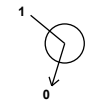
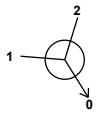
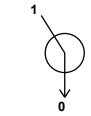
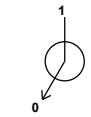
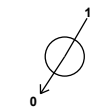
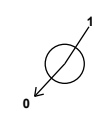
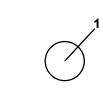
Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
F4-F3	0.319	1.369	106.6	1.3	1.004	1.413	0.000	585	0.0	0.0	24	0.458
F3-F2	0.317	1.364	106.3	1.3	1.413	3.514	0.000	585	0.0	0.0	24	0.456
F2-F1	0.324	1.351	105.3	1.3	3.514	4.379	0.000	585	0.0	0.0	24	0.452

Pipeline Schedule

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)
F10-F09	30.000	95.2	225	Circular	6.817	5.550	1.042	7.174	5.235	1.714
F9-F8	20.248	109.5	225	Circular	7.174	5.235	1.714	7.145	5.050	1.870
F8-F7	29.833	99.1	225	Circular	7.145	5.050	1.870	6.700	4.749	1.726
F7-F6	51.245	102.7	225	Circular	6.700	4.749	1.726	7.324	4.250	2.849
F13-F12	37.000	100.3	225	Circular	6.959	5.650	1.084	7.050	5.281	1.544
F12-F11	29.069	96.9	225	Circular	7.050	5.281	1.544	7.550	4.981	2.344
F11-F6	25.080	34.3	225	Circular	7.550	4.981	2.344	7.324	4.250	2.849
F6-F5	18.868	115.8	315	Circular	7.324	4.250	2.759	5.952	4.087	1.550
F5-F4	16.000	102.6	315	Circular	5.952	4.087	1.550	5.250	3.931	1.004
F4-F3	27.785	109.4	315	Circular	5.250	3.931	1.004	5.405	3.677	1.413
F3-F2	31.064	110.2	315	Circular	5.405	3.677	1.413	7.224	3.395	3.514
F2-F1	36.797	112.2	315	Circular	7.224	3.395	3.514	7.761	3.067	4.379

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
F10-F09	F10	1200	Manhole	Adoptable	F09	1200	Manhole	Adoptable
F9-F8	F09	1200	Manhole	Adoptable	F08	1200	Manhole	Adoptable
F8-F7	F08	1200	Manhole	Adoptable	F07	1200	Manhole	Adoptable
F7-F6	F07	1200	Manhole	Adoptable	F06	1200	Manhole	Adoptable
F13-F12	F13	1200	Manhole	Adoptable	F12	1200	Manhole	Adoptable
F12-F11	F12	1200	Manhole	Adoptable	F11	1200	Manhole	Adoptable
F11-F6	F11	1200	Manhole	Adoptable	F06	1200	Manhole	Adoptable
F6-F5	F06	1200	Manhole	Adoptable	F05	1200	Manhole	Adoptable
F5-F4	F05	1200	Manhole	Adoptable	F04	1200	Manhole	Adoptable
F4-F3	F04	1200	Manhole	Adoptable	F03	1200	Manhole	Adoptable
F3-F2	F03	1200	Manhole	Adoptable	F02	1200	Manhole	Adoptable
F2-F1	F02	1200	Manhole	Adoptable	F01	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
F13	659326.000	610690.000	6.959	1.309	1200		0	F13-F12	5.650	225
F12	659326.000	610653.000	7.050	1.769	1200		1	F13-F12	5.281	225
							0	F12-F11	5.281	225
F11	659328.000	610624.000	7.550	2.569	1200		1	F12-F11	4.981	225
							0	F11-F6	4.981	225
F10	659304.000	610707.000	6.817	1.267	1200		0	F10-F09	5.550	225
F09	659334.000	610707.000	7.174	1.939	1200		1	F10-F09	5.235	225
							0	F9-F8	5.235	225
F08	659345.000	610690.000	7.145	2.095	1200		1	F9-F8	5.050	225
							0	F8-F7	5.050	225
F07	659368.000	610671.000	6.700	1.951	1200		1	F8-F7	4.749	225
							0	F7-F6	4.749	225
F06	659353.000	610622.000	7.324	3.074	1200		1	F11-F6	4.250	225
							2	F7-F6	4.250	225
							0	F6-F5	4.250	315
F05	659363.000	610606.000	5.952	1.865	1200		1	F6-F5	4.087	315
							0	F5-F4	4.087	315
F04	659363.000	610590.000	5.250	1.319	1200		1	F5-F4	3.931	315
							0	F4-F3	3.931	315
F03	659349.000	610566.000	5.405	1.728	1200		1	F4-F3	3.677	315
							0	F3-F2	3.677	315
F02	659332.000	610540.000	7.224	3.829	1200		1	F3-F2	3.395	315
							0	F2-F1	3.395	315
F01	659307.000	610513.000	7.761	4.694	1200		1	F2-F1	3.067	315

Appendix E

Water Demand Calculations

Water Demand Calculation in accordance with Irish Water Code of Practise for Water Infrastructure - IW-CDS-5030-03

(3.7.2) 150L /Bay / person

Maximum occupancy = 648

$$648 \times 150L = 97,200\ L/Day$$

$$\text{Average Demand} = \frac{97,200}{60 \times 60 \times 24} = 1.125\ L/s$$

$$\text{Peak Demand} = 1.125 \times 1.25 = 1.41\ L/s$$

- The site is not developed
- No connection available

=> Pre-development demand = 0.

Appendix F

Uisce Éireann Pre-Connection Confirmation of Feasibility

CONFIRMATION OF FEASIBILITY

Caolan Carty

Malone O'Regan
3-4 Canada Street
Waterford
Co. Waterford
X91 V52K

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 September 2023

Our Ref: CDS22006904 Pre-Connection Enquiry
Cork Road, Waterford, Co. Waterford

Dear Applicant/Agent,

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

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Multi/Mixed Use Development of 110 unit(s) at Cork Road, Waterford, Co. Waterford **(the Development)**.

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

- **Water Connection** - Feasible Subject to upgrades:

  Approximately 185 m of watermain network extension will be required to facilitate a feasible connection between the proposed development and the public network. These extension works are not currently on Irish Water investment plan therefore, the applicant will be required to fund these local network upgrades. The fee will be calculated at a connection application stage.

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

  Approximately 50 m of wastewater network extension will be required to facilitate a feasible connection between the development and the public network. These extension works are not currently on Irish Water investment plan therefore, the applicant will be required to fund these local network upgrades. The fee will be calculated at a connection application stage.

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/

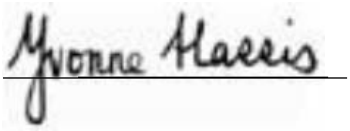
Where can you find more information?

- **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,



Yvonne Harris
Head of Customer Operations

Section A - What is important to know?

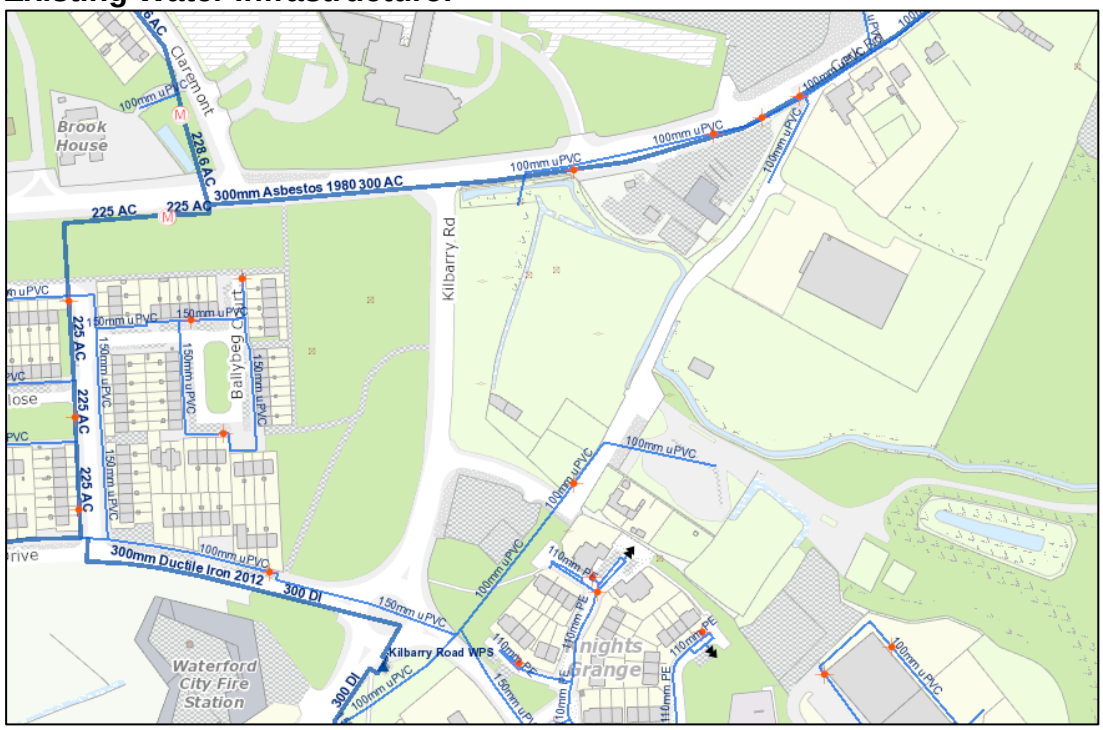
What is important to know?	Why is this important?
Do you need a contract to connect?	• Yes, a contract is required to connect. This letter does not constitute a contract or an offer in whole or in part to provide a connection to Uisce Éireann's network(s). • Before the Development can connect to Uisce 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)

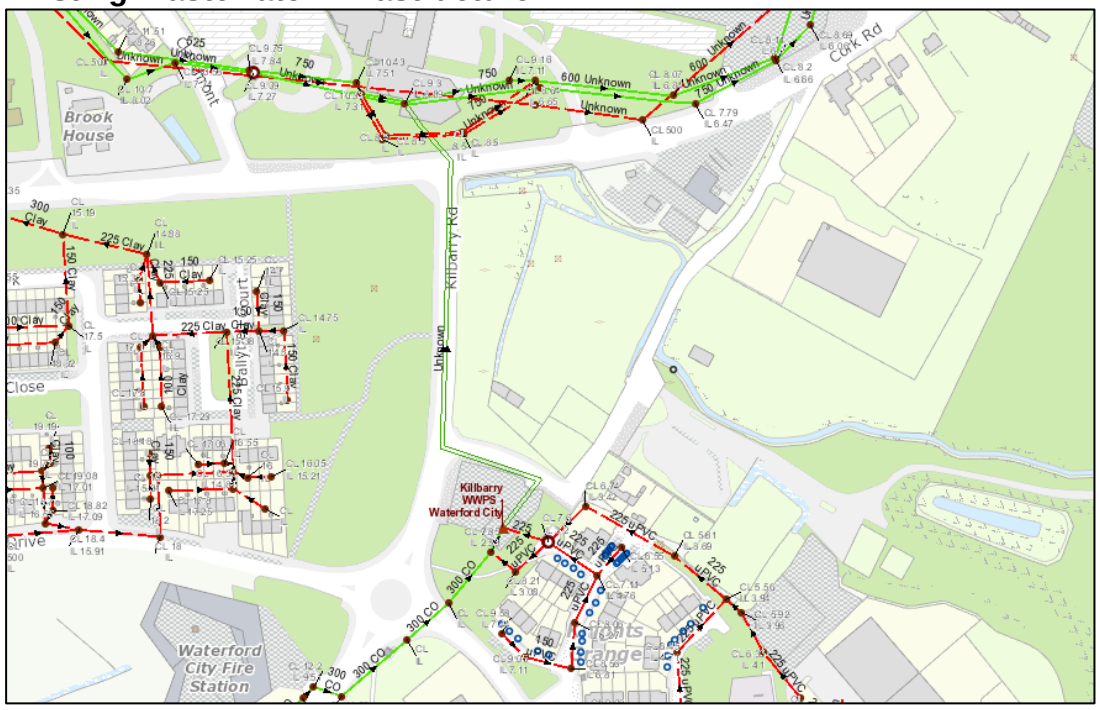
Section B – Details of Uisce Éireann's Network(s)

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

Existing Water Infrastructure:



Existing Wastewater Infrastructure:



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 G

Surface Water Maintenance and Management Plan

Maintenance and Management Plan			
Project	Student Accommodation - Noel Frisby Construction Ltd	Analysed by	Caolan Carty
Job no.	W22076	Date	Jan-24

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required Action	Typical Frequency
Permeable Paving Infiltration and Tanked Systems	Maintenance Company/ Developer	Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels to determine if maintenance is necessary.	Annually or post heavy rainfall events
			Inspect inlets and outlets for blockage.	Annually or post heavy rainfall events
		Regular Maintenance	If ponding is visible, joints should be brushed and vacuumed. Jointing material should not be removed from the joints and must be replaced if removed.	As required
			The overall appearance of the paving joints should be maintained by brushing joints and reinstating loose/displaced jointing material. The appearance of the blocks should be maintained by pressure washing in accordance with the block supplier's recommendations.	As required

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required Action	Typical Frequency
		Occasional Maintenance	Weeds will generally not establish in areas of regular traffic. If weeds develop, these should be dealt with in an appropriate manner.	As required
		Remedial Action	Individual damaged paving blocks should be removed and replaced with new paving blocks. Rutting of the surface will require the area to be lifted and reinstated immediately as this would likely cause a hazard to uses. All reinstatement shall be carried out as per the original construction with the correct sub-base, bedding and jointing materials are used. Any geotextiles or membranes shall also be reinstated/replaced to match the original construction. If blocks are not damaged	As required, reduced risk with regular maintenance as per the above points in maintenance schedule
Permeable Gravel Paths	Maintenance Company/ Developer	Occasional Maintenance	Monitor surface water and check for ponding and erosion to determine if maintenance is necessary. If weeds develop, these should be dealt with in an appropriate manner.	Bi-annually, or post heavy rainfall events
Petrol Interceptor	Maintenance Company/ Developer	Regular Inspections	Regular inspection (initially monthly) and cleaning to assess sediment and oil levels and prevent accumulated oil and grit from escaping. Cleaning involves a vacuum pump tanker therefore vehicular access necessary.	Every 6 months

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required Action	Typical Frequency
Hydrobrake	Maintenance Company/ Developer	Regular Inspections	Regular inspection (initially monthly) and cleaning to assess hydrobrake chambers and to insure as intended operation and there are no blockages/restrictions to the correction operation.	Annually
Bio Retention Ponds	Maintenance Company/ Developer	Regular Inspections	Record de-watering time and assess standing water levels to determine if maintenance is necessary. Assess plants for disease, infection, poor growth, invasive species etc. and replace as necessary. Inspect inlets and outlets for blockage and inspect flows after rain events.	Quarterly
		Regular Maintenance	Remove litter, surface debris, weeds. Replace plants to maintain density. Remove sediment, litter and debris buildup around inlets and outlets.	As required
		Occasional Maintenance	Monitor and repair erosion at the inlets/outlets and embankments if required. Vegetation to be cut and maintained as required.	As required

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required Action	Typical Frequency
		Remedial Actions	Remove and replace vegetation	As required, likely to be >20 years.

Appendix H

Uisce Eireann Correspondence

Reply Reply All Forward IM

Tue 27/02/2024 18:45

Caolan Carty

W22076 - Waterford Student Accommodation Statement of Design Acceptance [Filed 27 Feb 2024 18:45]

To 'cdsdesignqa@water.ie'

Filed by Mail Manager

This is the most recent version, but you made changes to another copy. Click here to see the other versions.

P852_P1 GA - Watermain Layout.pdf 971 KB

P855_P1 GA - Foul Drainage.pdf 860 KB

P857_P1 GA - Roads & Drainage Long Sections.pdf 384 KB

P860_P1 Site Development Details Sheet 1.pdf 2 MB

P861_P1 Site Development Details Sheet 2.pdf 830 KB

P862_P1 Site Development Details Sheet 3.pdf 795 KB

P864_P1 Site Development Details Sheet 5.pdf

Dear Sir/Madam,

Please find attached our design drawings and details for water and wastewater infrastructure for a proposed residential development at Cork Rd, Waterford City.

The pre-connection enquiry reference for this development is CDS22006904.

Caolan Carty

+353 (0)51 876855

www.maloneoregan.ie

MALONE O'REGAN
CONSULTING ENGINEERS

2B Richview Office Park, Clonskeagh, Dublin 14 D14 XT57 + 353 (0)1 2602655 dublin@morce.ie
3/4 Canada Street, Waterford X91 V52K + 353 (0)51 876855 waterford@morce.ie
Hitech House, Claregalway Corporate Pk, Galway H91 KFX3 + 353 (0)91 531069 galway@morce.ie

ENGINEERS IRELAND

ACEI ASSOCIATION OF CONSULTING ENGINEERS OF IRELAND

NSAI