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Engineering Planning Report

Whitechurch Road – Rathfarnham, County Dublin

Engineering Planning Report

Whitechurch Road – Rathfarnham, County Dublin

February 2022

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Document History

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1.0 INTRODUCTION

Dungrey Limited intends to apply for planning permission for a residential development on an overall site of approx. 0.58 ha on lands at "Silveracre" Whitechurch Road, Rathfarnham, Dublin 14, D14 W2K8. The proposed development shall provide for (a) the demolition of two existing habitable structures on site including a bungalow (Silveracre), an existing cottage (No. 6 Whitechurch Road) and a row of several derelict structures/ cottages located along the eastern boundary of the site, the extent of proposed demolition is 433 sq.m (b) the construction of 22 no. 4 bed 4 storey units ranging in size from 197 sq.m to 214 sq.m, all with associated private balcony/terrace areas.

Whitechurch Road bounds the site to the West, Loreto High School is located to the North, and residential units to the East and South. Vehicular and pedestrian access is proposed via a new entrance on Whitechurch Road. The proposed development shall provide for 44 no. car parking spaces, a new single storey bicycle storage shed (approx. 34sq.m) and provision of bin storage to be provided at the front curtilage of the dwelling for all terraced units, all boundary treatments, all site services and all associated site development and landscaping works.

This report should be read in conjunction with POGA Consulting Engineers drawings and all other Consultants' reports and drawings. The engineering drainage design philosophy is outlined below and detailed calculations are contained in the Appendices of this report.

Figure 1.1 Site Location from Google

2.0 EXISTING SERVICES

Appendix A shows the Irish Water map of the existing drainage networks in the vicinity of the subject site.

Wastewater

There is an existing ø225mm wastewater sewer network located under Whitechurch Road flowing northwards. It is proposed to outfall the wastewater from the site into this network.

Water

There is an existing 100mm (1969) uPVC watermain located under Whitechurch to the West of the site.

Surface Water

The Whitechurch stream, a tributary of the River Dodder, is located to the West of Whitechurch Road. It is proposed to store the surface water run-off from the site in an attenuation tank system and outfall into this stream.

3.0 PROPOSED SURFACE WATER MANAGEMENT

The management of surface water for the proposed development has been designed to comply with the policies and guidelines of the Greater Dublin Strategic Drainage Study (GDSDS). The overall objective is to minimise stormwater runoff and to collect and treat this minimised amount of runoff as close to the source as possible.

In accordance with the SuDS philosophy, a Surface Water Treatment Train approach has been applied to the design of the surface water drainage on this site. The techniques that apply here suit the site topography, ground conditions and receiving environment. There are also four main criteria to be satisfied in new developments regarding stormwater management, these are described below.

- **Criteria 1:** River Water Quality Protection – interception and treatment volume.
- **Criteria 2:** River Regime Protection – limit of discharge to receiving water.
- **Criteria 3:** Level of Service (flooding) for the site – internal protection against flooding of propriety.
- **Criteria 4:** River Flood Protection – long-term flood storage.

3.1 SuDS Techniques

SuDS techniques comprise a flexible series of options, which allow the drainage designer to select those systems that best suit the circumstances of the site. The treatment train approach assures that both runoff quantity and quality are addressed, through the overall techniques of: pollution prevention, source control, site control and regional control measures.

Pollution Prevention

Pollution prevention is essentially good housekeeping, since minimising or preventing pollution in the first place is more practical and cost effective than having to treat it afterwards. Thus, the best approach to urban runoff pollution is to prevent chemical and other pollutants from coming into contact with rainfall runoff through appropriate storage and management, and through education. In this respect, it is proposed that the developer will provide information to the operator on appropriate usage of the proposed drainage systems.

Source Control

The second element of the treatment train is to detain or infiltrate runoff as close as possible to the point of origin. The use of such source control devices reduces the peak run-off rate and attenuates flows, thus reducing stress on downstream facilities, allowing them to be smaller in capacity.

For the subject site, permeable paving, swales, and filter drains are proposed. These will minimise impermeable areas and encourage stormwater to soak into the ground/soil while filtering pollutants.

Permeable paving is a range of sustainable materials with a base and sub-base that allow the movement of stormwater through the surface. In addition to reducing runoff, this effectively

traps suspended solids and filters pollutants from the water, and recharges the ground water. Refer to Figure 3.1 for a typical permeable paving and drawing 21029-100-P0 for locations where this is proposed. In accordance with the SuDS design philosophy we are proposing to drain the surface water run-off from the roof areas through the permeable paving areas to act as a form of treatment.

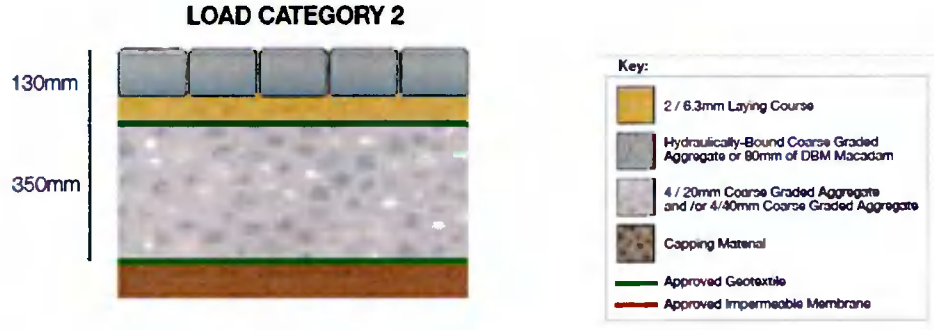


Figure 3.1 Typical Permeable Paving Build-up

It is proposed to drain the surface water run-off from a section of the roads into an infiltration trench and swale system located at the open space area, please refer to Drawing 21029-101 for locations. The infiltration trench and swale treat the surface water run-off and act as a form of attenuation during storm events. The infiltration trench has been designed to store the 1:100 year storm event +20% for climate change, with a ø150mm overflow pipe connecting back into the main ø225mm surface water network.

Site Control

Site control comprises runoff and treatment installations to serve individual developments (or combinations of developments on adjacent sites), using elements such as detention basins or cellular systems. The SuDS treatment train approach has now been provided by a combination of filter drains, swales, a detention pond, and an underground storage tank. On this development it is proposed to use an underground Stormtech attenuation tank system to store the 1 in 30-year storm event plus 20% for climate change and a grassed depression in the ground over the tank to store the surplus volume required to cater for the 1:100 year storm event.

The GDSDS allows for development sites to discharge surface water at either the greenfield or brownfield run-off rate. We are proposing to use the GDSDS recommended Qbar formula as described by the Institute of Hydrology Report No.124 and then apply an interpolated rate for sites less than 50Ha. Using a 0.58 Ha site area and a site-specific rainfall profile, this gives a Qbar flow rate for the site of 1.24/s. The calculation of the Qbar is attached in Appendix D.

Storage volumes in the attenuation system have been calculated using the 1, 30 and 100 year storm events, with no surface flooding taking place in the 100 year storm event. These calculations are attached in Appendix E.

Please refer to drawing 21029-101-P0 for a drainage plan and 21029-105-P0 for attenuation details.

Regional Control

Regional control comprises of treatment facilities to reduce pollutants from contaminated runoff, with the potential to provide biological treatment on a catchment scale. They are often end-of-pipe facilities. This is not appropriate for a site of this size.

3.2 Surface Water Drainage Design

It is proposed to intercept, treat and attenuate the rainfall water falling on the site using the methods mentioned in section 3.1. The site slopes from Northeast to Southwest with a fall of 1.4m over 60m, resulting in an approximate slope of 1:42. It is proposed to construct a new Ø225mm surface water network flowing towards the western boundary outfalling into the underground attenuation tank. The attenuated surface water flow then travels west crossing under Whitechurch Road, discharging into the existing stream, please see drawing 21029-101 for details.

The following runs off rates factors have been applied to the scheme to calculate the Percentage Run-off or PIMP:

1. 95% from Roofs
2. 85% from Roads/Hardstanding
3. 45% from Roads draining to SuDS features
4. 95% from Permeable Paving
5. 5% Grassed areas

We have conservatively not allowed for the reduction in surface water run-off from the roofs and permeable paving areas in our attenuation design.

Interception, Treatment and Attenuation volumes

The design criteria mentioned previously has been achieved as per described below.

- **Criteria 1:** River Water Quality Protection – satisfied by providing interception and treatment volume within swales, filter drains, and permeable paved areas.
- **Criteria 2:** River Regime Protection – satisfied by attenuating the run-off within attenuation system.
- **Criteria 3:** Level of Service (flooding) for the site – Refer to item 3.0 mentioned previously on this report.
- **Criteria 4:** River Flood Protection – long term storage not provided; outflow limited to Qbar (3.0 l/s).

The storage requirements were designed according to Drainage Design Process Flow Charts provided in the GDSDS document. Refer to Figure 3.3 for summary of the calculations.

- Required interception volume provided by the filter drains was calculated for a rainfall depth of 5mm and assuming 80% runoff from paved surfaces and 0% from pervious surfaces.
- Required treatment volume for the overlying swales was estimated for a rainfall depth of 15mm and assuming 80% runoff from paved surfaces and 0% from pervious surfaces.

- Storage volume in the attenuation system has been calculated using the 1, 30, and 100-year storm events +20% climate change, with no surface flooding taking place in the 100-year storm event.

STORAGE REQUIREMENTS	
Subject site information	
Site Area	0.58 Ha
PIMP Factor	0.52
Total Impermeable area	0.30 Ha
Criteria 1 - River Water Quality Protection	
Interception volume (5mm of rainfall)	12m³
Treatment volume (15mm of rainfall with interception volume deducted)	24m³
Total (Sum of interception and treatment Volume)	**36m³**
Criteria 2 - River Regime Protection	
Attenuation Volumes	
1 Year Storm	86m³
30-year storm	182m³
100-year storm	246m³
Total volume Required (100 Year –Minus Interception Volume)	**217.8m³**
Criteria 3 - Level of Service for the Site	
All house levels are set above top water level of attenuation system	
Criteria 4 - River Flood Protection	
Long term storage is not provided. Outflow limited to Qbar.	

STORAGE PROVISION			
SUDS techniques	**Interception**	**Treatment**	**Attenuation**
Swales	12m³	-	-
Filter Drains	16.2m³	-	-
Rainwater butts	-	-	-
Permeable paving (Treatment)	-	65m³	-
Attenuation Tank Storage	-	-	221m³
TOTAL	**93.2m³ >36m³ Ok**		**221m³>217.8m³ Ok**

Figure 3.2 Treatment Train Calculations

Refer to Figure 3.2 for indicative permeable paving build up details and to drawings 21029-101 & 105 for the full drainage layout and details.

Pipe Design

All surface water pipes sizes and gradients are designed in accordance with the Department of Environment Recommendation for Site Development Works, Building Regulations and Irish Water Standards.

Please refer to drawing 21021-101-P1 for full drainage layout and details. Also refer to drawing 21021-104-P0 for manhole and typical drainage details.

4.0 WASTEWATER

All foul water pipes sizes and gradients are designed in accordance with the Department of Environment Recommendation for Site Development Works, Building Regulations and Irish Water Standards – please refer to Appendix H for the pipe design.

All connections to the public wastewater infrastructure will be made following a connection agreement with Irish Water and under their direction. A Pre-Connection enquiry was submitted to Irish Water as part of this planning application, and we have received a Confirmation of Feasibility. The COF states that a connection to the wastewater network is feasible without upgrade, please refer to Appendix L for the Irish Water Confirmation of Feasibility. Refer to drawing 21029-101-P0 for the proposed wastewater drainage layout.

5.0 WATER SUPPLY

It is proposed to make a new ø100mm HDPE connection to the existing 100mm uPVC watermain (1969) under Whitechurch Road, or as directed by Irish Water. Refer to Appendix J for details of water demand for the proposed development.

All connection to the public water infrastructure will be made following a connection agreement with Irish Water and under their direction. A Pre-Connection enquiry was submitted to Irish Water as part of this planning application, and we have received a Confirmation of Feasibility. The COF states that a connection to the watermain network is feasible without upgrade, please refer to Appendix L for the Irish Water Confirmation of Feasibility. Refer to Drawing 21021-103-P0 for the watermain layout.

5.1 Water Conservation and Management

To conserve water the following is proposed;

1. All bathroom and staff facilities to be fitted with low flow fittings such as taps, shower head, etc.
2. All electrical appliances will be A energy rated.
3. All bathrooms will be fitted with dual flush toilet cisterns

6.0 ACCESS AND EGRESS

The main existing vehicular entrance to the site is via Whitechurch Road to the Northwest. It is proposed to move the vehicular entrance southwards and extend the existing footpath. Junction site distance is provided in accordance with the Design Manual for Urban Roads and Streets (DMURS) for a 50kph main road speed limit. This equates to a "Y" distance of 49m and a 2.4m "X" set back distance, please see drawing 21029-101 for junction plans and site visibility splays. There is also an existing vehicular access to the bungalow to the Southwest of the site, it is proposed to demolish the bungalow and remove this vehicular entrance.

Please refer to Transport Insights report and Swept Path Analysis completed as part of the planning application.

Report by;
Noel Mahon
BEng MEng MIEI

7.0 APPENDICES

7.1 APPENDIX A

Irish Water Existing Drainage Mapping

Irish Water Web Map

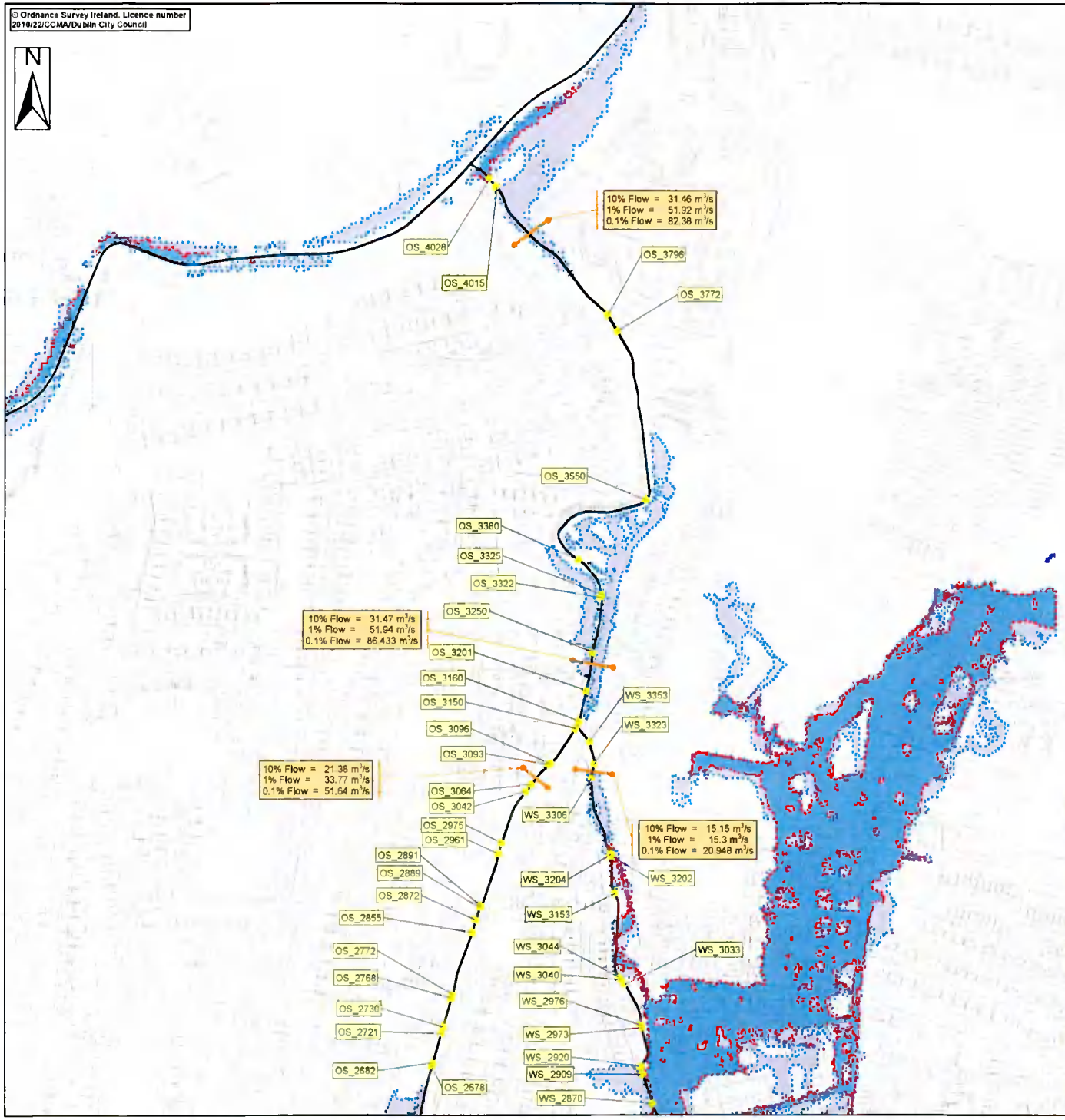
UISCE ÉIREANN : IRISH WATER

Print Date: 20/07/2021

Printed by:Irish Water

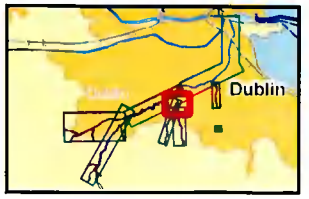
7.2 APPENDIX B

Flood Mapping



Node Label	Water Level (mOD) per AEP		
	WL 10%	WL 1%	WL 0.1%
OS-2678	54.93	55.33	55.84
OS-2682	54.90	55.30	55.80
OS-2721	54.69	55.09	55.57
OS-2730	54.64	55.03	55.53
OS-2768	54.36	54.73	55.21
OS-2772	54.33	54.71	55.18
OS-2855	53.22	53.59	54.07
OS-2872	53.17	53.54	54.02
OS-2889	53.10	53.49	53.97
OS-2891	53.09	53.47	53.95
OS-2961	52.32	52.68	53.14
OS-2975	52.17	52.51	52.92
OS-3042	51.02	51.24	51.58
OS-3064	50.90	51.13	51.48
OS-3093	50.03	50.39	50.93
OS-3096	50.00	50.37	50.92
OS-3150	49.13	49.70	50.48
OS-3160	49.52	50.50	51.90
OS-3201	49.48	50.45	51.80
OS-3250	49.44	50.42	51.82
OS-3322	47.49	48.05	48.64
OS-3325	47.49	48.02	48.61
OS-3380	45.84	46.18	46.60
OS-3550	43.83	44.31	44.95
OS-3772	42.28	43.06	44.07
OS-3796	39.77	40.24	40.80
OS-4015	38.13	38.62	39.26
OS-4028	38.08	38.57	39.21
WS-2870	57.52	57.53	57.62
WS-2909	57.38	57.39	57.70
WS-2920	56.80	56.81	57.12
WS-2973	56.34	56.35	56.74
WS-2976	56.28	56.29	56.63
WS-3033	54.82	54.83	55.88
WS-3040	54.72	54.74	55.97
WS-3044	54.72	54.73	55.96
WS-3153	52.86	52.87	53.14
WS-3202	52.01	52.02	52.30
WS-3204	51.94	51.95	52.21
WS-3306	50.59	50.58	50.85
WS-3323	50.09	50.06	50.29
WS-3353	48.26	49.70	48.91

Location Plan



Legend

- 10 % AEP Flood Extent (1 in 10 chance in any given year)
- 1 % AEP Flood Extent (1 in 100 chance in any given year)
- 0.1 % AEP Flood Extent (1 in 1000 chance in any given year)
- Defended Area
- High Confidence (<20m) (10% AEP)
- Medium Confidence (<40m) (10% AEP)
- Low Confidence (>40m) (10% and 0.1% AEP)
- High Confidence (<20m) (1% AEP)
- Medium Confidence (<40m) (1% AEP)
- Low Confidence (>40m) (1% AEP)
- River Centreline
- Node Point
- OS_2975 Node Label (refer to table)
- Flow reporting location
- Peak flow during design flood extent

USER NOTE

USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF BOUND VOLUME IT SHOULD NOT BE USED FOR ANY PURPOSE

Client

South Dublin County Council · Dún Laoghaire-Rathdown County Council · OPW

Project

DODDER CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT STUDY

Map

PRESENT DAY OWENDOHER & WHITECHURCH

Map Type FLOOD EXTENT
Source FLUVIAL FLOODING
Map Area URBAN AREA
Scenario CURRENT

Drawn By A.A.B Date 26 November 2010
Checked By A.J. Date 26 November 2010
Approved By A.G.B Date 26 November 2010

Figure No.

OSWS/EXT/UA/CURS/103

Map Series Page 3 of 3

Drawing Scale 1 5 000 Plot Scale 1 1 @ A3

0 0.1 0.2
Kilometers

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7.3 APPENDIX C

Rainfall Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 314287, Northing: 228180,

	Interval		Years												
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.6,	3.9,	4.6,	5.6,	6.3,	6.9,	8.8,	11.0,	12.5,	14.7,	16.6,	18.1,	20.5,	22.4,	23.9,	N/A ,
10 mins	3.7,	5.4,	6.4,	7.8,	8.8,	9.6,	12.3,	15.4,	17.5,	20.5,	23.2,	25.3,	28.6,	31.2,	33.3,	N/A ,
15 mins	4.3,	6.3,	7.5,	9.2,	10.4,	11.3,	14.5,	18.1,	20.6,	24.1,	27.2,	29.7,	33.6,	36.7,	39.2,	N/A ,
30 mins	5.7,	8.3,	9.7,	11.9,	13.3,	14.5,	18.3,	22.8,	25.7,	30.0,	33.8,	36.8,	41.4,	45.0,	48.0,	N/A ,
1 hours	7.5,	10.8,	12.6,	15.3,	17.1,	18.5,	23.2,	28.6,	32.2,	37.3,	41.9,	45.4,	50.9,	55.2,	58.8,	N/A ,
2 hours	10.0,	14.1,	16.3,	19.7,	21.9,	23.7,	29.5,	36.0,	40.4,	46.5,	51.9,	56.2,	62.7,	67.8,	72.0,	N/A ,
3 hours	11.7,	16.5,	19.0,	22.8,	25.4,	27.3,	33.8,	41.2,	46.0,	52.9,	58.9,	63.6,	70.8,	76.4,	81.1,	N/A ,
4 hours	13.2,	18.4,	21.2,	25.3,	28.1,	30.3,	37.3,	45.3,	50.6,	57.9,	64.4,	69.5,	77.2,	83.2,	88.2,	N/A ,
6 hours	15.5,	21.5,	24.6,	29.3,	32.5,	35.0,	42.9,	51.8,	57.7,	65.8,	73.1,	78.6,	87.2,	93.8,	99.3,	N/A ,
9 hours	18.2,	25.1,	28.7,	34.0,	37.6,	40.4,	49.3,	59.3,	65.8,	74.8,	82.9,	89.0,	98.5,	105.7,	111.8,	N/A ,
12 hours	20.5,	28.0,	31.9,	37.8,	41.7,	44.7,	54.4,	65.2,	72.2,	82.0,	90.6,	97.2,	107.3,	115.1,	121.6,	N/A ,
18 hours	24.1,	32.7,	37.2,	43.8,	48.2,	51.6,	62.5,	74.5,	82.4,	93.2,	102.7,	110.1,	121.2,	129.8,	136.8,	N/A ,
24 hours	27.1,	36.5,	41.4,	48.6,	53.4,	57.1,	68.9,	82.0,	90.4,	102.1,	112.3,	120.2,	132.1,	141.3,	148.8,	174.9,
2 days	33.7,	44.5,	50.0,	58.1,	63.4,	67.4,	80.3,	94.3,	103.3,	115.6,	126.4,	134.5,	146.9,	156.4,	164.1,	190.6,
3 days	39.1,	50.9,	57.0,	65.7,	71.4,	75.8,	89.5,	104.4,	113.9,	126.8,	138.1,	146.6,	159.4,	169.2,	177.2,	204.4,
4 days	43.8,	56.6,	63.1,	72.4,	78.4,	83.0,	97.6,	113.2,	123.1,	136.6,	148.3,	157.1,	170.4,	180.5,	188.7,	216.7,
6 days	52.1,	66.4,	73.6,	83.9,	90.6,	95.7,	111.5,	128.4,	139.1,	153.6,	166.1,	175.5,	189.6,	200.2,	208.9,	238.2,
8 days	59.4,	75.1,	82.9,	94.0,	101.3,	106.7,	123.7,	141.7,	153.1,	168.4,	181.5,	191.4,	206.2,	217.4,	226.4,	257.0,
10 days	66.1,	83.0,	91.3,	103.2,	110.9,	116.7,	134.7,	153.7,	165.7,	181.8,	195.5,	205.8,	221.3,	232.9,	242.3,	274.0,
12 days	72.3,	90.3,	99.2,	111.8,	119.9,	126.0,	144.9,	164.8,	177.3,	194.1,	208.4,	219.1,	235.1,	247.1,	256.9,	289.6,
16 days	83.9,	103.9,	113.7,	127.5,	136.4,	143.0,	163.6,	185.1,	198.5,	216.5,	231.8,	243.3,	260.3,	273.1,	283.4,	318.0,
20 days	94.7,	116.4,	127.0,	141.9,	151.4,	158.6,	180.6,	203.5,	217.8,	236.9,	253.1,	265.2,	283.1,	296.5,	307.4,	343.6,
25 days	107.3,	130.9,	142.5,	158.6,	168.9,	176.6,	200.2,	224.8,	240.0,	260.3,	277.5,	290.3,	309.3,	323.4,	334.9,	372.9,

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

M5 60 = 18.5
M5 2day = 67.4
Ratio = 0.27

7.4 APPENDIX D

Paved Area Factors

poga Consulting Engineers	Project :	Whitechurch Road
	POGA Ref:	21029
	Title:	Paved Area Factors
	Date:	Jul-21

Element

Roofs (m^2)	1796
Roads Draining to Gullies (m^2)	298
Hardstanding Draining to Gullies (m^2)	309
Roads Draining to SuDS (m^2)	573
Permeable Paving (m^2)	540
Grass (m^2)	2285
Total Area of New Development (m^2)	**5801**

Paved Area Factors (PIMP Factors)

Roof	=	0.95
Roads	=	0.85
Hardstanding	=	0.85
Roads SuDS	=	0.45
Permeable Paving	=	0.95
Grass	=	0.05

PIMP factor for Catchment Area 1

Element	
Roof	29.4%
Roads	4.5%
Hardstanding	4.5%
Roads SuDS	4.4%
Permeable Paving	8.8%
Grass	2.0%
Average PIMP Factor Per site	51.8%

Greenfield Outflow

Total Allowed Interpolated from a 50 hectare site

50 (Ha)	106.5 l/s
Site Area (Ha)	0.58 ha
QBar formula	(106.5/50)x0.58
Qbar allowed ouflow for Total Area (l/s)	**1.24**

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	50.000	Urban	0.000
SAAR (mm)	800	Region Number	User Defined

User Defined Growth Curve

Filename GDSDS.GCF Description "GDSDS"

Return Period (years)	Growth Curve Factor
1	0.850
2	0.000
5	0.000
10	1.700
20	0.000
25	0.000
30	2.100
50	0.000
100	2.600
200	2.900
500	0.000
1000	0.000

Results	l/s
QBAR Rural	106.5
QBAR Urban	106.5
Q100 years	277.0
Q1 year	90.6
Q2 years	0.0
Q5 years	0.0
Q10 years	181.0
Q20 years	0.0
Q25 years	1.8
Q30 years	223.5
Q50 years	0.8
Q100 years	277.0
Q200 years	308.9
Q250 years	233.7
Q1000 years	0.0

50 Ha = 106.5l/s
Site Area = 0.58 Ha
Qbar = (106.5/50)x(0.58)
Qbar = 1.24l/s

7.5 APPENDIX E

Attenuation Design
1, 30 & 100 Year Storm
+20% Climate Change

Summary of Results for 1 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	51.215	0.140	0.6	18.2	O K
30 min Summer	51.267	0.192	0.6	25.0	O K
60 min Summer	51.327	0.252	0.6	32.8	O K
120 min Summer	51.398	0.323	0.6	41.9	O K
180 min Summer	51.444	0.369	0.6	48.0	O K
240 min Summer	51.478	0.403	0.6	52.4	O K
360 min Summer	51.525	0.450	0.6	58.5	O K
480 min Summer	51.558	0.483	0.6	62.7	O K
600 min Summer	51.579	0.504	0.6	65.5	O K
720 min Summer	51.593	0.518	0.6	67.4	O K
960 min Summer	51.611	0.536	0.6	69.7	O K
1440 min Summer	51.631	0.556	0.6	72.3	O K
2160 min Summer	51.644	0.569	0.6	74.0	O K
2880 min Summer	51.648	0.573	0.6	74.5	O K
4320 min Summer	51.640	0.565	0.6	73.4	O K
5760 min Summer	51.621	0.546	0.6	71.0	O K
7200 min Summer	51.599	0.524	0.6	68.1	O K
8640 min Summer	51.585	0.510	0.6	66.3	O K
10080 min Summer	51.559	0.484	0.6	63.0	O K
15 min Winter	51.233	0.158	0.6	20.5	O K
30 min Winter	51.291	0.216	0.6	28.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	33.572	0.0	18.8	21
30 min Summer	23.151	0.0	26.0	35
60 min Summer	15.473	0.0	34.7	64
120 min Summer	10.174	0.0	45.7	124
180 min Summer	7.932	0.0	53.5	184
240 min Summer	6.644	0.0	59.7	242
360 min Summer	5.174	0.0	69.8	362
480 min Summer	4.334	0.0	77.9	482
600 min Summer	3.767	0.0	84.7	600
720 min Summer	3.356	0.0	90.6	720
960 min Summer	2.798	0.0	98.2	894
1440 min Summer	2.163	0.0	97.1	1140
2160 min Summer	1.673	0.0	135.4	1552
2880 min Summer	1.395	0.0	150.5	1964
4320 min Summer	1.076	0.0	173.9	2812
5760 min Summer	0.895	0.0	193.2	3640
7200 min Summer	0.776	0.0	209.3	4472
8640 min Summer	0.699	0.0	226.5	5280
10080 min Summer	0.634	0.0	239.4	6144
15 min Winter	33.572	0.0	21.1	21
30 min Winter	23.151	0.0	29.1	35

Summary of Results for 1 year Return Period (+20%)

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60	min Winter	51.360	0.285	0.6	37.0	O K
120	min Winter	51.441	0.366	0.6	47.5	O K
180	min Winter	51.493	0.418	0.6	54.4	O K
240	min Winter	51.532	0.457	0.6	59.4	O K
360	min Winter	51.589	0.514	0.6	66.8	O K
480	min Winter	51.628	0.553	0.6	71.9	O K
600	min Winter	51.655	0.580	0.6	75.4	O K
720	min Winter	51.675	0.600	0.7	78.0	O K
960	min Winter	51.701	0.626	0.7	81.3	O K
1440	min Winter	51.721	0.646	0.7	84.0	O K
2160	min Winter	51.735	0.660	0.7	85.8	O K
2880	min Winter	51.733	0.658	0.7	85.6	O K
4320	min Winter	51.706	0.631	0.7	82.1	O K
5760	min Winter	51.668	0.593	0.6	77.0	O K
7200	min Winter	51.625	0.550	0.6	71.5	O K
8640	min Winter	51.594	0.519	0.6	67.4	O K
10080	min Winter	51.549	0.474	0.6	61.6	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60	min Winter	15.473	0.0	38.9	64
120	min Winter	10.174	0.0	51.2	122
180	min Winter	7.932	0.0	59.9	180
240	min Winter	6.644	0.0	66.9	240
360	min Winter	5.174	0.0	78.2	356
480	min Winter	4.334	0.0	87.3	470
600	min Winter	3.767	0.0	94.9	584
720	min Winter	3.356	0.0	99.7	696
960	min Winter	2.798	0.0	101.1	914
1440	min Winter	2.163	0.0	99.6	1286
2160	min Winter	1.673	0.0	151.7	1644
2880	min Winter	1.395	0.0	168.7	2128
4320	min Winter	1.076	0.0	186.0	3032
5760	min Winter	0.895	0.0	216.4	3928
7200	min Winter	0.776	0.0	234.5	4832
8640	min Winter	0.699	0.0	253.6	5704
10080	min Winter	0.634	0.0	268.2	6560

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.500	Shortest Storm (mins)	15
Ratio R	0.270	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.300

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.250	4	8	0.050

Model Details

Storage is Online Cover Level (m) 52.875

Tank or Pond Structure

Invert Level (m) 51.075

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	130.0	0.700	130.0	1.400	130.0	2.100	130.0
0.100	130.0	0.800	130.0	1.500	130.0	2.200	130.0
0.200	130.0	0.900	130.0	1.600	130.0	2.300	130.0
0.300	130.0	1.000	130.0	1.700	130.0	2.400	130.0
0.400	130.0	1.100	130.0	1.800	130.0	2.500	130.0
0.500	130.0	1.200	130.0	1.900	130.0		
0.600	130.0	1.300	130.0	2.000	130.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0041-1200-2450-1200
Design Head (m)	2.450
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	41
Invert Level (m)	51.050
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.450	1.2
Flush-Flo™	0.180	0.6
Kick-Flo®	0.372	0.5
Mean Flow over Head Range	-	0.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.6	1.200	0.9	3.000	1.3	7.000	1.9
0.200	0.6	1.400	0.9	3.500	1.4	7.500	2.0
0.300	0.6	1.600	1.0	4.000	1.5	8.000	2.1
0.400	0.5	1.800	1.0	4.500	1.6	8.500	2.1
0.500	0.6	2.000	1.1	5.000	1.7	9.000	2.2
0.600	0.6	2.200	1.1	5.500	1.7	9.500	2.2
0.800	0.7	2.400	1.2	6.000	1.8		
1.000	0.8	2.600	1.2	6.500	1.9		

Summary of Results for 30 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	51.393	0.318	0.6	41.3	O K
30 min Summer	51.509	0.434	0.6	56.5	O K
60 min Summer	51.636	0.561	0.6	73.0	O K
120 min Summer	51.778	0.703	0.7	91.4	O K
180 min Summer	51.867	0.792	0.7	103.0	O K
240 min Summer	51.932	0.857	0.8	111.4	O K
360 min Summer	52.024	0.949	0.8	123.3	O K
480 min Summer	52.087	1.012	0.8	131.6	O K
600 min Summer	52.133	1.058	0.8	137.6	O K
720 min Summer	52.168	1.093	0.8	142.1	O K
960 min Summer	52.214	1.139	0.9	148.1	O K
1440 min Summer	52.255	1.180	0.9	153.4	O K
2160 min Summer	52.276	1.201	0.9	156.2	O K
2880 min Summer	52.280	1.205	0.9	156.6	O K
4320 min Summer	52.266	1.191	0.9	154.8	O K
5760 min Summer	52.240	1.165	0.9	151.4	O K
7200 min Summer	52.209	1.134	0.9	147.5	O K
8640 min Summer	52.176	1.101	0.8	143.1	O K
10080 min Summer	52.141	1.066	0.8	138.6	O K
15 min Winter	51.432	0.357	0.6	46.4	O K
30 min Winter	51.562	0.487	0.6	63.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	74.695	0.0	41.9	22
30 min Summer	51.190	0.0	50.7	37
60 min Summer	33.393	0.0	75.1	66
120 min Summer	21.283	0.0	95.7	124
180 min Summer	16.249	0.0	106.1	184
240 min Summer	13.391	0.0	108.5	244
360 min Summer	10.175	0.0	111.2	362
480 min Summer	8.365	0.0	113.8	482
600 min Summer	7.183	0.0	116.6	602
720 min Summer	6.341	0.0	119.5	722
960 min Summer	5.208	0.0	123.4	960
1440 min Summer	3.944	0.0	126.8	1342
2160 min Summer	2.983	0.0	234.5	1708
2880 min Summer	2.446	0.0	234.8	2104
4320 min Summer	1.847	0.0	232.7	2940
5760 min Summer	1.513	0.0	326.7	3752
7200 min Summer	1.296	0.0	349.9	4608
8640 min Summer	1.142	0.0	369.9	5448
10080 min Summer	1.026	0.0	385.2	6256
15 min Winter	74.695	0.0	47.0	22
30 min Winter	51.190	0.0	50.6	36

Summary of Results for 30 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	51.705	0.630	0.7	81.9	O K
120 min Winter	51.866	0.791	0.7	102.8	O K
180 min Winter	51.968	0.893	0.8	116.1	O K
240 min Winter	52.043	0.968	0.8	125.8	O K
360 min Winter	52.150	1.075	0.8	139.7	O K
480 min Winter	52.225	1.150	0.9	149.5	O K
600 min Winter	52.281	1.206	0.9	156.8	O K
720 min Winter	52.324	1.249	0.9	162.4	O K
960 min Winter	52.385	1.310	0.9	170.4	O K
1440 min Winter	52.448	1.373	0.9	178.5	O K
2160 min Winter	52.470	1.395	0.9	181.4	O K
2880 min Winter	52.475	1.400	0.9	182.0	O K
4320 min Winter	52.445	1.370	0.9	178.1	O K
5760 min Winter	52.395	1.320	0.9	171.6	O K
7200 min Winter	52.338	1.263	0.9	164.2	O K
8640 min Winter	52.280	1.205	0.9	156.6	O K
10080 min Winter	52.220	1.145	0.9	148.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	33.393	0.0	84.1	64
120 min Winter	21.283	0.0	105.2	122
180 min Winter	16.249	0.0	109.4	182
240 min Winter	13.391	0.0	111.5	240
360 min Winter	10.175	0.0	115.6	358
480 min Winter	8.365	0.0	120.2	474
600 min Winter	7.183	0.0	124.0	590
720 min Winter	6.341	0.0	126.8	706
960 min Winter	5.208	0.0	130.7	932
1440 min Winter	3.944	0.0	133.6	1372
2160 min Winter	2.983	0.0	245.9	1796
2880 min Winter	2.446	0.0	249.2	2220
4320 min Winter	1.847	0.0	248.8	3156
5760 min Winter	1.513	0.0	366.0	4088
7200 min Winter	1.296	0.0	391.8	4976
8640 min Winter	1.142	0.0	414.3	5872
10080 min Winter	1.026	0.0	414.3	6752

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.500	Shortest Storm (mins)	15
Ratio R	0.270	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.300

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.250	4	8	0.050

Model Details

Storage is Online Cover Level (m) 52.875

Tank or Pond Structure

Invert Level (m) 51.075

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	130.0	0.700	130.0	1.400	130.0	2.100	130.0
0.100	130.0	0.800	130.0	1.500	130.0	2.200	130.0
0.200	130.0	0.900	130.0	1.600	130.0	2.300	130.0
0.300	130.0	1.000	130.0	1.700	130.0	2.400	130.0
0.400	130.0	1.100	130.0	1.800	130.0	2.500	130.0
0.500	130.0	1.200	130.0	1.900	130.0		
0.600	130.0	1.300	130.0	2.000	130.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0041-1200-2450-1200
Design Head (m)	2.450
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	41
Invert Level (m)	51.050
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.450	1.2
Flush-Flo™	0.180	0.6
Kick-Flo®	0.372	0.5
Mean Flow over Head Range	-	0.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.6	1.200	0.9	3.000	1.3	7.000	1.9
0.200	0.6	1.400	0.9	3.500	1.4	7.500	2.0
0.300	0.6	1.600	1.0	4.000	1.5	8.000	2.1
0.400	0.5	1.800	1.0	4.500	1.6	8.500	2.1
0.500	0.6	2.000	1.1	5.000	1.7	9.000	2.2
0.600	0.6	2.200	1.1	5.500	1.7	9.500	2.2
0.800	0.7	2.400	1.2	6.000	1.8		
1.000	0.8	2.600	1.2	6.500	1.9		

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	51.320	0.245	0.6	53.9	O K
30 min Summer	51.411	0.336	0.6	74.0	O K
60 min Summer	51.508	0.433	0.6	95.2	O K
120 min Summer	51.615	0.540	0.6	118.7	O K
180 min Summer	51.682	0.607	0.7	133.5	O K
240 min Summer	51.731	0.656	0.7	144.3	O K
360 min Summer	51.802	0.727	0.7	159.8	O K
480 min Summer	51.851	0.776	0.7	170.8	O K
600 min Summer	51.889	0.814	0.7	179.1	O K
720 min Summer	51.919	0.844	0.8	185.6	O K
960 min Summer	51.962	0.887	0.8	195.1	O K
1440 min Summer	52.009	0.934	0.8	205.5	O K
2160 min Summer	52.030	0.955	0.8	210.0	O K
2880 min Summer	52.034	0.959	0.8	210.9	O K
4320 min Summer	52.025	0.950	0.8	209.1	O K
5760 min Summer	52.009	0.934	0.8	205.5	O K
7200 min Summer	51.990	0.915	0.8	201.3	O K
8640 min Summer	51.969	0.894	0.8	196.7	O K
10080 min Summer	51.947	0.872	0.8	191.9	O K
15 min Winter	51.350	0.275	0.6	60.5	O K
30 min Winter	51.452	0.377	0.6	83.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	97.140	0.0	50.9	22
30 min Summer	66.770	0.0	52.4	37
60 min Summer	43.245	0.0	96.6	66
120 min Summer	27.292	0.0	101.7	126
180 min Summer	20.700	0.0	101.9	184
240 min Summer	16.973	0.0	102.5	244
360 min Summer	12.801	0.0	104.8	364
480 min Summer	10.467	0.0	108.2	484
600 min Summer	8.950	0.0	111.1	602
720 min Summer	7.874	0.0	113.2	722
960 min Summer	6.432	0.0	116.2	962
1440 min Summer	4.833	0.0	118.5	1440
2160 min Summer	3.625	0.0	224.7	2016
2880 min Summer	2.953	0.0	228.2	2368
4320 min Summer	2.210	0.0	225.3	3156
5760 min Summer	1.798	0.0	388.2	3976
7200 min Summer	1.532	0.0	411.0	4824
8640 min Summer	1.344	0.0	400.3	5624
10080 min Summer	1.204	0.0	384.8	6456
15 min Winter	97.140	0.0	52.7	22
30 min Winter	66.770	0.0	50.7	37

Summary of Results for 100 year Return Period (+20%)

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60	min Winter	51.561	0.486	0.6	106.9	O K
120	min Winter	51.681	0.606	0.7	133.4	O K
180	min Winter	51.758	0.683	0.7	150.2	O K
240	min Winter	51.814	0.739	0.7	162.6	O K
360	min Winter	51.895	0.820	0.7	180.5	O K
480	min Winter	51.954	0.879	0.8	193.3	O K
600	min Winter	51.998	0.923	0.8	203.1	O K
720	min Winter	52.034	0.959	0.8	210.9	O K
960	min Winter	52.087	1.012	0.8	222.6	O K
1440	min Winter	52.150	1.075	0.8	236.5	O K
2160	min Winter	52.188	1.113	0.8	244.8	O K
2880	min Winter	52.192	1.117	0.8	245.8	O K
4320	min Winter	52.180	1.105	0.8	243.1	O K
5760	min Winter	52.155	1.080	0.8	237.5	O K
7200	min Winter	52.122	1.047	0.8	230.3	O K
8640	min Winter	52.086	1.011	0.8	222.5	O K
10080	min Winter	52.050	0.975	0.8	214.4	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60	min Winter	43.245	0.0	101.1	66
120	min Winter	27.292	0.0	102.1	124
180	min Winter	20.700	0.0	103.2	182
240	min Winter	16.973	0.0	105.1	242
360	min Winter	12.801	0.0	110.2	358
480	min Winter	10.467	0.0	114.3	476
600	min Winter	8.950	0.0	117.2	594
720	min Winter	7.874	0.0	119.4	710
960	min Winter	6.432	0.0	122.2	942
1440	min Winter	4.833	0.0	124.1	1398
2160	min Winter	3.625	0.0	238.3	2056
2880	min Winter	2.953	0.0	241.8	2676
4320	min Winter	2.210	0.0	238.0	3332
5760	min Winter	1.798	0.0	435.0	4272
7200	min Winter	1.532	0.0	436.2	5192
8640	min Winter	1.344	0.0	424.6	6136
10080	min Winter	1.204	0.0	414.9	7056

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.500	Shortest Storm (mins)	15
Ratio R	0.270	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.300

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.250	4	8	0.050

Model Details

Storage is Online Cover Level (m) 52.775

Tank or Pond Structure

Invert Level (m) 51.075

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	220.0	0.700	220.0	1.400	220.0	2.100	220.0
0.100	220.0	0.800	220.0	1.500	220.0	2.200	220.0
0.200	220.0	0.900	220.0	1.600	220.0	2.300	220.0
0.300	220.0	1.000	220.0	1.700	220.0	2.400	220.0
0.400	220.0	1.100	220.0	1.800	220.0	2.500	220.0
0.500	220.0	1.200	220.0	1.900	220.0		
0.600	220.0	1.300	220.0	2.000	220.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0041-1200-2450-1200
Design Head (m)	2.450
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	41
Invert Level (m)	51.050
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.450	1.2
Flush-Flo™	0.180	0.6
Kick-Flo®	0.372	0.5
Mean Flow over Head Range	-	0.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.6	1.200	0.9	3.000	1.3	7.000	1.9
0.200	0.6	1.400	0.9	3.500	1.4	7.500	2.0
0.300	0.6	1.600	1.0	4.000	1.5	8.000	2.1
0.400	0.5	1.800	1.0	4.500	1.6	8.500	2.1
0.500	0.6	2.000	1.1	5.000	1.7	9.000	2.2
0.600	0.6	2.200	1.1	5.500	1.7	9.500	2.2
0.800	0.7	2.400	1.2	6.000	1.8		
1.000	0.8	2.600	1.2	6.500	1.9		

7.6 APPENDIX F

Infiltration Trench Design
1 in 100 Year Storm
+20% Climate Change

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 17 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	52.829	0.729	0.5	1.7	2.2	9.7	O K
30 min Summer	52.890	0.790	0.5	6.7	7.2	10.8	O K
60 min Summer	52.918	0.818	0.5	9.5	10.0	11.2	O K
120 min Summer	52.915	0.815	0.5	9.3	9.8	11.2	O K
180 min Summer	52.903	0.803	0.5	8.0	8.5	11.0	O K
240 min Summer	52.892	0.792	0.5	6.8	7.3	10.8	O K
360 min Summer	52.872	0.772	0.5	5.3	5.8	10.5	O K
480 min Summer	52.861	0.761	0.5	4.3	4.8	10.3	O K
600 min Summer	52.855	0.755	0.5	3.7	4.2	10.2	O K
720 min Summer	52.850	0.750	0.5	3.2	3.7	10.1	O K
960 min Summer	52.843	0.743	0.5	2.5	3.0	10.0	O K
1440 min Summer	52.831	0.731	0.5	1.8	2.3	9.8	O K
2160 min Summer	52.821	0.721	0.5	1.2	1.7	9.6	O K
2880 min Summer	52.815	0.715	0.5	0.9	1.4	9.5	O K
4320 min Summer	52.806	0.706	0.5	0.6	1.0	9.3	O K
5760 min Summer	52.800	0.700	0.5	0.4	0.8	9.2	O K
7200 min Summer	52.796	0.696	0.5	0.3	0.7	9.2	O K
8640 min Summer	52.790	0.690	0.4	0.2	0.6	9.1	O K
10080 min Summer	52.781	0.681	0.4	0.0	0.5	8.9	O K
15 min Winter	52.864	0.764	0.5	4.7	5.1	10.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	97.140	0.0	10.4	17
30 min Summer	66.770	0.0	14.3	22
60 min Summer	43.245	0.0	18.5	38
120 min Summer	27.292	0.0	23.3	66
180 min Summer	20.700	0.0	26.5	96
240 min Summer	16.973	0.0	29.0	126
360 min Summer	12.801	0.0	32.8	186
480 min Summer	10.467	0.0	35.8	244
600 min Summer	8.950	0.0	38.3	306
720 min Summer	7.874	0.0	40.4	366
960 min Summer	6.432	0.0	44.0	488
1440 min Summer	4.833	0.0	49.6	728
2160 min Summer	3.625	0.0	55.8	1100
2880 min Summer	2.953	0.0	60.6	1464
4320 min Summer	2.210	0.0	68.0	2200
5760 min Summer	1.798	0.0	73.8	2888
7200 min Summer	1.532	0.0	78.6	3656
8640 min Summer	1.344	0.0	82.8	4408
10080 min Summer	1.204	0.0	86.5	5336
15 min Winter	97.140	0.0	11.6	15

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	52.922	0.822	0.5	10.0	10.5	11.3	O K
60 min Winter	52.927	0.827	0.5	10.6	11.1	11.4	O K
120 min Winter	52.904	0.804	0.5	8.1	8.6	11.0	O K
180 min Winter	52.885	0.785	0.5	6.3	6.8	10.7	O K
240 min Winter	52.870	0.770	0.5	5.1	5.6	10.4	O K
360 min Winter	52.856	0.756	0.5	3.8	4.3	10.2	O K
480 min Winter	52.848	0.748	0.5	3.0	3.5	10.1	O K
600 min Winter	52.843	0.743	0.5	2.5	3.0	10.0	O K
720 min Winter	52.837	0.737	0.5	2.2	2.7	9.9	O K
960 min Winter	52.829	0.729	0.5	1.7	2.2	9.7	O K
1440 min Winter	52.820	0.720	0.5	1.2	1.6	9.6	O K
2160 min Winter	52.811	0.711	0.5	0.8	1.2	9.4	O K
2880 min Winter	52.805	0.705	0.5	0.5	1.0	9.3	O K
4320 min Winter	52.797	0.697	0.5	0.3	0.7	9.2	O K
5760 min Winter	52.790	0.690	0.4	0.2	0.6	9.1	O K
7200 min Winter	52.784	0.684	0.4	0.0	0.5	9.0	O K
8640 min Winter	52.717	0.617	0.4	0.0	0.4	7.8	O K
10080 min Winter	52.646	0.546	0.4	0.0	0.4	6.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	66.770	0.0	16.0	22
60 min Winter	43.245	0.0	20.7	38
120 min Winter	27.292	0.0	26.1	66
180 min Winter	20.700	0.0	29.7	96
240 min Winter	16.973	0.0	32.5	126
360 min Winter	12.801	0.0	36.8	184
480 min Winter	10.467	0.0	40.1	246
600 min Winter	8.950	0.0	42.9	308
720 min Winter	7.874	0.0	45.2	366
960 min Winter	6.432	0.0	49.3	490
1440 min Winter	4.833	0.0	55.5	722
2160 min Winter	3.625	0.0	62.5	1100
2880 min Winter	2.953	0.0	67.9	1460
4320 min Winter	2.210	0.0	76.2	2188
5760 min Winter	1.798	0.0	82.6	2936
7200 min Winter	1.532	0.0	88.0	3824
8640 min Winter	1.344	0.0	92.7	4752
10080 min Winter	1.204	0.0	96.8	5448

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.500	Shortest Storm (mins)	15
Ratio R	0.270	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.057

Time (mins) From:	To:	Area (ha)
0	4	0.057

Model Details

Storage is Online Cover Level (m) 53.300

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.01500	Trench Width (m)	0.7
Infiltration Coefficient Side (m/hr)	0.01500	Trench Length (m)	60.0
Safety Factor	1.0	Slope (1:X)	200.0
Porosity	0.40	Cap Volume Depth (m)	0.000
Invert Level (m)	52.100	Cap Infiltration Depth (m)	0.000

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	200.0	Coefficient of Contraction	0.600
Length (m)	60.000	Upstream Invert Level (m)	52.775
Roughness k (mm)	0.600		

7.7 APPENDIX G

Surface Water Pipe Design

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.500	Add Flow / Climate Change (%)	20
Ratio R	0.270	Minimum Backdrop Height (m)	0.600
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.800
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	200

Designed with Level Soffits

Time Area Diagram for Surface Network 1

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.250	4-8	0.050

Total Area Contributing (ha) = 0.300

Total Pipe Volume (m³) = 5.428

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	10.246	0.057	179.8	0.037	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	16.983	0.094	180.7	0.038	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	6.323	0.035	180.7	0.012	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	23.846	0.477	50.0	0.062	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	19.189	0.107	179.3	0.037	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	19.550	0.217	90.1	0.041	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	10.118	0.112	90.3	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.18	51.438	0.037	0.0	0.0	1.0	0.97	38.6	6.0
1.001	50.00	4.47	51.381	0.075	0.0	0.0	2.0	0.97	38.5	12.2
1.002	50.00	4.58	51.286	0.087	0.0	0.0	2.4	0.97	38.6	14.1
2.000	50.00	4.21	52.470	0.062	0.0	0.0	1.7	1.85	73.7	10.1
1.003	50.00	4.90	51.251	0.186	0.0	0.0	5.0	0.97	38.7	30.2
3.000	50.00	4.24	52.519	0.041	0.0	0.0	1.1	1.38	54.8	6.7
3.001	50.00	4.36	52.302	0.055	0.0	0.0	1.5	1.38	54.7	8.9

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	17.027	0.095	179.2	0.059	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	50.00	5.15	51.145	0.300	0.0	0.0	8.1	1.17	82.8	48.7

7.8 APPENDIX H

Wastewater Pipe Design

FOUL SEWERAGE DESIGN

Design Criteria for Foul Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	8.937	0.050	178.7	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
1.001	20.621	0.115	179.3	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
1.002	7.146	0.040	178.7	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
2.000	17.544	0.292	60.1	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
1.003	17.298	0.096	180.2	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
1.004	7.785	0.043	180.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
3.000	18.965	0.379	50.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	
3.001	6.343	0.127	49.9	0.000	1	0.0	1.500	o	150	Pipe/Conduit	
1.005	12.726	0.071	179.2	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
1.006	17.972	0.100	179.7	0.000	2	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	51.590	0.000	0.0	2	0.0	10	0.19	0.65	11.6	0.1
1.001	51.540	0.000	0.0	6	0.0	16	0.27	0.65	11.5	0.3
1.002	51.425	0.000	0.0	6	0.0	16	0.27	0.65	11.6	0.3
2.000	52.549	0.000	0.0	4	0.0	10	0.32	1.48	58.9	0.2
1.003	51.310	0.000	0.0	14	0.0	22	0.33	0.85	33.9	0.6
1.004	51.214	0.000	0.0	14	0.0	22	0.33	0.85	34.0	0.6
3.000	52.674	0.000	0.0	3	0.0	9	0.33	1.24	21.9	0.1
3.001	52.295	0.000	0.0	4	0.0	10	0.36	1.24	21.9	0.2
1.005	51.171	0.000	0.0	20	0.0	26	0.37	0.86	34.0	0.9
1.006	51.100	0.000	0.0	22	0.0	27	0.38	0.85	34.0	1.0

7.9 APPENDIX J

Wastewater & Water Demand Calculations

poga Consulting Engineers

Project Name:	Whitechurch Road
Project Reference:	21029
Calculation Date:	28/07/2021
Calculation By:	NM

CALCULATIONS - PROPOSED DEVELOPMENT

Accomodation Schedule		Average Occupancy Rate	Population (P)	Daily Water Consumption per Capita (G)	Daily Water Consumption (L/s)
Existing Residential Units (unit)	0	2.7 people / unit	0	150 L/capita/day	0.000
Existing Commercial area (m2)	0	1 person / 25 m2	0	50 L/day/capita	0.000
Existing Light Industrial area (m2)	0	1 person / 33 m2	0	50 L/day/capita	0.000
Existing Retail area (m2)	0	1 person / 100 m2	0	30 L/day/capita	0.000
Proposed Residential Units (unit)	22	2.7 people / unit	59	150 L/capita/day	0.103
Proposed Commercial area (m2)	0	1 person / 25 m2	0	50 L/day/capita	0.000
Proposed Light Industrial area (m2)	0	1 person / 33 m2	0	50 L/day/capita	0.000
Proposed Creche (m2)	0	1 person / 20 m2	0	40 L/day/capita	0.000
Proposed Retail area (m2)	0	1 person / 100 m2	0	30 L/day/capita	0.000

Coefficients for Subject Site		
Infiltration rate for Existing properties (I)	=	20 %
Infiltration rate for New properties (I)	=	10 %
Commercial Peaking Factor (Pfdom,ind)	=	4.50 (up to 5.5Ha area)
Domestic Peaking Factor (Pfdom)	=	6.00 (0-750 Dwellings)
Trade Wastewater Flow Peaking Factor (Pftrade)	=	3.00 (No measured Data)
Gross Site Area	=	0.58 ha
C factor (Cv x Cr)	=	0.80
Rainfall intensity (i) for sub-catchment greater than 400m2 for 2 years Return Period	=	7.00 mm/hr
Storm Design event peak rate runoff (Q = 2.78 x C x I x A - Modified Rational Method)	=	9.03 l/s
SW Allowance (1.5% of Gross Area)	=	0.14

Foul Wastewater Discharge		
Domestic Dry Weather Flow (P x G + I)	=	0.11 l/s
Design Foul Flow (Eqn1 + SW Allowance)	=	0.82 l/s
Commercial/Retail Dry Weather Flow (P x G + I)	=	0.00 l/s
Design Foul Flow (Eqn1)	=	0.00 l/s
Industrial Dry Weather Flow (P x G + I)	=	0.00 l/s
Design Foul Flow (Eqn1)	=	0.00 l/s
Total Discharge		**0.82 l/s**

Water Demand		
Domestic	=	0.10 l/s
Average Day/Peak Week Domestic Demand (1.25 times average)	=	0.13 l/s
Domestic and Industrial Demand		0.00
Normal Demand (Industrial/ Commercial Demand over 8 hours)	=	0.00 l/s
Total Peak Demand		**0.13 l/s**

7.10 APPENDIX K

Stormtech Attenuation Sizing Tool

STORMTECH Stormwater Management System Design Tool

ver: Jan18

PROJECT REF:	21029
LOCATION:	Whitechurch Road
DATE:	09-Aug-21
CREATED BY:	NM

SYSTEM PARAMETERS

Required Total Storage	**194**	m^3
Stormtech chamber model	**DC780**	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity	40%		
Excavation Batter Angle (degrees)	60	°	*Minimum Requirement*
Stone Above Chambers	0.2	m	*0.15*
Stone Below Chambers	0.23	m	*0.23*
In-between Row Spacing	0.15	m	*0.15*
Additional Storage outside Excavation. E.g manholes, Header Pipe	0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Parrallel to IR	
Diameter of Header Pipe	0.6	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		9	ea
Number of units per Row		8	ea
System Installed Storage Depth (effective storage depth)	1.190		m
Tank overall installed Width at base	13.46	13.5	m
Tank overall installed Length at Base	18.06	20	m
Total Effective System Storage	**183.6**	**197.1**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	DC780	
Unit Width	1.295	m
Unit Length	2.17	m
Unit Height	0.76	m
Min Cover Over System	0.3	m
Max Cover Over Chamber (see StormTech for greater cover)	3.7	m
Chamber Internal Storage Vol.	1.3	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	350	m^3
Width at base	13.50	m
Width at top	14.87	m
Length at base	20.00	m
Length at top	21.37	m
Depth Of System	1.19	m
Area of Dig at Base of System	270	m^2
Area of Dig at Top of System	318	m^2
Void Ratio	56%	
Stone Requirement - m3	254	m^3
Stone Requirement - tonne	417	tonne

7.11 APPENDIX L

Confirmation of Feasibility
Irish Water

Joe Martin

BBA Architecture
Suite 3
Eden Gate Centre
Delgany
A63C966
Wicklow

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

Irish Water
PO Box 448
South City
Delivery Office
Cork City

www.water.ie

21 October 2021

Re: CDS21003376 pre-connection enquiry - Subject to contract | Contract denied

Connection for Housing Development of 32 unit(s) at Silveracre, Whitechurch Road, Dublin

Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Silveracre, Whitechurch Road, Dublin (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	OUTCOME OF PRE-CONNECTION ENQUIRY THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.
Water Connection	Feasible without infrastructure upgrade by Irish Water
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.	

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact Paul Lowry from the design team on 018230377 or email paullowr@water.ie. For further information, visit **www.water.ie/connections.**

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations